

Annex F: Bay of Biscay Sole

Quality Handbook

Stock Annex: Sole in Division VIIIab

Stock specific documentation of standard assessment procedures used by ICES.

Stock:	Sole (Division VIIIab)
Working Group:	Assessment of Hake, Monk and Megrim Stocks
Date:	July 2004 (G. Biais)
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A General

A.1 Stock definition

The Bay of Biscay sole stock extends on shelf that lies along Atlantic French coast from the Spanish boarder to the West point of Brittany. This shelf forms a geographical unit, being narrow at its two extreme parts, particularly in the south. As sole is chiefly present at less than 150 m, this geography of the living area gives some supports to the absence or only limited exchanges with other southern or northern stocks. However, a tagging experiment carried out in 1992 on two nursery areas has shown that fish may move from southern coast of Brittany to the Iroise sea, in the West of Brittany (Koutsikopoulos *et al.*, 1993).

Several spawning grounds are known at depth from 30 to 100 m , from south to north (Arbault *et al.*, 1986) :

- in the north of Cap Breton, off the Landes coast,
- Between Arcachon and the Gironde estuary,
- in front of La Rochelle,
- in front of the Loire estuary,
- in several but limited areas off the southern coast of Brittany.

Nursery grounds are located in the coastal waters, in bays (Pertuis d'Antioche, Pertuis Breton, Baie de Bourgneuf) and estuaries (Gironde, Loire, Vilaine) (Le Pape *et al.*, 2003a).

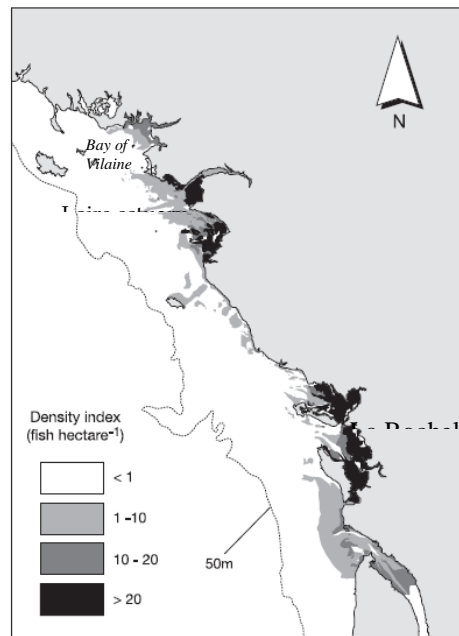


Figure 1 : Fitted 0-group sole density (number of fish per hectare) in the Bay of Biscay (Le Pape et al., 2003a).

A.2 Fishery

The French fleet is the major participant in the Bay of Biscay sole fishery with landings being about 90% of the total official international landings over the historical series. Most of the remaining part is usually landed by the Belgian fleet.

The fishery is largely a fixed net fishery directed on sole, particularly in the first term on the year. The other component is a French and Belgian trawl fishery. The French trawlers are otter trawlers with mixed species catches (sole, cuttlefish, squid, hake, pout, whiting...). The Belgium trawlers are beam trawlers directed at sole, but monk is an important part of its catch. The French coastal boats of these two fisheries have a larger proportion of young fish in their catch than offshore boats. These boats less than 12 m long contribute to the landings by about one third from 2000 onwards. Sole is a major resource for all these boats, given the price of this species on the market. Although the species is taken throughout the year, the catch of coastal netters is less important in autumn, those of coastal trawlers in winter and those of offshore French boats are heaviest in the first quarter.

Otter trawling predominated until the late 1980s, including a small-mesh shrimp fishery which decreased markedly in the beginning of the 1990s. The fixed fishery begun in the 1980s, and it have expanded in the 1990 to account for two third to three quarters of the French landings in the beginning of 2000s. The beam trawl effort increased also rapidly and continuously in the 1990s. It has decreased after 1999 until 2004 but it has returned to its previous 2001-2002 level in 2006-2007. On the opposite, the otter trawl effort shows a decreasing trend until 1999 but it is stable since then.

