Stock Annex: Sea bass (*Dicentrarchus labrax*) in division 8ab (Bay of Biscay)

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

Stock: Sea bass (*Dicentrarchus labrax)* in division 8ab

Working Group: Working Group for the Bay of Biscay and the Iberian Waters Ecoregion (WGBIE)

Revised by: WKBass 2018 and IBPBass 2018

Last updated: August 2018

Last Benchmarked: WKBASS and IBPBass 2018

General

1.1.1 Stock definition

Sea bass Dicentrarchus labrax is a widely distributed species in Northeast Atlantic shelf waters with a range from southern Norway, through the North Sea, the Irish Sea, the Bay of Biscay, the Mediterranean and the Black Sea to North-west Africa. The species is at the northern limits of its range around the British Isles and southern Scandinavia. Further studies are needed on sea bass stock identity, using conventional and electronic tagging, genetics and other individual and population markers (e.g. otolith micro-chemistry and shape), together with data on spawning distribution, larval transport and VMS data for vessels tracking migrating sea bass shoals, to confirm and quantify the exchange rate of sea bass between areas that could form management units for this stock (ICES, 2012).

The stock identity was assumed to be: Northern (ICES areas 4.b-c, 7.a,d-h); Southern Ireland and Western Scotland (ICES areas 6.a, 6.b and 7.j); Biscay (ICES areas 8.a-b); Portugal & Northern Spain (ICES areas 8.c & 9.a) (Figure 1). Since then, stock identity has not changed (ICES, 2018), but research on population structure are under progress.

Two large tagging programmes are underway that will provide significant information on the movements of sea bass, and could indicate the levels of mixing between stocks.

The first programme (C-Bass) is being led by the Cefas (UK) and has tagged almost 200 seabass with electronic data storage tags (DSTs) in two locations (Lowestoft and Weymouth). Around 20 tags have been returned and significant effort is being made to improve the geolocation algorithms through the inclusion of bathymetry and temperature at depth.

The BARGIP study is being led by IFREMER and has released 1220 fish with DSTs at 10 locations in the Channel and Bay of Biscay. So far, 414 tags have been returned (January 2018) and the movements of individual fish are being reconstructed.

Cefas and Ifremer are working together to compare geolocation algorithms.

Behavioural and genetic studies of sea bass are also underway at the Marine Institute, Ireland, with the aim of investigating the distribution of sea bass within Irish waters and the potential existence of an Irish sub-population.

Genetic studies have also been reported by Museum d'Histoire Naturelle (France) in the GenStock project ended in May 2018.

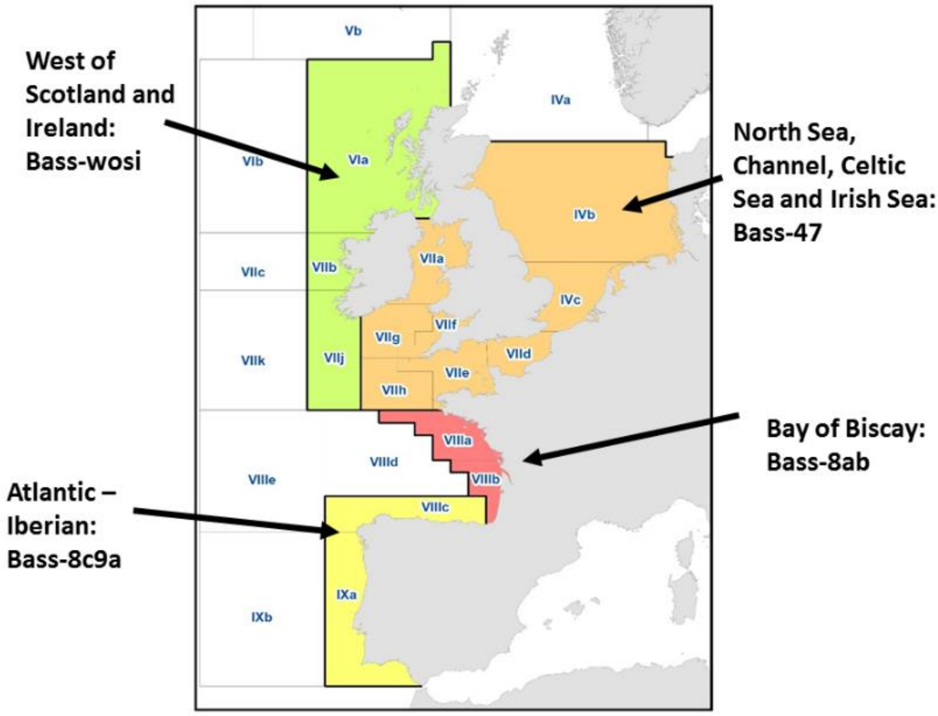


Figure 1. Main spawning and nursery areas. Spawning areas sloping downwards from left to right; Nursery areas sloping downwards from right to left. (from Casey and Pereiro, 1995)

A further study has been done using stable isotope analysis of (δ13C and δ15N) composition in scales from a number of locations around the Welsh coast (Cambiè *et al*., 2016). A random forest classification model was used to test for any differences in δ15N and δ13C values between north, mid and south Wales and whether it was possible to correctly assign a fish to the area where it was caught. The classification model correctly assigned about 75% of the fish to their collection region based on isotope composition. The results suggest that two sub-populations of sea bass may exist in Welsh waters, using separate feeding grounds (south vs. mid/north Wales) (Cambiè *et al*., 2016). Further details of this study have been provided for the benchmark workshop for sea bass led in February 2017.

Ecosystem aspects

In the well-known north stock (6.bc, 7.a,d-h) productivity of the stock is affected by extended periods of enhanced or reduced recruitment which appear to be related to changes in sea temperature (ICES, 2016). Warm conditions facilitate northward penetration of sea bass in the Northeast Atlantic, and enhance the growth and survival of young fish in estuarine and other coastal nursery habitats. In the Bay of Biscay there is no reason to observe different dynamics. In terms of numbers of recruits the Bay of Biscay area looks more productive than in the North.

In the north-eastern Atlantic, adult sea bass (*Dicentrarchus labrax)* is one of largest fish living on the shelf. In autumn and winter, sea bass seems to primarily target small pelagic fish (Spitz *et al*., 2013), most notably mackerel (*Scomber scombrus*), scads (*Trachurus* spp.), anchovy (*Engraulis encrasicolus*), and sardine (*Sardina pilchardus*). These four species also dominated the diets of common dolphins (*Delphinus delphis*). This overlap in feeding preferences could increase the risk of dolphins being caught by pelagic trawls while feeding among sea bass, and may be an underlying mechanism to explain the high rate of common dolphin bycatch observed in the pelagic trawl fishery for sea bass in the Bay of Biscay (Spitz *et al*., 2013).

Management

Sea bass are not subject to EU TACs and quotas. Under EU regulation, the minimum landing size (MLS) of sea bass in the Bay of Biscay is 38 cm total length from 2017[1], a variety of national restrictions on commercial sea bass fishing are also in place. These include:

- An historical landings limit of 5 t/boat/week for French and UK trawlers landing sea bass (which was not based on a biological point of reference). In France from 2012, following the implementation of a national licensing system for commercial gears targeting sea bass, the landings limits have slightly changed, from 1.5t/week to 5t/week depending on season and gear used[2]
- A licensing system from 2012 in France for commercial gears targeting sea bass in order to fix the level of the French commercial fishery
- A MLS of 38cm has been implemented in 2017 instead of 36cm for commercial fisheries
- A MLS of 42 cm for the French recreational fisheries has been implemented in 2013 (French association of anglers)
- A Voluntary closed season from February to mid-March for longline and handline sea bass fisheries in Brittany, France;

No management plan exists for this stock applicable to 2017, beside the regulations mentioned here before.

Fishery description

Sea bass in the Bay of Biscay are targeted mainly by France (more than 97% of international landings in 2017), followed by Spain (responsible for 3% of the commercial landings in area 8.b mainly, in 2017).

French fishery

From 2000 to 2008 in France, pelagic trawlers used to catch around 25% of the landings of the area Bss.8ab: they have reallocated their effort partly in the Channel Bss 47 because of the anchovy fishery closure in 2005. The pelagic fishery took place essentially in the Channel until 2015 (but with recent implementation of management measures in the “north” stock Bss 47, pelagic fishery doesn’t occur any more in Bss 47).

Lines fishery (handlines and longlines) takes place all the year, while nets, pelagic and bottom trawls fisheries take place from November to April on pre spawning and spawning grounds when seabass is aggregated. In 2017, nets represent 28% of the landings of the area, lines 33%, bottom trawl 20%, and pelagic trawl 11%.

[1] *http://eur-lex.europa.eu/legal-content/FR/TXT/?uri=OJ:L:2018:027:TOC*
[2] *http://www.comite-peches.fr/wp-content/uploads/B87-2017-Db-BAR-GdG-2018.pdf*

In Bss 8ab a high increase in the French landings for the net fishery is observed from 2011. An average of 585 tons during the period 2000-2012 is landed. In 2013, 834 tons have been landed, and 1131 tons in 2014. The main reason is the decrease of sole quotas from 2011 and an effort report on seabass which become more targeted, combined with good weather condition in 2014 and an increase in fishing technicality

In 2017 an increase in landings for all gear except netters is observed in Figure 2.

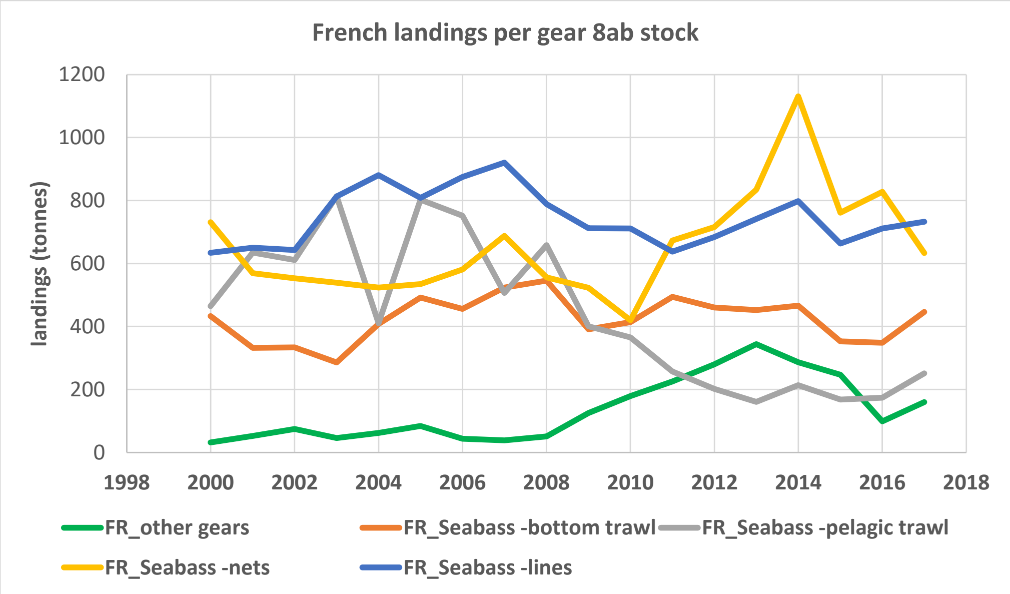


Figure 2 : French landings per gear from 2000 onwards (source Sacrois, DPMA)

Note: Historical landings (period 1985–2000) has been mainly driven by the pelagic trawlers particularly during the period 1985–1995. During this period up to 60 pairs trawlers could be observed. Nevertheless quality of data for this period is very poor.

Spanish fishery

Spain is responsible for 3% of the catches of the area (8.b essentially) in 2017, mainly with bottom trawlers. Spanish bass landings from Division 8.a,b,d have increased to around 20 tons in the 90’s to around 150 tons in the middle of the 2000’s, then a peak to 317 tons in 2011. 72 tons have been landed in 2017.

Data

Commercial landings

French Estimates

Landings series are available from different sources:

- Official statistics recorded in the Fishstat database since the mid-1980s (total landings).
- French landings for 2000–2017 from a separate analysis made by Ifremer of logbook and auction data. Landings are available per metier.

From 2000 onwards, French landings data from FishStat are replaced by more accurate figures from a separate analysis of logbook and auction data carried out by Ifremer (SACROIS methodology), in which landings have been correctly allocated to fishing grounds. The landings time series show a step change around 1998 (Figure 3**Error! Reference source not found.**).

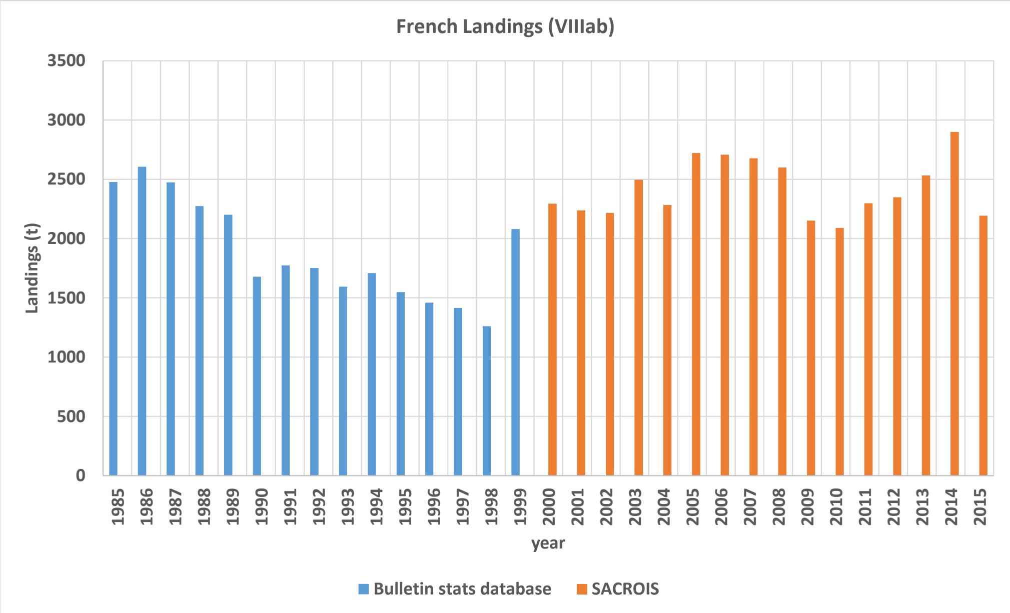


Figure 3. French Landings (Bulletin stats 1985–1999; Sacrois 2000–2015).

Following the WKBASS 2017 data WK, a discussion took place about the quality of French landings data during the historical period with French stakeholders. According to them, the trend observed in the oldest period is reliable. WKBASS 2017 assessment meeting proposed to rescale the historical time series of landings (i.e. before 1999), with the assumption that the step increase from 1998 to 1999 is an artefact of the change in the way the data were collected. Thus, the historical period from 1985 to 1998 have been rescaled by 943 tonnes (1998 Landings – average [landings 1999–2001]) as shown in Figure 4

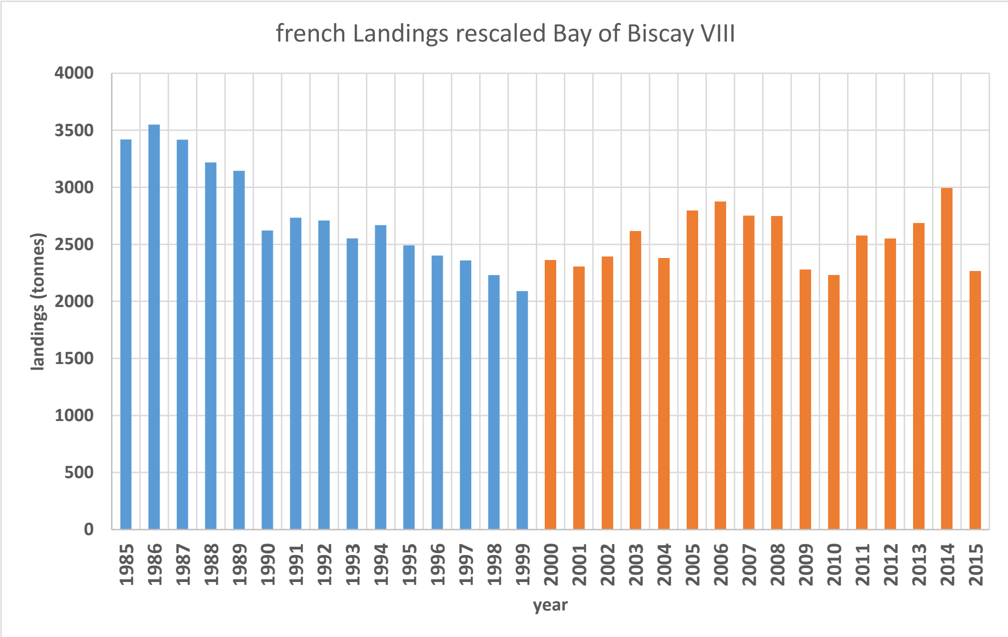


Figure 4 : French Landings (Bulletin stats 1985-1999; Sacrois 2000–2015) rescaled on the period 1985–1998.

Landings coverage and quality

Quality of French official landings data can be considered more robust from 2000 onwards. Ices estimates also corresponds to official estimates from 2014

Spanish estimates

Landings series are available from for 2007-2011 from sale notes and for 2012-2017 from official statistics

Commercial discards

Observer data from Spanish vessels fishing in Areas 8, have shown there was no seabass discard from 2003. No information from 2015 onwards were available on discards for WGBIE 2018. This section also presents only French data.

French survey design and analysis

The French sampling schemes use a vessel-list sampling frames and random selection of vessels within strata defined by area and fleet sector. From the activity calendars of French vessels for year n-1, vessels are grouped by métier. Thus, a vessel may belong to multiple groups if practicing several metiers in the period. If the metier has to be sampled as priority, the vessel to be boarded is chosen randomly within this group of vessels. The observer then chooses to go on board for a trip. During the trip, the fishing operations corresponding to metier are sampled. Optionally, if the vessel practices several metiers during the trip, fishing operation of the other metiers will also be sampled if the metier is included in the annual sampling plan. If the metier is not part of the plan, it is requested to sample at least one fishing operation of this metier in the trip. (see the complete documentation of the discard sampling protocol :http://sih.ifremer.fr/content/download/5587/40495/file/Manuel_OB-SMER_V2_2_2012.pdf). The objective of COST design based estimates for discards is to provide discards sampling users with methods that are practical, convenient and unbiased. The option used is a method for raising to an auxiliary variable that are based on landings (Vigneau 2006).

Discards coverage and quality

Discards data are available for French fleets from 2003 onwards. Discarding of sea bass by commercial fisheries can occur where fishing takes place in areas with bass smaller than the minimum landing size. Discards rates in France are relatively low. In 2016 total discards percentage is estimate at 3% of the total catches with an amount of 62 tonnes. In 2017 total discards percentage is estimate at 3% of the total catches with an amount of 74t (Table 1)

Table 1 : French discards estimates from 2015 onwards

YEAR	discards	landings	percentage of discards
2017	**74**	**2223**	**3.22%**
2016	**65**	**2160**	**2.92%**
2015	**69**	**2193**	**3.05%**

Length and age

Sampling methods and analysis

The French sampling programme for length compositions of sea bass landings covers sampling at sea and on shore. Since 2009, both sampling types are based on métiers composition and their relative importance to each fishing harbour and month. Both are also designed to sample the whole catch following a concurrent sampling of species, potentially leading to low sea bass sample size. In order to complement this effort, specific sampling for sea bass at the market is added at times and harbours when higher landings are occurring, especially from métiers targeting sea bass. The sampling frame is based on the main harbours, gear types (or grouping of métiers) and month and is available to all samplers on a dedicated website. Real-time follow-up of the plan, refusal rates and their reasons, and time taken to sample is also available from the website, together with sampling protocol (http://sih.Ifremer.fr/content/download/5587/40495/file/Manuel_OBSMER_V2_2_2012.pdf). Before 2009, only market specific sampling was in place, and the sampling plan was designed and followed by the stock coordinator.

The French sampling programme for age compositions of sea bass is based on age–length keys with fixed allocation. For BSS-8.ab, the information is available only from 2008. All length samples are stored in a central database (Harmonie) and regular extracts are available in the COST format, with raising to the population done using COST.

Data coverage and quality

Length compositions of French sea bass commercial landings are available from 2000 for the area 8.ab by gear. These are grouped into 2 cm length bins as input data for Stock Synthesis and represent the fleet-aggregated length compositions in 2 cm classes (20–21.9, 22–23.9, etc.) for each year from 2000 onwards.

