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Benchmark Workshop for Flatfish Stocks in the North Sea and Celtic Sea (WKFLATNSCS)

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BENCHMARK WORKSHOP FOR FLATFISH STOCKS IN THE NORTH SEA AND CELTIC SEA (WKFLATNSCS)

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BENCHMARK WORKSHOP FOR FLATFISH STOCKS IN THE NORTH SEA AND CELTIC SEA (WKFLATNSCS)

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Contents

i Executive summary

The WKFlatNSCS benchmark was convened to evaluate the appropriateness of data and methods to determine stock status for four sole stocks; North Sea (Sol.27.4), eastern English Channel (Sol.27.7d), Bristol Channel, Celtic Sea (Sol.27.7fg) and southwest of Ireland (Sol.27.7h–k); and one turbot stock, Skagerrak and Kattegat (tur.27.3a).

For **sole in the North Sea** a new index of stock abundance was derived, combining data from Belgium, Germany and The Netherlands (two survey series using different vessels). An updated category 1 assessment was agreed, continuing to use the Aarts and Poos model previously employed. Reference points were calculated using Eqsim and the forecast settings agreed.

For **sole in the eastern English Channel**, the main objective of the benchmark was to resolve an issue with the plus group in the French landings and commercial landings per unit of effort data. The catch data were revised several times between the data evaluation workshop and the benchmark meeting, and at the benchmark meeting, it became clear that there were issues that could not be addressed at that time concerning:

1. whether the methodology used to estimate ages for length classes where no samples for ageing had been taken was appropriate; and,
2. whether the calculations of effort being used to raise the sampled discards was being calculated appropriately and consistently between the sampled fleet and the total fleet.

As a result it was not possible to evaluate whether the catch-at-age data were appropriate for the assessment, or to evaluate the performance of an assessment. A further process following the benchmark meeting will be set up to complete this work.

For **Sole in Bristol Channel, Celtic Sea**, maturity assumptions and average stock weights-at-age were revised. An updated category 1 assessment was developed, reducing the reliance on commercial tuning series, and moving to a statistical catch-at-age model (SAM). Reference points were calculated using Eqsim and the forecast settings agreed.

For **Sole in the southwest of Ireland**, no appropriate method for evaluating the stock status and trends was found, due to the sampling only covering a small part of the total fishery, which is not considered to be representative of the whole area. The Workshop agreed to use category 5 to provide advice for this stock.

For **Turbot in Skagerrak and Kattegat**, a synthesis of work on stock boundaries within Division 3a was presented, indicating that turbot in this area may be part of two stocks, the North Sea and Baltic Sea. A combined index from five surveys (BTS, BITS, IBTS and two Danish national surveys) was used as a tuning index for a SPiCT biomass dynamics model to determine stock status.

The Workshop identified the need for future work:

- to provide a basis for catch advice for sole in 7d this year;
- to collect more sample data from 7h and to identify whether sole in 7h are connected to those in 7e or 7fg by genetics and movement for a future benchmark;
- to investigate whether the management boundaries for turbot in 3a are appropriate based on current understanding of stock boundaries for a future benchmark.

ii Expert group information

Expert group name	Benchmark Workshop for Flatfish Stocks in the North Sea and Celtic Sea(WKFlatNSCS)
Expert group cycle	Annual
Year cycle started	2020
Reporting year in cycle	1/1
Chairs	Meaghan Bryan, US
	Timothy Earl, UK
Meeting venues and dates	17–21 February 2020, Copenhagen, Denmark (20 participants)
	20–22 November 2019, Ghent, Belgium (12 participants)

1 Introduction

The Benchmark Workshop for Flatfish Stocks in the North Sea and Celtic Sea chaired by External Chair Meaghan Bryan (USA) and ICES Chair Timothy Earl (UK) took place during October 2019 and February 2020 for data evaluation and to review assessment methods for five flatfish stocks according to the Terms of Reference given in Section 1.1. The Workshop was attended by 21 members from eight countries including scientists and industry representatives. A full list of attendees is given in Annex 1.

The majority of data were submitted in a timely fashion to the data evaluation workshop, however, a number of datasets covering landings-at-age, discards, commercial landings per unit of effort and survey data were not available to this workshop. As a result, further data evaluation was carried out via Skype and at the main benchmark meeting, delaying the work on assessments. This reduced the time available to run and review assessments, and meant that in the case of sole in the eastern English Channel, progress could not be made on the assessment method at the benchmark meeting.

In the body of this report, the reviewers' report is presented first (Section 2) followed by sections for each stock (3–7), providing a summary of the analysis performed and the conclusions reached. Working documents referred to in the text are included in Annex 2.

1.1 Terms of Reference

2019/2/FRSG26 A **Benchmark Workshop for Flatfish stocks in the North Sea and Celtic Sea** (WKFlatNSCS), chaired by External Chair Meaghan Bryan*, USA and ICES Chair Timothy Earl*, UK, and attended by two invited external experts Eoghan Kelly, Ireland, and Morten Vinther, Denmark will be established and will meet in Ghent, Belgium 20–22 November 2019 for a data evaluation meeting and at ICES HQ, Copenhagen, Denmark, for a 5 day Benchmark meeting 17–21 February 2020 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:
   1. Stock identity and migration issues;
   2. Life-history data. For sole, fluctuations in mean weights-at-age will be explored;
   3. Review current sampling levels and adjust stratification levels for landings and discards accordingly;
   4. Examine alternative assessment models to the current model;
   5. Explore impact of all tuning fleets on assessment estimates;
   6. Further inclusion of environmental drivers, multispecies information, and ecosystem impacts for stock dynamics in the assessments and outlook;
   7. Examine mixed fisheries interaction.

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 about 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 (see Technical document on reference points);

d) Develop recommendations for future improving of the assessment methodology and data collection;

e) As part of the evaluation:

1. Conduct a 3 day data evaluation workshop. 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;
2. Following the Data evaluation, produce working documents to be reviewed during the Benchmark meeting at least 7 days prior to the meeting.

Stocks	**Stock leader**
tur.27.3a	Jon Svendsen
sol.27.7h-k	Claire Moore
sol.27.7fg	Sofie Nimmegeers
Sol.27.4	Iago Mosqueira
sol.27.7d	Lies Vansteenbrugge

2 Reviewer comments

Meaghan Bryan (Chair), Eoghan Kelly, and Morten Vinther acted as external experts for the WKFlatsNSCS benchmark. We reviewed data compilation methods and evaluated the modelling methods used for the assessment of the sole stocks from 27.7fg, 27.7hjk, and 27.4 and the turbot stock from 27.3a from 17–21 February, 2020. The intention of this benchmark was to also evaluate the assessment method for the sole stock from 27.7d, but data problems prohibited the review for this stock during the meeting.

We commend the workshop participants for their efforts during the benchmark process. The review panel asked for many additional model runs incorporating suggested improvements and to test model sensitivity during the meeting. The response of the participants to our requests was helpful in furthering our understanding of the assessment models and were successful in bringing useful information to the management process. We would also like to recognize the level of professionalism the participants exhibited when dealing with late stage data compilation issues that impacted their assessments.

Discussions concerning the data inconsistencies in the national (French) catch-at-age and discard estimates for sole 27.7d highlighted the need for clear documentation of the data processing procedures and communication of these procedures at the data compilation workshop. Proper documentation and communication will allow for adequate evaluation of the data during the data compilation workshop and help to identify concerns before moving forward with the benchmark workshop. Our conversations about this issue also brought to the light the need for standardized data processing procedures of national catch-at-age and effort data. Moving away from *ad hoc* and nation-dependent data processing procedures, is critical for ensuring consistency in data products between years and among the nations that submit data as part of the assessment process.

Working documents summarizing the assessment methods, preliminary model runs, and diagnostics were not provided before the meeting for the majority of reviewed stocks. We understand that this is a difficult task given the trend of increasing workloads across organizations and this compromises scientists' ability to prepare these documents in advance. However, the lack of this documentation impacts the quality of the review process given the compressed timeframe to review each individual stock. We strongly encourage assessment authors to provide working documents summarizing the proposed base model including the key model assumptions and preliminary model diagnostics prior to benchmark workshops in the future.

The sections below summarize the discussions during the meeting and the recommendations made regarding these stocks.

2.1 Sole 27.7d

The assessment of this stock has been postponed until the discrepancies in the French catch-at-age and discards data are resolved.

2.2 Sole 27.7fg

The Celtic Sea sole stock in area 27.7fg has previously been assessed using the XSA model. The data inputs for this model were presented and reviewed during this meeting. Catch-at-age was derived from landings-at-age and discards-at-age. Discard observations are available from 2004–present and discards prior to 2004 were assumed to be equal to the average value from 2004–

2018. The previous assessment used a maturity ogive derived from data collected in 1992–1993, whereas a new ogive was derived using a random effects model with data from the 2013–2019 UK Q1SWBEAM survey and presented. The panel agreed that the new maturity ogive should be used given it was informed by a longer time-series of data; however, observations of age-1 individuals were absent and the model estimated the proportion mature to be 9%. This seemed unreasonable and the panel agreed the maturity of age-1 should be assumed to be zero to reduce uncertainty in the final years of the assessment and in the forecast. During the workshop, the leads of the UK Q1SWBEAM survey indicated that the maturity ogive may not have been weighted properly since the stratified survey design was not considered in the development of the ogive. The panel agreed this should be corrected prior to the stock assessment workshop. Mean weight-at-age is another data input. The weight-at-age data indicated that mean weight of age-1 early in the time-series was higher than age-2, which was nonsensical. Given the uncertainty in the weight-at-age of age-1s we recommended that the age-1 weight-at-age be assumed constant over the time and set equal to the minimum observed weight-at-age for age-2. Four tuning indices were presented for use in the assessment model; the UK commercial index, the Belgian commercial index, a new scientific survey which was intended to target younger sole (UK-Q1SWECOS) and one survey already used in the assessment (UK(E&W)-BTS-Q3). The XSA model requires age structured tuning indices. The commercial age data to raise the catch-at-age were also used to provide the age structure for the commercial tuning indices.

Preliminary results from the XSA model were presented. The model fit the commercial data quite well. This was mainly due to the correlation between the catch-at-age data and the age-structured commercial tuning indices that was introduced by using the same age-distribution data. The panel recommended that a SAM model be developed with the commercial tuning indices specified as biomass indices.

The model comparison of the XSA and SAM results indicated that the SAM assessment using commercial tuning indices as biomass indices was an improvement and performed statistically better than XSA. The panel agreed that the SAM assessment model was appropriate for providing management advice.

Given the length of commercial tuning indices and the potential of technological creep the panel recommended splitting the indices to account for this. The UK tuning index was split into two time periods 1984–2005 and 2006–2019 in the final model. This split was chosen because we saw a large increase in cpue between then two years. The Belgian tuning index was 1971–1983 and 1984–1996 in the final model. A third tuning index, UK-Q1SWECOS survey, was considered, but ultimately was not included in the model. The panel recommended not including the UK-Q1SWECOS survey because it had very little impact on the assessment results, likely because it is currently a short time-series.

Reference points were discussed during the benchmark meeting. The panel decided that the stock–recruitment relationship is Type 5, "Stocks showing no evidence of impaired recruitment or with no clear relation between stock and recruitment (no apparent S–R signal)"; therefore, B_{lim} is set equal to B_{loss}. The panel determined that using the Ricker stock–recruitment relationship to identify B_{lim} was inappropriate because a biological explanation for low recruitment at larger stock size is currently lacking for sole; therefore, a segmented regression is used. We examined the trends in the exploitation and weight-at-age and recommended that the last five years of the selectivity and weight-at-age be used since prior to this period there were trends over time. We also discussed the age classes that should be included in the F_{bar} calculation. The panel recommended including ages 3–8 in the F_{bar} calculation since this age range represents 80% of the catch.

Recommendation

1. Re-evaluate the use of the UK-Q1SWECOS data for inclusion as a tuning index as it becomes a longer time-series. This survey is intended to provide information about younger age classes, which will be valuable in future assessments.

2.3 Sole 27.7hjk

Sole is a valued, bycatch species in area 27.7hjk and represents a data-limited stock. Initial discussions about this stock focused the current stock definition and data limitations. The two main areas 27.7h and 27.7j are separated by unsuitable habitat for sole and there is some indication of differences in growth between the two areas. Physical separation and differences in growth could indicate that these areas represent two different stocks of sole, but without genetic evidence or tagging data, we were not able to validate this hypothesis during the benchmark workshop.

Landings data are available from areas 27.7h and area 27.7j. The landings in area 27.7j are captured using otter trawls primarily by the Irish fleet. Conversely, the landings in area 27.7h are captured using beam trawls primarily by the Belgian, French and UK fleets. Belgian VMS data show that there is likely misreporting in area 27.7h. Vessels are allowed to fish within multiple areas in one trip and the VMS data indicate that effort in area 27.7h is concentrated at the border areas 27.7e and 27.7fg. Landings estimates accounting for this misreporting were submitted for this assessment. Age data are available from area 27.7j and have been used in previous assessments. Age data from area 27.7h from the UK exists; however, the level of sampling and the availability of the data for this assessment was unclear.

Recommendations

1. Efforts should be made to address this stock structure issue. We recommend that genetic studies be conducted to determine whether these stocks are different. This should be done as part of a larger study where genetic samples are taken from all areas adjacent to area 27.7h to identify the most appropriate management unit for this species. Redefining the stock definition also requires the stock identity working group to evaluate the data and make a recommendation to SCICOM and ACOM. We recommend that this issue be brought to the stock identity working group.
2. Efforts should continue to identify misreporting of landings in area 27.7h from other nations (France and the UK). This will be valuable in determining whether landings are more reflective of landings in other areas and whether it would be more suitable for the area 27.7h stock to be assessed with areas other than 27.7jk.

Sole 27hjk was defined as a category 3 assessment prior to this benchmark and was assessed using an XSA model with commercial landings and lpue from area 27.7j as data inputs. The age data from the commercial fleet was used to get landings-at-age and landings-at-age per unit of effort. The landings-at-age data were presented and indicated that cohort tracking was relatively poor. Landings data were available, but age information was not available from area 27.7h and precluded using XSA to assess the stock in this area. During previous assessments, it was assumed that the trends in areas 27.7jk were representative of 27.7h. The assessment results from the previous assessment were presented during the workshop. The model resulted in relatively poor fits to the data and severe retrospective variability, although the Mohn’s rho was within the range of acceptability.

We recommended that a data-limited approach be explored for this stock. We discussed using a mean length Z approach. The data requirements for the ICES approved approach included lengths, effort, growth parameters, and length at full selection. There were concerns that the mode of the length distribution was larger than the length of full selection and given that sole exhibit sex-dependent differences in growth the results would be difficult to interpret. Our next recommendation was to explore the utility of the SPiCT model for this stock for area 27.7jk. The SPiCT model was not explored for area 27.7h because effort data were not available.

SPiCT model runs were completed using the commercial landings (1995–2018) and effort data from area 27.7jk. Landings and effort were used as data inputs rather than landings and landings-per-unit of effort to avoid autocorrelation between the two inputs since they are not independent of one another. Two effort time-series were considered 2007–2018 and 1995–2018. Model runs estimating the shape parameter of the production curve and fixing this parameter to assume the Schaefer model were explored. This stock has a long history of exploitation and as such model runs using the default assumption about depletion (i.e. the stock is unfished) and assuming depletion of 50% were explored. Overall, the results indicated considerable uncertainty in the model estimates of the MSY-based metrics. We concluded that this model should not be used to provide category 3 advice about stock status at this time. We recommend that this stock be treated as a category 5 stock.

Recommendation

Other data-limited management procedures should be evaluated for this stock in the future. The DLMtoolkit (Carruthers and Hordyk, 2018) is an R package and contains a diversity of methods that may be suitable and provides a flexible framework to test multiple management procedures using management strategy evaluation. Users can identify the management procedures that are best to consider based on available data. Data-limited management procedures are often assumption rich; therefore, the assumptions of each approach will also need to be considered when identifying appropriate methods.

2.4 Sole 27.4

North Sea sole (area 27.4), prior to this benchmark workshop, has been assessed using the AAP model. Several issues with respect to tuning indices and the North Sea sole (area 27.4) stock assessment were identified during the WGNSSK 2019 meeting. They were as follows: 1) the tuning indices (i.e., BTS index from the Netherlands) should be re-evaluated and the inclusion of the Belgian BTS index should be considered, 2) a combined BTS tuning index (BTS data from the Netherlands, Germany, and Belgium) should be evaluated and considered for inclusion in the stock assessment model, and 3) the consistent residual pattern to the model fit to the age-2 and age-3 catch-at-age data should be addressed modifying the settings of the AAP model. The work presented at the beginning of the WKFlatNSCS focused on these issues.

The individual tuning indices and an index combining the BTS data from the Netherlands, Germany and Belgium were reviewed during the data compilation workshop. Previously the Belgian BTS data were not included in the assessment; however, there is a clear benefit for its inclusion. Namely, the Belgian BTS data improve the survey coverage of the southwestern portion of the North Sea, an area with a generally higher abundance of older individuals. The AAP model, a forward projecting age-structured model that uses a logistic function to describe the proportion of discards-at-age, has been used to assess this stock for several years. Preliminary model runs using the AAP model either included the BTS tuning index from the Netherlands (BTS-ISIS), the combined BTS index (Netherlands, Germany, and Belgium) derived using a GAM following the methodology described in Berg *et al*. or the standardized BTS-ISIS index using the same GAM to combine the three indices as data inputs. The catchability spline was also modified so that the model better fit the age-2 and age-3 catch data.

The assessment results from the three preliminary model runs were similar, with slight deviations in the most recent years of SSB and fishing mortality. Of the three model runs presented, the panel agreed that the combined index should be used as explained before. An evaluation of the model diagnostics showed that there were consistent patterns in the landings and discards residuals that were concerning, the model poorly fit the age-9 survey data, and the 2018 selectivity pattern suggested that selectivity of intermediate ages 4–6 was lower than younger and older age class, which seemed unreasonable. An error in the catch-at-age data, where the last two years used the same catch-at-age numbers resulted in the odd selection pattern in 2018. Including the correct catch-at-age data remedied the selectivity pattern and residual patterns in the landings were improved. The poor fit to the age-9 survey data was due to the assuming that age-9 was a plus group when fitting the GAM to derive the combined survey index. The GAM was refit to the survey data assuming age-9 was an individual age class and the plus group represented age-10+. This matched the assumption of the assessment model and the fit to the age-9 survey data was improved.

The corrected input data did not improve the fit to the discards of older age classes, mainly 6–8. The model generally underestimated the discards of these age classes and could not explain the high observed discards-at-age from 2012 or so. The observed discards were surprising to many participants including the fishing industry. Given the value of this species, most would not have expected many discards of age-6 and older sole. There were questions about the raising procedure used for the discards (e.g. was the multinomial used? how is the CV in age at length incorporated in the raising procedure, if at all?); however, there was no clear answer.

Similar to previous assessments of this stock, the AAP model resulted in a retrospective pattern where SSB was overestimated in the last three years. Two other models were explored, A4A and SAM, to determine whether this retrospective pattern could be improved. Model assumptions were similar to AAP and the assessment results, diagnostics, and retrospective patterns were similar among the three models. Since the results were similar among the model and A4A and SAM did not represent significant improvements we recommended that the presently used AAP model was suitable to provide management advice.

Reference points for North Sea sole were discussed during the benchmark workshop. The panel agreed that the stock–recruitment relationship was type 2 ("Stocks with a wide dynamic range of SSB, and evidence that recruitment is or has been impaired") and the reference points will be recalculated using Eqsim. The average of the five most recent years for selectivity and weights-at-age will be used to calculate the reference points. This time frame was chosen to represent a relatively stable time period for selectivity and weight-at-age. The calculation of reference points differs from the previous assessment, which assumed the stock–recruitment relationship was described by the Ricker model. The panel agreed that a biological explanation for low recruitment at larger stock size is currently lack for sole; therefore, we decided the Ricker model was inappropriate. Following the type 2 description a segmented regression will be used to define B_{lim}.

Recommendations

1. The AAP model was originally chosen to assess this stock because it can estimate historical discards; however, the model struggles to estimate the observed discards at older ages. A constant, logistic relationship was assumed to estimate the proportions of discards-at-age. It would be prudent to evaluate whether a time-varying relationship could be included in this model to help better estimate recent discards.

2. The raising procedure used for discards was also questioned and should be evaluated in the future to determine they are being consistently and adequately processed, and that higher than expected discards at older age classes are not an artefact of the data processing procedure.

2.5 Turbot 27.3a

Turbot is a high value, bycatch species in the plaice fishery in area 27.3a. This stock has previously been assessed as a category three assessment using the IBTS Q1 and Q3 surveys to provide abundance information. During the benchmark workshop a surplus production in continuous time (SPiCT) model (Pedersen and Berg, 2017) was presented as a potential assessment method to determine stock status for this stock rather than relying on the survey indices alone. Given its high value, an accurate understanding of this species' stock structure and the accurate accounting of catch and abundance is required to adequately assess the stock status of this species. As such, the initial discussions focused on the stock definition and the catch time-series.

The current definition of turbot in Area 27.3a (Skagerrak and Kattegat) assumes that this is a closed system. Genetic evidence from several studies indicate that area 27.3a represents a transition zone for turbot between the highly saline North Sea and the brackish Baltic Sea (Le Moan, 2019). The genetic data are generally consistent with the bottom trawl data that were presented. The data from several bottom trawl surveys were combined to get a spatially comprehensive view of turbot abundance. Abundance was generally highest at the border between the North Sea and Skagerrak and the border of the Kattegat and western Baltic Sea further indicating that this area represents a mixed stock. It was beyond the scope of this meeting to redefine the stock definition for this species; however, we have the following recommendations:

1. Turbot genetic studies in the North Sea, Skagerrak, Kattegat, and Baltic Sea should continue. The studies to date have had limited samples from the Skagerrak, so it would be prudent to focus on this area. Additional genetic evidence will help to better define turbot stock structure and better define adequate management units for this species.
2. Given the implications of this stock structure question, we also strongly recommend that turbot stock structure in area 27.3a be re-evaluated by the stock identity working group. This will require coordination and collaboration of scientists working in the North Sea, Skagerrak, Kattegat, and Baltic Sea.

Several issues concerning the landings and surveys were presented and discussed during the workshop. The available surveys have been used to provide abundance information for turbot in area 27.3a; however, they have been highly variable. As such, a key concern prior to the benchmark workshop was whether the surveys adequately sample areas with high turbot landings. The spatial distribution and the depth distribution of the surveys and catch data were compared to address this concern. The Danish commercial landings represent 75% of the total and as such were the point of comparison with the survey data. The comparisons show that there is considerable spatial overlap between areas with turbot landings and the survey areas and the depth distribution of the landings and surveys are similar. Given these results, we determined that the surveys are adequately surveying the areas with significant turbot landings.

There was some question about the Dutch landings from 1976–1980. Dutch landings in all other years are a small fraction of the total; therefore, the 1976–1980 Dutch landings were in question, e.g. misreported. Input from the fishing industry suggested that this increase was true due to a significant reduction in the Dutch quota for sole and plaice in the North Sea in those years. The reduction in quota led to increased fishing effort in area 27.3a by the Dutch fleet. Official 27.3a landings statistics in the 1970s and 19820 from the Netherlands for plaice and other species were not available and have not been reported to ICES; however, unofficial statistics provided by Wageningen University & Research during the benchmark showed good correlation between plaice landings and turbot landings in these years. We therefore concluded that the increase in the Dutch landings of turbot in years 1976–1980 was not a misreporting issue and was a realistic observation and should be considered for inclusion in the SPiCT model.

A single modelling approach was presented for turbot, the surplus production in continuous time (SPiCT) model (Pedersen and Berg, 2017). The data requirements for the SPiCT model are modest and include a catch time-series and an index of exploitable abundance or an effort time-series. Catch data from Denmark, Sweden, Germany, the Netherlands, and Norway were included in the model. Annual catch from each country represented the landings and discards; however, discards were assumed negligible for Norway. Discard information was available from 2002–2018. When reviewing the discard data, coverage seemed adequate; however, the discard rates in area 27.3a.21 seemed high (range: 7%–36%) given the economic value of this species. Although these rates seemed high, discards were a small proportion of total catch and we determined they should be included in the model. A model-based index of abundance was derived from five bottom trawl surveys that generally cover the area of exploitation. Following Berg *et al*. (2014) the index was derived using a Generalized Additive Model (GAM) approach where spatial and spatio-temporal factors were included to account for changes in spatial distribution over time. Also, differences in survey gear, haul duration, and fishing depth were accounted for as factors in the model. Overall, the panel agreed that this was a sensible approach and combining the survey data gave a spatially comprehensive estimate of turbot abundance.

Model runs were not ready at the start of the meeting due to delays in receiving the catch data; however, over the course of the week we were able to explore several alternatives. This modelling approach introduced data that had not been previously used to determine stock status for this stock. As such, decisions about the 1) the start year of the catch and index of abundance time-series, 2) the assumed shape of the production relationship (e.g. should it be fixed and assumed to follow the Schaefer model or some other model), and 3) the assumed level of depletion at the start of the model were needed.

The initial model runs started in 2002 for both the catch and abundance information (this covered the period of catch statistics from InterCatch). The default priors for the parameters describing the ratio of uncertainty between the index and biomass (alpha), the ratio of uncertainty between the catch and fishing mortality (beta), and the shape parameter (n) were used. The priors were relatively uninformative. Another model following the previously stated inputs and assumptions was run, but the production curve was assumed to follow the Schaefer model. The initial model runs were highly uncertain and exhibited considerable autocorrelation in the index; however, the uncertainty was reduced when assuming the Schaefer model. Subsequent model runs extended the time-series to start in either 1983 (both catch and index), 1975 (catch only, index start year was 1983), or 1950 (catch only), assumed either the default prior for the production relationship or the Schaefer model, and a sensitivity analysis to the assumed prior probability distribution for the level depletion was conducted.

The panel agreed that the model should start in 1975. Given that we could confirm that the catch estimates from the Netherlands between 1976 and 1980 were not spurious and this represents a peak in the catch history, including the data from 1975 allowed for a longer exploitation history to be included in the model. Including a longer catch series can improve the estimation of starting conditions in surplus production models. The panel also agreed that assuming production was described by the Schaefer model was an adequate assumption for this assessment. The posterior estimate of the shape parameter defining the production curve was not well informed by the data and was similar to the prior distribution. In absence of evidence to assume otherwise and given the uncertainty in the assessment outputs and the retrospective pattern were somewhat improved under this assumption the final model was assumed to follow the Schaefer relationship. The default assumption about depletion in the model is that the stock is at unfished levels. Turbot has been commercially fished for more than 100 years and we agreed this was an erroneous assumption. During the workshop several priors were considered and the model generally estimated depletion to be lower than the assumed prior. A well-developed prior was not available at the workshop; therefore, the panel agreed that an uninformative prior assuming depletion equal to 50% of unfished biomass was reasonable.

The diagnostics for this model configuration still exhibited autocorrelation in the index and considerable uncertainty in relative fishing mortality and biomass, but the general trend was similar to the other model configurations considered. Also the retrospective pattern remained within the confidence limits and was better behaved than other models we considered. Hence, this model configuration (model 3b in the working document) was deemed acceptable for providing category 3 advice about stock status for turbot in area 27.3a with one caveat. We recommend following the advice from the ICES WKLIFEX, which indicates that stock status should be assessed using the 35th percentile (and not the 50th) of the distribution of stock status (F/F_{MSY} and B/B_{MSY}) to account for the uncertainties in the estimates of F_{MSY} and B_{MSY}.

Recommendations for future work

1. It is unreasonable to assume that the turbot stock is unfished at the start of the model given the value and exploitation history of this stock. We recommend developing a better-informed prior for depletion.
2. The fits to the index exhibited autocorrelation indicating non-stationarity in the index. The smoothing of the year effect GAM used to derive the index introduced this autocorrelation. This should be investigated further to determine if the effect of autocorrelation could be reduced in the model.

3 Sole (*Solea solea*) in Subarea 4 (North Sea)

3.1 Stock ID and substock structure

No new information was available on stock identity and substock structure since the previous benchmark (WKNSEA 2015). An overview of current knowledge is available in the WKNSEA 2015 report (ICES, 2015).

3.2 Issue list

Stock	**Sol.27.4**	
Stock coordinator	Name: Iago Mosqueira	Email: iago.mosqueira@wur.nl
Stock assessor	Name: Iago Mosqueira	Email: iago.mosqueira@wur.nl
Data contact	Name: Iago Mosqueira	Email: iago.mosqueira@wur.nl

Issue	Problem/Aim	Work needed / possible direction of solution	Data needed to be able to do this: are these available / where should these come from?	External expertise needed at benchmark type of expertise / proposed names
(New) data to be considered and/or quantified[1]	Additional M - predator relations	Not at the moment		
	Prey relations	Not at the moment		
	Ecosystem drivers	Not at the moment		
	Other ecosystem parameters that may need to be explored?	Not at the moment		
New data				
Tuning series	Evaluate Belgium BTS index, and other surveys (eg. German BTS) covering stock area not covered by other surveys currently in assessment (SNS, BTS-ISIS)	Analyse DATRAS data	Data available in DATRAS	Holger Haslob
	Explore combining surveys	Analyse data and construct index using Delta Gam GAM method		Casper Berg, Holger Haslob
Assessment	Residuals patterns age 2–3 in landings	Investigate residuals using different setting of AAP model		
Forecast	Review forecast procedure	Evaluate current RCT3 settings and autumn reopening	Data available in DATRAS – Demersal Fish Survey (DFS)	
Biological Reference Points	Determine MSY (proxy) reference points	Depending on the assessment method and available data	See issue 'assessment method'	

[1] Include all issues that you think may be relevant, even if you do not have the specific expertise at hand. If need be, the Secretariat will facilitate finding the necessary expertise to fill in the topic. There may be items in this list that result in 'action points for future work' rather than being implemented in the assessment in one benchmark.

3.3 Scorecard on data quality

No scorecard was developed for this report.

3.4 Multispecies and mixed-fisheries issues

No new information on the multispecies and mixed-fisheries aspect of the fishery was presented at the meeting.

3.5 Ecosystem drivers

No new information on ecosystem considerations was presented at the meeting.

3.6 Stock assessment

3.6.1 Catch–quality, misreporting, discards

The benchmark work for North Sea sole was carried on the existing dataset of landings and discards-at-age for the stock, with data up to 2018. Catch data for 2019 are still in the process of being uploaded to InterCatch, and will be processed and raised according to the procedure followed by WGNSSK 2019 (ICES, 2019).

Questions have been raised on the current amounts of discards of fish of ages 6 and older for the Dutch beam trawl fleet (Figure 3.1). Numbers of fish discarded appear to be large enough to deserve some attention on the merits of the raising procedure. The patterns for older ages might be related to the strong influence of a limited number of samples. Raising of discards samples over the 2010–2019 period will be repeated and evaluated.

3.6.2 Surveys

Four trawl surveys are currently carried out that should provide information on population trends for North Sea sole:

- BTS-ISIS (Beam Trawl Survey, from 1985 until now, the Netherlands).
- SNS (Sole Net Survey, from 1970 until now, the Netherlands).
- BTS-Belgica (Beam Trawl Survey, from 2004 until now, Belgium).
- BTS-Solea (Beam Trawl Survey, from 1976 until 2012, Germany).

Furthermore, the BTS-Tridens Beam Trawl Survey, carried out by the Netherlands from 1996 until now, covers areas north of those sampled by BTS-ISIS, where sole is expected to be absent or only found occasionally. But recent analysis of the BTS-Tridens data (Brunel and Verkempynck, 2018) has shown an increasing presence of sole in more northern latitudes.

A standardized index of abundance for North Sea sole, based on the BTS datasets listed above (BTS-ISIS, BTS-Tridens, BTS-Belgica and BTS-Solea), has been developed and presented to WKFlatNSCS 2020 (Annex 2.1.1).

The inclusion of the BTS-Belgica data extends the index coverage to areas on the southwestern North Sea where the abundance of sole appears to have increased in time (Figure 3.10). Comparing this index with that based on BTS-ISIS samples (Figure 3.3), shows relatively minor differences, more marked when surveys report large abundances. A plot of the internal consistency for the index (Figure 3.2) shows that cohorts are properly tracked.

3.6.3 Weights, maturities, growth

3.6.3.1 Natural mortality

Natural mortality in the period 1957–2018 has been assumed constant over all ages at 0.1, except for 1963 where a value of 0.9 was used to take into account the effect of the severe winter (1962–1963).

3.6.3.2 Assessment model

The AAP model (Aarts and Poos, 2009) has been slightly refined from that used in the previous benchmark. The age dimension of the fishing mortality tensor spline, and the spline used to model catch selectivity-at-age, used to be defined with the same number of bases (knots). These two variables have now been separated, to allow the model greater flexibility. This change was intended to ameliorate the patterns in residuals on the fit to landings-at-age data for ages 2 and 3 observed in WGNSSK 2019 (ICES, 2019).

An R package is also now available for the model, which can be installed on multiple platforms. This facilitates, for example, incorporating model runs using AAP to the ICES TAF platform.

Table 3.1. Settings and dimensions of the AAP model run.

Assessment model	AAP (Aarts and Poos, 2015)
Assessment software	AAP R/FLR package, ADMB
Surveys	
BTS-GAM (NL,BE,DE)	
Ages:	1–9
Years:	1985–2018
SNS	
Ages:	1–6
Years:	1970–2018
Model settings	
F_{bar}	2–6
Knots of F matrix spline: Age and years (F_{age}.knots, F_{time}.knots)	8, 28
Knots selectivity-at-age spline (S_{age}.knots)	6
Age from which F is constant ($q_{plat}.F_{matrix}$)	9
Age from which selectivity is constant (q_{plat}.surveys)	8

The results of the run of AAP with the settings above can be found in Figure 3.4. SSB appears to remain stable over the last few years despite the decrease in F, as recruitment has oscillated at slightly lower than average levels.

Retrospective patterns for this model run are mostly within the 95% confidence intervals (Figure 3.5). Recruitment estimates are hardly affected, as the model does not fit a stock–recruit relationship and follows the information on year-class strength provided by both surveys.

Residuals to the fit of the four datasets still present some patterns (Figure 3.6), especially in the fit to landings-at-age data for age 1. The time-series of estimated fishing mortality-at-age can be found in Figure 3.8, while yearly selectivities are plotted in Figure 3.7.

Alternative model runs here conducted using both SAM (Nielsen and Berg, 2014) and a4a (Jardim *et al.*, 2016). The model setups adopted in both cases were not too distant from the base case AAP run, but none of them estimated discards in the past. Figure 3.9 shows a comparison of three model runs. Both population estimates and retrospective patterns were consistent. The figure also contains the population trajectories obtained by the AAP run from WGNSSK 2019. Note that this model run employed a different index of abundance from the BTS-ISIS survey, and had a different configuration for the selectivity and fishing mortality design matrices.

3.7 Short-term projections

The settings for short-term projections were agreed. Future selectivity and growth patterns-at-age will be computed from an average of the last five years.

3.8 Appropriate Reference Points (MSY)

The setup of the Eqsim procedure was agreed. Only the segmented regression relationship will be used, given the lack of fit of the Beverton–Holt model to this dataset and that no biological explanation for a negative density-dependence between SSB and recruitment was put forward. The stock was considered to be in category 2 of the ICES guidelines (ICES, 2017) so B_{lim} will be set by the estimate of the segmented regression inflection point.

3.9 Future research and data requirements

Data on discards-at-age for older ages should be analysed to understand if the recent increases are well supported by the available data.

3.10 External Reviewers comments

The external reviewers’ comments for all stocks are provided in Section 2.

3.11 References

Brunel, Thomas, and Ruben Verkempynck. 2018. Variations in North Sea Sole Distribution: Variation in North Sea Sole Distribution with Respect to the 56°n Parallel Perceived through Scientific Survey and Commercial Fisheries. Wageningen Marine Research Rapport, C087/18. IJmuiden: Wageningen Marine Research. https://doi.org/10.18174/465031.

Aarts, G., and J. J. Poos. 2009. "Comprehensive Discard Reconstruction and Abundance Estimation Using Flexible Selectivity Functions." ICES Journal of Marine Science 66 (4). Oxford University Press (OUP): 763–71. https://doi.org/10.1093/icesjms/fsp033.

Nielsen, A. and Berg, C.W. 2014. Estimation of time-varying selectivity in stock assessments using state–space models. Fisheries Research. 158. 10.1016/j.fishres.2014.01.014.

Jardim, Ernesto, Millar, Colin, Scott, F., Osio, Giacomo, Ferretti, M., Alzorriz Gamiz, Nekane and Orio, A.. 2016. What if stock assessment is as simple as a linear model? The a4a initiative. ICES Journal of Marine Science. 72. 232–236.

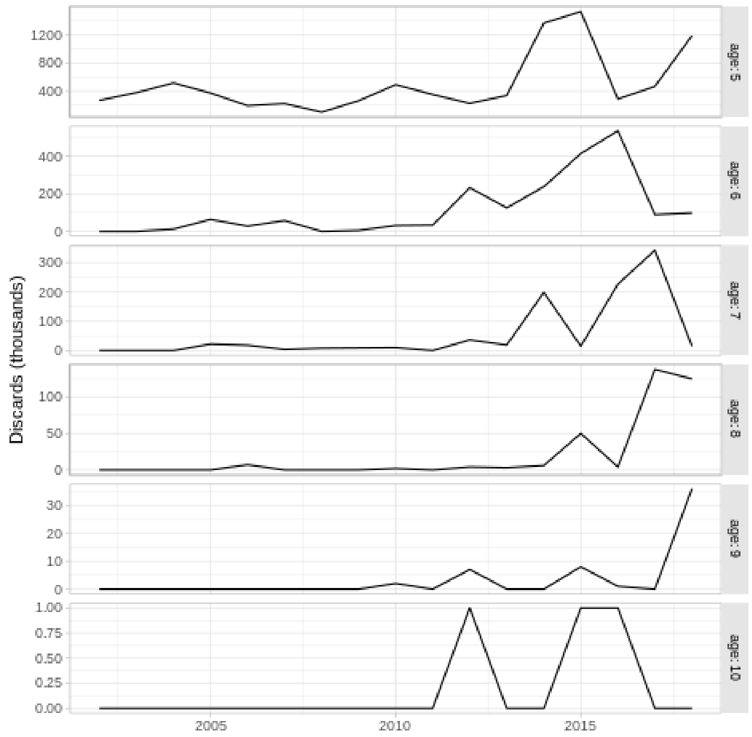


Figure 3.1. Discards-at-age in thousands, for ages 5–10 and from year 2002, in the current stock assessment dataset.

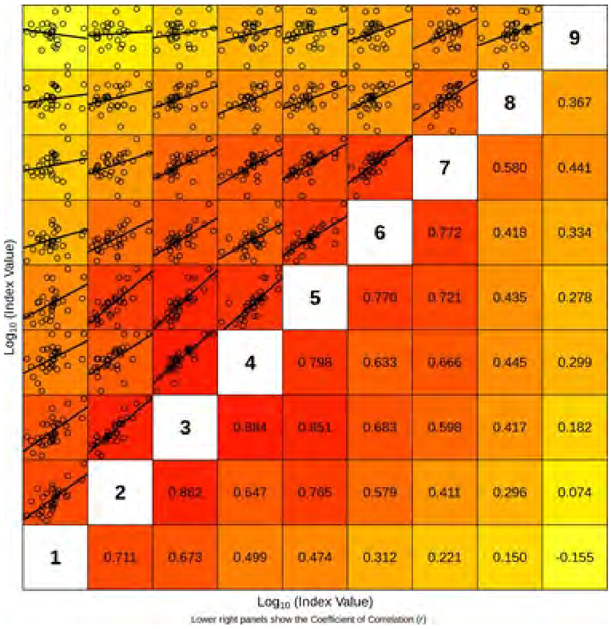


Figure 3.2. Internal consistency plot for the BTS-based delta-lognormal GAM standardized index of abundance for North Sea sole.

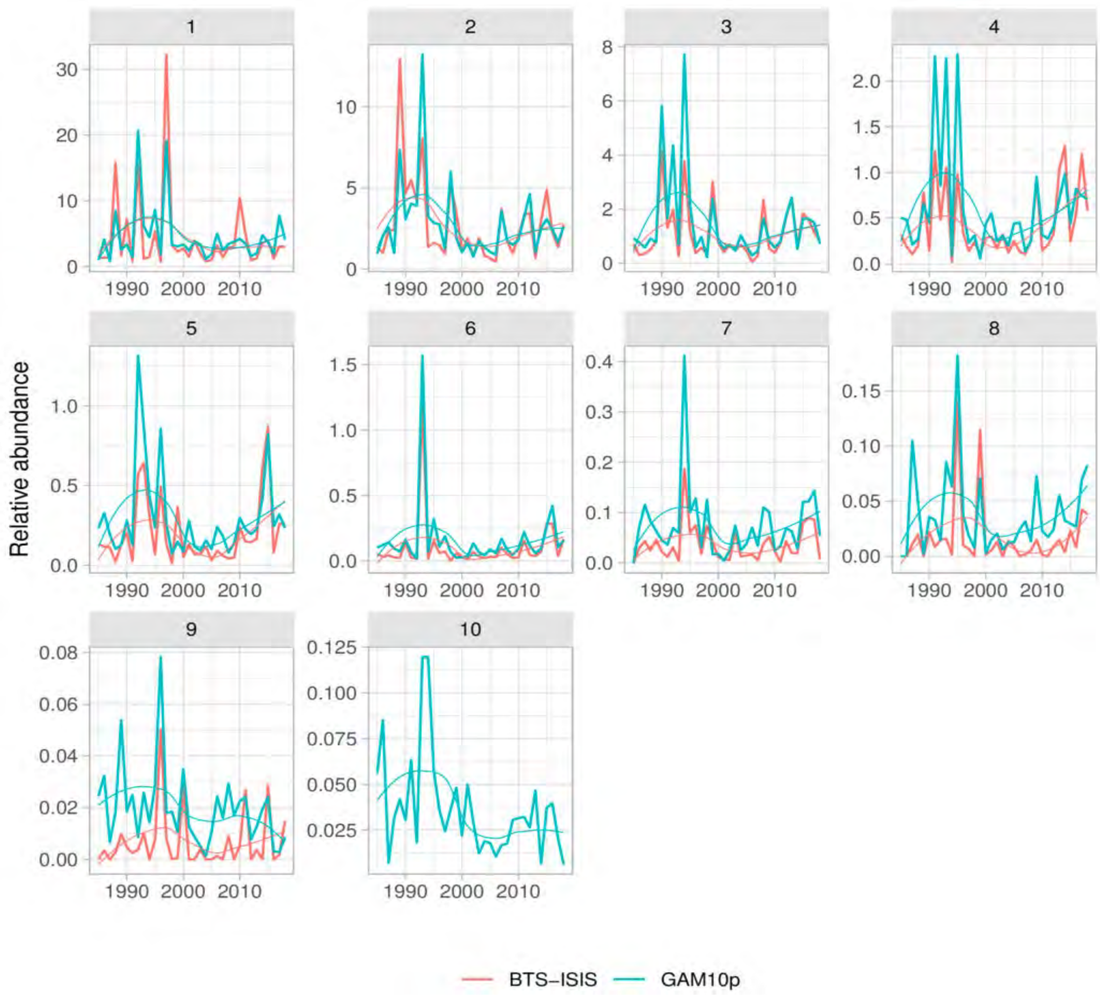


Figure 3.3. Comparison of the two alternative indices of abundance-at-age derived from samples taken during the quarter 3 Beam Trawl Survey (BTS). BTS-ISIS refers to the traditional index based, and GAM10p to the standardized index using NL, BE and DE data where age 10 has been set as a plus group. Indices are rescaled to the mean by age for plotting and a loess smoother is shown for each index.

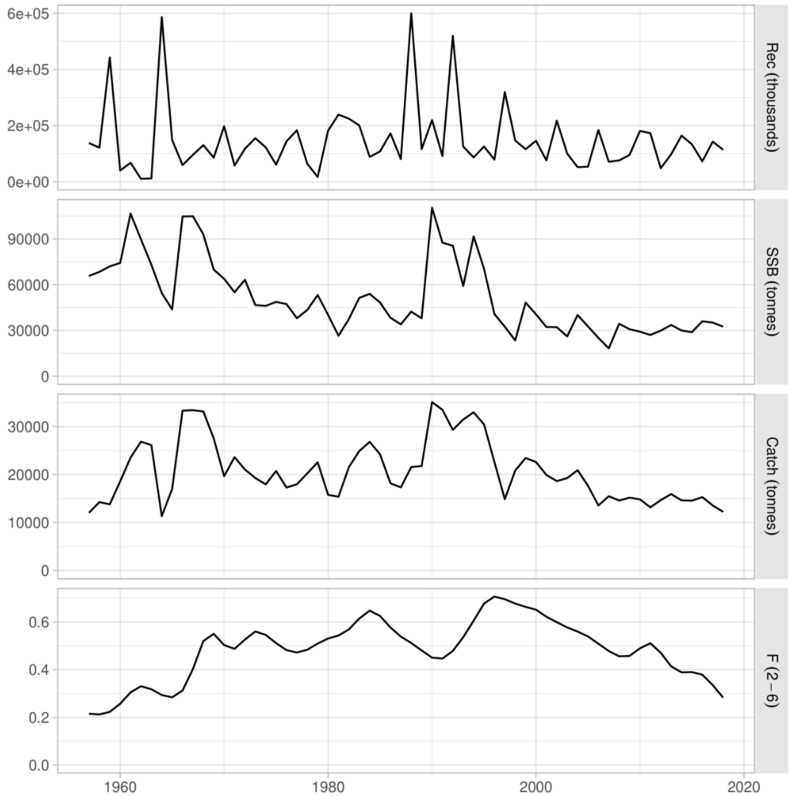


Figure 3.4. Estimates of recruitment, spawning–stock biomass, and mean fishing mortality for ages 2 to 6, as returned by the AAP model run.

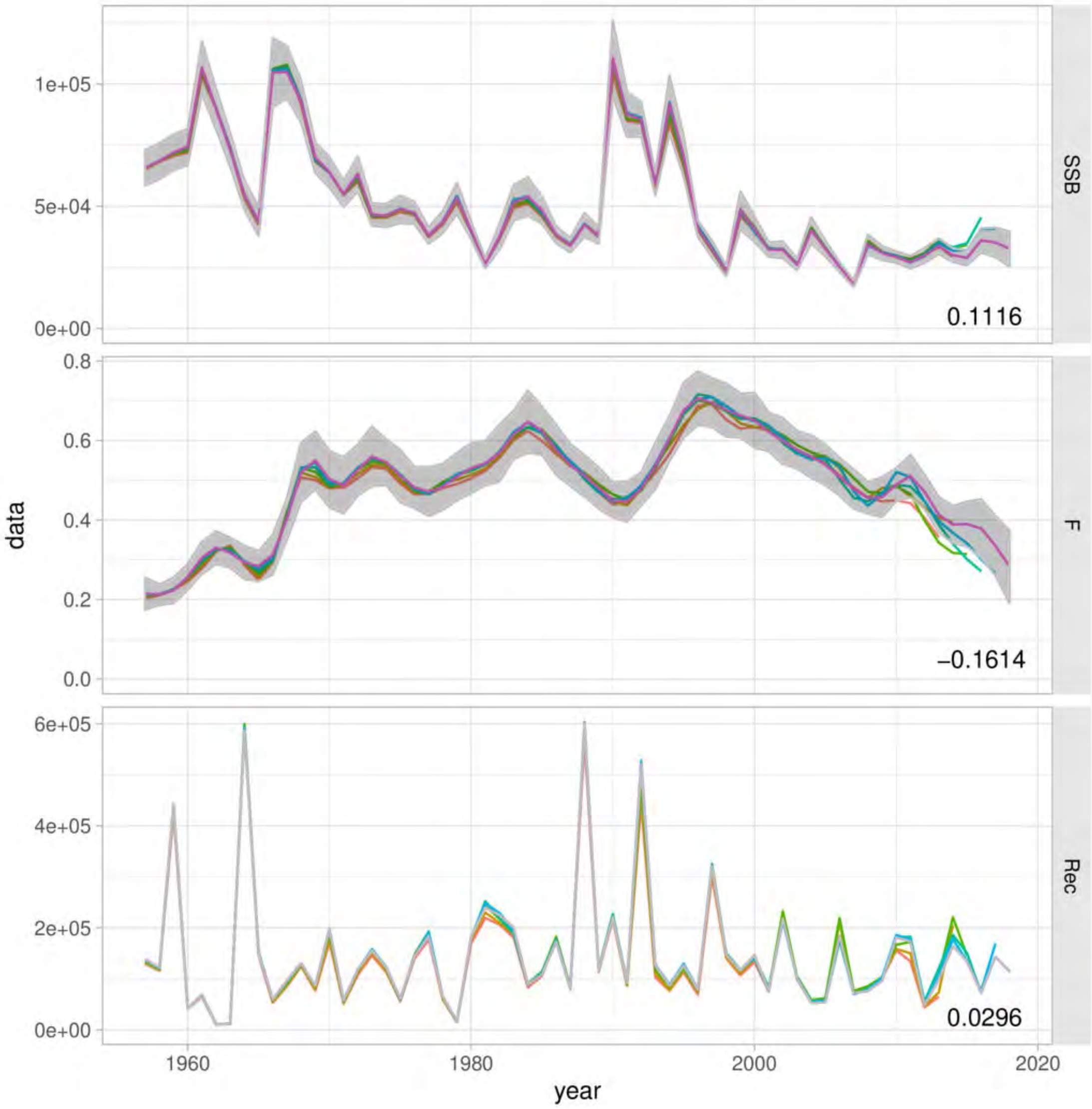


Figure 3.5. Five-year retrospective patterns for the estimates of SSB, F and recruitment returned by the AAP model run. Numbers on each panel show the value of Mohn's rho.

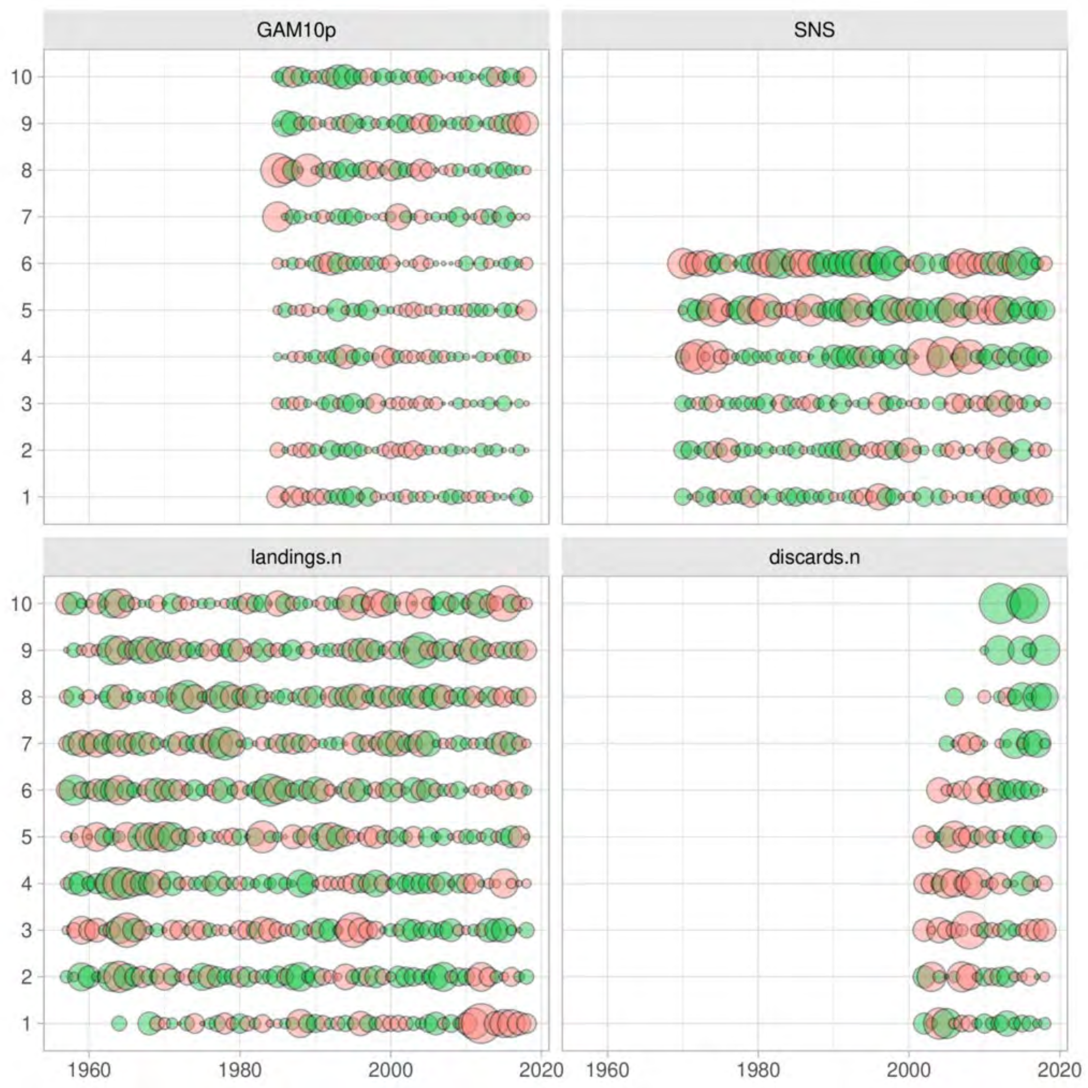


Figure 3.6. Log-standardized residuals-at-age by year for the fitted datasets. GAM10p refers to the GAM-standardized BTS-based index of abundance where age 10 has been set as a plus group.

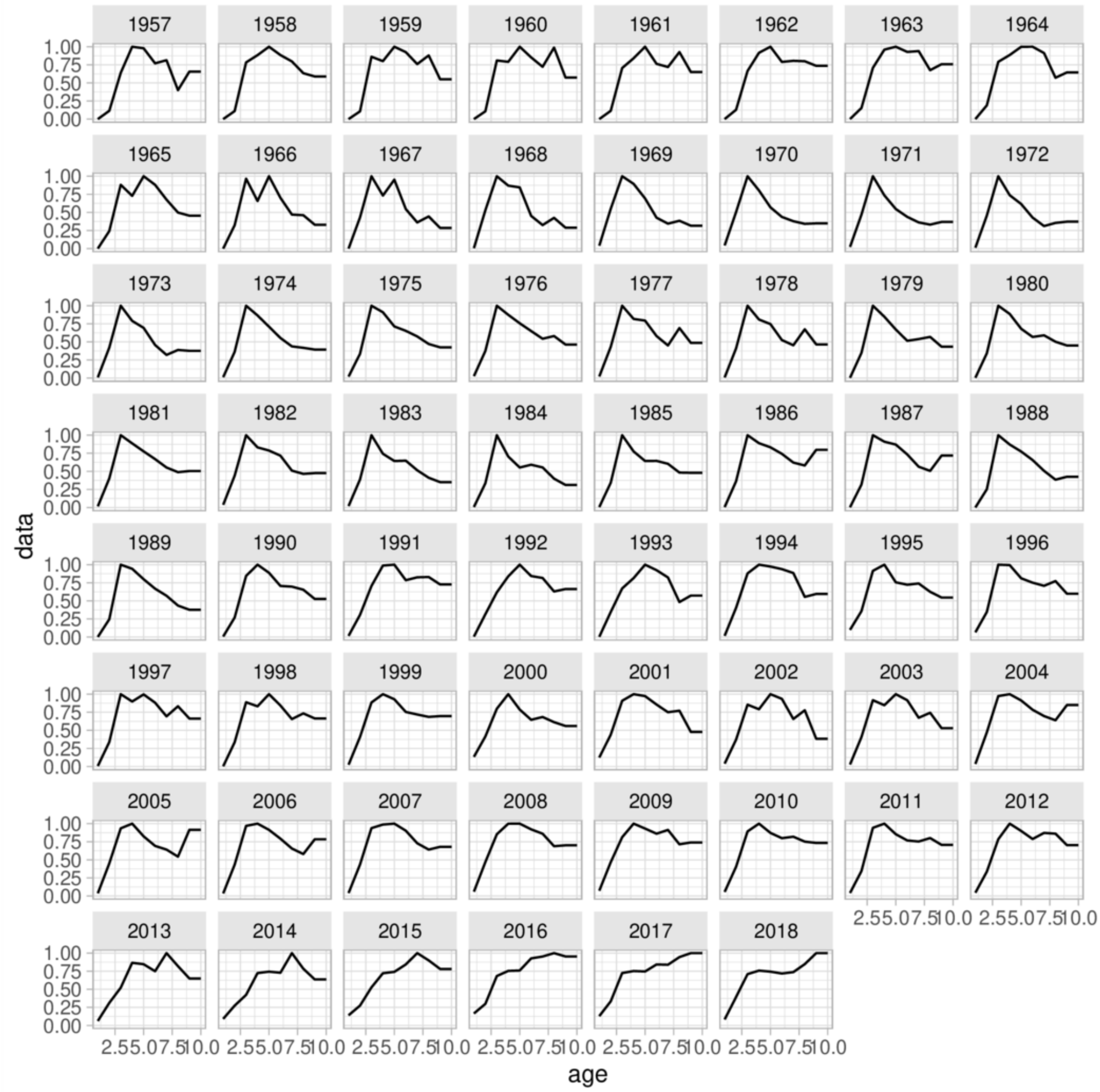


Figure 3.7. Yearly estimates of selectivity for the AAP model run.

Figure 3.8. Time-series of fishing mortality-at-age estimated by the AAP model run.

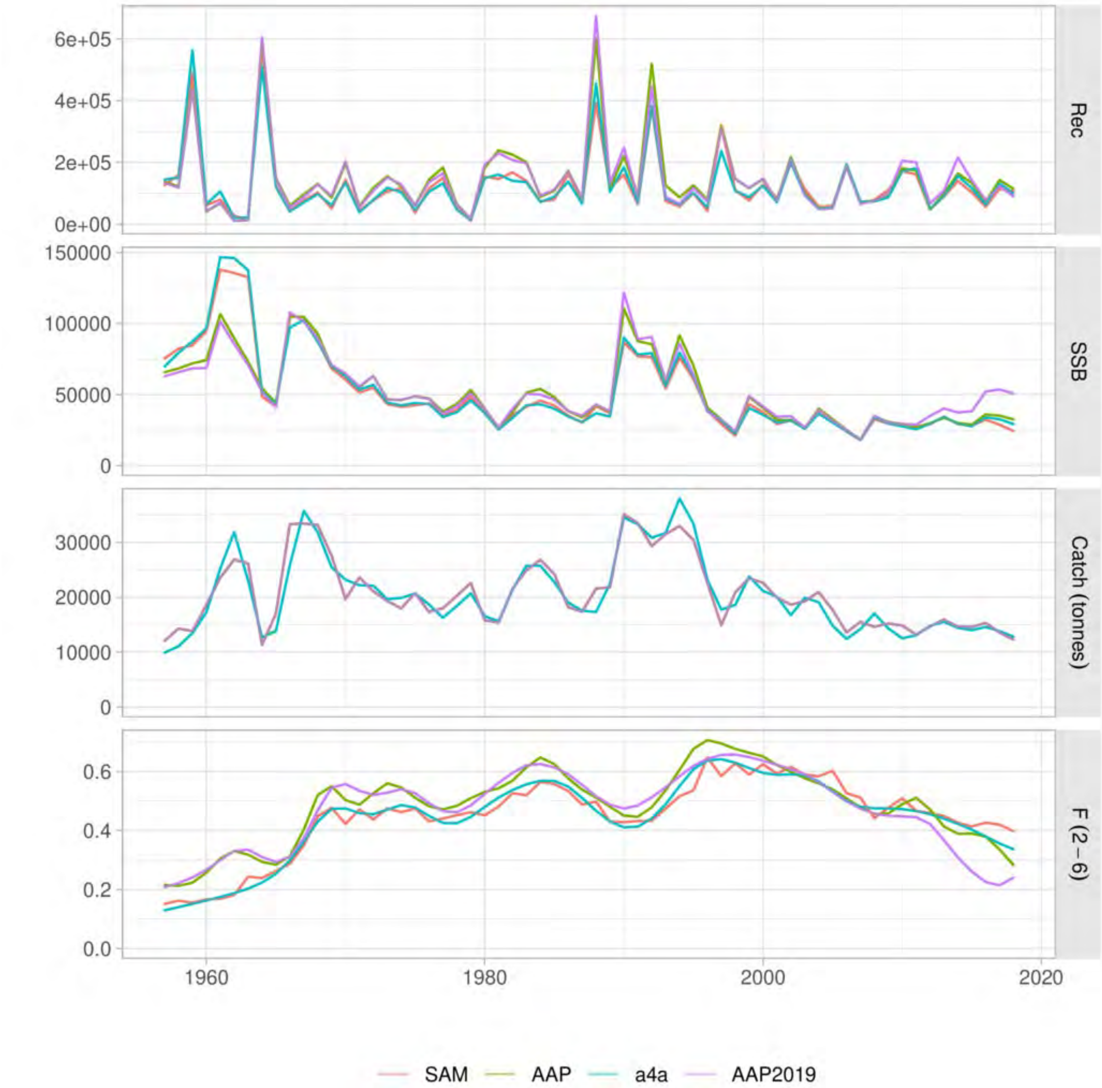


Figure 3.9. Comparison of population estimates obtained by the various models: SAM, AAP and a4a. AAP2019 refers to the run of AAP carried out in WGNSSK 2019.

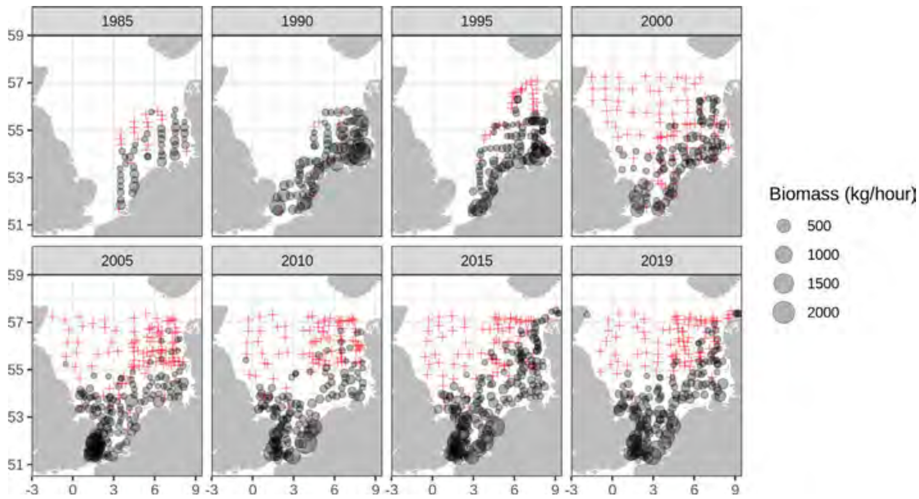


Figure 3.10. Biomass (kg/hour) of sole per haul in the BTS for the whole period 1985–2019. Red crosses indicate absence of sole.

4 Sole (*Solea solea*) in Division 7.d (eastern English Channel)

4.1 Stock ID and substock structure

No new information was available on stock identity and substock structure since the previous benchmark (WKNSEA 2017). An overview is available in the WKNSEA 2017 report (ICES, 2017). The French SMAC project is investigating the substock structure of sole in Division 7.d, however final results were not yet available for this benchmark.

4.2 Issue list

Issue	Problem/Aim	Work needed/ possible direction of solution	Data needed to be able to do this: are these available / where should these come from?	External expertise needed at benchmark type of expertise / proposed names
(New) data to be considered and/or quantified[2]	**Resolve the issue with the plus group in the French data**	**France to provide new data**	**On the national level: France to upload data without plus group for both the French commercial otter trawl tuning series as the commercial sampling data.**	**French experts in data raising and tuning fleets**
	Presence of subpopulations in the eastern English Channel	Await the final outcome of the SMAC project	Await the final outcome of the SMAC project	French experts involved in the SMAC project.
Tuning series	There are 6 tuning series in the assessment. Most of them are only covering a small part of Division 7d.	Explore methods to combine tuning fleets (e.g. delta GAM).	Age disaggregated tuning fleets are available.	UK (E&W), French and Belgian survey and commercial tuning fleet experts; a delta GAM expert
Biological Parameters	Investigate the observed decrease in mean weight and mean length-at-age.	Analyse commercial and survey data	Commercial and survey data at-age	Stock coordinator
Assessment method	**Move away from XSA**	**Explore other assessment models, such as SAM, AAP, …**	**/**	**Experts on SAM, AAP, …**
	Check if all tuning fleets should be retained in the assessment.	**Do several assessment runs.**	**/**	**Stock coordinator**
Biological Reference Points	**Determine MSY reference points**	**Run EqSim functions**	**Using the final assessment**	**Experts in computation of reference points**
Forecast	**/**	**Run the forecast**	**Using the final assessment**	**Stock coordinator**

4.3 Scorecard on data quality

No scorecard was developed for this report.

4.4 Multispecies and mixed-fisheries issues

Sole in Division 7.d is considered in multispecies and mixed-fisheries issues. However, the 2019 mixed-fisheries advice did not include sole in Division 7.d in the calculations as it was downgraded to a category 3 stock. No new information was presented at the benchmark.

[2] Include all issues that you think may be relevant, even if you do not have the specific expertise at hand. If need be, the Secretariat will facilitate finding the necessary expertise to fill in the topic. There may be items in this list that result in 'action points for future work' rather than being implemented in the assessment in one benchmark.

4.5 Ecosystem drivers

No ecosystem drivers were identified for this report.

4.6 Stock assessment

4.6.1 Catch–quality, misreporting, discards

4.6.1.1 Quality

Sole in Division 7.d had an Inter-benchmark in August 2019. It was found that French catch data for 2016 and 2017 were aggregated incorrectly for older ages, which meant that the catch-at-age data were not reliable for these years. A re-upload of French data for the period 2016–2018 was requested in the data call for the benchmark to be able to fix this issue. However, this issue was not fixed by the new upload. Additionally, France raises its data by effort and the way the effort was calculated had changed. More specifically, the calculation from fishing hours to days at sea was modified according to STECF FDI guidelines. France decided to upload its data for the whole recent time-series (2002–2018) to make sure this effort calculation was consistent over this time period. However, it became clear that the effort from the sampled fleet was still calculated in the old way, which could give problems when raising the data by effort.

Still, the issue with large numbers in the plus group was not resolved. During the benchmark, France was advised to use multinomial regression instead of von Bertalanffy growth curves to construct the age–length keys (ALKs). In this way, the presence of one very old fish in the data had a lower effect on the overall age distributions (numbers-at-age) (Gerritsen *et al.*, 2006).

In order to resolve these issues, France decided to 1) investigate whether it could go back to the old effort calculations and 2) use the multinomial function to avoid large plus groups.

As a result of these issues, data were not available to process, which delayed the benchmark work for sole in Division 7.d.

4.6.1.2 Misreporting

During the inter-benchmark protocols on sole in ICES Division 7.d (eastern English Channel) in August 2019, a revision of the Belgian commercial beam trawl tuning fleet occurred (ICES, 2019). Investigating the Belgian sole landings data revealed that pure trips, i.e. trips in which fishing activity was limited to one of the sole stock areas (ICES Division 7.d), often had a considerably different mean landing rate ($kg.h^{-1}$) than mixed trips (i.e. trips in which fishing occurred in multiple ICES divisions). The Belgian commercial fishing fleet has fishing opportunities in several ICES divisions. To allow an efficient exploitation of the stocks over all these areas, vessels are allowed to fish in different ICES divisions within one trip (e.g. while steaming from a Belgian harbour to a foreign harbour). This flexibility of fishing in different ICES divisions might create opportunity for non-compliance. The working document on the Belgian commercial landings data added to this report (Annex 2.2.2) aims to estimate the landings in two ways.

The <u>first method</u> uses landing and effort data as reported by fishers in the electronic logbooks. First, the annual landings of pure trips were divided by the annual effort of pure trips per area to calculate a pure trip lpue by management area and year (2004–2018). Secondly, this lpue was used to estimate the landings from the mixed trips by multiplying the effort (by management area and year) registered in these trips with the pure trip lpue derived in the first step. Finally, the estimated landings from the mixed trips were added to the registered landings from the pure trips to estimate the total landings per area per year. This method assumes that the effort as reported in the mixed (and pure) trips is reliable, and that lpue of pure trips is representative for the landing rate in mixed trips. In addition, this method does not account for additional sources of variation in lpue.

The second method uses the landings per unit of effort of pure trips, but gets the effort data for both the pure and mixed trips from the VMS dataset with data available from 2006 onwards. Similar to the first method, landings were estimated by multiplying the lpue by the total VMS derived effort in this area.

Although the analyses show differences between reported and estimated landings (both methods), we are unable to determine how landings should be corrected for sole in Division 7.d. Feedback from the fishing industry reveals that several components affect the fishing behaviour in the eastern English channel, which directly impacts the observed lpue values and reported landings. Estimated landings point towards over-reporting, especially by the large fleet segment. This means that Belgian landings for sole in Division 7.d are probably lower. As it is not possible to determine how accurate the estimated landings are, and given the typical fishing behaviour in Division 7.d, it was decided to retain the officially reported landings in the assessment.

It should be noted that misreporting is likely to be present in other fleets as well (e.g. the French and the English fleet).

4.6.1.3 Catch

Catch data were updated by UK England (2016–2018) and France (see Quality). UK England data differed only slightly with was uploaded before. French data were, due to the issues described under §Quality; not available for the benchmark.

France is responsible for the majority of the landings (50%), followed by Belgium (30%) and UK England (20%). In some years, there is a negligible amount of landings from The Netherlands and UK Scotland.

InterCatch was used for estimating the numbers- and weights-at-age in the catch.

To allocate age compositions, landings and discards were handled separately; samples from landings were used only for landings and vice versa. More information on the allocation scheme can be found in the working document on the preparation of catch data (Annex 2.2.1). The weighting factor used was 'Mean Weight weighted by numbers-at-age'.

4.6.2 Surveys

4.6.2.1 Research surveys

The eastern English Channel sole stock was assessed during the Inter-benchmark (August 2019) including three survey indices in the assessment: UK (E&W) BTS (1989–2018), UK YFS (1987–2006) and French YFS (1987–2018). The latter specifically focus on age 0 and 1. Only the information on age 1 is included in the assessment. Information on age 0 and 1 is used in the RCT3 estimation.

In 2019, UK England continued their Young Fish Survey (YFS), which had stopped in 2006. A working document (Annex 2.2.4) made available for this benchmark, described a new calculation of the tuning index for the period 2000–2006 and 2019. Although the continuation of this survey is highly encouraged to provide specific information on the northern part of the sole 7.d stock, the benchmark decided not to include this series in the assessment as there were not enough recent datapoints available (only 2019). Moreover, there was uncertainty on whether the catchability of the survey has changed over the period 2000–2006 compared to 2019 (not all the previous prime stations could be visited, and the index calculation was performed differently). Note that the French YFS survey does not provide the only index of recruitment, the UK BTS is the most important driver of recruitment estimates.

4.6.2.2 Catch and effort series

The eastern English Channel sole stock was assessed during the Inter-benchmark (August 2019) including three survey indices in the assessment: the Belgian commercial beam trawl cpue series from 2004–2018, the UK England commercial beam trawl series from 1986–2018 and the French commercial otter trawl series from 2002–2018. The two first series were recalculated during the inter-benchmark (ICES, 2019). For this benchmark, France provided a working document (Annex 2.2.5) on a new calculation method of the French otter trawl series using a model-based approach instead of a raw calculation of lpue (landings per unit of effort). The inclusion of this series in the assessment was tested.

4.6.3 Weights, growth, maturity, natural mortality

4.6.3.1 Weights and growth

Stock weights-at-age were calculated in three different ways over the entire time-series (1982–2018).

- From 1982–1987, stock weights-at-age were obtained from a smoothed curve of landings weights interpolated to the 1st of January (using the formula: $y=0.0018x^2 + 0.0192x + 0.1161$ with $R^2 = 0.96$).
- During the working group in 2002, second quarter landings weights were used in order to be in line with North Sea sole. This resulted in slightly higher estimates of the spawning–stock biomass. However, from the report it seems that this new calculation method could only be applied from 1988 onwards. During this benchmark, it was decided to use the quarter 2 landings weights for the period 1988–2003. For age 1, a default of 0.050 kg seems to be chosen. This might indicate that the "Rivard calculator" was used for this (as it cannot deal with zeros or NAs). However, no documentation on this was found.
- As discards were included from 2004 onwards, these also needed to be taken into account. For the period 2004–2018, the quarter 2 *catch* weights were extracted from InterCatch and used as stock weights-at-age. Age distributions from Belgium were provided per year instead of quarter. For the years 2004, 2005, 2008–2011 and 2016, Belgium stated it was not possible to provide qualitative age distributions per quarter (too few samples, thresholds were not met). For 2006, 2007, 2012–2015, 2017 and 2018, Belgian age distributions and more specifically mean catch weights-at-age were added and used for the calculation of the mean weight-at-age for quarter 2 (i.e. stock weights-at-age).

4.6.3.2 Maturity

The maturity ogive was not altered during this benchmark. The ogive as calculated during the previous benchmark (WKNSEA 2017) was used.

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

4.6.3.3 Natural mortality

Natural mortality is assumed constant over ages and years at 0.1. No new information was made available for this benchmark.

4.6.4 Assessment model

There is no information yet.

4.7 Short-term projections

There is no information yet.

4.8 Appropriate Reference Points (MSY)

There is no information yet.

4.9 Future research and data requirements

There is no information yet.

4.10 External Reviewers' comments

The external reviewers' comments for all stocks are provided in Section 2.

4.11 References

Gerritsen, H.D., McGrath, D, Lordan, C. 2006. A simple method for comparing age–length keys reveals significant regional differences within a single stock of haddock (*Melanogrammus aeglefinus*). ICES Journal of Marine Science, 63, 1096–1100.

ICES. 2017. Report of the Benchmark Workshop on North Sea Stocks (WKNSEA), 6–10 February 2017, Copenhagen, Denmark. ICES CM 2017/ACOM:34. 673 pp.

ICES. 2019. Inter-benchmark Protocol for sole in the Eastern English Channel (IBPsol7d). ICES Scientific Reports. 1–75. 88pp. http://doi.org/10.17895/ices.pub.5631.

5 Sole (*Solea solea*) in divisions 7.f and 7.g (Bristol Channel, Celtic Sea)

5.1 Stock ID and substock structure

No new results were presented on the stock ID during the WKFlatNSCS. However, concerns were raised on the identity of the neighbouring sol 7.h–k stock, and its, in particular the substock in 7.h, relationship to the sole 7.fg and 7.e stocks. Yet no data are available to clarify this.

A description of the sole stock in the Celtic Sea was given in the leaflet "Fisheries information-cod, sole, plaice and whiting in the southwest of the British Isles" published by Cefas under an EU funded project (SAMFISH: EU Study Contract 99-009, Improving sampling of western and southern European Atlantic Fisheries) and is taken over here.

In the coastal waters of western England and Wales, sole are found in greatest abundance in the eastern Celtic Sea. The main spawning areas for sole in the Celtic Sea are in deep waters (40–75 m) off Trevose Head (Figure 5.1), where spawning usually takes place between March and May. Sole nursery grounds are generally located in shallow waters such as estuaries, tidal inlets and sandy bays (Figure 5.1). Juvenile sole (0 and 1 year old fish) are found mainly in depths up to 40 m, and adult sole (fish aged 3 plus) are generally found in deeper water. Spawning and nursery grounds are well defined.

Over 6000 sole were tagged on the nursery grounds of the Bristol Channel and the Irish Sea between 1977 and 1988. The majority of fish tagged in Swansea Bay and Carmarthen Bay were between 15 and 24 cm in length. Most of the recaptures of these tagged fish occurred two or more years after release, which meant that many fish tagged as juveniles were recaptured as adults. The majority of returned fish were reported off the north coasts of Devon and Cornwall, and over a wide area in the eastern Celtic Sea and St George's Channel. These results suggest that once an adult sole has recruited to an area, it tends to remain there, and that there is only limited movement of sole between the Celtic Sea and adjacent areas.

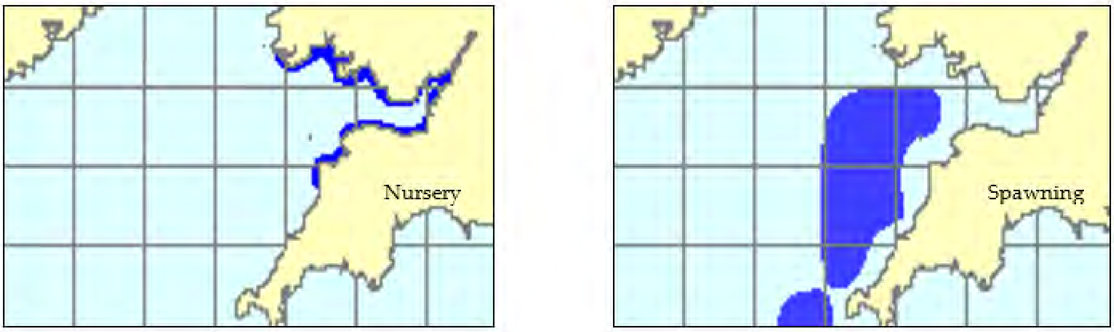


Figure 5.1. Nursery and spawning areas of sole in the Celtic Sea (After Coull, K.A., Johnstone, R., and S.I. Rogers. 1998. Fisheries Sensitivity Maps in British Waters. Published and distributed by UKOOA Ltd.)

A study based on gene-linked single nucleotide polymorphisms (SNPs) suggested an isolated population of sole inhabiting the Celtic Sea and the Cardigan Bay in the Irish Sea (Diopere *et al*., 2016). There are indications for a geographic isolation of this stock. Biologically significant is the tide-driven coastal flow and baroclinic currents in the Irish and Celtic Sea. The Ushant tidal front separates the tidally mixed Channel waters from the stratified Celtic Sea (Diopere *et al*., 2016). Unpublished work by Delrue-Ricard and Vandecasteele based op SNPs show a separation between the Irish and Celtic Sea stocks. In conclusion, there is evidence that the stock ID is biologically meaningful.

5.2 Issue list

Problem / Aim	Work needed / Work needed / possible direction of solution	Data needed to be able to do this: are these available/ where should these come from?
<u>**Commercial UK(E&W)-CBT fleet**</u> The UK beam trawl tuning series is in the current assessment used up to 2012, because of effort reporting issues. A new tuning series was provided with effort in days instead of hours up to 2015. The inclusion of this new tuning series results in a significant upward revision of F (fishing mortality) and downward revision of SSB (spawning–stock biomass) from the late 1990s up until now, compared to the original tuning series. <u>**Commercial BE-CBT fleet**</u> There's a retrospective bias in estimating F and SSB in the most recent years, at which F was underestimated and SSB was overestimated. Moreover, the 2018 assessment shows a substantial downward revision of the SSB and a substantial upward revision of the F back to 2003. This might be related to a change in the selectivity of the Belgian commercial tuning fleet over time. Moreover, in recent years the older ages in this tuning fleet have greater influence on the assessment as the UK(E&W)–CBT fleet doesn't provide information after 2012. <u>**UK(E&W)-BTS-Q3 survey**</u> The UK-(E&W)-BTS-Q3 survey is the only survey used in the current assessment and is the sole data source providing information on the recruiting age (age 1)	*Need to review the new UK(E&W)-CBT tuning series with effort in days *investigate new calculation method of cpue index *Investigate if commercial tuning fleets should still be used in future assessments of sole in 7.f and 7.g. *Investigate if additional survey information (e.g. UK(E&W)-Q1SWECOS, started in 2006) is available and can be incorporated in the assessment. *Additional survey data can confirm the info provided by the UK(E&W)-BTS-Q3 survey.	*UK(E&W)-CBT tuning series calculations *BE-CBT tuning series calculations *UK(E&W)-Q1SWECOS tuning series *other available survey data
Trends in mean weights **The mean weights have dropped over time (2000–2010) and recently increased again.**	***What drives this change?** ***Is it driven by an ecosystem change?** ***Is there a similar trend in the weights from other stocks?**	***information on the evolution in the Celtic Sea ecosystem**
Examine alternative assessment models to XSA. The current assessment has a developing retrospective pattern that could create issues in the forecast. It would be preferable to use a statistical method and propagated the main uncertainties into the forecasts properly.	Explore the use of A4A, ASAP and SAM as alternatives to XSA for this stock.	Standard assessment inputs

5.3 Scorecard on data quality

A scorecard was not used for this benchmark.

5.4 Multispecies and mixed-fisheries issues

No new information was presented at the benchmark.

5.5 Ecosystem drivers

No new information was presented at the benchmark.

5.6 Stock assessment

5.6.1 Catch–quality, misreporting, discards

5.6.1.1 Catch data

InterCatch was used for estimation of both landings and discards numbers and age compositions, as input for the assessment. Data submitters from each nation were asked to upload data for 2002–2018 in InterCatch, disaggregated by quarter and métier (fleet) following the 2019 WKFLATNSCS data call. Due to lacking data for 2002 and a limited age coverage for the landings in 2003, no catch data were processed through InterCatch for these years. Catch data for the years 2004–2011 have now been processed for the first time in InterCatch, whereas the catch data for the years 2012–2018 were recalculated.

5.6.1.2 Raising discard data

If discards were not included for a particular year-quarter-country-métier combination, they were raised. Discards on a year-quarter-country-métier basis were automatically matched by InterCatch to the corresponding landings. The matched discards–landings provided a landing–discard ratio estimate used for further raising. The weighting factor for raising the discards was 'Landings CATON' (landings catch). Discard raising was performed on a gear level regardless of season or country. Discard ratio's varied between 0.000 and 0.338 over the matched landings–discard strata. More information on which groups were distinguished, can be found in the working document on the preparation of catch data (Annex 2.3.2).

Raised discard data from InterCatch were available from 2004 onwards. To estimate discard mean weight-at-age and numbers-at-age prior to 2004, a constant ratio of discards to landings by age was applied using data from 2004–2018 (see Figures 28–29 in Annex 2.3.2).

5.6.1.3 Age allocations

To allocate age compositions, landings and discards were handled separately; samples from landings were used only for landings and vice versa. When age distributions were lacking, allocations were performed on a gear level. The gear groups used for discard raising were also applied here. The weighting factor used was '*Mean Weight weighted by numbers-at-age*'. An overview of the allocation scheme is provided in Annex 2.3.2.

5.6.1.4 Quality control

The quality of age allocations in InterCatch was verified by creating a second allocation scheme using the auto allocation option in InterCatch. The numbers-at-age, weight-at-age and overall tonnage were compared. In general, both allocation schemes resulted in quite similar outcomes.

Belgium takes most of the sole TBB_DEF_70-99_0_0_all landings. However, it is the only country that provided yearly data. As the auto allocation procedure does not include this yearly age distribution, we selected the manual allocation procedure. The InterCatch procedures as described in the working document, will be used for raising and age allocations in the future.

5.6.1.5 Belgian commercial beam trawl landings data

During the inter-benchmark protocol on sole in in ICES divisions 7.f and 7.g in 2019, a revision of the Belgian commercial beam trawl tuning fleet occurred (ICES, 2019a). Investigating the Belgian sole landings data revealed that pure trips, i.e. trips in which fishing activity was limited to one of the sole stock areas (ICES divisions 7.f and 7.g), often a considerably different mean landing rate (kg.h-1) than mixed trips (i.e. trips in which fishing occurred in multiple ICES divisions). The working document in Annex 2.2.2 further explores this difference in landing rate. Analyses show substantial differences between estimated and reported sole landings in 7.f and 7.g in 2004–2007 and fishermen confirm that there were compliance issues at that time. Therefore, these landing numbers were adjusted as the Belgian landings for sole in ICES divisions 7.f and 7.g are probably higher.

5.6.2 Surveys

5.6.2.1 Scientific surveys

The WGCSE 2019 Celtic Sea sole stock assessment used one scientific survey index: UK(E&W)-BTS-Q3 (1988–2018), from age 1 to 5. It is the only index providing information on the recruiting age (age 1). During this benchmark, we investigated if additional survey information is available and can be incorporated in the assessment.

The UK(E&W)-Q1SWECOS survey is conducted over a two week period in the first quarter of each year using a stratified random sampling design in ICES Division 7.e. In 2014, it was spatially extended into the Celtic Sea (including divisions 7f and 7g). A working document in Annex 2.3.4 describes this survey and the method used to calculate the provided standardised index of abundance-at-age for sole in ICES divisions 7.f and 7.g. With only six years of data and the index at-age showing a lot of variation in all age groups it is difficult to show good cohort tracking. The correlation between year classes is weak. The time-series is too short for any strong conclusions to be made on the indexes usefulness in a stock assessment. This survey has not yet been reviewed by ICES nor are the data uploaded in DATRAS. Although this survey could potentially add useful information from areas not covered by the UK(E&W)-BTS-Q3, it was decided not to use this survey for the calibration of the assessment. The next benchmark for this stock should reconsider the inclusion of this tuning series.

5.6.2.2 Catch and effort series

Two commercial tuning series (UK(E&W)-CBT and BE-CBT) were incorporated in the WGCSE 2019 assessment. The Belgian commercial beam trawl tuning fleet consists of two parts (1971–1996 and 2006–2018, BE_CBT and BE_CBT3). During the IBPBrisol (ICES, 2019b), the BE_CBT3 was constructed focusing on the landings and effort data of pure trips from the large fleet segment of the Belgian beam trawl fleet fishing in divisions 7.f and 7.g. Several models were tested and a GLMM including a categorical year effect, a log-linear relationship between the engine power of a beam trawler and the landing rate, a categorical temporal effect ‘month’ and a categorical spatial effect ‘ICES statistical rectangle’ were retained.

The UK(E&W)-CBT tuning-series used in the WGCSE 2019 assessment was limited to 2012, because of effort reporting issues. As the hours fished became an optional field in the logbooks and not consistently filled, this field is inappropriate to use as a metric for effort. A working document in Annex 2.3.3 describes the data processing, exploration and model development to provide a standardised Landings Per Unit of Effort (lpue) index based on UK Commercial data to replace the UK(E&W)-CBT series (from 1991–2012). The new UK(E&W)-CBT series from 1987–2018 was generated using a random effects model which was then disaggregated to lpue-at-age using sampled catch-at-age from the beam trawl fleet and the weights-at-age from the latest assessment input. Activity days was used as an effort measure, since it is mandatory to record."

These two series were also calculated as biomass tuning indices to be used in SAM assessments (see Annex 2.3.5).

5.6.3 Weights, maturities, growth

The stock weights were obtained using the Rivard weight calculator (http://nft.nefsc.noaa.gov./) that conducts a cohort interpolation of the catch weights. A stock weight for age 1 was calculated for 2004–2018 but not for 1971–2003, as the catch weight for age 1 is zero for the latter. The resulting stock weight for age 1 was very variable, and it was decided to set the stock weight of age 1 to the lowest estimated stock weight for age 2 for 1971–2018.

5.6.3.1 Maturity

The maturity ogive, the proportion of mature fish at-age, used in the WGCSE 2019 assessment is a combined sex maturity ogive taken from area 7.f and 7.g attributed to Pawson and Harley, working document presented to WGSSDS in 1997. This maturity ogive is based on samples taken during the UK(E&W) beam trawl survey of March 1993 and 1994, and is applied to all years in the assessment. Changes in life-history traits such as age and size at first maturation were reported in several commercially exploited fish stocks (Jørgensen, 1990; Rijnsdorp, 1993; Mollet *et al.*, 2007). Therefore, available maturity data for sole 7.fg were evaluated to verify whether this currently-used maturity ogive is still applicable.

To reduce the amount of variation linked to stratified sampling protocols, we used only survey data of the UK(E&W)-Q1SWECOS to estimate a maturity ogive. Maturity data are available for 2013–2019. Several analysis were performed and (see working document in Annex 2.3.1) finally, it was suggested to adopt a new maturity ogive according to the length-based model with sex specific ALK (Table 5.1). This new ogive indicates that >60% of the 2 and 3 year old individuals are mature, while this was not the case in the current index. The maturity-at-age 1 was manually set to 0 as no mature sole at age 1 were encountered at the UK(E&W)-Q1SWECOS survey.

Table 5.1. Updated maturity-at-age based on data from the UK(E&W)-Q1SWECOS survey.

Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Maturity	0.0	0.67	0.91	0.98	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

5.6.3.2 Natural mortality

No new information was presented at the benchmark meeting. Natural mortality is assumed constant over ages and years at 0.1.

5.6.4 Assessment model

The current model used to assess sole in ICES divisions 7.f and 7.g is an extended survival analysis (XSA). One of the aims of the WKFLATNSCS benchmark is to assess the performance of the current model against the new data and alternative stock assessment models.

Exploratory runs in XSA with updated landings data, incorporating discard data, updated tuning series and updated maturity-at-age were performed and compared with the base run from the WGCSE 2019. All exploratory runs are documented in the working document in Annex 2.3.5.

The applicability of the XSA framework to the sole 7.fg stock was questioned for the following assumptions/limitations:

- XSA assumes that catch data are known without error (no observation model for the catch data) which is highly unlikely due to e.g. the fact that only a subsample of the catch numbers-at-age is observed, age reading of otoliths may cause bias, misreporting of landings by fishers may occur.
- XSA requires that tuning fleets have age-structured information causing that the catch-at-age information is used twice in the model thereby down weighting the information from other data sources.
- XSA cannot handle missing data in catch or tuning series and requires to make assumptions on missing observations (e.g. catches equal landings if no discard information is available).

To overcome these shortcomings, the applicability of a state–space stock assessment model (SAM) was explored during the benchmark. The main feature of SAM is that it includes both process models on survival, recruitment and fishing mortality, describing the internal states of the system, and observation models for catch and tuning data. Additionally, tuning data can be introduced in different ways, e.g. as SSB (spawning–stock biomass), TSB (total stock biomass) or landings indices, while the random effects formulation of the process models resulting from the hierarchical nature of the state–space modelling framework, can easily be used to handle missing observations as is the case with catch information on age 1. Finally, SAM allows to specify different model configurations, and parametrization of both process and observation models.

The SAM model that was selected as the final assessment model is SAM run 5 described in the working document in Annex 2.3.5. For this run, the age-structured commercial tuning series (BEL-CBT, BEL-CBT3 and UK(E&W)-CBT) were transformed into a biomass index. These time-series of the commercial tuning series were split in order to better account for changes in catchability due to e.g. technological creep (Figure 5.2). The age-structured UK(E&W)-BTS-Q3 survey tuning series was also included. The model was further optimized in terms of parameter configuration for the process and observation models.

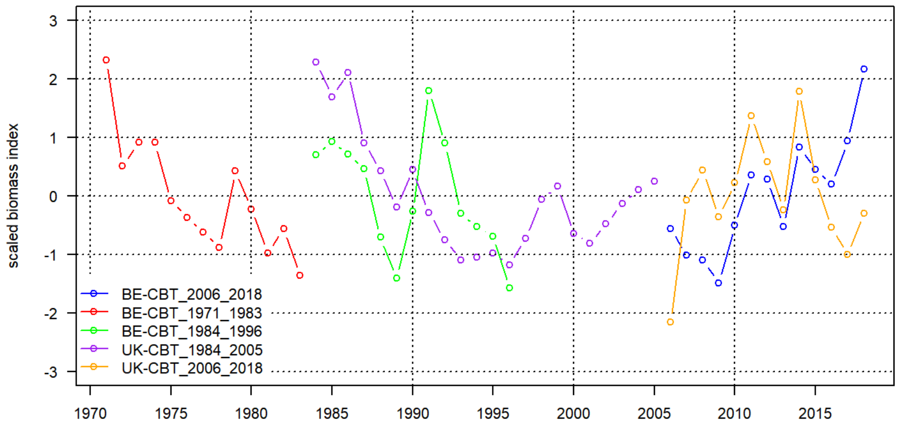


Figure 5.2. Scaled biomass indices of the commercial tuning fleets.

The F_{bar} calculates the mean fishing mortality for the set age range and should represent a significant part of the catch. The F_{bar} in the WGCSE 2019 assessment was set at age 4–8. However, as age 3 represents a large proportion of the catch, it was suggested to expand the F_{bar} to ages 3–8. The F_{bar} with ages 3–8 represents an average 77% of the catch, with a minimum of 48% and a maximum of 97% (Figure 5.3). The adjusted F_{bar} setting was applied in the final SAM run.

The model configuration and the data that were used in the final SAM assessment model are shown in Table 1 of the working document in Annex 2.3.5. Figure 5.4 shows the catch numbers-at-age, stock weights-at-age, landing weights-at-age, discard weights-at-age and catch weights-at-age used in the final SAM assessment.

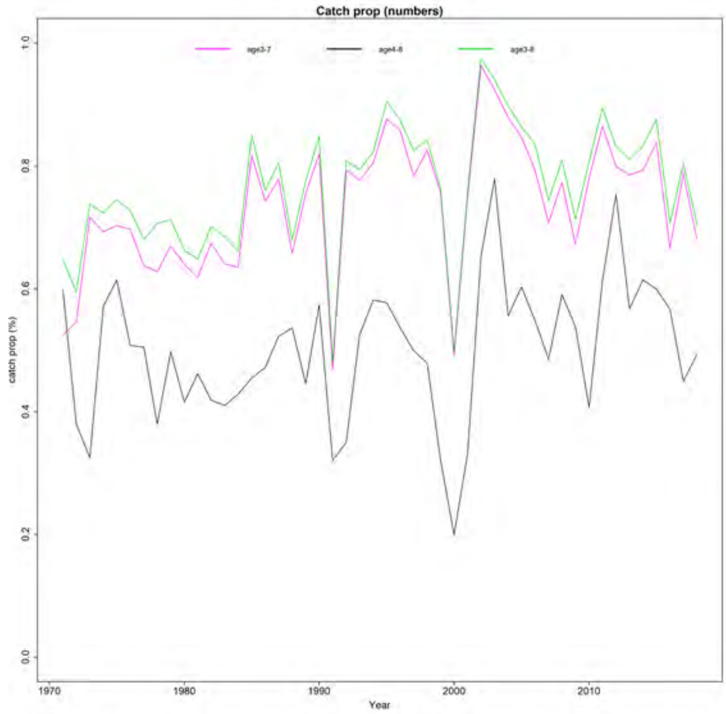


Figure 5.3. Comparison of the catch proportions represented by different age groupings for sole in ICES divisions 7.f and 7.g.

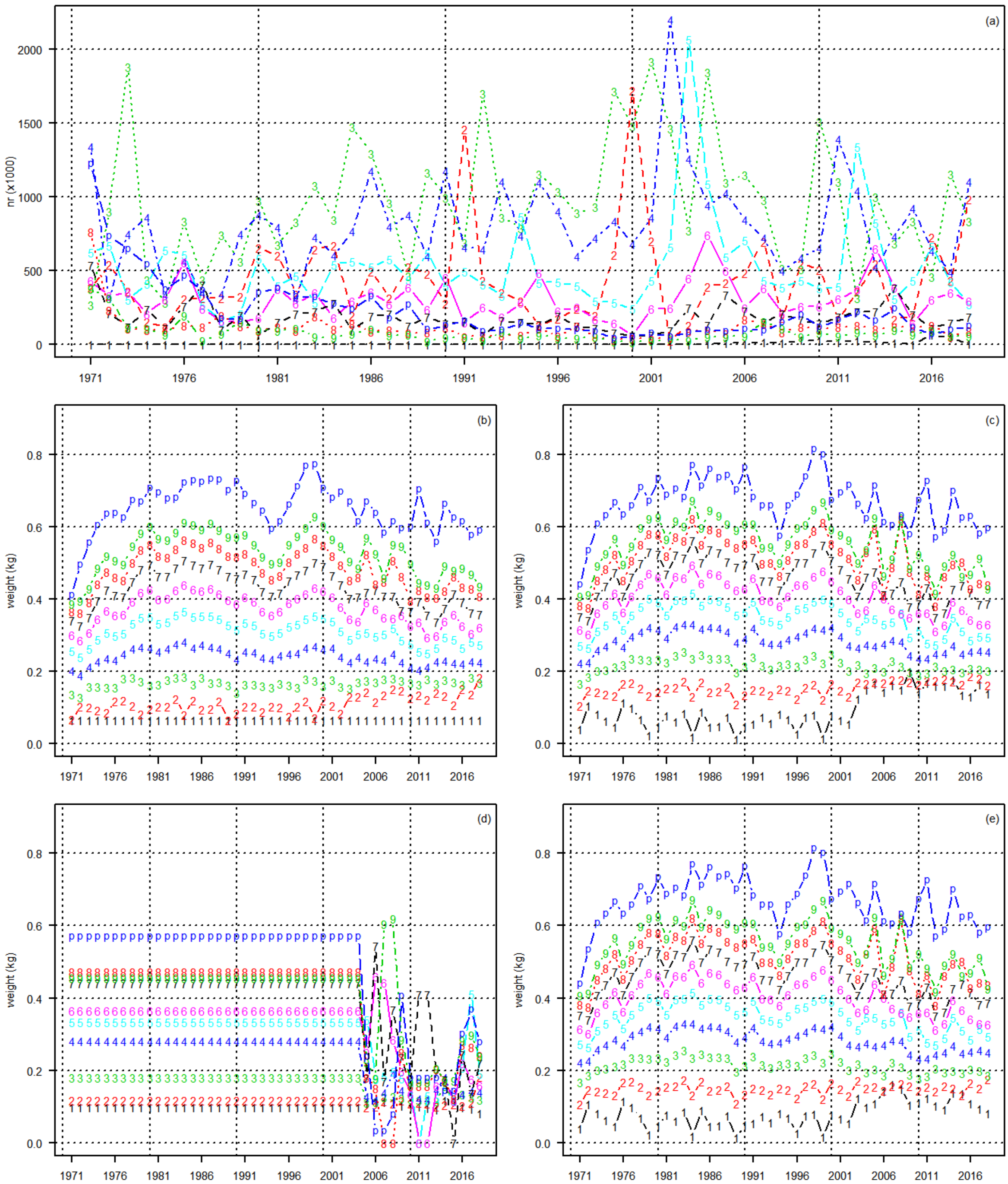


Figure 5.4. Catch numbers-at-age (a), stock weights-at-age (b), landing weights-at-age (c), discard weights-at-age (d), and catch weights-at-age (e) used in each of the SAM runs. Numbers refer to the age class with "p" indicating the plus group.

In general, the estimated catches from the SAM model are close to the observed catches (Figure 5.5). Only at the start of the time-series, some observed catches do not fall within the confidence bounds of the estimated catches. The SSB, F_{bar} and recruitment model output is shown in Figure 5.6. Age 4 and 5 have the highest fishing mortality, whereas fishing mortality on age 1 and 2 is considerable lower compared to the other age groups considered in the model (Figure 5.7). This pattern in F by age contrasts the selectivity pattern of the UK (E&W)-BTS-Q3 survey, for which catchability is highest for age 1 and 2 (Figure 5.8).

Specifying an AR(1) correlation structure-at-age for the catch number-at-age observations reduced the autocorrelation in the OSA (one step ahead) residuals of the catch information (Figures 5.9–5.10). Increasing the number of variance parameters on the N (stock numbers) and F processes removed most of the autocorrelation in both the OSA and process residuals (Figure 5.11).

Retrospective analysis does not indicate major problems, the retrospective patterns are within the confidence bounds and Mohn's rho values are low (Figure 5.12). The leave-one out runs show that the model is less dependent on the UK(E&W)-BTS-Q3 and BE-CBT3 tuning indices compared to the other runs presented in Annex 2.3.5. They further indicate dependency of the model on the UK(E&W)-BTS-Q3 survey in the most recent years of the assessment model, although SSB seems to converge again to the estimated value in the final year (Figure 5.13).

The simulation study (Figure 5.14) shows that the variance parameters of the process model seems more robust compared to the other SAM runs described in the working document in Annex 2.3.5.

