Stock Annex: Sole in Division 7.d

Stock-specific documentation of standard assessment procedures used by the International Council for Exploration of the Sea (ICES).

Stock:	Sole (*Solea solea L.*) in Division 7.d (sol 27.7d)
Working group:	ICES Working Group for the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK)
Last date when the stock was updated:	June 2017
Revised by:	Lies Vansteenbrugge (WKNSEA 2017)
Timeline of revisions:	May 2011
Main modifications:	New stock annex as a result of the benchmark
Last Benchmarked:	February 2017 (WKNSEA 2017)

A. General

A.1 Stock definition

Sole in the eastern English Channel (27.7.d) is considered to be a stock separated from the larger North Sea stock (27.4) to the east and the smaller geographically-separated stock to the west in 27.7.e (western English Channel).

Genetic analyses using outlier Single Nucleotide Polymorphisms (SNP) revealed that sole in area 27.7.e is genetically distinct from 27.7.d while 27.7.d sole shows a pattern of isolation by distance (gradual change in genetic diversity) with the North Sea sole (Diopere *et al*., submitted 2017). The intensive CEFAS tagging programme (Burt and Millner, 2008) showed that overall 91% of sole in the North Sea and 72% in 27.7.d remained resident. The remaining 9% of the North Sea were found in 27.7.d (7%) and in 27.7.e (2%). 20% of the sole released in 27.7.d had moved west into the neighbouring area 27.7.e (and 1% beyond 27.7.e), but more noticeably so in autumn and winter (31% in Q4–Q1 vs 15% in Q2–Q3). 7% moved into the North Sea. The extent of movement between 27.7.d and 27.7.e increases closer to the boundary between the two areas. However, the abundance of sole in the western part of 27.7.d is much lower than in the eastern area and this movement across the management boundary, although significant, might represent a relatively small number of fish. The assessment does not take account of these movements.

Three regions are distinguished within area 27.7.d that are associated with low connectivity for larvae and juveniles: a) along the English coast, b) in the Bay of Seine, and c) along the coast of northern France (Rochette *et al*., 2013; Archambault *et al*., 2016). Limited exchange of larvae or juveniles occurs between these three areas (Eastwood et al., 2001; Grioche *et al*., 2000; Rochette *et al*., 2012), with the exception of the northern side of the region ‘coast of northern France’, where exchange with the North Sea was observed due to the strong hydrodynamics (Savina *et al*., 2010; Savina *et al*., 2016).

Less information is available for adults, but a similar low exchange rate was suggested by tagging studies performed by CEFAS (Figure 1; Kotthaus, 1963; Burt et Millner, 2008).

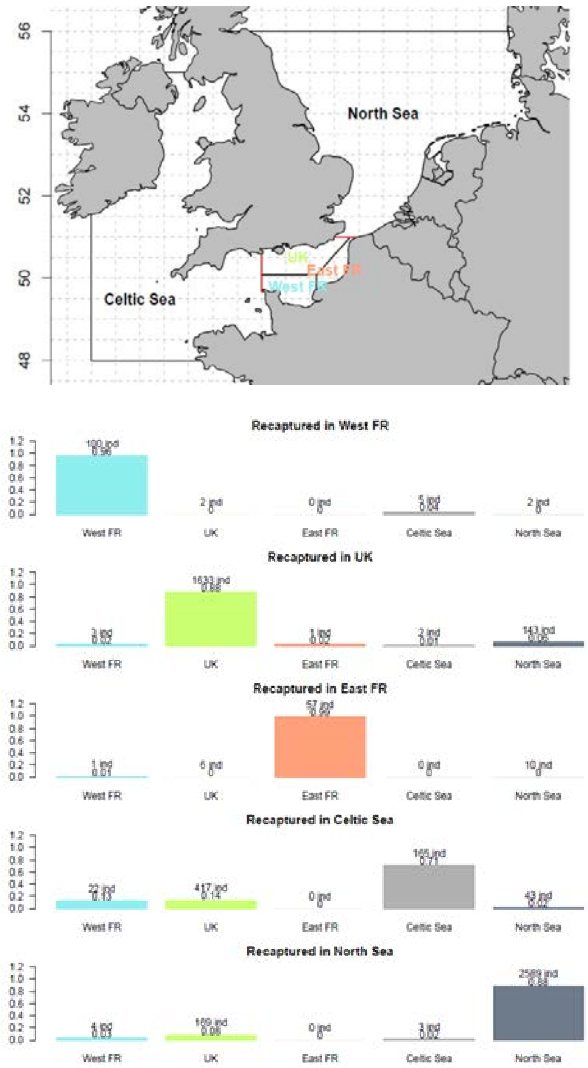


Figure 1: Origin of the sole caught in each spatial unit (Figure based on the CEFAS database; Burt and Millner, 2008). For example: from the tagged sole recaptured in the 'East FR' area, 57 (the majority, 99%) had been released in that area. A minority came from neighbouring areas: 1 individual from 'West FR' (1%), 6 individuals from 'UK' (<1%) and 10 from the North Sea (<1%), percentages are the ratio of tagged soled recovered in the area X and released in Y over the total amount of tags released in Y.

A.2 Fishery

A.2.1 General description

Countries involved in this fishery are France (contributing ~50%), Belgium (~30%) and the UK (England and Wales) (~20%). Some years, also UK (Scotland) and the Netherlands have a minor contribution to this fishery.

There is a directed fishery for sole by small inshore (mostly French and British) vessels using trammelnets and trawls, which fish mainly along the English and French coasts and possibly exploit different coastal populations. Sole represents the most important species for these vessels in terms of the annual value to the fishery. The fishery for sole by these boats occurs throughout the year with small peaks in landings in autumn and late winter.

There is also a directed fishery by English and Belgian beam trawlers (Figure 2). These vessels are able to fish for sole in winter before the fish move inshore and become accessible to the local fleets. In cold winters, sole are particularly vulnerable to the offshore beamers when they aggregate in localized areas of deeper water. Effort from the beam trawl fleet can change considerably depending on whether the fleet moves to other areas or directs effort at other species such as scallops and cuttlefish. French offshore trawlers fishing for mixed demersal species taking sole as a bycatch operate mainly in the northern part of division 27.7.d.

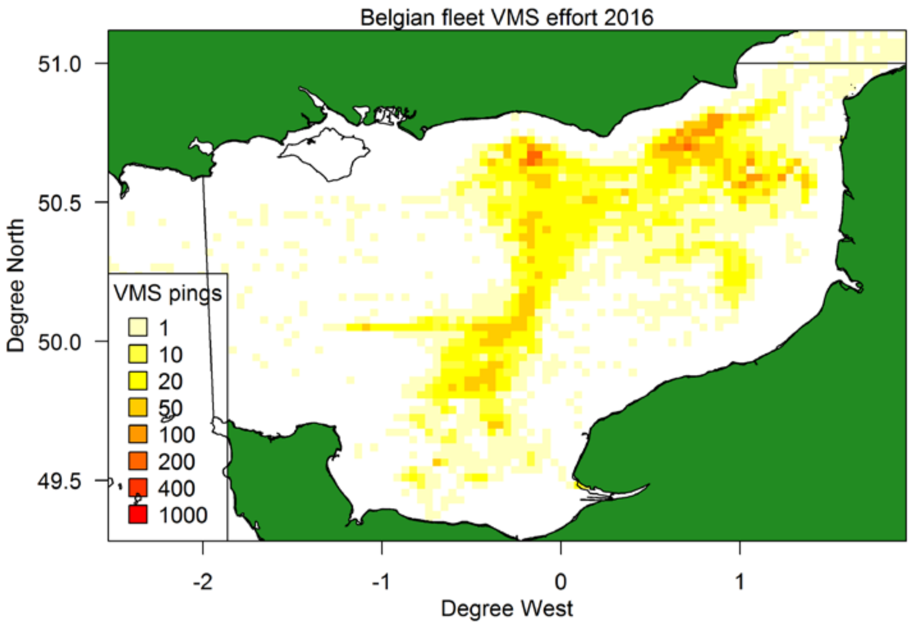


Figure 2: VMS effort in 2016 of the Belgian fleet in division 27.7.d.

A.2.2 Fishery management regulations

Management of sole in 27.7.d is by TAC and technical measures.

The minimum landing size for sole is 24 cm. Mesh size restrictions in place are 80 mm for beam trawling and 80 mm for otter trawlers. Fixed nets for the sole fisheries are required to use 100 mm mesh since 2002 although an exemption to permit 90 mm has been in force since that time.

A historical overview of the TAC for sole 27.7.d since 2000 is presented in the table below.

Historical overview of the TACs for sole in Division 27.7.d (2000–2017); Note: TAC represents catch from 2016 onwards (landing obligation):

Year	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
TAC	4100	4600	5200	5400	5900	5700	5720	6220	6590
Year	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
TAC	5274	4219	4852	5580	5900	4838	3483	3258*	2769*

* Catch TAC

Except for 2010, the TAC has not been restrictive for France, Belgium and the UK since 2003. In 2014, it became restrictive for Belgium, and in 2015 this was the case for Belgium and France.

In response to the drop in SSB and the poor recruitment in 2012–2016 (exception 2015), the two main countries participating in the fishery (France and Belgium) have also implemented additional conservation measures. For Belgian beam trawlers in 27.7.d (and 27.7.fg, 27.7.a) it is mandatory since 1 April 2015 to incorporate a 3 m long section (tunnel) with a 120 mm mesh size before the codend, in order to reduce the catches of small sole (reduction of undersized sole with 40% and marketable sole with 16%). France engaged in 2016 to i) strengthen the protection of the nursery areas, ii) increase the area closed to fishing within the nursery areas, and iii) increase the minimum conservation reference size to 25 cm for French vessels in accordance with EU legislation, where appropriate. From 11 March until 31 December 2017, the minimum conservation reference size for Belgian vessels has also increased to 25 cm. Finally, also UK beam trawlers usually fish using mesh sizes greater than statutory in order to avoid discarding and to avoid wasting quota.

A.3 Ecosystem aspects

Biology: Adult sole feed on worms, small molluscs and crustaceans. In the English Channel, reproduction occurs between February and April, mainly in the coastal areas of the Dover Strait and in large bays (Somme, Seine, Solent, Mont-Saint-Michel, Start and Lyme Bay). Pelagic eggs hatch after 5 to 11 days leading to larvae that are also pelagic and that metamorphose into benthic fry after 1 or 2 weeks. Juveniles spend the first 2 or 3 years in coastal nurseries (bays and estuaries), where growth fast occurs (11 cm at 1 year old) before moving to deeper waters (Carpentier *et al.,* 2009).

The spatial distribution of the different life stages of common sole demonstrates a particular pattern. Larval distribution (on spawning grounds) and juvenile distribution (in nursery grounds) overlap. If larvae are found everywhere during spring, the potential habitat for stage 2 larvae is along the Flanders coast and near the Pays de Caux, to the central zone of the English Channel. Older larvae have a more coastal habitat preference, which can be explained by a retention phenomenon linked to estuaries.

Environment: Sole is a benthic species that lives on fine sand and muddy seabeds between 0 and 150 meters depth. The species is found from marine to brackish waters in temperatures between 8 and 24°C. An overview of physical and hydrological features of the Eastern English Channel is shown in Figure 3.