The statistical design of fishery sampling schemes has undergone change in recent years in the European countries, following recommendations from ICES workshops on sampling survey design, with a move towards more representative sampling across trips within fleet segments. This can result in sampling more trips that have small catches of sea bass. This is one reason for the increase in numbers of sampled trips with sea bass since 2009 in France, which does not imply an increase of the proportion in numbers of fish measured per trip (this is also observed for other countries). Numbers of trips and numbers of fish sampled are presented in Table 2

Table 2 : Number of trip and number of fish sampled in French sampling program from 2000 onwards

year	Number of trip sampled	Number of fish sampled
2000	64	1611
2001	56	1793
2002	116	2209
2003	151	3417
2004	97	1833
2005	115	1968
2006	102	2591
2007	249	2962
2008	466	5403
2009	364	3800
2010	324	2873
2011	373	5297
2012	433	5393
2013	260	3645
2014	338	5568
2015	406	6022
2016	394	5758
2017	417	3183

As in SS3 model used for the assessment of the sea bass stock in areas 4 and 7 (BSS-47), the input sample size for annual estimates of length composition should reflect the relative precision of the length compositions from year to year. It is a proxy for effective sample size which is typically much less than the total number of fish measured or aged due to cluster sampling effects. In the BSS-47 assessment, input sample sizes for the length compositions are first computed using the number of trips sampled for length as a proxy for effective sample size, and the input sample sizes are iteratively rescaled a few times (while maintaining the relative values between years) using the Francis method based on the SS3 output estimates of effective sample size.

WGBIE 2018 were made aware of an issue with the sampling level in Q1 and Q2 of 2017 from France (The full explanation of it can be found in the working document from Quemar, Vigneau *et al* "Estimation of quarterly length distribution of landings in the context of a 6-months disruption in the French on-shore sampling"). Because of the lack of market sampling for length (biological and onboard sampling was unaffected), efforts were made to try and fill the deficiency in the number of samples by use of simulation techniques. Both simulated data and actual data were uploaded to InterCatch combined making it impossible to distinguish true samples from simulated ones. The simulation was based on commercial landings market categories (Figure 5)

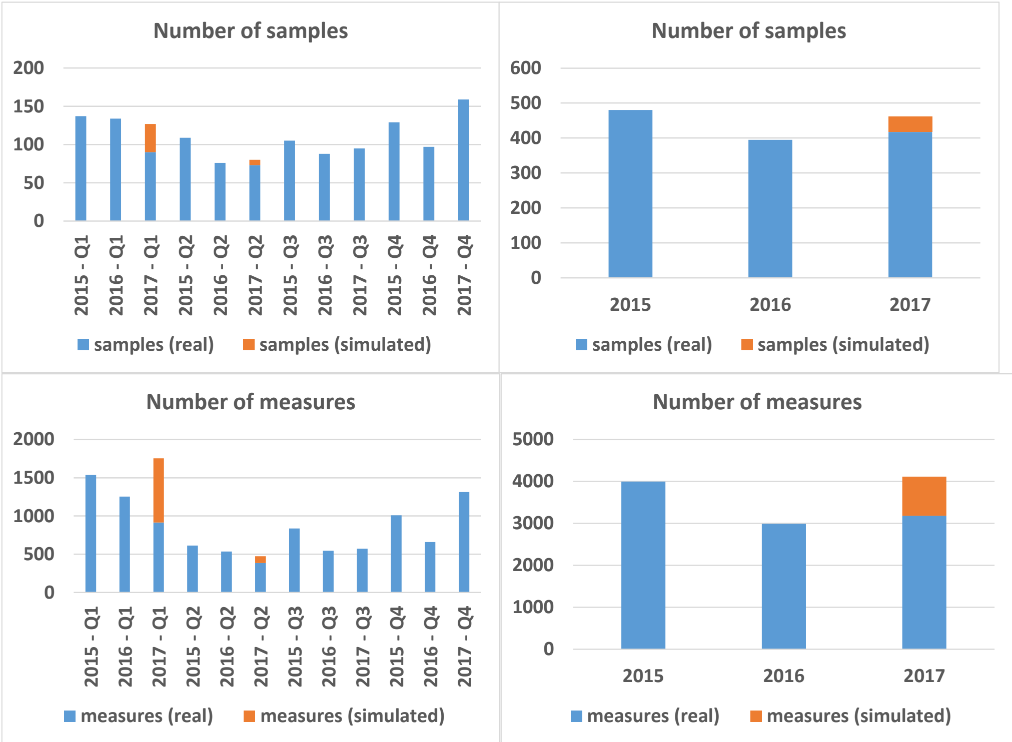


Figure 5: numbers of samples and measures simulated in French sampling scheme in 2017 compared to the previous years.

Recreational fishery catches, length compositions and post-release mortality

Recreational post released mortality

Recreational fisheries on European seabass are characterised by relatively high release rates, which appear to have increased following an increase of the MCRS from 36cm to 42cm in 2015 and the recent implementation of a bag limit and closed season. The WKBASS 2017 data WK (ICES 2017) reviewed information available on post-release mortality (PRM) of seabass caught by recreational sea angling from two recent studies conducted in Spain and Germany and compared these with estimates obtained for the US striped bass stock in the north west Atlantic. The WKBASS 2017 data WK proposed that a value of 15% for post-release mortality should be applied and that sensitivity of the assessment to larger and smaller values should be examined. The appropriateness of this value for post-release mortality was reviewed in details at the WKBASS 2018 assessment meeting (see working document from Hyder *et al.*, 2018 – Annex 2). **Based on the information provided by Hyder *et al.* (2018), WKBASS 2018 agreed on a figure of 5% for PRM in recreational fisheries on the Northern and the Bay of Biscay seabass stocks**. This estimate is based on a published German study (Lewin *et al.*, 2018) in which 160 fish were maintained in an aquaculture facility and then captured by experimental angling using a range of bait and articial lures. The fish were then released and held for 10 days to assess mortality. The effects of different bait types, air exposure, and deep hooking were investigated, with increased mortality associated with the use of natural bait (13.9%, 95% CI=4.7–29.5%) and deep hooking 76.5% (95% CI=50.0–93.2%). By combining the experimental results with country-specific information on sea angling practices, the average post-release mortality of seabass caught by recreational sea anglers in 2012 was set at 5.0% (95% CI=1.7–14.4%) for the Northern seabass stock (Lewin *et al.*, 2018). The WKBASS 2018 group agreed that this value applies also to the Bay of Biscay seabass stock.

Recreational fishery catches in the reference year

In previous reports, partitioning French recreational data between the Bay of Biscay and the Northern stocks was possible only for the 2009–2011 study (Rocklin *et al*., 2014). However, a reanalysis of the 2011–12 study (Levrel *et al*., 2013) provided separate estimates for the Bay of Biscay and the Northern stocks (Estimates of recreational catches of seabass in France, weight of retained and released components of the catch and release rates. The relative standard error (RSE) is provided where available and expressed as percentage.). A total weight of 3,173 t in 2009-11 and 3,922 in 2011–12 were estimated, with a much higher proportion from the Northern stock in 2011–12 (Table 3). This may be due to differences in the survey design and the low sampling effort deployed in the Bay of Biscay in the 2011–12 (Table 3).

Country	Year	Area	Numbers (thousands)							Weight (tonnes)							Source
			Retained	RSE	Released	RSE	Total	RSE	% released	Retained	RSE	relapsed	RSE	Total	RSE	% released	
France	2009–11	4 & 6	781		796		1,578	>26	50	940		332		1,272	>26	26	ICES (2014b)
	2009–11	Biscay	1,168		1,190		2,357	>26	50	1,405		496		1,901	>26	26	Calculated
	2009–11	All	1,949		1,986		3,935	26	50	2,345		828		3,173	26	26	Rocklin *et al.* (2014)
	2011–12	4 & 6	2,043		1,581		3,624		44	2,458		659		3,117		21	IFREMER
	2011–12	Biscay	572		281		852		33	688		117		805		15	IFREMER
	2011–12	All	2,615		1,861		3,935		47	3,146		776		3,922		20	IFREMER

Table 3. Estimates of recreational catches of seabass in France, weight of retained and released components of the catch and release rates. The relative standard error (RSE) is provided where available and expressed as percentage.

During WKBASS 2017, it has been decided to use the 2009–2010 study, as the second one (2011-2012) was not fully treated. Indeed, this study has been conducted mostly by a pooling institute and hasn't been enough reviewed by scientific experts as the first study.

Estimation of the catches in the 2009-2011 study (1,405 t) appeared to be too high and in this case recreational landings in the area would represent 39% of the total landings. The proportion of recreational removals for each country in the Northern stock is estimated to be rather constant (France: 25%; England: 28%; Netherlands: 26%; Belgium: 29%).

The reference year was set to 2010 and we used the same approach as in the Northern stock. The recreational fleet (**Error! Reference source not found.**) is now represented by the fish landed plus the released catch that is expected to die due to a post-release mortality of 5%. Thus, for the the Bay of Biscay seabass stock stock, catches in the reference year 2010 was estimated to be 1,405 t + 25 t (5%) = 1,430 t.

Recreational fishery catches reconstructed for the whole time serie

There are no historical estimates of the recreational catch over the entire time series. IBPBass 2014 considered more plausible to treat recreational fishing as having a more stable participation and effort over time than the commercial fishery. A decision was made during WKBASS 2018 assessment meeting to apply a constant recreational fishing mortality over time considering the same approach than used for the Northern stock. Total retained recreational catches were iteratively adjusted to obtain a constant recreational F over all years, which was derived using the catch of 1,430 t estimated in 2010.

The implementation of new management measures should have lead to a reduction in fishing mortality as more and larger fish are released (Hyder *et al* 2018). This means that it is not appropriate to assume constant recreational fishing mortality in the last years and thus it is necessary to re-estimate the recreational catches. This has been done using the estimated reductions generated from the assessment of the impact of different levels of bag limits and minimum landing sizes (Armstrong et al., 2014) (Table 4) in order to derive changes in recreational fishing mortality (Hyder *et al.*, 2018).

Also, the application of different management measures, gave a recreational mortality multiplier for 2010-2012 of 1 and of 0.684 for 2013-2016 (related to an increase in MCRS to 42 cm).

In 2017 with a 5 fish bag limit implementation, the multiplier was estimated to be unchanged. For 2018 with a 3 fish bag limit implementation, it was estimated to be 0.647.

Table 4 : Time series of commercial and recreational catches used in the SS3 final model run.

year	commercial landings (t)	recreational landings (t)
1985	3420	1431
1986	3549	1384
1987	3417	1350
1988	3217	1331
1989	3144	1323
1990	2621	1331
1991	2734	1342
1992	2709	1338
1993	2552	1317
1994	2668	1277
1995	2492	1215
1996	2402	1147
1997	2358	1089
1998	2231	1079
1999	2091	1124
2000	2362	1217
2001	2306	1295
2002	2392	1350
2003	2616	1380
2004	2380	1395
2005	2796	1408
2006	2875	1427
2007	2751	1448
2008	2745	1461
2009	2278	1451
2010	2229	1430
2011	2575	1392
2012	2549	1341
2013	2685	875
2014	2991	819
2015	2264	769
2016	2252	733
2017	2295	713

Recreational length compositions

The estimate of removals were recalculated for the 2010 reference year as the sum of retained and released fish with a PRM of 5%. A length composition for recreational removals for the 2010 reference year was estimated as described in working document from Hyder *et al*., (2018). Table 5 gives the released numbers at length reduced by 95% to represent dead releases for the reference year 2010. These are added to the retained fish to give a length composition for the total recreational removals.

Table 5 : Kept and released numbers at length reduced by 95%, which represents total removals for the reference year 2010.

	2010: PRM & MCRS 36		
length (cm	Kept	Released	LFD
14	0	1397	1397
16	0	980	980
18	0	4063	4063
20	0	4358	4358
22	5735	3143	8879
24	0	5607	5607
26	0	3648	3648
28	50877	2294	53171
30	4478	4768	9246
32	13472	4183	17655
34	41631	4334	45965
36	53892	6198	60090
38	83914	3122	87036
40	156774	4061	160835
42	106565	932	107497
44	102442	593	103035
46	98820	354	99173
48	50350	357	50707
50	78315	276	78590
52	46442	118	46560
54	36032	283	36315
56	55230	0	55230
58	35861	118	35978
60	52236	164	52400
62	19774	0	19774
64	17441	112	17553
66	16581	0	16581
68	7672	0	7672
70	12968	0	12968
72	10542	0	10542
74	5908	0	5908
76	0	0	0
78	3718	0	3718
80	0	0	0
82	0	0	0
84	0	0	0
86	0	0	0
88	0	0	0
90	0	0	0
92	0	0	0
94	0	0	0

Abundance indices from surveys

Currently, there is no survey providing relative indices of adult or juvenile sea bass abundance over time. A French study is undertaken from 2013 to explore the possibility of creating recruitment indices in estuarine waters. There were good results, but it needs support to be routinely carried out. Abundance indices have been calculated for year 2016 and 2017 in the Loire estuary and are planned for year 2018. The study has been submitted to FEAMP for year 2019-2021, including also the Gironde estuary in order to get two abundance index for the stock Bss 8ab. Final objective would be to make it sustainable through DCF from 2022.

Commercial landings–effort data

The absence of a relative index of abundance covering adult seabass has been identified as a major issue for the assessment of the seabass stock in the Bay of Biscay.

There are no scientific surveys providing sufficient data on adult seabass to develop an index of abundance for the area. Therefore, Ifremer investigated the potential for deriving an index from commercial fishery landings and effort data available since 2000. This allows the possibility to derive from French logbooks data (vessels with length > or < 10m) a LPUE index at the resolution of ICES rectangle and gear strata. The methods and results of a GLM analysis of landings and effort data covering Areas 6 and 8 were presented through a Working Document (Laurec, Woillez and Drogou). A review of this second document has been done by an external expert (M. Christman) during summer 2017 and before WKBASS 2018.

A new LPUE index was thus presented at WKBASS 2018. This index is obtained by modelling the zeros and non-zeros values using a delta-GLM approach. The reviewer recommended the new LPUE index to be used in the assessment of Bay of Biscay seabass stock.

Two main issues were highlighted by the reviewer:

1) The alleged false positive pollution of the data set before 2009 was not considered to be a problem and could easily be corrected. Also, the index should be consider the entire time period (i.e. 2000-2016). WKBASS 2018 followed this recommendation.

2) The spawning season should be included in the LPUE as these catches are also indicative of the stock size. However, this recommendation was not followed by WKBASS 2018. The LPUEs are probably affected by the aggregative behaviour of seabass (i.e. hyperstability) during the spawning season.

The new LPUE index has been incorporated in the Northern and the Bay of Biscay stocks assessment models (Figure 6**Error! Reference source not found.**).

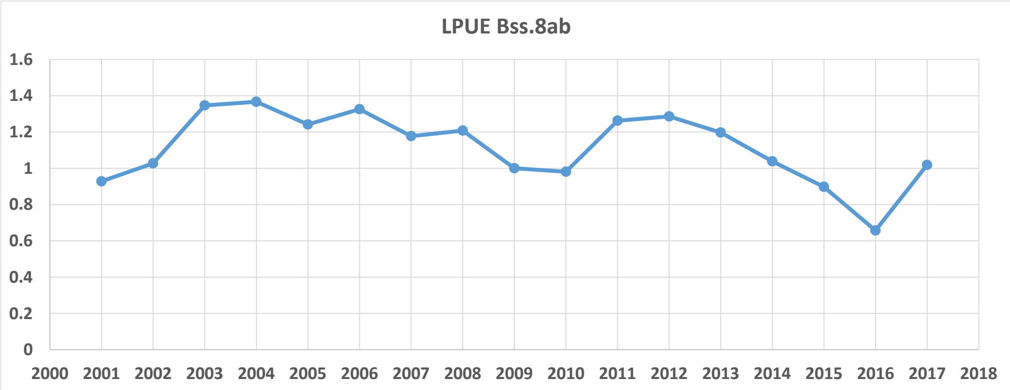


Figure 6. The "new" LPUE index series for the Bay of Biscay stock presented at WKBASS 2018 assessment meeting.

Figure 7 shows the comparison between the "old" index used to assess the Bay of Biscay seabass stock in WGBIE 2017 and the new index presented during WKBASS 2018 used in the SS3 final model run

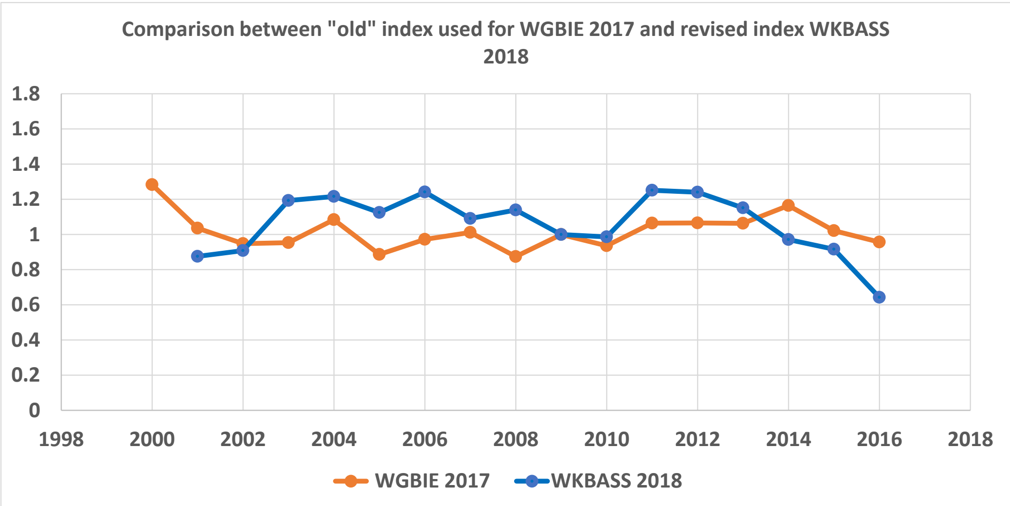


Figure 7. Comparison between the "old" index used for WGBIE 2017 and the "new" index from WKBASS 2018 assessment WK.

Biological parameters

Growth

Von Bertalanffy growth parameters were calculated for seabass sampled by Ifremer around the coasts of France in area 8.a and 8.b (Ices WKBASS 2017). Growth has been previously studied in the Bay of Biscay by D.Dorel (1986) and M.Bertignac (1987). Von Bertalanffy model parameters estimated using an absolute error model minimising ∑(obs-exp)^2) in length-at-age has been used. L_{inf} has been fixed to 80.4cm (Bertignac 1987) while K has been estimated by the SS3 model (0.11). The standard deviation of the length could be described by the linear model SD = 0.1861 * age + 2.6955 (samples included age 0 to age 15). The standard deviation of the length-at-age increased with age as expected.

Maturity

Maturity has been studied for seabass sampled by France in the Bay of Biscay. Data are derived from samples of French fishery around the Bay of Biscay coast (very few seabass adults are taken in surveys and were generally unsexed before 2009). Sampling has been specifically conducted under the "Bargip" project (Ifremer, France Filière pêche, French Ministry of the Environment, Energy and the Sea) in 2014 and 2015.

A logistic regression model has been used and a GLM has been fitted using a binomial distribution to model the probability of being mature.

Equation of parameters is as follows: P(Mature=1|Length=x) = exp(-15.93+0.37809*x)/(1+exp(-15.93+0.37809*x)). From this equation, the size x at which 50% of the females are mature is calculated as P(Mature=1|Length=x) = 0.5.

The size at which 50% of the females are mature ($L_{50\%}$) is 42.14 cm (low limit 41.31cm and upper limit 43.08 cm). The Pearson test (pvalue = 0.597) revealed a good model fit of the data (Figure 8)

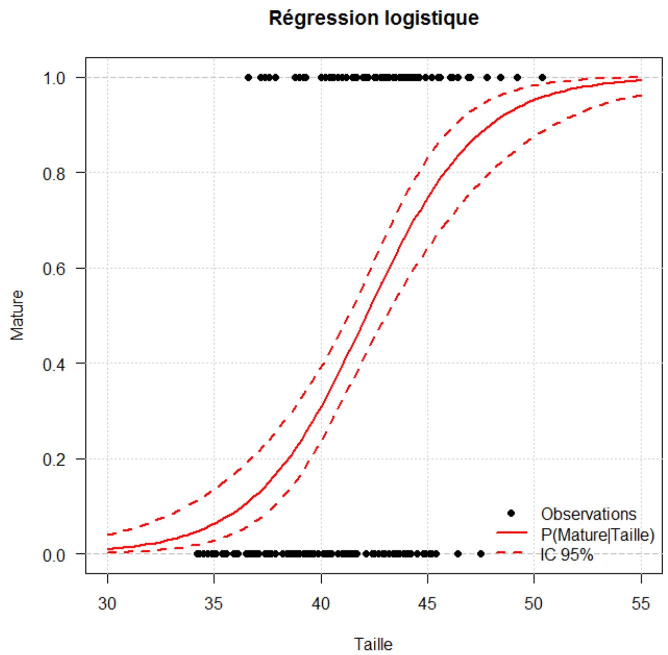


Figure 8. Maturity ogive for seabass in Bay of Biscay.

