

Annex F	Stock Annex	Bay of Biscay Sole
Quality Handbook		Stock Annex F
Stock specific documentation of standard assessment procedures used by ICES.		
Stock	Sole (division VIIIab)	
Working Group:	Assessment of Southern Shelf Stocks of Hake, Monk and Megrim	
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Revised by	M. Lissardy	

A General

A.1 Stock definition

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

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

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

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

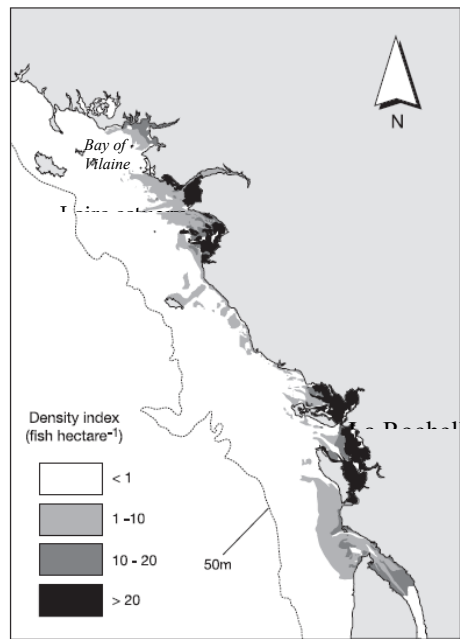


Figure 1: Fitted 0-group sole density (number of fish per hectare) in the Bay of Biscay (Le Pape *et al.*, 2003a).

A.2 Fishery

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

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

Otter trawling predominated until the late 1980s, including a small-mesh shrimp fishery which decreased markedly in the beginning of the 1990s. The fixed fishery begun in the 1980s and it have expanded in the 1990 to account for two third to three quarters of the French landings in the beginning of 2000s. The beam trawl effort increased also rapidly and continuously in the 1990s. It has decreased after 1999 until 2004 but it has returned to its previous 2001-2002 level in 2006-2007. In 2010 it had increased until 11 % (his max until 1999) On the opposite, the otter trawl effort shows a decreasing trend until 1999 but it is stable since then.

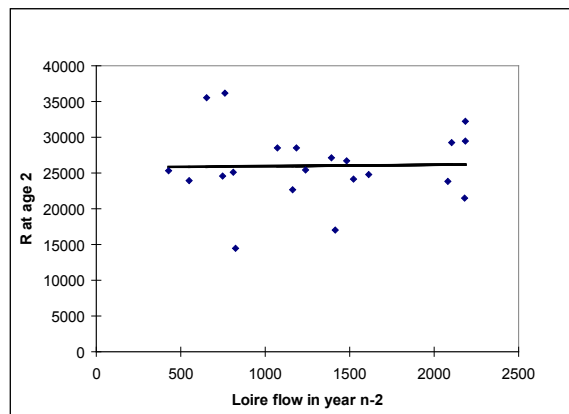
Catches have increased continuously since the beginning of the 1980s, until a maximum was reached in 1994 (7 400 t). They have decreased afterwards to 3600-4800t in 2003-2010. The year 2009 is the lower and the year 2011 is the higher since 2006 (4600 t).

A.3 Ecosystem aspects

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

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

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



B. Data

B.1 Commercial Catch

B.1.1 Discards estimates

Discard data are not included in the assessment because the available discards estimates are limited and, furthermore, may be biased (see thereafter).

Discards data collected within the DCF regulation framework:

These observations have shown that discards of beam trawlers and gillnetters are generally low but that the inshore trawlers fleet may have occasionally high discards of sole. Unfortunately, they are difficult to estimate because the effort data of inshore trawlers are not precise enough to allow estimating them by relevant areas. However, if one considers the discards have probably been high in 2009 because the 2007 year class seems to have been above the mean according to the ORHAGO survey, and if one uses the observed ratio of discards on landings of the inshore trawler fleet in 2009, which is likely to be an overestimate because the observed trips were mainly in nursery areas, the discards of the inshore trawlers are no more than 5 % of the landings in number.