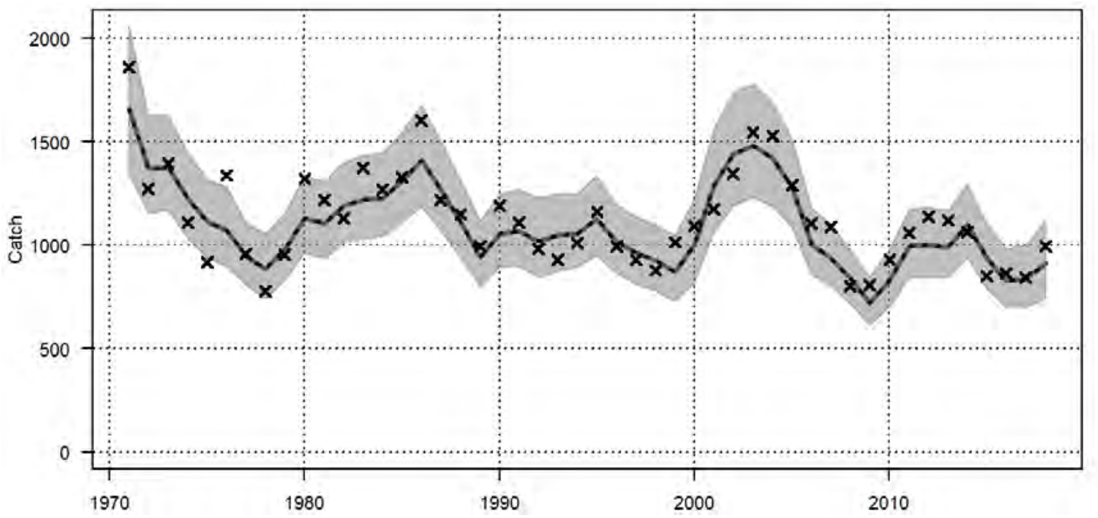


Figure 5.5. Reported (black cross) and estimated catches (solid line) with 95% confidence bounds (shaded area).

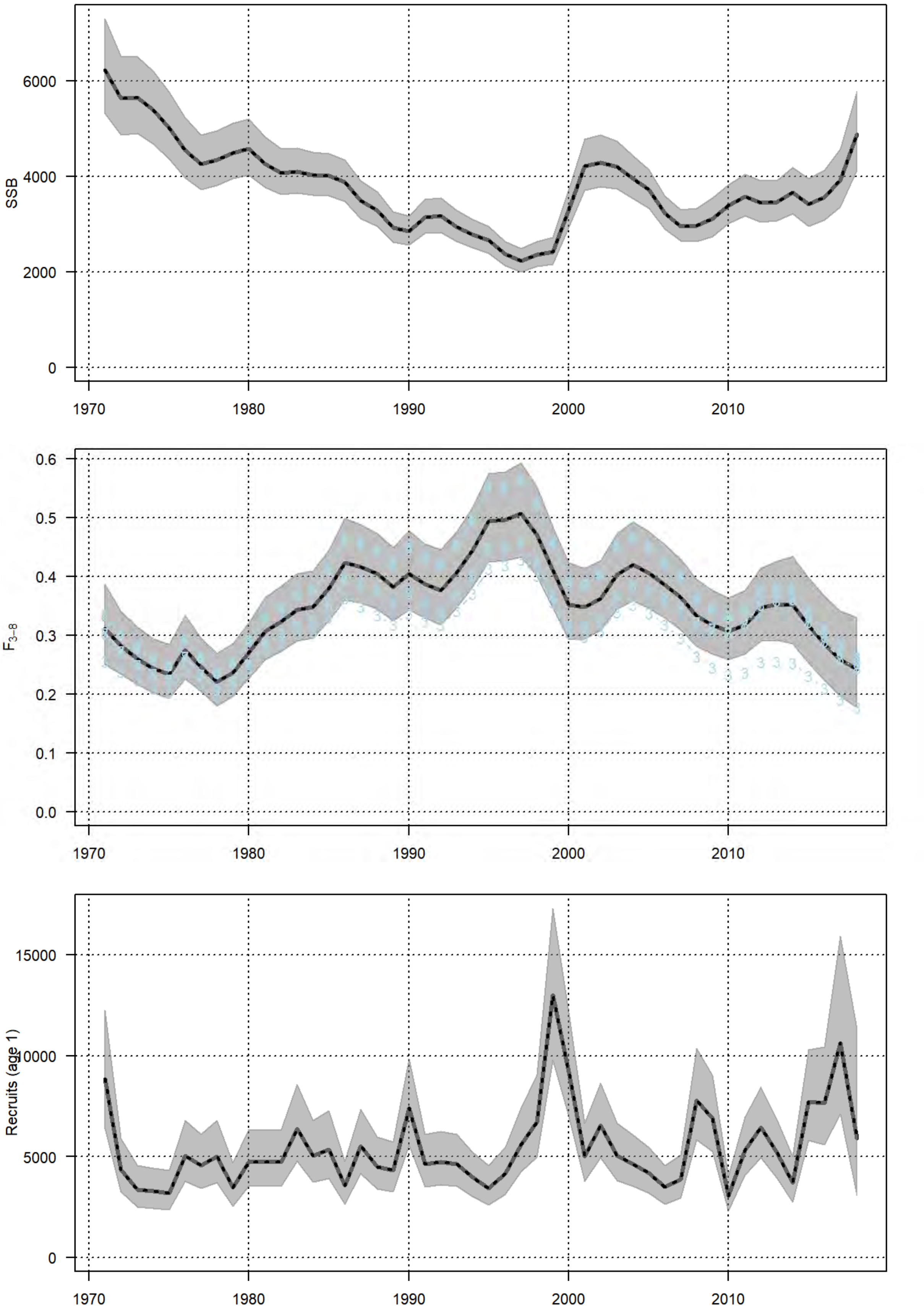


Figure 5.6. SSB (top panel), F_{bar} (middle panel) and recruitment (bottom panel) estimates of the sol 7.fg SAM model. The shaded areas represent the 95% confidence interval.

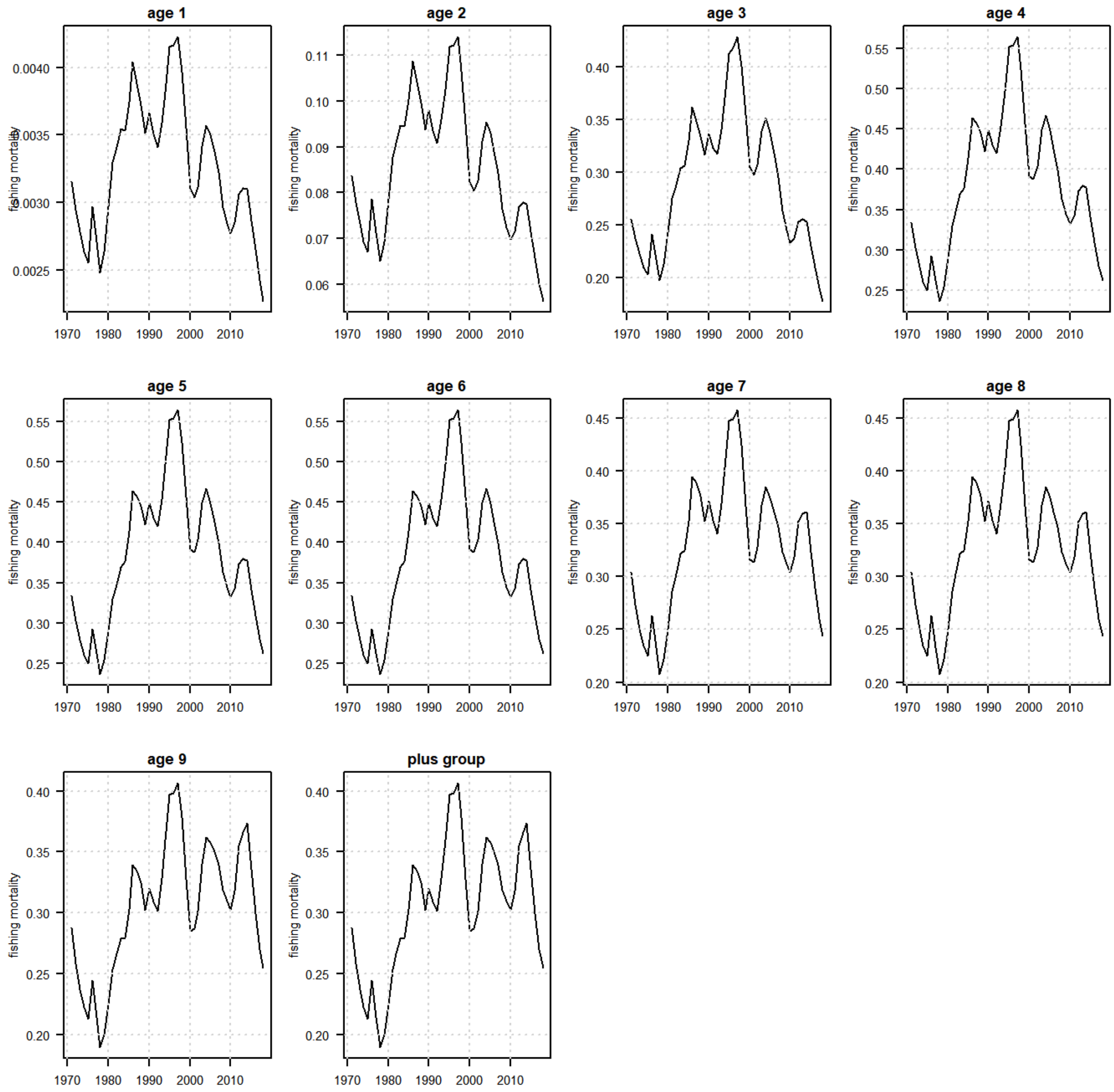


Figure 5.7. F estimates by age.

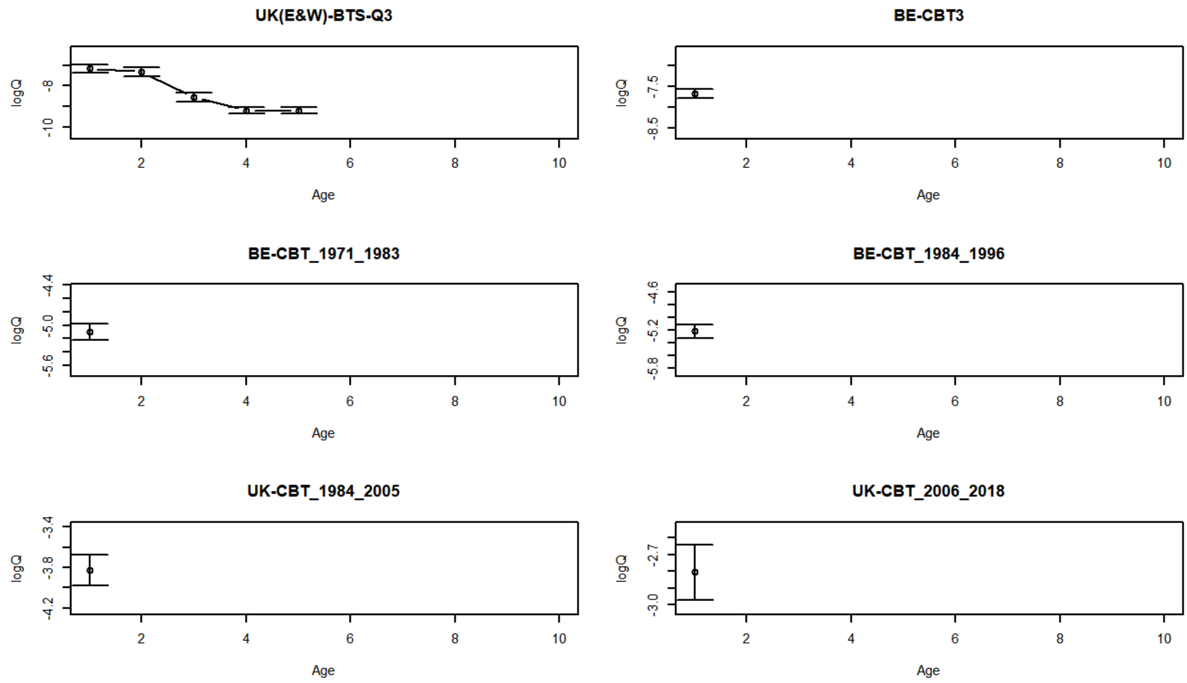


Figure 5.8. Log catchability by age of the different tuning fleets. Whiskers indicate the 95% confidence bounds.

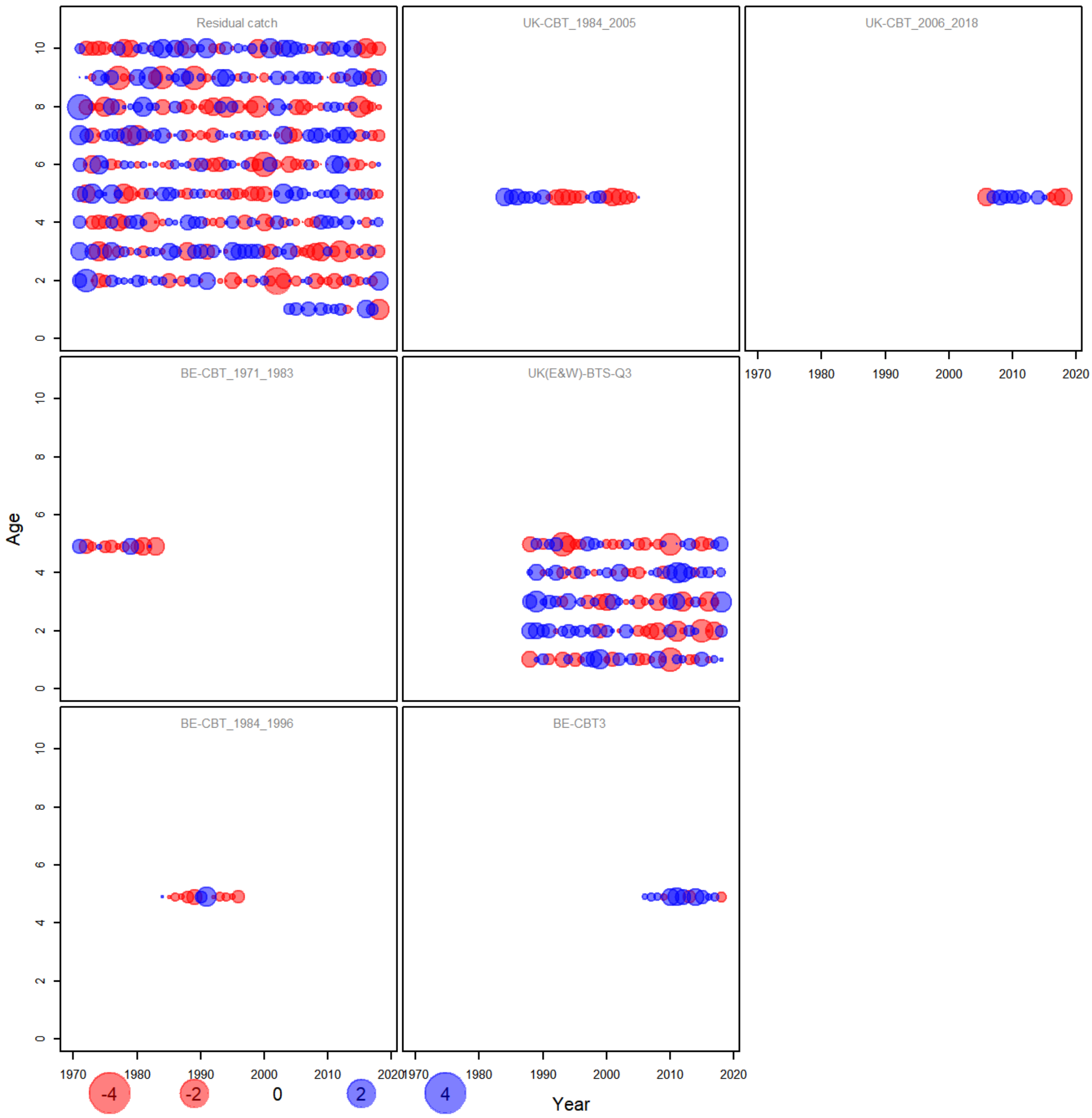


Figure 5.9. Normalized one-observation-ahead. Each panel represents a specific observation category. Blue circles indicate a positive residual and red circles a negative residual.

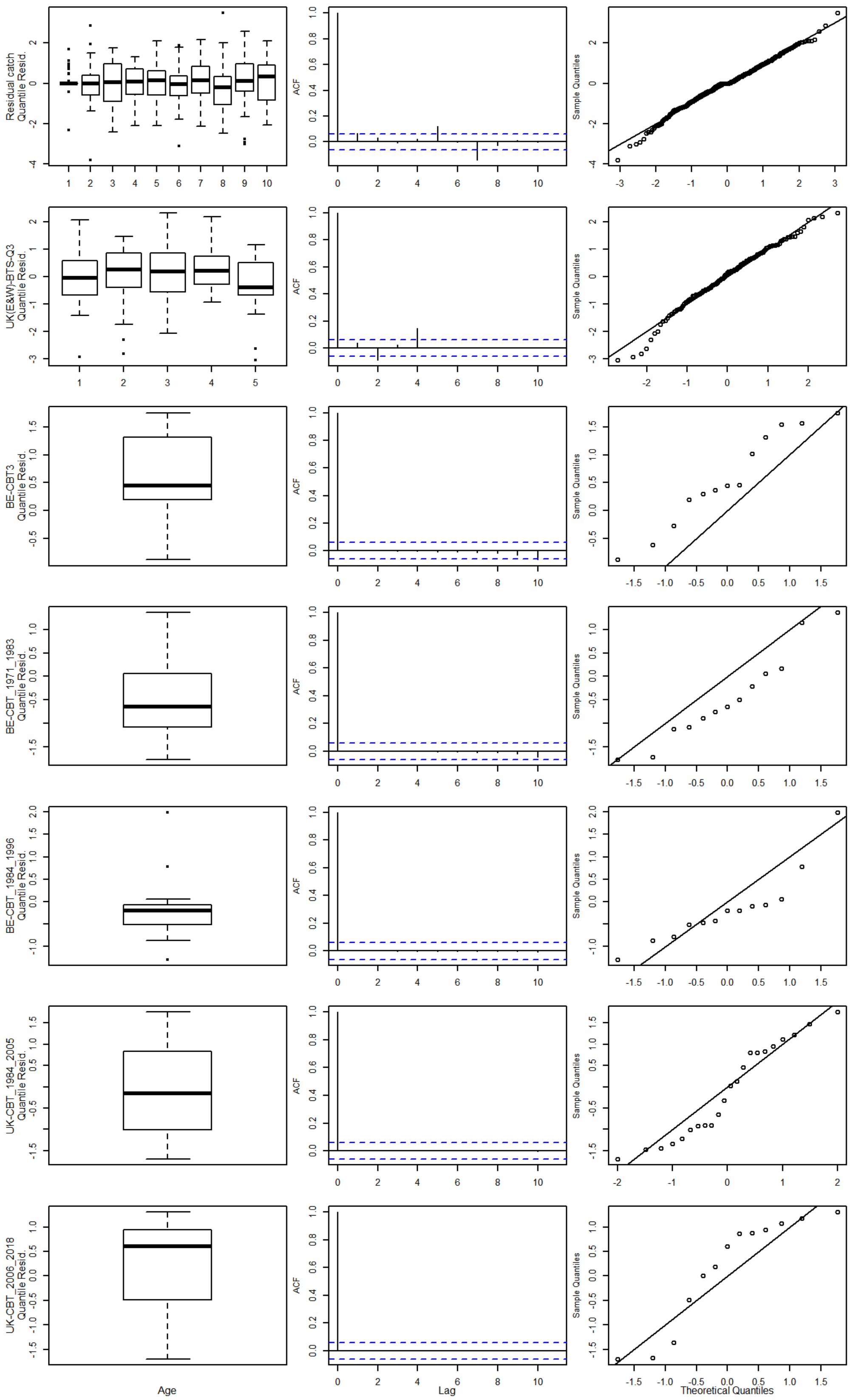
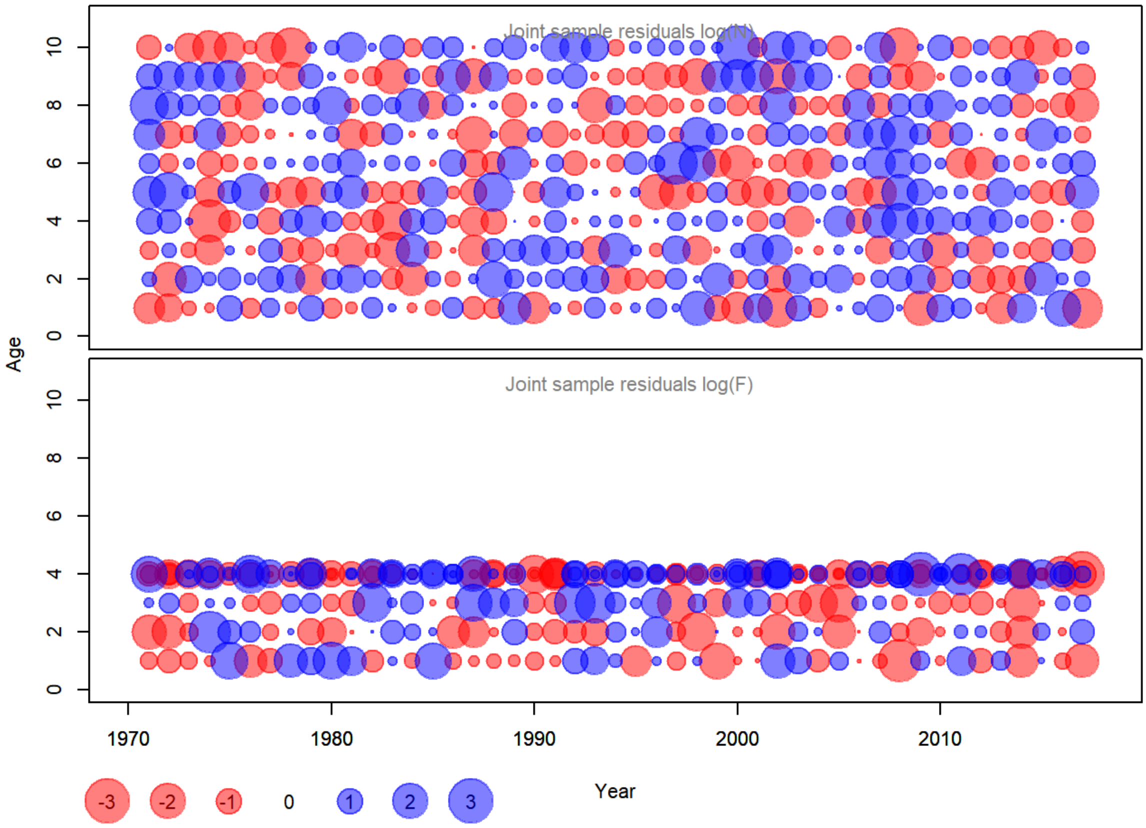


Figure 5.10. Boxplots, autocorrelation and normal Quantile Quantile plots of the normalized one-observation-ahead residuals. Panels are organized so that each row refers to a specific category of observations.



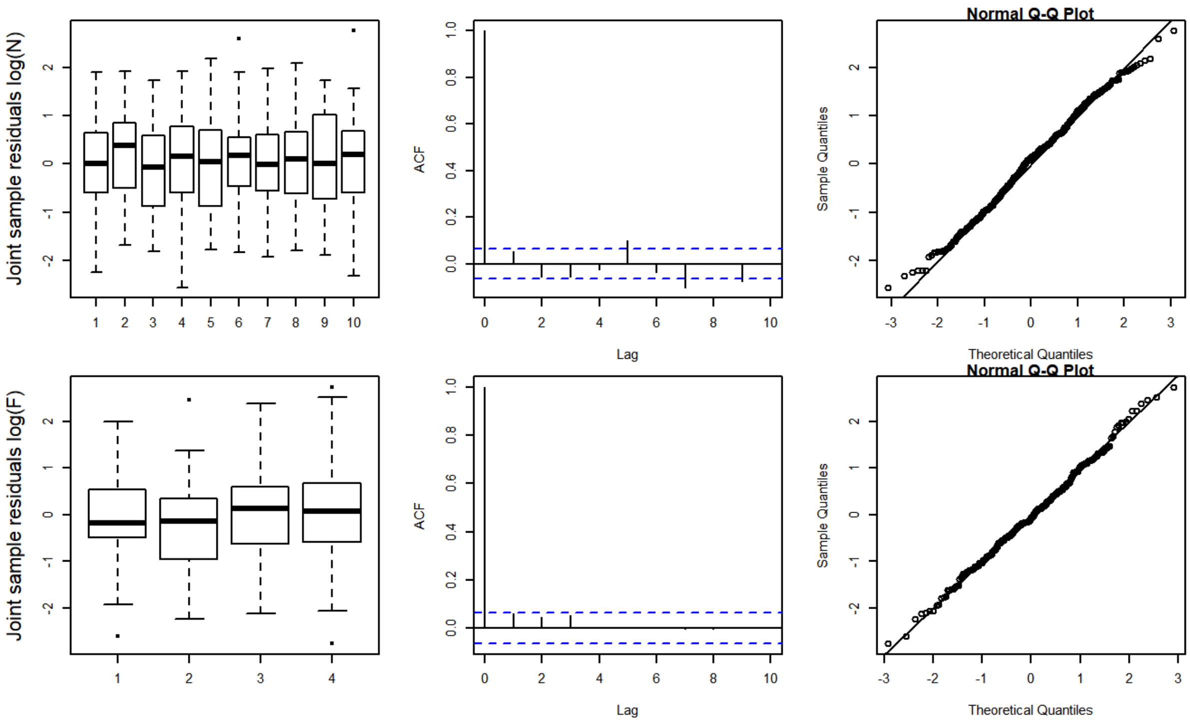


Figure 5.11. Normalized residuals for the recruitment and survival processes.

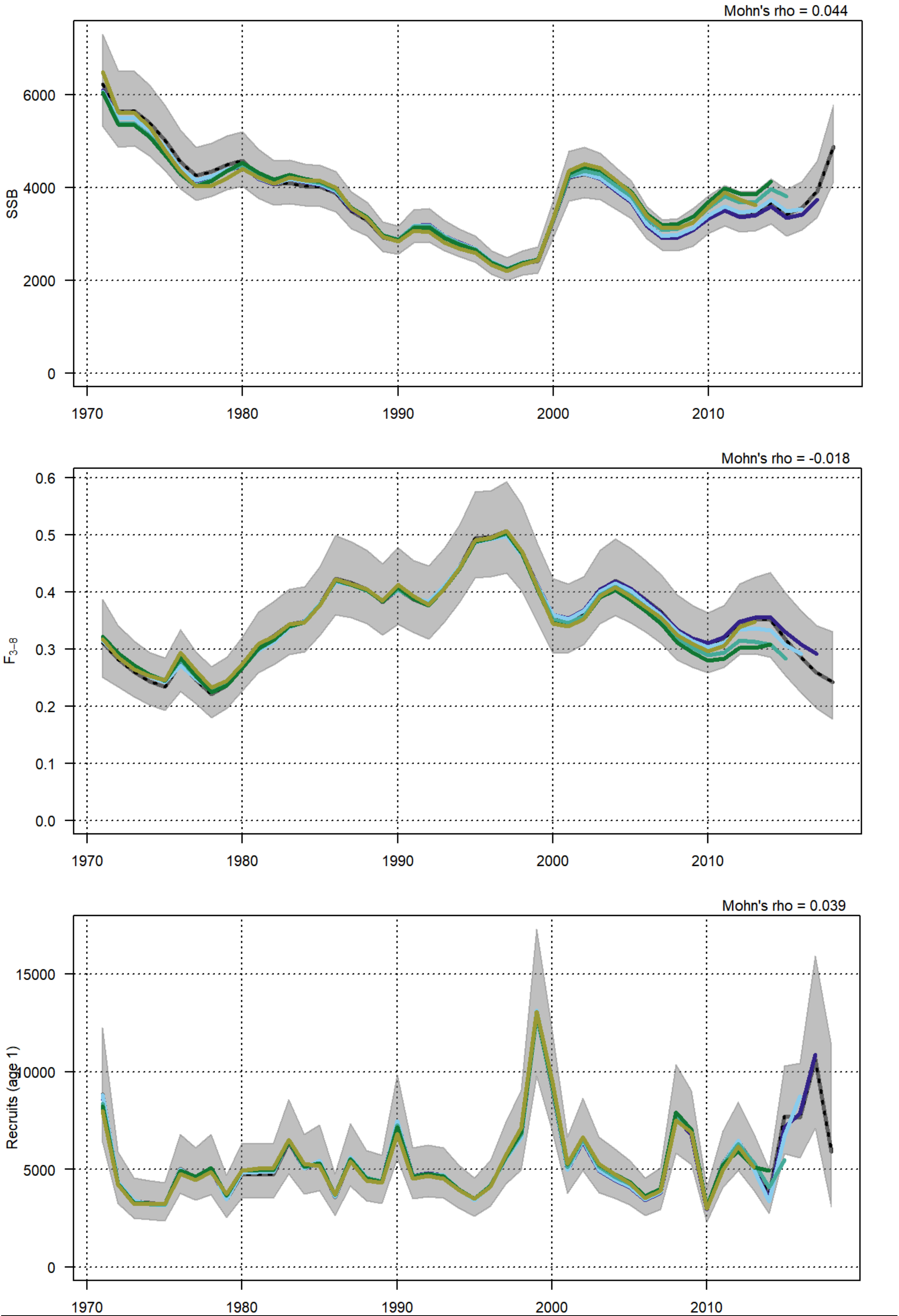


Figure 5.12. Retrospective estimates (5 years) from the SAM assessment. Estimated yearly SSB (top panel), F_{bar} (middle panel) and recruitment age 1 (bottom panel), together with corresponding point-wise 95% confidence intervals (shaded area).

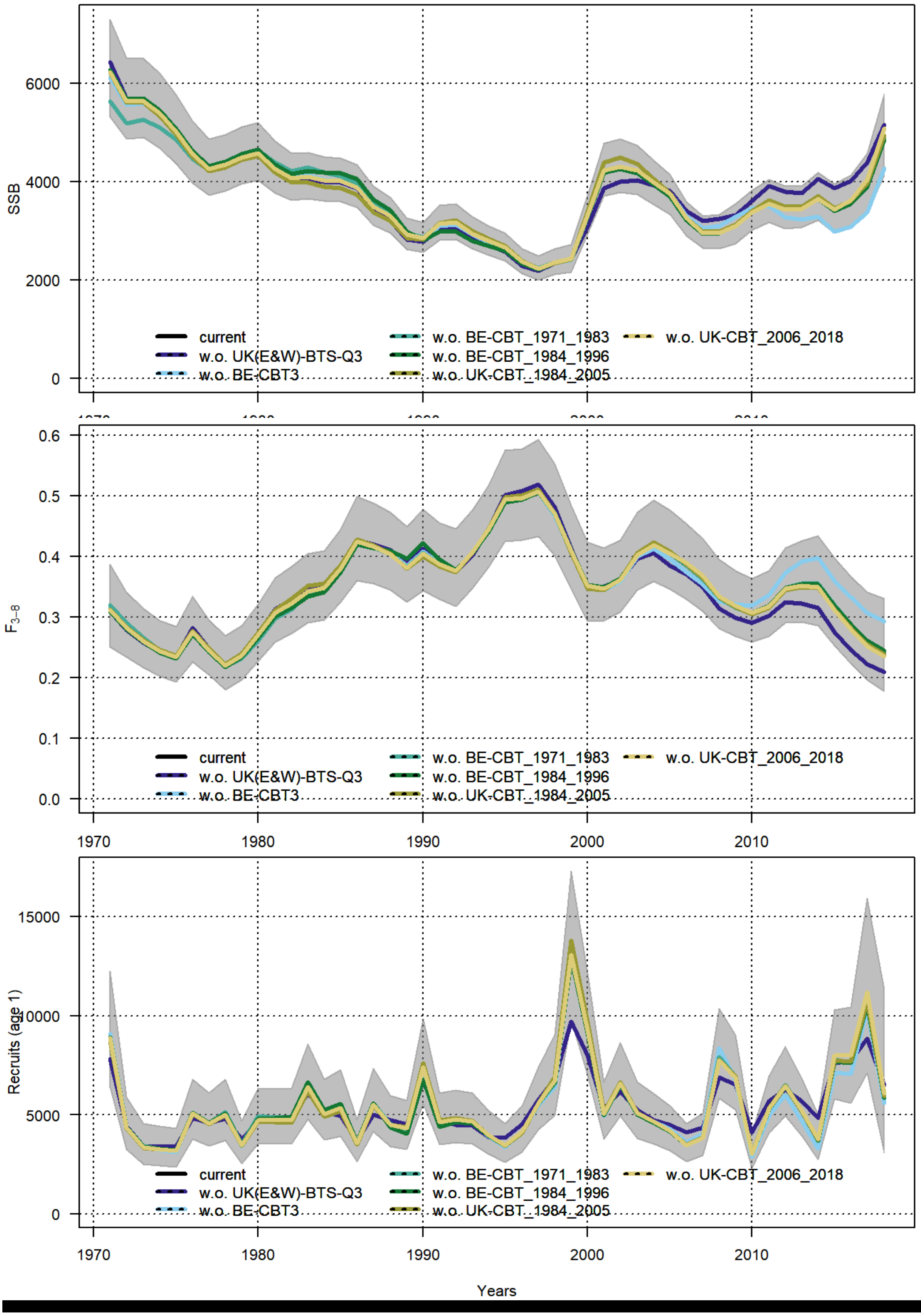


Figure 5.13. SSB (top panel), F_{bar} (middle panel), and recruitment (bottom panel) estimates (solid lines) from model fits in which one tuning series was removed from the data. The shaded area indicates the confidence bounds of the full model.

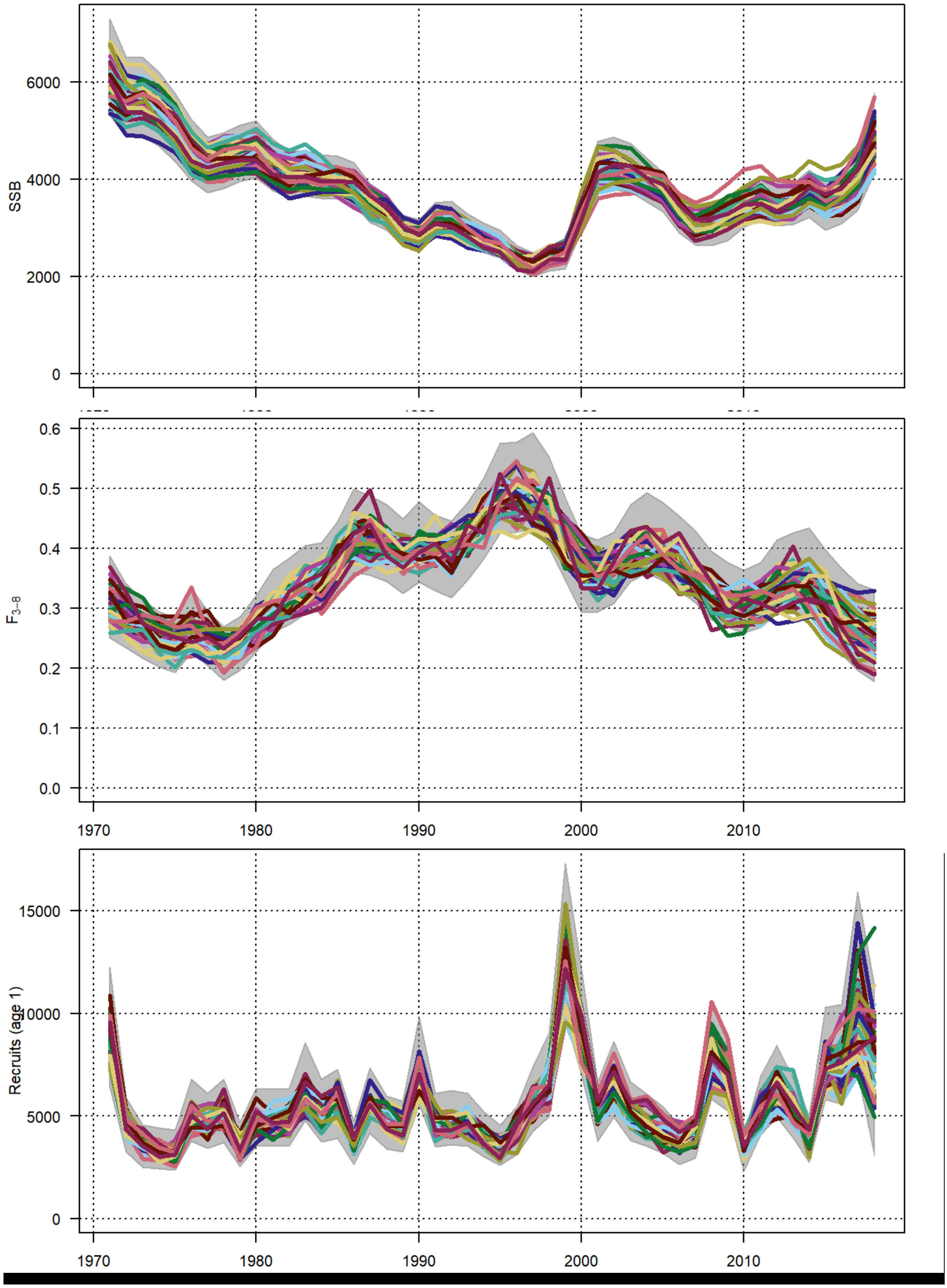


Figure 5.14. SSB (top panel), F_{bar} (middle panel) and recruitment (bottom panel) estimates from the refitted models on 50 simulated datasets based on the original plot. The shaded area indicates the confidence bounds of the original model.

5.6.5 Comparing XSA and SAM models

The difference between SAM and XSA, with similar settings, reveals minor differences with respect to the magnitude in SSB, F_{bar}, and recruitment. Only at the start of the time-series, the XSA model estimates SSB to be significantly lower than the SAM estimate, whereas the opposite trend appears in the F_{bar} estimates at the start of the time-series. The major differences between XSA and SAM are found in the F_{bar} estimates. The estimates of the XSA model are much more variable compared to the SAM estimates which is related to the fact that SAM does not consider the catches as deterministic, and includes a process model on fishing mortality-at-age. Recruitment is very similar between both models, except from 2002 until 2012, where there seems to be a lag of order 1 between the recruitment estimates of both models.

5.6.6 Conclusion on SAM model runs from the benchmark

Both the reviewers and participants concluded that the final SAM run (RUN_5) provides the best framework to assess the sole 7.fg stock. The main reasons for selecting this model are:

- Its ability to include biomass based indices for the commercial tuning fleets (thereby avoiding duplicated data usage);
- Splitting up the long commercial tuning series enables to account for changes in catchability over time;
- The UK(E&W)-Q1SWECOS tuning series seems too short to provide new information to the model. In addition, a lack of information on the index calculation hampers proper model specification in order to reduce autocorrelation;
- Increasing the number of variance parameters in the process models increases the accuracy of the process models, while a correlation structure between the observations removed the autocorrelation from the OSA residuals.

5.7 Short-term projections

Short-term projections were conducted as implemented in the *stockassessment* package. For the entire forecast period (2019–2021), recruitment was re-sampled from the estimated recruitment numbers over the entire time-series (1971–2018). Population numbers-at-age at the start of the final data year (2018) were taken from the SAM output. Subsequently, population numbers-at-age at the start of the intermediate year (2019) were calculated by multiplying these number-at-age with the estimated survival rates of the final year (2018). Stock and catch weights-at-age used in the forecast were based on the mean weights during the three last years (2016–2018). The forecast was conducted in a stochastic way, implying that both F and N processes are subjected to process variance as estimated by the SAM model.

Two intermediate year scenarios need to be explored during the assessment working group (WGCSE): 1) a TAC constraint option and 2) an F *status quo* option scaled or not scaled to the last data year (depending on the presence of an increasing or decreasing trend in F). In the 2019 WGCSE, a TAC constraint option was used for advice as recent catches had been close to the TAC.

The table below (Table 5.2) summarises the intermediate year assumptions of the TAC constraint scenario based on the SAM output. Catches in 2019 are constrained to 1009 tonnes (ICES, 2019c) and result in a total catch of 1355 tonnes in 2020 for the F_{MSY} option (F = 0.285) (Table 5.3).

Table 5.2. Assumptions made for the intermediate year and forecast.

Variable	Value	Notes
F ages 3–8 (2019)	0.225	TAC constraint
SSB (2020)	5439	Short-term forecast (STF), tonnes
R_{age1}(2019–-2020)	5011	Median recruitment re-sampled from the period 1971–2018, thousands
Total catch (2019)	1009	TAC 2019, tonnes
Wanted catch (2019)	954	Assuming average of 2016–2018 wanted catch fraction by age, tonnes
Unwanted catch (2019)	55	Assuming average of 2016–2018 unwanted catch fraction by age, tonnes

Table 5.3. Predicted catch-at-F = F_{MSY} = 0.285 for 2020.

Basis	Total catch (2020)*	Wanted catch (2020)*	Unwanted catch (2020)*	F_{total} (2020)	F_{wanted} (2020)	$F_{unwanted}$ (2020)	SSB (2021)
F_{MSY}	1353	1294	59	0.285	0.276	0.009	5201

*** "Wanted" and "unwanted" catch are used to describe fish that would be landed and discarded in the absence of the EU landing obligation.**

5.8 Appropriate Reference Points (MSY)

As the sole 7.fg assessment was thoroughly revised during the WKFlatNSCS 2020 benchmark, the MSY and PA reference points were examined and updated according to the ICES guidelines (ICES, 2017) using Eqsim.

5.8.1 Reference points prior to benchmark

The biological reference points prior to the current benchmark were calculated during the WGCSE 2019 and are given in Table 5.4. The management plan (MAP) that is referred to, is the EU multiannual plan (MAP) for the Western Waters (EU, 2019).

Table 5.4. The biological reference points used during the WGCSE 2019.

Framework	Reference point	Value	Technical basis
MSY approach	MSY $B_{trigger}$	2228 tonnes	B_{pa}
	F_{MSY}	0.297	EQsim analysis based on the recruitment period 1971–2017
Precautionary approach	B_{lim}	1592 tonnes	B_{loss} estimated in 2018, corresponding to SSB in 1998
	B_{pa}	2228 tonnes	B_{lim} × 1.4
	F_{lim}	0.578	EQsim analysis, based on the recruitment period 1971–2017
	F_{pa}	0.420	$F_{lim} \times \exp(-1.645 \times 0.2) \approx F_{lim} / 1.4$
Management plan	MAP MSY $B_{trigger}$	2228 tonnes	MSY $B_{trigger}$
	MAP B_{pa}	2228 tonnes	B_{pa}
	MAP B_{lim}	1592tonnes	B_{lim}
	MAP F_{MSY}	0.297	F_{MSY}
	MAP F_{lower}	0.165	Minimum F which produces at least 95% of maximum yield
	MAPF_{upper}	0.297	Maximum F which produces at least 95% of maximum yield

5.8.1.1 Source of data

Data used in the MSY analyses, SSB [1971;2017] and recruitment [1972;2018] estimates, were taken from the fitted SAM assessment model of sole in ICES divisions 7.f and g upon which was agreed during the WKFlatNSCS 2020 benchmark (see Working document in Annex 2.3.5).

5.8.1.2 Methods and settings

All analyses were conducted with Eqsim and following the ICES technical guidelines as described in ICES (2017). The R code is included in the working document (Annex 2.3.6). Model and data selection settings are listed in Table 5.5.

Table 5.5. Model and data selection settings.

Data and parameters	Settings	Comments
SSB-recruitment data	R=(1971–2017) SSB=(1972–2018)	To be in line with the forecast, no years were removed as the SAM model was used to make catch predictions. Considering a lag of 1 year between spawning and recruitment, the final SSB and first recruitment estimate were removed from the time-series.
Exclusion of extreme values (option extreme.trim)	No	
Mean weights and proportion mature; natural mortality	2009–2018	There's no pattern in the mean weight-at-age over the past ten years. Therefore, the default 10-year-period was applied.
Exploitation pattern	2014–2018	There is a slight pattern in the exploitation of this stock with age 3 decreasing and age 9 and 10 increasing over the last ten years. Therefore, instead of taking the default 10-year-period, only the last five years were selected (**Error! Reference source not found.**5).
Assessment error in the advisory year. CV of F	0.212	Default value for stocks where these uncertainties cannot be estimated
Autocorrelation in assessment error in the advisory year	0.423	Default value for stocks where these uncertainties cannot be estimated.

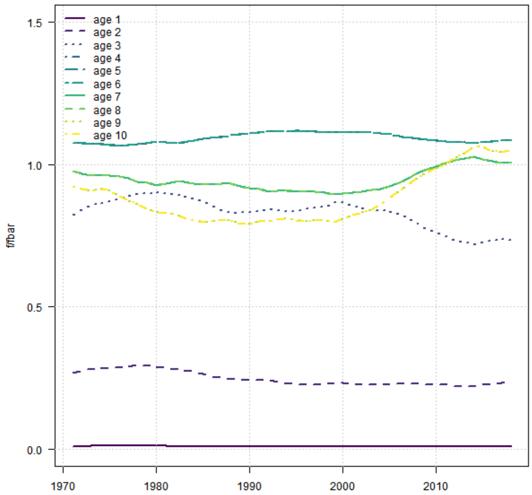


Figure 5.15. The exploitation pattern-at-age (the fishing mortality-at-age as estimated by the F_{bar} (age 3–8) per year). Note that due to SAM model settings the fishing mortalities overlap for certain ages (see Working document in Annex 2.3.5).

5.8.1.3 Stock–recruitment relation and new B_{lim} and B_{pa} reference points

Stock–recruitment relationships were plotted and in a first step, three models were used: Ricker, Beverton–Holt and segmented regression, weighted by the default 'Buckland' method (**Error! Reference source not found.**5.16).

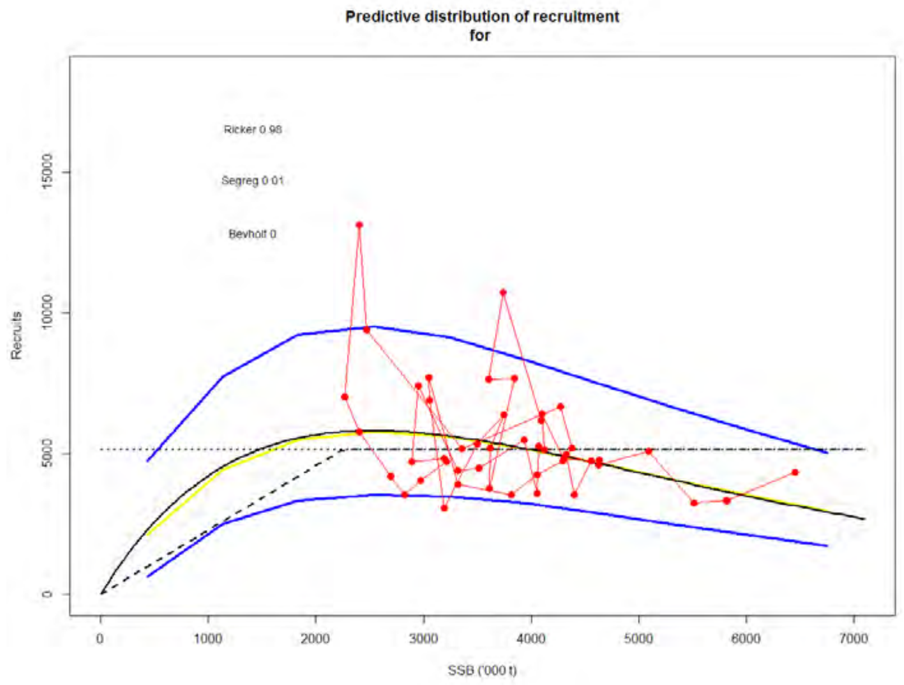


Figure 5.16. Stock–recruitment relationships for sole in ICES divisions 7.f and 7.g showing the estimation of the three regression models over the entire time period (Ricker: full black line; Beverton–Holt: dotted line; segmented regression: dashed line; yellow line represents the best fit over the three models).

The stock–recruitment relationship was evaluated as **type 5**, showing a stock with no evidence of impaired recruitment or with no clear relation between stock and recruitment (no apparent S–R signal). Therefore, B_{lim} should be set to B_{loss}, being 2264 tonnes. B_{pa} was then derived using the standard multiplier of 1.4, resulting in 3170 tonnes.

5.8.1.4 Determine F_{lim} and F_{pa}

The preferred method to derive F_{lim} is simulating a stock with a segmented regression S–R relation (Figure 5.17) with the point of inflection fixed at B_{lim}, thus determining the fishing mortality (F) that, at equilibrium, gives a 50% probability of the SSB being larger than B_{lim}. This simulation was conducted based on a fixed F (i.e. without inclusion of a $B_{trigger}$) and without inclusion of assessment/advice errors (i.e. F_{cv} and F_{phi} set to zero).

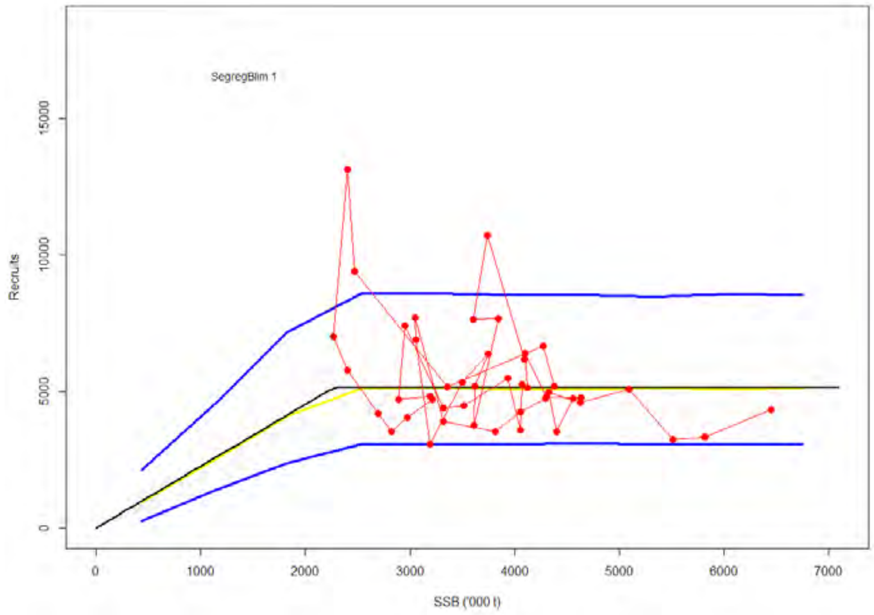


Figure 5.17. Stock–recruitment relationship for sol in ICES divisions 7.f and 7.g based on segmented regression over the entire time period, where the inflection point was set to B_{lim}.

F_{lim} was estimated at 0.521 (0.5208733) using the last five years of data (2014–2018) (see Table 5.6). F_{pa} was estimated at 0.372 (0.3720524) from the equation $F_{pa} = F_{lim}/1.4$.

Table 5.6. Summary table for determining F_{lim}.

	F05	F10	F50	medianMSY	meanMSY	Medlower	Meanlower	Medupper	Meanupper
catF	0.440	0.458	**0.521**	NA	0.280	NA	NA	NA	NA
lanF	NA	NA	NA	0.275	0.280	0.154	0.158	0.500	0.483
catch	921.039	914.732	845.219	NA	948.897	NA	NA	NA	NA
landings	NA	NA	NA	963.410	962.925	914.944	927.752	917.713	928.632
catB	2794.044	2694.781	2261.122	NA	4196.767	NA	NA	NA	NA
lanB	NA	NA	NA	4258.505	4196.767	6925.344	NA	2462.530	NA

5.8.1.5 Determine initial F_{MSY} and its ranges

The initial F_{MSY} was calculated using the fit by the segmented regression model using the whole time-series (Figure 5.18). Beverton–Holt did not contribute much to the S–R relation and Ricker showed lower recruitment when biomass was high, which is unexpected and not fully supported by the raw data (Figure 5.16).

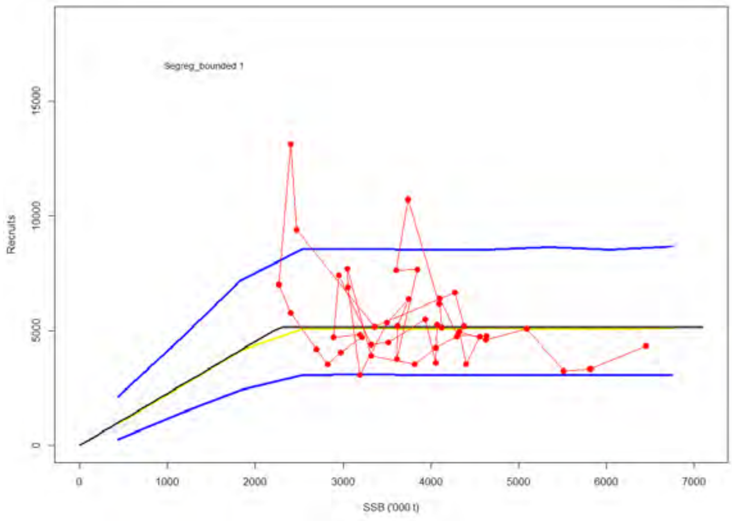


Figure 5.18. Stock–recruitment relationship for sole in ICES divisions 7.f and 7.g, based on segmented regression over the entire time period.

For this simulation run, the assessment/advice errors were set to the default values and $B_{trigger}$ was set to zero. This resulted in a median F_{MSY} of 0.285 (0.285282853) (<F_{pa}). The median of the SSB estimates at F_{MSY} was 4096 tonnes. The upper bound of the F_{MSY} range, giving at least 95% of the maximum yield, was estimated at 0.461 and the lower bound at 0.157. The results of the Eqsim simulations are shown in the Table 5.7 and Figures 5.19–5.21.

Table 5.7. Summary table for determining initial F_{MSY}.

	F05	F10	F50	medianMSY	meanMSY	Medlower	Meanlower	Medupper	Meanupper
catF	**0.389**	0.415	0.501	NA	0.260	NA	NA	NA	NA
lanF	NA	NA	NA	**0.285**	0.280	**0.157**	0.154	**0.461**	0.451
catch	920.118	910.601	803.288	NA	938.093	NA	NA	NA	NA
landings	NA	NA	NA	952.572	952.578	905.900	929.485	905.398	929.335
catB	3104.551	2923.084	2261.277	NA	4449.538	NA	NA	NA	NA
lanB	NA	NA	NA	**4095.724**	4166.639	6773.757	NA	2623.814	NA

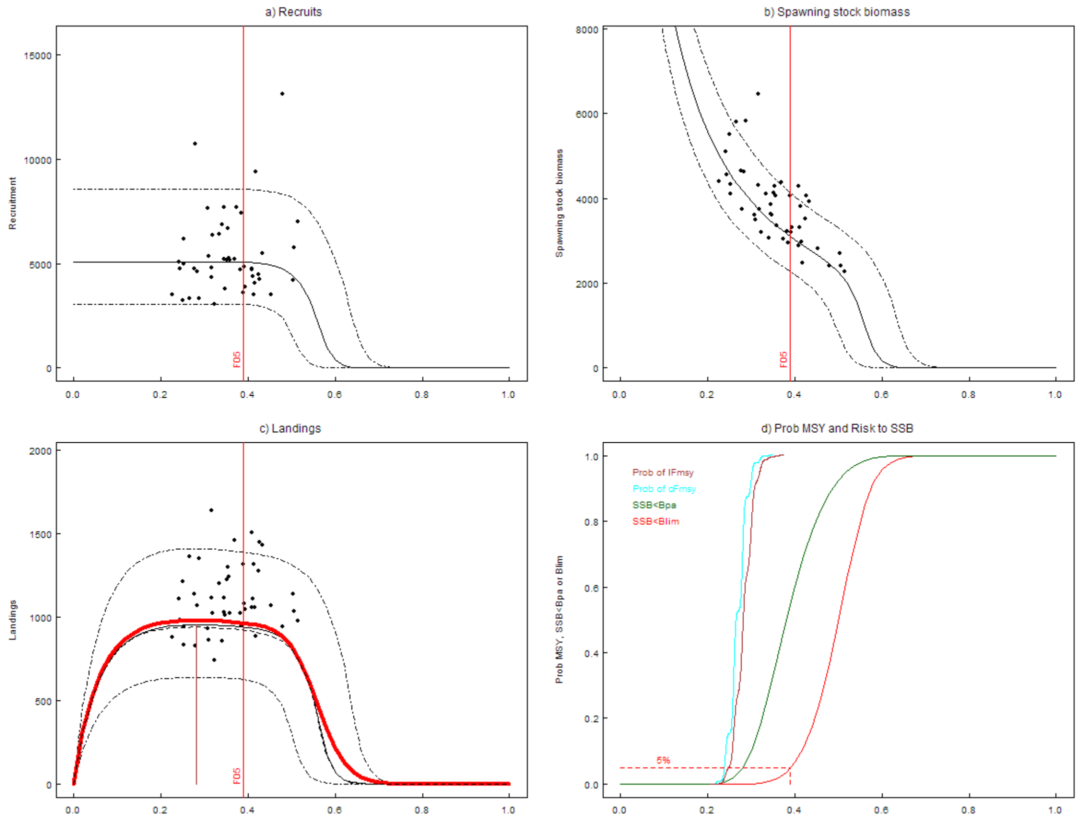


Figure 5.19. Eqsim summary plot for sole in ICES divisions 7.f and 7.g (without $B_{trigger}$). Panels a–c: historic values (dots) median (solid black line) and 90% intervals (dotted black lines) for recruitment, SSB and landings for exploitation at fixed values of F (on x-axis). Panel c also shows mean landings (red solid line). Panel d shows the probability of SSB<B_{lim} (red), SSB <B_{pa} (green), and the cumulative distribution of F_{MSY} based on yield as landings (brown) and catch (cyan).

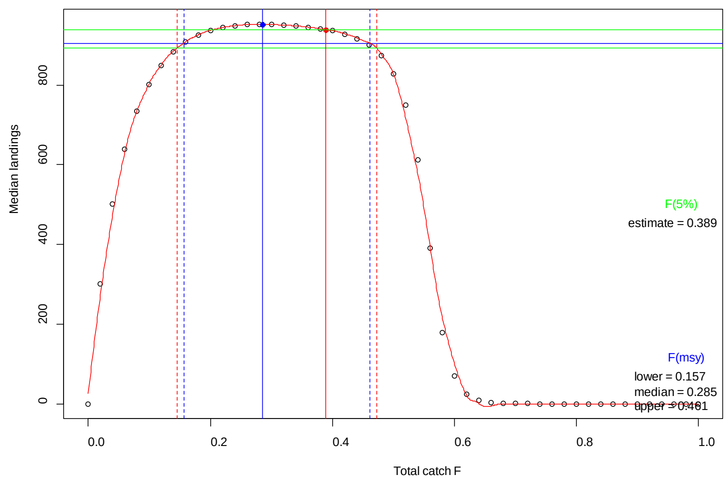


Figure 5.20. Median landings yield curve for sole in ICES divisions 7.f and 7.g, with estimated reference points (without $B_{trigger}$) and with a fixed F exploitation from F=0 to 1.0. Blue lines: F_{MSY} estimate (solid line) and range at 95% of maximum yield (dotted lines). Green lines: $F_{p0.5}$ estimate (solid line) and range at 95% of yield implied by $F_{p0.5}$ (dotted lines).

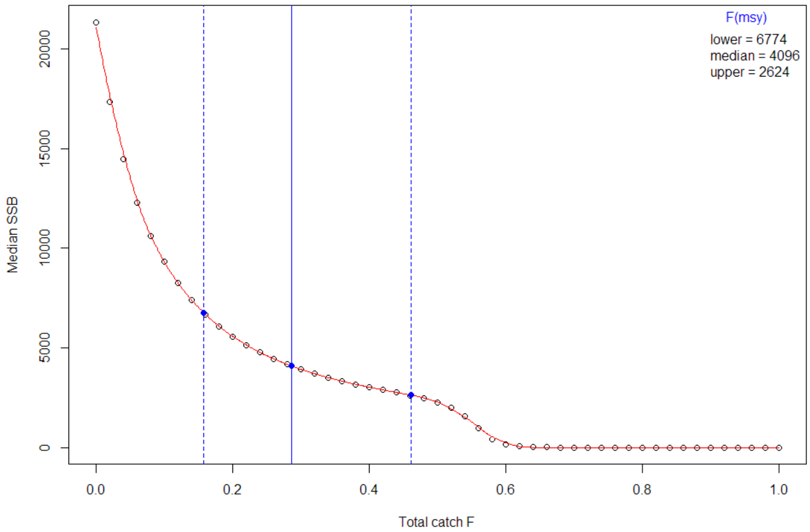


Figure 5.21. Median SSB curve over a range of target F values (without $B_{trigger}$) for sole in ICES divisions 7.f and 7.g. Blue lines: F_{MSY} estimate (solid line) and range at 95% of maximum yield (dotted line).

5.8.1.6 Determine MSY $B_{trigger}$ and evaluate ICES MSY Advice rule

Since the stock has not been fished at F_{MSY} for five or more years, MSY $B_{trigger}$ should be set at B_{pa}: 3170 tonnes.

To evaluate the reference points when enforcing the $B_{trigger}$, a final Eqsim run was performed. When applying the ICES MSY advice rule with a $B_{trigger}$ of 3170 tonnes, median F_{MSY} increased a little bit to 0.292 with a lower bound of the range at 0.157 and an upper bound at 0.621. The $F_{p0.5}$ value (0.491) is larger than the initial F_{MSY} (0.285). Therefore, F_{MSY} stays at the value initially calculated. $F_{p0.5}$ is however lower than the estimate of the upper bound on F_{MSY} implying that fishing at this upper bound is not precautionary and should therefore be lowered to $F_{p0.5}$ (0.4910758). The results of the Eqsim simulations are shown in Table 5.8–5.9 below and in Figures 5.22–5.24.

Table 5.8. Summary table for evaluating ICES MSY advice rule.

	F05	F10	F50	medianMSY	meanMSY	Medlower	Meanlower	Medupper	Meanupper
catF	**0.491**	0.538	0.730	NA	0.280	NA	NA	NA	NA
lanF	NA	NA	NA	**0.292**	0.280	**0.157**	0.155	**0.621**	0.629
catch	911.915	902.637	842.904	NA	937.285	NA	NA	NA	NA
landings	NA	NA	NA	952.378	951.835	905.502	920.956	904.642	920.269
catB	2809.436	2680.782	2264.718	NA	4169.593	NA	NA	NA	NA
lanB	NA	NA	NA	4013.681	4169.593	6772.313	NA	2488.949	NA

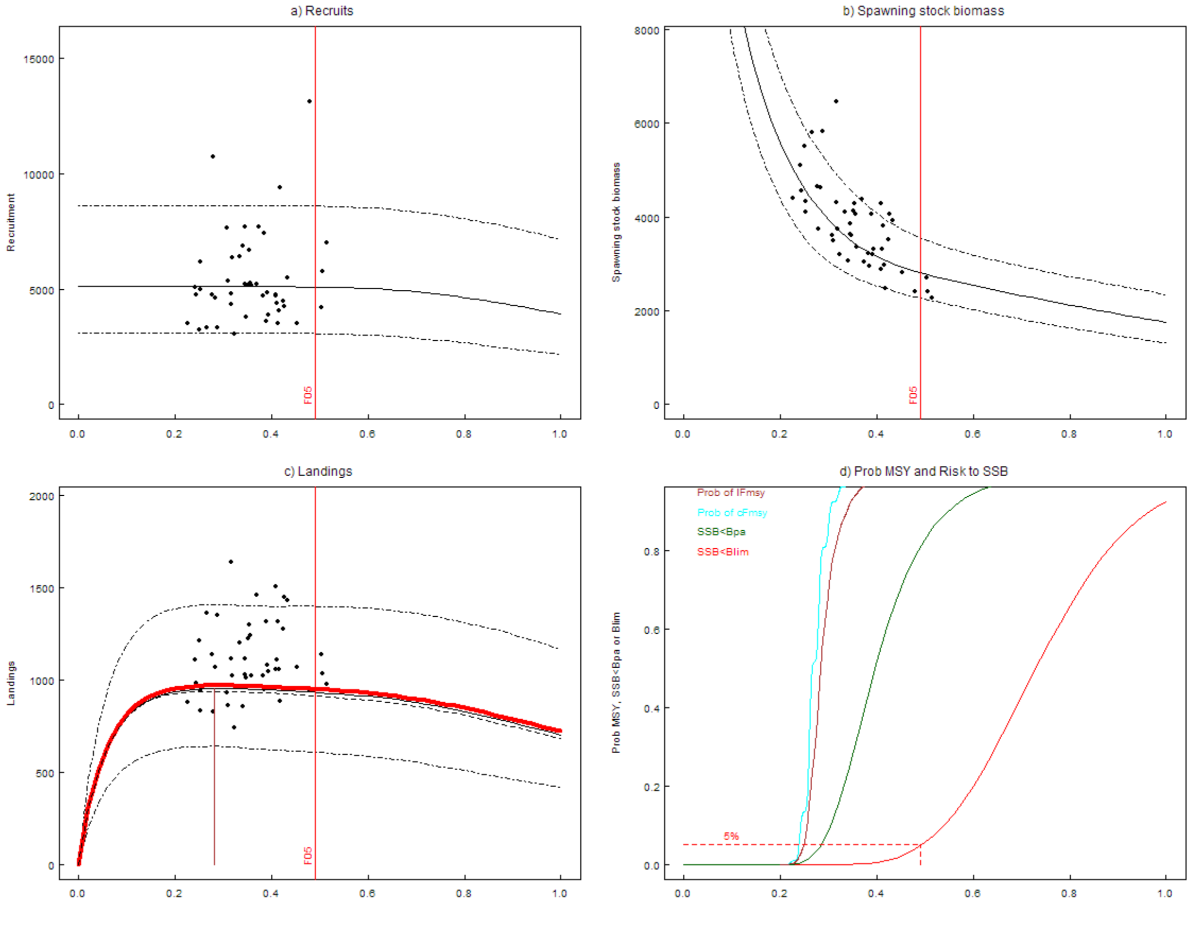


Figure 5.22. Eqsim summary plot for sole in ICES divisions 7.f and 7.g (with $B_{trigger}$ = 3170 tonnes). Panels a–c: historic values (dots) median (solid black line) and 90% intervals (dotted black lines) for recruitment, SSB and landings for exploitation at fixed values of F (on x-axis). Panel c also shows mean landings (red solid line). Panel d shows the probability of SSB <B_{lim} (red), SSB <B_{pa} (green), and the cumulative distribution of F_{MSY} based on yield as landings (brown) and catch (cyan).

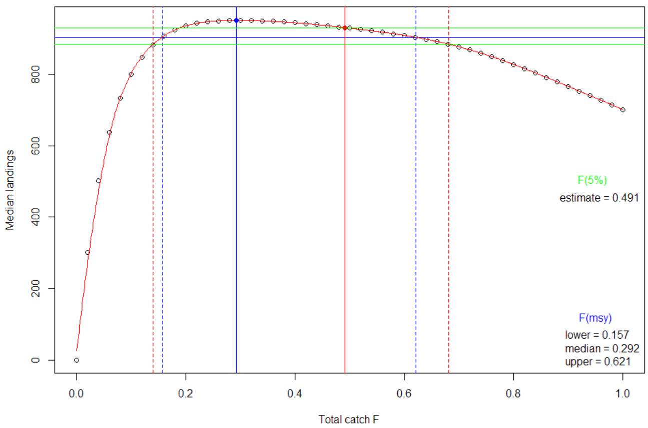


Figure 5.23. Median landings yield curve for sole in ICES divisions 7.f and 7.g, with estimated reference points ($B_{trigger}$ = 3170 tonnes) and with a fixed F exploitation from F=0 to 1.0. Blue lines: F_{MSY} estimate (solid line) and range at 95% of maximum yield (dotted lines). Green lines: $F_{p0.5}$ estimate (solid line) and range at 95% of yield implied by $F_{p0.5}$ (dotted lines).

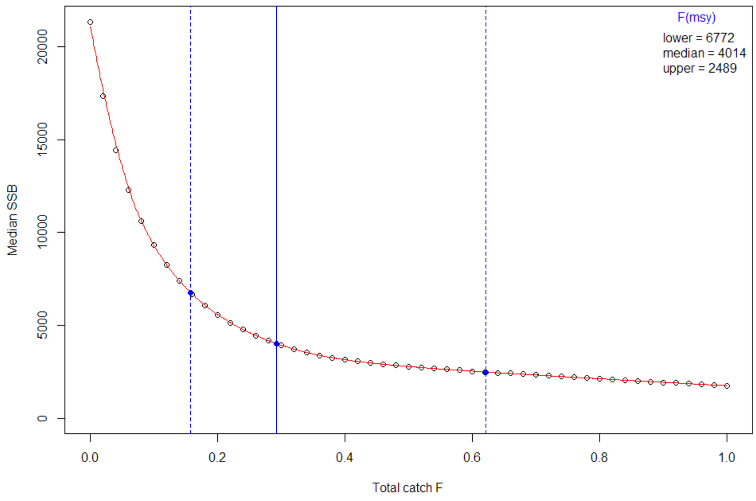


Figure 5.24.1: Median SSB curve over a range of target F values ($B_{trigger}$ = 3170 tonnes) for sole in ICES divisions 7.f and 7.g. Blue lines: F_{MSY} estimate (solid line) and range at 95% of maximum yield (dotted line).

Table 5.9. Proposed reference points.

Reference point	Value
B_{lim}	2264
$B_{pa\ (1.4)}$	3170
$B_{pa\ (sigma)}$	/
$B_{trigger}$	3170
F_{lim}	0.521
$F_{pa\ (1.4)}$	0.372
$F_{pa\ (sigma)}$	/
F_{MSY} without $B_{trigger}$	**0.285**
F_{MSY} without $B_{trigger}$ precautionary	0.285
F_{MSY} lower without $B_{trigger}$	0.157
F_{MSY} upper without $B_{trigger}$	0.461
New $F_{P.05}$ (5% risk to B_{lim} without $B_{trigger}$)	0.389
F_{MSY} upper precautionary without $B_{trigger}$	0.461
$F_{P.05}$ (5% risk to B_{lim} with $B_{trigger}$)	0.491
F_{MSY} lower with $B_{trigger}$	0.157
F_{MSY} upper with $B_{trigger}$	0.621
F_{MSY} upper precautionary with $B_{trigger}$	0.491

5.8.1.7 Sensitivity runs

A sensitivity analysis was conducted which involved running Eqsim with a moving window of ten years of selectivity data starting with 1991–2000 and ending with 2009–2018 (bio data year range 2009–2018 remained constant). The effect on the estimate of median F_{MSY} is shown in Figure 5.25. The estimate varies between 0.285 and 0.297 depending on the year range chosen and is thus very stable over the entire time period.

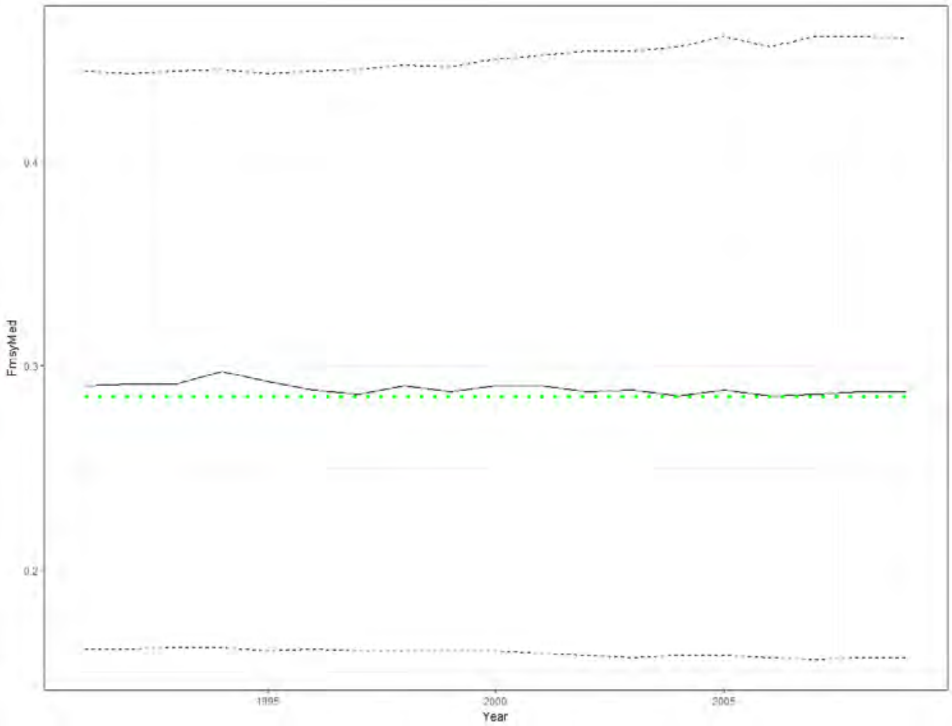


Figure 5.25. Sensitivity of F_{MSY} estimate (solid black line) to year range of selectivity data for sole in ICES divisions 7.f and 7.g (Year label is 1st year of a ten year range). Dotted lines represent the 5th and 95th percentiles of F_{MSY}. Green striped line represents the F_{MSY} value as estimated by the Eqsim analysis described above (=0.285).

5.9 Future research and data requirements

The following were noted as needing further exploration:

- Alternate rates of natural mortality. Natural mortality is assumed constant over ages and years at 0.1. When new information is available, this should be investigated;
- Trends and reasons for the decreasing catch and stock weights for the older ages;
- Effect of changing exploitation patterns related to the Trevose Box closure. ICES rectangles 30E4, 31E4 and 32E3 form the Trevose Box which is closed for fishing from February 1st until March 31st. This management measure is in place since 2006 and aims to protect spawning fish, cod and other demersal stocks such as sole in particular (ICES Special Request, 2007). This measure has a significant effect on the behaviour of the fleets. During the first week after re-opening of the Trevose box, catch rates of the Belgian beam trawl fleet are estimated to be twice as high with respect to the situation before the closure of the Trevose Box (prior to 2006) (Sys *et al*., 2017). Those temporal and spatial effects were accounted for in the new modelled Belgian commercial tuning index (ICES, 2019b). However, this change in exploitation pattern may also have an effect on the mortality of mature females or exhibit hyperstability, in which catch per unit of effort (cpue) remains elevated as stock abundance declines.
- Criteria such as length of the time-series, amount of spatial coverage and consistent statistical sampling design were considered for including/excluding the new UK-Q1SWECOS tuning series. However, we recommend that those survey data will be uploaded into DATRAS and that the survey design will be reviewed by the WGBEAM (The Working Group on Beam Trawl Surveys), to assure quality control of the data. The time-series was too short for any strong conclusions now but the inclusion of those survey indices should be reconsidered during the next benchmark.

5.10 External Reviewers' comments

The external reviewers' comments for all stocks are provided in Section 2.

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6 Sole (*Solea solea*) in divisions 7.h—k (Celtic Sea South, southwest of Ireland)

6.1 Stock ID and substock structure

This is the first time the stock sole in 7h–k has been benchmark. During the literature review for this benchmark, no information was found on the identity of this stock. A number of different auxiliary data sources were used to determine the geographical spread and behaviour of this fishery, and where possible its life-history parameters.

6.1.1 Landings information

Landings data submitted to STECF Fisheries Dependant Information (FDI) (https://stecf.jrc.ec.europa.eu/dd/effort) were used to explore trends in the geographical spread and behaviour of fleets targeting sole in 7h–k. Unlike ICES InterCatch data, this data source provides a summary of landings by Member State, gear type, and statistical rectangle.

The geographical separation between where the landings in 7h and 7j are taken, suggests that there are two discrete fisheries occurring in the stock area (Figure 6.1). This perception is further supported by the clear variation in the gears used to catch sole within the two ICES divisions. Within 7j, sole is predominantly landed by otter trawls, whereas the 7h fishery is mainly targeted by beam trawls (Figure 6.1 right). This would suggest the two separate assessments are required to effectively manage this fishery.

Using Irish VMS data, it can be seen that sole in 7j is typically targeted by the otter trawl fleet, which operate on sandy grounds off the southwest of Ireland, close to shore. Sole is a small (but valuable) component (up to 5%) of the landings in this mixed fishery (Figure 6.3). A similar description could not be provided for sole in 7h as no VMS data or tuning series were supplied for this area.

Plots of the STECF landings at the level of statistical rectangle revealed a pattern of possible transboundary catches or misreporting occurring on the border between the three sole stocks in the regions, sole 7a, sole 7h–k and sole fg (Figure 6.2). While this level of misreporting will have little impact on the adjoining stocks (sol7e, solfg) where landings of sole are substantially higher, the relativity large magnitude of these transboundary catches could have a major impact on the overall tonnage reported to 7h every year, and therefore an impact on the assessment and perception of the stock. After the data evaluation workshop, this concern was effectively followed up by the Belgians, who in conjugation with Belgian fishers, produced as estimate of transboundary catches for the entire time-series. This relocation resulted in substantial decrease in effort and landings (Figure 6.4) (full detail found in Annex 2.4.1). Given that the majority of sole landings in 7h, for all Member States, is taken in the same area, the likelihood of transboundary catches are high for all Member States. For this reason it is important that all Member States operating in this area, conduct a similar exercise and reflect this misreporting in their data submissions. By fishing from one division to another, skippers are allowed to choose to which ICES division they report their landings. However, when taking into account the effort along the borders of ICES division 7.e and 7.g, our estimated landings for ICES division 7.h are still lower than the reported values, which implies the existence of non-compliance. The trans-zonal fishing raises concerns about the stock identity in this area.

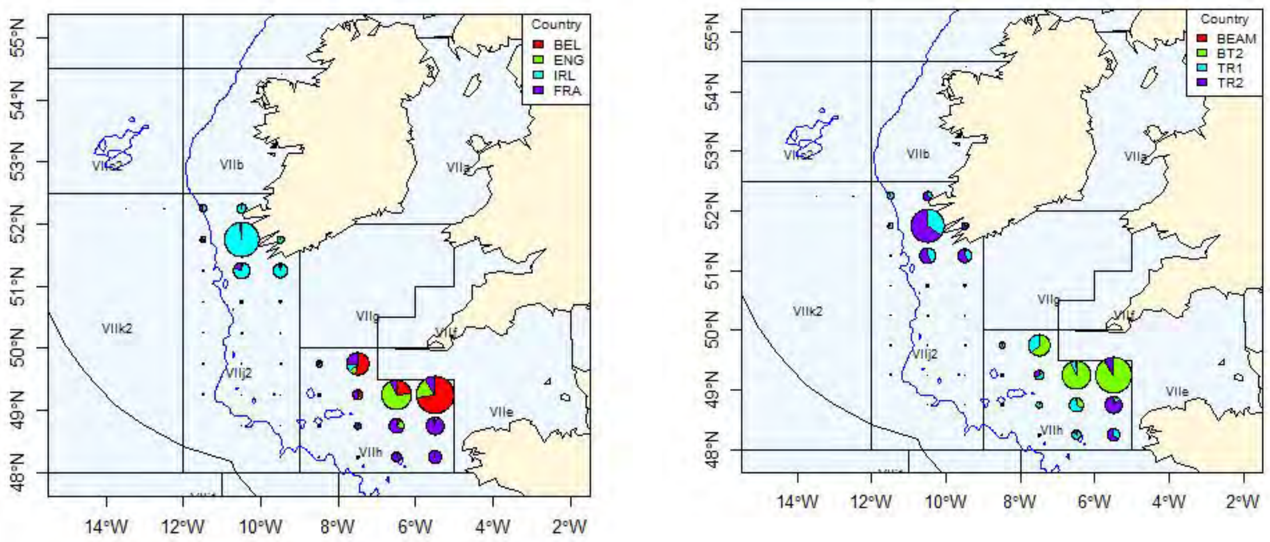

Figure 6.1. The spatial distribution of sole landing as reported to the STECF FDI data call in 2016. The landings are plotted by statistical rectangle and show the relative landings reported by Member State (left) and gear type (right), and weighted by the overall landings of sole in ICES divisions 7hjk in 2016.

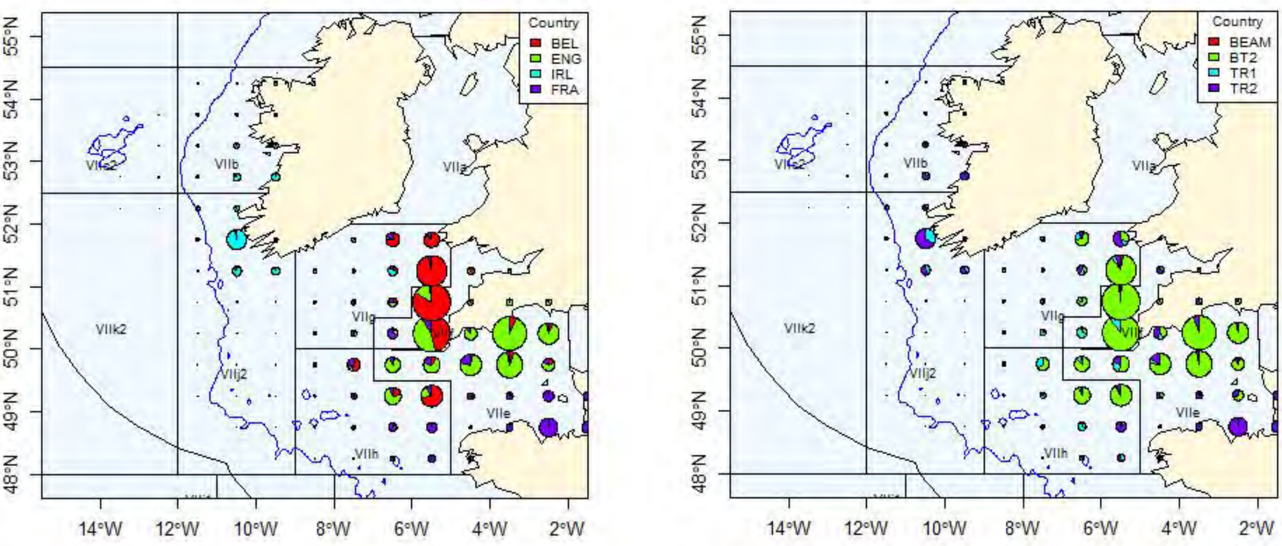

Figure 6.2. The spatial distribution of sole landing as reported to the STECF FDI data call in 2016. The landings are plotted by statistical rectangle and show the relative landings reported by Member State (left) and gear type (right), and weighted by the overall landings of sole in ICES divisions 7 b,c,e,f,g,h and k in 2016.

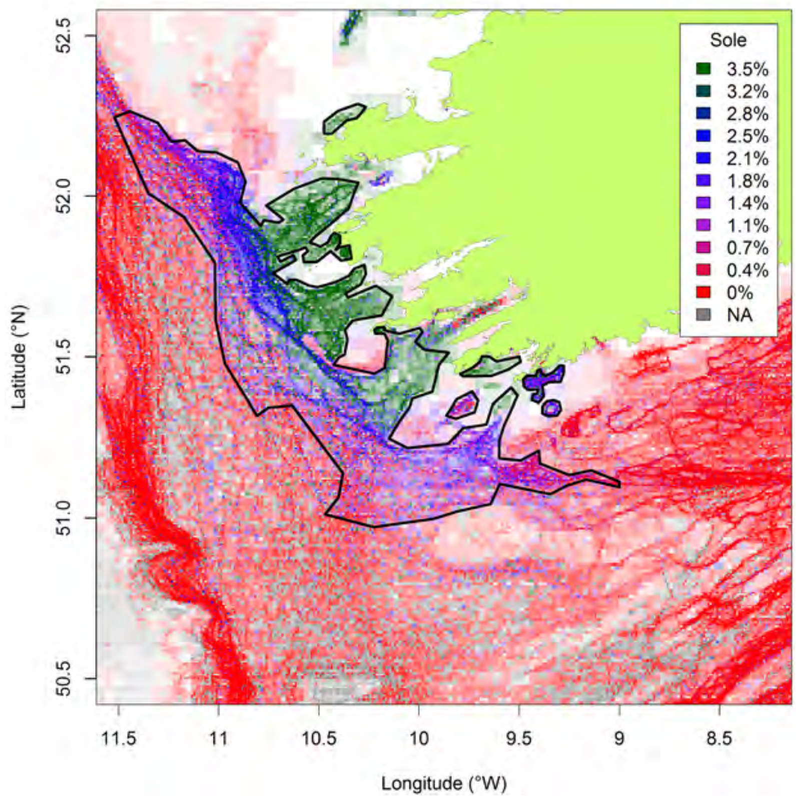

Figure 6.3. The black line is the polygon which encompasses the data that are used in the tuning fleet. This area includes anywhere that more than around 1% of sole has been landed. This also illustrates that sole is a very minor bycatch species as in no area do they make up more that 3.5% of the landings.

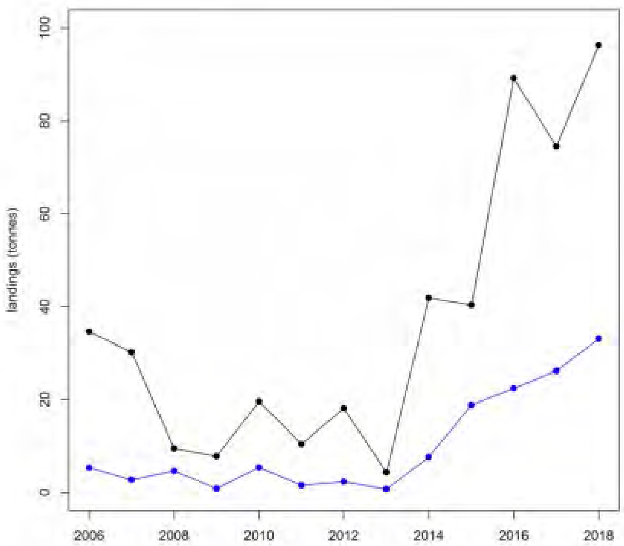

Figure 6.4. Reported (black) and estimated landings (blue) for sole in ICES Division 7.h from the Belgium fleet over the period 2006–2018. Estimated landings based on VMS effort data and an estimated lpue. For full explanation see Annex 2.4.1.

6.1.2 Biological information

Given the geographical separation between the sole fishery in 7h and 7j (fig 6.1), variation in life-history parameters between these two divisions was explored, to detect any possible stock separation or subgroups. Given the proximity of sole landings in 7h to landings sole in 7e and 7fg, there is an increased likelihood that sole landings in 7h are in fact part of the same stock as those in the 7e and 7fg.

Ideally, a genetic or tagging study would be used to assess the connectivity of all three of these sole management units (7hjk, 7e and 7fg). In the absence of such information, the data submitted to InterCatch were used to explore variations in growth between 7j and 7k. Simple plots of weight-at-age indicate that there may be variation in growth rates between 7h and 7j (Figure 6.5). However, it is unclear if this is due to the impact of stock separation, habitat variation, or an artefact of the targeting capacity of the very different gear types used in these areas. Ideally this analysis would be conducted on raw length weigh and age data. Or the life-history parameters supplied by Member States.

A cohort analysis was also conducted using the aged InterCatch submissions, to determine if there were any trends in cohorts which could indicate connectivity between 7j, 7h, and 7e. This analysis shows that there are no evident trends in cohorts that could be used to link recruitment any of the adjoining ICES divisions (Figure 6.6).

6.1.3 Conclusion and recommendation

Due to the data-poor nature of this fishery, there is currently no reliable evidence by which to separate the population of sole in 7h and 7j. However, geographical distribution of the landings data would suggest that the fleets are targeting of two discrete populations. Therefore, it is the recommendation of this group to propose sole in 7h–k to the stock identity working group (SIMWG) for further discussion on the possible separation.

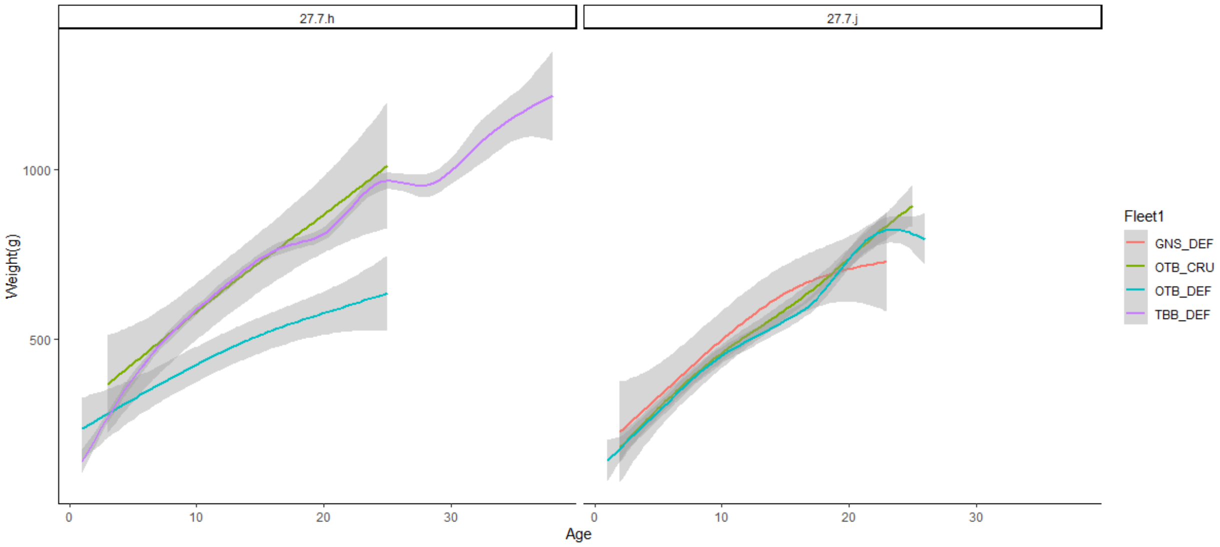

Figure 6.5. The smoothed age–weight relationship of samples submitted to InterCatch for sole in ICES divisions 7h (left) and 7j (right), spanning 14 years (2004–2018), separated by gear and target assemblage of trips (GNS_DEF = gillnetter targeting demersal fish, OTB_CRU = otter trawl targeting crustaceans, OTB_DEF = otter trawl targeting demersal fish, TBB_DEF = beam trawl targeting demersal fish).

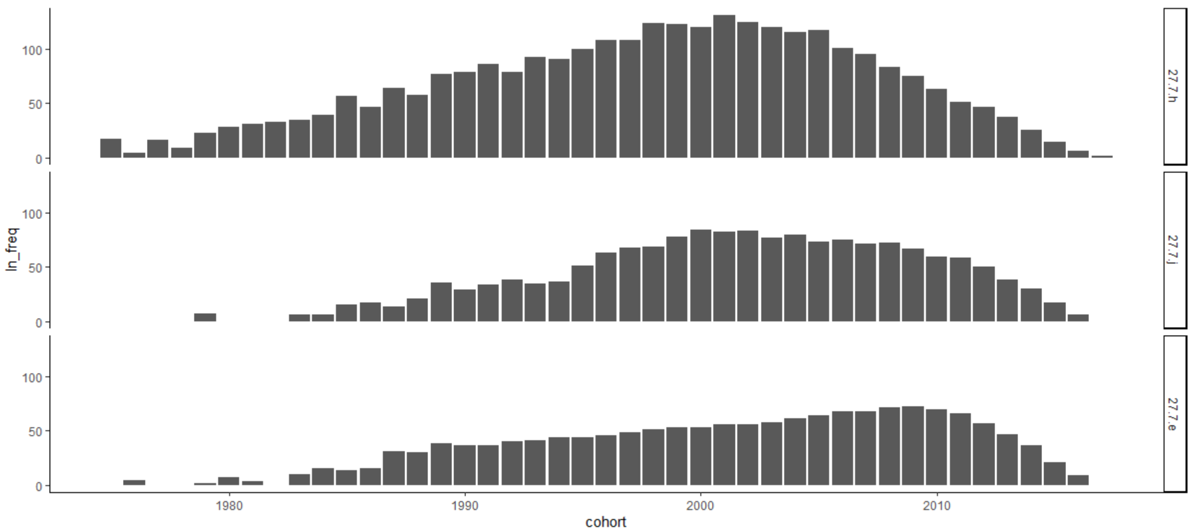

Figure 6.6. A proxy for cohort size was back calculated (year–age) from age data submitted to InterCatch for ICES divisions 7h, 7j, and 7.e. As sample numbers in 7e were substantially larger than those in 7j or 7h, the log of the frequency of cohorts was plotted so that trends between areas could be comfortably compared.

6.2 Issue list

Sole in 7 h–k is considered a data-poor stock and has not been previously benchmarked. An overview of the initial issue list can be found below in Table 6.1. Originally this stock came to benchmark to consider the addition of new data from the division 7h, for which there was historically no available age-disaggregated data or tuning series. The quality and categorisation of the assessment for 7j had not initially been considered, but on inspection by the group was deemed not fit for purpose, and so became an additional topic for this benchmark.

Table 6.2. Original issue list set out prior to the benchmark.

Issue	Problem/Aim	Work needed/ possible direction of solution	Data needed to be able to do this: are these available / where should these come from?
(New) data to be considered and/or quantified	Problem: Data from 7h is currently not included in the model Aim: Examine inclusion of this information in the assessment.	Data exploration: are the data consistently available across the area, from enough gear types/ quarters, to be able to raise for the remaining métiers where no such data are provided	This data should be available in InterCatch
Discards	Problem: There are currently no discards included in the assessment as they are not submitted to InterCatch. It may be useful to examine alternative methodologies for estimating these using methods which are capable of operating with missing datapoints. Aim: Investigate the method by which missing data can be estimated, and apply to available data.	Explore possible methods for discard estimation, and use resulting data in assessment to compare the impact on forecasts	They are currently not available, they should come from InterCatch.
Tuning series	Explore possibility a survey index	Run assessment with inclusion of survey index from IAMS, IBTS. And examine their impact on the assessment.	Data are available from DATRAS
Tuning series	Potential new commercial tuning data for 7h	Investigate the possibility of a commercial index from 7h.	Currently not available
Assessment method	Consider alternative methods	Investigate use of SAM and a4a	
Biological Reference Points	Update as required		
Other	Data compilation	Streamlining of catch-at-age data compilation for Celtic flatfish. Consistency and standardisation of métiers across stocks	

6.3 Scorecard on data quality

Not applicable.

6.4 Multispecies and mixed-fisheries issues

Sole in 7h–k is taken as part of a mixed demersal fishery, and has been previously considered for inclusion in mixed-fisheries analysis for the Celtic Sea (ICES, 2018). Sole in this area is classified as a valued bycatch, forming a very small proportion (~ <5% of total catch of trips) (WKTarget) (Figure 6.7).

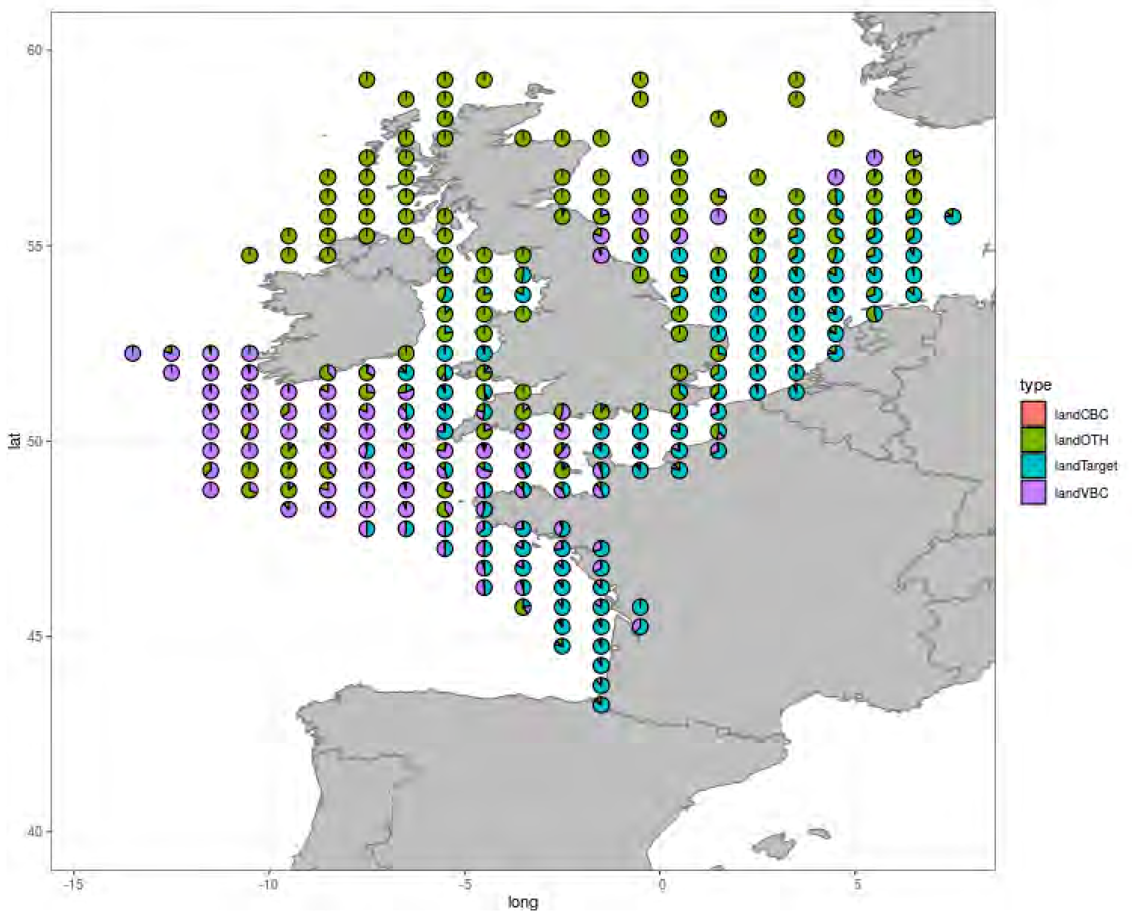

Figure 6.7. Map of the proportion of targeting behaviour for sole by ICES rectangle, using RDB (Regional DataBase) and STECF FDI data ("landCBC" = landed as collateral bycatch, "landOTH" = landed in unknown behaviour, "landTarget" = landed as a target species, "landVBC" = landed as a valued bycatch species)(https://proby-fish.shinyapps.io/GlobalAnalysis/**)**

6.5 Ecosystem drivers

Not applicable.

6.6 Stock assessment

6.6.1 Catch–quality, misreporting, discards

Landings of sole vary widely across the three ICES divisions (7h, j & k) covered by this stock (Figure 6.8). The majority of landings have historically been taken in 7h, followed by 7j. Landings in 7k are considered negligible, and will therefore not be discussed further in this section. As discussed in Section 6.1 and Annex 2.4.1, misreporting is assumed to constitute a substantial proportion of the landings reported to this region. Therefore, there are concerns about the quality and the final figure of the landings reported to InterCatch. This has been addressed by Belgium and needs to be addressed by the UK and France, who are key Member States operating in this area. Discards in 7j are considered negligible. Discards in 7h have only been reported by one

Member State (UK), for one fleet (TBB_DEF), for five years over the full time-series (2004–2018). The discard rate reported for this single fleet is highly variable, ranging from 29% to <5% (6.9). Although it is unclear if these variable discard rates are reflective of the whole fishery, it does provide more evidence that the sole fisheries in 7h and 7j are executed in very different manners, and should be assessed separately.

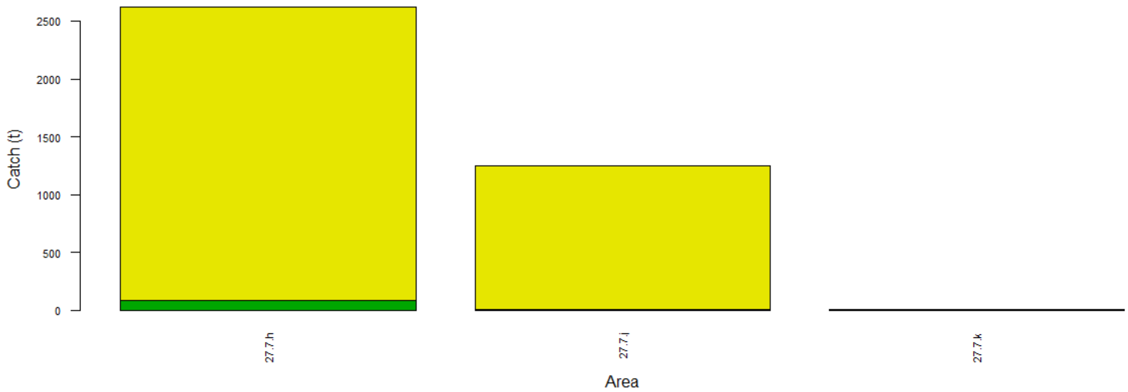

Figure 6.8. Total landings (yellow) and discards (green) reported to InterCatch for sol.27.7h-k, 2004–2018.