The study has been conducted on a short period (2 years) but nevertheless, it indicates similar results compared to Dorel (1986) (i.e. 42cm for females). Stequert (1972) also reported a similar value of $L_{50\%}$ for this area.

Natural mortality

There are no direct estimates of M for seabass. The WKBASS 2017 data WK reviewed a number of life-history based methods for estimating natural mortality rates in teleost fish based on life history metrics such as lifespan and growth parameters. The WKBASS 2017 assessment meeting adopted the predictions from a recent paper by Then *et al* (2015), which analysed data from 226 studies on natural mortality in fishes to evaluate the robustness of life-history based M estimates. Their equation $M = 4.899 . tmax^{-0.916}$ gives M values of 0.23 – 0.25 for tmax of 28-26 years as observed in the Northern seabass stock.

Because of the short time series for the French biological data (no biological data before 2000's, compared to 1985 for UK data), the WKBASS 2017 assessment meeting proposed to use the same M value for both stocks. Then *et al*. (2015) tmax method was considered as being more robust than estimates derived from other methods.

WKBASS 2017 Data WK also considered methods to derive age-dependent M (Gislason *et al*, 2010; Lorenzen, 1996) and to rescale these to match the Then *et al*. prediction over the age range of mature fish. However, this was not adopted for the benchmark assessment which choose **M = 0.24 for all age groups**.

Following recommendation of the external expert, a sensitivity analysis of the effect of different M values on the assessment of the Bay of Biscay seabass stock was conducted. M estimates have been computed from different methods based on life history information (Figure 9 left). A composite M median value from all the methods explored was 0.178 Figure 9 right), which is lower than the value derived from the method based on maximum age developed by Then *et al*. (i.e. M=0.24) and used in the assessment. WKBASS 2018 kept M = 0.24, since Then *et al*. (2015) evaluated the predictive performance of different life history-based methods in estimating natural mortality, and demonstrated that maximum age-based methods perform better than the others.

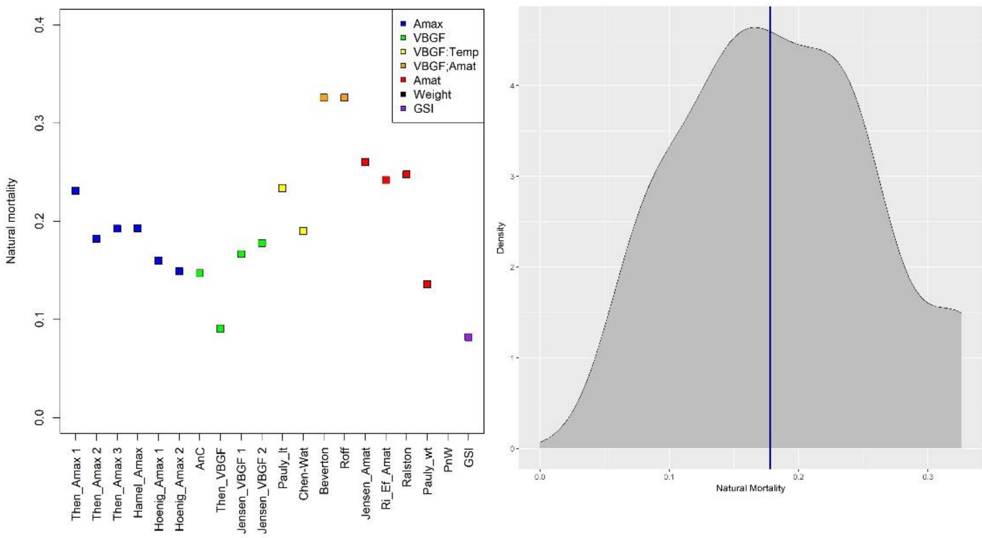


Figure 9. Left) Natural mortality estimates and methods applied. Right) Composite natural mortality value.

Assessment

The assessment has been developed in three stages during WKBASS 2017, WKBASS 2018 and IBPBASS 2018 which focused on reference points.

Assessment model development during WKBASS 2017 and 2018

Input data and model specifications

The Stock Synthesis (SS) assessment model (Methot, 1990; Methot and Wetzel, 2013) was chosen primarily for its highly flexible statistical model framework, allowing building simple to complex models. This model is written in ADMB (www.admb-project.org) and is available at the NOAA toolbox: http://nft.nefsc.noaa.gov/SS3.html. For

European seabass, a range of assessment models were built using Stock Synthesis 3 (SS3) version V3.24U to integrate the mix of fisheries and recreational data available (fleet-based landings; landings age or length compositions, landings age-at-length and discards age or length compositions for variable combinations of fleets and years) and biological information from recent research on growth rates, maturity and mortality.

Many model structures were explored before and during the WKBASS benchmark 2017 (Ices WKBASS 2017). Age and length model; including conditional age-at-length data for two fleets (French commercial and recreational fisheries) over the period 1985-2015 with corrected historical catch data has been selected as final model.

During the WKBASS benchmark 2018, the assessment model development focused on improving the 2017 final base model. The main improvements concerned:

i) the incorporation of the revised LPUE
ii) the integration of a robust reconstruction of the recreational catches
iii) the improvement of the data weighting

SS3 Data and Control files developed for WGBIE 2018 can be found in Annex 1.

Incorporation of the improved LPUE index series

The new LPUE presented above was incorporated within the SS3 assessment model. There is no specific issue regarding its integration through the SS3 Q_setup parameter. However, it was investigated which functional form should be used. Two options were tested: the relationship between the LPUE and the abundance of the stock is either proportional or non-linear. This is ruled by the SS3 Q_power parameter.

Integration of a robust reconstruction of the recreational catches

In 2018, catches from recreational fishery were estimated to ensure a constant fishing mortality for the recreational fishery over the whole time period. The fishing mortality for the recreational fishery was set to the level derived for the reference year 2010. In addition, fishing mortality multipliers were used for the last years of the series to account for the recent management measures (i.e. minimum conservation size and bag limit; see working document from Hyder *et al.,* 2018).

Regarding the length composition data of the recreational fishery, it was updated because a mistake was found and also the post release mortality was reduced to 5% (compared to the previous 15%) following most recent information (Hyder *et al.,* 2018).

Improvement of the data weighting

In Stock Synthesis version that was used for this assessment, two approaches to compositional data weighting were available, including Francis weighting approach (Francis 2011, Francis 2014, Francis 2017) and the McAllister-Ianelli harmonic mean method (McAllister and Ianelli 1997). The Francis (2011) method is based on each composition data set (e.g., year) as a data point and can be very imprecise when the number of compositions is low. Therefore, the Francis approach should only be used when the number of compositions is large enough, otherwise the multinomial likelihood with effective sample sizes based on the harmonic mean method should be used (Mounder *et al*. 2017). In the assessment for the Bay of Biscay seabass stock, very limited amount of length and age compositional data were available and therefore, the McAllister-Ianelli harmonic mean based method was used for compositional data weighting.

Final assessment model, diagnostics and retrospective

The final assessment model considered two fleets: a commercial fishing fleet and a recreational fleet (Figure 10). Commercial fleet includes French and Spanish fleets, even though the latter only accounts for 3% percent of the total landings in 8.ab area. Catch data were considered for years 1985-2016. Historical data (years 1985–1999) were reported from a different database than the modern data (years 2000–2015). A correction was applied to merge both series. A LPUE abundance index were considered for the modern period. Length compositions were available for the commercial fishery over the modern period. Only one year was available for the compositional length of the recreational fishery. Conditional age-at-length compositions were available only for the years 2008–2016.

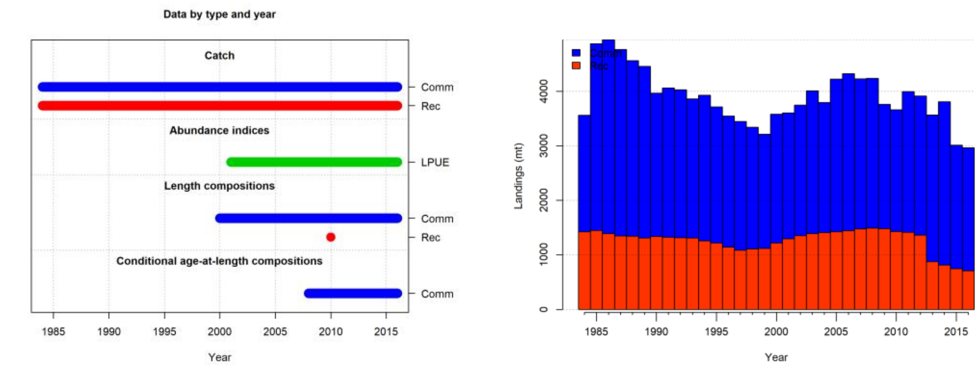


Figure 10. Left: Datasets used in the final assessment model. Right: Landings series for the two fleets.

Selectivity were mainly driven by length rather than age (Figure 11). Length-based selectivity curved were fitted for the two fishing fleets. The selectivity of the LPUE abundance index was mirrored to the commercial ones and set as logistic. The slope of the selectivity of the recreational fishery is steeper than the 2017 final model. The latter was considered to be not realistic, as a mistake was found in the computation of the length composition data of the recreational fishery.

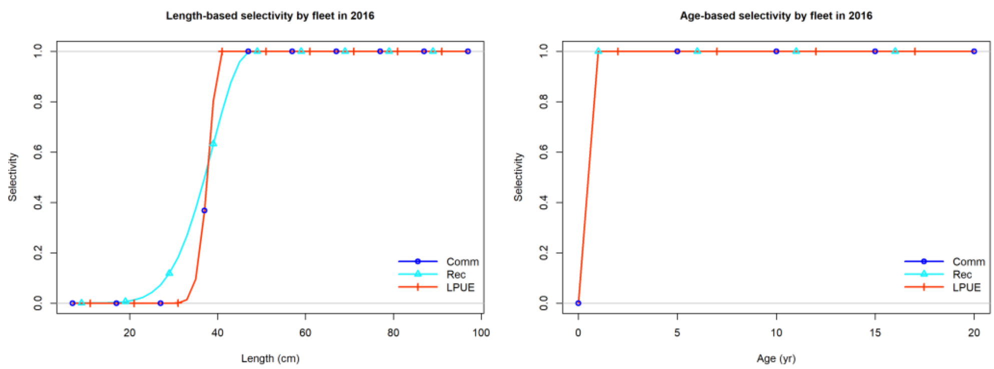


Figure 11. Final Bay of Biscay seabass stock assessment model: fitted length-based and age-based selectivity curves.

Model fit for the commercial length composition data were good (Figure 12**Error! Reference source not found.**).

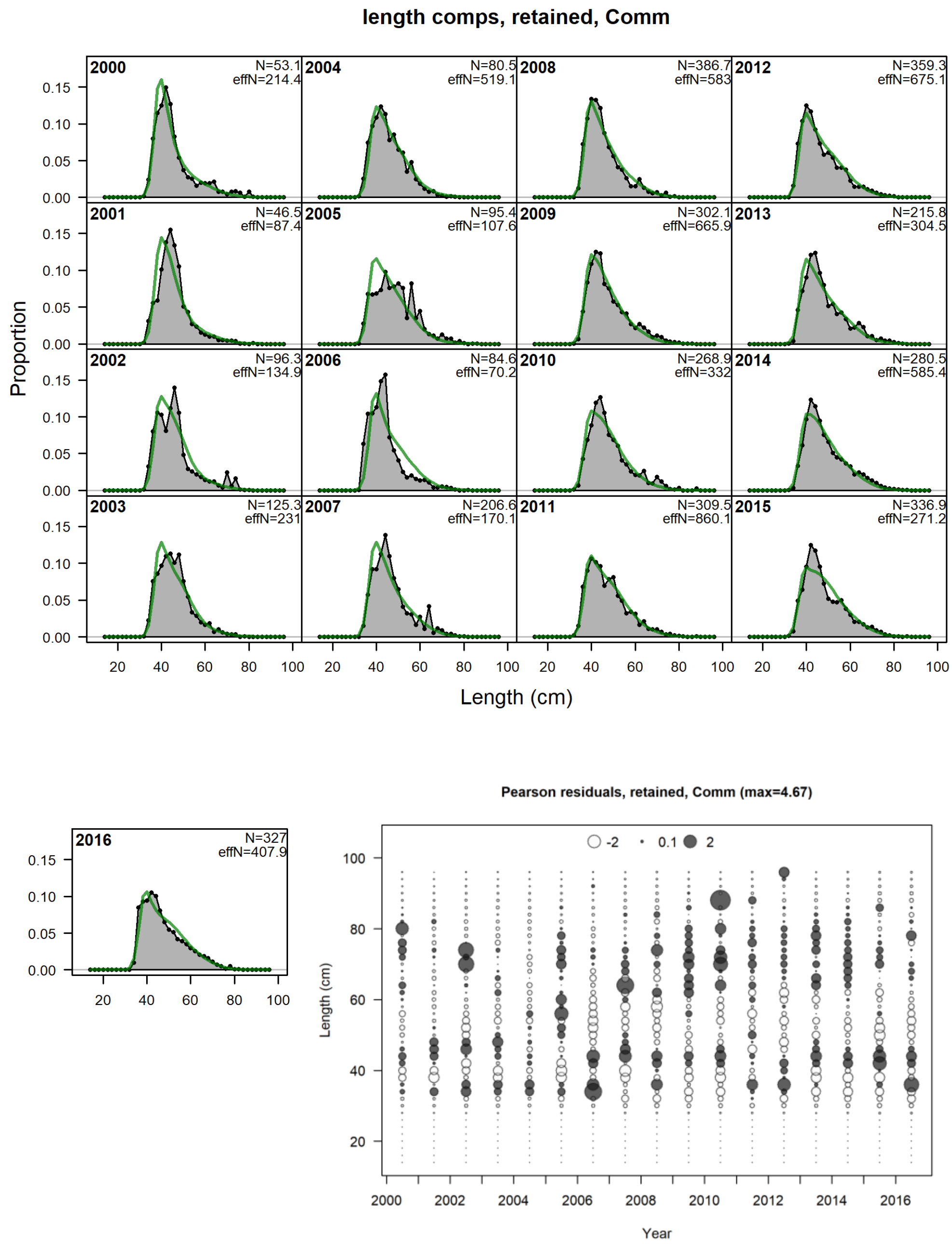


Figure 12. Final Bay of Biscay seabass stock assessment model: fit to commercial fishery length composition data and residuals.

Model fit for the recreational length composition data were good and better than for the 2017 final model (Figure 13). However, there were two spikes at 38 cm and 40 cm, which are likely related to reporting bias from interviewed recreational fishermen. Length composition data for recreational fisheries were only available for one year.

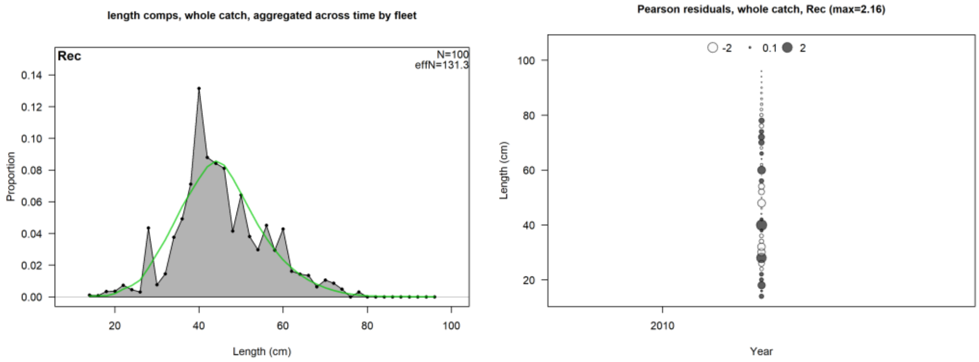


Figure 13. Final Bay of Biscay seabass stock assessment model: fit to recreational fishery length composition data and residuals.

The model fit for the commercial length composition data aggregated across time were satisfactory (Figure 14).

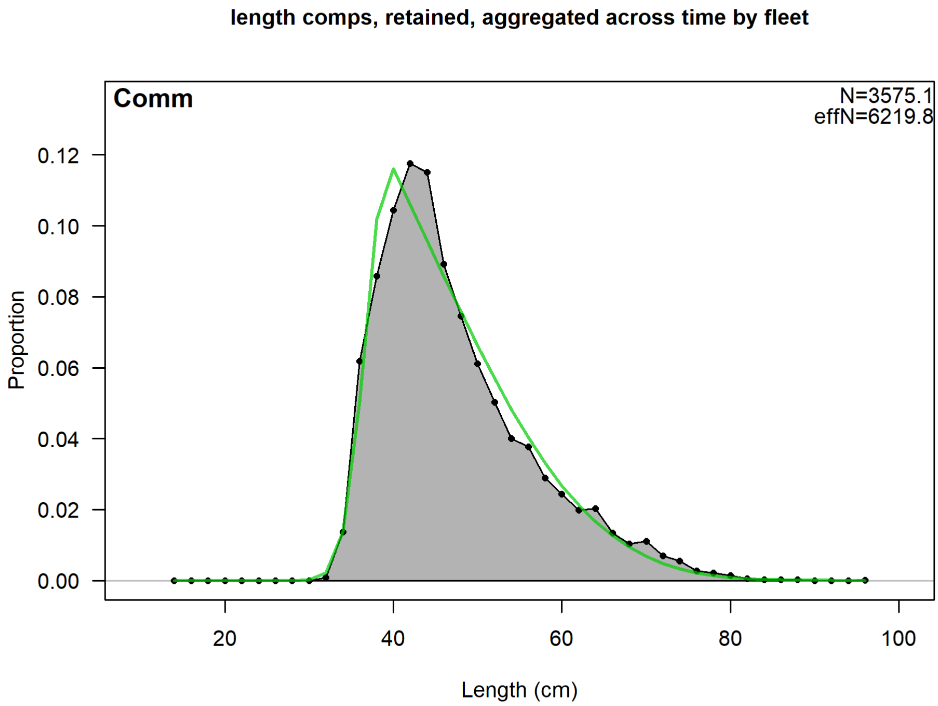
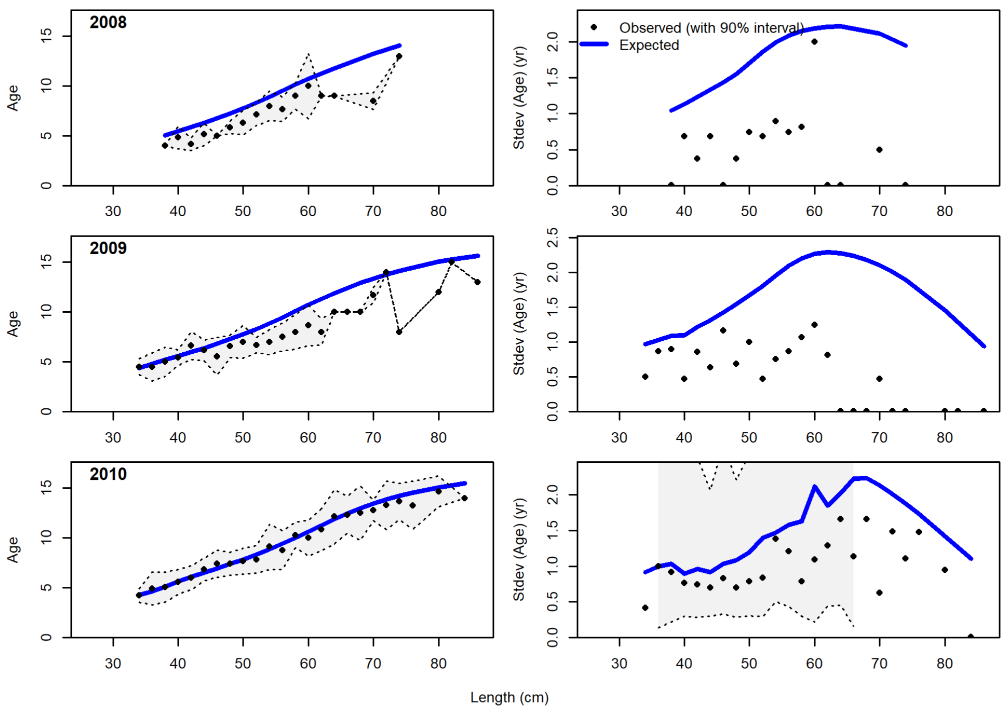