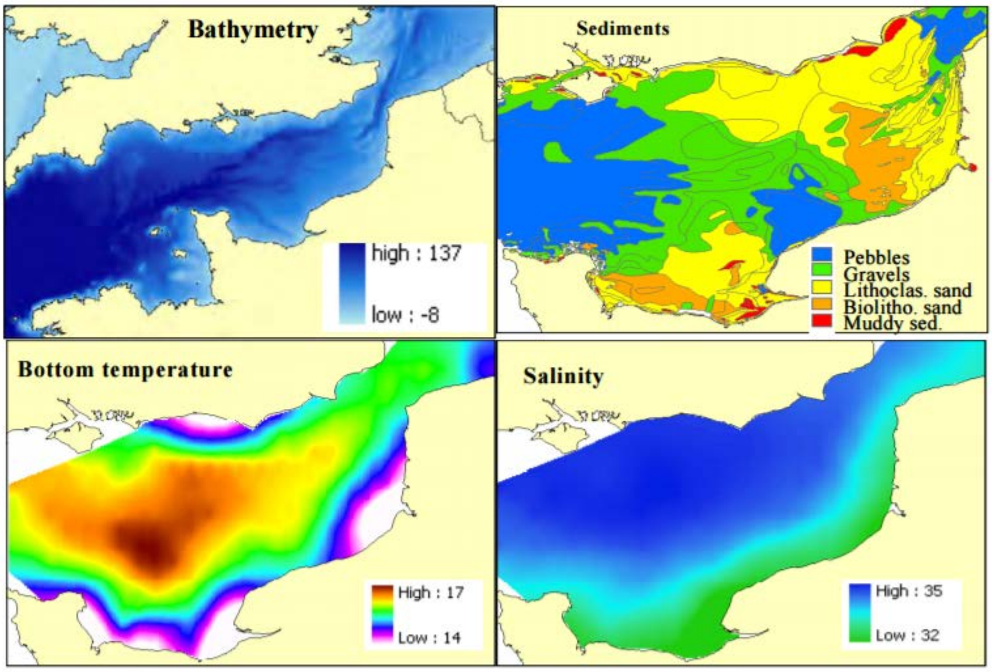


Figure 3: Eastern English Channel physical and hydrological features: Bathymetric depth and simplified sediment types representation. Survey bottom temperature and bottom salinity (averaged for 1997 to 2003) obtained by Kriging (in Vaz *et al.*, 2005).

Geographical distribution: Sole is found in the Eastern Atlantic, from southern Norway to Senegal, Mediterranean Sea including Sea of Marmara and Black Sea.

Species assemblage: Vaz *et al.*, 2007 used multivariate and spatial analyses to identify and locate fish, cephalopod, and macrocrustacean species assemblages in the eastern English Channel from 1988 to 2004. Four sub-communities with varying diversity levels were identified in relation to depth, salinity, temperature, seabed shear stress, sediment type, and benthic community nature. One Group (class 4 in Figure 4 below) was a coastal heterogeneous community represented by pouting, poor cod, and sole and was classified as preferential for many flatfish and gadoids. It displayed the greatest diversity and was characterized by heterogeneous sediment type (from muds to coarse sands) and various associated benthic community types, as well as by coastal hydrology and bathymetry. It was mostly near the coast, close to large river estuaries, and in areas subject to big salinity and temperature variations. Possibly resulting from this potentially heterogeneous environment (both in space and in time), this sub-community type was the most diverse.

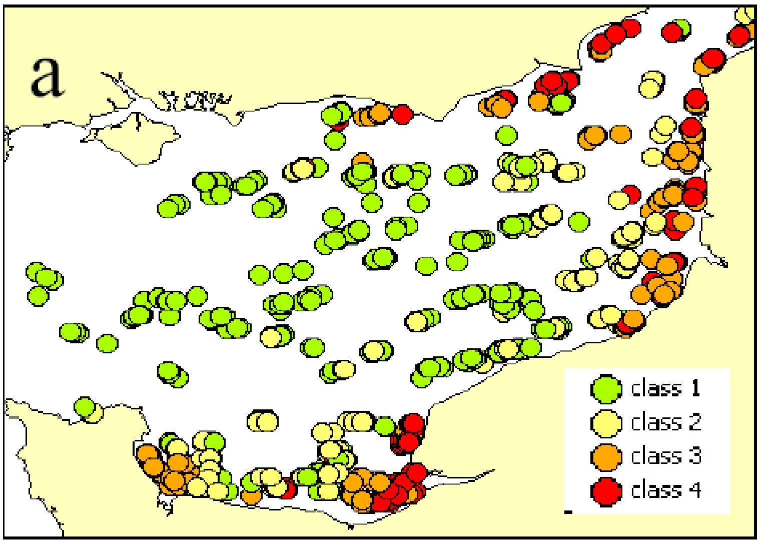


Figure 4: Spatial distribution of fish sub-communities in the Eastern Englisch Channel from 1988–2004. The graduation from open sea community to coastal and estuarine communities is shown. (from Vaz *et al.*, 2005).

Vaz *et al.* (2007) investigated the community evolution over time and concluded that the community relationship with its environment was remarkably stable over the 17 years of observation. However, the community structure changed significantly over time without any detectable trend, as did temperature and salinity. The community is so strongly structured by its environment that it may reflect interannual climate variations, although no patterns could be distinguished over the study period. The absence of any trend in the structure of the eastern English Channel fish community suggests that fishing pressure and selectivity have not altered greatly over the study period at least. However, the period considered here (1988–2004) may be insufficient to detect such a trend.

More details on the biology, habitat and distribution of sole in division 27.7.d may be found in section H1 (from the Interreg 3a project CHARM II, Carpentier *et al.*, 2009).

B. Data

B.1 Commercial catch

B.1.1 Landings data

Three main countries are involved in taking up the landings of this stock: France (~50%), Belgium (~30%) and UK (England and Wales) (20%). This uptake is more or less constant over the years. Some years, also UK (Scotland) and the Netherlands have a minor contribution.

Landings data are available from 1982 onwards and present in InterCatch from 2003 onwards as a result of the benchmark data call (WKNSEA 2017). Age sampling for the period before 1980 was poor, but between 1981 and 1984 quarterly samples were provided by both Belgium and the UK. Since 1985, quarterly catch and weight-at-age compositions were available from Belgium, France, and the UK. The proportion of landings with discards has gradually increased over the years (2003–2016; Figure 5). The age coverage for landings has remained stable (~80%) (Figure 5).

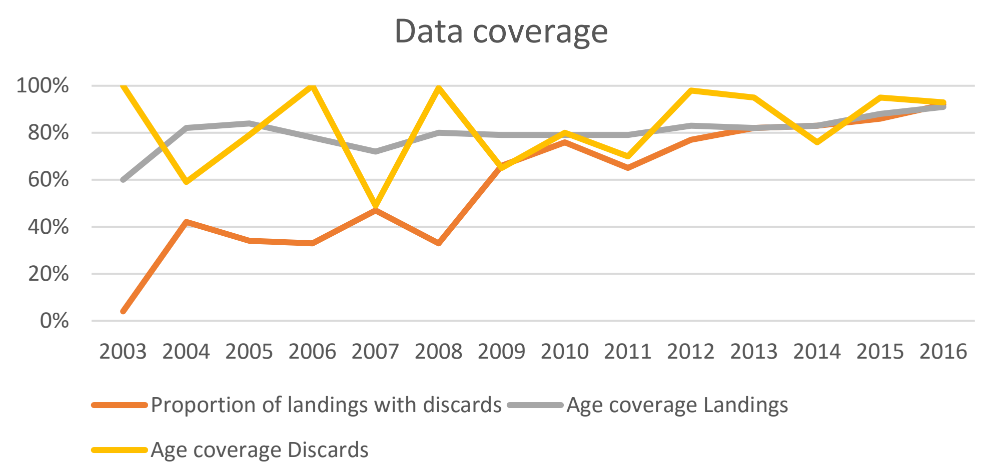


Figure 5: Overview of data coverage for data uploaded in InterCatch (from 2003 onwards).

For the landings without age coverage, age compositions were allocated using the 'mean weight weighted by numbers at age' weighting factor and according to the following scenarios.

By **métier** for métiers representing 75% of the total landings

By **gear group** when the proportion of landings covered by age was ≥75%. The following gear groups were distinguished: TBB, OTB/SSC/SDN and GTR/GNS.

Overall: When the proportion of landings covered by age was <75%, unsampled data were pooled in a rest group and ages were allocated using all sampled data.

More information on the age allocations is provided in the WKNSEA 2017 benchmark report and associated working document (ICES, 2017). This method for age allocation was used from working year 2017 (2016 assessment) onwards. Modifications to this method should be mentioned in the report.

B.1.2 Discards data

For the benchmark (WKNSEA 2017), a data call for all countries involved in this fishery was launched to acquire discard data from 2003 onwards. Discards are included in the assessment from working year 2017 onwards. Prior to this benchmark, discard rates were estimated.

The proportion of landings with discards has gradually increased over the years (Figure 5). When discards were not available, these were raised in InterCatch. Discards on a country-quarter-métier basis were automatically matched by InterCatch to the corresponding landings. The matched discards-landings provided a landing-discard ratio estimate, which was then used for further raising (creating discard amounts) of the unmatched discards (discard ratios larger than 0.5 were excluded as they were not assumed to be representative for the available strata). The weighting factor for raising the discards was 'Landings CATON'. Discard raising was performed on a gear level regardless of season or country.

- The following groups were distinguished based on the gear:

- TBB
- OTB, SSC and SDN
- GTR and GNS

- The remaining gears were combined in a REST group (including for example MIS, FPO, LLS and DRB)
- Raising within a gear group was performed when the proportion of landings for which discard weights are available, was equal or larger than 75% compared to the total landings of that group.

More information on how discard raising was performed is provided in the WKNSEA 2017 benchmark report and associated working document (ICES, 2017). This method for discard raising was used from working year 2017 (2016 assessment) onwards. Modifications to this method should be mentioned in the report.

The age coverage for discards fluctuates over the years from 50–100%, but has gradually improved (Figure 5). For some fleets, discards had not been sampled. Age compositions for the remaining discards were allocated using the 'mean weight weighted by numbers at age' weighting factor and according to the following scenarios.

By **gear group** when the proportion of discards covered by age was ≥75%. The following gear groups were distinguished: TBB, OTB/SSC/SDN and GTR/GNS.

Overall: When the proportion of landings covered by age was <75%, unsampled data were pooled in a rest group and ages were allocated using all sampled data.

More information on the age allocations is provided in the WKNSEA 2017 benchmark report and associated working document (ICES, 2017). This method for age allocation was used from working year 2017 (2016 assessment) onwards. Modifications to this method should be mentioned in the report.

B.1.3 Data collection and quality by country

Data are uploaded in InterCatch by the countries involved (mainly France, Belgium and UK (England)) and include quarterly or yearly numbers at age, weight at age and total landings. The files are processed in InterCatch by the stock coordinator to produce a FLR stock object. SOP corrections are applied to the data.

B.1.3.1 French data

French commercial landings in tonnes by quarter, area and gear are derived from logbooks for boats over 10 m and from sales declaration forms for vessels under 10 m. These self-declared productions are then linked to the auction sales in order to have a complete and precise trip description.

The collection of discard data has begun in 2003 within the EU Regulation 1639/2001. The first years of collection were incomplete in terms of time and métier coverage. An increase of sampling effort as required by ICES/ACOM from 2009 onwards, has positively affected the data quality.

The length measurements are done by market commercial categories and by quarter into the principal auctions of Grandcamp, Port-en-Bessin, Dieppe and Boulogne. Samplings from Grandcamp and Port-en-Bessin are used for raising catches from Cherbourg to Fecamp and samplings from Dieppe and Boulogne are used to raise the catches from Dieppe to Dunkerque.

Otoliths samples are taken by quarter throughout the length range of the catch for quarters 1 to 3. These are aged and combined to the quarterly level. The age–length key thus obtained is used to transform the quarterly length compositions. The lengths not sampled during one quarter are derived from the nearest quarter of that same year.