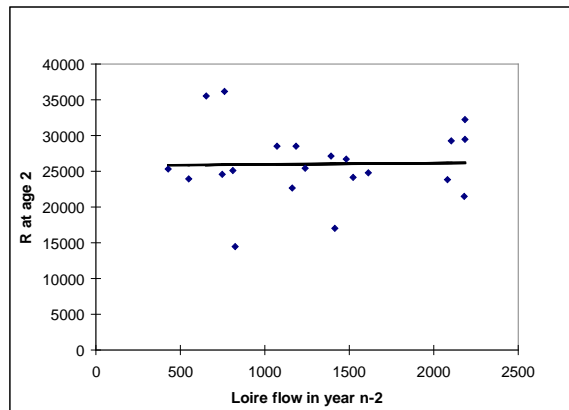
Catches have increased continuously since the beginning of the 1980s, until a maximum was reached in 1994 (7 400 t). They have decreased afterwards to 3600-4800t in 2003-2009, the last year is the lower.

A.3 Ecosystem aspects

The quality and the extend of the nursery grounds have likely a major effect in the dynamic of sole recruitment. Studies in Vilaine bay showed a significant positive relationship between the fluvial discharges in winter-spring and the size of the nursery (Le Pape *et al.*, 2003b). The extent of the river plume influences both the larval supply and the size and biotic capacity of habitats in estuarine nursery grounds and determines the number of juveniles produced.

The WGSSDS looked at the possibility of such effect for the whole Bay of Biscay stock at it 2006 meeting. The relationship between recruitment and river flows was investigated using the Loire river flow in the first half of the year which is considered to be a representative index of the water discharge influences on nursery areas in the Bay of Biscay. Unfortunately, no relationship can be seen between this index and the recruitment at age 2 (Figure 2). The environmental effect is likely to be more complex at the Bay of Biscay scale.

Figure 2: relationship between recruitment at age 2 (as estimated by WGSSDS in 2006) and mean Loire flow in first half year



B. Data

B.1 Commercial Catch

B.1.1 Discards estimates of the French offshore trawlers

Discards estimates are available for the French offshore trawlers from 1984 to 2003. They were provided by the French trawl surveys FR-RESSGASC-S from 1984 to 2002. This surveys were carried out each quarter until 1997, but only in the second and last quarter since 1998. Consequently, discards in the first and third quarter have been estimated using respectively the last quarter survey of the preceding year and the second quarter survey from 1998 onwards.

In 2002, this survey was discontinued because the discards estimates that it provides were estimated to depend on some questionable assumptions (see below). They are no longer used in the assessment since 2005.

In 2004 assessment, commercial trawler sample trips were used to estimate 2003 discards, doing the same assumptions and using the same estimation method than previously for the FR-RESSGASC-S estimates.

Discards estimates when using RESSGASC surveys (Gwen Drez R/S using 55mm Vendéen trawl)

Assumptions :

Between length T1 and T2, defined for being :

- T1 = Length above which discards are assumed to be low
 - T2 = Length above which catch are low
- 1) Trawls of the Gwen Drez R/S and the offshore trawlers have the same selectivity
 - 2) Gwen Drez R/S operate in the same area and in the same conditions than the offshore trawlers during the quarter (up to 1997) or the semester of the survey (quarter 4 year n + quarter 1 year n+1 for november survey year n; quarter 2 and 3 for may survey)

If so, RESSGASC length distribution is representative of total catch distribution between T1 and T2, and

$$\text{discard estimate} = (\text{RGL} \cdot \text{OTT}/\text{RGT}) - \text{OTL}$$

with

RGL = Catch number at length L during a RESSGASC 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 :

$K = \text{OTT}/\text{RGT}$ for $T1 < T1'$ with $T1'$ true length above which discard are negligible

$$\text{RGT} = \text{RGT}'' + \text{RGT}'$$

With $\text{RGT}'' =$ Total catch number from T1 to $T1'$ during a RESSGASC survey

$\text{RGT}' =$ Total catch number from $T1'$ to T2 during a RESSGASC survey

$$\text{OTT} = \text{OTT}'' + \text{OTT}'$$

With $\text{OTT}'' =$ 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

$OTT' = K' \cdot RGT'$

Furthermore, if D are the discards between T1 and T1'

Then $D = RGT'' \cdot K' - OTT''$

And $OTT'' = RGT'' \cdot K' - D$

$K = OTT/RGT$

$K \cdot RGT = OTT'' + OTT' = (K' \cdot RGT'' - D) + K' \cdot RGT' = K' \cdot (RGT'' + RGT') - D$