The French fishing industry agreed with the data used in the assessment but suggested that the use of the discards might improve the assessment because the development of high-grading in some areas. The discards data are available since 2010 but total discards cannot be estimated because we have not an historical series (lack of data between 2004 and 2009).

Discards estimates of the French offshore trawlers provided by the RESSGASC surveys from 1987 to 2003:

Discards estimates of the French offshore trawlers were provided by the French trawl surveys FR-RESSGASC-S from 1987 to 2002. These surveys were carried out each quarter until 1997 and in the second and last quarter from 1998 to 2002.

In 2002, this survey was discontinued because the discards estimates that it provides were estimated to depend on the following questionable assumptions:

- 1) Trawls of the Gwen Drez R/S and the offshore trawlers have the same selectivity,
- 2) Gwen Drez R/S operate in the same area and in the same conditions than the offshore trawlers during the quarter (up to 1997) or the semester of the survey (quarter 4 year n + quarter 1 year $n+1$ for November survey year n ; quarter 2 and 3 for may survey).

These discards estimates are been included several years in the assessments. They have represented about 1 to 3 % of the total catches from 1991 to 2003 and less than 0.5% since in 2002 and 2003. Given their low contribution to the total catch and the uncertainty due to the assumptions on which they are based, they have been no longer used in the assessment, as recommended by ACFM, since 2005.

Their estimation method may be finding in the annexes appended to the 2005 and 2006 WGSSDS reports or in the WGHMM stock annexes from 2007 to 2010 (Bay of Biscay sole stock was moved from WGSSDS to WGHMM in 2007)

B.1.2 Landing numbers at length

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

B.1.3 Catch number at age

Age reading method

From 1984 to 2008, the ages in the French landings have been determined by reading otoliths which have been burnt and manually cut. From 1996 onwards, the ages in Belgian landings begun to be determined by reading the age on thin slices of otolith.

In 2005, the ages in French landings begun to be also determined by using this latter method which is the more commonly used for sole age reading. However, in order to estimate the effect of the change in age reading method, from 2005 to 2008 the age reading of French sampled fishes were carried out using the two methods. One otolith was burnt and the second was collected to get thin slices.

Two catch and weight at age 1984-2008 time series can thus be used to carry out two assessments, the set of data differing one from the other in the four terminal years. A comparison of these two assessments was presented to the 2010 WGHMM. It shows only limited differences in the outputs. Consequently, the French catch and weight at age were revised from 2005 onwards at the 2010 WGHMM to use the 2005-2009 data set provided by age reading on otolith slices, which is now the unique age reading method for the Bay of Biscay sole stock.

ALKs use to get catch at age estimates

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

Prior to 1994, the age composition of French offshore trawler catches is raised to include Belgian landings. In 1994 and 1995, FR-RESSGASC-S ALKs are applied to Belgian length distributions. From 1996 ahead, catch numbers at age of the Belgian fleet are estimated with Belgian ALKs. French and Belgian age composition are added before being raised to the total international catch except in 2001 where the Belgian age compositions were raised to the total of Belgian and Dutch landings.

B.2 Biological

Weights at Age

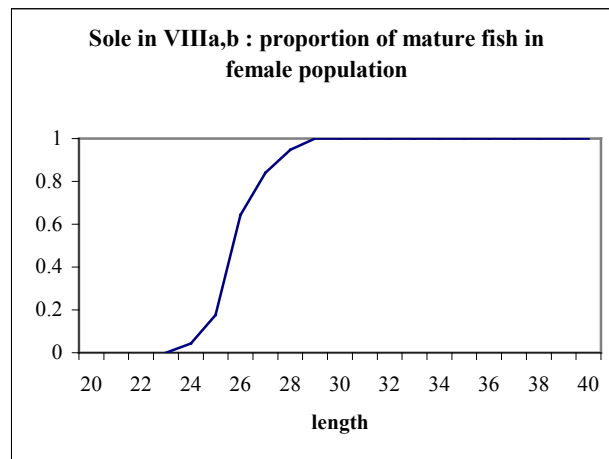
French mean weights at age are estimated using quarterly length-weight relationships in which weight are gutted weight multiplied by the fresh/gutted transformation coefficient of French landing. This latter was changed from 1.11 to 1.04 in 2007. The French mean weights at age in catches are consequently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