Weight, sex and maturity-at-length and -at-age are obtained from the fish sampled for the age–length keys.

B.1.3.2 Belgian data

Belgian commercial landings and effort information by quarter, area and gear are derived from logbooks.

Sampling for age and length occurs on board by seagoing observers for both landings and discards. Only the beam trawl fleet is sampled (TBB_DEF), as it is the most important Belgian fleet operating in the area. Length is measured to the cm below. Quarterly otolith samples are taken throughout the length range of the catch. These are aged and sexed and maturity is determined from December until April.

B.1.3.3 UK data

English commercial landings in tonnes by quarter, area and gear are derived from the sales notes statistics for vessels under 12 m which do not complete logbooks. For those over 12 m (or >10 m fishing away for more than 24 h), data are taken from the EC logbooks. Effort and gear information for the vessels <10 m is not routinely collected and is obtained by interview and by census. No information is collected on discarding from vessels <10 m but it is known to be low. Discarding from vessels >10 m has been obtained since 2002 under the EU Data Collection Framework and is also relatively low.

Length samples are combined and raised to monthly totals by port and gear group. Months and ports are then combined to give quarterly total length compositions by gear group; unsampled port landings are added in at this stage. Quarterly length compositions are added to give annual totals by gear. These are for reference only, as ALK conversion takes place at the international level. Age structure from otolith samples are combined to the quarterly level, and generally include all ports, gears and months. For sole the sex ratio from the randomly collected otolith samples are used to split the unsexed length composition into sex-separate length compositions. The quarterly separate age–length-keys are used to transform quarterly length compositions by gear group to quarterly age compositions. At this stage the age compositions by gear group are combined to give total quarterly age compositions.

A minimum of 24 length samples are collected per gear category per quarter. Age samples are collected by sexes separately and the target is 300 otoliths per sex per quarter. If this is not reached, the 1st and 2nd or 3rd and 4th quarters are combined. Weight-at-age is derived from the length samples using the length/weight relationship W=aL^b, where a and b are reference condition factors for the stock.

B.1.4 Recreational catches

Information from recreational fisheries is currently not included in the assessment. No official estimation of the amount of sole caught by recreational fishermen in division 27.7.d is available. Only recently countries have initiated the official data collection for recreational fisheries or are still finalising the pilot study involving a nationwide survey (questionnaires and telephone calls).

B.1.4.1 French data

The French pilot study showed that not sole but other species (such as cod, sea bass and sharks) are targeted by recreational fishermen.

B.1.4.2 Belgian data

The Belgian pilot study showed that Belgian recreational fishermen most often catch sole when angling on sandbanks (within the first 3 nautical miles). However, the available data so far do not show that Belgian recreational fishermen have been angling specifically for sole in division 27.7.d. Probably other species are targeted.

B.1.4.3 UK data

The UK pilot study is still ongoing and no results have been reported so far (cfr. Annual report DCF).

B.2 Biological sampling

B.2.1 Maturity

During the WKNSEA 2017 benchmark, the knife-edged maturity ogive with full maturation from age 3 onwards was investigated. Using data from the French IBTS survey and commercial data from Belgium, France and the UK (15 191 records), a new maturity ogive was constructed (see table below). More information on how this was achieved is provided in the WKNSEA 2017 report and the associated working document (ICES, 2017).

Age	0	1	2	3	4	5	6	7	8	9	10	11 (+)
Maturity	0.00	0.00	0.53	0.92	0.96	0.97	1.00	1.00	1.00	1.00	1.00	1.00

B.2.2 Natural mortality

Natural mortality is assumed constant over ages and years at 0.1.

B.2.3 Age composition of landed and discarded fish in commercial fisheries

Available age composition data is described in paragraph B.1.1 and B.1.2 for landings and discards respectively. Age allocations are performed using InterCatch. The method is also described in paragraph B.1.1 and B.1.2.

B.3 Surveys

Three survey indices are used as tuning series for the calibration of the assessment of sole in division 27.7.d:

- The UK Beam Trawl Survey (BTS) in quarter 3 from 1989 onwards
- The French Young Fish Survey (YFS) from 1987 onwards
- The UK Young Fish Survey (YFS) from 1987–2006

B.3.1 Survey design and analysis

A dedicated 4 m beam trawl survey for plaice and sole has been carried out by the UK using the RV Corystes since 1988. From 2008 onwards the RV Endeavour was used to carry out this survey. The survey covers the whole of division 27.7.d and is a depth stratified survey with most samples allocated to the shallower inshore stations where the abundance of sole is highest (Figure 5). Each stations is trawled for 30 minutes at 4 knots with a 40 mm cod end.

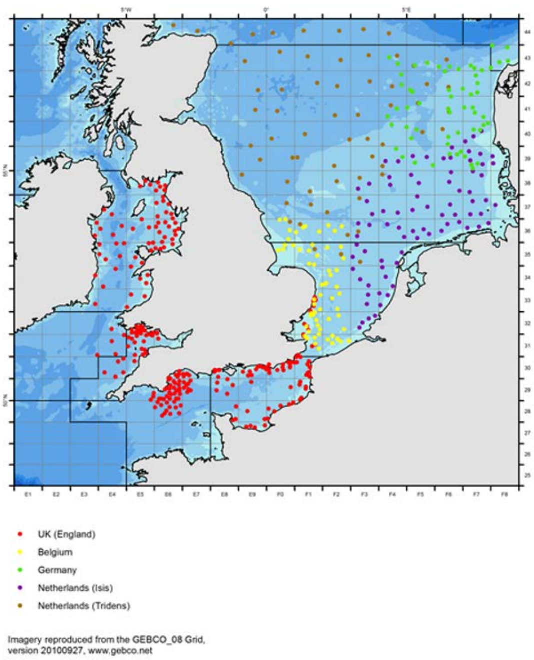


Figure 5: Map showing the sampled stations during BTS surveys. Red dots in division 27.7.d are sampled by the RV endeavour (UK).

In addition, 2 inshore small boat Young Fish Surveys using 3 m beam trawls are undertaken along the English coast and in a restricted area of the Baie de Somme on the French coast (Figure 6). The two surveys operate with the same gear (beam trawl) during the same period (September) in two different nursery areas. However, the UK component of the YFS was last conducted in 2006. Nevertheless, the UK index is still used in the assessment (up to 206) next to the French YFS index. The lack of information from the UK YFS may impede the recruitment estimates and therefore the forecast.

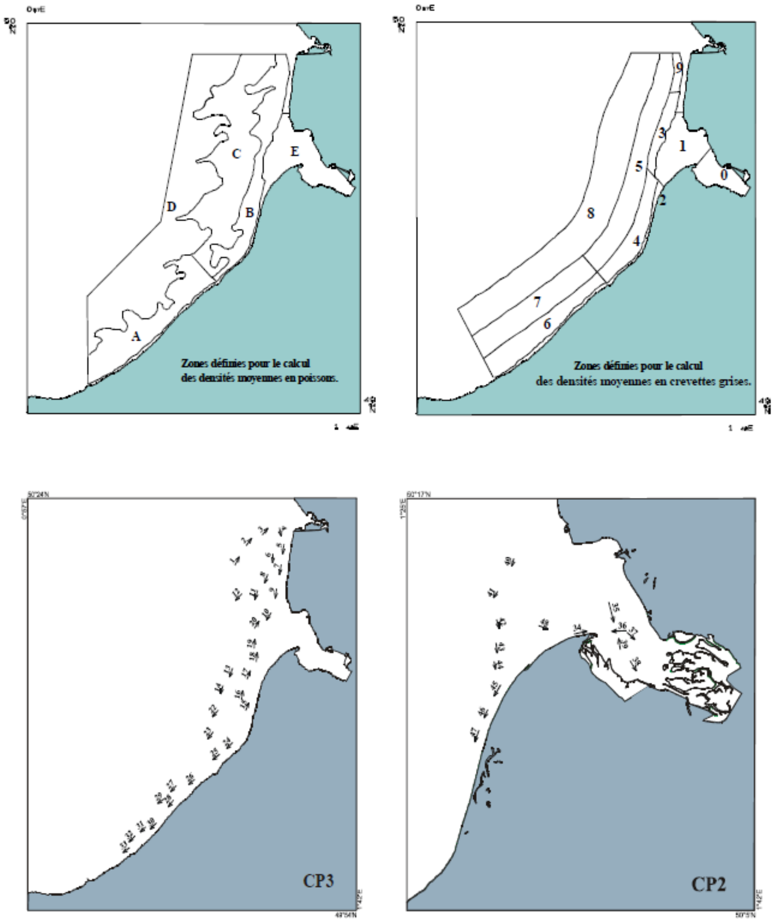


Figure 6: Map showing the sampled stations during FRA YFS survey along the Bay of Somme (lower panel) and the bathymetric zones in which sampling locations are situated (upper panel).

B.3.2 Survey data used

The survey data used in the assessment are summarised in the following tables (Table 1–3).

Table 1: Sol 27.7.d - Tuning series: UK (E&W) beam trawl survey (Q3) (1989–2016).

	Effort	Age1	Age2	Age3	Age4	Age5	Age6
1989	1	3.01	22.09	4.62	2.45	0.56	0.35
1990	1	17.96	5.55	5.55	1.24	1.01	0.33
1991	1	12.14	31.17	3.19	2.82	0.48	0.67
1992	1	1.33	15.29	13.47	1.07	1.61	0.34
1993	1	0.82	22.96	11.42	9.97	1.14	1.52
1994	1	8.33	4.26	11.07	4.65	4.3	0.28
1995	1	5.89	16.09	2.22	3.51	1.67	2.12
1996	1	5.3	10.79	5.97	1.07	1.86	1.15
1997	1	24.75	10.85	4.42	1.94	0.26	0.82
1998	1	3.27	24.11	3.67	1.47	0.83	0.19
1999	1	35.99	8.22	11.33	1.59	0.73	1.02
2000	1	14.98	27.45	5.52	4.85	1.48	0.68
2001	1	10.19	27.88	11.55	1.67	2.33	0.75

2002	1	53.56	16.11	8.6	5.11	0.45	1.04
2003	1	11.03	45.65	5.87	3.2	2.05	0.42
2004	1	12.67	11.81	10.97	2.08	2.02	1.34
2005	1	43.27	6.91	3.5	5.18	1.9	1.15
2006	1	10.84	42.62	4.51	2.68	2.59	0.55
2007	1	2.57	28.97	15.45	1.47	1.04	1.56
2008	1	3.77	7.35	9.14	5.82	0.4	0.68
2009	1	51.25	19.16	7.1	5.81	5.02	0.44
2010	1	16.59	30.76	5.14	1.66	2.7	2.73
2011	1	13.66	28.6	14.7	1.66	0.54	2.62
2012	1	1.75	9.72	7.51	3.53	0.92	0.39
2013	1	0.72	8.91	15.09	9.72	3.23	1.12
2014	1	25.39	16.35	12.38	11.92	5.09	2.73
2015	1	25.24	21.36	6.04	2.29	4.51	2.08
2016	1	10.17	33.14	11.17	3.16	3.17	3.02

Table 2: Sol 27.7.d - Tuning series: UK (E&W) young fish survey (1987–2006).

	Effort	Age1
1987	1	1.38
1988	1	1.87
1989	1	0.62
1990	1	1.9
1991	1	3.69
1992	1	1.5
1993	1	1.33
1994	1	2.68
1995	1	2.91
1996	1	0.57
1997	1	1.12
1998	1	1.12
1999	1	1.47
2000	1	2.47
2001	1	0.38
2002	1	4.15
2003	1	1.44
2004	1	2.72
2005	1	4.07
2006	1	2.21

Table 3: Sol 27.7.d - Tuning series: UK (E&W) young fish survey (1987–2006).