$K \cdot RGT = K' \cdot RGT - D$

$K' = K + (D/RGT)$

Then $K' > K$ and discards are underestimated when using K

B.1.2 Landing numbers at length

The quarterly French sampling for length compositions is by gear (trawl or fixed net) and boat length (below or over 12 m long). The contributions of each of these components of the French fleet to the landings are estimated by quarter from logbook data, assuming that the landings associated with logbooks are representative of the whole landings. In 2000-2002, surveys on fishing activities by month have provided a likely less biased estimate of landing split by gear than logbooks, which are filled in only by a part of the fleet (50-60% of the landings in 2000-2002). As logbooks are often recorded in the file with delay, the percentage of landings associated with logbook may be well below preceding years, particularly in the last quarter. In that case, the process is to use logbooks to get a landing split in the last year if it is close to the mean over the three preceding years otherwise the quarterly mean over the three preceding years is used.

B.1.3 Catch number at age

Age compositions of the French landings and discards (up to 2003) are estimated using quarterly ALKs. Up to 1998, it is only FR-RESSGASC-S surveys ALKs. From the second half of the 1998 year and up to 2002, the first and third quarter ALKs are obtained from commercial landings samples. In 2003, commercial landing samples are completed by fish caught during a survey which was planned to design gear and methodology for the future survey ORHAGO aiming at a sole abundance index series in the Bay of Biscay. In 2004 and 2005, only market samples are used. From 2006 onwards, market samples are mainly used but the ORHAGO survey series provides age estimates at length for a large part of the landing length distribution in the last quarter of the year. Another survey (Langolf) provides also some fish in the second quarter. Market samples are used to complete these ALKs for the upper part of the distribution.

Prior to 1994, the age composition of French offshore trawler catches is raised to include Belgian landings. In 1994 and 1995, FR-RESSGASC-S ALKs are applied to Belgian length distributions. From 1996 ahead, catch numbers at age of the Belgian fleet are estimated with Belgian ALKs. French and Belgian age composition are added be-

fore being raised to the total international catch except in 2001 where the Belgian age compositions were raised to the total of Belgian and Dutch landings.

French offshore trawlers discards are estimated to have represented about 1 to 3 % of the total catches in recent years (1991-2003) and less than 0.5% since in 2002 and 2003. Given their low contribution to the total catch and the questionable assumptions on which they are based, their monitoring was not continued in 2004 and they have been no longer used in the assessment, as recommended by ACFM, since 2005. Available discards estimates for a limited number of trips shows that discards of beam trawlers and gillnetters are also generally low. They can be occasionally high in the inshore trawlers fleet. However, this fleet only account for 12% of the total French landing and therefore discards estimates are not considered to be a priority for this stock given their likely low contribution to the total catch.

B.2 Biological

Weights at Age

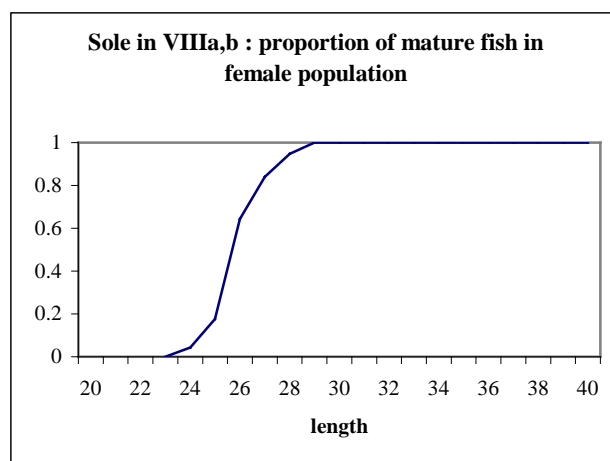
French mean weights at age are estimated using quarterly length-weight relationships in which weight are gutted weight multiplied by the fresh/gutted transformation coefficient of French landing. This latter was changed from 1.11 to 1.04 in 2007. The French mean weights at age in catches are consequently estimated with a fresh/gutted transformation coefficient which is 1.11 up to 2006 and 1.04 from 2007 onwards.