Quarterly RESSGASC survey series are available from 1987 to 2002 but it worth noting that these surveys were carried out to provide hake discard estimates and consequently not well designed for providing sole abundance indices. Each quarter from 1987 to 1998, and thereafter each second and fourth quarter of the year, the survey aimed to catch as commercial fishing boats in the same areas. These series were disrupted in 2003. They have been withdrawn from the assessment by the 2011

WKFLAT because they no longer contribute to the estimates of the terminal population numbers.

ORHAGO survey

The ORHAGO survey was launched in 2007. The fishing gear is a beam trawl with 40 mm codend. This survey is carried out in November-December in order to have a good catchability of sole at the age 1. The sampling plan is systematic. 50 hauls are distributed in 10' latitude by 10' longitude rectangles all over the sole habitat in the Bay of Biscay. The haul positions are kept unchanged from year to year. This beam trawl survey is coordinated by the WGBEAM to which the results are reported each year since its beginning. The inclusion of this survey in the assessment was examined by the 2011 WKFLAT who concluded that this series is not long enough to be included in the assessment in 2011 but that possibility should be examined by the WGHMM when the series is more than five years long.

B.4 Commercial CPUE

Four commercial CPUE series are used in the assessment: La Rochelle offshore trawlers (FR-ROCHELLE), Les Sables d'Olonne offshore trawlers (FR-SABLES), the Bay of Biscay offshore trawlers in the second quarter (FR-BB-OFF-Q2) and the Bay of Biscay inshore trawlers in the last quarter (FR-BB-IN-Q4).

These series are provided by boats which are selected to form homogeneous groups and to limit year to year changes in fleet compositions. The following methods were adopted:

- The La Rochelle and the Les Sables d'Olonne offshore trawler fleets are two fixed groups of fishing boats. These fleets were first included in the tuning fleets at the 2005 WGSSDS. They were formed by boats which have landed sole either in La Rochelle (or near La Rochelle) or in Les Sables and for which CPUE data (with sole and *Nephrops* percentage in catches thresholds indicated thereafter) are available for a minimum number of years (10 from 1984 or 7 from 1995 to 2004). The criterion of skippers having declared to have looked for sole in 2003-2004 (IFREMER annual activities survey) was added to avoid inclusion of boats fishing sole sporadically. The La Rochelle vessels are 14 to 20 meters long and the Les Sables vessels are 12 to 23 meters long.
- The Bay of Biscay offshore trawler fleet in the second quarter and the Bay of Biscay inshore trawler fleet in the fourth quarter are formed by fishing boats which have caught sole in Bay of Biscay and for which CPUE data (with sole and *Nephrops* percentage in catches thresholds indicated thereafter) are available for five years over the ten last years. Furthermore, to limit effect of changes in fishing area, the CPUE were calculated by selecting the statistical rectangles which have provided a CPUE for more than 5 years from 2000 onwards. After the selection of rectangles, we keep the fishing boats which have caught sole for five years over the ten last years. These tuning series were first included in the tuning process at the 2011 WKFLAT. They were added to the tuning series because the decrease in number of trawlers in La Rochelle or Les Sables fleets due to the decommissioning measures or the change in gear. The inshore vessels are 10 to 12 meters long and the offshore vessels are 14 to 18 meters long.

To take into account changes in fishing areas due to change in targeting species, a minimum percentage of sole in total landing of a trip (data from 1984 to 1998) or of a day (from 1999 onwards) was selected to avoid effects of a shift in target species from

sole to cephalopods in recent years. This percentage has been set to 10 % in 2005 for selecting relevant fishing periods for the La Rochelle and Les Sables tuning fleets. It resulted from the advice of fishermen given at a meeting. For defining new tuning fleets in 2011, it was necessary to reduce this percentage to 6 % for increasing the number of available data. This requirement is due to the choice to carry out the work on a more reduced time period than previously (quarter instead of year) and to pay attention to the spatial distribution of effort.