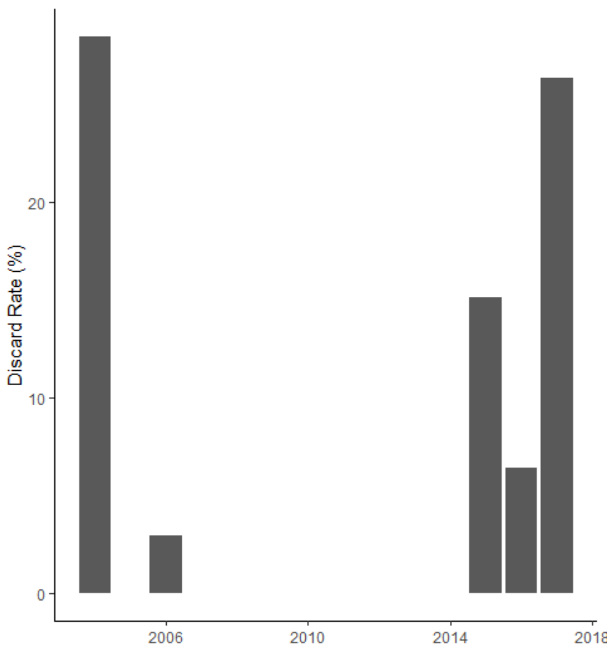

Figure 6.9. Discards rates submitted InterCatch for UK TBB fleet in 7h from 2004–2018.

6.6.2 Surveys

No survey index is available for sol in 7h–k. The Irish Bottom Trawl Survey (IBTS) Q4 survey does occur in this area, however the gear used is not optimum for catching sole, and is therefore considered too noisy to be used as an index for sole. The Irish Beam Trawl Ecosystem Survey (IBES) was considered as a possible future index, however the survey was discontinued after only three years, and therefore the time-series is too short be used as a tuning index.

A commercial tuning index is currently used for the assessment of the 7j part of the stock. This tuning index comprises of a VMS-based lpue. The use of a commercial tuning fleet has the potential to introduce bias if the behaviour or efficiency of the fleet changes. E.g. changes to the gear, vessel power, towing speed, etc. can influence the catch rates. As the majority of the sole landings (>80%) in 7j are landed by the Irish OTB fleet, this tuning index is resulting in the same data being inputted into the assessment model twice (tuning index and the catch numbers-at-age), which could be the reason for wide interannual recruitment and unwanted retrospective patterns. As no tuning or survey index was supplied for 7h, it was not possible to create an XSA or FLSAM assessment for this area.

6.6.3 Weights, maturities, growth

Maturity data were supplied for 7j only. These data were taken from the Marine Institute Q1 Biological sampling programme (2010–2019), At-Sea Observer programme (2010–2019), Irish Anglerfish and megrim survey (2016–2019), the Irish beam trawl Ecosystem survey (2016–2019 and the MI Biological sampling survey (2004–2009). Proportions mature-at-age were estimated by constructing a matrix containing the sample numbers by age, sex and maturity state (mature/immature) at each length class. Unsexed individuals (usually small fish with undeveloped gonads) were assigned in equal numbers to both sexes. This Age–Sex–Maturity–Length Key (ASMLK) was applied to the length–frequency data to estimate the proportions mature-at-age for either sex and both sexes combined. Any gaps in the ASMLK were filled in using a multinomial model (Gerritsen *et al.*, 2006). However, the results should be interpreted with caution based as the information is based on limited sample numbers (Tables 6.2 and 6.3, Figure 6.10). "All" sexes is a weighted maturity ogive and included unsexed individuals most likely to be immature. The results how a maturity for age 2 and age 3, which is higher than that used in WGCSE. Because Irish sampling generally does not cover the full extent of the stocks, it is difficult to determine whether the Irish estimates are biased. It is possible that the lack of full spatial coverage can explain some of the differences between these findings and what is currently used for this stock.

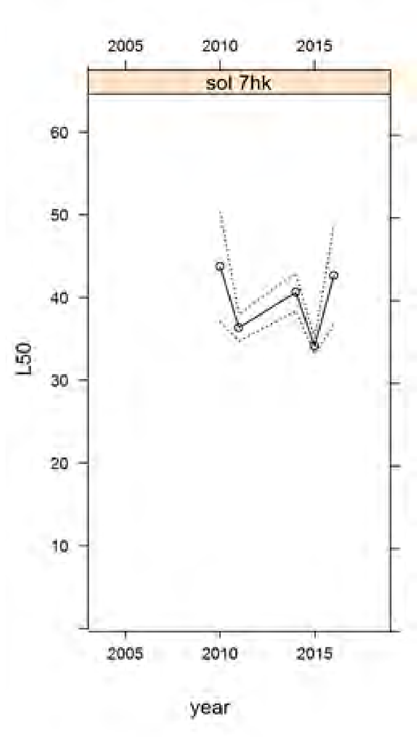

Figure 6.10. Length at 50% maturity (L50; cm) for females by stock and year.

Table 6.2. Estimated proportions mature (sample numbers in table below) by stock, sex and age. Maturity ogives used by the WG are also given.

Stock	Sex/WG	1	2	3	4	5	6	7	8	9	10+
sol 7hk	F	0.86	1		1	1					
	M	0.66	0.98	1							
	All	0	0.78	1							
sol 7.hk	WGCSE	0	0.14	0.45	0.88	0.98	1	1	1	1	1

Table 6.3. Sample numbers by stock, sex and age for associated maturity in Table 6.1 above.

Stock	Sex/WG	1	2	3	4	5	6	7	8	9	10+
sol 7hk	F	78	163	14		1	1				
	M	95	180	15	3						
	All	202	345	29	3	1	1				

6.6.4 Assessment model

To date sole in 7h–k has been assessed using an age-based assessment. This category 3 assessment uses catch numbers-at-age and a commercial tuning index to give indications of trends in stock metrics such as mortality, recruitment, and biomass.

The model was applied to catch numbers for ages 2–10+ for the years 1993–2018. The tuning fleet included ages 3–9 for the years 2006–2018. A summary of model options is outlined in Table 6.4 below.

Table 6.4. Model options for sole 7h–k XSA assessment run during WGCSE 2019.

Option	Setting
Ages catch dep stock size	None
Q plateau	7
Taper	No
F shrinkage SE	1.5
F shrinkage year range	5
F shrinkage age range	5
Fleet SE threshold	0.2
Prior weights	No

During the benchmark it was noted that there were a number of issues with this assessment. There is very little tracking of cohorts in the catch numbers-at-age, and because the catch and the tuning fleet have nearly identical age compositions, it results in strong year effects within the model (Figures 6.12, 6.13 and 6.14), and results in a variable recruitment without a clear trend (Figure 6.14). Therefore the benchmark group concluded that the input data were not of a suitable quality to produce a category 3 assessment, and decided to categorise the stock as category 5.

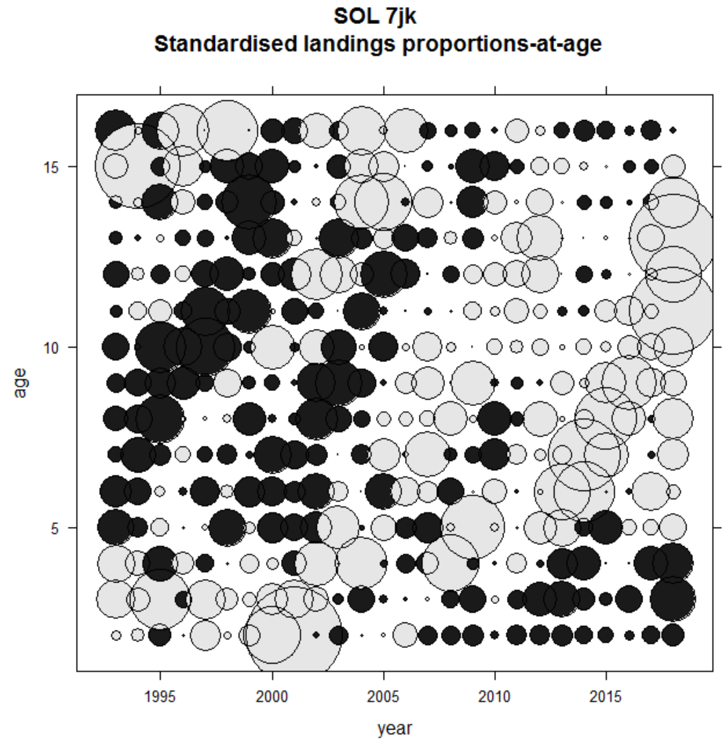

Figure 6.12. Standardised catch proportions-at-age for sole in 7.jk. Grey bubbles represent higher than average catch-at-age and black bubbles represent lower than average catch-at-age.

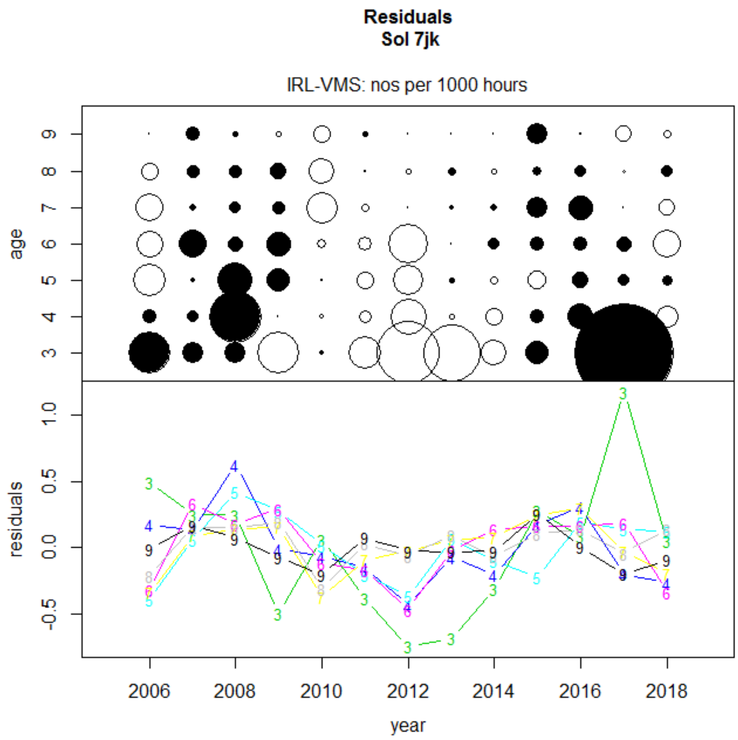

Figure 6.13. Residuals of the index fit from sole 7h–k XSA assessment in 2019.

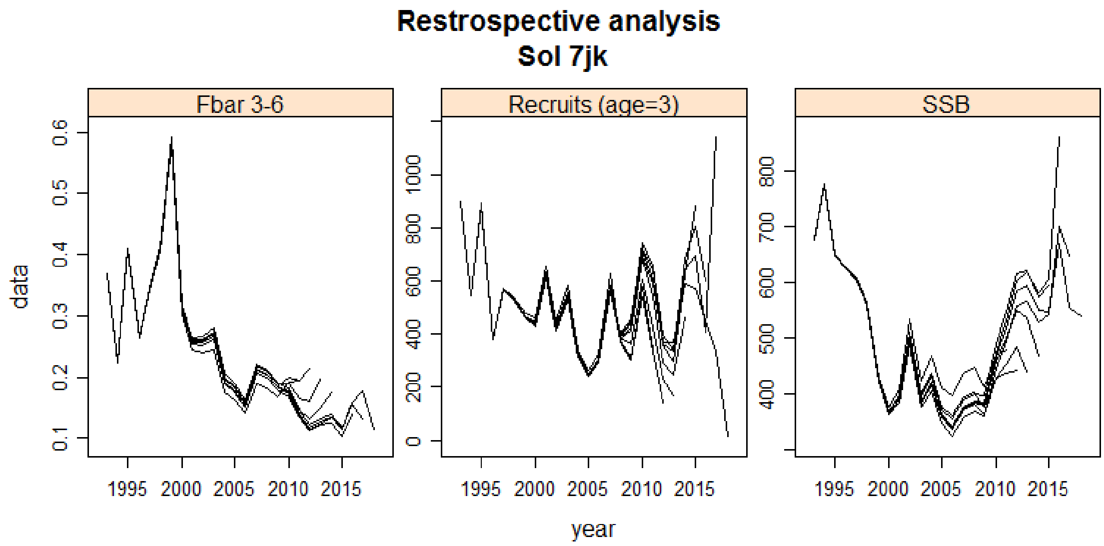

Figure 6.14. Retrospective pattern for XSA assessment of sole in 7h–k 2019.

The numbers of actual samples collected in 7h and j is actually quite small. This is not likely to be resolved as the TAC is reducing (plot), landings are well below Member Sates legal requirements to provide age samples under the DCF. In conclusion, the input data (sample size and tuning series) is not robust enough to support age-based assessment, and as a result produces a highly variable and uncertain perception of the stock. Therefore the group concluded that a data-poor method should be used to assess this stock. During the benchmark, it was decided to test the application of a data-poor method to assess this stock, however there were a number of missing data sources, in particular for area 7h (Table 6.5).

It was decided to apply SPiCT to area 7j. A total of seven test runs were completed using variations in data inputs, which varied in time-series length and indices (Annex 2.4.1). The assessment summary indicates a large uncertainty, making it unsuitable for advice purposes.

Table 6.5. Data-poor methods considered and available data.

Method	Data Requirements	Data availability	
		7j	7h
Length-based indicators (LBI)	Length at maturity	✓	✗
	von Bertalanffy growth parameters	✓	✗
	Catch-at-length by year	✓	✓
	Length–weight relationship parameters for landings and discards	✓	✗
Mean-length Z (MLZ)–effort	Time-series of length measurements	✓	✓
	von Bertalanffy growth parameters for the stock	✓	✗
	Time-series of fishing effort	✓	✗
	Natural mortality	✓	✗
	Weight-at-age	✓	✓
	Maturity	✓	✗
	Fishing effort prior to the first year of the mean length data	✗	✗
Length-based spawner per recruit (LBSPR)	Length composition data of the catch	✓	✓
	Ratio of natural mortality and the von Bertalanffy growth coefficient	✓	✗
	Maximum length	✓	✓
	Maturity-at-length	✓	✗
	Proportion of animals surviving to maximum age	✗	✗
	Allometric exponent from the length–weight relationship	✓	✗
Surplus Production model in Continuous tome (SPiCT)	Landings	✓	✗

Method	Data Requirements	Data availability	
		7j	7h
	Lpue/effort	✓	✘

6.7 Short-term projections

No short-term forecast was conducted for this stock as it is a category 5.

6.8 Appropriate Reference Points (MSY)

Not applicable.

6.9 Future research and data requirements

Although this benchmark provided increased age and length data for ICES area 7h, there was still substantial gaps in the available information for effort, indices, and life-history parameters. These data gaps limited the models which could be applied during the benchmark. Intersessional work should be done to get this information and to apply a number of data-poor methods to this stock. Efforts should also be made to understand the extent of misreporting by all Member States operating within 7h.

Given the extent of the geographical separation between sole landed in ICES area 7j and 7h, effort should be made to clarify the stock structure within this area. Life-history parameters, genetics and tagging studies should be used to determine the connectivity between 7h and 7j, as well as other neighbouring sole management units.

6.10 External Reviewers' comments

The external reviewers' comments for all stocks are provided in Section 2.

6.11 References

Gerritsen, H.D., Armstrong, M.J., Allen, M., McCurdy, W.J. and Peel, J.A.D. 2003. Variability in maturity and growth in a heavily exploited stock: whiting (*Merlangius merlangus* L.) in the Irish Sea. J. Sea Res., 49(1): 69–82.

Gerritsen, H.D., McGrath, D. and Lordan, C. 2006. A simple method for comparing age–length keys reveals significant regional differences within a single stock of haddock (*Melanogrammus aeglefinus*). ICES J. Mar. Sci., 63(3): 1096–1100.

ICES. 2018. *Ad hoc* Report on the Special Request on further development of ICES mixed fisheries considerations and biological interactions, November–December 2018, Claire Moore, Youen Vermard, Clara Ulrich, Marc Taylor, Thomas Brunel, Paul Dolder, Katja Ringdahl, Kirsten Birch Håkansson and Johan Lövgren. ICES CM 2018/ACOM: 65. 82 pp.

7 Turbot (*Scophthalmus maximus*) in Division 3.a (Skagerrak and Kattegat)

7.1 Stock ID and substock structure

The geographical area of Skagerrak is bounded to the west by a line drawn from the Hanstholm lighthouse in Denmark to the Lindesnes lighthouse in Norway. To the south, Skagerrak is bounded by a line running from the Skagen lighthouse in Denmark to the Tistlarna lighthouse in Sweden, and from this point to the nearest point on the Swedish coast. The southern boundary of Skagerrak forms the northern boundary of Kattegat. The southern boundary of Kattegat is constituted by a line running from Hasenøre on the east coast of Jutland and across the Great Belt to Gniben on the west coast of Zealand in Denmark. From there, the line runs along the northern coast of Zealand to Gilbjerg and further in a northeastern direction to Kullen on the western coast of Sweden (Figure 7.1).

Figure 7.1. Boundaries of ICES Division 27.3.a. ICES subdivisions and codes: Skagerrak (Subdivision 27.3.a.20), Kattegat (Subdivision 27.3.a.21), Belt Sea (Division 27.3.c), Sound (Division 27.3.b), Baltic Sea (Division 27.3.d), Northern North Sea (Division 27.4.a), Central North Sea (Division 27.4.b), Southern North Sea (Division 27.4.c).

7.1.1 Stock definition

Turbot lives in the eastern North Atlantic and occurs from the Mediterranean Sea in the south to Iceland and Lofoten in Norway in the north. More centrally, turbot is distributed in the North Sea, Skagerrak, Kattegat and large parts of the Baltic Sea, including ICES Area 3.a. Studies have revealed genetic structures and migration patterns of turbot in a number of areas. At a large scale, population genetic studies by Vandamme *et al.* (2014) identified an Atlantic group, a Baltic Sea group, a group on the Irish Shelf, and an additional break in the North Sea, subdividing southern from northern Atlantic individuals. Florin and Höglund (2007) found low genetic differentiation and no evidence of isolation by distance in the Baltic Sea and Kattegat. In contrast, Nielsen *et al.* (2004) reported a sharp cline in genetic differentiation going from the low saline Baltic Sea to the high saline North Sea. The data were explained best by two divergent populations connected by a hybrid zone (Nielsen *et al.*, 2004).

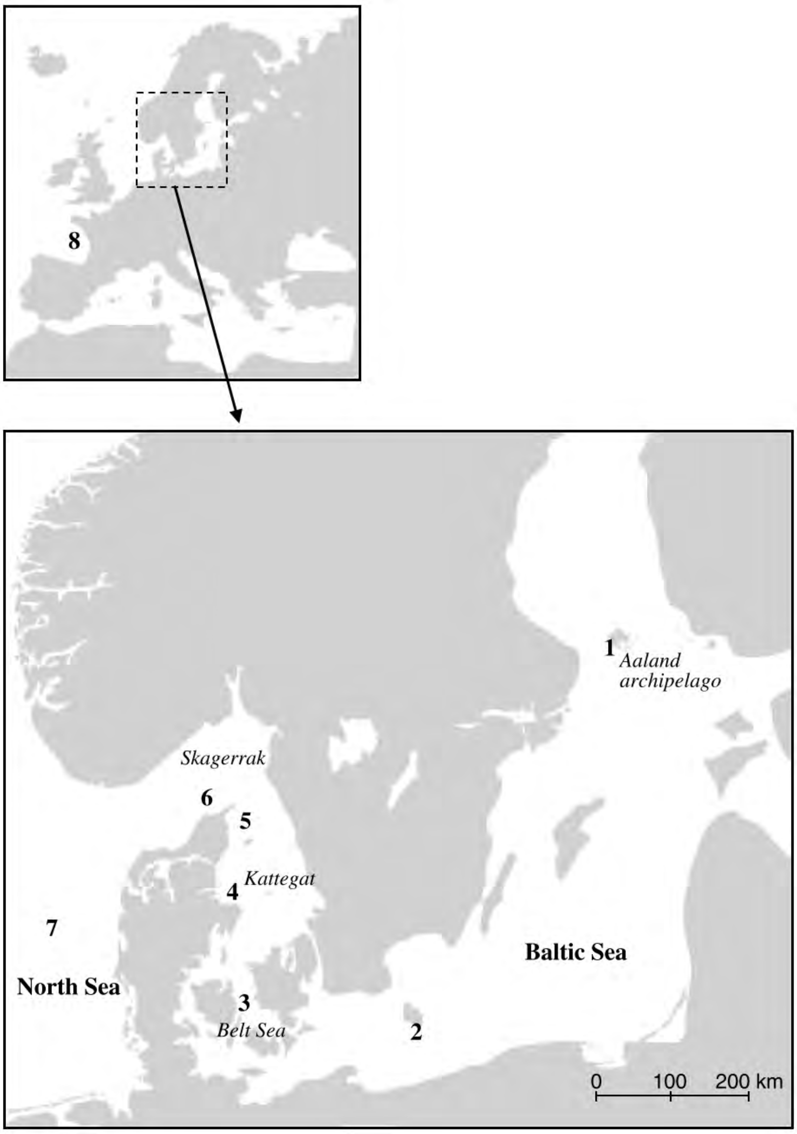

Figure 7.2. Map of sea areas showing sampling locations (Nielsen *et al.*, 2004).

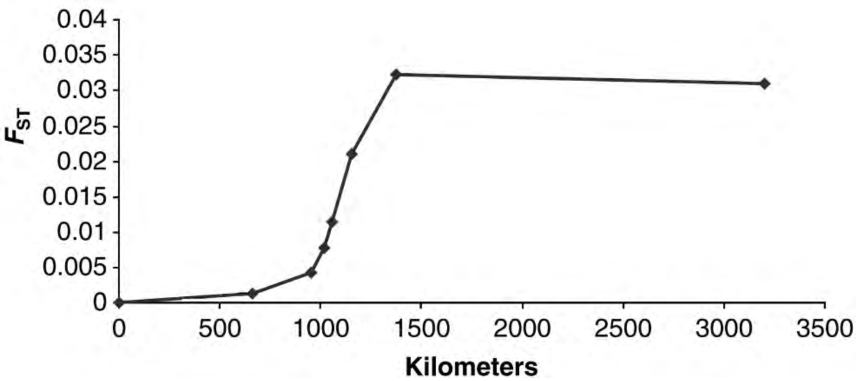

Figure 7.3. Genetic differentiation between the Northern Baltic Sea sample (1) and all other samples of turbot (2–8). Samples are included following a geographical transect going from the Northern Baltic Sea to the Atlantic Ocean, French Biscay. The steepest cline in genetic differentiation occurs through Kattegat. Modified from Nielsen *et al*. (2004).

More recently, Le Moan (2019) reported distinct genetic differences between the Baltic Sea and the North Sea (Figure 7.1). Areas sampled included the Western Baltic Sea and Kattegat, but not Skagerrak. The fish sampled in Kattegat were typically intermediate compared to fish sampled in the Baltic Sea and the North Sea, but occasionally individual fish sampled in Kattegat matched fish sampled in the Baltic Sea or the North Sea.

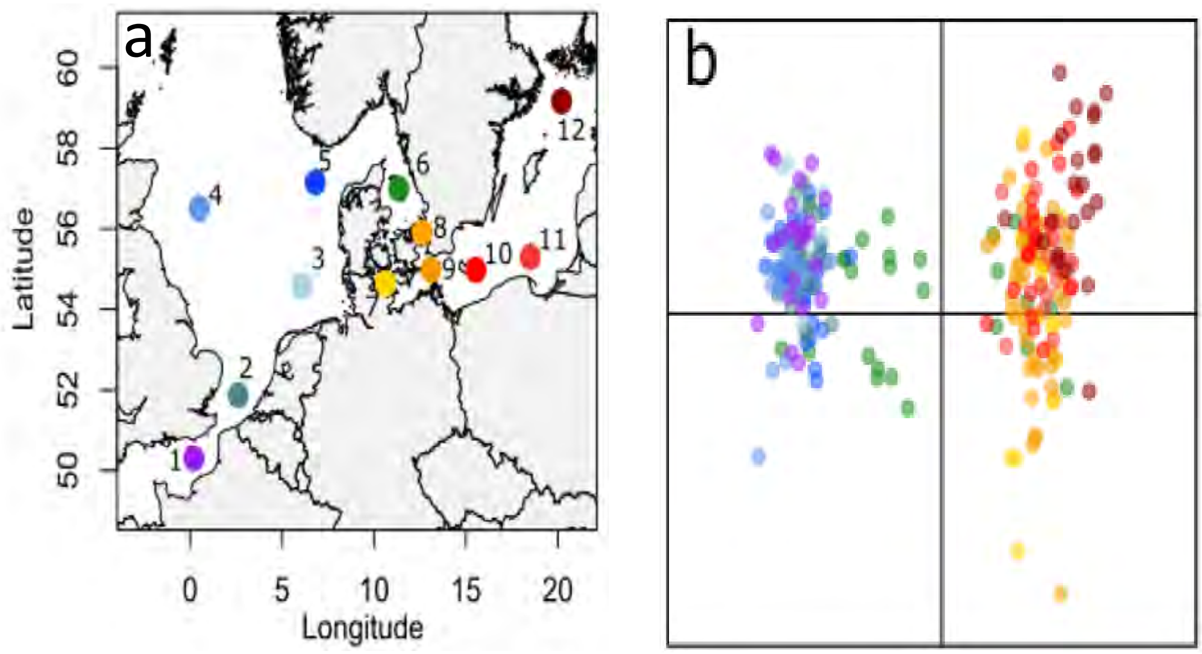

Figure 7.4. Geographical sampling of turbot in a), and corresponding population structure in b) based on principal component analyses. The colours of the individual fish in b) correspond to the colours of the sampling sites in a). The North Sea is clearly separated from the Baltic Sea, whereas individual turbot from Kattegat (green circles) mainly occur in between, but are also matching both the North Sea and the Baltic Sea turbot. The figure is modified from Le Moan (2019).

Collectively, these findings indicate distinct genetic difference between the North Sea and the Baltic Sea. Skagerrak and Kattegat appear to be hybrid zones, while turbot occurring in the Kattegat also occasionally match the genetic structure of both the North Sea and the Baltic Sea. Less is known about the genetic composition of turbot in the Skagerrak, although Nielsen *et al.* (2004) reported a cline in genetic differentiation between the Skagerrak and the North Sea.

The genetic evidence is largely consistent with observation of turbot distribution from bottom trawl surveys in the North Sea, Skagerrak, Kattegat and the Baltic Sea. Five different survey series were included in the analysis (Fig. 7.5). Three of these surveys are available in the DATRAS database hosted by ICES, namely the beam trawl survey (BTS), the North Sea International Bottom Trawl Survey (NS-IBTS), and the Baltic International Trawl Survey (BITS). The last two surveys (TN and TOR) are Danish national surveys that specifically cover Division 3a.

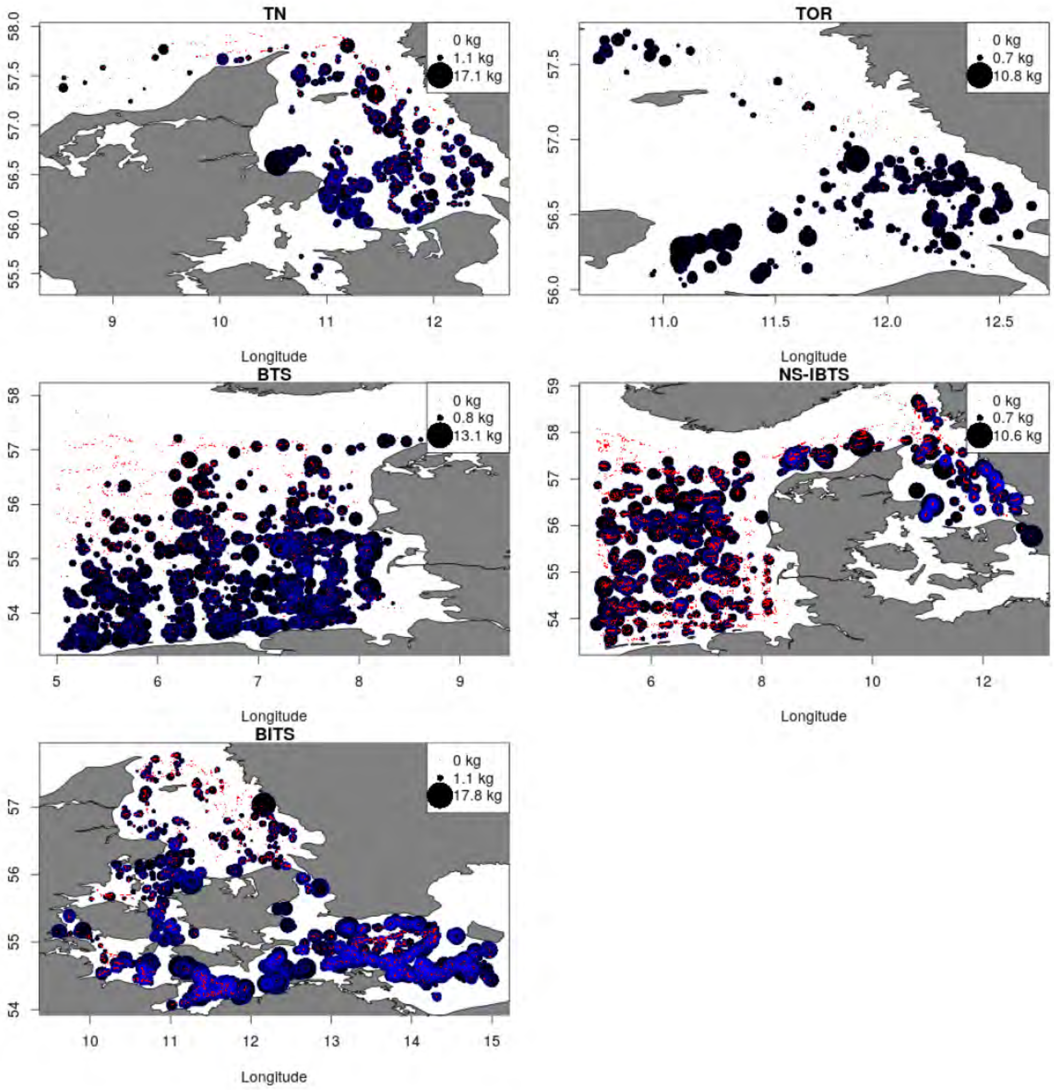

Figure 7.5. Surveys covering ICES Area 3.a. including the beam trawl survey (BTS), the North Sea International Bottom Trawl Survey (NS-IBTS), and the Baltic International Trawl Survey (BITS). The last two surveys are Danish national surveys that target sole (tunge, TN) and cod (torsk, TOR) and cover Division 3a.

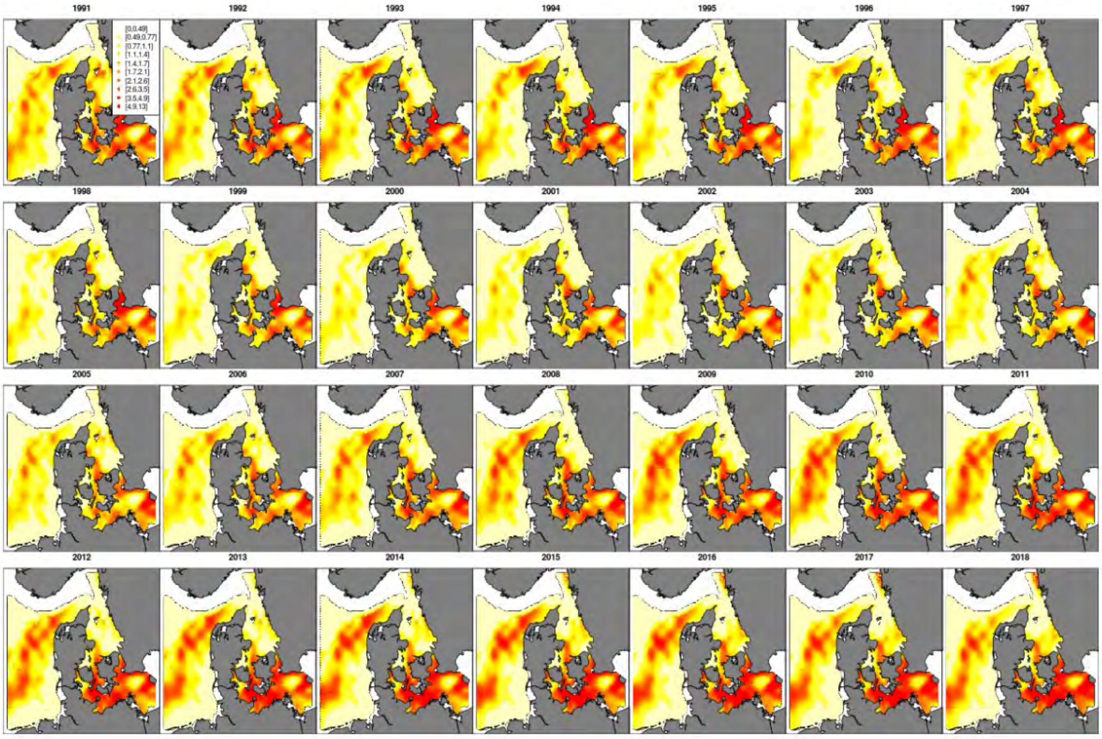

Figure 7.6. Combined survey data for turbot (Figure 7.5) in quarter four covering the North Sea, Skagerrak, Kattegat and the Baltic Sea.

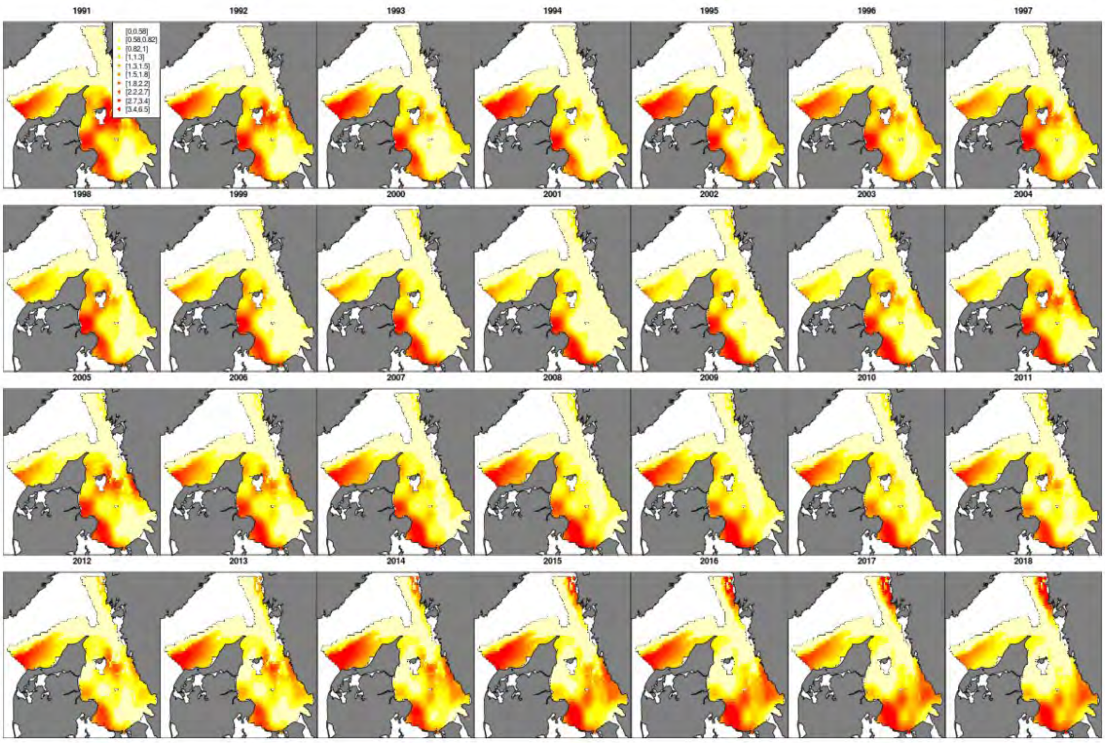

Figure 7.7. Combined survey data for turbot (Figure 7.5) in quarter four covering ICES Area 3.a. Highest turbot abundances occur near the boundaries to the neighbouring areas.

Both genetic and survey data indicate a separation of turbot populations in the North Sea and Baltic Sea through ICES Area 3.a., in particular through Kattegat, where a hybrid zone and relatively low abundances of turbot are observed.

7.1.2 Conclusion and recommendation

The current separation of the turbot into stocks does not seem to reflect its actual distribution. It is the recommendation of this group to propose turbot in Division 3a would be to the stock identity working group (SIMWG) for further discussion on possible merge of the Skagerrak part of the stock with the North Sea stock and the Kattegat part with the Baltic Sea stock.

7.2 Issue list

The following issues expressed by Clara Ulrich on the assessment of turbot in ICES Area 3.a. were addressed:

a) There is need for a closer description of the spatial distribution of landings (ICES rectangle, depth) in relation to the coverage of the survey data.

b) The spiked Dutch landings from 1976–1980. Do they appear to be missing from North Sea landings, or are the Dutch landings still questionable?

c) Do sampled water depth in IBTS and BITS align with the water depths at which turbot are landed?

Issue a)

The analyses related to issue a) targeted the Danish fisheries, because this fishery provides the majority of the landings compared to other involved countries. The purpose was to examine if there is a spatial overlap between commercial landings and survey data. Available data included VMS data from the Danish commercial fishery on turbot for vessels above 15 meters for the years 2005–2011 and vessels above 12 meters from 2012 and onwards. For 2005–2011, VMS coverage was about 55%, whereas it increased to approximately 80% after 2011. For each year, landings were summed for Skagerrak and Kattegat. The analysis covered 2005–2018 and results are presented in Figure 7.8 as kg year^{-1}. Landings included the beam trawl, demersal trawl, gillnet and Danish Seine/anchor-dragging fishery. Recreational landings are unknown and are not included. Landings predominantly originated from the southwestern part of Skagerrak, between Hanstholm in Denmark and Kristiansand in Norway. The landings are adjacent to the boarder of the Central North Sea, Division 27.4.b, and are relatively consistent between years. In Kattegat, landings are less aggregated with relatively high landings in the southern parts of Kattegat, southeast of Anholt and east of Ebeltoft in Denmark. Landings here are more variable between years. There are few commercial turbot landings in the Norwegian Trench Subdivision 27.3.a.20 and between Jutland, Læsø and Anholt Subdivision 27.3.b.21. Data on the landings are overlapping survey data. Specifically, the spatial distribution of IBTS and BITS in Skagerrak and Kattegat during 2005–2018 includes areas with both high and low levels of turbot landings (Figure 7.9). This is further supported by the additional surveys included in Figure 7.5. Thus, surveys are covering areas with significant turbot landings.

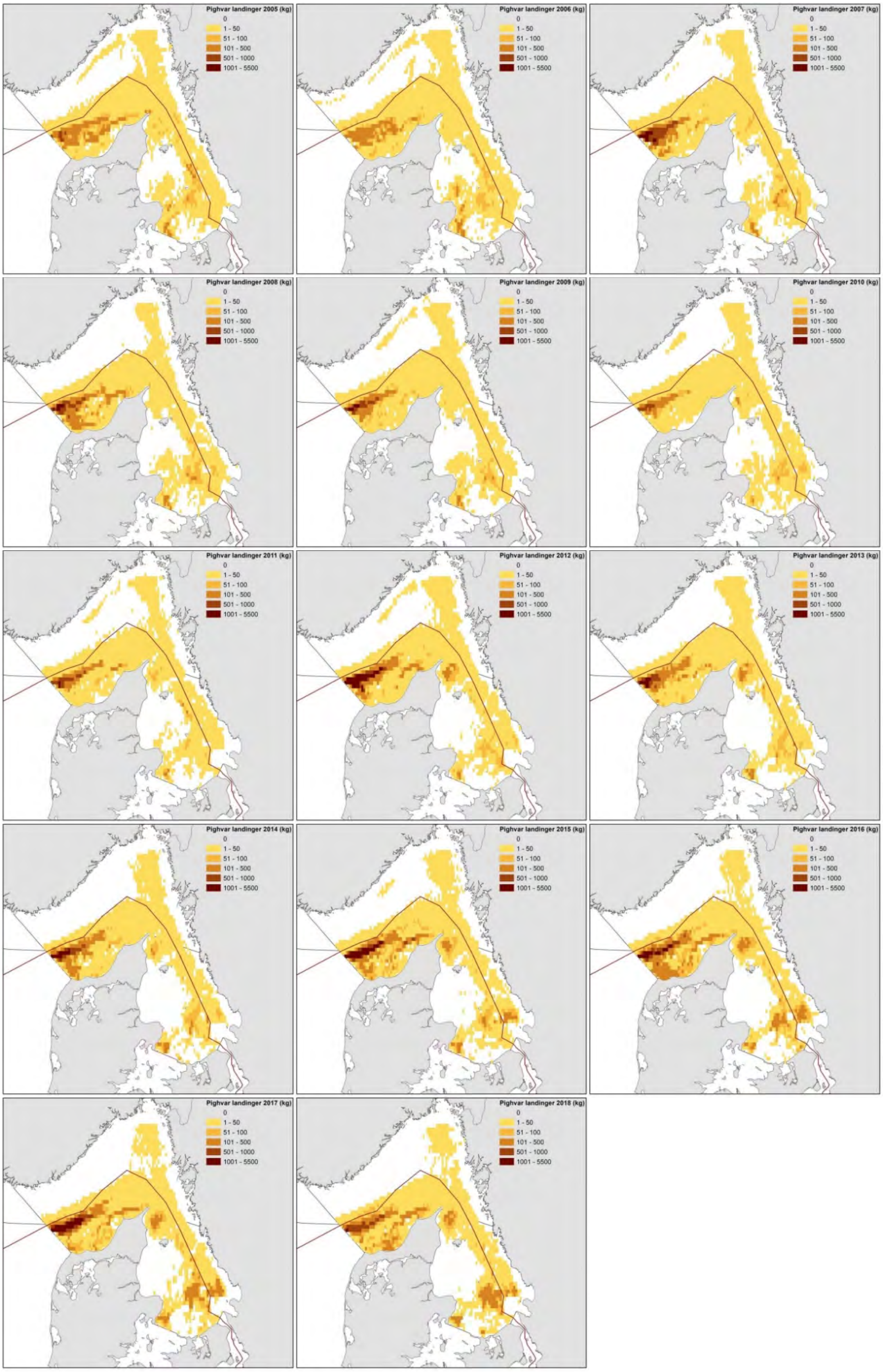

Figure 7.8. Locations of Danish commercial turbot landings in Denmark from 2005–2018. The Danish landings constitute the majority of the turbot landings in ICES Area 3.a. and are mainly aggregated in southwestern Skagerrak and southern Kattegat.

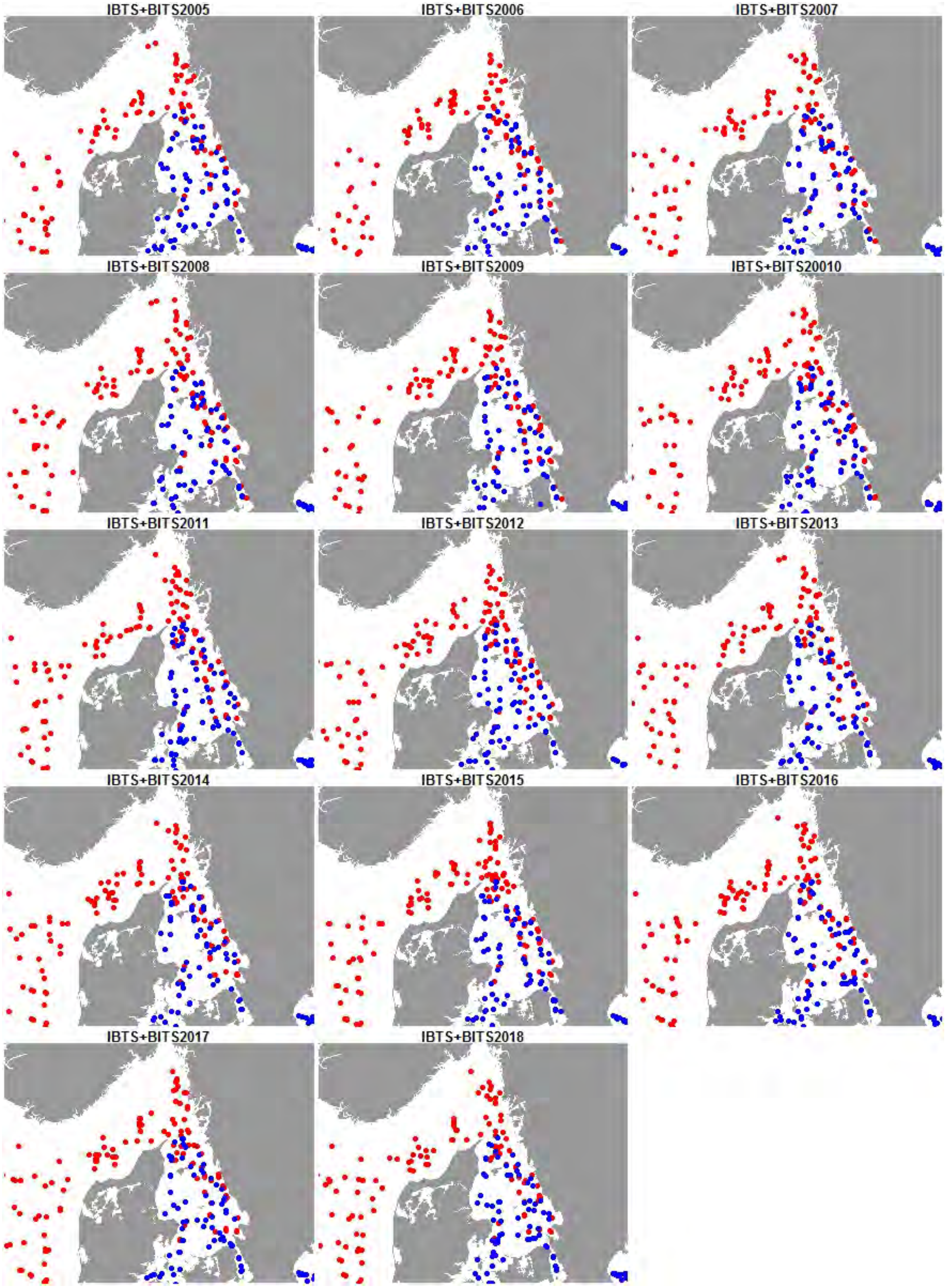

Figure 7.9. Locations of two international bottom trawl surveys, IBTS (red circles) and BITS (blue circles) in Skagerrak and Kattegat between 2005–2018. The survey data overlap the areas of turbot landings (Figure 7.8).

Issue b)

Over the years 1976–1979, the Netherland reported landings between 87–389 tonnes in ICES Area 3.a.; a dramatic increase compared to reported landings in other years (Figure 7.10). The landings could potentially originate from the North Sea, and might be missing from the landings reported from the North Sea over the same years (1976–1979). To examine the issue, landings from the North Sea (Area 27.4) were plotted and compared across years (Figure 7.11). Although the Dutch landings approached 389 tonnes in ICES Area 3.a. (in 1976–1979), the Dutch landings in the North Sea in the same period were about 10-fold larger (3000–4000 tonnes). This means that it is not possible to detect if the large Dutch landings observed in 27.3.a. across the years 1976–1979 were missing from the North Sea landings over the same years. Stakeholders report that this period corresponds with the introduction of ITQs in the North Sea, and consequently a reduction in the fishing opportunities for Netherlands vessels in the North Sea, as a result some of these vessels temporarily moved their effort into Division 3.a.

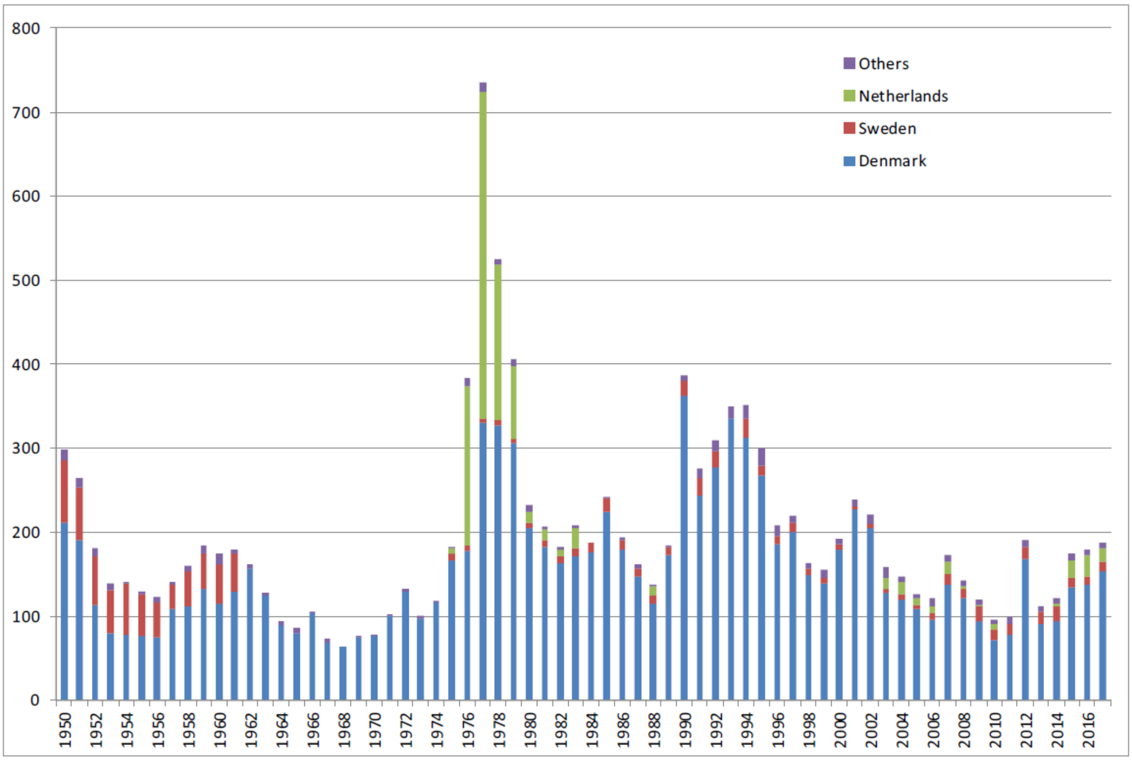

Figure 7.10. Country specific landings from Skagerrak and Kattegat (ICES Area 3.a.) between 1950 and 2017.

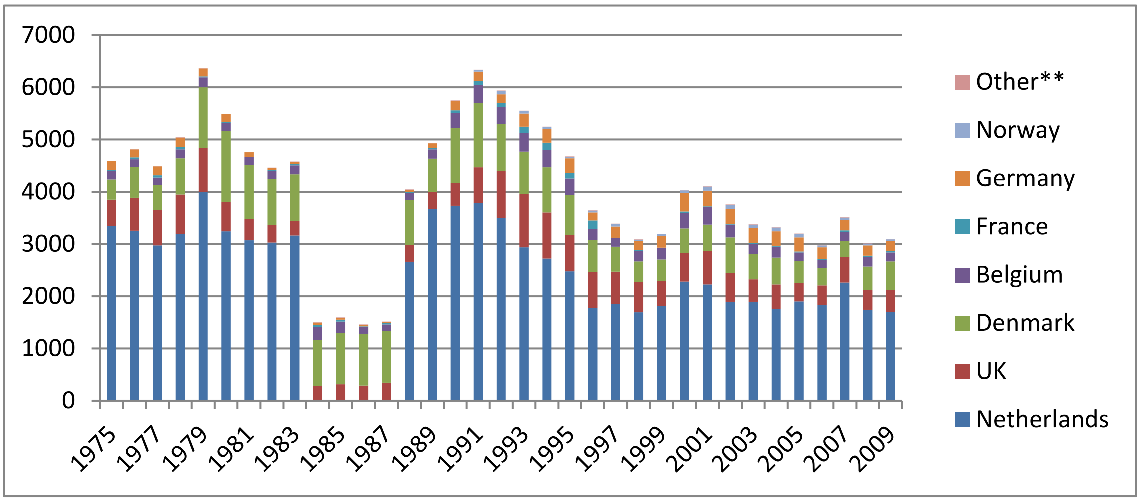

Figure 7.11. Country specific landings from the North Sea (Division 27.4) between 1975 and 2009.

Issue c)

It was unknown if the sampled water depths in the IBTS survey and the BITS survey aligned with the water depths from which turbot is landed. To address the issue, a comparison was made involving the water depths at which IBTS and BITS are conducted in Skagerrak and Kattegat, and the water depths of the Danish commercial fishery in the same waters. The comparison targeted Danish turbot fisheries, because Danish landings constitute the majority of the turbot landings in ICES Area 3.a. The analysis covered the years 2005–2016. Water depths of the IBTS surveys and the BITS surveys were narrowed down to coordinates in Skagerrak and Kattegat. Using VMS data, turbot landings of the Danish commercial fishery and water depths of ICES c-squares (0.05 degree) were derived. The data included turbot landings from vessels >15 meters until year 2011 and >12 meters after year 2011. Data were plotted with water depths on the x-axis and surveys and landings on the y-axis (Figure 7.12). The analysis revealed overlap between the water depths covered by the two surveys (IBTS and BITS) and the water depths from which turbot are landed in the Danish commercial fishery.

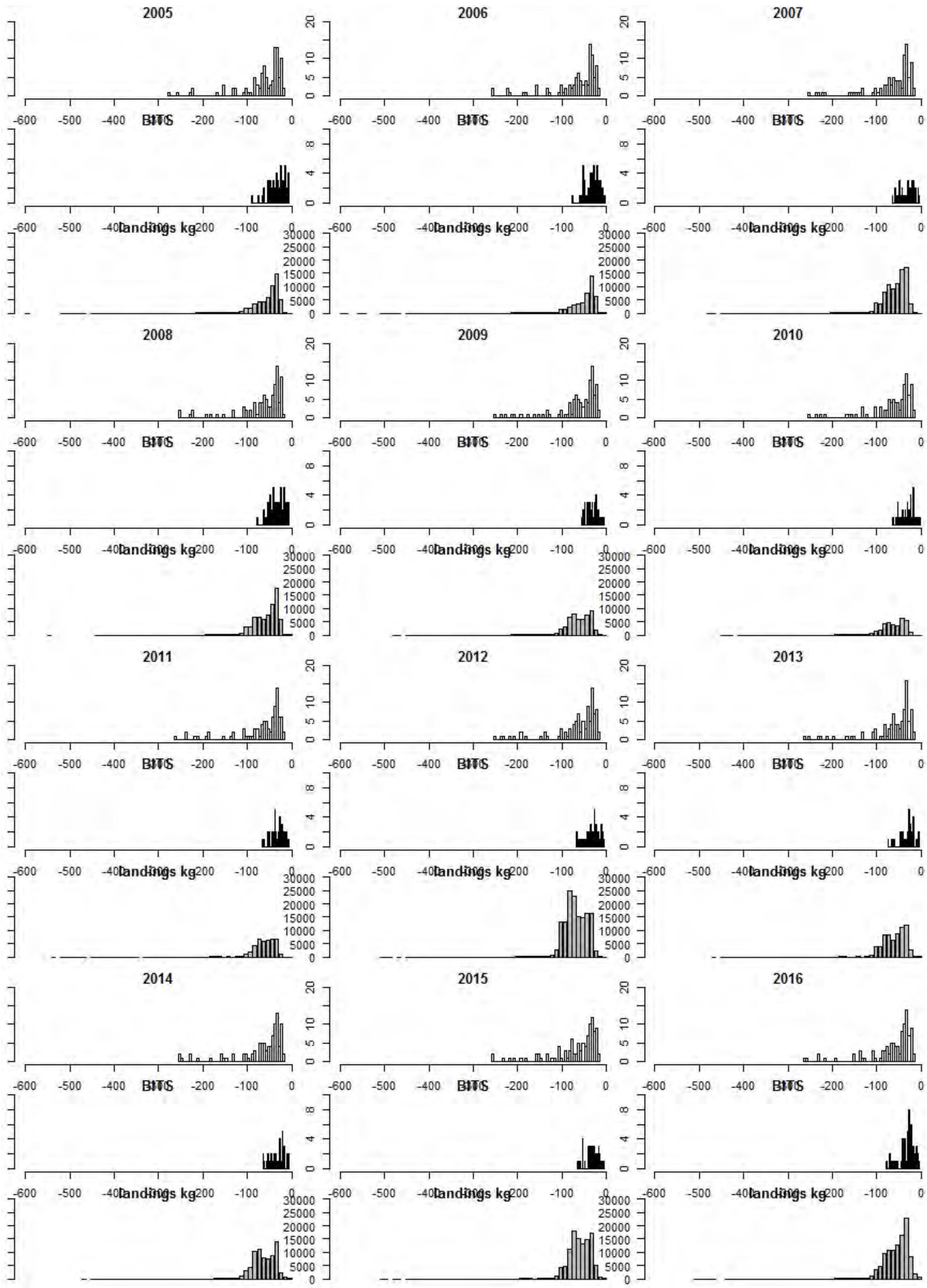

Figure 7.12. A comparison of water depths associated with surveys and landings of turbot. The graph shows the water depth distribution in IBTS surveys (1st, 4th, 7th, 10th row), BITS surveys (2nd, 5th, 8th, 11th row) and turbot landings in the Danish fishery. For the landings data, the label for the x-axis has been omitted, but it goes from -600–0 meters (3rd, 6th, 9th, 12th row). The graphs reveal overlapping water depths associated with surveys and turbot landings.

7.3 Scorecard on data quality

No scorecard was developed for this report.

7.4 Multispecies and mixed fisheries issues

In ICES Division 3a, turbot is mainly caught as bycatch in the trawl, trammelnet and gillnet fisheries, although due to its high economic value, targeted fisheries might occur in specific areas and seasons.

7.5 Ecosystem drivers

No ecosystem drivers were identified for this report.

7.6 Stock assessment

7.6.1 Catch–quality, misreporting, discards

There are three sources of catch information: (i) official nominal catches: each of the 20 ICES Member Countries fishing in FAO Area 27 are submitting their annual landings into a common database, and (ii) Intercatch, a detailed database of landings, discards, age/length information that is available by country, fleet, quarter, and subdivision. Data for turbot in 3a are available in InterCatch for the period 2002–2018 and include landings, discards and length distributions. Available landings in InterCatch by country are shown in Figure 7.13. Denmark is responsible for most of the landings, followed by the Netherlands, Sweden, and Norway with significantly less landings. There are negligible landings from Germany and UK for some years. Further information about the catch of turbot in Division 3a are given in the Working Document in Annex 2.5.1.

Discard information is available in InterCatch for the period 2002–2018. There is a relatively good coverage (mostly around 60–80%) of the landings of the Danish and Swedish fleets in Skagerrak, but Kattegat fleets seem to be less sampled (50–60%, Figure 7.17).

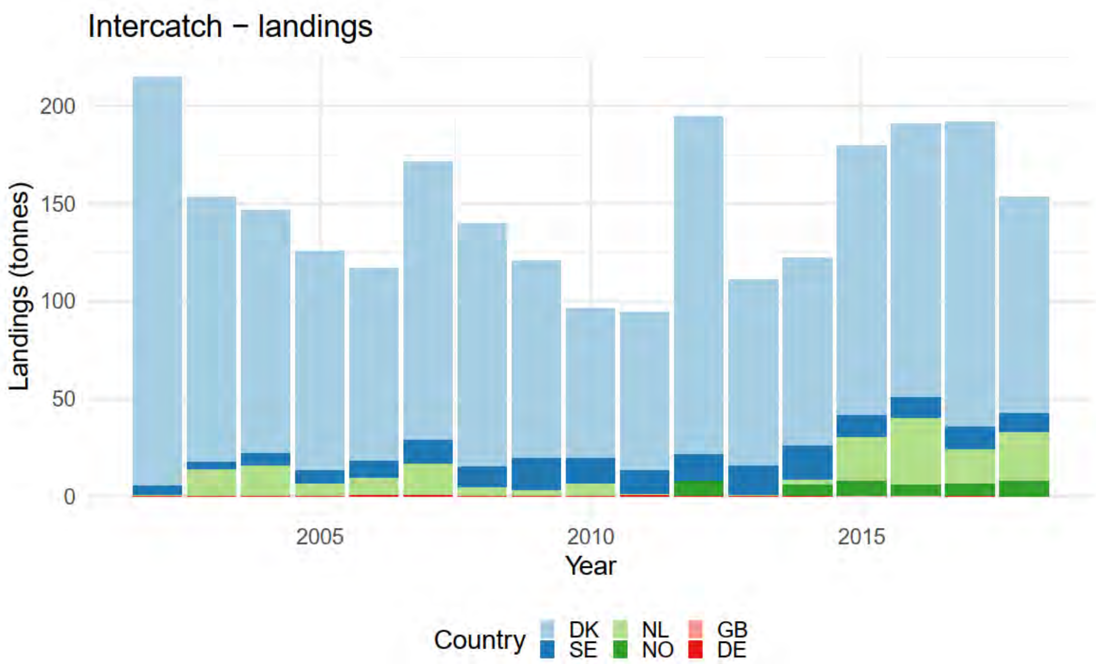

Figure 7.13. InterCatch landings by country in tonnes for turbot in Division 3a.

Table 1. Turbot landings in ICES Area 3.a. (tur.27.3a). Total landings (tonnes) and average percent of landings per country in the years 2015–2018.

Country	Total (2015-2018)	%
DK	543	75.87
NL	98.89	13.82
SE	43.72	6.11
NO	28.79	4.02
DE	0.893	0.12
GB	0.372	0.05

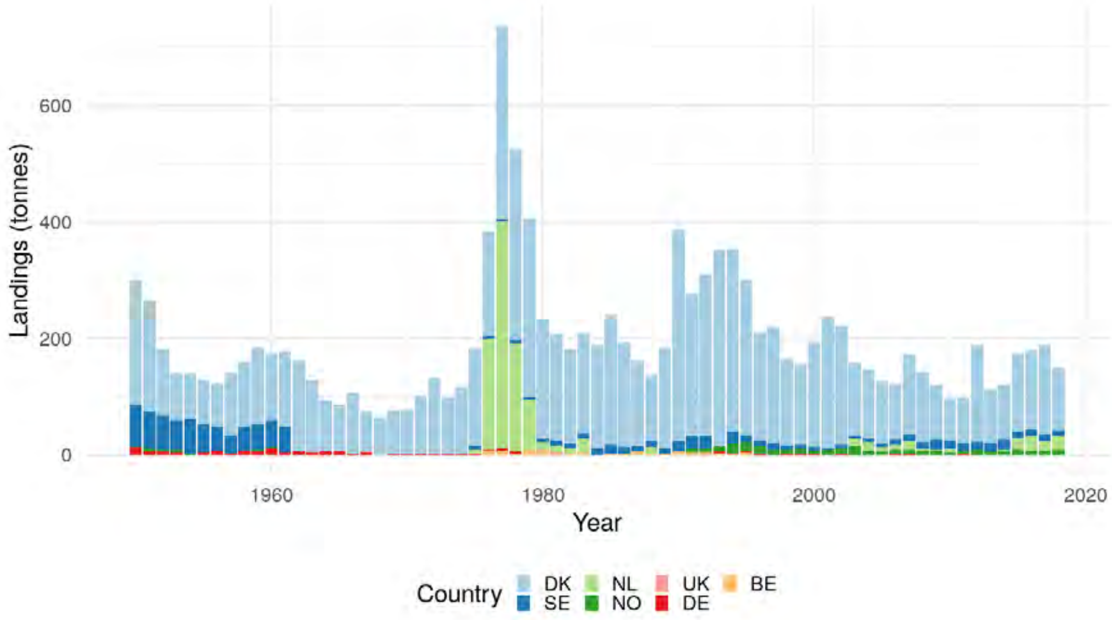

Figure 7.14. Official turbot landings (in tonnes) by country in Division 3a for Denmark (DK), the Netherlands (NL), United Kingdom (UK), Belgium (BE), Sweden (SE), Norway (NO), and Germany (DE).

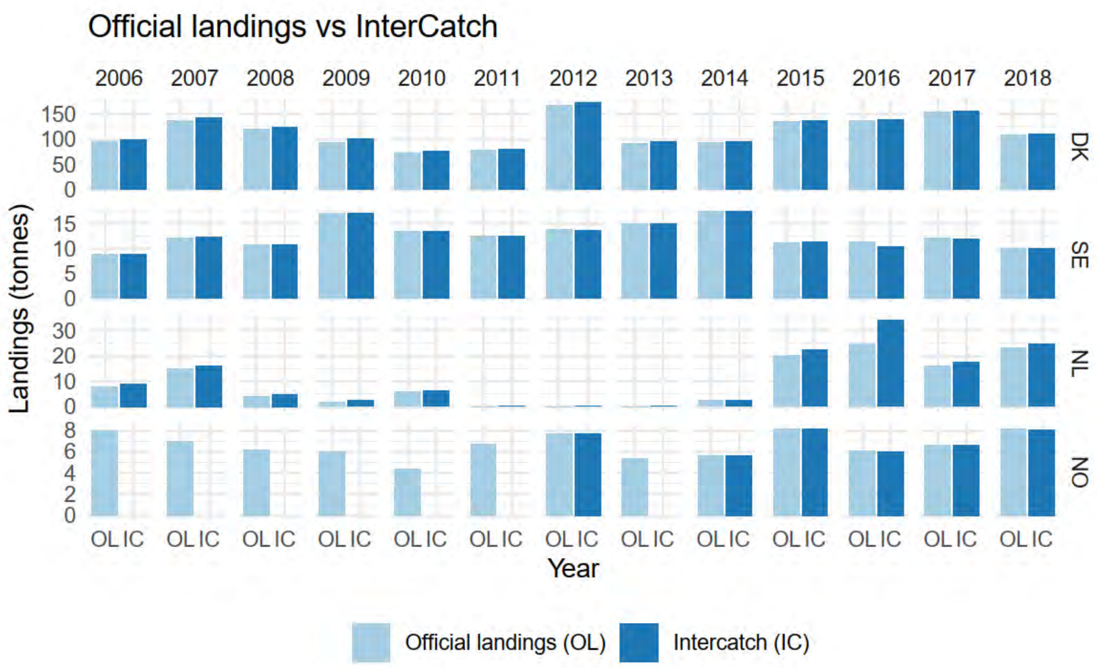

Figure 7.15. Comparison of landings (in tonnes) reported in the Official Nominal Catches (OL) and in InterCatch (IC) for Denmark (DK), Sweden (SE), the Netherlands (NL), and Norway (NO). The y-axes are in different scale for each country. There are no data submitted to InterCatch for the years before 2012 and for 2013.

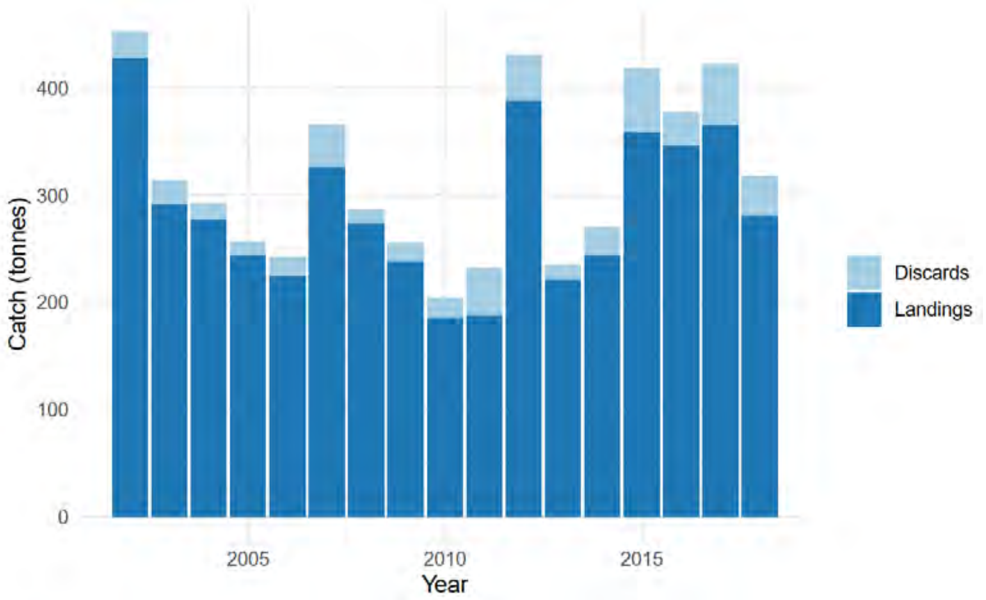

Figure 7.16. InterCatch landings and (imported and raised) discards of turbot in Division 3a for the period 2002–2018.

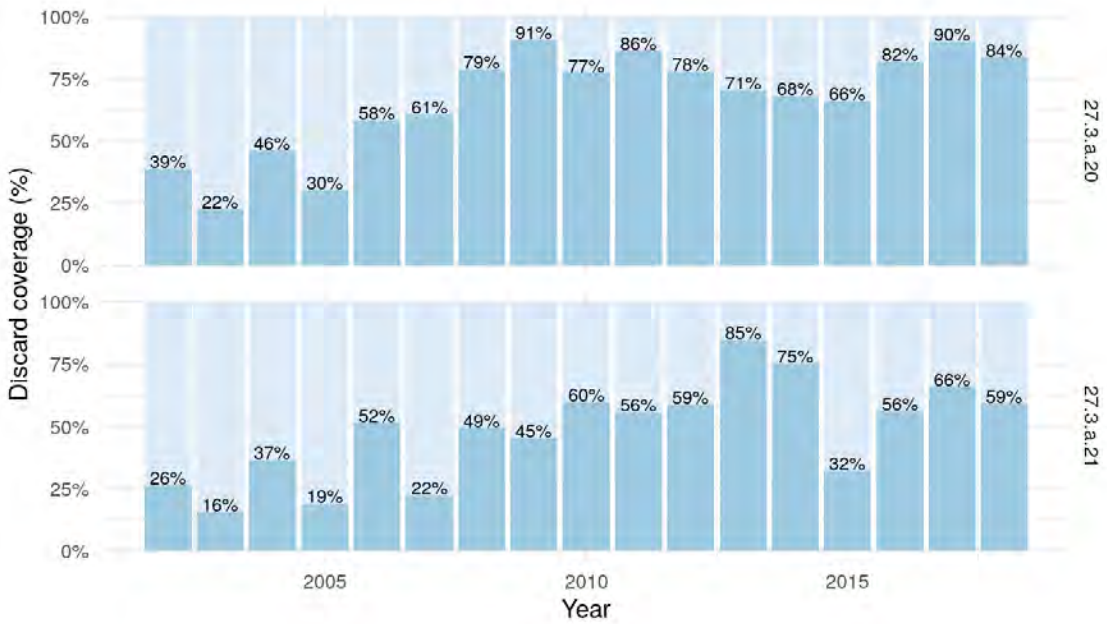

Figure 7.17. Percent of landings that are reported with corresponding discard information in the Skagerrak (top) and Kattegat (bottom).

7.6.2 Surveys

Getting accurate survey indices of abundance for Turbot in ICES Area 3.a. is problematic, because it is a relatively rare species, because most of the available trawl surveys do not cover the area very well, and because all available surveys are not designed for turbot. The present high resolution standardized abundance maps and indices are based on five different bottom trawl surveys that were combined using a generalised additive model. The study area included a part of the North Sea and the Baltic Sea, as the data showed high abundance of turbot close the borders of Division 3a in the west and east. The observations from the surveys were corrected to down-weight smaller individuals that are not selected by the commercial fleets, so that the resulting standardised biomass index corresponds to the exploitable biomass. A detailed description of the input data, the assumptions, and the model are given in the survey index Working Document in Annex 2.5.2.

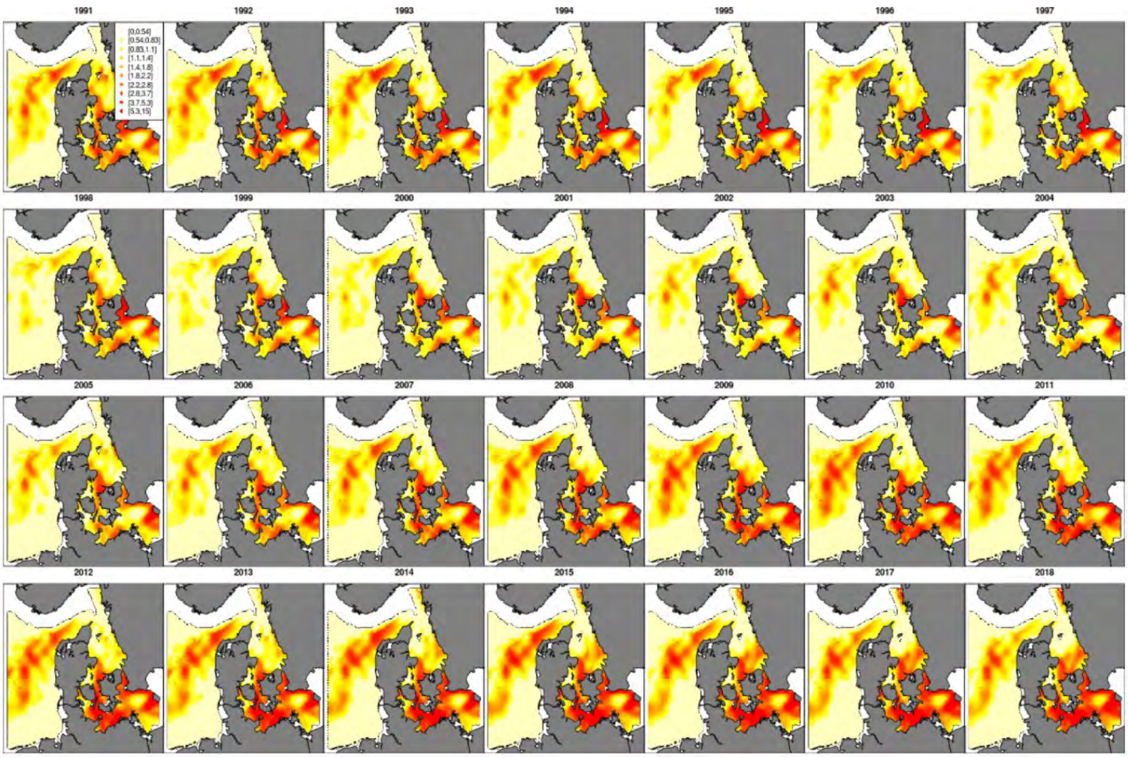

Figure 7.18. Estimated spatial distribution of turbot in quarter 1 (January–March) for the years 1991–2018 The maps show the distribution in absolute values and the colours are comparable between years.

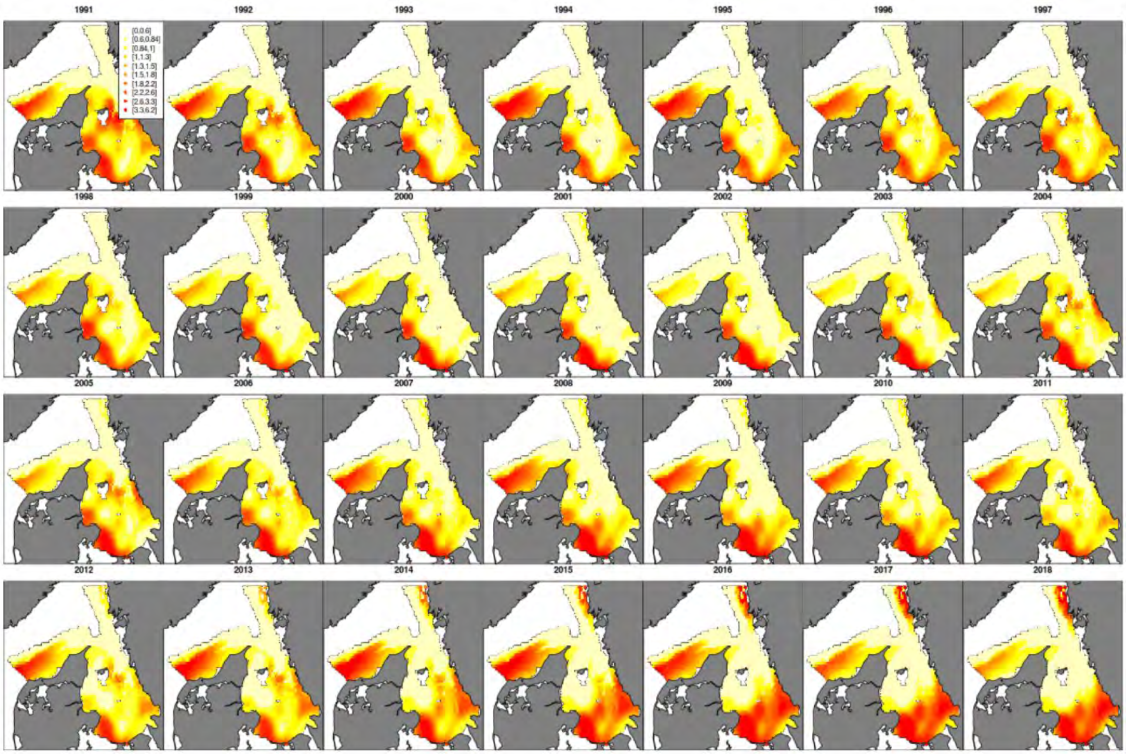

Figure 7.19. Absolute maps Q1 across years (1991–2018) (ICES Area 3.a. only).

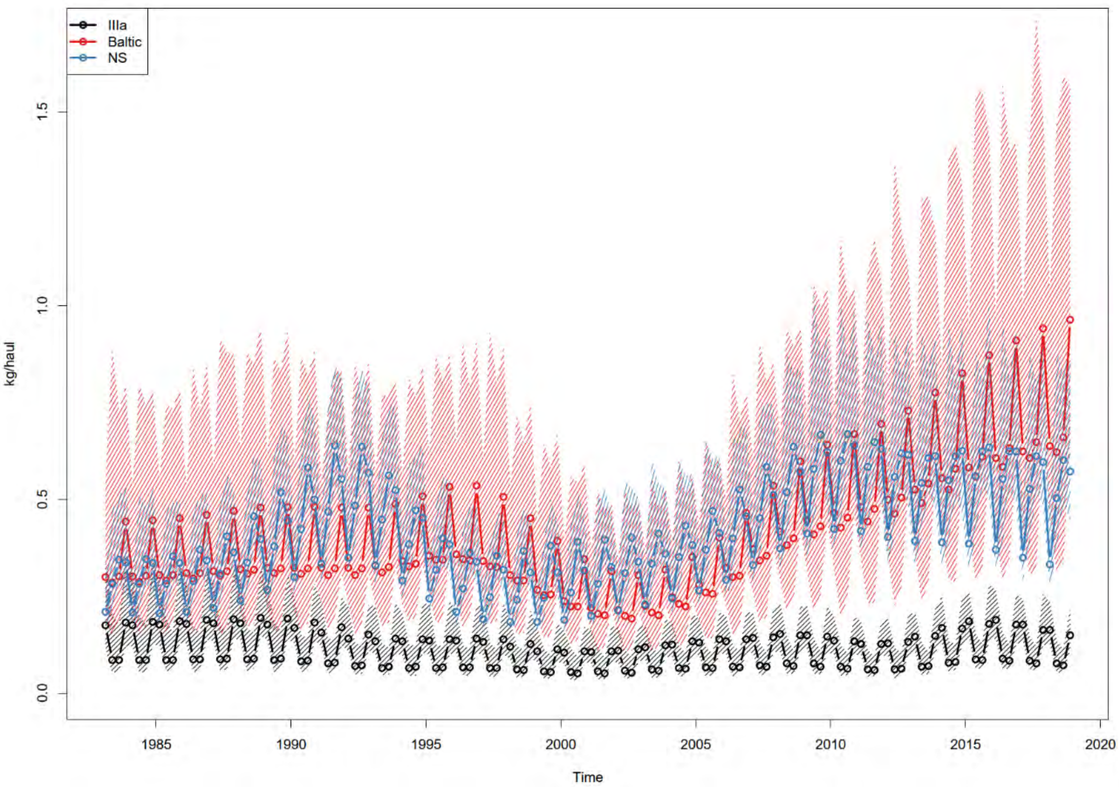

Figure 7.20. Standardized catch rate over time (quarterly time steps) by area (average haul within area). Shaded areas indicate 95% confidence intervals.

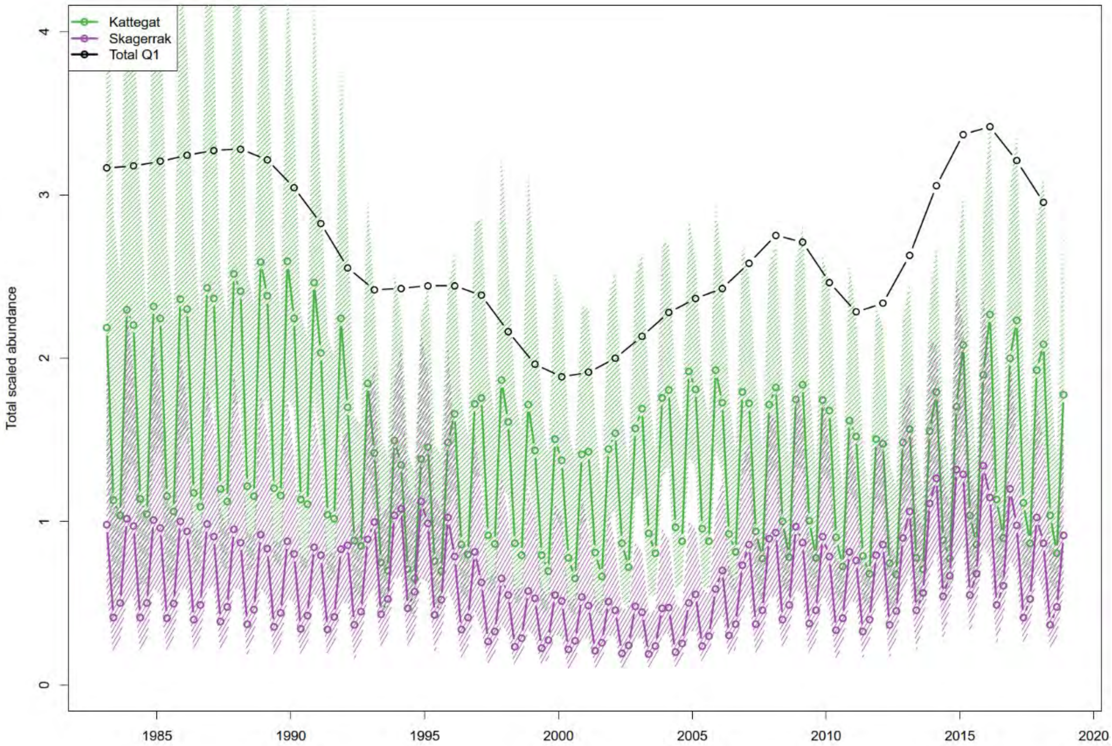

Figure 7.21. Total scaled abundance by subarea within ICES Area 3.a. Shaded areas indicate 95% confidence intervals.

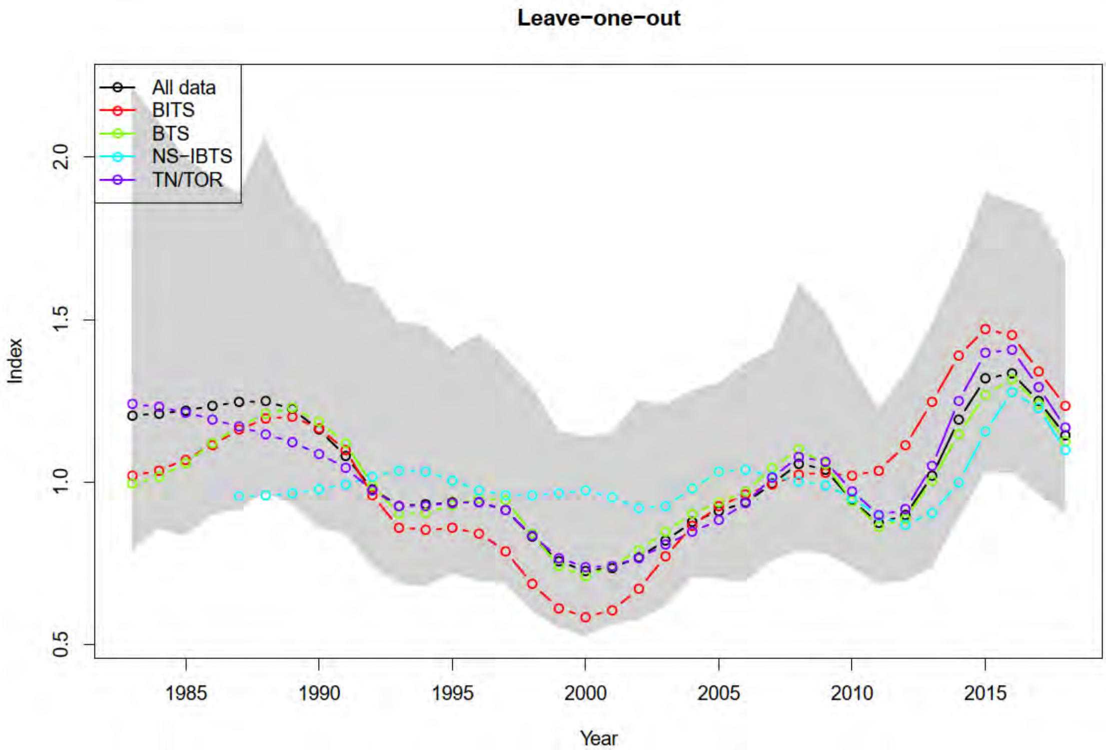

Figure 7.22. Leave-one-survey-out analysis of the standardised quarter 1 biomass index of turbot in Division 3a.

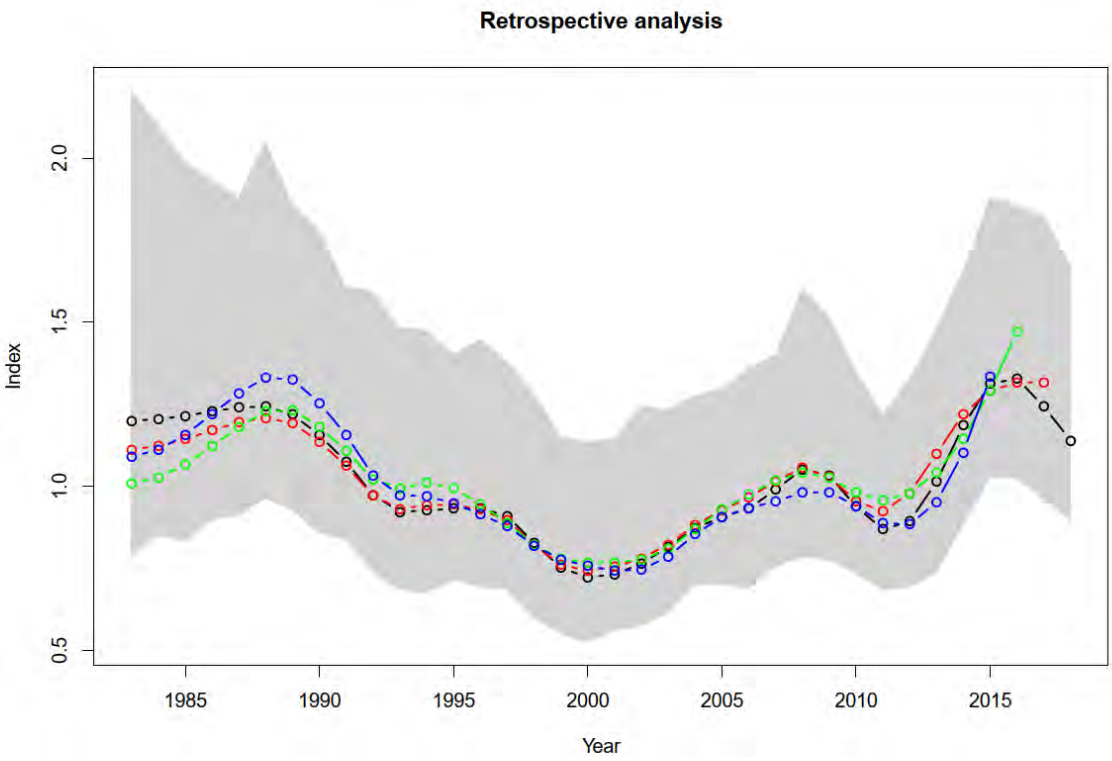

Figure 7.23. Retrospective analysis of the standardised quarter 1 biomass index of turbot in Division 3a.

7.6.3 Weights, maturities, growth

Little information is available concerning turbot in ICES Area 3.a., whereas considerably more information is available concerning turbot in the North Sea and the Baltic Sea. Growth curves of males and females diverge markedly from about age three and onwards, females growing larger than males in both marine areas (Molander, 1964; Jones, 1974; Stankus, 2003). Females may approach 100 cm in body length, but fish larger than 75 cm (12.5 kg) are very rare in ICES Area 3.a. The maximum length of males approach 50 cm. In the North Sea, evidence suggests that 50% of the females are mature when they reach 46 cm in body length, and they are all mature at approximately 55 cm (Jones, 1974). In comparison, Stankus (2003) found that all females are mature when they reach 28 cm in body length in the Baltic Sea. Females in the Baltic Sea often carry about two million eggs kg^{-1} (Stankus, 2003), whereas females in the North Sea carry about one million eggs kg^{-1} (Jones, 1974). Turbot parameters of the von Bertalanffy growth equation differ between the North Sea and the Baltic Sea, including female L_∞, which is 64.8 cm and 53.5 cm in the North Sea and Baltic Sea, respectively. Corresponding parameters for ICES Area 3.a. have not been identified, but the parameters for ICES Area 3.a. could be intermediate to the parameters originating from the North Sea and Baltic Sea. During the first years of life, females grow up to 8-10 cm per year. Females older than ten years continue to grow about 1–2 cm per year.

7.6.4 Assessment model

The surplus production model in continuous time (SPiCT, Pedersen and Berg, 2017) was considered, as it makes use of the available time-series of catch and survey biomass index and estimates stock status and reference points.

Four main scenarios were presented (See Annex 2.5.3), differing in the time periods of catch and index time-series:

Scenario 1: catch and index from 2002–2018. Period of the best available catch information from InterCatch.

Scenario 2: catch and index from 1983–2018. Period where both catch and survey index are available.

Scenario 3: catch from 1975–2018 and index from 1983–2018. Period that includes the high catch observations from the Netherlands.

Scenario 4: catch from 1950–2018 and index from 1983–2018. Historical catch time-series.

Sub-scenarios that aimed to fine tune the assessment and improve the model fit using additional information or different prior distribution of model parameter, such as the shape parameter (n) and the depletion level in the beginning of the time-series.

The uncertainty of the estimates was relatively high and diagnostics of the residuals and retrospective analysis, indicate some issues in most of the considered scenarios.

Since turbot in 3a is not receiving catch advice, only the stock status is estimated based on the best available model. The uncertainty is taken into account following the ICES guidelines for category 3 and 4 stocks developed at WKLIFE (ICES, 2020) for the cases where SPiCT is used. In such cases instead of the median (50th percentile) estimates, a lower percentile is used for the relative biomass B/B_{MSY} and a higher percentile is used for the relative fishing mortality F/F_{MSY}.

Scenario 3 is proposed to estimate the stock status. The selected run is using the catch time-series from 1975–2018, the index time-series from 1983–2018 and assumes Shaefer model, i.e. shape parameter is fixed to be equal to 2. Furthermore, there are three prior distributions used, on the depletion level in the beginning of the time-series ($\log(B/K(1975)) \sim N(0.5, 0.5)$, and on the two ratios of the uncertainties between states and observations (α: ratio between index and biomass uncertainty and β: ratio between catch and fishing mortality uncertainty). The initial depletion prior was used as without it there was an unrealistic perception of the status of the stock in the beginning of the series. Such a behaviour is typical in production models when there is a period in the beginning where only catch information is available.

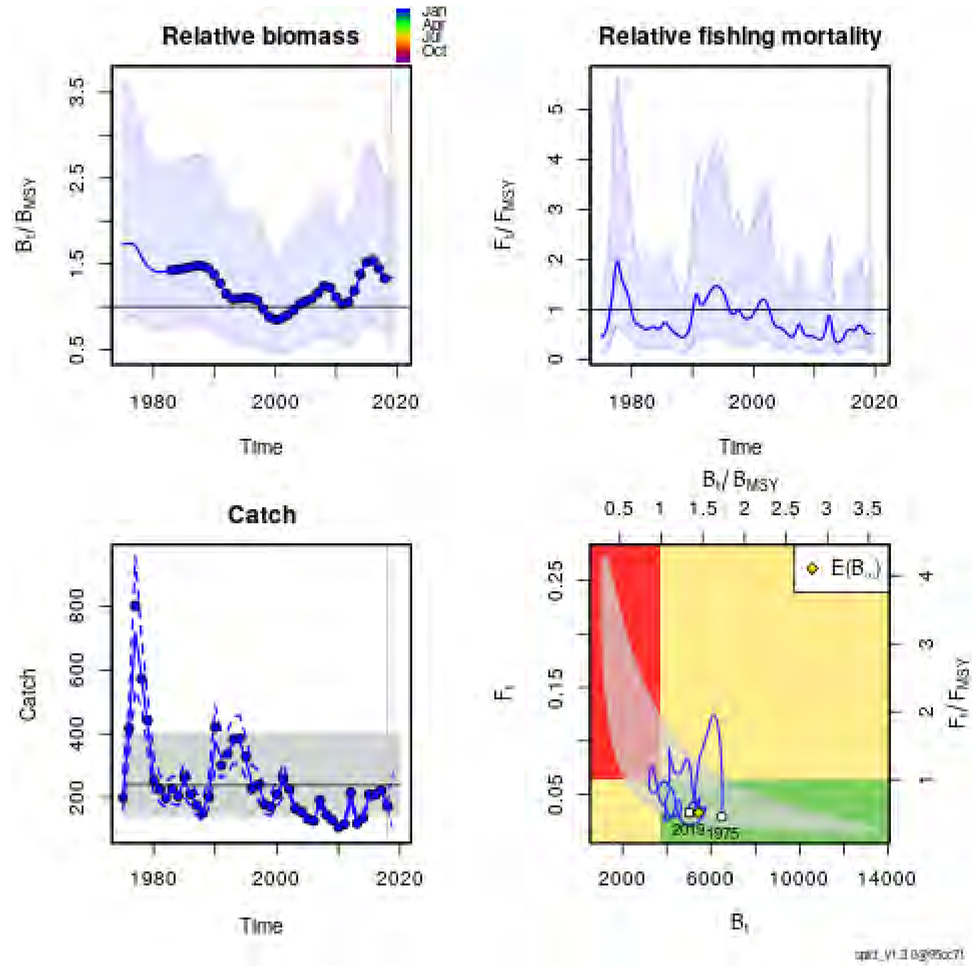

Figure 7.24. Results of the proposed assessment for turbot in division 3a, relative biomass (top left), relative fishing mortality (top right), catch (bottom left) and Kobe plot (top right). The points are the observations, blue solid lines show the median estimates, shaded areas and dashed lines show 95% confidence intervals. Horizontal lines show the reference points, equal to 1 for F/F_{MSY} and B/B_{MSY} and equal to the estimated MSY reference point for the catch. Grey shaded areas in the catch plot and the Kobe plot show 95% confidence intervals around the reference points.

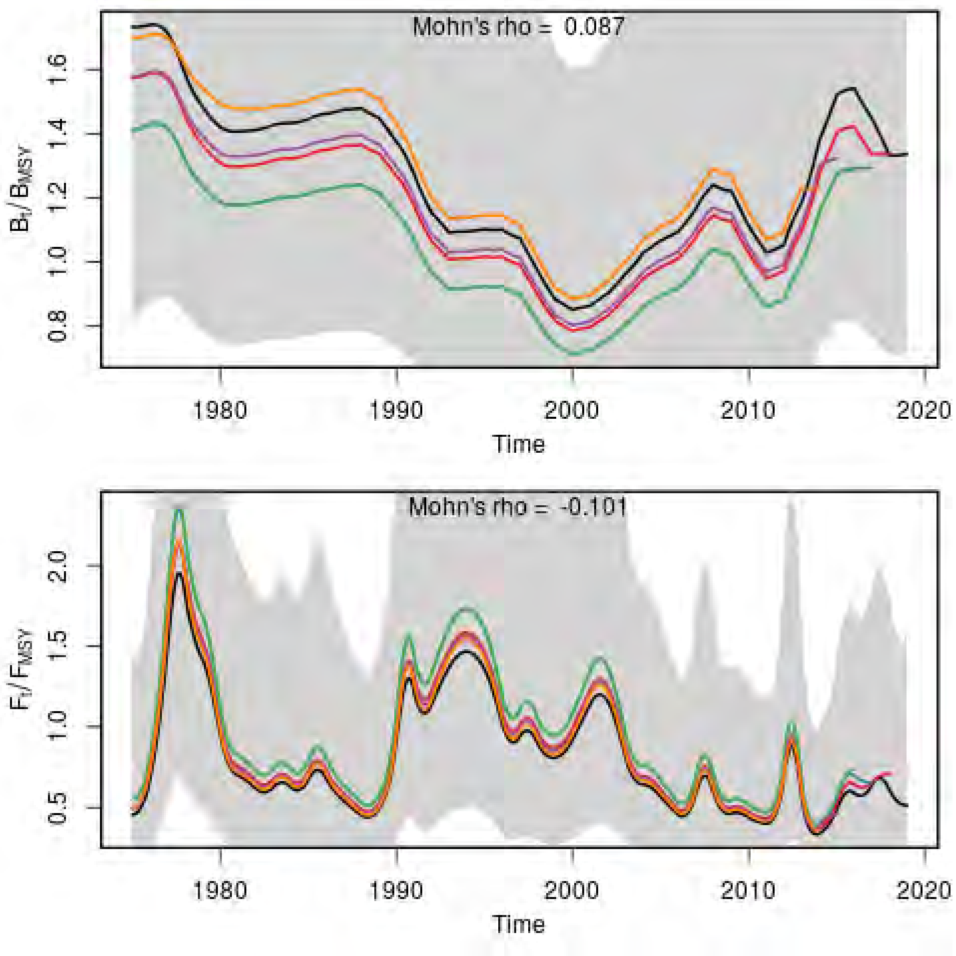

Figure 7.25. Retrospective analysis of B/B_{MSY} (top) and F/F_{MSY} (bottom) turbot in Division 3a. Mohn's rho was calculated to give an indication of retrospective bias and is shown inside each panel.

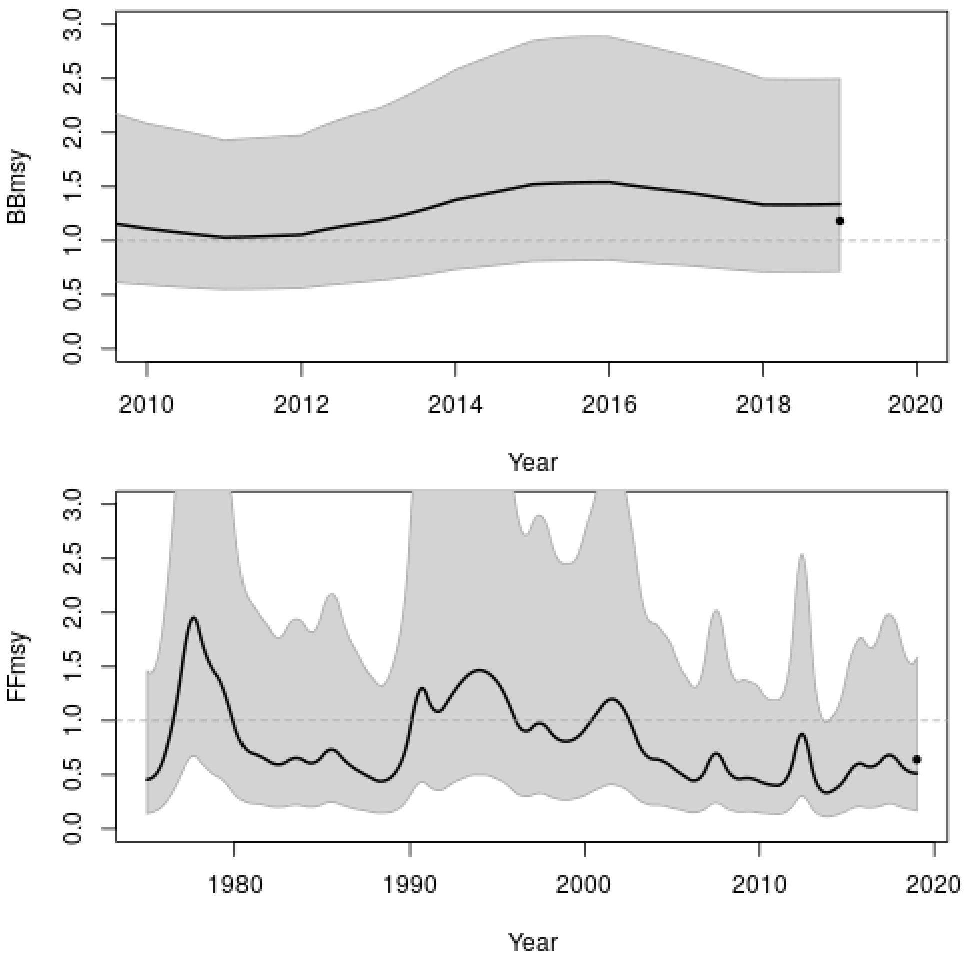

Figure 7.26. Main results for the relative biomass and fishing mortality. The black dots indicate the stock status of turbot in Division 3a.

