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Report of the Data Evaluation meeting for the Benchmark Workshop on Sea Bass (DEWKBASS)

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International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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H. C. Andersens Boulevard 44–46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

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Executive summary

WKBASS is a three-part benchmark workshop aimed at improving the scientific advice on sea bass (*Dicentrarchus labrax*) stocks in the Bay of Biscay (BSS-8.ab: ICES areas 8.a,b) and in the North Sea, Channel, Celtic Sea and Irish Sea (BSS-47: ICES areas 4.b,c and 7.a, d–h). This report is of the first workshop which focused on the compilation and evaluation of data available for use by the assessment workshop. The workshop, at ICES HQ, was attended physically and remotely by six scientists from France and the UK, and by the ICES secretariat. The data compilation and evaluation was done in January 2017, followed by assessment workshops in February 2017 and February 2018. There were concerns following the first assessment workshop in February 2017, so the methodology was finalised at the second assessment workshop in February 2018. As a result, additional data and analyses were available at the second assessment workshop, but this report reflects the evaluation of data in January 2017. Any additional data or changes to the way that the data were compiled and used for the second assessment workshop in February 2018, are captured in the WKBASS assessment report.

The Biscay stock has not previously been benchmarked. WKBASS compiled and reviewed all available information and data relevant to the assessment, including: the history of fishery management measures; biological parameters (growth, maturity, natural mortality); commercial and recreational fisheries catch and length/age compositions; survival of released fish; fishery selectivity patterns; relative abundance indices; and environmental drivers. Data quality indicators such as coefficients of variation or numbers of primary sampling units, where available, were tabulated.

WKBASS identified the most appropriate data and compiled these in a form suitable for use in assessment models, with particular focus on use of the Stock Synthesis integrated modelling framework. Candidate values for age-dependent natural mortality (M) were reviewed using published life-history based methods, using the Lorenzen (1996) method to infer age-dependence in younger fish and maximum observed age to scale the M vector to appropriate values for older sea bass. A fishery-dependent landings-per-unit-of-effort (lpue) series of relative abundance indices was derived starting in 2000, using generalized linear modelling (GLM) of trip-based data for over 1000 French vessels within selected ICES rectangles and gear types covering the sea bass fishery. This provided lpue series for French vessels fishing on the BSS-47 stock in the Celtic Sea, Channel, and southern North Sea as well.

For the BSS-47 stock, the main focus of WKBASS is the evaluation of biological reference points such as F_{MSY} and MSY-$B_{trigger}$, as this was not completed in the most recent inter-benchmark (IBPBASS in 2016). Many of the datasets and parameters for this stock have been thoroughly reviewed in the previous inter-benchmarks, and WKBASS did not revisit these unless it was relevant to biological reference points (e.g. natural mortality values) or for addressing issues that may arise with the current assessment formulation such as impacts of new management measures in 2015 and 2016 which will impact the formulation of the model and forecasts.

Recreational fishery survey data were reviewed and updated with new data from the Netherlands, and the French survey data collected in 2011/2012 were disaggregated to give separate estimates for areas 7 and 8. WKBASS considered ways in which the changes in management measures for the BSS-47 stock in 2015 and 2016 (increased minimum conservation reference size from 36–42 cm and imposition of recreational fishery bag limits) could be dealt with in the update assessment for this stock in 2017. Information on post-release mortality of recreational-caught sea bass was compiled

from the limited studies available. WKBASS reviewed progress on compilation of evidence on stock structure in Areas 4, 7 and 8 from ongoing tagging and genetics studies, to be submitted in a working document to the second (assessment) workshop.

1 Introduction

WKBASS is a three-part benchmark workshop aimed at improving the scientific advice on sea bass (*Dicentrarchus labrax*) stocks in the Bay of Biscay (BSS-8.ab: ICES areas 8.a,b) and in the North Sea, Channel, Celtic Sea and Irish Sea (BSS-47: ICES areas 4.b,c and 7.a, d–h). This report is of the first workshop which focused on the compilation and evaluation of data available for the assessment. The data compilation and evaluation was done in January 2017, followed by assessment workshops in February 2017 and February 2018. There were concerns following the first assessment workshop in February 2017, so the methodology was finalised at the second assessment workshop in February 2018. As a result, additional data and analyses were available at the second assessment workshop, but this report reflects the evaluation of data in January 2017. Any additional data or changes to the way that the data were compiled and used for the second assessment workshop in February 2018 are captured in the WKBASS assessment report.

The Biscay stock has not previously been benchmarked, whereas the BSS-47 stock has had a series of inter-benchmark procedures which have focused on progressive development of an application of the integrated statistical assessment framework model Stock Synthesis (Table 1.1). The Stock Synthesis approach was chosen to deal with the types of data available, which have variable coverage over years.

For the BSS-47 stock, the main focus of WKBASS was the evaluation of biological reference points such as F_{MSY} and MSY-$B_{trigger}$, as this was not completed in the most recent inter-benchmark (IBPBASS2: 2016). Many of the datasets and parameters for this stock have been thoroughly reviewed in the previous inter-benchmarks, and WKBASS did not revisit these unless it was relevant to biological reference points (e.g. natural mortality values) or for addressing issues that may arise with the current assessment formulation such as impacts of new management measures in 2015 and 2016 which will impact the formulation of the model and forecasts. These are addressed in Section 3 of this report.

As the Biscay stock had not previously been benchmarked, WKBASS reviewed all available datasets, identified the most appropriate data and compiled these in a form suitable for use in assessment models (with particular focus on Stock Synthesis), advised on the quality of the data, and proposed candidate values of key parameters for natural mortality, growth and maturity. The data evaluation for this stock is given in Section 4.

The general Terms of Reference (ToRs) for WKBASS, and the detailed ToRs for the data workshop, are given in Annex 1. The detailed ToRs follow the guidelines for benchmark data evaluation workshops developed by the ICES Planning Group on data Needs for Assessments and Advice (PGDATA: ICES 2015b), which provides detailed guidance on work needed to be completed under each ToR. A detailed agenda for the meeting was drawn up well in advance of the meeting, and is located on SharePoint. Time slots were allocated under each Term of Reference for each stock. The participants at the meeting are in Annex 2.

Two skype meetings were also held in 2016 to plan the work, identify responsibilities and record progress. At the first skype meeting, there was extended discussion on current projects in France (BARGIP), UK (C-Bass) and Ireland aimed at improving the understanding of stock structure and movements of bass within and between the present management units. It was agreed that a working document would be developed by the laboratories involved in these studies, to summarise results from the ongoing electronic tagging studies, genetics, and modelling of egg/larva drift, and presented at the WKBASS benchmark assessment meeting in February 2017. The assessment workshop would then consider the implications for the stock assessments and identify a longer term programme of work needed to alter the assessment procedures and spatial scales for data aggregation if the current stock units are deemed to be inappropriate as a basis for stock assessment and developing management advice. A ToR was added to the data workshop to obtain a progress update on preparation of this Working Document.

The WKBASS team included several external expert reviewers appointed to help in developing the stock assessments and to provide an expert review of the process and outcomes, and to provide advice on future development needs. Although they were not involved in the data workshop, Section 2 of this report includes their comments on the work done and recommendations made by the data evaluation team in Sections 3 and 4 of the report.

Table 1.1. History of benchmark and update assessments for sea bass in areas 4.b,c and 7.a,d–h.

Meeting	Year	Assessment	Changes made to data and assessment procedure
IBPNEW	2012	Stock Synthesis (Comparative ASAP combined fleet run)	New model development: no recreational fishery data included; separate selectivity parameters for UK otter trawl, nets, lines, midwater trawl and French all gears (all fleets asymptotic selectivity); age composition data for UK fleets; length data for French fleet; survey tuning data - UK Solent survey (age 2–4) in spring and autumn; UK Thames survey (age 0–3). M=0.2 all ages. Trends-only assessment.
WGCSE	2013	WGNEW SS3 update assessment with some adjustments	1st year for recruitment deviations changed to 1965 from 1980; length rather than age compositions used for UK midwater fleet, with pre-1996 data excluded; UK trawls, nets and lines combined as one fleet (all fleet still asymptotic). Trends-only assessment
IBPBASS1	2014	SS3 model with adjustments	Channel groundfish survey index series and length compositions added, with domed selectivity; UK Solent (spring) and Thames survey removed; UK trawl/nets/lines fleet with domed selectivity; revision to input sample sizes for composition data; add a constant recreational F (0.07) that gives annual rec landings of 1500 t in 2012 with same asymptotic selectivity as UK commercial lines (Rec F added to M in assessment); true M reduced from 0.2 to 0.15 based on life-history correlates; plus-group increased from 14+ to 16+; UK midwater fleet age compositions reintroduced (1996 on); category 1 assessment, now with short-term forecast using MSY approach. Fmsy from SPR35%.
WGCSE	2014, 2015	IBPBASS1 SS3 assessment	Update assessment according to stock annex
IBPBASS2	2016	SS3 model with adjustments	Recreational F no longer included with M, landings series estimated that gives constant recreational F in initial model iterations, then entered into the model as a landings series. UK lines fleet modelled as separate fleet and not in a trawls/lines/nets complex; recreational fishery selectivity mirrored with UK commercial lines; Solent survey entered as aggregate age 2–4 index with separate age compositions and length-based selectivity estimated; Solent survey variance inflator applied; Channel groundfish survey data in 2015 removed due to vessel/design change pending review; Francis method used for iteratively adjusting weights applied to composition data using fleet lambda values; length at maximum age fixed at age 20 rather than von Bertalanffy growth function L infinity; and length and age data included for UK and French commercial fleets with length-based selectivity (French age data used for first time).
WGCSE	2016	IBPBASS2 update assessment	None
WKBASS	2017	Current report	

2 External Experts comments on sea bass stock assessments reviewed at WKBASS 2017

The Panel of the External Experts evaluated the data and modelling approaches used for assessments of sea bass stock in central and southern North Sea, Irish Sea, English Channel and Celtic Sea (Divisions 4.b–c, 7.a, and 7.d–h) and sea bass stock in Bay of Biscay (Divisions 8.a,b). The Panel was presented with sets of stock specific issues and made recommendations regarding these issues for each stock.

2.1 Issues and recommendations sea bass stock in central and southern North Sea, Irish Sea, English Channel and Celtic Sea (Divisions 4.b–c, 7.a, and 7.d–h)

1) Fisheries landings and discards

In the model, commercial catches are divided among several fleets that include UK bottom trawl and nets, UK lines, UK midwater trawl, French fleet (all gears combined) and "others" (i.e. all remaining fleets). For two fleets, recent discard data are used to model discard amount for the entire modelling period and length composition data from discarded catch are used to estimate retention curves. The Panel agreed that the model was able to fit the annual discard amounts for both fleets reasonably well, and fits to discarded length compositions were also reasonable. The Panel also agreed that including discard separately from landings (a new feature in this model) enabled a more accurate description of the impact of the fishery upon the stock, and evaluate more complete evaluation of the effectiveness of management measures imposed on this stock.

For the historical period, catches of the French fleet were reported for all gears combined, and in the assessment model, the French fleet included catches from all gears combined. However, landings are available separated by gear group within the French fleet since 2011. Given that selectivity of different gear types is different, the Panel recommended that fleets would be defined based on gear types rather than countries for the next assessment (e.g. the French fleet).

2) Fishery composition data and selectivity

The Panel reviewed the size composition data and the selectivity assumptions used in the model. The model uses marginal length and age compositional data for fleets when both types of data are available, but set the emphasis factors (lambda) for the length and age compositions for fleets with both types of data to 0.5 (instead of 1) to minimize overall negative log likelihood and alleviate a "double counting" concern (since lambda values are being multiplied in the model by the corresponding likelihood component).

The Panel agreed that using marginal age composition is appropriate to the current model, but for the next assessment, recommended to use a conditional age-at-length approach to incorporate age data along with length compositions; this is now a common practice within SS. In the conditional age-at-length approach, individual length and age observations are arranged in an age–length key matrix), with age across the columns and length down the rows. Using conditional age distributions for each length bin allows only the additional information from age data to be captured, without creating a "double-counting" of the data in the total likelihood. This approach also allows estimation of all growth parameters within the stock assessment model, including the CV of length at young age and the CV at old age (which is only possible if based on age-composition (or length) observations for which very strong and well-separated cohorts exist). At the present, all growth parameters in the assessment model are fixed as estimated outside the model.

The Panel evaluated selectivity assumptions for each of the fleet and explored a variety of blocking schemes to reflect changes in fisheries and to improve model fit to compositional data. The Panel concluded that the base model agreed upon at the end of the meeting exhibit good fits to length and age composition data and estimated selectivity curves reflect current knowledge of fisheries and how they changed over time.

3) Recreational catches

Following the 2016 sea bass inter-benchmark review, recreational catches were included in the model as a separate fleet. The time-series of recreational catches were estimated via an iterative process based on a single observation of 1500 t estimated in 2012. In this process, the model was run a number of times until the estimated recreational catches in 2012 were equal to 1500 t. The fishing mortality of the recreational fleet as estimated in 2012was applied to remaining years to estimate the recreational catches for the rest of the time-series. However, the time-series of recreational catches for the base model were recalculated once again (using the same approach) at the WKBASS review, and then they were fixed within the model, to allow exploration of model sensitivity to other assumptions in the model.

The Panel approved the approach, and the final time-series for use in the model, but recommended to further explore recreational catches in the future assessment, and incorporate any new information that will become available. A thorough sensitivity analysis was also recommended to evaluate the impact of assumptions regarding recreational catch to model output.

The base model also utilized a new length composition data for recreational catch. These length composition data included both retained and discarded portions of the catch. The Panel reviewed the new length composition data and agreed that these data should be used to estimate selectivity of the recreational fleet (previously, the selectivity of recreational removal was "mirrored" to one of the commercial fleets). The Panel agreed that using length compositions data collected from recreational catches enables more accurate description of selectivity of this fleet and thus to model the impact of the recreational catches on the stock.

4) Relative abundance indices

Several indices of abundance were used in the model, including new landings-per-unit of effort (lpue) developed using data from the French fishery by Alain Laurec. This new index was found to be very influential, substantially stabilizing the model. The Panel discussed methods used to develop the index, and held a conference call with Alain Laurec. The Panel agreed that the use of lpue index in the model is an improvement, but recommended to provide additional diagnostics of the performance for the Generalized Linear Model used to develop the index (such additional diagnostics were requested from Alain Laurec during the conference call at the meeting).

5) Stock structure

The Panel reviewed the most recent information on sea bass stock structure. The available information does not suggest changes in the current stock boundaries. However, the sampling design and locations of tagging studies that were presented at the meeting did not cover the entire range of sea bass distribution, and as such, the relevance and utility of those results are limited. The Panel recommended to further investigate the issue in order to enable a full evaluation of connectivity among areas within the sea bass range, but agreed that at present the current (though limited) information does not present a basis for changing the current definition of stocks.

6) Biological parameters

The Panel evaluated assumptions about several life-history parameters in the model, including natural mortality and spawner-recruit steepness via profile analyses, and agreed that parameters assumed in the model are reasonable. The Panel also discussed at length multiple approaches that currently exist to inform natural mortality and agreed that the method selected for the base model (see stock annex for details) represent the best available science.

In the model, all the growth parameters are fixed at values estimated outside the model. Although these parameters were estimated based on large amount of length and age data from multiple sources, the Panel recommends pursuing estimation of the growth parameters within the model in future assessments, because doing so allows for uncertainty associated with growth parameter estimates to be propagated to the assessment results. It is also recommended to input age data as conditional age-at-length compositions so the model can reliably estimate growth parameters (as stated earlier in this report).

7) Assessment methods

The assessment uses the Stock Synthesis (SS) modelling platform (Methot and Wetzel, 2013). This is a flexible platform that allows to incorporate a variety of available information, and explore various assumptions and modelling choices regarding the stock, and the Panel recommends using this platform for this assessment.

8) Biological reference points

Biological reference points were re-evaluated by stock assessment leads following the meeting.

2.2 Issues and recommendations for sea bass stock in Bay of Biscay (divisions 8.a,b)

1) Fisheries landings and discards

In this model, fisheries catches are divided between two fleets; commercial and recreational. The Panel explored several options for fleet structure, including multiple commercial fleets that represent different gear types. Afterward, the panel agreed that combining commercial catches into one fleet was a reasonable approach, given 1) the limited amount of data to estimate selectivity curves for each separate gear and fleet, and 2) the history of the fishery, which presented relatively static proportional contributions among fisheries operating with different gear types. The length composition data used to estimate selectivity of the commercial fleet were expanded (raised) by gear and area.

The Panel also evaluated available data on discarded catch, and agreed that discards were negligible, and thus they were not modelled separately from landings.

Finally, the Panel discussed whether catch time-series (and thus modelling period) should be started in 2000 (when catch records were more reliable) or in 1985 (when catch records existed but have higher degree of uncertainty than those after 2000). The Panel agreed that incorporating all the data available and using the longer time-series of catch is the more reasonable approach since history of fishing allows to understand better the current status of the stock. The Panel recommended to evaluate uncertainty in pre-2000 catch via sensitivity analysis.

2) Tuning series

The only available index information for this assessment was based on landings-per-unit of effort (lpue), developed using data from the French fishery by Alain Laurec. The Panel discussed at length methods used to develop the index, and held a conference call with Alain Laurec. The Panel agreed that the model should use this lpue index, but recommended to provide additional diagnostics of the performance for the Generalized Linear Model used to develop the index; additional diagnostics were requested from Alain Laurec during the conference call at the meeting.

3) Recreational catches

Recreational catches were treated as a separate fleet. Catches in this fleet were adjusted to account for discard mortality of released fish. The selectivity curve for this fleet was estimated based on the data from recreational catches, and length samples from retained and released portions of the catch were expanded appropriately and combined into a single length distribution. The Panel evaluated and recommended to use this approach in the assessment.

4) Biological parameters

The Panel evaluated assumptions about several life-history parameters in the model, including natural mortality and spawner-recruit steepness via likelihood profile analyses, and agreed that parameter values assumed in the model are reasonable. The Panel also discussed at length, the multiple approaches that currently exist to inform natural mortality, and agreed that the method selected for the base model (see stock annex for details) represent the best available science.

Age data for the commercial fleet were entered as conditional age-at-length compositions, which normally enable the estimation of growth parameters within the model. However, age samples from fishery were limited and did not cover the range of ages for the stock. As a result, the model had trouble estimating length at initial age ($L\_at\_A_{min}$) and asymptotic length ($L\_at\_A_{max}$), so these parameters were fixed at levels estimated outside the model. The model was able to estimate the von Bertalanffy growth coefficient *k*, but it was later fixed at the estimated level.

The Panel agreed that given the amount the data, it is reasonable to fix growth parameters, but recommends to work towards improving age data and continue to pursue estimating growth parameters within the model.

3 Data evaluation for sea bass in ICES Area 4.b,c and 7.d, e–h

3.1 ToR 1: Record progress in production of a working document on sea bass stock structure and mixing rates between stock areas being developed for WKBASS2 based on recent tagging, genetics and other studies

This ToR addresses both stocks considered by WKBASS (BSS-47: Area 4.b,c, and 7.a, d–h and BSS-8.ab: Area 8.a, b).

No update of stock identity was available in advance of the data evaluation workshop, so the stock identity was assumed to be the same as previous descriptions with the following Atlantic stocks: Northern (ICES areas 4.bc, 7.a,d–h); Southern Ireland and Western Scotland (ICES areas 4.a, 7.b and 7.j); Biscay (ICES areas 8.a–b); Portugal and Northern Spain (ICES areas 8.c and 9.a) (ICES, 2012; 2014).

During the first pre-WKBASS skype conference, it was agreed that scientists working on sea bass behaviour and stock structure would compile a Working Document for the WKBASS assessment meeting in February, summarising results of several large research projects on this topic currently underway. WKBASS data workshop was provided with a brief update on progress, indicating that the WD will be available in time for the assessment workshop in February 2017.

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 sea bass with electronic data storage tags (DSTs) at 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 ten locations in the Channel and Bay of Biscay. To date, 282 tags have been returned 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 in Ireland, with the aim of investigating the distribution of sea bass within Irish waters and the potential existence of an Irish subpopulation. An update of progress for all these studies will be provided in advance of the assessment workshop in February 2017.

A further study has been done using stable isotope an analysis of (δ13C and δ15N) composition in scales from several 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 subpopulations 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 will also be provided in advance of the assessment workshop in February 2017.

3.2 ToR 2: Review and recommend life-history parameters (e.g. growth parameters, maturity ogives, fecundity, natural mortality), for use in assessments. Where applicable, provide appropriate models to describe growth, maturation, and fecundity by age, sex, or length

3.2.1 Growth and maturity

The growth parameters and maturity ogive currently used in the BSS-47 Stock Synthesis model have not been updated. The sampling and analysis for length-at-age and maturity are explained in IBPNEW (ICES, 2012a) and the supporting working document.

Maturity ogives for BSS-47 were derived entirely from sporadic sampling in the UK since the early 1980s. Samples collected in the southern North Sea from 2005 to 2011 by the Netherlands were supplied to IBPNEW and indicated 50% maturity in female sea bass at age 4. This is substantially lower than the age at 50% maturity of six years in the Cefas 1982–2003 samples. This may suggest that sea bass are maturing earlier than in the 1980s to early 2000s, at least for the North Sea. IBPNEW noted that a clearer indication of maturity patterns will require a sampling programme and data collection method that ensures representative sampling of mature and immature sea bass across the geographic range of the population, using a robust, validated marker for maturity. As sea bass undertake offshore migrations to spawn, the use of the (predominantly) inshore commercial fishery for collection of maturity data is likely to have led to biased estimates due to non-representative sampling of the mature and immature components of the population. Interpretation of maturity stages II (spent-recovering) and III (early developing gonads) is difficult in the absence of histological screening. Finally, sample sizes are low, particularly in the critical ascending limb of the maturity ogive, where many of the fish are below the current minimum landing size. The maturity ogives and parameters estimated from the available samples should therefore be considered as approximate.

During WKBASS it was noted that maturity ogives for female sea bass in the Bay of Biscay stock were derived using only fish with ovaries in development stage IV and above (fish with eggs clearly undergoing vitellogenesis or recently spent), sampled during or close to the spawning season from January–April. However, the ogives for the more northerly BSS-47 stock were calculated using fish collected during December to April with ovaries at or beyond stage III (the latter stage was considered to potentially include females which could be starting to produce a batch of eggs within the batch spawning cycle). In a working document to IBPNEW 2012, Armstrong and Walmsley (2012) discussed the issues with visual interpretation of ovary stages in sea bass that are between batches in the spawning season, given that sea bass produce only a few batches each year. The more recent study on Biscay sea bass (see Section 4.2) uses microscopy and sampling of fish in aquaculture to support use of stage IV and above for defining maturity in fish collected in the spawning season. This may cause a shift in the estimated female maturity ogive towards larger females in the Biscay stock compared with the BSS-47 stock. Further work is needed on validation of maturity stages in the BSS-47 stock to resolve this issue.

3.2.2 Natural mortality

IBPNEW 2012 (ICES, 2012a) applied a range of life-history based methods to make inferences of appropriate values for natural mortality (M). The currently value of 0.15 reflected the results of the Hoenig (1983) method based only on a maximum observed age of 28 years from a large dataset of age readings collected by Cefas (UK) from the 1980s onwards. A maximum observed age of 26 years was recorded in a dataset of 1145 age readings from fish provided by southern Ireland anglers (ICES, 2012a). WKBASS this year has updated the life-history analyses using information from additional and more recent studies, and has considered the use of an age-dependent method combined with methods based on maximum observed age.

Brodziak *et al.* (2009) reviewed the use of maximum observed age and life-history parameters for deriving plausible size/age dependent or age-invariant natural mortality rate. This was based on empirical evidence and ecological theory indicating that the M of fish and invertebrate fishery resources scale with body mass or size. In addition, early life-history stages for a given species experience higher M than juvenile stages, and juveniles experience higher M than mature adults. They note that the traditional assumption of a constant M may be appropriate when only mature fish are of explicit interest in the assessment. However, when juvenile fish need to be modelled explicitly (e.g. because these juveniles are targeted in a fishery or caught as bycatch), then size dependence in M should be incorporated into the assessment, for example, by using a Lorenzen (1996) curve. In addition, the size-dependent mortality model for juveniles may be extended into the adult age groups, or combined with either a constant adult M or a more complex model for adults that allows for increasing M at age due to reproduction or senescence. They suggest that, where multiple estimates of M are available, averaging the set of candidate estimates is considered good practice unless a single best value can be identified based on relative credibility or goodness-of-fit to observed data. However, it is important to characterize the variability of estimates of M for stock assessment applications.

A more recent evaluation of the predictive performance of empirical estimators of M, using information from over 200 fish species, is presented by Then *et al.* (2015). This includes the stocks used by Hoenig (1983). Then *et al.* (2015) evaluated estimators based on various combinations of maximum age (tmax), growth, and water temperature applied to 200 fish stocks with independent, direct estimates of M, and concluded that a tmax based estimator performs the best. The tmax-based estimators performed better than the Alverson–Carney (1975) method based on tmax and the von Bertalanffy K coefficient, Pauly's method based on growth parameters, and water temperature and methods based just on K. Based on cross-validation prediction error, model residual patterns, model parsimony, and biological considerations, they recommend the use of a tmax-based estimator ($M = 4.899 tmax^{-0.916}$, prediction error = 0.32), when possible and a growth-based method ($M = 4.118 K^{0.73} Linf^{-0.33}$,prediction error = 0.6) otherwise.

The values of M from the Then *et al.* (2015) estimators are given in Table 3.2.1 compared with the estimators used previously for the sea bass assessment. Values of M for tmax values of 26–28 range from 0.23–0.25. The Then *et al.* (2015) method based on VBGF parameters is 0.173. These are larger than given by the Hoenig (1983) tmax method for teleosts, and in the range given by Alverson and Carney (1975), Pauly (1980), Ralston (1987). Age-dependent predictions from the Gislason *et al.* (2010) are in the range of the Then *et al.* (2015) values only around ages 6–7 and fall to 0.10 by age 20. The Lorenzen (1996) method for the equation for marine and freshwater fish in natural environments (Table 3.2.1) gives larger M values than the Gislason *et al.* (2010) method from age 3 onwards and do not reach the values given by Then *et al.* (2015) until over 20 years of age.

WKBASS data WK proposes that the benchmark assessment explores a range of M values from age-dependent and age-independent methods, to evaluate sensitivity of the stock trends and management to the choice of M. The proposed values are:

1) M = 0.15 at all ages (current value from Hoenig, 1983)

2) M = 0.24 at all ages (Then *et al.* (2015) for tmax 27 years)

3) Lorenzen (1996) M at age re-scaled to 0.15 averaged over 10–20 years of age (Table 3.2.2, Figure 3.2.1c)

4) Lorenzen (1996) M at age re-scaled to 0.24 averaged over 10–20 years of age (Table 3.2.2, Figure 3.2.1c)

The Then *et al.* (2015) prediction using VBGF parameters (0.173) is encompassed by this range. The Lorenzen (1996) M estimates are given in Table 3.2.2 out to 28 years of age. Lorenzen (1996) also gives a predictor for marine fish species ($M = 3.69W^{-0.305}$) which generates larger M values, but when re-scaled to M=0.15 or 0.24 at ages 10–20 the resultant M at age is very similar.

Table 3.2.1. BSS-47: inferences on natural mortality rate from a range of life-history based methods (update of table provided by ICES WGNEW 2012 (ICES, 2012b) sea bass benchmark).

Source	Formulation	Combined sex M		
		tmax28	tmax 27	tmax26
Hoenig 1983	variety of taxa ln(M) = 1.44-0.982*ln(tmax);	0.160	0.166	0.160
	teleosts ln(M) = 1.46-1.01*ln(tmax)	0.149	0.154	0.160
	M= 4.899*tmax^-.916 (from 226 species)	0.231	0.239	0.248
Then *et al* 2015	M= 4.118*K^0.73. Linf^-0.33		0.173	
Alverson and Carney 1975	M = 3k/(exp(0.38*tmax*k)-1)	0.161	0.171	0.181
Pauly 1980	M=exp(-0.0152+0.6543*ln(k)-0.279*ln(Linf,cm)+0.4634*lnT(oC))	0.196	TdegC=	12
		0.211	TdegC=	14
		0.224	TdegC=	16
Ralston 1987	M=0.0189+2.06*k	0.219		
Beverton 1992	M=3k/(exp(*am* *k)-1) am = age at 50% maturity	0.369	female *am* ; comb sex k	
		0.614	male *am* , comb sex k	
Jensen (1997)	M=1.5K	0.146		
			Gislason	Lorenzen
Gislason 2010	M = exp(0.55-1.61*Ln(L) + 1.44* Ln (Linf)+ Ln(K))	age 1	1.599	1.210
Lorenzen	M=3*W^-0.288	age 3	0.539	0.644
		age 5	0.312	0.482
	Gislason: L = length at age from VBGF	age 7	0.221	0.402
	Lorenzen: W = mean wt at age from 2016 WGCSE SS3 run	age 9	0.175	0.355
		age 15	0.117	0.287
		age 20	0.100	0.262

Life history parameters	
VBGF K (combined sex)	0.097
VBGF Linf (combined sex)	84.55
VBGF to (combined sex	-0.73
Age at 50% maturity females (L50% converted to age)	6
Age at 50% maturity males (L50% converted to age)	4
Max age (combined sex)	28
Length at 50% mat females	40.65
Length at 50% mat males	34.67

Table 3.2.2. BSS-47: Inferences on natural mortality rate by age class using the Gislason *et al.* (2010) and Lorenzen (1996) methods. Values are given unscaled, and scaled to a mean M of 0.24 at ages 10–20 (based on Then *et al.* (2015) for maximum age of 27 years) and mean M of 0.15 at ages 10–20 (from Hoenig (1983) using maximum age of 27–28 years).

	Gislason method M				Lorenzen method M			
age class	**L**	**Not scaled**	**Scaled to 0.24 at ages 10–20**	**Scaled to 0.15 at age 5–20**	**W (kg)**	**Not scaled**	**Scaled to 0.24 at ages 10–20**	**Scaled to 0.15 at age 5–20**
1	13.1	1.599	3.145	1.966	0.023	1.210	0.995	0.622
2	19.7	0.827	1.627	1.017	0.096	0.807	0.663	0.415
3	25.7	0.539	1.060	0.662	0.209	0.644	0.530	0.331
4	31.1	0.395	0.778	0.486	0.369	0.547	0.450	0.281
5	36.1	0.312	0.613	0.383	0.570	0.482	0.397	0.248
6	40.5	0.258	0.508	0.317	0.807	0.436	0.359	0.224
7	44.6	0.221	0.435	0.272	1.073	0.402	0.331	0.207
8	48.3	0.195	0.383	0.239	1.359	0.376	0.309	0.193
9	51.6	0.175	0.344	0.215	1.659	0.355	0.292	0.182
10	54.7	0.159	0.314	0.196	1.968	0.338	0.278	0.174
11	57.5	0.147	0.290	0.181	2.279	0.324	0.266	0.166
12	60.0	0.138	0.270	0.169	2.588	0.312	0.257	0.160
13	62.2	0.130	0.255	0.159	2.893	0.302	0.249	0.155
14	64.3	0.123	0.242	0.151	3.190	0.294	0.242	0.151
15	66.2	0.117	0.231	0.144	3.476	0.287	0.236	0.147
16	67.9	0.113	0.222	0.138	3.751	0.280	0.231	0.144
17	69.4	0.109	0.214	0.134	4.013	0.275	0.226	0.141
18	70.8	0.105	0.207	0.129	4.262	0.270	0.222	0.139
19	72.1	0.102	0.201	0.126	4.498	0.266	0.219	0.137
20	73.2	0.100	0.196	0.122	4.719	0.262	0.216	0.135
21	74.3	0.097	0.192	0.120	4.926	0.259	0.213	0.133
22	75.2	0.095	0.188	0.117	5.119	0.256	0.211	0.132
23	76.1	0.094	0.184	0.115	5.299	0.254	0.209	0.130
24	76.9	0.092	0.181	0.113	5.464	0.252	0.207	0.129
25	77.6	0.091	0.179	0.112	5.616	0.250	0.205	0.128
26	78.2	0.090	0.176	0.110	5.755	0.248	0.204	0.127
27	78.8	0.089	0.174	0.109	5.882	0.246	0.203	0.127
28	79.3	0.088	0.172	0.108	5.996	0.245	0.201	0.126
mean over ages 10–20		0.122	0.240	0.150	3.422	0.292	0.240	0.150

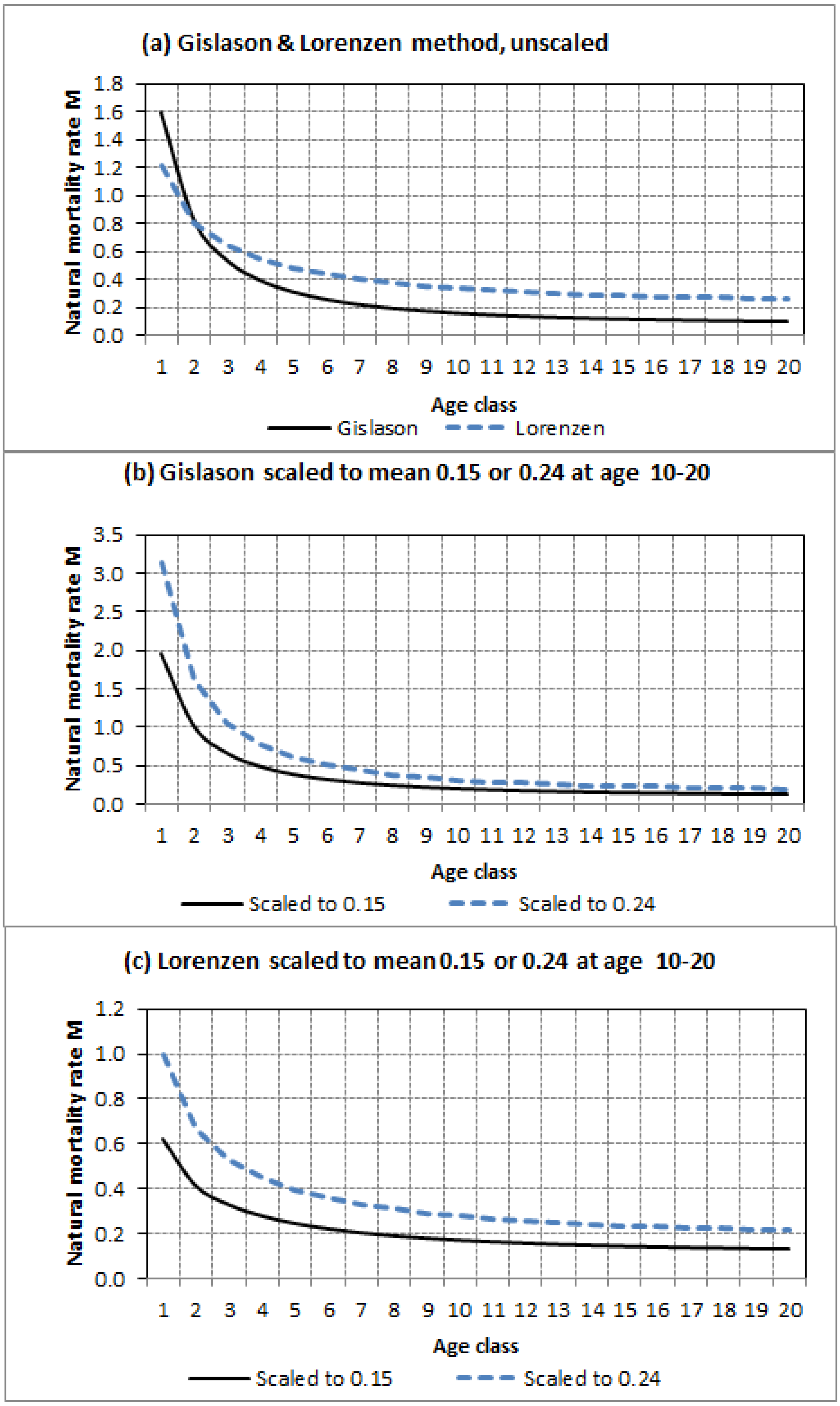

Figure 3.2.1. BSS-47 stock: (a) Natural mortality values inferred from Gislason *et al.* (2010) and Lorenzen (1996); (b) Gislason M values rescaled to average M=0.15 or 0.24 at ages 10–20); (c) Lorenzen (1996) M values rescaled to average M=0.15 or 0.24 at ages 10–20.

3.3 ToR 3: Describe the history of fishery management regulations and actions that are expected to have caused changes in the quality of fishery catch data or the selectivity patterns of fisheries that are of relevance for the scientific assessment of the stocks and provision of advice

3.3.1 Fishery management regulations

Sea bass are not subject to EU TACs and quotas and until recently had limited management measures in place for its conservation. Under EU regulations. The first implementation of a Minimum Conservation Reference Size (MCRS) of sea bass in the Northeast Atlantic (32 cm total length) was in 1983. It was increased to 36 cm in 1990 and then to 42 cm in July 2015 (EEC Regulations 171/83, 4056/89 and EU Regulation 2015/523 of 25 March 2015). Other general measures included days-at-sea limits for commercial vessels catching sea bass within cod recovery zones, based on gear, mesh, and species composition, and effectively a ban for enmeshing nets of 70–89 mm stretched mesh in Regions 1 and 2 of Community waters[1]. A continued area closure around Ireland for commercial fishing is also in place. (http://ec.europa.eu/fisheries/cfp/fishing_rules/sea-bass/index_en.htm).

Recent scientific analyses have reinforced previous concerns about the state of the stock and advised to reduce fishing by 80%. In 2015, the European Council adopted measures to help sea bass recover. As well as the MCRS increase to 42 cm, emergency measures implemented in January 2015 placed: (i) a ban on targeting sea bass by pair-trawling during the spawning season up until the end of April 2015; (ii) a bag limit of three sea bass per day for recreational fishing (EU Regulation 2015/523 of 25 March 2015); and (iii) a monthly catch limit (1.5 t for pelagic trawlers; 1.8 t for bottom trawlers; 1 t for driftnets; 1.3 t for liners; 3 t for purse-seiners).

Measures introduced in 2015 and updated in 2016 through consultation with Member States and stakeholders, included reduction or prohibition of landings depending on gear and month (Table 3.3.1). For recreational anglers, a catch and release fishery from January to June and a one sea bass per day bag limit between July and December.

Measures announced for 2017 again provided controls for both commercial and recreational fisheries (EU regulation 2017/127 of 20 January 2017). This prohibited commercial catches outside 12 nm (UK sovereignty) in 7.a–c,g,j&k and inside of 12 nm (UK sovereignty) in 4.b&c and 7.a,d–h. There were derogations for incidental and unavoidable bycatch by demersal trawls and seines (maximum 3% of landings on a single day and 400 kg / month) and fixed gillnets (250 kg / month). In additional hook and line commercial landings in January and April to December could not exceed 10 tonnes per vessel, with a closed period in February and March. Catch limits cannot be transferred between boats. For recreational fisheries both from both shore and boat, catch and release fishing only permitted from 1 January to 30 June and a one fish bag limit for the

[1] Region 1: All waters which lie to the north and west of a line running from a point at latitude 48°N, longitude 18°W; thence due north to latitude 60°N; thence due east to longitude 5°W; thence due north to latitude 60°30'N; thence due east to longitude 4°W; thence due north to latitude 64°N; thence due east to the coast of Norway.
Region 2: All waters situated north of latitude 48°N, but excluding the waters in Region 1 and ICES divisions 3.b, 3.c and 3.d.

remainder of the year in 4.b&c, 7.a,d–h. Bag limits were also implemented for the whole year of one fish per trip in 7.j&k and five fish per trip in 8.a&b.

Table 3.3.1. Commercial fishery regulations on allowable catches by gear and month in 2016.

2016 measures	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec
Bottom trawlers	X (1% by catch)	X (1% by catch)	X (1% by catch)	X (1% by catch)	X (1% by catch)	X (1% by catch)	1 t	1 t	1 t	1 t	1 t	1 t
Seiners	X (1% by catch)	X (1% by catch)	X (1% by catch)	X (1% by catch)	X (1% by catch)	X (1% by catch)	1 t	1 t	1 t	1 t	1 t	1 t
Pelagic trawlers	X	X	X	X	X	X	1 t	1 t	1 t	1 t	1 t	1 t
Drift Gillnets	X	X	X	X	X	X	1 t	1 t	1 t	1 t	1 t	1 t
Hooks	1.3t	X	X	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t
Lines	1.3t	X	X	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t
Set Gillnets	1.3t	X	X	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t

Additional to EU regulations a variety of national restrictions on commercial sea bass fishing are also in place. These include:

- Closure of 37 sea bass nursery areas in England and Wales to specific fishing methods.
- Minimum gillnet mesh size of 100 mm in South Wales.
- A variety of control measures in Ireland that effectively ban commercial fishing for sea bass in Irish waters.
- Licensing from 2012 in France for commercial gears targeting sea bass.
- Voluntary closed season from February to mid-March for longline and handline sea bass fisheries in Brittany (may be superseded by new EU measures).

Depending on country, there may be more conservative measures affecting recreational fisheries including: increased MCRS, further restrictions on sale of catch, and gear restrictions. Management measures introduced since 2015 raise several important problems for the stock assessment including:

- The assumption of constant recreational fishing mortality over time will no longer hold due to bag limits and increased MCRS leading to much higher release rates (depending on post-release mortality).
- Overall selectivity patterns in the fisheries may change, for example due to the removal of the pelagic pair trawl fishery.
- Discard rates may increase significantly.
- Short-term forecast assumptions for this stock will change.

WKBASS data WK recommends that the assessment workshop: i) evaluates the performance of discard data in the Stock Synthesis model to allow changes in selectivity and fishing mortality due to discarding to be estimated in future assessments; ii) considers any changes in overall selectivity of combined French fleets due to reduction in pelagic trawling on spawning aggregations; and iii) explores ways to reflect the likely reduction in recreational fishing mortality due to the MCRS and bag limits.