A second threshold was fixed on the percentage of *Nephrops* in total landing (below or equal to 10%) to avoid the inclusion of trips or days during which a large part of effort is devoted to this species.

The effort is in hours. It is not corrected for horse power ($H \times 100$ kW) because this correction is considered introducing more noise, because of the quality of the measurement of horse power, than any improvement in fleets which are constructed to be homogeneous and with limited change in composition over the time period.

Because of the decreasing on the numbers of vessels for Les Sables and the large decreasing on the fishing effort for La Rochelle for 2010, the WGHMM decision is to withdraw the 2010 CPUE value for the Les Sables and La Rochelle.

C. Assessment: Data and method

Model used: XSA

Software used: Lowesstoff VPA program

The XSA settings to be used were set by the WKFLAT 2011 and revised by the WGHMM are given in the following text table.

	WGHMM 2012
Catch data range	84- last year
Catch age range	2-8+
Sables d'Olonne offshore trawlers fleets tuning fleet (FR – SABLES)	1991 - 2009 2-7
La Rochelle offshore trawlers fleets tuning fleet (FR – ROCHELLE)	1991 - 2009 2-7
Bay of Biscay offshore trawlers in the second quarter tuning fleet (FR-BB-OFF-Q2)	2000 - last year 2-6
Bay of Biscay inshore trawlers in the fourth quarter tuning fleet (FR-BB-IN-Q4)	2000 - last year 3-7
Taper	No
Ages catch dep. Stock size	No
Q plateau	6
F shrinkage se	1.5
Year range	5
age range	3
Fleet se threshold	0.2
F bar range	3-6

Historical review of changes in XSA settings (see text table thereafter):

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

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

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

WG year XSA	1998 XSA	1999 & 2000 XSA	2001 XSA	2002 XSA	2003 XSA	2004 XSA	2005 XSA	2006 XSA	2007 XSA	2008 XSA	2009 XSA	2010 XSA	2011 XSA	2012 XSA
Catch data range	1984-1997	1984-1998	1984-2000	1984-2001	1984-2002	1984-2003	1984-2004	1984-2005	1984-2006	1984-2007	1984-2008	1984-2009	1984-2010	1984-2011
Age range in catch data	1-8+	1-8+	1-8+	1-8+	1-8+	2-8+	2-8+	2-8+	2-8+	2-8+	2-8+	2-8+	2-8+	2-8+
FR – SABLES	88-97 1-7	89-98 1-7	84-00 2-7	84-01 2-7	84-02 2-7	84-03 2-7	91-04 revised 2-7	91-05 2-7	91-06 corrected 2-7	91-07 2-7	91-08 2-7	91-09 2-7	91-09 2-7	91-09 2-7
FR – ROCHELLE	88-97 1-7	89-98 1-7	84-00 2-7	84-01 2-7	84-02 2-7	removed	95-04 revised 2-7	91-05 corrected 2-7	91-06 corrected 2-7	91-07 2-7	91-08 2-7	91-09 2-7	91-09 2-7	91-09 2-7
FR – ROCHELLE1	Not used	Not used	Not used	Not used	Not used	84-92 2-7	Removed	Removed	Removed	Removed	Removed	Removed	Removed	Removed
FR – ROCHELLE2	Not used	Not used	Not used	Not used	Not used	93-03 2-7	Removed	Removed	Removed	Removed	Removed	Removed	Removed	Removed
FR – OTHER	Not used	Not used	Not used	Not used	Not used	Not used	95-04 2-7	Removed	REMOVED	REMOVED	REMOVED	REMOVED	REMOVED	REMOVED
FR – RESSGASC-S	88-97 1-7	89-98 1-7	removed	removed	removed	removed	REMOVED	Removed	Removed	Removed	Removed	Removed	Removed	Removed
FR – RESSGASC-S 2	Not used	Not used	87-00 2-6	87-01 2-6	87-02 2-6	87-02 2-6	87-02 2-6	87-02 2-6	87-02 2-6	87-02 2-6	87-02 2-6	87-02 2-6	Removed	Removed

D. Short term projection

Model used: Age structured deterministic projection

Software used: MFDP

Inputs

Initial stock size:

- Recruitment is the geometric mean of recruitment values XSA over 1993 to three years before the assessment year (short mean because recruitment values are lower since 1993) if the XSA last year recruitment is considered poorly estimated according to the retrospective pattern.
- Recruitment is XSA last year recruitment if this latter one is considered to be accurately estimated according to the retrospective pattern.
- Age group above recruitment is derived from the GM.