	Effort	Age1
1987	1	0.07
1988	1	0.17
1989	1	0.14
1990	1	0.54
1991	1	0.38
1992	1	0.22
1993	1	0.03
1994	1	0.7
1995	1	0.28
1996	1	0.15
1997	1	0.03
1998	1	0.1
1999	1	0.35
2000	1	0.31
2001	1	1.21
2002	1	0.11
2003	1	0.32
2004	1	0.15
2005	1	0.82
2006	1	0.83
2007	1	0.08
2008	1	0.06
2009	1	2.78
2010	1	0.1
2011	1	0.32
2012	1	0.35
2013	1	0.052
2014	1	0.04
2015	1	0.09
2016	1	0.04

B.4 Commercial cpue

The commercial tuning series have been revised during the benchmark (WKNSEA 2017 report and associated working document, ICES, 2017). From working year 2017 (2016 assessment) onwards, three commercial tuning fleets were used: the Belgian commercial beam trawl fleet (BE–CBT 2004–2016), the UK commercial beam trawl fleet (UK–CBT 1986–2016) and the French commercial otter trawl fleet (FR–COT 2002–2016). The BE–CBT and the UK–CBT carry out fishing directed towards sole but can switch effort between ICES areas.

The UK–CBT tuning series are derived from trips where landings of sole from 27.7.d exceeded 10% of the total demersal catch-by-weight on a trip basis.

The BE–CBT tuning series was extensively revised during the 2017 WKNSEA benchmark (ICES, 2017). Prior to the benchmark, the BE–CBT series included more years (1986–2015). The effort was corrected for horse power (HP), based on a study carried out by IMARES and CEFAS in the mid '90s. This study calculated an effort correction for HP applicable to sole and plaice effort in the beam trawls fisheries. The corresponding equation for sole was $P=0.000204\ BHP^{1.23}$. During WKFLAT 2009, a more realistic conversion factor for horse power was investigated to convert nominal fishing effort to effective effort. However, suggestions made by WKFLAT 2009 were not implemented. Therefore, an update of the BE–CBT tuning series was put forward as a task for the WKNSEA 2017 benchmark. To ensure a higher data quality, the index was shortened and now includes data from 2004 onwards. Additionally, only the large fleetsegment (> 221 kW, métier TBB_DEF_70–99) was included in the index calculation (representing on average 53% of the fishing hours in division 27.7.d), as misreporting of HP often occurs for the small fleet segment (≤ 221 kW) and the index was modelled using a Generalised Linear model (GLM).

Prior to the WKNSEA 2017 benchmark, no French commercial tuning series was included in the assessment. A new tuning index was calculated based on the OTB–DEF–70–99 fleet, which targets sole seasonally and mainly along the French coast (WKNSEA 2017 report and associated working document, ICES, 2017). This index is included in the assessment from working year 2017 onwards (2016 assessment).

B.5 Other relevant data

No other relevant data are used.

C. Assessment methods and settings

C.1 Choice of stock assess model

During the WKNSEA 2017 benchmark, three different assessment models were tested: XSA, AAP and SAM. Especially the XSA model, which was also the model used for the assessment in working year 2016, was extensively investigated. For the SAM and AAP model, only exploratory runs were conducted as the baserun could not be fully reproduced. The different runs are described in the report and associated working document on assessment (ICES, 2017).

When comparing similar scenarios of the SAM, AAP and XSA model, the trends generally concur, but absolute values differ, with XSA estimating SSB higher and Fbar lower. However, as both AAP and SAM did not allow the same flexibility in settings and data input as the XSA model did, the latter was used to move forward for the future assessments.

C.2 Model used of basis for advice

The XSA model was used for the advice.

C.3 Assessment model configuration

Type	Name	Year range	Age range	Variable from year to year Yes/No
Caton	Catch in tonnes	1982-present	1–11+	No
Canum	Catch at age in numbers	1982-present	1–11+	No
Weca	Weight at age in the commercial catch	1982-present	1–11+	No

West	Weight at age of the spawning stock at spawning time.	1982-present	1–11+	No
Mprop	Proportion of natural mortality before spawning	1982-present	1–11+	No
Fprop	Proportion of fishing mortality before spawning	1982-present	1–11+	No
Matprop	Proportion mature at age	1982-present	1–11+	No
Natmor	Natural mortality	1982-present	1–11+	No

The XSA diagnostics are listed in the table below.

	WKNSEA 2017 and WGNSSK 2017		
Fleets	Years	Ages	α-β
BE_CBT_2004-2015 commercial	04–ass. year -1	3–8	0–1
FR_COT commercial	02–ass. year -1	3–8	0–1
UK(E&W)_CBT commercial	86–ass. year -1	3–8	0–1
UK(E&W)_BTS survey	89–ass. year -1	1–6	0.5–0.75
UK_YFS survey	87–06	1–1	0.5–0.75
FR_YFS survey	87–ass. year -1	1–1	0.5–0.75
-First data year	1982		
-Last data year	Assessment year - 1		
-First age -Last age	1 11+		
Time series weights	None		
-Model	No Power model		
-Q plateau set at age	7		
-Survivors estimates shrunk towards mean F	5 years / 5 ages		
-s.e. of the means	2.0		
-Min s.e. for pop. Estimates	0.3		
-Prior weighting	None		

D. Short-term prediction

Model used:	Age structured
Software used*:*	FLR package, R version 3.1.1
Initial stock size:	- the survivors at age 2 and greater are obtained from the XSA output - the numbers at age 1 are the geometric mean of the time

	series minus the last 3 data years; however, also the RCT3 output should be calculated and the working group should make a decision on what numbers should be used
Maturity:	Same ogive as in the assessment
F and M before spawning:	Set to 0 for all ages in all years
Weight at age in the stock and in the catch:	Averaged over the last three years
Exploitation pattern:	Standard procedure for setting the fishing mortality in the forecast is to take the mean over the last three years, not rescaled. If a trend occurs in fishing mortality (3 consecutive higher or lower estimates), the working group may use a scaled F to the last year.
Intermediate year assumptions:	In 2016, the working group decided to use a TAC constraint for the intermediate year (2016) as landings had been close to the TAC. In 2017, the working group used a status quo fishing mortality (mean over last three years) scaled to the last data year (2016) as a decreasing trend in F was observed.
Stock recruitment model used:	Segmented regression
Procedures used for splitting projected catches:	not applicable

E. Medium-term prediction

No medium-term prediction was performed for this stock. In the past an age structured model was used (WGMTERM software), but since 2005 no more medium-term predictions were done.

F. Long-term prediction

No long-term prediction was performed for this stock.

G. Biological reference points

	Type	Value	Technical basis
MSY Approach	MSY Btrigger	19251 t	B_{pa}
	FMSY	0.256	EQsim analysis based on recruitment period 1983-2012
Precautionary Approach	Blim	13751 t	Break-point of hockey stick, stock-recruit relationship, based on recruitment period 1983-2012
	Bpa	19251 t	$B_{lim} \times \exp(1.645 \times 0.2) \approx 1.4 \times B_{lim}$
	Flim	0.359	EQsim analysis based on recruitment period 1983–2012
	Fpa	0.256	$F_{lim} \times \exp(-1.645 \times 0.2) \approx F_{lim} / 1.4$

H. Other issues

H.1 Biology of species (from Carpentier *et al.*, 2009)

Solea solea

(Linnaeus, 1758)

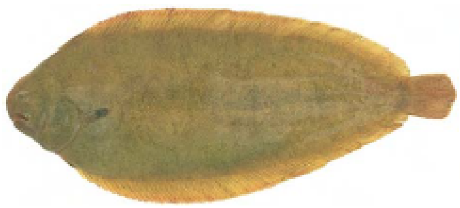
Sole commune
Common sole, Dover sole

Embranchement-Phylum : Chordata

Classe-Class : Actinopterygii

Ordre-Order : Pleuronectiformes

Famille-Family : Soleidae



Biologie - La sole adulte se nourrit d'annélides, petits mollusques et crustacés. Elle est active surtout la nuit, et s'enfouit plus ou moins totalement dans la journée. En Manche, la période de reproduction s'étale de février à juin avec une période d'intensité maximale en avril-mai, essentiellement dans les zones côtières du Pas-de-Calais et les grandes baies (Somme, Seine, Solent, Mont Saint-Michel, Start et Lyme). Les œufs pélagiques éclosent après 5 à 11 jours pour donner des larves, elles aussi pélagiques, qui se métamorphoseront en alevins benthiques après 1 à 2 semaines. Les juvéniles passent leurs 2 à 3 premières années dans les nourriceries côtières (baies et estuaires) où la croissance est rapide (11 cm à un an) avant de gagner les eaux plus profondes. A partir de cet âge, certains individus peuvent entamer une migration.

Caractères démographiques - Taille maximale 70 cm ; taille commune 24-35 cm ; taille minimale de capture 24 cm (UE) ; longévité maximale 27 ans ; âge et taille à maturité 3-5 ans et 23-35 cm ; paramètres de von Bertalanffy : taille asymptotique L_{inf} = 37.7 cm, taux de croissance $k = 0.3$ an^{-1}, âge théorique t_0 = -0.84 ; paramètres de fécondité *alpha* = 0.0031 ovules.cm^{-beta} et *beta* = 4.97 (130 000 à 1 300 000 ovules par femelle).

Environnement - Poisson benthique vivant sur les fonds de sables fins ou vaseux, entre 0 et 150 mètres de profondeur. Il peut se trouver dans les eaux marines à saumâtres ayant des températures comprises entre 8 et 24°C.

Répartition géographique - Atlantique est, du sud de la Norvège au Sénégal, mer Méditerranée dont la mer de Marmara et la mer Noire.

Biology - Adult sole feed on annelid worms, small molluscs and crustaceans. Sole are active, especially at night, and bury themselves more or less completely during the day. In the English Channel, breeding takes place between February and June, with a peak from April to May, mainly in the coastal areas of the Dover Strait and in larger bays (e.g. Somme, Seine, Solent, Mont-Saint-Michel, Start and Lyme Bays). Pelagic eggs hatch after 5 to 11 days leading to larvae that are also pelagic and that will metamorphose into benthic fry after 1 or 2 weeks. Juveniles spend the first 2 or 3 years in coastal nurseries (bays and estuaries), where fast growth occurs (11 cm at 1 year old), before later moving to deeper waters. From this age, some individuals start migrating to join the adult stock.

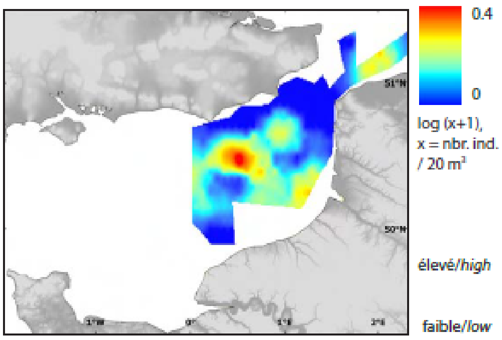
Life history parameters - Maximum length 70 cm; common length 24-35 cm; minimum landing size 24 cm (EU); maximum lifespan 27 years; age and length at maturity 3-5 years and 23-35 cm; von Bertalanffy parameters: asymptotic length L_{inf} = 37.7 cm, growth rate $k = 0.3$ year^{-1}, theoretical age t_0 = -0.84; fecundity parameters *alpha* = 0.0031 oocytes.cm^{-beta} and *beta* = 4.97 (130,000 to 1,300,000 oocytes per female).