7.7 Short-term projections

There were no short-term projections produced for turbot in Division 3a.

7.8 Appropriate Reference Points (MSY)

No appropriate reference points are proposed for turbot in Division 3a, apart from the relative MSY reference points defined by SPiCT.

7.9 Future research and data requirements

7.9.1 Stock identity

The major issue about turbot in 3a is that it appears not to be a separate stock in the area. All the evidence presented during the benchmark, namely genetic information, spatial distribution of the catches and estimated distribution from the scientific surveys, indicate that the turbot in Skagerrak would more appropriately be considered together as one stock with the North Sea. Similarly the Baltic and Kattegat turbot stocks could be merged. Therefore, further research and gathering more information (genetics, life-history parameters) in the area are necessary to clarify the stock identity issues for turbot in the greater North Sea and inner Danish waters.

7.9.2 Scientific surveys

There were some issues raised during the benchmark about the appropriateness of the surveys used to calculate the biomass index for turbot. Especially, with respect to the gear and the speed during trawling. Further investigations are necessary to answer such questions and research into ways of taking into account catchability problems when calculating the biomass index.

7.9.3 Assessment

The attempts for an analytical assessment using the surplus production model SPiCT in this benchmark did not lead to an acceptable assessment for providing catch advice. The uncertainty was high in the estimated relative fishing mortality and relative biomass, but more importantly there were issues with the residual diagnostics, especially for the biomass index. SPiCT was not able to fit such a biomass index that was calculated by combining observations from several surveys into a spatio-temporal GAM model, leading with estimates that are not independent, but correlated. Future research is needed that will look into relaxing the assumption of independent biomass index observations in SPiCT and allow some correlation structure, e.g. an AR1 process.

7.10 External Reviewers’ comments

The external reviewers’ comments for all stocks are provided in Section 2.

Annex 1: List of participants

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Annex 2: Working Documents

Listed below are the working documents presented at the WKFlatNSCS. They are inserted in full in the following pages of this report:

Sole 4

2.1.1 Development of a combined BTS index of abundance for North Sea sole; Esther Beukhof and Iago Mosqueira.

2.1.2 Stock assessment of North Sea sole (sol.27.4) using the Aarts & Poos (AAP) model; Iago Mosqueira.

Sole 7d

2.2.1 Preparation of catch data for Sole (*Solea solea* L.) in the eastern English Channel (ICES Division 7.d); Lies Vansteenbrugge and Sofie Nimmegeers.

2.2.2 Belgian commercial beam trawl landings data for sole in the eastern English Channel (ICES Division 7.d) and sole in the Bristol Channel and the Celtic Sea (ICES divisions 7.f and 7.g); Klaas Sys, Bart Vanelslander, Sofie Nimmegeers and Lies Vansteenbrugge.

2.2.3 Commercial LPUE from French Otter Trawlers for sol.27.7d stock assessment; Raphaël Girardin.

2.2.4 Young Fish Survey indices for 7.d Sole; Gary Burt, Sally Songer, Lisa Readdy and José de Oliveira.

Sole 7fg

2.3.1 Investigating maturity of Sole (*Solea solea* L.) in the Bristol Channel and Celtic Sea (ICES divisions 27.7.fg); Klaas Sys, Lies Vansteenbrugge, Bart Vanelslander and Sofie Nimmegeers.

2.3.2 Preparation of Catch Data for Sole (*Solea solea*) in divisions 7.f and 7.g (Bristol Channel, Celtic Sea); Sofie Nimmegeers, Lies Vansteenbrugge and Bart Vanelslander.

2.3.3 UK Commercial Index for Bristol Channel (7fg) Sole; Paul J. Dolder, Hayley Bannister, Johnathan Ball and Lisa Readdy.

2.3.4 Development of an index for sole in ICES divisions 7.f and 7.g using the UK quarter 1 South-West ecosystem survey (UK-Q1SWECOS); Lisa Readdy.

2.3.5 Assessment models for sole in the Bristol Channel and the Celtic Sea (ICES divisions 7.f and 7.g); Sofie Nimmegeers, Bart Vanelslander and Lies Vansteenbrugge.

2.3.6 Calculation of appropriate Reference points (MSY) for sole in divisions 27.7f and g; Lies Vansteenbrugge, Klaas Sys, Bart Vanelslander and Sofie Nimmegeers.

Sole 7h–k

2.4.1 Data Evaluation for Sole 27.7h–k; Claire Moore.

2.4.2 Assessment of sole (*Solea solea*) in divisions 7.h–k (sol.27.7h–k); Alexandros Kokkalis.

Turbot 3a

2.5.1 Turbot in Subdivision 3a (tur.27.3a) Commercial catches; Alexandros Kokkalis.

2.5.2 Survey Index Calculations for Turbot in Area IIIa and Adjacent Waters; Casper W. Berg.

2.5.3 Assessment of turbot in Division 3a (tur.27.3a); Alexandros Kokkalis.

Development of a combined BTS index of abundance for North Sea sole (sol.27.4)

Working Document to WKFlatNSCS, Copenhagen, 17-21 February 2020

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13 February, 2020

Contents

1 Introduction

The stock assessment of North Sea sole (ICES sol.27.4) depends heavily on indices of abundance-at-age generated using the results of the Beam Trawl Survey (BTS). The last benchmark for this stock, while deciding to use the BTS-Isis (NL) survey as an index of abundance for the stock assessment model, recommended that an index should be

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created from the Belgian BTS covering the Southwestern North Sea. A similar suggestion was made regarding the German Solea survey. A final suggestion was made for a single index to be developed that includes data from the various sections of the BTS so as to cover the whole distribution area of the stock.

The present document shows an attempt at generating such an unified index that combines the Dutch, Belgian and German data. A standardization procedure, employing various formulations of a delta-lognormal generalized additive model (GAM) (Berg *et al.*, 2014) was applied to the datasets currently available in DATRAS (1985-2019). Different model set-ups were explored and are presented for discussion.

2 Data

The main source of data for this analysis are the results of the BTS, as available through the ICES DATRAS database[1]. The database was accessed on 17/1/2020, and the query included all raw data for North Sea sole coming from the BTS carried out by Germany, the Netherlands and Belgium.

2.1 Time series

The following time series plots (Figures 1, 2 and 3) show the number of hauls taken each year by each country, ship and gear, respectively.

The Belgian survey in 2015 and 2016 was carried out using a different vessel than usual (called '11TQ'). Although DATRAS also reports a different gear category ('BT4S'), both vessels employed the same 4m beam trawl, although operated from a different side of the vessel. For the pourpose of this analysis, thes etwo gear categories were simply merged into one ('BT4').

The Dutch BTS started in 1985 with the vessel *Isis* covering the southeastern North Sea, while later on the *Tridens* joined to survey in the northwestern North Sea. From 2017 onwards, *Isis* stopped participating in the BTS, and *Tridens* now covers the entire Dutch survey area, although samples corresponding to the *Isis* sample locations are identified as such.

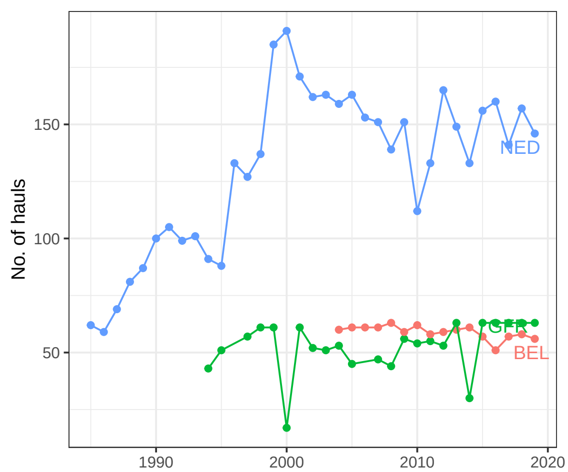

Figure 1: Number of hauls taken on the BTS by country over the 1985-2019 period.

[1] http://www.ices.dk/marine-data/data-portals/Pages/DATRAS.aspx

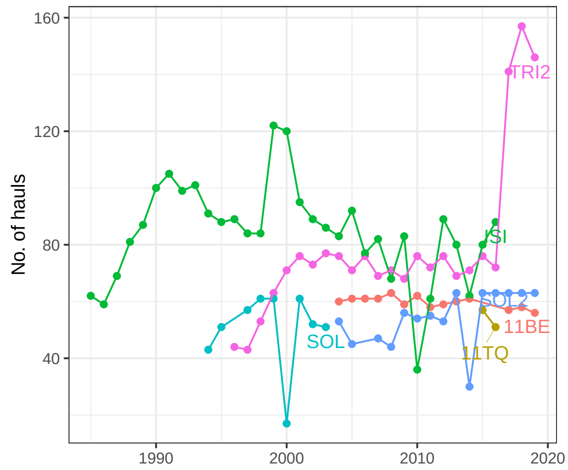

Figure 2: Number of hauls taken on the BTS by each vessel over the 1985-2019 period.

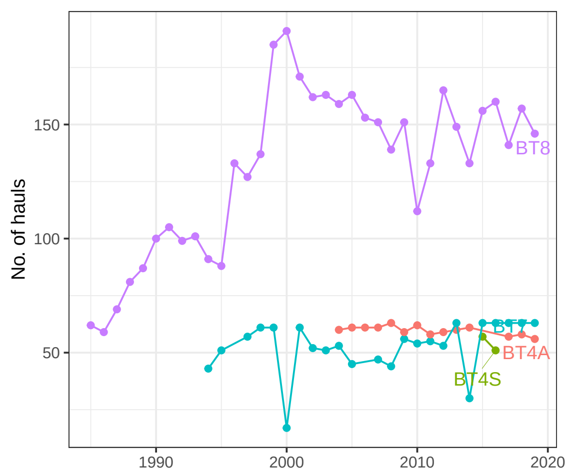

Figure 3: Number of hauls taken on the BTS using each gear over the 1985-2019 period.

2.2 Spatial coverage

The spatial coverage of the complete BTS dataset changes over time, and is presented in Figures 4 and 5. Note that the current BTS-Isis index only covers the southeastern North Sea that is visible in the years 1985-1995 in Figure 5. The overall biomass distribution (and presence/absence) is presented in Figure6. Figures 7 and 8 show the the biomass every 5 years throughout the study period and every year for the last ten years (2010-2019). The maps indicate that the area covered by the Belgian BTS is one of relatively high biomasses of sole and has become an increasingly important area for the stock. Although biomasses in the German part of the survey are not very high, they include a part of the distribution of sole that is not taken into account in the current BTS-Isis index.

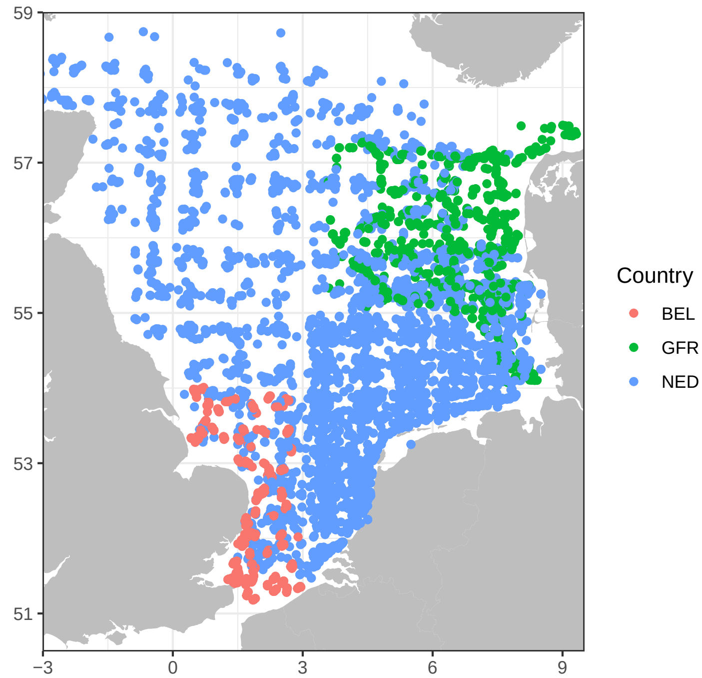

Figure 4: Hauls carried out under the BTS by each of the participant countries for the whole period 1985-2019.

Figure 5: BTS hauls by country and year.

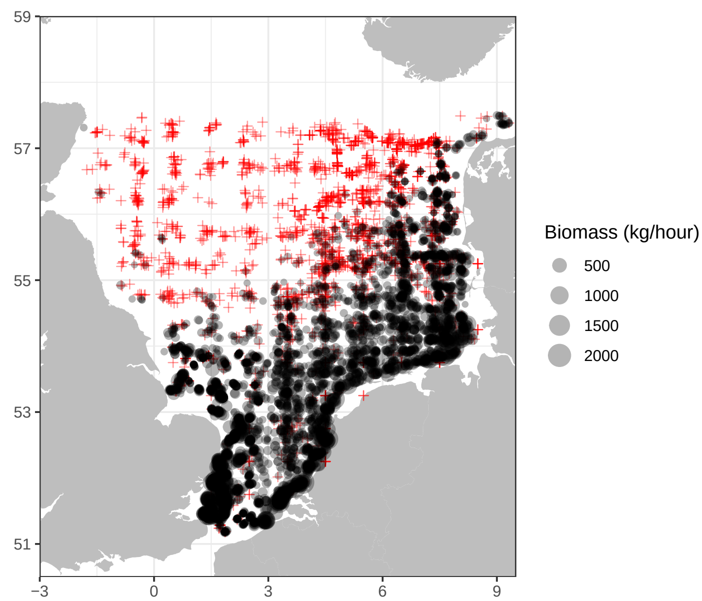

Figure 6: Biomass (kg/hour) of sole per haul in the BTS for the whole period 1985-2019. Red crosses indicate absence of sole.

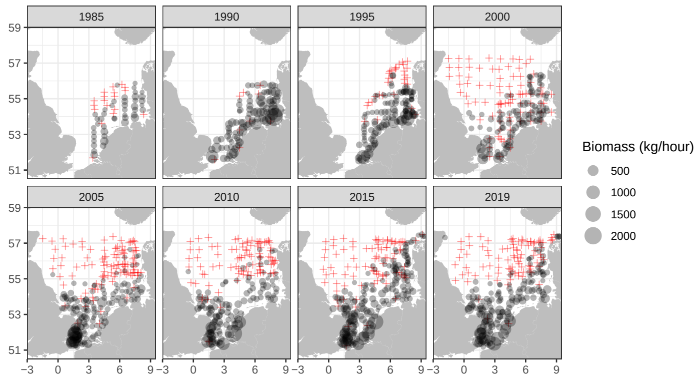

Figure 7: Biomass (kg/hour) of sole per haul in the BTS for the whole period 1985-2019. Red crosses indicate absence of sole.

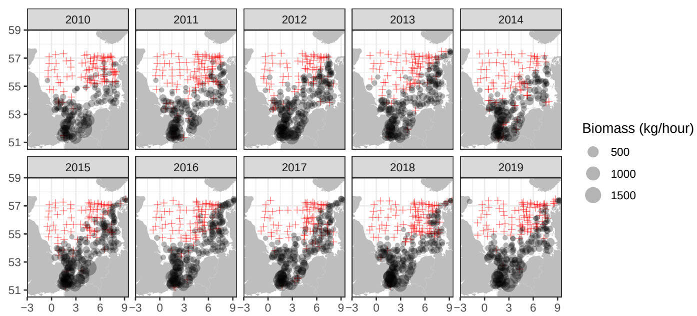

Figure 8: Biomass (kg/hour) of sole per haul in the BTS for the whole period 1985-2019. Red crosses indicate absence of sole.

2.3 Length distribution

Figure 9 presents the length frequency distribution of the BTS by the three gear types.

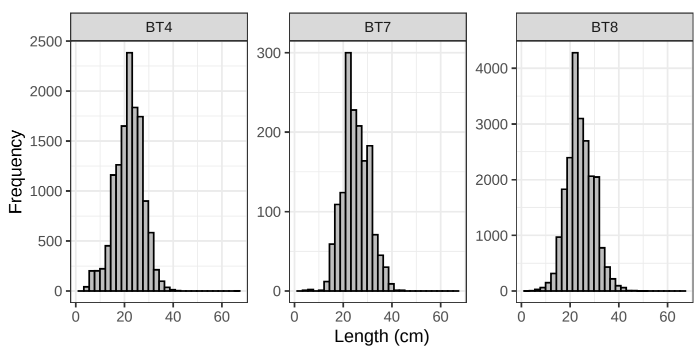

Figure 9: Length distribution (cm) of sole in the BTS by gear for the whole period 1985-2019.

2.4 Selection of area

Hauls north of 57.5°N were excluded, since they are outside of the usual BTS area and/or fall outside the known spatial distribution of sole.

2.5 Data presence in DATRAS

Some (parts of the) BTS data are missing from the current version of the dataset in DATRAS. The early years of the Belgian survey are not yet in DATRAS (1992-2003), and depth information is missing for both the Belgian survey in 2004 and 2006, and the German survey in 2009. However, all countries have a few hauls throughout the study period with missing depth information. A simple spatial Generalized Additive Model was applied to interpolate depth for these hauls, thereby making use of the depth information from the other hauls.

3 Methods

3.1 Software

The package used to extract the BTS data was *DATRAS* (https://github.com/DTUAqua/DATRAS). Modelling was performed using the *surveyIndex* package (https://github.com/casperwberg/surveyIndex). A complete description of the methods for the delta-lognormal GAM models applied can be found in (Berg *et al.*, 2014).

3.2 Variables

3.2.1 Ship, gear and rigging

A number of ships are or have been involved in the BTS, including multiple ships per country, as well as different types of gear and gear attachments (*rigging*). The survey started in 1985 carried out by the Netherlands with the RV Isis in the southeastern part of the North Sea and the German Bight. This vessel used an 8m-beam trawl ('BT8') without rigging. In 1996 and 1997 an additional larger part of the central and western North Sea was covered by the RV Tridens (as part of the International Bottom Trawl Survey in Quarter 3), using a flip-up rope as gear attachment to prevent big boulders from entering the net. From 1998 onwards, the area covered by the Tridens became officially part of the BTS. The Isis continued surveying the sout-eastern North Sea without rigging, as the gear has no issues with the sandy seabed in this area. Since 2017, the Dutch BTS is entirely operated by the Tridens, without any rigging in the southwestern North Sea and German Bight (i.e. same as the Isis), and with a flip-up rope in the central western North Sea.

Germany is part of the BTS since 1991 surveying the eastern North Sea, where it partially overlaps with the Dutch southeastern BTS. It uses a 7m-beam trawl ('BT7') with tickler chains as gear attachment. From 1991 to 2003 the survey was done by the RV Solea, and from 2004 onwards by a new RV Solea (abbreviated in DATRAS as 'SOL2'). Some years in the survey are missing due to technical failure (1996, 2006) and age data for sole have not always been collected each year, because the German part of the BTS was not considered to be the main distribution area of sole. Moreover, until 2012 a separate sole survey was run along the German coast.

Belgium joined the survey in 1992 with the RV Belgica that takes care of the southwestern North Sea. Since 1993 the standard gear set-up has been used, with a 4m-beam trawl ('BT4'), a chain mat as gear attachment and 40 mm mesh in the codend. In 2015 and 2016, the RV Belgica broke down and a commercial fishing vessel was used instead, deploying the same gear. Currently, only the years 2004-2019 are uploaded to DATRAS.

Considering the different survey characteristics, it was decided to use Gear as a variable to be considered in the model to reflect differences in gear, but also in country, ship and any other factors that may differ between the surveys. The model was also run with Country and Ship instead of Gear, leading to very similar results.

3.2.2 Haul duration

Across all valid BTS hauls currently available in DATRAS, haul duration varies from 5 to 60 minutes with a median of 30 minutes. A lower limit of 10 minutes was set to ensure hauls were likely to contain a representative abundance of the species.

3.2.3 Ground speed

For the Dutch BTS, the actual ground speed that is trawled at is not reported in DATRAS. Instead, the target speed of 4 knots is reported for all hauls. For the majority of the Belgian hauls ground speed is not reported in DATRAS either,

Table 1: Summary of distance trawled as reported in DATRAS per ship.

Ship	dist.mean	dist.sd	dist.med	dist.min	dist.max	dist.NA
11BE	3848	2494.3	3656	591	45074	0
11TQ	3763	973.2	3750	1456	8259	0
ISI	4634	1668.8	3868	740	10080	291
SOL	3484	2836.0	3563	-16668	56952	0
SOL2	3329	311.3	3333	827	6155	0
TRI2	4408	1403.0	4018	198	10730	55

except for the years 2012 and 2013 (median = 4.07 knots). The German BTS data in DATRAS always reported the measured ground speed for each haul with an overall median of 3.85 knots.

To be consistent, the ground speed of all hauls and countries has been set to 4 knots for this analysis. Note that the ground speed (and haul duration) are only used to calculate swept area when the distance trawled is not available or has an outlying value (see also section below).

3.2.4 Distance trawled

Table 1 summarizes the distance trawled (in m) reported by ship in DATRAS across all years, including the number of hauls for which no distance is reported. Several outlying values were observed, e.g. very large distances or negative values, that became also visible when plotting the reported distance versus the calculated distance based on speed and haul duration (Figure **??**). Therefore, in the calculation of swept area, the calculated distance was used instead of the reported distance for all hauls with NA for distance, and for hauls where distance was below zero (one haul in total) or above 10 000 m. Additionally, calculated distance was used for all Belgian hauls, since their reported distance in DATRAS cannot be trusted according to ILVO. In total, for approximately 1300 out of 6800 hauls the calculated distance had to be used instead of the reported distance to calculate swept area, of which the majority were from Belgium, followed by the Netherlands.

3.2.5 Swept area

The area swept by the trawl (SA) is used to standardize the number of fish caught by the fishing effort. In this analysis, for hauls for which was decided to use the reported distance, swept area was calculated in km^2 as $SA = D \cdot BL$, where distance (D) and beam length (BL) were converted from m to km prior to the calculation. For the remaining hauls, swept area (in km^2) was calculated as:

$$SA = 1.852 \cdot GS \cdot BL \cdot HD$$

where ground speed (GS) is converted from knots to km/h by multiplying by 1.852, haul duration (GD) is in hours and beam length in km. Note that the first part of the calculation is the same as the aforementioned calculated distance.

3.2.6 Depth

Depth is considered as a covariate in the model, since it may influence the abundance and distribution of the different age groups of sole. Depth was taken as the reported sampling depth in DATRAS (Figure **??**). Missing values were interpolated using a simple spatial GAM.

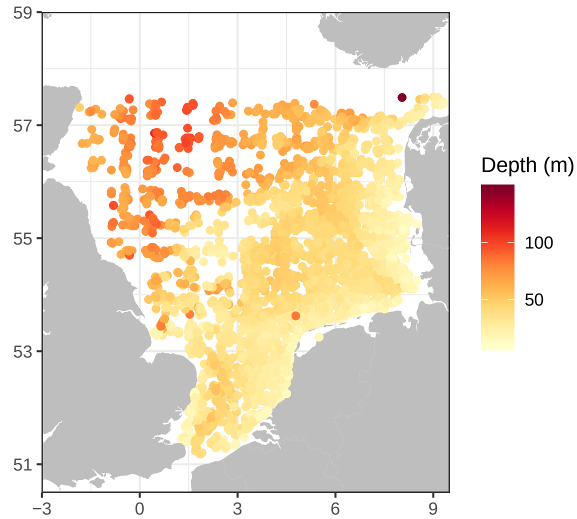

Figure 10: Bathymetry map based on sampling depth by haul from the BTS in DATRAS.

3.3 Models

As response variable we model here abundance at age of sole for age 1 to 9 separately, with 9 as a plus group. All models include Year and Gear as factors and a time-invariant or time-varying spatial effect. Depth is also considered as a covariate. Swept area is included as an offset to standardize the abundance at age. Delta-GAMs, as described by (Berg *et al.*, 2014), consist of two parts: one part that models the presence/absence, and one part that models the positive values or 'counts'. The presence/absence part of the model is assumed to follow a binomial distribution, whereas we consider three distributions for the positive part: lognormal, Gamma and Tweedie distribution. All these options can be selected in the *surveyIndex* package.

An overview of the considered models can be found in Table 2. First, a model with only data from the Dutch Isis area (by the vessels Isis in 1985-2016, and Tridens in 2017-2019) is constructed that will serve as a direct comparison with the currently used BTS-Isis index. Then a range of models will include all available data from the Netherlands, Belgium and Germany. Additionally, models are constructed that include the Dutch Isis area and either the Belgian or the German data, to see how the addition of the data of only one country (Belgium or Germany) influences the index. One model will be run with a time-varying spatial component to see if including such a time-dependent spatial effect improves the model fit. Several models will be run with a lognormal distribution for the positive part of the model, as well as with a Gamma and Tweedie distribution. A model is constructed that does not include depth as a covariate to investigate the importance of depth for the modelling the abundance at age. The splines used for the smoothing functions (denoted as s in Table 2) of space, time-varying space and depth are thin-plate regression splines.

Of all the models and indices proposed here, the initial candidate that we consider to replace the current index is the delta-GAM with a lognormal distribution, time-invariant spatial effect and depth as an additional covariate ('ALL-LN-Tinv-Depth). This model will be compared in detail with the traditional index and the indices resulting from the other potential models that are discussed.

Table 2: Delta General Additive Models evaluated for various subsets of the BTS SOL.27.4 dataset, different covariate combinations and distributions.

Code	Country	Ship and rigging	Distribution	Time	Covariates
Isis-LN-Tinv-Depth	NED	ISI, TRI	Log-normal	invariant	Year + s(Lon,Lat) + s(Depth)
ALL-LN-Tinv-Depth	NED, BEL, GER	ISI, TRI, ISI-F, TRI-F, 11BE-M, 11TQ-M, SOL-T, SOL2-T	Log-normal	invariant	Year + Gear + s(Lon,Lat) + s(Depth)
Isis-LN-Tvar-Depth	NED (Isis)	ISI-TRI	Log-normal	varying	Year + s(Year,Lon,Lat) + s(Depth)
ALL-LN-Tvar-Depth	NED, BEL, GER	ISI, TRI, ISI-F, TRI-F, 11BE-M, 11TQ-M, SOL-T, SOL2-T	Log-normal	varying	Year + Gear + s(Year,Lon,Lat) + s(Depth)
ALL-Ga-Tinv-Depth	NED, BEL, GER	ISI, TRI, ISI-F, TRI-F, 11BE-M, 11TQ-M, SOL-T, SOL2-T	Gamma	invariant	Year + Gear + s(Lon,Lat) + s(Depth)
ALL-Tw-Tinv-Depth	NED, BEL, GER	ISI, TRI, ISI-F, TRI-F, 11BE-M, 11TQ-M, SOL-T, SOL2-T	Tweedie	invariant	Year + Gear + s(Year,Lon,Lat) + s(Depth)
ALL-LN-Tinv	NED, BEL, GER	ISI, TRI, ISI-F, TRI-F, 11BE-M, 11TQ-M, SOL-T, SOL2-T	Log-normal	invariant	Year + Gear + s(Lon,Lat)
Isis-BEL-LN-Tinv-Depth	NED, BEL	ISI, TRI, 11BE-M, 11TQ-M	Log-normal	invariant	Year + Gear + s(Lon,Lat) + s(Depth)
Isis-GER-LN-Tinv-Depth	NED, GER	ISI, TRI, SOL-T, SOL2-T	Log-normal	invariant	Year + Gear + s(Lon,Lat) + s(Depth)
BEL-LN-Tinv-Depth	BEL	11BE-M, 11TQ-M	Log-normal	invariant	Year + s(Lon,Lat) + s(Depth)
ALL-LN-Tinv-Depth-HaulDur	NED, BEL, GER	ISI, TRI, ISI-F, TRI-F, 11BE-M, 11TQ-M, SOL-T, SOL2-T	Log-normal	invariant	Year + Gear + s(Lon,Lat) + s(Depth)

4 Indices of abundance

4.1 Current index

The BTS-based index of abundance in use from the last benchmark has now been updated with the 2019 quarter 3 data (Figure 11). This index is generated at WMR based on the BTS-Isis hauls and is currently not being uploaded to DATRAS. The 2019 abundance of age-1 fish appears to confirm the signal of a large recruitment in 2018 that was already present in the sole net survey (SNS). This has led to a substantial increase in the predicted recruitment used to provide catch advice for the stock in 2020 during the autumn update process in 2019.

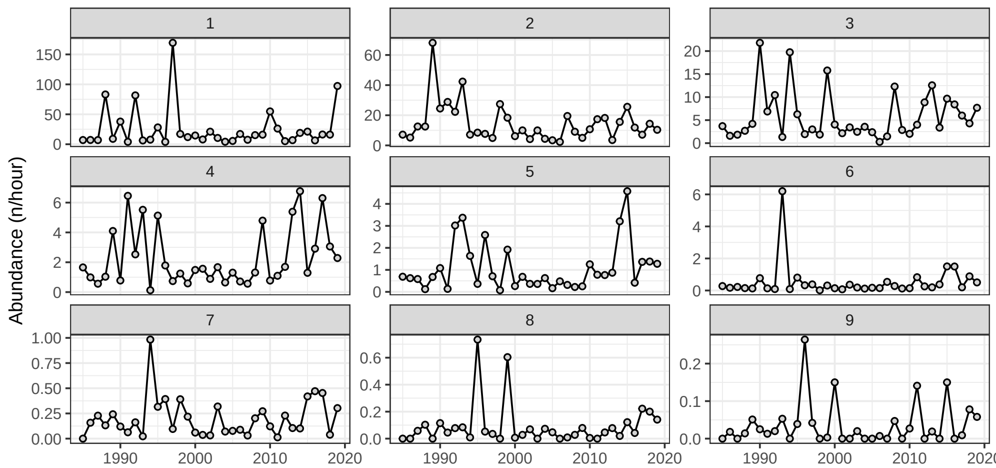

Figure 11: Index of abundance at age (n/hour) for SOL.27.4 obtained from the BTS-Isis survey and derived with the traditional method.

Strong signals in age-1 fish have not always led to substantially larger abundances in ages 2+, as for example happened with the 1996 cohort (Figure 12).

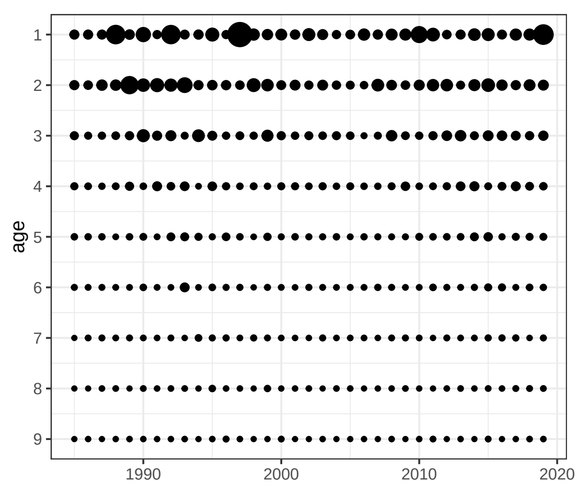

Figure 12: Relative abundances at age by year from the SOL.27.4 BTS-Isis index of abundance.

4.2 New proposed index

A delta-lognormal GAM was constructed that combines all available BTS hauls from the Netherlands, Belgium and Germany, and that includes Depth as a covariate (*ALL-LN-Tinv-Depth* in Table 2, Figures 13 and 14). Figure 15 compares the proposed index with the traditional BTS-Isis index. This index seems to coincide with the traditional index over most of the time series. Main differences seem to occur in years with large peaks in abundance, where the two indices provide a different relative height of the peak, although their order is not always the same.

Spatial variation in abundances at age becomes clear from the spatial predictions of the delta-lognormal GAM (Figure 14), with young fish of age 1 occuring close to the southwest and southeast coast, whereas abundances of older fish are highest in the southwest.

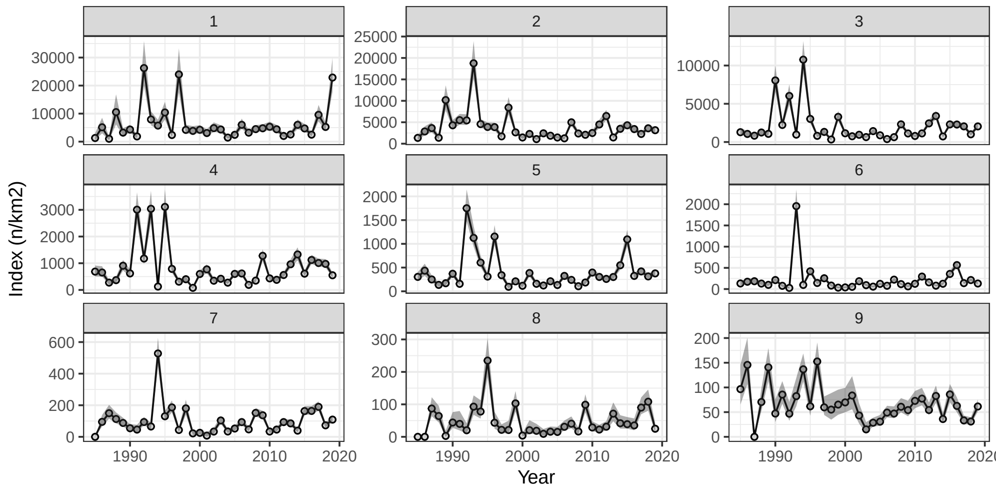

Figure 13: Index of abundance at age (n/km2) for SOL.27.4 estimated from all surveys, with data starting in 1985, using a delta-lognormal, time invariant GAM and including depth as a covariate (ALL-LN-Tinv-Depth).The grey shaded areas are the 95% confidence interval.

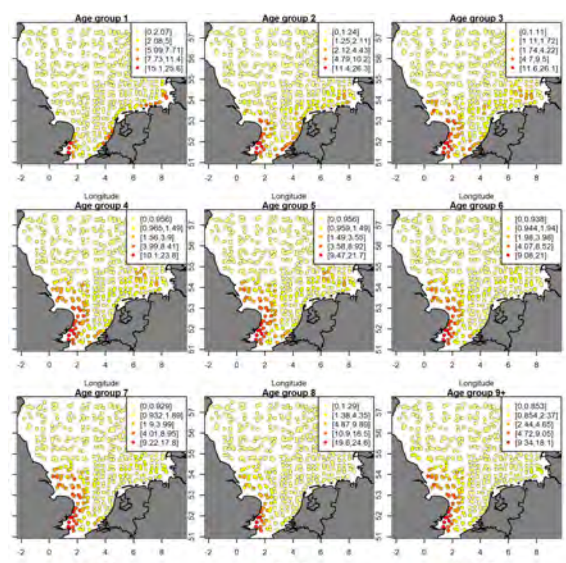

Figure 14: Index of abundance at age for SOL.27.4 estimated from all surveys, using a delta-lognormal, time invariant GAM and including depth as a covariate (ALL-LN-Tinv-Depth). Values are rescaled within each age group from 0 to 1. Plotted year is 2019.

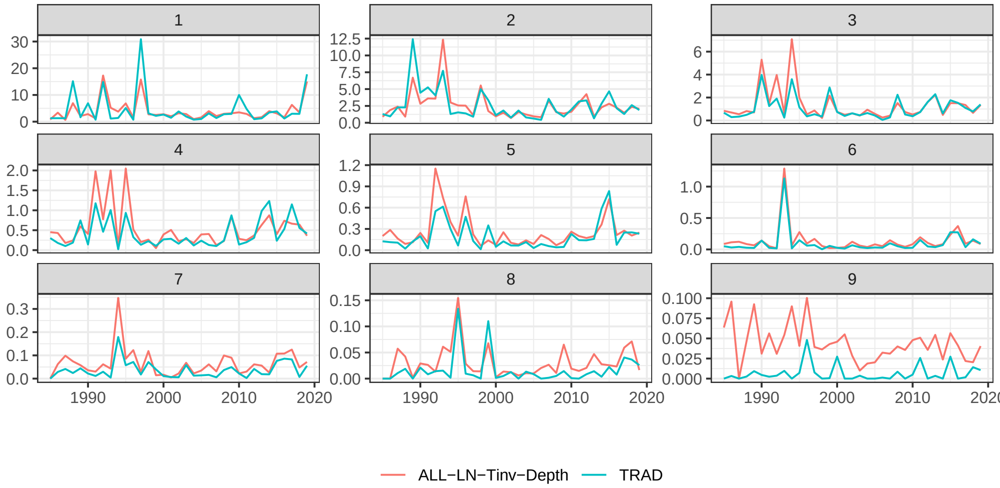

Figure 15: Comparison of the delta-lognormal, time invariant GAM index of abundance at age (ALL-LN-Tinv-Depth) with the traditional BTS-Isis index currently in use. Index values have been standardized by the mean.

4.2.1 Residuals

Figures 16 and 17 show the residuals plotted per year and gear type, whereas Figure 20 shows the spatial residuals of the the last three years.

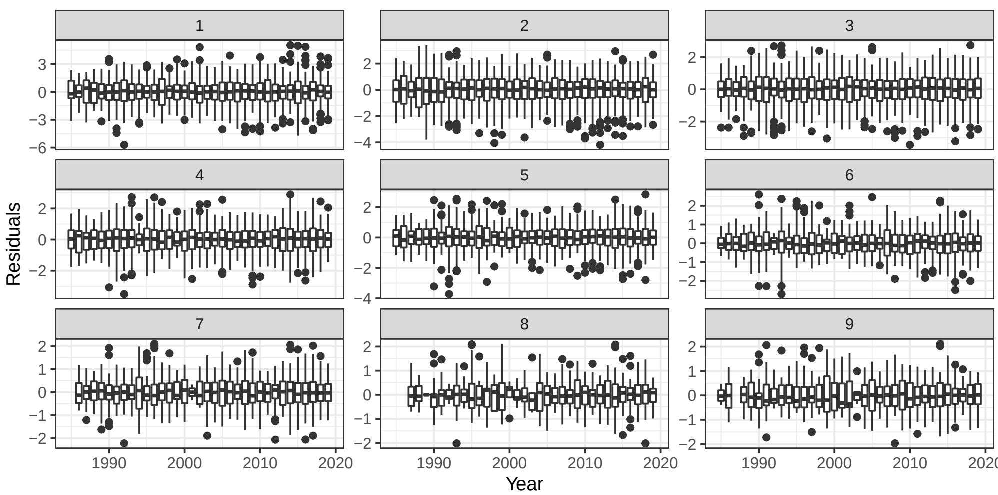

Figure 16: Residuals by year of the delta-GAMs ran for the abundance of each age group of sole (ALL-LN-Tinv-Depth).

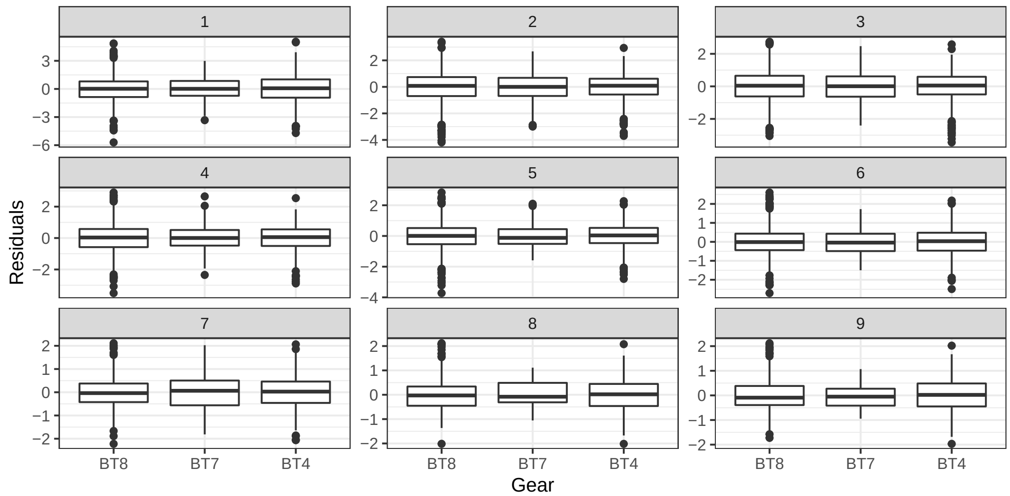

Figure 17: Residuals by gear of the delta-GAMs ran for the abundance of each age group of sole (ALL-LN-Tinv-Depth).

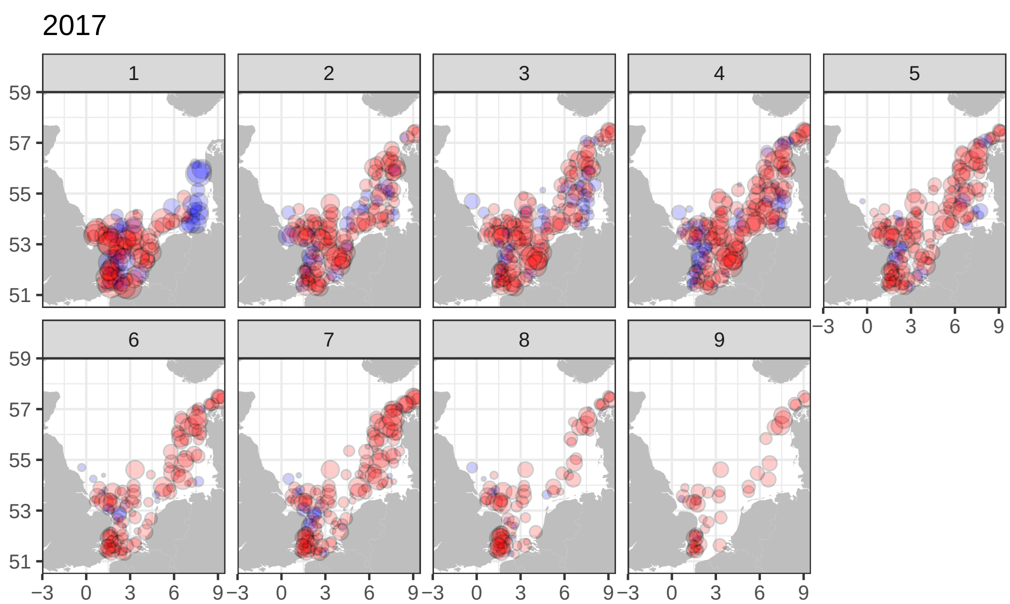

Figure 18: Spatial residuals of the last three years of the delta-GAMs ran for the abundance of each age group of sole (ALL-LN-Tinv-Depth). Red indicates positive values, blue negative values.

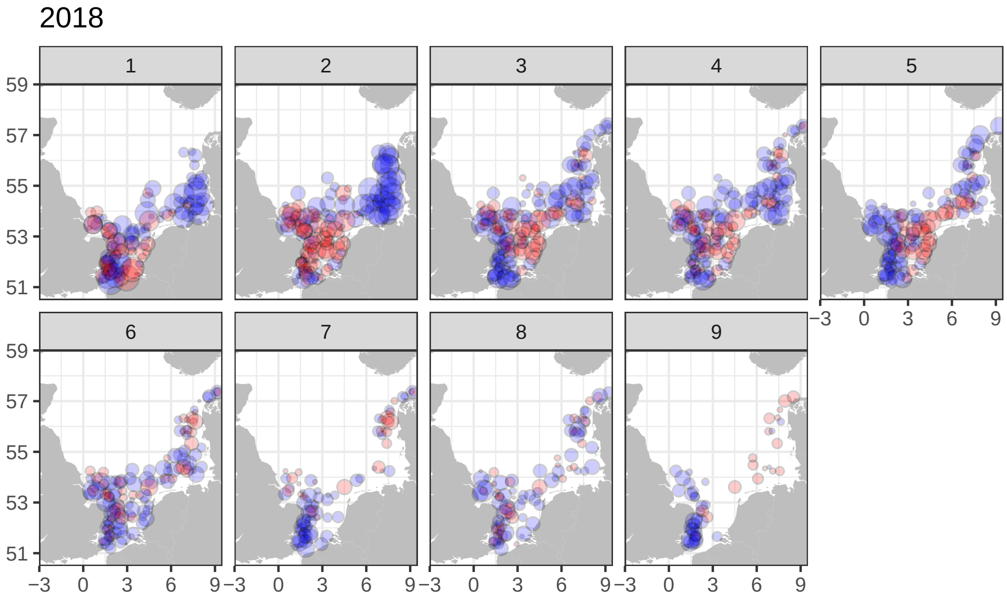

Figure 19: Spatial residuals of the last three years of the delta-GAMs ran for the abundance of each age group of sole (ALL-LN-Tinv-Depth). Red indicates positive values, blue negative values.

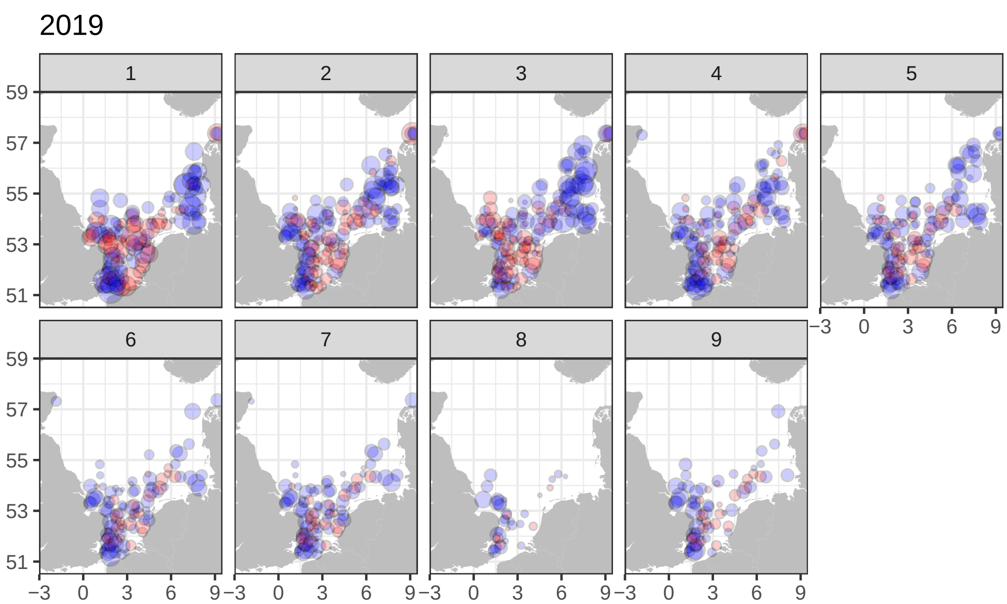

Figure 20: Spatial residuals of the last three years of the delta-GAMs ran for the abundance of each age group of sole (ALL-LN-Tinv-Depth). Red indicates positive values, blue negative values.

4.2.2 Internal consistency

Figure 21 shows the internal consistency of the lognormal time-invariant delta-GAM. The high correlations between the abundances of cohorts in one year with the next indicate that the cohorts can be tracked.

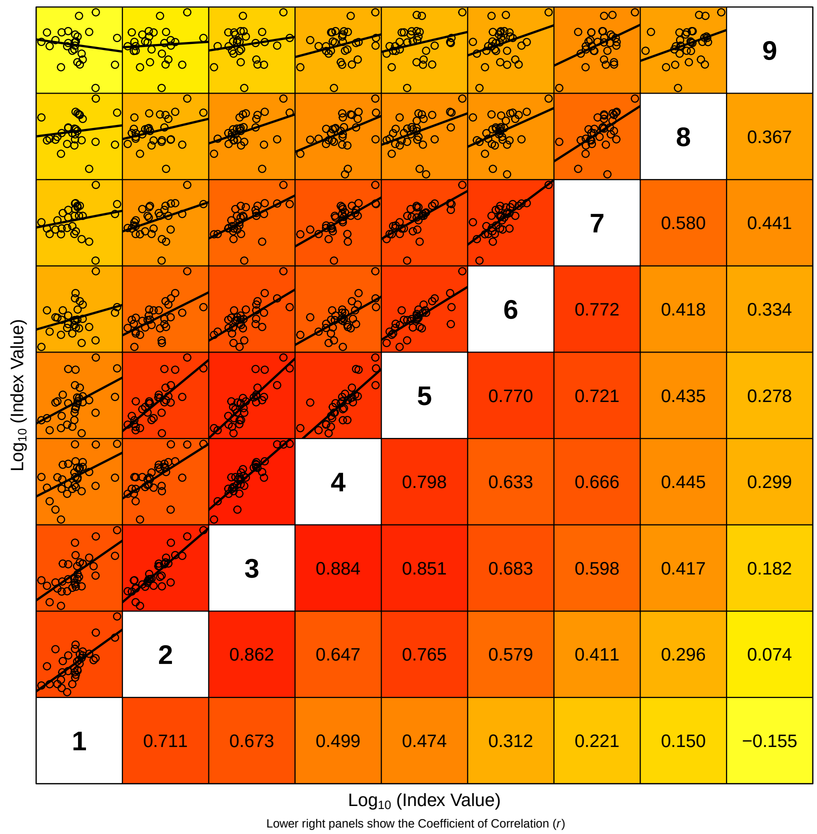

Figure 21: Internal consistency of the information by cohort of the delta-lognormal, time invariant GAM index of abundance at age (ALL-LN-Tinv-Depth).

4.3 Impact of standardization procedure

The impact of the standardization procedure and the addition of covariates to the index can be assessed by comparing the delta-lognormal GAM index based on only Dutch data (from the same area covered by the BTS-Isis index) with the traditional index (Figure 22). The procedure apppears to have an effect on the extent of large changes in abundance signals, but not always in the same direction - in a similar way as when remaining Dutch data and Belgian and German data are also included (Figure 15). The differences between the model for the 9+ group may be caused by that the ALK underlying the delta-GAM does not allow for zeroes, and hence dummy values had to be introduced.

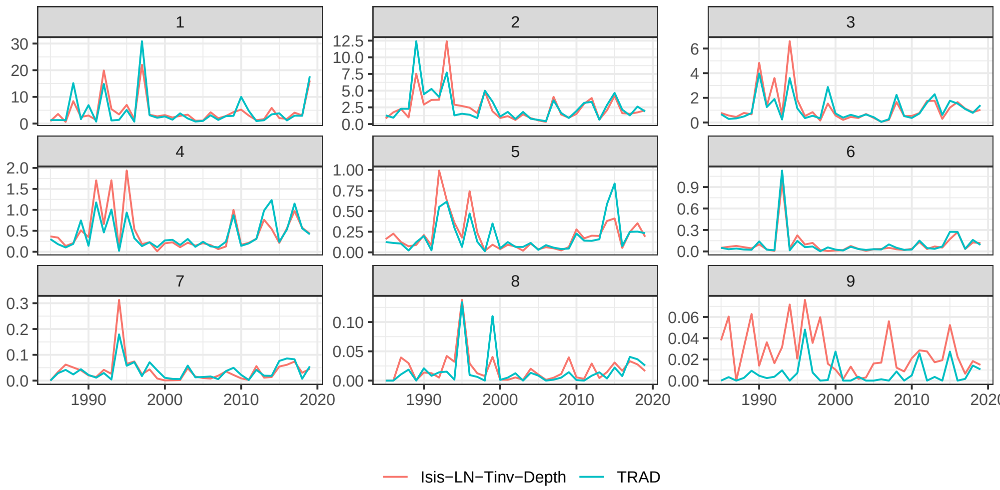

Figure 22: Comparison of the delta-lognormal, time invariant GAM index of abundance based on the Dutch data (Isis-LN-Tinv-Depth) with the traditional BTS-Isis index currently in use. Index values are standardized by the mean.

The impact of adding Belgian data, German data and Belgian and German data together to the delta-GAM index (based on the Isis area only) is presented in Figure 23, indicating very few discrepancies. This is expected, as the major distribution area of sole is covered by the Dutch part of the BTS. Note that the 'full' model that includes all data ('ALL-LN-Tinv-Depth') also includes the data by the Tridens in the northwestern North Sea. However, due to the low presence of sole in this area (6), adding these additional Dutch data to the Isis index likely has no major influence either.

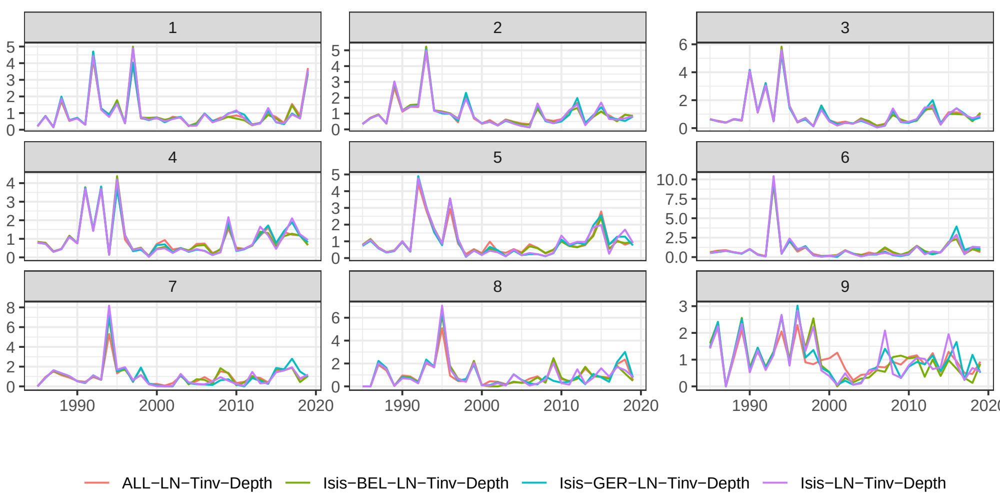

Figure 23: Comparison of the delta-lognormal, time invariant GAM index of abundance based on the Dutch data (Isis-LN-Tinv-Depth) with either the Belgian (Isis-BEL-LN-Tinv-Depth) or German data (Isis-GER-LN-Tinv-Depth) added. Index values are standardized by the mean.

4.4 Space-time interactions

A comparison of the indices generated with the lognormal delta-GAM including all countries but considering time-constant vs time-varying variance spatial effects shows no appreciable differences in estimated trends in abundance at age (Figure 24).

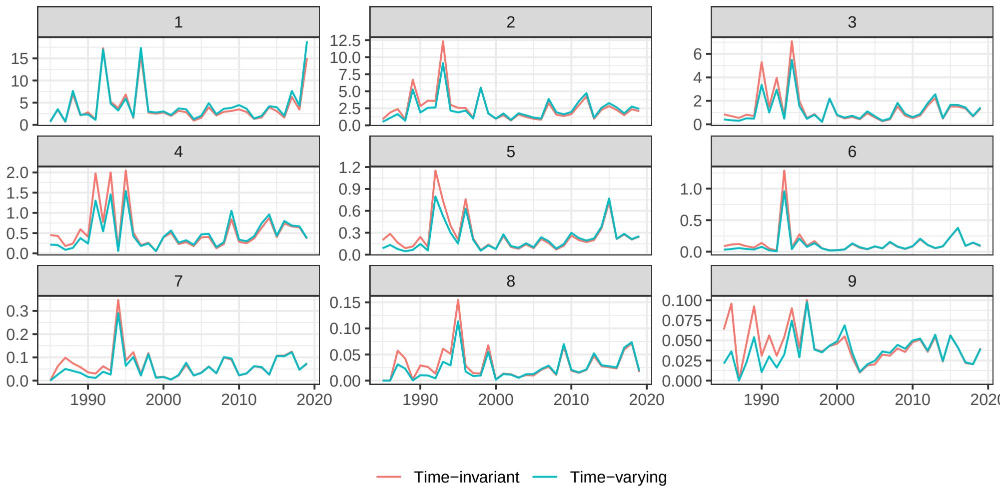

Figure 24: Comparison of the delta-lognormal, time invariant GAM index of abundance at age (ALL-LN-Tinv-Depth) with the formulation including space-time variance (ALL-LN-Tvar-Depth). Index values are standardized by the mean.

4.5 Compare log-normal with Gamma and Tweedie distribution

In all models discussed above, a lognormal distribution was assumed for the positive (i.e. abundance) part of the delta-GAM. The Gamma or Tweedie distributions are two possible alternatives. Figure 25 compares the indices based on the three possible distributions. The indices seem to follow very similar trends, with some deviations of the Tweedie model for older ages (age 7-9).

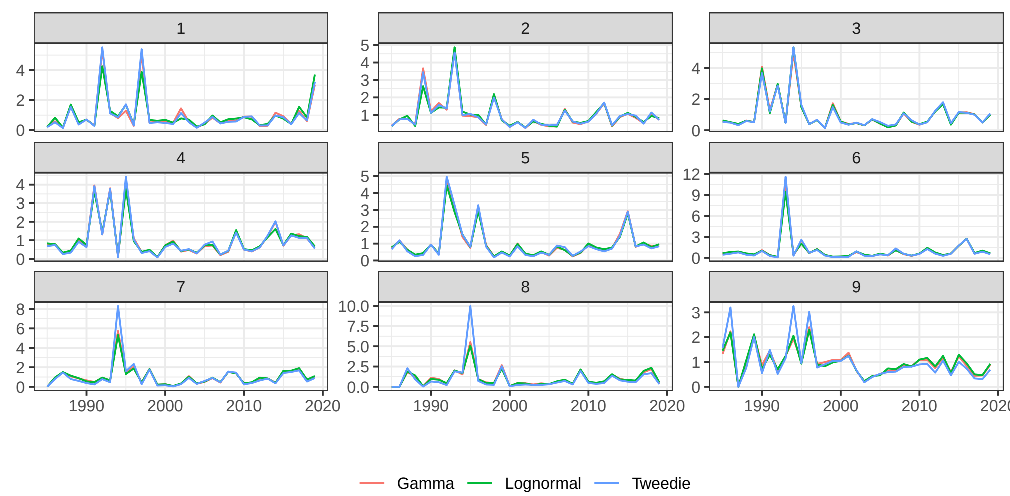

Figure 25: Comparison of the lognormal, Gamma and Tweedie distribution assumed for the positive part of the delta-GAM for the abundance at age (ALL-LN-Tinv-Depth, ALL-Ga-Tinv-Depth and ALL-Tw-Tinv-Depth). Index values have been standardized by the mean.

4.6 Effect of depth

Figure 26 demonstrates how the abundance at age varies with depth according to the lognormal time-invariant delta-lognormal GAM. For the majority of age groups, abundance increases with depth, whereas for age 1 the abundance first decreases with depth up to 40 m after which it increases again.

To explore the relevance of depth as a covariate in the model, we ran the lognormal time-invariant delta-lognormal GAM based on data from all countries but without depth as a covariate (ALL-LN-Tinv), and compared it the model with depth (ALL-LN-Tinv-Depth). As shown in Figure 27, there are hardly any differences between the models, indicating that depth has no major effect on the abundance index.

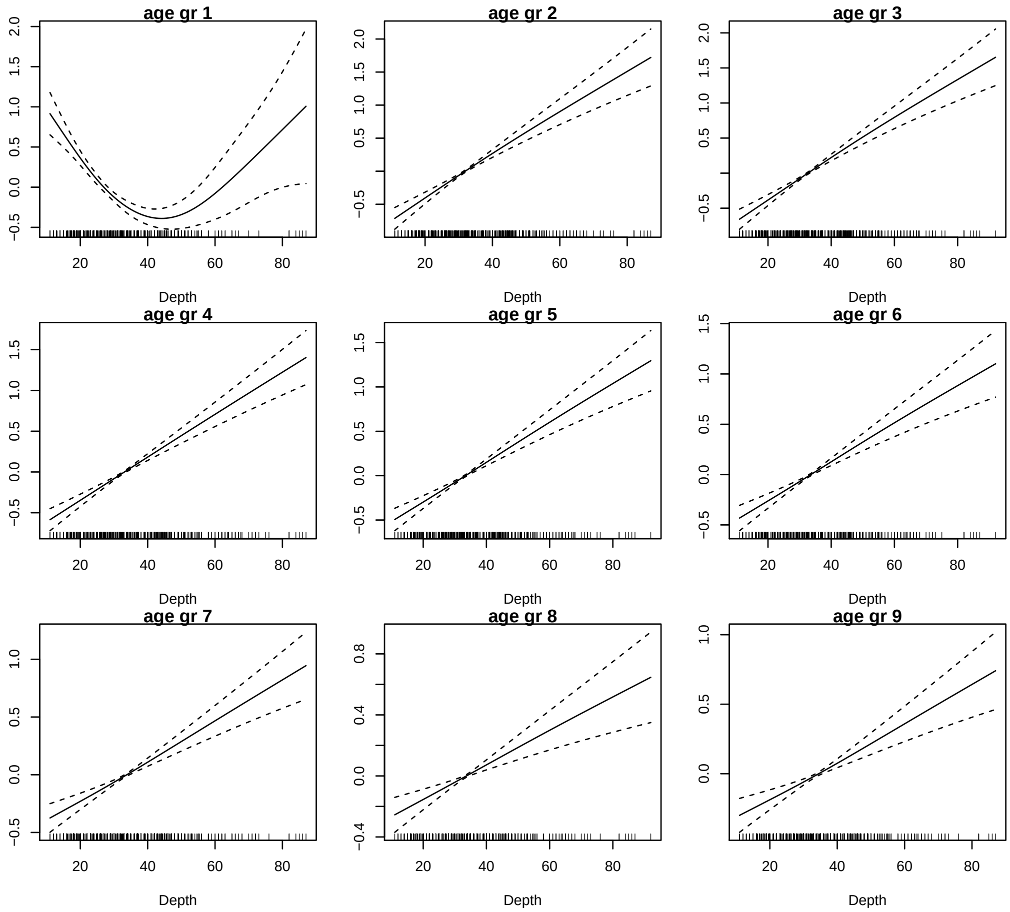

Figure 26: Effect of depth on the abundance-at-age based on the delta-GAMs ran for the abundance of each age group of sole (ALL-LN-Tinv-Depth). From left top to bottom right: age 1 to 9.

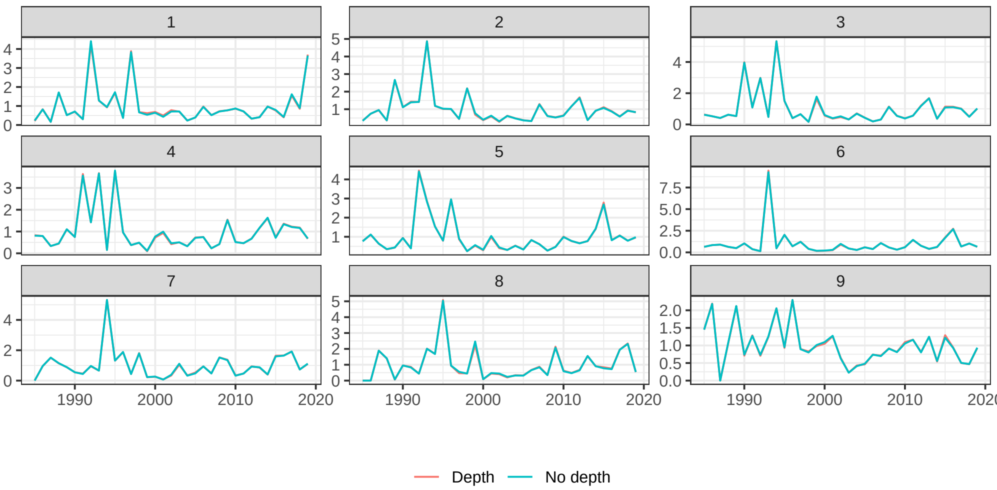

Figure 27: Comparison of the log-normal time-invariant delta-GAM including and excluding depth as a covariate (ALL-LN-Tinv-Depth vs. ALL-LN-Tinv). Index values have been standardized by the mean.

4.7 Comparison of swept area with haul duration

The current BTS-Isis index standardizes the abundance by one hour of fishing. An alternative and more precise form of standardization is the swept area, as it, besides duration, also takes the width of the gear and the distance trawled into account. The swept area was used in all models above, but to test its influence on the abundance index, we constructed a model that uses haul duration to standardize the abundance. Figure 28 reveals that the two models result in very similar time series in terms of the temporal trends in abundance. However, there is some variation in the extent of the peaks, although again one model does not consistently predict a higher or lower abundance than the other.

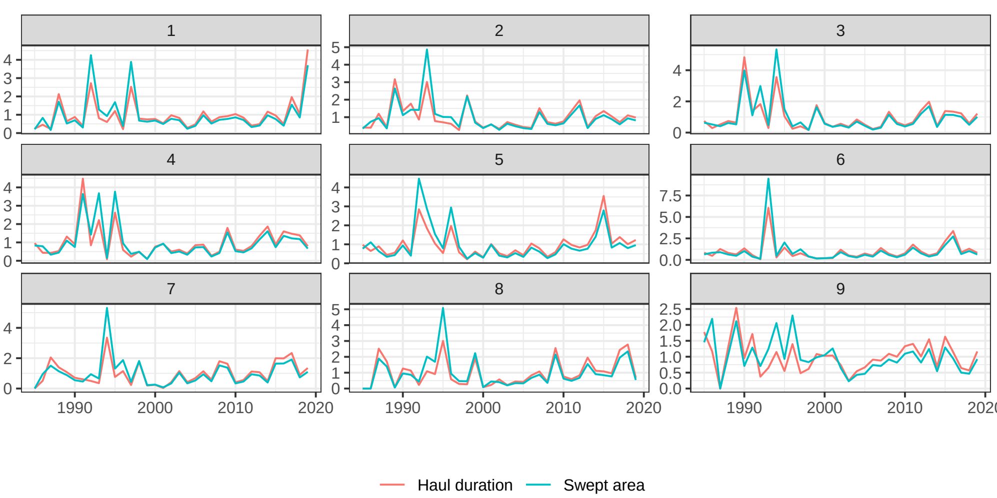

Figure 28: Comparison of the log-normal time-invariant delta-GAM including and excluding depth as a covariate (ALL-LN-Tinv-Depth vs. ALL-LN-Tinv). Index values have been standardized by the mean.

5 Discussion

The work presented here provides a potential unified index of abundance at age from three of the BTS datasets: the Netherlands, Belgium and Germany. The delta-lognormal time-invariant GAM index does not differ markedly from the traditional and currently used index. The Dutch data still dominate in the delta-GAMs, but the inclusion of the

Belgian and German datasets, should make the index a more robust indicator of stock abundance, as it will cover a larger part of the stock's spatial distribution (German data in the northeast) and includes additional data from an area with high biomass (Belgian data in the southwest).

Several alternative model set-ups were considered that all resulted in similar temporal trends of the abundances at age and fits to the data: - Different assumed distributions for the positive abundances (lognormal, Gamma, Tweedie) - Time-invariant versus a time-varying spatial effect - Inclusion or exlcusion of depth as a covariate - Use of swept area or haul duration as an offset

These different set-ups of the BTS delta-lognormal GAM index of abundance are to be discussed during the benchmark meeting.

6 Acknowledgements

We would like to thank Casper Berg (DTU Aqua) for his patience with our multiple questions on the use of *indexSurvey* and its R classes.

References

Berg, C. W., Nielsen, A., and Kristensen, K. 2014. Evaluation of alternative age-based methods for estimating relative abundance from survey data in relation to assessment models. Fisheries Research, 151: 91–99. Elsevier BV.

Stock assessment of North Sea sole (sol.27.4) using the Aarts & Poos (AAP) model.

Working Document to WKFlatNSCS, Copenhagen, 17-21 February 2020

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Abstract

The stock of North sea sole (sol.27.4) has been assessed using the AAP model, reformulated to improve the fit to the landings data. A new standardized BTS index of abundance has been applied, combined with the SNS survey. The index incorporates data from the Netherlands, Belgium and Germany. Trends in biomass and fishing mortality differ from those estimated using the previous model formulation for the last few years.

1 Introduction

This document presents an stock assessment of North Sea sole (sol.27.4) using the statistical catch-at-age model formulated by Aarts & Poos (2009), commonly called AAP. This model was already applied during the previous benchmark of North sea sole. The model has been extended to better explain patterns in selectivity-at-age by separating the specified number of knots applied to the age dimension of the fishing mortality tensor spline, and those used in the selectivity-at-age spline.

Furthermore, a delta-lognormal GAM standardized index of abundance based on the Beam Trawl Survey (BTS) dataset has been developed and is applied here. Comparisons are made on the results of alternative model runs using the different indices. A more detailed explanation on the procedure followed to develop the new index can be found in a companion Working Document.

No update of the catch data has been yet carried out as the same procedure followed in the previous benchmark, and subsequent working groups, will be applied on the 2019 data before the 2020 session of WGNSSK. No major revisions of the catch dataset have been recorded.

1.1 Issue list

The following items form the issue list assembled by the last session of WGNSSK (ICES 2019).

Tuning series

- Evaluate Belgium BTS index, and other surveys (eg. German BTS) covering stock area not covered by other surveys currently in assessment (SNS, BTS-ISIS).

- Explore combining surveys. Analyse data and construct index using Delta GAM method.

Assessment

- Assessment residuals patterns age 2-3 in landings. Investigate residuals using different setting of AAP model.

Forecast

- Review forecast procedure. Evaluate current RCT3 settings and autumn reopening.

Biological Reference Points

- Determine MSY (proxy) reference points. Depending on the assessment method and available data.

The work carried out for this benchmark has concentrated on addressing the first two items in the list. An standardized BTS index of abundances, using all samples available in DATRAS, has been developed and is presented in a working document to this meeting. Patterns in residuals to the catch-at-age fit for ages 2 and 3 have been improved by separating the parameters controlling the flexibility of the selectivity-at-age and fishing mortality splines. Regarding the settings used for the RCT3 recruitment forecast and its application in the autumn reopening of advice, an ICES workshop will soon meet to discuss the issue in detail, so no further work has been carried out. Finally, the determination of candidate reference points is presented below based on the results of the base case stock assessment run.

2 Data

2.1 Life history parameters

2.1.1 Growth

Weights-at-age in the landings are obtained from the various national market sampling programmes, while those in the stock are the 2nd quarter landings weights, as estimated when raising the North Sea sole data. Estimates of weights for older ages fluctuate more widely due to the smaller samples sizes, most notably on ages 8-10 over the last few years. The discards-at-age are estimated from the different sampling programmes since 2002. Discards weights-at-age for the period prior to 2002 are assumed to be equal to the average of the period 2002–2013.

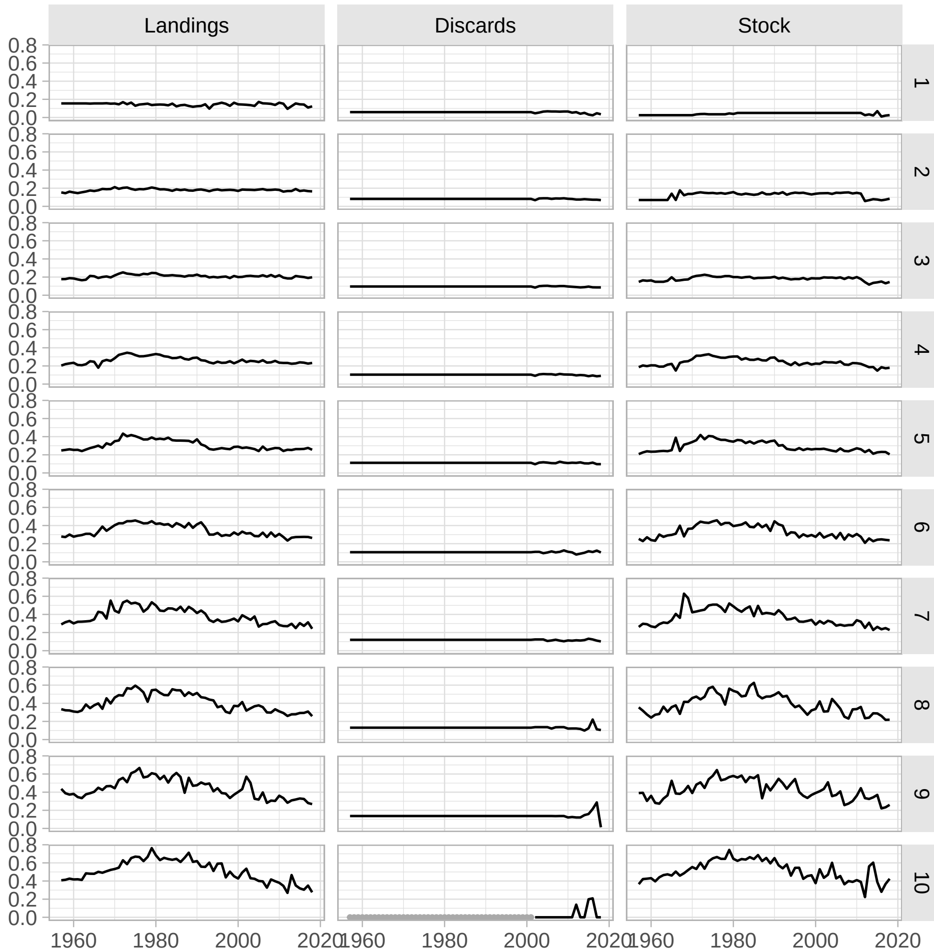


Figure 1: Time series of weights-at-age in the landings, discards and stock for North Sea sole (sol.27.4) and for the 1957-2018 period, as used in all stock assessment runs.

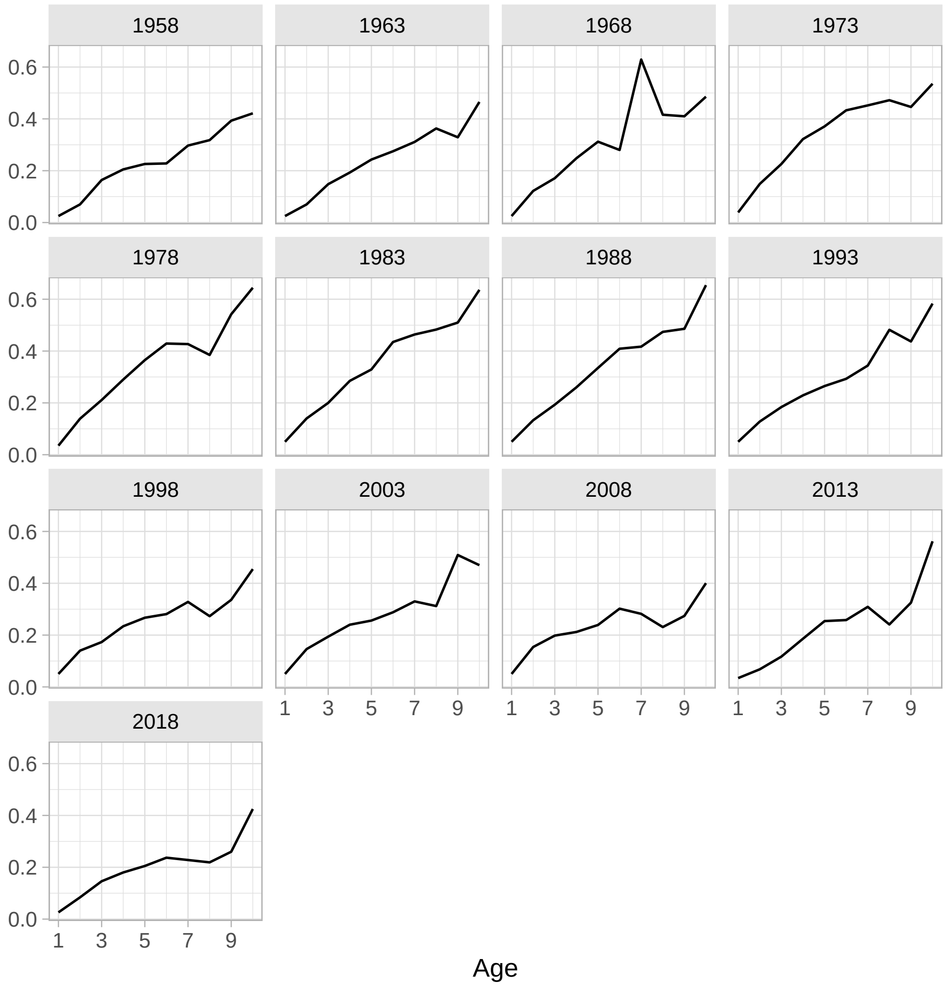


Figure 2: Weights-at-age in the stock, as sampled during the various surveys, as used in the stock assessment.

2.1.2 Maturity

A knife-edge maturity-ogive is currently being used, assuming no maturation at-ages 1 and 2, and full maturation at-age 3, as has been done in the past. Although data on maturity is available from sampling on both surveys and commercial fleets, no investigation of possible alternative maturity schedules, or of changes over time, could be conducted.

2.1.3 Natural mortality

As in previous assessments, natural mortality in the period 1957–2019 has been assumed constant over all ages at 0.1, except for 1963 where a value of 0.9 was used to take into account the effect of the severe 1962-1963 winter.

2.2 Landings and discards

Model runs presented here are bnased on the landings and discards dataset employed in the 2019 assessment (ICES 2019). Discards data for this stock are only available from 2002 (Figure 3).

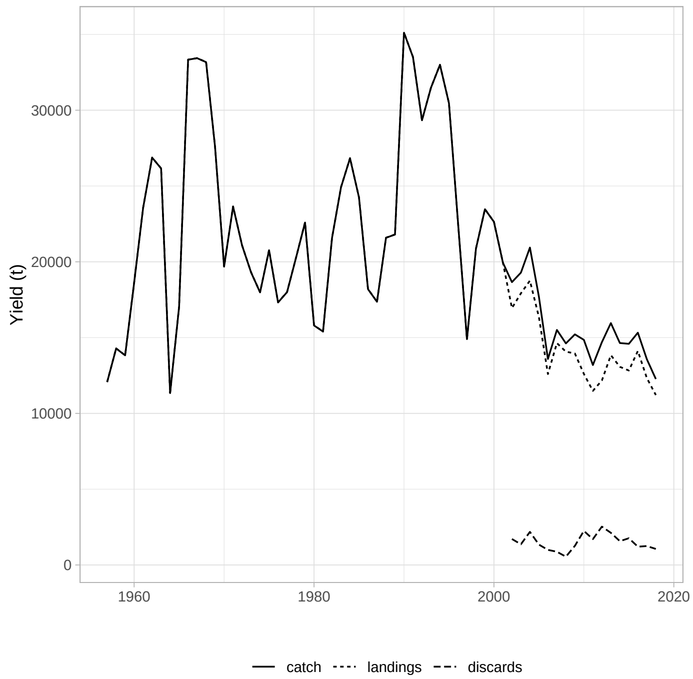


Figure 3: Time series of total catch, landings and discards for North Sea sole (sol.27.4) and for the 1957-2018 period.

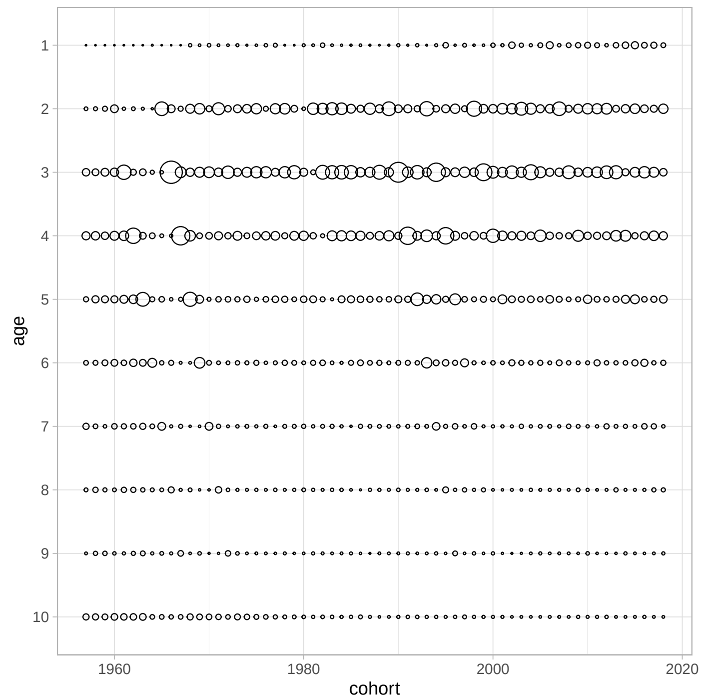


Figure 4: Bubble plot of the catch-at-age series for North Sea sole (sol.27.4) and for the 2002-2018 period.

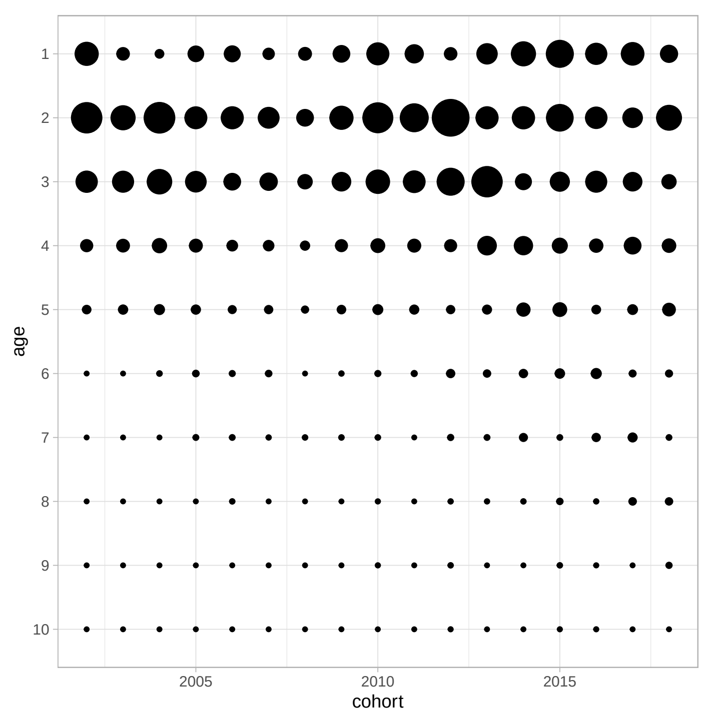


Figure 5: Bubble plot of the discards-at-age series for North Sea sole (sol.27.4) and for the 2002-2018 period.

2.3 Surveys

Two surveys are carried out that provide information on this stock: The Beam Trawl Survey (BTS) and the Sole Net Survey (SNS). Use of the BTS data has so far been limited to the Dutch BTS-Isis dataset. A combined index, incorporating BTS quarter 3 samples taken by the Netherlands, Belgium and Germany, is used together with the SNS survey as a base case run of the AAP model. Runs are also presented using the traditional BTS-Isis index. Trends in abundance-at-age for both BTS indices can be foiund in Figure 6.

2.3.1 BTS tuning indices

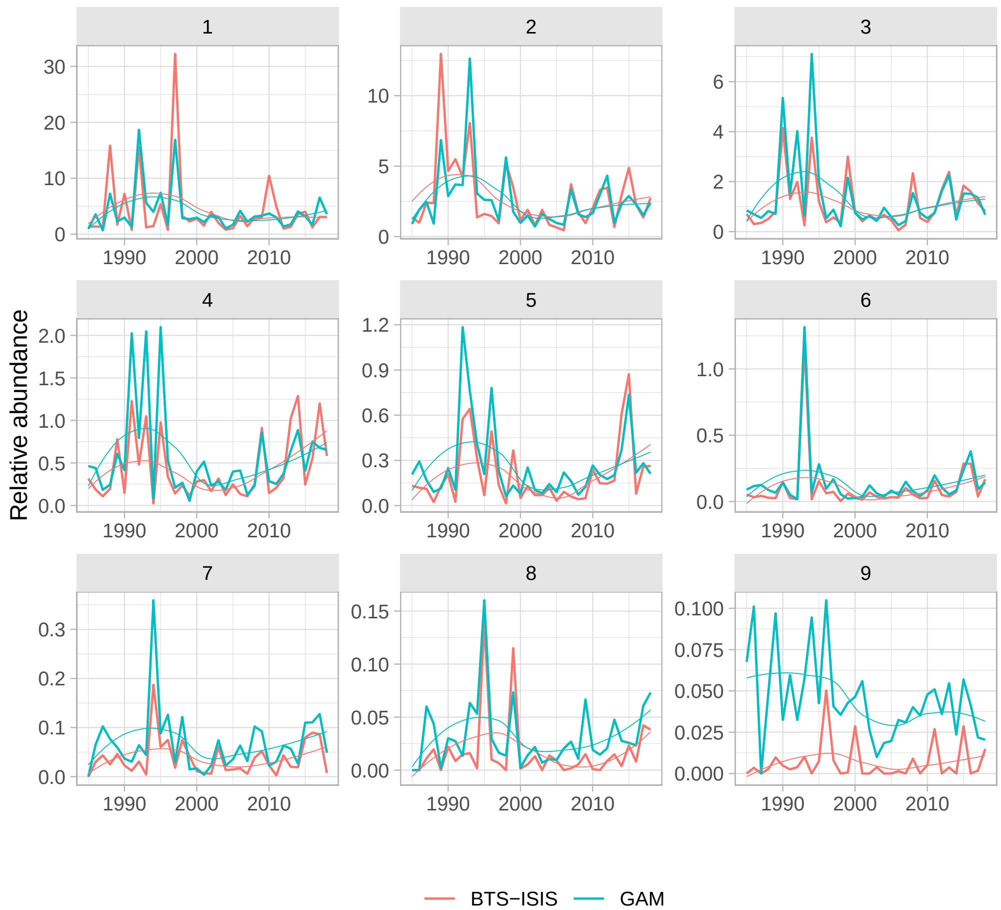


Figure 6: Comparison of the two alternative indices of abundance-at-age derived from samples taken during the quarter 3 Beam Trawl Survey (BTS). BTS-ISIS refers to the traditional index based, and GAM to the standardized index using NL, BE and DE data. Indices are rescaled to the mean by age for plotting and a loess smoother is shown for each index.

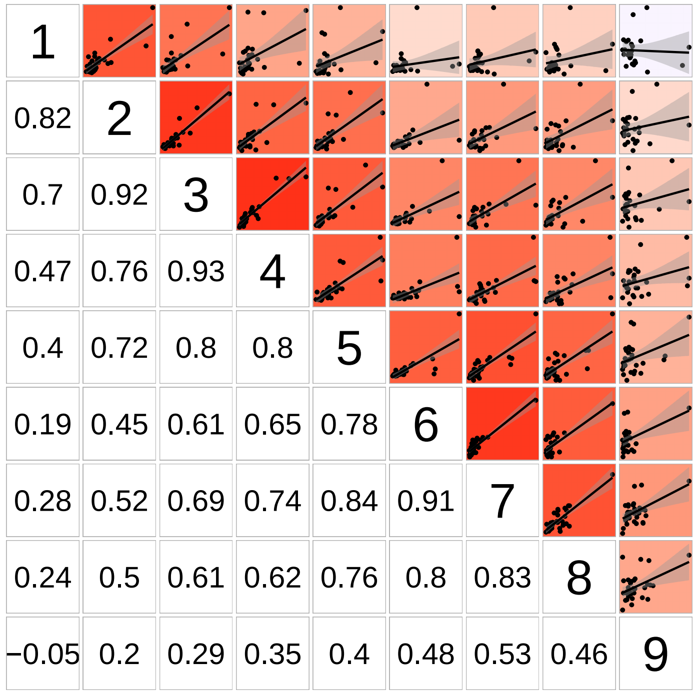


Figure 7: Internal consistency of the information by cohort of the standardized index of abundance at age based on the BTS survey samples (GAM).

2.3.2 SNS - Sole Net Survey

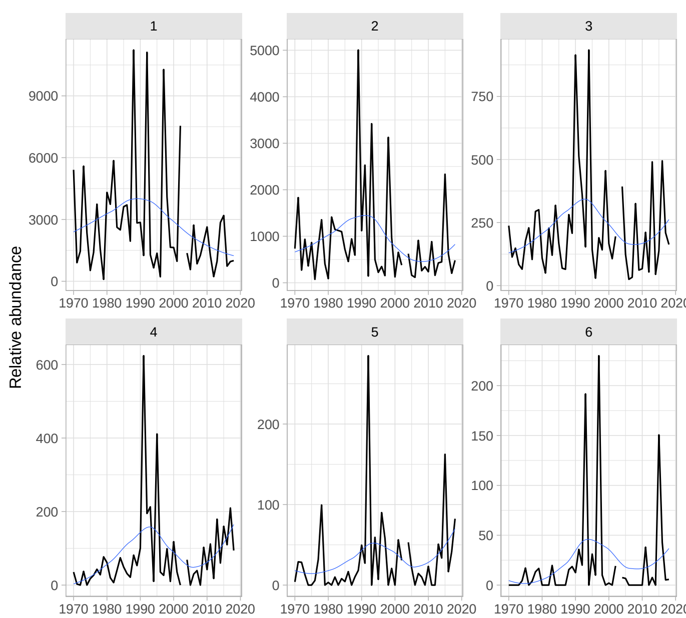


Figure 8: Relative abundances at age in the Sole Net Survey (SNS) for the 1970-2018 period, and for ages 0 to 6.

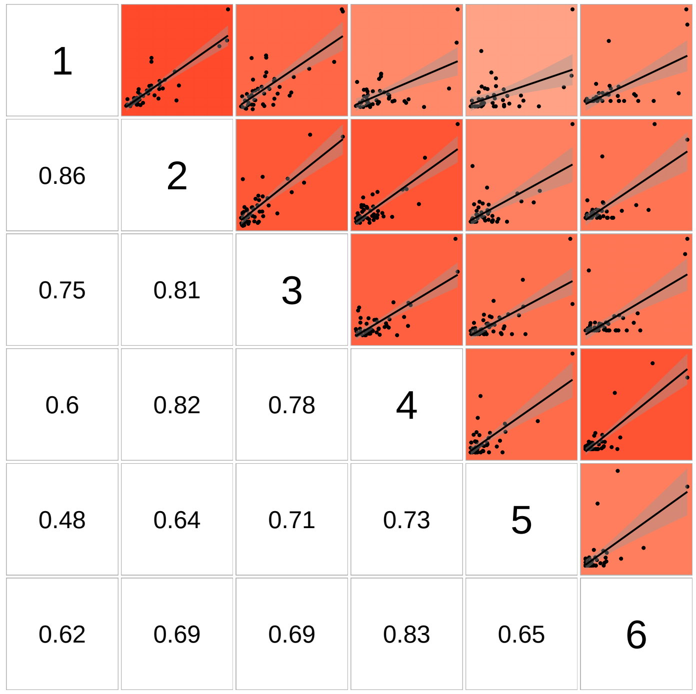


Figure 9: Internal consistency of the information by cohort of the index of abundance at age based on the SNS survey samples (SNS).

2.3.3 Commercial landings-per-unit-effort series

No commercial LPUE series has been included in this analysis, following the considerations of the previous benchmark (ICES 2015) on the suitability of the Dutch beam trawl series as an index of abundance. The changes brought to this fleet by the adoption of pulse fishing over the recent period will furthermore soon be undone, as a ban on the use of this gear will be applied in 2020-2021.

3 Assessment model

The base case stock assessment has been carried out using the currently-employed model, AAP (Aarts and Poos 2009). This is a traditional discrete-time age-structured population model that estimates separately both landings and discards-at-age. The extensions to the original formulation used in the sol.27.4 assessment since the last benchmark (ICES 2015) have been retained, namely:

1. Modelling of the F-at-age matrix by means of a tensor spline rather than using a full separability assumption.
2. The proportion discarded at-age is described by a simple logistic function.
3. Use of the maximum likelihood search in ADMB (Fournier et al. 2012).

In addition, the model has been modified so as to separate the number of knots in the selectivity-at-age spline and those in the age dimension of the F-at-age tensor spline. Finally, the model has been turned into an R package (available at https://github.com/iagomosqueira/AAP), making use of the FLR classes and methods (Kell et al. 2007). This has simplified the development of the stock assessment work following the ICES TAF guidelines.

3.0.1 Model settings and data

The base case run of AAP employs the following data sources and model settings. In the case if the tuniung indices, the base case run empoyes the standardized BTS series (BTS-GAM) and the SNS one. Comparison runs are presented using the traditonal BTS-based index of abundance (BTS-Isis), and one in which the data employed in this index (BTS samples for the Dutch Isis series) have also been standardized using the same GAM-based methodology, so as to assess the effect of the procedure on the index.

Setting / data	Value / source
Catch-at-age	Landings (since 1957, ages 1-10)
	Discards (since 1957, ages 1-10)
Tuning indices	BTS-GAM (since 1985, ages 1-9)
	SNS (since 1970, ages 1-6)
	BTS-Isis (since 1985, ages 1-9)
	GAM-Isis (since 1985, ages 1-9)
Plus group	10
First tuning year	1970
Time-series weights	No taper
Catchability catches independent of ages stock size for age >=	9
Catchability surveys independent of ages for ages >=	7
Tensor spline for catchability-at-age both indices k value ages	6
Tensor spline for F-at-age: k value ages	8
Tensor spline for F-at-age: k value years	28

4 Stock assessment runs

4.1 Base case (GAM-combined BTS)

The AAP run with the BTS-GAM and SNS indices, and the variable setup presented before, provides the following estimates of historical dynamics and present stock status.

4.1.1 Abundances, recruitment and fishing mortality

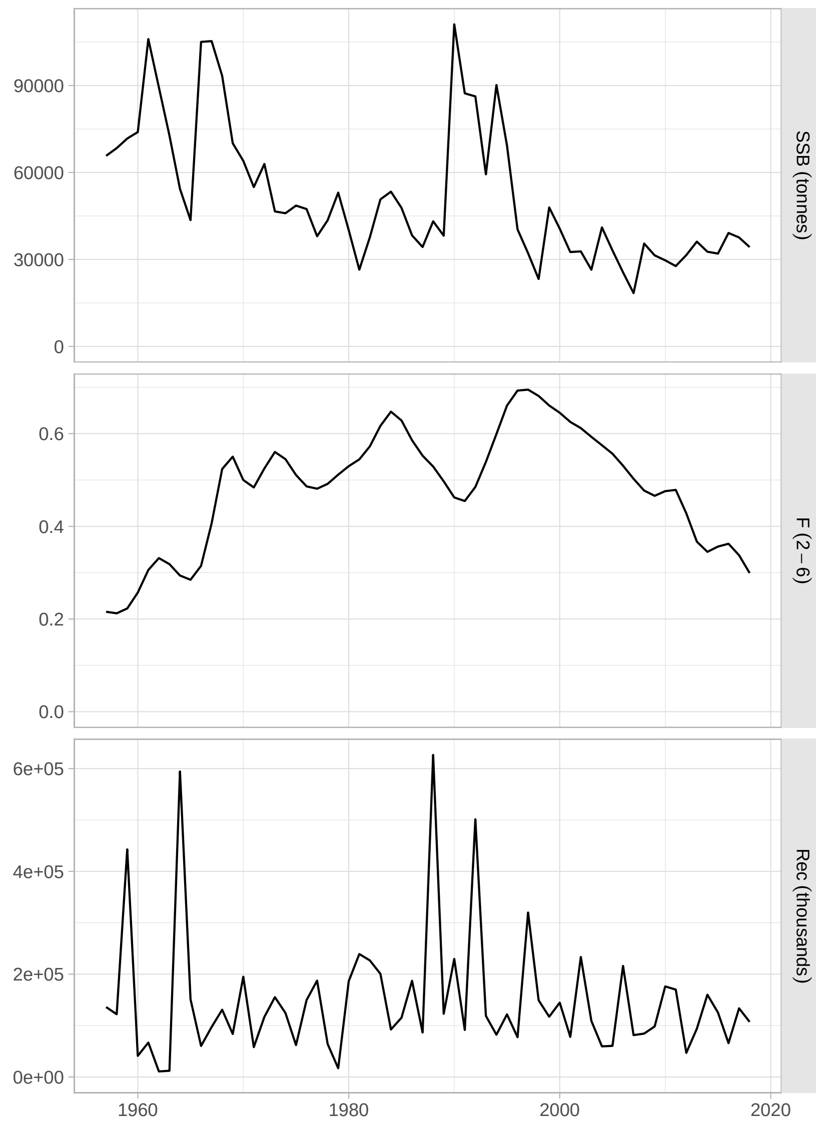


Figure 10: Estimates of SSB, mean fishing mortality and recruitment derived from the base-case AAP run employing the combined BTS index.

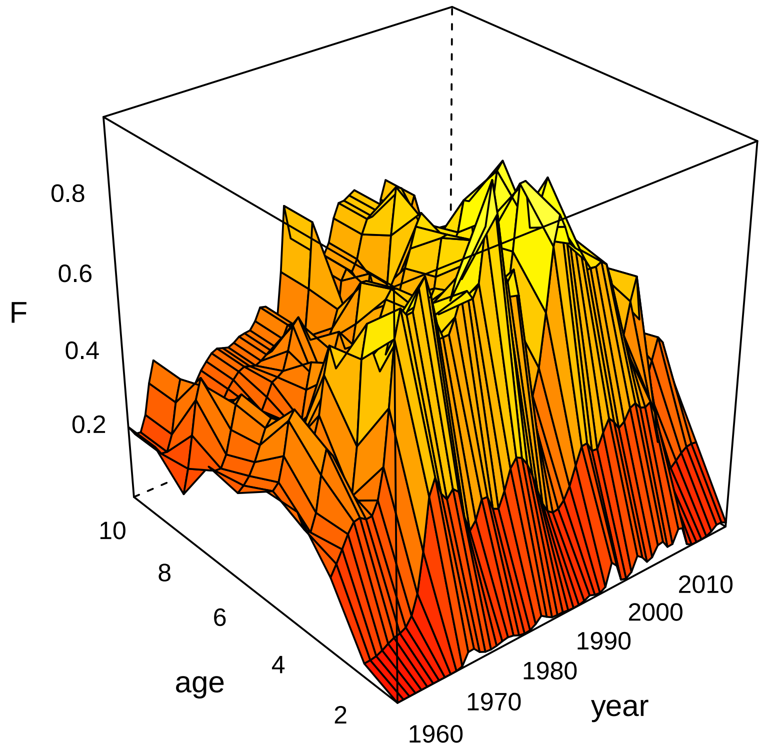


Figure 11: Wireframe plot of the estimated fishing mortality values by age and year.

Figure 12: Yearly values of fishing mortality at age for the base case AAP model run.

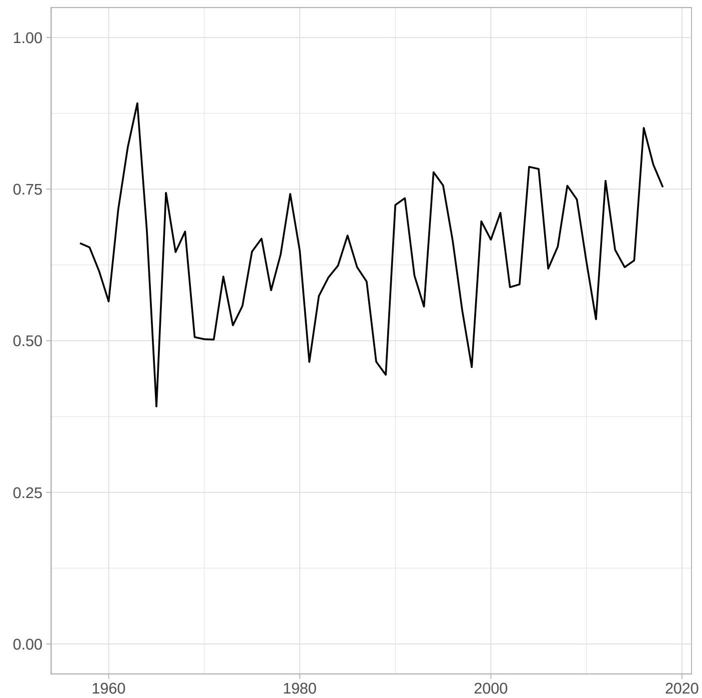


Figure 13: Harvest rate as the percentage of the estimated vulnerable biomass being caught by year.