Natural mortality: Set to 0.1 for all ages in all years

Maturity: Same ogive used for all years (given in section B.2)

F and M before spawning: None

Weight at age:

- Weights at age in the landings are the unweighted means over the last 3 years using the new fresh/gutted transformation coefficient of French landing which was changed from 1.11 to 1.04 in 2007.
- Weights at age in the stock are the unweighted means over the last 3 years using the old fresh/gutted transformation coefficient of French landing (1.11). The predicted spawning biomass are consequently comparable to the precautionary biomass reference point (Bpa) set before the change in fresh/gutted transformation coefficient of the French landing.

Exploitation pattern:

- Fishing mortality at recruiting age is the arithmetic mean over the 2 years before the terminal year if the XSA recruitment estimate is overwritten by a GM.
- Fishing mortalities above recruiting age is the arithmetic mean over the 3 last years of the assessment
- Unscaled if no trend is detected,
- Scaled to the last year's Fbar if a trend is detected.

Intermediate year assumptions:

Status quo F except if there is some information about the possibility that the TAC may be limiting.

F. Yield and biomass per recruit / long term projections

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

G. Biological reference points

	Type	Value	Technical basis
MSY Approach	MSY $B_{trigger}$	13 000 t	B_{pa} (provisional estimate. MSY $B_{trigger}$ to be re-evaluated).
	F_{MSY}	0.26	F_{max} (as estimated by WGHMM 2010) because no stock-recruitment relationship, limited variations of recruitment, Fishing mortality pattern known with low uncertainty
Precautionary Approach	B_{lim}	Not defined	
	B_{pa}	13 000 t	The probability of reduced recruitment increases when SSB is below 13 000 t, based on the historical development of the stock.
	F_{lim}	0.58	Based on the historical response of the stock.
	F_{pa}	0.42	$F_{lim} * 0.72$

(unchanged since: 2010)

H. Other Issues

None

I. References

- Arbault S., P. Camus and C. Le Bec, 1986. Estimation du stock de sole (*Solea vulgaris*, Quensel 1806) dans le golfe de Gascogne à partir de la production d'œufs. *J. Appl. Ichtyol.*, 4, 145-156.
- Koutsikopoulos C., D. Dorel, Y. Désaunay, B. Le Cann and A. Forest, 1993. Interaction entre processus physiques et comportement individuel : conséquence sur l'organisation et le fonctionnement du stock de sole (*Solea solea* L.) du golfe de Gascogne. Les recherches françaises en évaluation quantitative et modélisation des ressources et des systèmes halieutiques. Actes du premier Forum Halieumétrique, Ortom ed., 49-74.
- Guichet R., Ph. Moguedet, B. Mesnil and A. Battaglia, 1998. Echantillonnage biologique des rejets de poissons et autres organismes dans le golfe de Gascogne. Rapport final du Contrat BIO ECO 94-054 CEE DG XIV. IFREMER La Rochelle, 121 p.
- Le Pape O., Chauvet F., Mahevas S., Lazure L., Guérault G. & Désaunay, Y. (2003a). Quantitative description of habitat suitability for the juvenile common sole (*Solea solea*, L.) and contribution of different habitats to the adult population in the Bay of Biscay (France). *J. Sea Res.* 50, 139-149.
- Le Pape O., Désaunay, Y. & Guérault G. (2003b). Relationship between fluvial discharge and sole (*Solea solea*) recruitment in the Bay of Biscay (France), ICES Marine Science Symposia 219 : 241-248