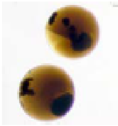
Environment - A benthic species that lives on fine sand and muddy substrates between 0 and 150 metres in depth. They can be found from marine to brackish waters where temperatures are between 8 and 24°C.

Geographical distribution - Eastern Atlantic, from southern Norway down to Senegal, and the Mediterranean Sea including the Marmara and Black Seas.

Œufs / Eggs - Solea solea

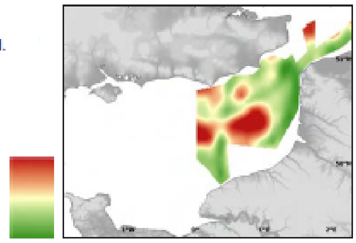
Abondance en janvier (IBTS, 2007)
Abundance in January (IBTS, 2007)



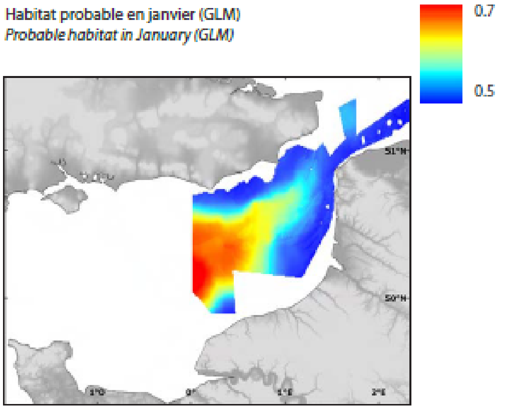


stades 1
stages 1

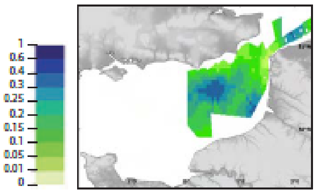
Erreur de krigeage
Kriging error



Habitat probable en janvier (GLM)
Probable habitat in January (GLM)

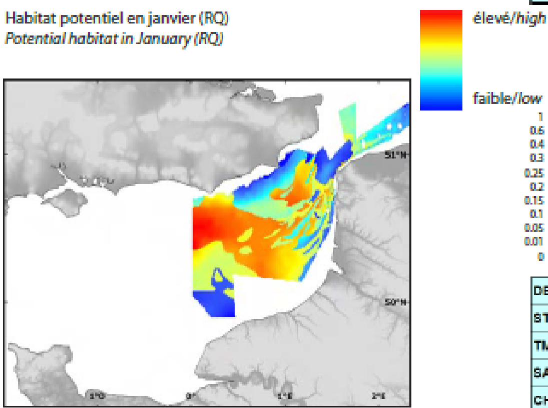


Erreur du modèle / *Model error*

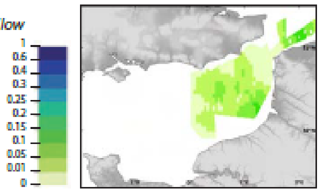


DEP	
STR	
TMP	+
SAL	
CHL	+2
SED	

Habitat potentiel en janvier (RQ)
Potential habitat in January (RQ)



Erreur du modèle / *Model error*



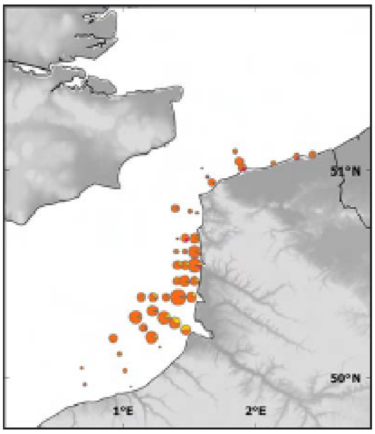
DEP	+2
STR	
TMP	+2
SAL	
CHL	+2
SED	CS - G - FS - M - P

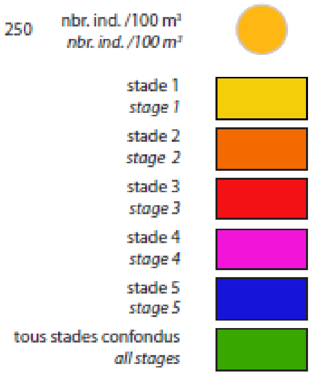
ŒUFS / EGGS
LARVES / LARVAE
NOURRICERIES/NURSERIES
TOUS AGES / ALL AGES

Larves / Larvae - Solea solea

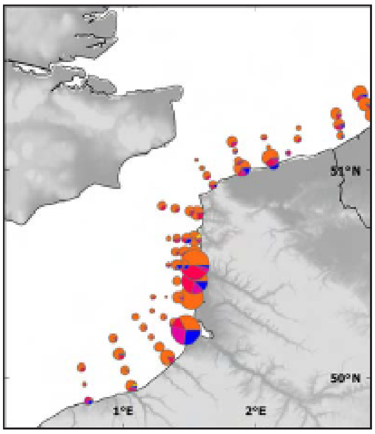
Abondances par stade de développement
Abundance per developmental stage

REISE 1 (avril/*April* 1995)

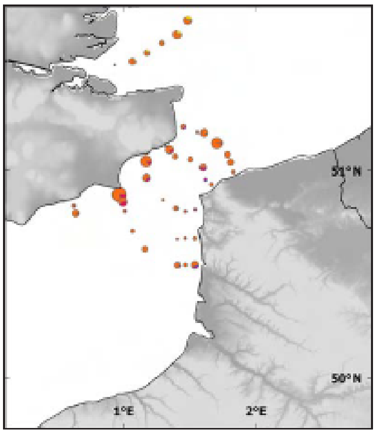




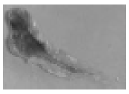
REISE 2 (mai/*May* 1995)



BCD (avril/*April* 1999)



Larves de sole commune
Common sole larvae



stade 1
stage 1

stade 2
stage 2

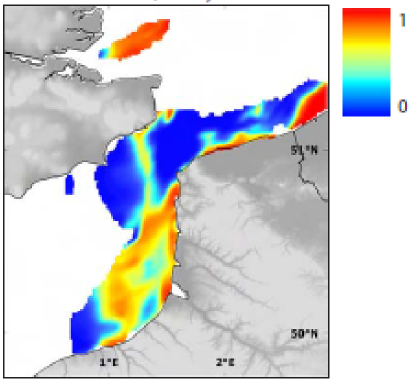
stade 3
stage 3

stade 4
stage 4

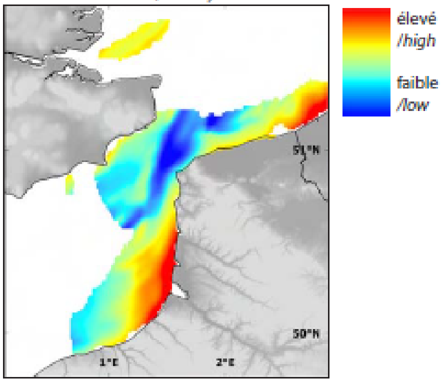
Larves / Larvae - *Solea solea*

Stade/*Stage* 1

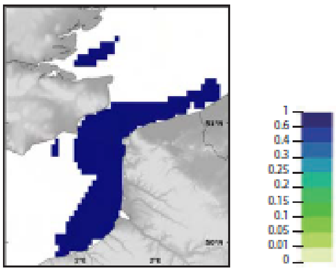
Habitat probable en avril/mai (GLM)
Probable habitat in April/May (GLM)



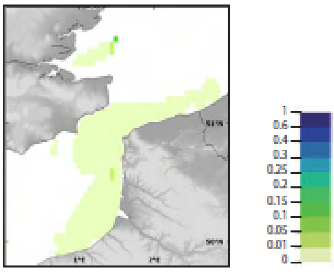
Habitat potentiel en avril/mai (RQ)
Potential habitat in April/May (RQ)



Erreur du modèle / *Model error*

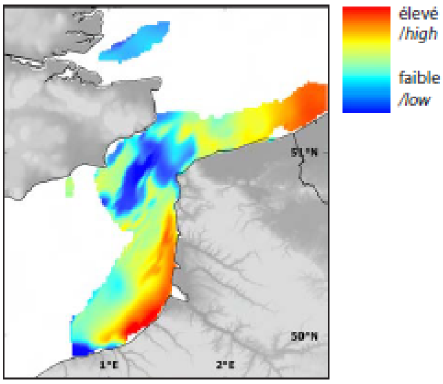


Erreur du modèle / *Model error*

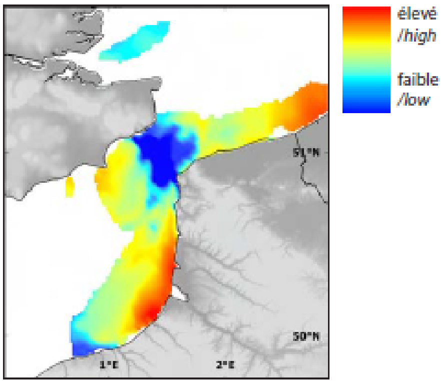


Stade/*Stage* 2

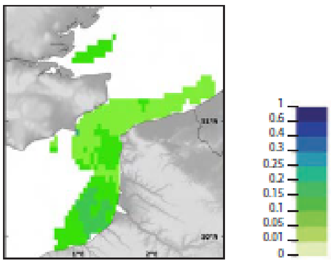
Habitat préférentiel en avril/mai (GLM)
Preferential habitat in April/May (GLM)



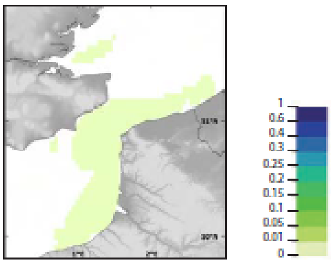
Habitat potentiel en avril/mai (RQ)
Potential habitat in April/May (RQ)