4.1.2 Selectivities

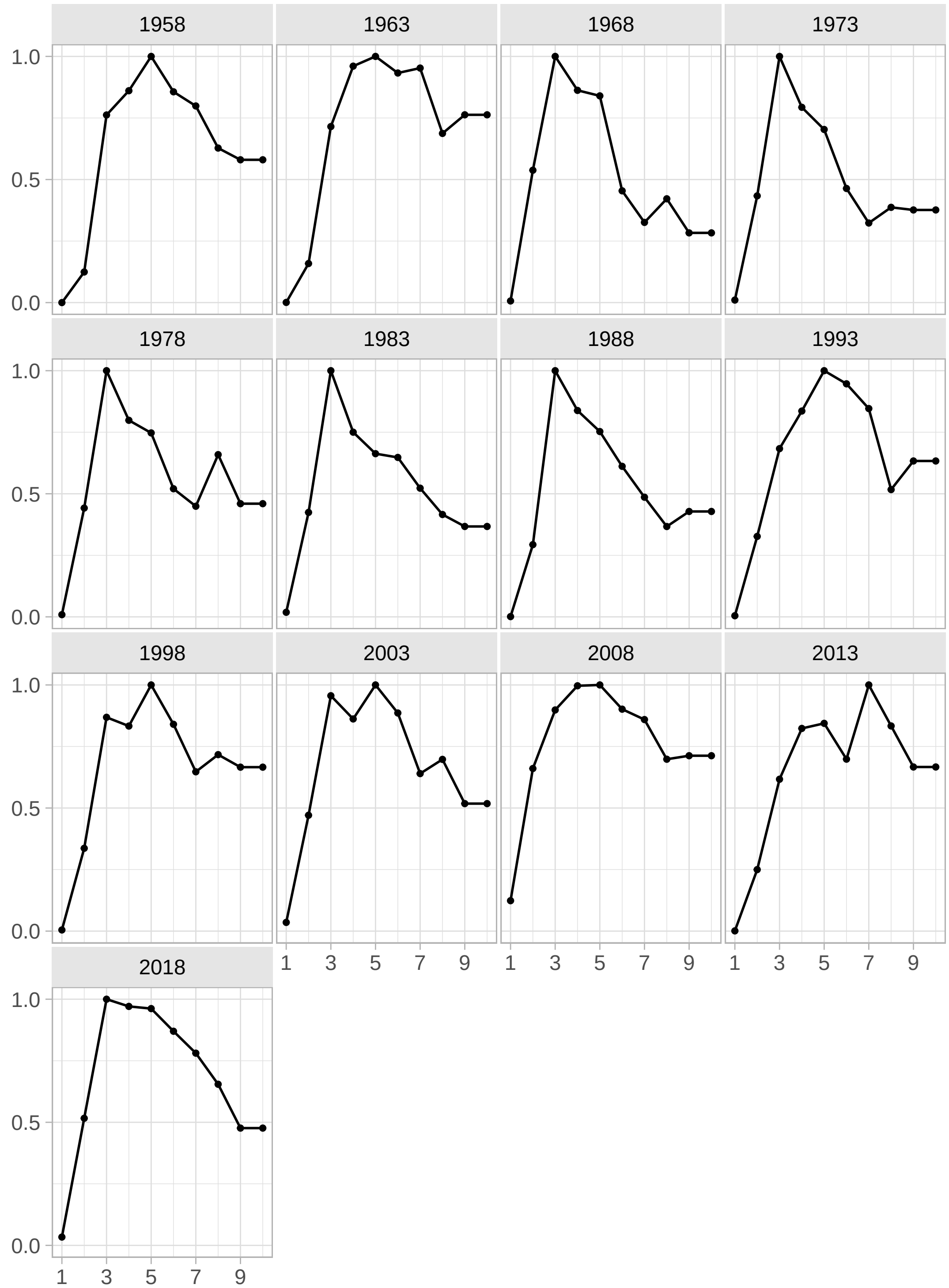


Figure 14: Estimates of selectivity at age in the catch every five years.

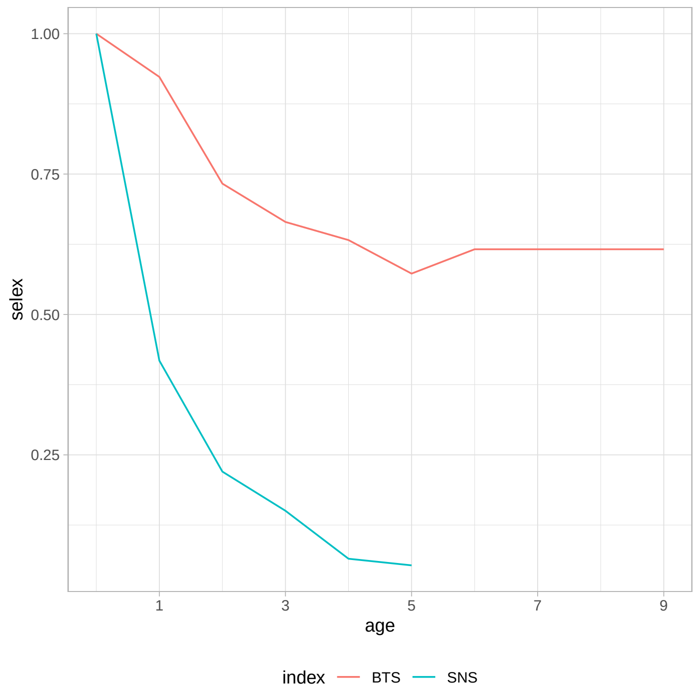


Figure 15: Selectivities at age for the BTS-GAM and SNS surveys.

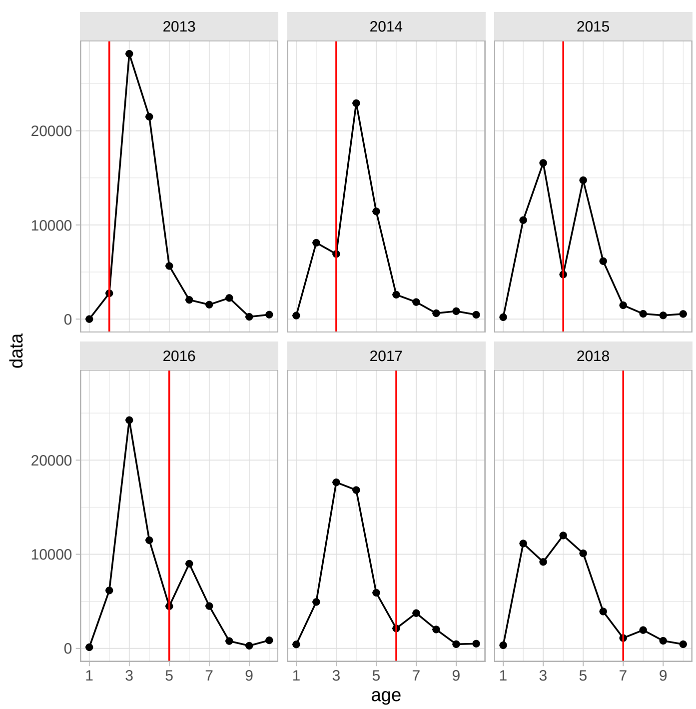


Figure 16: Landings and survey abundances at age for the last six years of the series. The red line shows the progression of the 2010 cohort.

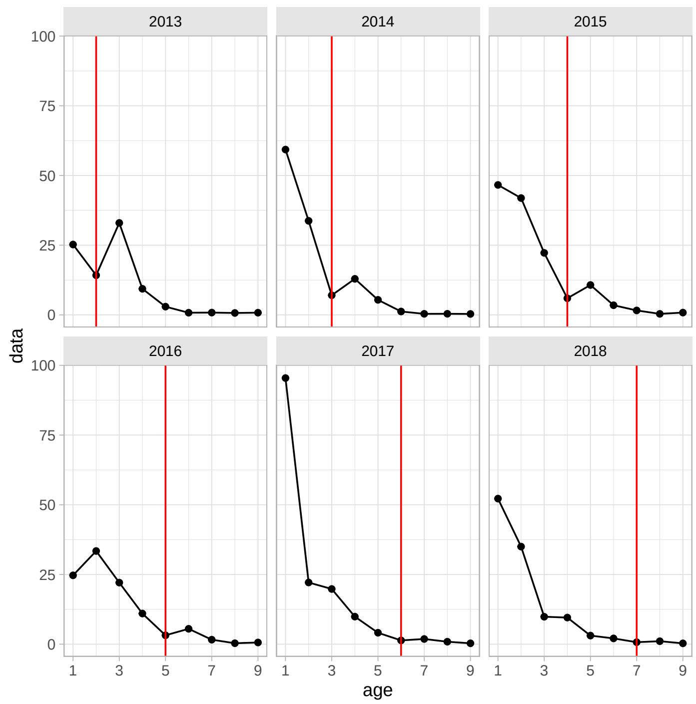


Figure 17: Landings and survey abundances at age for the last six years of the series. The red line shows the progression of the 2010 cohort.

4.1.3 Residuals

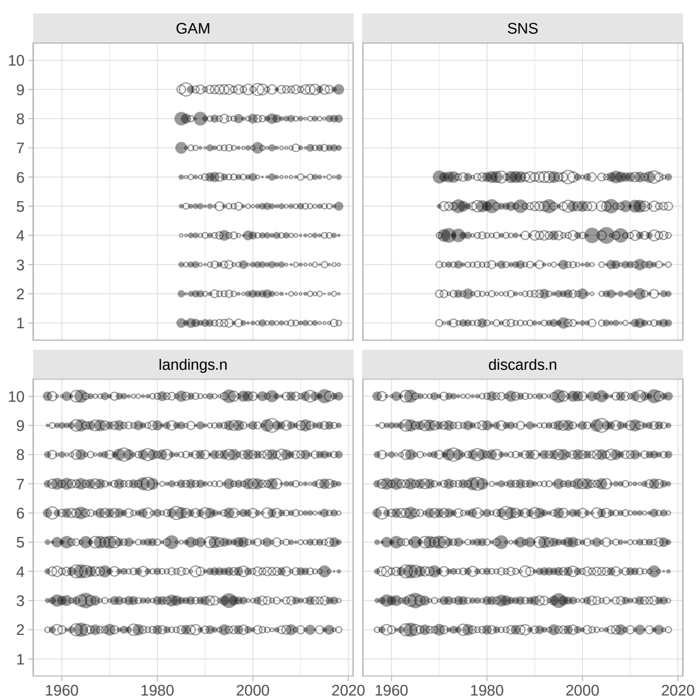


Figure 18: Bubbleplot of residuals at age by year for the indices of abundance, landings-at-age and discards-at-age.

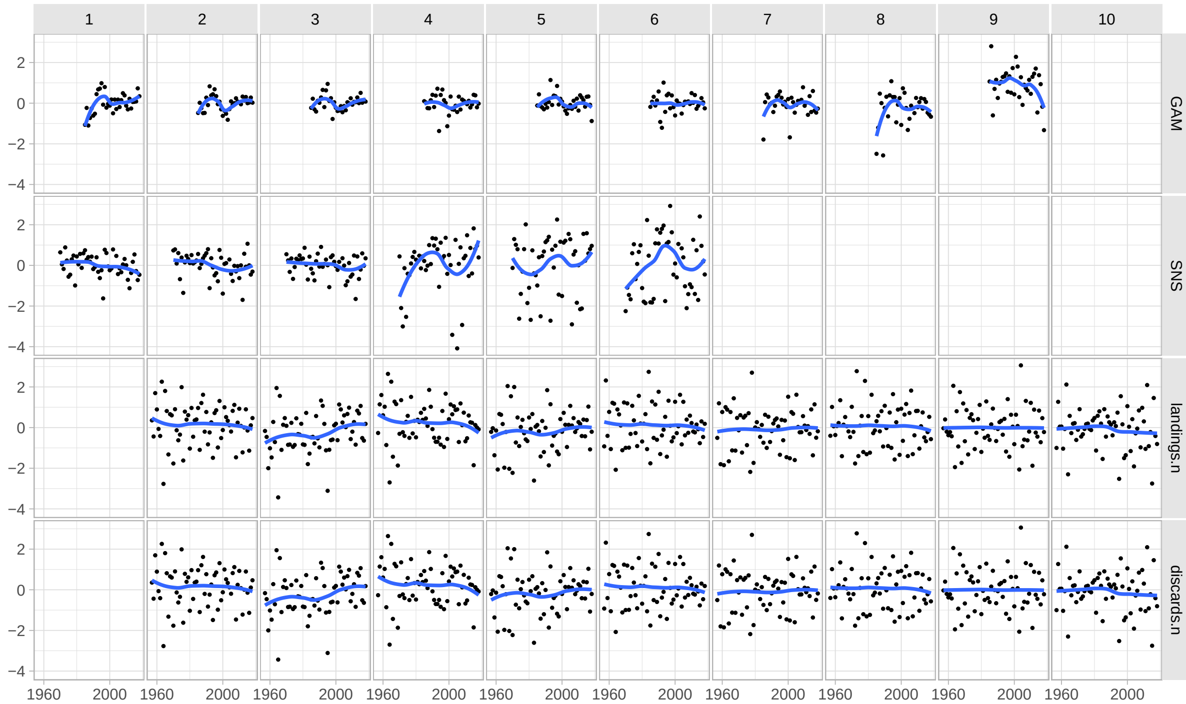


Figure 19: Time series of log residuals for the fits to each abundance index, landings-at-age and discards-at-age.

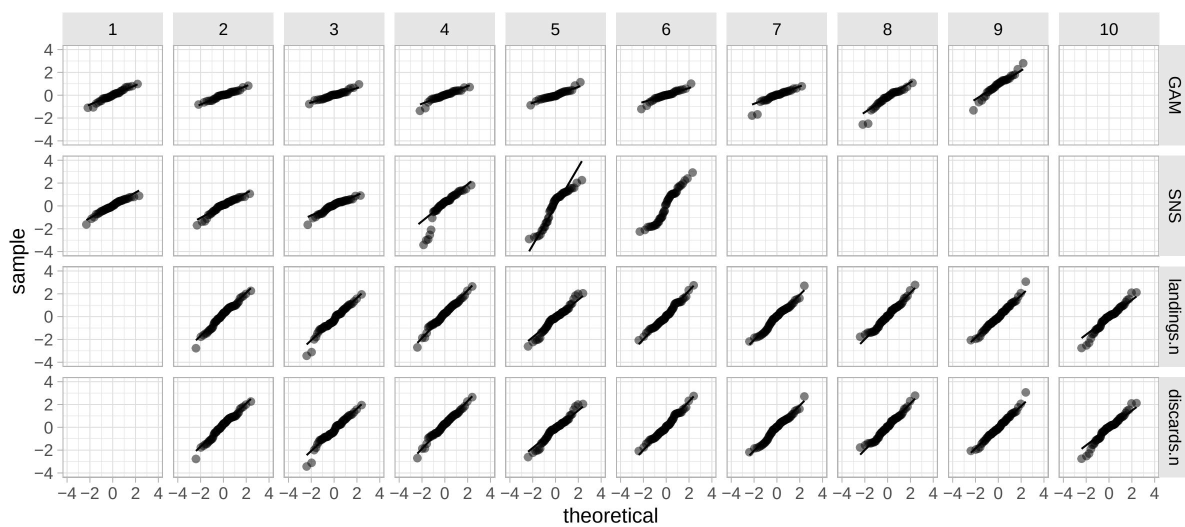


Figure 20: QQplot of residuals at age by year.

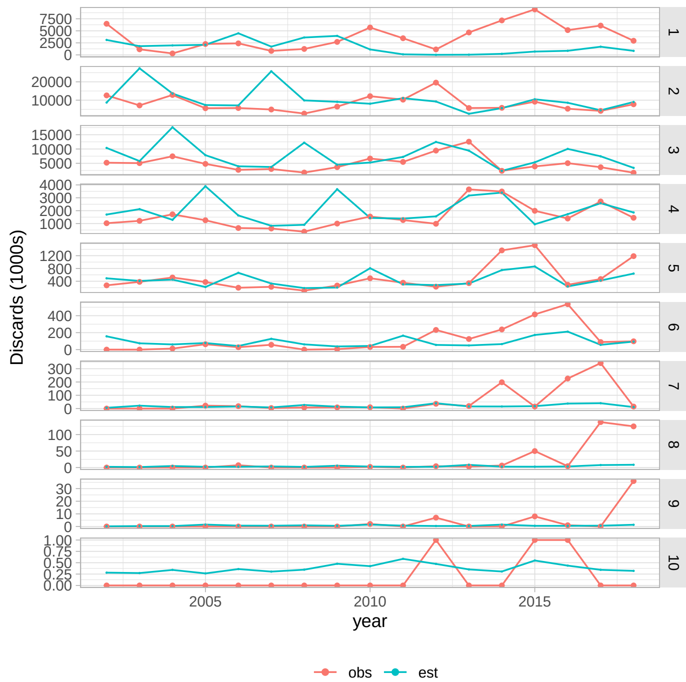


Figure 21: Estimated and observed discards-at-age.

4.1.4 Estimation uncertainty

A run of the base case AAP stock assessment was carried out using the `mcmc`=TRUE argument, which employs the Metropolis-Hastings algorithm implemented in ADMB. The McMC chain was run for 100,000 iterations and thinned down to every 100th. No detailed exploration of the chain output has been carried out.

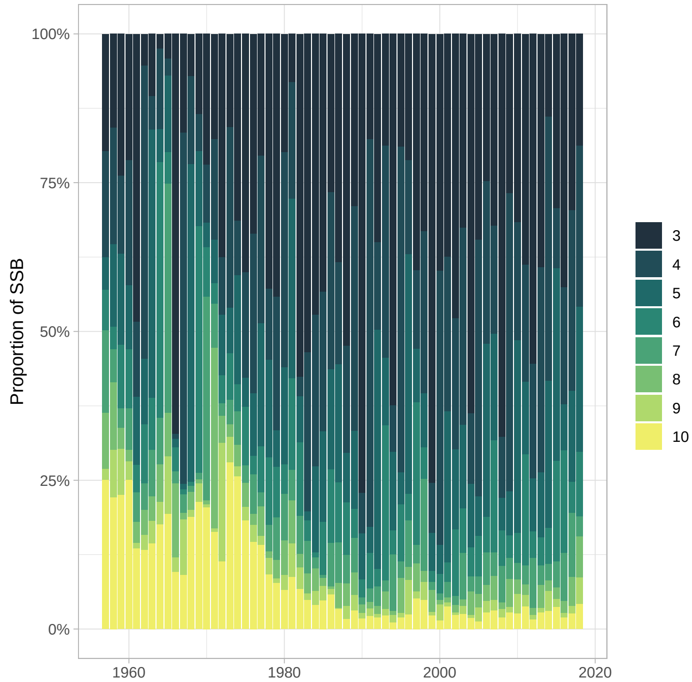
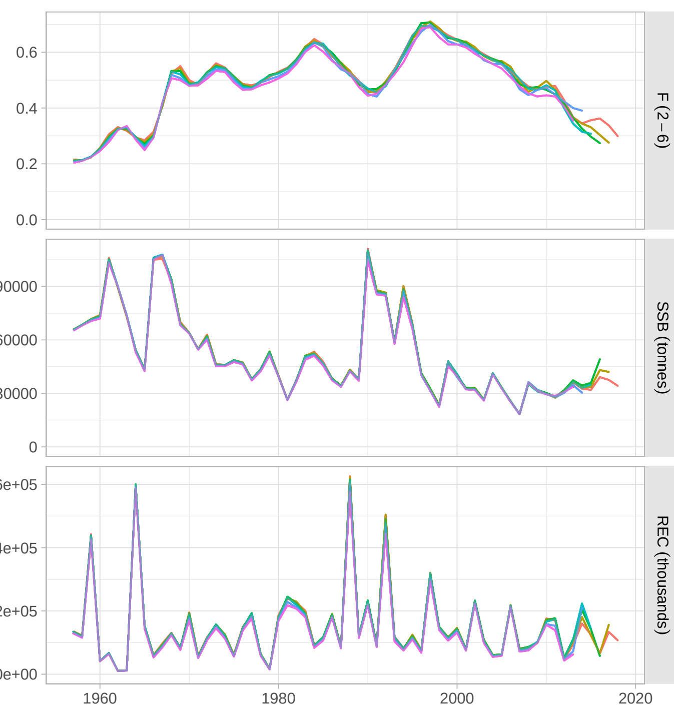
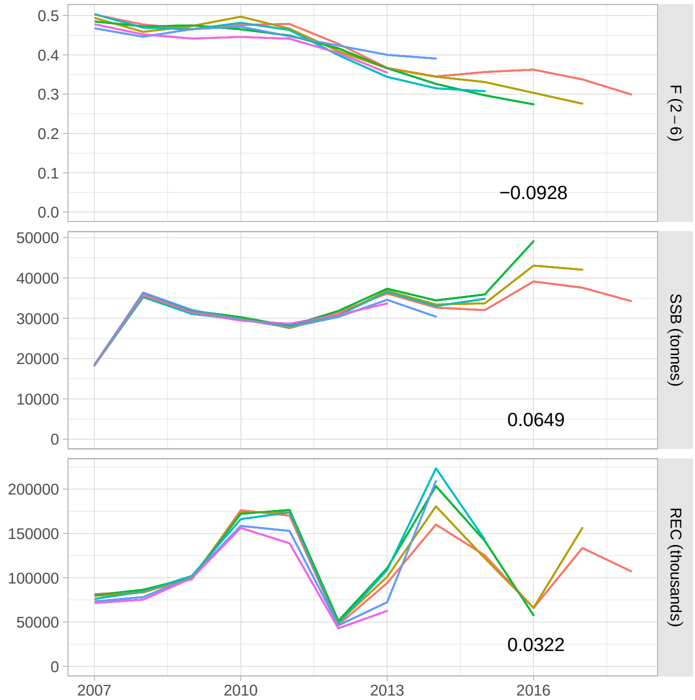


Figure 22: Changes in the proportion of SSB accounted for by each age in the stocks, for the 1957-2018 period.

4.1.5 Retrospective

The retrospective patterns of the AAP base case model fits can be seen here, for the whole time series, and for the last 11 years only.




0.5
0.4
0.3
0.2
0.1
0.0
−0.0928
F (2 − 6)
50000
40000
30000
20000
10000
0
0.0649
SSB (tonnes)
200000
150000
100000
50000
0
0.0322
REC (thousands)
2007
2010
2013
2016

5 Comparison of model runs

The use of the delta-lognormal GAM standardized index of abundance leads to estimates of recent stock status that are around 69% of those obtained when the traditional index was used (Figure 23). Trends in F and SSB differ for the cohorts still alive. A run carried out with the GAM-ISIS index (standardized but using the BTS-ISIS dataset) appears to indicate that the majority of the differences are due to the different datasets employed (Figure 23).

Figure 23: Time series of recruitment, SSB and fishing mortality obtained from runs of AAP using three different BTS-based indices of abundance.

6 Stock-recruitment relationship

Three stock-recruits relationship were fitted to the estimates of the AAP base case model run: Beverton & Holt, Ricker, and segmented regression. The parameterizations and likelihood functions contained in the *FLCore* package (Kell et al. 2007) were used.

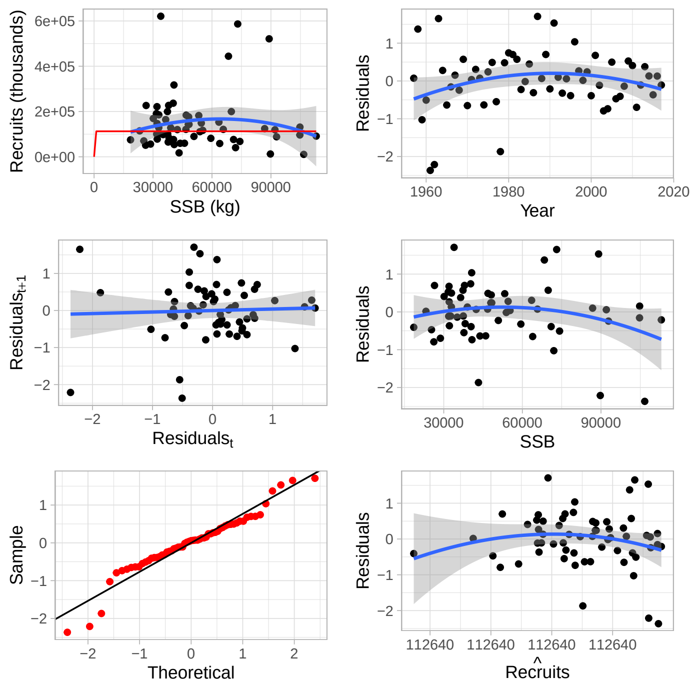


Figure 24: Fit to the Beverton and Holt stock-recruits relationship, $R = a \cdot \text{SB} / \cdot b + \text{SB}$.

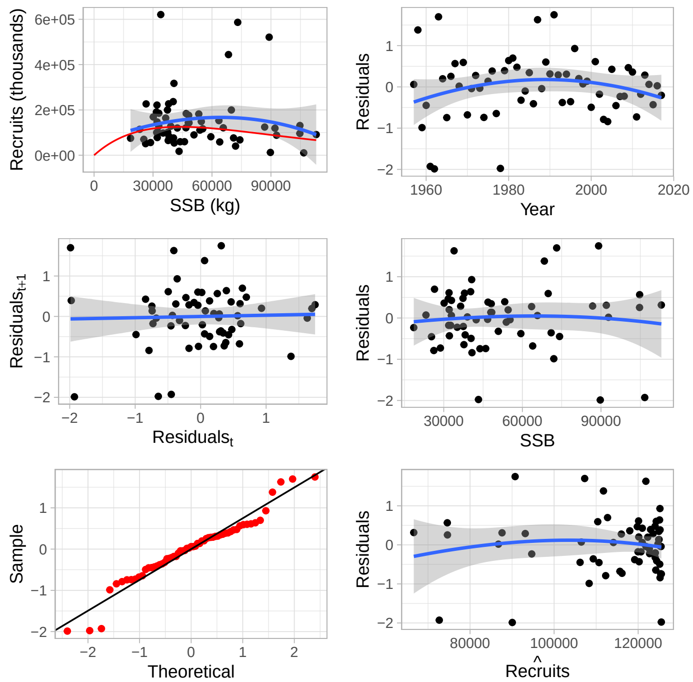


Figure 25: Fit to the Ricker stock-recruits relationship, $R = a \cdot \text{SB} \cdot e^{-b \cdot \text{SB}}$.

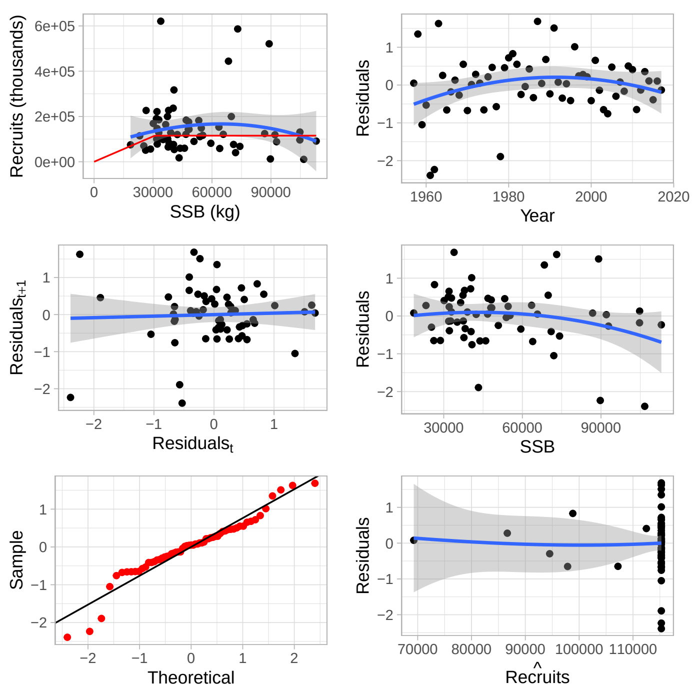


Figure 26: Fit to the segmented regression stock-recruits relationship.

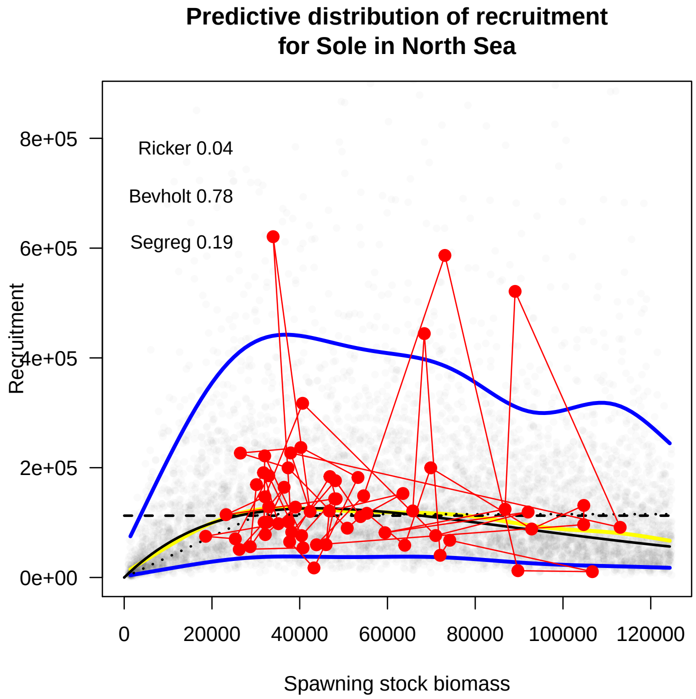


Figure 27: Results of the application of the *eqsim* procedure to the stock/recruits estimates from the base case model run.

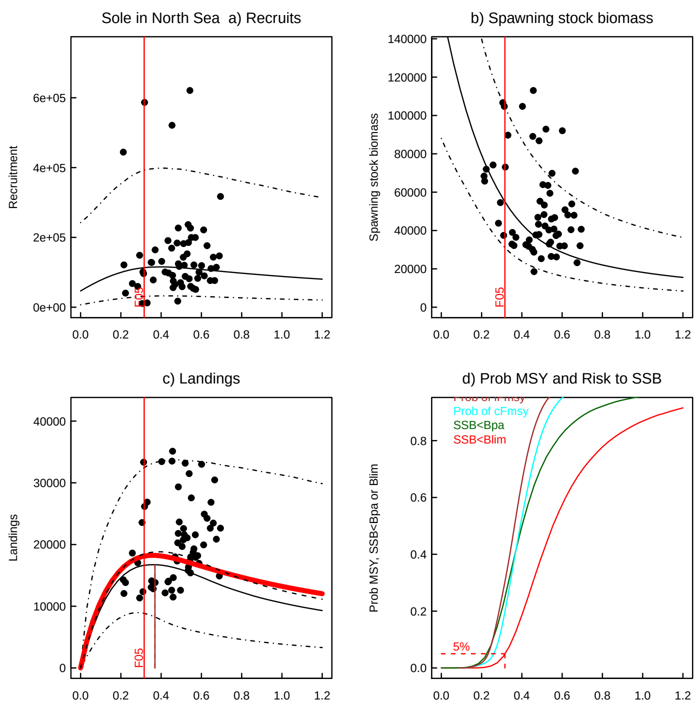


Figure 28: Results of the application of the *eqsim* procedure to the stock/recruits estimates from the base case model run.

7 Reference points

Application of the standard *eqsim* procedure to estimate the reference points for this stock has led to the following values:

Table 2: Estimated initial set of reference points.

Parameter	Estimate
Fmsy	0.356
F05	0.316
Flim	0.494
Fpa	0.353
Btrigger	31378.862
Blim	30884.249
Bpa	43237.948

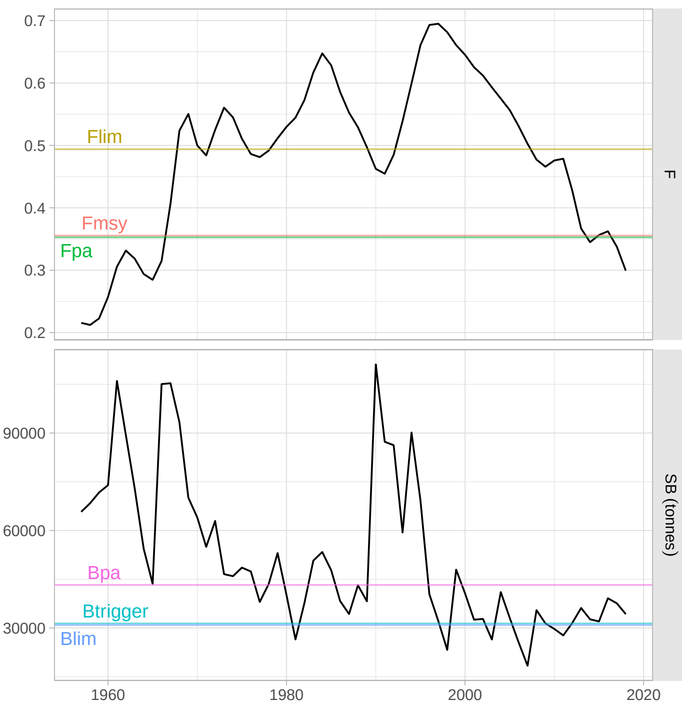


Figure 29: Time series of estimated F and SSB with corresponding calculated reference points.

8 Discussion

A base case run of the AAP model (Aarts and Poos 2009) for the North sea sole stock, using a combined (NL+BE+DE) index of abundance is fit to the current dataset of landings and discards for the 1957 - 2018 period. The model configuration is almost identical to that employed since the previous benchmark, with some changes to the flexibility given to some of the various model splines. The modifications made to the model seem to have eliminated the poor fit to the landings of ages 2 and 3 reported in previous working group reports.

Using the combined index leads to a difference in current status and trends over the last few years. The methodology employed in the standardization of the index has been well tested and validated, but a careful reviwew of the precise application that was made of it in this case is required.

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Working document: Preparation of catch data for Sole (*Solea solea* L.) in the eastern English Channel (ICES division 7.d)

Authors: Lies Vansteenbrugge and Sofie Nimmegeers

Introduction

The WKFLATNSCS 2020 benchmark data call asked for a review of the French catch data after an issue with the plusgroup was discovered after the Interbenchmark Protocol in August 2019. France re-uploaded its data to InterCatch for the period 2016-2018. Although other member states were not asked to upload new data, UK England uploaded an update of their catch data for 2016-2018, and also Scotland re-uploaded data for the period 2002-2008. After extraction of the data for 2002-2008, it appeared to be zero landings with the exception of 2008 (18 kg).

As a result of the re-upload of the data for the period 2016-2018, two things are clear:

- France grouped its catch data in fewer métiers for this new upload.
- The total catch differed by -6% for 2016, -3% for 2017 and -4% for 2018 compared to the catch used during the last working group (WGNSSK). The main difference was found when comparing the discards. An overview is given in the table below.

		Catch	
	WGNSSK	WKFLATNSCS 2020	Difference (%)
2016	2869	2689	-6%
2017	2393	2320	-3%
2018	2589	2484	-4%
		Landings	
	WGNSSK	WKFLATNSCS 2020	Difference (%)
2016	2538	2543	0%
2017	2228	2240	1%
2018	2314	2317	0%
		Discards	
	WGNSSK	WKFLATNSCS 2020	Difference (%)
2016	331	146	-56%
2017	165	80	-52%
2018	275	167	-39%

Discard raising and age allocations were performed in InterCatch according to the 2017 benchmark WKNSEA procedures. Below an overview is given on these procedures.

Raising discard data

If discards were not included for a particular métier-quarter-country-year combination, they were assumed to be unknown (non-zero) and raised. The instructions in the data call specified that if discards were 0, this had to be included in the upload to InterCatch (as a 0).

Discards on a country-quarter-métier basis were automatically matched by InterCatch to the corresponding landings. The matched discards-landings provided a landing-discard ratio estimate, which was then used for further raising (creating discard amounts) of the unmatched discards. Discard rates larger than 0.5 were excluded from the raising process. Given sole is a target species, such large discard rates were not considered representative. The weighting factor for raising the discards was '*Landings CATON*' (landings catch).

Discard raising was performed on a gear level regardless of season or country. This approach was favoured over a more detailed one (e.g. using 1 or 2 quarters from 1 country to complete all other quarters of that country). Raising per gear group was performed when the proportion of landings for which discard weights are available, was equal or larger than 75% compared to the total landings of that group (discard ratio coverage: Ldis_gear).

- The following groups were distinguished based on the gear:
    - TBB
    - OTB, SSC and SDN
    - GTR and GNS
    - REST combining the remaining gears, e.g. MIS, FPO, LLS and DRB

An overview of the discard ratio coverage per year is given in the table below.

Gear group	2016	2017	2018
TBB	89%	88%	91%
OTB, SSC, SDN	89%	80%	89%
GTR, GNS	97%	86%	90%
REST	0%	0%	0%

When the threshold was not reached for a gear group, it was pooled with the rest group to raise discards based on all available information (overall). However, for these three years, this was not the case.

Age allocations

To allocate age compositions, landings and discards were handled separately; samples from landings were used only for landings and vice versa.

When age distributions had to be borrowed from other métiers, allocations were completed according to the following scenarios:

1. **By métier.** Age allocation for landings of the most important métiers representing 75% of the total landings were performed on the métier level. For example: In 2018, TBB_DEF_70-99, GTR_DEF_90-99, OTB_DEF_70-99 and GTR_DEF_100-119 together covered ≥75% of the total landings (79%). Unsampled data for each of these métiers was complemented with age data from that same métier. This scenario was only used when performing age allocations for landings.
2. **By gear group.** For the remaining unsampled data (both landings and discards), the same gear groups (TBB; OTB-SSC-SDN; GTR-GNS; REST) as used for discard raising were applied. When the threshold of 75% was reached for the proportion of landings or discards covered by age (Lage_gear and Dage_gear respectively), allocation of age occurred with all available information within that gear group. For example: In 2018, the proportion of landings covered by age was 99.8% for the gear group OTB/SSC/SDN . Age allocations for all strata within that group (e.g. SSC_DEF_70-99, quarter 4) were performed using the available sampled OTB/SSC/SDN data.
3. **Use all (overall).** When the threshold of 75% was not reached for the proportion of landings or discards covered by age for a gear group, unsampled data were pooled in the REST group and ages were allocated using all sampled data (overall).

The weighting factor used with all scenarios was '*Mean Weight weighted by numbers at age*'.

Conclusion

The procedures of raising discards and allocating ages as determined during the WKNSEA 2017 was still considered appropriate as there were no large changes in the different strata uploaded to InterCatch.

Working document: Belgian commercial beam trawl landings data for sole in the eastern English Channel (ICES division 7.d) and sole in the Bristol channel and the Celtic Sea (ICES divisions 7.f and 7.g).

Authors: Klaas Sys, Bart Vanelslander, Sofie Nimmegeers and Lies Vansteenbrugge (ILVO, Belgium)

1. Introduction

The Belgian commercial fishing fleet has fishing opportunities in several ICES Divisions. To allow an efficient exploitation of the stocks over all these areas, vessels are allowed to fish in different ICES divisions within one trip (e.g. while steaming from a Belgian harbour to a foreign harbour). This flexibility of fishing in different ICES divisions might create opportunity for non-compliance. During the inter-benchmark protocols on sole in ICES division 7.d (eastern English Channel) and on sole in ICES divisions 7.f and 7.g (Bristol Channel , Celtic Sea), both in 2019, a revision of the Belgian commercial beam trawl tuning fleet occurred (ICES, 2019 a,b). Investigating the Belgian sole landings data revealed that pure trips, *i.e.* trips in which fishing activity was limited to one of the sole stock areas (ICES division 7.d or ICES divisions 7.f and 7.g), often a considerably different mean landing rate ($kg.h^{-1}$) than mixed trips (*i.e.* trips in which fishing occurred in multiple ICES divisions). In this working document, we further explore this difference in landing rate.

2. Data sources

2.1. Logbook and sales notes data

Every period of 24 hours during a fishing trip, except while steaming, the skipper has to report his fishing activity in the electronic logbook. The logbooks contain the estimated weight (kg) for all commercial species landed, grouped by ICES statistical rectangle (if fishing activity occurred in more than one ICES statistical rectangle, the ICES statistical rectangle with the highest proportion of fishing effort must be reported) and by day. They also provide information on the hours spent fishing per day. The landed weights were divided by those fishing hours to calculate the landings per unit effort (lpue; in kg/h). As the retained landings from the logbooks are estimated weights (with an upper and lower tolerance of 10%), the landed weights are derived from the quantities recorded in the sales notes. The sales notes contain information on the quantities auctioned by market category for all species landed, but no area information. Therefore, the percentage share of a species in an ICES statistical rectangle from the logbooks, is the basis for the distribution of the quantities auctioned on the ICES statistical rectangles.

2.2. VMS data

VMS (Vessel Monitoring by Satellite) data of all Belgian commercial vessels were used to analyse the fishing activity in ICES divisions 7.d, 7.f and 7.g. VMS is a satellite-based monitoring system which provides data to the fisheries authorities at regular intervals (mainly every 2 hours) on the location, data-time, course and speed of vessels. VMS equipment onboard is compulsory for all Belgian commercial fishing vessels. Belgian VMS data are collected by dienst Zeevisserij (Departement Landbouw en Visserij; Afdeling landbouw- en visserijbeleid) and can be analyzed by ILVO.

All data processing of combined VMS and logbook data was done in R using the vmstools package (Hintzen *et al.,* 2012). Only VMS records with speeds that corresponds with fishing activity were selected. VMS and logbook data were linked based on vessel identity and date-time. Using this link , we can combine data on fishing location, data and time, fishing speed and fishing gear. An extensive quality control of the data was performed. We checked for duplicated data, locations inside the harbours, impossible time, dates, headings and locations.

3. Pure versus mixed trips

Two fleet segments are actively fishing in ICES divisions 7.d, 7.f and 7.g: the small fleet segment with an engine power ≤ 221 kW and the large fleet segment with an engine power > 221 kW. Both fleet segments are known to carry out pure and mixed trips. Pure trips are defined as fishing trips during which a vessel registered fishing effort exclusively in one of the sole stock areas, so in ICES division 7.d or in ICES divisions 7.f and 7.g. The mixed trips, on the other hand are defined as fishing trips during which a vessel registered fishing effort in multiple ICES divisions, among which the 2 sole stock areas. An overview of the number of trips over the period 2004-2018 is provided in the tables below.

In ICES division 7.d:

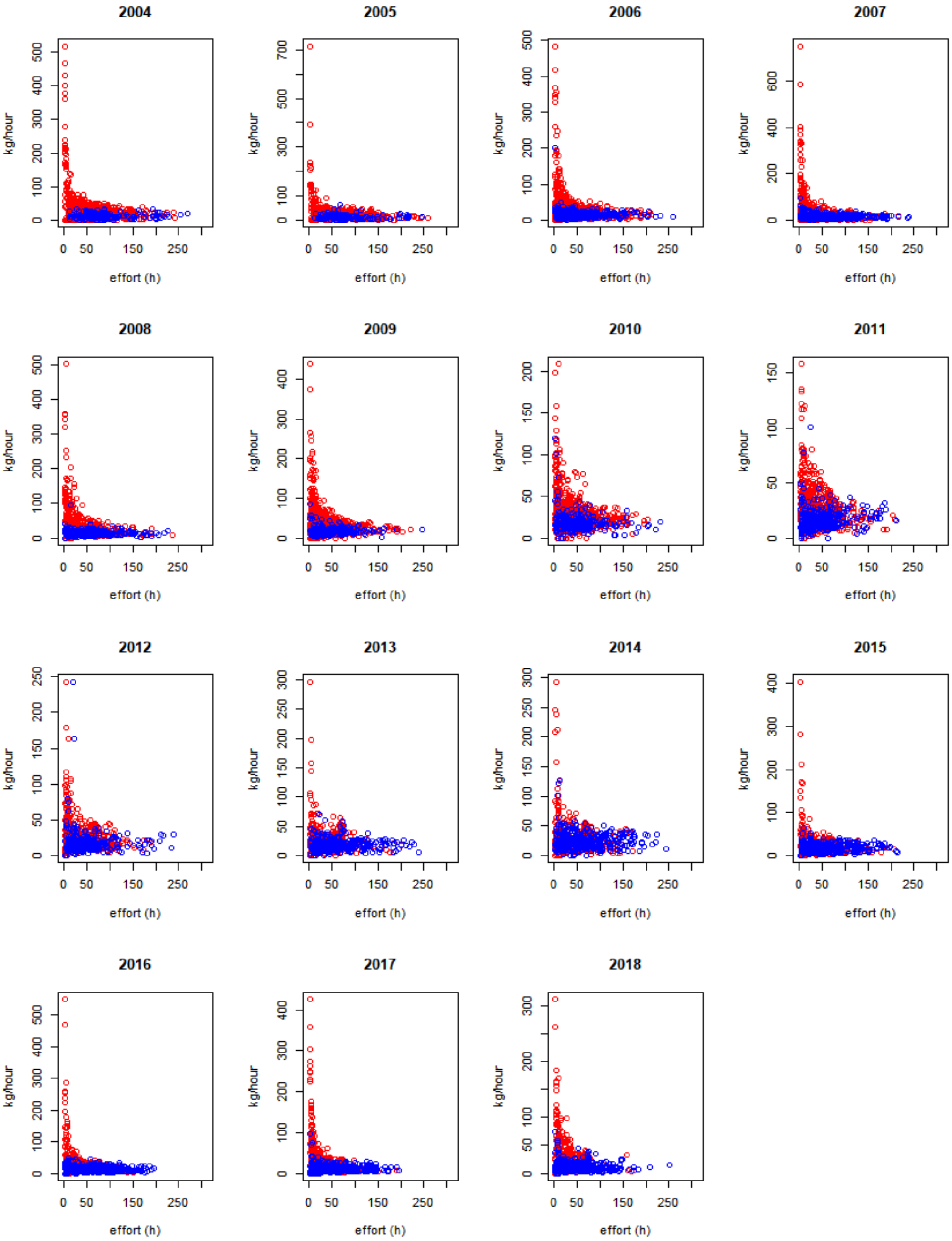
	Total # trips	# pure trips	# mixed trips
≤ 221 kW	6888	2239	4649
> 221 kW	5798	1623	4175

In ICES divisions 7.f and 7.g:

	Total # trips	# pure trips	# mixed trips
≤ 221 kW	402	260	142
> 221 kW	4902	1679	3223

Some of the mixed trips showed much higher lpue values (>100 $kg.h^{-1}$) compared to pure trips (Figure 1). Moreover, the difference between mixed and pure trips is mainly found at low effort levels (< 20 hours). This supports the hypothesis that fishers may misreport landings in mixed trips from one ICES division to another by fishing for a very short time in one of the sole stock areas (ICES division 7.d or ICES divisions 7.f and 7.g). Note that for sole in ICES division 7.d more zero catches (24%) occurred in the pure trips compared to the mixed trips (5%), whereas for sole in ICES divisions 7.f and 7.g, more zero catches (7.3%) occurred in the mixed trips compared to the pure trips (1.5%).

a


2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
kg/hour
effort (h)

b

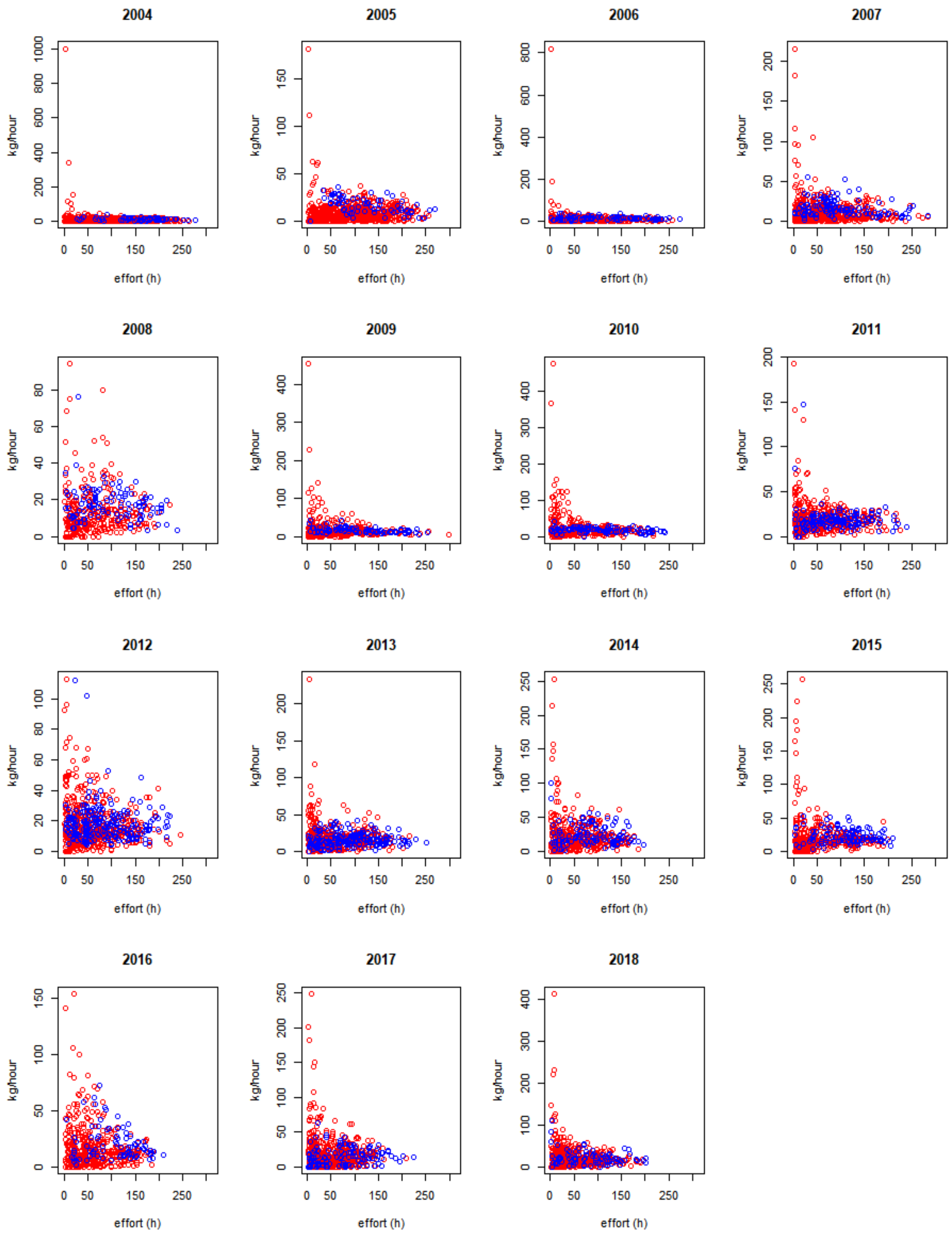


Figure 1: Scatter plot of fishing effort (in fishing hours) versus sole lpue per year based on logbook observations from the Belgian beam trawl fleet in ICES division 7.d (a) and ICES divisions 7.f and 7.g (b). Observations of pure and mixed trips are indicated in blue and red, respectively.

4. Estimate the landings

Two methods were explored to estimate the landings of the 2 sole stocks, which were then compared to the reported landings in that area.

The first method uses landing and effort data as reported by fishers in the electronic logbooks. First, the annual landings of pure trips were divided by the annual effort of pure trips per area to calculate a pure trip lpue (t ϵ pure,mixed) by management area (a ϵ {7.d} or a ϵ {7.fg}) and year (y ϵ {2004 to 2018}). Secondly, this lpue was used to estimate the landings from the mixed trips by multiplying the effort (by management area and year) registered in these trips with the pure trip lpue derived in step 1. Finally, the estimated landings from the mixed trips were added to the registered landings from the pure trips to estimate the total landings per area per year.

$$lpue_{a,y,t=pure} = \sum_{a,y,t=pure} landings / \sum_{a,y,t=pure} effort$$

$$landings_{a,y} = lpue_{a,y,t=pure} x\ effort_{a,y,t=mixed} + landings_{a,y,t=pure}$$

This method assumes that the effort as reported in the mixed (and pure) trips is reliable, and that lpue of pure trips is representative for the landing rate in mixed trips. In addition, this method does not account for additional sources of variation in lpue.

The second method uses the landings per unit of effort of pure trips, but gets the effort data for both the pure and mixed trips from the VMS dataset with data available from 2006 onwards. Similar to the first method, landings were estimated by multiplying the lpue by the total VMS derived effort in this area.

4.1. Sole in ICES division 7.d - using Belgian logbooks

The pure trip lpue is considerably lower than the mixed trip lpue in most of the years considered in this analysis (Table 1).

Table 1: Effort (fishing hours), landings (tonnes) and lpue ($kg.h^{-1}$) from pure and mixed trips, and estimated landings (tonnes) based on the lpue from pure trips compared to reported landings from the beam trawl fleet and from other fleets.

	PURE			MIXED			ALL		
Year	effort	reported landings	lpue	effort	reported landings	lpue	estimated landings	reported landings	reported landings other métiers
2004	22854	309.3	13.5	51544	1096.7	21.3	1006.9	1406	53.9
2005	19025	263.7	13.9	47511	915	19.3	922.3	1178.8	34.6
2006	29096	452.5	15.6	53535	1041.4	19.5	1285.2	1494	36.1
2007	38867	602.9	15.5	44890	868	19.3	1299.2	1470.9	40.5
2008	26295	382.1	14.5	44765	927.9	20.7	1032.5	1309.9	35
2009	13394	241	18	47990	1167.6	24.3	1104.4	1408.6	53.1
2010	15258	261.7	17.1	46776	1007.3	21.5	1063.9	1268.9	35.6
2011	20036	341.1	17	39915	836.3	21	1020.8	1177.4	45.3
2012	14893	264.2	17.7	27743	627.8	22.6	756.4	892	47.7
2013	22423	417.7	18.6	22130	506.2	22.9	829.9	923.8	26.3
2014	28043	687.5	24.5	29511	744.4	25.2	1411.1	1431.9	58.5
2015	22773	421.8	18.5	31986	616.6	19.3	1014.1	1038.3	10.9
2016	31486	422.9	13.4	19320	373.9	19.4	682.4	796.8	3.3
2017	27494	308.2	11.2	20826	385.4	18.5	541.6	693.6	2.7
2018	26243	298.9	11.4	17448	353.8	20.3	497.6	652.6	0.2

Consequently, the landings are estimated lower than what is reported (Figure 2). However, in the period 2014-2015, the estimated landings match well with the reported landings. In these years, Belgium overshot its original quota and the TAC was fished almost completely (>96%). In all other years considered in this analysis, the Belgian quota were not limiting, which could allow for reporting sole landings from other areas.

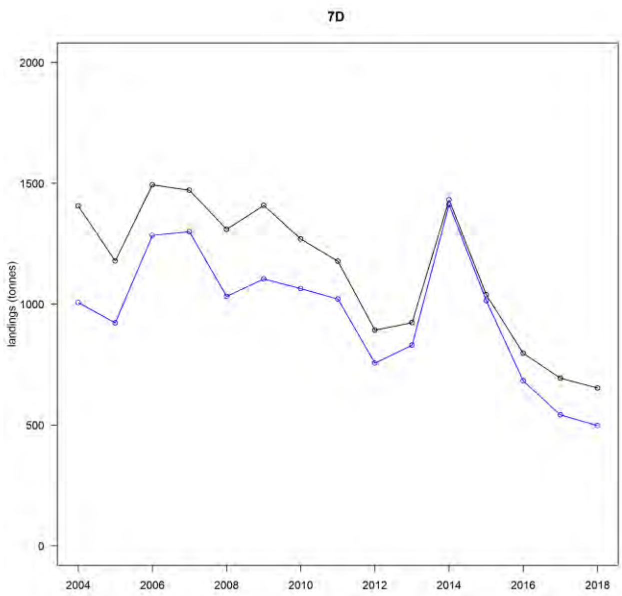


Figure 2: Reported (black) and estimated landings (blue) for sole in ICES division 7.d from the Belgian beam trawl fleet over the period 2004-2018 based on logbook data.

4.2. Sole in ICES division 7.d - using Belgian VMS data

This method gives a similar pattern compared to the first method (including the good match in 2014-2015), but there are some minor differences in absolute values (e.g. in 2006, the second method gives an estimate of 1353 tonnes, while the first method gives landings of 1285 tonnes).

Table 2: Effort (VMS derived fishing hours), landings (tonnes) and lpue (kg.h^{-1}) from pure and mixed trips, and estimated landings (tonnes) based on the lpue from pure trips compared to reported landings from the beam trawl fleet and from other fleets.

	PURE			MIXED			ALL		
Year	effort	reported landings	lpue	effort	reported landings	lpue	estimated landings	reported landings	reported landings other métiers
2006	17578	452.5	25.7	35076	1041.4	29.7	1353.2	1494	36.1
2007	32139	601.8	18.7	38746	869.1	22.4	1325.5	1470.9	40.5
2008	24428	381.3	15.6	41385	928.7	22.4	1026.7	1309.9	35
2009	12380	241	19.5	43170	1167.6	27	1083.2	1408.6	53.1
2010	15123	261.7	17.3	43526	1007.3	23.1	1014.6	1268.9	35.6
2011	18796	338.8	18	36183	838.6	23.2	989.6	1177.4	45.3
2012	13346	263.7	19.8	24145	629.2	26.1	742.3	892.9	47.7
2013	21215	417.7	19.7	20812	506.2	24.3	827.9	923.8	26.3
2014	27879	686.3	24.6	28106	748.2	26.6	1377.2	1434.5	58.5
2015	21682	421.8	19.5	30339	616.6	20.3	1014.4	1038.3	10.9
2016	29754	422.9	14.2	17724	373.9	21.1	674.2	796.8	3.3
2017	24910	308.2	12.4	20036	385.4	19.2	557.3	693.6	2.7
2018	22596	298.9	13.2	15745	353.8	22.5	506.1	652.6	0.2

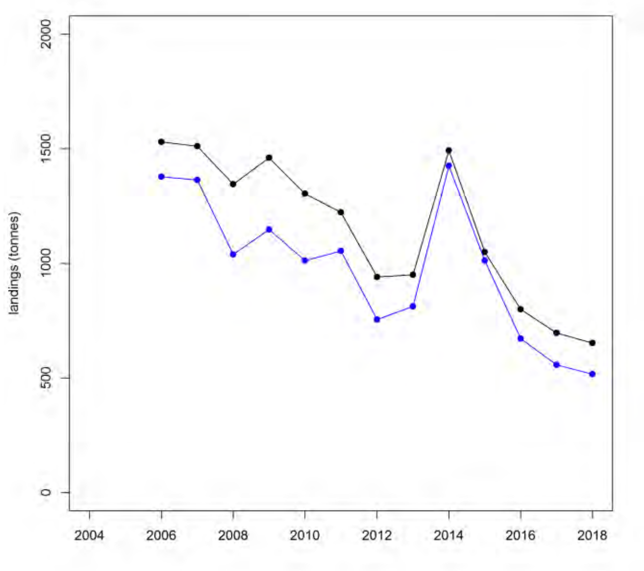


Figure 3: Reported (black) and estimated landings (blue) for sole in ICES division 7.d from the Belgian fleet over the period 2004-2018. Estimated landings based on VMS effort data.

4.3. Sole in ICES division 7.d – differences in fleet segment

The analyses on estimated landings are performed by combining data from both the small and the large fleet segment. Considering the differences between both fleet segments, the outcome of the above analyses could be confounded. In contrast to ICES divisions 7.f and 7.g, the small fleet segment is responsible for an important part of the sole landings in ICES division 7.d.

4.3.1. Using Belgian logbooks

The first method using the logbook data shows that the small fleet segment (≤ 221 kW) shows a rather constant deviation over the time series, where estimated landings are slightly lower than reported landings (Figure 4). Our analysis shows no evidence for non-compliance by the small fleet segment. The deviation between reported and estimated landings could be linked to the assumptions we made for this calculation method. Additionally, the small fleet segment is active in the North Sea and the eastern English Channel and thus has less opportunity to misreport compared to the large fleet segment. Finally, in contrast to the large fleet segment, the small fleet segment does not show a different pattern in 2014-2015, where the quota were limiting.

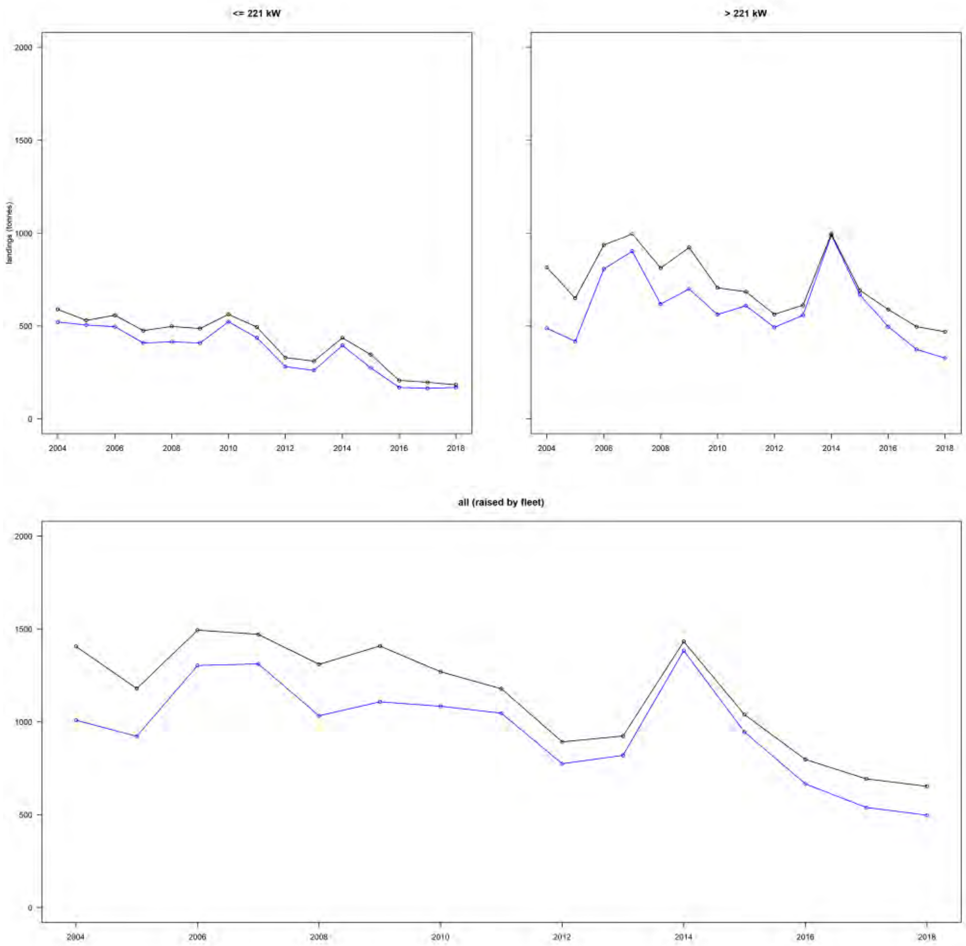


Figure 4: Reported (black) and estimated landings (blue) for sole in ICES division 7.d from the Belgian small beam trawl fleet segment (≤ 221 kW) and the large fleet segment (> 221 kW) over the period 2004-2018 based on logbook data.

An overview of the output of this analysis is listed in Table 2 and 3.

Table 3: Effort (fishing hours), landings (tonnes) and lpue ($kg.h^{-1}$) from pure and mixed trips of the large fleet segment (> 221 kW), and estimated landings (tonnes) based on the lpue from pure trips compared to reported landings from the large fleet segment.

	PURE			MIXED			ALL	
Year	effort	reported landings	lpue	effort	reported landings	lpue	estimated landings	reported landings
2004	9734	136	14	25157	680.2	27	487.5	816.2
2005	6006	83.4	13.9	24085	565.4	23.5	418.1	648.8
2006	14509	247.3	17	32820	689.2	21	806.7	936.5
2007	23118	385.8	16.7	30994	609.6	19.7	903	995.3
2008	15196	224.6	14.8	26612	587.7	22.1	617.9	812.2
2009	7302	149.4	20.5	26903	773.2	28.7	699.8	922.6
2010	5822	120.7	20.7	21249	584.9	27.5	561.3	705.6
2011	8103	182.9	22.6	18907	501	26.5	609.8	684
2012	6899	157.1	22.8	14746	405.4	27.5	493	562.5
2013	13676	295.8	21.6	12131	316.3	26.1	558.2	612.1
2014	17796	514.3	28.9	16411	481.7	29.4	988.6	996
2015	17144	351.7	20.5	15486	339.8	21.9	669.5	691.5

2016	22537	336.6	14.9	10730	252.7	23.6	496.8	589.3
2017	19887	228.6	11.5	12645	267.5	21.2	373.9	496.1
2018	16951	198.4	11.7	11067	271.2	24.5	327.9	469.6

Table 4: Effort (fishing hours), landings (tonnes) and lpue (kg.h^{-1}) from pure and mixed trips of the small fleet segment (≤ 221 kW), and estimated landings (tonnes) based on the lpue from pure trips compared to reported landings from the small fleet segment.

	PURE			MIXED			ALL	
Year	effort	reported landings	lpue	effort	reported landings	lpue	estimated landings	reported landings
2004	13120	173.3	13.2	26387	416.5	15.8	521.8	589.8
2005	13019	180.3	13.8	23426	349.6	14.9	504.7	529.9
2006	14587	205.2	14.1	20715	352.2	17	496.7	557.4
2007	15749	217.1	13.8	13896	258.4	18.6	408.6	475.5
2008	11099	157.5	14.2	18153	340.2	18.7	415.1	497.7
2009	6092	91.6	15	21087	394.4	18.7	408.5	486
2010	9436	141	14.9	25527	422.4	16.5	522.3	563.3
2011	11933	158.2	13.3	21008	335.2	16	436.7	493.4
2012	7994	107.1	13.4	12997	222.4	17.1	281.2	329.5
2013	8747	121.8	13.9	9999	189.8	19	261.1	311.7
2014	10247	173.2	16.9	13100	262.6	20	394.7	435.9
2015	5629	70	12.4	16500	276.8	16.8	275.2	346.8
2016	8949	86.3	9.6	8590	121.1	14.1	169.2	207.5
2017	7607	79.6	10.5	8181	117.9	14.4	165.2	197.5
2018	9292	100.5	10.8	6381	82.6	12.9	169.5	183.1

4.3.2. Using Belgian VMS data

The second method to estimate the landings of both fleet segments uses the landings per unit of effort of pure trips for both segments separately, but gets the effort data for both the pure and mixed trips in the VMS dataset with data available from 2006 onwards.

Similar to the first method, using the VMS effort data shows that the small fleet segment (≤ 221 kW) estimated landings are consistently, but only slightly lower than the reported landings (Figure 5). For the large fleet segment (> 221 kW) there is the same irregular pattern as derived with the first method. Estimated landings are lower than reported landings with the exception of 2014 and 2015. There is almost no deviation between estimated and reported landings in 2014-2015 when the Belgian quota were limiting. An overview of the output of this analysis is listed in Table 5 and 6.

Table 5: Effort (VMS derived fishing hours), landings (tonnes) and lpue (kg.h^{-1}) from pure and mixed trips of the large fleet segment (> 221 kW), and estimated landings (tonnes) based on the lpue from pure trips compared to reported landings from the large fleet segment.

	PURE			MIXED			ALL	
Year	effort	reported landings	lpue	effort	reported landings	lpue	estimated landings	reported landings
2006	10431	247.3	23.7	23410	689.2	29.4	802	936.5
2007	20421	384.7	18.8	27261	610.6	22.4	896.4	995.3
2008	14044	224.6	16	25504	587.7	23	632.8	812.2
2009	6563	149.4	22.8	23762	773.2	32.5	691.4	922.6
2010	5861	120.7	20.6	20692	584.9	28.3	547	705.6
2011	7630	180.6	23.7	17121	503.3	29.4	586.6	684
2012	6110	157.1	25.7	12945	405.4	31.3	489.7	562.5
2013	12794	295.8	23.1	11428	316.3	27.7	559.5	612.1
2014	17801	515.4	29	15252	481.7	31.6	958.5	997.1
2015	15690	351.7	22.4	14105	339.8	24.1	667.4	691.5
2016	21569	336.6	15.6	9305	252.7	27.2	481.6	589.3
2017	17803	228.6	12.8	12163	267.5	22	383.6	496.1
2018	15086	198.4	13.1	9962	271.2	27.2	328.1	469.6

Table 6: Effort (VMS derived fishing hours), landings (tonnes) and lpue (kg.h^{-1}) from pure and mixed trips of the small fleet segment (≤ 221 kW), and estimated landings (tonnes) based on the lpue from pure trips compared to reported landings from the small fleet segment.

	PURE			MIXED			ALL	
Year	effort	reported landings	lpue	effort	reported landings	lpue	estimated landings	reported landings
2006	7147	205.2	28.7	11666	352.2	30.2	539.9	557.4
2007	11718	217.1	18.5	11484	258.4	22.5	429.2	475.5
2008	10384	156.7	15.1	15881	341	21.5	396.6	497.7
2009	5817	91.6	15.7	19408	394.4	20.3	396	486
2010	9262	141	15.2	22833	422.4	18.5	487.8	563.3
2011	11166	158.2	14.2	19062	335.2	17.6	429.2	493.4
2012	7237	106.5	14.7	11200	223.9	20	271	330.4
2013	8421	121.8	14.5	9384	189.8	20.2	258.2	311.7
2014	10078	170.9	17	12854	266.4	20.7	389.8	437.4
2015	5992	70	11.7	16235	276.8	17	260.1	346.8
2016	8185	86.3	10.5	8419	121.1	14.4	174.3	207.5
2017	7108	79.6	11.2	7874	117.9	15	167.8	197.5
2018	7510	100.5	13.4	5783	82.6	14.3	178.1	183.1

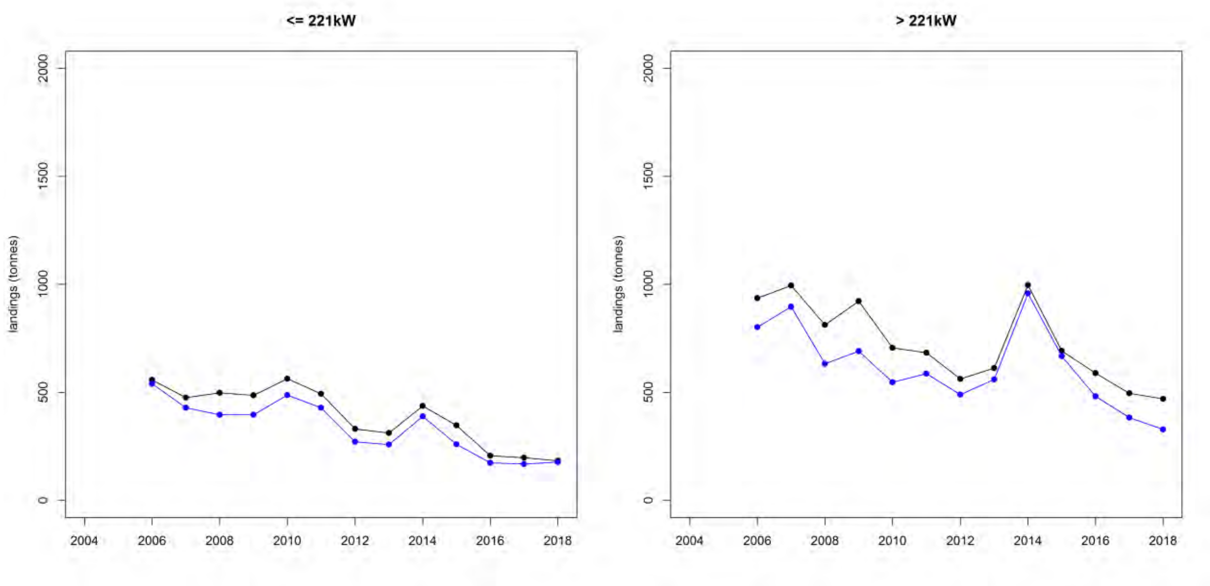


Figure 5: Reported (black) and estimated landings (blue) for sole in ICES division 7.d from the Belgian small beam trawl fleet segment (≤ 221 kW) and the large fleet segment (> 221 kW) over the period 2006-2018 based on VMS effort data.

4.4. Sole in ICES divisions 7.f and 7.g - using Belgian logbooks

The pure trip lpue is considerably higher than the mixed trip lpue in 2004-2007,2012, 2016 and 2018 (Table 7). Consequently, the landings for these years are estimated higher than what is reported (Figure 6). For 2009 the landings were estimated to be lower than what is reported.

Table 7: Effort (fishing hours), landings (tonnes) and lpue (kg.h^{-1}) from pure and mixed trips, and estimated landings (tonnes) based on the lpue from pure trips compared to reported landings from the beam trawl fleet and from other fleets.

	PURE			MIXED			ALL		
Year	effort	reported landings	lpue	effort	reported landings	lpue	estimated landings	reported landings	reported landings other métiers
2004	11077	144.4	13	62042	569.8	9.2	953	714.2	19.1
2005	11092	161.5	14.6	51184	465.7	9.1	906.6	627.2	17.7
2006	17939	249.3	13.9	30514	278.3	9.1	673.3	527.5	43.3
2007	18829	273.6	14.5	25812	255.6	9.9	648.8	529.3	45.7
2008	15522	227.4	14.6	12855	184.7	14.4	415.6	412	49.9
2009	16953	221.9	13.1	13192	207.5	15.7	394.5	429.4	74.5
2010	19008	312.5	16.4	13167	229	17.4	529	541.5	81.1
2011	24081	435.9	18.1	14625	257.9	17.6	700.7	693.9	80.7
2012	29753	550.9	18.5	16416	235.9	14.4	854.8	786.8	55.8
2013	31044	509.6	16.4	13985	238.6	17.1	739.2	748.2	40
2014	17862	385.7	21.6	13206	281	21.3	670.9	666.8	36.3
2015	21698	438.4	20.2	9679	201.7	20.8	634	640.2	33.6
2016	14418	256	17.8	17334	269.7	15.6	563.7	525.6	37.9
2017	13930	231.2	16.6	17732	293.2	16.5	525.4	524.4	26.2
2018	12960	256.8	19.8	17716	312.8	17.7	607.8	569.6	37.1

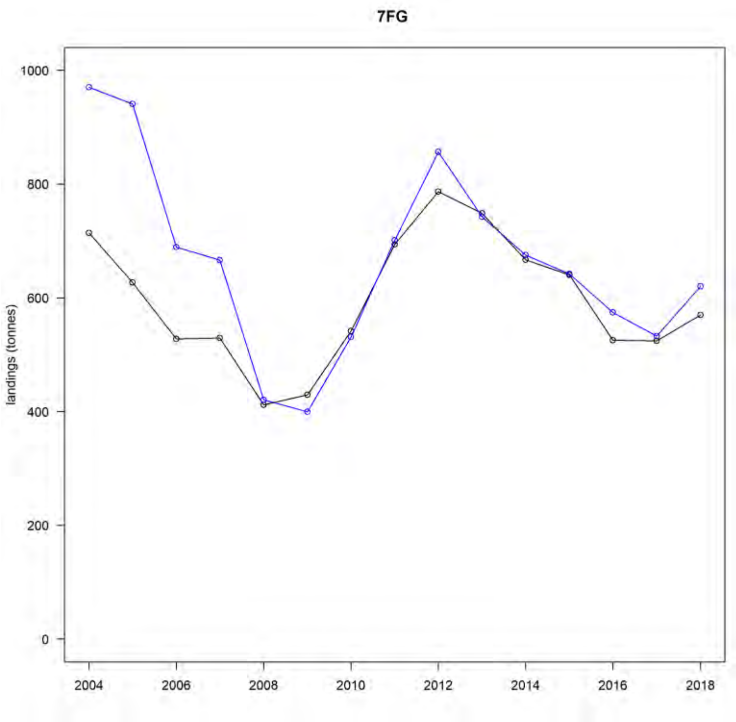


Figure 6: Reported (black) and estimated landings (blue) for sole in ICES divisions 7.f and 7.g from the Belgian beam trawl fleet over the period 2004-2018 based on logbook data.

4.5. Sole in ICES divisions 7.f and 7.g - using Belgian VMS data

The second method to estimate the landings uses the landings per unit of effort of pure trips, but gets the effort data for both the pure and mixed trips from the VMS dataset with data available from 2006 onwards. Similar to the first method, landings were estimated by multiplying the lpue by the total VMS derived effort in this area (Figure 7, table 8). This second method gives a similar pattern compared to the first method.

Table 8: Effort (VMS derived fishing hours), landings (tonnes) and lpue (kg.h^{-1}) from pure and mixed trips, and estimated landings (tonnes) based on the lpue from pure trips compared to reported landings from the beam trawl fleet and from other fleets.

	PURE			MIXED			ALL		
Year	effort	reported landings	lpue	effort	reported landings	lpue	estimated landings	reported landings	reported landings other métiers
2006	14757	249.3	16.9	24383	278.3	11.4	661.5	527.5	43.3
2007	16739	273.6	16.3	25539	255.6	10	689.1	529.3	45.7
2008	14893	227.4	15.3	12104	184.7	15.3	413.1	412	49.9
2009	16111	221.9	13.8	13157	207.5	15.8	403.9	429.4	74.5
2010	19352	312.5	16.2	12889	229	17.8	522.3	541.6	81.1
2011	23298	435.9	18.7	14380	257.9	17.9	704.6	693.9	80.7
2012	24231	550.9	22.7	13816	235.9	17.1	863.7	786.8	55.8
2013	28180	509.6	18.1	13030	238.6	18.3	745.9	748.2	40
2014	18237	385.7	21.2	12446	281	22.6	650.5	666.8	36.3
2015	20643	438.4	21.2	9759	201.7	20.7	644.5	640.2	33.6
2016	12641	256	20.2	16300	269.7	16.5	584.6	525.6	37.9

2017	12613	231.2	18.3	16405	293.2	17.9	531	524.4	26.2
2018	11926	256.8	21.5	15403	312.8	20.3	587.6	569.6	37.1

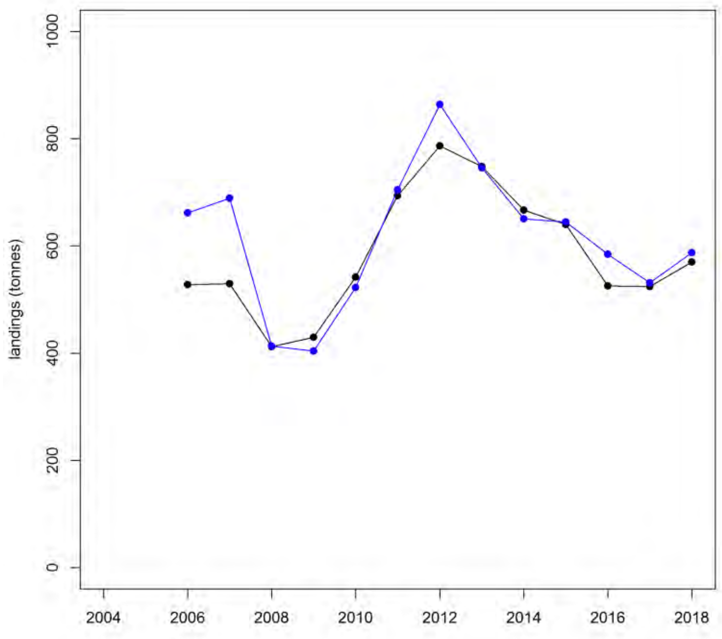


Figure 7: Reported (black) and estimated landings (blue) for sole in ICES divisions 7.f and 7.g from the Belgian fleet over the period 2006-2018. Estimated landings based on VMS effort data.

Considering the minor importance of the small fleet segment in ICES divisions 7.f and 7.g, no separate analysis to investigate the differences in fleet segment was performed.

5. Input from the Belgian fishing industry

During the data compilation workshop of this WKFLATNSCS benchmark, the Belgian fishing industry was briefly involved and further contacted in this matter. Discussions provided insights on the behaviour of fishermen in ICES divisions 7.d, 7.f and 7.g

5.1. Sole in ICES division 7.d

Fishermen pointed out that mixed trips in ICES division 27.7.d are very common. This division is sometimes crossed on the way to fishing grounds in the Western Waters, such as the Celtic and Irish Sea, and combined trips with the western English Channel and the North Sea are decided upon by skippers aiming for a successful fishery activity. Skippers indicate that they aim to make optimal use of their fishing opportunities in several ICES divisions and to decide where to operate, they take into account all aspects that can influence the success.

From the analyses and the assumptions described above, it seems not beneficial to move away from the 7d area when lpue is high. Fishermen contradict this notion and state that several factors play a role in their fishing behaviour. Especially in ICES division 27.7.d, the tide is a very important factor. Fishing during neap tide for example results in less yield. Furthermore, fishermen admit that it is much more profitable to fish during the night and indicate that weather conditions are also crucial. Finally, when they have found a hotspot of sole for instance in a gully, and they have trawled it several times, the lpue could have been very high. Depending on what was caught earlier during that trip and whether or not the day limits in the 7d area are reached, they might decide to remain in the 7d area and try to find another hotspot or move to another ICES division.

The Belgian quota allocation is centrally managed by the authorities. For sole 7d a quantity per day in the area on a voyage basis is allocated. The quantity for the small fleet segment is mostly half of the large fleet segment.

5.2. Sole in ICES divisions 7.f and 7.g

Fishermen confirm that there have been compliance issues in 2004-2007 and that several fishermen have been caught for non-compliance. In recent years, they state that compliance and control has increased. They state that mixed trips in ICES divisions 7.f and 7.g are very common. This division is crossed on the way to other fishing grounds in the Western Waters, such as Irish Sea and the Southern Celtic Sea, and they indicate that they aim to make optimal use of their fishing opportunities in several ICES divisions.

6. Conclusion

Although the analyses show differences between estimated and reported landings, we are unable to determine how landings should be corrected **for sole in ICES division 7.d**. The feedback from the fishing industry reveals that several components affect the fishing behaviour in the eastern English channel, which directly impacts the observed lpue values and reported landings. Estimated landings point towards over-reporting, especially by the large fleet segment. This means that Belgian landings for sole in ICES division 7.d are probably lower. As we are unable to determine how accurate our estimated landings are and given the typical fishing behaviour in division 27.7.d, we decided to retain the officially reported landings in the assessment.

For **sole in ICES divisions 7.f and 7.g**, both analyses show substantial differences between estimated and reported landings in the period 2004-2007 (> 22 %) and fishermen confirm that there were compliance issues in the beginning of this time series. Therefore it seems reasonable to adjust these landing numbers as the Belgian landings for sole in ICES divisions 7.f and 7.g are probably higher. For 2009, 2012, 2016 and 2018 the difference between the estimated and reported landings is between 6.7 and 8.6%. For the remaining years, the differences are negligible. Taken into account the upper and lower tolerance of 10% to fill in the retained landings in the logbooks, it was decided not to adjust those landing numbers.

7. References

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WD Commercial LPUE from French Otter Trawlers for sol.27.7d stock assessment

Raphael Girardin (Ifremer, France)

15-12-2019

Eastern Channel Sole is currently assessed using 3 survey indices: UK(E&W) BTS, UK(E&W) YFS, and FR YFS; and 3 commercial indices: BE CBT, UK(E&W) CBT, and FR COTB. Recently, BE and UK CBT were reviewed and modified during the IBPsol7d in 2019 (ICES, 2019a). BE-CBT moved from a LPUE to a CPUE index using the all fleet segment and UK-CBT was modified to account for UK effort database recent changes; however FR COTB was not investigated even if the index is computed as a raw LPUE (ICES, 2017). This document reviews the data available from the French fleet and is an attempt to create a LPUEs standardized time series using French Otter Trawlers that target sole seasonally and mainly in the French coast.

1. Available data / Analysis of the raw data

All the data used for the analyses were extracted from the French commercial fishery database: SACROIS version 3.3.6.

1.1. Mesh sizes used

Trawlers fishing for sole use mesh size around 80mm. However, in the logbooks, mesh sizes can be missing or misreported. Table 1 shows the data available in the logbooks and how mesh sizes have been reported in the past without filtering on the landings.

Table 1: Number of trips per métier.

	1999	2000	2001	2002	2003	2004
OTB_DEF_>=120_0	0	0	0	3500	561	55
OTB_DEF_0_0_0	0	37025	29790	23389	29725	13446
OTB_DEF_0_16_0	0	0	15	858	434	811
OTB_DEF_100_119_0	0	8790	6395	18652	6170	3652
OTB_DEF_16_31_0	0	121	82	1343	1519	1469
OTB_DEF_32_69_0	0	229	787	3913	17037	25585
OTB_DEF_70_99_0	28	125577	227270	288054	298676	386534

	2005	2006	2007	2008	2009	2010
OTB_DEF_>=120_0	181	188	7	0	58	168
OTB_DEF_0_0_0	3514	866	2891	2461	1073	202

OTB_DEF_0_16_0	154	85	31	81	335	122
OTB_DEF_100_119_0	2481	2080	20458	3460	9575	8417
OTB_DEF_16_31_0	1217	375	420	1422	2560	3110
OTB_DEF_32_69_0	24450	10404	9699	6027	5888	5349
OTB_DEF_70_99_0	430631	350250	404816	366008	367414	361955

	2011	2012	2013	2014	2015	2016
OTB_DEF_>=120_0	816	71	395	738	281	17
OTB_DEF_0_0_0	22	319	486	2132	12558	12948
OTB_DEF_0_16_0	113	618	461	179	2	30
OTB_DEF_100_119_0	3099	1997	307	241	123	3268
OTB_DEF_16_31_0	2170	1602	1214	1555	1392	817
OTB_DEF_32_69_0	8143	6816	3498	4021	7226	4445
OTB_DEF_70_99_0	316673	330671	286801	291538	231399	198225

	2017	2018
OTB_DEF_>=120_0	11	2
OTB_DEF_0_0_0	11586	1173
OTB_DEF_0_16_0	0	15
OTB_DEF_100_119_0	501	2065
OTB_DEF_16_31_0	1080	1066
OTB_DEF_32_69_0	3041	5638
OTB_DEF_70_99_0	141566	181313

Most of the trips using demersal trawl in the Eastern Channel are done using mesh size range 70_99. However, mesh size reporting rate increased in time with a lot of missing mesh sizes at the beginning of the time series (around 20 000 trips in the beginning of the 2000').

Table 2 shows the same data selecting only trips that landed sole.

Table 2: Number of trips landing sole per métier.

	1999	2000	2001	2002	2003	2004	2005
OTB_DEF_>=120_0	0	0	0	87	52	2	16
OTB_DEF_0_0_0	0	3294	2932	1924	3686	2054	568
OTB_DEF_0_16_0	0	0	3	50	39	71	12
OTB_DEF_100_119_0	0	111	116	330	141	149	187
OTB_DEF_16_31_0	0	12	42	251	169	175	111
OTB_DEF_32_69_0	0	11	36	452	1327	1985	2286
OTB_DEF_70_99_0	1	4266	9461	13790	14488	15181	15905

	2006	2007	2008	2009	2010	2011	2012
OTB_DEF_>=120_0	76	0	0	1	13	14	0
OTB_DEF_0_0_0	182	362	278	61	17	1	61
OTB_DEF_0_16_0	19	6	11	1	7	5	75
OTB_DEF_100_119_0	24	190	96	235	132	91	74
OTB_DEF_16_31_0	42	50	143	81	82	182	132
OTB_DEF_32_69_0	1230	438	445	558	419	774	882
OTB_DEF_70_99_0	17148	18562	15101	13429	14078	15379	17365

	2013	2014	2015	2016	2017	2018
OTB_DEF_>=120_0	20	39	6	1	0	0
OTB_DEF_0_0_0	51	367	699	720	429	92
OTB_DEF_0_16_0	110	28	0	3	0	2
OTB_DEF_100_119_0	12	9	12	90	21	57
OTB_DEF_16_31_0	132	182	141	153	137	109
OTB_DEF_32_69_0	536	580	791	632	515	655
OTB_DEF_70_99_0	15832	15924	12851	12140	10243	13762

The number of trips that recorded sole in their landings with missing mesh sizes fluctuated in time but does not represent a significant proportion of the trips. Sole is mostly caught using *OTB_DEF_70_99_0*.

1.2. Vessels

In order to create a time series from commercial catches, it would be better to get long time series with boats staying in the fisheries.

Table 3: Number of boats landing Sole each year (without threshold) between 2002-2018.

Number Of years with Sole landings	Number of boats
1	107
2	65
3	37
4	33
5	46
6	39
7	26
8	26
9	12
10	14
11	16

12	23
13	18
14	20
15	20
16	27
17	30

Table 3 shows that Very few boats are observed during the whole time series (30).

1.3. Trends in Sole landings

Trawlers are not targeting sole the whole year and change target species (and gear) during the year.

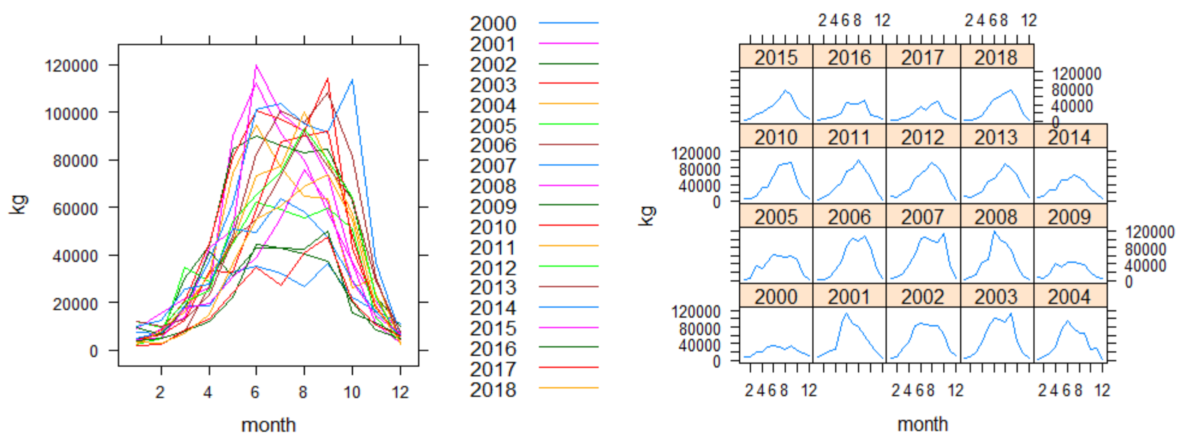


Figure 1: Monthly sole landing per year.

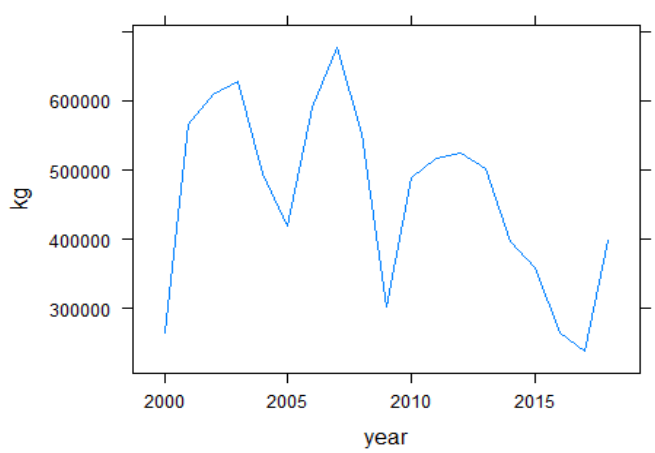


Figure 2: Sole landing per year.

Landings patterns are quite consistent between years with a peak in the landings during summer/autumn (Figure 1).

1.4. Trends in the number of boats landing Sole

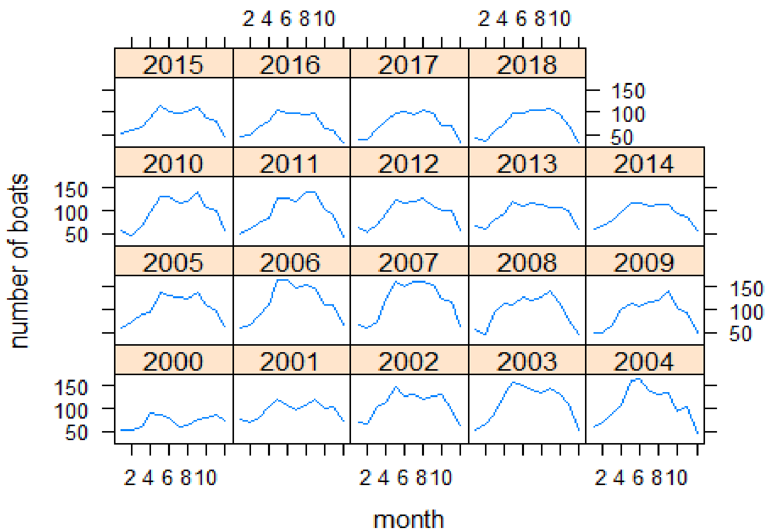


Figure 3: Number of vessels landing sole monthly per year

The total number of boats increased from 2000 to 2007 and then decreased. The number of boats landing Sole per month is following the landings trends per month with a peak during summer/autumn (Figure 3).

1.5. Trends in effort (fishing hours)

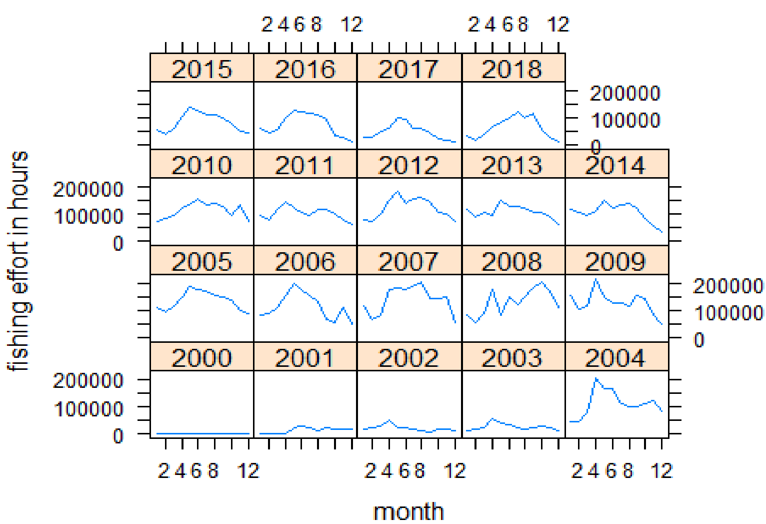


Figure 4: Fishing monthly effort per year in hours

The fishing effort in hours increased from 2000 to 2007 and then decreased. The effort per month is following the landings trends per month with a peak during summer/autumn. In the earlier period of the time series (up to 2004) fewer trips had reported effort in the database (Figure 4).

1.6. Trends in effort (kwH)

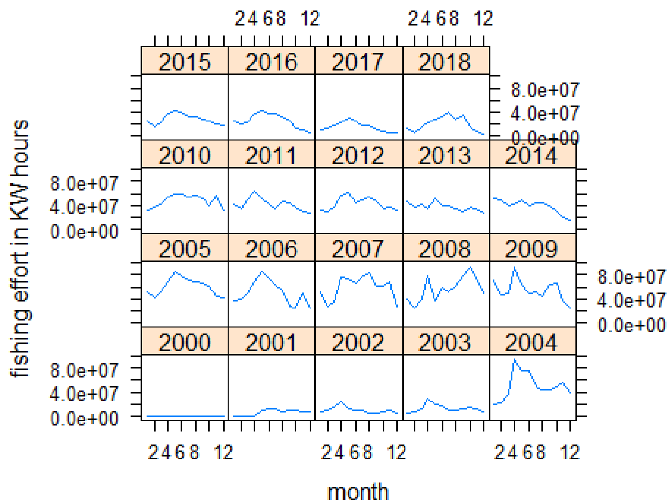


Figure 5: Fishing monthly effort per year in hours

1.7. Spatial plots of landings

Most of the sole landings reported by the *OTB_DEF_70_99_0* fleet are from the French coastal area, with a predominance of landing from the Bay of Seine in the South West part of the 7d area. In the early period of the time series, sole catches were more important in the North East part of the 7d than now.

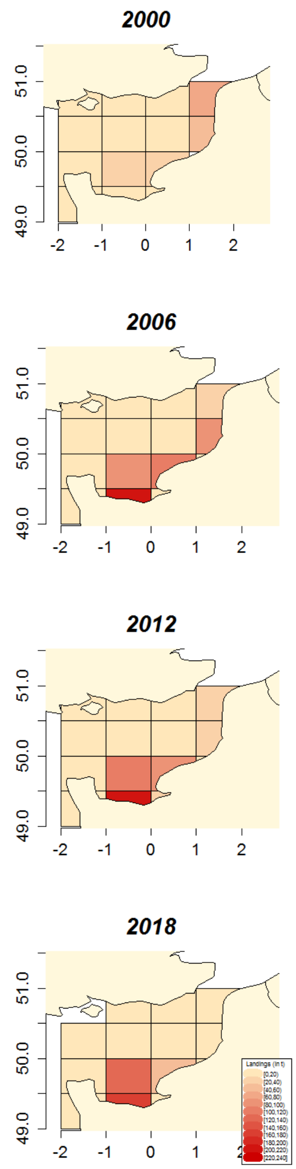


Figure 6: Spatial distribution of sole landings.

2. Data filtering and clean-up

After removing fishing operation with no effort information associated with, sole landing and effort in fishing hours were aggregated from the fishing operation level to the combine ices rectangle/trip level. In addition, data prior to 2005 were removed from the analyses to account for potential effort misreporting before that period.

2.1. Vessels in activity

Table 4: Number of boats landing Sole each year with effort information between 2005-2018.

Number Of years with Sole landings	Number of boats
1	51
2	42
3	37
4	31
5	33
6	18
7	41
8	29
9	11
10	10
11	10
12	12
13	11
14	15

After data filtering, Table 1 shows that Very few boats are observed during the whole time series (15). In our case, we decided to keep at least vessels staying 10 years in the fisheries (58) to proceed further with the analysis.

2.2. Trends in Sole landings of the selected fleets

Same trends and seasonal pattern can be observed in the selected fleets landings. However, in 2004 the reported landing is low for the fleet considered and consequently that year was dropped from the analysis.

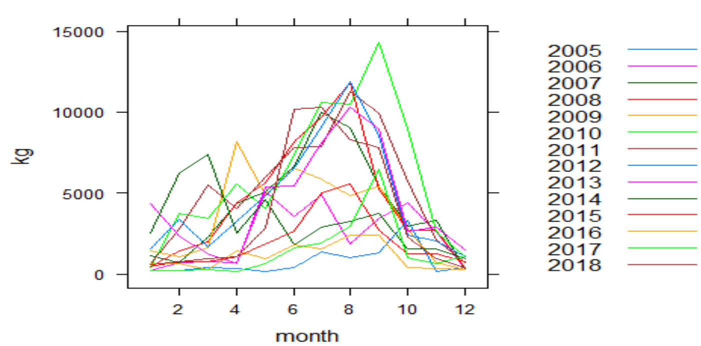


Figure 7: Monthly sole landing per year of the selected fleet.

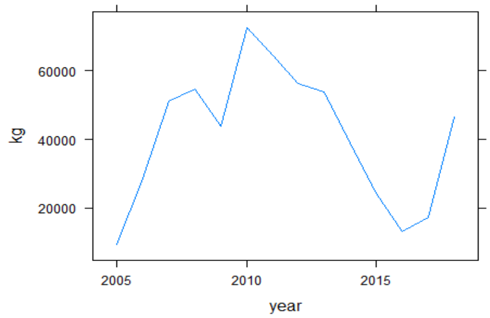


Figure 8: Sole landing per year of the selected fleet.

2.3. Spatial plots of the selected fleet landings

The selected fleet sole landings are taken on the same fishing ground as the entire *OTB_DEF_70_99_0* fleet.