3.4 ToR 4: Develop time-series of (commercial and recreational) fishery catch estimates, including both retained and discarded catch, with associated measures or indicators of bias and precision

3.4.1 Commercial fishery landings

The commercial fishery landings for BSS-47 are described and evaluated in previous benchmarks (IBPNEW 2012 (ICES, 2012a); IBPBASS1 & 2 (ICES, 2014c, 2016c)) and were not subject to any additional evaluation in WKBASS. The landings series by fleet as used in the latest assessment (ICES, 2016d) will be used in any WKBASS assessment runs.

3.4.2 Commercial fishery discards

The BSS-47 assessment currently excludes discards, which have been considered to be relatively small (~5% of total international commercial fishery catch weight), with estimates are given annually by WGCSE. However, the recent management measures including a moratorium period, monthly vessel landings or bycatch limits, and an increase in Minimum Conservation Reference Size (MCRS) from 36 cm to 42 cm are expected to cause an increase in discarding. WKBASS therefore updated the discards estimates to include observer data.

3.4.2.1 UK commercial discards data

Cefas (UK) operates an observer scheme to estimate discards of all species and collect length and age data. Estimates for sea bass are obtained for a relatively small proportion of observed trips where sea bass are caught and discarded. The design of the scheme is described in the Stock Annex (ICES, 2016d). Annual retained landings are from fleet census logbook data for the whole fleet, and discards from sampled trips are ratio estimates derived by raising to total annual values using the landed weight of sea bass on the observed trips.

Data are mainly from the inception of the EU Data Collection Regulation in the early 2000s, with the programme redesigned to be more statistically robust from 2010 onwards following advice on sampling designs from ICES expert groups WKMERGE, WKPICS and SGPIDS. The sampling frame comprising a list of fishing vessels, from which vessels are selected at random to take an observer. A trip on a vessel is treated as the primary sampling unit (PSU) although all the trips of a vessel during a quarter are not known in advance. The frame coverage is not complete, as vessels under 7m are currently considered unsuitable for taking observers. Prior to around 2010, no vessels under 10m were sampled at sea by observers. Also, since devolution of Wales, Cefas have not had an observer programme in Wales, but this has recently restarted again.

The vessel lists are currently stratified by area (coastline from which they operate), quarter, vessel size (<10m; 10m+), and predominant fishing type. In the current scheme, all vessels using otter trawls, nets, and lines are included in the same gear stratum. A randomised vessel list is developed for each area x quarter x vessel type x vessel size stratum. The observers contact skippers in sequence until a sampling trip can be arranged and refusal rates have been recorded since 2013.

In most cases, a ratio estimator is used for raising from sampled trips to the total fleet, with the landed catch weight of the species as the auxiliary variable. Trip-raised estimates are summed for sampled vessels in stratum, and then raised to total fleet using reported total fleet landings of the stock from logbooks and/or sales data, and the landings of sampled vessels. Due to the small proportion of trips with sea bass, the raised estimates given by WKBASS are derived after collapsing the area, quarter and vessel size strata as most sea bass are caught by under-10m vessels. This will lead to increased potential for bias, and precision estimates were not available for the data workshop.

The annual raised discarded catch shows that the discard rate is generally highest in otter trawlers and lowest in gillnetters, and varies widely from year to year, partly due to low precision (Table 3.4.1). Weak recruitment, particularly the 2010–2012 year classes (as shown by ICES, 2016d), will have contributed to low discard rates in recent years up to 2015. A very large increase in discard rate in 2016 coincides with the increased MCRS of 42 cm operating for the full year. Sampling of sea bass on gillnets has particularly poor coverage and quality during 2002–2006, and if these estimates are used, they should be given low weighting.

Table 3.4.1. Estimates of annual discard volumes (weight in tonnes) for sea bass in BSS-47 from UK vessels, derived from the Cefas observer scheme, for otter trawl, gillnets and beam trawls. No. trips samples is the number of observer trips irrespective of whether sea bass were caught. Data for 2016 represent only part of the year. Highlighted cells show years with less reliable estimates due to small sample sizes for gillnets.

	Otter trawl			No. trips sampled	Nets			No. trips sampled	Beam trawl			No. trips sampled	Total OTB, nets and BTS		
	discards	retained	rate (%)		discards	retained	rate %		discards	retained	rate %		discards	retained	rate%
2002	17	161	9	34	0	201	0	4	0.2	24	0.7	-	17	386	4
2003	16	207	7	75	0	146	0	12	1.9	21	8.1	-	18	374	5
2004	59	173	25	120	0	207	0	17	0.3	24	1.3	-	59	404	13
2005	6	181	3	79	90	172	34	6	2.4	15	13.7	-	99	368	21
2006	34	160	17	102	19	199	9	21	0.4	14	2.5	-	53	373	12
2007	49	173	22	220	1	239	0.4	72	0.0	19	0.0	-	50	432	10
2008	5	196	3	196	3	318	0.9	40	1.2	21	5.6	-	9	535	2
2009	85	175	33	121	0	311	0.1	48	0.2	10	1.5	-	86	495	15
2010	49	150	25	104	1	302	0.3	42	1.2	6	17.1	-	51	458	10
2011	8	137	6	105	14	324	4.2	51	0.0	5	0.0	-	22	467	5
2012	27	157	15	109	2	407	0.5	70	0.0	5	0.0	-	29	569	5
2013	4	125	3	92	2	405	0.4	100	1.1	4	20.1	-	6	534	1
2014	1	104	1	147	6	647	0.9	84	0.0	8	0.0	-	7	758	1
2015	6	77	7	132	1	340	0.4	51	0.0	8	0.0	-	7	425	2
2016 to Oct	56	24	70	-	61	135	31.0	-	0.2	8	2.3	-	117	168	41
Mean to 2015	26	155	14		10	301	3		1	13	5		37	470	7

Nets: poor coverage pre-2007
2004: no bass in observed trips

3.4.2.2 France commercial discards

French discards are assumed to be low in BSS-47. Methodology used to estimate discards and length composition are described in the section linked to the Bay of Biscay area. The most recent estimate is an average of 68 t compared with 2426 tons landed per year for 2003 onwards. Table 3.4.2 presents annual estimates and associated sampling information.

Table 3.4.2. Estimated discards by French vessels in BSS-47from Ifremer observer scheme.

FR gear	year	area	discards (t)	cv	Number Trip	Number fish
FR_LINES	2009	North VII-IV	1.7	0.537	17	21
FR_LINES	2015	North VII-IV	8.0	0.346	28	21
FR_MDW	2007	North VII-IV	0.3	7.338	12	2
FR_MDW	2008	North VII-IV	0.2	4.394	21	4
FR_MDW	2010	North VII-IV	69.2	0.418	35	106
FR_MDW	2011	North VII-IV	5.2	9.282	9	46
FR_MDW	2012	North VII-IV	1.1	16.340	7	29
FR_MDW	2015	North VII-IV	1.8	0.439	32	5
FR_NETS	2007	North VII-IV	12.2	0.210	32	2
FR_NETS	2009	North VII-IV	0.6	0.208	196	3
FR_NETS	2010	North VII-IV	2.2	0.003	108	5
FR_NETS	2012	North VII-IV	9.3	0.120	269	9
FR_NETS	2013	North VII-IV	0.7	0.096	173	2
FR_NETS	2014	North VII-IV	2.2	0.223	118	3
FR_NETS	2015	North VII-IV	1.9	0.173	217	8
FR_OTB	2003	North VII-IV	131.8	1.653	18	26
FR_OTB	2004	North VII-IV	69.6	2.379	24	3
FR_OTB	2006	North VII-IV	22.2	4.400	24	36
FR_OTB	2008	North VII-IV	22.0	8.601	57	63
FR_OTB	2009	North VII-IV	64.6	0.623	143	102
FR_OTB	2010	North VII-IV	95.7	0.653	137	5
FR_OTB	2011	North VII-IV	17.1	1.101	122	57
FR_OTB	2012	North VII-IV	118.3	0.190	151	118
FR_OTB	2013	North VII-IV	47.7	1.151	139	145
FR_OTB	2014	North VII-IV	15.5	0.922	133	29
FR_OTB	2015	North VII-IV	30.6	0.828	189	356
FR_OTHERS	2012	North VII-IV	0.9	1.222	6	9
FR_OTHERS	2014	North VII-IV	59.8	0.705	130	96

3.4.3 Recreational catch updates

The BSS-47 Stock Synthesis assessment was adapted at IBPBASS to use a reconstructed time-series of international recreational fishery landings that is consistent with an assumption of constant recreational fishing F over time (ICES, 2016c&d). The recreational F was estimated so that the predicted landings in 2012 were 1500 t, this being a figure constructed from a patchy set of recreational survey estimates obtained from 2009 to 2012. This did not include any estimates of released catch expected to be lost due to post-release mortality. WKBASS reviewed the existing and any new estimates since previous (inter)benchmark assessments.

Recreational removals include the landed component (catches) and the proportion of the released fish that do not survive. Recreational catches and releases of sea bass in the North Sea, Channel, Celtic Sea and Irish Sea are possible from France, Ireland, the UK, the Netherlands, Belgium, Germany, and Denmark. Estimates of recreational catches and releases of sea bass were described in detail in previous assessments (ICEs, 2016c&d) and were available for France, Netherlands, England, and Belgium (ICES, 2012a&b; 2014a). This section provides data from additional studies and reanalysis that have been done since this original assessment, and summarise what will be available before the Working Group for the Celtic Seas Ecoregion (WGCSE) in May 2017.

In previous reports, partitioning French recreational data between the Biscay and Northern stock was only possible for the 2009–2011 study (Rocklin *et al.*, 2014). However, a reanalysis of the 2011–2012 study (Levrel *et al.*, 2013) was done that provided separate estimates for the Biscay and Northern stocks (Table 3.4.3). There was difference between the estimates from the two years with a total weight of 3173 t in 2009–2011 and 3922 in 2011–2012 with a much larger proportion of the catch from the Northern stock in 2011–2012 (Table 3.4.3). The may be due to the differences in the survey design and the low sampling effort in Biscay in the 2011–2012 survey (Figure 3.4.1).

Additional estimates of catches of sea bass in the Netherlands was also available for 2012–2013 (van der Hammen and de Graaf, 2015) and 2014–2015 (van der Hammen and de Graaf, unpublished data). These used the same methodology as the 2010–2011 survey (van der Hammen *et al.*, 2016; van der Hammen and de Graaf, 2013). The methodology was assessed by the ICES Working Group on Recreational Fisheries Surveys (WGRFS) in 2015 with the survey judged to be of good quality and could be used for assessment purposes, but was likely to represent an underestimate of total recreational catch due to non-coverage of some fishing sectors (ICES, 2015a). There was large variation in the numbers and weights of fish, and a large increase in release rates over the period of the surveys (Table 3.4.3).

England has estimates for 2012–2013 using a population survey to estimate fishing effort, onsite surveys to estimate catch-per-unit-of-effort for shore and private boat angling, and a separate diary-type survey of angling charter boats. The approach and the outcomes have been assessed by WGRFS and other external experts (Armstrong *et al.*, 2013). Length–frequency distributions were available for the kept and released components of the catch (Armstrong *et al.*, 2013). Two methods were used to estimate effort from the 2012–2013 data giving rise to two estimates of catches and releases (Armstrong *et al.*, 2013) that are presented in the table (Table 3.4.3) and the mean of the two methods is used. UK surveys of recreational sea angling have been done since 2016 to assess effort, catches, and total economic impact. These have used a different approach to the 2012 survey, with a population survey to obtain the number of anglers and offsite catch diaries to estimate catch per angler. Analysis of the data is underway, with preliminary results and it is hoped that additional estimates of sea bass catches will be provided in time for the WGCSE assessment in May 2017.

At present, no survey data are available for Ireland, Belgium, Germany or Denmark. The original estimate of 60 t for Belgium was removed as the evidence underpinning this value was not available. Belgium will be carrying out pilot surveys in 2017, but these data will not be available in time for the 2017 assessment. For Germany, a national CATI-Bus telephone screening survey was carried out covering 50200 private households in 2014. The screening survey was followed by a 1-year diary survey and quarterly follow-ups. The survey revealed that there were 174000 recreational sea fishers in Germany in 2013/2014, with the majority fishing in the Baltic Sea (163000) and only 32000 in the North Sea (H.V. Strehlow and M.S. Weltersbach, unpublished data). Preliminary data analysis of fishing diaries showed only a few trips catching sea bass indicating that the German marine recreational sea bass catches are only of minor importance. Sea bass angling in the North Sea is possible in Denmark, but it is not currently included in the Danish recall survey. Thus, no estimates are available of sea bass catches in Denmark.

Following the increase in MCRS from 36 to 42 cm and introduction of bag limits for sea bass from 2015 onwards (Section 3.3), the assumption of constant recreational fishing mortality and selectivity for the BSS-47 stock will no longer hold. These changes to the management of recreational angling will affect the levels of retained and released fish, so need to be accounted for in the assessment model. There are no recreational survey estimates currently available to ICES for sea bass that include either 2015 or 2016 for BSS-47 or after 2013 for BSS-8.ab.

A study of the potential reduction in recreational catches due to increased MCRS and imposition of bag limits was carried out in 2014 for the STECF in order to help understand the impact of potential management measures (Armstrong *et al.*, 2014). Table 3.4.4 gives a summary of changes in retained catch that would have been expected had the measures been imposed in the years with recreational fishery survey data. This will not translate directly into reductions in 2015 and 2016 as there have been changes in recruitment and stock structure. In addition, post-release mortality will become a more important factor to consider due to the management measures leading to increased release rates.

WKBASS notes the importance of recreational fishery catch estimates for the assessment, and the additional uncertainties in recreational F that will arise due to the implementation of the new management measures in from 2015 onwards. National survey data are poorly aligned in terms of coverage by year, and the area-disaggregation of the French survey data for 2011–2012 needs to be reviewed and the precision of the regional estimates provided. New survey data need to be reviewed.

WKBASS data WK recommends that there is an ICES data call for survey data on sea bass recreational fishery data from different countries including the derivation of estimates, sample sizes, standard errors, and length composition sampling data for retained and released fish where available. This should then be processed by WGRFS at their meeting in 2017 and the most appropriate time-series of data for sea bass provided for future sea bass assessments.

Table 3.4.3. Estimates of recreational catches of sea bass in different countries and years in numbers and weight of fish for retained and released components of the catch, and release rates. The relative standard error (RSE) is provided where available and expressed as a percentage. The source of the data is also provided.

			Numbers (thousands)							Weight (tonnes)							
Country	Year	Area	Retained	RSE	Released	RSE	Total	RSE	% released	Retained	RSE	relapsed	RSE	Total	RSE	% released	Source
France	2009–2011	IV & VII	781		796		1,578	>26	50	940		332		1,272	>26	26	ICES (2014b)
	2009–2011	Biscay	1,168		1,190		2,357	>26	50	1,405		496		1,901	>26	26	Calculated
	2009–2011	All	1,949		1,986		3,935	26	50	2,345		828		3,173	26	26	Rocklin *et al.* (2014)
	2011–2012	IV & VII	2,043		1,581		3,624		44	2,458		659		3,117		21	Ifemer
	2011–2012	Biscay	572		281		852		33	688		117		805		15	Ifremer
	2011–2012	All	2,615		1,861		3,935		47	3,146		776		3,922		20	Ifremer
Netherlands	2010–2011	North Sea	234	38	131	27	366	30	36	138	37						van der Hammen and de Graaf (2013)
	2012–2013	North Sea	335	26	332	21	667		50	229	26						van der Hammen and de Graaf (2015)
	2014–2015	North Sea	176	19	499	20	675		74	138	20						van der Hammen and de Graff (unpublished data.)
UK	2012–2013	IV & VII	243–366		467–576		710–942		61	229–436		152–252		381–688	26–38	36–39	Armstrong *et al.* (2013)

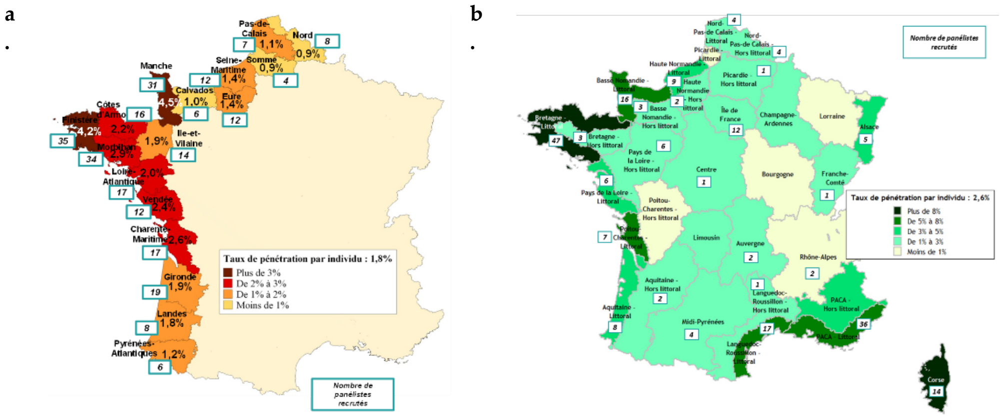

Figure 3.4.1. Sample sizes (number of people keeping recreational catch diaries) by province in France from the 2009–2011 survey (a) and the 2011–2012 survey (b).

Table 3.4.4. Country specific reductions due to different management measures (Armstrong *et al.*, 2014) and mean weights in kg of retained and released fish calculated from surveys, for the BSS-47 stock. MCRS represents an increase from 36 to 42 cm.

	Management measure (%)			Weights (kg)	
Country	**MCRS & bag limit of 1**	**MCRS & bag limit of three**	**MCRS only**	**Retained**	**Released**
France	61	39	34	1.20	0.42
Netherlands	>64	>64	64	1.46	0.43
UK	>52	>23	23	1.19	0.44

3.5 ToR 5: Estimate the length and age distributions of fishery landings and discards if feasible, with associated measures or indicators of bias and precision

Only data on discard length frequencies have been evaluated by WKBASS, as the landings length and age compositions have been thoroughly reviewed by previous inter-benchmarks. The data used by WGCSE in 2016 (ICES, 2016d) will be utilised for WKBASS.

3.5.1 UK discards length compositions

Raised length compositions are given for the UK otter trawl and beam trawl fleet in Table 3.5.1. From 2002 to 2014, the discarding ogive was closely aligned with the MCRS of 36 cm (Figure 3.5.1). Although the MCRS increased to 42 cm in July 2015, very few discards were observed in the sampled vessels so there was little evidence to demonstrate a shift in discard ogive (Figure 3.5.2). In contrast, there were clear signs of increased discarding in otter trawls and gillnetters in 2016 due to the larger MCRS, and a shift in the discard ogive although with continued retention of fish below 42 cm (Figure 3.5.3). The potential for increased discarding from 2016 onwards suggests that the ICES Stock Synthesis assessment of BSS-47 should start to include estimates of discards so that this component of fishing mortality can be estimated.

Table 3.5.1. Numbers of fish discarded and retained length compositions for UK otter trawlers, raised to the fleet, based only on the observer trips (i.e. excluding port samples) in BSS-47.

	2002	2002	2003	2003	2004	2004	2005	2005	2006	2006	2007	2007	2008	2008	2009	2009
Length cm	Discarded	Retained	Discarded	Retained	Discarded	Retained	Discarded	Retained	Discarded	Retained	Discarded	Retained	Discarded	Retained	Discarded	Retained
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12159	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12159	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	133744	0
20	0	0	0	0	47	0	0	0	0	0	0	0	0	0	206695	0
22	0	0	0	385	0	0	0	0	0	0	0	0	0	0	147671	0
24	0	0	483	0	505	0	0	0	970	0	16070	0	0	0	36655	0
26	0	0	1450	0	2709	0	0	0	105	0	38812	0	0	0	26049	0
28	0	0	38	22	23767	0	1761	0	5975	0	34687	0	588	0	2813	0
30	27949	0	1161	0	63941	0	3638	0	5907	0	52326	0	4964	528	6865	0
32	10487	0	19658	109	53293	1391	2873	0	59795	0	15258	617	4442	15	29651	807
34	5244	37005	14442	31602	13974	25288	5890	16348	9769	113212	4990	20183	2919	16603	2177	5279
36	0	13239	0	60910	0	47799	0	28948	132	35742	0	46242	0	24149	29	28304
38	0	7995	0	37258	78	39442	0	48654	0	37900	0	39243	0	37773	0	34820
40	0	32057	0	35014	0	32367	0	36648	0	19782	0	40557	0	44594	0	21333
42	0	18482	0	25754	0	26099	0	11515	0	14197	0	27516	0	35555	0	28484
44	0	5502	0	12919	0	12245	0	11480	0	7224	0	16021	0	28083	0	12398
46	0	17165	0	9501	0	9276	0	6078	0	3456	0	6645	0	8715	0	5819
48	0	32315	0	5777	0	3737	0	1100	0	2692	0	4050	0	9306	0	6336
50	0	3668	0	9530	0	3185	0	31620	0	948	0	5221	0	4247	0	14499
52	0	0	0	2716	0	1878	0	4310	0	2377	0	4099	0	3038	0	4329
54	0	2751	0	3128	0	1762	0	3301	0	446	0	770	24	3402	0	1679
56	0	2751	0	1245	0	1184	0	0	0	484	0	591	0	793	0	2379
58	0	0	0	2350	0	704	0	0	0	672	0	553	0	369	0	403
60	0	0	0	454	0	639	0	0	0	369	0	0	0	1623	0	782
62	0	0	0	1004	0	314	0	0	0	0	0	0	0	528	0	0
64	0	0	0	1933	0	801	0	0	0	0	0	0	0	0	0	77
66	0	0	0	0	0	314	0	0	0	105	0	52	0	125	0	38
68	0	0	0	0	0	262	0	0	0	0	0	378	0	0	0	0
70	0	0	0	0	0	651	0	0	0	0	0	0	0	0	0	807
72	0	0	0	0	0	105	0	0	0	485	0	154	0	14	0	705
74	0	0	0	0	0	52	0	0	0	0	0	0	0	0	0	807
76	0	0	0	385	0	52	0	0	0	0	0	0	0	0	0	1615
Total	43680	172931	37231	241996	158315	209549	14162	200004	82653	240091	162143	212890	12937	219461	616664	171701
Trips sampled	34		75		120		79		102		220		196		121	
Weight(t)	17	161	16	207	59	173	6	181	34	160	49	173	5	196	85	175

	2010	2010	2011	2011	2012	2012	2013	2013	2014	2014	2015	2015	2016	2016
Length cm	Discarded	Retained	Discarded	Retained	Discarded	Retained	Discarded	Retained	Discarded	Retained	Discarded	Retained	Discarded	Retained
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	410	0	0	0	0	0	0	0	0	0
24	10295	0	0	0	553	0	0	0	0	0	0	0	0	0
26	23448	0	229	0	1275	0	0	14563	0	0	0	0	1590	0
28	23056	0	2580	0	1823	0	332	16442	0	0	0	0	462	0
30	29348	78	5681	0	18434	0	2753	10667	0	0	0	0	7556	0
32	47848	68	9919	0	25801	2889	3676	5500	1024	0	0	0	14281	0
34	9498	11058	2832	10659	18545	50932	2196	9618	1461	1200	0	0	18171	0
36	262	27019	71	34852	173	67439	0	35148	0	3897	0	9951	26100	1142
38	0	30340	0	40046	0	24568	0	34006	0	15166	8445	8671	21899	1488
40	0	24963	0	10915	0	28182	0	23764	0	18682	0	23190	6828	9178
42	0	23169	0	16195	0	7916	0	12229	0	20350	0	13687	336	8703
44	0	12607	0	10755	0	7761	0	5768	0	14602	0	3662	691	2803
46	0	8002	0	5939	0	11416	0	3050	0	17128	0	926	261	2064
48	0	4229	0	6619	0	4595	0	4190	0	6431	0	2046	261	347
50	0	3500	0	5423	0	316	0	1720	0	939	0	7367	93	0
52	0	4764	0	1025	0	2460	0	470	0	3742	0	2779	37	709
54	0	2803	0	2968	0	331	0	1675	0	674	0	926	0	0
56	0	84	0	1536	0	2340	0	2479	0	0	0	926	0	0
58	0	207	0	737	0	764	0	664	0	0	0	1549	0	0
60	0	2129	0	2748	0	341	0	470	0	512	0	0	0	0
62	0	1922	0	1128	0	385	0	0	0	301	0	0	0	0
64	0	1486	0	669	0	606	0	0	0	0	0	0	0	42
66	0	79	0	57	0	0	0	0	0	0	0	926	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	301	0	0	0	0
72	0	640	0	0	0	0	0	0	0	0	0	0	0	42
74	0	0	0	0	0	0	0	403	0	0	0	0	0	0
76	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	143756	159145	21311	152272	67014	213243	8957	182826	2486	103925	8445	76608	98568	26518
Trips sampled	104		105		109		92		147		132		-	
Weight(t)	49	150	8	137	27	157	4	125	1	104	6	77	56	24

2016 data only to October

Preliminary

Table 3.5.2. Numbers of fish discarded and retained length compositions for UK gillnetters, raised to the fleet, based only on the observer trips (i.e. excluding port samples) in BSS-47. Poor coverage from 2002 to 2006, so data are of poor quality.

	2002	2002	2003	2003	2004	2004	2005	2005	2006	2006	2007	2007	2008	2008	2009	2009
Length cm	Discarded	Retained	Discarded	Retained	Discarded	Retained	Discarded	Retained	Discarded	Retained	Discarded	Retained	Discarded	Retained	Discarded	Retained
14	0	0	0	0			0	0	0	0	0	0	0	0	0	0
16	0	0	0	0			0	0	0	0	0	0	0	0	0	0
18	0	0	0	0			0	0	0	0	0	0	0	0	0	0
20	0	0	0	0			0	0	1989	0	0	0	0	0	0	0
22	0	0	0	0			0	0	1989	0	139	0	0	0	357	0
24	0	0	0	0			0	0	0	0	139	0	0	0	0	0
26	0	0	0	0			0	0	3977	0	139	0	0	0	357	0
28	0	0	0	0			0	0	5966	0	139	0	0	0	0	0
30	0	0	0	0			0	0	5966	0	312	0	0	0	357	0
32	0	0	0	0			0	0	5966	0	1109	555	0	0	0	0
34	0	0	0	0			0	0	0	3977	416	3743	4585	1467	357	357
36	0	0	0	0			0	0	1989	9943	0	5142	0	4889	0	714
38	0	0	0	0			0	0	0	11932	0	9011	0	17413	0	103722
40	0	0	0	0			0	0	0	3977	0	12502	0	43277	0	2857
42	0	0	0	0			0	0	0	21875	0	9301	0	3544	0	57486
44	0	0	0	0			0	0	0	9920	0	6906	0	21504	0	55611
46	0	0	0	0			0	0	0	3977	0	4540	0	27187	0	6607
48	0	42117	0	14629			0	0	3930	1989	0	1149	0	36052	0	5446
50	0	0	0	0			0	47395	0	9872	0	3630	0	16655	0	17669
52	0	84234	0	15740			0	0	0	13802	0	10746	0	16092	0	10665
54	0	0	0	14629			47395	0	0	5919	0	5656	0	5319	0	9593
56	0	0	0	14629			0	47395	0	9726	0	7344	0	19965	0	1786
58	0	0	0	0			0	0	1989	1965	0	11339	207	5686	0	3214
60	0	0	0	15740			0	0	0	9849	0	10815	0	7204	0	2143
62	0	0	0	0			0	0	0	9896	0	9313	0	2917	0	7718
64	0	0	0	0			0	0	0	1965	0	17576	0	696	0	0
66	0	0	0	0			0	0	0	0	0	655	0	829	0	357
68	0	0	0	0			0	0	0	1989	0	277	0	415	0	0
70	0	0	0	0			0	0	0	0	0	451	0	489	0	357
72	0	0	0	0			0	0	0	0	0	757	0	489	0	357
74	0	0	0	0			0	0	0	0	0	0	0	0	0	357
76	0	0	0	0			0	0	0	0	0	139	0	978	0	0
78	0	0	0	0			0	0	0	0	0	0	0	0	0	0
80	0	0	0	0			0	0	0	0	0	0	0	0	0	0
82	0	0	0	0			0	0	0	0	0	0	0	0	0	0
84	0	0	0	0			0	0	0	0	0	0	0	0	0	357
Total	0	126351	0	75368	-	-	47395	94790	33760	132573	2391	131546	4792	233068	1429	287374
Trips sampled	4		12		17		6		21		72		40		48	
Weight (t)	-	201	-	146	-	207	90	172	19	199	1	239	3	318	0	311

	2010	2010	2011	2011	2012	2012	2013	2013	2014	2014	2015	2015	2016	2016
Length cm	Discarded	Retained	Discarded	Retained	Discarded	Retained	Discarded	Retained	Discarded	Retained	Discarded	Retained	Discarded	Retained
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	1655	0	0	0	0	0	0	0
20	8736	0	0	0	0	0	1655	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	7537	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	586	0	0	0	2163	0	0	0	7148	0
30	0	0	0	0	0	0	0	0	1082	0	0	0	7148	0
32	0	0	33702	1064	0	785	3359	0	1082	0	0	0	0	0
34	0	0	0	240	3533	17270	0	7648	0	802	0	0	0	0
36	0	0	0	1183	0	29438	0	22013	0	39868	0	0	34253	0
38	0	8736	0	1064	0	31202	0	49160	0	84999	1296	0	14295	0
40	0	0	0	1183	0	16485	0	26302	2827	238863	653	2089	14295	12810
42	0	0	0	1199	0	24639	0	33539	0	117053	0	32917	14362	11325
44	0	17472	0	407	0	23069	0	18751	0	83924	0	53584	0	5662
46	0	0	0	7216	0	3518	0	15840	0	54778	0	77484	67	7148
48	0	17472	0	52251	0	30686	0	11454	0	4407	0	15381	67	0
50	0	22965	0	20312	0	17206	0	35087	0	4431	0	22834	0	0
52	0	39239	0	13545	0	14657	0	37140	0	8462	0	12212	0	5662
54	0	19093	0	44827	0	17003	0	25566	0	2005	0	9469	0	7148
56	0	14230	0	40552	0	23114	0	11852	0	0	0	10195	0	0
58	0	18549	0	3253	0	25211	0	5413	0	12015	0	0	0	14295
60	0	0	0	1220	0	9043	0	7745	0	5654	0	720	0	7148
62	0	4411	0	1335	0	8794	0	4386	802	991	0	5	0	0
64	0	0	0	136	0	2931	0	0	0	2827	0	0	0	0
66	0	8736	0	0	0	0	0	1027	0	0	0	10869	0	7148
68	0	0	0	136	0	0	0	1027	0	0	0	0	0	0
70	0	0	0	0	0	1173	0	0	0	2827	0	0	0	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	0	0	0	0	0	0	0
76	0	0	0	0	0	0	0	1027	0	0	0	0	0	0
78	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0	0	2827	0	720	0	0
82	0	0	0	0	0	0	0	0	0	0	0	0	0	0
84	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	8736	170902	33702	191122	4119	296226	6669	314975	7955	666733	1950	248478	99171	78345
Trips sampled	42		51		70		100		84		51		-	
Weight (t)	1	302	14	324	2	407	2	405	6	647	1	340	61	135

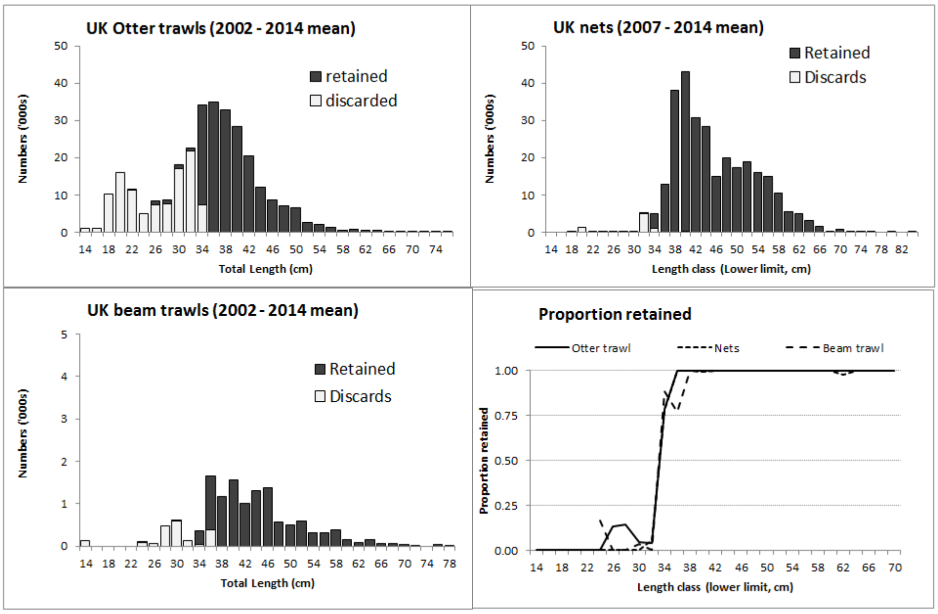

Figure 3.5.1. Mean annual fleet-raised numbers retained and discarded by gear type in the UK fleet from 2002–2014, and the discarding ogives for BSS-47.

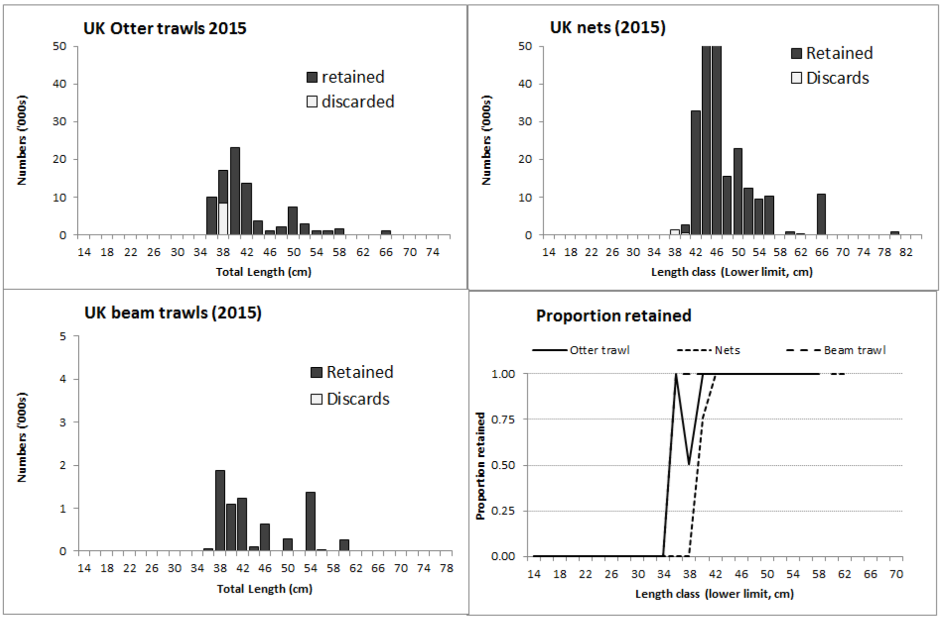

Figure 3.5.2. Fleet-raised numbers retained and discarded by gear type in the UK fleet in 2015, and the discarding ogives for BSS-47. Number of trips with sea bass was 21 (Otter trawl); eight (nets) and eight (beam trawl).

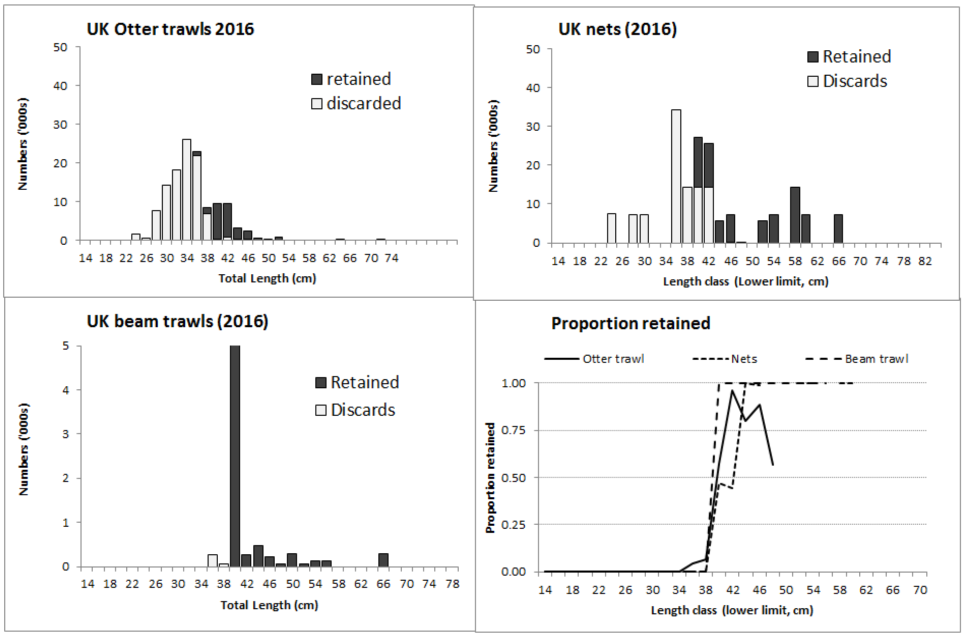

Figure 3.5.3. Fleet-raised numbers retained and discarded by gear type in the UK fleet in 2016 up to October, and the discarding ogives for BSS-47. Number of trips with sea bass was 17 (Otter trawl); eight (nets) and nine (beam trawl).

3.5.2 Discards in French commercial fleets: Length data

French numbers-at-length of discards are presented in Table 3.5.3 and Figure 3.5.4. Data are provided for the French nets, midwater, otter and other fleets for each year between 2007 and 2015 in 2 cm size classes from 6 to 38 cm (Table 3.5.3). Comparisons of the length-frequencies of discarded sea bass varied between years and gears, with large variation between years observed in nets (Figure 3.5.4).

Table 3.5.3. French discards and retained length compositions for each gear in BSS-47.

FR_DIS	YEAR	6CM	8CM	10CM	12CM	14CM	16CM	18CM	20CM	22CM	24CM	26CM	28CM	30CM	32CM	34CM	36CM	38CM	40CM	42CM+
FR_other	2012	0	0	0	0	0	0	0	0	0	0	0	0	0	87	208	416	931	0	0
FR_other	2014	0	236113	1211920	1758149	239751	27324	0	0	0	319513	0	0	0	0	0	0	0	0	0
FR_other	2015	0	0	0	0	0	0	0	0	0	2075	0	20720	0	0	8305	0	0	0	0
FR_nets	2007	0	0	0	0	0	0	0	0	4870	0	0	0	4870	0	0	0	0	0	0
FR_nets	2009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	873	0	437	0	0
FR_nets	2010	0	0	0	0	0	0	0	0	1897	0	3794	1897	0	1897	0	0	0	0	0
FR_nets	2012	0	0	0	0	0	0	0	0	0	0	0	0	704	4101	4101	0	0	0	4397
FR_nets	2013	0	0	0	0	0	0	0	0	0	1389	0	0	0	1563	0	0	0	0	0
FR_nets	2014	0	0	0	0	0	0	1329	0	0	0	0	0	0	0	1329	0	0	0	1347
FR_nets	2015	0	0	0	0	0	846	423	1269	423	2115	3175	2539	3385	1692	4655	0	846	846	5924
FR_lines	2009	0	0	0	0	0	0	0	0	0	0	0	0	295	295	1640	295	442	147	0
FR_lines	2015	0	0	0	0	0	0	0	0	0	0	0	0	2818	1879	8228	2818	0	939	0
FR_MDW	2007	0	0	0	0	0	0	0	0	0	0	0	0	0	229	229	0	0	0	0
FR_MDW	2008	0	0	0	0	0	0	0	0	0	0	0	0	0	0	561	0	0	0	0
FR_MDW	2009	0	0	0	0	0	0	0	0	0	661	0	661	0	0	688	305	0	0	0

FR_DIS	Year	6cm	8cm	10cm	12cm	14cm	16cm	18cm	20cm	22cm	24cm	26cm	28cm	30cm	32cm	34cm	36cm	38cm	40cm	42cm+
FR_MDW	2010	0	0	0	0	0	0	0	0	0	0	0	0	79486	86833	32146	3619	0	0	0
FR_MDW	2011	0	0	0	0	0	0	0	0	0	0	0	0	74	238	1657	4531	1718	0	238
FR_MDW	2012	0	0	0	0	0	0	0	0	0	0	0	0	0	227	1582	545	82	41	0
FR_MDW	2015	0	0	0	0	0	0	0	0	22973	7658	7658	0	0	7658	7658	0	0	0	0
FR_OTB	2003	0	727586	2224428	1933439	7139	7139	0	514407	0	0	0	0	0	0	0	0	0	0	0
FR_OTB	2004	0	0	0	0	0	0	0	0	0	0	0	29991	59981	0	0	0	0	0	0
FR_OTB	2006	0	0	0	0	0	0	0	0	0	0	0	0	164490	260132	72778	0	0	0	0
FR_OTB	2008	0	0	0	0	0	0	0	0	0	3304	16439	30566	21810	19111	8729	0	0	0	0
FR_OTB	2009	0	23785	77757	646	0	0	0	0	0	0	14082	1536	109077	136481	272252	9052	0	0	0
FR_OTB	2010	0	0	0	0	0	0	0	0	0	560	2242	10089	7850	64020	101564	0	0	0	5882
FR_OTB	2011	0	0	0	0	0	0	0	784	4313	9803	1569	0	5019	17149	17020	0	0	0	0
FR_OTB	2012	8406	89382	89194	24097	13076	8406	934	0	0	934	0	0	59445	132218	124692	0	0	0	0
FR_OTB	2013	0	0	0	0	0	0	0	3378	14450	11259	21204	3753	15573	18616	20024	38846	0	0	0
FR_OTB	2014	0	0	0	0	0	0	0	0	0	358	715	1073	1430	12200	17203	6008	0	0	0
FR_OTB	2015	0	0	0	0	0	7897	22563	23691	28204	42876	30465	13538	5265	21983	0	0	0	0	0

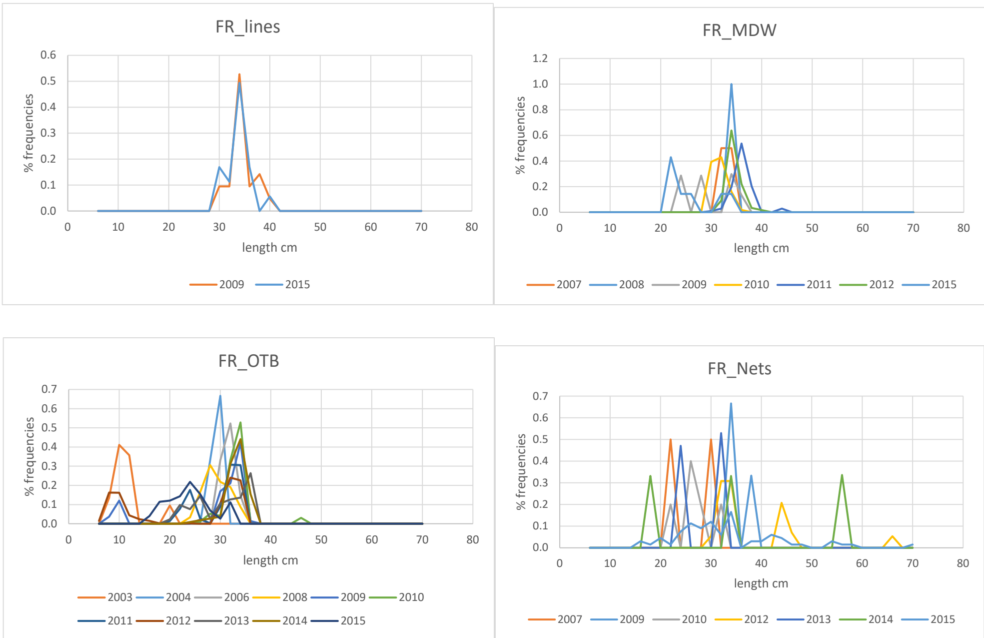

Figure 3.5.4. French discards length frequencies from 2007–2015 for different gear types.