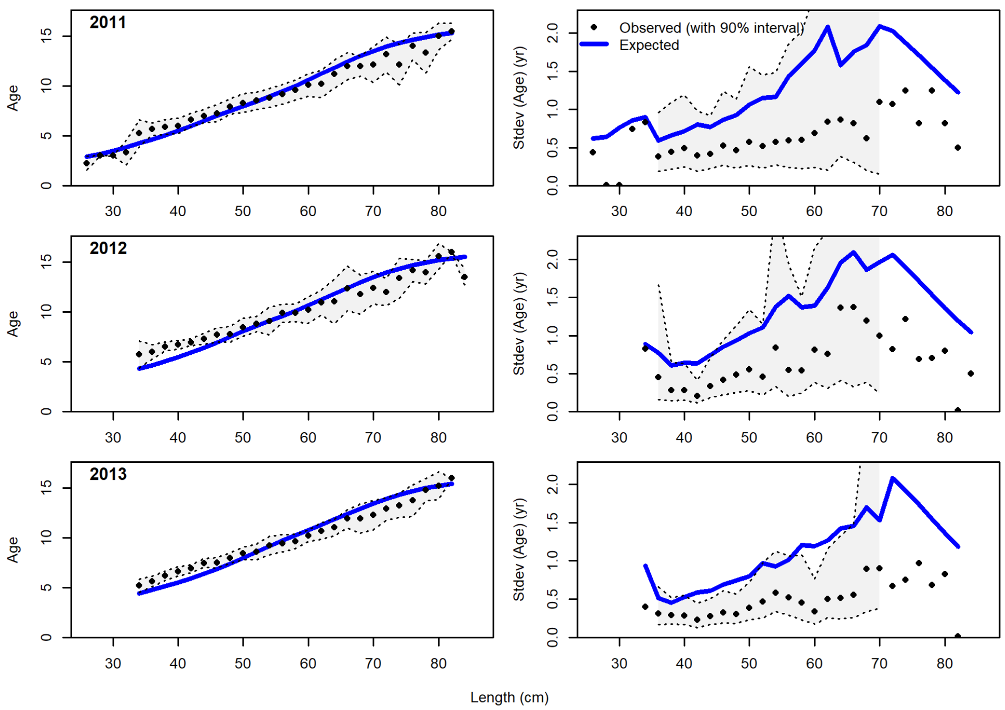
Figure 14. Final Bay of Biscay seabass stock assessment model: fit to length composition data by fishery aggregated across time.

Model fit for the aggregated fishery age-at-length composition data were good (Figure 15 and Figure 16). The fit were poor for first 2 years (2008 and 2009). However, for these years the sampling size was low.

Conditional AAL plot, retained, Comm



Conditional AAL plot, retained, Comm



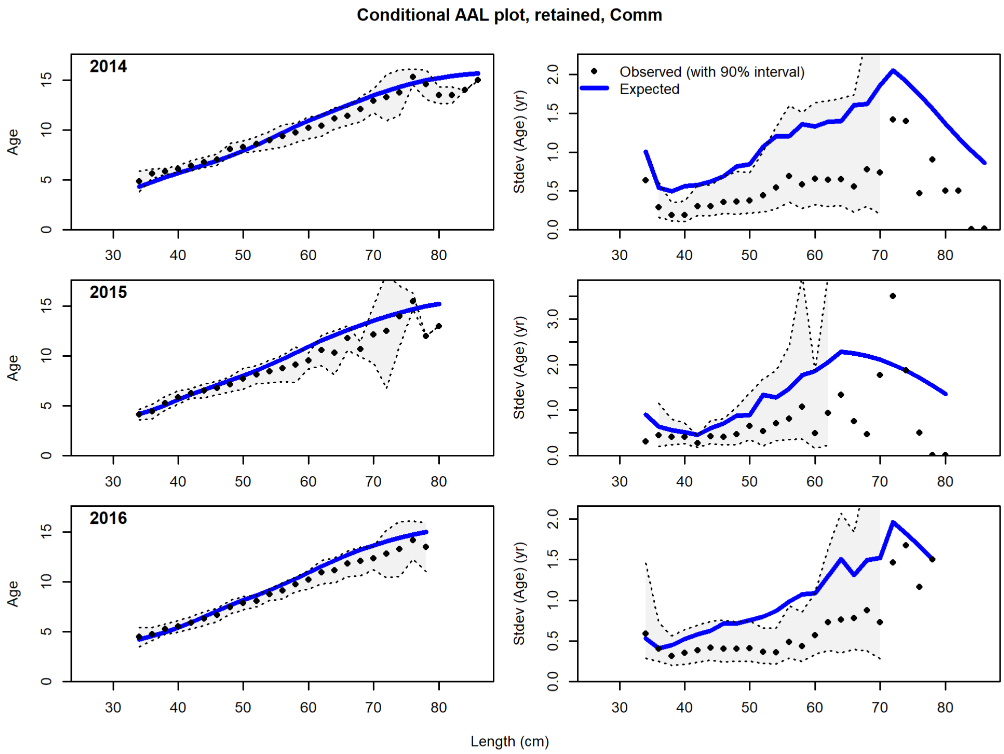


Figure 15. Final Bay of Biscay seabass stock assessment model: fit to conditional age-at-length for commercial fishery.

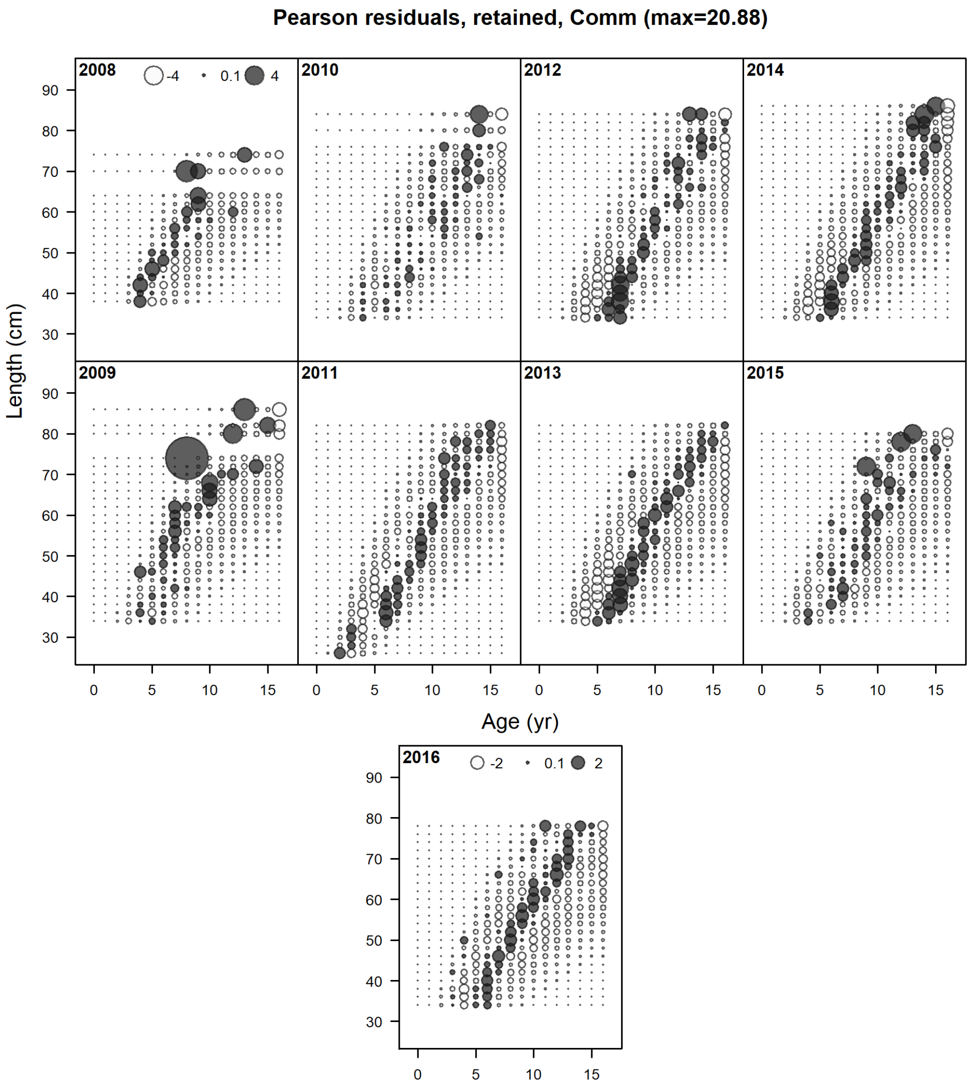


Figure 16. Final Bay of Biscay seabass stock assessment model: fit to conditional age-at-length for commercial fishery and residuals.

Age compositions data were included in the base model as "ghost", meaning that they were not used for estimating the model likelihood. The purpose was to illustrate what the model estimated in terms of age composition data (Figure 17). Model and observations compared well, even though a discrepancies for some years was evident. For instance, in years 2011-2014, the model overestimated the proportion of age ≤ 5 compared to observations, or vice versa. Uncertainty in age reading or sampling bias may be considered as a potential explanation.

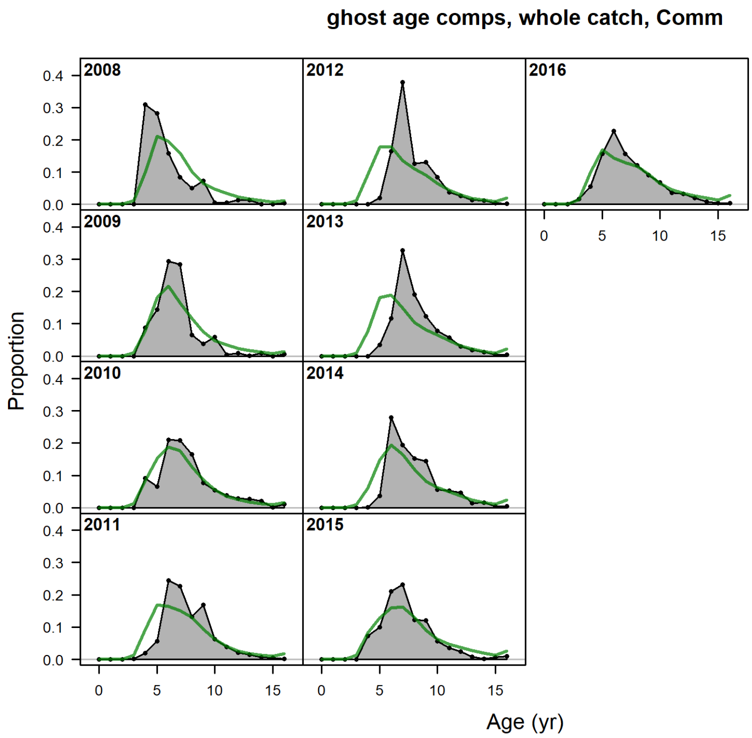


Figure 17. Final Bay of Biscay seabass stock assessment model: fit to ghost age composition data for commercial fishery.

Fit of the LPUE abundance index was good (Figure 18).

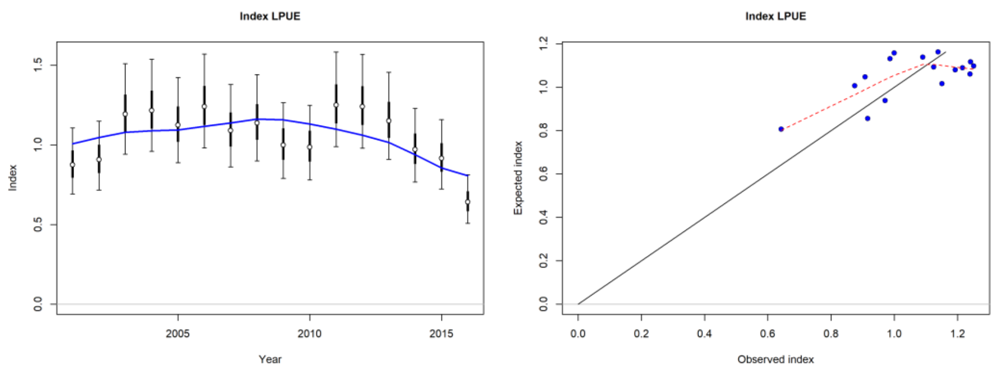


Figure 18. Final Bay of Biscay seabass stock assessment model: fit to LPUE abundance index.

The Bay of Biscay seabass stock showed a narrow dynamic range of SSB and no evidence of past or present impaired recruitment (Figure 19)

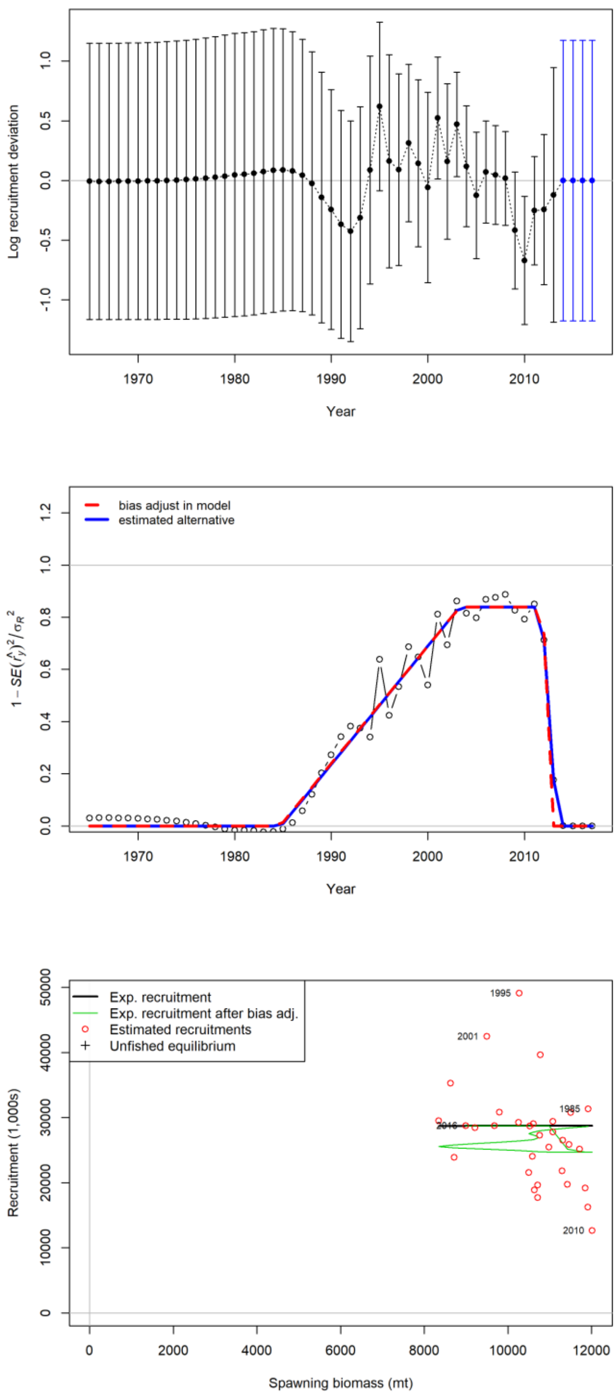


Figure 19 : Final Bay of Biscay seabass stock assessment model: Top) time-series of log recruitment deviations (deviations for 1965–1984 present the period of input catch data). Middle) Adjustment for bias due to variability of estimated recruitments in fishery. Red line shows current settings for bias adjustment. Blue line shows least squares estimate of alternative bias adjustment relationship for recruitment deviations. Bottom) Stock–recruitment scatter plot (model is fitted assuming Beverton–Holt stock–recruitment model and steepness = 0.999).

The recruitment series was variable around ~30,000,000 individuals per year. Recruitment below average was observed for years 2009-2012 (**Error! Reference source not** found.). The SSB fluctuated around 20,000 t. A low SSB was observed just before the 2000s, and high SSB was observed around year 2010. Since then, a decreasing trend is observed. F computed for ages 4 – 15 showed a slight decreasing trend over the whole time series (Figure 20)

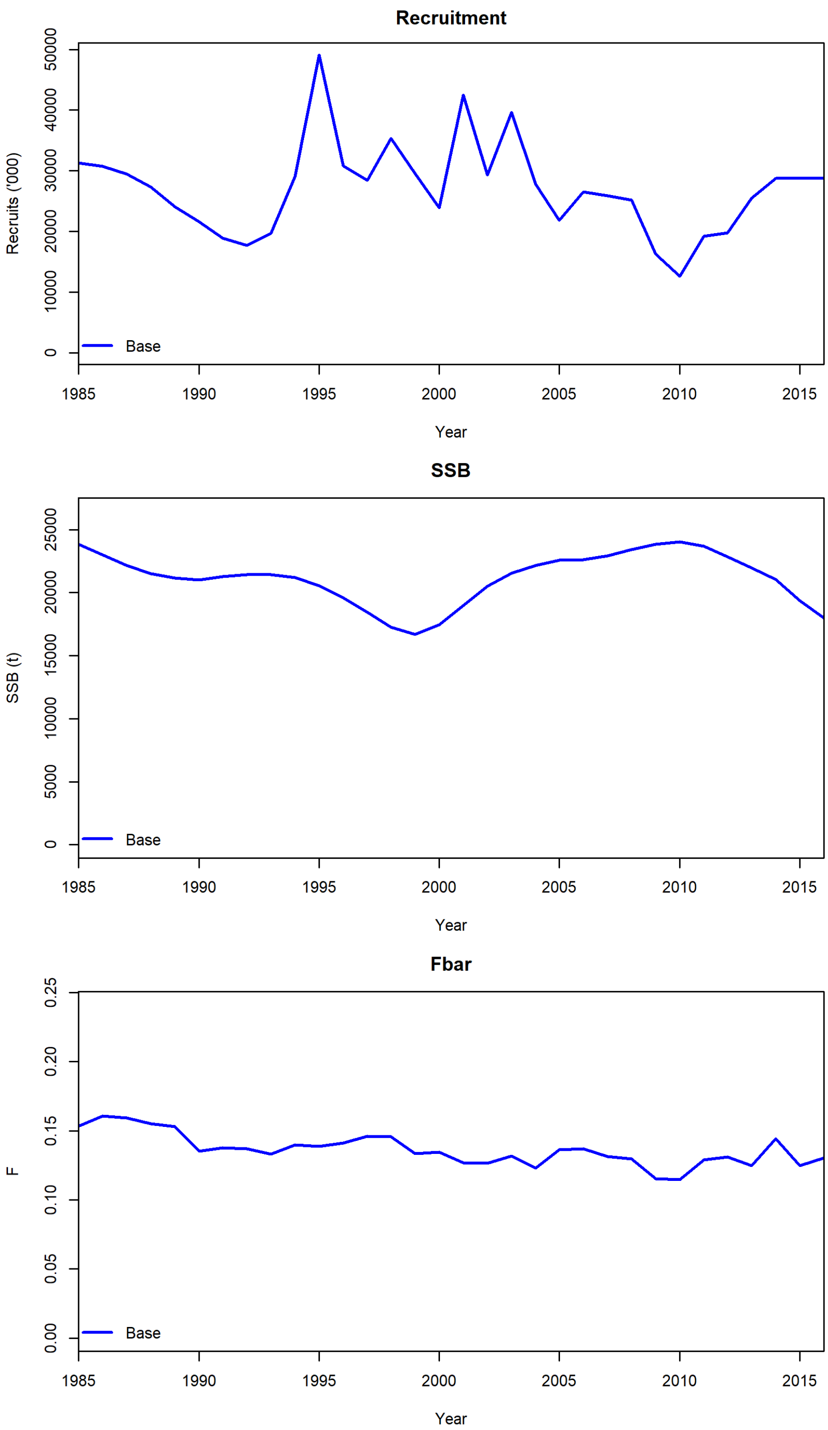


Figure 20. Final Bay of Biscay seabass stock assessment model: Recruitment, SSB and F (computed from ages 4-15) time-series.