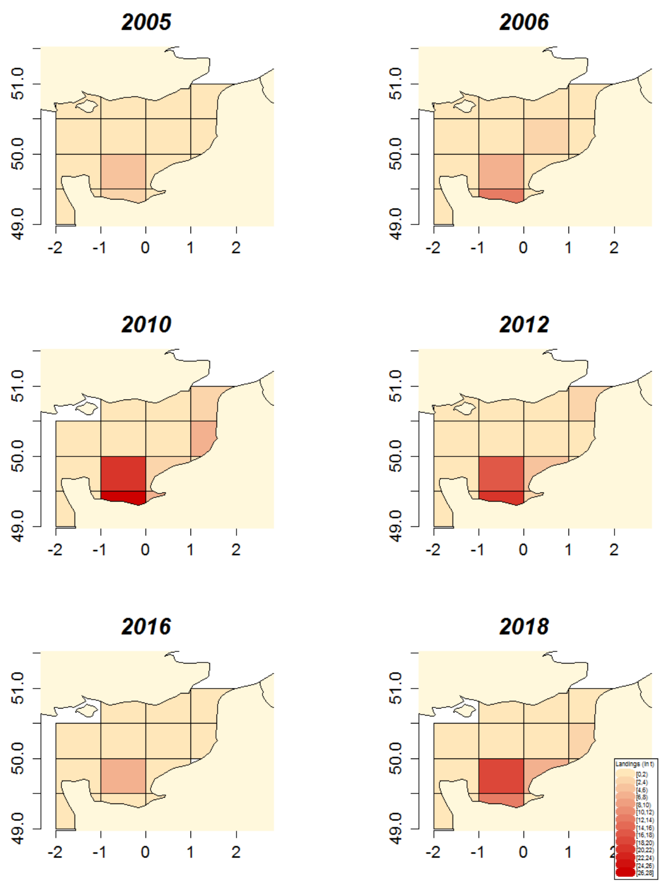


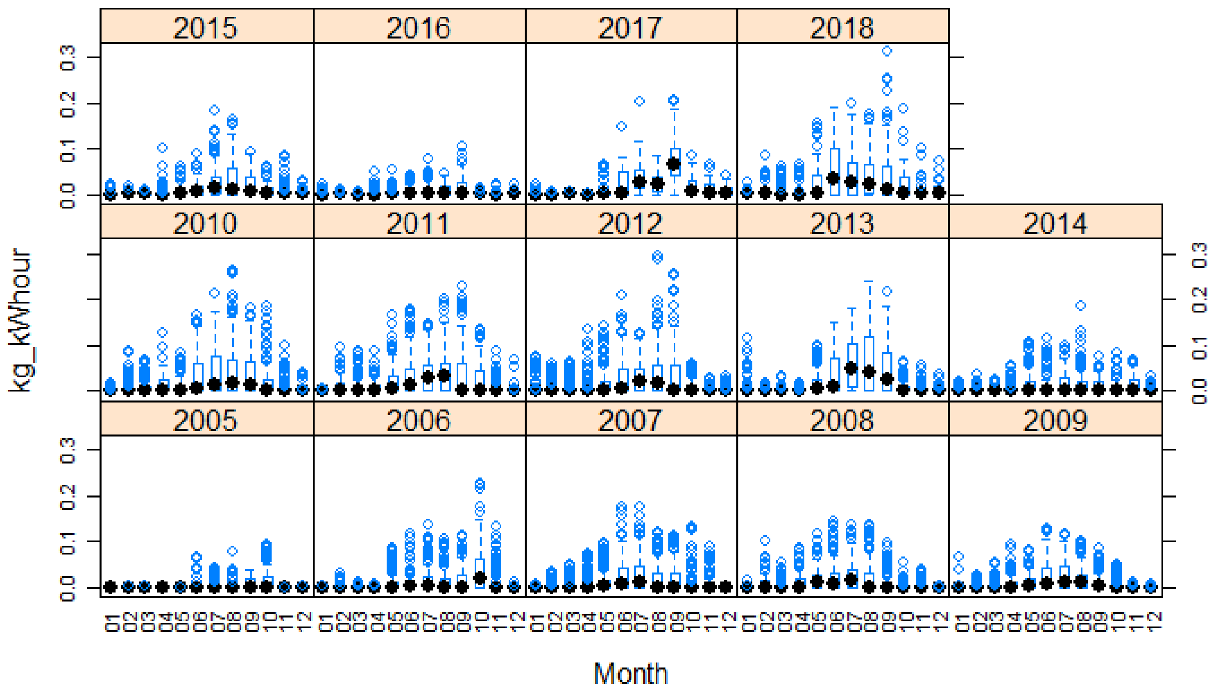
Figure 9: Spatial distribution of the selected fleet sole landings.

2.4. Trends in sole raw LPUE ($kg.kWh^{-1}$)

To account for misreporting and abberant data still present in the dataset, raw LPUE was calculated as:

$LPUE_{m,y,r,t,v} = \frac{landing_{m,y,i,t,v}}{power_{y,v}.effort_{m,y,r,t,v}}$, where m is the month, y the year, r the ices rectangle, t the trip and v a given vessel.

Trips of a given vessel in a given ices rectangles were trimmed of the dataset if their $LPUE_{m,y,r,t,v}$ was above the 99th percentile of the LPUE of that year and month. We the display the trend in $LPUE_{m,y,r,t,v}$ for the remaining trips.



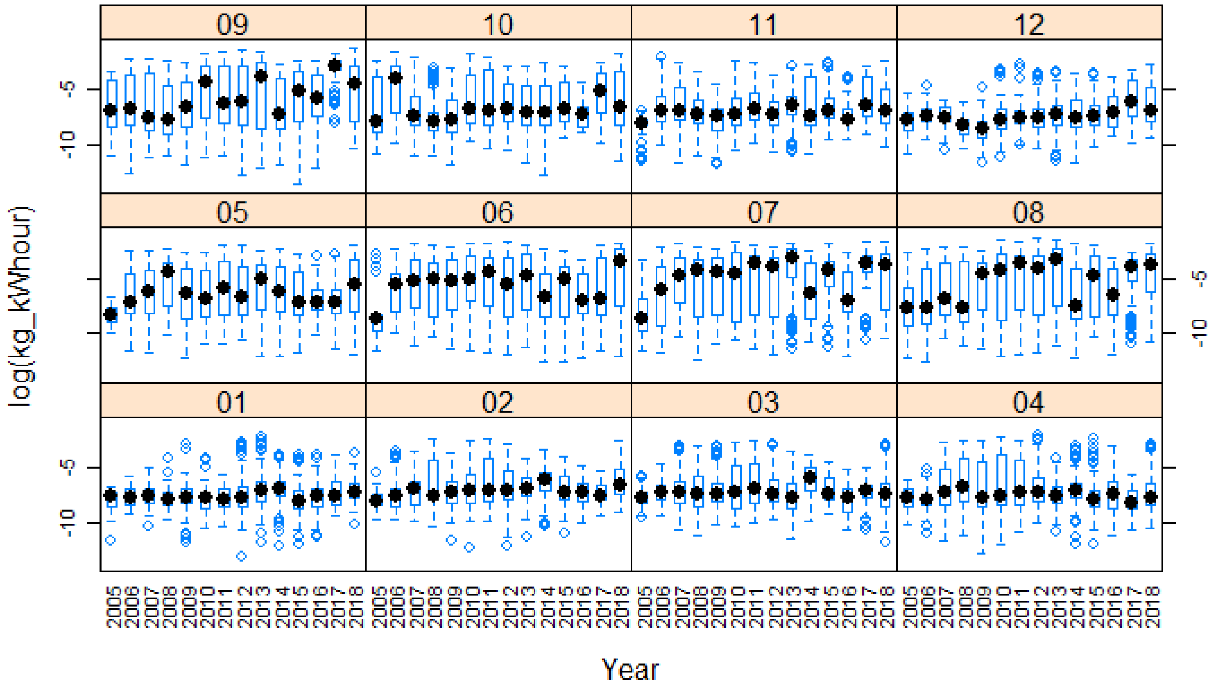


Figure 10: Monthly sole LPUE and Log. LPUE per year.

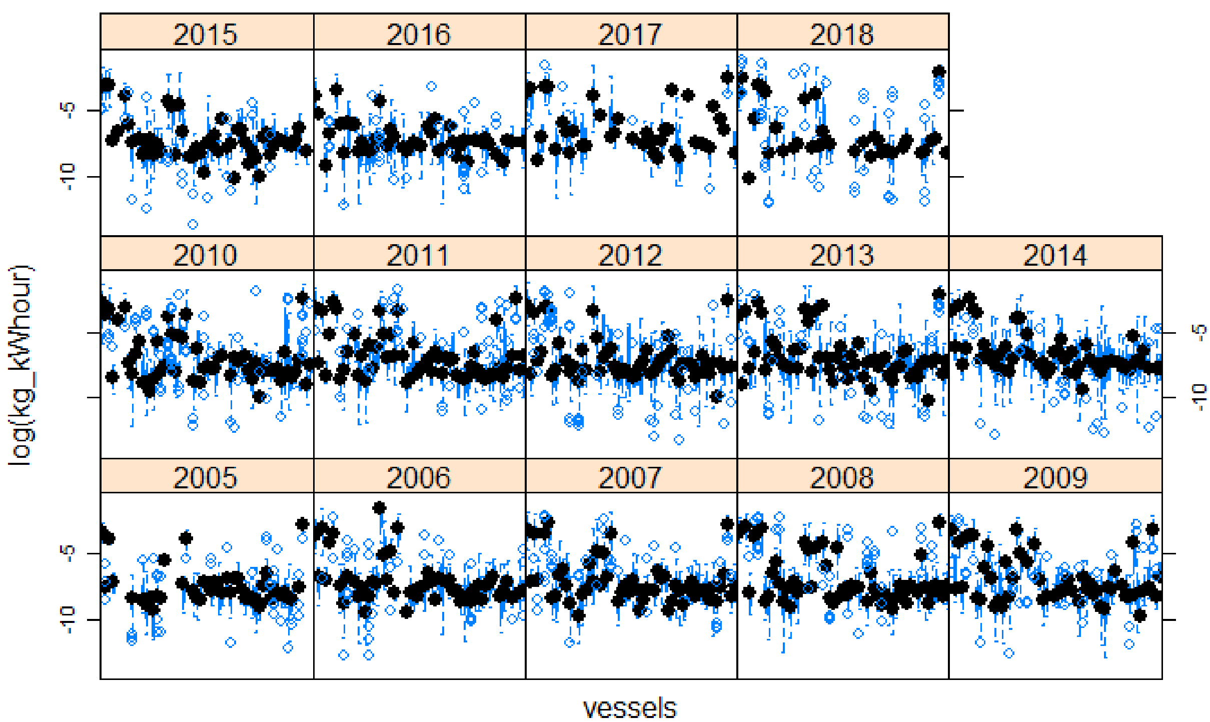


Figure 11: Log. LPUE per year for each vessel.

Seasonal pattern and vessel effect remain in the raw sole LPUE of the selected fleets.

3. LPUE standardization

3.1. Model description

To standardize FR-COTB index we decided to apply a similar methodology as the one used to compute BE-CBT index of sol.27.7d (ICES, 2019a). The following regression models were fitted to data with the indices y,m,r,v indicating respectively the year, month, ICES statistical rectangle, and the vessel reference number.

$$kg_{y,m,r,v} \sim NB(\mu_{y,m,r,v}, \theta_{obs})$$

$$E(kg_{y,m,r,v}) = \mu_{y,m,r,v}$$

$$var(kg_{y,m,r,v}) = \mu_{y,m,r,v} + \frac{\mu^2_{y,m,r,v}}{\theta_{obs}}$$

(1) $log(\mu_{y,m,r,v}) = intercept + log(effort_{y,m,r,v}) + A.log(power_{y,v}) + \alpha_r + \beta_m + \gamma_v + \delta_y$

(2) $log(\mu_{y,m,r,v}) = intercept + log(effort_{y,m,r,v}) + \alpha_r + \beta_m + \gamma_v + \delta_y$

(3) $log(\mu_{y,m,r,v}) = intercept + log(effort_{y,m,r,v}) + log(power_{y,v}) + \alpha_r + \beta_m + \gamma_v + \delta_y$

(4) $log(\mu_{y,m,r,v}) = intercept + log(effort_{y,m,r,v}) + A.log(power_{y,v}) + \alpha_r + \gamma_v + \delta_y$

(5) $log(\mu_{y,m,r,v}) = intercept + log(effort_{y,m,r,v}) + \alpha_r + \gamma_v + \delta_y$

(6) $log(\mu_{y,m,r,v}) = intercept + log(effort_{y,m,r,v}) + log(power_{y,v}) + \alpha_r + \gamma_v + \delta_y$

$$\alpha_r \sim N(0, \theta_r)$$

$$\sum_{m=1}^{12} \beta_m \sim N(0, \theta_m)$$

$$\gamma_v \sim sfN(0, \theta_v)$$

$$\Delta\delta_y = \delta_y - \delta_{y-1} \sim N(0, \theta_y)$$

Spatial variability was included using a random effects model for ICES statistical rectangle. A random vessel effect was added to considered skipper behaviour, or technical aspect that was not recorded in the data. To account for temporal correlation between years, a first order random walk model was specified over the years. Different way of including fishing effort were tested, either by including the logarithm of hours fished as an offset (2)(5), or by including logarithm of kWhours fished as an offset, or adding logarithm of hours fished as an offset and the logarithm of engine power as a linear effect (3)(6). The month effect was tested by including a seasonal random effect vector (β_{jan}+…+β_{dec}) follows a Gaussian distribution (1)(2)(3). Finally, the observation error was assumed to follow a negative binomial distribution with logarithmic link function.

3.2. Model estimation and selection

A Bayesian framework, as implemented by the INLA software, was used to estimate the model parameters. The default INLA settings were used so that the prior distributions on the parameters are uninformative, while hyperparameters were estimated through Laplace approximation. The best model was selected based on the DIC and the level of assumption violation (CPO failure) during the estimation of the model.

Table 5: Models DIC and CPO failure

model	seasonal	effort_type	DIC	CPO_failure
(1)	Yes	hour offset & linear kW	154536	0
(2)	Yes	hour offset	154543	0
(3)	Yes	kWhour offset	154529	0
(4)	No	hour offset & linear kW	155470	0
(5)	No	hour offset	155472	0
(6)	No	kWhour offset	155460	0

None of the model assumption was violated during the “leave one out” validation procedure of each model (CPO failure at 0). Based on the DIC, the best model used a seasonal random effect and a logarithm of kW.hour to account for the different level of effort (3). The posteriors distributions of fixed effect parameters and hyperparameters are shown in Figure 12.

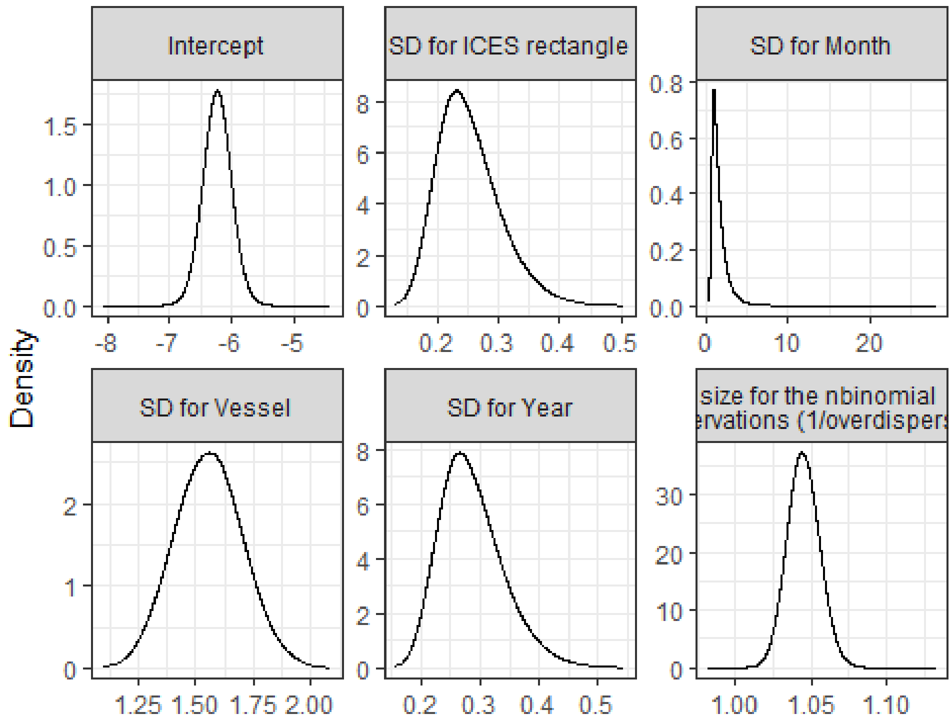


Figure 12: Posterior distributions of the model fixed effects (intercept) and hyperparameters governing the processes and observation model.

3.3. Model validation: residuals exploration

Model validation was performed by inspecting QQplot and Anscombe residuals against all covariates. Pearson residuals are also displayed even if they are not supposed to follow a normal distribution they are shown just for comparison with Anscombe one (Figure 13, Figure 14). The approximation of Anscombe was used to normalise the residual of the negative binomial following this equation:

$$A_{y,m,r,v} = \frac{\frac{3}{\theta_{obs}} \cdot \left[(1+\theta_{obs}.kg_{y,m,r,v})^{\frac{2}{3}} - (1+\theta_{obs}.\hat{\mu}_{y,m,r,v})^{\frac{2}{3}}\right] + 3(kg^{\frac{2}{3}}_{y,m,r,v} - \hat{\mu}^{\frac{2}{3}}_{y,m,r,v})}{2(\hat{\mu}_{y,m,r,v} + \theta_{obs}.\hat{\mu}^{2}_{y,m,r,v})^{\frac{1}{6}}}$$

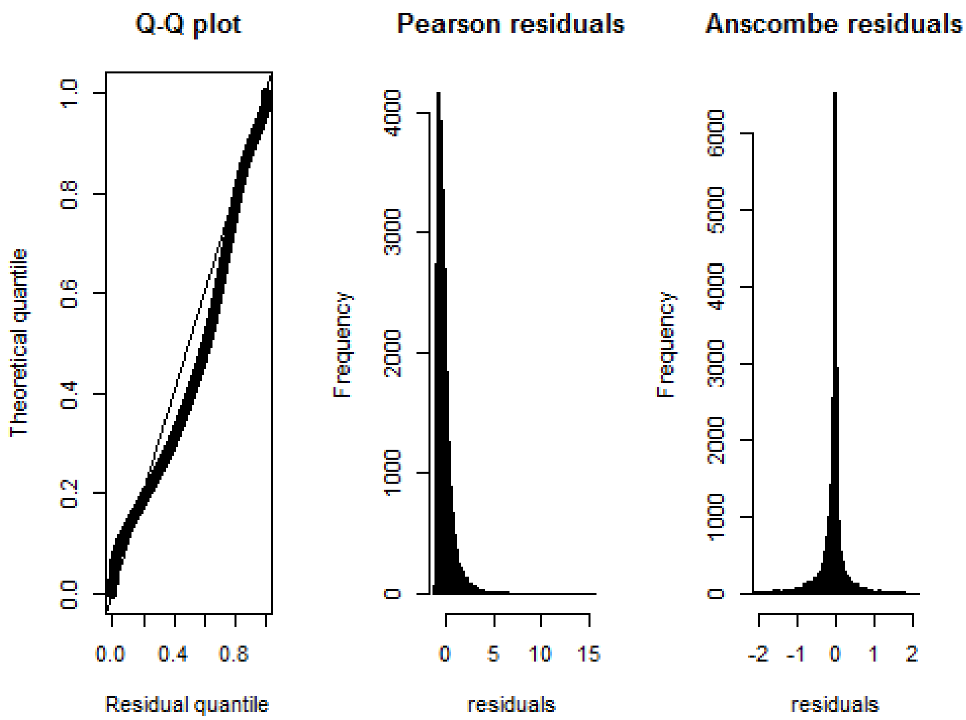
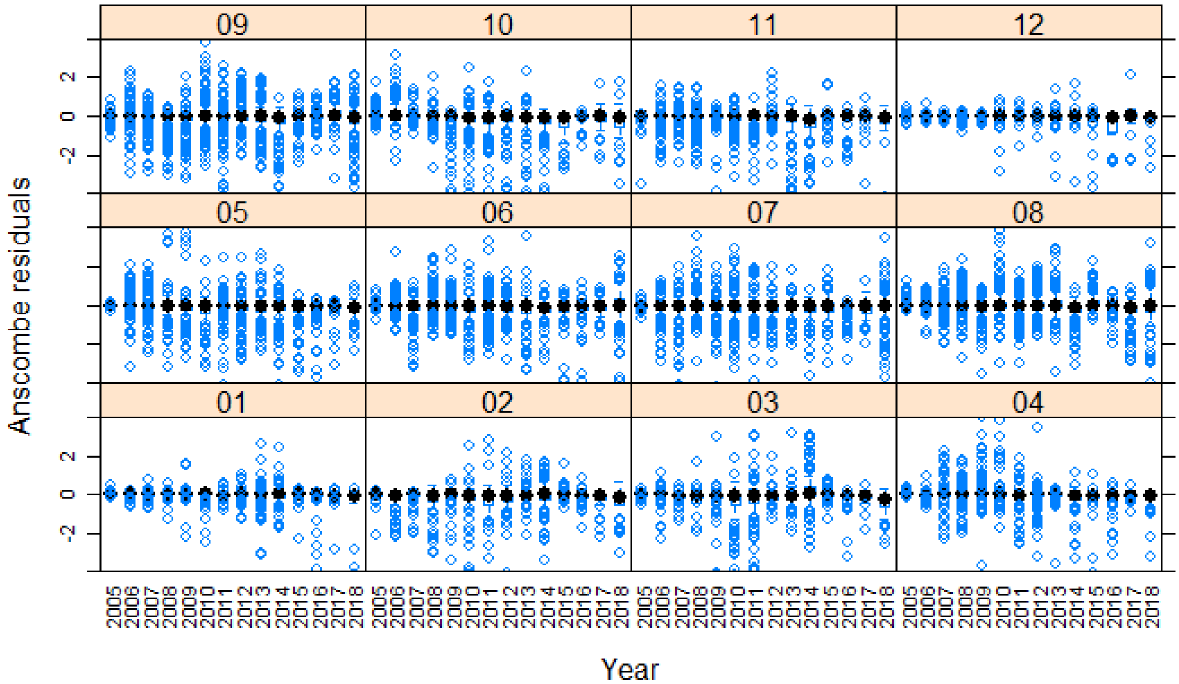


Figure 13: Q-Q plot and model residuals distributions (Pearson and Anscombe)



09
10
11
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05
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07
08
01
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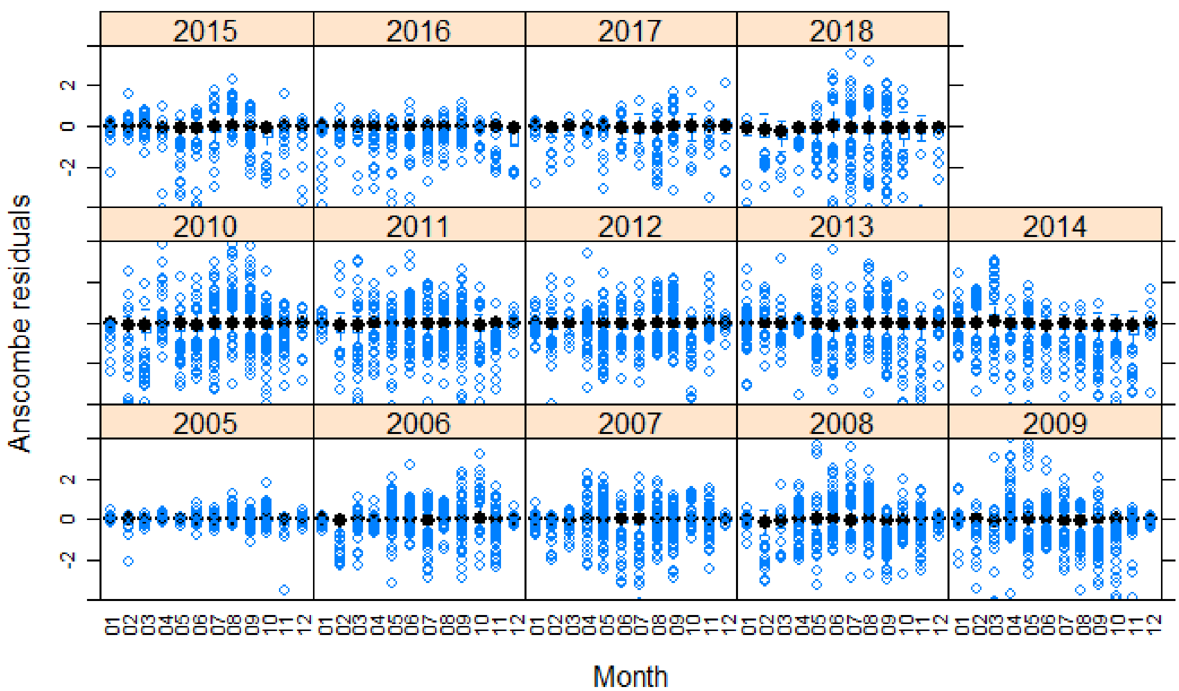
03
04
Anscombe residuals
Year



2015
2016
2017
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2010
2011
2012
2013
2014
2005
2006
2007
2008
2009
Anscombe residuals
Month

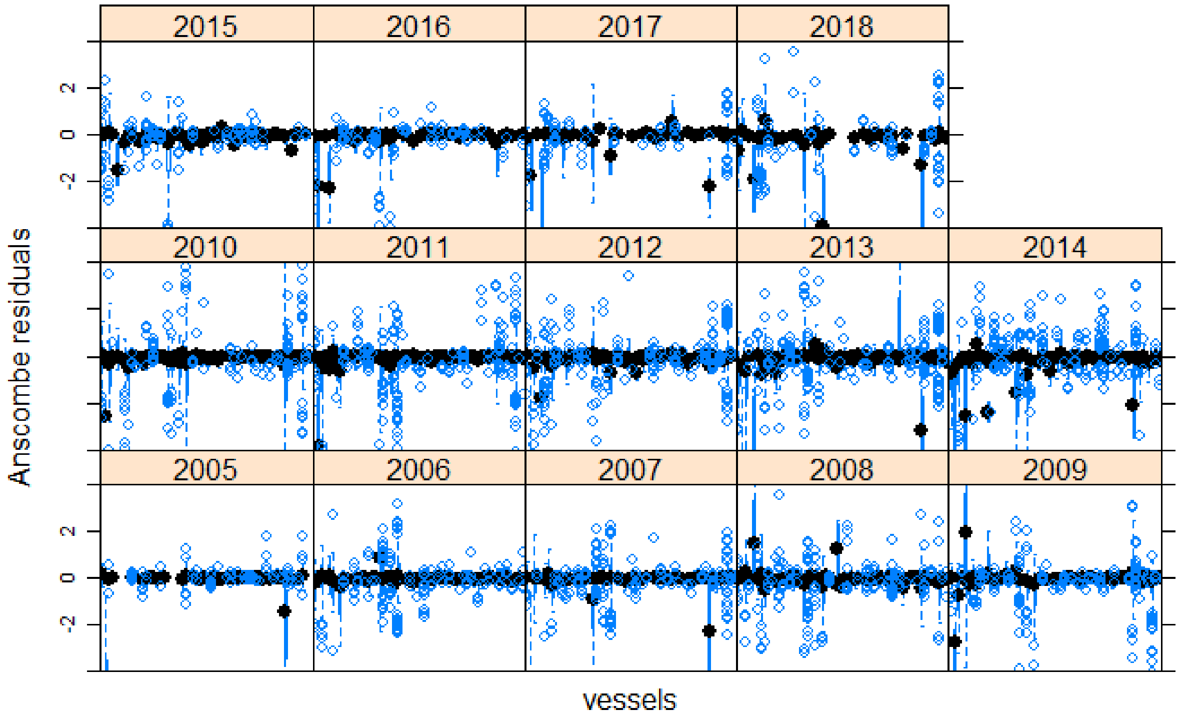


Figure 14: Boxplot of Anscombe residuals distributions against model covariates

No significant trends or effect remains in the residuals except for some vessels in particular month and years.

3.4. Standardized LPUE

To estimate the annual cpue trend and its 95% credible interval, the expected values and 0.025 and 0.975 quantiles were extracted from the marginal posterior distributions of the intercept and the annual yearly random effects (Table 6, Figure 15).

Table 6: Expected value and 0.025 and 0.975 quantile of the marginal posterior distribution (after exponential transformation) of each random year effect.

Year	expected	0.025	0.975
2005	1.048	0.9711	1.133
2006	1.727	1.634	1.827
2007	1.534	1.463	1.609
2008	1.819	1.735	1.908
2009	1.453	1.384	1.526
2010	2.169	2.072	2.273
2011	2.24	2.14	2.347

2012	2.145	2.048	2.247
2013	2.784	2.652	2.923
2014	3.289	3.131	3.458
2015	1.878	1.765	2.001
2016	1.59	1.482	1.707
2017	2.128	1.972	2.301
2018	2.678	2.522	2.846

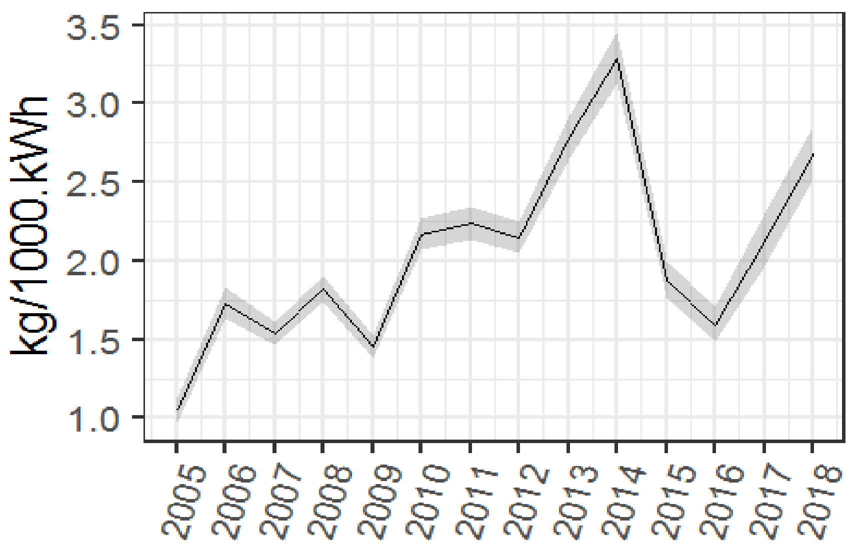


Figure 15: FR-new-COTB: estimated LPUE per year

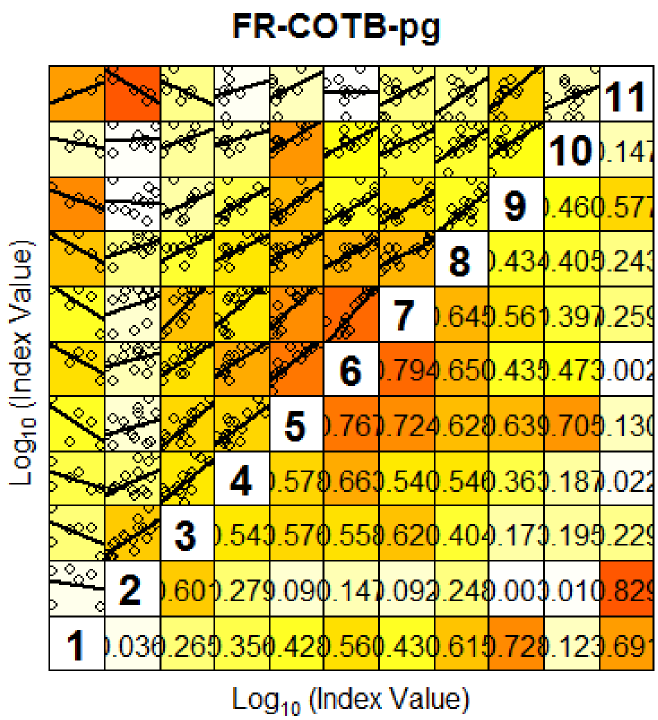
4. Age-structured LPUE index

Landings weight, individual weight and numbers at age are obtained from observer trips, market sampling and scientific survey and were raised per year. To transform the lpue (kg/kWh) index into an age structured index (N@age/kWhour), the annual landings were divided by the annual lpue estimates so that an annual standardized effort coefficient was derived (landings per year/standardized annual cpue estimate). Then we divided the numbers at age by that standardized effort coefficient per year. This resulted in an age based index expressed as numbers per unit of effort (Table 7).

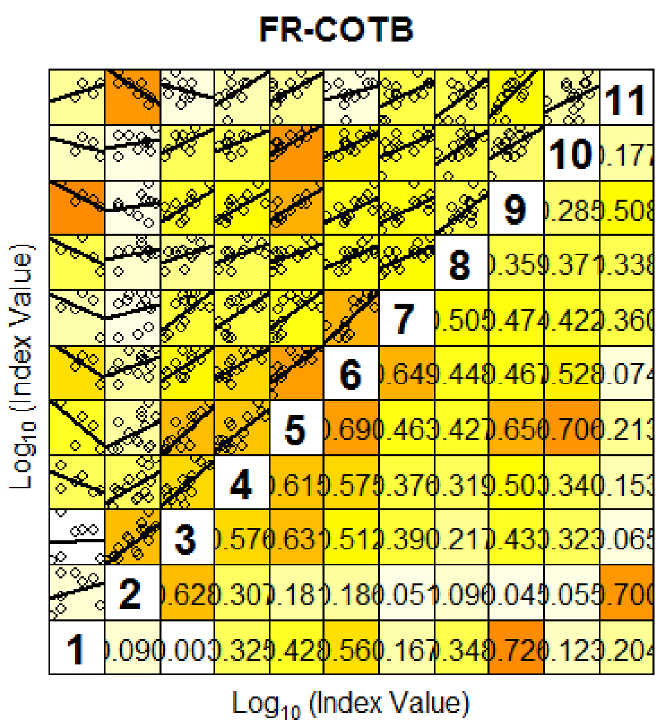
We compare FR-COTB index used during WGNSSK 2019 (ICES, 2019b) that was built from age data with a plus group in 2016 and 2017, the same index but this time calculated with the new dataset submitted to InterCatch without plus group and finally the new FR-COTB standardized using the mixed modeling approach described in this document (Figure 16).

Table 7: New FR-COTB tuning series from 2005-2018

FR-COTB-new																						
2005	2018																					
1	1	0	1																			
0	21																					
1	0	0.11	0.89	1.36	1.18	0.47	0.26	0.08	0.08	0.04	0.01	0	0.01	0.01	0	0	0	0	0	0	0	0
1	0	0.19	4.9	1.18	0.71	0.8	0.24	0.16	0.09	0.04	0.09	0.01	0	0.01	0.01	0	0	0.01	0	0	0	0
1	0	0	2.36	3.01	1.21	0.47	0.65	0.14	0.06	0.05	0.02	0.02	0.01	0.01	0	0	0.01	0	0	0	0	0.03
1	0	0	1.42	3.35	1.56	0.33	0.27	0.26	0.15	0.04	0.04	0.04	0.01	0.01	0.01	0	0.01	0.01	0	0	0	0
1	0	0	1.17	2.47	2.17	0.47	0.18	0.09	0.12	0.04	0.04	0	0.01	0	0	0.05	0	0	0	0	0	0
1	0	0.05	6.37	1.51	1.58	1.04	0.32	0.07	0.14	0.08	0.04	0.03	0.01	0.01	0.01	0	0	0	0	0	0	0
1	0	0	4.41	3.66	0.9	0.62	0.56	0.23	0.06	0.04	0.04	0.02	0.01	0.03	0	0	0	0	0	0	0	0
1	0	0.02	1.8	4.34	2.36	0.47	0.44	0.21	0.08	0.04	0.02	0.03	0.01	0	0.02	0.01	0	0	0	0.01	0	0
1	0	0	1.53	5.02	3.02	1	0.45	0.35	0.29	0.09	0.01	0.03	0	0	0.04	0	0	0	0	0	0.03	0
1	0	0.01	0.81	3.12	5.2	2.53	1.02	0.44	0.24	0.16	0.04	0.07	0.01	0.04	0.01	0	0.01	0	0	0	0	0
1	0	0.05	2.12	1.17	1.47	1.61	1.02	0.47	0.19	0.06	0.08	0.02	0.02	0	0	0.01	0.01	0	0	0	0	0.02
1	0	0.03	0.67	1.63	0.77	0.79	0.87	0.42	0.24	0.15	0.13	0.1	0.09	0.06	0.05	0.05	0.08	0.05	0.05	0.05	0.05	0.06
1	0	0.05	0.67	1.76	1.3	0.69	0.73	0.64	0.38	0.17	0.19	0.13	0.11	0.1	0.13	0.15	0.15	0.12	0.1	0.13	0.1	0.1
1	0	0.1	1.74	1.32	1.97	0.85	0.56	0.71	0.66	0.4	0.28	0.25	0.19	0.16	0.14	0.17	0.14	0.14	0.15	0.12	0.14	0.15



Lower right panels show the Coefficient of Determination (r^2)



Lower right panels show the Coefficient of Determination (r^2)

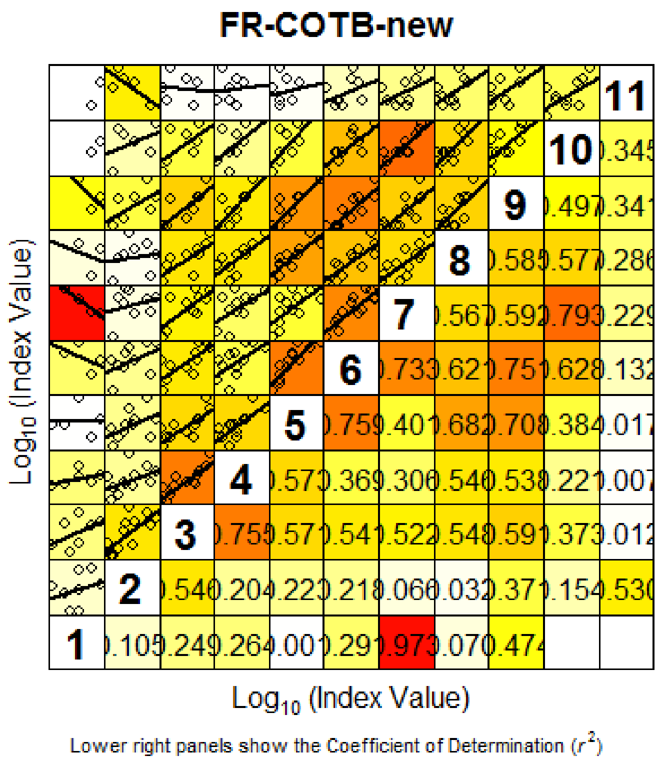


Figure 16: Consistency plot of WGNSSK 2019 FR-COTB with plus group, WGNSSK 2019 FR-COTB without plus group and new FR-COTB.

The new index seems to track well sole cohort from age 3 to 4 and 5 to 7, and reasonably well from age 2 to 9.

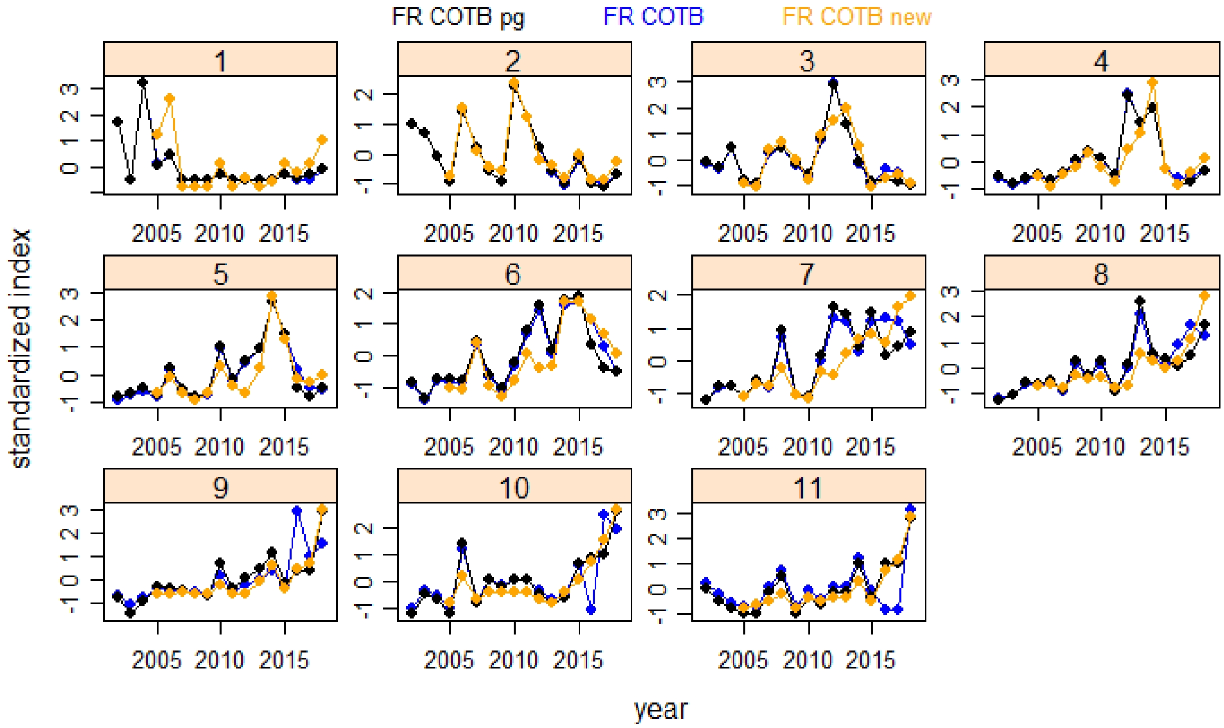


Figure 17: Index comparison of WGNSSK 2019 FR-COTB with plus group, WGNSSK 2019 FR-COTB without plus group and new FR-COTB.

The old FR-COTB index and the new one remain consistant with each other except for ages 7-8 where the new index is more optimistic than the old one (Figure 17).

5. Conclusion

To compute the new FR-COTB index, logbooks where used to estimate the landing rates of the *OTB_DEF_70_99_0*. Compare to the last benchmark, a fleet selection was done and LPUE index was standardized using a regression model including a random effect with ICES rectangle, month and vessel. To move from a LPUE per year to an age-structured LPUE per year, first the annual LPUE estimated by the model was divided by the annual landings so that an annual standardized effort coefficient as derived. Numbers at age of the landing were divided by that standardized effort to produce an age structured index expressed as a numbers per unit of effort.

6. References

ICES. 2017. Report of the Benchmark Workshop on North Sea Stocks (WKNSEA), 6–10 February 2017, Copenhagen, Denmark. ICES CM 2017/ACOM:34. 673 pp. http://doi.org/10.17895/ices.pub.5339.

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ICES. 2019b. Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK). ICES Scientific Reports, 1:7. http://doi.org/10.17895/ices.pub.5402.

Centre for Environment Fisheries & Aquaculture Science

Cefas

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Young Fish Survey indices for 7.d Sole

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Executive Summary

English fishers of Dover sole in the English Channel wish to see the reinstatement of the English Young Fish Survey and the data to be incorporated into the ICES stock assessment. This survey ceased in 2006 and estimates of sole recruitment in ICES subdivision 7.d rely upon surveys in inshore French waters which may not be representative of the stock as a whole.

As historical surveys were processed by hand, it was decided to re-work the entire time series in a single unified script to ensure consistency of approach. The revised estimates for the period 2000-2006 and a new estimate for 2019 are presented. In order to be considered for inclusion in the assessment for Eastern Chanel sole, the data will being presented to the benchmark meeting WKFlatNSCS which runs from the 17th to the 21st of February 2020. The decision on whether to include the revised and new estimates and how to include them is up to this benchmark.

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Tables

Figures

1 Introduction

Sole is a key stock for UK fishermen operating in the English Channel. It is a high value stock which is taken throughout the year and so contributes significantly to the economic stability of the fishing and processing industries at small ports in South East England.

Since the UK ceased their Young Fish Survey (YFS) in 2006, the ICES assessment for 7d sole has been wholly dependent upon French data for a recruitment index. These French data represent the state of recruitment on French inshore grounds that are at least 70 miles away from any UK fishing activity and there is concern amongst the industry that the recruitment index represents local conditions rather than the whole ICES area. Estimates of recent recruitment in the assessment are highly influential on the quota advice, therefore the inclusion of data on juvenile sole abundance from UK waters is expected to improve the robustness of the advice. Data for the older portion of the stock comes from the commercial fisheries and the Cefas 7DBTS survey which cover the entire area.

In order to address this, it was agreed that a survey should be conducted within 7.d with the objective of collecting data on juvenile sole which could be used to contribute to the assessment of this stock. This survey would be based on the YFS series which Cefas had previously carried out in this area, up until it's conclusion in 2006, with the intention that enough consistency between the new and historic data sets could be achieved to allow the data to be included in the stock assessment as a continuation of the original time-series.

The sections below describe the survey planning process, implementation and results. Followed by some recommendations for future surveys and lessons learned.

1.1 Methods

This section describes the methods used to establish consistency between the previous YFS timeseries and the 2019 survey.

1.1.1 Background

Historically (1981–2006) the Cefas YFS was conducted along the South coast of England and was once quite extensive sampling inshore locations between Southampton Water and North Foreland. This large survey area was divided up into smaller geographical areas (split by prominent geographical features), referred to as mini areas (Rogers *et.al.*, 1998). From 2000 onwards, the coverage of the survey was reduced to sample locations between Beachy Head and Dover, covering two mini-areas (Figure 1):

- J - Dover to Dungeness
- K - Dungeness to Beachy Head

Within these mini areas, at inshore locations, prime stations were identified to be fished annually, ideally at the beginning of September. These prime stations were fixed fishing stations distributed within four depth bands. The survey was originally designed so that more stations were selected in depth bands where common flatfish species were caught in the largest numbers. In a fixed station survey such as this Prime stations are fixed positions that are consistently visited each time a survey is undertaken to ensure that data can be compared year on year. These fixed survey positions are identified as ‘Prime’ to differentiate them from any ‘Additional’ stations that may be visited during a survey for the purposes of meeting specific research aims not relevant to the whole timeseries of data.

At the time the survey ceased in 2006, annual abundance-at-age indices were calculated for both sole and plaice and these were used within the ICES stock assessments.

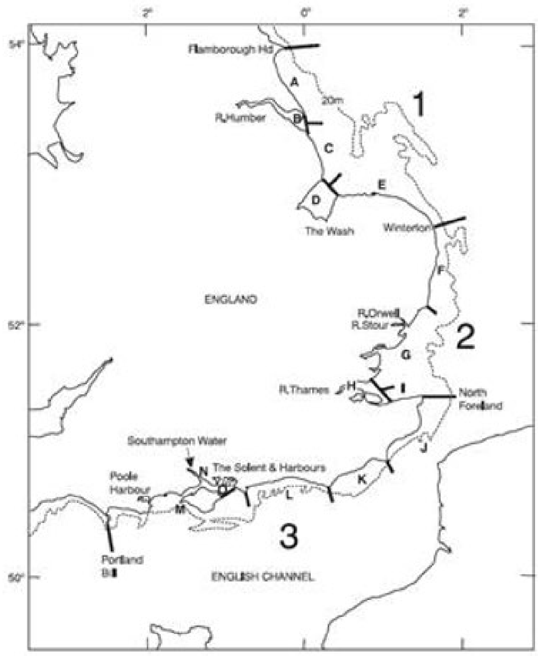


Figure 1: Map of YFS mini areas (taken from Rogers *et.al*., 1998).

Although it was the intention to replicate the historic survey, as this had not taken place since 2006 it was necessary to ensure that the prime station positions were still open to fishing activity and were not off limits due to other marine usage (e.g. MPA, windfarms etc).

1.1.2 Station selection

Historic survey stations that were sampled between 2000–2006 were studied to determine how consistently they had been targeted during those years. From a total of 102 stations visited, 81 were considered to have been sampled consistently enough to form a list of prime stations to be targeted by the reinstated survey in 2019 (Figures 2–4). The remaining 21 stations had been fished only on a small number of occasions in the previous timeseries.

For these 81 stations the actual historic locations fished were plotted against the original prime target position and as it was apparent that there had been some moderate deviations of actual positions fished across the timeseries and it was not always clear which of these fished positions related to the original agreed prime position, all target prime positions were thus re-established as averages of the shot position over this period for the purposes of the 2019 survey .

As the survey is stratified by depth revised station locations were overlaid against chart depth bands (0–1.9 m (DB1), 2–5.9 m (DB2), 6–11.9 m (DB3), and 12–20m (DB4). (Figures 2 to 4, respectively)) to ensure they were still allocated correctly. The bathymetry used was from GEBCO (as gridded bathymetry data, https://www.gebco.net/about_us/overview/), at a resolution of 15 arc-second intervals. GEBCO's global elevation models are generated by the assimilation of data from different sources on the assumption that all of them are referenced to mean sea level (Table 1).

Table 1: Allocation of prime station by mini area and chart depth band for the stations targeted during the 2019 south coast survey, and in previous surveys ()).

Chart depth band	Mini-area J (Dover to Dungeness)	Mini-area K (Dungeness to Beachy Head)	Total
1	9 (9)	26 (22)	35 (31)
2	11 (8)	15 (15)	26 (23)
3	4 (6)	16 (19)	20 (25)
4	0 (1)	0 (1)	0 (2)
Total	24	57	81

1.1.3 Sample areas

During the calculation of indices, abundance-at-age data were raised to the total area covered in each chart depth band for the two mini-areas J and K (table 2). As prime station locations are well distributed across mini-area area K (Dungeness to Beachy Head) it was appropriate to raise catches to the total area. For mini-area J (Dover to Dungeness) the stations that were deemed to have been visited regularly enough in previous years to be considered ‘Prime’ were concentrated towards the western extent of the mini-area so catches were raised to the proportion of the mini area sampled as sole distribution tends to be variable across the area and extrapolation could generate potential bias in results if the unsampled area has different depth proportions compared to the sampled area.

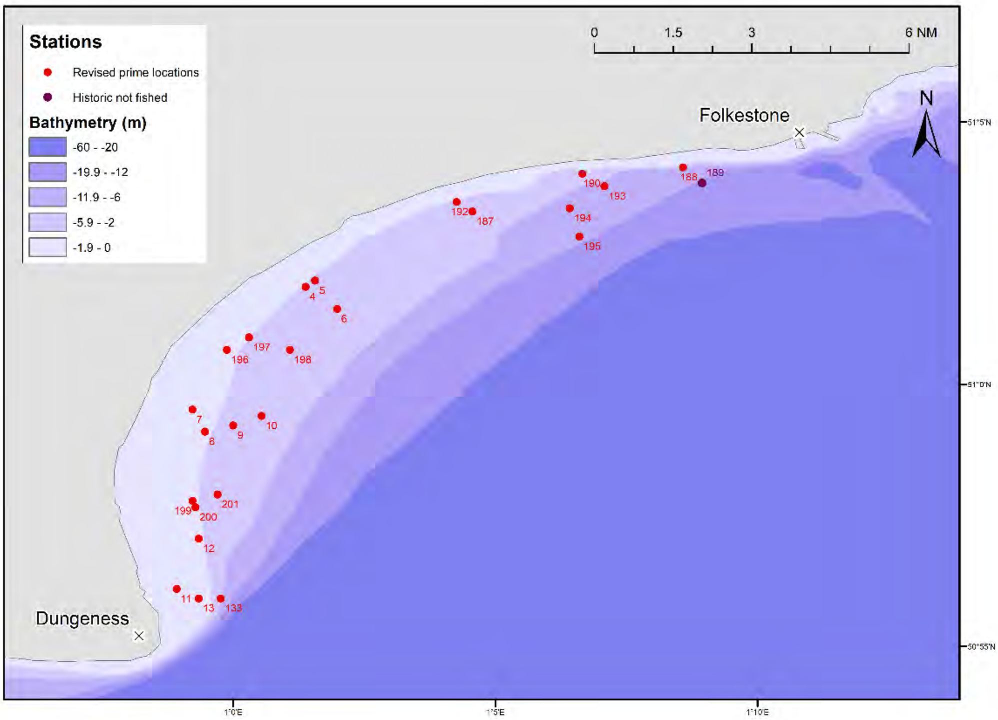


Figure 2: Proposed prime stations (red circles) to be fished in mini area J

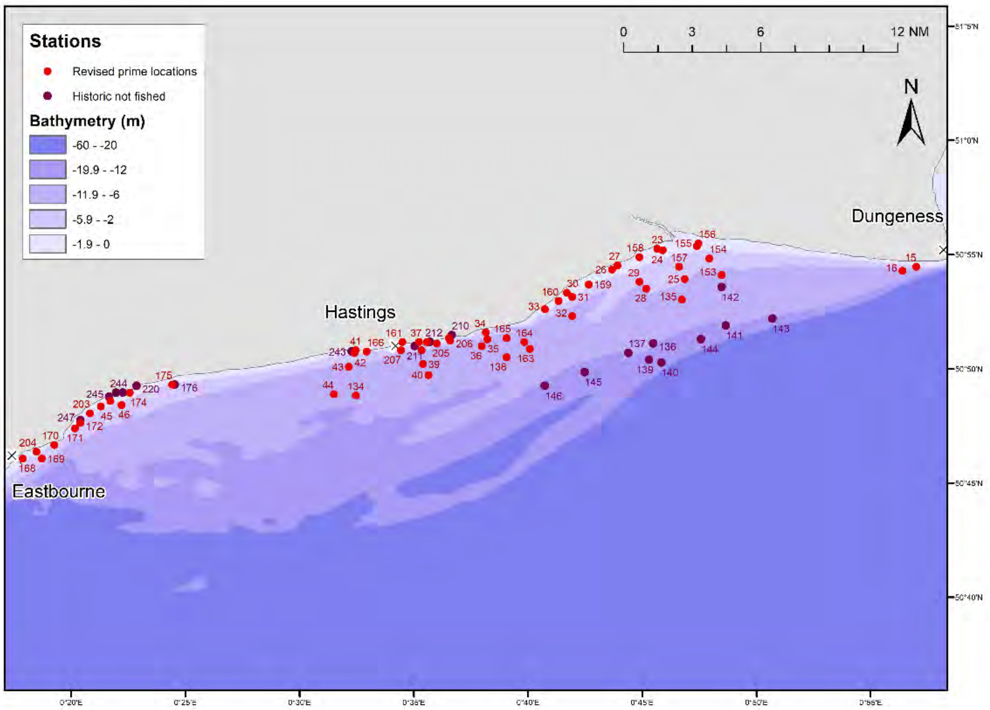


Figure 3: Proposed prime stations (red circles) to be fished in mini area K.

1.1.4 Biological samples

Ages for biological samples of sole and plaice collected on the 2019 survey were input into the FSS database. For lengths with no available age length key an iterative process was used to fill the gaps in the data, full details of the process can be found in section 2.2.1.

2 Results

2.1 Survey implementation

2.1.1 Survey aims

1. To conduct a beam trawl survey at inshore locations (n=81) along the southeast coast between Eastbourne and Folkestone (ICES Division 7.d) to gather abundance-at-age data for juvenile sole (*Solea solea*) and plaice (*Pleuronectes platessa*).
2. To collect abundance and length (measured to 0.5 cm precision, rounded down – e.g. 5.6 is recorded as 5.5) distribution data of all species of fish, cephalopod and shellfish encountered.
3. To collect biological samples for sole and plaice for age determination purposes.
4. To record the presence of epibenthic taxa, and the volume of the shrimp catch.

2.1.2 Vessel and gear

The commercial trawler FV *Lily May* was chartered for the survey. The two-metre beam trawl used in 2019 was the same as used in the historic survey. This comprised a fine mesh net with a cod-end liner of 4 mm knotless mesh, a light chain footrope and three tickler chains stretched loosely between the shoes. Gear deployment was also the same as the previous surveys, the beam trawl being towed at the pre-selected fixed prime stations for 10 minutes at approximately 1 knot with the tide, covering 450 m.

For narrative and further information on survey implementation see Appendix 1

2.2 Analysis of data

2.2.1 Index calculation

The historical indices were calculated in spreadsheets and it has not been possible to replicate the results of these exercises using a standardised script. Therefore, we have opted to recalculate the series, using scripts, so that they are easily reproducible. Age-based information are only available on the Cefas databases since 2000, so the new index runs from 2000-2006 plus 2019. To ensure maximum consistency only data from the 81 stations selected for the 2019 survey are now included in the index estimation.

As mentioned in section 1.1.3, the index is an area-based index of abundance raising standardised fixed station catches at age to the area within a depth-band in each of the mini-areas J and K. Table 2 details the area within the three depth bands used for each mini-area.

Previously there were 102 stations included in the index and not all stations where consistently fished throughout the timeseries. In order to create a more robust index, 81 fixed station locations across 3 depth-bands within 2 mini-areas were selected as these were consistently fished. The 81 fixed stations are now the target stations included in the survey design and will be fished each year, logistics allowing.

To obtain numbers at age per km^2, the numbers at length were first standardised to numbers per 1000 m^2 for each fixed station location. Age length keys were compiled for each station and then merged with the numbers at length to apportion the numbers at length by the age and sex for each length category. As not all length categories were biologically sampled due to logistical issues, age length keys were merged using a standard iterative process. This process firstly looks to borrow age compositions from length classes immediately adjacent to the missing length. If this does not provide a satisfactory answer then age-at-length compositions are sought from sequentially aggregated data (e.g. pooling samples over depth-band, mini-area and sex) used for merging on the age length key to the raised standardised numbers at length. Using this method all numbers at length had an assigned age, both in 2019 and historically.

Standardised numbers at age for each year and prime station were then averaged over the depth-band within each mini-area. The resulting average was then raised using the areas in table 2 by depth-band and mini-area and the values summed and then divided by the total summed area in depth bands 1 – 3 in mini area J and K giving a weighted average, shown in table 3, results giving indices for age 0-2 are provided in table 3 and figure 4.

Table 2: Area covered(km^2) by mini-areas J (Dover to Dungeness) and K (Dungeness to Beachy Head) by chart depth band for scenario (i) for the whole of the mini-area, (ii) the portion of the mini-area fished,

Chart depth band	Depth (m)	Mini-area J (i)	Mini-area J (ii)	Mini-area K
1	0–1.9	28.11	7.60	16.32
2	1.9–5.9	83.67	31.46	49.78
3	5.9–11.9	132.10	18.85	196.90
4	11.9–-20	178.49	30.51	185.01
Total		422.37	88.42	448.01

Table 3:Average number per km² by age and year, numbers in brackets are the number of measured lengths at age 1.

Year	Age-class		
	0	1	2
2000	0.44	0.71 (174)	0.23
2001	2.39	0.17 (15)	0.26
2002	2.36	2.36 (252)	0.21
2003	2.02	1.04 (83)	1.72
2004	3.38	1.30 (196)	0.36
2005	5.33	1.86 (76)	0.12
2006	1.40	1.34 (194)	0.18
2019	0.53	0.06 (13)	0.00

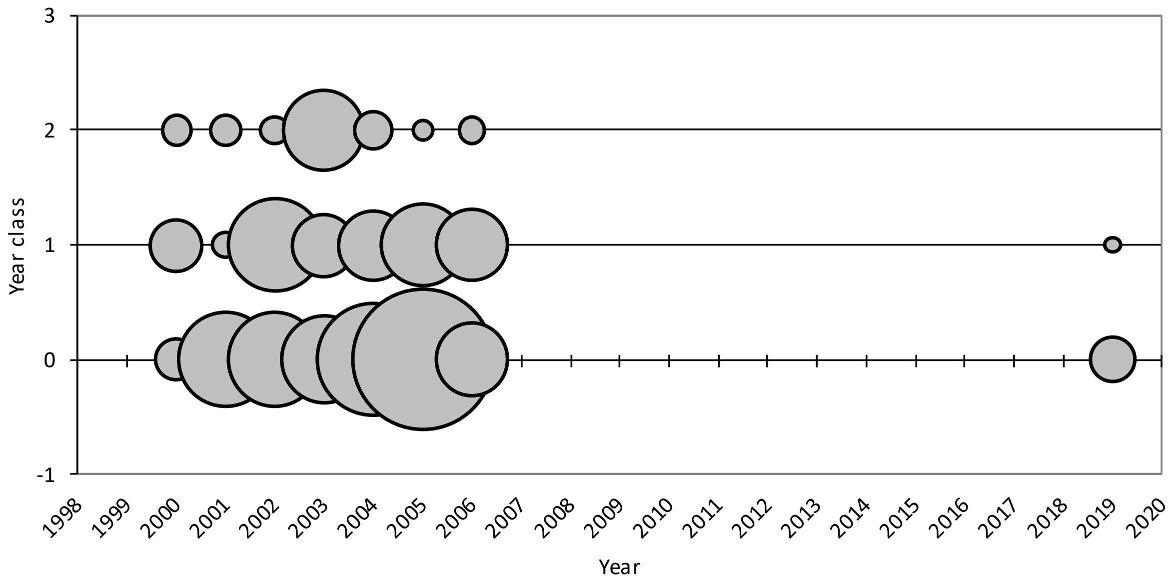


Figure 4: Total numbers at age by year.

2.2.2 Results and Comparison.

Recruitment at age 1 from the historic young fish survey (987-2006) has been used in the ICES assessments including that undertaken in 2019. Table 4 provides a comparison between this index and the newly developed index. The new index shows very similar trends to that of the index used in the current assessment, figure 5. Nevertheless, there are differences, and these are likely due to moving from spreadsheet calculations to an automated process and restricting the analysis to only those stations fished on a consistent basis. Other differences in data processing include fixed station positions being re-allocated to depth bands as more accurate information on depth has become available. This will have changed the area each depth band represents.

Additional analyses are required to investigate the uncertainty in the index, including the uncertainty caused by incomplete survey coverage in any given year (usually for logistical reasons such as weather). These uncertainty estimates are important given the patchiness of sole over the survey area.

Table 4: Index used in the ICES 2019 stock assessment (1987-2006) and the updated index (2000-2006)

Year	Index used in the stock assessment	Updated index
	Year-class age 1	
1987	1.38	
1988	1.87	
1989	0.62	
1990	1.9	
1991	3.69	
1992	1.5	
1993	1.33	
1994	2.68	
1995	2.91	
1996	0.57	
1997	1.12	
1998	1.12	
1999	1.47	
2000	2.47	0.71
2001	0.38	0.17
2002	4.15	2.36
2003	1.44	1.04
2004	2.72	1.30
2005	4.07	1.86
2006	2.21	1.34
2019		0.06

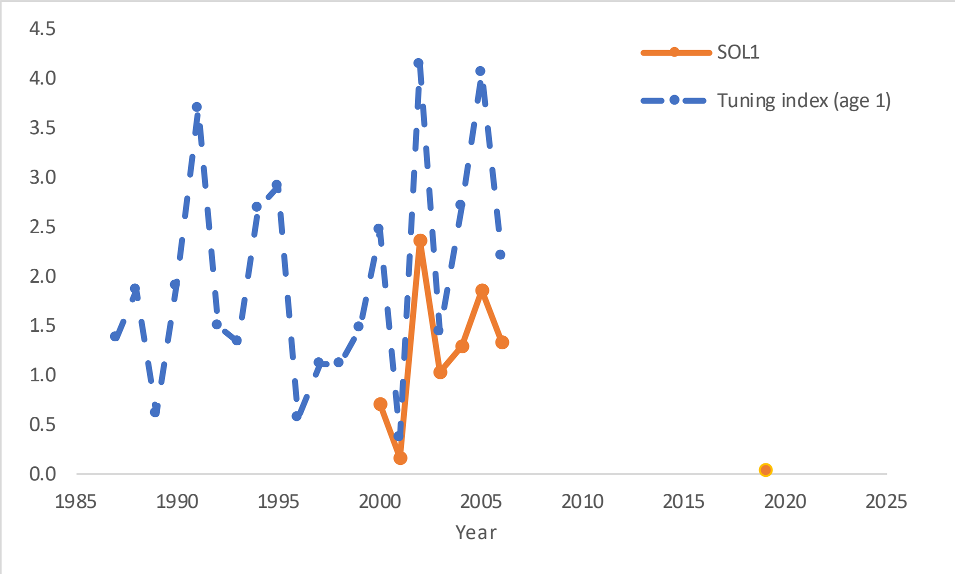


Figure 5: Comparison between new index (Sol1) and the index used in the ICES 2019 assessment (tuning index (age 1).

3 Conclusions

The analysis presented provides revised estimates for the Cefas Young Fish Survey for the period 2000-2006, and a new estimate for 2019. Given the high similarity in survey protocol and gear, coupled with the restriction of analysis to a consistent set of fishing positions, we believe that the 2019 survey point can be considered to be a continuation of the survey time series and is appropriate to be used in both the Eastern Channel sole and plaice stock assessments.

4 References

Rogers, S.I., Millner R.S. and Mead T.A., 1998. The distribution and abundance of young fish on the east a nd south coast of England (1981 to 1997). Science Series Technical Report No. 108, Cefas, Lowestoft. 130pp.

5 Appendix 1: Survey report

5.1.1 Stations sampled

Out of a total of 81 stations targeted for the survey, valid samples were collected for 68 tows. Samples could not be collected at the other thirteen locations due to the issues described in the narrative and detailed below (Figure 6).

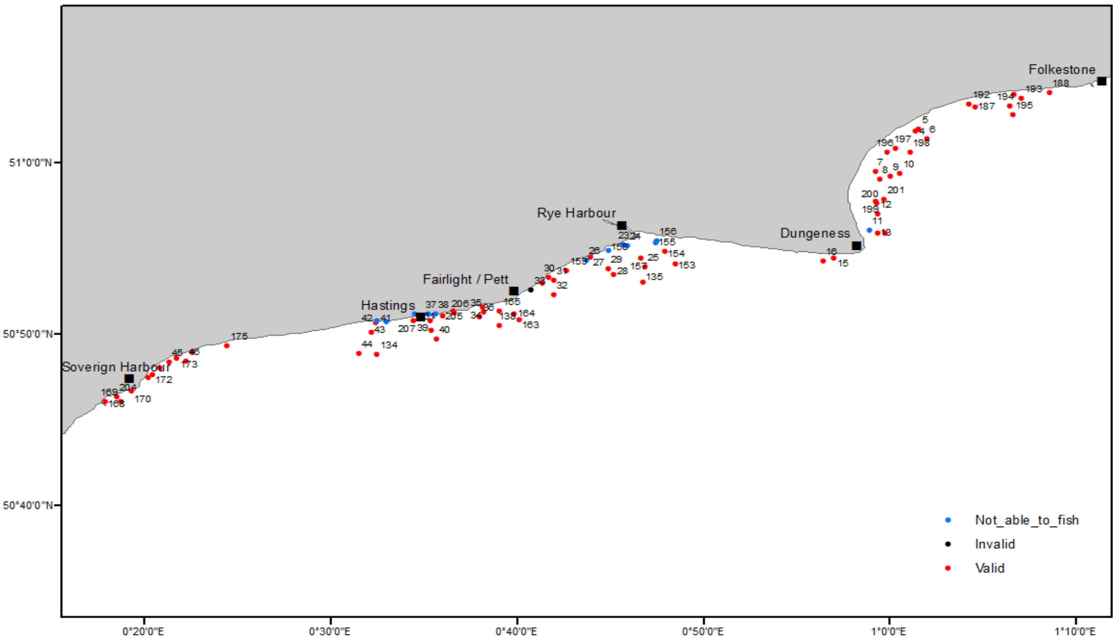
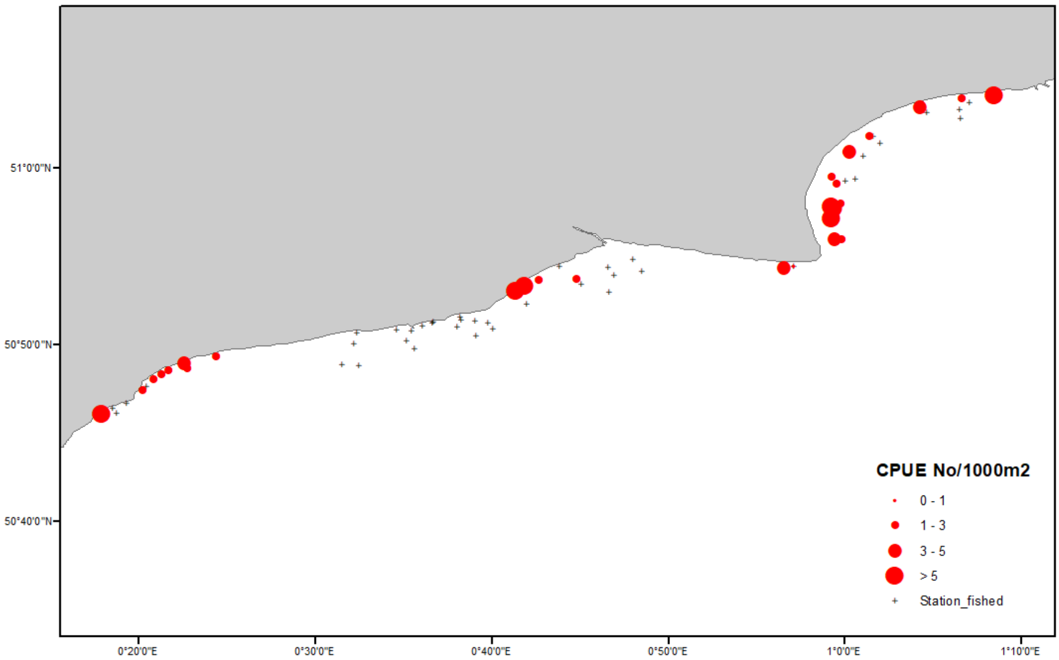


Figure 6: Prime stations targeted during the survey, showing valid stations (red circles), invalid stations (black circles), and stations that were not possible to fish (blue circles).

5.2 Summary of data collected



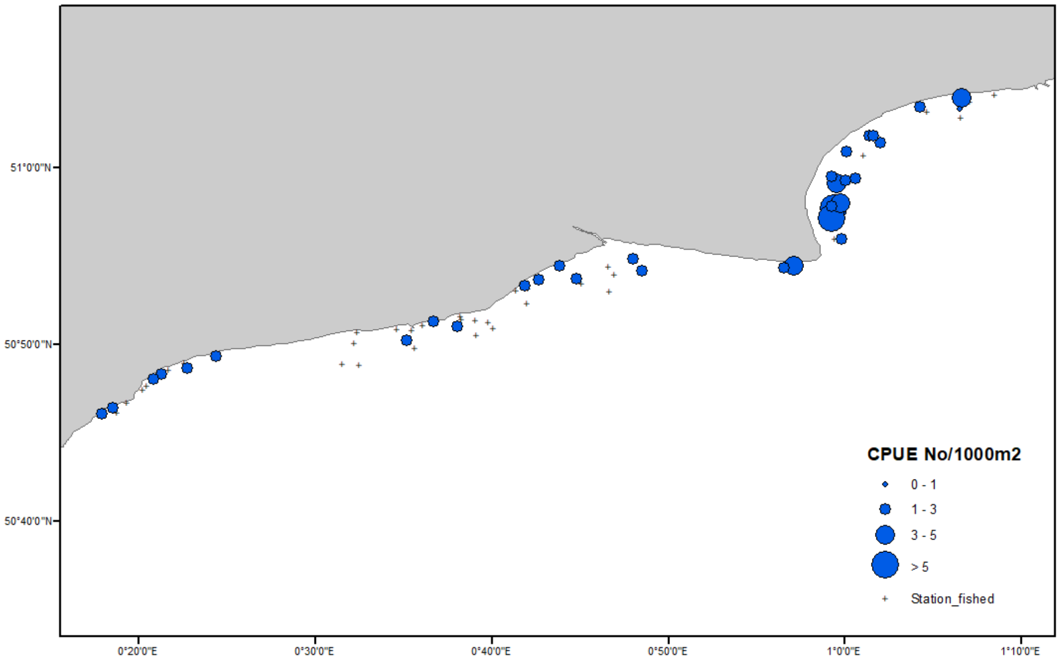
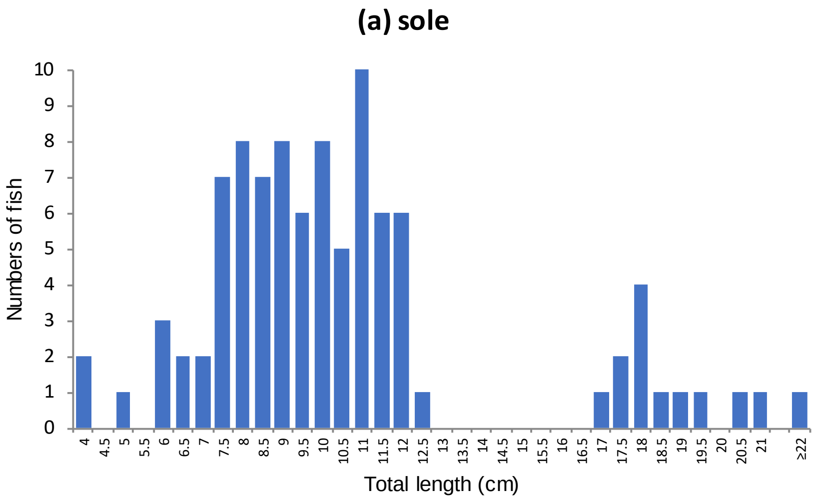


Figure 7:Distribution and relative abundance (number per 1000 m^2) for sole (top) and plaice (bottom). Valid stations with zero catch shown as '+'.



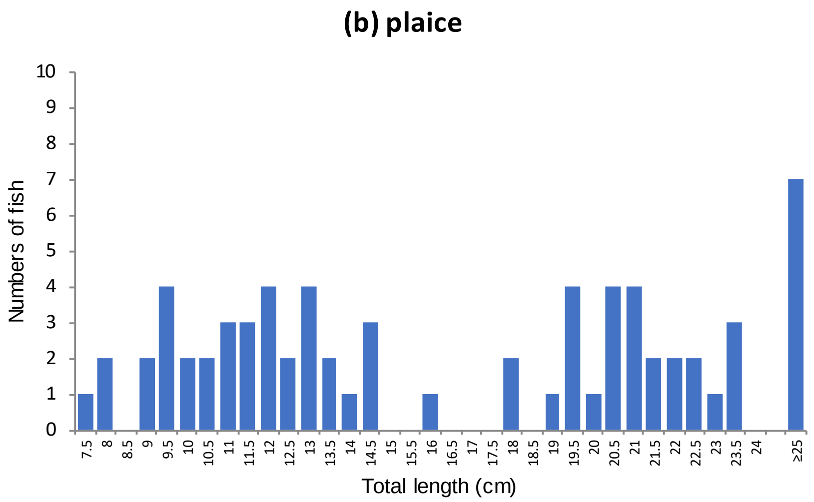


Figure 8:Length distributions for (a) sole and (b) plaice.

5.2.1 Biological samples;

A total of 49 sole and 66 plaice biological samples were collected for the survey, primarily for age determination purposes.

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Working document: Investigating maturity of Sole (*Solea solea* L.) in the Bristol Channel and Celtic Sea (ICES Division 27.7.fg)

Authors: Klaas Sys, Lies Vansteenbrugge, Bart Vanelslander and Sofie Nimmegeers

<u>Introduction</u>

The proportion of mature fish at age, often called the maturity ogive, is an important population characteristic and used for estimating spawning stock biomass (SSB) in the stock assessment. For sole in the Bristol Channel and Celtic Sea, the current maturity ogive is a combined sex maturity ogive taken from area 7.f and 7.g attributed to Pawson & Harley, working document presented to WGSSDS in 1997 (Table 1). The maturity ogive is based on samples taken during the UK (E&W) beam trawl survey of March 1993 and 1994 and is applied to all years in the assessment.

Table 1: Maturity ogive for sole in the Bristol Channel and Celtic Sea

Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Maturity	0.00	0.14	0.45	0.88	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Changes in life history traits such as age and size at first maturation were reported in several commercially exploited fish stocks (Jørgensen 1990; Rijnsdorp 1993; Mollet et al. 2007). Therefore, available maturity data for sole 7fg were evaluated to verify whether this currently-used maturity ogive is still applicable.

<u>Material and methods</u>

<u>Available datasets</u>

Maturity data on sole in Divisions 27.7.f and g were available from Belgium (commercial data) and the UK (commercial and survey data).

a) UK commercial data

UK commercial data were provided for the period 2013-2019. The current year (2019) was removed from the dataset, because the year was still ongoing. This resulted in 5500 maturity records. More insight in the data is provided in the Table 2 and Figure 1.

Table 2: Overview of the available maturity data from the UK commercial dataset.

Variable	Parameter		Number of records
Year	2013		792
	2014		611
	2015		1028
	2016		1276
	2017		835
	2018		958
Quarter	unknown		/
Sex	Male		1288
	Female		4212
Length	Min	22	3
(cm)	Max	54	1
	Median	35	287
Age	Min	2	116

(years)	Max	45	1
	Median	6	681
Maturity	Mature		5299
	Immature		201

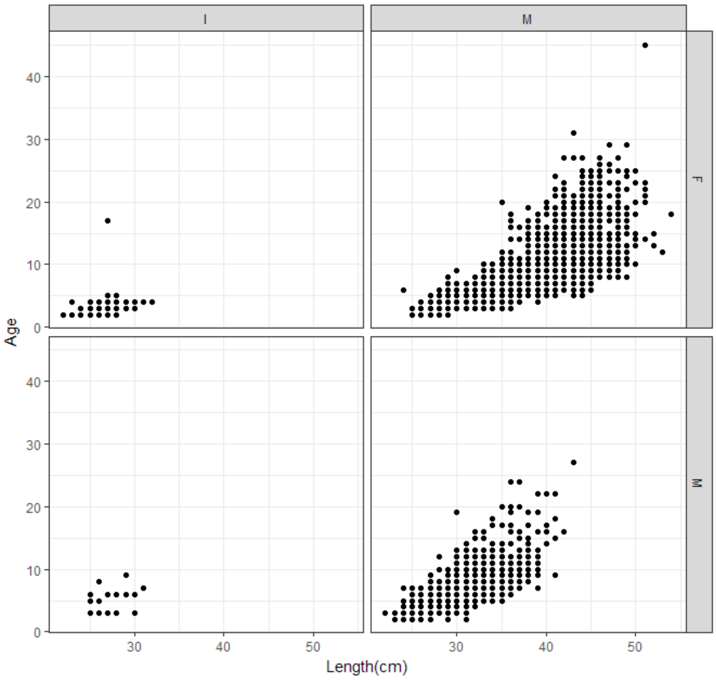

Figure 2: Age-length distribution with indication of sex (Female (F) or Male (M)) and maturation level (Immature (I) or Mature (M)) of the UK commercial dataset.

b) UK survey data

The UK survey data originated from 5 different surveys in the period 1986-2019 (Table 3). The 2019 data were removed, because the year was still ongoing. Records with undetermined sex (46 records) or undetermined age (1176 records) were also removed. This resulted in 6690 maturity records. Length data were available in mm, but were rounded to the centimeter below (*i.e.* 27.8 cm becomes 27 cm). More insight in the data is provided in Table 4 and Figure 3.

Table 3: Overview of maturity records per survey type over time.

	DCRDC	NWGFS	Q1SWBEAM	Q4SWIBTS	WCGFS
1986	0	0	0	0	8
1987	0	0	0	0	2
1988	0	12	0	0	0
1989	0	0	0	0	2
1991	0	133	0	0	0
1993	0	314	0	0	4
1994	0	316	0	0	2
1995	0	219	0	0	18
1996	0	197	0	0	3
1997	0	313	0	0	3
1998	0	304	0	0	2
1999	0	282	0	0	2

2000	0	310	0	0	2
2001	0	196	0	0	6
2002	0	187	0	0	10
2003	0	172	0	0	0
2004	0	244	0	9	5
2005	285	174	0	9	0
2006	80	154	0	10	0
2007	0	170	0	0	0
2008	18	152	0	11	0
2009	191	169	0	17	0
2010	179	1	0	10	0
2011	0	39	0	11	0
2013	0	13	54	0	0
2014	0	0	113	0	0
2015	0	276	65	0	0
2016	0	227	56	0	0
2017	0	229	117	0	0
2018	0	342	241	0	0

Table 4: Overview of the available maturity data from the UK survey dataset.

Variable	Parameter	Number of records
Year	1986	8
	1987	2
	1988	12
	1989	2
	1991	133
	1993	318
	1994	318
	1995	237
	1996	200
	1997	316
	1998	306
	1999	284
	2000	312
	2001	202
	2002	197
	2003	172
	2004	258
	2005	468
	2006	244
	2007	170
	2008	181
	2009	377
	2010	190
	2011	50
	2013	67
	2014	113

	2015	341
	2016	283
	2017	346
	2018	583
Quarter	unknown	/
Sex	Male	3492
	Female	3198
Length (cm)	Min 5	5
	Max 53	1
	Median 26	504
Age (years)	Min 0	214
	Max 30	1
	Median 3	1269
Maturity	Mature	4672
	Immature	2018

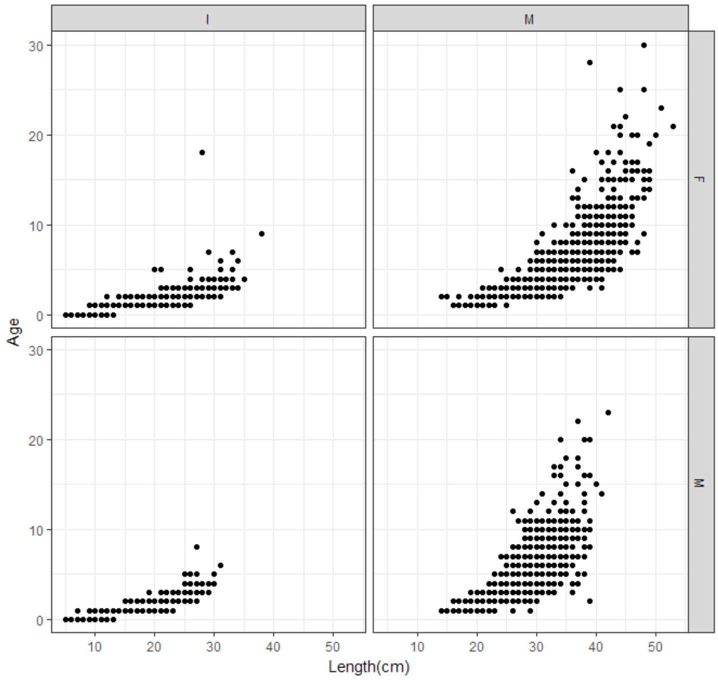

Figure 3: Age-length distribution with indication of sex (Female (F) or Male (M)) and maturation level (Immature (I) or Mature (M)) of the UK survey dataset.

c) Belgian commercial data

Belgian commercial data were provided for the period 2011-2018. Records with undetermined sex (1 record) or undetermined age (125 records) were removed. This resulted in 3795 maturity records. Length data were available in mm, but were rounded to the centimeter below (*i.e.* 27.5 cm becomes 27 cm). More insight in the data is provided in the Table 5 and Figure 4.

Table 5: Overview of the available maturity data from the Belgian commercial dataset.

Variable	Parameter	Number of records
Year	2011	547
	2012	668

	2013		310
	2014		394
	2015		388
	2016		520
	2017		529
	2018		439
Quarter	1		1056
	2		1712
	3		119
	4		908
Sex	Male		1007
	Female		2788
Length (cm)	Min	22	3
	Max	51	2
	Median	31	196
Age (years)	Min	1	9
	Max	32	1
	Median	5	631
Maturity	Mature		3785
	Immature		10

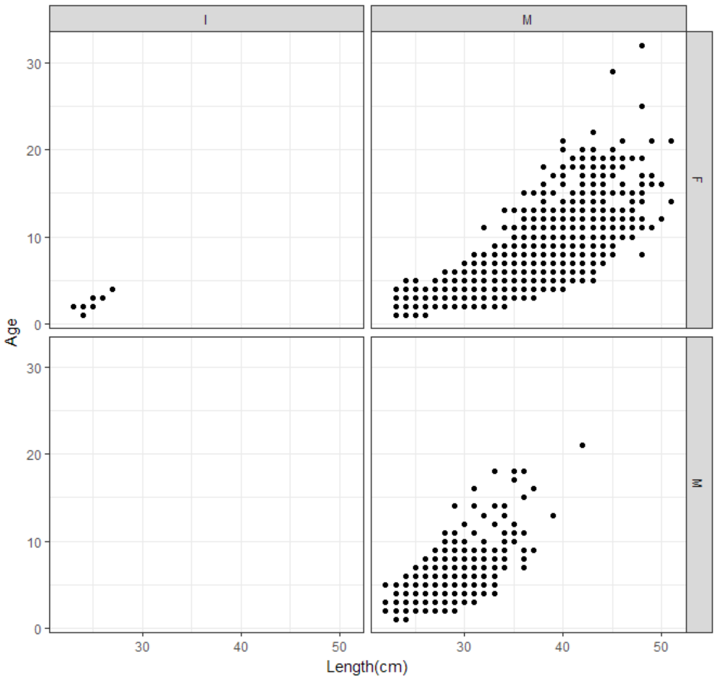

Figure 4: Age-length distribution with indication of sex (Female (F) or Male (M)) and maturation level (Immature (I) or Mature (M)) of the Belgian commercial dataset.

Combined dataset and data exploration

The combined maturity dataset provides data from 1986 until 2018. This resulted in 15985 maturity records. More insight in the data is provided in Table 6 and Figures 5-7.

Table 6: Overview of all available maturity data for sole in 7fg.

Variable	Parameter		Number of records
Year	1986		8
	1987		2
	1988		12
	1989		2
	1991		133
	1993		318
	1994		318
	1995		237
	1996		200
	1997		316
	1998		306
	1999		284
	2000		312
	2001		202
	2002		197
	2003		172
	2004		258
	2005		468
	2006		244
	2007		170
	2008		181
	2009		377
	2010		190
	2011		597
	2012		668
	2013		1169
	2014		1118
	2015		1757
	2016		2079
	2017		1710
	2018		1980
Sex	Male		5787
	Female		10198
Length	Min	5	5
(cm)	Max	54	1
	Median	30	873
Age	Min	0	214
(years)	Max	45	1
	Median	4	2361
Maturity	Mature		13756
	Immature		2229

The survey data provide most of the information on immature sole. The commercial datasets seem to also differ in their age-length distribution (Figure 5).

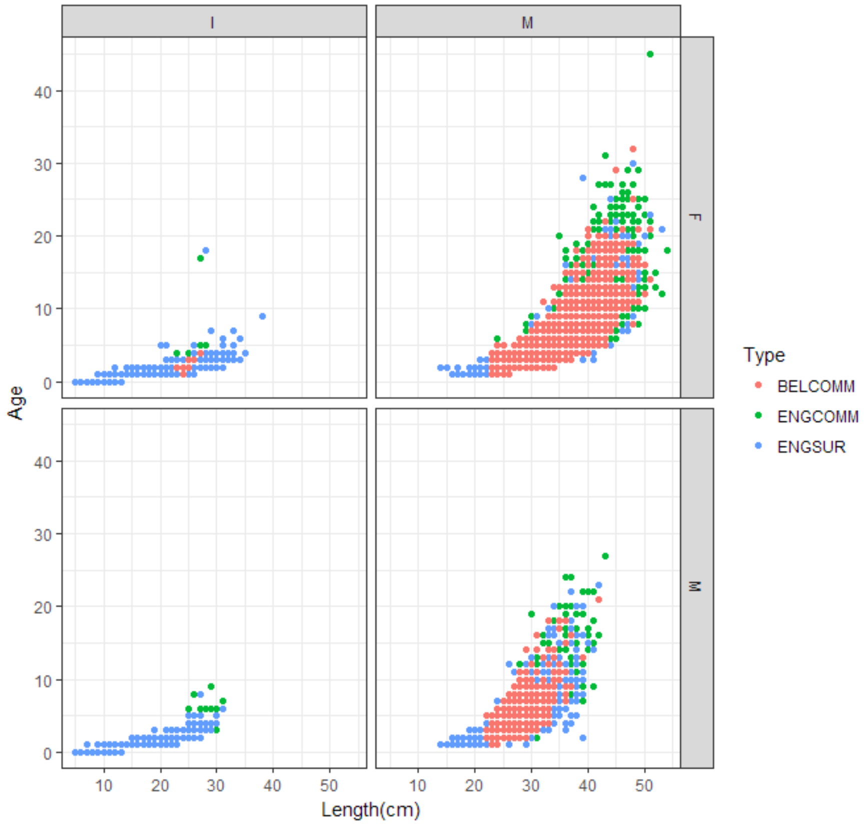

Figure 5: Age-length distribution with indication of sex (Female (F) or Male (M)) and maturation level (Immature (I) or Mature (M)) for all three datasets.

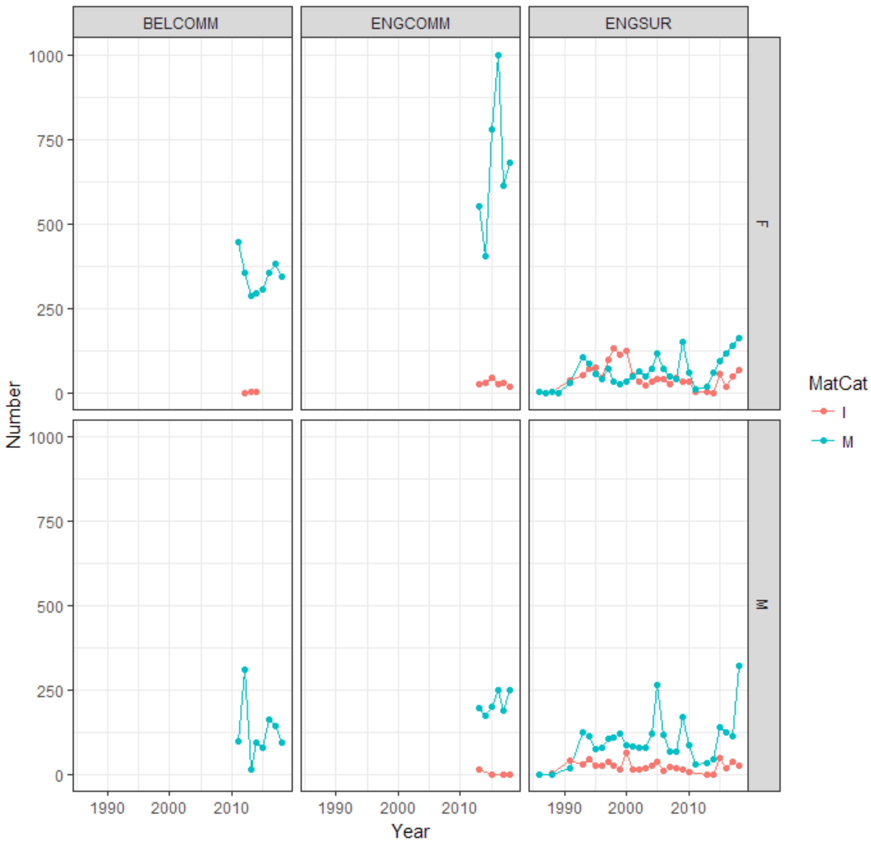

Figure 6: Number of records per sex (F and M) and dataset type with indication of maturation level.

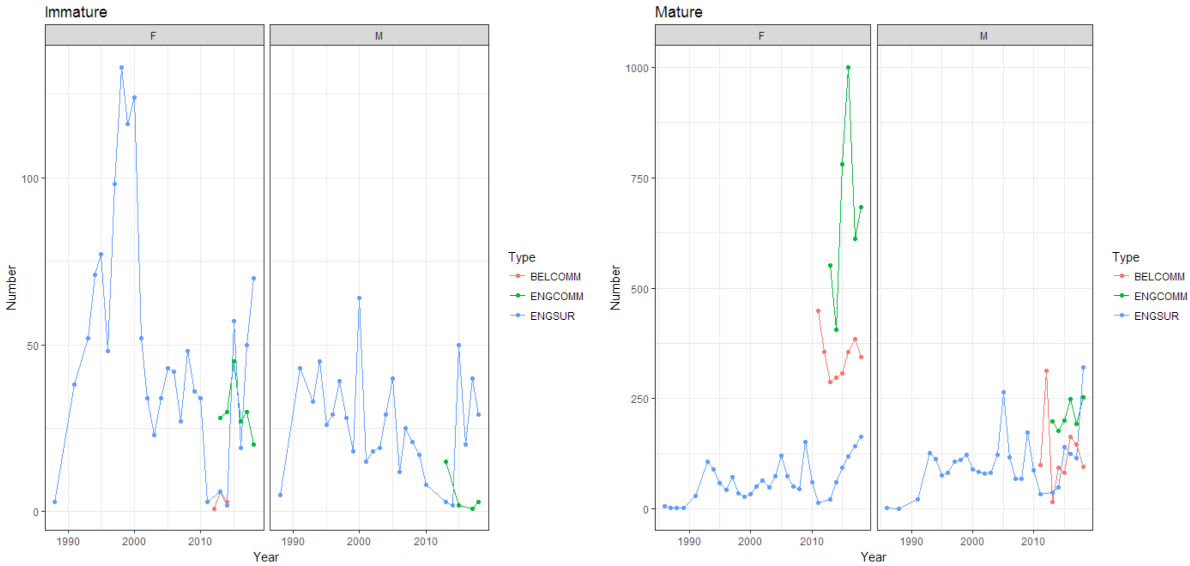

Figure 7: Number of records per sex (F and M) and dataset type. Left: immature sole, right mature sole (note different scale on the y-axis).

Little bit more than half of the data originate from commercial datasets (58%, 42% survey). However, most of the immature records come from the survey dataset.

```
> table(MATTOT$Type, MATTOT$MatCat)

            I    M
  BELCOMM   10 3785
  ENGCOMM  201 5299
  ENGSUR  2018 4672
```

Used dataset

In order to reduce the amount of variation linked to stratified sampling protocols, we decided to base the maturity ogive on the survey data of the Q1SWBEAM. This survey covers a large part of the divisions 7f and g and occurs in quarter 1 (see working document on the development of an index for sole in ICES Divisions 7.f and 7.g using the UK quarter 1 South-West ecosystem survey (UK-Q1SWECOS). Maturity data are available from 2013-2019. Over this time period a similar amount of females and males were scored for maturity: 432 females and 423 males.

This maturity dataset provides data from 2013-2019. This resulted in 855 maturity records. More insight in the data is provided in Table 7 and Figures 8-10.

Table 7: Overview of the Q1SWBEAM maturity data for sole in 7fg.

Variable	Parameter	Number of records
Year	2013	54
	2014	113
	2015	65
	2016	56
	2017	117
	2018	241
	2019	209
Sex	Male	423
	Female	432

Length (cm)	Min	9	1
	Max	47	3
	Median	28	76
Age (years)	Min	1	16
	Max	28	1
	Median	4	160
Maturity	Mature		781
	Immature		74

For both males and females a number of immature records are available (Figure 8).

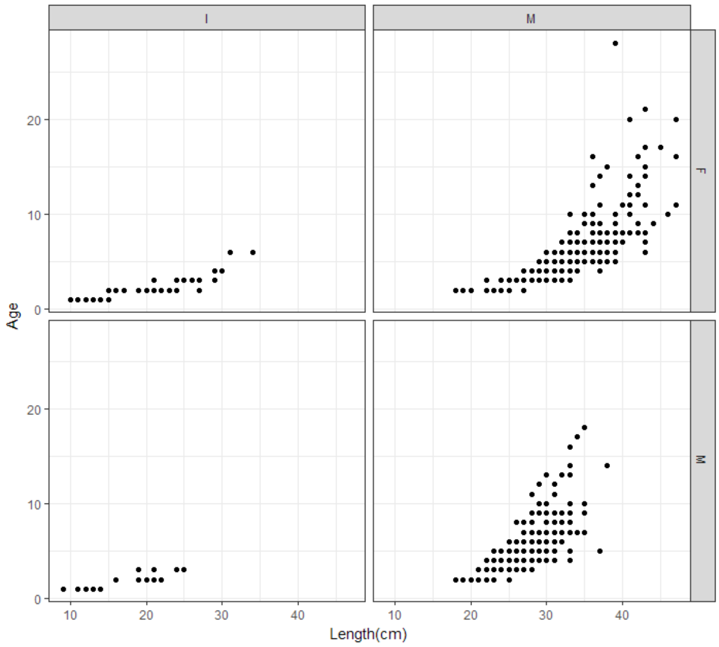

Figure 8: Age-length distribution with indication of sex (Female (F) or Male (M)) and maturation level (Immature (I) or Mature (M)) for the Q1SWBEAM datasets.

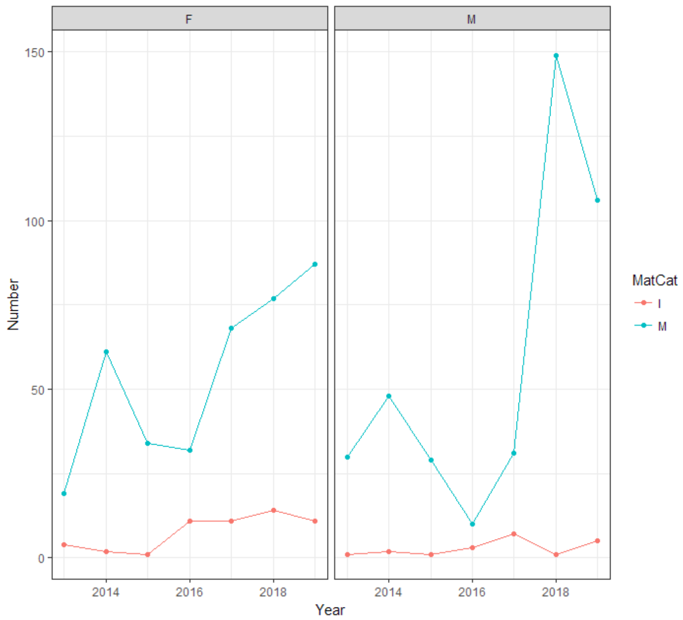

Figure 9: Number of records per sex (F and M) per year with indication of maturation level (I=immature, M=mature).

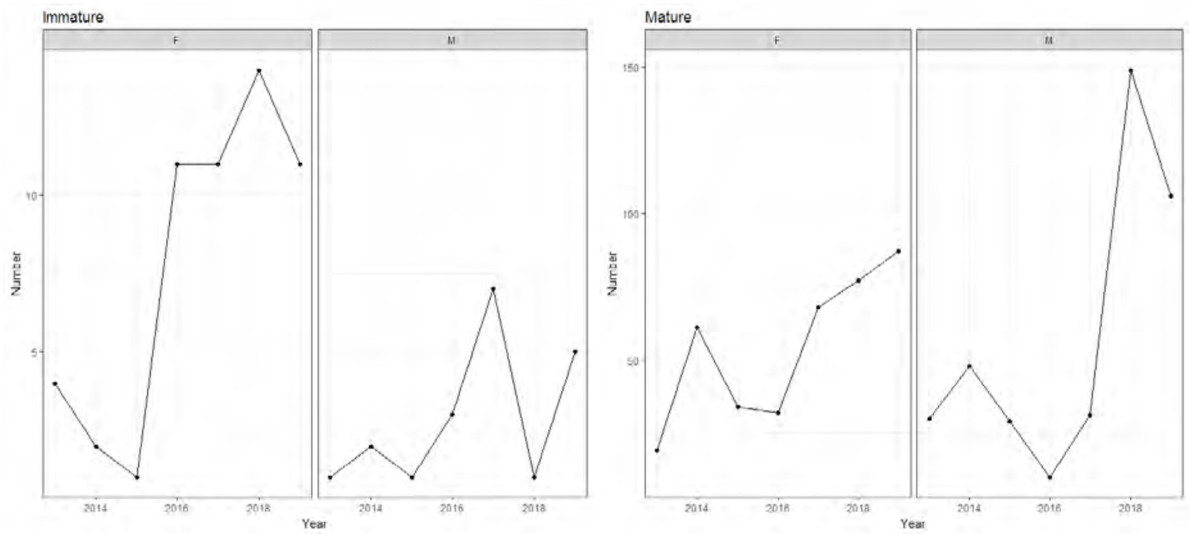

Figure 10: Number of records per sex (F and M) per year. Left: immature sole, right mature sole (note different scale on the y-axis).

Analysis

General

An estimate of the proportion of mature fish at age (*i.e.* maturity at age) is required to be able to evaluate the maturity ogive as input for the stock assessment model.

First, we estimated maturity at age by simply averaging the yearly age samples (raw ogive). However, applying statistical models has several advantages:

- Age samples (including maturity) are not a random sample of the fish population. Protocols describe to collect x number of fish per cm-class (e.g. for Belgian commercial data, 3-5 fish per cm-class are collected for ICES Divisions 27.7.f and g together). This results in stratification by length. Therefore, a simple average at age could give a biased estimate.
- Model based estimation helps to adjust other factors (than age) that are associated with maturity, especially if these factors were not originally considered in the sampling design, for instance length, sex and year. It can help to explain the mechanism of maturity changes with respect to those factors.
- Statistical models allow to correct for both observation and eventually process error by assuming that both processes have statistical properties that can be captured by specifying appropriate statistical distributions.

Raw maturity ogive

A maturity ogive based on the **raw data** provides more insight in the data. It is calculated by estimating maturity at age by simply averaging the yearly age samples, as shown in Figure 11 by age and Figure 12 by length. Most of the 3-year-olds for males and 4-year-olds for females are considered mature. We learn from Figure 11 that it is likely better to make a plusgroup in the data from age 10 onwards.