Belgian mean weights at age are straight estimates. International mean weights at age are French-Belgian quarterly weighted mean weights.

Stock weights are set to the catch weights but always using the old fresh/gutted transformation coefficient of French landing (1.11) to have the predicted spawning biomass comparable to the biomass reference point of the management plan (Bpa as estimated in 2006 using mean weights in the stock which were mean weights in the catches).

Maturity ogive

In assessments up to the 2000 Working Group, a knife-edge maturity was used, assuming a full maturity at age 3.



During the 4 first months in 2000, the maturity at length and at age was observed on 296 female fish, 112 being between 24 cm and 28 cm long, which is the observed length range for maturity occurrence of sole in Bay of Biscay. The sampling was assumed to be at random within a length class of 1 cm. The maturity ogive was then estimated applying a maturity/age/length key thus obtained to the length distribution of the first quarter in 2000.

The maturity at age was so estimated to be :

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

Natural Mortality

Natural mortality is assumed to be 0.1 for all age groups and all years.

B.3 Surveys

RESSGASC survey series are available but it worth noting that these surveys were carried out to provide hake discard estimates and consequently not well designed for providing abundance indices. Each quarter from 1987 to 1998, and thereafter each second and fourth quarter of the year, the survey aimed to catch as commercial fishing boats in the same areas. These series were disrupted in 2003.

Consequently, the abundance indices provided by these surveys are closed of commercial CPUE with the advantage to guarantee that no change occurred in fishing gear but the disadvantage to provide a CPUE based on a limited number of hours.

Because the change from a quarterly to an half yearly planning of this survey in 1998, the annual FR-RESSGASC-5 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 ($H \times 100 \text{ kW}$) to hours because this correction was considered introducing more noise, because of the quality of its measurement, than any improvement in this rather homogeneous fleet.

French commercial LPUE in the tuning files came from the fraction of catches for which gear and fishing effort data are available. As a consequence, the tuning effort series were partial and no estimate of effort can be provided by fleet but only for the total effort of French offshore trawlers (revised in 2004 using LPUE calculated for the whole trawler fleet).

Up to 2004 WG, the French commercial LPUE were calculated using all the available effort data. At 2005 WG, the French series of commercial fishing effort data and LPUE indices were revised to take into account changes in fishing areas due to change in targeting species in recent years and the decreasing number of offshore trawlers which land sole in La Rochelle and Les Sables. A minimum 10% of sole in total landing of a trip (data from 1984 to 1998) or of a day (from 1999 onwards) was selected to avoid effects of a shift in target species from sole to cephalopods in recent years. A second threshold was fixed on the percentage of nephrops in total landing (below or equal to 10%) to avoid the inclusion of trips or days during which a large part of effort is devoted to this species. To limit the effect of change in fishing power of the fleets throughout the tuning period and particularly the effect of the decreasing number of La Rochelle trawlers, a minimum number of years (10 from 1984 or 7 in the last 10 years) with sole landings was added to include boats in a fleet. The criterion of skippers having declared to have looked for sole in 2003-2004 (IFREMER annual activities survey) was added to avoid inclusion of boats fishing sole sporadically.

The series of LPUE of trawlers landing sole in other harbours than La Rochelle and Les Sables (FR-OTHER) was presented at 2005 WG for the first time. This additional information was estimated to be helpful to compensate for the lack of La Rochelle LPUE in 2004 which results from the combination of the decrease of number of boats in this fleet and from a delay in recording its 2004 logbooks. The same threshold in landing percentage was used to calculate this new LPUE series but neither the criterion of a minimum duration of participation in the fishery nor the skipper survey on target species were used. This LPUE series adds information on LPUE trend in the northern part of the Bay of Biscay, but the quality is lower because it was not possible to carry out the same selection process of vessels than for the two other fleets. Consequently, this fleet have not been used since the 2005 WG.