A retrospective analysis was conducted (**Error! Reference source not found.**). Recruitment, SSB and F series showed some variability, however the stock trend is rather robust. In the last 5 years, the SSB is stable around 20,000 t showing a decreasing trend, while the F is below 0.15 and fluctuating without a trend. Recruitment was poorly estimated in recent years and showed high variability (Figure 21)

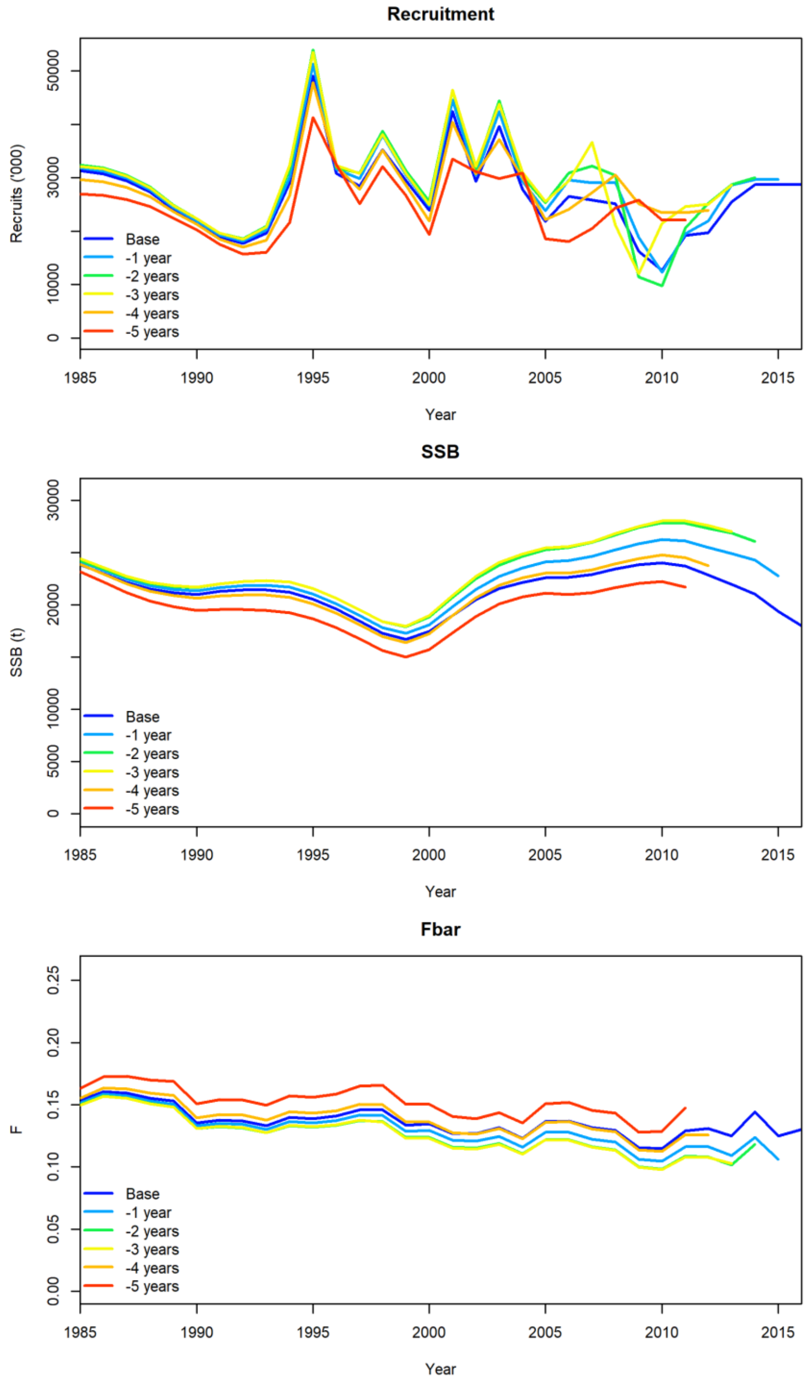


Figure 21. Retrospective analysis of the final Bay of Biscay seabass stock assessment model: Recruitment, SSB and F time-series.

Biological Reference Points and forecast (IBPBASS 2018)

Current reference points

There is no current Biological Reference Points for the Seabass (*Dicentrarchus labrax*) in Divisions 8.ab (Bay of Biscay North and Central). Reference points presented have been accepted during IBPBass 2018.

Source of data

The Seabass 8.ab stock is intending to be a category 1 stock with an analytical assessment based on a Stock Synthesis 3 (SS3) modelling approach. Data used in the analysis were taken from the final assessment model obtained during the benchmark meeting ICES WKBASS 2018.

Methods used

All analyses were conducted with EQSIM in R. To do so, the SS3 model output was converted to a FLStock object in order to run EQSIM. All model and data selection setting are presented in Table 6.

Table 6 : Model and data selection settings

DATA AND PARAMETERS	SETTING	COMMENTS
SSB-recruitment data	Full data series (years classes 1985–2016)	
Exclusion of extreme values (option extreme.trim)	No	
Trimming of R values	Yes	-3,+3 Standard deviations
Mean weights and proportion mature; natural mortality	2007–2016	
Exploitation pattern	2007–2016	
Assessment error in the advisory year. CV of F	0.212	Set ICES default value
Autocorrelation in assessment error in the advisory year	0.423	Set ICES default value

Results

Stock–Recruitment relationship

The S-R relationship was explored using age 0 as age of recruitment. As no fishing mortality occurs for most fish below or equal to age 3, we assumed that considering age 3 as age of recruitment rather than age 0 would not provide any better information. Several models were fitted to the S-R relationship (Figure 22). The most statistically appropriate model seems to be a Ricker model, which model some density dependence at high SSB. However a segmented regression was considered as an appropriate S-R model given the lack of biologically understandable trends in S-R that would justify a density-dependent process occurring at current stock state.

Based on the S-R relationship classification proposed by ICES (2017), the seabass stock can be categorised as a type 6 S-R plot. This is a stock with a narrow dynamic range of

SSB and showing no evidence of past or present impaired recruitment. Thus, it is justified to consider B_{pa} at the breakpoint of a segmented regression (Figure 22).

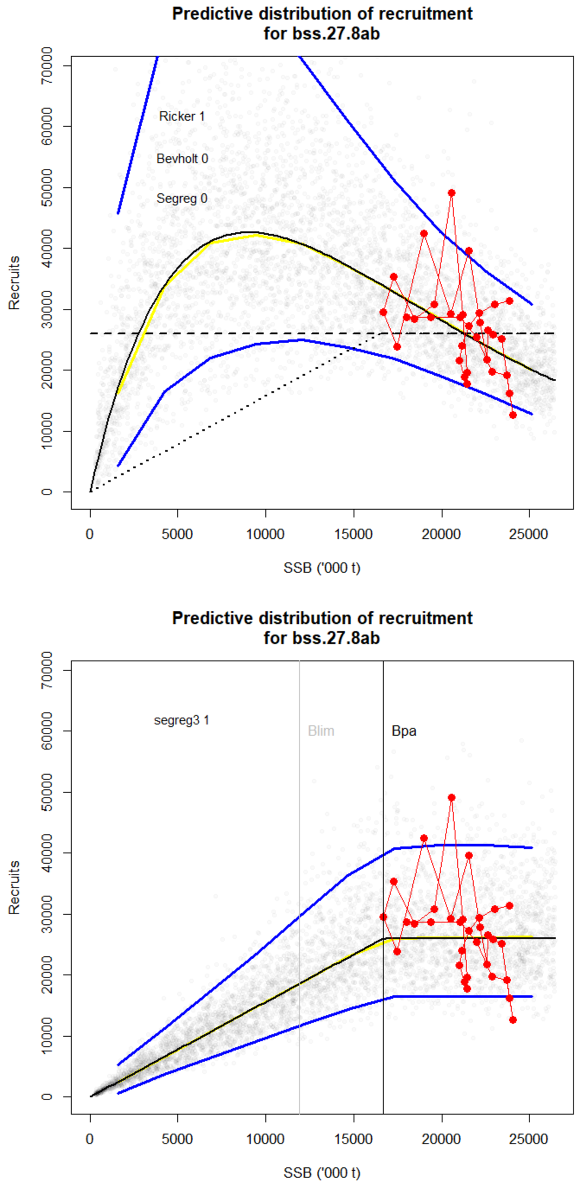


Figure 22: Stock recruitment relationship for the seabass in divisions 8.ab.

B_{pa} is estimated to be equal to B_{loss}. This implies a B_{pa} of 16,688 tonnes with a $B_{lim} = B_{pa} / \exp(CV * 1.645) = B_{pa} / 1.4 = 11{,}920$ tonnes, with CV taken equal to 0.2045 (default value recommended by ICES).

Yield and SSB

F_{MSY} is estimated from the base run and taken as the peak of the median landings equilibrium yield curve. The F_{MSY} range is calculated as those F values associated with median yield that is 95% of the peak of the median yield curve.

Eqsim analysis

a) Segmented regression method, full SR time-series, without $B_{trigger}$

F_{lim} and F_{pa} was estimated using the EqSim software to run the simulation with $B_{trigger}$ set to 0 (i.e. no $B_{trigger}$ used), $F_{cv} = F_{phi} = 0$ (i.e. no assessment/advice error set for this first run) and the segmented regression as the only SR method. F_{lim} is estimated as the fishing mortality that, at equilibrium from a long-term stochastic projection, leads to a 50% probability of having SSB above B_{lim}. F_{lim} was estimated to be 0.172, and F_{pa} is estimated to be 0.123 based on the following equation [$F_{pa} = F_{lim}/\exp(CV * 1.645)$].

Initially, F_{MSY} is calculated as the fishing mortality that maximises median long-term yield in stochastic simulations under constant F exploitation (i.e. without MSY Btrigger). Using the same simulation method with the inclusion of assessment/advice error default values: Fcv=0.212, Fphi=0.423 from WKMSYREF4 (ICES, 2016). $F_{MSY} = 0.138$ and is thus above $F_{pa} = 0.123$, see Figure 23 and Figure 24. In such a case, F_{MSY} is reduced to F_{pa} (i.e. F_{MSY} can not exceed F_{pa}).

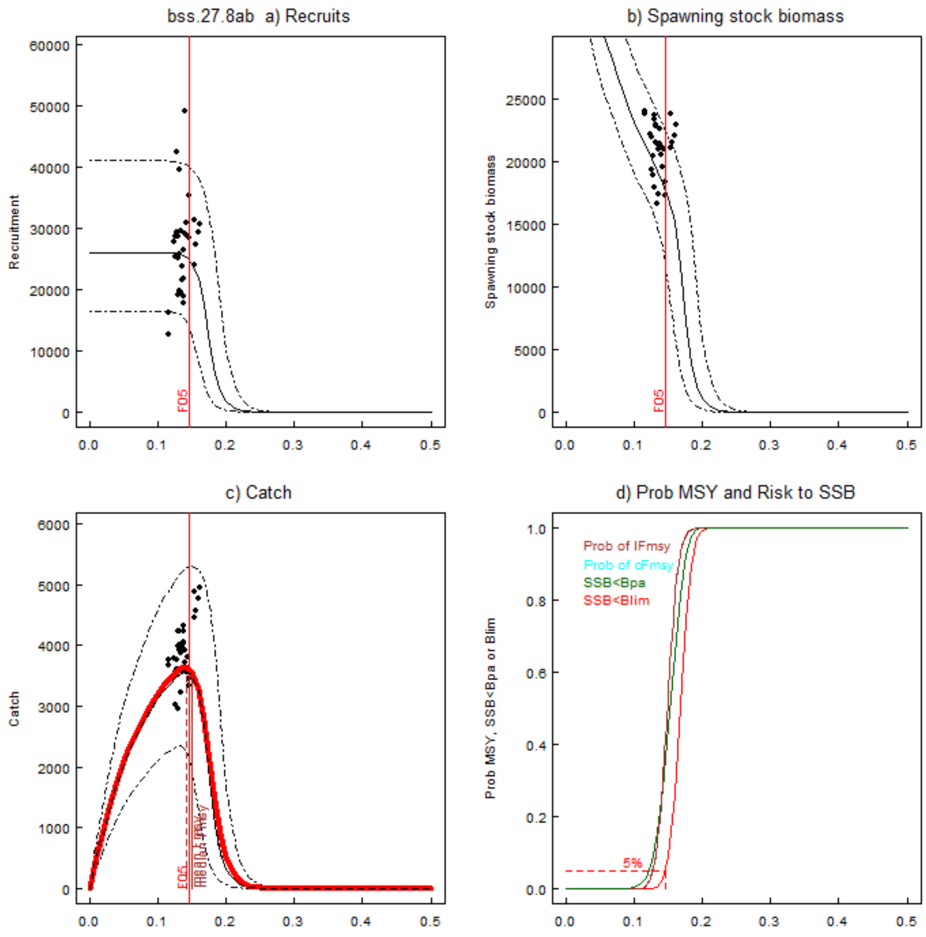


Figure 23 : Eqsim summary plot without $B_{trigger}$. Panels a to c: historic values (dots) median (solid black) and 90% intervals (dotted black) recruitment, SSB and landings for exploitation at fixed values of F. Panel c also shows mean landings (red solid line). Panel d shows the probability of $SSB < B_{lim}$ (red), $SSB < B_{pa}$ (green) and the cumulative distribution of F_{MSY} based on yield as landings (brown).

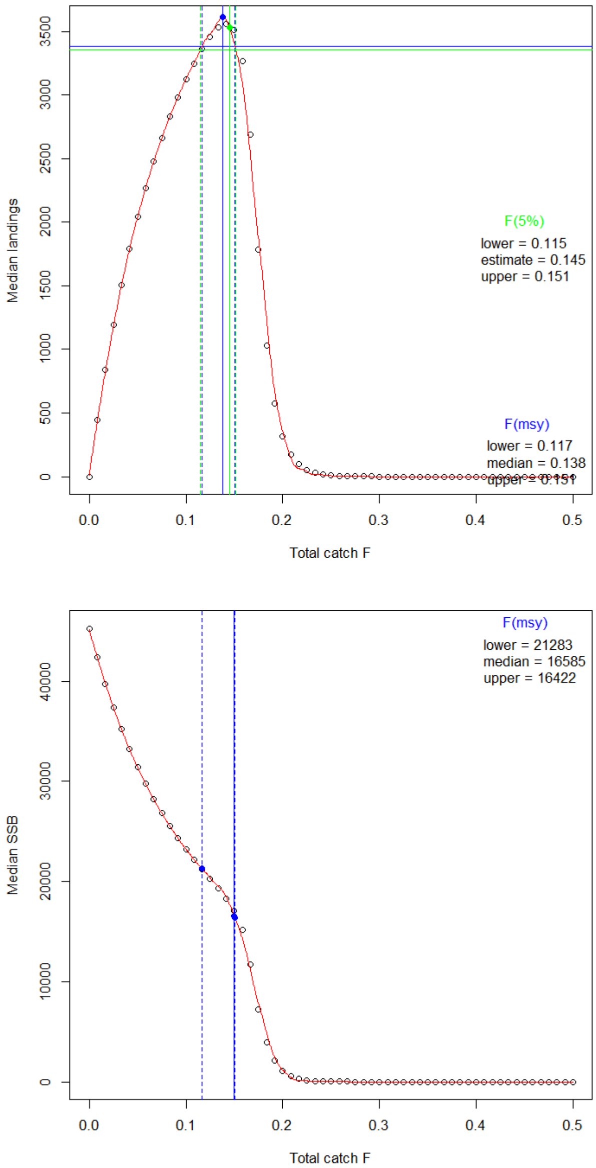


Figure 24: Left) Eqsim median landings yield curve with estimated reference points without $B_{trigger}$. Blue lines: F_{MSY} estimate (solid) and range at 95% of maximum yield (dotted). Green lines: F (5%) estimate (solid) and range at 95% of yield implied by F (5%) (Dotted). Right) Eqsim median SSB curve with estimated reference points without $B_{trigger}$. Blue dots: lower and upper SSB corresponding to lower and upper F_{MSY}.

b) Segmented regression method, full SR time-series, with $B_{trigger}$

ICES defines MSY $B_{trigger}$ as the 5th percentile of the distribution of SSB when fishing at F_{MSY}. However if the stock has not been fished at F_{MSY}, as in this case, then MSY $B_{trigger}$ is set to B_{pa}.

For this final run, assessment/advice error were included using the same default values and MSY $B_{trigger}$ was set to 16,688 tonnes. As shown in Figure 25, EqSim output $F_{p.05}$ (fishing mortality that gives 5% probability of SSB below B_{lim}) equals 0.186. As F_{MSY} estimated in the first run is below $F_{p.05}$, then F_{MSY} is kept to 0.123.

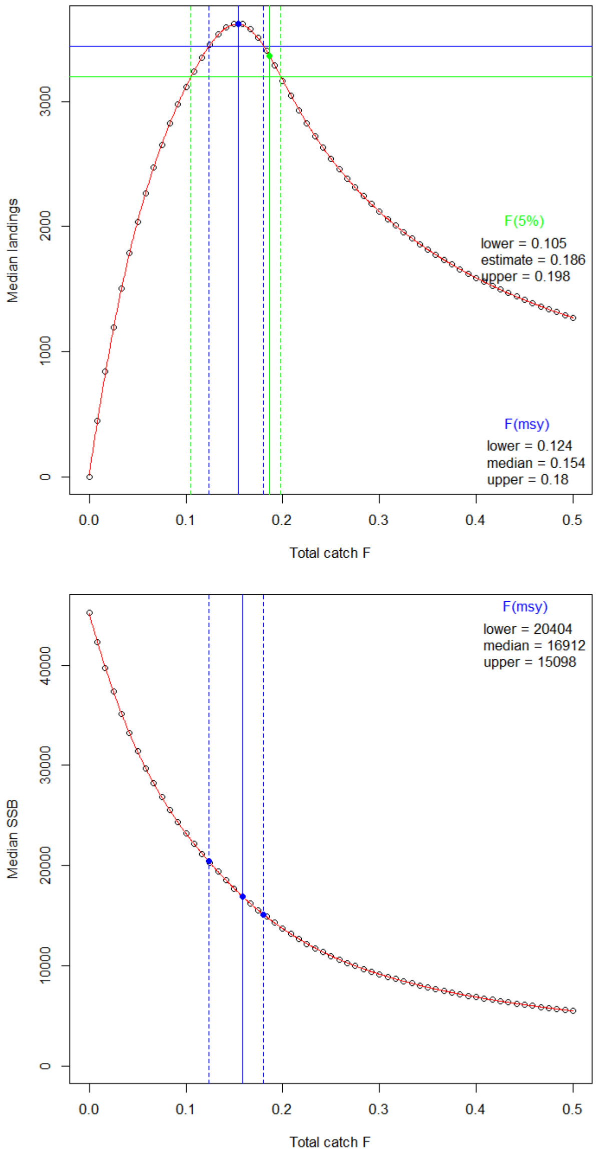


Figure 25: Eqsim median landings yield curve with estimated reference points with $B_{trigger}$. Blue lines: F_{MSY} estimate (solid) and range at 95% of maximum yield (dotted). Green lines: F (5%) estimate (solid) and range at 95% of yield implied by F (5%) (Dotted).

Proposed reference points

For the seabass in division 8ab stock, the proposed reference points are reported in the Table 7. Those proposed reference points are then displayed on the diagnostic plots of the final assessment (Figure 26 : Recruitment, SSB and Fbar time-series with IBP2018 biological reference points), i.e. the recruitment, the SSB and the F_{bar} (computed from ages 4–15) time-series.

Table 7 : Summary table of proposed stock reference points for method Eqsim.