3.5.3 Length compositions of recreational catches, retained and released

A single length composition was required for the assessment that considers the both the kept component and post release mortality. To achieve this, the length composition of retained and released components were estimated for recreational catches in the BSS-47 and BSS-8.ab stocks. Length–frequency data for kept and released fish for individual stock were obtained from the French 2009–2011 (Rocklin *et al.*, 2014) and the UK 2012 surveys (Armstrong *et al.*, 2013). There were no length composition for released fish in the Netherlands surveys, with catches being reconstructed from onsite survey (van der Hammen and de Graff, 2013; 2015; van der Hammen *et al.*, 2016), so these distributions were excluded from the analysis.

The length-frequencies for each country were compiled and corrected for the total numbers of fish caught. This gave a single distribution of caught and released fish for each of the stocks. For the UK, it was necessary to sum the kept and released fish across each of the platforms (i.e. shore, private boat, charter boat) to give overall distributions of kept and released fish. For the BSS-8.ab stock, only French data were available and showed smaller fish were released than retained, but releases of fish that were larger that the MCRS (Figure 3.5.5). For the BSS-47 stock, the kept and released components were summed for the UK and France showing voluntary releases of fish above the MCRS and some rounding bias (large peaks at 30 and 40 cm) (Figure 3.5.6).

A large proportion of the recreational catch of sea bass is released (Ferter *et al.*, 2013b), but some of these fish will die after release (Section 3.7.1). Hence, a discard mortality was applied to the released component to scale the distribution of released fish to represent only fish that died using a realistic post-release mortality of 15% and an extreme post-release mortality for sensitivity analysis (Section 3.7.1). The length compositions of recreational catches (kept and released) were then combined to provide a single length–frequency distribution for each stock for realistic (Figure 3.5.7) and extreme 50% (Figure 3.5.8) post-release mortalities. There are no data for the recreational length compositions since the implementation of the management measures in 2015, so it is not possible to assess how the length–frequency distribution of catches may have been affected.

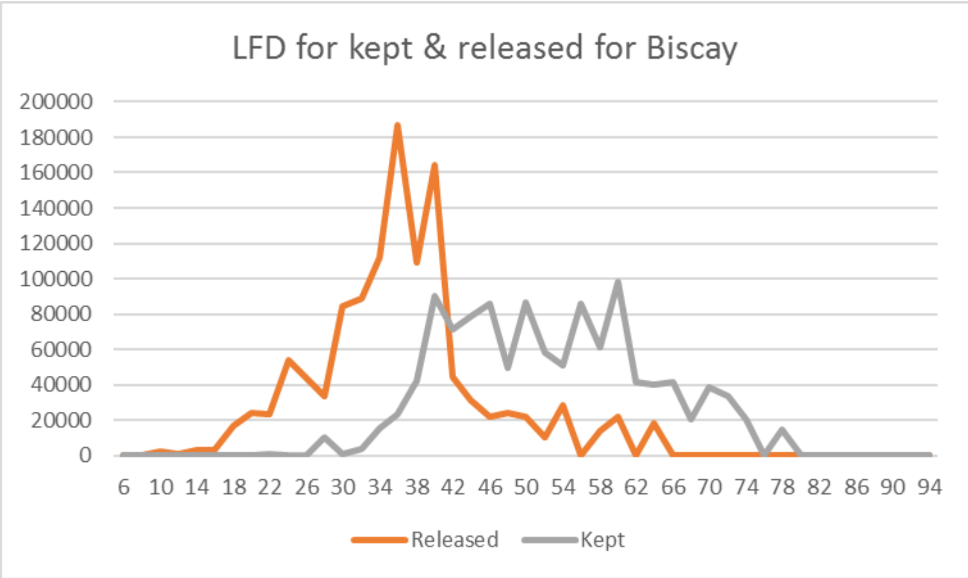

Figure 3.5.5. Recreational length composition data for kept and released fish in BSS-8.ab.

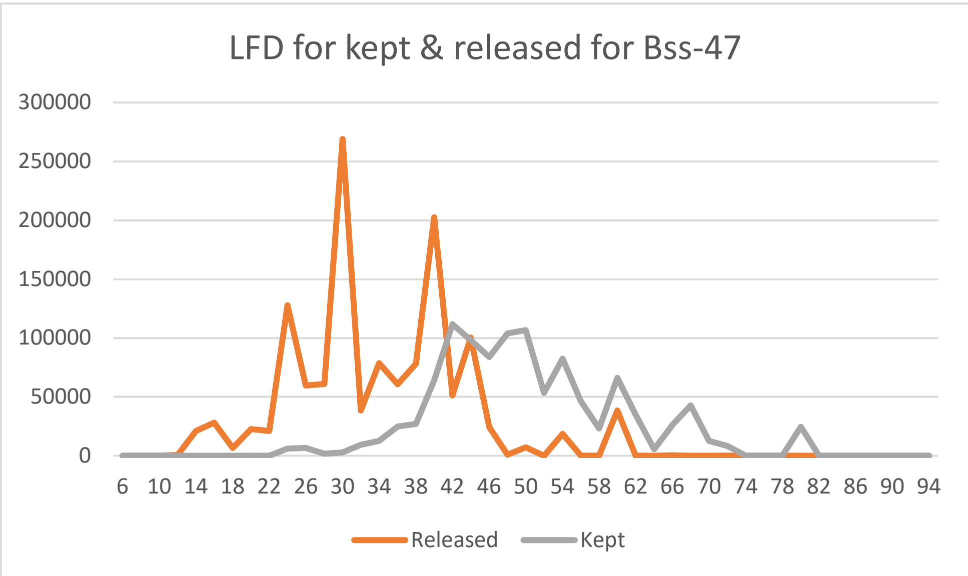

Figure 3.5.6. Recreational length composition data for kept and released fish in the BSS-47 stock.

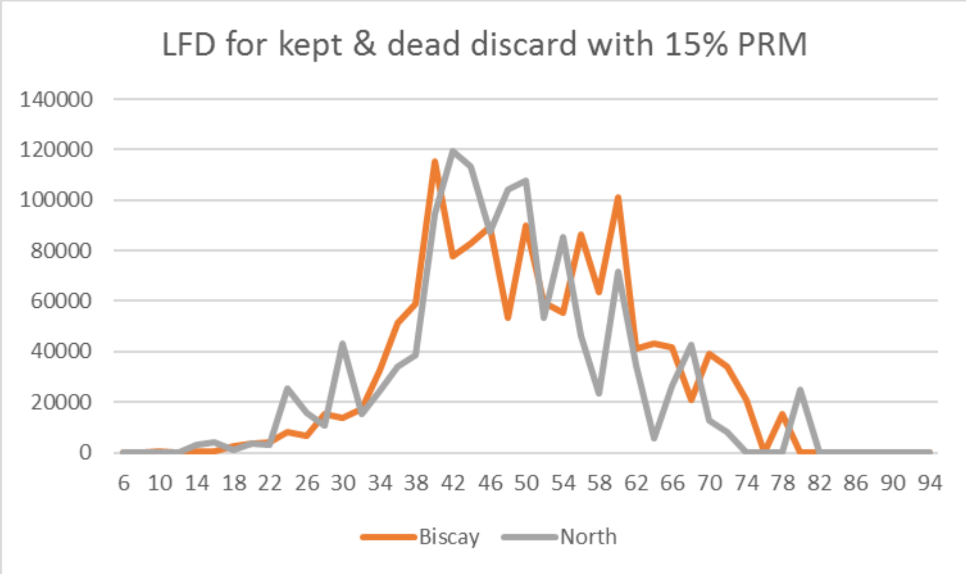

Figure 3.5.7. Recreational length composition for BSS-47 and BSS-8.ab using a realistic post-release mortality of 15%.

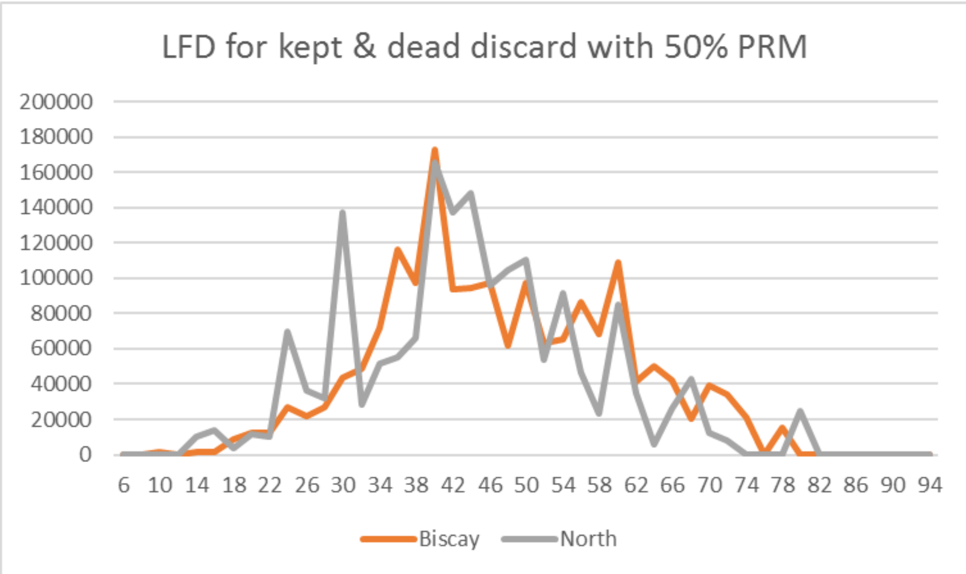

Figure 3.5.7. Recreational length composition for BSS-47 and BSS-8.ab using an extreme port-release mortality of 50%.

The WKBASS data WK recommends that the assessment include both retained and dead releases to allow changes in recreational selectivity to be evaluated in future years.

3.6 ToR 6: Develop recommendations for addressing fishery selectivity (pattern of catchability at length or age) in the assessment model

Considerable attention has been paid to estimation of fleet selectivity in the BSS-47 Stock Synthesis assessment in successive benchmarks (e.g. ICES, 2016c&d). The WKBASS data workshop did not consider this further, though noted the potential shift in selectivity and discarding ogive resulting from the change in MCRS in 2015, if fishermen adapt their fishing activity and gears to avoid capture of undersized fish.

The WKBASS data WK recommends that the assessment includes discards to allow changes in selectivity to be evaluated in future years.

3.7 ToR 7: Recommend values for discard mortality rates for commercial and recreational fisheries following the guidelines provided by ICES WKMEDS and indicate the range of uncertainty in values

3.7.1 Recreational post-release mortality

Discards of unwanted bycatch species and target species are high in recreational marine hook and line fisheries in Europe. European marine recreational anglers often release more than 50% of their Atlantic cod, European sea bass, pollack, and sea trout catches (Ferter *et al*., 2013b). Releases by marine recreational fishers can be mandatory or voluntary (Ferter *et al*., 2013b). Mandatory releases can be due to protected species (e.g. eel, some elasmobranchs) or due to management measures including the minimum conservation reference size and closed areas (e.g. sea bass nursery areas). Voluntary releases by anglers are related to the angling experience, conservation, existing catch, and palatability. With the introduction of recreational bag limits and increase in MCRS, the proportion of released sea bass is likely to have increased significantly. Hence, post-release mortality of recreationally caught fish is a large uncertainty and should be included the assessment of sea bass stocks.

Post-release mortality of hook and line caught fish is not easy to measure and can vary significantly between species and fisheries. Many factors are also important including water temperature, hooking damages and on-board handling (Bartholomew and Bohnsack, 2005; Brownscombe *et al.*, 2017; ICES, 2014c). Extrapolation of existing post-release mortality to other species or regions is likely to depend on the similarity of the fishing practices and environmental conditions (ICES, 2015a). Most studies of post-release mortality due to recreational sea angling in Europe have focused on cod (Ferter *et al*., 2013a; 2015a; 2015b; Weltersbach and Strehlow, 2013), with individual studies of halibut (Ferter *et al.*, 2017) and sea bream (Pinder *et al.*, 2016), and a comprehensive review of elasmobranchs is also available (Ellis *et al*., 2016). Most studies have assessed post-release mortality in relation to fishing gear, hooking location and handling practices, but individual studies have also assessed sublethal effects (Ferter *et al*., 2015a).

No published studies exist for sea bass, but two studies have been done that are yet to be published and several studies are available for the striped bass (*Morone saxatilis*) that provide an alternate estimate of mortality (Diodati and Richards, 1996). Thus, it is important to review relevant studies that could be used to assign a value of post-release mortality to be used for recreational releases in the assessment.

Striped bass are very similar to sea bass in terms of morphology, habitats and angling methods, so there is the potential to use their post-release mortality as a proxy for European sea bass. The US National Marine Fisheries Service used an average hooking mortality of 9% for striped bass (Diodati and Richards, 1996) in their 2016 assessment (ASMFC, 2016). Fish of between 27 and 52 cm were studied over 58 days caught using different methods (bait & lures) from a 2-hectare pond. The average hooking mortality was 9%, but varied between 3 and 26% depending on the conditions (N = 173). All previously hooked were in worse condition than the control group fish at the end of the study (Diodati and Richards, 1996). A literature review of hooking mortality for a range of species compiled by the Massachusetts Division of Marine Fisheries included a total of 40 different experiments by 16 different authors where striped bass hooking mortality was estimated over two or more days (Gary A. Nelson, Massachusetts Division of Marine Fisheries, pers. comm.). The mean hooking mortality rate was 0.19 (standard deviation 0.19). Hooking mortality of striped bass was higher in freshwater than marine studies. Selection of the marine and estuarine studies gave an average hooking mortality of 0.15 (standard deviation 0.17, n = 5) from 3 studies.

Two studies of post-release mortality have been done for European sea bass, but neither have been published. The first study was done in the port of Bilbao, Northern Spain, that aimed to compare mortality from recreational fishing from different methods (bait, lures, hook type), fighting times, and hooking injuries (Ruiz *et al.*, 2016). Sea bass were captured in the harbour basin and impairment tested using RAMP scores (Davis, 2007), then kept in cages for seven days to assess mortality (Ruiz *et al.*, 2016). In total, 103 sea bass were captured with a mean length of 33 cm (ranging from 23 to 44 cm). A comprehensive analysis of the data has not been done, but initial analysis suggested post-release mortality of 15.5% or 16 fish, most of which died in the first 2.5 hours after capture (Ruiz *et al.*, 2016). The second study on post-release mortality of sea bass was done in an aquaculture facility in Hamburg, Germany (Harry Strehlow, pers. comm.). A total of 144 cultured sea bass were caught using different lure and bait types in summer 2015, and held in tanks for ten days to assess mortality. A control group of 50 sea bass showed no mortality after ten days. Preliminary analysis revealed that post-release mortality rates ranged from 0.0 to 65.0%. No mortality was observed for 61 lure-caught sea bass, whereas 14% mortality was observed for 36 bait-caught sea bass and 65% mortality for 20 deep hooked sea bass caught on natural bait. Air exposure trials demonstrated sea bass to be relatively robust to duration of air exposure.

There is a lack of data on post-release mortality of recreationally caught sea bass, but the importance of post-release mortality is likely to increase with management. Hence, further direct experiments are needed on European sea bass to estimate hooking mortality for conditions, angling methods, and sizes of fish caught that are typical of European fisheries. In addition, best practice guidelines should be implemented for sea bass to minimize negative effects of C&R on this species.

Given the importance of post-release mortality, it would be prudent to include this in the assessment. The studies presented are either yet to be analysed completely or are for a different species, so the outputs are indicative.

WKBASS data WK proposes that a post-release mortality of 15% represents a realistic worst-case scenario based on the existing studies, but the sensitivity of the assessment to a post-release mortality should also be included.

3.7.2 Commercial discard mortality

No discard mortality studies for sea bass were identified during a recent synthesis and meta-analysis (ICES, 2016) so are unlikely to exist. Assessments of striped bass include discard mortalities for different gear types, with an estimated 299 566 dead discard out of a total of 1.4 million discarded fish in 2016 (ASMFC, 2016). Release mortalities for specific gears are used in the assessment of striped bass including anchor gillnet (0.43), drift gillnet (0.08), hook & line (0.09), other (0.20), poundnets (0.05) and trawls (0.35) (ASMFC, 2013).

Commercial discards of sea bass were estimated to be low and in the region of 5% (ICES, 2015b), but are likely to have increased with the change of MCRS to 42 cm and boat limits.

WKBASS data WK proposes that studies are developed to understand the discard survival of sea bass in commercial fisheries and should focus initially on bottom trawls as these produce the largest amounts of discards. Future changes in quantities discarded from trawls and other gears such as gillnets must be monitored so that removals from dead discards can be reliably estimated.

3.8 ToR 8: Review all available and relevant fishery-dependent and independent data sources on relative trends in abundance or absolute fish abundance, and recommend which series are considered adequate and reliable for use in stock assessments

3.8.1 UK Solent survey series update

The UK (Cefas) Solent survey (Figure 3.8.1) was updated with data from the survey in autumn 2016. The updated SS3 input data are given in Table 3.8.1.

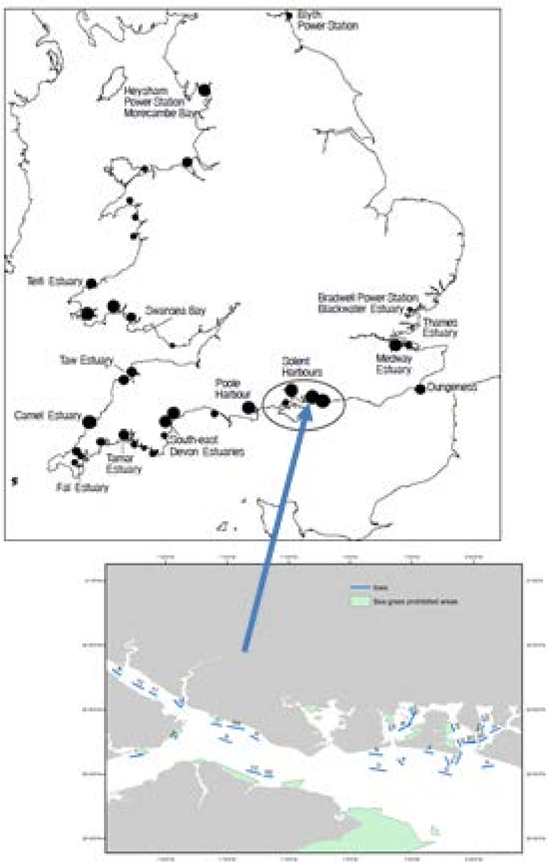

Figure 3.8.1. BSS-47: Location of UK (Cefas) Solent survey of age 2–4 sea bass prerecruits. Black spots on the upper map show location of sea bass nursery areas designated in UK legislation for specific measures to protect young sea bass.

The Stock Synthesis model includes the total abundance index for ages 2–4 combined, and a separate input of age compositions for each year. Cefas also produces a year-class index from the survey, derived from the catch rates at ages 2, 3, and 4 in each year class. This is developed by averaging across ages after standardising each age using the mean of the time-series. The resultant index is shown in Figure 3.8.2 compared with a separate index based on age-1 sea bass that has been derived for years from 1996 onwards. The 1-gp index has not been used in the assessment previously due to concerns that high and variable natural mortality at this age could lead to poor correlation with numbers recruiting to the fishery. However, for most years other than 2005 and 2007, it tracks the age 2–4 index for each year class, particularly since 2008. It supports the age-2–4 index suggesting that the 2013 and 2014 year classes have returned to a more average value after five years of very weak year classes in the Solent. Unfortunately, the 1-gp index suggests another very weak year class in 2015 as very few one-year-olds were caught in 2016. WKBASS proposes that the 1-gp index is presented as supporting information but not included in the assessment as it only starts in 1996.

Table 3.8.1. Time-series of relative abundance indices for BSS-47 sea bass age groups 2, 3 and 4 from the UK Solent spring and autumn trawl surveys. A change in trawl design took place in 1993.

	May–July			September		
Year	age 2	age 3	age 4	age 2	age 3	age 4
1981	0	0.3	0.25	No survey		
1982	0.51	2.17	0.16	3.25	10.1	0.38
1983	No survey			9.87	0.91	1.88
1984	0.95	2.66	0.43	1.38	0.65	0.09
1985	0	10.33	2.56	No survey		
1986	No survey			0.27	4.26	1.31
1987	0	0.42	3.18	0.05	0.28	2.27
1988	0	0.02	0.47	No survey		
1989	No survey			6.68	0.37	0
1990	2.84	2.48	0	2.81	1.15	0.02
1991	5.78	0.62	0.09	3.08	0.21	0.03
1992	0.11	7.04	0.35	0.95	18.59	0.16
1993	0.05	7.33	14.02	6.65	3.59	4.39
1994	0.04	1.63	1.14	3.33	1.84	0.29
1995	0.05	1.57	0.97	4.83	4.69	0.72
1996	1.43	4.09	3.36	5.52	0.43	0.11
1997	0.27	1.94	0.11	33.62	4.52	0.06
1998	0	6.75	5.79	1.22	5.5	0.61
1999	0.61	0.95	12.3	19.37	0.67	0.87
2000	0.49	37.03	1.06	6.07	11.35	0.03
2001	1.71	6.33	3.43	34.42	3.92	1.57
2002	0.63	1.62	0.29	7.42	3.87	0.4
2003	0.06	0.32	0.38	8.37	4.6	0.59
2004	0.17	0.28	0.16	No survey		
2005	0.05	0.42	0.35	13.12	7.98	0.84
2006	0.44	2.47	1.03	9.51	9.21	1.02
2007	0.33	0.5	0.5	3.42	1.78	0.3
2008	No survey			18.52	6.66	0.34
2009	0.72	1.03	0.13	13.25	6.25	0.33
2010	No survey			No survey		
2011	No survey			2.25	1.39	0.42
2012	No survey			No survey		
2013	No survey			1.34	0.08	0.1
2014	No survey			0.74	0.64	0.02
2015	No survey			6.95	0.44	0.05
2016	No Survey			3.75	2.17	0.11

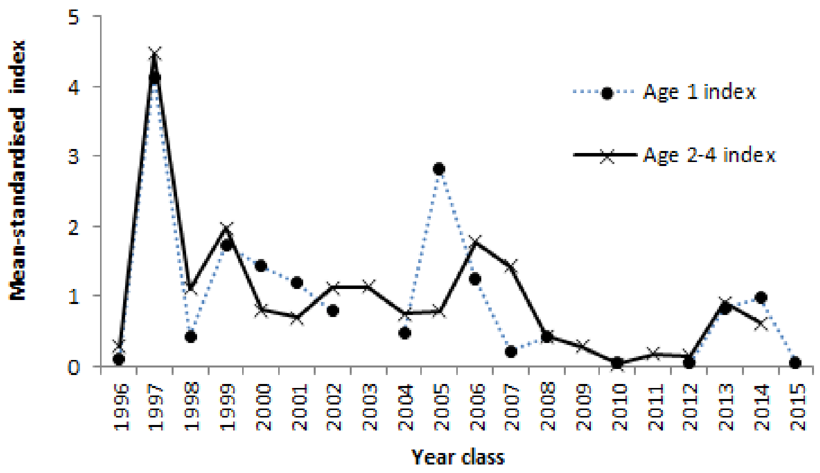

Figure 3.8.2. BSS-47: Solent survey age-1 sea bass index compared with a recruitment index derived from fish at ages 2, 3 and 4 in the same year class (2014 year class: age 2 only; 2013: age 2& 3; 2012: ages 2,3,4).

3.8.2 Ifremer Channel Groundfish survey

An index from the channel groundfish survey was derived and has been used in the assessment (WGCSE, 2016). In 2015, a new methodology was used that included a larger vessel, a larger trawlnet and a new sampling scheme with reduced sampling intensity in coastal regions. The trawl locations for the old and new sampling schemes are provided in Figures 3.8.3 and 3.8.4. A document "Intercalibration of research survey vessels: "GWEN DREZ" and "THALASSA" was provided to the group. WKBASS decided to use the old index as a series terminating in 2014. Data from 2015 will form a new time-series.

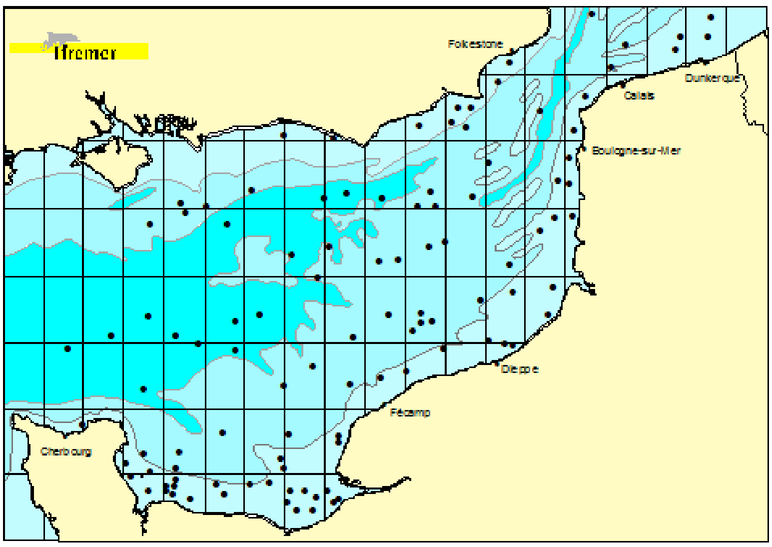

Figure 3.8.3. Original sampling scheme for French channel groundfish survey conducted using the vessel Gwen Drez until 2014 (19.7/25.9 GOV trawl deployed).

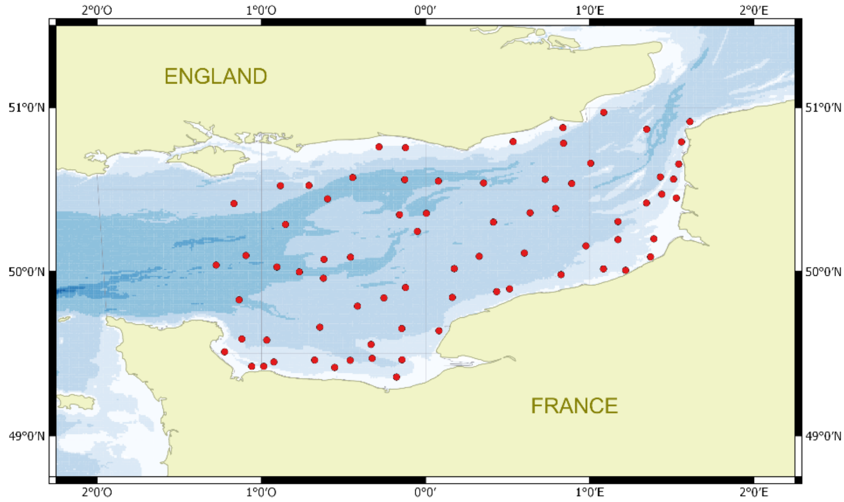

Figure 3.8.4. New sampling scheme for French channel groundfish survey conducted using the vessel Thalassa from 2015 (36/47 GOV trawl deployed).

3.8.3 Fishery-dependent lpue series for French vessels

The lpue methodology was finalised during the second assessment workshop in February 2018 after external review, so this section represents preliminary results which have been revised.

3.8.3.1 Methodology

Linear models have been commonly used in the analysis of logbook data since the 1960s (Robson, 1966; Laurec and Fonteneau, 1979; Gavaris, 1980). Specific models can be used to assess the vessels effect, area effect, seasonal patterns, and interannual variation. However, it is important to carefully design both the modelling approach and the selection of fishing techniques. The output of from linear models can be used to develop fishery-dependent lpue series to tune the assessment. Where the main aim is to get annual abundance indices, seasonal patterns for the stocks structure must be included in the analysis, and drives the number of rectangles that can be grouped to derive overall annual indices.

The landings analysed are from the logbooks of French vessels that caught sea bass between 2000 and 2015. It includes a number of different gears including: trawls (bottom and midwater), Scottish and others purse-seine (“bolinche”), trolling, fixed nets, and longlines. Catches are recorded daily for each ICES rectangle following EU regulations. Fishing hours within a day are recorded sporadically, so catches per unit of effort (cpue) are expressed as kilograms of sea bass caught per day in an ICES rectangle.

Vessels and rectangles providing limited data were eliminated, leaving 1034 vessels (hull x technique), eleven fishing gears, and 70 ICES rectangles that cover all major fishing areas. A monthly time-step was used, so strata correspond to an ICES rectangle, year, and month. If the same vessel provided data for several days within a stratum, these data were grouped to derive a total catch, total number of days, and the average cpue[2]. The corresponding observations were treated as replicates.

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[2]Arithmetic means and weighted least squares give the same results.

Vessels (i) are associated with ICES rectangle (j), months (k), and year (l). A daily individual observation (o = 1,.... number of records in the logbook, No) is associated with: (1) cpue Uo[3] of vessel i(o); (2) the individual fishing power, $\boldsymbol{P}_{i(o)}$; (3) ICES rectangle j(o); (4) month k(o); and (5) to year l(o). In order to use the simplest linear models, only non-null values are considered (the frequency of null and non-null catches will be analysed later on). The cpues (Uo) and fishing power ($\boldsymbol{P}_{i(o)}$) were logarithmically transformed, where $u_o = log_{10}(U_o)$ and power is $p_i = log_{10}(P_i)$.). Spatial (ICES rectangle - $\boldsymbol{G}_j$ and $\mathrm{g_j}$ for the logarithm) effects will be considered in some models. Monthly effects may vary among rectangles and interactions can exist between rectangle and month. Hence, seasonal changes in apparent abundance or cpue between rectangles need to be considered, where $\boldsymbol{S}_{j,k}$ is the monthly effect for square j and month k, and the logarithmically transformed parameter is $\boldsymbol{s}_{\boldsymbol{j},\boldsymbol{k}}$. The same logic applies to year effects that may vary among rectangles (e.g. because they are associated with different individual stocks), so year effects or "interannual trends" for rectangle j in year l is $T_{j,l}$ and the logarithmically transform variable is $t_{j,l}$ for the logarithms. Inclusion of interactions between rectangle, month, and year are considered (Model 1) implies an overall stratum effect $\mathbf{C}_{\mathrm{j,k,l}}$ or $\boldsymbol{c}_{\boldsymbol{j},\boldsymbol{k},\boldsymbol{l}}$ on a logarithmic scale.

Three additive models are considered The simplest model follows Robson (1966) and produces a two factors model (hereafter known as Model 1):

$$(\boldsymbol{Model\ 1})\ \boxed{\mathbf{u_o} = \mathbf{p_{i(o)}} + \mathbf{c_{j(o),k(o),y(o)}} + \boldsymbol{\epsilon}_\mathbf{o}^\mathbf{1}}$$

where ϵ_o^1 is the residual. Where interactions between month and year effects are strong, this simple first model offers the best basis (Cheikh-Baye *et al.*, 2014). The second model is a basic four factor model that includes: (1) vessel; (2) rectangle; (3) rectangle x month; and (4) rectangle x year. Hereafter known as Model 2, it can be written as:

$$(\boldsymbol{Model\ 2})\ \boxed{\boldsymbol{u_o} = \boldsymbol{p_{i(o)}} + \mathbf{g_{j(o)}} + \boldsymbol{s_{j(o),k(o)}} + \boldsymbol{t_{j(o),l(o)}} + \boldsymbol{\epsilon_o^2}}$$

where ϵ_o^2 is the residual. The final model is a modified four factor model, which considers groups of rectangles for either months or year effects. For all rectangles that have seasonal effects in the group, gm, month effects are equal for any given month. The same rule applies to year effects, for example all rectangles with a stock can be considered as a group, even if seasonal patterns may differ between squares. The following equation describes Model 3:

$$(\boldsymbol{Model\ 3})\ \boxed{\boldsymbol{u_o} = \boldsymbol{p_{i(o)}} + \mathbf{g_{j(o)}} + \boldsymbol{s_{gm(j(o)),k(o))}} + \boldsymbol{t_{gy(j(o)),l(o))}} + \boldsymbol{\epsilon_o^3}}$$

where ϵ_o^3 is the residual.

Constraints must be added to all three models to avoid over parameterisation. For fishing power, the overall sum of log relative fishing power or the sum within a specified

[3]Capital bold letters are used for basic non-transformed parameters, by contrast to the logarithmic values. All logarithms are decimal ones.

set of vessels is set to zero. The same rule is applied to month effects within a square (equation for Model 2) or a group of squares (equation for Model 3).

For all three models, parameters are estimated by minimising residual sum of squared between the model prediction and each observation u_o. This procedure does not correspond to any optimal criteria in any statistical sense, since optimality would require modelling of the statistical distributions and is not realistic. All analyses showed strong correlations between residuals associated of the same vessel over neighbouring days. Simple least square fitting is a robust approach, which gives the same results as fitting the means when there are no missing strata (i.e. all vessels have data for all strata).

Changes in the seasonal pattern in a single rectangle between years is possible using Model 1. In addition, it is also possible to refer to an average seasonal pattern in order to split month from year effects in the stratum effects $c_{j,m(o),y(o)}$ related to a single rectangle j. This is best obtained by fitting a two factor model (month and year) for each rectangle and has been done for 2015. Initially, priority was given to Models 2 and 3, and interactions between years and months were of lower priority. For Model 1, the key message is that similar conclusions are reached using the average seasonal patterns (Model 1) and interannual variation (Models 2 and 3), but the results are more noisy for Models 2 and 3 due to the increased number of parameters.

To get an "overall" annual index of abundance for a set of rectangles, it is necessary to treat yearly abundance indices related to individual rectangles in the same way whether they come from Model 1 (arithmetic mean) or Model 2 (geometric mean). Log fishing powers have been standardised by setting the overall average to zero. In addition, within each square the average of all month log effects has been set to zero, as has the year effects the average for 2008–2009 has also been set to zero. For several treatments, logarithms are used directly, but in other cases it may be appropriate to back-transform to normal scales.

3.8.3.2 Bootstraping

Variances, confidence intervals and significance tests can be used to assess the reliability of the linear modelling approach, but the validity of the outcomes relies on assumptions of normality, homoscedascity (equal variances), and independence. The most important of these is independence for logbook data, as catches for the same vessels on two consecutive days are generally highly correlated. To get around this, the logbook data have been analysed using a bootstrapping approach to assess the reliability of the conclusions.

Each bootstrap simulation selects a set of vessels at random with replacement, and the linear models fitted to the simulated logbook dataset. This is then repeated many times and summary statistics of the distribution extracted. For example, each bootstrap sample of a group of rectangles (Model 3) and average monthly pattern (month effects) leads to an estimate of the seasonal pattern. As expected the average bootstrap simulation is close to the basic model, provided the number of bootstrap simulations is high enough. Following the bootstrap logic, variability among the bootstrap results for the same statistics will be used in order to assess the reliability of the estimates. It is, for instance, possible to calculate the standard deviation among individual bootstrap simulations and estimate 95% confidence intervals. It is also possible to estimate "approximate" confidence limits for each of the parameters.

3.8.3.3 Results

Results of the linear modelling are presented in Figure 8.3.5 and Table 3.8.2 below.

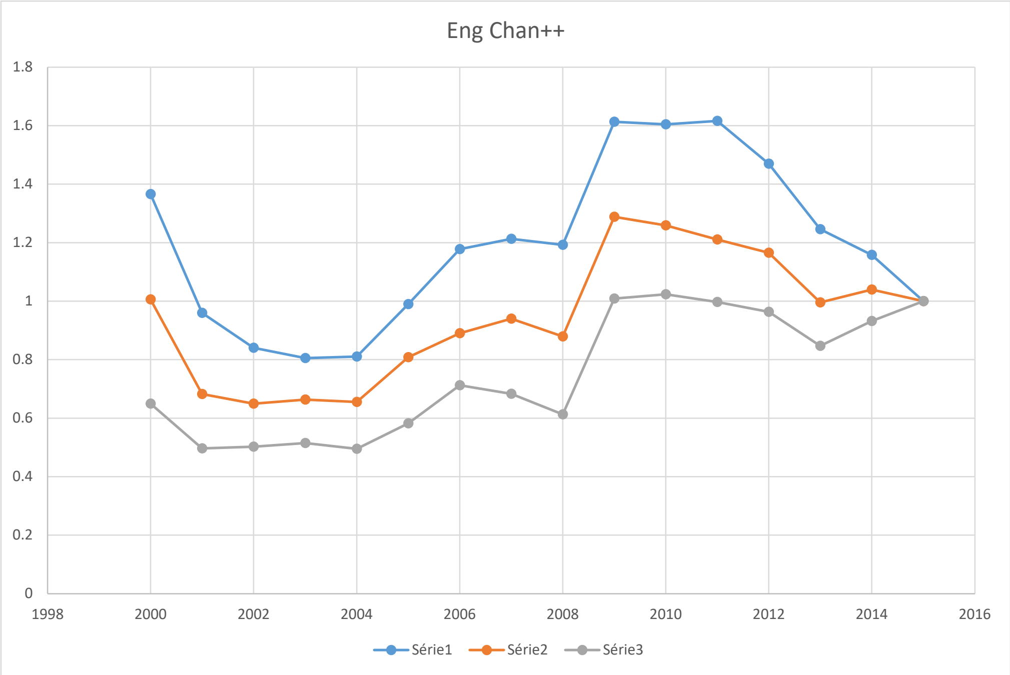


Figure 8.3.5. Outputs of the French lpue modelling.

Table 3.8.2. Result of French lpue index calculation using the bootstrap method.

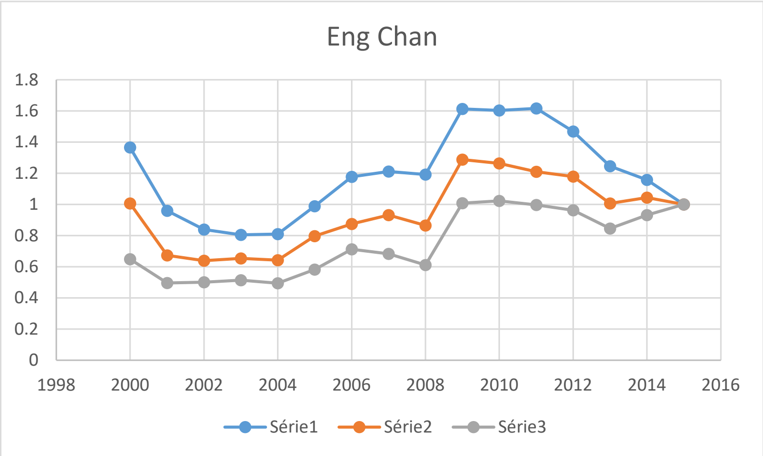
Measure	Area	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Maximum bootstrap	Eng.Chan++	1.3659	0.96	0.8403	0.8051	0.8107	0.9895	1.1782	1.2127	1.1923	1.6132	1.6043	1.6164	1.4696	1.2457	1.158	1
Average. bootstrap	Eng.Chan++	1.008	0.6745	0.6391	0.6543	0.6436	0.7981	0.8761	0.9322	0.8661	1.2893	1.264	1.2102	1.1799	1.007	1.0451	1
Minimum bootstrap	Eng.Chan++	0.6494	0.4964	0.5023	0.5146	0.495	0.5821	0.7124	0.6833	0.6129	1.0085	1.0233	0.9975	0.9634	0.847	0.9321	1

3.8.3.4 Summary of French lpue

The aim is to provide an index to tune the sea bass stock assessment, as scientific surveys cannot provide this information for BSS-8.ab due to the very low level of sea bass caught during existing survey. In addition, for BSS-47 the data available from one survey of recruitment and one groundfish survey do not cover the entire area. The spatial consistency between the small areas (statistical rectangle) and temporal consistency allowed conclusion about migration. In order to have a reference point, BSS-47 analysis was conducted to see if it was possible to get an index correlated with existing data.

For both stocks, there is a large decrease from 2000–2001 that may be due to the lack of data in French logbooks in 2000, so the series should only be used from 2001 onwards. An increase is observed from 2008–2011 in BSS-47 that could correspond to the strong 2002–2003 year class entering the fishery. The index calculated for the English Channel is correlated with the assessment results, both showing an increase in biomass during the 2000s, followed by a decline. Trends are observed in the BSS-8.ab index, so it should be possible to use it to tune the assessment model for that stock.