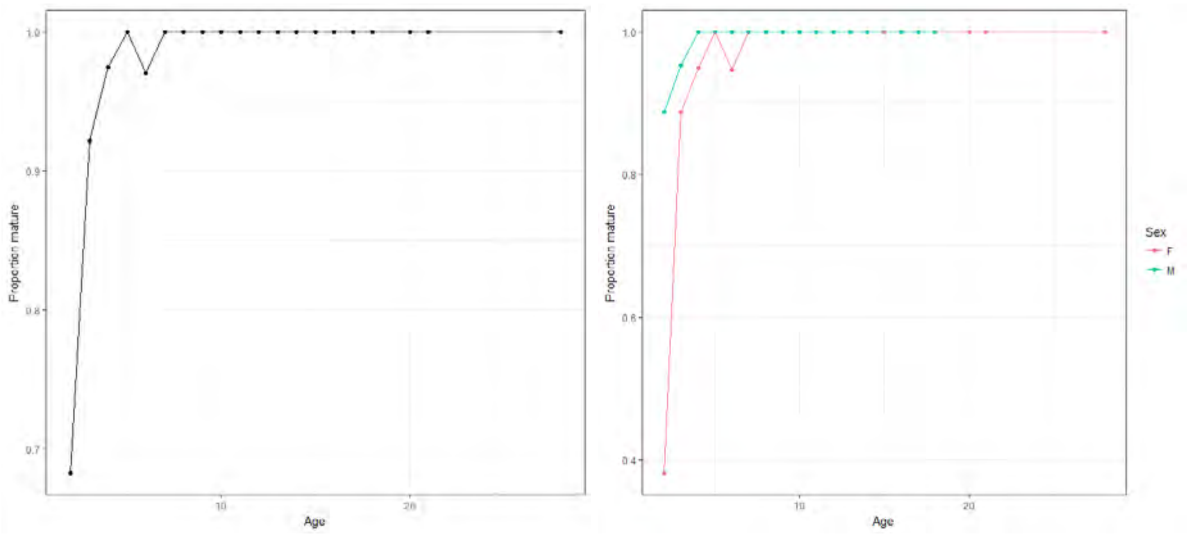

Figure 11: Proportion of mature fish at age for all sexes (left) and per sex (right).

When considering proportion mature at length, there is an outlier present at 18 cm for both males and females as no immature specimens were scored for this length. In general, males reach full maturity at approximately 23 cm and females at approximately 30 cm.

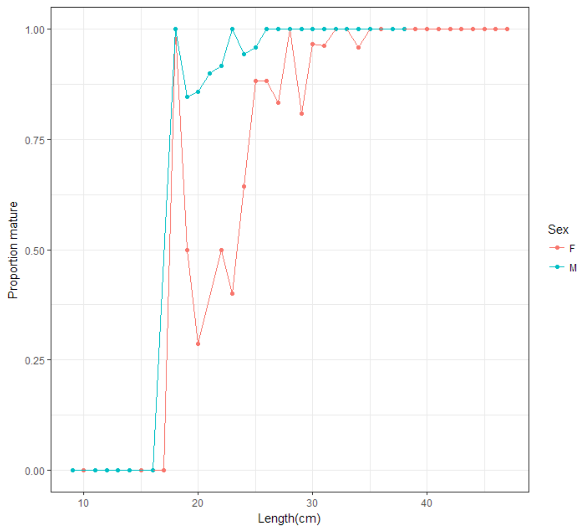

Figure 12: Proportion of mature fish at length per sex.

Additionally, a raw maturity ogive per year was made (Figure 13). This clarified that not in all years there is a solid representation of immature males and females. However, no clear shift in maturity over the period 2013-2019 is apparent.

```
> table(Q1SWBEAM$Sex, Q1SWBEAM$Year)

    2013 2014 2015 2016 2017 2018 2019
  F   23   63   35   43   79   91   98
  M   31   50   30   13   38  150  111
```

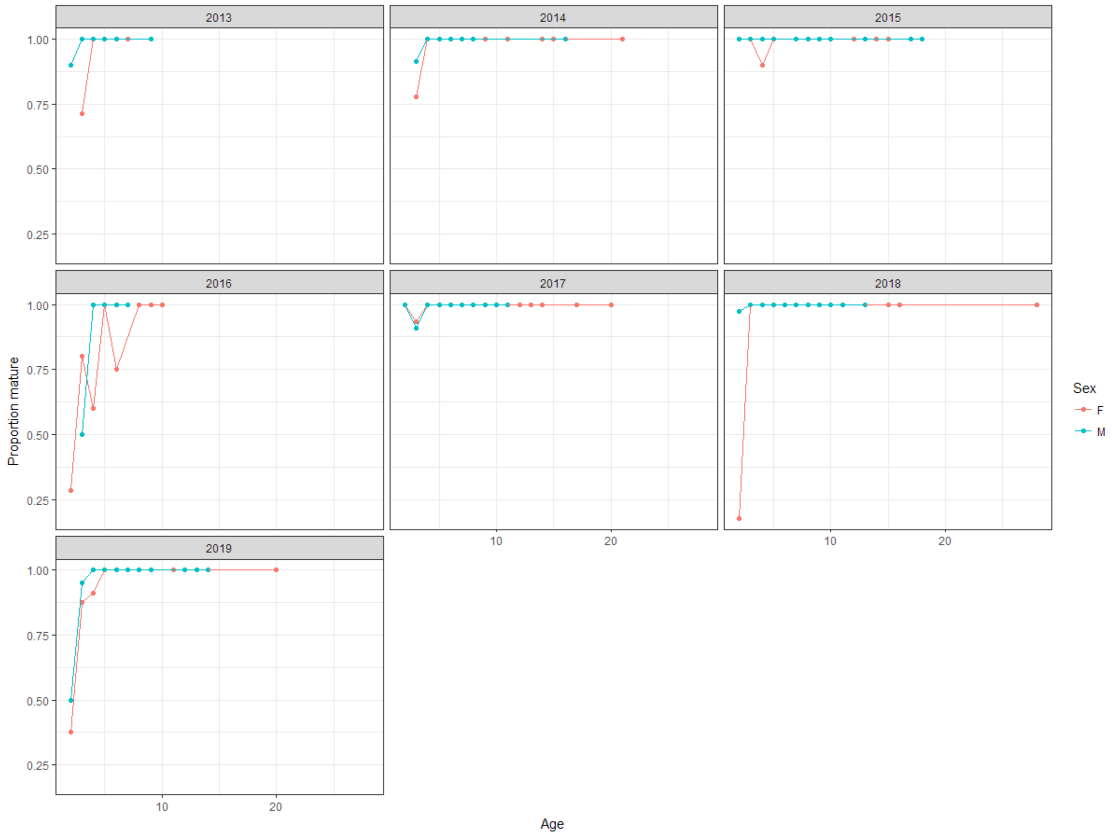

Figure 13: Proportion of mature fish at age per sex per year.

Modelled maturity ogive

a) Data exploration

In the process of modelling the maturity ogive, the data is further explored ensuring appropriate covariate selection to consider in the model. Collinearity was detected between the variables 'age' and 'length' (0.76). A simple ANOVA revealed that 58% of the variation in length is explained by age. Age and length should therefore not be included in the same model. Next, collinearity was investigated with the factors sex and year (Figure 14). Approximately 20% of the variation in length is explained by the factor sex, which is also pretty high (males tend to be smaller than females). However, this relationship is mainly driven by the high ratio of females in the larger length categories (> 40 cm). When only considering that part of the population with a length ≤ 40 cm, the strength of this relationship declined becoming therefore acceptable. For age and sex, it is only 0.7% of the variation in age that is explained by sex. The relation between age or length and the factor year is also acceptable (variation explained by 4% for age and 6% for length).

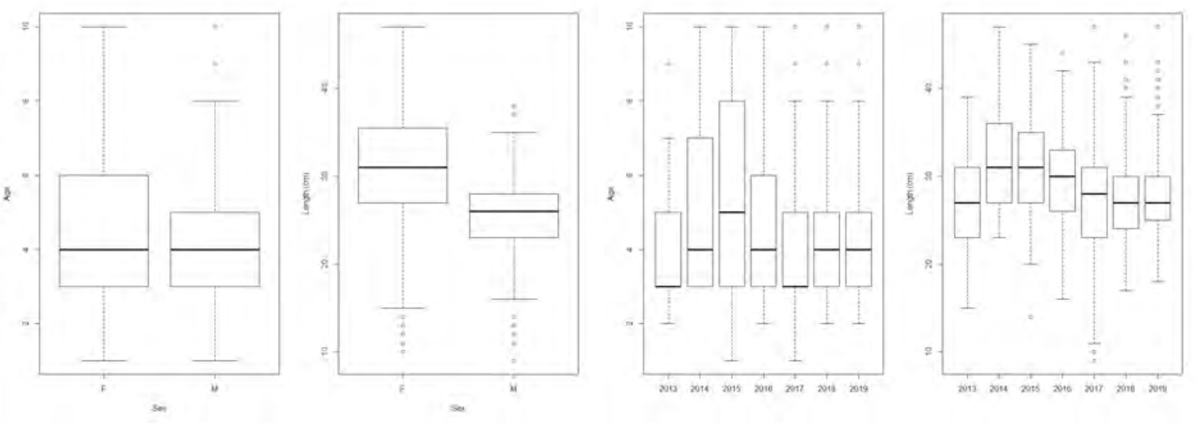

Figure 14: Exploring the relation between the factors sex and year with age and length using boxplots.

b) Logistic regression

The data exploration showed the presence of various relationships in the data. To account for this, different methods, and if appropriate, different assumptions about sex-ratios and growth models were compared to estimate the maturity ogive (Pr(Mat | Age)).

Given the binary nature of the response variable (0 = immature; 1 = mature), binomial regression with a logistic link function was used to analyse the data. To account for the presence of collinearity between age and length, models were specified that included either age or length as a covariate, and optionally, a covariate to account for sex specific maturity differences. Hence, each model comprised of an intercept (β_0), age and length were included both as a linear effect (with slope given by β_1), or as non-linear effect (*s(age)*; *s(length)*) by means of smoothing splines. Sex-specific variation was included as a categorical effect (dummy variable) (with β_2 the effect of females vs. males), eventually in interaction with the linear age or length effect (with sex-specific slope given by β_3), or to sex-specific smoothers over age ($s(age)_{sex}$) or length ($s(length)_{sex}$).

Finally, two random effects were included in the models to account for pseudo replication (*i.e.* when there is violation of the assumption of independent observations). The first random effect was related to the sampling design (μ_y) (e.g. location, metrological conditions, date which was added to the model as the factor 'year'). The second random effect accounted for the cohort (μ_c) (e.g. time of recruitment for a cohort). An overview of the different models is shown in Table 8. All models were estimated using maximum likelihood estimation as implemented in the *lme4* and *mgcv* package using the R software (R Core Team, 2020). Model selection was performed based on the value of the AIC criterion which considers both the maximum likelihood estimate and number of model parameters.

Table 8: Overview of the different models tested to construct a maturity ogive for sole in ICES division 27.7fg.

Ref.	Model	*df*	AIC
(eq. 1)	$maturity \sim \beta_0 + \beta_1 x\ age + \mu_y + \mu_c$	6	332
(eq. 2)	$maturity \sim \beta_0 + \beta_1 x\ age + \beta_2 x\ sex + \mu_y + \mu_c$	7	306
(eq. 3)	$maturity \sim \beta_0 + \beta_1 x\ age + \beta_2 x\ sex + \beta_3 x\ age\ x\ sex + \mu_y + \mu_c$	8	307
(eq. 4)	$\boldsymbol{maturity \sim \beta_0 + \beta_1 x\ sex + s(age) + \mu_y + \mu_c}$	**12**	**291**
(eq. 5)	$maturity \sim \beta_0 + \beta_1 x\ sex + s(age)_{sex} + \mu_y + \mu_c$	13	293
(eq. 6)	$maturity \sim \beta_0 + \beta_1 x\ length + \beta_2 x\ sex + \mu_y + \mu_c$	7	274
(eq. 7)	$maturity \sim \beta_0 + \beta_1 x\ length + \beta_2 x\ sex + \beta_3 x\ length\ x\ sex + \mu_y + \mu_c$	8	275
(eq. 8)	$\boldsymbol{maturity \sim \beta_0 + \beta_1 x\ sex + s(length) + \mu_y + \mu_c}$	**10**	**266**
(eq. 9)	$maturity \sim \beta_0 + \beta_1 x\ sex + s(length)_{sex} + \mu_y + \mu_c$	13	276

For each of the tested model formulae, the length-based equivalent performed always better than the age-based equivalent in terms of AIC. Overall, the model with the non-linear smoother effect on length had the lowest AIC. Including an interaction effect between age/length and sex did not improve the models in terms of AIC both for the linear and non-linear covariate formulae.

The next section shows how the maturity ogive can be derived from the models.

Age-based models

The advantage of the age-based structure is that the maturity ogive at age can be directly calculated from the estimated model parameters. Only in case sex is included as a covariate (Pr(Mat | Age, Sex)), additional assumptions have to be made on the sex ratio at age (Pr(Sex | Age)) to derive a maturity ogive independent of sex (Pr(Mat | Age)).

The model as described by eq.1 allows to obtain a direct estimate of the probability of being mature at a specific age by substituting the model formulae in the inverse logit function (Figure 15).

$$\Pr(Mat \mid Age) = 1/_{(1 + e^{-(\beta_0 + \beta_1\, x\, Age)})}$$

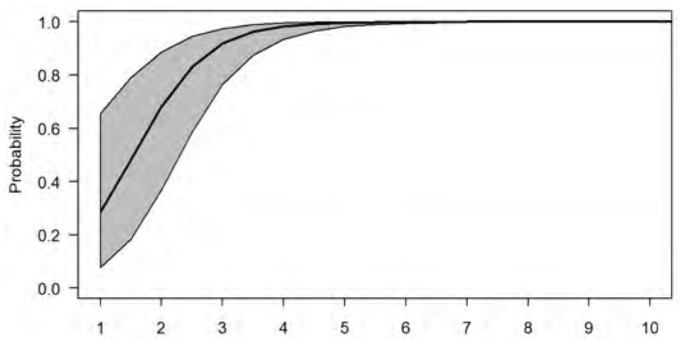

Figure 15: Expected probability of being mature at a given age. The grey shaded area indicates the 95% confidence interval.

Including sex as a covariate in the model (eq. 2) significantly improved the model in terms of the AIC. Figure 16 shows that female individuals reach maturity at older ages (M50 = age 2.1) compared to male individuals (M50= age 1.1). Since this model estimates the probability of an individual being mature given its age and sex (Pr(Mat|Age, Sex)), further assumptions have to be made on the sex ratio-at-age to obtain the Pr(Mat|Age).

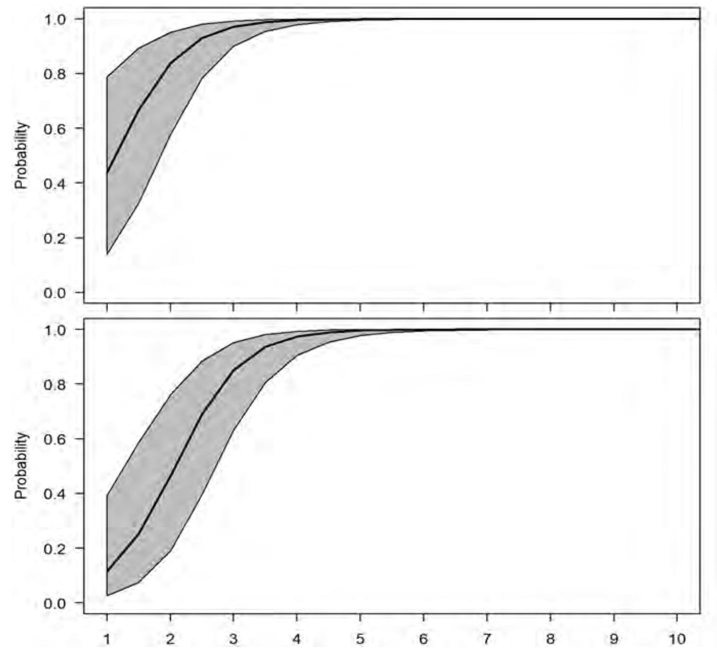

Figure 16: Expected probability of being mature at a given age for male (upper panel), and female individuals (lower panel). The grey shaded area indicates the 95% confidence interval.

For eq.4, the sex-specific maturity ogive is shown in Figure 17.

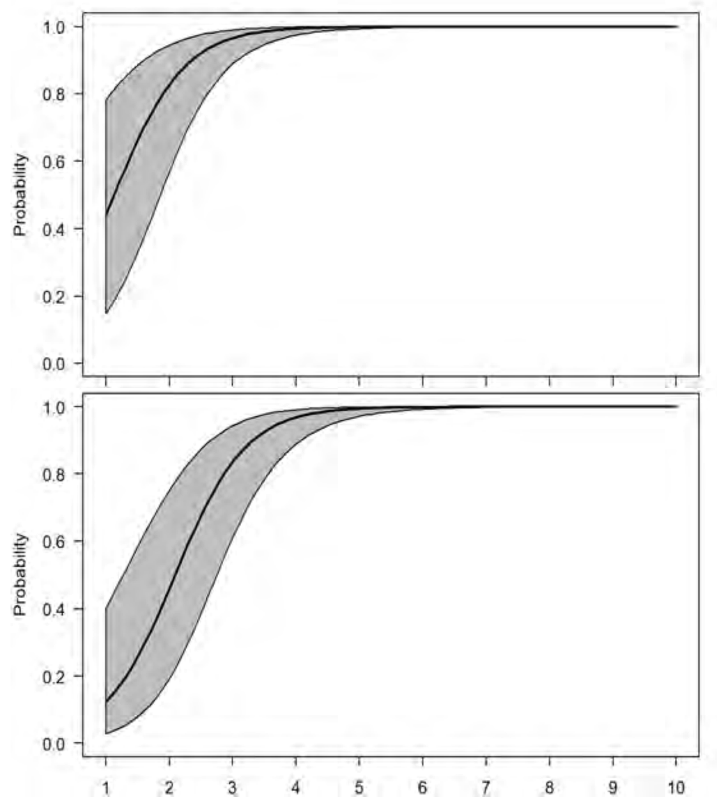

Figure 17: Expected probability of being mature at a given age for male (upper panel), and female individuals (lower panel). The grey shaded area indicates the 95% confidence interval.

Assuming a 50/50 sex ratio at every age, the maturity-at-age equals the average of both sex-specific maturity curves at age. However, to account for potential differences in sex ratios at age, a weighted average of both sex-specific maturity curves was also obtained with weighting ratios derived from the following logistic regression model (Pr(Sex|Age): *sex* ~ β_0 + *s(age)*) (further referred to as eq. 10). This model reveals that there are slightly more males in the population at age 1, and more female individuals above age 8 (Figure 18). Since this effect is only marginal at age 1, and not relevant for the older ages (both males and females are 100% mature from age 5 onwards), we assume a 50/50 sex ratio at age to derive the maturity ogive using the age-based models.

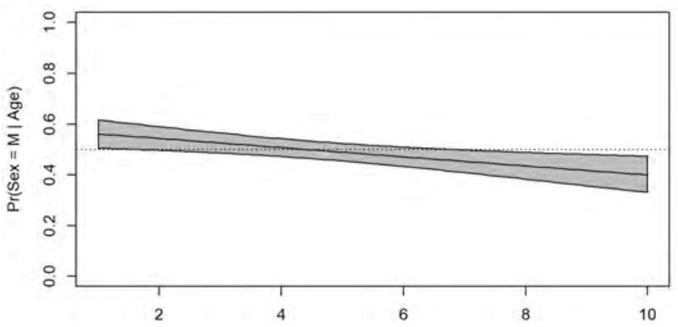

Figure 18: Expected probability of being male at a given age. The grey shaded area indicates the 95% confidence interval.

Length-based models

The length-based maturity model (eq. 6) resulted in a further improvement in terms of AIC compared to the age-based models. Also in terms of length, sex is an important factor to consider as females reach maturity at a larger size (M50 = 22.7 cm) compared to males (M50 = 16,7 cm) (Figure 19).

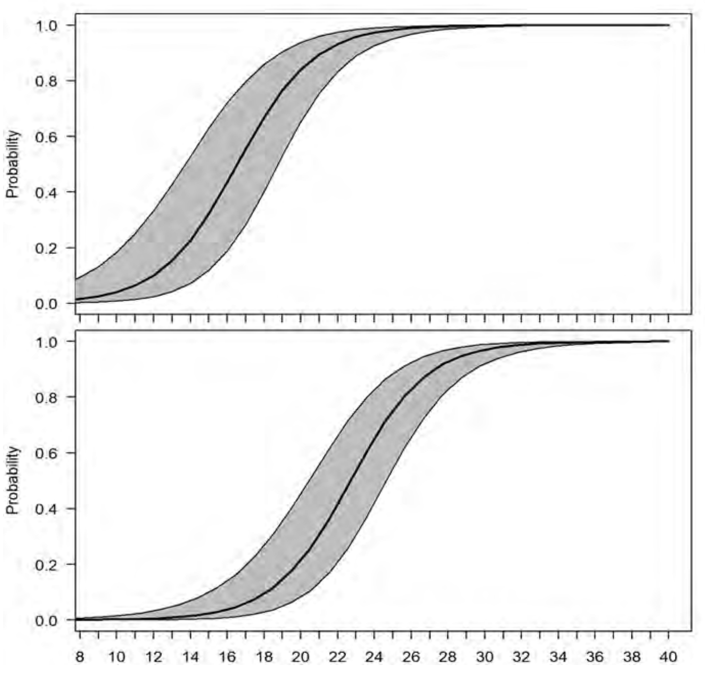

Figure 19: Expected probability of being mature at a given length for male (upper panel), and female individuals (lower panel). The grey shaded area indicates the 95% confidence interval.

The non-linear length based model (eq. 8) gives a similar result compared with eq. 6 (Figure 20).

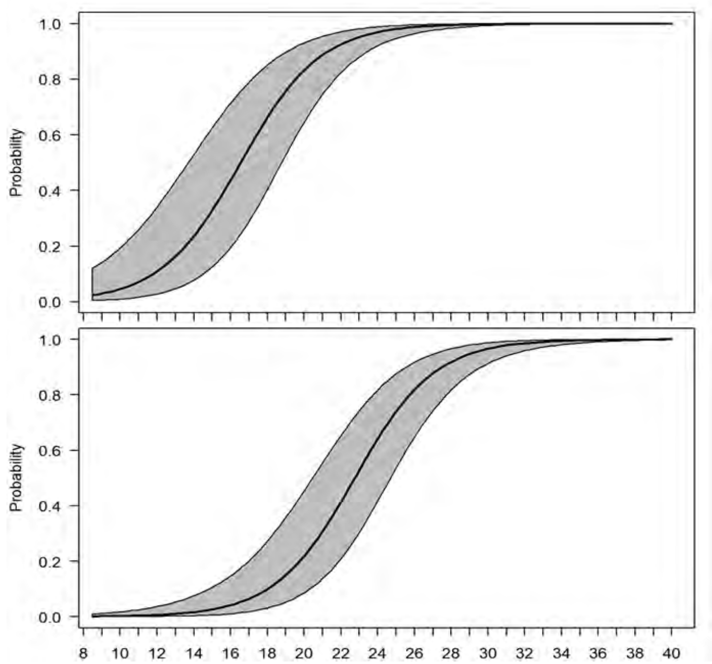

Figure 20: Expected probability of being mature at a given length for male (upper panel), and female individuals (lower panel). The grey shaded area indicates the 95% confidence interval.

The length-based models express the probability of being mature at a given length and sex Pr(Mat|Sex, Length). Therefore, further assumptions on sex ratios and growth are required to convert this to the quantity of interest: Pr(Mat|Age). For the conversion from a length-based estimate to an age-based estimate, both the length-frequency Pr(Length) and age-length key (ALK) must be calculated (Pr(Age|Length)).

The length-frequency was estimated directly from the data (Pr(Length = l) = count(n_i=l)/N, with N the number of observations, and n_i the i^{th} observation), while the ALK was determined using multinomial regression as implemented in the R package *nnet*. The different ages represented in the data were considered as the different levels of the response variable, while length and sex were included as covariates to account for potential sex-specific growth): $Age \sim \beta_0 + \beta_1\, x\ length + \beta_2\, x\ sex$ (further referred to as eq. 11) (with β_0 being the intercept; with slope given by β_1 and with β_2 being the effect of females vs. males).

Using the ALK and length-frequency, the Pr(Length|Age, Sex) was estimated which can be used to visualize growth curves (Figure 21).

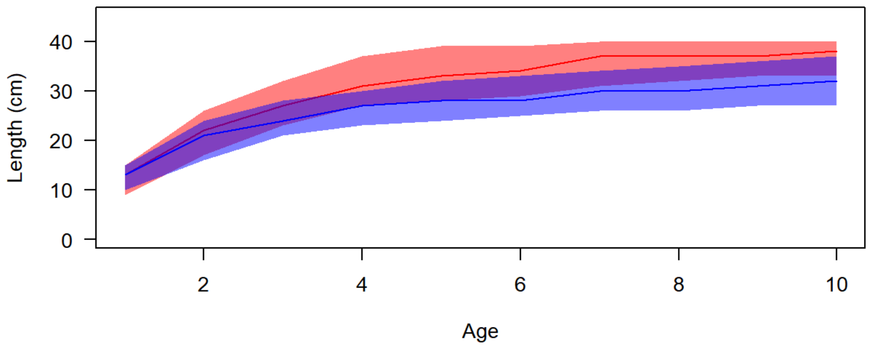

Figure 21: Median length-at-age (solid line) and upper (97.5%) and lower (0.025%) quantiles (shaded area) of 10 000 samples from the length-at-age distribution for males (blue) and females (red).

The sex-specific factor in the maturity model (eq. 8) requires to make assumptions on the sex-ratio at length of the population. Therefore, the sex ratio at length was determined with the following non-linear logistic regression model (Pr(Sex|Length): $sex \sim \beta_0 + s(length)$) (further referred to as eq. 12; with β_0 being the intercept).

Figure 22 shows that the sex ratio is strongly dependent on the size of a fish. Below ±17 cm, the sex ratio can be considered equal, however, from ±17 to ±28 cm, the population is dominated by males, while females are dominant from ±32 cm onwards. The presence of a length-dependent sex ratio, and absence of a clear age-dependent sex-ratio can be explained by the differences in growth between male and female individuals (Figure 21). Up to age 1.5 (length 17 cm), there is little difference in growth between males and females. This results in the sex ratio being 50/50 up to this length (assuming a 50/50 sex ratio in recruitment). From 17 cm, female individuals grow slightly faster, while male individuals need more time to reach a length of ±24 cm. The smaller L_∞ growth of male individuals is likely to result in an accumulation of the male population in the length range 20-30 cm, while female individuals tend to pass this length interval at the age of 4. Few male individuals tend to reach a length >30cm. This results in the larger length classes being dominated by the presence of females.

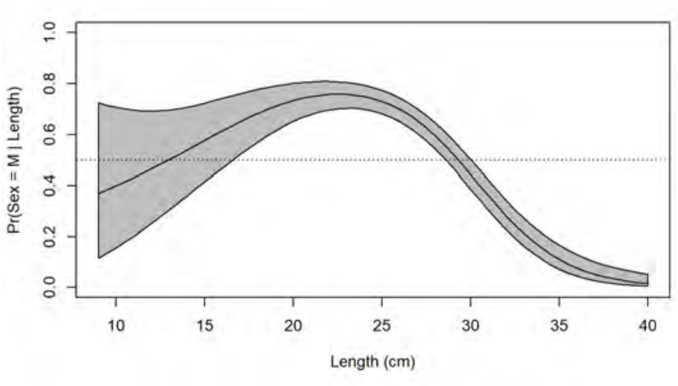

Figure 22: The expected probability of encountering a male individual given the length as calculated from the model sex ~s(length). The grey shaded area indicates the 95% confidence interval.

Finally, the maturity ogive can be determined by applying the following steps:

Pr(Age| Sex, Length) x Pr(Sex | Length) x Pr(Length) = Pr(Age,Sex,Length)

Pr(Age,Sex,Length)/ Pr(Age) = Pr(Sex,Length |Age)

Pr(Mat | Sex, Length) x Pr(Sex,Length | Age) = Pr(Mat, Length, Sex | Age)

Pr(Mat | Age) = $\sum_{Sex} \sum_{Length}$Pr(Mat, Length, Sex | Age)

c) Maturity ogive

An overview of the estimated maturity ogives is given in Table 10. The different maturity curves all indicate an increase of the proportion of fish mature at age compared to the current maturity ogive (Table 1). The new ogives indicate that >50% of the 2 and 3 year old individuals are mature, while this was not the case in the current index. At age 4, almost all species are expected to be mature. At age 1, there is a discrepancy between the different methods used. The raw maturity ogive indicates that all species are immature at age 1. The age-based methods indicate that about 28% of the population is mature at age 1, while the length-based models are more conservative with 9%. Although the

Q1SWBEAM survey did not encounter mature sole at this age, other surveys did. We therefore assume that 9% mature at age 1 is a realistic estimation. The assumption of a 50/50 ratio between males and females tends to provide slightly lower maturity estimates compared to the length-based sex ratio, or model without sex covariate. This can be explained by the fact that the 50/50 assumption is probably not valid and that the presence of males in age 1 and 2 is underestimated, hereby giving a larger weight to the slower maturing female population.

We suggest to adopt a new maturity ogive according to the length based model with sex specific ALK. The advantage of this series is its flexibility towards potential changes in the length frequency of the population and sex ratio.

Table 10: Summary of all estimated maturity ogives.

		raw	age-based		length-based	current
maturity model		-	eq 1.	eq. 4	eq. 8	-
sex ratio		-	-	50/50	eq. 10	-
age-length key		-	-	-	eq. 11	-
length-frequency		-	-	-	raw	-
age\	1	0.00	0.29	0.28	**0.09**	0.00
	2	0.68	0.68	0.64	**0.67**	0.14
	3	0.92	0.92	0.90	**0.91**	0.45
	4	0.98	0.98	0.98	**0.98**	0.88
	5	1.00	1.00	1.00	**0.99**	0.98
	6	0.97	1.00	1.00	**0.99**	1.00
	7	1.00	1.00	1.00	**1.00**	1.00
	8	1.00	1.00	1.00	**1.00**	1.00
	9	1.00	1.00	1.00	**1.00**	1.00
	10	1.00	1.00	1.00	**1.00**	1.00

Flexible maturity ogive

Given the substantial difference between the current maturity ogive (based on data from 1992-1993), and the new maturity ogive (based on Q1SWBEAM data from 2013 to 2019), a further analysis was performed to quantify the temporal trends underlying the maturity ogive. Therefore, the *length-based* method as presented above, was applied to an extended dataset that comprised observations from the NWGF and Q1SWBEAM surveys. This combined dataset provides a time series from 1988 until 2019 with overlap between both survey from 2013 until 2019. Due to missing years at the start of the time series, the analysis was performed on data from 1993 until 2019 (Table 11).

Table 11: Observations of sole per survey and per year.

	Survey (DCRDC)	Survey (NWGFS)	Survey (Q1SWBEAM)	Survey (Q1SWOTTER)	Survey (Q4SWIBTS)	Survey (WCGFS)
1986	0	0	0	0	0	8
1987	0	0	0	0	0	2
1988	0	12	0	0	0	0
1989	0	0	0	0	0	2
1990	0	0	0	0	0	0
1991	0	133	0	0	0	0
1992	0	0	0	0	0	0
1993	0	314	0	0	0	4
1994	0	316	0	0	0	2
1995	0	219	0	0	0	18

1996	0	197	0	0	0	3
1997	0	313	0	0	0	3
1998	0	304	0	0	0	2
1999	0	282	0	0	0	2
2000	0	310	0	0	0	2
2001	0	196	0	0	0	6
2002	0	187	0	0	0	10
2003	0	172	0	0	0	0
2004	0	244	0	0	9	5
2005	285	174	0	0	9	0
2006	80	154	0	0	10	0
2007	0	170	0	0	0	0
2008	18	152	0	0	11	0
2009	191	169	0	0	17	0
2010	179	1	0	0	10	0
2011	0	39	0	0	11	0
2012	0	0	0	0	0	0
2013	0	13	54	0	0	0
2014	0	0	113	0	0	0
2015	0	276	65	0	0	0
2016	0	227	56	0	0	0
2017	0	229	117	0	0	0
2018	0	342	241	0	0	0
2019	0	339	209	37	0	0

The NWGFS and Q1SWBEAM survey differ substantially in terms of gear used (GOV vs beam trawl) and sampling period (3rd quarter vs 1st quarter). To account for this, the regression models were adjusted to include a survey effect while smoothed and linear temporal effects were included to capture changes over time (Table 12).

Table 12: Regression models used derive a maturity ogive per year.

Pr(Mat | Sex, Length, Year, Survey)	$maturity \sim \beta_0 + \beta_1 x\ sex + \beta_2 x\ survey + s(length)_{survey} + s(year)_y + \mu_c$
Pr(Sex| Length, Year, Survey)	$sex \sim \beta_0 + \beta_1 x\ survey + s(length)_{survey} + s(year) + \mu_c$
Pr(Age| Sex, Length, Year, Survey)	$age_{i \in [1;10]} \sim \beta_0 + \beta_1 x\ length + \beta_2 x\ survey + \beta_3 x\ sex + \beta_4 x\ year$
Pr(Length | Year, Survey)	$length_{i \in [5;40]} \sim \beta_0 + \beta_1 x\ year + \beta_2 x\ survey$

Finally, the maturity ogive per year (Figure 22) can be determined by making annual predictions for each of the fitted regression models. As sole spawns in the first quarter, the survey effect was fixed at Q1SWBEAM, while the length range for both male and female individuals was set from 5 to 40 cm. From these expected probabilities, maturity is derived by applying the following steps for each year (*y ϵ [1993; 2019]*):

Pr(Age| Sex, Length, **Year = *y*, Survey = Q1SWBEAM**) x Pr(Sex | Length, **Year = *y*, Survey = Q1SWBEAM**) x Pr(Length, **Year = *y*, Survey = Q1SWBEAM**) = Pr(Age,Sex,Length| **Year = *y*, Survey = Q1SWBEAM**)

Pr(Age,Sex,Lengt| **Year = *y*, Survey = Q1SWBEAM**)/ Pr(Age | **Year = *y*, Survey = Q1SWBEAM**) = Pr(Sex,Length |Age, **Year = *y*, Survey = Q1SWBEAM**)

Pr(Mat | Sex, Length, **Year = *y*, Survey = Q1SWBEAM**) x Pr(Sex,Length | Age, **Year = *y*, Survey = Q1SWBEAM**) = Pr(Mat, Length, Sex | Age, **Year = *y*, Survey = Q1SWBEAM**)

Pr(Mat | Age, **Year = *y*, Survey = Q1SWBEAM**) = $\sum_{Sex} \sum_{Length}$Pr(Mat, Length, Sex | Age, **Year = *y*, Survey = Q1SWBEAM**)

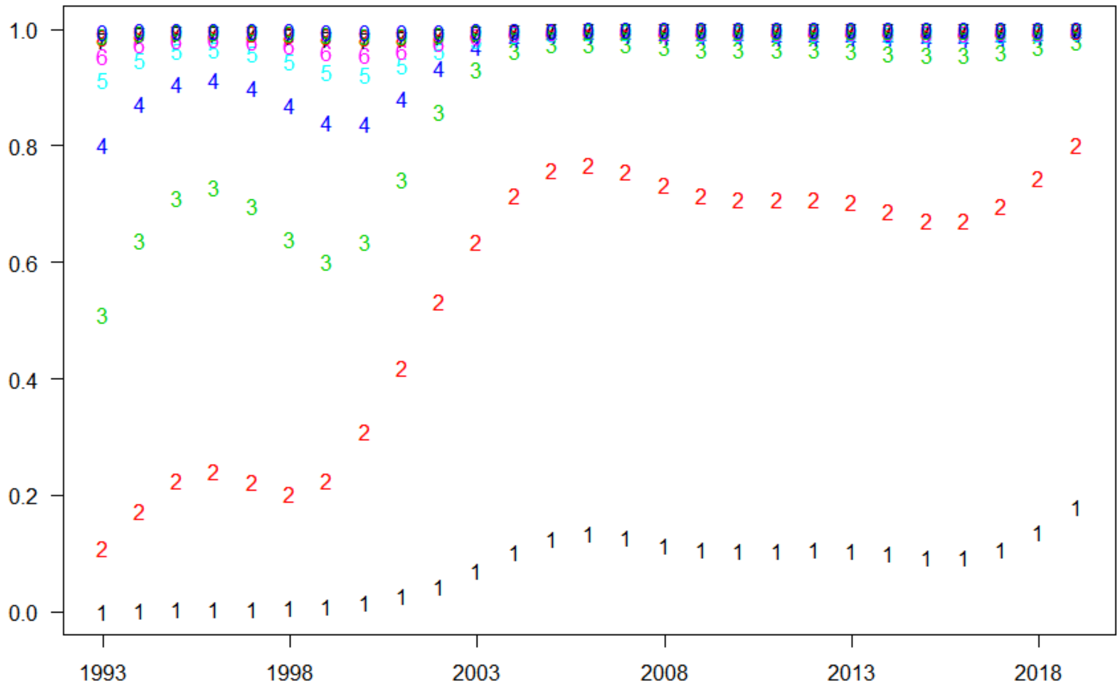

Figure 22: Maturity ogive over the period 1993 - 2019. The numbers correspond to the age class.

Table 13: Maturity ogive by year from age 1 to age 10.

	1	2	3	4	5	6	7	8	9	10
current	0	0.14	0.45	0.88	0.98	1	1	1	1	1
1993	0.00	0.11	0.51	0.80	0.91	0.96	0.98	0.99	0.99	0.99
1994	0.00	0.17	0.64	0.87	0.95	0.97	0.99	0.99	0.99	1.00
1995	0.00	0.23	0.71	0.91	0.96	0.98	0.99	1.00	1.00	1.00
1996	0.01	0.24	0.73	0.91	0.97	0.98	0.99	1.00	1.00	1.00
1997	0.01	0.22	0.70	0.90	0.96	0.98	0.99	0.99	1.00	1.00
1998	0.01	0.20	0.64	0.87	0.94	0.97	0.99	0.99	0.99	1.00
1999	0.01	0.23	0.60	0.84	0.93	0.96	0.99	0.99	0.99	1.00
2000	0.02	0.31	0.64	0.84	0.92	0.96	0.98	0.99	0.99	0.99
2001	0.03	0.42	0.74	0.88	0.94	0.96	0.98	0.99	0.99	0.99
2002	0.04	0.53	0.86	0.94	0.96	0.98	0.99	0.99	0.99	1.00
2003	0.07	0.64	0.93	0.97	0.98	0.99	0.99	0.99	1.00	1.00
2004	0.10	0.72	0.96	0.99	0.99	0.99	1.00	1.00	1.00	1.00
2005	0.13	0.76	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00
2006	0.13	0.77	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
2007	0.13	0.76	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00
2008	0.12	0.73	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00
2009	0.11	0.72	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00
2010	0.10	0.71	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00
2011	0.11	0.71	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00
2012	0.11	0.71	0.96	0.99	0.99	1.00	1.00	1.00	1.00	1.00
2013	0.11	0.70	0.96	0.99	0.99	1.00	1.00	1.00	1.00	1.00
2014	0.10	0.69	0.96	0.99	0.99	0.99	1.00	1.00	1.00	1.00

2015	0.09	0.67	0.96	0.98	0.99	0.99	1.00	1.00	1.00	1.00
2016	0.09	0.67	0.96	0.98	0.99	0.99	1.00	1.00	1.00	1.00
2017	0.11	0.70	0.96	0.99	0.99	0.99	1.00	1.00	1.00	1.00
2018	0.14	0.75	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00
2019	0.18	0.80	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00

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Working document: Preparation of Catch Data for Sole (Solea solea) in divisions 7.f and 7.g (Bristol Channel, Celtic Sea)

Sofie Nimmegeers, Lies Vansteenbrugge and Bart Vanelslander

Catch data for 2002-2018

InterCatch was used for estimation of both landings and discards numbers and age compositions, as input for the assessment. Data submitters from each nation were tasked to upload data for 2002-2018 in InterCatch, disaggregated by quarter and métier (fleet). However, not every country could upload data for 2002. Belgium could not provide quarterly data for the TBB_DEF_70-99 métier, but uploaded data on a yearly basis. It was also not possible to provide a qualitative age distribution for 2003. For that year, all the age information is provided by one country (the UK) and covers only 26% of the total landings. Therefore, it was not possible to process the catch data for 2002 and 2003 through InterCatch. Although InterCatch was previously used to estimate 2012-2018 landings data, these years were re-calculated in InterCatch following the 2019 WKFLATNSCS data call. Catch data for the years 2004-2011 have now been processed for the first time.

Raising discard data

If discards were not included for a particular year-quarter-country-métier combination, they were assumed to be unknown (non-zero) and raised. The instructions in the data call specified that if zero discards were observed, this had to be entered as a value of “zero” to InterCatch.

Discards on a year-quarter-country-métier basis were automatically matched by InterCatch to the corresponding landings. The matched discards-landings provided a landing-discard ratio estimate, which was then used for further raising (creating discard amounts) of the unmatched discards. The weighting factor for raising the discards was *‘Landings CATON’* (landings catch).

Discard raising was performed on a gear level regardless of season or country. This approach was favored over a more detailed one (e.g. using 1 or 2 quarters from 1 country to complete all other quarters of that country). The following groups were distinguished based on the gear:

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

The remaining gears were combined in a REST group (including MIS, FPO, LLS, DRB, PTM and OTM). Raising within a gear group was performed when the proportion of landings for which discard weights are available, was equal or larger than 50% compared to the total landings of that group (an overview per year is provided in appendix 1, section E (Ldis_gear)). For the TBB gear group the threshold was reached for the whole time series and only the métier TBB_DEF_70-99_0_0 is providing a landing-discard ratio estimate. TBB_DEF_70-99_0_0 is the most important métier, representing more than 75% of the total landings (appendix 1 section A.5). When the threshold was not reached for a gear group, it was pooled with the rest group to raise discards based on all available information (overall).

Discard ratio’s varied between 0.000 and 0.338 over the matched landings-discard strata. Six ratios were not included in the raising as those ratios were larger than 0.5. As those higher ratios generally came from TBB_DEF_70-99 and given that sole is a target species, such large discard rates were not considered representative.

Age allocations

To allocate age compositions, landings and discards were handled separately; samples from landings were used only for landings and vice versa. An overview of the allocation scheme is provided in appendix 2 (example for 2018).

When age distributions (both landings and discards) had to be borrowed from other métiers, allocations were performed on a gear level. The same gear groups (TBB; OTB-OTT-SSC-SDN; GTR-GNS; REST) as used for discard raising were applied. When the threshold of 50% was reached for the proportion of landings or discards covered by age (Lage_gear and Dage_gear respectively, see appendix 1 section D), allocation of age occurred with all available information within that gear group. For the TBB gear group the threshold was reached for the whole time series. Age allocations for all métiers within that group (e.g. TBB_DEF_>120_0_0) were performed using the available sampled TBB data, in this case only the TBB_DEF_70-99 métier. When the threshold of 50% was not reached for the proportion of landings or discards covered by age for the gear groups (appendix 1 section D), unsampled data were pooled in the REST group and ages were allocated using all sampled data (overall).

The weighting factor used with all scenarios was '*Mean Weight weighted by numbers at age'*.

It was difficult to determine how representative the samples for discards and landings were for a stratum as the number of age and length samples was not always reported, nor was the amount of the sampled catch.

Quality control

The quality of age allocations in InterCatch was verified by (1) creating a second allocation scheme using the autoallocation option in InterCatch, (2) comparing the numbers at age and (3) comparing the weight at age. Based on this quality control, a decision was made which allocation scheme to go forward with.

(1) Creating a second 'autoallocation' scheme

The 'Automatic allocation' option in InterCatch was used to create a second allocation scheme. First, CatchCategory, SeasonType, Season and fleet were selected. In a second step, only CatchCategory and fleet were selected and in a third step only CatchCategory was selected until all strata were allocated. The outcome was compared with the manual allocation schema as described above (example for 2018 in appendix 2 and 3).

In the automatic allocation, ages can be allocated based on only one stratum. For example: landings from quarter 1 of the UK TBB_DEF_70-99_0_0_all métier in ICES division 7.g was filled with the UK TBB_DEF_70-99_0_0_all quarter 1 métier in ICES division 7.f, while in the manual allocation, all available age information from all TBB métiers were used to fill this stratum. Using only one stratum might be problematic when this information is not entirely representative, then a more general approach, such as grouping over different strata, can be more safe. On the other hand, when the information of this one stratum is accurate, it will provide a more correct allocation compared to the general approach. It is also possible that in the automatic allocation ages are allocated based on all available information, while in the manual allocation, only information from the same gear is used. For example: in the automatic allocation, landings from quarter 1 of the UK TBB_DEF_>=120_0_0_all métier in ICES division 7.f were filled with the 20 strata for which age information is available, while in the manual allocation only information from the TBB métiers were used to fill this stratum.

In appendix 4, an detailed overview of the InterCatch output per year is provided for both discard raising and age allocation (using the script of Youen Vermard). The SOP percentage ((N@A x W@A)/CATON) from both allocation schemes is >98.

(2) Comparing numbers at age

Differences were identified when comparing the original landings numbers at age matrix, used as input for the 2019 assessment, with the InterCatch outcome based on the new allocation schemes (Table 1). Especially age 2 and the older ages (10+), which are landed less frequently, and the earlier data years (2004-2010) showed the largest differences (> 40%). In the 2019 assessment input, the number at age 1 was set to zero for the entire time series. As the age 1 information from the Intercatch outcome is now taken into account, both allocation schemes have '#DIV/0!' in the first column of table 1.

Table 1: Differences by age for landings numbers, using (a) the manual allocation scheme and (b) the autoallocation scheme compared with the 2019 assessment input. This was not possible for discards because discard age data has not been reported prior to the benchmark data call. Differences are shaded such that darker colours highlight greater differences.

a)

Landings

Year/Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2004	#DIV/0!	-42	-15	0	15	-16	-8	27	21	25	44	-10	450	800	24
2005	#DIV/0!	12	10	13	16	17	-10	41	25	62	27	160	167	350	171
2006	#DIV/0!	-55	-27	15	22	53	55	-5	36	65	130	133	50	100	250
2007	#DIV/0!	42	5	-4	-9	18	-6	-2	-16	-11	33	57	71	11	90
2008	#DIV/0!	-33	9	-11	-32	-23	6	12	0	-32	17	113	25	-25	8
2009	#DIV/0!	-31	-5	35	25	-12	-5	17	16	22	-22	37	63	100	21
2010	#DIV/0!	11	-4	-14	9	-2	-15	-13	21	18	42	-7	-67	50	-9
2011	#DIV/0!	-4	-5	-6	-1	13	-4	-11	-15	-23	-8	-19	-29	0	50
2012	#DIV/0!	16	26	-3	1	2	7	-4	-8	0	-2	5	-24	-24	-32
2013	#DIV/0!	-9	-13	51	-2	-6	-2	30	-8	0	-4	8	-6	-8	-11
2014	#DIV/0!	1	-6	-4	41	-10	-10	-12	18	-4	14	0	55	22	12
2015	#DIV/0!	5	-1	6	13	2	-7	-3	-16	9	-25	-33	-26	10	-17
2016	#DIV/0!	6	0	2	0	23	28	-7	-3	-50	-23	-8	-13	0	-19
2017	#DIV/0!	10	0	2	9	8	12	28	-13	12	-69	75	33	17	24
2018	#DIV/0!	6	-6	8	0	2	7	8	53	11	-30	25	25	0	6

b)

Landings

Year/Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2004	#DIV/0!	-43	-16	-1	14	-16	-6	33	26	31	56	-10	500	800	29
2005	#DIV/0!	9	5	11	13	14	-11	55	48	146	47	220	300	550	214
2006	#DIV/0!	-56	-29	13	23	52	57	-2	41	70	140	150	50	150	267
2007	#DIV/0!	38	3	-5	-9	20	-4	0	-14	-5	39	71	71	22	110
2008	#DIV/0!	-34	10	-11	-33	-24	7	12	0	-32	17	113	25	0	17
2009	#DIV/0!	-33	-7	33	22	-13	-6	18	23	20	-22	32	63	150	21
2010	#DIV/0!	11	-6	-15	10	-1	-15	-13	23	18	42	-4	-67	50	0
2011	#DIV/0!	4	-5	-7	-1	14	-4	-12	-15	-23	-8	-19	-26	0	50
2012	#DIV/0!	11	25	-5	-2	0	6	-5	-7	2	-2	14	-21	-24	-23
2013	#DIV/0!	-17	-18	48	-7	-10	1	45	-3	5	0	20	6	-8	14
2014	#DIV/0!	-2	-8	-6	40	-10	-10	-9	20	4	19	6	55	28	12
2015	#DIV/0!	6	-1	5	14	4	-7	-3	-16	9	-25	-33	-26	10	-17
2016	#DIV/0!	0	-2	-1	-3	23	35	-5	0	-33	-14	8	0	17	-14
2017	#DIV/0!	4	-2	2	7	4	9	28	-12	12	-64	100	33	33	24
2018	#DIV/0!	0	-9	5	3	-2	6	10	61	14	-30	33	75	33	6

Additionally, numbers at age were compared between both allocation schemes for both landings and discards (Table 2).

Table 2: Differences by age for landings numbers between the outcome of manual allocation scheme and the autoallocation scheme for (a) the landings and (b) the discards. Differences are shaded such that darker colours highlight greater differences.

a)

Landings

Year/Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2004	#DIV/0!	0	0	2	0	0	0	0	0	0	0	0	0	0	0
2005	#DIV/0!	0	0	0	0	0	0	0	1	1	1	0	1	1	0
2006	#DIV/0!	0	0	0	0	0	0	-1	0	0	0	0	0	1	0
2007	#DIV/0!	0	0	0	0	0	0	-1	0	-1	0	0	0	1	0
2008	#DIV/0!	0	0	0	0	0	0	0	#DIV/0!	0	0	0	0	-1	1
2009	#DIV/0!	0	0	0	0	0	0	0	0	0	0	0	0	1	0
2010	#DIV/0!	0	0	0	0	0	0	0	0	0	0	-1	0	0	-1
2011	#DIV/0!	-2	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!	0
2012	#DIV/0!	0	0	1	-3	-1	0	0	0	#DIV/0!	0	2	0	0	0
2013	#DIV/0!	1	0	0	3	1	-2	1	-1	#DIV/0!	-1	2	-2	0	-2
2014	#DIV/0!	-3	0	0	0	0	0	0	0	-2	0	#DIV/0!	0	0	0
2015	#DIV/0!	0	1	0	0	1	0	0	0	0	0	0	0	0	0
2016	#DIV/0!	-1	4	-2	-21	0	0	0	-1	0	0	-2	-1	#DIV/0!	0
2017	#DIV/0!	-1	#DIV/0!	0	0	0	0	0	0	0	0	0	0	1	0
2018	#DIV/0!	-1	0	0	#DIV/0!	-2	0	0	0	0	0	0	2	#DIV/0!	0

b)

Discards

Year/Age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2004	#DIV/0!	-20	-3	-1	0	0	2	0	7	0	33	0	0	50	0	0
2005	#DIV/0!	0	1	-1	0	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2006	#DIV/0!	#DIV/0!	0	-1	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2007	#DIV/0!	#DIV/0!	0	0	0	0	#DIV/0!	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2008	#DIV/0!	#DIV/0!	0	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2009	#DIV/0!	0	0	0	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2010	#DIV/0!	0	0	0	7	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2011	#DIV/0!	0	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2012	#DIV/0!	0	0	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2013	#DIV/0!	0	0	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2014	#DIV/0!	0	0	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2015	#DIV/0!	#DIV/0!	0	0	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2016	#DIV/0!	0	0	0	0	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2017	#DIV/0!	-4	-2	-2	0	3	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2018	#DIV/0!	0	7	-2	-2	0	0	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Comparing the two allocation schemes resulted for both landings and discards in small differences (Table 2). The largest difference for the landings is the 21% in 2016 for age 5, which originates from the 661 thousand fish after manual allocation and the 640 thousand fish after autoallocation. The OTB_CRU_70-99_0_0_all strata from Belgium and the OTB_DEF_100-119_0_0_all strata from France represent the highest CATON for which age information is missing. In both allocation schemes, an overall allocation based on 16 strata is used to allocate the ages to the OTB_CRU_70-99_0_0_all strata from Belgium. For the OTB_DEF_100-119_0_0_all strata from France, only the available OTB_DEF_100-119_0_0_all age information (third quarter strata from France in ICES division 7.f and 7.g and the year stratum from Ireland in ICES division 7.g) is used in the autoallocation, while in the manual allocation an overall allocation (including samples from TBB_DEF_70-99_0_0_all, OTT_DEF_100-119_0_0_all, OTB_DEF_70-99_0_0_all, GNS_DEF_ALL)) is used. The 2016 TBB_DEF_70-99_0_0_all stratum from Belgium is respresenting 74% of the sampled CATON and the resulting weighting factor (the ratio of numbers over CATON) for the overall allocation equals 0.79 for age 5. The weighting factor from the 3 OTB_DEF_100-119_0_0_all strata equals 0.47 for age 5.

The largest differences for the discards are reported in 2004 (50% for age 13, 33% for age 10 and 20% for age 1). However, those differences originate from a very small number of fish (5 (age 1), 3 (age 10) and 2 (age 13) thousand fish after manual allocation and 4 (age 1 and age 10) and 3 (age 13) thousand fish after autoallocation). The only difference between both allocation schemes, is the age allocation to the TBB_DEF_70-99_0_0_all strata for which age information is missing. In the manual allocation, an overall allocation based on 6 strata (only samples from TBB_DEF_70-99_0_0_all) is used, while in the autoallocation only the TBB_DEF_70-99_0_0_all strata of the corresponding quarter are used. Therefore, the Belgian 2004 TBB_DEF_70-99_0_0_all stratum is not used in the latter. For example: in the autoallocation for age 1, only numbers are allocated to the 3 quarter 4 TBB_DEF_70-99_0_0_all strata, as only the quarter 4 TBB_DEF_70-99_0_0_all stratum from the UK has sampled one-year-old sole. In the manual allocation, on the other hand, the age 1 information is also delivered by the Belgian 2004 TBB_DEF_70-99_0_0_all stratum and is applied on the 11 TBB_DEF_70-99_0_0_all strata with missing age information.

(3) Comparing mean weights at age

Differences were identified when comparing the original landings mean weights at age matrix, used as input for the 2019 assessment, with the InterCatch outcome based on the new allocation schemes (Table 3). Especially age 1 and the older ages (11+), which are landed less frequently, showed the largest differences (> 40%).

Table 3: Differences by age for mean weights, using (a) the manual allocation scheme and (b) the autoallocation scheme compared with the 2019 assessment input. This was not possible for discards because discard age data has not been reported prior to the benchmark data call. Differences are shaded such that darker colors highlight greater differences.

a)

Landings Year/Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2004	126	28	1	7	10	-2	6	8	-2	6	-12	-13	-17	-35	-15
2005	144	18	-4	-7	-2	6	0	13	8	2	-1	-4	6	-9	2
2006	67	22	4	12	11	15	3	-9	-7	-2	-12	-4	-14	4	-23
2007	115	27	15	10	7	2	0	6	2	5	-15	-3	6	-3	-10
2008	16	7	8	9	17	18	9	19	17	10	1	14	10	8	-5
2009	55	-5	-10	-3	-8	-11	-9	3	1	-8	-12	-17	-28	5	-11
2010	9	3	2	3	1	4	-4	2	-1	16	-2	4	22	14	-3
2011	21	7	6	6	2	2	3	4	2	-1	7	4	21	-1	23
2012	45	7	0	0	-2	-4	3	1	2	-2	4	-4	-6	12	10
2013	-100	0	-1	-1	2	-1	3	-3	19	2	1	5	12	-9	2
2014	141	2	-1	-1	-5	0	0	2	-1	7	-1	8	-10	1	2
2015	1	0	-2	-2	-3	5	-1	-3	6	-3	28	13	20	-3	1
2016	0	0	-1	-3	-3	-3	-10	-1	-1	8	-2	0	-4	7	0
2017	49	-1	-5	-2	-8	-7	-2	-12	10	4	86	-25	-9	0	-7
2018	11	0	-3	-1	-3	-5	-3	-9	-11	-1	10	-4	-13	-6	-9

b)

Landings Year/Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2004	126	28	1	7	10	-2	6	6	-3	4	-13	-13	-17	-35	-16
2005	99	18	-4	-7	-2	6	0	11	6	0	1	-4	2	-5	1
2006	67	22	4	12	11	15	3	-8	-6	-1	-11	-2	-12	4	-22
2007	115	27	15	10	7	1	0	6	1	5	-14	-3	6	-3	-9
2008	16	7	8	9	17	18	8	18	17	10	1	14	10	8	-5
2009	49	-5	-10	-2	-7	-10	-8	3	2	-7	-11	-14	-27	5	-10
2010	10	4	3	3	1	5	-4	3	-2	16	-2	4	21	14	-2
2011	21	8	7	6	2	2	2	4	1	-1	7	4	20	-1	22
2012	45	7	2	2	-1	-2	4	3	5	1	6	-2	-3	17	14
2013	-100	0	-1	0	4	0	7	4	19	1	2	6	11	-3	7
2014	141	2	-1	-1	-4	1	0	3	-1	7	-2	7	-10	-1	1
2015	1	0	-2	-2	-3	5	-1	-3	6	-3	28	12	21	-3	1
2016	0	0	0	-2	-1	-2	-9	0	-1	4	-2	0	-1	5	1
2017	49	0	-4	0	-7	-5	-1	-10	10	6	75	-21	-8	5	-6
2018	-2	0	-2	0	-1	-4	-2	-9	-9	-2	10	-4	-11	-3	-9

Additionally, mean weights at age were compared between both allocation schemes for both landings and discards (Table 4).

Table 4: Differences by age for mean weights between the outcome of manual allocation scheme and the autoallocation scheme for (a) the landings and (b) the discards. Differences are shaded such that darker colors highlight greater differences.

a)

Landings Year/Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	-1	0	0	-1	-2	0	-1	0	0
2006	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	0	0	3	3	0	0	1	2	1	-1	1	-1	-1	0	0
2013	0	#DIV/0!	0	-1	1	-1	1	-2	0	0	0	0	0	-1	3
2014	0	0	0	0	0	1	0	0	0	0	1	0	0	-3	0
2015	0	#DIV/0!	0	0	0	0	0	0	0	0	0	0	0	0	0
2016	#DIV/0!	#DIV/0!	-1	0	-1	0	0	-1	0	0	0	-4	-1	0	0
2017	0	-1	0	-1	0	0	-1	0	0	0	0	0	0	23	0
2018	-1	#DIV/0!	0	-1	-1	0	0	0	0	0	0	0	0	0	0

b)

Discards

Year/Age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2004	#DIV/0!	0	0	0	0	0	0	0	-1	0	0	0	0	0	-1	1
2005	#DIV/0!	0	0	0	-1	-3	-1	0	0	0	0	0	0	0	0	0
2006	#DIV/0!	0	0	0	0	-3	-3	-2	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0
2007	#DIV/0!	#DIV/0!	0	0	0	0	0	0	#DIV/0!	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2008	#DIV/0!	#DIV/0!	0	0	0	0	0	0	#DIV/0!	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2009	#DIV/0!	0	0	0	0	0	1	1	1	1	1	-1	1	0	0	4
2010	#DIV/0!	0	0	1	0	0	0	0	0	0	0	0	0	#DIV/0!	#DIV/0!	0
2011	#DIV/0!	0	0	0	0	#DIV/0!	#DIV/0!	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2012	#DIV/0!	0	0	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2013	#DIV/0!	0	0	0	0	0	0	0	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2014	#DIV/0!	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!	0	#DIV/0!	#DIV/0!
2015	#DIV/0!	#DIV/0!	0	0	0	0	0	#DIV/0!	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2016	#DIV/0!	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!	0	0
2017	0	0	1	0	1	-1	3	2	1	3	8	0	0	1	11	-2
2018	0	0	-6	0	0	-1	0	0	0	0	0	0	0	0	0	-3

Comparing the two allocation schemes resulted for both landings and discards in small differences (Table 4). The largest difference for the landings is the 23% in 2017 for age 14, which originates from the 530 g mean weight after manual allocation and the 553 g mean weight after autoallocation. The stratum mostly contributing to the mean weight (based on CANUM) is the Belgian 2017 TBB_DEF_70-99_0_0_all stratum. However, the mean weight for age 14 of this stratum (406.85 g) is the lowest of all the sampled strata (mean weight at age 14 = 407 g – 863 g). In the autoallocation scheme, this stratum (together with other strata) is used to allocate the weights to 37 unsampled strata, while in the manual allocation it is used to allocate the weights to 79 strata.

(4) Comparing overall tonnage

Overall tonnage estimates of landings were compared for landings between the 2019 assessment input and the output of the new allocations schemes (Table 5).

Table 5: Comparison of overall tonnage estimates of landings used in the 2019 assessment and the outcome of the allocation schemes. For discards only the outcome of the allocation schemes is presented because discards have not been estimated prior to the benchmark. Differences are shaded such that darker colors highlight greater differences.

	2019 assessment	WKFLATNSCS 2020		
Year	landings (t)		discards (t)	dif landings
2004	1398	1391	141	-0.5
2005	1118	1263	23	13.0
2006	946	1058	41	11.8
2007	945	1052	36	11.3
2008	800	790	8	-1.3
2009	805	772	30	-4.1
2010	876	867	56	-1.0
2011	1029	1027	28	-0.2
2012	1104	1101	32	-0.3
2013	1093	1093	26	0.0
2014	1042	1041	27	-0.1
2015	830	831	17	0.1
2016	831	832	31	0.1
2017	776	778	66	0.3
2018	850	850	141	0.0

Analysis of the Belgian sole TBB_DEF_70-99_0_0_all landings data (see Working document: Belgian commercial beam trawl landings data for sole in the eastern English Channel (ICES division 7.d) and sole in the Bristol channel and the Celtic Sea (ICES divisions 7.f and 7.g)), shows substantial differences between estimated and reported landings in the period 2004-2007 (> 22 %) and fishermen confirm that there were compliance issues in the beginning of this time series. Therefore, these landing numbers were adjusted as the Belgian landings for sole in ICES divisions 7.f and 7.g were probably higher. This explains the larger differences in landed weight noted for the earlier data years (2005-2007). However, those differences are smaller then the tonnage that was added to adjust for the misreporting and in 2004 even less sole was landed compared to what was used as input for the 2019 assessment. This is due to the revisions of the Belgian sole TBB_DEF_70-99_0_0_all landings data that were implemented at the WKCELT in 2014 (ICES, 2014). At this benchmark initial analysis for misreporting were done and it was decided for the period 2003-2005 to add the registered sole landings in ICES divisions 7.h-k with lpue's higher than 40 kg/h to the sole 7.fg landings. For 2003-2005, they comprise 23% (149 t), 21% (143 t) and 12% (71 t) respectively of the total landings of sole registered in 7.fg. Finally, it should be noted that the official reported landings were updated as we now have access to the logbook and sales notes database that is hosted by the administration. Therefore, an extended quality control procedure is being applied.

Conclusions

In general, both allocation schemes resulted in quite similar outcomes for both the numbers at age and the mean weights at age. This is related to the high age coverage of the imported landings and discards (>78% for the landings and >53% for the discards). For the TBB_DEF_70-99_0_0_all metier that covers more than 75% of the total landings, more than 90% of the landings strata and more than 66% of the discards strata had an age distribution. Belgium takes most of the sole TBB_DEF_70-99_0_0_all landings. However, it is the only country that provided yearly data. As the autoallocation procedure does not include this yearly age distribution, it is preferred to use the manual allocation procedure. Moreover, in the autoallocation the age allocation of some strata had to be edited afterwards because some metiers did not follow the officially naming convention. For example: the French OTB_DEF_100-119_0_0 and OTB_DEF_70-99_0_0 strata were missing the '_all' at the end. This significantly increases the chance of making mistakes.

The percentage of discards that were raised was rather low (7-46%). For 2006-2008, the least amount of discard information was provided. Except for 2013, all the imported discard strata had also an age distribution.

Differences between the two allocation schemes and the 2019 assessment input are larger, especially for age 1 and 2, the older ages and the earlier years. Several reasons were identified to contribute to this differences:

- more sampled strata were provided for this benchmark
- some data were adapted as they appeared to be wrong
- the allocations for the years 2004-2011 have now been done for the first time in InterCatch

The InterCatch procedures as described in this working document, will be used for raising and age allocations in the future.

Appendix 1: Intercatch input for discard raising and age allocation (based on script from José De Oliveira)

InterCatch input for 2003

```
##                 1         2         3          4
## 27.7.f 0.3128021 0.8214626 0.6372260 0.61230650
## 27.7.g        NA 0.2761957 0.2117729 0.05250678
```

This appendix lists 5 sections of tables (A-E) for each InterCatch year. It provides a detailed summary of the InterCatch input data in terms of importance by landed weight and the proportional coverage for age data and discard ratios.

Section A: Importance by landed weight (Lwt / sum(Lwt))

1. Proportion of landings by area and season

```
L_AS*100

##                1        2        3         4
## 27.7.f 44.05150 5.059604 4.460697  3.211311
## 27.7.g 18.84796 4.303522 8.571483 11.493920
```

2. Proportion of landings by métier and country

```
format(data.frame(L_FC*100),scientific=3,digit=1)

##                           Belgium France Ireland UK..England. UK.Scotland.
## DRB_MOL_0_0_0_all              NA     NA   0.002           NA           NA
## GNS_DEF_120-219_0_0_all        NA     NA   0.056           NA           NA
## GNS_DEF_all_0_0_all            NA     NA      NA        0.092           NA
## LLS_FIF_0_0_0_all              NA     NA      NA        0.010           NA
## MIS_MIS_0_0_0_HC               NA  0.505   0.323        0.002           NA
## OTB_CRU_100-119_0_0_all        NA  1.723   0.005        0.003           NA
## OTB_CRU_16-31_0_0_all          NA     NA      NA        0.867           NA
## OTB_CRU_70-99_0_0_all        0.05  0.431   0.429           NA           NA
## OTB_DEF_>=120_0_0_all          NA     NA      NA        0.168        0.000
## OTB_DEF_100-119_0_0_all        NA  3.426   0.107           NA           NA
## OTB_DEF_70-99_0_0_all          NA  0.432   0.329        0.969        0.005
## OTM_DEF_100-119_0_0_all        NA  0.003      NA           NA           NA
## OTT_CRU_100-119_0_0            NA  3.196      NA           NA           NA
## OTT_CRU_70-99_0_0_all          NA  0.510      NA           NA           NA
## OTT_DEF_100-119_0_0            NA  2.327      NA           NA           NA
## SSC_DEF_100-119_0_0_all        NA     NA   0.056           NA           NA
## TBB_CRU_16-31_0_0_all          NA     NA      NA        0.128           NA
## TBB_DEF_70-99_0_0_all       57.67     NA   0.790       25.388           NA
```

3. Proportion of landings by country

```
apply(L_FC*100,2,function(x) sum(x,na.rm=T))

##       Belgium       France      Ireland UK (England) UK(Scotland)
##   57.71922797  12.55282225   2.09593564  27.62749408   0.00452006
```

4. Proportion of landings by fleet and area

```
format(data.frame(L_FA*100),scientific=4,digit=1)

##                         X27.7.f X27.7.g
## DRB_MOL_0_0_0_all            NA  0.0016
## GNS_DEF_120-219_0_0_all      NA  0.0556
## GNS_DEF_all_0_0_all      0.0538  0.0381
## LLS_FIF_0_0_0_all        0.0002  0.0101
## MIS_MIS_0_0_0_HC         0.1074  0.7231
## OTB_CRU_100-119_0_0_all  0.0084  1.7220
## OTB_CRU_16-31_0_0_all    0.8591  0.0082
## OTB_CRU_70-99_0_0_all    0.0305  0.8812
## OTB_DEF_>=120_0_0_all    0.1675  0.0008
## OTB_DEF_100-119_0_0_all  0.6446  2.8889
## OTB_DEF_70-99_0_0_all    1.2691  0.4650
## OTM_DEF_100-119_0_0_all      NA  0.0031
## OTT_CRU_100-119_0_0      0.0133  3.1826
## OTT_CRU_70-99_0_0_all    0.0002  0.5102
## OTT_DEF_100-119_0_0      0.0265  2.3001
## SSC_DEF_100-119_0_0_all      NA  0.0559
## TBB_CRU_16-31_0_0_all    0.1248  0.0036
## TBB_DEF_70-99_0_0_all   53.4777 30.3669
```

5. Proportion of landings by métier, ranked from largest to smallest, together with cumulative sum

```
L_F1<-L_F
L_F1$rank_Total<-L_F1$rank_Total*100
L_F1<-L_F1[rev(order(L_F1$rank_Total)),]
L_F1$cum<-cumsum(L_F1$rank_Total)
format(L_F1,scientific=4,digit=1)

##                         rank_Total                   Fleet cum
## TBB_DEF_70-99_0_0_all       83.845   TBB_DEF_70-99_0_0_all  84
## OTB_DEF_100-119_0_0_all      3.533 OTB_DEF_100-119_0_0_all  87
## OTT_CRU_100-119_0_0          3.196     OTT_CRU_100-119_0_0  91
## OTT_DEF_100-119_0_0          2.327     OTT_DEF_100-119_0_0  93
## OTB_DEF_70-99_0_0_all        1.734   OTB_DEF_70-99_0_0_all  95
## OTB_CRU_100-119_0_0_all      1.730 OTB_CRU_100-119_0_0_all  96
## OTB_CRU_70-99_0_0_all        0.912   OTB_CRU_70-99_0_0_all  97
## OTB_CRU_16-31_0_0_all        0.867   OTB_CRU_16-31_0_0_all  98
## MIS_MIS_0_0_0_HC             0.831        MIS_MIS_0_0_0_HC  99
## OTT_CRU_70-99_0_0_all        0.510   OTT_CRU_70-99_0_0_all  99
## OTB_DEF_>=120_0_0_all        0.168   OTB_DEF_>=120_0_0_all 100
## TBB_CRU_16-31_0_0_all        0.128   TBB_CRU_16-31_0_0_all 100
## GNS_DEF_all_0_0_all          0.092     GNS_DEF_all_0_0_all 100
## SSC_DEF_100-119_0_0_all      0.056 SSC_DEF_100-119_0_0_all 100
## GNS_DEF_120-219_0_0_all      0.056 GNS_DEF_120-219_0_0_all 100
## LLS_FIF_0_0_0_all            0.010       LLS_FIF_0_0_0_all 100
## OTM_DEF_100-119_0_0_all      0.003 OTM_DEF_100-119_0_0_all 100
## DRB_MOL_0_0_0_all            0.002       DRB_MOL_0_0_0_all 100
```

Section B: Age coverage

1. Total proportion of the landings/sampled discards that is covered for age composition

```
Lage_A_tot #(Lwt !Lagesamp / sum(Lwt))

## [1] 0.2635179

Dage_A_tot #(Dwt !Dagesamp / sum(Dwt))

## [1] 0.9873086
```

2. Proportion of landings/sampled discards by area and season that is covered for age composition

```
Lage_AS

##                 1         2         3          4
## 27.7.f 0.3128021 0.8214626 0.6372260 0.61230650
## 27.7.g        NA 0.2761957 0.2117729 0.05250678

Dage_AS

##         2  3  4
## 27.7.f  1 NA  1
## 27.7.g NA  0 NA
```

3. Proportion of landings/sampled discards in each métier-country stratum that is covered for age composition

```
Lage_FC

##                          Belgium France Ireland UK (England) UK(Scotland)
## DRB_MOL_0_0_0_all             NA     NA       0           NA           NA
## GNS_DEF_120-219_0_0_all       NA     NA       0           NA           NA
## GNS_DEF_all_0_0_all           NA     NA      NA   0.52021090           NA
## LLS_FIF_0_0_0_all             NA     NA      NA   0.00000000           NA
## MIS_MIS_0_0_0_HC              NA      0       0   0.00000000           NA
## OTB_CRU_100-119_0_0_all       NA      0       0   0.66666667           NA
## OTB_CRU_16-31_0_0_all         NA     NA      NA   0.08441135           NA
## OTB_CRU_70-99_0_0_all          0      0       0           NA           NA
## OTB_DEF_>=120_0_0_all         NA     NA      NA   0.00000000          NaN
## OTB_DEF_100-119_0_0_all       NA      0       0           NA           NA
## OTB_DEF_70-99_0_0_all         NA      0       0   0.98633219            0
## OTM_DEF_100-119_0_0_all       NA      0      NA           NA           NA
## OTT_CRU_100-119_0_0           NA      0      NA           NA           NA
## OTT_CRU_70-99_0_0_all         NA      0      NA           NA           NA
## OTT_DEF_100-119_0_0           NA      0      NA           NA           NA
## SSC_DEF_100-119_0_0_all       NA     NA       0           NA           NA
## TBB_CRU_16-31_0_0_all         NA     NA      NA   0.00000000           NA
## TBB_DEF_70-99_0_0_all          0     NA       0   0.99551079           NA

Dage_FC #note: proportions shown prior to discard raising

##                          Belgium France Ireland UK (England) UK(Scotland)
## DRB_MOL_0_0_0_all             NA     NA     NaN           NA           NA
## GNS_DEF_120-219_0_0_all       NA     NA     NaN           NA           NA
## GNS_DEF_all_0_0_all           NA     NA      NA          NaN           NA
```

```
## LLS_FIF_0_0_0_all           NA     NA     NA         NaN         NA
## MIS_MIS_0_0_0_HC            NA    NaN    NaN         NaN         NA
## OTB_CRU_100-119_0_0_all     NA    NaN    NaN         NaN         NA
## OTB_CRU_16-31_0_0_all       NA     NA     NA         NaN         NA
## OTB_CRU_70-99_0_0_all      NaN    NaN    NaN          NA         NA
## OTB_DEF_>=120_0_0_all       NA     NA     NA         NaN        NaN
## OTB_DEF_100-119_0_0_all     NA    NaN    NaN          NA         NA
## OTB_DEF_70-99_0_0_all       NA    NaN    NaN    1.000000        NaN
## OTM_DEF_100-119_0_0_all     NA    NaN     NA          NA         NA
## OTT_CRU_100-119_0_0         NA    NaN     NA          NA         NA
## OTT_CRU_70-99_0_0_all       NA    NaN     NA          NA         NA
## OTT_DEF_100-119_0_0         NA    NaN     NA          NA         NA
## SSC_DEF_100-119_0_0_all     NA     NA    NaN          NA         NA
## TBB_CRU_16-31_0_0_all       NA     NA     NA         NaN         NA
## TBB_DEF_70-99_0_0_all      NaN     NA    NaN    0.985404         NA
```

Section C: Discard ratio coverage (Lwt !Dwt / sum(Lwt))

1. Total proportion of the landings for which discard weights are available

```
Ldis_A_tot

## [1] 0.03557852
```

2. Proportion of landings for which discard weights are available by area and season

```
Ldis_AS

##          1          2         3         4
## 27.7.f 0 0.03911651 0.0000000 0.4816312
## 27.7.g 0 0.00000000 0.2115469 0.0000000
```

3. Proportion of landings for which discard weights are available in each métier-country stratum

```
Ldis_FC

##                           Belgium France Ireland UK (England) UK(Scotland)
## DRB_MOL_0_0_0_all              NA     NA       0           NA           NA
## GNS_DEF_120-219_0_0_all        NA     NA       0           NA           NA
## GNS_DEF_all_0_0_all            NA     NA      NA    0.0000000           NA
## LLS_FIF_0_0_0_all              NA     NA      NA    0.0000000           NA
## MIS_MIS_0_0_0_HC               NA      0       0    0.0000000           NA
## OTB_CRU_100-119_0_0_all        NA      0       0    0.0000000           NA
## OTB_CRU_16-31_0_0_all          NA     NA      NA    0.0000000           NA
## OTB_CRU_70-99_0_0_all           0      0       0           NA           NA
## OTB_DEF_>=120_0_0_all          NA     NA      NA    0.0000000          NaN
## OTB_DEF_100-119_0_0_all        NA      0       0           NA           NA
## OTB_DEF_70-99_0_0_all          NA      0       0    0.2043504            0
## OTM_DEF_100-119_0_0_all        NA      0      NA           NA           NA
## OTT_CRU_100-119_0_0            NA      0      NA           NA           NA
## OTT_CRU_70-99_0_0_all          NA      0      NA           NA           NA
## OTT_DEF_100-119_0_0            NA      0      NA           NA           NA
## SSC_DEF_100-119_0_0_all        NA     NA       0           NA           NA
## TBB_CRU_16-31_0_0_all          NA     NA      NA    0.0000000           NA
## TBB_DEF_70-99_0_0_all           0     NA       0    0.1323458           NA
```

Section D: Landings age coverage ranked by landed weights

This section shows the proportion of landings covered for age composition, in total (Lage_tot), by métier and for the larger gear groups (Lage_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable age coverage for landings. Additionally, the proportion of landings for which discard age coverage is available is presented for the larger gear groups (Dage_gear).

```
Lage_tot<-sum(Lage_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Lage_AS = Lwt !Lagesamp / sum(Lwt); L_AS = Lwt / sum(Lwt))
Lage_tot

## [1] 0.2635179

format(Lage_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Lage_AS

##                      Fleet Total rank_Total
## 18   TBB_DEF_70-99_0_0_all 0.301    0.83845
## 10 OTB_DEF_100-119_0_0_all 0.000    0.03533
## 13     OTT_CRU_100-119_0_0 0.000    0.03196
## 15     OTT_DEF_100-119_0_0 0.000    0.02327
## 11   OTB_DEF_70-99_0_0_all 0.551    0.01734
## 6  OTB_CRU_100-119_0_0_all 0.001    0.01730
## 8    OTB_CRU_70-99_0_0_all 0.000    0.00912
## 7    OTB_CRU_16-31_0_0_all 0.084    0.00867
## 5          MIS_MIS_0_0_0_HC 0.000    0.00831
## 14   OTT_CRU_70-99_0_0_all 0.000    0.00510
## 9    OTB_DEF_>=120_0_0_all 0.000    0.00168
## 17   TBB_CRU_16-31_0_0_all 0.000    0.00128
## 3     GNS_DEF_all_0_0_all 0.520    0.00092
## 16 SSC_DEF_100-119_0_0_all 0.000    0.00056
## 2  GNS_DEF_120-219_0_0_all 0.000    0.00056
## 4        LLS_FIF_0_0_0_all 0.000    0.00010
## 12 OTM_DEF_100-119_0_0_all 0.000    0.00003
## 1        DRB_MOL_0_0_0_all 0.000    0.00002

Lage_gear

##        GTR        OTB       REST        TBB
## 0.32402846 0.06853854 0.00000000 0.30097303

Dage_gear

##        GTR        OTB       REST        TBB
## 0.00000000 0.01316438 0.00000000 0.01841864
```

Section E: Discard ratio coverage ranked by landed weight

This section shows the proportion of landings for which discard weights are available, in total (Ldis_tot), by métier and for the larger gear groups (Ldis_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable discard ratio coverage.

```
Ldis_tot<-sum(Ldis_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Ldis_AS = Lwt !Dwt / sum(Lwt); L_AS = Lwt / sum(Lwt)
Ldis_tot

## [1] 0.03557852

format(Ldis_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Ldis_AS

##                        Fleet Total rank_Total
## 18   TBB_DEF_70-99_0_0_all  0.04    0.83845
## 10 OTB_DEF_100-119_0_0_all  0.00    0.03533
## 13     OTT_CRU_100-119_0_0  0.00    0.03196
## 15     OTT_DEF_100-119_0_0  0.00    0.02327
## 11   OTB_DEF_70-99_0_0_all  0.11    0.01734
## 6  OTB_CRU_100-119_0_0_all  0.00    0.01730
## 8    OTB_CRU_70-99_0_0_all  0.00    0.00912
## 7    OTB_CRU_16-31_0_0_all  0.00    0.00867
## 5          MIS_MIS_0_0_0_HC  0.00    0.00831
## 14   OTT_CRU_70-99_0_0_all  0.00    0.00510
## 9    OTB_DEF_>=120_0_0_all  0.00    0.00168
## 17   TBB_CRU_16-31_0_0_all  0.00    0.00128
## 3     GNS_DEF_all_0_0_all  0.00    0.00092
## 16 SSC_DEF_100-119_0_0_all  0.00    0.00056
## 2  GNS_DEF_120-219_0_0_all  0.00    0.00056
## 4        LLS_FIF_0_0_0_all  0.00    0.00010
## 12 OTM_DEF_100-119_0_0_all  0.00    0.00003
## 1        DRB_MOL_0_0_0_all  0.00    0.00002

Ldis_gear

##        GTR        OTB       REST        TBB
## 0.00000000 0.01316438 0.00000000 0.04001215
```

InterCatch input for 2004

```
##                  1         2         3         4 2004
## 27.7.f 0.9291451 0.8310975 0.9058248 0.9491808    1
## 27.7.g        NA 0.3012624 0.3688413 0.2945715   NA
```

This appendix lists 5 sections of tables (A-E) for each InterCatch year. It provides a detailed summary of the InterCatch input data in terms of importance by landed weight and the proportional coverage for age data and discard ratios.

Section A: Importance by landed weight (Lwt / sum(Lwt))

1. Proportion of landings by area and season

```
L_AS*100
```

```
##                 1        2        3        4     2004
## 27.7.f 8.256441 3.953043 2.983655 2.849262 68.49749
## 27.7.g 3.091144 3.772213 3.729983 2.866765       NA
```

2. Proportion of landings by métier and country

```
format(data.frame(L_FC*100),scientific=3,digit=1)
```

```
##                          Belgium France Ireland UK..England. UK.Scotland.
## DRB_MOL_0_0_0_all             NA     NA   0.026           NA           NA
## GNS_DEF_120-219_0_0_all       NA     NA   0.008           NA           NA
## GNS_DEF_all_0_0_all           NA     NA      NA       0.1650           NA
## GTR_DEF_90-99_0_0_all         NA    0.1      NA           NA           NA
## GTR_DEF_all_0_0_all           NA     NA      NA       0.0008           NA
## LLS_FIF_0_0_0_all             NA     NA      NA       0.0009           NA
## MIS_MIS_0_0_0_HC              NA    0.1      NA       0.0105           NA
## OTB_CRU_100-119_0_0_all       NA    0.9   0.053       0.0004           NA
## OTB_CRU_16-31_0_0_all         NA     NA      NA       0.2730           NA
## OTB_CRU_70-99_0_0_all          1    0.1   0.488           NA           NA
## OTB_DEF_>=120_0_0_all         NA     NA      NA       0.0817        0.001
## OTB_DEF_100-119_0_0_all       NA    2.0   0.114           NA           NA
## OTB_DEF_70-99_0_0_all         NA    0.5   0.752       0.9695        0.000
## OTT_CRU_100-119_0_0           NA    2.1      NA           NA           NA
## OTT_CRU_70-99_0_0_all         NA    0.1      NA           NA           NA
## OTT_DEF_100-119_0_0           NA    1.5      NA           NA           NA
## SSC_DEF_100-119_0_0_all       NA     NA   0.089           NA           NA
## TBB_CRU_16-31_0_0_all         NA     NA      NA       0.0543           NA
## TBB_DEF_>=120_0_0_all         NA     NA      NA       0.0276           NA
## TBB_DEF_70-99_0_0_all         68     NA   0.865      18.7561           NA
```

3. Proportion of landings by country

```
apply(L_FC*100,2,function(x) sum(x,na.rm=T))
```

```
##      Belgium       France      Ireland UK (England) UK(Scotland)
## 69.784643375  7.479938590  2.394393521 20.339587001  0.001437513
```

4. Proportion of landings by fleet and area

```
format(data.frame(L_FA*100),scientific=4,digit=1)
```

```
##                           X27.7.f X27.7.g
## DRB_MOL_0_0_0_all              NA  0.0262
## GNS_DEF_120-219_0_0_all        NA  0.0081
## GNS_DEF_all_0_0_all        0.1427  0.0222
## GTR_DEF_90-99_0_0_all      0.1329      NA
## GTR_DEF_all_0_0_all        0.0006  0.0002
## LLS_FIF_0_0_0_all              NA  0.0009
## MIS_MIS_0_0_0_HC           0.0401  0.0808
## OTB_CRU_100-119_0_0_all    0.0081  0.9424
## OTB_CRU_16-31_0_0_all      0.2684  0.0046
## OTB_CRU_70-99_0_0_all      0.3479  1.5437
## OTB_DEF_>=120_0_0_all      0.0794  0.0037
## OTB_DEF_100-119_0_0_all    0.4260  1.6805
## OTB_DEF_70-99_0_0_all      1.3614  0.8784
## OTT_CRU_100-119_0_0        0.0409  2.0763
## OTT_CRU_70-99_0_0_all          NA  0.1080
## OTT_DEF_100-119_0_0        0.0328  1.4540
## SSC_DEF_100-119_0_0_all        NA  0.0886
## TBB_CRU_16-31_0_0_all      0.0543      NA
## TBB_DEF_>=120_0_0_all      0.0046  0.0230
## TBB_DEF_70-99_0_0_all     83.5997  4.5185
```

5. Proportion of landings by métier, ranked from largest to smallest, together with cumulative sum

```
L_F1<-L_F
L_F1$rank_Total<-L_F1$rank_Total*100
L_F1<-L_F1[rev(order(L_F1$rank_Total)),]
L_F1$cum<-cumsum(L_F1$rank_Total)
format(L_F1,scientific=4,digit=1)
```

```
##                           rank_Total                   Fleet cum
## TBB_DEF_70-99_0_0_all        88.1182   TBB_DEF_70-99_0_0_all  88
## OTB_DEF_70-99_0_0_all         2.2398   OTB_DEF_70-99_0_0_all  90
## OTT_CRU_100-119_0_0           2.1172     OTT_CRU_100-119_0_0  92
## OTB_DEF_100-119_0_0_all       2.1064 OTB_DEF_100-119_0_0_all  95
## OTB_CRU_70-99_0_0_all         1.8916   OTB_CRU_70-99_0_0_all  96
## OTT_DEF_100-119_0_0           1.4868     OTT_DEF_100-119_0_0  98
## OTB_CRU_100-119_0_0_all       0.9505 OTB_CRU_100-119_0_0_all  99
## OTB_CRU_16-31_0_0_all         0.2730   OTB_CRU_16-31_0_0_all  99
## GNS_DEF_all_0_0_all           0.1650     GNS_DEF_all_0_0_all  99
## GTR_DEF_90-99_0_0_all         0.1329   GTR_DEF_90-99_0_0_all  99
## MIS_MIS_0_0_0_HC              0.1210        MIS_MIS_0_0_0_HC 100
## OTT_CRU_70-99_0_0_all         0.1080   OTT_CRU_70-99_0_0_all 100
## SSC_DEF_100-119_0_0_all       0.0886 SSC_DEF_100-119_0_0_all 100
## OTB_DEF_>=120_0_0_all         0.0831   OTB_DEF_>=120_0_0_all 100
## TBB_CRU_16-31_0_0_all         0.0543   TBB_CRU_16-31_0_0_all 100
## TBB_DEF_>=120_0_0_all         0.0276   TBB_DEF_>=120_0_0_all 100
## DRB_MOL_0_0_0_all             0.0262       DRB_MOL_0_0_0_all 100
## GNS_DEF_120-219_0_0_all       0.0081 GNS_DEF_120-219_0_0_all 100
## LLS_FIF_0_0_0_all             0.0009       LLS_FIF_0_0_0_all 100
## GTR_DEF_all_0_0_all           0.0008     GTR_DEF_all_0_0_all 100
```

Section B: Age coverage

1. Total proportion of the landings/sampled discards that is covered for age composition

```
Lage_A_tot #(Lwt !Lagesamp / sum(Lwt))

## [1] 0.8821809

Dage_A_tot #(Dwt !Dagesamp / sum(Dwt))

## [1] 1
```

2. Proportion of landings/sampled discards by area and season that is covered for age composition

```
Lage_AS

##                 1         2         3         4 2004
## 27.7.f 0.9291451 0.8310975 0.9058248 0.9491808    1
## 27.7.g        NA 0.3012624 0.3688413 0.2945715   NA

Dage_AS

##        1   2  3  4 2004
## 27.7.f 1 NaN NA  1    1
## 27.7.g 1   1  1 NA   NA
```

3. Proportion of landings/sampled discards in each métier-country stratum that is covered for age composition

```
Lage_FC

##                          Belgium France Ireland UK (England) UK(Scotland)
## DRB_MOL_0_0_0_all             NA     NA       0           NA           NA
## GNS_DEF_120-219_0_0_all       NA     NA       0           NA           NA
## GNS_DEF_all_0_0_all           NA     NA      NA    0.6074074           NA
## GTR_DEF_90-99_0_0_all         NA      0      NA           NA           NA
## GTR_DEF_all_0_0_all           NA     NA      NA    0.0000000           NA
## LLS_FIF_0_0_0_all             NA     NA      NA    0.0000000           NA
## MIS_MIS_0_0_0_HC              NA      0      NA    0.0000000           NA
## OTB_CRU_100-119_0_0_all       NA      0       0    0.0000000           NA
## OTB_CRU_16-31_0_0_all         NA     NA      NA    0.9536598           NA
## OTB_CRU_70-99_0_0_all          0      0       0           NA           NA
## OTB_DEF_>=120_0_0_all         NA     NA      NA    0.0000000            0
## OTB_DEF_100-119_0_0_all       NA      0       0           NA           NA
## OTB_DEF_70-99_0_0_all         NA      0       0    0.9902877          NaN
## OTT_CRU_100-119_0_0           NA      0      NA           NA           NA
## OTT_CRU_70-99_0_0_all         NA      0      NA           NA           NA
## OTT_DEF_100-119_0_0           NA      0      NA           NA           NA
## SSC_DEF_100-119_0_0_all       NA     NA       0           NA           NA
## TBB_CRU_16-31_0_0_all         NA     NA      NA    0.0000000           NA
## TBB_DEF_>=120_0_0_all         NA     NA      NA    0.0000000           NA
## TBB_DEF_70-99_0_0_all          1     NA       0    0.9810157           NA

Dage_FC #note: proportions shown prior to discard raising

##                          Belgium France Ireland UK (England) UK(Scotland)
## DRB_MOL_0_0_0_all             NA     NA     NaN           NA           NA
```

```
## GNS_DEF_120-219_0_0_all       NA      NA      NaN          NA          NA
## GNS_DEF_all_0_0_all           NA      NA       NA         NaN          NA
## GTR_DEF_90-99_0_0_all         NA     NaN       NA          NA          NA
## GTR_DEF_all_0_0_all           NA      NA       NA         NaN          NA
## LLS_FIF_0_0_0_all             NA      NA       NA         NaN          NA
## MIS_MIS_0_0_0_HC              NA     NaN       NA         NaN          NA
## OTB_CRU_100-119_0_0_all       NA     NaN      NaN         NaN          NA
## OTB_CRU_16-31_0_0_all         NA      NA       NA         NaN          NA
## OTB_CRU_70-99_0_0_all        NaN     NaN      NaN          NA          NA
## OTB_DEF_>=120_0_0_all         NA      NA       NA         NaN         NaN
## OTB_DEF_100-119_0_0_all       NA     NaN      NaN          NA          NA
## OTB_DEF_70-99_0_0_all         NA     NaN      NaN         NaN         NaN
## OTT_CRU_100-119_0_0           NA     NaN       NA          NA          NA
## OTT_CRU_70-99_0_0_all         NA     NaN       NA          NA          NA
## OTT_DEF_100-119_0_0           NA     NaN       NA          NA          NA
## SSC_DEF_100-119_0_0_all       NA      NA      NaN          NA          NA
## TBB_CRU_16-31_0_0_all         NA      NA       NA         NaN          NA
## TBB_DEF_>=120_0_0_all         NA      NA       NA         NaN          NA
## TBB_DEF_70-99_0_0_all          1      NA      NaN           1          NA
```

Section C: Discard ratio coverage (Lwt !Dwt / sum(Lwt))

1. Total proportion of the landings for which discard weights are available

```
Ldis_A_tot

## [1] 0.8195765
```

2. Proportion of landings for which discard weights are available by area and season

```
Ldis_AS

##                1         2         3         4 2004
## 27.7.f 0.9001300 0.1134034 0.0000000 0.9491808    1
## 27.7.g 0.1175395 0.3012624 0.3688413 0.0000000   NA
```

3. Proportion of landings for which discard weights are available in each métier-country stratum

```
Ldis_FC

##                           Belgium France Ireland UK (England) UK(Scotland)
## DRB_MOL_0_0_0_all              NA     NA       0           NA           NA
## GNS_DEF_120-219_0_0_all        NA     NA       0           NA           NA
## GNS_DEF_all_0_0_all            NA     NA      NA   0.04400871           NA
## GTR_DEF_90-99_0_0_all          NA      0      NA           NA           NA
## GTR_DEF_all_0_0_all            NA     NA      NA   0.00000000           NA
## LLS_FIF_0_0_0_all              NA     NA      NA   0.00000000           NA
## MIS_MIS_0_0_0_HC               NA      0      NA   0.00000000           NA
## OTB_CRU_100-119_0_0_all        NA      0       0   0.00000000           NA
## OTB_CRU_16-31_0_0_all          NA     NA      NA   0.00000000           NA
## OTB_CRU_70-99_0_0_all           0      0       0           NA           NA
## OTB_DEF_>=120_0_0_all          NA     NA      NA   0.00000000            0
## OTB_DEF_100-119_0_0_all        NA      0       0           NA           NA
## OTB_DEF_70-99_0_0_all          NA      0       0   0.66599941          NaN
## OTT_CRU_100-119_0_0            NA      0      NA           NA           NA
## OTT_CRU_70-99_0_0_all          NA      0      NA           NA           NA
```

```
## OTT_DEF_100-119_0_0          NA        0        NA            NA            NA
## SSC_DEF_100-119_0_0_all      NA       NA         0            NA            NA
## TBB_CRU_16-31_0_0_all        NA       NA        NA    0.00000000            NA
## TBB_DEF_>=120_0_0_all        NA       NA        NA    0.00000000            NA
## TBB_DEF_70-99_0_0_all         1       NA         0    0.68283056            NA
```

Section D: Landings age coverage ranked by landed weights

This section shows the proportion of landings covered for age composition, in total (Lage_tot), by métier and for the larger gear groups (Lage_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable age coverage for landings. Additionally, the proportion of landings for which discard age coverage is available is presented for the larger gear groups (Dage_gear).

```
Lage_tot<-sum(Lage_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Lage_AS = Lwt !Lagesamp / sum(Lwt); L_AS = Lwt / sum(Lwt))
Lage_tot

## [1] 0.8821809

format(Lage_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Lage_AS

##                        Fleet Total rank_Total
## 20    TBB_DEF_70-99_0_0_all   1.0   0.881182
## 13    OTB_DEF_70-99_0_0_all   0.4   0.022398
## 14      OTT_CRU_100-119_0_0   0.0   0.021172
## 12 OTB_DEF_100-119_0_0_all   0.0   0.021064
## 10    OTB_CRU_70-99_0_0_all   0.0   0.018916
## 16      OTT_DEF_100-119_0_0   0.0   0.014868
## 8  OTB_CRU_100-119_0_0_all   0.0   0.009505
## 9     OTB_CRU_16-31_0_0_all   1.0   0.002730
## 3       GNS_DEF_all_0_0_all   0.6   0.001650
## 4     GTR_DEF_90-99_0_0_all   0.0   0.001329
## 7          MIS_MIS_0_0_0_HC   0.0   0.001210
## 15    OTT_CRU_70-99_0_0_all   0.0   0.001080
## 17 SSC_DEF_100-119_0_0_all   0.0   0.000886
## 11    OTB_DEF_>=120_0_0_all   0.0   0.000831
## 18    TBB_CRU_16-31_0_0_all   0.0   0.000543
## 19    TBB_DEF_>=120_0_0_all   0.0   0.000276
## 1         DRB_MOL_0_0_0_all   0.0   0.000262
## 2  GNS_DEF_120-219_0_0_all   0.0   0.000081
## 6         LLS_FIF_0_0_0_all   0.0   0.000009
## 5       GTR_DEF_all_0_0_all   0.0   0.000008

Lage_gear

##       GTR       OTB      REST       TBB
## 0.3265861 0.1075693 0.0000000 0.9852313

Dage_gear

##       GTR       OTB      REST       TBB
## 0.0000000 0.0000000 0.0000000 0.9218211
```

Section E: Discard ratio coverage ranked by landed weight

This section shows the proportion of landings for which discard weights are available, in total (Ldis_tot), by métier and for the larger gear groups (Ldis_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable discard ratio coverage.

```
Ldis_tot<-sum(Ldis_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Ldis_AS = Lwt !Dwt / sum(Lwt); L_AS = Lwt / sum(Lwt)
Ldis_tot

## [1] 0.8195765

format(Ldis_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Ldis_AS

##                        Fleet Total rank_Total
## 20   TBB_DEF_70-99_0_0_all  0.92   0.881182
## 13   OTB_DEF_70-99_0_0_all  0.29   0.022398
## 14     OTT_CRU_100-119_0_0  0.00   0.021172
## 12 OTB_DEF_100-119_0_0_all  0.00   0.021064
## 10   OTB_CRU_70-99_0_0_all  0.00   0.018916
## 16     OTT_DEF_100-119_0_0  0.00   0.014868
## 8  OTB_CRU_100-119_0_0_all  0.00   0.009505
## 9    OTB_CRU_16-31_0_0_all  0.00   0.002730
## 3      GNS_DEF_all_0_0_all  0.04   0.001650
## 4    GTR_DEF_90-99_0_0_all  0.00   0.001329
## 7         MIS_MIS_0_0_0_HC  0.00   0.001210
## 15   OTT_CRU_70-99_0_0_all  0.00   0.001080
## 17 SSC_DEF_100-119_0_0_all  0.00   0.000886
## 11   OTB_DEF_>=120_0_0_all  0.00   0.000831
## 18   TBB_CRU_16-31_0_0_all  0.00   0.000543
## 19   TBB_DEF_>=120_0_0_all  0.00   0.000276
## 1        DRB_MOL_0_0_0_all  0.00   0.000262
## 2  GNS_DEF_120-219_0_0_all  0.00   0.000081
## 6        LLS_FIF_0_0_0_all  0.00   0.000009
## 5      GTR_DEF_all_0_0_all  0.00   0.000008

Ldis_gear

##        GTR        OTB       REST        TBB
## 0.02366226 0.05691117 0.00000000 0.92182108
```

<u>InterCatch input for 2005</u>

```
##                 1         2         3         4 2005
## 27.7.f 0.9441077 0.8519867 0.6801689 0.8153812    1
## 27.7.g        NA 0.3171100 0.6735236 0.3318964   NA
```

This appendix lists 5 sections of tables (A-E) for each InterCatch year. It provides a detailed summary of the InterCatch input data in terms of importance by landed weight and the proportional coverage for age data and discard ratios.