STOCK	Seabass divisions 8ab	
PA Reference points	Value	Rational
B_{lim}	11,920 t	B_{pa} / 1.4
B_{pa}	16,688 t	Lowest observed SSB
F_{lim}	0.172	In equilibrium gives a 50% probability of SSB>B_{lim}
F_{pa}	0.123	$F_{pa} = F_{lim}$ / 1.4
MSY Reference point	Value	
F_{MSY} without $B_{trigger}$	0.138	
F_{MSY} lower without $B_{trigger}$	0.117	
F_{MSY} upper without $B_{trigger}$	0.150	
$F_{P.05}$ (5% risk to B_{lim} without $B_{trigger}$)	0.145	
F_{MSY} upper precautionary without $B_{trigger}$	0.151	
MSY $B_{trigger}$	16,688 t	Value reduced to B_{pa}. Never fished at F_{MSY} before. (originally equals to 17,715 t)
$F_{P.05}$ (5% risk to B_{lim} with $B_{trigger}$)	0.186	With WKMSYREF4 default values for assessment/advice error
F_{MSY} with $B_{trigger}$	0.123	Reduced value (originally equals to 0.154)
F_{MSY} lower with $B_{trigger}$	0.123	
F_{MSY} upper with $B_{trigger}$	0.180	
F_{MSY} upper precautionary with $B_{trigger}$	0.180	
Median SSB at F_{MSY}	20,528 t	
Median SSB lower precautionary (median at F_{MSY} upper precautionary)	15,123 t	
Median SSB upper (median at F_{MSY} lower)	20,528 t	

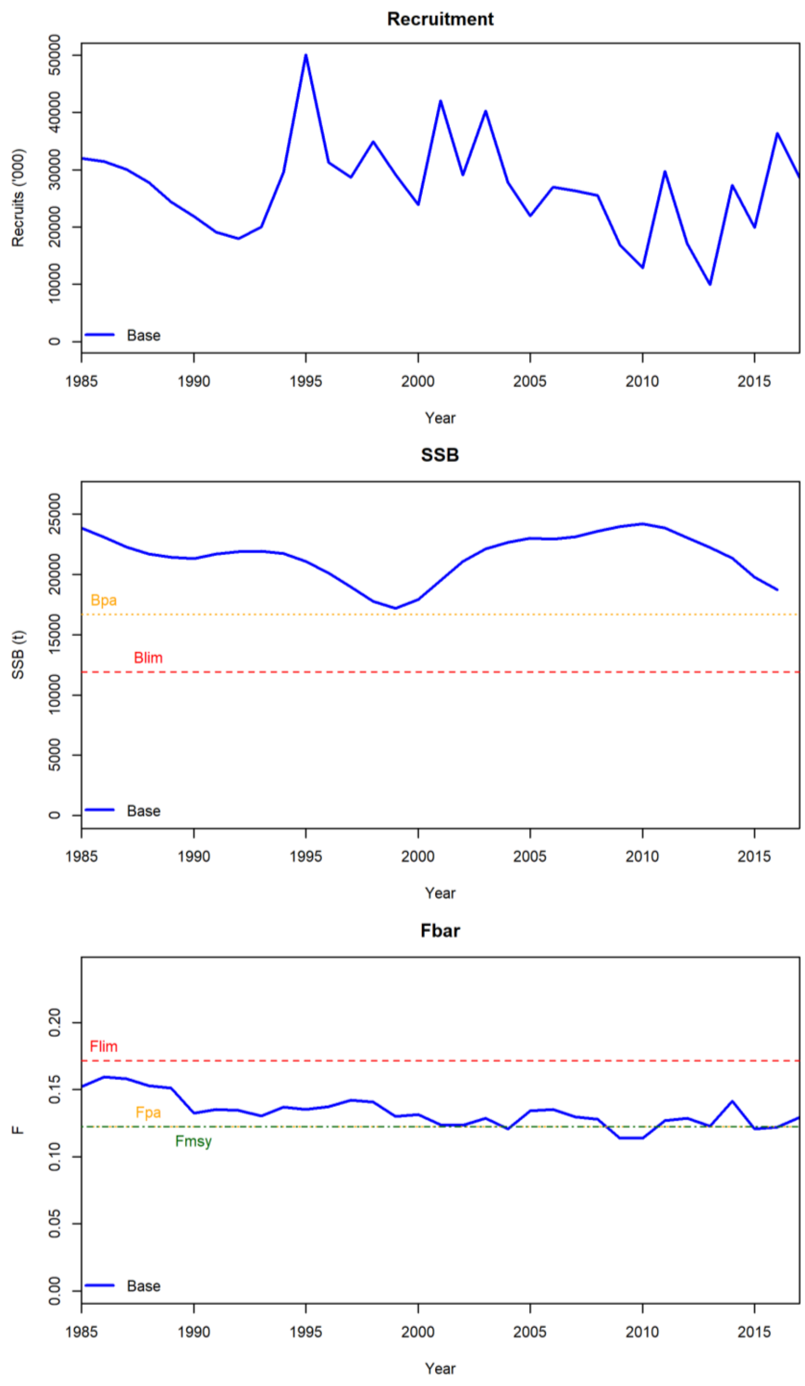


Figure 26 : Recruitment, SSB and F_{bar} time-series with IBP2018 biological reference points

Short-Term projection, catch options and prognosis

The recruitment used for projections is the geometric mean (GM) calculated from 2008 to 2014. For the short-term projection, scaled F-at-age to the average of the last 3 years (2015-2017) were used for commercial and recreational fleets. For illustration purpose, forecasting inputs used for projections in 2017 are compiled in **Error! Reference source not found.** and Table 9.

Table 8. Seabass in Division 8.a-b. Forecast inputs table.

Age	Numbers at age	Weight in stock	Proportion mature	Commercial F	Commercial mean weights	Recreational F	Recreational mean weight	M
0	18584	0,004	0,000	0,000	0,009	0,000	0,009	0,24
1	14618	0,020	0,000	0,000	0,044	0,000	0,051	0,24
2	11498	0,078	0,000	0,000	0,295	0,001	0,151	0,24
3	9675	0,183	0,003	0,001	0,460	0,004	0,300	0,24
4	10400	0,332	0,031	0,019	0,592	0,011	0,485	0,24
5	2879	0,519	0,167	0,066	0,726	0,020	0,690	0,24
6	3578	0,737	0,431	0,096	0,900	0,027	0,906	0,24
7	4328	0,977	0,683	0,105	1,120	0,031	1,134	0,24
8	1283	1,232	0,842	0,107	1,368	0,032	1,378	0,24
9	1149	1,494	0,923	0,108	1,628	0,033	1,633	0,24
10	1176	1,757	0,962	0,108	1,889	0,033	1,892	0,24
11	825	2,018	0,980	0,108	2,146	0,033	2,148	0,24
12	580	2,271	0,989	0,108	2,395	0,033	2,396	0,24
13	324	2,516	0,994	0,108	2,634	0,033	2,634	0,24
14	283	2,749	0,996	0,108	2,861	0,033	2,861	0,24
15	281	2,969	0,998	0,108	3,074	0,033	3,074	0,24
16	471	3,534	0,998	0,108	3,593	0,033	3,593	0,24

Age 0,1,2 over-written as follows:

2018 yc 2018 age 0 replaced by 2008–2014 LTGM (18 584 thousand);

2017 yc 2018 age 1 from SS3 survivor estimate at-age 1, 2018 * LTGM / SS3 estimate of age 0 in 2016;

2016 yc 2018 age 2 from SS3 survivor estimate at-age 2, 2018 * LTGM / SS3 estimate of age 0 in 2015.

Table 9. Seabass in Division 8.a-b. The basis for the catch scenarios.

Variable	Value	Notes
F ages 4–15 (2018)	0.124	F_{sq}; $F_{average(2015\text{-}2017)}$ scaled to 2017; commercial fishery F= 0.096; recreational fishery F=0.028 (reduced to account for 2018 management measures; $F_{recreational(2018)} = F_{recreational(2017)} * 0.945$)
SSB (2019)	15573 t	Short-term forecast
R_{age0} (2016, 2017, 2018)	18584 thousands	Geometric mean (2008-2014)
Total catch (2018)	2718 t	Fishing at F_{sq} with $F_{recreational(2018)}$ reduced
Wanted commercial catch (2018)	2092 t	Short-term forecast
Unwanted commercial catch (2018)	negligible	
Recreational Catch (2018)	626 t	Short-term forecast with management measures taken into account and full compliance assumed

Depending of the level of SSB of year N+2, ICES basis rules should be followed.

For assessment year 2017, we had Blim < SSB_{2019} < Bpa, so the MSY approach recommended to have F=Fmsy * SSB_2019 / MSY_Btrigger

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Annexe 1: Stock Synthesis 3 Model data and control files for seabass 8.ab stock

SS3 control file

C Sea bass 8 input data file

_SS-V3.24f

benchmark WKBASS 2017

----

1 #_N_Growth_Patterns

1 #_N_Morphs_Within_GrowthPattern(GP)

#_Cond 1 #_Morph_between/within_stdev_ratio (no read if N_morphs=1)

#_Cond 1 #vector_Morphdist_(-1_in_first_val_gives_normal_approx)

#

##1 # N recruitment designs goes here if N_GP*nseas*area>1 #here 1 gp, 4 seasons, 1 area

##0 # placeholder for recruitment interaction request

#GP seas area for each recruitment assignment

##1 1 1 # example recruitment design element for GP=1, season=1, area=1

#

#_Cond 0 # N_movement_definitions goes here if N_areas > 1

#_Cond 1.0 # first age that moves (real age at begin of season, not integer) also cond on do_migration>0

#_Cond 1 1 1 2 4 10 # example move definition for seas=1, morph=1, source=1 dest=2, age1=4, age2=10

#

----

0 #_Nblock_Patterns

#_blocks_per_pattern

begin and end years of blocks in first pattern

#

0.5 #_fracfemale #? Note sex ratio in bass increases with length.

0 #_natM_type:_0=1Parm; 1=N_breakpoints;_2=Lorenzen;_3=agespecific;_4=agespec_withseasinterpolate

#0.150 0.150 0.150 0.152 0.163 0.209 0.247 0.256 0.257 0.257
0.257 0.257 0.257 0.257 0.257 0.257 0.257 0.257 0.257
0.257 0.257 0.257 0.257 0.257 0.257 0.257 0.257 0.257
0.257 0.257 0.257

-------------------------modifs 2 et 28 à la place 1 et 999

1 # GrowthModel: 1=vonBert with L1&L2; 2=Richards with L1&L2; 3=not implemented; 4=not implemented #note - maguire et al 2008 pg 1270, Downloaded from icesjms.oxfordjournals.org at ICES on October 17, 2011

1 #_Growth_Age_for_L1

999 #_Growth_Age_for_L2 (999 to use as Linf)

0 #_SD_add_to_LAA (set to 0.1 for SS2 V1.x compatibility)

1 #_CV_Growth_Pattern: 0 CV=f(LAA); 1 CV=F(A); 2 SD=F(LAA); 3 SD=F(A)

1 #_maturity_option: 1=length logistic; 2=age logistic; 3=read age-maturity matrix by growth_pattern; 4=read age-fecundity; 5=read fec and wt from wtatage.ss

#_placeholder for empirical age-maturity by growth pattern

----

4 #_First_Mature_Age

1 #_fecundity option:(1)eggs=Wt*(a+b*Wt);(2)eggs=a*L^b;(3)eggs=a*Wt^b

0 #_hermaphroditism option: 0=none; 1=age-specific fxn

1 #_parameter_offset_approach (1=none, 2= M, G, CV_G as offset from female-GP1, 3=like SS2 V1.x)

1 #_env/block/dev_adjust_method (1=standard; 2=logistic transform keeps in base parm bounds; 3=standard w/ no bound check)

#_growth_parms

#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev dev_minyr dev_maxyr dev_stddev Block Block_Fxn

#_growth_parms. Faire démarrer à 15cm age moyen 1 an courbe croissance (cf michel)

0.01 0.5 0.24 0.15 -1 0.1 -3 0 0 0 0 0 0 0 # NatM_p_1_GP_1 #Has a Vestor of Mortality to include the Rec fishing component.

7 25 12 12 -1 0.5 -3 0 0 0 0 0 0 0 # L_at_Amin_GP_1

60 100 80.4 80.4 -1 15 -3 0 0 0 0 0 0 0 # L_at_Amax_GP_1

0.05 0.2 0.11 0.139 -1 0.05 3 0 0 0 0 0 0 0 # VonBert_K_GP_1

0.05 0.40 0.1 0.05 -1 0.8 -3 0 0 0 0 0 0 0 # CV_young_GP_1

0.05 0.40 0.1 0.05 -1 0.8 -3 0 0 0 0 0 0 0 # CV_old_GP_1

weight-length relationship

0 1 0.00001244 0.00001244 -1 0.05 -3 0 0 0 0 0 0 0 # Wtlen_1

2 4 2.95 2.95 -1 0.05 -3 0 0 0 0 0 0 0 # Wtlen_2

proportion mature at length

30 50 42.14 42.14 -1 5 -3 0 0 0 0 0 0 0 # Mat50%

-5 1 -0.37809 -0.37809 -1 0.06015 -3 0 0 0 0 0 0 0 # Mat_slope

fecundity option 1, parm values from dissertation (units of millions of eggs per kg)

-3 3 1 1 -1 0.8 -3 0 0 0 0 0 0 0 # Eg/gm_inter

-3 3 0 0 -1 0.8 -3 0 0 0 0 0 0 0 # Eg/gm_slope_wt

recruitment apportionment

0 0 0 0 -1 0 -3 0 0 0 0 0 0 0 # RecrDist_GP_1

0 0 0 0 -1 0 -3 0 0 0 0 0 0 0 # RecrDist_Area_1

0 0 0 0 -1 0 -4 0 0 0 0 0 0 0 # RecrDist_Seas_1

cohort growth deviation (fix value at 1 with negative phase; needed for blocks or annual devs)

0 0 0 0 -1 0 -4 0 0 0 0 0 0 0 # CohortGrowDev

#

```
#_Cond 0 #custom_MG-env_setup (0/1)
#_Cond -2 2 0 0 -1 99 -2            #_placeholder when no MG-environ parameters
#
#_Cond 0 #custom_MG-block_setup (0/1)
#_Cond -2 2 0 0 -1 99 -2            #_placeholder when no MG-block parameters
#_Cond No MG parm trends
#
#_seasonal_effects_on_biology_parms
0 0 0 0 0 0 0 0 0 0
        #_femwtlen1,femwtlen2,mat1,mat2,fec1,fec2,L1,K
#_Cond -2 2 0 0 -1 99 -2            #_placeholder when no seasonal MG parameters
#
#-6     #_MGparm_Dev_Phase
#
#_Spawner-Recruitment
3       #_SR_function

#_LO HI INIT PRIOR PR_type SD PHASE
 1   16    10     5    -1 1     1        # SR_R0
 0.2  0.999  0.999  0.999 -1 0.2  -1     # SR_steep
 0.1  2     0.6    0.6   -1 0.2  -5      # SR_sigmaR
-5    5     0      0     -1 1    -3      # SR_envlink
-5    5     0     -0.7   -1 2    -2      # SR_R1_offset
 0    0     0      0     -1 0   -99      # SR_autocorr

0                #_SR_env_link
0                #_SR_env_target_0=none;1=devs;_2=R0;_3=steepness

1                #do_recdev:  0=none; 1=devvector; 2=simple deviations
1965         # first year of main recr_devs; early devs can preceed this era
2013         # last year of main recr_devs; forecast devs start in following year 2013.
Youngest survey age 2gp 2013; revised WGCSE 2015
```

3 #_recdev phase

1 # (0/1) to read 13 advanced options (on avait mis 0)

0 #_recdev_early_start (0=none; neg value makes relative to recdev_start)

-4 #_recdev_early_phase

0 #_forecast_recruitment phase (incl. late recr) (0 value resets to max-phase+1)

1 #_lambda for prior_fore_recr occurring before endyr+1

1984.7 #_last_early_yr_nobias_adj_in_MPD

2003.3 #_first_yr_fullbias_adj_in_MPD

2011.9 #_last_yr_fullbias_adj_in_MPD

2012.7 #_first_recent_yr_nobias_adj_in_MPD

0.8394 #_max_bias_adj_in_MPD (1.0 to mimic pre-2009 models)

0 #_period of cycles in recruitment (N parms read below)

-5 #min rec_dev

5 #max rec_dev

0 # 3 #_read_recdevs

#_end of advanced SR options

#

#Fishing Mortality info p74

0.2 # F ballpark for tuning early phases

-2001 # F ballpark year (neg value to disable)

3 # F_Method: 1=Pope; 2=instan. F; 3=hybrid (hybrid is recommended)

2.9 # max F or harvest rate, depends on F_Method. A value of about 4 is recommended for F merthod 2 and 3 (donc on devrait mettre 4?)

no additional F input needed for Fmethod 1

if Fmethod=2; read overall start F value; overall phase; N detailed inputs to read

#0.3 3 0 # if Fmethod=3; read N iterations for tuning for Fmethod 3

5 # N iterations for tuning F in hybrid method (recommend 3 to 7)

#FROTB%FRMWT%FRNets%FRLines%FROther%FRRecFish%SPOther%CPUEindex

#_initial_F_parms (pourquoi 0.3 Uk et 0.03 FR?)

#_LO HI INIT PRIOR PR_type SD PHASE

0.05 2 0.05 0.3 -1 0.5 1 # InitF_Comm

0.05 2 0.05 0.3 -1 0.5 1 # InitF_Rec

#

Catchability Specification (Q_setup)

A=do power: 0=skip, survey is prop. to abundance, 1= add par for non-linearity

B=env. link: 0=skip, 1= add par for env. effect on Q

C=extra SD: 0=skip, 1= add par. for additive constant to input SE (in ln space)

D=type: <0=mirror lower abs(#) fleet, 0=no par Q is median unbiased, 1=no par Q is mean unbiased, 2=estimate par for ln(Q)

3=ln(Q) + set of devs about ln(Q) for all years. 4=ln(Q) + set of devs about Q for indexyr-1

A B C D

0 0 0 0 # Comm

0 0 0 0 # Rec

0 0 1 0 # LPUE

Lo Hi Init Prior Prior_type Prior_sd Phase

0 1 0.1 0.1 -1 99 3 # Q_extraSD_LPUE

#_size_selex_types

#_RDM now all fleets have size selectivity

24 0 0 0 # 1 Comm

24 0 0 0 # 2 Rec

15 0 0 1 # 3 LPUE

#

#_age_selex_types a mettre? ATTENTION J AI MODIFIE LE RECFR POUR QUE CA MARCHE!!!