A. BSS-47



B. BSS-8.ab

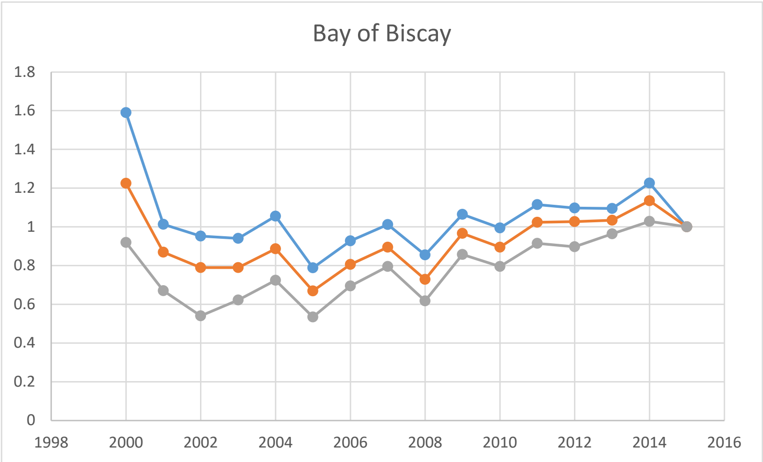


Figure 8.3.6. Lpue index for BSS-47 (A) and BSS-8.ab (B).

WKBASS data WK recommends that additional information is provided on the modelling and the diagnostics in advance of the assessment WK, and the validity of the derivation of the lpue series reviewed by an independent expert.

3.9 ToR 9: Identify any longer term or episodic/transient changes in environmental drivers known to influence distribution, growth, recruitment, natural mortality or other aspects of productivity and which are relevant to assessments and forecasts

Previous inter-benchmark and WGCSE reports have examined the relationship between sea surface temperature and recruitment of sea bass, as warmer temperatures generally lead to higher levels of recruitment. In addition, Cefas have been investigating the environmental effects on egg and larval dispersal during the pelagic phase of sea bass. The potential to use temperature to explain some of the variability of the stock–recruitment relationships is being assessed, but were not complete before the DEWK. WKBASS encourages further development of this work.

3.10 ToR 10: Review progress on existing recommendations for research to develop and improve the input data and parameters for assessments, and develop and prioritise new proposals

The following recommendations are extracted from the IBPBASS (ICES, 2016b) report, mostly from the text prepared by the external experts:

i) For the model to reliable estimate growth parameters, it is again strongly recommended to input age data as conditional age-at-length compositions. This approach normally allows estimation of all growth parameters within the stock assessment model, including the CV of length at both young and old ages. This is only possible to do using marginal age-composition observations when very strong and well-separated cohorts exist. Estimation of growth within the model allows for uncertainty associated with growth parameters to be propagated to the assessment results.

Progress: WKBASS did not carry out any work to compile input data for BSS-47 as conditional age-at-length compositions, so this remains a topic for future exploration.

ii) In future assessment, it is recommended to further explore time-series of recreational catch and conduct a thorough sensitivity analysis to evaluate impact of assumptions regarding recreational catch to model output. It is also recommended to include existing length-composition data for the recreational fleet in the assessment model, to more accurately describe selectivity of this fleet rather than mirroring the selectivity of commercial line fishery.

Progress: WKBASS recommends in Section 3.4.3 that a formal ICES data call is used to source all recreational fishery survey catch and size composition data, and that the ICES Working Group on Recreational Fishery Surveys (WGRFS) should review the quality and utility of the data.

iii) Explore potential differences in length compositions used for calculating numbers-at-age via the age–length key for the French fishery using old and new raising procedures.

Progress: This was not addressed by WKBASS, so should be done for future assessments.

iv) Evaluate how representative ages sampled from liners and pelagic trawlers in subdivision 7.e,h and 7.d are of the entire French fishery.

Progress: This was not addressed by WKBASS, so should be done for future assessments.

v) Evaluate if ages sampled from the French Channel groundfish survey, currently included in the ALK applied to fishery-length compositions, are representative of the French fishery.

Progress: This was not addressed by WKBASS, so should be done for future assessments.

vi) Specify model as two-sex model and estimate growth parameters for females and males separately;

Progress: This was not addressed by WKBASS, so remains a topic for future model development. Currently, fishery and survey catch and length composition data are not collected by sex, and data on size-at-age and sex ratio can only be obtained from any historical and current samples collected for ageing where whole fish were available for dissection.

vii) Include available length-composition data for juvenile survey from Solent nursery area to estimate length-based selectivity parameters for the survey.

Progress: This was not addressed by WKBASS, so should be done for future developments of the assessment model.

viii) Explicitly incorporate discard data in the assessment model. Currently, discard is not included in the model. It is estimated to be around 5% of the total catch for commercial fleets.

Progress: WKBASS compiled and evaluated available discards estimates from France and the UK and has recommended inclusion of discards and associated composition data in the model, particularly to allow changes in fishery selectivity due to recent management measures to be accounted for in future assessments.

3.11 ToR 11: For each stock, develop a spreadsheet of assessment model input data that reflects the decisions and recommendations of the data evaluation workshop

The existing data inputs used by WGCSE (ICES, 2016a) for the update assessment, will be used for any Stock Synthesis runs done at WKBASS. The SS3 data input file containing these data is in the data folder on the WKBASS SharePoint site. Additional data that could be included in an extended model (discard estimates and length compositions by fleet; new recreational catch estimates; French lpue index) are documented in a spreadsheet in the data folder on SharePoint.

3.12 ToR 12: Prepare the data evaluation workshop report providing complete documentation of workshop actions, decisions, list of working documents, other information used by the workshop, and a list of any

additional tasks to be completed following the workshop with dates and responsibilities for completion

This report fulfils this ToR. All Working Documents supplied to the WKBASS data workshop are in the Working Document folder on SharePoint. These are mostly drafts of text, tables and figures for the report prepared in advance of the meeting. All objectives of the Data Workshop were met at the meeting, and subsequent work focuses on completion of the report. Tasks were allocated to WKBASS members for this purpose on the final day of the meeting.

4 Data evaluation for sea bass in ICES Area 8.a,b

4.1 ToR 1: Record progress in production of a working document on sea bass stock structure and mixing rates between stock areas being developed for WKBASS2 based on recent tagging, genetics and other studies

See Section 3.1 for a progress update on this working document. The rest of this section describes the stock structure of sea bass in the Bay of Biscay (Figure 4.1.1, BSS-8.ab). Bass 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 Northwest Africa. The species is at the northern limits of its range around the British Isles and southern Scandinavia.

Stock structure of sea bass in the Atlantic has been reviewed by WGNEW (ICES, 2012b) and IBPNEW (ICES, 2012a) based on evidence from genetics studies, tagging studies, distribution of commercial catches, and similarities in stock trends between areas, drawing also on extensive information contained in previous WGNEW and ICES SGBASS reports. IBPNEW (ICES, 2012a) considered that stock structure remains uncertain, and recommends further studies on sea bass stock identity, using conventional and electronic tagging, genetics, and other individual and population markers (e.g. otolith microchemistry and shape), together with data on spawning distribution, larval transport, and VMS data for vessels tracking migrating bass shoals, to confirm and quantify the exchange rate of sea bass between sea areas that could form management units for this stock. Such information is critical to support development of models to describe the spatial dynamic of the species under environmental drivers (e.g. temperature and food). A study is being carried out by Ifremer and Cefas (BARGIP and C-Bass project), but results are not available in advance of WKBASS data evaluation workshop.

The pragmatic view of IBPNEW (ICES, 2012a) was to structure the baseline stock assessments into four units:

- Assessment area 1. Sea bass in ICES areas 4.bc, 7.d, 7.e,h and 6.a,f&g (BSS-47). Lack of clear genetic evidence, concentration of area 4 sea bass fisheries in the southern North Sea, and seasonal movements of sea bass across ICES divisions. Relatively data-rich area with data on fishery landings and length/age composition; discards estimates and lengths; growth and maturity parameters; juvenile surveys, and fishery lpue trends.
- Assessment area 2. Sea bass in Biscay (ICES Subarea 8.a,b, BSS-8.ab). Available data are fishery landings, with length compositions from 2000, discards from 2009, and some fishery lpue.
- Assessment area 3. Sea bass in 8.c and 9.a with only landings and effort data.
- Assessment area 4. Sea bass in Irish coastal waters (6.a, 7.b, 7.j). Available data: Recreational fishery catch rates; no commercial fishery operating.

Fishery landings of sea bass are extremely small in Irish coastal waters of 7.a and 7.g and the stock assessment for assessment area 1 will not reflect the sea bass populations around the Irish coast, which may be more strongly affiliated to the population in assessment area 4 off southern, western and Northern Ireland.

At IBPNEW (ICES, 2012a), it was agreed that sea bass in the North Sea (4.b&c) and in the Irish Sea, Channel and Celtic Sea (7.a,d–h) would be treated as a functional stock unit as there is no clear basis from fishery data, tagging and genetics studies to subdivide the populations in the Irish Sea, Celtic Sea, Channel and North Sea into independent stock units (BSS-47). Supporting information can be found in the IBPNEW report (ICES, 2012a). The other stock units defined for sea bass are: west of Scotland and Ireland (6.a and 7.b,j); Bay of Biscay (8.a,b, BSS-8.ab); and the more southerly population in 8.c and 9.a.

In the absence of new information, the pragmatic view of WGBIE (ICES, 2016b) was to continue to assume the presence of discrete sea bass stocks off southern Ireland and in the Bay of Biscay (8.ab) and Iberian waters (8.c, 9.a), (Figure 4.1.1).

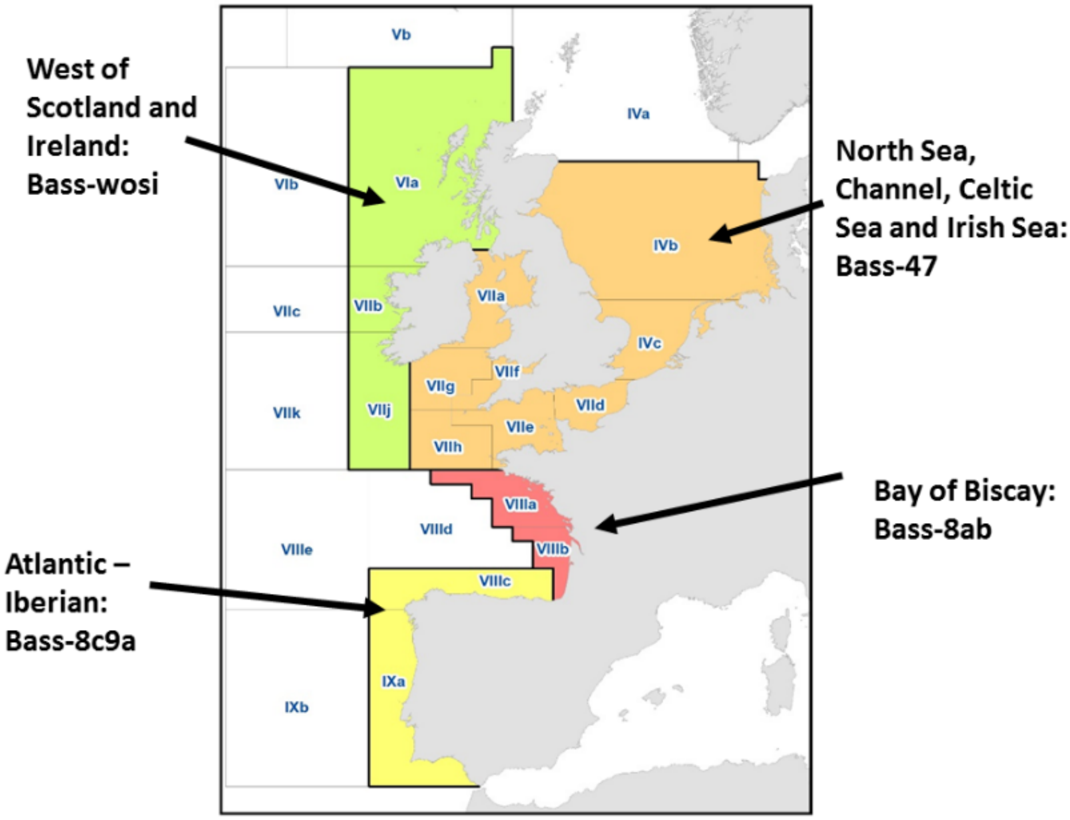


Figure 4.1.1. Current stock definitions for sea bass.

4.2 ToR 2: Review and recommend life-history parameters (e.g. growth parameters, maturity ogives, fecundity, natural mortality), for use in assessments. Where applicable, provide appropriate models to describe growth, maturation, and fecundity by age, sex, or length

4.2.1 Growth curve

Von Bertalanffy growth parameters are presented for sea bass sampled by Ifremer around the coasts of France in areas 8.a&b. Growth has previously been studied in the Bay of Biscay (Dorel, 1986; Bertignac, 1987), and BSS-47 (North Sea, Channel, Celtic Sea and Irish Sea) (Pickett and Pawson, 1994; Armstrong and Walmsley, 2012).

4.2.1.1 Data sources

The data are derived from sampling of French fishery catches in the Bay of Biscay as well as from scientific surveys (EVHOE, ORHAGO, PELGAS) and a new trawl survey of young sea bass in the Loire estuary in 2016 (BARGIP). 5200 sea bass have been aged since 2003 (Table 1): 3931 from fisheries; 845 from scientific surveys (789 from EVHOE, 43 from ORHAGO, 13 from PELGAS); and 424 from Loire Estuary (Figure 4.2.1 and 4.2.2). The inshore surveys included young sea bass (from age 0), whereas the fishery sampled older fish up to 22 years of age. The level of sampling has increased since 2009 (Figure 4.2.3).

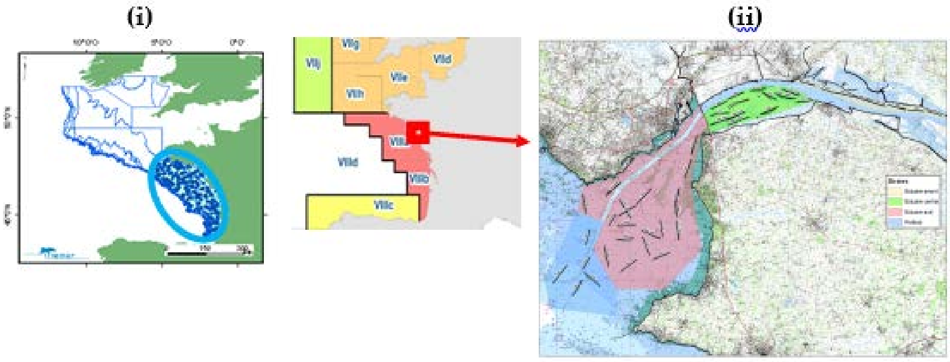


Figure 4.2.1. Distribution of sea bass sampling in the scientific surveys EVHOE-ORHAGO (i) and the location and tow positions from Loire surveys (ii).

Figure 4.2.2. Distribution of sea bass market sampling in the Bay of Biscay.

year	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*Total*
Number of samples	28	28	1	40	0	70	136	401	585	886	953	872	703	497	5200

Figure 4.2.3. Numbers of sea bass sampled from 2003 onwards (2016 provisional).

4.2.1.2 Methods

All ageing is done by counting the annual marks on scales, excluding scales considered to be re-grown. Scales are removed under the pectoral fin, an area where regeneration is less frequent. Regenerated scales are easy to identify. Comparative images from the ICES, 2011 bass age exchange exercise (Mahé *et al.*, 2011) are reproduced in Figure 4.2.4.

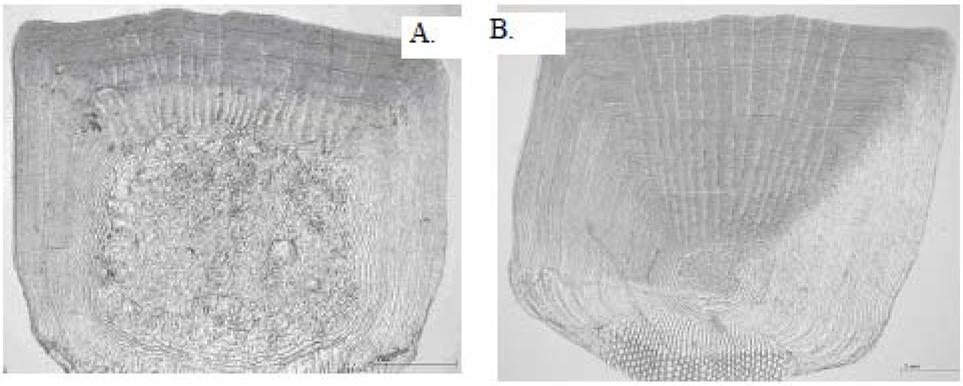


Figure 4.2.4. Difference between a regenerated scale (A) which does not enable all the growth rings to be seen and a non-regenerated scale (B). The scales are from the same individual. Images: Jérome Huet, Ifremer; In Mahé *et al.* (2009, and reproduced from Mahé *et al.* (2011).

Scales are collected from the auctions in a length-stratified manner to obtain three samples per quarter per centimetre. The following analyses were carried out to evaluate:

i) Differences in length-at-age between males and females (from fishery data);

ii) Spatial differences in length-at-age and fitted von Bertalanffy growth parameters (all data).

Parameters of the von Bertalanffy growth curve were fitted using the Microsoft ® Excel ® (2016) add-in Solver. The non-linear minimisation of the sums of squared errors algorithm was used for lengths-at-age for individual fish based on Newton cancellation of gradient.

4.2.1.3 Results

4.2.1.3.1 Sexual dimorphism of growth

Only 30% of sea bass sampled are sexed, due to the predominance of sampling from fisheries where the cost of purchasing whole fish is prohibitive. Sea bass sampled on the inshore and onshore surveys are sexed, and some from fisheries (BARGIP 2014–2015). In total, 660 female and 883 male sea bass were sampled. As in previous studies (Pickett and Pawson, 1994; Armstrong and Walmsley, 2012), females attain a larger average size than males (Figure 4.2.5). Mean length-at-age was almost identical for males and females up to nine years of age and sex ratio changes with age (Figure 4.2.5).

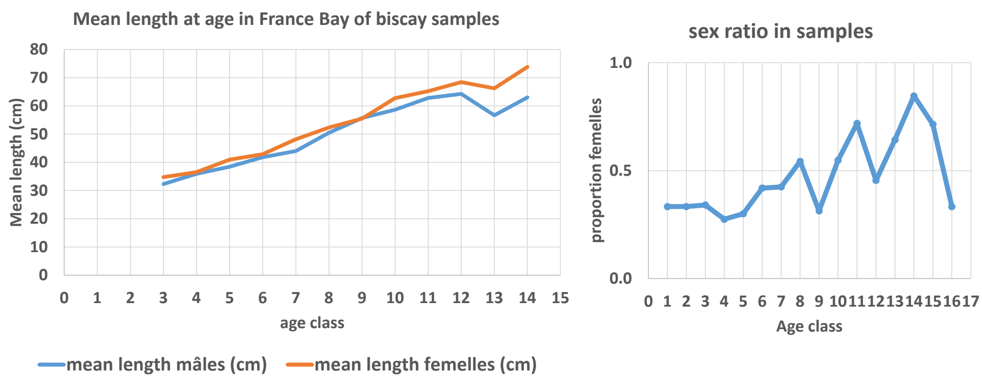


Figure 4.2.5. Comparison of mean length-at-age of sea bass males and females in BSS-8.ab (number of samples used and proportion of females).

Unfortunately, it is not possible to conduct stock assessments separately by sex as the fishery data cannot be reliably disaggregated (ICES, 2012a&b). The observed male-female differences are relatively small, particularly in young sea bass, but the estimates of von Bertalanffy parameters for combined data, will reflect the tendency for asymptotic length to be weighted towards the value for females.

4.2.1.3.2 Length-at-age distributions and effects of age errors

Consistency in age reading of sea bass between four operators in Cefas and Ifremer was examined during a limited exchange of otolith and scale images between laboratories in 2011 (Mahé *et al.*, 2011). A total of 155 fish of 17–74 cm were sampled on board French research vessels during two international surveys. The precision of ageing was similar for scales and otoliths. The coefficient of variation of age readings for individual fish was around 12%, implying a standard deviation of +/- 1 year for a 10-year-old fish, and relatively few fish had identical readings by all four operators. However, it was noted by the operators that photographic images were more difficult to evaluate than original material, which was likely to have a negative effect on the consistency of ageing. These results provide no indication of the validity of ages, only the consistency between operators, and cannot indicate data quality in earlier years when different operators provided age data. It is concluded that the length-at-age distributions show some evidence of aging errors which will result in "bleeding" of ages between year classes, which would impact year classes adjacent to strong ones in particular. This will result in some smoothing of recruitment estimates in assessments. There is would therefore be a benefit to using aging error matrices in the assessment models applied to sea bass.

The workshop on age reading of sea bass (WKARDL) was held at Cefas, Lowestoft, in 2015. The meeting was chaired by Kélig Mahé (France) and Mary Brown (England UK), and included seven age readers from three countries. The objective of this first workshop was to review, document, and make recommendations on current methods for ageing sea bass. This workshop was preceded by otolith exchanges in 2011 and 2013, which were undertaken using WebGR. Participants, who had not taken part in the exchange, were asked to annotate the images prior to the workshop. Seven readers participated in a scale calibration exercise during this workshop. The overall agreement was 78% (ranging between 29 and 100%) with a CV of 5.2% (ranging from 0 to 13%), and 24 out of the 55 scales (43%) were read with 100% agreement. The image analysis exercise clarified that the errors were often due to the difficulty identifying the position of the first annulus, the presence of checks, and the dates of sample collection. The workshop resolved, through discussion and calibration, some of the major difficulties in ageing otoliths of sea bass. This group recommended use of scales for sea bass ageing. For future exchanges, it would be beneficial to compare unstained otolith sections with transmitted and reflected lights, and stained otolith sections with the scales. For scale exchanges, the group recommended the use of multiple scale images (or videos) for each fish. The group reached agreement on a definition of an ageing guideline and a reference collection presented in this report and the aim is to employ these tools for all laboratories.

A study of French length distribution of sea bass for a given read age has been conducted and described in a working document (Laurec and Drogou, 2012). Initial conclusions indicated that in a methodological approach, the length distributions analysis of apparent ages was a tool to validate age readings. Two types of ageing errors can occur: underestimation (rings undetected); and overestimation (false rings). In older and larger individuals, underestimation of the ages should prevail assuming that the linear growth slows down with age. An age+ from 10 years old could be explored if stock synthesis approach can incorporate this information (considering that fish continue to grow after ten years old in the model).

4.2.1.3.3 Growth

The von Bertalanffy model parameters estimated using an absolute error model minimising ∑(obs-exp)^2 in lengths-at-age. The lack of very old individuals (>22 years) led to testing of several L_{inf}, both with or without a constraint. Two constraints were tested: growth curve in the adjacent ICES area 7.e (Armstrong and Walmsley, 2012); and Bertignac (1987). Results are shown in Table 4.2.1 and Figure 4.2.6.

Table 4.2.1. Results of von Bertalanffy growth with or without constraint on L_{inf}.

	No constraint	Constraint Linf= Linf UK VIIe	Constraint = Linf Bertignac
Linf	134.5	92.3	80.4
K	0.05	0.1	0.1391
t0	-1.19	-0.55	-0.321

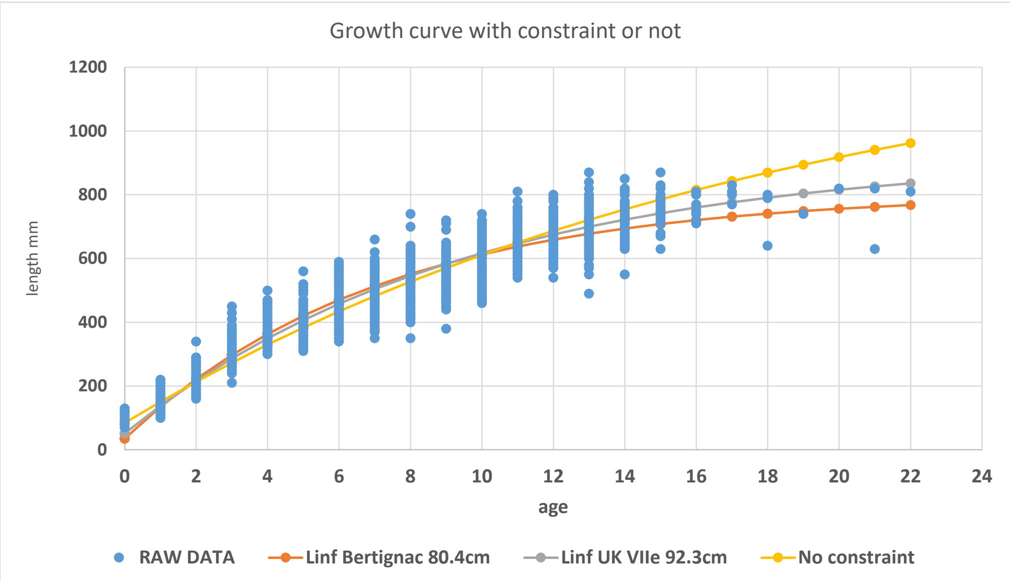


Figure 4.2.6. Fitted curves from the von Bertalanffy model with and without constraints for L_{inf}.

The total number-at-length for commercial fisheries observed in BSS-8.ab from 2000 (Figure 4.2.7) and age reading errors indicated that the Bertignac (1987) approach was favourable.

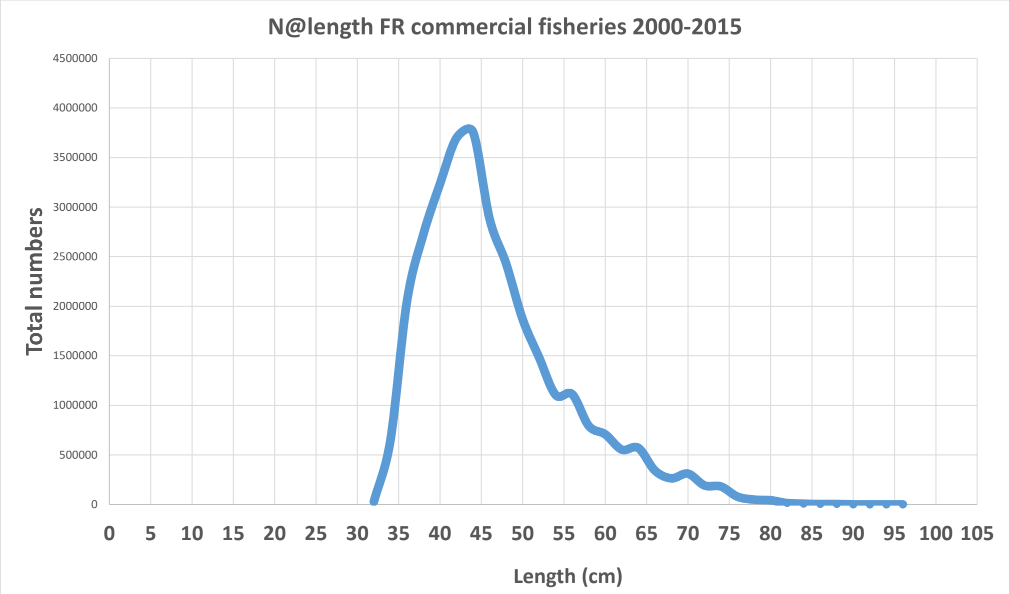


Figure 4.2.7. Length–frequency for landings of all fleets in BSS-8.ab since 2000.

Area related variations in growth in 8.a (Bay of Biscay north) and 8.b (Bay of Biscay south)

Length-at-age data were disaggregated by ICES area 8.a (north of Bay of Biscay) and 8.b (south of Bay of Biscay). Von Bertalanffy model parameters were estimated by area using an absolute error model minimising ∑(obs-exp)^2) for lengths-at-age. There was little difference between the two areas (Figure 4.2.8).

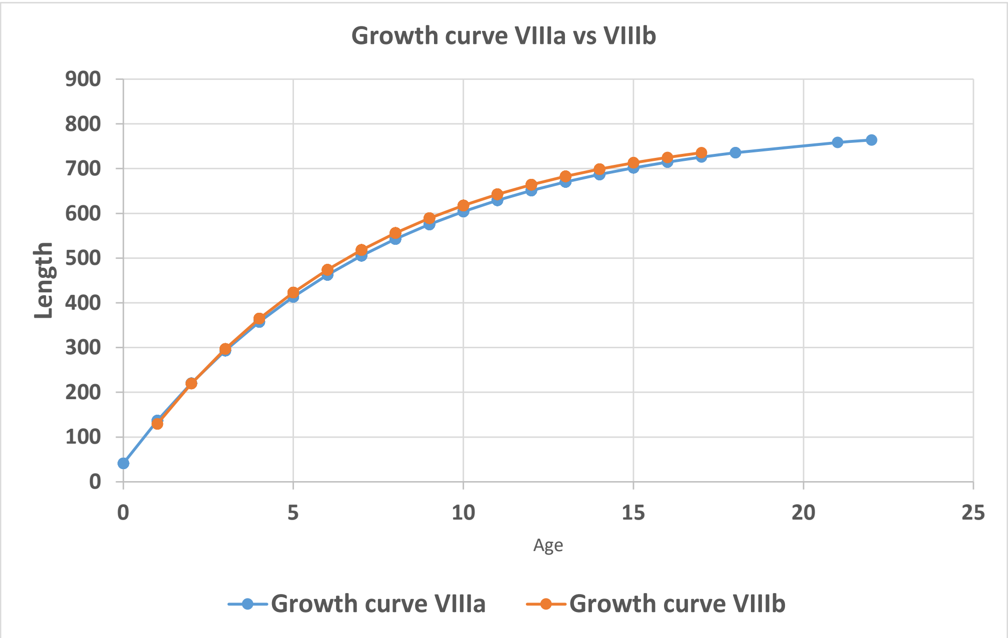


Figure 4.2.8. Comparison between growth curve fitted for ICES 8.a and 8.b.

Area related variations in growth between BSS-47 and BSS-8.ab

The growth curve from for BSS-47 (Armstrong and Walmsley, 2012) was compared with results obtained for BSS-8.ab (Figure 4.2.9). Growth in BSS-8.ab was faster than in BSS-47, possibly due to the warmer temperatures. Indeed, growth rates are higher than in the south than north, with the average size of five year old females being 54 cm in the Mediterranean, 40 cm on the coasts of Brittany, and 35 cm Ireland (Gallet and Cazaubon, 1998).

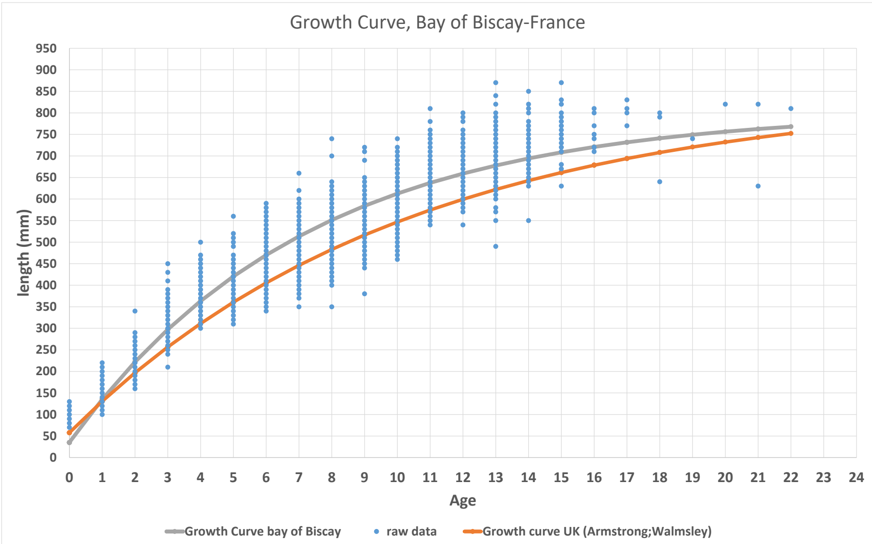


Figure 4.2.9. Comparison between growth curve from BSS-8.ab (grey line and points) and BSS-47 (orange line) (Armstrong and Walmsley, 2012).

Standard deviation

Depending of the choice of ages included, the trend could be described by the linear model SD = 0.0759 * age + 3.3641 (age 0–18) or SD = 0.1861 * age + 2.6955 (age 0–15). In the latter case, the standard deviation of length-at-age increased with length as expected (Table 4.2.2 and Figure 4.2.10).

Table 4.2.2 Standard deviation of length-at-age estimated for samples for BSS-8.ab.

age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
nb of samples	21	75	162	189	240	381	767	934	550	599	423	325	226	144	93	36	12	4	6	1	1	2	1
SD	1.73	3.36	3.64	3.97	3.28	3.82	4.15	4.58	4.72	4.60	4.74	4.78	4.50	5.69	5.18	4.49	3.79	2.50	8.02			13.44	

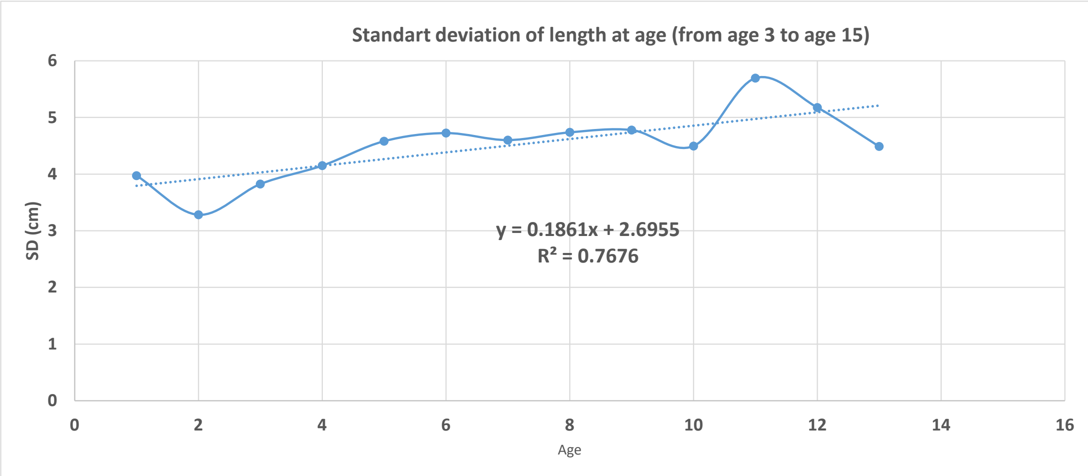


Figure 4.2.10. Standard deviation of length-at-age distributions (age 3–15).

4.2.2 Maturity

This section provides estimates of maturity ogives for sea bass sampled by France in the Bay of Biscay. The data are derived from samples of French fishery around the Bay of Biscay coast (very few sea bass adults are taken in surveys and were generally unsexed before 2009). Sampling was conducted in the BARGIP project (Ifremer, France Filière pêche, French Ministry of the Environment, Energy and the Sea) in 2014 and 2015. The objective was to test historical results of the size at first maturity being 42 cm for females from a sample of 1590 sea bass (Dorel, 1986). 1402 sea bass were purchased between 2014 and 2015 from commercial fisher: 612 at Ciboure in the Southwest of Franc; 645 at Quiberon (North of Bay of Biscay Stock); 133 at La Rochelle; and twelve from the Stuart (Gironde). This represented a good geographical coverage of the whole Bay of Biscay (Figure 4.2.11).

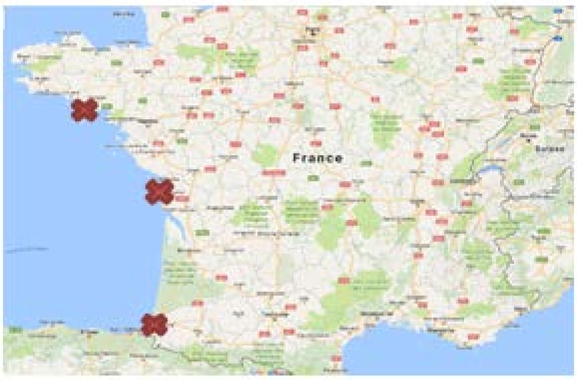


Figure 4.2.11. Location of the sea bass sampling (BARGIP project).

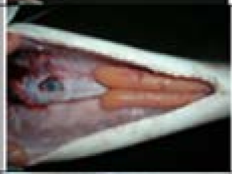
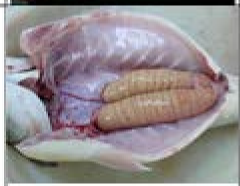
4.2.2.1 Material and Methods

Sea bass samples came mainly from commercial fishing (longliners and bottom trawlers) throughout 2014, with more precise targeting during the spawning season in 2015. Sampling throughout the year was necessary in 2014 to evaluate the monthly evolution of the gonadosomatic ratio. For the southwest and la Rochelle, the analysis was carried out on frozen fish, whereas in Quiberon fresh fish were generally used. The size range of the sea bass sampled was between 19 and 50 cm, with the majority between 34–46 cm (Table 4.2.3).

Table 4.2.3. Number of sea bass sampled per length (cm).

taille (cm)	19	22	25	28	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
nombre de bars	2	2	1	2	4	1	1	8	50	125	100	107	119	146	135	132	140	128	97	42	36	13	5	4	2

The sea bass were dissected in the Ifremer (France). The data collected were: (i) the weight of the whole individual and its gonad (gonado–somatic relationship); (ii) the overall length (mm) of the individual and its gonad; and (iii) gender and stage of maturity (see maturity scale in Figure 4.2.12).

Stade	Labelle	Description	Photos se rapprochant le plus de la description	
1	Immature	Ovaire en forme de petit fil ; rose – rouge		
2	Recouvrement après ponte	**LgCV** : 1/3 **Couleur** : opaque, rose **Apparence** : Parois épaisses, Présence possible d'œufs atrétiques		Femelle 37 cm
3	Début de développement	**LgCV** : ½ **Couleur** : opaque, rouge-orange **Apparence** : granuleuse légère		Femelle 52 cm
4	Fin de développement	**LgCV** : >1/2 **Couleur** : Orangé **Apparence** : Ovocytes clairement visible et non hyalins		Femelle 62 cm
5	Gravide (mûre)	**LgCV** : 2/3 **Couleur** : Orange jaune pâle **Apparence** : Ovocytes opaques clairement visible et qq hyalins		
6	Fluent	**LgCV** : Ovaires très Gonflés **Apparence** : Ovocytes opaque et large clairement visible et membrane translucide. Ovocyte 1 mm		
7	Ponte récente	Ovaires flasques et non vides **Couleur** : Rouge **Apparence** : Parois très épaisse, Œufs atrétiques jaunes		

LgCV = Longueur des ovaires dans la Cavité Ventrale

Figure 4.2.12. Maturity grid for sea bass females.

The identification of the stages of maturity followed the convention used during French scientific (Figure 4.2.12). Gonad samples at different stages of maturity were analysed microscopically (Ifremer, Palavas Les Flots) to validate the macroscopically readings from the grid of identification. Each stage of maturity corresponds to a stage of oocyte development and therefore to a range of oocyte sizes (and evolution of the DNA content of the nucleus). A logistic regression model predicting probabilities based on covariates was used to process the data and provide a first maturity size for females. The fit of the model to the data was tested using Pearson residuals.

4.2.2.2 Results

4.2.2.2.1 Gonado-somatic ratio

Figure 4.2.13 presents the evolution of the gonado–somatic ratio of females (gonad weight / total weight of the individual) in each month from 2014–2015. From May to October, gonado–somatic ratios are similar, at around ten. From November to April, some individuals present larger gonado–somatic ratios (maximum in February) reflecting the induction of maturation (Stage 3). The sampling effort was carried out in 2015 during this period that and the spawning season was between January and April in In BSS, which was consistent with earlier studies (Stequert, 1972; Lam Hoai, 1970).

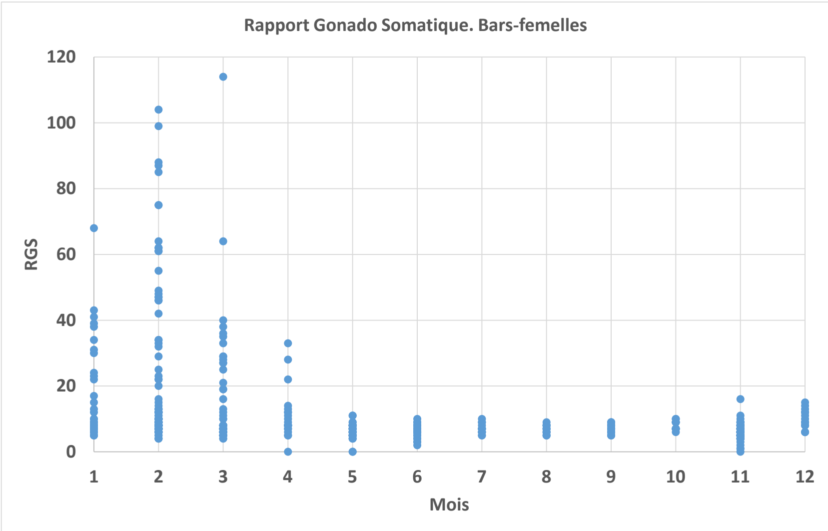


Figure 4.2.13. Monthly evolution of the gonado–somatic ratio for females in BSS-8.ab from 2014–2015.

The choice of the period of selection of female individuals for the calculation of the size at first maturity must be made considering that all adults have begun the process of maturation. The analysis of the oocytes outside the reproductive period does not indicate if an individual will participate in reproduction regardless of size (C. Fauve, pers. comm.). The targeted period January–April, based on the monthly results of gonado–somatic reports, was appropriate to the study of the size at first sexual maturity of females.

4.2.2.2.2 Validation of macroscopic readings using microscopic analysis

In order to validate the macroscopic evaluation of the stages carried out at the laboratories of Brest and Lorient, microscopic observations of female gonads taken during the full breeding period (January–April) were made (Figure 4.2.14).