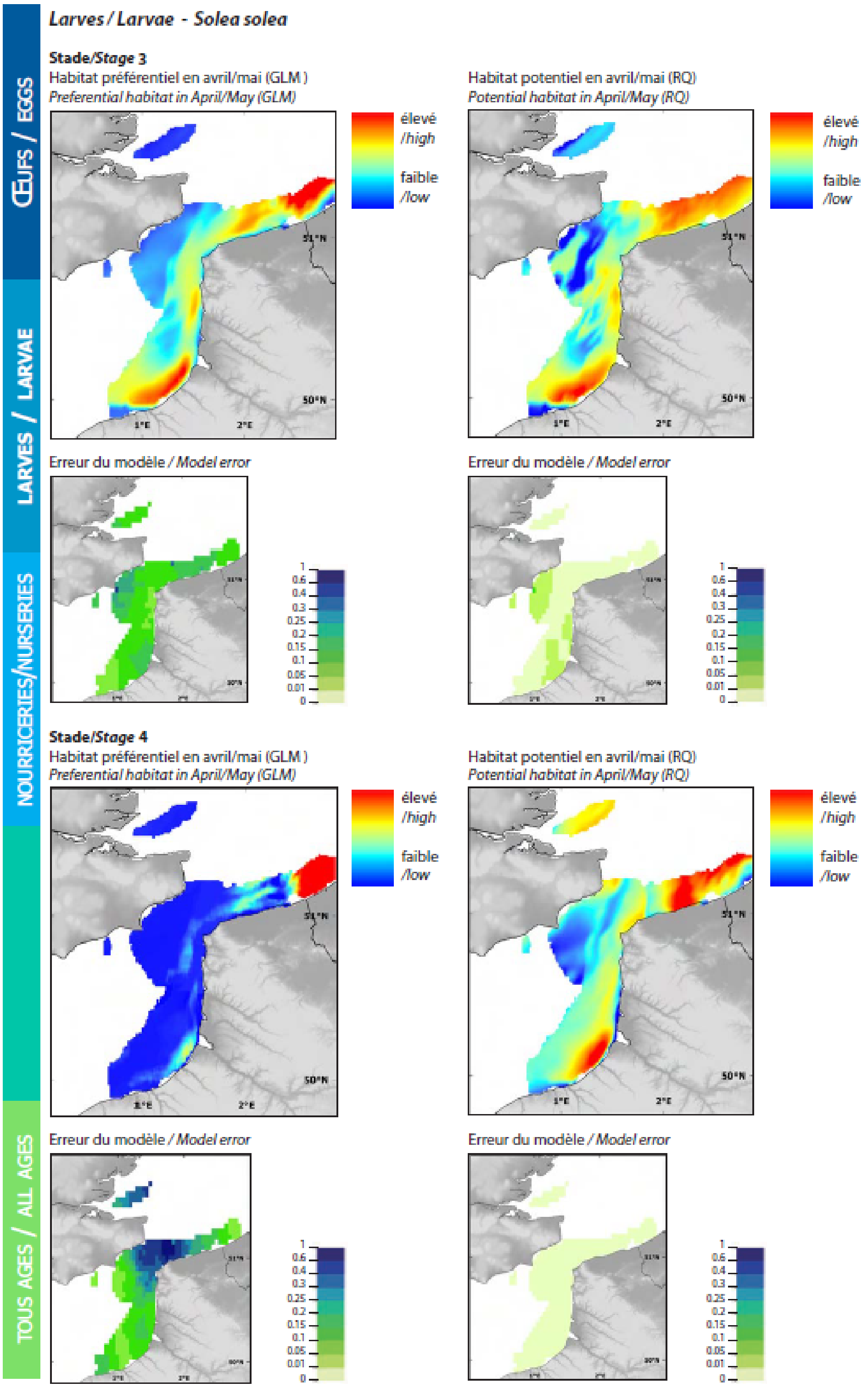


Erreur du modèle / *Model error*



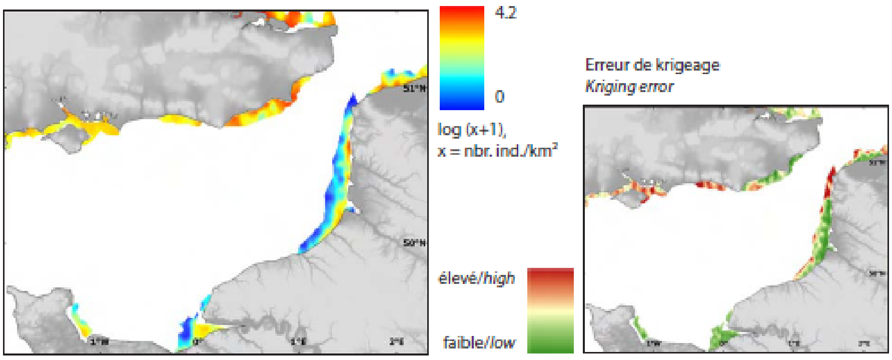
Erreur du modèle / *Model error*



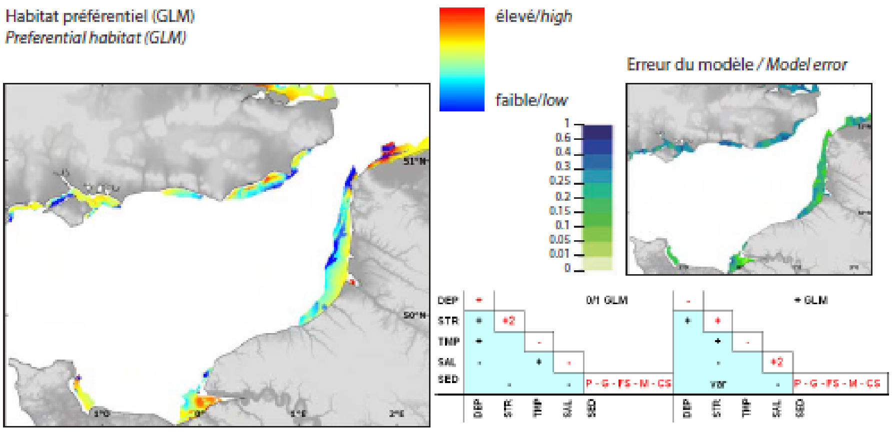

ŒUFS / EGGS
LARVES / LARVAE
NOURRICERIES/NURSERIES
TOUS AGES / ALL AGES
Larves / Larvae - Solea solea
Stade/Stage 3
Habitat préférentiel en avril/mai (GLM)
Preferential habitat in April/May (GLM)
Habitat potentiel en avril/mai (RQ)
Potential habitat in April/May (RQ)
élevé /high
faible /low
51°N
50°N
1°E
2°E
Erreur du modèle / Model error
1
0.6
0.4
0.3
0.25
0.2
0.15
0.1
0.05
0.01
0
Stade/Stage 4
Habitat préférentiel en avril/mai (GLM)
Preferential habitat in April/May (GLM)
Habitat potentiel en avril/mai (RQ)
Potential habitat in April/May (RQ)
élevé /high
faible /low
Erreur du modèle / Model error

Nourriceries côtières / Coastal nurseries - Solea solea

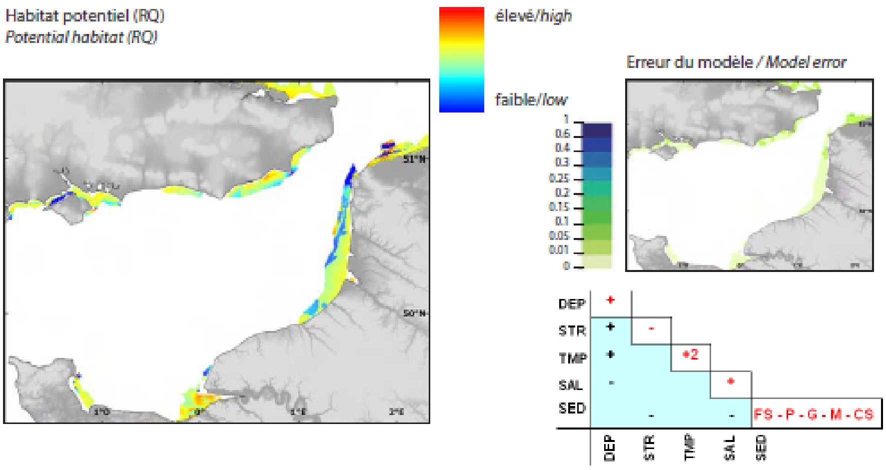
Abondance pluriannuelle en septembre
(YFS, 1977-2006)
Multi-annual abundance in September (YFS, 1977-2006)



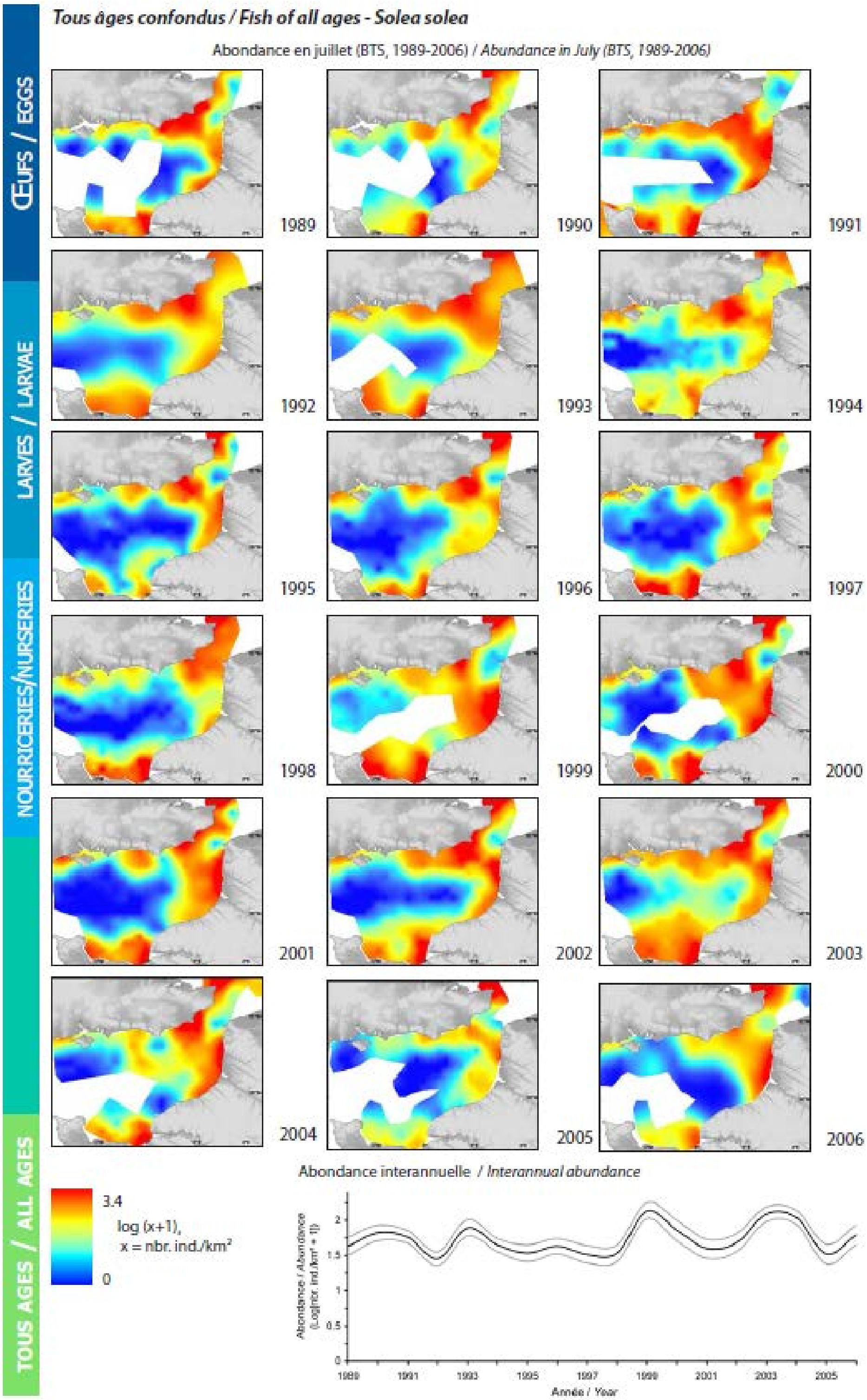
Habitat préférentiel (GLM)
Preferential habitat (GLM)