C. Historical stock development : Assessment Methods and Settings

WG year XSA	1998 XSA	1999 & 2000 XSA	2001 XSA	2002 XSA	2003 XSA	2004 XSA	2005 XSA	2006 XSA	2007 XSA	2008 XSA	2009 XSA	2010 XSA
Catch data range	1984-1997	1984-1998	1984-2000	1984-2001	1984-2002	1984-2003	1984-2004	1984-2005	1984-2006	1984-2007	1984-2008	1984-2009
Age range in catch data	1-8+	1-8+	1-8+	1-8+	1-8+	2-8+	2-8+	2-8+	2-8+	2-8+	2-8+	2-8+
FR – SABLES	88-97 1-7	89-98 1-7	84-00 2-7	84-01 2-7	84-02 2-7	84-03 2-7	91-04 revised 2-7	91-05 2-7	91-06 corrected 2-7	91-07 2-7	91-08 2-7	91-09 2-7
FR – ROCHEL	88-97 1-7	89-98 1-7	84-00 2-7	84-01 2-7	84-02 2-7	removed	95-04 revised 2-7	91-05 corrected 2-7	91-06 corrected 2-7	91-07 2-7	91-08 2-7	91-09 2-7
FR – ROCHEL1	Not used	Not used	Not used	Not used	Not used	84-92 2-7	Removed	Removed	Removed	Removed	Removed	Removed
FR – ROCHEL2	Not used	Not used	Not used	Not used	Not used	93-03 2-7	Removed	Removed	Removed	Removed	Removed	Removed
FR – OTHER	Not used	Not used	Not used	Not used	Not used	Not used	95-04 2-7	Removed	REMOVED	REMOVED	REMOVED	REMOVED
FR – RESSGASC-S	88-97 1-7	89-98 1-7	removed	removed	removed	removed	REMOVED	Removed	Removed	Removed	Removed	Removed
FR – RESSGASC-S 2	Not used	Not used	87-00 2-6	87-01 2-6	87-02 2-6	87-02 2-6	87-02 2-6	87-02 2-6	87-02 2-6	87-02 2-6	87-02 2-6	87-02 2-6
FR – RESSGASC-S 3	Not used	Not used	87-97 2-6	removed	removed	removed	Removed	Removed	Removed	Removed	Removed	Removed
FR – RESSGASC-S 4	Not used	Not used	87-00 1-6	87-01 1-6	87-02 1-6	87-02 2-6	87-02	87-02 2-6	87-02 2-6	87-02 2-6	87-02 2-6	87-02 2-6
Taper	No	No	Yes	Yes	YES	NO	NO	NO	NO	NO	NO	NO
Tuning range	10	10	17	18	19	20	14	15	16	17	18	19
Ages catch dep. Stock size	No	No	No	No	No	No	No	No	No	No	No	No
Q plateau	6	6	6	6	6	6	6	6	6	6	6	6
F shrinkage se	1.0	1.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Year range	5	5	5	5	5	5	5	5	5	5	5	5
age range	3	3	3	3	3	3	3	3	3	3	3	3
Fleet se threshold	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
F bar range	2-6	2-6	2-6	2-6	2-6	3-6	2-6	3-6	3-6	3-6	3-6	3-6

Age range in the assessment was changed from 0-8+ to 1-8+ in 1998, and to 2-8+ in 2004. In both cases, this change is largely due to the uncertainties in discards estimates.

Because French 1999 catch were not available at the 2000 WG, the 2000 XSA was identical to the 1999 XSA.

The age range of F bar was change from 2-6 to 3-6 at the 2004 WG because the age 2 is not fully recruited. This age range was turned back to 2-6 by ACFM because its implication on reference points. The Review Group asked nevertheless to investigate changing it again to 3-6 in 2005 and ACFM accepted the change to 3-6 in 2006.

D. Short term projection

Inputs

WG Year	1998	1999	2000	2001	2002	2003	2004
Recruitment	Age 1 GM 84-95	Age 1 GM 84-96	Age 1 GM 92-96	Age 1 GM 92-99	Age 1 GM 92-00	Age 1 GM 92-01	Age 2 GM 93-02
Age 2	XSA	derived from GM	derived from GM	derived from GM	Derived from GM	Derived from GM	XSA
Age 3	XSA	derived from GM	derived from GM	derived from GM	Derived from GM	Derived from GM	XSA + Derived from GM
Age>3	XSA	XSA	XSA	XSA	XSA	XSA	XSA
F	Unscaled 95-97	Unscaled 96-98	- Unscaled 96-97 at age 1 - Unscaled 96-98 at age>1	- Unscaled 98-99 at age 1 - Unscaled 98-00 at age>1	- Unscaled 99-00 at age 1 - Unscaled 99-01 at age>1	- Unscaled 00-01 at age 1 - Unscaled 00-02 at age>1	Scaled 01-03
Weight at age	Unweighted 95-97	Unweighted 96-98	Unweighted 96-98	Unweighted 96-98	Unweighted 99-01	Unweighted 00-02	Unweighted 01-03