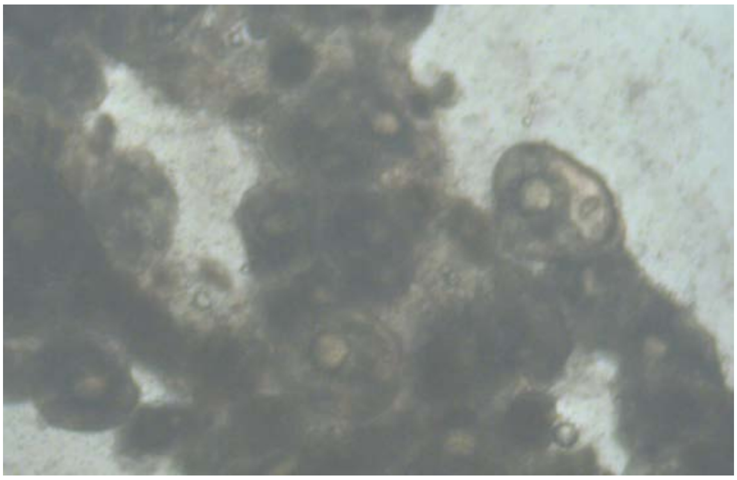


Figure 4.2.14. Example of microscopic observation of a female Stage V of 41.7 cm caught on 28th January 2015. Oocyte size is 0.690 micrometres.

The chronological relationships between seasons, the evolution of ovarian maturity, and the different stages of oocyte development are shown in Figure 4.2.15 (Mayer *et al.*, 1988; 1990).

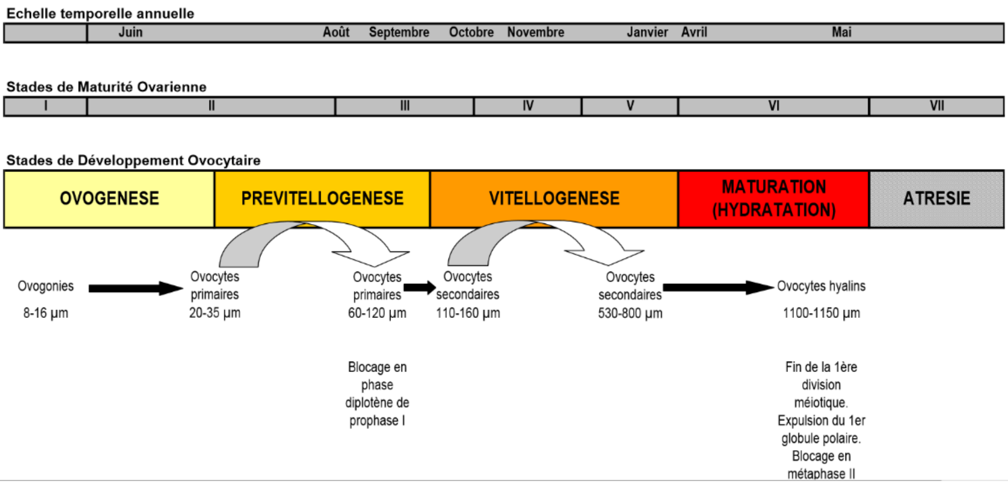


Figure 4.2.15. The chronological relationships between seasons, the evolution of ovarian maturity, and the different stages of oocyte development of the sea bass.

Each of the stages (I to VII) is characterised by a specific oocyte diameter and a change in the state of the cells (ovogenesis, previtellogenesis, vitellogenesis, maturation, and atresia). The onset of vitellogenesis is linked to a sudden drop in temperature if the photoperiod is adequate.

Stage III of the grid used corresponds to slightly translucent oocytes representing the very beginning of vitellogenesis. An in-depth study with the participation of Ifremer aquaculture scientists specializing in the reproduction of sea bass shows that a female Stage 3 female found in full breeding period will not participate in breeding. As a result, females that are only in stage III during the breeding season will not breed in the current year, so will not reproduce until the following breeding period. Conversely, a female identified in stage IV (vitellogenesis) at the time of the reproduction period, will finish its maturation and spawn before the end of the current spawning period. However, its egg production will be of average quality.

4.2.2.2.3 Relationship between the size and maturity of sea bass

Figure 4.2.16 shows all the data collected by sex and allows the visualisation of the maturity stages observed by size regardless of the season. Stage III is observed at similar sizes for males and females (34 cm). However, few females <40 cm have a gonado–somatic ratio predicting reproductive participation, while many males <36 cm have stages of maturity between IV and VI and important Gonado–Somatic Ratio. Females appear to show the first signs of development of their gonads at 34 cm, but cannot participate effectively in reproduction until 40 cm (stages V and VI). This finding is similar to the literature where males appear mature to a smaller size than females (Pickett and Pawson, 1994).

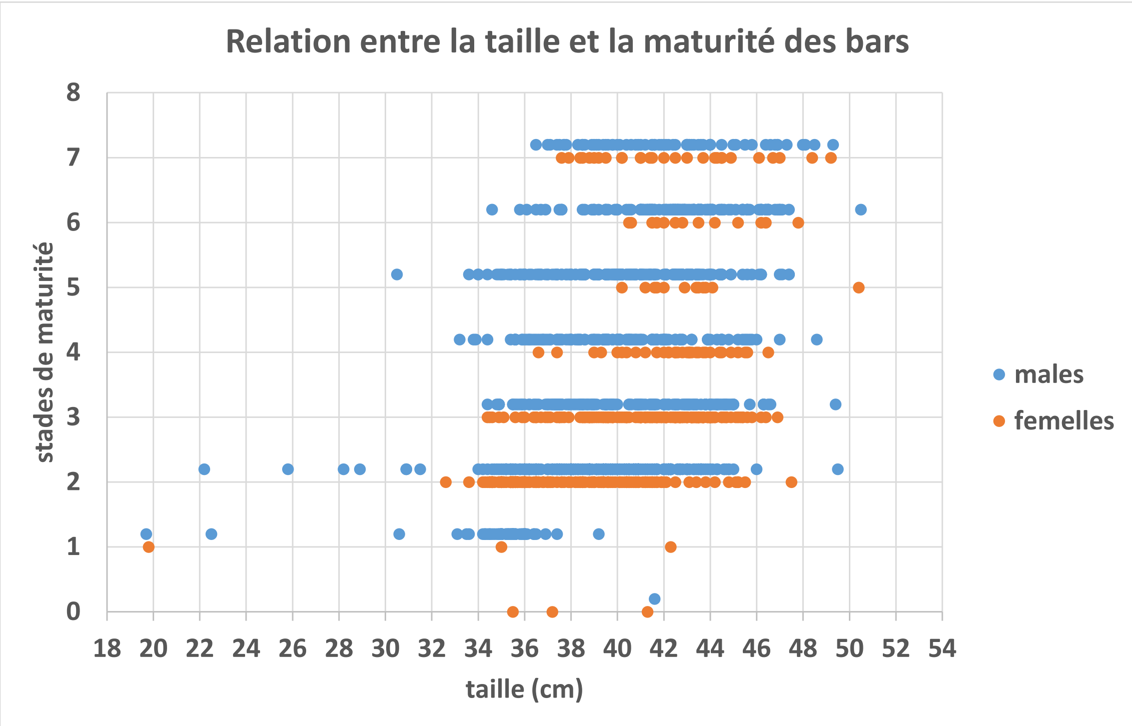


Figure 4.2.16. Relationship between the size and stage of maturity of sea bass in BSS-8.ab.

4.2.2.2.4 Determination of a size at first maturity (for which 50% of the females are mature)

A logistic regression model has been fitted using a GLM (Generalized Linear Model) with a binomial distribution to model the probability of being mature using R (© CRAN) (Figure 4.2.17) and leads to the following maturity ogive:

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 is 42.14 cm (41.31 cm - 43.08 cm). The Pearson test shows a good fit to the data (p= 0.5967).

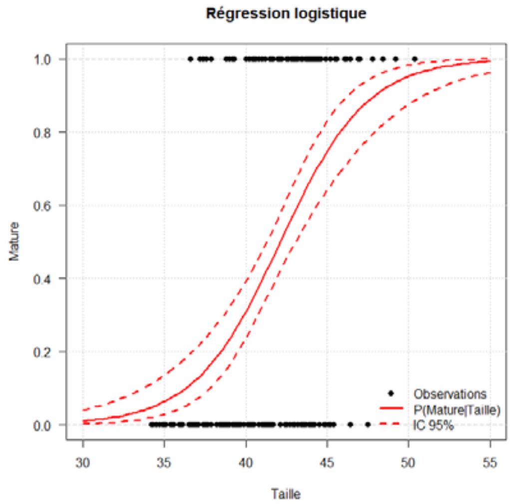


Figure 4.2.17. Maturity ogive of female sea bass over the period January–April, stages 4,5,6,7.

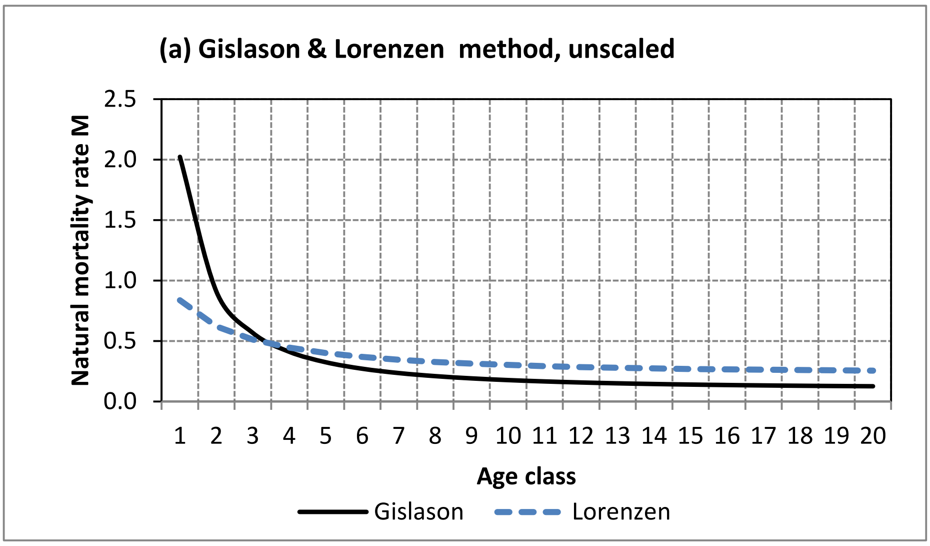
Thus, these results indicate the size at which 50% of the females are mature is in the order of 42 cm. The study has been done over a short period (two years), but results were not different from the older studies (Dorel, 1986; Stequert, 1972).

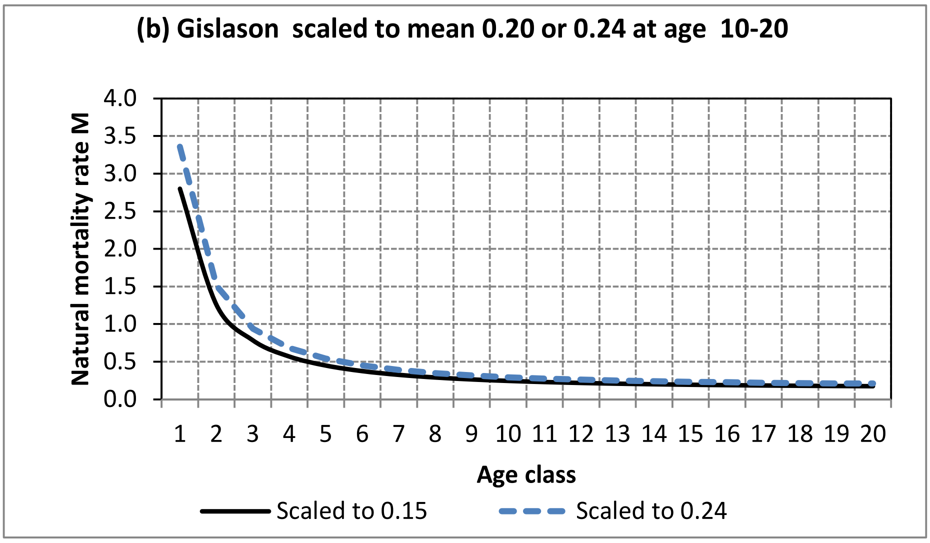
4.2.3 Alternative life-history inferences of M-at- age

As for the stock in Area 4 and 7 (BSS-47) described in Section 3.2, M-at-age has been explored using different scenario (Table 4.2.4). Scaling of the Lorenzen (1996) method was also assessed (Figure 4.2.18).

Table 4.2.4. Life-history inferences of natural mortality in sea bass in the Bay of Biscay.

Source	Formulation	Combined sex M		
		tmax22	tmax 21	tmax20
Hoenig 1983	variety of taxa ln(M) = 1.44-0.982*ln(tmax);	0.203	0.212	0.223
	teleosts ln(M) = 1.46-1.01*ln(tmax)	0.190	0.199	0.209
	M= 4.899*tmax^-.916 (from 226 species)	0.289	0.301	0.315
Then *et al* 2015	M= 4.118*K^0.73. Linf^-0.33	0.229		
Alverson and Carney 1975	M = 3k/(exp(0.38*tmax*k)-1)	0.190	0.205	0.222
Pauly 1980	M=exp(-0.0152+0.6543*ln(k)-0.279*ln(Linf,cm)+0.4634*lnT(oC))	0.252	TdegC=	12
		0.271	TdegC=	14
		0.288	TdegC=	16
Ralston 1987	M=0.0189+2.06*k	0.305		
Beverton 1992	M=3k/(exp(*am* *k)-1) am = age at 50% maturity	0.320	female *am* ; comb sex k	
		#DIV/0!	male *am* , comb sex k	
Jensen (1997)	M=1.5K	0.209		
			Gislason	Lorenzen
Gislason 2010	M = exp(0.55-1.61*Ln(L) + 1.44* Ln (Linf)+ Ln(K))	age 1	2.024	0.837
Lorenzen	M=3*W^-0.288	age 3	0.567	0.511
		age 5	0.325	0.400
	Gislason: L = length at age from VBGF	age 7	0.235	0.345
	Lorenzen: W = mean wt at age from 2016 WGCSE SS3 run	age 9	0.191	0.313
		age 15	0.140	0.270
		age 20	0.126	0.256





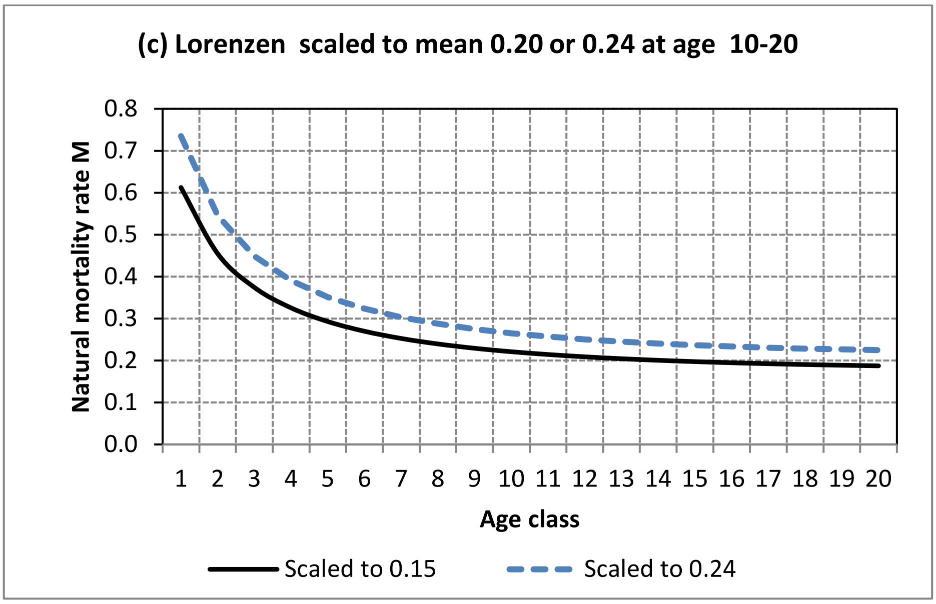


Figure 4.2.18. BSS-8.ab sea bass M-at-age estimated using the Gislason *et al.* (2010) and Lorenzen (1996) methods – a) unscaled values; b) Gislason *et al.* (2010) scaled to 0.20 and 0.24 at ages 10–20; and c) Lorenzen (1996) scaled to 0.20 and 0.24 at ages 10–20.

4.3 ToR 3: Describe the history of fishery management regulations and actions that are expected to have caused changes in the quality of fishery catch data or the selectivity patterns of fisheries that are of relevance for the scientific assessment of the stocks and provision of advice

A minimum landing size (MLS) was set at 36 cm by the community regulation from 1990 (Forest, 2001). A landings limit was put in place in 1996 from January to April for all trawlers (2 t per vessel per week) and increased to 5 t per vessel per week in 1999. Mesh size of 70 mm and 80 mm for netters was set by the EU in 2000. Sea bass are not subject to EU TACs and quotas and the minimum landing size (MLS) of sea bass in the Northeast Atlantic is 36 cm total length. A variety of national restrictions on commercial sea bass fishing are also in place including:

- A historical limit of 5 t per vessel per week for French and UK trawlers landing sea bass was implemented, but was not based on a biological reference point. In France from 2012, following the implementation of a national licensing system for commercial gears targeting sea bass, the landings limits changed slightly depending on season and gear[4]. However, this did not limit total landings, as observed from the large increase in landings in 2014.
- A licensing system was implemented from 2012 in France for commercial gears targeting sea bass in order to fix the level of the French commercial fishery. This set a mesh size for pelagic trawlers and netters of 100 mm, but was effective prior to the licensing system.
- A voluntary closed season from February to mid-March for longline and handline sea bass fisheries in Brittany, France was implemented.

[4] www.comite-peches.fr/wp-content/uploads/B17-2015_Bar-Cadre1.pdf

- An MLS of 42 cm for the recreational fisheries was implemented in 2013 by the French association of anglers (JORF 0258, 2012).

4.4 ToR 4: Develop time-series of (commercial and recreational) fishery catch estimates, including both retained and discarded catch, with associated measures or indicators of bias and precision

4.4.1 Commercial fishery landings in BSS-8.ab

4.4.1.1 Total Landings

Sea bass in the Bay of Biscay is exploited mainly by France with over 96% of landing by the French fleet in 2015. This fleet is comprised of artisanal line fisheries (vessel size 8–10 m), nets, pelagic trawlers, and mixed bottom-trawl fisheries. In 2015 nets represented 35% of the landings mainly through targeting the spawning aggregations. Handlines and longlines represented 26%, bottom trawl 16%, and pelagic trawl 8% of landings. Pelagic trawlers took around 25% of the landings of the area from 2000–2008, but this has decreased to 9% and was mainly in the Channel before 2015. A high increase in the French landings by the net fishery was observed from 2011 during winter in spawning areas. An average of 585 t during the period 2000–2012 was landed. Landings in 2013 and 2014 were 834 and 1131 t, respectively. The main reason was the decrease of sole quotas from 2011 and increasing effort on sea bass. Sea bass had become more targeted, combined with good weather condition in 2014, and an improvement in nets fishing techniques on this species. In 2015, a decrease in landings for all gears (except purse-seiners) is observed. French landings by métier are presented in Table 4.4.4 and Figure 4.4.4.

Before 2000, little information on French landings for each gear is available, but there are some differences between 1985 and the period 2000–2015, especially with the high increase of midwater trawlers (more than 60 pairtrawlers were fishing at this time between 1985 and 1995) in the Bay of Biscay or the Channel. Spain was responsible for 3% of the landings of the area (8.b) in 2015, mainly from bottom trawlers. Spanish sea bass landings from BSS-8.ab have increased from around 20 t in the 1990s to around 150 t in the mid-2000s, reaching a peak of 317 t in 2011. Landings were 71 t in 2015. An overview of international landings is presented in Figure 4.4.1 and Table 4.4.1. The spatial distribution of French landings from 2000 onwards appears to be stable across years (Figure 4.4.2).

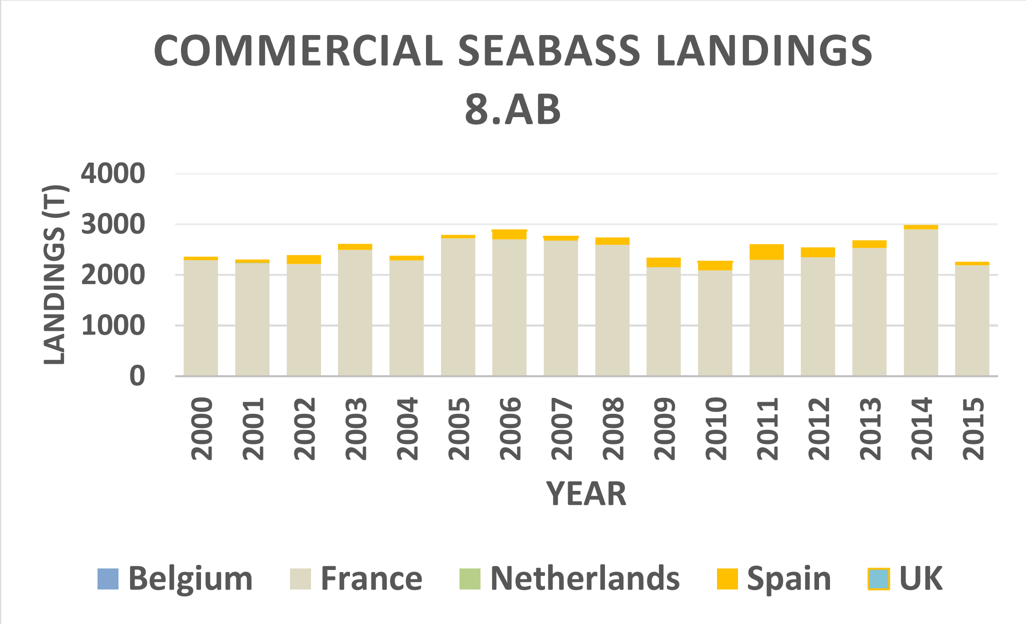


Figure 4.4.1. European landings in the Bay of Biscay (source WGBIE 2016).

Table 4.4.1. European landings in the Bay of Biscay (source WGBIE 2016)

VIIIab	Belgium	France	France	Netherlands	Spain	Spain	UK(Eng+Wales +N.Irl+Scotland)
Source	official stats	official stats	Ices stats	official stats	official stats	Ices stats	official stats
1978	0	1146	1146	0	0		0
1979	0	1132	1132	0	0		0
1980	0	1086	1086	0	0		0
1981	0			0	0		0
1982	0			0	0		0
1983	0	1363	1363	0	0		0
1984	0	2886	2886	0	0		0
1985	0	2477	2477	0	0		0
1986	0	2606	2606	0	0		0
1987	0	2474	2474	0	0		5
1988	0	2274	2274	0	0		15
1989	0	2201	2201	0	0		0
1990	0	1678	1678	0	0		0
1991	0	1774	1774	0	17		0
1992	0	1752	1752	0	14		0
1993	0	1595	1595	0	14		0
1994	0	1708	1708	0	17		0
1995	0	1549	1549	0	0		0
1996	0	1459	1459	0	0		0
1997	0	1415	1415	0	0		0
1998	0	1261	1261	0	27		0
1999	0	0	2080	0	11		0
2000	0	2080	2295	0	67		0
2001	0	2020	2238	3	68		0
2002	0	1937	2216	0	176		0
2003	0	2812	2497	0	119		0
2004	0	2561	2284	0	96		0
2005	0	3184	2722	0	74		0
2006	0	3318	2707	0	168		2
2007	1	2984	2677	0	74	90	1
2008	0	1508	2600	0	145		0
2009	1	2339	2152	0	194	126	0
2010	0	2322	2089	0	165	140	2
2011	1	2295	2297	0	311	278	0
2012	0	2325	2348			201	
2013	0		2532	0		153	0
2014	0	2900	2900	0	91	91	0
2015*	0	2193	2193	0	71	71	0

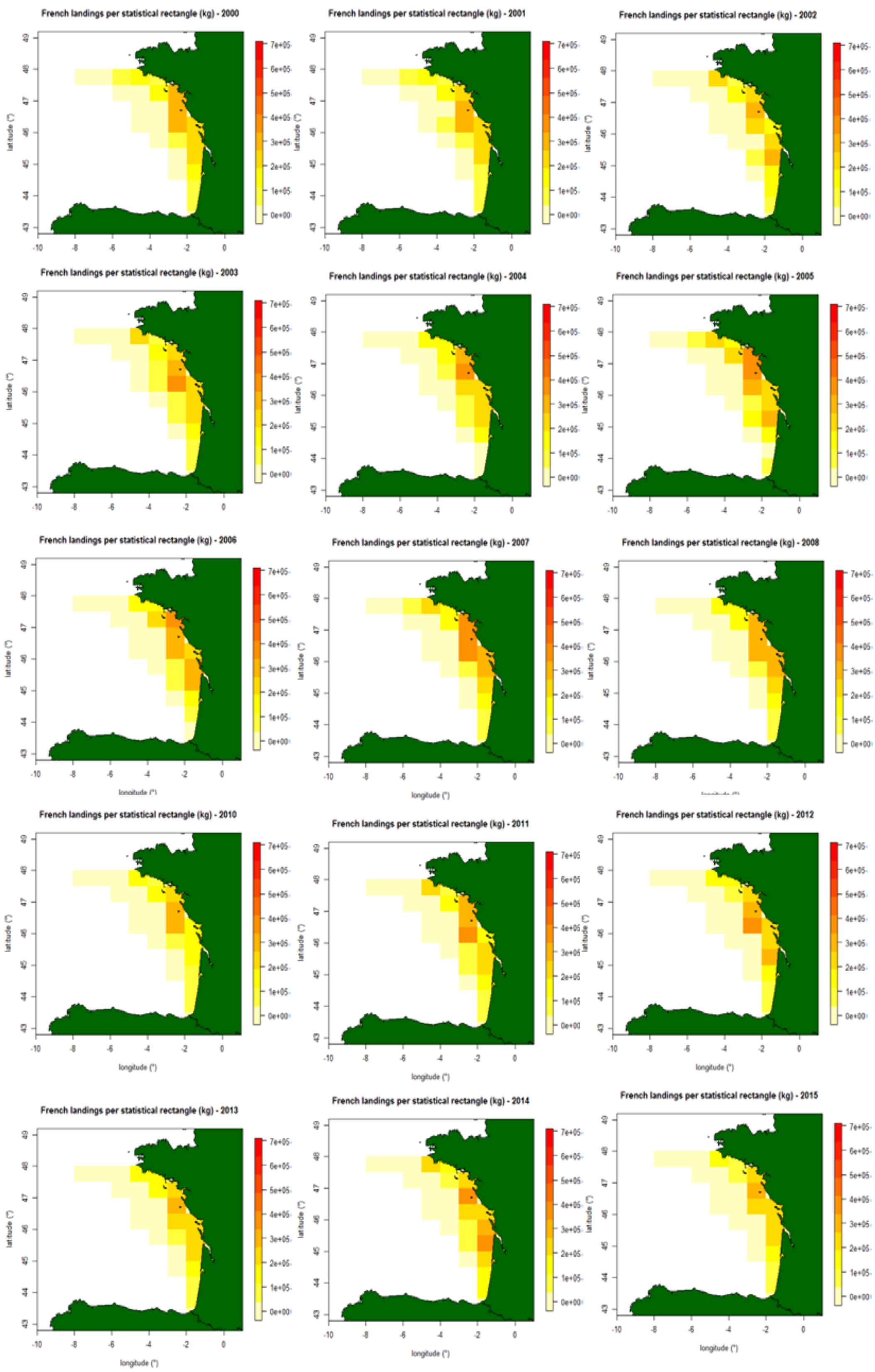


Figure 4.4.2. Annual spatial distribution of French sea bass landings from BSS-8.ab since 2000.

4.4.1.2 French landings by métier

Figure 4.4.3 presents monthly landings averaged over the period 2010–2014. The period from November to February represents a high percentage of total landings, with some métiers targeting sea bass during spawning period (netters for example).

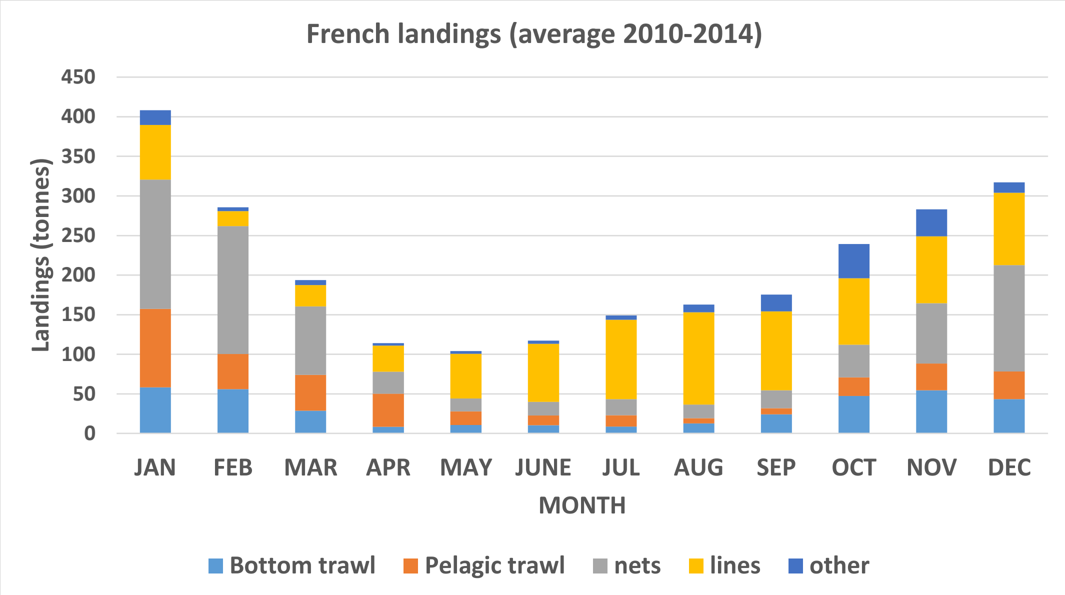


Figure 4.4.3. Monthly landings for each métier in BSS-8.ab averaged over the period 2010–2014).

French landings by métier show a decline in pelagic trawl landings since 2008 and an increase in landings by nets and "other gears" (Figure 4.4.4). Bottom-trawl and lines landings have varied without much trend.

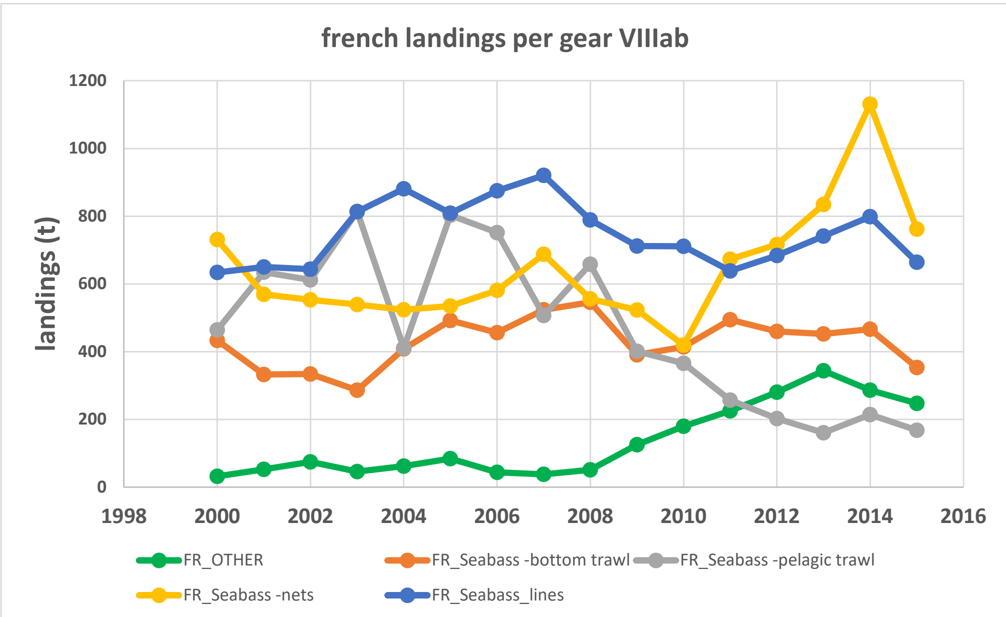


Figure 4.4.4. French landings in tonnes in BSS-8.ab by gear type.

4.4.1.3 Spanish landings by métier

Some data from the ICES InterCatch database are available for landings by gear for Spanish commercial fisheries, but these are small compared with the French fishery (Table 4.4.2).

Table 4.4.2. Official Spanish landing by gear in BSS-8.ab. Source InterCatch.

Landings SPAIN-Source Intercatch	*2013*	*2014*	*2015*
GNS_DEF_>=100_0_0			1
GNS_DEF_60-79_0_0			
LLS_DEF_0_0_0			
MIS_MIS_0_0_0_HC	31		
OTB_DEF_>=70_0_0	59	45	41
OTB_MCF_>=70_0_0	35	42	22
PS_SPF_0_0_0			1
PTB_DEF_>=70_0_0	27		5
Total	153	87	71

4.4.1.4 Quality of Landings data 8.ab

Landings series are available from three sources:

i) Official statistics recorded in the FishStat database since around the mid-1980s (total landings).

ii) French landings for 2000–2015 from a separate analysis by Ifremer of log-book and auction data. Landings are available per métier.

iii) Spanish landings for 2007–2011 from sale notes and for 2012–2015 from official statistics.

The official landings data for sea bass available are subject to several uncertainties that could affect the accuracy of assessments:

- Incomplete reporting of landings in the 1970s and early 1980s when the fisheries were developing.
- Poor reporting accuracy for small vessels that do not supply EU logbooks.

Historic landings of sea bass recorded in France (CAAM) for the period 1989–1997 do not account for sea bass sold outside auction markets which can be very important. The conditions of exploitation of sea bass are very difficult to follow. The data that would enable an assessment are not available or too old (more than ten years). Knowledge of landings is incomplete (sales outside the auction, recreational fisheries). Only a few samples of the landings of the various métiers occurred and cannot be extrapolated to the total catches (A. Forest, pers. comm.).

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 ground. The time-series for each component fishing ground therefore has a step change around 2000. The definition of all the fishing trips of the French fleet with their associated features is based on a cross-validation tool: SACROIS of the different declarative sources aiming to provide the best possible fishing statistics data. SACROIS is a validation tool for the fisheries statistics, aiming at cross-checking data from different declarative sources, as demanded in article 145 of the EU control Regulation (EC Reg. 404/2011). The application is cross-referencing information, at the most disaggregated level, from the fishing fleet register, logbooks, monthly declarative forms (for vessels less than 10 m without logbooks declarative forms adapted to the special features of the small-scale coastal fisheries), sales notes data, VMS data and the scientific census of fishing activity calendars (activity survey). From this, it builds a dataset compiling the most accurate and complete information for each individual fishing trip. The application verifies and controls the different sources of data, with the aim of displaying validated and qualified landings per species and effort dataseries. The application also provides several quality indicators and evaluates the completeness of the data flows. A specific algorithm is included in this application to estimate the value of landings based on sales note data available (sometimes directly derived from them) or estimation of an average price. For some fleet segments, estimated price based on expert knowledge is used to calculate the value. The allocation of métiers to a fishing trip is also included in the SACROIS tool and is based on the dominant landed species (or group of species) in value, the activity calendar survey of the vessel considered, and the gear registered. The methodology to determine the dominant landed species (or group of species) is based on the raw ordination of the landed species. The quality of French official landings data can be considered as robust from 2000 onwards (Figure 4.4.5).

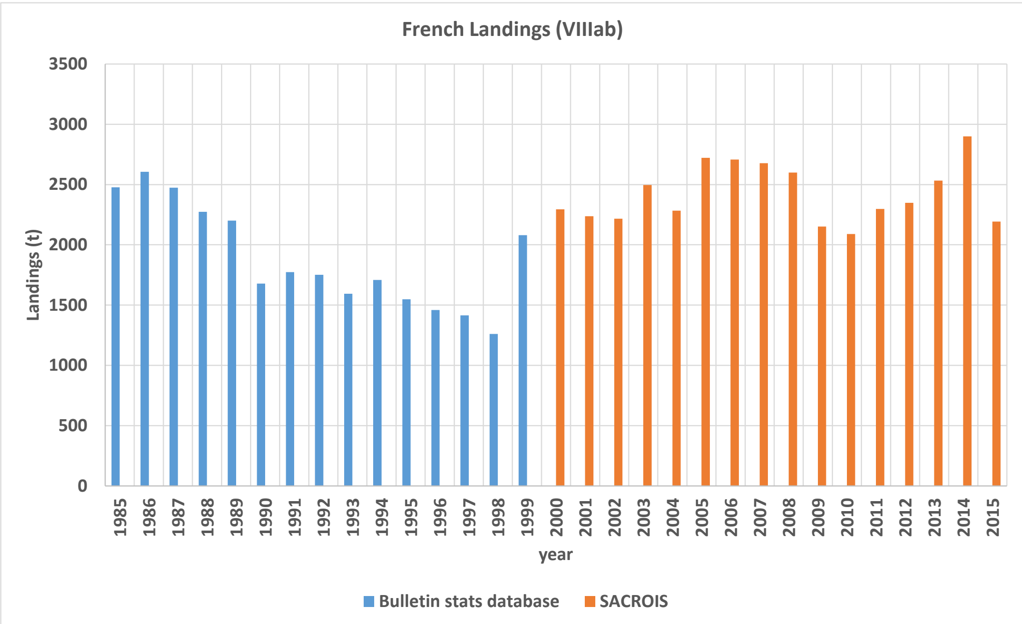


Figure 4.4.5. French Landings (Bulletin stats 1985–1999; SACROIS 2000–2015).

4.4.2 Discards estimates

4.4.2.1 French Survey design and analysis

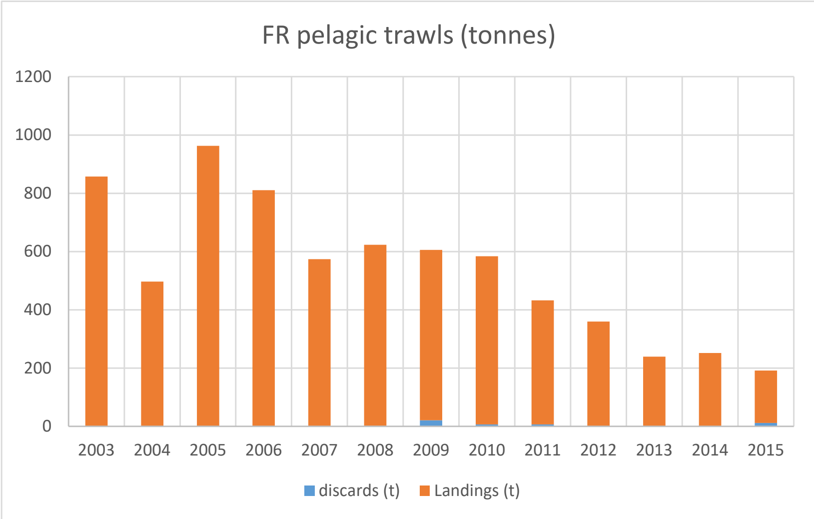
The French sampling schemes use a vessel list sampling frames and random selection of vessels within strata defined by area and fleet sector. From the activity calendars of French vessels for year n-1, vessels are grouped by métier. Thus, a vessel may belong to multiple groups if practicing several métiers in the period. If the métier 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 métier are sampled. Optionally, if the vessel practises several métiers during the trip, fishing operation of the other métiers will also be sampled if the métier is included in the annual sampling plan. If the métier is not part of the plan, it is requested to sample at least one fishing operation of this métier 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).

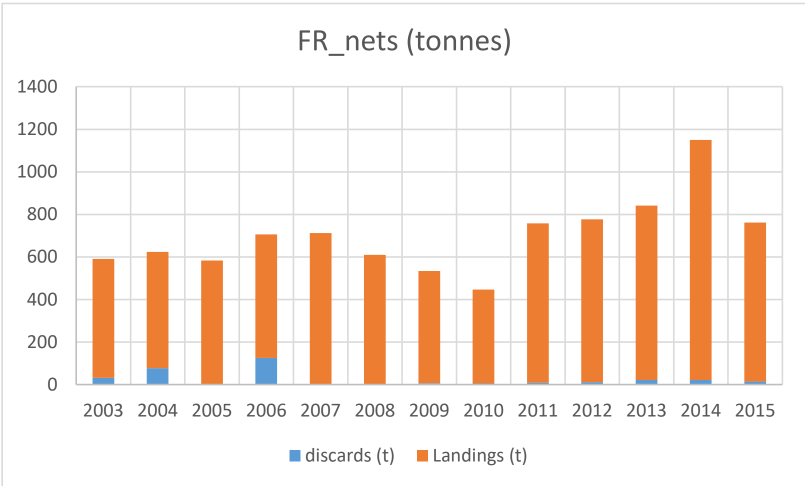
4.4.2.2 Data coverage and quality

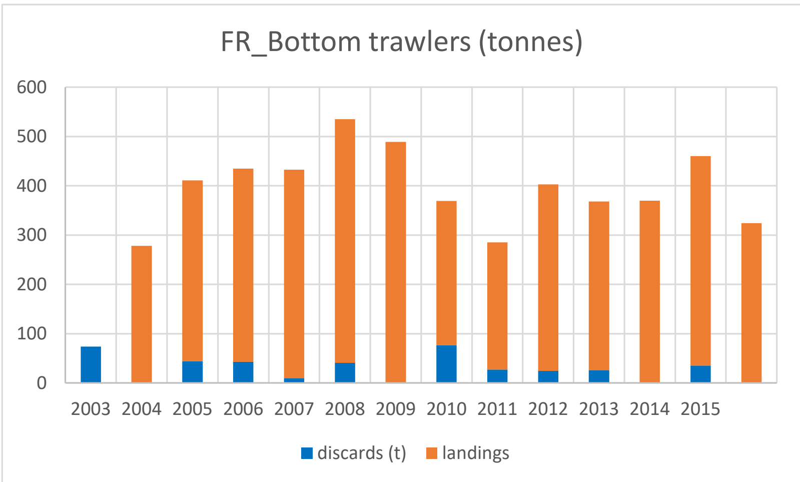
Discards data are available for French fleets from 2003 onwards. Discarding of sea bass by commercial fisheries can occur where fishing takes place in areas with sea bass smaller than the minimum landing size (36 cm). Precision is low at current sampling rates. Weighting and raising of France discards estimates was carried out using COST tools, which have limited flexibility to match raising procedures to the sampling stratification, including where vessels are stratified by LOA. There is therefore a large potential for bias in the discards estimates. As in BSS-47, discards rates in France are relatively low with the MLS of 36 cm, and the highest rates is found for bottom trawlers. (Table 4.4.3 and Figure 4.4.6).