#_Pattern ___ Male Special

10 0 0 0 # 1 Comm

10 0 0 0 # 2 Rec

10 0 0 0 # 3 LPUE

#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev dev_minyr dev_maxyr dev_stddev Block Block_Fxn

#Comm

20 80.4 45 45 -1 0.05 2 0 0 0 0 0 0 0 # SizeSel_2P_1_Comm #PEAK

-6 4.0 -6.0 -6.0 -1 0.05 -3 0 0 0 0 0 0 0 # SizeSel_2P_2_Comm #TOP:_width_of_plateau

-1 9 3.3 3.3 -1 0.05 3 0 0 0 0 0 0 0 # SizeSel_2P_3_Comm #Asc_width

-1 9 4.4 4.4 -1 0.05 -3 0 0 0 0 0 0 0 # SizeSel_2P_4_Comm #Desc_width

-999.0 9.0 -999 -999 -1 0.05 -2 0 0 0 0 0 0 0 # SizeSel_2P_5_FROT #INIT:_selectivity_at_fist_bin B

-999.0 9.0 9 9 -1 0.05 -2 0 0 0 0 0 0 0 # SizeSel_2P_6_FROT #FINAL:_selectivity_at_last_binB

#Rec

20 80.4 45 45 -1 0.05 2 0 0 0 0 0 0 0 # SizeSel_2P_1_FROTB #PEAK

-6 4.0 -6.0 -6.0 -1 0.05 -3 0 0 0 0 0 0 0 # SizeSel_2P_2_FROTB #TOP:_width_of_plateau

-1 9 3.3 3.3 -1 0.05 3 0 0 0 0 0 0 0 # SizeSel_2P_3_FROTB #Asc_width

-8.5 6.0 4.4 4.4 -1 0.05 -3 0 0 0 0 0 0 0 # SizeSel_2P_4_FROTB #Desc_width

-999.0 9.0 -999 -999 -1 0.05 -2 0 0 0 0 0 0 0 # SizeSel_2P_5_FROTB #INIT:_selectivity_at_fist_bin B

-999.0 9.0 9 9 -1 0.05 -2 0 0 0 0 0 0 0 # SizeSel_2P_6_FROTB #FINAL:_selectivity_at_last_binB

#_Cond 0 #_custom_sel-env_setup (0/1)

#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no enviro fxns

#_custom_sel-blk_setup (0/1)

#_Cond No selex parm trends

#_Cond -4 # placeholder for selparm_Dev_Phase

#_env/block/dev_adjust_method (1=standard; 2=logistic trans to keep in base parm bounds; 3=standard w/ no bound check)

#

Tag loss and Tag reporting parameters go next

0 # TG_custom: 0=no read; 1=read if tags exist

#_Cond -6 6 1 1 2 0.01 -4 0 0 0 0 0 0 0 #_placeholder if no parameters

##FROTB%FRMWT%FRNets%FRLines%FROther%FRRecFish%SPOther%CPUE-index

1 #_Variance_adjustments_to_input_values

#_fleet/svy: 1 2 3

0 0 0 #_add_to_survey_CV

0 0 0 #_add_to_discard_stddev

0 0 0 #_add_to_bodywt_CV

0.829886 1 1 #_mult_by_lencomp_N

0.089975 1 1 #_mult_by_agecomp_N

1 1 1 #_mult_by_size-at-age_N

#

2 #_maxlambdaphase

1 #_sd_offset

#

0 # number of changes to make to default Lambdas (default value is 1.0)

Like_comp codes: 1=surv; 2=disc; 3=mnwt; 4=length; 5=age; 6=SizeFreq; 7=sizeage; 8=catch;

9=init_equ_catch; 10=recrdev; 11=parm_prior; 12=parm_dev; 13=CrashPen; 14=Morphcomp; 15=Tag-comp; 16=Tag-negbin

#like_comp fleet/survey phase value sizefreq_method

5 1 1 0.1 1 #_RDM reduce emphasis on age comp and wt-at-age by 10x

5 2 1 0.1 1

5 3 1 0.1 1

5 4 1 0.1 1

7 1 1 0.1 1

7 2 1 0.1 1

7 3 1 0.1 1

7 4 1 0.1 1

#

lambdas (for info only; columns are phases)

0 0 0 0 #_CPUE/survey:_1

1 1 1 1 #_CPUE/survey:_2

1 1 1 1 #_CPUE/survey:_3

1 1 1 1 #_lencomp:_1

1 1 1 1 #_lencomp:_2

0 0 0 0 #_lencomp:_3

1 1 1 1 #_agecomp:_1

1 1 1 1 #_agecomp:_2

0 0 0 0 #_agecomp:_3

1 1 1 1 #_size-age:_1

1 1 1 1 #_size-age:_2

0 0 0 0 #_size-age:_3

1 1 1 1 #_init_equ_catch

1 1 1 1 #_recruitments

1 1 1 1 #_parameter-priors

1 1 1 1 #_parameter-dev-vectors

1 1 1 1 #_crashPenLambda

0 # (0/1) read specs for more stddev reporting

1 1 -1 5 1 5 1 -1 5 # selex type, len/age, year, N selex bins, Growth pattern, N growth ages, NatAge_area(-1 for all), NatAge_yr, N Natages

5 15 25 35 43 # vector with selex std bin picks (-1 in first bin to self-generate)

1 2 14 26 40 # vector with growth std bin picks (-1 in first bin to self-generate)

1 2 14 26 40 # vector with NatAge std bin picks (-1 in first bin to self-generate)

999

SS3 control file

#C data file created using the SS_writedat function in the R package r4ss

#C should work with SS version:

#C file write time: 2018-04-09 15:43:16

#

1985 #_styr

2017 #_endyr

1 #_nseas

12 #_months_per_seas

1 #_spawn_seas

2 #_Nfleet

1 #_Nsurveys

1 #_N_areas

Comm%Rec%LPUE #_fleetnames

-1 -1 -1 #_surveytiming_in_season

1 1 1 #_area_assignments_for_each_fishery_and_survey

1 1 #_units of catch: 1=bio; 2=num

0.1 0.1 #_se of log(catch) only used for init_eq_catch and for Fmethod 2 and 3

1 #_Ngenders

20 #_Nages

2125 1410 #_init_equil_catch_for_each_fishery

33 #_N_lines_of_catch_to_read

#_Comm Rec year seas

3420 1431.2399 1985 1

3549 1383.5521 1986 1

3417 1349.9494 1987 1

3217 1330.7479 1988 1

3144 1322.8046 1989 1

2621 1331.0681 1990 1

2734 1341.8414 1991 1

2709 1337.6787 1992 1

```
  2552 1317.3367 1993    1
  2668 1277.3742 1994    1
  2492 1215.4993 1995    1
  2402 1147.1736 1996    1
  2358 1089.3784 1997    1
  2231 1079.3955 1998    1
  2091 1123.9005 1999    1
  2362 1216.7399 2000    1
  2306 1295.1030 2001    1
  2392 1350.0833 2002    1
  2616 1380.0698 2003    1
  2380 1395.2080 2004    1
  2796 1407.6398 2005    1
  2875 1426.7797 2006    1
  2751 1447.5792 2007    1
  2745 1461.4891 2008    1
  2278 1451.3784 2009    1
  2229 1430.0000 2010    1
  2575 1392.4568 2011    1
  2549 1341.1073 2012    1
  2685  874.9097 2013    1
  2991  818.6358 2014    1
  2264  768.7657 2015    1
  2252  732.7570 2016    1
  2295  712.7570 2017    1
17 #_N_cpue
 #_Fleet Units Errtype
     1    1     0
     2    1     0
     3    1     0
 #_year seas index      obs se_log
```

2001	1	3	0.9279832	0.05
2002	1	3	1.0274510	0.05
2003	1	3	1.3462521	0.05
2004	1	3	1.3669888	0.05
2005	1	3	1.2413025	0.05
2006	1	3	1.3258824	0.05
2007	1	3	1.1774006	0.05
2008	1	3	1.2075574	0.05
2009	1	3	1.0000000	0.05
2010	1	3	0.9815574	0.05
2011	1	3	1.2624538	0.05
2012	1	3	1.2862521	0.05
2013	1	3	1.1969608	0.05
2014	1	3	1.0384118	0.05
2015	1	3	0.8974790	0.05
2016	1	3	0.6576134	0.05
2017	1	3	1.0180700	0.05

0 #_N_discard_fleets

#_discard_units (1=same_as_catchunits(bio/num); 2=fraction; 3=numbers)

#_discard_errtype: >0 for DF of T-dist(read CV below); 0 for normal with CV; -1 for normal with se; -2 for lognormal

0 #_N_discard

0 #_N_meanbodywt

30 #_DF_for_meanbodywt_T-distribution_like

2 # length bin method: 1=use databins; 2=generate from binwidth,min,max below; 3=read vector

2 # binwidth for population size comp

6 # minimum size in the population (lower edge of first bin and size at age 0.00)

96 # maximum size in the population (lower edge of last bin)

-0.001 #_comp_tail_compression

1e-07 #_add_to_comp

0 #_combine males into females at or below this bin number

42 #_N_lbins

#_lbin_vector

14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94 96

19 #_N_Length_comp_observations

#_Yr Seas FltSvy Gender Part Nsamp l14 l16 l18 l20 l22 l24 l26 l28 l30 l32 l34 l36 l38 l40 l42 l44 l46 l48 l50 l52 l54 l56 l58 l60 l62 l64 l66 l68 l70 l72 l74 l76 l78 l80 l82 l84 l86 l88 l90 l92 l94 l96

2000 1 1 0 2 64 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.00 0.00000 2880.6160 45935.078 152808.48 220335.69 239160.1 286599.0 243502.6 158673.1 104186.91 71658.55 52722.97 49019.25 30042.41 38825.23 37663.68 36813.82 40636.42 15478.248 15352.052 8982.587 15588.181 16524.015 12757.4025 1570.8971 14753.3667 1629.88370 753.2115 357.62060 0.0000 0.00000 0.000 0.00000 0.0000

2001 1 1 0 2 56 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.00 0.00000 2367.3798 44146.375 79387.21 84484.63 145582.2 198129.6 222465.8 191913.0 150638.13 72993.45 62442.92 38597.04 33756.28 21942.42 18042.47 14175.65 14721.53 7940.522 7301.362 6580.313 6231.832 6005.226 642.9437 1019.3995 0.0000 1757.15120 0.0000 0.00000 0.0000 0.00000 0.000 0.00000 0.0000

2002 1 1 0 2 116 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.00 0.00000 2217.3742 64033.767 158333.67 208344.88 203219.8 160072.7 220448.6 275940.5 208063.69 95311.49 57518.93 51192.28 43569.23 35597.87 28199.75 24671.82 23594.32 12646.647 8457.892 48787.198 11862.237 32055.382 3115.8504 1103.4541 598.9841 0.00000 299.4921 0.00000 0.0000 0.00000 0.000 0.00000 0.0000

2003 1 1 0 2 151 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.00 0.00000 2171.3467 51250.887 174977.94 197448.71 223289.2 253115.2 261608.4 233459.2 258428.74 174191.31 125278.05 77151.77 66032.44 46152.56 38554.35 42296.66 16223.10 23962.189 14509.113 10024.502 7672.616 7356.215 836.7932 966.3659 544.2019 407.63180 418.3966 0.00000 0.0000 0.00000 0.000 0.00000 0.0000

2004 1 1 0 2 97 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.00 0.00000 2671.9342 42557.239 123000.97 160618.97 180252.5 205086.4 187123.9 128734.6 141156.56 108068.80 101203.03 57574.88 79654.09 41356.82 31054.03 19798.09 12940.35 13865.759 6681.104 3676.903 1918.746 3249.945 1981.8732 539.3221 539.3221 0.00000 0.0000 0.00000 0.0000 0.00000 0.000 0.00000 0.0000

2005 1 1 0 2 115 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.00 0.00000 1164.5892 55443.219 137364.81 135848.55 138312.8 148490.5 197589.8 153242.0 158238.70 165846.11 153338.67 71593.06 166532.15 71182.88 90897.29 40598.16 26529.28 22865.734 14696.354 25783.039 14940.030 14540.260 4245.2005 7154.3609 1753.3554 0.00000 291.1473 582.29461 0.0000 0.00000 0.000 0.00000 0.0000

2006 1 1 0 2 102 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.00 0.00000 2367.0183 166780.934 274898.67 278234.77 299072.4 393220.0 416833.2

191492.2 143960.09 107616.07 65599.68 46715.82 54133.76 41722.99 35770.08 38066.38
28126.09 10744.546 10103.280 14538.301 12726.773 9402.127 2831.6538 600.9166
156.2932 838.51255 181.9410 0.00000 78.1466 0.00000 198.481 0.00000 0.0000

2007 1 1 0 2 249 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.00
0.00000 812.2151 35403.089 133102.42 213251.61 214113.8 261257.3 321529.9 254983.8
184784.54 150861.83 95433.28 75099.85 71801.53 38135.41 64217.70 26022.44 96611.72
13074.550 26961.984 20777.636 10036.489 8922.491 4094.3986 1970.6327 1005.2861
532.86472 860.6264 41.08093 0.0000 0.00000 0.000 0.00000 0.0000

2008 1 1 0 2 466 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.00
0.00000 852.6931 30133.499 168970.43 250712.22 311782.8 309231.9 283237.0 203485.4
159457.08 131043.29 95910.74 88115.48 60397.92 36236.82 35442.31 58386.19 31528.26
17653.468 13267.171 16475.498 7517.035 15102.523 2321.5173 3608.5154 1224.3059
53.40678 1215.2198 0.00000 0.0000 0.00000 0.000 0.00000 0.0000

2009 1 1 0 2 364 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.00
0.00000 478.7088 10465.673 70312.86 132366.49 173051.0 199404.6 195232.9 129267.6
119587.04 91843.60 84278.27 69347.08 66240.29 42946.03 34348.93 42833.85 35155.93
26614.393 14340.414 18012.255 14898.646 6849.389 5346.9888 3597.1674 2449.4628
381.50170 344.0620 476.43606 0.0000 94.93436 0.000 0.00000 0.0000

2010 1 1 0 2 324 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.00
0.00000 1470.5349 9944.856 64016.86 103982.56 133714.3 178939.9 190658.7 159074.6
114068.60 103384.15 90955.34 61441.00 53571.80 39354.20 32033.21 31047.13 39977.90
15204.163 14524.299 27430.392 18763.584 9350.064 2568.0029 2244.8295 4723.8756
175.88996 292.6414 0.00000 3672.0156 0.00000 0.000 0.00000 0.0000

2011 1 1 0 2 373 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.00
0.00000 4833.8672 30968.928 137217.95 181185.22 213609.9 204740.9 193882.6 139659.2
157785.28 163768.38 112846.77 98995.45 64373.08 69257.62 63898.78 33605.67 42185.42
21843.610 20974.864 21369.792 13544.986 6912.131 8857.2189 4097.0426 2914.2178
1357.11677 439.9774 215.64376 846.1015 0.00000 0.000 0.00000 0.0000

2012 1 1 0 2 433 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.00
0.00000 486.1150 32037.853 145818.19 206519.28 247822.3 232390.5 183730.3 145106.8
116135.90 121439.91 107385.09 80211.84 80379.30 74905.27 45409.94 28876.93 29283.26
28578.630 22632.907 18775.452 12849.107 8490.193 6532.7035 4265.0598 3266.7446
1135.14923 373.9598 454.92221 0.0000 60.87409 0.000 68.31591 324.0767

2013 1 1 0 2 260 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.00
0.00000 906.6648 6898.542 80884.34 125220.21 157747.8 211358.8 216303.0 167782.7
140299.52 90151.14 94931.08 70884.46 74933.50 58868.63 36778.63 38472.73 49777.31
40296.686 18716.968 19089.699 8938.021 12811.394 7466.8552 8045.8338 3922.7949
1810.00766 944.0484 120.56652 0.0000 0.00000 0.000 0.00000 0.0000

2014 1 1 0 2 338 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.00
0.00000 685.9602 7423.377 70034.41 129796.64 204387.2 259965.5 241160.5 200240.1
160287.15 139274.74 107449.51 94700.07 88511.39 77066.78 68714.10 45761.73 51646.59
45282.515 35849.165 28757.337 21219.576 13188.121 9162.9937 5098.2679 3605.0520
3063.53421 1091.6076 673.41142 0.0000 139.49969 0.000 0.00000 0.0000

2015 1 1 0 2 406 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.00 0.00000 1840.6083 12103.243 76331.59 100032.25 149633.9 195459.1 183043.2 148892.9 113111.63 81404.91 74585.56 74077.14 78118.14 59730.44 46413.52 31999.62 31575.31 26571.422 19854.246 21888.236 13731.048 10620.543 5877.4243 3420.5305 1247.6312 1088.82978 385.1580 1327.46097 0.0000 0.00000 0.000 0.00000 0.0000

2016 1 1 0 2 394 0.000 0.000 0.000 0.0000 0.000 0.000 0.000 0.00 33.24201 607.3719 16030.098 138248.96 151184.10 153494.6 171179.8 163230.5 130766.2 106280.40 89395.19 83848.22 67969.91 63719.87 56807.80 47697.33 40976.64 34246.04 30679.586 26004.028 18351.000 11375.025 8205.115 2778.7961 8262.4545 2076.5885 1789.96835 182.8707 505.63244 0.0000 0.00000 0.000 0.00000 0.0000

2017 1 1 0 2 447 0.000 0.000 0.000 322.4597 0.000 0.000 0.000 0.00 0.00000 108.3776 3024.805 29792.31 111825.48 126008.0 161278.1 149349.5 139217.6 87973.89 58592.50 44959.03 44766.27 43567.95 28037.16 29087.70 22712.89 21925.51 27472.327 13885.842 11465.614 9530.569 9448.126 3275.8418 3403.5207 1826.9066 946.99782 453.5681 0.00000 0.0000 0.00000 0.000 0.00000 0.0000

2010 1 2 0 0 100 1396.693 980.001 4062.675 4358.4690 8878.725 5606.782 3648.191 53171.41 9245.97974 17654.9961 45965.322 60090.19 87036.03 160835.3 107496.8 103035.0 99173.4 50706.71 78590.41 46559.84 36314.94 55229.99 35978.15 52400.21 19774.02 17552.75 16580.729 7671.649 12968.333 10542.023 5908.419 0.0000 3718.4939 0.0000 0.00000 0.0000 0.00000 0.0000 0.00000 0.000 0.00000 0.0000

17 #_N_agebins

#_agebin_vector

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

1 #_N_ageerror_definitions

#_age0 age1 age2 age3 age4 age5 age6 age7 age8 age9 age10 age11 age12 age13 age14 age15 age16 age17 age18 age19 age20

0.50 1.50 2.50 3.50 4.50 5.50 6.50 7.50 8.50 9.50 10.50 11.50 12.50 13.50 14.50 15.50 16.50 17.50 18.50 19.50 20.50

0.05 0.15 0.25 0.35 0.45 0.55 0.65 0.75 0.85 0.95 1.05 1.15 1.25 1.35 1.45 1.55 1.65 1.75 1.85 1.95 2.05

279 #_N_agecomp

3 #_Lbin_method: 1=poplenbins; 2=datalenbins; 3=lengths

0 #_combine males into females at or below this bin number

#_Yr Seas FltSvy Gender Part Ageerr Lbin_lo Lbin_hi Nsamp a0 a1 a2 a3 a4 a5 a6 a7 a8 a9 a10 a11 a12 a13 a14 a15 a16

2008 1 1 0 2 1 38 38 2 0 0 0.0000 0.0000 2.0000 0.00 0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2008 1 1 0 2 1 40 40 6 0 0 0.0000 0.0000 2.0000 3.00
1.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2008 1 1 0 2 1 42 42 6 0 0 0.0000 0.0000 5.0000 1.00
0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2008 1 1 0 2 1 44 44 6 0 0 0.0000 0.0000 1.0000 3.00
2.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2008 1 1 0 2 1 46 46 6 0 0 0.0000 0.0000 0.0000 6.00
0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2008 1 1 0 2 1 48 48 6 0 0 0.0000 0.0000 0.0000 1.00
5.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2008 1 1 0 2 1 50 50 6 0 0 0.0000 0.0000 0.0000 1.00
2.0 3.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2008 1 1 0 2 1 52 52 6 0 0 0.0000 0.0000 0.0000 0.00
1.0 3.0 2.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2008 1 1 0 2 1 54 54 5 0 0 0.0000 0.0000 0.0000 0.00
0.0 2.0 1.0 2.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2008 1 1 0 2 1 56 56 6 0 0 0.0000 0.0000 0.0000 0.00
0.0 3.0 2.0 1.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2008 1 1 0 2 1 58 58 3 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 1.0 1.00 1.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2008 1 1 0 2 1 60 60 4 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 2.0 0.00 0.00 0.000 2.00 0.0000 0.000 0.0000 0.000

2008 1 1 0 2 1 62 62 2 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 2.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2008 1 1 0 2 1 64 64 2 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 2.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2008 1 1 0 2 1 70 70 2 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 1.0 1.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2008 1 1 0 2 1 74 74 1 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 0.00 0.000 0.00 1.0000 0.000 0.0000 0.000

2009 1 1 0 2 1 34 34 2 0 0 0.0000 0.0000 1.0000 1.00
0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2009 1 1 0 2 1 36 36 4 0 0 0.0000 0.0000 3.0000 0.00
1.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2009 1 1 0 2 1 38 38 5 0 0 0.0000 0.0000 2.0000 1.00
2.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2009 1 1 0 2 1 40 40 12 0 0 0.0000 0.0000 0.0000 7.00
5.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2009 1 1 0 2 1 42 42 8 0 0 0.0000 0.0000 0.0000 1.00
2.0 4.0 1.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2009 1 1 0 2 1 44 44 7 0 0 0.0000 0.0000 0.0000 1.00
4.0 2.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2009 1 1 0 2 1 46 46 9 0 0 0.0000 0.0000 2.0000 3.00
1.0 3.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2009 1 1 0 2 1 48 48 9 0 0 0.0000 0.0000 0.0000 0.00
5.0 3.0 1.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2009 1 1 0 2 1 50 50 8 0 0 0.0000 0.0000 0.0000 0.00
3.0 3.0 1.0 1.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2009 1 1 0 2 1 52 52 6 0 0 0.0000 0.0000 0.0000 0.00
2.0 4.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2009 1 1 0 2 1 54 54 7 0 0 0.0000 0.0000 0.0000 0.00
2.0 3.0 2.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2009 1 1 0 2 1 56 56 4 0 0 0.0000 0.0000 0.0000 0.00
0.0 3.0 0.0 1.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2009 1 1 0 2 1 58 58 7 0 0 0.0000 0.0000 0.0000 0.00
0.0 3.0 2.0 1.00 1.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2009 1 1 0 2 1 60 60 3 0 0 0.0000 0.0000 0.0000 0.00
0.0 1.0 0.0 1.00 1.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2009 1 1 0 2 1 62 62 3 0 0 0.0000 0.0000 0.0000 0.00
0.0 1.0 1.0 1.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2009 1 1 0 2 1 64 64 1 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 1.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2009 1 1 0 2 1 66 66 1 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 1.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2009 1 1 0 2 1 68 68 1 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 1.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2009 1 1 0 2 1 70 70 3 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 0.00 1.000 2.00 0.0000 0.000 0.0000 0.000