WG Year	2005	2006	2007	2008	2009	2010
Recruitment	Age 2 GM 93-03	Age 2 GM 93-04	Age 2 GM 93-05	Age 2 GM 93-05	Age 2 GM 93-06	Age 2 GM 93-07
Age 2	GM	GM	GM	GM	GM	GM
Age 3	Derived from GM	Derived from GM	Derived from GM	Derived from GM	Derived from GM	Derived from GM
Age>3	XSA	XSA	XSA	XSA	XSA	XSA
F	- Unscaled 03-04 in 2005 - Unscaled 00-04 in 2006-07	- Unscaled 03-04 at age 2 - Unscaled 03-05 at age>2	- Unscaled 04-05 at age 2 - Unscaled 04-06 at age>2	- Unscaled 05-06 at age 2 - Unscaled 05-07 at age>2	- Unscaled 06-07 at age 2 - Unscaled 06-08 at age>2	- Scaled 07- 09 at age >= 2
Weight at age	Unweighted 02-04	Unweighted 03-05	Unweighted 04-06	Unweighted 05-07	Unweighted 06-08	Unweighted 07-09

Up to 2003: recruitment is at age 1. XSA last year numbers are considered poorly estimated and are overwritten using a geometric mean of past recruitment values.

In 2004: recruitment is at age 2. XSA last year numbers are used.

From 2005 to 2010: recruitment is at age 2. XSA last year numbers are considered poorly estimated and are overwritten using a geometric mean of past recruitment values. A mean from 1993 up to two years before the terminal years is preferred to a mean to one year before the terminal year because the retrospective pattern shows that convergence may not be before two years when terminal year estimate differs largely from posterior annual estimate.

Recruitments is observed to be at a lower level after 92 (after 93 at age 2). Consequently a short term geometric mean is used.

The exploitation pattern is generally an un-scaled 3 year arithmetic mean (2 years at first age when recruitment is overwritten by GM).

A scaled mean was used in 2004 to take in account the 2002 fixed net catchability increase and available information on landings in the first part of 2004.

An un-scaled 5 year arithmetic mean (4 years at age 2 when recruitment is overwritten by GM) was used in 2005 for the same reason.

A scaled mean was used in 2010 because the decreasing trend in F.

Catch and stock weights at age are taken as the mean of the last 3 years. Since 2007, weight in catches were corrected for a change in transformation coefficient for the French landing.

Maturity ogive and natural mortality estimates are those indicated previously.

E. Medium term projections

Medium term projection are carried out using the following inputs :

- last year deleted when recruitment is overwritten by GM (in SUM file)
- short series of same length than adopted GM for recruitment estimate (in SUM file)
- TAC year population number and fishing mortality (=WG year + 1) to be consistent with the short term forecast (in SEN file).

Several stock recruit relationships have been used 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 random bootstrap has been preferred since 2002.

F. Yield and biomass per recruit / long term projections

Yield per recruit calculations are conducted using the same input values as those used for the short term forecasts.

G. Biological reference points

The following biological reference points were proposed for this stock since 1998 :

	ACFM 1998	ACFM 1999	WG & ACFM 2001	WG 2004
			Change in maturity ogive	Change in recruitment age and in FBar age range
F_{lim}	Not defined	Not defined	0.5 (potential collapse)	Not defined
F_{pa}	0.40 (<i>prob</i> ($SSB_{MT} < B_{pa}$) < .1)	0.45 (<i>prob</i> ($SSB_{MT} < B_{pa}$) < .05)	$F_{pa} = F_{lim} e^{(-1.645 \cdot .2)} = 0.36$.	F proposal
B_{li} m	Not defined	Not defined	Not defined	Not defined
B_{pa}	11 300 t (B_{loss})	11 300 t (B_{loss})	13 000 t	Not relevant

H. Other Issues

None

I. References

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