Table 4.4.3. Estimated discards (tonnes) of French vessels in BSS-8.ab.

	Discards (average 2003-2015, t)	Landings (average 2003-2015, t)	% discards (2003-2015)
FR_pelagic	3.9	533.8	1%
FR_nets	25.3	674.4	4%
FR_lines	13.5	819.3	2%
FR_bottom trawlers	40.1	371.9	11%
FR_others	4.9	76.7	6%
FR_total	87.7	2476.1	4%


FR pelagic trawls (tonnes)
1200
1000
800
600
400
200
0
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
discards (t)
Landings (t)


FR_nets (tonnes)
1400
1200
1000
800
600
400
200
0
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
discards (t)
Landings (t)


FR_Bottom trawlers (tonnes)
600
500
400
300
200
100
0
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
discards (t)
landings

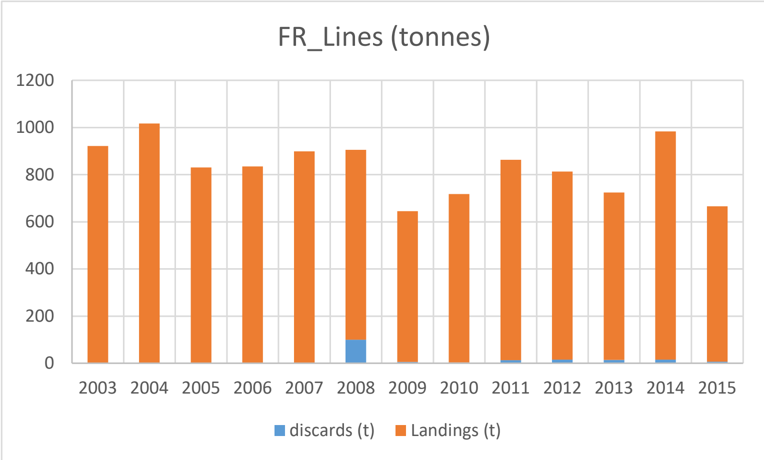


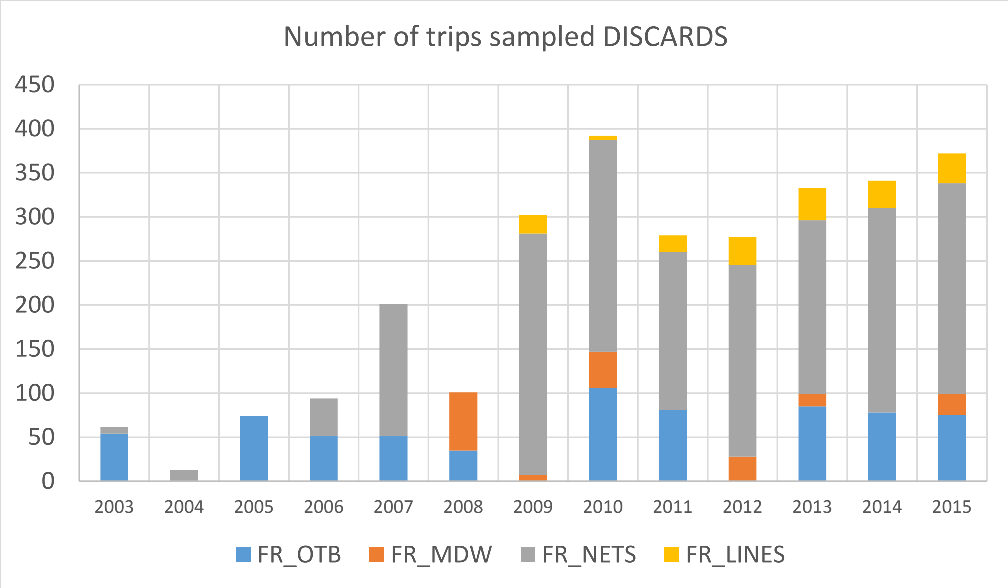
Figure 4.4.6. Discards and landings for each métier in French fleet in BSS-8.ab.

Tables 4.4.4. French annual discards estimate by gear and year, and total landings which have been raised (these can differ from official landings because of the stratification used). The CV (relative standard error) of the estimates is derived using COST tools.

Pelagic trawl FR 8.ab provisional				
Year	Discards (t)	Landings (t)	Discard rates	CV indicator
2003	0.0	857.3	0.0%	NA
2004	0.0	496.7	0.0%	NA
2005	0.0	963.1	0.0%	NA
2006	0.0	810.6	0.0%	NA
2007	0.0	573.7	0.0%	NA
2008	2.0	621.0	0.3%	3.93
2009	21.2	584.3	3.6%	0.05
2010	7.4	577.0	1.3%	0.71
2011	7.2	425.5	1.7%	0.12
2012	0.9	359.3	0.2%	2.38
2013	0.3	239.3	0.1%	2.00
2014	0.0	251.9	0.0%	NA
2015	11.7	180.2	6.5%	0.03
Nets FR 8.ab provisional				
Year	Discards (t)	Landings (t)	Discard rates	CV indicator
2003	31.7	559.1	5.7%	1.20
2004	77.6	546.2	14.2%	0.10
2005	0.0	584.2	0.0%	NA
2006	125.5	580.8	21.6%	0.34
2007	2.2	709.8	0.3%	0.61
2008	0.5	609.1	0.1%	0.79
2009	6.4	527.7	1.2%	0.41
2010	6.1	440.7	1.4%	0.29
2011	9.0	748.8	1.2%	0.35
2012	11.8	765.4	1.5%	0.55
2013	21.6	820.4	2.6%	0.18
2014	21.7	1128.0	1.9%	0.11
2015	14.7	746.8	2.0%	0.20

Lines FR 8.ab provisional				
Year	**Discards (t)**	**Landings (t)**	**Discard rates**	**CV indicator**
2003	0.0	922.2	0.0%	NA
2004	0.0	1017.1	0.0%	NA
2005	0.0	831.2	0.0%	NA
2006	0.0	835.6	0.0%	NA
2007	0.0	899.2	0.0%	NA
2008	100.3	805.3	12.5%	0.35
2009	5.6	639.9	0.9%	0.71
2010	3.9	714.2	0.5%	1.24
2011	13.1	850.8	1.5%	0.35
2012	15.8	798.2	2.0%	0.26
2013	14.2	710.5	2.0%	0.45
2014	15.8	968.1	1.6%	0.40
2015	7.4	658.9	1.1%	0.32
Bottom trawl FR 8.ab provisional				
Year	**Discards (t)**	**Landings (t)**	**Discard rates**	**CV indicator**
2003	73.8	278.3	26.5%	0.35
2004	NA	367.3	NA	NA
2005	43.9	391.9	11.2%	0.90
2006	42.9	423.3	10.1%	1.07
2007	9.6	494.3	1.9%	0.73
2008	40.7	489.4	8.3%	0.94
2009	NA	292.5	NA	NA
2010	76.6	258.3	29.7%	0.32
2011	27.2	378.4	7.2%	0.46
2012	24.5	341.7	7.2%	0.23
2013	26.3	369.8	7.1%	0.37
2014	NA	425.2	NA	NA
2015	35.4	324.6	10.9%	0.49
Other FR 8.ab provisional				
Year	**Discards (t)**	**Landings (t)**	**Discard rates**	**CV indicator**
2003	0.0	33.8	0.0%	NA
2004	6.6	33.6	19.7%	NA
2005	0.0	29.1	0.0%	NA
2006	0.0	29.2	0.0%	NA
2007	0.0	4.1	0.0%	NA
2008	0.0	0.0	0.0%	NA
2009	0.0	0.0	0.0%	NA
2010	0.0	36.5	0.0%	NA
2011	44.8	138.3	32.4%	5.97
2012	1.1	185.2	0.6%	0.25
2013	0.0	191.0	0.0%	NA
2014	0.0	134.6	0.0%	NA
2015	11.0	181.1	6.1%	0.58

Estimates for number-at-length for French discards are presented by métier in Figure 4.5.9 including number of trip and number of fish measured.



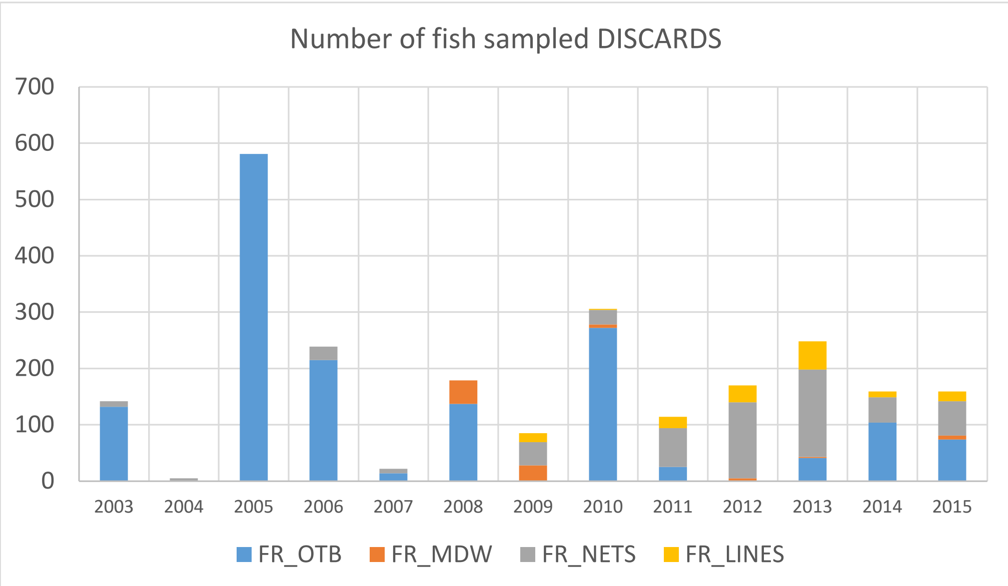


Figure 4.5.9. French observer scheme: numbers of fishing trips sampled and numbers of sea bass measured by gear type.

4.4.2.3 Spanish Discards

Observer data from Spanish vessels fishing in BSS-8.ab have shown there was no sea bass discard from 2003. No information in 2013, 2014 and 2015 were available on discards for WGBIE.

4.4.3 Recreational fishery catches and releases

The available recreational fishery survey estimates for sea bass in the Bay of Biscay are from French surveys carried out from 2009 to 2012 (see Section 3.4.3).

4.5 ToR 5: Estimate the length and age distributions of fishery landings and discards if feasible, with associated measures or indicators of bias and precision

4.5.1 French sampling of landings

4.5.1.1 Sampling methods and analysis

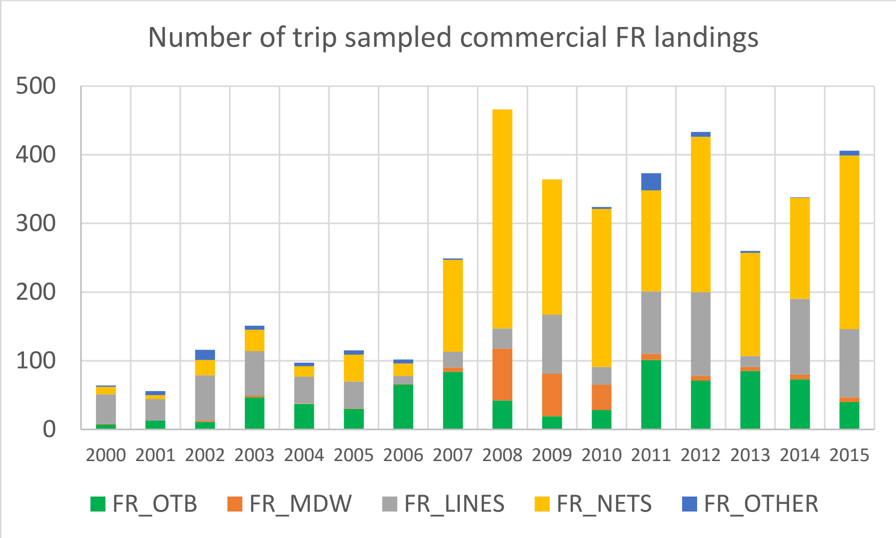
The French sampling programme for length compositions of sea bass landings covers sampling at sea and on shore. Since 2009, both sampling types are based on métiers composition and their relative importance to each fishing harbour and month. Both are also designed to sample the whole catch following 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.

4.5.1.2 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 (Table 4.5.1a–e).

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 Figure 4.5.1.



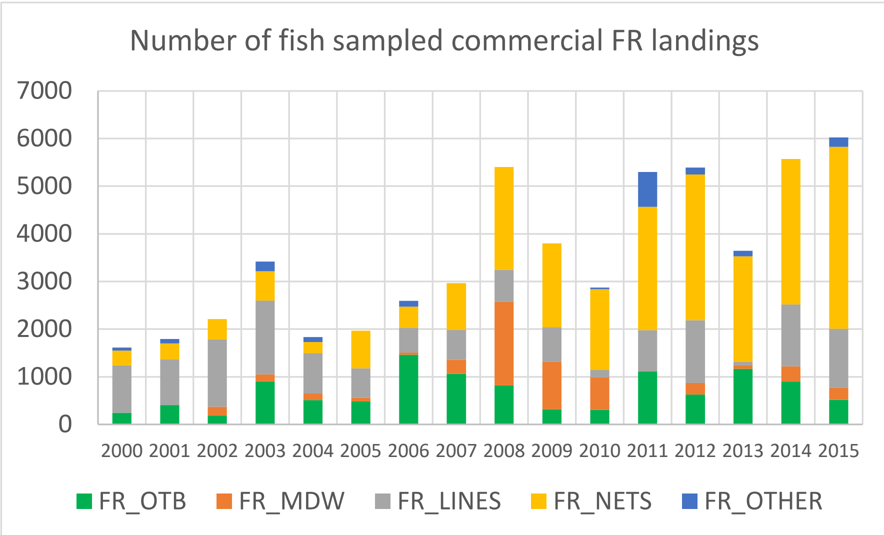


Figure 4.5.1. Sampling of landings of sea bass by France in Bay of Biscay (fishing trips and nos. sea bass measured) for French discard observations.

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.

4.5.1.3 French landings length compositions 8.ab

French length composition for 8.ab over time for all gears are presented in Figure 4.5.2 and disaggregated per métier in Figures 4.5.3–4.5.7 and Tables 4.5.1 a–e.

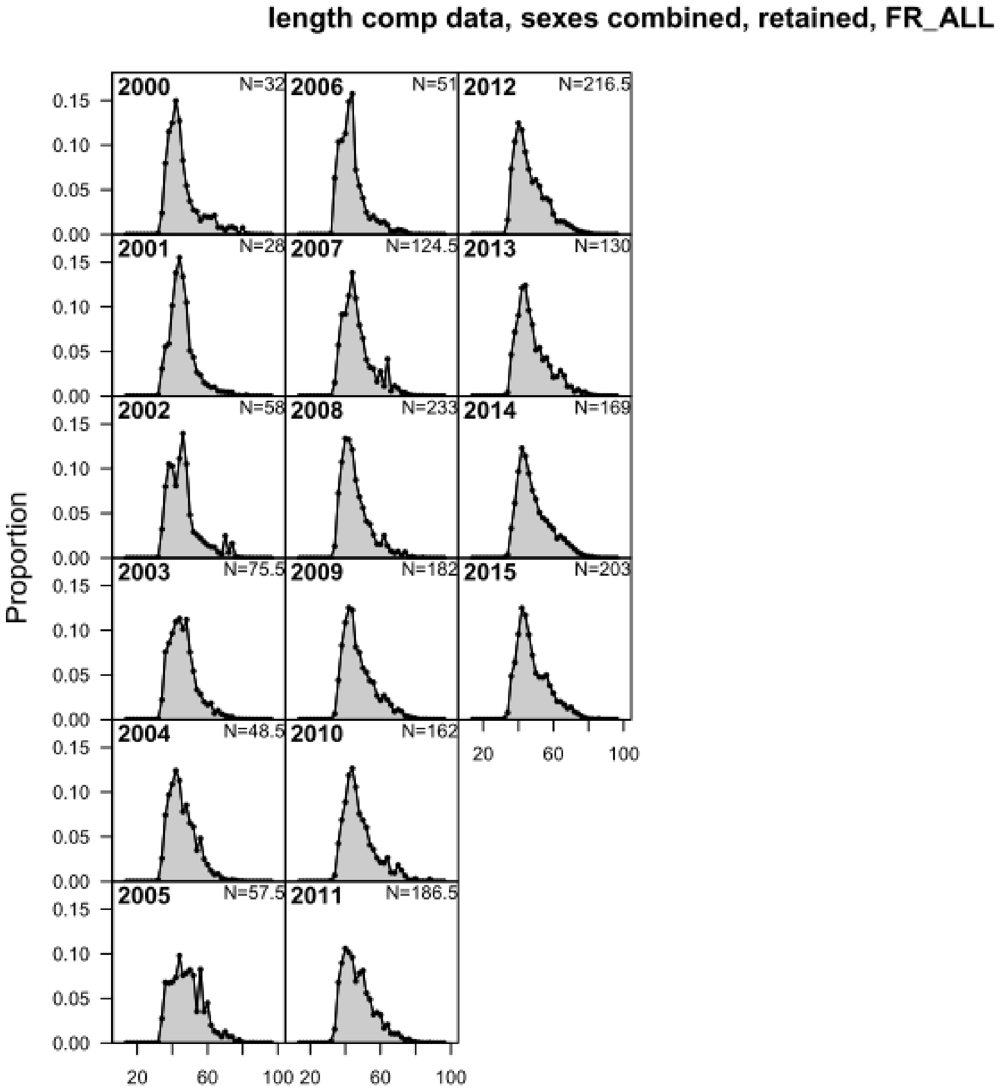


Figure 4.5.2. Length composition for the combined French fleet from 2000 onwards.

length comp data, sexes combined, retained, FROTB

Figure 4.5.3. Length composition for French bottom trawlers from 2000 onwards.

length comp data, sexes combined, retained, FRMWT

Figure 4.5.4. Length composition for French midwater trawlers from 2000 onwards.

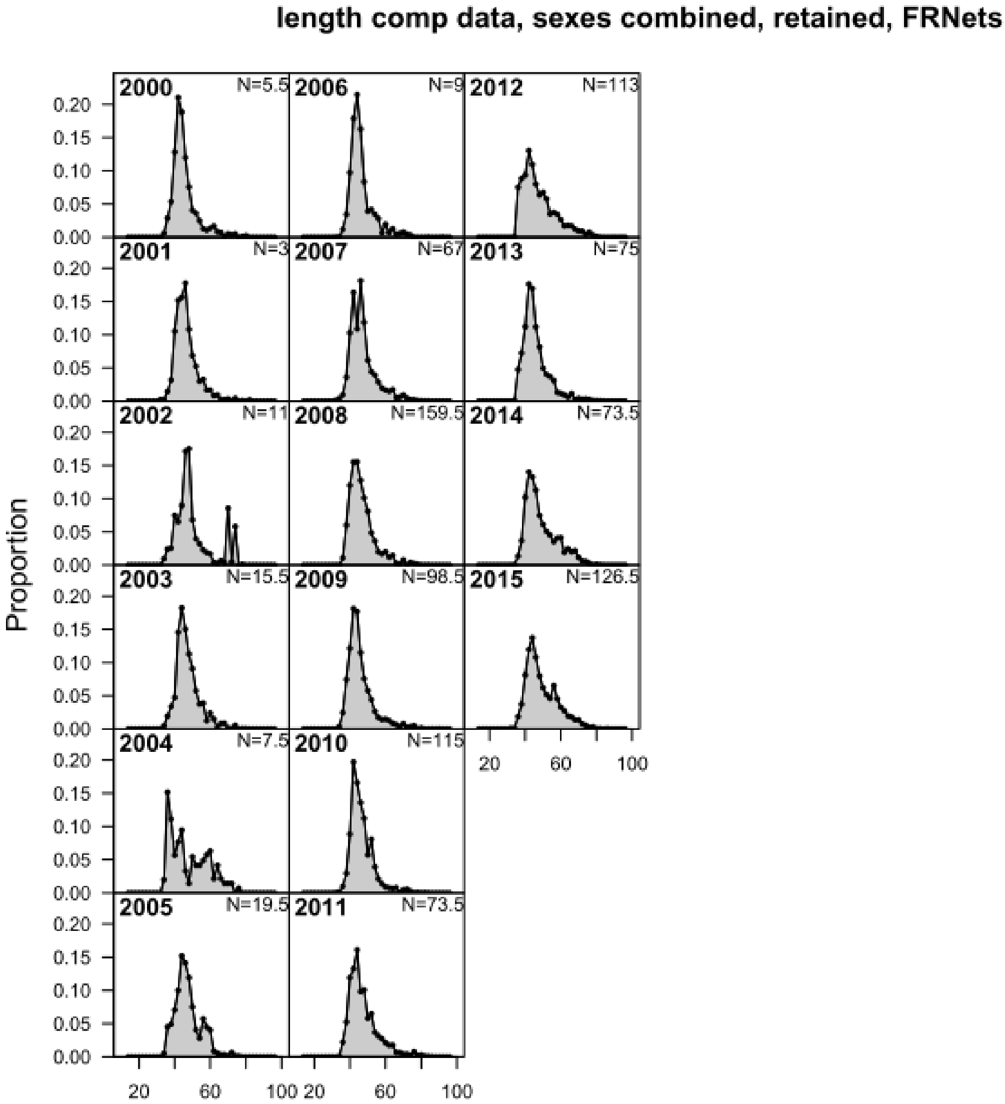


Figure 4.5.5. Length composition for French netters from 2000 onwards.

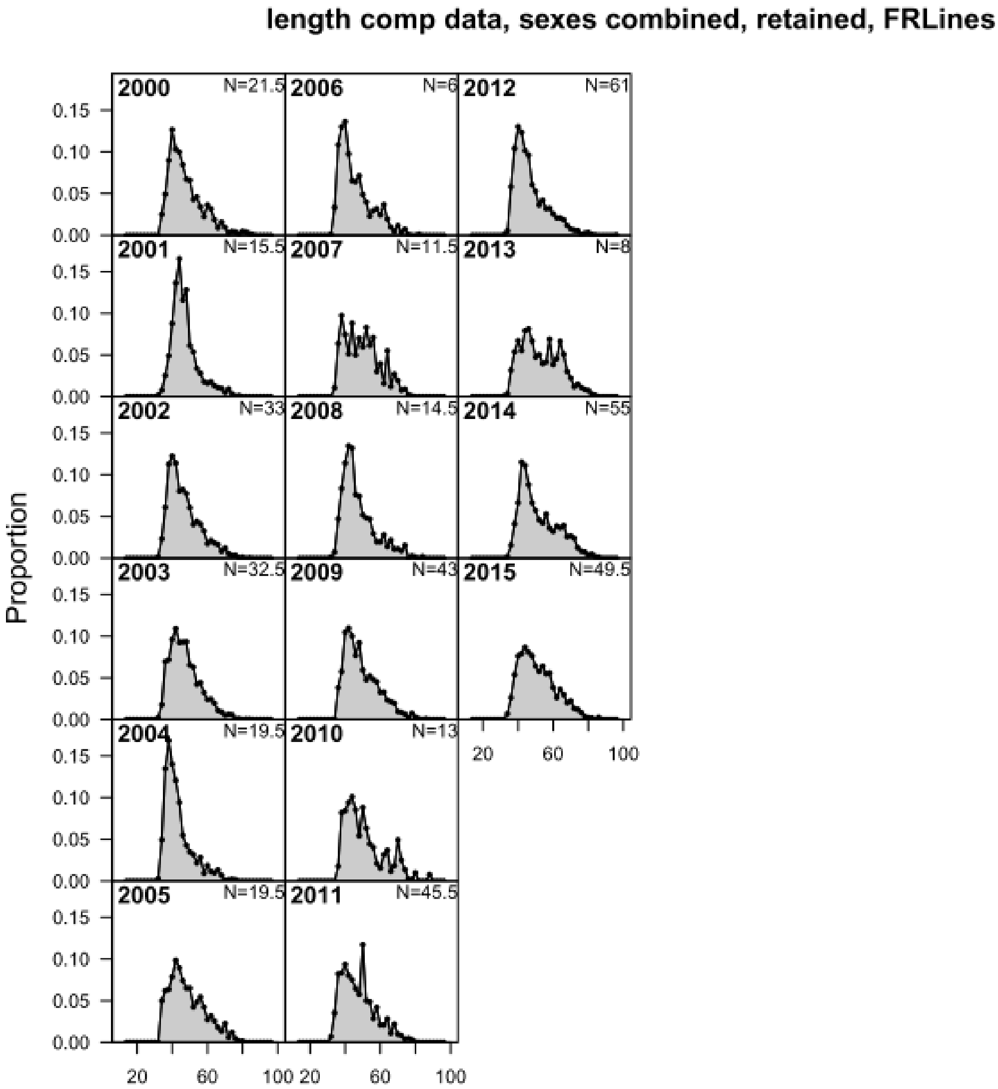


Figure 4.5.6. Length composition for French lines from 2000 onwards.

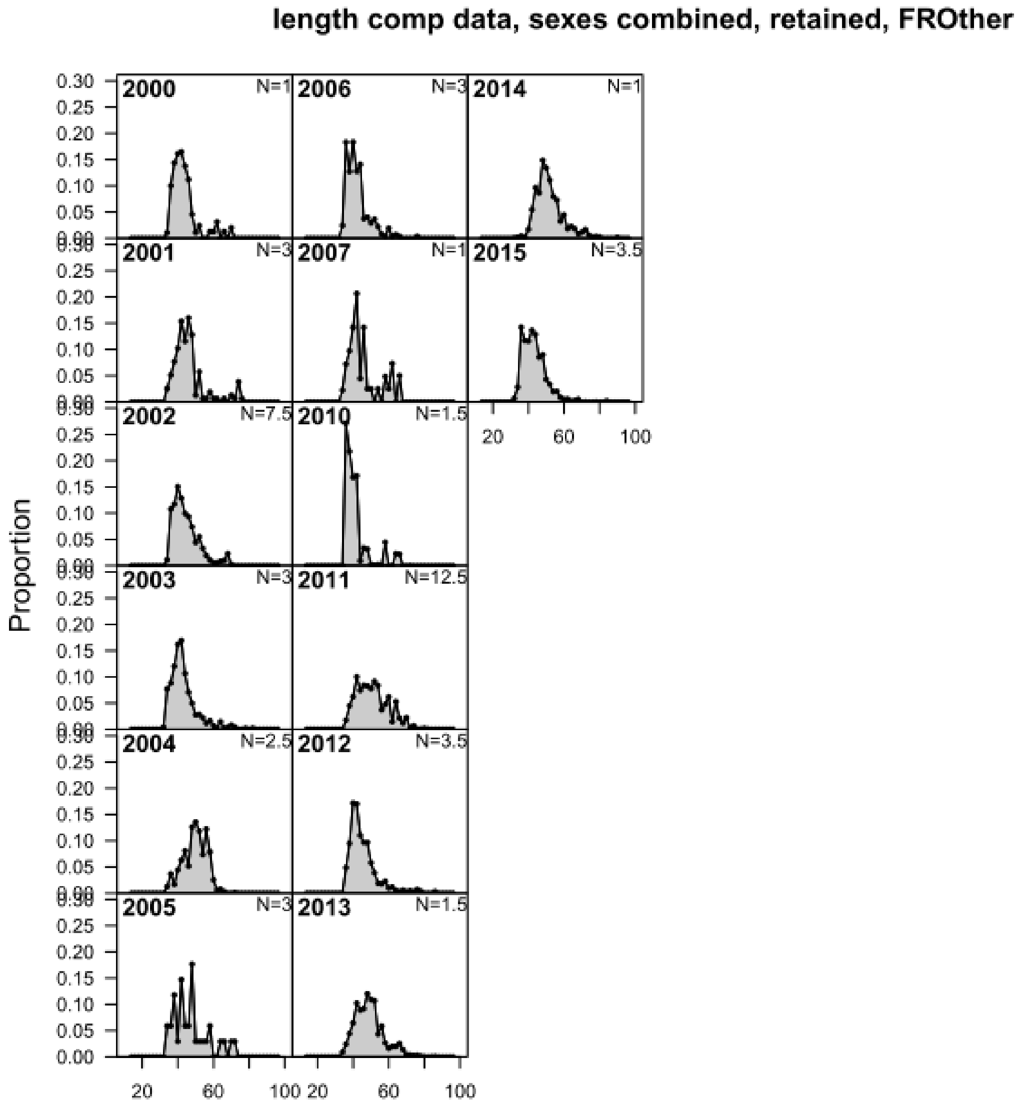


Figure 4.5.7. Length composition for French other from 2000 onwards.

Table 4.5.1. Sea bass raised number-at-length in French landings 2000–2015 in the Bay of Biscay for different gears (a–e).

a) Otter trawl

year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
gear	FR_OTB	FR_OTB	FR_OTB	FR_OTB	FR_OTB	FR_OTB	FR_OTB	FR_OTB	FR_OTB	FR_OTB	FR_OTB	FR_OTB	FR_OTB	FR_OTB	FR_OTB	FR_OTB
number of trip	7	13	11	47	37	30	65	84	42	19	28	101	71	85	73	40
number of fish	245	404	186	904	508	483	1462	1063	818	319	307	1116	626	1164	898	516
32	2881	218	1319	341	314	1165	1347	0	0	438	1305	245	0	556	519	0
34	30740	37544	40639	17773	0	23761	11027	25120	24287	6616	9346	7227	24081	2912	5821	2919
36	98885	56291	86058	38742	3497	79561	28872	84502	123942	35846	39012	68043	55202	28918	49641	26867
38	108294	39297	77444	58193	24083	73985	34149	100739	124122	63131	42907	77420	62746	41604	74011	33992
40	70238	42271	29016	39612	56284	54116	42934	74192	141358	57682	34254	60658	71097	36178	71890	51287
42	77133	43799	26378	30368	88669	33658	46155	63843	78417	53244	30362	38407	40376	42672	59070	69711
44	37373	52420	19783	20890	83521	51301	47439	63446	40222	39617	25100	27516	26713	38217	51036	46192
46	18272	35152	14508	23235	67453	28694	42096	32129	28836	21745	14451	24269	14688	24511	36226	38206
48	13185	23572	9232	31653	61889	8888	43467	23679	19221	13781	10988	20248	9089	20868	31188	17066
50	6000	6245	14508	16465	30350	6993	25149	16462	12497	5688	7063	14589	8133	10929	22603	11324
52	4255	5483	13189	4358	32560	6707	15348	9858	8017	4788	3652	11216	10836	12103	15169	9873
54	2593	5778	6594	7852	13051	6516	5628	6781	6225	3938	6568	7699	8802	11332	10754	4941
56	1818	2576	5276	4157	12089	5759	5137	6190	5805	2666	4429	7434	6276	10078	7560	5754
58	966	3343	6594	3218	4032	4425	9236	3811	4424	4376	3815	2799	11321	10748	5224	3520
60	2289	873	7913	2311	5987	2620	8250	3844	4434	1313	2719	4878	5486	6528	3893	3527
62	305	437	2638	1215	8396	6088	8679	3899	2807	875	3258	2638	1224	7040	3115	1865
64	1476	3429	1319	800	1718	2911	7840	3323	2593	1378	2707	2763	3973	5286	2336	2187
66	1442	873	0	343	2264	4639	1635	1375	1089	2239	2160	3506	3456	4393	3374	1433
68	2221	873	1319	1333	1256	2620	3930	5385	1846	875	1910	1711	1642	2614	1038	1198
70	865	1653	1319	323	2738	2717	2647	2024	2184	438	1040	2094	2061	2824	779	1649
72	865	779	1319	2813	0	1747	1088	1979	1846	875	2220	1619	921	1496	0	767
74	305	218	0	723	1482	1165	2688	1376	2601	1313	793	2316	1674	556	522	954
76	0	0	1319	162	628	1165	1669	1031	720	1313	1057	897	419	508	1557	664
78	0	0	0	0	539	291	601	687	1255	0	793	757	0	371	260	166
80	0	0	0	323	539	910	156	687	0	438	264	553	419	278	0	0
82	0	779	0	0	0	0	0	344	0	0	0	589	0	185	0	0
84	0	0	0	81	0	291	0	727	0	0	0	0	0	0	0	0
86	0	0	0	0	0	582	0	0	0	0	0	0	0	0	0	0
88	0	0	0	0	0	0	78	0	0	0	308	846	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
96	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

b) Midwater trawl

year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
gear	FR_MDW	FR_MDW	FR_MDW	FR_MDW	FR_MDW	FR_MDW	FR_MDW	FR_MDW	FR_MDW	FR_MDW	FR_MDW	FR_MDW	FR_MDW	FR_MDW	FR_MDW	FR_MDW
number of trip	1	0	2	2	1	1	1	6	76	62	37	9	7	6	7	7
number of fish	0	0	183	145	140	71	48	293	1754	994	682	0	246	74	318	249
32	0	0	0	0	1179	0	0	0	0	41	0	0	0	0	0	0
34	0	0	5651	15970	18789	0	131215	761	1377	2165	77	0	4134	505	0	187
36	8849	0	22807	74409	51171	0	157458	1263	9293	5665	893	0	1378	673	0	454
38	30972	0	51466	67954	63895	0	131215	25737	39249	8198	3465	12923	9847	2345	1658	707
40	22123	0	64715	87268	53143	5460	104972	21988	29324	10680	20869	12923	10192	2695	8150	452
42	18276	0	34573	70400	45727	8191	183701	52643	56585	10822	24604	23261	8268	1896	13582	1791
44	32128	0	109664	85022	35758	21842	209944	127951	70351	26606	57697	11631	9503	8436	7593	1850
46	19431	0	130985	70457	20774	13651	20591	67446	52983	18408	53773	5169	6265	14964	11983	2362
48	10004	0	69993	105316	16224	51386	6864	35518	35065	28805	35210	30369	14820	14930	15714	3783
50	10004	0	13190	67346	13258	85644	27454	54382	39047	32118	35356	29675	30336	8010	21043	1750
52	5132	0	1047	48086	11993	102772	0	2557	29482	37309	28597	20677	33021	17507	13961	6417
54	10135	0	3513	20725	8230	23836	6864	2328	31464	29485	20233	29023	21065	10099	15477	13996
56	5132	0	3985	11792	10713	102049	13727	977	24619	33973	23152	15507	28967	16832	14951	10554
58	20529	0	1519	13568	3514	20120	6864	1547	9819	11690	18909	17878	19129	6733	14458	7093
60	10265	0	2466	7580	7134	53655	0	23688	7175	11525	19033	26492	6518	3859	8010	8454
62	10265	0	8158	16428	4317	12686	0	1667	31116	21319	10811	5169	2401	3366	3115	3478
64	25661	0	10563	0	3717	5979	0	46218	11877	19319	17245	5169	877	10099	6192	3328
66	5132	0	0	11779	5075	5979	0	238	1471	11646	3938	5169	2778	3366	1262	2364
68	5565	0	0	2522	2538	2989	0	229	3642	2981	4130	0	5531	0	1542	1910
70	0	0	0	5044	295	8968	0	238	2889	9494	2601	8400	5791	3535	2147	3544
72	11130	0	5281	0	589	5979	6864	37	103	9163	3253	3877	1963	0	958	3183
74	11130	0	2815	0	884	5979	0	115	500	899	1511	0	292	3366	360	1629
76	11130	0	0	0	589	0	0	0	248	651	375	0	0	0	270	586
78	0	0	349	0	0	5979	0	110	0	0	77	0	292	3366	165	62
80	11130	0	0	0	0	0	0	41	308	0	0	0	0	0	280	0
82	0	0	0	0	0	0	0	41	0	0	0	0	292	0	0	0
84	0	0	0	0	0	0	0	0	0	344	220	0	0	0	0	0
86	0	0	0	0	0	0	0	41	0	0	0	0	0	0	0	0
88	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
96	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

c) Nets

year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
gear	FR_NETS	FR_NETS	FR_NETS	FR_NETS	FR_NETS	FR_NETS	FR_NETS	FR_NETS	FR_NETS	FR_NETS	FR_NETS	FR_NETS	FR_NETS	FR_NETS	FR_NETS	FR_NETS
number of trip	11	6	22	31	15	39	18	134	319	197	230	147	226	150	147	253
number of fish	305	338	423	613	230	789	450	980	2157	1759	1696	2588	3060	2221	3050	3817
32	0	1157	0	0	0	0	182	812	53	0	166	0	0	0	81	526
34	3943	1336	4440	2218	485	2469	364	2718	53	1685	522	498	565	880	376	509
36	19067	7183	11415	9233	3678	21843	6013	6526	6133	11741	3742	13586	44184	35043	11168	9983
38	35467	15770	12076	16101	2691	23682	17310	24395	34681	35464	11033	32146	51912	53185	30460	19864
40	84650	52344	35387	22416	1376	34184	49273	69979	69351	58059	33269	73035	54851	82492	84836	43288
42	139047	75369	30725	68964	1861	48371	90535	111328	89469	86516	74044	81258	76623	129692	116570	63889
44	124556	77732	42394	86374	2290	73303	108719	73845	89659	84463	62351	98658	64468	124966	110278	73357
46	79234	88238	81033	71206	795	68187	82537	123109	73724	54884	51156	60185	46885	82316	93902	57798
48	49967	53640	82789	53404	350	57562	42324	80776	58376	36033	42200	61829	37426	60272	62108	42628
50	26795	34042	32129	42985	1320	36250	19854	41837	46892	27650	21552	35505	39745	36422	50882	33125
52	23813	26022	18626	27256	1009	19552	21087	30149	28050	21065	30327	39807	33932	29627	42129	27575
54	16498	14821	15059	17840	1009	13560	17451	26697	20874	12659	14688	22670	20510	27233	37321	24520
56	8453	16195	10767	18393	1184	27669	14217	19404	11436	8288	7957	19199	21918	22850	29256	34903
58	7108	8288	8828	5869	1398	21641	3353	13386	9696	6773	5174	16605	20224	9671	33890	24149
60	8910	8295	7919	11321	1534	19439	9844	11417	11543	7053	3367	13091	15496	8540	34447	17512
62	11155	4104	1820	7114	524	4111	3558	10037	6867	6091	2870	10742	10078	6821	15885	14666
64	5513	4511	1361	1043	1009	2611	6433	11864	8351	4094	2544	10757	10472	4613	20258	10579
66	4532	1039	3184	4005	524	1437	2265	3557	1502	3165	2942	4055	10121	8345	16622	9702
68	818	1157	1820	4067	350	1495	2820	4162	1085	1807	284	3843	7131	1936	17959	7414
70	3202	1657	40488	663	350	756	3822	6182	4406	3857	1732	2474	5664	3035	9557	7338
72	2409	179	2276	221	350	3152	2260	3154	172	1044	2070	2382	5362	2164	5159	4118
74	3156	2205	27443	2582	0	649	1685	1593	2308	1693	929	1338	2628	2471	4637	2976
76	0	0	0	0	175	550	187	1453	1354	2334	104	4741	4296	2052	2403	1105
78	818	358	455	221	0	41	0	636	755	202	342	1177	1857	569	230	1585
80	1635	0	0	221	0	0	0	277	117	649	72	1673	827	503	888	302
82	0	978	0	0	0	0	0	148	53	0	176	719	186	313	370	247
84	0	0	0	0	0	0	182	133	115	0	72	440	50	142	81	0
86	0	0	0	0	0	0	0	0	0	95	0	216	0	0	0	245
88	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	95	0	0	61	0	0	0
92	0	0	0	0	0	0	198	0	0	0	0	0	0	0	0	0
94	0	0	0	0	0	0	0	0	0	0	0	0	68	0	0	0
96	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

d) Lines

year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
gear	FR_LINES	FR_LINES	FR_LINES	FR_LINES	FR_LINES	FR_LINES	FR_LINES	FR_LINES	FR_LINES	FR_LINES	FR_LINES	FR_LINES	FR_LINES	FR_LINES	FR_LINES	FR_LINES
number of trip	43	31	66	65	39	39	12	23	29	86	26	91	122	16	110	99
number of fish	997	960	1417	1551	848	625	513	626	674	728	152	862	1314	71	1302	1244
32	0	992	898	1688	1179	0	839	0	799	0	0	4588	486	350	0	0
34	10740	4018	12900	12606	18789	27836	23296	6721	4417	0	0	23244	3257	1318	1055	2901
36	21181	13415	34161	49513	51171	34584	75927	40542	29602	17061	7883	53984	36878	12807	8833	10899
38	38667	25671	63131	51004	63895	35428	90959	62017	52660	25573	36568	54619	66046	21792	23445	22409
40	54369	45972	68667	68340	53143	43863	95259	47423	71750	46630	37571	61356	82714	27146	37979	31766
42	44211	71469	63765	77482	45727	54829	68202	32672	84761	48823	42048	52748	78430	22416	65865	33068
44	42813	86694	45021	65618	35758	49768	45633	56121	83005	44547	45083	49362	64477	31970	63633	36203
46	36339	60718	46047	66100	20774	41332	44918	31769	47943	34230	38147	42446	60989	32871	50374	33645
48	28835	67182	43378	66323	16224	36271	49862	44718	46794	40968	24213	37840	38493	27039	37973	31828
50	28328	32081	33893	46432	13258	36271	34107	38088	32607	26387	39290	76972	33496	19135	32745	26687
52	18364	28129	22663	44588	11993	23619	27841	52869	30362	21117	28317	32862	23092	20386	26260	24084
54	19794	17686	24826	29962	8230	26993	15983	39201	29552	23265	19850	32043	26661	16052	24025	26686
56	14639	14673	22848	31298	10713	30367	20767	45231	18537	21313	18014	18849	20200	16810	30221	22886
58	9613	9375	18261	22920	3514	23619	22132	19210	12299	20108	9411	27664	20440	27945	20599	23282
60	15591	8562	9700	17101	7134	15183	16977	25176	12290	14459	6894	13816	16241	15561	18371	15966
62	13586	9323	11855	17470	4317	17714	25692	10146	17596	14548	14108	13761	13253	18405	21998	10933
64	7986	6781	10050	13866	3717	14340	13601	35207	8707	10364	16440	18712	13127	26899	20860	15153
66	3763	5717	9101	7765	5075	10122	6707	7718	13591	9565	5162	7179	11769	20561	22392	12513
68	6748	5271	4497	6446	2538	7592	3353	17185	6695	8678	8181	14358	7419	12199	14545	8357
70	3954	2646	6880	3714	295	12653	8069	12333	6995	4224	22057	6392	4805	9084	15258	9359
72	1184	4961	2986	4499	589	3374	2516	4867	5397	3816	11201	5493	3889	4789	13595	5573
74	1932	1708	1797	4051	884	6748	5029	5839	9694	2944	6117	2641	3440	6056	7103	5062
76	1627	331	1797	675	589	2531	839	1610	0	1049	1032	3170	648	4465	4708	3523
78	753	662	299	675	0	844	0	537	1599	3395	1032	2113	1535	3514	4133	1547
80	1988	0	599	0	0	844	0	0	799	1363	4387	528	2021	3069	2207	945
82	1630	0	0	338	0	0	839	0	0	382	0	0	657	1311	2694	812
84	753	0	299	338	0	0	0	0	1100	0	0	0	324	729	1010	0
86	358	0	0	0	0	0	0	0	0	382	0	0	0	0	673	1083
88	0	0	0	0	0	0	0	0	0	0	3364	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
96	0	0	0	0	0	0	0	0	0	0	0	0	324	0	0	0

e) Other gears

year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
gear	FR_OTHER	FR_OTHER	FR_OTHER	FR_OTHER	FR_OTHER	FR_OTHER	FR_OTHER	FR_OTHER	FR_OTHER	FR_OTHER	FR_OTHER	FR_OTHER	FR_OTHER	FR_OTHER	FR_OTHER	FR_OTHER
number of trip	2	6	15	6	5	6	6	2	0	0	3	25	7	3	1	7
number of fish	64	91	0	204	107	0	118	0	0	0	36	731	147	115	0	196
32	0	0	0	142	0	0	0	0	0	0	0	0	0	0	85	1315
34	512	1249	403	2684	4494	1377	879	83	0	0	0	0	0	1284	171	5588
36	4827	2497	3893	3081	13483	1377	6629	270	0	0	12487	1604	8175	3443	393	28128
38	6935	3746	4227	4196	6055	2754	4602	364	0	0	10010	4077	15969	6294	222	23060
40	7780	4995	5435	5653	16306	688	6634	531	0	0	7751	5638	28968	9237	1532	22841
42	7933	7492	4631	5903	23103	3442	4627	771	0	0	7883	9067	28693	14682	4878	27000
44	6633	5619	3586	3704	29798	1377	5098	167	0	0	427	6715	18570	12713	8621	25440
46	5397	7805	3367	2462	18938	1377	1351	531	0	0	1548	7591	16280	13121	7754	16881
48	2195	6244	2671	1734	46470	4131	1443	93	0	0	1457	7499	16308	17190	13304	17807
50	531	624	1592	963	49883	688	1053	93	0	0	123	7027	9730	15656	12001	8519
52	1158	2810	1994	990	43648	688	1324	0	0	0	62	8285	6505	15309	9930	6637
54	0	312	1200	773	27055	688	790	93	0	0	102	7559	3173	6169	7123	3934
56	0	312	693	392	44955	688	286	0	0	0	20	3384	3017	8365	6524	4022
58	609	937	395	579	28899	1377	138	181	0	0	2046	4313	3791	3773	2897	1686
60	609	312	201	241	9266	0	699	93	0	0	20	5622	1668	2290	3993	954
62	1503	312	201	70	2243	0	138	274	0	0	0	1295	1922	2840	1649	1058
64	0	0	302	514	2780	688	251	0	0	0	1043	4783	834	2881	2001	329
66	609	312	361	70	927	688	138	187	0	0	1003	1935	455	3632	1633	559
68	0	0	822	140	0	0	0	0	0	0	20	1064	910	1967	765	975
70	962	624	101	280	0	688	0	0	0	0	0	2010	455	611	1016	0
72	0	312	0	140	390	688	0	0	0	0	20	174	715	489	1508	91
74	0	1873	0	0	0	0	0	0	0	0	0	617	455	362	567	0
76	0	312	0	0	0	0	138	0	0	0	0	50	1170	443	225	0
78	0	0	0	70	0	0	0	0	0	0	0	50	581	226	310	60
80	0	0	0	0	0	0	0	0	0	0	0	160	0	72	230	0
82	0	0	0	70	0	0	0	0	0	0	0	50	0	0	0	30
84	0	0	0	0	0	0	0	0	0	0	0	0	0	72	0	385
86	0	0	0	0	0	0	0	0	0	0	0	0	455	121	0	0
88	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	139	0
92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
96	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

4.5.2 Sampling for age compositions, and effects of age errors

4.5.2.1 Quality of data

A summary of the accuracy of age reading is provided in Section 4.2.1.3.2. Figure 4.5.8 summarises the number of sea bass aged each year in 8.ab, with low sampling rates from 2004 to 2010.