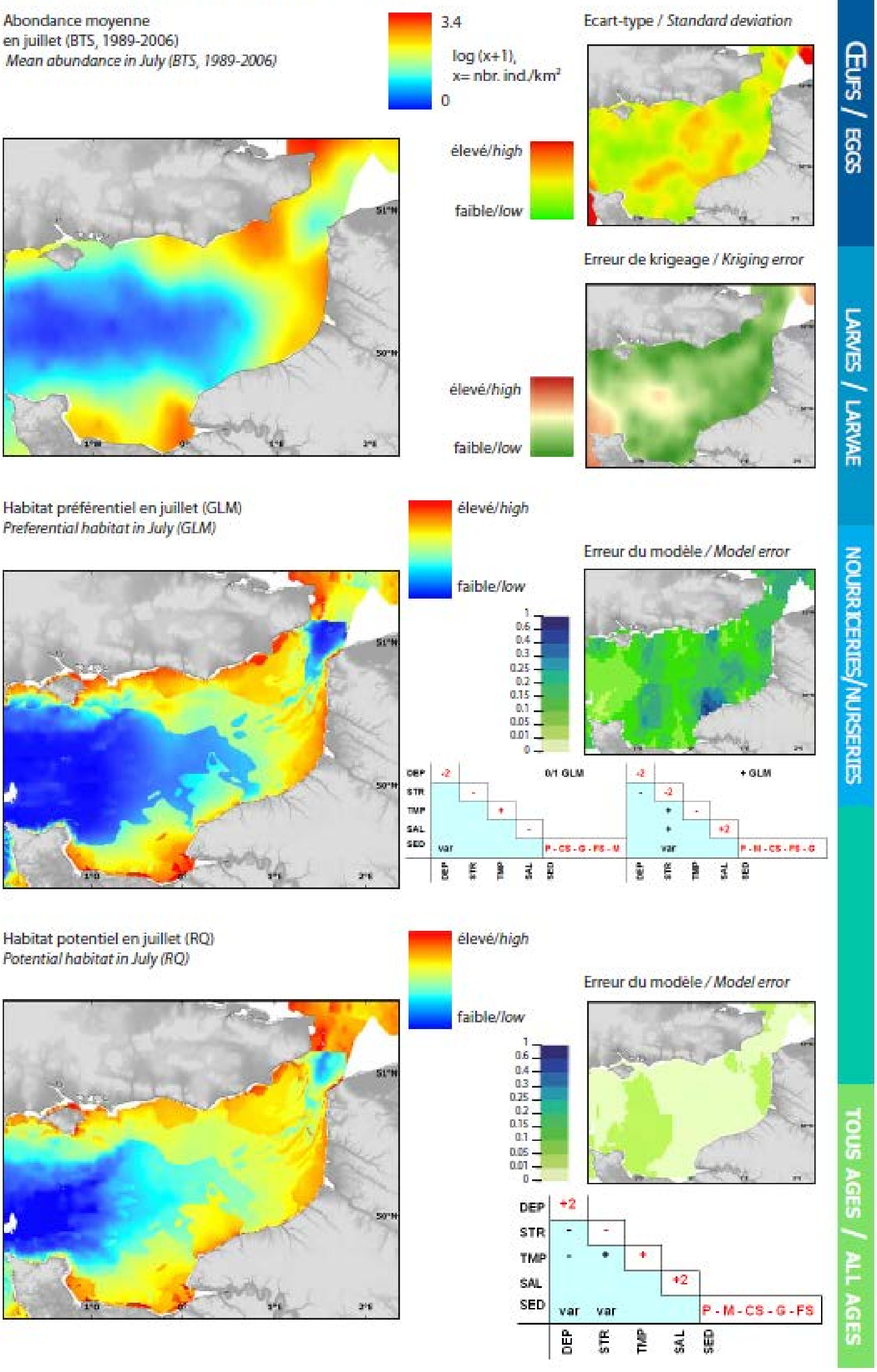
Habitat potentiel (RQ)
Potential habitat (RQ)

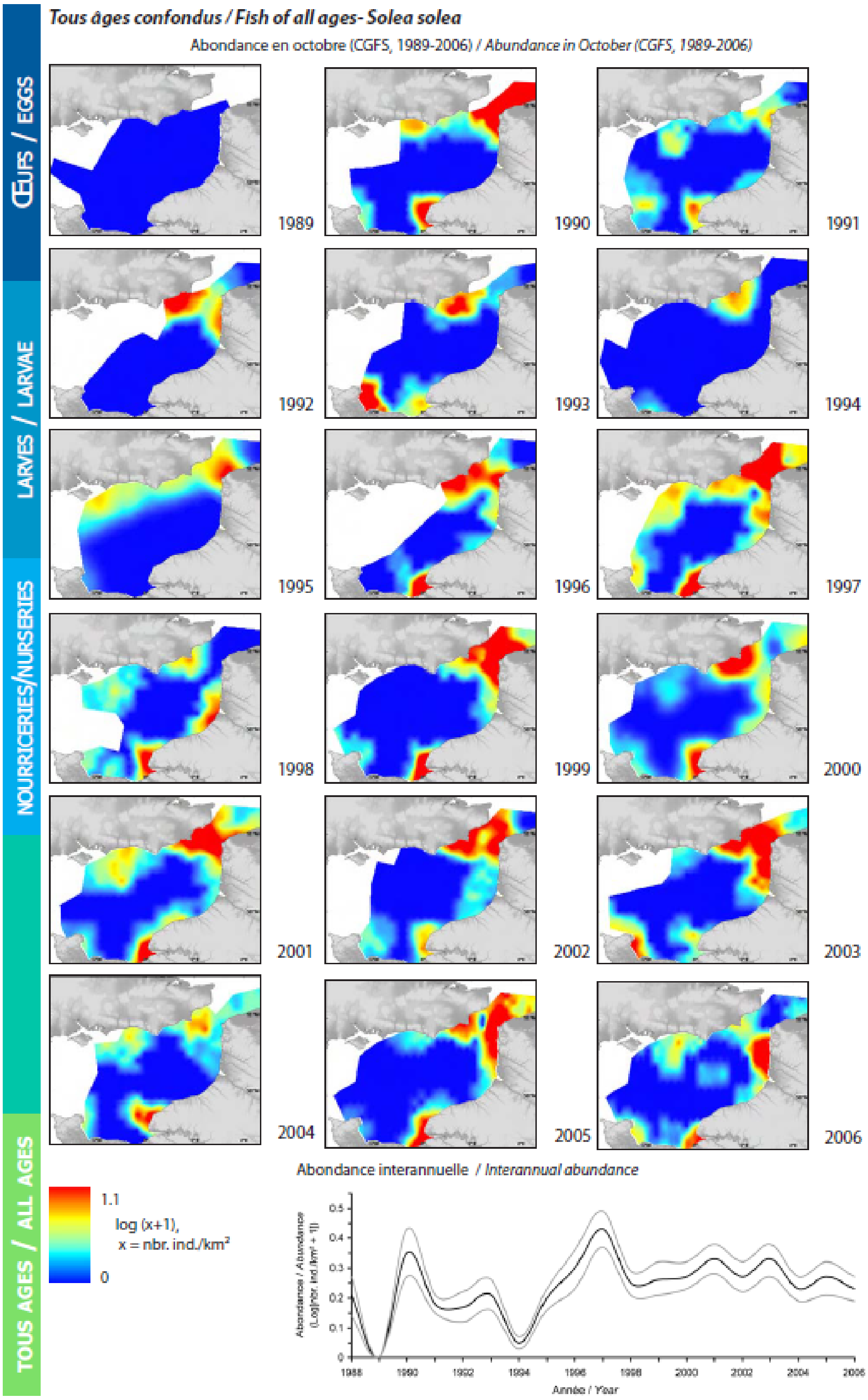


ŒUFS / EGGS
LARVES / LARVAE
NOURRICERIES / NURSERIES
TOUS AGES / ALL AGES

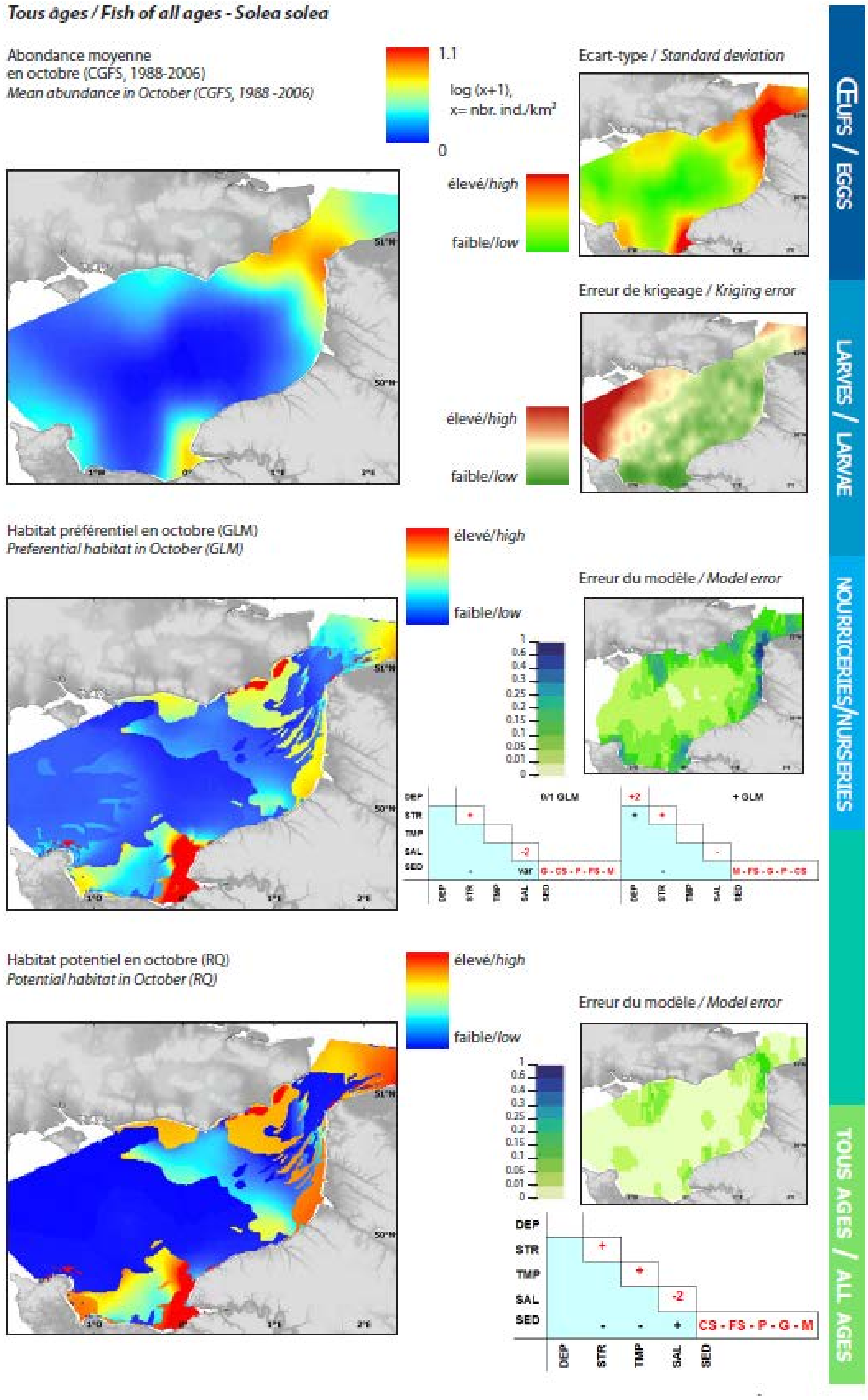

Œufs / Eggs
Larves / Larvae
Nourriceries/Nurseries
Tous ages / All ages
Tous âges confondus / Fish of all ages - Solea solea
Abondance en juillet (BTS, 1989-2006) / Abundance in July (BTS, 1989-2006)
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
3.4
log (x+1),
x = nbr. ind./km²
0
Abondance interannuelle / Interannual abundance
Abondance / Abundance (Log(nbr. ind./km² + 1))
Année / Year

Tous âges confondus / Fish of all ages - Solea solea





ŒUFS / EGGS
LARVES / LARVAE
NOURRICERIES/NURSERIES
TOUS AGES / ALL AGES
Tous âges confondus / Fish of all ages- Solea solea
Abondance en octobre (CGFS, 1989-2006) / Abundance in October (CGFS, 1989-2006)
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
1.1
log (x+1),
x = nbr. ind./km²
0
Abondance interannuelle / Interannual abundance
Année / Year