2009 1 1 0 2 1 72 72 1 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 1.000 0.0000 0.000

2009 1 1 0 2 1 74 74 1 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 1.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2009 1 1 0 2 1 80 80 1 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 0.00 0.000 1.00 0.0000 0.000 0.0000 0.000

2009 1 1 0 2 1 82 82 1 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 1.0000 0.000

2009 1 1 0 2 1 86 86 1 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 0.00 0.000 0.00 1.0000 0.000 0.0000 0.000

2010 1 1 0 2 1 34 34 9 0 0 0.0000 0.0000 7.0000 2.00
0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2010 1 1 0 2 1 36 36 12 0 0 0.0000 0.0000 6.0000 2.00
3.0 1.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2010 1 1 0 2 1 38 38 14 0 0 0.0000 0.0000 6.0000 2.00
5.0 1.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2010 1 1 0 2 1 40 40 21 0 0 0.0000 0.0000 4.0000 6.00
6.0 5.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2010 1 1 0 2 1 42 42 20 0 0 0.0000 0.0000 3.0000 1.00
9.0 7.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2010 1 1 0 2 1 44 44 24 0 0 0.0000 0.0000 0.0000 2.00
9.0 4.0 9.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2010 1 1 0 2 1 46 46 21 0 0 0.0000 0.0000 0.0000 1.00
3.0 7.0 7.0 2.00 1.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2010 1 1 0 2 1 48 48 22 0 0 0.0000 0.0000 0.0000 0.00
4.0 9.0 5.0 4.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2010 1 1 0 2 1 50 50 21 0 0 0.0000 0.0000 0.0000 0.00
3.0 7.0 6.0 4.00 1.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2010 1 1 0 2 1 52 52 18 0 0 0.0000 0.0000 0.0000 0.00
2.0 5.0 6.0 4.00 1.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2010 1 1 0 2 1 54 54 19 0 0 0.0000 0.0000 0.0000 0.00
1.0 2.0 5.0 4.00 3.00 3.000 0.00 0.0000 1.000 0.0000 0.000

2010 1 1 0 2 1 56 56 19 0 0 0.0000 0.0000 0.0000 0.00
1.0 3.0 6.0 3.00 1.00 5.000 0.00 0.0000 0.000 0.0000 0.000

2010 1 1 0 2 1 58 58 20 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 1.0 3.00 8.00 5.000 3.00 0.0000 0.000 0.0000 0.000

2010 1 1 0 2 1 60 60 13 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 2.0 2.00 4.00 4.000 1.00 0.0000 0.000 0.0000 0.000

2010 1 1 0 2 1 62 62 18 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 4.00 4.00 5.000 4.00 0.0000 0.000 0.0000 1.000

2010 1 1 0 2 1 64 64 15 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 4.00 2.000 4.00 2.0000 1.000 0.0000 2.000

2010 1 1 0 2 1 66 66 12 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 2.00 0.000 3.00 6.0000 1.000 0.0000 0.000

2010 1 1 0 2 1 68 68 4 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 1.00 0.000 1.00 0.0000 2.000 0.0000 0.000

2010 1 1 0 2 1 70 70 9 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 0.00 0.000 3.00 5.0000 1.000 0.0000 0.000

2010 1 1 0 2 1 72 72 7 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 1.00 0.000 0.00 2.0000 3.000 1.0000 0.000

2010 1 1 0 2 1 74 74 6 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 0.00 0.000 0.00 4.0000 1.000 0.0000 1.000

2010 1 1 0 2 1 76 76 4 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 0.00 1.000 0.00 1.0000 1.000 1.0000 0.000

2010 1 1 0 2 1 80 80 3 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 2.000 0.0000 1.000

2010 1 1 0 2 1 84 84 1 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 1.000 0.0000 0.000

2011 1 1 0 2 1 26 26 4 0 0 3.0000 1.0000 0.0000 0.00
0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2011 1 1 0 2 1 28 28 3 0 0 0.0000 3.0000 0.0000 0.00
0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2011 1 1 0 2 1 30 30 3 0 0 0.0000 3.0000 0.0000 0.00
0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2011 1 1 0 2 1 32 32 6 0 0 0.0000 5.0000 0.0000 1.00
0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2011 1 1 0 2 1 34 34 8 0 0 0.0000 0.0000 2.0000 2.00
4.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2011 1 1 0 2 1 36 36 31 0 0 0.0000 0.0000 1.0000 10.00
18.0 2.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2011 1 1 0 2 1 38 38 31 0 0 0.0000 0.0000 1.0000 7.00
17.0 6.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2011 1 1 0 2 1 40 40 32 0 0 0.0000 0.0000 3.0000 2.00
19.0 8.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2011 1 1 0 2 1 42 42 31 0 0 0.0000 0.0000 0.0000 1.00
12.0 16.0 2.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2011 1 1 0 2 1 44 44 39 0 0 0.0000 0.0000 0.0000 0.00
11.0 18.0 9.0 1.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2011 1 1 0 2 1 46 46 34 0 0 0.0000 0.0000 0.0000 0.00
9.0 9.0 14.0 2.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2011 1 1 0 2 1 48 48 32 0 0 0.0000 0.0000 0.0000 0.00
0.0 11.0 12.0 9.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

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0.0 7.0 6.0 13.00 1.00 0.000 0.00 0.0000 0.000 0.0000 0.000

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0.0 4.0 5.0 16.00 1.00 0.000 0.00 0.0000 0.000 0.0000 0.000

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0.0 4.0 3.0 18.00 3.00 1.000 0.00 0.0000 0.000 0.0000 0.000

2011 1 1 0 2 1 56 56 22 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 5.0 9.00 7.00 1.000 0.00 0.0000 0.000 0.0000 0.000

2011 1 1 0 2 1 58 58 20 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 2.0 6.00 10.00 2.000 0.00 0.0000 0.000 0.0000 0.000

2011 1 1 0 2 1 60 60 18 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 5.00 7.00 5.000 1.00 0.0000 0.000 0.0000 0.000

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0.0 0.0 1.0 1.00 7.00 4.000 1.00 0.0000 0.000 0.0000 0.000

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0.0 0.0 0.0 3.00 4.00 8.000 6.00 3.0000 1.000 0.0000 0.000

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0.0 0.0 0.0 0.00 1.00 6.000 7.00 5.0000 0.000 1.0000 0.000

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0.0 0.0 0.0 0.00 0.00 5.000 7.00 5.0000 0.000 0.0000 0.000

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0.0 0.0 0.0 0.00 0.00 5.000 2.00 3.0000 2.000 0.0000 0.000

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0.0 0.0 0.0 0.00 0.00 0.000 2.00 2.0000 1.000 1.0000 0.000

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0.0 0.0 0.0 0.00 0.00 3.000 2.00 0.0000 2.000 0.0000 0.000

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0.0 0.0 0.0 0.00 0.00 0.000 0.00 2.0000 2.000 2.0000 0.000

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0.0 0.0 0.0 0.00 0.00 0.000 1.00 1.0000 0.000 1.0000 0.000

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0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 1.000 1.0000 1.000

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0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 1.0000 1.000

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12.0 24.0 1.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

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5.0 38.0 3.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

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3.0 23.0 14.0 1.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

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0.0 17.0 15.0 4.00 1.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2012 1 1 0 2 1 48 48 35 0 0 0.0000 0.0000 0.0000 0.00
1.0 14.0 13.0 6.00 1.00 0.000 0.00 0.0000 0.000 0.0000 0.000

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0.0 0.0 0.0 6.00 9.00 4.000 0.00 0.0000 0.000 0.0000 0.000

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0.0 0.0 4.0 2.00 12.00 5.000 4.00 1.0000 0.000 0.0000 0.000

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0.0 0.0 0.0 3.00 4.00 6.000 9.00 0.0000 0.000 0.0000 0.000

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0.0 0.0 0.0 0.00 3.00 2.000 0.00 5.0000 4.000 0.0000 0.000

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0.0 0.0 0.0 1.00 3.00 2.000 7.00 2.0000 1.000 1.0000 0.000

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0.0 0.0 0.0 0.00 0.00 3.000 5.00 4.0000 1.000 1.0000 0.000

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0.0 0.0 0.0 0.00 0.00 2.000 6.00 0.0000 1.000 0.0000 0.000

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0.0 0.0 0.0 0.00 0.00 1.000 1.00 1.0000 4.000 1.0000 0.000

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0.0 0.0 0.0 0.00 0.00 0.000 0.00 1.0000 3.000 2.0000 0.000

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0.0 0.0 0.0 0.00 0.00 0.000 0.00 1.0000 2.000 1.0000 0.000

2012 1 1 0 2 1 80 80 5 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 1.000 0.0000 4.000

2012 1 1 0 2 1 82 82 1 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 1.000

2012 1 1 0 2 1 84 84 2 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 0.00 0.000 0.00 1.0000 1.000 0.0000 0.000

2013 1 1 0 2 1 34 34 5 0 0 0.0000 0.0000 0.0000 4.00
1.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2013 1 1 0 2 1 36 36 42 0 0 0.0000 0.0000 0.0000 18.00
21.0 3.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2013 1 1 0 2 1 38 38 61 0 0 0.0000 0.0000 0.0000 9.00
30.0 22.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2013 1 1 0 2 1 40 40 52 0 0 0.0000 0.0000 0.0000 1.00
20.0 28.0 3.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2013 1 1 0 2 1 42 42 50 0 0 0.0000 0.0000 0.0000 0.00
8.0 38.0 4.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2013 1 1 0 2 1 44 44 57 0 0 0.0000 0.0000 0.0000 0.00
1.0 31.0 22.0 3.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2013 1 1 0 2 1 46 46 54 0 0 0.0000 0.0000 0.0000 0.00
1.0 31.0 16.0 6.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

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0.0 12.0 33.0 9.00 1.00 0.000 0.00 0.0000 0.000 0.0000 0.000

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0.0 7.0 23.0 19.00 7.00 0.000 0.00 0.0000 0.000 0.0000 0.000

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0.0 0.0 0.0 0.00 6.00 17.000 5.00 0.0000 1.000 0.0000 0.000

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0.0 0.0 1.0 0.00 0.00 3.000 9.00 6.0000 4.000 0.0000 0.000

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0.0 0.0 0.0 0.00 0.00 0.000 3.00 6.0000 2.000 0.0000 0.000

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0.0 0.0 0.0 0.00 0.00 0.000 2.00 4.0000 5.000 0.0000 0.000

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0.0 0.0 0.0 0.00 0.00 0.000 1.00 2.0000 3.000 2.0000 0.000

2013 1 1 0 2 1 78 78 6 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 2.000 3.0000 1.000

2013 1 1 0 2 1 80 80 4 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 1.000 1.0000 2.000

2013 1 1 0 2 1 82 82 1 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 1.000

2014 1 1 0 2 1 34 34 7 0 0 0.0000 0.0000 2.0000 4.00
1.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2014 1 1 0 2 1 36 36 43 0 0 0.0000 0.0000 1.0000 15.00
26.0 1.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2014 1 1 0 2 1 38 38 58 0 0 0.0000 0.0000 0.0000 10.00
46.0 2.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2014 1 1 0 2 1 40 40 49 0 0 0.0000 0.0000 0.0000 2.00
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33.0 15.0 4.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2014 1 1 0 2 1 44 44 53 0 0 0.0000 0.0000 0.0000 1.00
16.0 30.0 6.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2014 1 1 0 2 1 46 46 51 0 0 0.0000 0.0000 0.0000 2.00
8.0 27.0 14.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2014 1 1 0 2 1 48 48 44 0 0 0.0000 0.0000 0.0000 0.00
1.0 7.0 24.0 12.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

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1.0 6.0 20.0 21.00 1.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2014 1 1 0 2 1 52 52 36 0 0 0.0000 0.0000 0.0000 0.00
0.0 4.0 10.0 19.00 3.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2014 1 1 0 2 1 54 54 32 0 0 0.0000 0.0000 0.0000 0.00
0.0 1.0 8.0 17.00 3.00 3.000 0.00 0.0000 0.000 0.0000 0.000

2014 1 1 0 2 1 56 56 35 0 0 0.0000 0.0000 0.0000 0.00
0.0 2.0 5.0 13.00 10.00 2.000 3.00 0.0000 0.000 0.0000 0.000

2014 1 1 0 2 1 58 58 29 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 2.0 12.00 7.00 8.000 0.00 0.0000 0.000 0.0000 0.000

2014 1 1 0 2 1 60 60 31 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 1.0 8.00 10.00 7.000 5.00 0.0000 0.000 0.0000 0.000

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0.0 0.0 1.0 5.00 8.00 11.000 4.00 0.0000 0.000 0.0000 0.000

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0.0 0.0 0.0 2.00 5.00 11.000 8.00 3.0000 0.000 0.0000 0.000

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0.0 0.0 0.0 0.00 1.00 5.000 9.00 3.0000 3.000 0.0000 0.000

2014 1 1 0 2 1 70 70 15 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 0.00 0.000 6.00 4.0000 5.000 0.0000 0.000

2014 1 1 0 2 1 72 72 11 0 0 0.0000 0.0000 0.0000 0.00
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2015 1 1 0 2 1 38 38 50 0 0 0.0000 0.0000 12.0000 15.00
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9.0 13.0 13.0 1.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

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0.0 5.0 9.0 8.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

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2015 1 1 0 2 1 78 78 1 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 0.0 0.00 0.00 0.000 1.00 0.0000 0.000 0.0000 0.000

2015 1 1 0 2 1 80 80 1 0 0 0.0000 0.0000 0.0000 0.00
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-2016 1 1 0 2 1 6 6 2 2 0 0.0000 0.0000 0.0000 0.00 0.0
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-2016 1 1 0 2 1 8 8 3 3 0 0.0000 0.0000 0.0000 0.00 0.0
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-2016 1 1 0 2 1 12 12 35 4 31 0.0000 0.0000 0.0000 0.00
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-2016 1 1 0 2 1 14 14 7 0 7 0.0000 0.0000 0.0000 0.00
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-2016 1 1 0 2 1 20 20 23 0 3 19.0000 1.0000 0.0000 0.00
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0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

-2016 1 1 0 2 1 24 24 30 0 0 17.0000 13.0000 0.0000 0.00
0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

-2016 1 1 0 2 1 26 26 35 0 0 13.0000 22.0000 0.0000 0.00
0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

-2016 1 1 0 2 1 28 28 25 0 0 5.0000 19.0000 0.0000 1.00
0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

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0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

-2016 1 1 0 2 1 32 32 44 0 0 0.0000 21.0000 2.0000 20.00
1.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2016 1 1 0 2 1 34 34 31 0 0 0.0000 6.0000 9.0000 11.00
5.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2016 1 1 0 2 1 36 36 61 0 0 0.0000 7.0000 15.0000 24.00
15.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2016 1 1 0 2 1 38 38 64 0 0 0.0000 1.0000 7.0000 31.00
23.0 2.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2016 1 1 0 2 1 40 40 59 0 0 0.0000 1.0000 5.0000 19.00
30.0 4.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2016 1 1 0 2 1 42 42 61 0 0 0.0000 1.0000 2.0000 15.00
28.0 14.0 1.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2016 1 1 0 2 1 44 44 64 0 0 0.0000 0.0000 3.0000 9.00
23.0 22.0 7.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

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16.0 32.0 3.0 0.00 1.00 0.000 0.00 0.0000 0.000 0.0000 0.000

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9.0 18.0 25.0 7.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

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2.0 9.0 34.0 12.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2016 1 1 0 2 1 52 52 60 0 0 0.0000 0.0000 0.0000 0.00
1.0 13.0 29.0 14.00 3.00 0.000 0.00 0.0000 0.000 0.0000 0.000

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0.0 3.0 20.0 24.00 11.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2016 1 1 0 2 1 56 56 52 0 0 0.0000 0.0000 0.0000 0.00
2.0 1.0 5.0 30.00 10.00 3.000 1.00 0.0000 0.000 0.0000 0.000

2016 1 1 0 2 1 58 58 49 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 2.0 19.00 20.00 5.000 3.00 0.0000 0.000 0.0000 0.000

2016 1 1 0 2 1 60 60 51 0 0 0.0000 0.0000 0.0000 0.00
0.0 0.0 2.0 9.00 25.00 11.000 0.00 2.0000 2.000 0.0000 0.000

2016 1 1 0 2 1 62 62 37 0 0 0.0000 0.0000 0.0000 0.00
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2016 1 1 0 2 1 64 64 27 0 0 0.0000 0.0000 0.0000 0.00
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2016 1 1 0 2 1 72 72 11 0 0 0.0000 0.0000 0.0000 0.00
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2016 1 1 0 2 1 74 74 10 0 0 0.0000 0.0000 0.0000 0.00
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2016 1 1 0 2 1 78 78 4 0 0 0.0000 0.0000 0.0000 0.00
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2017 1 1 0 2 1 12 12 2 0 2 0.0000 0.0000 0.0000 0.00
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2017 1 1 0 2 1 14 14 14 0 14 0.0000 0.0000 0.0000 0.00
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2017 1 1 0 2 1 16 16 8 0 8 0.0000 0.0000 0.0000 0.00
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0.0 0.0 0.0 0.00 0.00 0.000 0.00 0.0000 0.000 0.0000 0.000

2017 1 1 0 2 1 26 26 12 0 0 0.0000 12.0000 0.0000 0.00
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2017 1 1 0 2 1 28 28 10 0 0 0.0000 10.0000 0.0000 0.00
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2008 1 -1 0 0 1 -1 -1 83 0 0 0.0000 0.0000 659539.2490 600950.63
338923.2 178922.2 107763.8 155543.65 12078.94 10306.880 28028.03 27915.0813
2505.678 2505.6782 8422.965

2009 1 -1 0 0 1 -1 -1 113 0 0 159.5696 159.5696 139799.7915
228557.74 467190.1 452595.0 102904.6 59903.26 93695.52 6004.085 14457.63 476.4361
14898.646 381.5017 9383.153

2010 1 -1 0 0 1 -1 -1 339 0 0 0.0000 490.1783 137107.8251
98838.56 317758.2 313346.4 250285.3 114918.55 82075.69 58090.566 42502.94
40407.9756 31159.687 3322.5127 16280.932

2011 1 -1 0 0 1 -1 -1 504 0 0 0.0000 4028.2226 38039.2283
113679.68 492257.9 457161.7 266919.1 339628.82 125252.03 78704.645 43774.01
30867.7612 13405.253 9317.7297 3151.687

2012 1 -1 0 0 1 -1 -1 536 0 0 0.0000 162.0384 162.0384 40484.00
325821.9 750933.5 249638.8 260047.42 167133.65 74075.626 54154.51 26919.2578
24579.964 6977.5581 4656.734

2013 1 -1 0 0 1 -1 -1 823 0 0 0.0000 0.0000 302.2216 61994.50
205099.3 571156.2 333016.7 215525.02 137519.52 99204.966 51295.89 33438.4193
22761.759 6870.3295 6176.992

2014 1 -1 0 0 1 -1 -1 727 0 0 0.0000 228.6534 3978.3252 76930.02
589930.8 409732.3 321441.4 304372.54 118200.53 110344.896 97713.36 28984.0978
34630.939 8967.0458 8781.901

2015 1 -1 0 0 1 -1 -1 602 0 0 0.0000 613.5361 112118.1032
156460.99 328730.8 363403.4 192173.4 187671.81 89240.26 54539.797 38397.66
13857.9942 2655.136 9241.8872 15260.821

2016 1 -1 0 0 1 -1 -1 1053 0 0 0.0000 27946.4234 89258.8723
254298.91 368054.8 254533.9 197610.7 147468.15 109824.68 59033.793 54400.46
33503.6024 13854.360 5554.6308 6029.000

2017 1 -1 0 0 1 -1 -1 335 0 0 0.0000 6594.0453 40668.5407
161225.30 289219.2 235707.5 120565.8 78451.32 53343.52 41669.593 33832.19
39142.2318 0.000 0.0000 0.000

0 #_N_MeanSize_at_Age_obs

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0 #_N_environ_obs

0 #_N_sizefreq_methods

0 #_do_tags

0 #_morphcomp_data

#

999