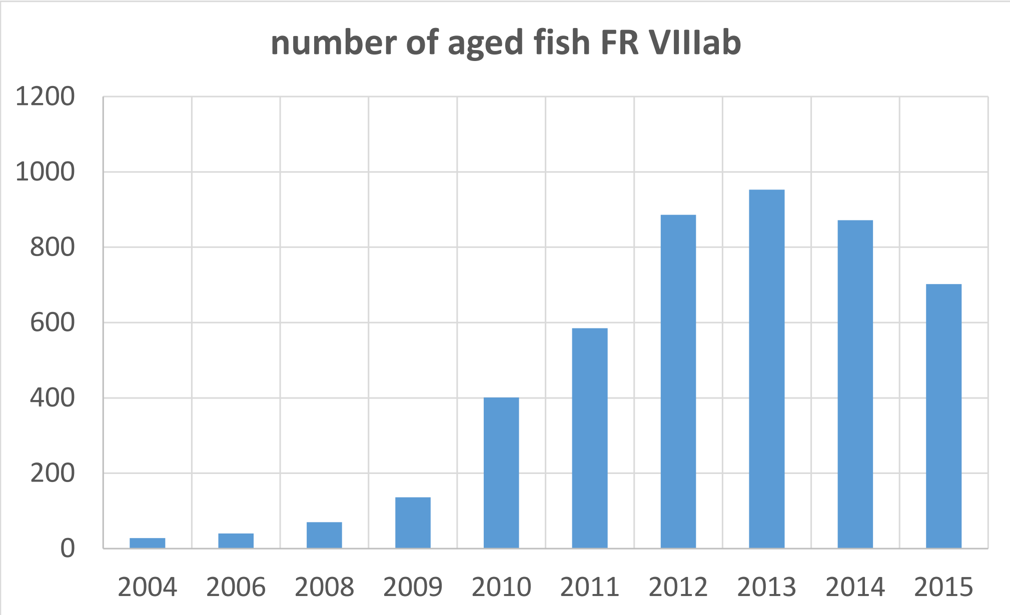


Figure 4.5.8. Numbers of sea bass aged from French sampling of Bay of Biscay catches.

4.5.2.2 Age-Length Keys from French sampling of landings

French ALKs for Bay of Biscay are presented for the period 2004–2015 in Table 4.5.2.

Table 4.5.2. Age–length keys for the Bay of Biscay between 2004 and 2015.

2004		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
	31				1																			
	32				1																			
	33				1																			
	34				2	1																		
	35																							
	36				1																			
	37																							
	38					1																		
	39					1	2	1																
	40						1																	
	41																							
	42																							
	43					1	1																	
	44																							
	45																							
	46																							
	47							1																
	48																							
	49							3	1															
	50									1														
	51																							
	52																							
	53									1														
	54																							
	55								1															
	56																							
	57																							
	58																							
	59																							
	60									1														
	61										1													
	62																							
	63												1		1		1							
	64																							

2006		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
	37				1	1	2																	
	38					3																		
	39				1	1																		
	40					1	1																	
	41					1	1																	
	42						4																	
	43						1	1																
	44							3																
	45																							
	46						1																	
	47																							
	48																							
	49							1																
	50																							
	51						1	1	2															
	52						1																	
	53																							
	54									1														
	55								2															
	56																							
	57																							
	58																							
	59												1											
	60										1													
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	62																							
	63												1											
	64																							
	65										1	1												
	66																							
	67																							
	68																							
	69										1													
	70																							
	71																							
	72																							
	73																							
	74																							
	75																							
	76																							
	77																							
	78																							
	79														1									

2008		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
	39					2																		
	40					2	1																	
	41						2	1																
	42					3																		
	43					2	1																	
	44					1	1	1																
	45						2	1																
	46						3																	
	47						3																	
	48							3																
	49						1	2																
	50							1	2															
	51						1	1	1															
	52								3															
	53							1		2														
	54								1	1														
	55								1		2													
	56								1	2														
	57								2		1													
	58								1	1														
	59										1	1												
	60									2														
	61													2										
	62										2													
	63																							
	64										1													
	65										1													
	66																							
	67																							
	68																							
	69																							
	70									1														
	71										1													
	72																							
	73																							
	74																							
	75																							
	76														1									

2009		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
	32				2																			
	33				4																			
	34																							
	35					1	1																	
	36				2	1																		
	37				1	3		1																
	38					1	1	1																
	39					1	1	1																
	40						4	2																
	41						3	3																
	42					1	4	1	2															
	43							1	2	1														
	44						1	3	1															
	45							3	1															
	46					2	1	2	2															
	47						3		1															
	48							2	1															
	49							4	2	1														
	50							1	1		1													
	51							2	2	1														
	52							1	1															
	53							2	3															
	54							1	2	1														
	55							1	1	1														
	56						1		2		2													
	57								2															
	58								2	2														
	59								1	1	1	1												
	60								1			1												
	61									1	1	1												
	62								1		1		1											
	63									1														
	64											1												
	65																							
	66											1												
	67																							
	68																							
	69											1												
	70												1	2										
	71											1												
	72															1								
	73																							
	74									1														
	75												1											
	76												1											
	77																							
	78																							
	79																							
	80													1										
	81																							
	82																1							
	87														1									

2010		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
	33					1																		
	34					5	2																	
	35					5	2			1														
	36					4	4																	
	37					3	3	4	1															
	38					4	1	3			1													
	39					3	2	3	1															
	40					2	4	3	3															
	41					2	3	5	5															
	42						1	5	4															
	43					3		5	4															
	44							5	4	4														
	45						2	4	4	5														
	46						1	2	5	5		1												
	47						1	1	5	3	2													
	48							3	6	3	2													
	49							3	5	7	3													
	50							1	8	2	3													
	51							3	1	5	1	1												
	52							1	4	5	4													
	53							1	1	3	2	1												
	54							1	3	3		2	1											
	55									3	5	3	2			1								
	56							1	1	3	2		2											
	57								3	5	1	1	3											
	58									1	3	5	3	2										
	59										2	5	2	1										
	60									1	1	2	3	1										
	61									1	1	2	1	1										
	62										2	2	2	4										
	63										2	2	3	1									1	
	64											3		2	1					2				
	65											1	2	2	1	1								
	66											1		4	3									
	67											1			3	1								
	68											1		1		1								
	69															1								
	70													1	5									
	71													2		2								
	72											1			2	1	1							
	73															2								
	74														2						1			
	75														2	1								
	76												1		1									
	77															1	1							
	78																							
	79																							
	80															1				1				
	81															1								
	82																							
	83																							
	84																							
	85															1								

2011		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
	26			1																				
	27			2	1																			
	28				1																			
	29				2																			
	30				2																			
	31				1																			
	32				2		3																	
	33				3		1																	
	34					1	1	1																
	35					1	2	4																
	36					1	6	12																
	37						7	7	2															
	38					1	6	10	4															
	39						4	14	2															
	40						2	15	2															
	41					3	3	8	6															
	42						1	8	4	1														
	43							5	18	1														
	44							3	14	3														
	45							8	6	6	1													
	46							6	3	7	1													
	47							6	9	7	1													
	48								7	6	3													
	49								7	6	6													
	50								3	4	6													
	51								4	2	8	1												
	52								3	2	7													
	53								4	3	12	1												
	54									3	10		1											
	55								4	3	8	3												
	56									6	10	3												
	57									2	2	4	1											
	58									2	3	4	3											
	59										3	6	2											
	60										3	5	2											
	61										2	2	3	1										
	62									1	1	6	1											
	63										1	1	6	1										
	64										2	1	5		1									
	65										1	3	6	6	2	1								
	66											2	4	5	2									
	67												2	2	3		1							
	68												4	5	3									
	69												1	2	2									
	70												1		3	1								
	71												4	2		1		3						
	72													2		1								
	73														2		1							
	74													2		1								
	75												3			1								
	76														1									
	77														1	2	2							
	78																1							
	79													1	1									
	80															1	1	1						
	81																							
	82																					1		
	83																1							

2012		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
	31						2																	
	32					2																		
	33					2	2																	
	34					10																		
	35					8	6	3	1															
	36					2	8	6																
	37					2	8	14	3															
	38						7	17	6															
	39							5	15															
	40							16	12															
	41							6	25	1														
	42							8	25															
	43							4	29	3														
	44							2	14	7	1													
	45							1	15	9														
	46								12	7	1													
	47								12	12	3	1												
	48							1	13	7	4													
	49								9	8	2	1												
	50							1	9	7	10	1												
	51								6	1	12	3												
	52								1	4	15	4												
	53							2	1	2	17	4												
	54								2		7	5	2											
	55								1	2	9	5												
	56									2	13	6	3											
	57										13	11	1											
	58									1	11	17	5	3										
	59										5	13	3	2										
	60									3	5	12	2	2	1									
	61									1	3	12	5	6										
	62										1	3	6	4										
	63										2	9	10	5		2								
	64									1	3	1	15	4		1								
	65											6	5	2	2									
	66											7	3	2	5	1								
	67											4	1	6	2	3								
	68											2	2	3	1		1							
	69										1	1		6	1	1								
	70												2	5	2									
	71												3	2	2	1	1							
	72												1	4		1								
	73												1	2										
	74												1			6	1							
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	76														1	3								
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	79														1		1							
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2013		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
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	78															2	1							
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2014		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
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	33					5																		
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	35					9	13	1																
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2015		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
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	42					1	11	22	24	1														
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	45				1	2	5	12	6	3														
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	62								1		1	2	2	2										
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	72										1							1						
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	77																		1					
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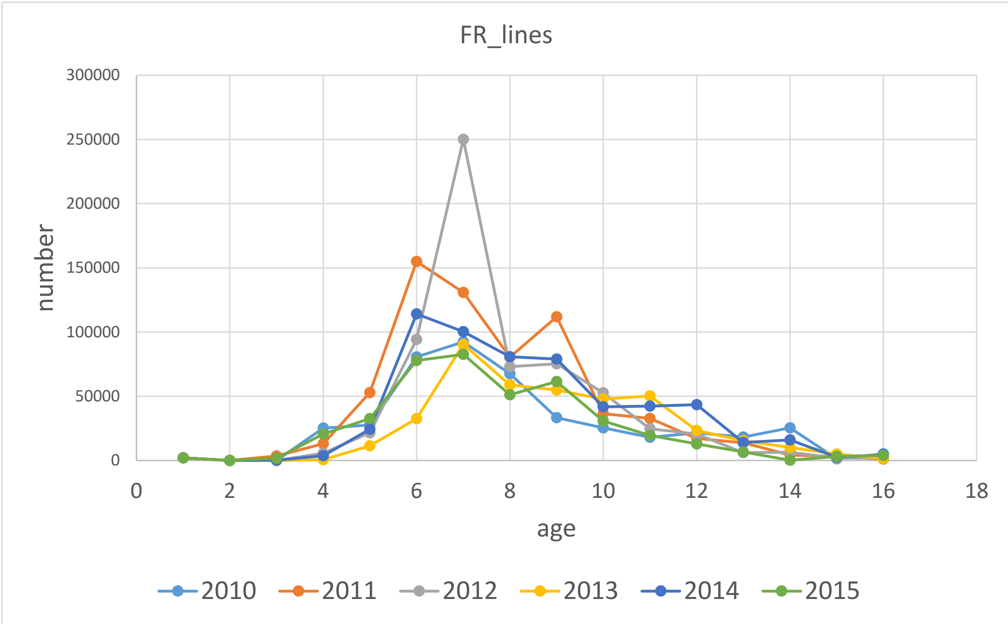
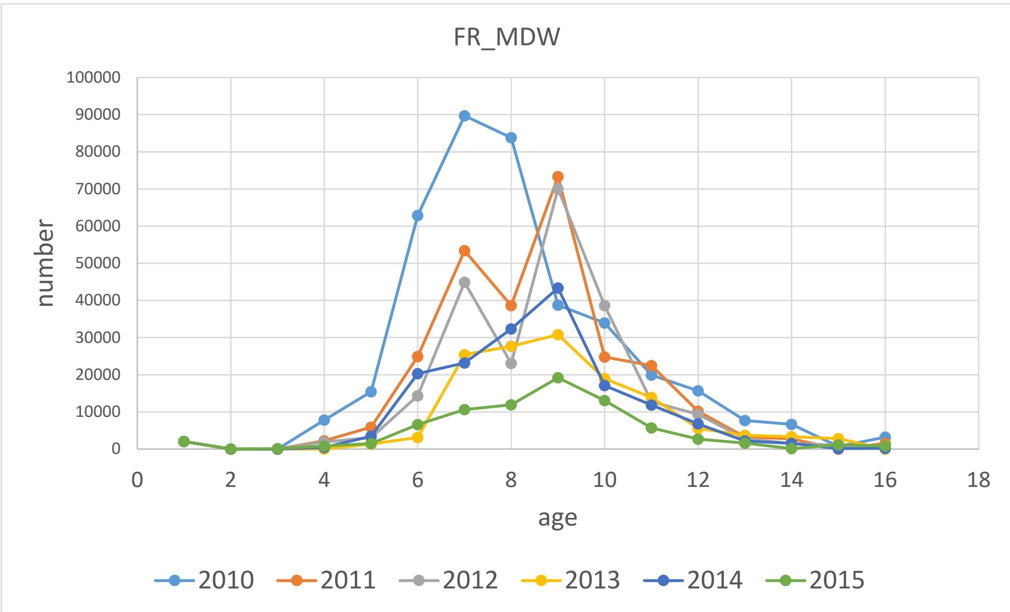
4.5.2.3 Age composition of French sea bass landings by métier from 8.ab

Figure 4.5.8 presents numbers-at-age by métier for the French fleet from 2010–2015). The ALK is applied to number-at-length using COST tools.

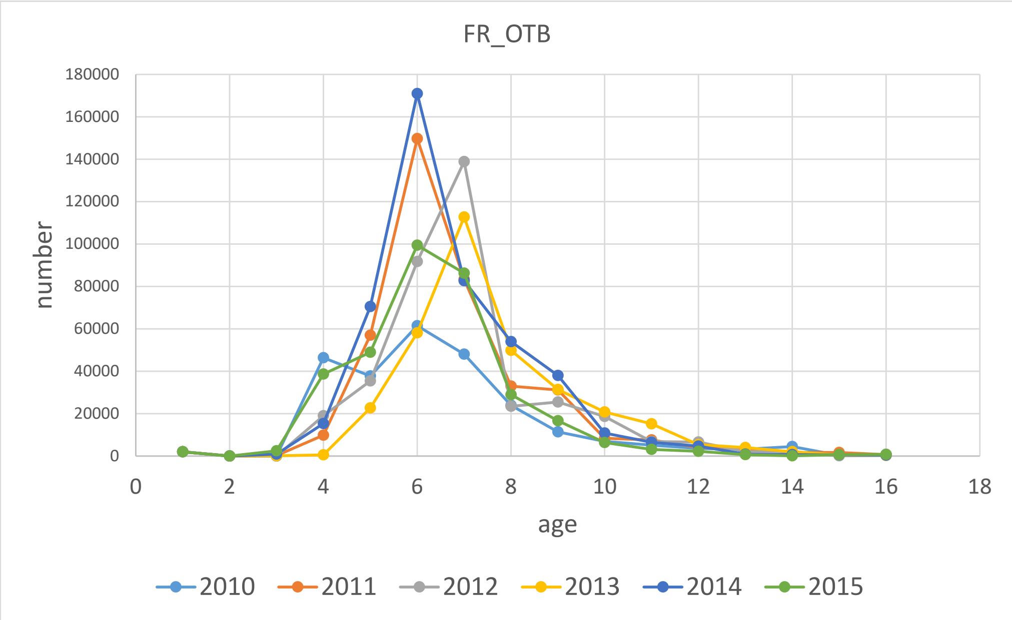
(a)


FR_lines
number
300000
250000
200000
150000
100000
50000
0
0 2 4 6 8 10 12 14 16 18
age
2010 2011 2012 2013 2014 2015

(b)


FR_MDW
number
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0 2 4 6 8 10 12 14 16 18
age
2010 2011 2012 2013 2014 2015

(c)



(d)

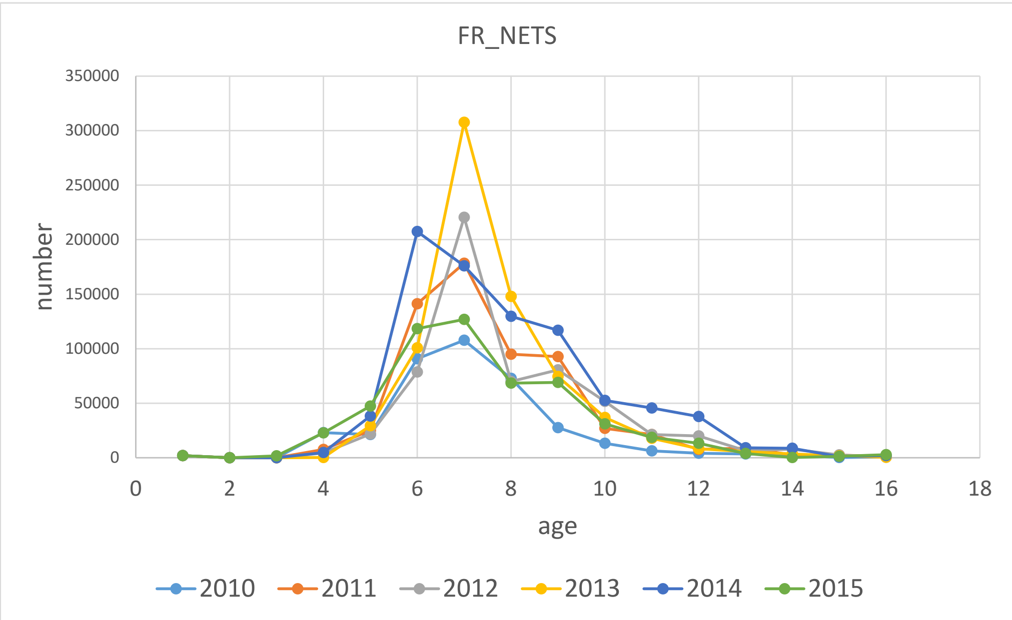


Figure 4.5.8. Estimated age compositions of French landings by gear type (a–d) based on application of age–length keys to fleet raised landings length compositions.

4.5.3 French discards number-at-length estimates

4.5.3.1.1 French Survey design and analysis

The French sampling design for discards is covered in Section 4.4.2.1.

4.5.3.2 Data coverage and quality

4.5.3.3 The coverage and quality of the French is covered in Section 4.4.2.2. Discards: length composition

Length composition of French discards is presented in Figures 4.5.10–14 and Table 4.5.3.

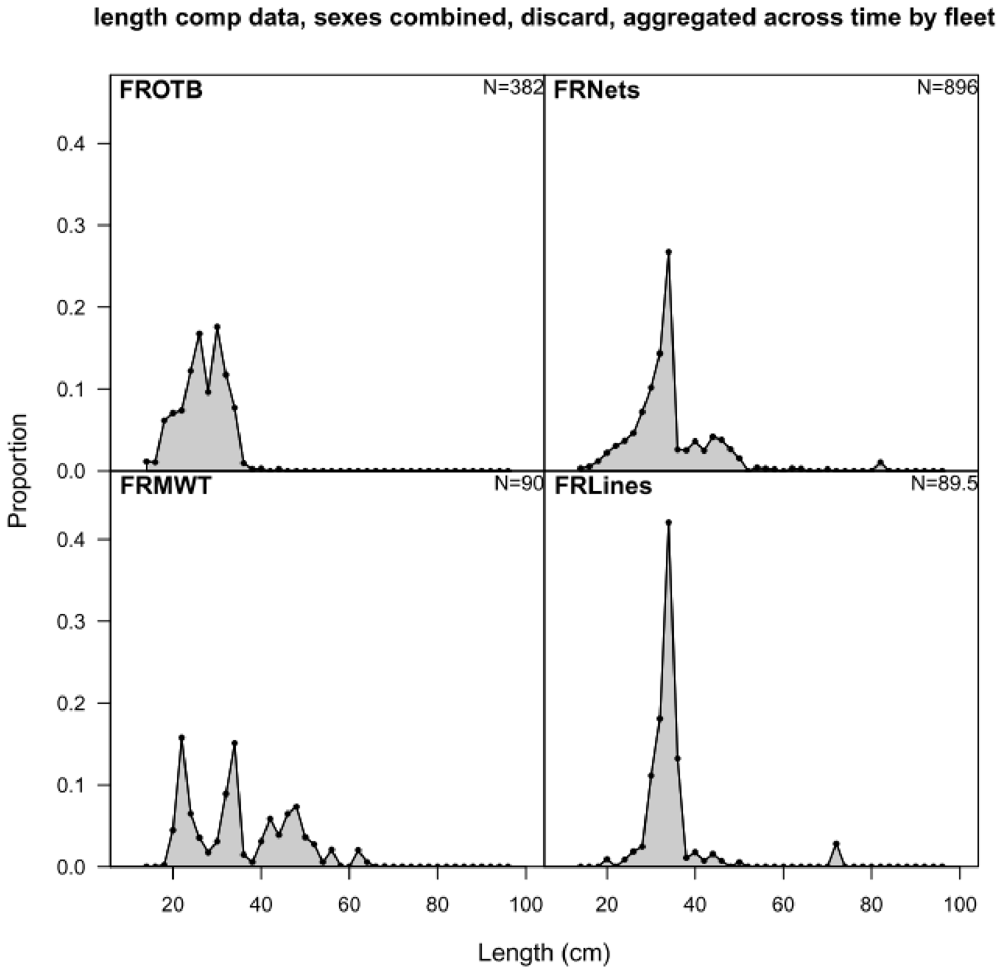


Figure 4.5.10. Length compositions of sea bass discarded from French vessels, by gear type, aggregated over time.

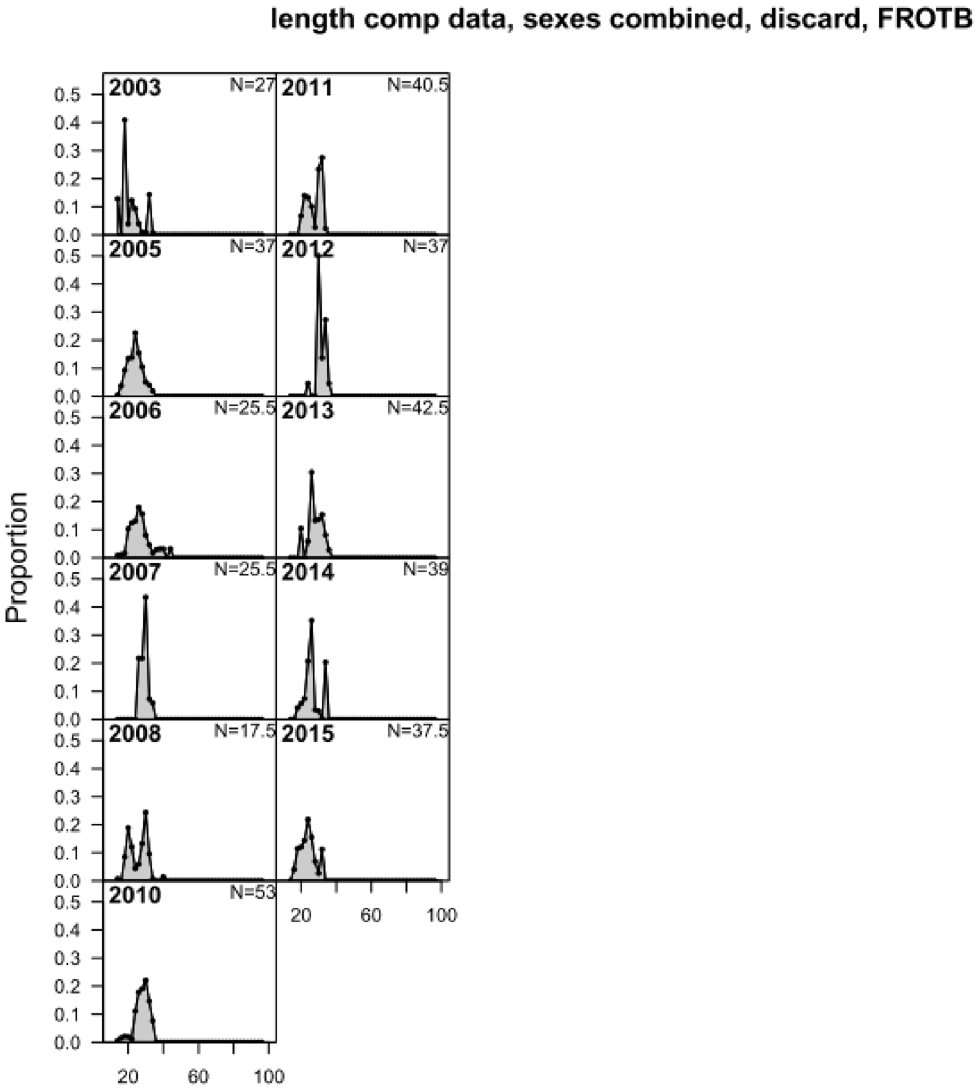


Figure 4.5.11. Annual length compositions of sea bass discarded from French otter trawl vessels.

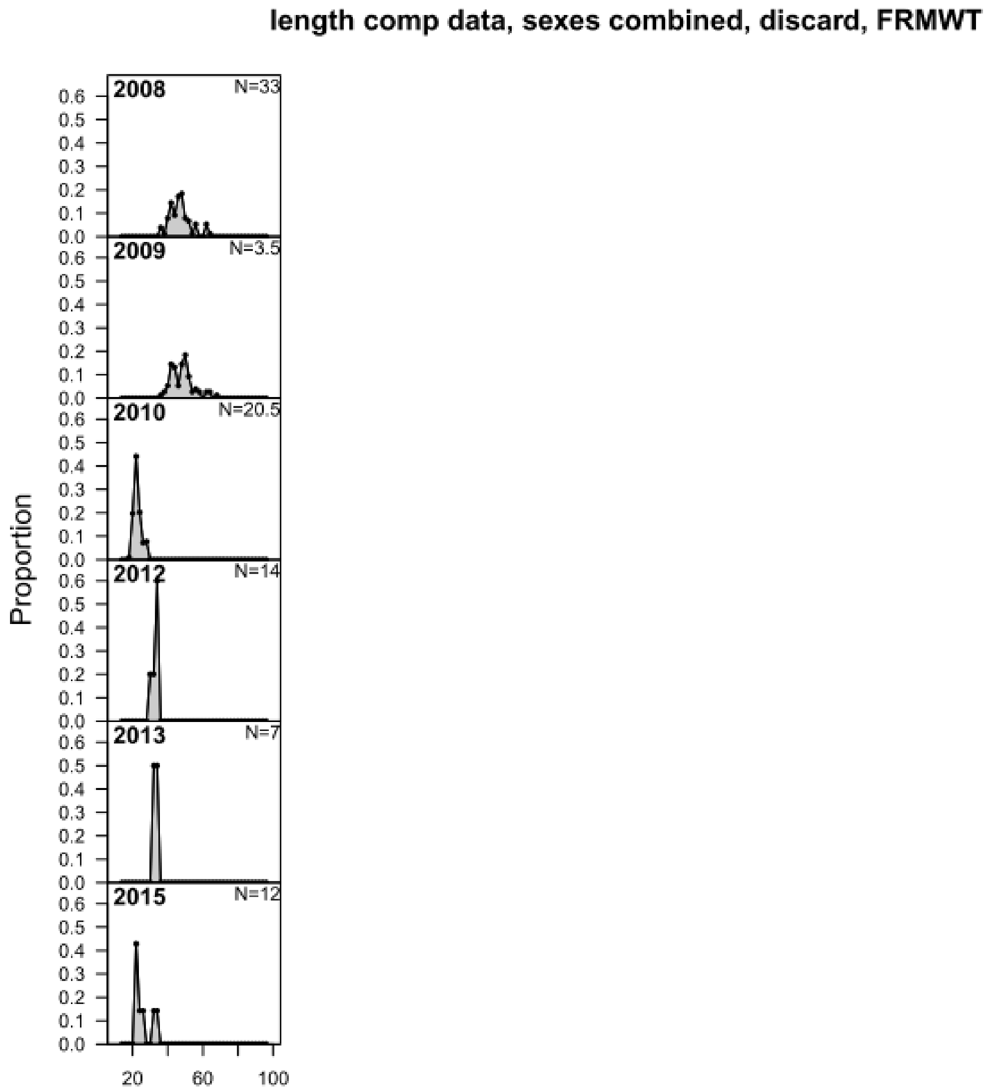


Figure 4.5.12. Annual length compositions of sea bass discarded from French midwater trawl vessels.

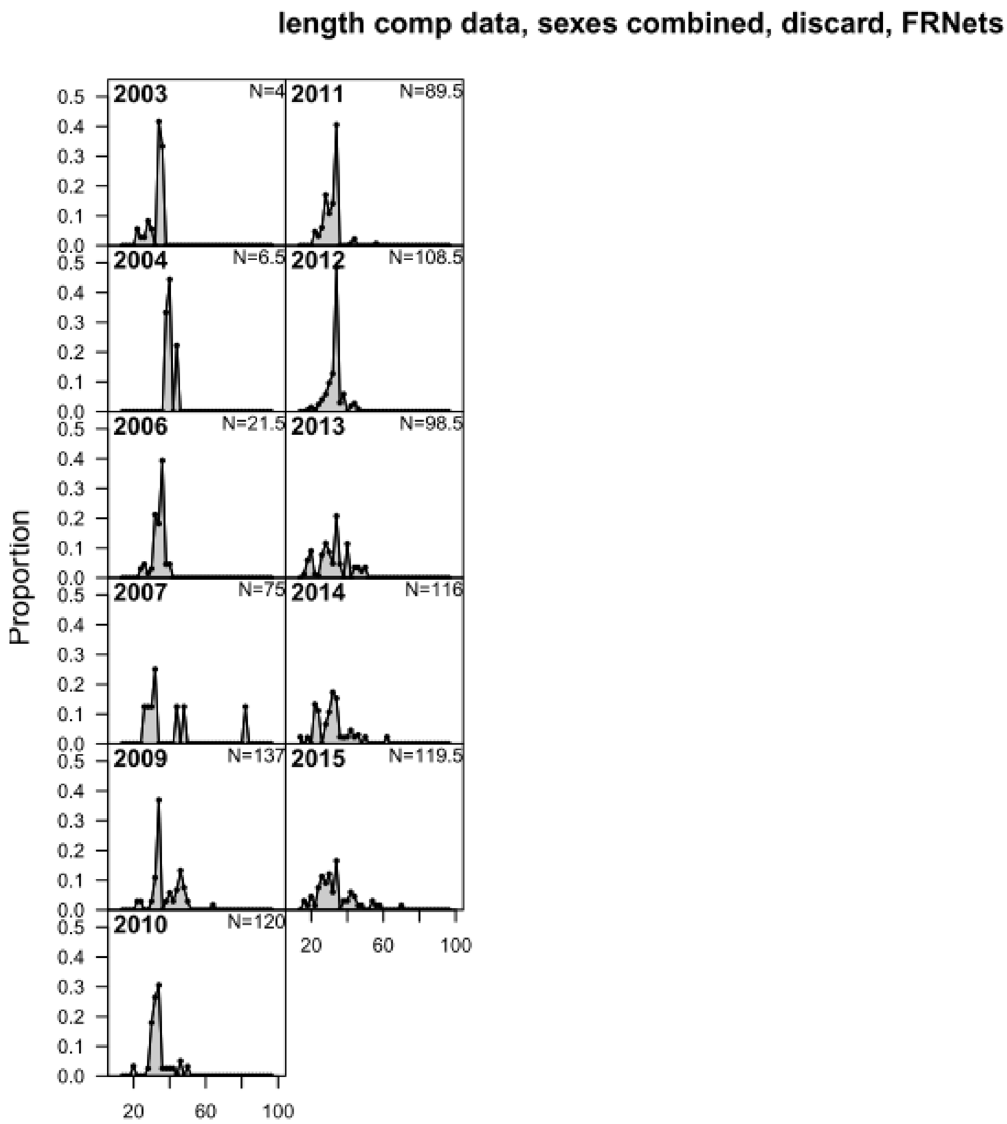


Figure 4.5.13. Annual length compositions of sea bass discarded from French netting vessels.

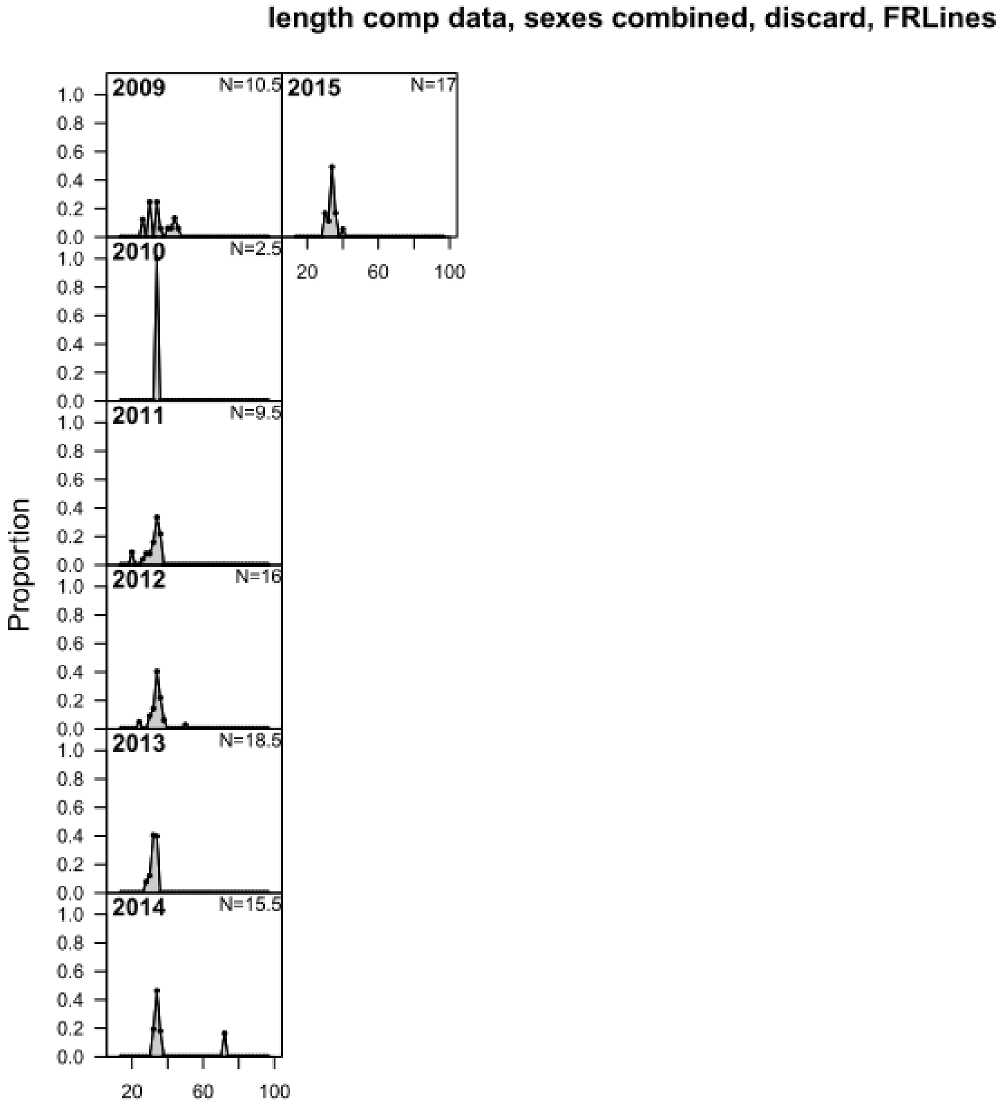


Figure 4.5.14. Annual length compositions of sea bass discarded from French line vessels.