Tous âges / Fish of all ages - Solea solea
Abondance moyenne en octobre (CGFS, 1988-2006)
Mean abundance in October (CGFS, 1988 -2006)
1.1
log (x+1), x= nbr. ind./km²
0
Ecart-type / Standard deviation
élevé/high
faible/low
Erreur de krigeage / Kriging error
élevé/high
faible/low
Habitat préférentiel en octobre (GLM)
Preferential habitat in October (GLM)
élevé/high
faible/low
Erreur du modèle / Model error
0/1 GLM
+ GLM
DEP
STR
TMP
SAL
SED
Habitat potentiel en octobre (RQ)
Potential habitat in October (RQ)
élevé/high
faible/low
Erreur du modèle / Model error
CS - FS - P - G - M
ŒUFS / EGGS
LARVES / LARVAE
NOURRICERIES/NURSERIES
TOUS AGES / ALL AGES

Œufs

Les soles pondent de février à juin en Manche, la ponte démarrant lorsque la température de l'eau dépasse 7°C. La carte d'abondance correspondant à janvier 2007 montre un pic d'abondance au centre de la zone échantillonnée, et des abondances un peu moins importantes au large de la baie de Somme. La zone de forte abondance est en accord avec le modèle d'habitat probable mais celui-ci prévoit une occurrence plus forte à l'ouest de la zone échantillonnée et ne considère pas le large de la baie de Somme comme une zone d'habitat probable. La température et la concentration en chlorophylle *a* sont les seuls paramètres significatifs prédictifs de ce modèle. L'habitat potentiel est plus étalé, défini dans des zones profondes avec des températures assez élevées et des sédiments grossiers. Les données étant récoltées en janvier, les densités d'œufs sont encore très faibles car la période de reproduction commence à peine. Le schéma de distribution n'est peut-être alors pas représentatif de son étendue en pleine période de reproduction.

Larves

Les larves de soles ont été capturées à chacune des campagnes. Si les larves sont largement distribuées lors du printemps, l'habitat préférentiel des stades 2 se trouve le long des côtes de Flandres et le long du pays de Caux, s'étendant au centre de la Manche. Ces habitats sont localisés à proximité des frayères connues pour cette espèce et en accord avec la distribution spatiale des œufs décrite dans la littérature (Grioche *et al.*, 2001). Il s'agit probablement d'une stratégie qui permet aux jeunes larves de se développer dans des zones de rétention associées à de faibles courants, les frayères étant dans des eaux de faible profondeur avec de fortes températures et fluorescences (Grioche *et al.*, 2001). Les larves plus âgées ont un habitat plus côtier. Cette distribution côtière semble s'expliquer par la présence de phénomènes de rétention face aux estuaires. Ces larves montrent, en Manche orientale, même pour les jeunes stades, des migrations verticales (Grioche *et al.*, 2000). Ce comportement aide au transport lors des marées descendantes et limite l'advection de cette espèce vers la mer du Nord. Pour le moment, on ne peut estimer les mélanges des larves issues des frayères du centre Manche par rapport à celles issues des frayères de la mer du Nord. Pour cela, il faudrait utiliser des techniques de génétique des populations.

Nourriceries côtières

La carte d'abondance pluriannuelle pour les nourriceries côtières montre que plus d'individus ont été trouvés le long des côtes britanniques. Pourtant le modèle d'habitat préférentiel ne favorise pas vraiment ces zones, sauf quelques petites zones près de Dungeness. Du coté français, on retrouve plus d'individus en face de la baie de Somme qu'en baie de Seine même si les deux modèles considèrent la zone comme moins favorable. Ces résultats montrent que les nourriceries se trouvent dans un secteur très côtier et, comme il a été dit précédemment, dans des zones de rétentions.

Tous âges confondus

Les abondances de soles recueillies en juillet sont relativement importantes. De plus, l'aire de répartition

Eggs

Sole spawn from February to June in the English Channel, and laying starts when the temperature reaches at least 7°C. In January 2007, there was a high abundance area in the centre of the sampled zone, with lower abundance levels found off the Bay of Somme. The higher abundance area agrees with the probable habitat model even though it predicts a higher occurrence in the western part of the study area and does not consider the Bay of Somme as probable habitat. Temperature and chlorophyll *a* concentrations were the only significant predictive parameters of the model. The potential habitat is more dispersed, covering deep waters with warmer temperatures and coarse sediments. With data being collected in January, eggs densities were low because it was the beginning of the breeding period, and therefore the spatial extent of the distribution pattern may not be representative of that of the main reproductive period.

Larvae

Sole larvae were caught during each survey. Though larvae were ubiquitous during the spring, the potential habitat for stage 2 larvae was along the Flanders coast, near the Pays de Caux, spreading up to the central parts of the English Channel. These habitats were located close to known spawning grounds for this species, i.e. in agreement with the egg distribution described by Grioche *et al.* (2001). This may be linked to the strategy of the youngest larvae being in areas with weaker currents (which allows their retention), with spawning occurring in shallow waters with high temperatures and fluorescence (Grioche *et al.*, 2001). Older larvae preferred more inshore coastal habitats, which can be explained by retention phenomenons linked to estuarial characteristics. In the eastern English Channel, these larvae exhibit, even at the youngest stages, vertical migrations (Grioche *et al.*, 2000). This behaviour enables transport during ebb tides and limits advection of the species to the North Sea. At the present time, it is not possible to estimate the mixing of larvae from the English Channel with those from the North Sea spawning grounds. Population genetics studies may help in assessing the extent of this mixing.

Coastal nurseries

Multi-annual abundance maps of the coastal nurseries showed that common sole were found along the British coast even though the preferential habitat model does not indicate these areas as being favourable, except for some areas around Dungeness. On the French side, more sole were found off the Bay of Somme than off the Bay of Seine, even though both models consider this area as less favourable. Results show that nurseries were mainly found in areas very close to the coast, where young fish are readily retained.

Fish of all ages

Abundance levels in July were relatively high. Moreover, the spatial extent of the distribution pattern was wide across the study area, with a preference for coastal areas. No sole were found in the western central part of the study area. High abundance patches were found in the Dover Strait and in the Bay of Seine, with this pattern recurring every year. In the summer, the preferential habitat was based on semble assez large dans la zone échantillonnée avec toutefois une préférence pour les zones côtières. Aucun individu n'est trouvé dans la partie centrale de la Manche orientale. Les zones de fortes abondances sont situées au niveau du détroit du Pas-de-Calais et de la baie de Seine. Ce schéma est retrouvé tous les ans. L' habitat préférentiel pour cette période s'appuie sur une faible tension de cisaillement, de faibles profondeurs et un type de sédiment de fond plutôt meuble. Le modèle favorise les zones côtières et est en accord avec la distribution moyenne observée en Manche orientale. Seule la côte britannique, de l'Ile de Wight jusque Beachy Head, révèle de faibles abondances malgré le fait que ce soit un habitat préférentiel. Les habitats potentiels sont similaires aux habitats préférentiels et s'appuient sur les même paramètres, plus un certain nombre d'interactions illustrant la complexité des relations entre paramètres prédictifs.

Les cartes d'abondances montrent en octobre une abondance moindre et une répartition plus restreinte. Cela est probablement dû aux différences d'efficacité des engins de prélèvement, le chalut à perche utilisé lors des campagnes de juillet étant plus approprié pour les poissons plats enfouis, comme la sole, que le chalut de fond GOV utilisé lors des campagnes d'octobre. Cependant, comme en été, les zones de forte abondance sont situées dans des secteurs côtiers comme le détroit du Pas-de-Calais et la baie de Seine. L'erreur de krigeage est plus élevée là où l'échantillonnage est plus clairsemé. Le modèle d'habitat préférentiel privilégie la baie de Seine et la côte près de Dungeness et propose ainsi des habitats toujours très côtiers. La carte d'habitat potentiel est très semblable à celle de l'habitat préférentiel. Ces poissons benthiques préfèrent les zones côtières peu profondes où prédominent les sédiments sableux et la vase.

Les aires de distribution de la sole en été et en automne sont similaires et sont en accord avec les données sur les nourriceries côtières. La sole est un poisson benthique vivant dans des secteurs très côtiers. La superposition des frayères, des zones de distribution des larves et des nourriceries rend la distribution spatiale de la sole commune particulière.

weak bed shear stress and shallow depths, in areas having soft sediment type. The model favours coastal areas which agrees with the mean survey distribution in the English Channel. From the Isle of Wight up to Beachy Head however, low abundance levels were found in spite of the fact that this is preferential habitat. The potential habitat model is similar to the preferential habitat model, depending on the same predictive parameters, with additional interactions that illustrate the complexity of the relationships between environmental parameters.

Maps from the October survey show lower abundance levels and a less dispersed distribution pattern. This is probably caused by differences in the survey gear efficiency. The beam trawl used during the July surveys is more suitable than the VHVO (or GOV) bottom trawl used during the October surveys for catching flatfish like sole that are buried in the sand. Still, as in the summer, areas of high abundance were also located in coastal areas, as well as the Dover Strait and the Bay of Seine. The kriging error was higher where observations were more sparse. The preferential habitat model shows the Bay of Seine and the coast close to Dungeness as favourable areas. The potential habitat map resembles the preferential habitat map. This benthic fish prefers shallow coastal areas with sandy or muddy sediment types.

Distribution patterns in the summer and autumn are very similar and they agree with the nursery data. Sole is a benthic fish living in very coastal areas. The spatial distribution of the various life stages is very particular as there is overlapping of spawning, larval and nursery areas.

H.2 Overview of the previous assessment method

The settings (XSA diagnostics) used for the assessment from WKFLAT 2009 until WGNSSK 2016 are listed in the table below.

	WKFLAT 2009 - WGNSSK 2016		
Fleets	Years	Ages	α-β
BE_CBT commercial	86– ass. year-1	2–10	0–1
UK(E&W)_CBT commercial	86– ass. year-1	2–10	0–1
UK(E&W)_BTS survey	89– ass. year-1	1–6	0.5–0.75
YFS – survey (combined index UK-FR)			
UK_YFS survey	87–06	1–1	0.5–0.75
FR_YFS survey	87–ass. year-1	1–1	0.5–0.75

-First data year	1982
-Last data year	Assessment year -1
-First age -Last age	1 11+
Time series weights	None
-Model	No Power model
-Q plateau set at age	7
-Survivors estimates shrunk towards mean F	5 years / 5 ages
-s.e. of the means	2.0
-Min s.e. for pop. Estimates	0.3
-Prior weighting	None

During the WKNSEA 2017 benchmark, discards were included in the assessment. Additionally, thorough modifications to the tuning series occurred and a new maturity ogive was included (detailed information on the modifications are described in the benchmark report and the associated working documents; ICES, 2017).

The XSA diagnostics as used during the benchmark are listed in the table below.

	WKNSEA 2017		
Fleets	Years	Ages	α-β
BE_CBT_2004-2015 commercial	04–ass. year -1	3–8	0–1
FR_COT commercial	02–ass. year -1	3–8	0–1
UK(E&W)_CBT commercial	86–ass. year -1	3–8	0–1
UK(E&W)_BTS survey	89–ass. year -1	1–6	0.5–0.75
UK_YFS survey	87–06	1–1	0.5–0.75
FR_YFS survey	87–ass. year -1	1–1	0.5–0.75

-First data year	1982
-Last data year	Assessment year - 1
-First age -Last age	1 11+
Time series weights	None
-Model	No Power model
-Q plateau set at age	7
-Survivors estimates shrunk towards mean F	5 years / 5 ages
-s.e. of the means	2.0
-Min s.e. for pop. Estimates	0.3
-Prior weighting	None

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