Table 4.5.3. French estimates of annual numbers of sea bass discarded by length class and gear type (a–d) in Bay of Biscay.

a) Otter trawl

year	2003	2005	2006	2007	2008	2010	2011	2012	2013	2015
gear	FR_OTB	FR_OTB	FR_OTB	FR_OTB	FR_OTB	FR_OTB	FR_OTB	FR_OTB	FR_OTB	FR_OTB
nb trips	54	74	51	51	35	106	81	74	85	75
Nb fish	132	581	215	14	137	272	25	10	41	74
14	53568	1656	1219	0	3128	2253	0	0	0	0
16	0	13251	1422	0	0	5633	0	0	0	7897
18	170788	33127	2032	0	35977	7661	0	0	0	22563
20	16384	48157	13207	0	79774	7100	10410	0	10261	23691
22	51041	49384	15916	0	51619	4057	21384	0	0	28204
24	38756	80672	16762	0	18770	39473	20389	3327	5778	42876
26	16701	55209	23092	5699	25027	63193	15425	0	29851	30465
28	3781	37468	20051	5699	56311	67449	4144	0	13000	13538
30	3781	18036	10282	11399	103238	78210	35781	36589	13379	5265
32	59874	14319	5952	1900	40669	51981	42017	9978	15037	21983
34	3151	6740	2276	1520	3128	27102	3481	19959	7910	0
36	0	0	3658	0	0	0	0	3327	2737	0
38	0	0	4064	0	0	0	0	0	0	0
40	0	0	4066	0	6257	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0
44	0	0	4063	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0
50+	0	0	0	0	0	0	0	0	0	0

b) Midwater trawl

	2008	2009	2010	2012	2013	2015
gear	FR_MDW	FR_MDW	FR_MDW	FR_MDW	FR_MDW	FR_MDW
nb trips	66	7	41	28	14	24
Nb fish	42	28	6	5	2	7
14	0	0	0	0	0	0
16	0	0	0	0	0	0
18	0	0	3513	0	0	0
20	0	0	69920	0	0	0
22	0	0	156705	0	0	22973
24	0	0	71676	0	0	7658
26	0	0	25649	0	0	7658
28	0	0	27405	0	0	0
30	0	0	0	430	0	0
32	0	0	0	430	335	7658
34	0	0	0	1290	335	7658
36	64	21	0	0	0	0
38	21	43	0	0	0	0
40	129	86	0	0	0	0
42	236	236	0	0	0	0
44	150	214	0	0	0	0
46	279	86	0	0	0	0
48	300	236	0	0	0	0
50+	450	708	0	0	0	0

c) Nets

	2003	2004	2006	2007	2009	2010	2011	2012	2013	2014	2015
gear	FR_NETS	FR_NETS	FR_NETS	FR_NETS	FR_NETS	FR_NETS	FR_NETS	FR_NETS	FR_NETS	FR_NETS	FR_NETS
nb trips	8	13	43	150	274	240	179	217	197	232	239
Nb fish	10	5	24	8	41	26	69	135	155	45	61
14	0	0	0	0	0	0	0	0	0	1138	0
16	0	0	0	0	0	0	0	0	653	0	846
18	0	0	0	0	0	0	0	146	3267	1071	423
20	0	0	0	0	0	600	0	395	4964	0	1269
22	4368	0	0	0	302	0	1024	146	653	6627	423
24	2182	0	614	0	302	0	682	644	436	5556	2115
26	2182	0	921	557	0	0	1324	1089	4265	0	3175
28	6550	0	307	557	0	451	3713	1580	6397	3281	2539
30	4368	0	614	557	302	3191	2348	2623	4746	5357	3385
32	0	0	4287	1114	1139	4694	3071	3483	2638	8638	1692
34	32740	0	3673	0	3862	5411	8831	13214	11447	7633	4655
36	26181	0	7954	0	0	451	0	822	2522	1138	0
38	0	35540	921	0	302	451	0	1594	0	1071	846
40	0	47387	921	0	605	451	0	0	6306	1138	846
42	0	0	0	0	302	451	150	523	0	2275	1692
44	0	23693	0	557	705	126	491	747	1892	1138	1269
46	0	0	0	0	1387	902	0	249	1892	1518	423
48	0	0	0	557	783	0	0	0	1261	0	423
50+	0	0	0	557	480	571	150	0	1892	2275	2116

d) Lines

	2009	2010	2011	2012	2013	2014	2015
gear	FR_LINES	FR_LINES	FR_LINES	FR_LINES	FR_LINES	FR_LINES	FR_LINES
nb trips	21	5	19	32	37	31	34
Nb fish	16	2	20	30	50	10	17
14	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0
20	0	0	3456	0	0	0	0
22	0	0	0	0	0	0	0
24	0	0	0	1516	0	0	0
26	1314	0	1549	0	0	0	0
28	0	0	3098	0	2250	0	0
30	2627	0	3098	2843	3507	0	2818
32	0	0	6196	4359	11686	3057	1879
34	2627	12254	12982	12318	11475	7323	8228
36	657	0	8409	6633	0	2844	2818
38	0	0	0	1895	0	0	0
40	657	0	0	0	0	0	939
42	657	0	0	0	0	0	0
44	1407	0	0	0	0	0	0
46	657	0	0	0	0	0	0
48	0	0	0	0	0	0	0
50+	0	0	0	948	0	2586	0

4.6 ToR 6: Develop recommendations for addressing fishery selectivity (pattern of catchability at length or age) in the assessment model

Average landings length composition from 2000 onwards, by gear, indicate differences in selectivity patterns. Most notably, otter trawls appear to select smaller sea bass than other gears and, therefore, probably have marked, domed selectivity relative to the other gears (Figure 4.6.1). Thus, it is important to take this into account when fitting selectivity in the Stock Synthesis model, as the landings by gear are changing over time due to varying activities of individual fleets (for example the declining activity of pelagic trawlers).

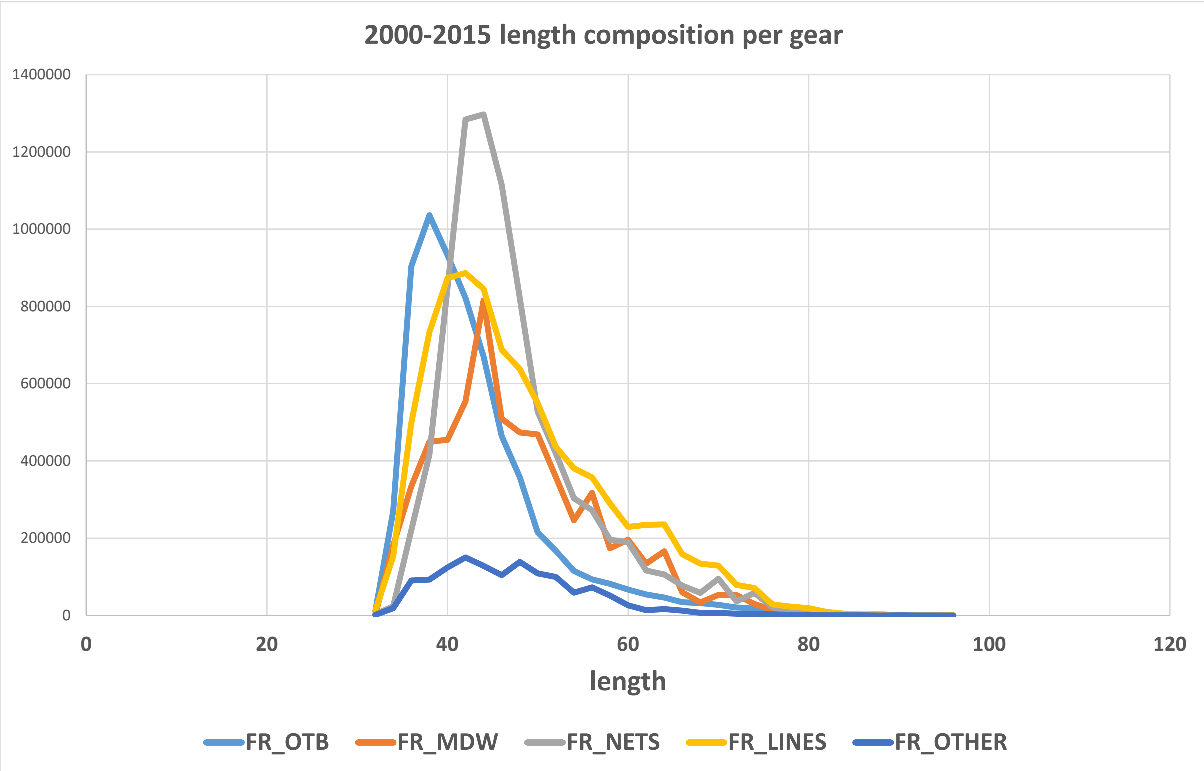


Figure 4.6.1. French length composition by gear from 2000.

4.7 ToR 7: Recommend values for discard mortality rates for commercial and recreational fisheries, if required, following the guidelines provided by ICES WKMEDS and indicate the range of uncertainty in values

See Section 3.7.1 for discussion of post release mortality of recreational fishers.

4.8 ToR 8: Review all available and relevant fishery-dependent and independent data sources on relative trends in abundance or absolute fish abundance, and recommend which series are considered adequate and reliable for use in stock assessments. Provide measures or indicators of bias and precision

The methodology for the derivation of the lpue series for French vessels is covered in Section 3.8.3 and full description is provided elsewhere (Laurec and Drogou, 2017), so only the results for Biscay are summarised below.

The seasonal patterns in the Southern part of the Bay of Biscay (squares 16E8, 17E8, 18E8) on a logarithmic scale (log10), and the arithmetic average over the twelve months are set to zero (Table 4.8.1). Only 100 bootstrap simulations were done, with 92 retained as they successfully covered sufficient rectangles and months. Prior to the analysis pelagic gears (midwater trawl + purse-seine) and zero sea bass catch day have been removed (Table 4.8.1 and Figure 4.8.1).

Table 4.8.1. Seasonal patterns of lpue from the southern part of the Bay of Biscay (squares 16E8, 17E8, 18E8).

	January	February	March	April	May	June	July	August	September	October	November	December
Basic estimate	0.473	0.366	0.11	-0.17	-0.31	-0.28	-0.21	-0.21	-0.085	-0.085	0.101	0.309
Average over 100 bootstrap simulations	0.47	0.361	0.11	-0.17	-0.31	-0.27	-0.2	-0.21	-0.083	-0.09	0.103	0.311
Standard Deviation σ	0.043	0.033	0.03	0.026	0.047	0.038	0.057	0.04	0.033	0.035	0.024	0.038
$\bar{x} - 1.96\sigma$	0.386	0.297	0.04	-0.22	-0.41	-0.35	-0.32	-0.29	-0.148	-0.16	0.056	0.237
$\bar{x} + 1.96\sigma$	0.554	0.425	0.17	-0.12	-0.22	-0.2	-0.09	-0.13	-0.017	-0.021	0.151	0.385

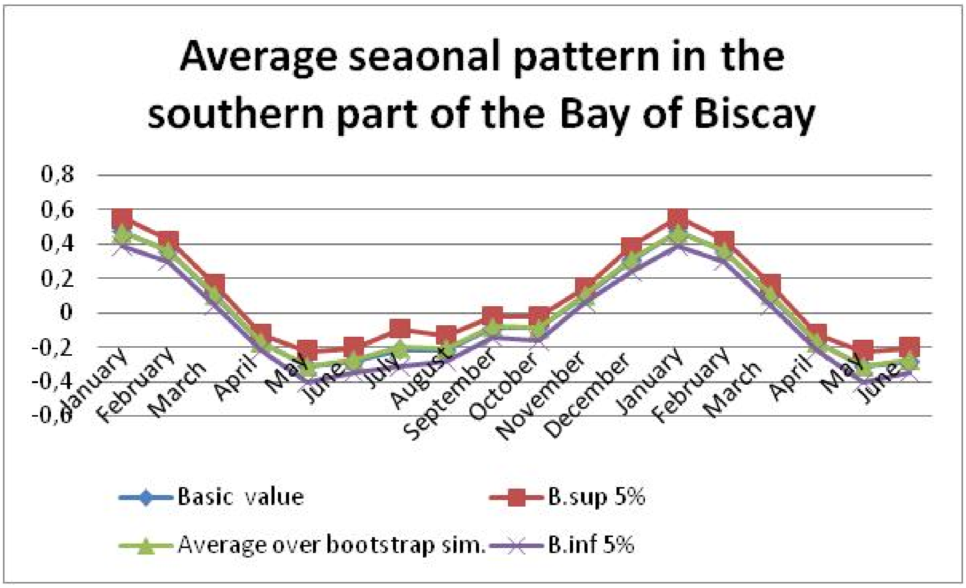


Figure 4.8.1. Average seasonal patters in the southern part of the Bay of Biscay.

The accuracy of year effects estimates are on average less good, with results presented for the year effects in the Bay of Biscay (Figure 4.8.3) and the "extended English Channel", including the southern part of the North Sea and the Bristol Channel (Figure 4.8.2). In both cases yearly abundance indices have used the average over years 2006 and 2007.

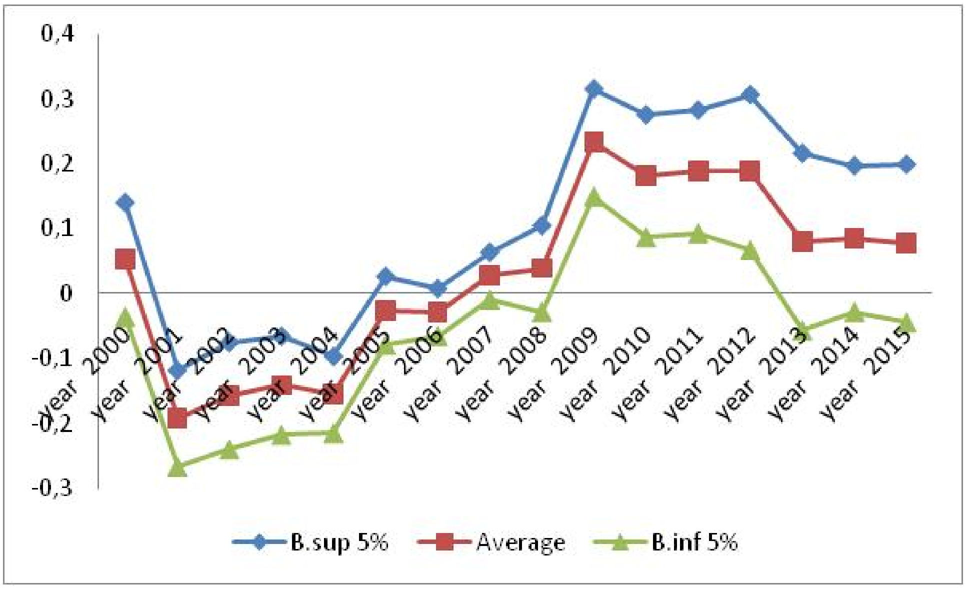


Figure 4.8.2. Multiannual apparent abundance indices for the enlarged English Channel derived from bottom trawlers' logbooks.

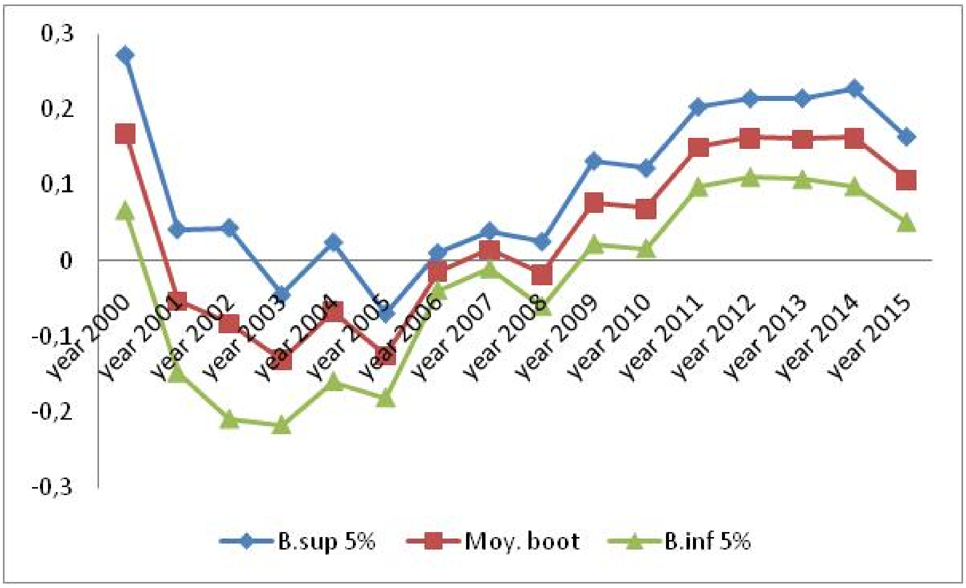


Figure 4.8.3. Multiannual apparent abundance indices for the Bay of Biscay derived from bottom trawlers' logbooks.

If the proposed bootstrap approach takes into account several sources of variability, (i.e. the "random" effect of the local spatial distributions of the fish, events which affected the case of fishing operation on an individual vessel on a given day, between vessels variability of efficiency changes over time.), it can cover neither the influence of the overall efficiency trends in the fleet nor the fact that the studied period is limited to a few years, which can lead to some anomalies (see extrapolation over years). The results of the bootstrap methodology are presented in Figure 4.8.4 and Tables 4.8.2–4.8.4.

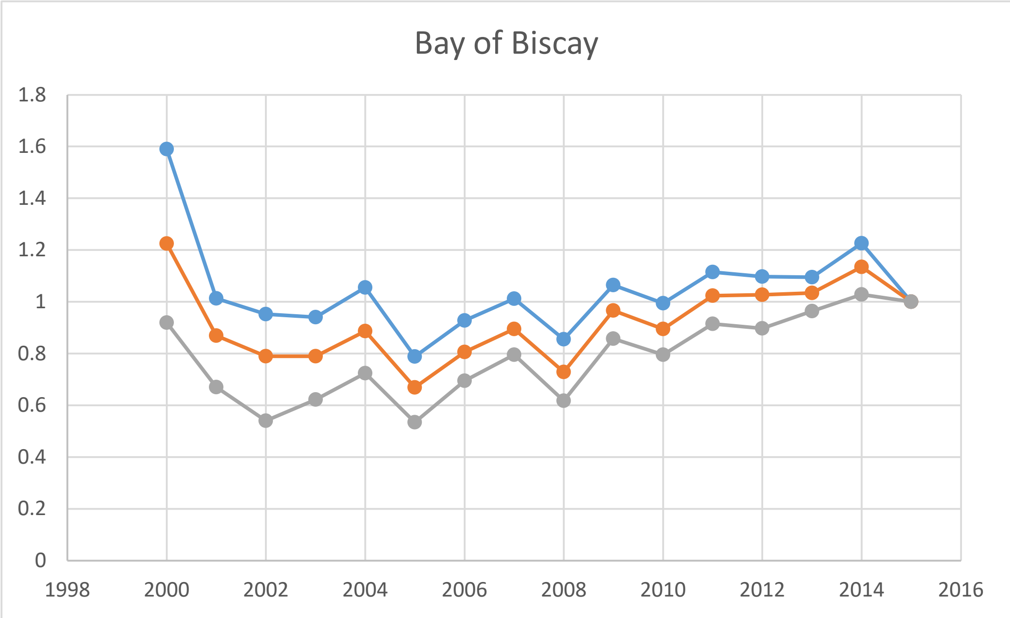


Figure 4.8.4. Results of the bootstrap of the lpue indices for the Bay of Biscay.

Table 4.8.2. Results of Bay of Biscay lpue index calculation.

Measure	Area	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Maximum bootstrap	Bay of Biscay	1.5899	1.0137	0.9528	0.9404	1.0547	0.7883	0.9276	1.0119	0.8555	1.0643	0.9949	1.1153	1.0977	1.095	1.2264	1
Average bootstrap	Bay of Biscay	1.2248	0.869	0.7893	0.7901	0.8862	0.6688	0.806	0.8953	0.7287	0.9666	0.8949	1.0231	1.0271	1.0347	1.1344	1
Minimum bootstrap	Bay of Biscay	0.9193	0.67	0.5404	0.6225	0.7241	0.5347	0.6944	0.796	0.6173	0.8573	0.7957	0.9153	0.8975	0.9642	1.0289	1

Simple linear models applied to logbooks data make it possible to reveal useful patterns. Many models are possible, and one must carefully define the details of the specific models that are used. Although this point has not been addressed here, Model 1 (two factors) should be used when interactions occur between year and month in a square (indicated changes between years in the seasonal patterns). However, for this specific case Model 2 is the most appropriate basis. Grouping of squares (model 3) so that within a group the same year or month effects are imposed should be preferred to averaging over squares after square specific year effects have been calculated using Model 2. Least squares fitting over individual observations results in more weight to squares (and) vessels that provide more individual observations, so appropriate use of weighted least squares would be prudent. Time-series describing month or year effects are of course necessary, but simple maps are also useful. Comparisons of seasonal patterns in the different squares are robust to changes in the details of the model and generally to the selection of gears. They do reveal crucial patterns in the stocks structures debate. If year effects are robust in the Bay of Biscay, and to a large extent up to 2013 in the English Channel, recent developments in this later area require further analyses.

Table 4.8.3. Results of the calculation of lpue indices in the Bay of Biscay.

Gears	Stat	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
All gears	Max. boot	1.728	1.238	1.144	1.200	1.189	0.914	1.006	1.109	0.969	1.242	1.153	1.302	1.293	1.354	1.526	1.315
All gears	B.sup 5%	1.615	1.148	1.094	1.085	1.182	0.872	1.000	1.086	0.918	1.223	1.148	1.293	1.295	1.317	1.451	1.282
All gears	Basic result	1.396	1.010	0.949	0.969	1.060	0.794	0.958	1.044	0.859	1.131	1.064	1.198	1.199	1.208	1.320	1.171
All gears	Ave. boot	1.397	1.014	0.945	0.959	1.051	0.793	0.960	1.042	0.858	1.131	1.063	1.201	1.194	1.205	1.319	1.171
All gears	B.inf 5%	1.179	0.881	0.796	0.833	0.919	0.715	0.920	0.998	0.798	1.038	0.978	1.108	1.092	1.094	1.188	1.059
All gears	Min. boot	1.197	0.849	0.719	0.778	0.926	0.698	0.902	0.994	0.794	1.035	0.993	1.100	1.054	1.073	1.199	1.062
All gears	Ecart type	0.111	0.068	0.076	0.064	0.067	0.040	0.020	0.022	0.031	0.047	0.044	0.047	0.052	0.057	0.067	0.057
All gears but pel	Max. boot	1.670	1.171	1.192	1.197	1.251	0.874	1.005	1.111	0.949	1.288	1.180	1.362	1.391	1.392	1.536	1.351
All gears but pel	B.sup 5%	1.622	1.133	1.074	1.082	1.182	0.861	0.987	1.097	0.932	1.251	1.142	1.320	1.338	1.351	1.487	1.307
But pel	Basic result	1.438	0.981	0.914	0.919	1.038	0.780	0.948	1.055	0.859	1.138	1.051	1.204	1.216	1.227	1.340	1.184
All gears but pel	Ave. boot	1.429	0.967	0.913	0.930	1.035	0.780	0.949	1.054	0.865	1.142	1.052	1.214	1.216	1.225	1.342	1.189
All gears but pel	B.inf 5%	1.237	0.802	0.753	0.777	0.888	0.700	0.911	1.012	0.799	1.032	0.962	1.107	1.095	1.100	1.196	1.071
All gears but pel	Min. boot	1.134	0.766	0.721	0.782	0.887	0.675	0.900	0.995	0.766	1.004	0.943	1.063	1.064	1.103	1.192	1.058
All gears but pel	Ecart type	0.098	0.085	0.082	0.078	0.075	0.041	0.020	0.022	0.034	0.056	0.046	0.054	0.062	0.064	0.074	0.060
Bottom Trawl	Max. boot	1.914	1.317	1.229	0.949	1.069	0.867	1.022	1.112	1.066	1.400	1.391	1.674	1.723	1.744	1.741	1.512
Bottom Trawl	B.sup 5%	1.841	1.090	1.081	0.889	1.041	0.847	1.023	1.094	1.056	1.348	1.320	1.591	1.633	1.632	1.678	1.451
Bottom trawl	Basic result	1.470	0.889	0.830	0.739	0.859	0.746	0.973	1.028	0.956	1.187	1.172	1.412	1.454	1.446	1.455	1.278
Bottom Trawl	Ave. boot	1.487	0.890	0.835	0.743	0.861	0.751	0.968	1.034	0.961	1.196	1.175	1.417	1.456	1.452	1.459	1.283
Bottom Trawl	B.inf 5%	1.133	0.690	0.589	0.597	0.681	0.654	0.912	0.974	0.867	1.045	1.030	1.243	1.279	1.271	1.240	1.115
Bottom Trawl	Min. boot	1.087	0.686	0.535	0.566	0.644	0.636	0.900	0.978	0.804	1.033	1.018	1.243	1.278	1.232	1.252	1.135

Gears	Stat	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Bottom Trawl	Ecart type	0.181	0.102	0.126	0.075	0.092	0.049	0.028	0.031	0.048	0.078	0.074	0.089	0.090	0.092	0.112	0.086
Netters	Max. boot	2.178	3.022	1.920	2.067	2.132	0.784	0.942	1.310	1.022	1.560	1.403	1.580	1.499	1.516	2.106	1.626
Netters	B.sup 5%	1.749	2.216	1.569	1.872	1.839	0.746	0.903	1.294	0.984	1.495	1.287	1.465	1.406	1.391	1.912	1.504
Netters	Basic result	1.426	1.489	1.069	1.314	1.383	0.607	0.833	1.200	0.863	1.279	1.114	1.245	1.178	1.166	1.540	1.266
Netters	Ave. boot	1.178	1.486	1.078	1.327	1.376	0.629	0.836	1.198	0.850	1.260	1.100	1.230	1.171	1.156	1.546	1.259
Netters	B.inf 5%	0.606	0.755	0.587	0.781	0.913	0.512	0.769	1.103	0.717	1.024	0.913	0.995	0.935	0.921	1.181	1.014
Netters	Min. boot	0.552	0.852	0.619	0.843	0.893	0.520	0.764	1.061	0.696	0.969	0.852	0.946	0.918	0.898	1.144	0.976
Netters	Ecart type	0.291	0.373	0.251	0.279	0.236	0.060	0.034	0.049	0.068	0.120	0.096	0.120	0.120	0.120	0.187	0.125

Table 4.8.4. Results of the calculation of lpue indices in the English Channel.

Gear selection	Statistic	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
All gears	B.sup 5%	1.276	0.857	0.801	0.859	0.805	0.985	1.029	1.070	1.066	1.611	1.648	1.466	1.449	1.336	1.306	1.272
All gears	Basic result	1.091	0.747	0.710	0.742	0.719	0.904	0.987	1.014	0.956	1.418	1.421	1.273	1.217	1.112	1.106	1.068
All gears	Average	1.098	0.753	0.714	0.755	0.723	0.902	0.981	1.020	0.964	1.415	1.425	1.274	1.223	1.127	1.113	1.070
All gears	B.inf 5%	0.920	0.649	0.628	0.651	0.641	0.820	0.933	0.971	0.862	1.219	1.202	1.082	0.996	0.917	0.919	0.869
All gears	Standard deviation	0.091	0.053	0.044	0.053	0.042	0.042	0.024	0.025	0.052	0.100	0.114	0.098	0.116	0.107	0.099	0.103
All but pel	B.sup 5%	1.320	0.863	0.824	0.830	0.800	0.966	1.024	1.078	1.056	1.584	1.571	1.498	1.529	1.311	1.355	1.316
But pel	Basic result	1.125	0.751	0.715	0.731	0.725	0.888	0.973	1.028	0.958	1.394	1.356	1.281	1.248	1.058	1.108	1.074
All but pel	Average	1.123	0.744	0.714	0.727	0.722	0.885	0.975	1.026	0.952	1.411	1.369	1.292	1.261	1.081	1.120	1.082
All but pel	B.inf 5%	0.927	0.626	0.605	0.624	0.644	0.804	0.926	0.975	0.848	1.238	1.167	1.086	0.993	0.850	0.885	0.848
All but pel	Standard deviation	0.100	0.061	0.056	0.053	0.040	0.041	0.025	0.026	0.053	0.088	0.103	0.105	0.137	0.118	0.120	0.119
Bottom trawl	B.sup 5%	1.366	0.756	0.832	0.853	0.797	1.060	1.019	1.156	1.267	2.055	1.867	1.895	1.986	1.610	1.545	1.549
Bottom trawl	Basic result	1.120	0.649	0.707	0.729	0.704	0.940	0.941	1.063	1.091	1.679	1.514	1.520	1.519	1.171	1.213	1.192
Bottom trawl	Average	1.136	0.646	0.700	0.726	0.701	0.945	0.939	1.067	1.098	1.719	1.529	1.553	1.555	1.219	1.227	1.209
Bottom trawl	B.inf 5%	0.906	0.535	0.569	0.599	0.606	0.830	0.859	0.978	0.928	1.383	1.191	1.211	1.125	0.828	0.909	0.869
Bottom trawl	Standard deviation	0.118	0.056	0.067	0.065	0.049	0.059	0.041	0.045	0.087	0.171	0.172	0.175	0.220	0.200	0.162	0.173

4.9 ToR 9: Identify any longer term or episodic/transient changes in environmental drivers known to influence distribution, growth, recruitment, natural mortality or other aspects of productivity and which are relevant to assessments and forecasts

In the Bay of Biscay, no environmental drivers for sea bass have been studied.

4.10 ToR 10: Review progress on existing recommendations for research to develop and improve the input data and parameters for assessments, and develop and prioritise new proposals

4.10.1 Landings and discards data

The historical fishery catch data are subject to several biases. From 2000, French landings data from the ICES commercial landings database are replaced by more accurate figures from a separate analysis of logbook, auction data, and VMS. Prior to 2000, official French landings figures had to be estimated from logbook rescaled by comparing 1999 to 2000, meaning that landing estimates are uncertain before 2000.

4.10.2 Fishery composition data

The ability to fit selectivity patterns for defined groups of fishery métiers, and to detect changes in selectivity, depends upon collection of adequate numbers of independent, representative samples of length and age to sufficiently characterise the length or age compositions. What constitutes "sufficient" is impossible to define without simulation studies to examine relationship between precision of input data and the precision of estimates required for management. The absence of length composition data for French fisheries prior to 2000 is a serious deficiency in the model preventing any evaluation of changes in selectivity that may have occurred, for example due to changes in the mix of gear types. The numbers of trips of each métier group sampled on shore in France has varied widely over time.

ICES has developed extensive advice on establishing statistically sound sampling designs for estimating fishery length and age compositions, and discard quantities (see reports of ICES Workshops on Practical Implementation of Statistically Sound Catch Sampling Programmes - WKPICS1–3, available on ICES website). Stratified random sampling of fishing vessels or harbours may lead to low sample sizes for species such as sea bass for which large fractions of the total catches may be taken in relatively small numbers of fishing trips. The cost–benefit of expanding the sampling in vessel or harbour strata where most sea bass landings are recorded, without compromising statistical sampling design, should be investigated.

4.10.3 Recreational fishery harvests

WGCSE has since 2014 included an estimate of recreational fishing mortality in the assessment and forecasts. This is however a crude approach based on two surveys for a few years in France. Further survey data are needed to confirm the level of recreational catches and releases, and to develop a time-series to evaluate changes in recreational fishing mortality and any changes in selectivity. More work is needed on post-release (e.g. hooking) mortality rates given the high incidence of catch-and-release practices in sea angling for sea bass. Release rates are expected to increase due to bag limits and increases in MLS that are in place or planned. WGBIE should collaborate closely with the ICES Working Group on Recreational Fishery Surveys to identify priorities for future surveys and hooking mortality studies.

WKBASS data WK recommends that surveys of recreational sea angling catches and post-release mortality are needed to improve the assessment.

4.10.4 Surveys

There is no survey available for the Bay of Biscay assessment. A pilot survey was done between 2014 and 2017 in one estuary in Brittany and a second in the Loire estuary. These provided good results in term of sampling coverage and the material used (trawling). No funds have been allocated to continue this survey, which is an issue for the assessment.

4.10.5 Stock structure and migrations

The assessment treats all sea bass in 8.a&b as a single biological stock, despite potential for extensive migrations. For example, between the north of the area and the Bay of Biscay, or between the North Sea and the Channel, there is also strong site fidelity (Pawson *et al.*, 2008) resulting in a large proportion of tagged fish being recaptured at the same coastal location, even in subsequent years after migrations to offshore spawning sites. Immature sea bass remain close inshore, and exploitation of young fish in coastal waters (<6 nautical miles offshore) may be predominantly by inshore fleets. Mature fish originating in coastal waters of the UK, France, the Netherlands, or other countries may become increasingly vulnerable to offshore pelagic pairtrawlers fishing during spawning aggregations between December and April. These spatial, ontogenetic patterns may lead to complex responses of length and age compositions to previous fishery catches of each country and fleet. This could potentially be addressed using spatial structuring in Stock Synthesis, but the data demand would increase substantially. Both the UK (England) and France have embarked on major programmes of sea bass research involving electronic and conventional tagging, and modelling of larval drift patterns, to try to improve knowledge of spatial dynamics (Section 3.1). Stock structure and impact of migration on the assessment should be revisited in the light of finds from these studies.

4.11 ToR 11: For each stock, develop a spreadsheet of assessment model input data that reflects the decisions and recommendations of the data evaluation workshop

The model for the Bay of Biscay has been developed based on the Northern stock (BSS-47) assessment. The same methodology has been utilised to assess the Bay of Biscay (Table 4.10.1).

Table 4.10.1. Description of datasets and recommendations for the Biscay stock.

Issue	Problem/Aim	Work needed / possible direction of solution	Data required. Are these available? Where should they come from?	Recommendation
Landings data	Historical landings	Landings, fleet, area yearly required from 2000.	Landings from all the involved countries split by fleet, area (all countries; Spain lacking fleet data).	Analysis done on French pre-2000 landings, no possibility to split landings by gear prior 2000. Landings split by gear from 2000 onwards for France.
Tuning series	Commercial tuning data are available.	Finalise the appropriate commercial tuning series including 2015.	WD already in the SharePoint,	French lpue series was presented at WKBASS data but had not been subject to expert review. A new series excluding vessels with predominantly zero sea bass landings was provided at WKBASS assessment meeting and has been used in the assessment pending provision of lpue model diagnostics.
Recreational Fisheries	To include recreational fisheries in the assessment	Data are available for 2010	Data already collected and have been explored.	WKBASS updated information on all available recreational fishery survey estimates for sea bass. Separate length compositions derived for French survey estimates in BSS-47 and BSS-8.ab. French survey estimates of catch in 2011-12 previously supplied for whole of France. WKBASS obtained separate estimates by area, but could not validate the method so this survey is not used.
Survey tuning series	No survey tuning survey			
Discards	Considered as negligible			Information on discards are available from 2003 onwards. Discard estimates and length compositions for France were compiled by WKBASS and will be tested in the SS3 model at the benchmark assessment meeting.
Length compositions	French length composition from 2000 not yet available.	Supply length and age distributions for landings, including sampling intensities.	French length and age distribution per year from 2000 per ICES area French age distribution from 2008 onwards.	Sampling design, coverage and sample numbers for length and age sampling in France presented at WKBASS data workshop
	Spain Length composition note available	Spanish Landings represents 3% of the total from BSS-8.ab. If not available may not be an issue		No information available from Spain, but is unlikely to be an issue due to the very low level of Spanish landings in BSS-8.ab.

Issue	Problem/Aim	Work needed / possible direction of solution	Data required. Are these available? Where should they come from?	Recommendation
Biological Parameters	No Biological Parameters available in 2015, but data collection is underway for maturity and growth.	Use some of the biological data (natural mortality) from the WGCSE 2016 assessment.	Growth curve and maturity ogive to be discussed at the assessment workshop.	Growth curve and Maturity studied in BARGIP project (2013–2016) and used for assessment. WKBASS explored various life-history and maximum age-based methods, including age-dependent M. The WKBASS assessment meeting should explore the sensitivity of the assessment to different M options.
Assessment method	No analytical assessment has been done for BSS-8.ab.	Test similar approach to BSS-47 using SS3.	Will be done with available data at assessment workshop.	Development of the SS3 model will be carried out at WKBASS assessment meeting.

4.12 ToR 12: Prepare the data evaluation workshop report providing complete documentation of workshop actions, decisions, list of working documents, other information used by the workshop, and a list of any additional tasks to be completed following the workshop with dates and responsibilities for completion

This report fulfils this ToR. All Working Documents supplied to the WKBASS data workshop are in the Working Document folder on SharePoint. These are mostly drafts of text, tables and figures for the report prepared in advance of the meeting. All objectives of the Data Workshop were met at the meeting, and subsequent work focuses on completion of the report. Tasks were allocated to WKBASS members for this purpose on the final day of the meeting.

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Annex 1: Terms of reference for the WKBASS

Overall Terms of Reference for WKBASS

2016/ACOM32 A Benchmark Workshop on Sea Bass (WKBASS), chaired by ICES Chair Massimiliano Cardinale, Sweden (for Benchmark) and ICES Chairs Mike Armstrong and Kieran Hyder (UK) (for Data Evaluation), and attended by two/three invited external experts John Hoenig (USA), Karim Erzini (Portugal), and Vladlena Gertseva (USA) will be established. They will meet at ICES, Copenhagen for a data evaluation meeting on 10–12 January 2017 and a Benchmark meeting on 20–24 February 2017 to:

a) Evaluate the appropriateness of data and methods to determine stock status and investigate methods for short-term outlook taking agreed or proposed management plans into account for the stocks listed in the text table below. The evaluation shall include consideration of:

   i) Stock identity and migration issues.

   ii) Life-history data.

   iii) Fishery-dependent and fishery-independent data.

   iv) Inclusion of environmental drivers, multispecies information, and ecosystem impacts for stock dynamics in the assessments and outlook.

b) Agree and document the preferred method for evaluating stock status and, where applicable, short-term forecast, and update the stock annex as appropriate. Knowledge of environmental drivers, including multispecies interactions, and ecosystem impacts should be integrated in the methodology. If no analytical assessment method can be agreed, then an alternative method (the former method, or following the ICES data-limited stock approach) should be put forward.

c) Re-examine and update (if necessary) MSY and PA reference points according to ICES guidelines (ICES. 2017. ICES Reference points for stocks in categories 1 and 2. In Report of the ICES Advisory Committee, 2017. ICES Advice 2017, Book12, Section 12.4.3.1).

d) Develop recommendations for future improvement of the assessment methodology and data collection.

e) As part of the evaluation:

   i) Conduct a three day data evaluation workshop (DEWK). Stakeholders are invited to contribute data (including data from non-traditional sources) and to contribute to data preparation and evaluation of data quality. As part of the data compilation workshop consider the quality of data including discard and estimates of misreporting of landings.

   ii) Following the DEWK, produce working documents to be reviewed during the Benchmark meeting at least seven days prior to the meeting.

Stocks	Stock leader
Sea bass (*Dicentrarchus labrax*) in Divisions 4.b and c, 6.a, and 7.d–h (Central and South North Sea, Irish Sea, English Channel, Bristol Channel, Celtic Sea)	Lisa Readdy
Sea bass (*Dicentrarchus labrax*) in Divisions 8.a,b (Bay of Biscay North and Central)	Mickael Drogou

The Benchmark Workshop will report by 1 April 2017 for the attention of ACOM.

Detailed Terms of Reference for the data workshop

The WKBASS data evaluation, chaired by Mike Armstrong and Kieran Hyder (UK) will meet in ICES in Copenhagen from 10–12 January 2017 to carry out the following tasks for sea bass stocks in ICES area 4.b,c, 7.d, e–h and ICES area 8.a,b, and provide input data and parameters for the WKBASS benchmark assessment meeting:

1) Record progress in production of a working document on sea bass stock structure and mixing rates between stock areas being developed for the assessment based on recent tagging, genetics, and other studies.

2) Review and recommend life-history parameters (e.g. growth parameters, maturity ogives, fecundity, natural mortality), for use in assessments. Where applicable, provide appropriate models to describe growth, maturation, and fecundity by age, sex, or length.

3) Describe the history of fishery management regulations and actions that are expected to have caused changes in the quality of fishery catch data or the selectivity patterns of fisheries that are of relevance for the scientific assessment of the stocks and provision of advice.

4) Develop time-series of (commercial and recreational) fishery catch estimates, including both retained and discarded catch, with associated measures or indicators of bias and precision.

5) Estimate the length and age distributions of fishery landings and discards if feasible, with associated measures or indicators of bias and precision.

6) Develop recommendations for addressing fishery selectivity (pattern of catchability at length or age) in the assessment model.

7) Recommend values for discard mortality rates for commercial and recreational fisheries, if required, following the guidelines provided by ICES WKMEDS and indicate the range of uncertainty in values.

8) Review all available and relevant fishery-dependent and independent data sources on relative trends in abundance or absolute fish abundance, and recommend which series are considered adequate and reliable for use in stock assessments. Provide measures or indicators of bias and precision.

9) Identify any longer term or episodic/transient changes in environmental drivers known to influence distribution, growth, recruitment, natural mortality or other aspects of productivity and which are relevant to assessments and forecasts.

10) Review progress on existing recommendations for research to develop and improve the input data and parameters for assessments, and develop and prioritise new proposals.

11) For each stock, develop a spreadsheet of assessment model input data that reflects the decisions and recommendations of the data evaluation workshop.

12) Prepare the data evaluation workshop report providing complete documentation of workshop actions, decisions, list of working documents, other information used by the workshop, and a list of any additional tasks to be completed following the workshop with dates and responsibilities for completion.

Annex 2: List of participants

Name	Address	Phone/Fax	E-mail
Mike Armstrong Chair	Cefas Pakefield Road Lowestoft Suffolk NR33 0HT UK		mike.armstrong@cefas.co.uk
Rui Catarino ICES Secretariat	ICES H.C. Andersens Blvd. 44–46 1553 Copenhagen V Denmark		rui.catarino@ices.dk
Mickael Drogou	Ifremer Centre de Brest PO Box 70 Technopole de Brest-Iroise 29280 Plouzané France		Mickael.Drogou@ifremer.fr
Kieran Hyder Chair	Cefas Pakefield Road Lowestoft Suffolk NR33 0HT UK		kieran.hyder@cefas.co.uk
Alain Laurec	ENSAR Department Halieutique 65 Rue de Saint-Brieuc CS 84215 France		laurec-joud.alain@orange.fr laurec@agrorennes.educagri.fr
Lisa Readdy	Cefas Lowestoft Laboratory Pakefield Road Lowestoft Suffolk NR33 0HT UK		lisa.readdy@cefas.co.uk
Filip Volckaert By correspondence	Catholic University of Leuven Science Laboratory of Aquatic Ecology Research Group on Fish Genetics Charles Deberiotstraat 32-bus 2439 3000 Leuven Belgium		filip.volckaert@kuleuven.be
Mathieu Woillez	Ifremer Centre de Brest PO Box 70 Technopole de Brest-Iroise 29280 Plouzané France		Mathieu.Woillez@ifremer.fr