Section A: Importance by landed weight (Lwt / sum(Lwt))

1. Proportion of landings by area and season

```
L_AS*100

##                1        2        3        4     2005
## 27.7.f 9.689285 2.637037 2.195487 1.841123 71.76396
## 27.7.g 2.257574 2.944225 3.091965 3.579341  0.00000
```

2. Proportion of landings by métier and country

```
format(data.frame(L_FC*100),scientific=3,digit=1)

##                          Belgium France Ireland UK..England. UK.Scotland.
## GNS_DEF_120-219_0_0_all       NA     NA   0.007           NA           NA
## GNS_DEF_all_0_0_all           NA     NA      NA        0.077           NA
## GTR_DEF_all_0_0_all           NA     NA      NA        0.005           NA
## LLS_FIF_0_0_0_all             NA     NA      NA        0.000           NA
## MIS_MIS_0_0_0_HC              NA    0.3      NA        0.017            0
## OTB_CRU_100-119_0_0_all       NA    1.0   0.039           NA           NA
## OTB_CRU_16-31_0_0_all         NA     NA      NA        0.178           NA
## OTB_CRU_70-99_0_0_all          1    0.1   0.723        0.002           NA
## OTB_DEF_>=120_0_0_all         NA     NA      NA        0.032            0
## OTB_DEF_100-119_0_0_all       NA    1.3   0.061           NA           NA
## OTB_DEF_70-99_0_0_all         NA    0.7   0.636        1.267            0
## OTT_CRU_100-119_0_0           NA    2.2      NA           NA           NA
## OTT_CRU_70-99_0_0_all         NA    0.2      NA           NA           NA
## OTT_DEF_100-119_0_0           NA    1.4      NA           NA           NA
## TBB_CRU_16-31_0_0_all         NA     NA      NA        0.017           NA
## TBB_DEF_70-99_0_0_all         72     NA   1.232       15.568           NA
```

3. Proportion of landings by country

```
apply(L_FC*100,2,function(x) sum(x,na.rm=T))

##      Belgium       France      Ireland UK (England) UK(Scotland)
##    72.876757     7.261581     2.698550    17.163113     0.000000
```

4. Proportion of landings by fleet and area

```
format(data.frame(L_FA*100),scientific=4,digit=1)

##                          X27.7.f X27.7.g
## GNS_DEF_120-219_0_0_all       NA   0.007
## GNS_DEF_all_0_0_all       0.0629   0.014
```

```
## GTR_DEF_all_0_0_all      0.0040   0.001
## LLS_FIF_0_0_0_all            NA   0.000
## MIS_MIS_0_0_0_HC         0.0184   0.305
## OTB_CRU_100-119_0_0_all  0.0148   1.048
## OTB_CRU_16-31_0_0_all    0.1752   0.003
## OTB_CRU_70-99_0_0_all    0.3602   1.619
## OTB_DEF_>=120_0_0_all    0.0302   0.002
## OTB_DEF_100-119_0_0_all  0.5316   0.840
## OTB_DEF_70-99_0_0_all    1.9390   0.691
## OTT_CRU_100-119_0_0      0.0308   2.131
## OTT_CRU_70-99_0_0_all    0.0002   0.205
## OTT_DEF_100-119_0_0      0.0241   1.362
## TBB_CRU_16-31_0_0_all    0.0045   0.012
## TBB_DEF_70-99_0_0_all   84.9310   3.633
```

5. Proportion of landings by métier, ranked from largest to smallest, together with cumulative sum

```
L_F1<-L_F
L_F1$rank_Total<-L_F1$rank_Total*100
L_F1<-L_F1[rev(order(L_F1$rank_Total)),]
L_F1$cum<-cumsum(L_F1$rank_Total)
format(L_F1,scientific=4,digit=1)
```

```
##                         rank_Total                   Fleet cum
## TBB_DEF_70-99_0_0_all       88.564   TBB_DEF_70-99_0_0_all  89
## OTB_DEF_70-99_0_0_all        2.630   OTB_DEF_70-99_0_0_all  91
## OTT_CRU_100-119_0_0          2.162     OTT_CRU_100-119_0_0  93
## OTB_CRU_70-99_0_0_all        1.979   OTB_CRU_70-99_0_0_all  95
## OTT_DEF_100-119_0_0          1.386     OTT_DEF_100-119_0_0  97
## OTB_DEF_100-119_0_0_all      1.371 OTB_DEF_100-119_0_0_all  98
## OTB_CRU_100-119_0_0_all      1.062 OTB_CRU_100-119_0_0_all  99
## MIS_MIS_0_0_0_HC             0.323        MIS_MIS_0_0_0_HC  99
## OTT_CRU_70-99_0_0_all        0.205   OTT_CRU_70-99_0_0_all 100
## OTB_CRU_16-31_0_0_all        0.178   OTB_CRU_16-31_0_0_all 100
## GNS_DEF_all_0_0_all          0.077     GNS_DEF_all_0_0_all 100
## OTB_DEF_>=120_0_0_all        0.032   OTB_DEF_>=120_0_0_all 100
## TBB_CRU_16-31_0_0_all        0.017   TBB_CRU_16-31_0_0_all 100
## GNS_DEF_120-219_0_0_all      0.007 GNS_DEF_120-219_0_0_all 100
## GTR_DEF_all_0_0_all          0.005     GTR_DEF_all_0_0_all 100
## LLS_FIF_0_0_0_all            0.000       LLS_FIF_0_0_0_all 100
```

Section B: Age coverage

1. Total proportion of the landings/sampled discards that is covered for age composition

```
Lage_A_tot #(Lwt !Lagesamp / sum(Lwt))

## [1] 0.9035706

Dage_A_tot #(Dwt !Dagesamp / sum(Dwt))

## [1] 1
```

2. Proportion of landings/sampled discards by area and season that is covered for age composition

```
Lage_AS

##                  1         2         3         4 2005
## 27.7.f 0.9441077 0.8519867 0.6801689 0.8153812    1
## 27.7.g        NA 0.3171100 0.6735236 0.3318964   NA

Dage_AS

##         2 2005
## 27.7.f NA    1
## 27.7.g  1   NA
```

3. Proportion of landings/sampled discards in each métier-country stratum that is covered for age composition

```
Lage_FC

##                          Belgium    France Ireland UK (England)
## GNS_DEF_120-219_0_0_all       NA        NA       0           NA
## GNS_DEF_all_0_0_all           NA        NA      NA   0.64278403
## GTR_DEF_all_0_0_all           NA        NA      NA   0.36923077
## LLS_FIF_0_0_0_all             NA        NA      NA          NaN
## MIS_MIS_0_0_0_HC              NA 0.0000000      NA   0.00000000
## OTB_CRU_100-119_0_0_all       NA 0.4744361       0           NA
## OTB_CRU_16-31_0_0_all         NA        NA      NA   0.09657321
## OTB_CRU_70-99_0_0_all          0 0.3821361       0   0.00000000
## OTB_DEF_>=120_0_0_all         NA        NA      NA   0.00000000
## OTB_DEF_100-119_0_0_all       NA 0.0000000       0           NA
## OTB_DEF_70-99_0_0_all         NA 0.0000000       0   0.99662563
## OTT_CRU_100-119_0_0           NA 0.5377615      NA           NA
## OTT_CRU_70-99_0_0_all         NA 0.0000000      NA           NA
## OTT_DEF_100-119_0_0           NA 0.1555075      NA           NA
## TBB_CRU_16-31_0_0_all         NA        NA      NA   0.00000000
## TBB_DEF_70-99_0_0_all          1        NA       0   0.98560591
##                          UK(Scotland)
## GNS_DEF_120-219_0_0_all            NA
## GNS_DEF_all_0_0_all                NA
## GTR_DEF_all_0_0_all                NA
## LLS_FIF_0_0_0_all                  NA
## MIS_MIS_0_0_0_HC                  NaN
## OTB_CRU_100-119_0_0_all            NA
## OTB_CRU_16-31_0_0_all              NA
## OTB_CRU_70-99_0_0_all              NA
## OTB_DEF_>=120_0_0_all             NaN
## OTB_DEF_100-119_0_0_all            NA
## OTB_DEF_70-99_0_0_all             NaN
## OTT_CRU_100-119_0_0                NA
## OTT_CRU_70-99_0_0_all              NA
## OTT_DEF_100-119_0_0                NA
## TBB_CRU_16-31_0_0_all              NA
## TBB_DEF_70-99_0_0_all              NA

Dage_FC #note: proportions shown prior to discard raising

##                          Belgium France Ireland UK (England) UK(Scotland)
## GNS_DEF_120-219_0_0_all       NA     NA     NaN           NA           NA
```

```
## GNS_DEF_all_0_0_all          NA     NA     NA          NaN          NA
## GTR_DEF_all_0_0_all          NA     NA     NA          NaN          NA
## LLS_FIF_0_0_0_all            NA     NA     NA          NaN          NA
## MIS_MIS_0_0_0_HC             NA    NaN     NA          NaN         NaN
## OTB_CRU_100-119_0_0_all      NA    NaN    NaN           NA          NA
## OTB_CRU_16-31_0_0_all        NA     NA     NA          NaN          NA
## OTB_CRU_70-99_0_0_all       NaN    NaN    NaN          NaN          NA
## OTB_DEF_>=120_0_0_all        NA     NA     NA          NaN         NaN
## OTB_DEF_100-119_0_0_all      NA    NaN    NaN           NA          NA
## OTB_DEF_70-99_0_0_all        NA    NaN    NaN          NaN         NaN
## OTT_CRU_100-119_0_0          NA    NaN     NA           NA          NA
## OTT_CRU_70-99_0_0_all        NA    NaN     NA           NA          NA
## OTT_DEF_100-119_0_0          NA    NaN     NA           NA          NA
## TBB_CRU_16-31_0_0_all        NA     NA     NA          NaN          NA
## TBB_DEF_70-99_0_0_all         1     NA    NaN            1          NA
```

Section C: Discard ratio coverage (Lwt !Dwt / sum(Lwt))

1. Total proportion of the landings for which discard weights are available

```
Ldis_A_tot

## [1] 0.7248722
```

2. Proportion of landings for which discard weights are available by area and season

```
Ldis_AS

##         1         2 3 4 2005
## 27.7.f 0 0.0000000 0 0    1
## 27.7.g 0 0.2456537 0 0  NaN
```

3. Proportion of landings for which discard weights are available in each métier-country stratum

```
Ldis_FC

##                         Belgium France Ireland UK (England) UK(Scotland)
## GNS_DEF_120-219_0_0_all      NA     NA       0           NA           NA
## GNS_DEF_all_0_0_all          NA     NA      NA   0.00000000           NA
## GTR_DEF_all_0_0_all          NA     NA      NA   0.00000000           NA
## LLS_FIF_0_0_0_all            NA     NA      NA          NaN           NA
## MIS_MIS_0_0_0_HC             NA      0      NA   0.00000000          NaN
## OTB_CRU_100-119_0_0_all      NA      0       0           NA           NA
## OTB_CRU_16-31_0_0_all        NA     NA      NA   0.00000000           NA
## OTB_CRU_70-99_0_0_all         0      0       0   0.00000000           NA
## OTB_DEF_>=120_0_0_all        NA     NA      NA   0.00000000          NaN
## OTB_DEF_100-119_0_0_all      NA      0       0           NA           NA
## OTB_DEF_70-99_0_0_all        NA      0       0   0.00000000          NaN
## OTT_CRU_100-119_0_0          NA      0      NA           NA           NA
## OTT_CRU_70-99_0_0_all        NA      0      NA           NA           NA
## OTT_DEF_100-119_0_0          NA      0      NA           NA           NA
## TBB_CRU_16-31_0_0_all        NA     NA      NA   0.00000000           NA
## TBB_DEF_70-99_0_0_all         1     NA       0   0.04645664           NA
```

Section D: Landings age coverage ranked by landed weights

This section shows the proportion of landings covered for age composition, in total (Lage_tot), by métier and for the larger gear groups (Lage_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable age coverage for landings. Additionally, the proportion of landings for which discard age coverage is available is presented for the larger gear groups (Dage_gear).

```
Lage_tot<-sum(Lage_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Lage_AS = Lwt !Lagesamp / sum(Lwt); L_AS = Lwt / sum(Lwt))
Lage_tot

## [1] 0.9035706

format(Lage_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Lage_AS

##                       Fleet Total rank_Total
## 16   TBB_DEF_70-99_0_0_all  0.98    0.88564
## 11   OTB_DEF_70-99_0_0_all  0.48    0.02630
## 12     OTT_CRU_100-119_0_0  0.54    0.02162
## 8    OTB_CRU_70-99_0_0_all  0.03    0.01979
## 14     OTT_DEF_100-119_0_0  0.16    0.01386
## 10 OTB_DEF_100-119_0_0_all  0.00    0.01371
## 6  OTB_CRU_100-119_0_0_all  0.46    0.01062
## 5          MIS_MIS_0_0_0_HC  0.00    0.00323
## 13   OTT_CRU_70-99_0_0_all  0.00    0.00205
## 7    OTB_CRU_16-31_0_0_all  0.10    0.00178
## 2      GNS_DEF_all_0_0_all  0.64    0.00077
## 9    OTB_DEF_>=120_0_0_all  0.00    0.00032
## 15   TBB_CRU_16-31_0_0_all  0.00    0.00017
## 1  GNS_DEF_120-219_0_0_all  0.00    0.00007
## 3      GTR_DEF_all_0_0_all  0.37    0.00005
## 4        LLS_FIF_0_0_0_all   NaN    0.00000

Lage_gear

##       GTR       OTB      REST       TBB
## 0.5739437 0.2904943 0.0000000 0.9833752

Dage_gear

##       GTR       OTB      REST       TBB
## 0.0000000 0.0000000 0.0000000 0.8183157
```

Section E: Discard ratio coverage ranked by landed weight

This section shows the proportion of landings for which discard weights are available, in total (Ldis_tot), by métier and for the larger gear groups (Ldis_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable discard ratio coverage.

```
Ldis_tot<-sum(Ldis_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Ldis_AS = Lwt !Dwt / sum(Lwt); L_AS = Lwt / sum(Lwt)
Ldis_tot
```

```
## [1] 0.7248722

format(Ldis_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Ldis_AS

##                       Fleet Total rank_Total
## 16   TBB_DEF_70-99_0_0_all   0.8    0.88564
## 11   OTB_DEF_70-99_0_0_all   0.0    0.02630
## 12     OTT_CRU_100-119_0_0   0.0    0.02162
## 8    OTB_CRU_70-99_0_0_all   0.0    0.01979
## 14     OTT_DEF_100-119_0_0   0.0    0.01386
## 10 OTB_DEF_100-119_0_0_all   0.0    0.01371
## 6  OTB_CRU_100-119_0_0_all   0.0    0.01062
## 5           MIS_MIS_0_0_0_HC   0.0    0.00323
## 13   OTT_CRU_70-99_0_0_all   0.0    0.00205
## 7    OTB_CRU_16-31_0_0_all   0.0    0.00178
## 2      GNS_DEF_all_0_0_all   0.0    0.00077
## 9    OTB_DEF_>=120_0_0_all   0.0    0.00032
## 15   TBB_CRU_16-31_0_0_all   0.0    0.00017
## 1  GNS_DEF_120-219_0_0_all   0.0    0.00007
## 3      GTR_DEF_all_0_0_all   0.0    0.00005
## 4        LLS_FIF_0_0_0_all   NaN    0.00000

Ldis_gear

##       GTR       OTB      REST       TBB
## 0.0000000 0.0000000 0.0000000 0.8183157
```

InterCatch input for 2006

```
##                  1         2         3         4 2006
## 27.7.f 0.94526985 0.9187631 0.7415337 0.6882422   NA
## 27.7.g 0.06469191 0.2867229 0.3461007 0.1283911    1
```

This appendix lists 5 sections of tables (A-E) for each InterCatch year. It provides a detailed summary of the InterCatch input data in terms of importance by landed weight and the proportional coverage for age data and discard ratios.

Section A: Importance by landed weight (Lwt / sum(Lwt))

1. Proportion of landings by area and season

```
L_AS*100
```

```
##                1        2        3        4     2006
## 27.7.f 9.013163 7.453685 2.799239 1.655923       NA
## 27.7.g 3.084724 4.136057 4.313995 3.894923 63.64829
```

2. Proportion of landings by métier and country

```
format(data.frame(L_FC*100),scientific=3,digit=1)
```

```
##                          Belgium France Ireland UK..England. UK.Scotland.
## DRB_MOL_0_0_0_all             NA     NA   0.004           NA           NA
## GNS_DEF_120-219_0_0_all       NA     NA   0.081           NA           NA
## GNS_DEF_all_0_0_all           NA     NA      NA      0.34722           NA
## GTR_DEF_90-99_0_0_all         NA  0.168      NA           NA           NA
## GTR_DEF_all_0_0_all           NA     NA      NA      0.00009           NA
## LLS_FIF_0_0_0_all             NA     NA      NA      0.00009           NA
## MIS_MIS_0_0_0_HC              NA  0.090      NA      0.02997            0
## OTB_CRU_100-119_0_0_all       NA  1.099   0.043           NA           NA
## OTB_CRU_16-31_0_0_all         NA     NA      NA      0.19823           NA
## OTB_CRU_70-99_0_0_all          4     NA   0.548           NA           NA
## OTB_DEF_>=120_0_0_all         NA     NA      NA      0.01087            0
## OTB_DEF_100-119_0_0_all       NA  1.197   0.085           NA           NA
## OTB_DEF_70-99_0_0_all         NA  0.302   0.713      4.09172            0
## OTM_DEF_100-119_0_0_all       NA  0.002      NA           NA           NA
## OTT_CRU_100-119_0_0           NA  2.053      NA           NA           NA
## OTT_CRU_70-99_0_0_all         NA  0.112      NA           NA           NA
## OTT_DEF_100-119_0_0           NA  1.695      NA           NA           NA
## SSC_DEF_100-119_0_0_all       NA     NA   0.077           NA           NA
## TBB_DEF_70-99_0_0_all         64     NA   2.049     17.25754           NA
```

3. Proportion of landings by country

```
apply(L_FC*100,2,function(x) sum(x,na.rm=T))
```

```
##      Belgium       France      Ireland UK (England) UK(Scotland)
##    67.744356     6.718433     3.601474    21.935737     0.000000
```

4. Proportion of landings by fleet and area

```
format(data.frame(L_FA*100),scientific=4,digit=1)
```

```
##                            X27.7.f  X27.7.g
## DRB_MOL_0_0_0_all               NA  0.00444
## GNS_DEF_120-219_0_0_all         NA  0.08139
## GNS_DEF_all_0_0_all        0.33171  0.01550
## GTR_DEF_90-99_0_0_all           NA  0.16789
## GTR_DEF_all_0_0_all        0.00009  0.00000
## LLS_FIF_0_0_0_all               NA  0.00009
## MIS_MIS_0_0_0_HC           0.11783  0.00238
## OTB_CRU_100-119_0_0_all    0.00788  1.13446
## OTB_CRU_16-31_0_0_all      0.19823       NA
## OTB_CRU_70-99_0_0_all      0.80948  3.83468
## OTB_DEF_>=120_0_0_all      0.00870  0.00217
## OTB_DEF_100-119_0_0_all    0.49976  0.78256
## OTB_DEF_70-99_0_0_all      4.34777  0.75815
## OTM_DEF_100-119_0_0_all         NA  0.00188
## OTT_CRU_100-119_0_0        0.02004  2.03329
## OTT_CRU_70-99_0_0_all      0.00169  0.11019
## OTT_DEF_100-119_0_0        0.02253  1.67278
## SSC_DEF_100-119_0_0_all         NA  0.07723
## TBB_DEF_70-99_0_0_all     14.55630 68.39889
```

5. Proportion of landings by métier, ranked from largest to smallest, together with cumulative sum

```
L_F1<-L_F
L_F1$rank_Total<-L_F1$rank_Total*100
L_F1<-L_F1[rev(order(L_F1$rank_Total)),]
L_F1$cum<-cumsum(L_F1$rank_Total)
format(L_F1,scientific=4,digit=1)
```

```
##                           rank_Total                   Fleet cum
## TBB_DEF_70-99_0_0_all       82.95519   TBB_DEF_70-99_0_0_all  83
## OTB_DEF_70-99_0_0_all        5.10592   OTB_DEF_70-99_0_0_all  88
## OTB_CRU_70-99_0_0_all        4.64416   OTB_CRU_70-99_0_0_all  93
## OTT_CRU_100-119_0_0          2.05333     OTT_CRU_100-119_0_0  95
## OTT_DEF_100-119_0_0          1.69531     OTT_DEF_100-119_0_0  96
## OTB_DEF_100-119_0_0_all      1.28232 OTB_DEF_100-119_0_0_all  98
## OTB_CRU_100-119_0_0_all      1.14235 OTB_CRU_100-119_0_0_all  99
## GNS_DEF_all_0_0_all          0.34722     GNS_DEF_all_0_0_all  99
## OTB_CRU_16-31_0_0_all        0.19823   OTB_CRU_16-31_0_0_all  99
## GTR_DEF_90-99_0_0_all        0.16789   GTR_DEF_90-99_0_0_all 100
## MIS_MIS_0_0_0_HC             0.12020        MIS_MIS_0_0_0_HC 100
## OTT_CRU_70-99_0_0_all        0.11188   OTT_CRU_70-99_0_0_all 100
## GNS_DEF_120-219_0_0_all      0.08139 GNS_DEF_120-219_0_0_all 100
## SSC_DEF_100-119_0_0_all      0.07723 SSC_DEF_100-119_0_0_all 100
## OTB_DEF_>=120_0_0_all        0.01087   OTB_DEF_>=120_0_0_all 100
## DRB_MOL_0_0_0_all            0.00444       DRB_MOL_0_0_0_all 100
## OTM_DEF_100-119_0_0_all      0.00188 OTM_DEF_100-119_0_0_all 100
## LLS_FIF_0_0_0_all            0.00009       LLS_FIF_0_0_0_all 100
## GTR_DEF_all_0_0_all          0.00009     GTR_DEF_all_0_0_all 100
```

Section B: Age coverage

1. Total proportion of the landings/sampled discards that is covered for age composition

```
Lage_A_tot #(Lwt !Lagesamp / sum(Lwt))

## [1] 0.8561035

Dage_A_tot #(Dwt !Dagesamp / sum(Dwt))

## [1] 1
```

2. Proportion of landings/sampled discards by area and season that is covered for age composition

```
Lage_AS

##                   1         2         3         4 2006
## 27.7.f 0.94526985 0.9187631 0.7415337 0.6882422   NA
## 27.7.g 0.06469191 0.2867229 0.3461007 0.1283911    1

Dage_AS

##         3 2006
## 27.7.f NA   NA
## 27.7.g  1    1
```

3. Proportion of landings/sampled discards in each métier-country stratum that is covered for age composition

```
Lage_FC

##                           Belgium    France Ireland UK (England)
## DRB_MOL_0_0_0_all              NA        NA       0           NA
## GNS_DEF_120-219_0_0_all        NA        NA       0           NA
## GNS_DEF_all_0_0_all            NA        NA      NA    0.8606044
## GTR_DEF_90-99_0_0_all          NA 0.0000000      NA           NA
## GTR_DEF_all_0_0_all            NA        NA      NA    0.0000000
## LLS_FIF_0_0_0_all              NA        NA      NA    0.0000000
## MIS_MIS_0_0_0_HC               NA 0.0000000      NA    0.0000000
## OTB_CRU_100-119_0_0_all        NA 0.2883137       0           NA
## OTB_CRU_16-31_0_0_all          NA        NA      NA    0.0000000
## OTB_CRU_70-99_0_0_all           0        NA       0           NA
## OTB_DEF_>=120_0_0_all          NA        NA      NA    0.0000000
## OTB_DEF_100-119_0_0_all        NA 0.0000000       0           NA
## OTB_DEF_70-99_0_0_all          NA 0.0000000       0    0.9993069
## OTM_DEF_100-119_0_0_all        NA 0.0000000      NA           NA
## OTT_CRU_100-119_0_0            NA 0.0000000      NA           NA
## OTT_CRU_70-99_0_0_all          NA 0.0000000      NA           NA
## OTT_DEF_100-119_0_0            NA 0.0000000      NA           NA
## SSC_DEF_100-119_0_0_all        NA        NA       0           NA
## TBB_DEF_70-99_0_0_all           1        NA       0    1.0000000
##                           UK(Scotland)
## DRB_MOL_0_0_0_all                   NA
## GNS_DEF_120-219_0_0_all             NA
## GNS_DEF_all_0_0_all                 NA
## GTR_DEF_90-99_0_0_all               NA
```

```
## GTR_DEF_all_0_0_all              NA
## LLS_FIF_0_0_0_all                NA
## MIS_MIS_0_0_0_HC                NaN
## OTB_CRU_100-119_0_0_all          NA
## OTB_CRU_16-31_0_0_all            NA
## OTB_CRU_70-99_0_0_all            NA
## OTB_DEF_>=120_0_0_all           NaN
## OTB_DEF_100-119_0_0_all          NA
## OTB_DEF_70-99_0_0_all           NaN
## OTM_DEF_100-119_0_0_all          NA
## OTT_CRU_100-119_0_0              NA
## OTT_CRU_70-99_0_0_all            NA
## OTT_DEF_100-119_0_0              NA
## SSC_DEF_100-119_0_0_all          NA
## TBB_DEF_70-99_0_0_all            NA
```

```
Dage_FC #note: proportions shown prior to discard raising
```

```
##                            Belgium France Ireland UK (England) UK(Scotland)
## DRB_MOL_0_0_0_all               NA     NA     NaN           NA           NA
## GNS_DEF_120-219_0_0_all         NA     NA     NaN           NA           NA
## GNS_DEF_all_0_0_all             NA     NA      NA          NaN           NA
## GTR_DEF_90-99_0_0_all           NA    NaN      NA           NA           NA
## GTR_DEF_all_0_0_all             NA     NA      NA          NaN           NA
## LLS_FIF_0_0_0_all               NA     NA      NA          NaN           NA
## MIS_MIS_0_0_0_HC                NA    NaN      NA          NaN          NaN
## OTB_CRU_100-119_0_0_all         NA    NaN     NaN           NA           NA
## OTB_CRU_16-31_0_0_all           NA     NA      NA          NaN           NA
## OTB_CRU_70-99_0_0_all          NaN     NA     NaN           NA           NA
## OTB_DEF_>=120_0_0_all           NA     NA      NA          NaN          NaN
## OTB_DEF_100-119_0_0_all         NA    NaN     NaN           NA           NA
## OTB_DEF_70-99_0_0_all           NA    NaN     NaN          NaN          NaN
## OTM_DEF_100-119_0_0_all         NA    NaN      NA           NA           NA
## OTT_CRU_100-119_0_0             NA    NaN      NA           NA           NA
## OTT_CRU_70-99_0_0_all           NA    NaN      NA           NA           NA
## OTT_DEF_100-119_0_0             NA    NaN      NA           NA           NA
## SSC_DEF_100-119_0_0_all         NA     NA     NaN           NA           NA
## TBB_DEF_70-99_0_0_all            1     NA     NaN            1           NA
```

Section C: Discard ratio coverage (Lwt !Dwt / sum(Lwt))

1. Total proportion of the landings for which discard weights are available

```
Ldis_A_tot
```

```
## [1] 0.6482455
```

2. Proportion of landings for which discard weights are available by area and season

```
Ldis_AS
```

```
##         1 2         3 4 2006
## 27.7.f 0 0 0.0000000 0   NA
## 27.7.g 0 0 0.2726614 0    1
```

3. Proportion of landings for which discard weights are available in each métier-country stratum

```
Ldis_FC

##                           Belgium France Ireland UK (England) UK(Scotland)
## DRB_MOL_0_0_0_all              NA     NA       0           NA           NA
## GNS_DEF_120-219_0_0_all        NA     NA       0           NA           NA
## GNS_DEF_all_0_0_all            NA     NA      NA   0.00544514           NA
## GTR_DEF_90-99_0_0_all          NA      0      NA           NA           NA
## GTR_DEF_all_0_0_all            NA     NA      NA   0.00000000           NA
## LLS_FIF_0_0_0_all              NA     NA      NA   0.00000000           NA
## MIS_MIS_0_0_0_HC               NA      0      NA   0.00000000          NaN
## OTB_CRU_100-119_0_0_all        NA      0       0           NA           NA
## OTB_CRU_16-31_0_0_all          NA     NA      NA   0.00000000           NA
## OTB_CRU_70-99_0_0_all           0     NA       0           NA           NA
## OTB_DEF_>=120_0_0_all          NA     NA      NA   0.00000000          NaN
## OTB_DEF_100-119_0_0_all        NA      0       0           NA           NA
## OTB_DEF_70-99_0_0_all          NA      0       0   0.00000000          NaN
## OTM_DEF_100-119_0_0_all        NA      0      NA           NA           NA
## OTT_CRU_100-119_0_0            NA      0      NA           NA           NA
## OTT_CRU_70-99_0_0_all          NA      0      NA           NA           NA
## OTT_DEF_100-119_0_0            NA      0      NA           NA           NA
## SSC_DEF_100-119_0_0_all        NA     NA       0           NA           NA
## TBB_DEF_70-99_0_0_all           1     NA       0   0.06804961           NA
```

Section D: Landings age coverage ranked by landed weights

This section shows the proportion of landings covered for age composition, in total (Lage_tot), by métier and for the larger gear groups (Lage_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable age coverage for landings. Additionally, the proportion of landings for which discard age coverage is available is presented for the larger gear groups (Dage_gear).

```
Lage_tot<-sum(Lage_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Lage_AS = Lwt !Lagesamp / sum(Lwt); L_AS = Lwt / sum(Lwt))
Lage_tot

## [1] 0.8561035

format(Lage_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Lage_AS

##                       Fleet Total rank_Total
## 19    TBB_DEF_70-99_0_0_all   1.0  0.8295519
## 13    OTB_DEF_70-99_0_0_all   0.8  0.0510592
## 10    OTB_CRU_70-99_0_0_all   0.0  0.0464416
## 15      OTT_CRU_100-119_0_0   0.0  0.0205333
## 17      OTT_DEF_100-119_0_0   0.0  0.0169531
## 12  OTB_DEF_100-119_0_0_all   0.0  0.0128232
## 8   OTB_CRU_100-119_0_0_all   0.3  0.0114235
## 3       GNS_DEF_all_0_0_all   0.9  0.0034722
## 9     OTB_CRU_16-31_0_0_all   0.0  0.0019823
## 4     GTR_DEF_90-99_0_0_all   0.0  0.0016789
## 7          MIS_MIS_0_0_0_HC   0.0  0.0012020
## 16    OTT_CRU_70-99_0_0_all   0.0  0.0011188
```

```
## 2  GNS_DEF_120-219_0_0_all   0.0  0.0008139
## 18 SSC_DEF_100-119_0_0_all   0.0  0.0007723
## 11   OTB_DEF_>=120_0_0_all   0.0  0.0001087
## 1         DRB_MOL_0_0_0_all   0.0  0.0000444
## 14 OTM_DEF_100-119_0_0_all   0.0  0.0000188
## 6         LLS_FIF_0_0_0_all   0.0  0.0000009
## 5      GTR_DEF_all_0_0_all   0.0  0.0000009

Lage_gear

##       GTR       OTB      REST       TBB
## 0.5008715 0.2699305 0.0000000 0.9752956

Dage_gear

##       GTR       OTB      REST       TBB
## 0.0000000 0.0000000 0.0000000 0.7814178
```

Section E: Discard ratio coverage ranked by landed weight

This section shows the proportion of landings for which discard weights are available, in total (Ldis_tot), by métier and for the larger gear groups (Ldis_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable discard ratio coverage.

```
Ldis_tot<-sum(Ldis_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Ldis_AS = Lwt !Dwt / sum(Lwt); L_AS = Lwt / sum(Lwt)
Ldis_tot

## [1] 0.6482455

format(Ldis_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Ldis_AS

##                        Fleet Total rank_Total
## 19   TBB_DEF_70-99_0_0_all 0.781  0.8295519
## 13   OTB_DEF_70-99_0_0_all 0.000  0.0510592
## 10   OTB_CRU_70-99_0_0_all 0.000  0.0464416
## 15     OTT_CRU_100-119_0_0 0.000  0.0205333
## 17     OTT_DEF_100-119_0_0 0.000  0.0169531
## 12 OTB_DEF_100-119_0_0_all 0.000  0.0128232
## 8  OTB_CRU_100-119_0_0_all 0.000  0.0114235
## 3      GNS_DEF_all_0_0_all 0.005  0.0034722
## 9    OTB_CRU_16-31_0_0_all 0.000  0.0019823
## 4    GTR_DEF_90-99_0_0_all 0.000  0.0016789
## 7          MIS_MIS_0_0_0_HC 0.000  0.0012020
## 16   OTT_CRU_70-99_0_0_all 0.000  0.0011188
## 2  GNS_DEF_120-219_0_0_all 0.000  0.0008139
## 18 SSC_DEF_100-119_0_0_all 0.000  0.0007723
## 11   OTB_DEF_>=120_0_0_all 0.000  0.0001087
## 1        DRB_MOL_0_0_0_all 0.000  0.0000444
## 14 OTM_DEF_100-119_0_0_all 0.000  0.0000188
## 6        LLS_FIF_0_0_0_all 0.000  0.0000009
## 5      GTR_DEF_all_0_0_all 0.000  0.0000009
```

```
Ldis_gear

##        GTR        OTB       REST        TBB
## 0.00316907 0.00000000 0.00000000 0.78141776
```

InterCatch input for 2007

```
##                 1         2         3         4 2007
## 27.7.f 0.7685160 0.8553705 0.6182701 0.7695291    1
## 27.7.g 0.1142758 0.1758311 0.2588813 0.2113683   NA
```

This appendix lists 5 sections of tables (A-E) for each InterCatch year. It provides a detailed summary of the InterCatch input data in terms of importance by landed weight and the proportional coverage for age data and discard ratios.

Section A: Importance by landed weight (Lwt / sum(Lwt))

1. Proportion of landings by area and season

```
L_AS*100

##                 1        2        3        4    2007
## 27.7.f 12.997437 9.271901 2.457052 1.262802 61.6968
## 27.7.g  2.810977 4.769527 2.224890 2.508619  0.0000
```

2. Proportion of landings by métier and country

```
format(data.frame(L_FC*100),scientific=3,digit=1)

##                         Belgium France Ireland UK..England. UK.Scotland.
## GNS_DEF_120-219_0_0_all      NA     NA   0.008           NA           NA
## GNS_DEF_all_0_0_all          NA     NA      NA       0.4022           NA
## GTR_DEF_90-99_0_0_all        NA   0.29      NA           NA           NA
## GTR_DEF_all_0_0_all          NA     NA      NA       0.0007           NA
## LLS_FIF_0_0_0_all            NA     NA      NA       0.0000           NA
## MIS_MIS_0_0_0_HC             NA   0.25      NA       0.0118            0
## OTB_CRU_100-119_0_0_all      NA   0.47   0.052           NA           NA
## OTB_CRU_16-31_0_0_all        NA     NA      NA       0.0404           NA
## OTB_CRU_70-99_0_0_all         4   0.01   0.871       0.0029           NA
## OTB_DEF_>=120_0_0_all        NA     NA      NA       0.0376            0
## OTB_DEF_100-119_0_0_all      NA   2.58   0.177           NA           NA
## OTB_DEF_70-99_0_0_all        NA   1.29   0.713       2.4841            0
## OTT_CRU_100-119_0_0          NA   1.47      NA           NA           NA
## OTT_CRU_70-99_0_0_all        NA   0.09      NA           NA           NA
## OTT_DEF_100-119_0_0          NA   1.18      NA           NA           NA
## SSC_DEF_100-119_0_0_all      NA     NA   0.032           NA           NA
## TBB_DEF_70-99_0_0_all        62     NA   1.202      20.2956           NA
```

3. Proportion of landings by country

```
apply(L_FC*100,2,function(x) sum(x,na.rm=T))

##      Belgium       France      Ireland UK (England) UK(Scotland)
##    66.045051     7.624454     3.055266    23.275230     0.000000
```

4. Proportion of landings by fleet and area

```
format(data.frame(L_FA*100),scientific=4,digit=1)

##                         X27.7.f X27.7.g
## GNS_DEF_120-219_0_0_all      NA  0.0080
```

```
## GNS_DEF_all_0_0_all       0.3768  0.0254
## GTR_DEF_90-99_0_0_all         NA  0.2873
## GTR_DEF_all_0_0_all       0.0005  0.0002
## LLS_FIF_0_0_0_all             NA  0.0000
## MIS_MIS_0_0_0_HC          0.0356  0.2292
## OTB_CRU_100-119_0_0_all   0.0033  0.5173
## OTB_CRU_16-31_0_0_all     0.0395  0.0010
## OTB_CRU_70-99_0_0_all     1.8499  3.3832
## OTB_DEF_>=120_0_0_all     0.0376  0.0000
## OTB_DEF_100-119_0_0_all   1.8188  0.9427
## OTB_DEF_70-99_0_0_all     3.6535  0.8347
## OTT_CRU_100-119_0_0       0.0122  1.4537
## OTT_CRU_70-99_0_0_all     0.0003  0.0874
## OTT_DEF_100-119_0_0       0.0623  1.1132
## SSC_DEF_100-119_0_0_all       NA  0.0324
## TBB_DEF_70-99_0_0_all    79.7958  3.3986
```

5. Proportion of landings by métier, ranked from largest to smallest, together with cumulative sum

```
L_F1<-L_F
L_F1$rank_Total<-L_F1$rank_Total*100
L_F1<-L_F1[rev(order(L_F1$rank_Total)),]
L_F1$cum<-cumsum(L_F1$rank_Total)
format(L_F1,scientific=4,digit=1)

##                          rank_Total                   Fleet cum
## TBB_DEF_70-99_0_0_all       83.1943   TBB_DEF_70-99_0_0_all  83
## OTB_CRU_70-99_0_0_all        5.2331   OTB_CRU_70-99_0_0_all  88
## OTB_DEF_70-99_0_0_all        4.4882   OTB_DEF_70-99_0_0_all  93
## OTB_DEF_100-119_0_0_all      2.7615 OTB_DEF_100-119_0_0_all  96
## OTT_CRU_100-119_0_0          1.4659     OTT_CRU_100-119_0_0  97
## OTT_DEF_100-119_0_0          1.1755     OTT_DEF_100-119_0_0  98
## OTB_CRU_100-119_0_0_all      0.5206 OTB_CRU_100-119_0_0_all  99
## GNS_DEF_all_0_0_all          0.4022     GNS_DEF_all_0_0_all  99
## GTR_DEF_90-99_0_0_all        0.2873   GTR_DEF_90-99_0_0_all 100
## MIS_MIS_0_0_0_HC             0.2648        MIS_MIS_0_0_0_HC 100
## OTT_CRU_70-99_0_0_all        0.0876   OTT_CRU_70-99_0_0_all 100
## OTB_CRU_16-31_0_0_all        0.0404   OTB_CRU_16-31_0_0_all 100
## OTB_DEF_>=120_0_0_all        0.0376   OTB_DEF_>=120_0_0_all 100
## SSC_DEF_100-119_0_0_all      0.0324 SSC_DEF_100-119_0_0_all 100
## GNS_DEF_120-219_0_0_all      0.0080 GNS_DEF_120-219_0_0_all 100
## GTR_DEF_all_0_0_all          0.0007     GTR_DEF_all_0_0_all 100
## LLS_FIF_0_0_0_all            0.0000       LLS_FIF_0_0_0_all 100
```

Section B: Age coverage

1. Total proportion of the landings/sampled discards that is covered for age composition

```
Lage_A_tot #(Lwt !Lagesamp / sum(Lwt))

## [1] 0.8437341

Dage_A_tot #(Dwt !Dagesamp / sum(Dwt))

## [1] 1
```

2. Proportion of landings/sampled discards by area and season that is covered for age composition

```
Lage_AS

##                  1         2         3         4 2007
## 27.7.f 0.7685160 0.8553705 0.6182701 0.7695291    1
## 27.7.g 0.1142758 0.1758311 0.2588813 0.2113683   NA

Dage_AS

##        2007
## 27.7.f    1
## 27.7.g   NA
```

3. Proportion of landings/sampled discards in each métier-country stratum that is covered for age composition

```
Lage_FC

##                          Belgium France Ireland UK (England) UK(Scotland)
## GNS_DEF_120-219_0_0_all       NA     NA       0           NA           NA
## GNS_DEF_all_0_0_all           NA     NA      NA     0.000000           NA
## GTR_DEF_90-99_0_0_all         NA      0      NA           NA           NA
## GTR_DEF_all_0_0_all           NA     NA      NA     0.000000           NA
## LLS_FIF_0_0_0_all             NA     NA      NA          NaN           NA
## MIS_MIS_0_0_0_HC              NA      0      NA     0.000000          NaN
## OTB_CRU_100-119_0_0_all       NA      0       0           NA           NA
## OTB_CRU_16-31_0_0_all         NA     NA      NA     0.000000           NA
## OTB_CRU_70-99_0_0_all          0      0       0     0.000000           NA
## OTB_DEF_>=120_0_0_all         NA     NA      NA     0.000000          NaN
## OTB_DEF_100-119_0_0_all       NA      0       0           NA           NA
## OTB_DEF_70-99_0_0_all         NA      0       0     0.958504          NaN
## OTT_CRU_100-119_0_0           NA      0      NA           NA           NA
## OTT_CRU_70-99_0_0_all         NA      0      NA           NA           NA
## OTT_DEF_100-119_0_0           NA      0      NA           NA           NA
## SSC_DEF_100-119_0_0_all       NA     NA       0           NA           NA
## TBB_DEF_70-99_0_0_all          1     NA       0     1.000000           NA

Dage_FC #note: proportions shown prior to discard raising

##                          Belgium France Ireland UK (England) UK(Scotland)
## GNS_DEF_120-219_0_0_all       NA     NA     NaN           NA           NA
## GNS_DEF_all_0_0_all           NA     NA      NA          NaN           NA
## GTR_DEF_90-99_0_0_all         NA    NaN      NA           NA           NA
## GTR_DEF_all_0_0_all           NA     NA      NA          NaN           NA
## LLS_FIF_0_0_0_all             NA     NA      NA          NaN           NA
## MIS_MIS_0_0_0_HC              NA    NaN      NA          NaN          NaN
## OTB_CRU_100-119_0_0_all       NA    NaN     NaN           NA           NA
## OTB_CRU_16-31_0_0_all         NA     NA      NA          NaN           NA
## OTB_CRU_70-99_0_0_all        NaN    NaN     NaN          NaN           NA
## OTB_DEF_>=120_0_0_all         NA     NA      NA          NaN          NaN
## OTB_DEF_100-119_0_0_all       NA    NaN     NaN           NA           NA
## OTB_DEF_70-99_0_0_all         NA    NaN     NaN          NaN          NaN
## OTT_CRU_100-119_0_0           NA    NaN      NA           NA           NA
## OTT_CRU_70-99_0_0_all         NA    NaN      NA           NA           NA
## OTT_DEF_100-119_0_0           NA    NaN      NA           NA           NA
```

```
## SSC_DEF_100-119_0_0_all      NA      NA     NaN         NA          NA
## TBB_DEF_70-99_0_0_all         1      NA     NaN        NaN          NA
```

Section C: Discard ratio coverage (Lwt !Dwt / sum(Lwt))

1. Total proportion of the landings for which discard weights are available

```
Ldis_A_tot

## [1] 0.616968
```

2. Proportion of landings for which discard weights are available by area and season

```
Ldis_AS

##          1 2 3 4 2007
## 27.7.f 0 0 0 0    1
## 27.7.g 0 0 0 0  NaN
```

3. Proportion of landings for which discard weights are available in each métier-country stratum

```
Ldis_FC

##                          Belgium France Ireland UK (England) UK(Scotland)
## GNS_DEF_120-219_0_0_all      NA     NA       0           NA           NA
## GNS_DEF_all_0_0_all          NA     NA      NA            0           NA
## GTR_DEF_90-99_0_0_all        NA      0      NA           NA           NA
## GTR_DEF_all_0_0_all          NA     NA      NA            0           NA
## LLS_FIF_0_0_0_all            NA     NA      NA          NaN           NA
## MIS_MIS_0_0_0_HC             NA      0      NA            0          NaN
## OTB_CRU_100-119_0_0_all      NA      0       0           NA           NA
## OTB_CRU_16-31_0_0_all        NA     NA      NA            0           NA
## OTB_CRU_70-99_0_0_all         0      0       0            0           NA
## OTB_DEF_>=120_0_0_all        NA     NA      NA            0          NaN
## OTB_DEF_100-119_0_0_all      NA      0       0           NA           NA
## OTB_DEF_70-99_0_0_all        NA      0       0            0          NaN
## OTT_CRU_100-119_0_0          NA      0      NA           NA           NA
## OTT_CRU_70-99_0_0_all        NA      0      NA           NA           NA
## OTT_DEF_100-119_0_0          NA      0      NA           NA           NA
## SSC_DEF_100-119_0_0_all      NA     NA       0           NA           NA
## TBB_DEF_70-99_0_0_all         1     NA       0            0           NA
```

Section D: Landings age coverage ranked by landed weights

This section shows the proportion of landings covered for age composition, in total (Lage_tot), by métier and for the larger gear groups (Lage_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable age coverage for landings. Additionally, the proportion of landings for which discard age coverage is available is presented for the larger gear groups (Dage_gear).

```
Lage_tot<-sum(Lage_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Lage_AS = Lwt !Lagesamp / sum(Lwt); L_AS = Lwt / sum(Lwt))
Lage_tot

## [1] 0.8437341
```

```
format(Lage_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Lage_AS

##                         Fleet Total rank_Total
## 17   TBB_DEF_70-99_0_0_all   1.0   0.831943
## 9    OTB_CRU_70-99_0_0_all   0.0   0.052331
## 12   OTB_DEF_70-99_0_0_all   0.5   0.044882
## 11 OTB_DEF_100-119_0_0_all   0.0   0.027615
## 13     OTT_CRU_100-119_0_0   0.0   0.014659
## 15     OTT_DEF_100-119_0_0   0.0   0.011755
## 7  OTB_CRU_100-119_0_0_all   0.0   0.005206
## 2      GNS_DEF_all_0_0_all   0.0   0.004022
## 3    GTR_DEF_90-99_0_0_all   0.0   0.002873
## 6          MIS_MIS_0_0_0_HC   0.0   0.002648
## 14   OTT_CRU_70-99_0_0_all   0.0   0.000876
## 8    OTB_CRU_16-31_0_0_all   0.0   0.000404
## 10   OTB_DEF_>=120_0_0_all   0.0   0.000376
## 16 SSC_DEF_100-119_0_0_all   0.0   0.000324
## 1  GNS_DEF_120-219_0_0_all   0.0   0.000080
## 4      GTR_DEF_all_0_0_all   0.0   0.000007
## 5        LLS_FIF_0_0_0_all   NaN   0.000000

Lage_gear

##       GTR       OTB      REST       TBB
## 0.0000000 0.1502930 0.0000000 0.9855521

Dage_gear

##       GTR       OTB      REST       TBB
## 0.0000000 0.0000000 0.0000000 0.7415984
```

Section E: Discard ratio coverage ranked by landed weight

This section shows the proportion of landings for which discard weights are available, in total (Ldis_tot), by métier and for the larger gear groups (Ldis_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable discard ratio coverage.

```
Ldis_tot<-sum(Ldis_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Ldis_AS = Lwt !Dwt / sum(Lwt); L_AS = Lwt / sum(Lwt)
Ldis_tot

## [1] 0.616968

format(Ldis_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Ldis_AS

##                         Fleet Total rank_Total
## 17   TBB_DEF_70-99_0_0_all   0.7   0.831943
## 9    OTB_CRU_70-99_0_0_all   0.0   0.052331
## 12   OTB_DEF_70-99_0_0_all   0.0   0.044882
## 11 OTB_DEF_100-119_0_0_all   0.0   0.027615
## 13     OTT_CRU_100-119_0_0   0.0   0.014659
## 15     OTT_DEF_100-119_0_0   0.0   0.011755
## 7  OTB_CRU_100-119_0_0_all   0.0   0.005206
## 2      GNS_DEF_all_0_0_all   0.0   0.004022
```

```
## 3    GTR_DEF_90-99_0_0_all   0.0   0.002873
## 6         MIS_MIS_0_0_0_HC   0.0   0.002648
## 14   OTT_CRU_70-99_0_0_all   0.0   0.000876
## 8    OTB_CRU_16-31_0_0_all   0.0   0.000404
## 10   OTB_DEF_>=120_0_0_all   0.0   0.000376
## 16 SSC_DEF_100-119_0_0_all   0.0   0.000324
## 1  GNS_DEF_120-219_0_0_all   0.0   0.000080
## 4      GTR_DEF_all_0_0_all   0.0   0.000007
## 5        LLS_FIF_0_0_0_all   NaN   0.000000
```

```
Ldis_gear
```

```
##       GTR       OTB      REST       TBB
## 0.0000000 0.0000000 0.0000000 0.7415984
```

InterCatch input for 2008

```
##                  1         2         3          4 2008
## 27.7.f 0.91583648 0.9130772 0.6639525 0.77946844    1
## 27.7.g 0.01644008 0.0000000 0.2492997 0.04889066   NA
```

This appendix lists 5 sections of tables (A-E) for each InterCatch year. It provides a detailed summary of the InterCatch input data in terms of importance by landed weight and the proportional coverage for age data and discard ratios.

Section A: Importance by landed weight (Lwt / sum(Lwt))

1. Proportion of landings by area and season

```
L_AS*100

##                 1         2        3        4     2008
## 27.7.f 14.205459 10.439402 2.731452 1.047238 52.14329
## 27.7.g  5.542593  4.612355 5.625754 3.652460  0.00000
```

2. Proportion of landings by métier and country

```
format(data.frame(L_FC*100),scientific=3,digit=1)

##                         Belgium France Ireland UK..England. UK.Scotland.
## GNS_DEF_120-219_0_0_all      NA     NA    0.02           NA           NA
## GNS_DEF_all_0_0_all          NA     NA      NA        0.191           NA
## GTR_DEF_90-99_0_0_all        NA   3.38      NA           NA           NA
## GTR_DEF_all_0_0_all          NA     NA      NA        0.002           NA
## LLS_FIF_0_0_0_all            NA     NA      NA        0.000           NA
## MIS_MIS_0_0_0_HC             NA   0.06      NA        0.016            0
## OTB_CRU_100-119_0_0_all      NA   0.69    0.12           NA           NA
## OTB_CRU_16-31_0_0_all        NA     NA      NA        0.002           NA
## OTB_CRU_70-99_0_0_all         6     NA    1.16        0.037           NA
## OTB_DEF_>=120_0_0_all        NA     NA      NA        0.129            0
## OTB_DEF_100-119_0_0_all      NA   2.37    0.22           NA           NA
## OTB_DEF_70-99_0_0_all        NA   0.45    0.49        3.076            0
## OTT_CRU_100-119_0_0          NA   1.81      NA           NA           NA
## OTT_CRU_70-99_0_0_all        NA   0.02      NA           NA           NA
## OTT_DEF_100-119_0_0          NA   1.61      NA           NA           NA
## SSC_DEF_100-119_0_0_all      NA     NA    0.03           NA           NA
## TBB_CRU_16-31_0_0_all        NA     NA      NA        0.050           NA
## TBB_DEF_70-99_0_0_all        52     NA    1.53       24.090           NA
```

3. Proportion of landings by country

```
apply(L_FC*100,2,function(x) sum(x,na.rm=T))

##      Belgium       France      Ireland UK (England) UK(Scotland)
##    58.461365    10.374739     3.570411    27.593485     0.000000
```

4. Proportion of landings by fleet and area

```
format(data.frame(L_FA*100),scientific=4,digit=1)
```

```
##                           X27.7.f X27.7.g
## GNS_DEF_120-219_0_0_all        NA   0.018
## GNS_DEF_all_0_0_all       0.18098   0.011
## GTR_DEF_90-99_0_0_all          NA   3.380
## GTR_DEF_all_0_0_all       0.00177      NA
## LLS_FIF_0_0_0_all         0.00000      NA
## MIS_MIS_0_0_0_HC          0.02036   0.051
## OTB_CRU_100-119_0_0_all   0.00960   0.799
## OTB_CRU_16-31_0_0_all          NA   0.002
## OTB_CRU_70-99_0_0_all     0.69188   6.828
## OTB_DEF_>=120_0_0_all     0.12921   0.000
## OTB_DEF_100-119_0_0_all   1.60150   0.980
## OTB_DEF_70-99_0_0_all     3.42195   0.591
## OTT_CRU_100-119_0_0       0.01099   1.798
## OTT_CRU_70-99_0_0_all     0.00006   0.017
## OTT_DEF_100-119_0_0       0.06092   1.553
## SSC_DEF_100-119_0_0_all        NA   0.029
## TBB_CRU_16-31_0_0_all          NA   0.050
## TBB_DEF_70-99_0_0_all    74.43760   3.326
```

5. Proportion of landings by métier, ranked from largest to smallest, together with cumulative sum

```
L_F1<-L_F
L_F1$rank_Total<-L_F1$rank_Total*100
L_F1<-L_F1[rev(order(L_F1$rank_Total)),]
L_F1$cum<-cumsum(L_F1$rank_Total)
format(L_F1,scientific=4,digit=1)
```

```
##                         rank_Total                   Fleet cum
## TBB_DEF_70-99_0_0_all       77.764   TBB_DEF_70-99_0_0_all  78
## OTB_CRU_70-99_0_0_all        7.520   OTB_CRU_70-99_0_0_all  85
## OTB_DEF_70-99_0_0_all        4.013   OTB_DEF_70-99_0_0_all  89
## GTR_DEF_90-99_0_0_all        3.380   GTR_DEF_90-99_0_0_all  93
## OTB_DEF_100-119_0_0_all      2.582 OTB_DEF_100-119_0_0_all  95
## OTT_CRU_100-119_0_0          1.809     OTT_CRU_100-119_0_0  97
## OTT_DEF_100-119_0_0          1.614     OTT_DEF_100-119_0_0  99
## OTB_CRU_100-119_0_0_all      0.809 OTB_CRU_100-119_0_0_all  99
## GNS_DEF_all_0_0_all          0.191     GNS_DEF_all_0_0_all 100
## OTB_DEF_>=120_0_0_all        0.129   OTB_DEF_>=120_0_0_all 100
## MIS_MIS_0_0_0_HC             0.071        MIS_MIS_0_0_0_HC 100
## TBB_CRU_16-31_0_0_all        0.050   TBB_CRU_16-31_0_0_all 100
## SSC_DEF_100-119_0_0_all      0.029 SSC_DEF_100-119_0_0_all 100
## GNS_DEF_120-219_0_0_all      0.018 GNS_DEF_120-219_0_0_all 100
## OTT_CRU_70-99_0_0_all        0.017   OTT_CRU_70-99_0_0_all 100
## GTR_DEF_all_0_0_all          0.002     GTR_DEF_all_0_0_all 100
## OTB_CRU_16-31_0_0_all        0.002   OTB_CRU_16-31_0_0_all 100
## LLS_FIF_0_0_0_all            0.000       LLS_FIF_0_0_0_all 100
```

Section B: Age coverage

1. Total proportion of the landings/sampled discards that is covered for age composition

```
Lage_A_tot #(Lwt !Lagesamp / sum(Lwt))

## [1] 0.7898718

Dage_A_tot #(Dwt !Dagesamp / sum(Dwt))

## [1] 1
```

2. Proportion of landings/sampled discards by area and season that is covered for age composition

```
Lage_AS

##                   1         2         3          4  2008
## 27.7.f 0.91583648 0.9130772 0.6639525 0.77946844     1
## 27.7.g 0.01644008 0.0000000 0.2492997 0.04889066    NA

Dage_AS

##          1   3   4  2008
## 27.7.f NaN NaN NaN     1
## 27.7.g  NA  NA NaN    NA
```

3. Proportion of landings/sampled discards in each métier-country stratum that is covered for age composition

```
Lage_FC

##                           Belgium France Ireland UK (England) UK(Scotland)
## GNS_DEF_120-219_0_0_all        NA     NA       0           NA           NA
## GNS_DEF_all_0_0_all            NA     NA      NA    0.0000000           NA
## GTR_DEF_90-99_0_0_all          NA      0      NA           NA           NA
## GTR_DEF_all_0_0_all            NA     NA      NA    0.0000000           NA
## LLS_FIF_0_0_0_all              NA     NA      NA          NaN           NA
## MIS_MIS_0_0_0_HC               NA      0      NA    0.0000000          NaN
## OTB_CRU_100-119_0_0_all        NA      0       0           NA           NA
## OTB_CRU_16-31_0_0_all          NA     NA      NA    0.0000000           NA
## OTB_CRU_70-99_0_0_all           0     NA       0    0.0000000           NA
## OTB_DEF_>=120_0_0_all          NA     NA      NA    0.0000000          NaN
## OTB_DEF_100-119_0_0_all        NA      0       0           NA           NA
## OTB_DEF_70-99_0_0_all          NA      0       0    0.9852288          NaN
## OTT_CRU_100-119_0_0            NA      0      NA           NA           NA
## OTT_CRU_70-99_0_0_all          NA      0      NA           NA           NA
## OTT_DEF_100-119_0_0            NA      0      NA           NA           NA
## SSC_DEF_100-119_0_0_all        NA     NA       0           NA           NA
## TBB_CRU_16-31_0_0_all          NA     NA      NA    0.0000000           NA
## TBB_DEF_70-99_0_0_all           1     NA       0    0.9885108           NA

Dage_FC #note: proportions shown prior to discard raising

##                           Belgium France Ireland UK (England) UK(Scotland)
## GNS_DEF_120-219_0_0_all        NA     NA     NaN           NA           NA
## GNS_DEF_all_0_0_all            NA     NA      NA          NaN           NA
## GTR_DEF_90-99_0_0_all          NA    NaN      NA           NA           NA
```

```
## GTR_DEF_all_0_0_all          NA      NA       NA           NaN           NA
## LLS_FIF_0_0_0_all            NA      NA       NA           NaN           NA
## MIS_MIS_0_0_0_HC             NA     NaN       NA           NaN          NaN
## OTB_CRU_100-119_0_0_all      NA     NaN      NaN            NA           NA
## OTB_CRU_16-31_0_0_all        NA      NA       NA           NaN           NA
## OTB_CRU_70-99_0_0_all       NaN      NA      NaN           NaN           NA
## OTB_DEF_>=120_0_0_all        NA      NA       NA           NaN          NaN
## OTB_DEF_100-119_0_0_all      NA     NaN      NaN            NA           NA
## OTB_DEF_70-99_0_0_all        NA     NaN      NaN           NaN          NaN
## OTT_CRU_100-119_0_0          NA     NaN       NA            NA           NA
## OTT_CRU_70-99_0_0_all        NA     NaN       NA            NA           NA
## OTT_DEF_100-119_0_0          NA     NaN       NA            NA           NA
## SSC_DEF_100-119_0_0_all      NA      NA      NaN            NA           NA
## TBB_CRU_16-31_0_0_all        NA      NA       NA           NaN           NA
## TBB_DEF_70-99_0_0_all         1      NA      NaN           NaN           NA
```

Section C: Discard ratio coverage (Lwt !Dwt / sum(Lwt))

1. Total proportion of the landings for which discard weights are available

```
Ldis_A_tot

## [1] 0.5435916
```

2. Proportion of landings for which discard weights are available by area and season

```
Ldis_AS

##                  1 2         3          4 2008
## 27.7.f 0.07434562 0 0.2642373 0.37486994    1
## 27.7.g 0.00000000 0 0.0000000 0.01243922  NaN
```

3. Proportion of landings for which discard weights are available in each métier-country stratum

```
Ldis_FC

##                           Belgium France Ireland UK (England) UK(Scotland)
## GNS_DEF_120-219_0_0_all        NA     NA       0           NA           NA
## GNS_DEF_all_0_0_all            NA     NA      NA    0.0000000           NA
## GTR_DEF_90-99_0_0_all          NA      0      NA           NA           NA
## GTR_DEF_all_0_0_all            NA     NA      NA    0.0000000           NA
## LLS_FIF_0_0_0_all              NA     NA      NA          NaN           NA
## MIS_MIS_0_0_0_HC               NA      0      NA    0.0000000          NaN
## OTB_CRU_100-119_0_0_all        NA      0       0           NA           NA
## OTB_CRU_16-31_0_0_all          NA     NA      NA    0.0000000           NA
## OTB_CRU_70-99_0_0_all           0     NA       0    0.0000000           NA
## OTB_DEF_>=120_0_0_all          NA     NA      NA    0.0000000          NaN
## OTB_DEF_100-119_0_0_all        NA      0       0           NA           NA
## OTB_DEF_70-99_0_0_all          NA      0       0    0.7204164          NaN
## OTT_CRU_100-119_0_0            NA      0      NA           NA           NA
## OTT_CRU_70-99_0_0_all          NA      0      NA           NA           NA
## OTT_DEF_100-119_0_0            NA      0      NA           NA           NA
## SSC_DEF_100-119_0_0_all        NA     NA       0           NA           NA
## TBB_CRU_16-31_0_0_all          NA     NA      NA    0.0000000           NA
## TBB_DEF_70-99_0_0_all           1     NA       0    0.0000000           NA
```

Section D: Landings age coverage ranked by landed weights

This section shows the proportion of landings covered for age composition, in total (Lage_tot), by métier and for the larger gear groups (Lage_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable age coverage for landings. Additionally, the proportion of landings for which discard age coverage is available is presented for the larger gear groups (Dage_gear).

```
Lage_tot<-sum(Lage_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Lage_AS = Lwt !Lagesamp / sum(Lwt); L_AS = Lwt / sum(Lwt))
Lage_tot

## [1] 0.7898718

format(Lage_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Lage_AS

##                       Fleet Total rank_Total
## 18   TBB_DEF_70-99_0_0_all   1.0    0.77764
## 9    OTB_CRU_70-99_0_0_all   0.0    0.07520
## 12   OTB_DEF_70-99_0_0_all   0.8    0.04013
## 3    GTR_DEF_90-99_0_0_all   0.0    0.03380
## 11 OTB_DEF_100-119_0_0_all   0.0    0.02582
## 13     OTT_CRU_100-119_0_0   0.0    0.01809
## 15     OTT_DEF_100-119_0_0   0.0    0.01614
## 7  OTB_CRU_100-119_0_0_all   0.0    0.00809
## 2      GNS_DEF_all_0_0_all   0.0    0.00191
## 10   OTB_DEF_>=120_0_0_all   0.0    0.00129
## 6           MIS_MIS_0_0_0_HC   0.0    0.00071
## 17   TBB_CRU_16-31_0_0_all   0.0    0.00050
## 16 SSC_DEF_100-119_0_0_all   0.0    0.00029
## 1  GNS_DEF_120-219_0_0_all   0.0    0.00018
## 14   OTT_CRU_70-99_0_0_all   0.0    0.00017
## 4      GTR_DEF_all_0_0_all   0.0    0.00002
## 8    OTB_CRU_16-31_0_0_all   0.0    0.00002
## 5         LLS_FIF_0_0_0_all   NaN    0.00000

Lage_gear

##       GTR       OTB      REST       TBB
## 0.0000000 0.1635987 0.0000000 0.9761342

Dage_gear

##       GTR       OTB      REST       TBB
## 0.0000000 0.0000000 0.0000000 0.6701027
```

Section E: Discard ratio coverage ranked by landed weight

This section shows the proportion of landings for which discard weights are available, in total (Ldis_tot), by métier and for the larger gear groups (Ldis_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable discard ratio coverage.

```
Ldis_tot<-sum(Ldis_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Ldis_AS = Lwt !Dwt / sum(Lwt); L_AS = Lwt / sum(Lwt)
Ldis_tot

## [1] 0.5435916

format(Ldis_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Ldis_AS

##                      Fleet Total rank_Total
## 18   TBB_DEF_70-99_0_0_all   0.7    0.77764
## 9    OTB_CRU_70-99_0_0_all   0.0    0.07520
## 12   OTB_DEF_70-99_0_0_all   0.6    0.04013
## 3    GTR_DEF_90-99_0_0_all   0.0    0.03380
## 11 OTB_DEF_100-119_0_0_all   0.0    0.02582
## 13     OTT_CRU_100-119_0_0   0.0    0.01809
## 15     OTT_DEF_100-119_0_0   0.0    0.01614
## 7  OTB_CRU_100-119_0_0_all   0.0    0.00809
## 2      GNS_DEF_all_0_0_all   0.0    0.00191
## 10   OTB_DEF_>=120_0_0_all   0.0    0.00129
## 6           MIS_MIS_0_0_0_HC   0.0    0.00071
## 17   TBB_CRU_16-31_0_0_all   0.0    0.00050
## 16 SSC_DEF_100-119_0_0_all   0.0    0.00029
## 1  GNS_DEF_120-219_0_0_all   0.0    0.00018
## 14   OTT_CRU_70-99_0_0_all   0.0    0.00017
## 4      GTR_DEF_all_0_0_all   0.0    0.00002
## 8    OTB_CRU_16-31_0_0_all   0.0    0.00002
## 5        LLS_FIF_0_0_0_all   NaN    0.00000

Ldis_gear

##       GTR       OTB      REST       TBB
## 0.0000000 0.1196262 0.0000000 0.6701027
```

InterCatch input for 2009

```
##                1         2         3         4 2009
## 27.7.f 0.917877 0.8524561 0.4122216 0.5004057    1
## 27.7.g       NA 0.2182745 0.2291982 0.1502671   NA
```

This appendix lists 5 sections of tables (A-E) for each InterCatch year. It provides a detailed summary of the InterCatch input data in terms of importance by landed weight and the proportional coverage for age data and discard ratios.

Section A: Importance by landed weight (Lwt / sum(Lwt))

1. Proportion of landings by area and season

```
L_AS*100
```

```
##                 1        2        3        4         2009
## 27.7.f 16.371873 5.228508 2.154167 2.379167 5.563555e+01
## 27.7.g  2.437934 5.041604 6.442583 4.308354 2.591171e-04
```

2. Proportion of landings by métier and country

```
format(data.frame(L_FC*100),scientific=3,digit=1)
```

```
##                          Belgium France Ireland UK..England. UK.Scotland.
## GNS_DEF_120-219_0_0_all       NA     NA    0.03           NA           NA
## GNS_DEF_all_0_0_all           NA     NA      NA       0.1978           NA
## GTR_DEF_90-99_0_0_all         NA 0.3928      NA           NA           NA
## LLS_FIF_0_0_0_all             NA     NA      NA       0.0004           NA
## MIS_MIS_0_0_0_HC              NA 0.5678      NA       0.0500           NA
## OTB_CRU_100-119_0_0_all       NA 0.3979    0.10       0.0004           NA
## OTB_CRU_16-31_0_0_all         NA     NA      NA       0.0023           NA
## OTB_CRU_70-99_0_0_all         10 0.0003    0.88       0.1031           NA
## OTB_DEF_>=120_0_0_all         NA     NA      NA       0.2019           NA
## OTB_DEF_100-119_0_0_all       NA 1.1362    0.35           NA           NA
## OTB_DEF_70-99_0_0_all         NA 0.3929    0.45       2.0654       0.0003
## OTM_DEF_100-119_0_0_all       NA 0.0416      NA           NA           NA
## OTT_CRU_100-119_0_0           NA 1.8561      NA           NA           NA
## OTT_CRU_70-99_0_0_all         NA 0.0006      NA           NA           NA
## OTT_DEF_100-119_0_0           NA 1.5981      NA           NA           NA
## TBB_DEF_70-99_0_0_all         56     NA    1.56      22.3417           NA
```

3. Proportion of landings by country

```
apply(L_FC*100,2,function(x) sum(x,na.rm=T))
```

```
##      Belgium       France      Ireland UK (England) UK(Scotland)
## 6.528676e+01 6.384360e+00 3.365542e+00 2.496308e+01 2.591171e-04
```

4. Proportion of landings by fleet and area

```
format(data.frame(L_FA*100),scientific=4,digit=1)
```

```
##                         X27.7.f X27.7.g
## GNS_DEF_120-219_0_0_all      NA   0.030
## GNS_DEF_all_0_0_all      0.1895   0.008
```

```
## GTR_DEF_90-99_0_0_all    0.0018   0.391
## LLS_FIF_0_0_0_all        0.0004      NA
## MIS_MIS_0_0_0_HC         0.0554   0.562
## OTB_CRU_100-119_0_0_all  0.0056   0.496
## OTB_CRU_16-31_0_0_all    0.0023   0.000
## OTB_CRU_70-99_0_0_all    2.1772   8.453
## OTB_DEF_>=120_0_0_all    0.1889   0.013
## OTB_DEF_100-119_0_0_all  0.7730   0.711
## OTB_DEF_70-99_0_0_all    2.3263   0.585
## OTM_DEF_100-119_0_0_all  0.0027   0.039
## OTT_CRU_100-119_0_0      0.0126   1.843
## OTT_CRU_70-99_0_0_all    0.0006      NA
## OTT_DEF_100-119_0_0      0.0352   1.563
## TBB_DEF_70-99_0_0_all   75.9976   3.536
```

5. Proportion of landings by métier, ranked from largest to smallest, together with cumulative sum

```
L_F1<-L_F
L_F1$rank_Total<-L_F1$rank_Total*100
L_F1<-L_F1[rev(order(L_F1$rank_Total)),]
L_F1$cum<-cumsum(L_F1$rank_Total)
format(L_F1,scientific=4,digit=1)

##                         rank_Total                   Fleet cum
## TBB_DEF_70-99_0_0_all      79.5339   TBB_DEF_70-99_0_0_all  80
## OTB_CRU_70-99_0_0_all      10.6299   OTB_CRU_70-99_0_0_all  90
## OTB_DEF_70-99_0_0_all       2.9110   OTB_DEF_70-99_0_0_all  93
## OTT_CRU_100-119_0_0         1.8561     OTT_CRU_100-119_0_0  95
## OTT_DEF_100-119_0_0         1.5981     OTT_DEF_100-119_0_0  97
## OTB_DEF_100-119_0_0_all     1.4839 OTB_DEF_100-119_0_0_all  98
## MIS_MIS_0_0_0_HC            0.6178        MIS_MIS_0_0_0_HC  99
## OTB_CRU_100-119_0_0_all     0.5013 OTB_CRU_100-119_0_0_all  99
## GTR_DEF_90-99_0_0_all       0.3928   GTR_DEF_90-99_0_0_all 100
## OTB_DEF_>=120_0_0_all       0.2019   OTB_DEF_>=120_0_0_all 100
## GNS_DEF_all_0_0_all         0.1978     GNS_DEF_all_0_0_all 100
## OTM_DEF_100-119_0_0_all     0.0416 OTM_DEF_100-119_0_0_all 100
## GNS_DEF_120-219_0_0_all     0.0304 GNS_DEF_120-219_0_0_all 100
## OTB_CRU_16-31_0_0_all       0.0023   OTB_CRU_16-31_0_0_all 100
## OTT_CRU_70-99_0_0_all       0.0006   OTT_CRU_70-99_0_0_all 100
## LLS_FIF_0_0_0_all           0.0004       LLS_FIF_0_0_0_all 100
```

Section B: Age coverage

1. Total proportion of the landings/sampled discards that is covered for age composition

```
Lage_A_tot #(Lwt !Lagesamp / sum(Lwt))

## [1] 0.8042302

Dage_A_tot #(Dwt !Dagesamp / sum(Dwt))

## [1] 1
```

2. Proportion of landings/sampled discards by area and season that is covered for age composition

```
Lage_AS

##                 1         2         3         4 2009
## 27.7.f 0.917877 0.8524561 0.4122216 0.5004057    1
## 27.7.g       NA 0.2182745 0.2291982 0.1502671   NA

Dage_AS

##         1 2009
## 27.7.f  1    1
## 27.7.g NA   NA
```

3. Proportion of landings/sampled discards in each métier-country stratum that is covered for age composition

```
Lage_FC

##                          Belgium     France Ireland UK (England)
## GNS_DEF_120-219_0_0_all       NA         NA       0           NA
## GNS_DEF_all_0_0_all           NA         NA      NA    0.2730845
## GTR_DEF_90-99_0_0_all         NA 0.00000000      NA           NA
## LLS_FIF_0_0_0_all             NA         NA      NA    0.0000000
## MIS_MIS_0_0_0_HC              NA 0.00000000      NA    0.0000000
## OTB_CRU_100-119_0_0_all       NA 0.00000000       0    0.0000000
## OTB_CRU_16-31_0_0_all         NA         NA      NA    0.0000000
## OTB_CRU_70-99_0_0_all          0 0.00000000       0    0.0000000
## OTB_DEF_>=120_0_0_all         NA         NA      NA    0.0000000
## OTB_DEF_100-119_0_0_all       NA 0.04108094       0           NA
## OTB_DEF_70-99_0_0_all         NA 0.00000000       0    0.6022456
## OTM_DEF_100-119_0_0_all       NA 0.00000000      NA           NA
## OTT_CRU_100-119_0_0           NA 0.61824026      NA           NA
## OTT_CRU_70-99_0_0_all         NA 0.00000000      NA           NA
## OTT_DEF_100-119_0_0           NA 0.00000000      NA           NA
## TBB_DEF_70-99_0_0_all          1         NA       0    0.9979240
##                          UK(Scotland)
## GNS_DEF_120-219_0_0_all            NA
## GNS_DEF_all_0_0_all                NA
## GTR_DEF_90-99_0_0_all              NA
## LLS_FIF_0_0_0_all                  NA
## MIS_MIS_0_0_0_HC                   NA
## OTB_CRU_100-119_0_0_all            NA
## OTB_CRU_16-31_0_0_all              NA
## OTB_CRU_70-99_0_0_all              NA
## OTB_DEF_>=120_0_0_all              NA
## OTB_DEF_100-119_0_0_all            NA
## OTB_DEF_70-99_0_0_all               0
## OTM_DEF_100-119_0_0_all            NA
## OTT_CRU_100-119_0_0                NA
## OTT_CRU_70-99_0_0_all              NA
## OTT_DEF_100-119_0_0                NA
## TBB_DEF_70-99_0_0_all              NA

Dage_FC #note: proportions shown prior to discard raising

##                          Belgium France Ireland UK (England) UK(Scotland)
## GNS_DEF_120-219_0_0_all       NA     NA     NaN           NA           NA
```

```
## GNS_DEF_all_0_0_all          NA     NA     NA          NaN           NA
## GTR_DEF_90-99_0_0_all        NA    NaN     NA           NA           NA
## LLS_FIF_0_0_0_all            NA     NA     NA          NaN           NA
## MIS_MIS_0_0_0_HC             NA    NaN     NA          NaN           NA
## OTB_CRU_100-119_0_0_all      NA    NaN    NaN          NaN           NA
## OTB_CRU_16-31_0_0_all        NA     NA     NA          NaN           NA
## OTB_CRU_70-99_0_0_all       NaN    NaN    NaN          NaN           NA
## OTB_DEF_>=120_0_0_all        NA     NA     NA          NaN           NA
## OTB_DEF_100-119_0_0_all      NA    NaN    NaN           NA           NA
## OTB_DEF_70-99_0_0_all        NA    NaN    NaN          NaN          NaN
## OTM_DEF_100-119_0_0_all      NA    NaN     NA           NA           NA
## OTT_CRU_100-119_0_0          NA    NaN     NA           NA           NA
## OTT_CRU_70-99_0_0_all        NA    NaN     NA           NA           NA
## OTT_DEF_100-119_0_0          NA    NaN     NA           NA           NA
## TBB_DEF_70-99_0_0_all         1     NA    NaN            1           NA
```

Section C: Discard ratio coverage (Lwt !Dwt / sum(Lwt))

1. Total proportion of the landings for which discard weights are available

```
Ldis_A_tot

## [1] 0.7100495
```

2. Proportion of landings for which discard weights are available by area and season

```
Ldis_AS

##                 1 2 3 4 2009
## 27.7.f 0.9387686 0 0 0    1
## 27.7.g 0.0000000 0 0 0    0
```

3. Proportion of landings for which discard weights are available in each métier-country stratum

```
Ldis_FC

##                         Belgium France Ireland UK (England) UK(Scotland)
## GNS_DEF_120-219_0_0_all      NA     NA       0           NA           NA
## GNS_DEF_all_0_0_all          NA     NA      NA    0.0000000           NA
## GTR_DEF_90-99_0_0_all        NA      0      NA           NA           NA
## LLS_FIF_0_0_0_all            NA     NA      NA    0.0000000           NA
## MIS_MIS_0_0_0_HC             NA      0      NA    0.0000000           NA
## OTB_CRU_100-119_0_0_all      NA      0       0    0.0000000           NA
## OTB_CRU_16-31_0_0_all        NA     NA      NA    0.0000000           NA
## OTB_CRU_70-99_0_0_all         0      0       0    0.0000000           NA
## OTB_DEF_>=120_0_0_all        NA     NA      NA    0.0000000           NA
## OTB_DEF_100-119_0_0_all      NA      0       0           NA           NA
## OTB_DEF_70-99_0_0_all        NA      0       0    0.1917576            0
## OTM_DEF_100-119_0_0_all      NA      0      NA           NA           NA
## OTT_CRU_100-119_0_0          NA      0      NA           NA           NA
## OTT_CRU_70-99_0_0_all        NA      0      NA           NA           NA
## OTT_DEF_100-119_0_0          NA      0      NA           NA           NA
## TBB_DEF_70-99_0_0_all         1     NA       0    0.6701963           NA
```

Section D: Landings age coverage ranked by landed weights

This section shows the proportion of landings covered for age composition, in total (Lage_tot), by métier and for the larger gear groups (Lage_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable age coverage for landings. Additionally, the proportion of landings for which discard age coverage is available is presented for the larger gear groups (Dage_gear).

```
Lage_tot<-sum(Lage_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Lage_AS = Lwt !Lagesamp / sum(Lwt); L_AS = Lwt / sum(Lwt))
Lage_tot

## [1] 0.8042302

format(Lage_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Lage_AS

##                       Fleet Total rank_Total
## 16   TBB_DEF_70-99_0_0_all  0.98   0.795339
## 8    OTB_CRU_70-99_0_0_all  0.00   0.106299
## 11   OTB_DEF_70-99_0_0_all  0.43   0.029110
## 13     OTT_CRU_100-119_0_0  0.62   0.018561
## 15     OTT_DEF_100-119_0_0  0.00   0.015981
## 10 OTB_DEF_100-119_0_0_all  0.03   0.014839
## 5          MIS_MIS_0_0_0_HC  0.00   0.006178
## 6  OTB_CRU_100-119_0_0_all  0.00   0.005013
## 3    GTR_DEF_90-99_0_0_all  0.00   0.003928
## 9    OTB_DEF_>=120_0_0_all  0.00   0.002019
## 2      GNS_DEF_all_0_0_all  0.27   0.001978
## 12 OTM_DEF_100-119_0_0_all  0.00   0.000416
## 1  GNS_DEF_120-219_0_0_all  0.00   0.000304
## 7    OTB_CRU_16-31_0_0_all  0.00   0.000023
## 14   OTT_CRU_70-99_0_0_all  0.00   0.000006
## 4        LLS_FIF_0_0_0_all  0.00   0.000004

Lage_gear

##        GTR        OTB       REST        TBB
## 0.08698736 0.12708237 0.00000000 0.97984473

Dage_gear

##       GTR       OTB      REST       TBB
## 0.0000000 0.0000000 0.0000000 0.8877834
```

Section E: Discard ratio coverage ranked by landed weight

This section shows the proportion of landings for which discard weights are available, in total (Ldis_tot), by métier and for the larger gear groups (Ldis_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable discard ratio coverage.

```
Ldis_tot<-sum(Ldis_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Ldis_AS = Lwt !Dwt / sum(Lwt); L_AS = Lwt / sum(Lwt)
Ldis_tot
```

```
## [1] 0.7100495

format(Ldis_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Ldis_AS

##                       Fleet Total rank_Total
## 16   TBB_DEF_70-99_0_0_all   0.9   0.795339
## 8    OTB_CRU_70-99_0_0_all   0.0   0.106299
## 11   OTB_DEF_70-99_0_0_all   0.1   0.029110
## 13     OTT_CRU_100-119_0_0   0.0   0.018561
## 15     OTT_DEF_100-119_0_0   0.0   0.015981
## 10 OTB_DEF_100-119_0_0_all   0.0   0.014839
## 5           MIS_MIS_0_0_0_HC   0.0   0.006178
## 6  OTB_CRU_100-119_0_0_all   0.0   0.005013
## 3    GTR_DEF_90-99_0_0_all   0.0   0.003928
## 9    OTB_DEF_>=120_0_0_all   0.0   0.002019
## 2      GNS_DEF_all_0_0_all   0.0   0.001978
## 12 OTM_DEF_100-119_0_0_all   0.0   0.000416
## 1  GNS_DEF_120-219_0_0_all   0.0   0.000304
## 7    OTB_CRU_16-31_0_0_all   0.0   0.000023
## 14   OTT_CRU_70-99_0_0_all   0.0   0.000006
## 4        LLS_FIF_0_0_0_all   0.0   0.000004

Ldis_gear

##        GTR        OTB       REST        TBB
## 0.00000000 0.02064407 0.00000000 0.88778336
```

InterCatch input for 2010

```
##                    1          2          3          4 2010
## 27.7.f 0.95370663 0.7832422 0.2601276 0.7709467   NA
## 27.7.g 0.07028417 0.0979584 0.2059895 0.4112295    1
```

This appendix lists 5 sections of tables (A-E) for each InterCatch year. It provides a detailed summary of the InterCatch input data in terms of importance by landed weight and the proportional coverage for age data and discard ratios.

Section A: Importance by landed weight (Lwt / sum(Lwt))

1. Proportion of landings by area and season

```
L_AS*100
```

```
##                  1        2        3        4     2010
## 27.7.f 10.864325 4.500044 2.997915 1.682801       NA
## 27.7.g  2.564759 3.127846 7.115785 4.667701 62.47882
```

2. Proportion of landings by métier and country

```
format(data.frame(L_FC*100),scientific=3,digit=1)
```

```
##                         Belgium France Ireland UK..England. UK.Scotland.
## GNS_DEF_120-219_0_0_all      NA     NA   0.016           NA           NA
## GNS_DEF_all_0_0_all          NA     NA      NA       0.4140           NA
## GTR_DEF_90-99_0_0_all        NA  0.417      NA           NA           NA
## GTR_DEF_all_0_0_all          NA     NA      NA       0.0001           NA
## LLS_FIF_0_0_0_all            NA     NA      NA       0.0000           NA
## MIS_MIS_0_0_0_HC             NA  0.182   0.002       0.0550           NA
## OTB_CRU_100-119_0_0_all      NA  0.147   0.082           NA           NA
## OTB_CRU_16-31_0_0_all        NA     NA      NA       0.0028           NA
## OTB_CRU_70-99_0_0_all         9     NA   1.166       0.0465            0
## OTB_DEF_>=120_0_0_all        NA     NA      NA       0.2133            0
## OTB_DEF_>=120_0_0_all_FDF    NA     NA      NA           NA            0
## OTB_DEF_100-119_0_0_all      NA  0.895   0.378           NA           NA
## OTB_DEF_70-99_0_0_all        NA  0.124   0.476       1.9942           NA
## OTM_DEF_100-119_0_0_all      NA  0.004      NA           NA           NA
## OTT_CRU_100-119_0_0          NA  1.198      NA           NA           NA
## OTT_DEF_100-119_0_0          NA  1.543      NA           NA           NA
## SSC_DEF_100-119_0_0_all      NA     NA   0.009           NA           NA
## TBB_DEF_>=120_0_0_all        NA     NA      NA       0.1407           NA
## TBB_DEF_70-99_0_0_all        62     NA   0.979      17.6829           NA
```

3. Proportion of landings by country

```
apply(L_FC*100,2,function(x) sum(x,na.rm=T))
```

```
##      Belgium       France      Ireland UK (England) UK(Scotland)
##    71.833793     4.508781     3.107825    20.549601     0.000000
```

4. Proportion of landings by fleet and area

```
format(data.frame(L_FA*100),scientific=4,digit=1)
```

```
##                            X27.7.f X27.7.g
## GNS_DEF_120-219_0_0_all         NA  0.0158
## GNS_DEF_all_0_0_all          0.399  0.0147
## GTR_DEF_90-99_0_0_all        0.000  0.4168
## GTR_DEF_all_0_0_all             NA  0.0001
## LLS_FIF_0_0_0_all            0.000      NA
## MIS_MIS_0_0_0_HC             0.073  0.1658
## OTB_CRU_100-119_0_0_all      0.001  0.2275
## OTB_CRU_16-31_0_0_all        0.003      NA
## OTB_CRU_70-99_0_0_all        1.805  8.7629
## OTB_DEF_>=120_0_0_all        0.213  0.0007
## OTB_DEF_>=120_0_0_all_FDF       NA  0.0000
## OTB_DEF_100-119_0_0_all      0.559  0.7140
## OTB_DEF_70-99_0_0_all        2.034  0.5595
## OTM_DEF_100-119_0_0_all      0.003  0.0006
## OTT_CRU_100-119_0_0          0.011  1.1873
## OTT_DEF_100-119_0_0          0.027  1.5157
## SSC_DEF_100-119_0_0_all         NA  0.0091
## TBB_DEF_>=120_0_0_all        0.141      NA
## TBB_DEF_70-99_0_0_all       14.776 66.3644
```

5. Proportion of landings by métier, ranked from largest to smallest, together with cumulative sum

```
L_F1<-L_F
L_F1$rank_Total<-L_F1$rank_Total*100
L_F1<-L_F1[rev(order(L_F1$rank_Total)),]
L_F1$cum<-cumsum(L_F1$rank_Total)
format(L_F1,scientific=4,digit=1)
```

```
##                           rank_Total                     Fleet cum
## TBB_DEF_70-99_0_0_all        81.1408     TBB_DEF_70-99_0_0_all  81
## OTB_CRU_70-99_0_0_all        10.5679     OTB_CRU_70-99_0_0_all  92
## OTB_DEF_70-99_0_0_all         2.5934     OTB_DEF_70-99_0_0_all  94
## OTT_DEF_100-119_0_0           1.5426       OTT_DEF_100-119_0_0  96
## OTB_DEF_100-119_0_0_all       1.2730   OTB_DEF_100-119_0_0_all  97
## OTT_CRU_100-119_0_0           1.1983       OTT_CRU_100-119_0_0  98
## GTR_DEF_90-99_0_0_all         0.4168     GTR_DEF_90-99_0_0_all  99
## GNS_DEF_all_0_0_all           0.4140       GNS_DEF_all_0_0_all  99
## MIS_MIS_0_0_0_HC              0.2393          MIS_MIS_0_0_0_HC  99
## OTB_CRU_100-119_0_0_all       0.2286   OTB_CRU_100-119_0_0_all 100
## OTB_DEF_>=120_0_0_all         0.2133     OTB_DEF_>=120_0_0_all 100
## TBB_DEF_>=120_0_0_all         0.1407     TBB_DEF_>=120_0_0_all 100
## GNS_DEF_120-219_0_0_all       0.0158   GNS_DEF_120-219_0_0_all 100
## SSC_DEF_100-119_0_0_all       0.0091   SSC_DEF_100-119_0_0_all 100
## OTM_DEF_100-119_0_0_all       0.0036   OTM_DEF_100-119_0_0_all 100
## OTB_CRU_16-31_0_0_all         0.0028     OTB_CRU_16-31_0_0_all 100
## GTR_DEF_all_0_0_all           0.0001       GTR_DEF_all_0_0_all 100
## OTB_DEF_>=120_0_0_all_FDF     0.0000 OTB_DEF_>=120_0_0_all_FDF 100
## LLS_FIF_0_0_0_all             0.0000         LLS_FIF_0_0_0_all 100
```

Section B: Age coverage

1. Total proportion of the landings/sampled discards that is covered for age composition

```
Lage_A_tot #(Lwt !Lagesamp / sum(Lwt))

## [1] 0.8231395

Dage_A_tot #(Dwt !Dagesamp / sum(Dwt))

## [1] 1
```

2. Proportion of landings/sampled discards by area and season that is covered for age composition

```
Lage_AS

##                  1         2         3         4 2010
## 27.7.f 0.95370663 0.7832422 0.2601276 0.7709467   NA
## 27.7.g 0.07028417 0.0979584 0.2059895 0.4112295    1

Dage_AS

##         1 2010
## 27.7.f  1   NA
## 27.7.g NA    1
```

3. Proportion of landings/sampled discards in each métier-country stratum that is covered for age composition

```
Lage_FC

##                            Belgium    France Ireland UK (England)
## GNS_DEF_120-219_0_0_all         NA        NA       0           NA
## GNS_DEF_all_0_0_all             NA        NA      NA    0.2265255
## GTR_DEF_90-99_0_0_all           NA 0.0000000      NA           NA
## GTR_DEF_all_0_0_all             NA        NA      NA    0.0000000
## LLS_FIF_0_0_0_all               NA        NA      NA          NaN
## MIS_MIS_0_0_0_HC                NA 0.0000000       0    0.0000000
## OTB_CRU_100-119_0_0_all         NA 0.0000000       0           NA
## OTB_CRU_16-31_0_0_all           NA        NA      NA    0.0000000
## OTB_CRU_70-99_0_0_all            0        NA       0    0.0000000
## OTB_DEF_>=120_0_0_all           NA        NA      NA    0.0000000
## OTB_DEF_>=120_0_0_all_FDF       NA        NA      NA           NA
## OTB_DEF_100-119_0_0_all         NA 0.0000000       0           NA
## OTB_DEF_70-99_0_0_all           NA 0.0000000       0    0.8260543
## OTM_DEF_100-119_0_0_all         NA 0.0000000      NA           NA
## OTT_CRU_100-119_0_0             NA 0.0000000      NA           NA
## OTT_DEF_100-119_0_0             NA 0.6139505      NA           NA
## SSC_DEF_100-119_0_0_all         NA        NA       0           NA
## TBB_DEF_>=120_0_0_all           NA        NA      NA    0.0000000
## TBB_DEF_70-99_0_0_all            1        NA       0    0.9696901
##                            UK(Scotland)
## GNS_DEF_120-219_0_0_all              NA
## GNS_DEF_all_0_0_all                  NA
## GTR_DEF_90-99_0_0_all                NA
## GTR_DEF_all_0_0_all                  NA
```

```
## LLS_FIF_0_0_0_all                   NA
## MIS_MIS_0_0_0_HC                    NA
## OTB_CRU_100-119_0_0_all             NA
## OTB_CRU_16-31_0_0_all               NA
## OTB_CRU_70-99_0_0_all              NaN
## OTB_DEF_>=120_0_0_all              NaN
## OTB_DEF_>=120_0_0_all_FDF          NaN
## OTB_DEF_100-119_0_0_all             NA
## OTB_DEF_70-99_0_0_all               NA
## OTM_DEF_100-119_0_0_all             NA
## OTT_CRU_100-119_0_0                 NA
## OTT_DEF_100-119_0_0                 NA
## SSC_DEF_100-119_0_0_all             NA
## TBB_DEF_>=120_0_0_all               NA
## TBB_DEF_70-99_0_0_all               NA
```

```
Dage_FC #note: proportions shown prior to discard raising
```

```
##                            Belgium France Ireland UK(England) UK(Scotland)
## GNS_DEF_120-219_0_0_all         NA     NA     NaN          NA           NA
## GNS_DEF_all_0_0_all             NA     NA      NA         NaN           NA
## GTR_DEF_90-99_0_0_all           NA    NaN      NA          NA           NA
## GTR_DEF_all_0_0_all             NA     NA      NA         NaN           NA
## LLS_FIF_0_0_0_all               NA     NA      NA         NaN           NA
## MIS_MIS_0_0_0_HC                NA    NaN     NaN         NaN           NA
## OTB_CRU_100-119_0_0_all         NA    NaN     NaN          NA           NA
## OTB_CRU_16-31_0_0_all           NA     NA      NA         NaN           NA
## OTB_CRU_70-99_0_0_all          NaN     NA     NaN         NaN          NaN
## OTB_DEF_>=120_0_0_all           NA     NA      NA         NaN          NaN
## OTB_DEF_>=120_0_0_all_FDF       NA     NA      NA          NA          NaN
## OTB_DEF_100-119_0_0_all         NA    NaN     NaN          NA           NA
## OTB_DEF_70-99_0_0_all           NA    NaN     NaN         NaN           NA
## OTM_DEF_100-119_0_0_all         NA    NaN      NA          NA           NA
## OTT_CRU_100-119_0_0             NA    NaN      NA          NA           NA
## OTT_DEF_100-119_0_0             NA    NaN      NA          NA           NA
## SSC_DEF_100-119_0_0_all         NA     NA     NaN          NA           NA
## TBB_DEF_>=120_0_0_all           NA     NA      NA         NaN           NA
## TBB_DEF_70-99_0_0_all            1     NA     NaN           1           NA
```

Section C: Discard ratio coverage (Lwt !Dwt / sum(Lwt))

1. Total proportion of the landings for which discard weights are available

```
Ldis_A_tot
```

```
## [1] 0.7271354
```

2. Proportion of landings for which discard weights are available by area and season

```
Ldis_AS
```

```
##                  1 2 3 4 2010
## 27.7.f 0.9420477 0 0 0   NA
## 27.7.g 0.0000000 0 0 0    1
```

3. Proportion of landings for which discard weights are available in each métier-country stratum

```
Ldis_FC

##                              Belgium France Ireland UK (England) UK(Scotland)
## GNS_DEF_120-219_0_0_all          NA     NA       0           NA           NA
## GNS_DEF_all_0_0_all              NA     NA      NA    0.0000000           NA
## GTR_DEF_90-99_0_0_all            NA      0      NA           NA           NA
## GTR_DEF_all_0_0_all              NA     NA      NA    0.0000000           NA
## LLS_FIF_0_0_0_all                NA     NA      NA          NaN           NA
## MIS_MIS_0_0_0_HC                 NA      0       0    0.0000000           NA
## OTB_CRU_100-119_0_0_all          NA      0       0           NA           NA
## OTB_CRU_16-31_0_0_all            NA     NA      NA    0.0000000           NA
## OTB_CRU_70-99_0_0_all             0     NA       0    0.0000000          NaN
## OTB_DEF_>=120_0_0_all            NA     NA      NA    0.0000000          NaN
## OTB_DEF_>=120_0_0_all_FDF        NA     NA      NA           NA          NaN
## OTB_DEF_100-119_0_0_all          NA      0       0           NA           NA
## OTB_DEF_70-99_0_0_all            NA      0       0    0.0000000           NA
## OTM_DEF_100-119_0_0_all          NA      0      NA           NA           NA
## OTT_CRU_100-119_0_0              NA      0      NA           NA           NA
## OTT_DEF_100-119_0_0              NA      0      NA           NA           NA
## SSC_DEF_100-119_0_0_all          NA     NA       0           NA           NA
## TBB_DEF_>=120_0_0_all            NA     NA      NA    0.0000000           NA
## TBB_DEF_70-99_0_0_all             1     NA       0    0.5787922           NA
```

Section D: Landings age coverage ranked by landed weights

This section shows the proportion of landings covered for age composition, in total (Lage_tot), by métier and for the larger gear groups (Lage_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable age coverage for landings. Additionally, the proportion of landings for which discard age coverage is available is presented for the larger gear groups (Dage_gear).

```
Lage_tot<-sum(Lage_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Lage_AS = Lwt !Lagesamp / sum(Lwt); L_AS = Lwt / sum(Lwt))
Lage_tot

## [1] 0.8231395

format(Lage_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Lage_AS

##                         Fleet Total rank_Total
## 19      TBB_DEF_70-99_0_0_all   1.0   0.811408
## 9       OTB_CRU_70-99_0_0_all   0.0   0.105679
## 13      OTB_DEF_70-99_0_0_all   0.6   0.025934
## 16        OTT_DEF_100-119_0_0   0.6   0.015426
## 12    OTB_DEF_100-119_0_0_all   0.0   0.012730
## 15        OTT_CRU_100-119_0_0   0.0   0.011983
## 3       GTR_DEF_90-99_0_0_all   0.0   0.004168
## 2         GNS_DEF_all_0_0_all   0.2   0.004140
## 6            MIS_MIS_0_0_0_HC   0.0   0.002393
## 7     OTB_CRU_100-119_0_0_all   0.0   0.002286
## 10      OTB_DEF_>=120_0_0_all   0.0   0.002133
## 18      TBB_DEF_>=120_0_0_all   0.0   0.001407
```

```
## 1    GNS_DEF_120-219_0_0_all   0.0   0.000158
## 17   SSC_DEF_100-119_0_0_all   0.0   0.000091
## 14   OTM_DEF_100-119_0_0_all   0.0   0.000036
## 8      OTB_CRU_16-31_0_0_all   0.0   0.000028
## 4        GTR_DEF_all_0_0_all   0.0   0.000001
## 11 OTB_DEF_>=120_0_0_all_FDF   NaN   0.000000
## 5          LLS_FIF_0_0_0_all   NaN   0.000000
```

```
Lage_gear
```

```
##       GTR       OTB      REST       TBB
## 0.1107663 0.1471692 0.0000000 0.9796291
```

```
Dage_gear
```

```
##       GTR       OTB      REST       TBB
## 0.0000000 0.0000000 0.0000000 0.8945889
```

Section E: Discard ratio coverage ranked by landed weight

This section shows the proportion of landings for which discard weights are available, in total (Ldis_tot), by métier and for the larger gear groups (Ldis_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable discard ratio coverage.

```
Ldis_tot<-sum(Ldis_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Ldis_AS = Lwt !Dwt / sum(Lwt); L_AS = Lwt / sum(Lwt)
Ldis_tot
```

```
## [1] 0.7271354
```

```
format(Ldis_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Ldis_AS
```

```
##                        Fleet Total rank_Total
## 19     TBB_DEF_70-99_0_0_all   0.9   0.811408
## 9      OTB_CRU_70-99_0_0_all   0.0   0.105679
## 13     OTB_DEF_70-99_0_0_all   0.0   0.025934
## 16       OTT_DEF_100-119_0_0   0.0   0.015426
## 12   OTB_DEF_100-119_0_0_all   0.0   0.012730
## 15       OTT_CRU_100-119_0_0   0.0   0.011983
## 3      GTR_DEF_90-99_0_0_all   0.0   0.004168
## 2        GNS_DEF_all_0_0_all   0.0   0.004140
## 6           MIS_MIS_0_0_0_HC   0.0   0.002393
## 7    OTB_CRU_100-119_0_0_all   0.0   0.002286
## 10     OTB_DEF_>=120_0_0_all   0.0   0.002133
## 18     TBB_DEF_>=120_0_0_all   0.0   0.001407
## 1    GNS_DEF_120-219_0_0_all   0.0   0.000158
## 17   SSC_DEF_100-119_0_0_all   0.0   0.000091
## 14   OTM_DEF_100-119_0_0_all   0.0   0.000036
## 8      OTB_CRU_16-31_0_0_all   0.0   0.000028
## 4        GTR_DEF_all_0_0_all   0.0   0.000001
## 11 OTB_DEF_>=120_0_0_all_FDF   NaN   0.000000
## 5          LLS_FIF_0_0_0_all   NaN   0.000000
```

```
Ldis_gear

##       GTR       OTB      REST       TBB
## 0.0000000 0.0000000 0.0000000 0.8945889
```

InterCatch input for 2011

```
##                1         2         3         4 2011
## 27.7.f 0.927321 0.8280958 0.4800377 0.6165775   NA
## 27.7.g       NA 0.2281715 0.1580244        NA    1
```

This appendix lists 5 sections of tables (A-E) for each InterCatch year. It provides a detailed summary of the InterCatch input data in terms of importance by landed weight and the proportional coverage for age data and discard ratios.

Section A: Importance by landed weight (Lwt / sum(Lwt))

1. Proportion of landings by area and season

```
L_AS*100

##                1        2        3        4     2011
## 27.7.f 9.666966 2.177521 3.254393 2.032372       NA
## 27.7.g 2.676752 3.809529 5.292338 3.534187 67.55594
```

2. Proportion of landings by métier and country

```
format(data.frame(L_FC*100),scientific=3,digit=1)

##                         Belgium France Ireland UK..England. UK.Scotland.
## FPO_CRU_0_0_0_all            NA     NA  0.0005           NA           NA
## GNS_DEF_120-219_0_0_all      NA     NA  0.0058           NA           NA
## GNS_DEF_all_0_0_all          NA     NA      NA        0.326           NA
## GTR_DEF_90-99_0_0_all        NA 0.4654      NA           NA           NA
## GTR_DEF_all_0_0_all          NA     NA      NA        0.001           NA
## LLS_FIF_0_0_0_all            NA     NA      NA        0.003           NA
## MIS_MIS_0_0_0_HC             NA 0.3030      NA        0.035           NA
## OTB_CRU_100-119_0_0_all      NA 0.0510  0.1306           NA           NA
## OTB_CRU_16-31_0_0_all        NA     NA      NA        0.006           NA
## OTB_CRU_70-99_0_0_all         8     NA  0.9995           NA           NA
## OTB_DEF_>=120_0_0_all        NA     NA      NA        0.074           NA
## OTB_DEF_100-119_0_0_all      NA 1.1823  0.6039           NA           NA
## OTB_DEF_70-99_0_0_all        NA 0.0550  0.5152        2.125            0
## OTM_DEF_100-119_0_0_all      NA 0.2095      NA           NA           NA
## OTT_CRU_100-119_0_0          NA 0.5422      NA           NA           NA
## OTT_CRU_70-99_0_0_all        NA 0.0009      NA           NA           NA
## OTT_DEF_100-119_0_0          NA 2.2525      NA           NA           NA
## SSC_DEF_100-119_0_0_all      NA     NA  0.0202           NA           NA
## TBB_DEF_70-99_0_0_all        68     NA  0.8996       13.779           NA
```

3. Proportion of landings by country

```
apply(L_FC*100,2,function(x) sum(x,na.rm=T))

##      Belgium       France      Ireland UK (England) UK(Scotland)
##    75.414026     5.061684     3.175284    16.349005     0.000000
```

4. Proportion of landings by fleet and area

```
format(data.frame(L_FA*100),scientific=4,digit=1)
```

```
##                           X27.7.f X27.7.g
## FPO_CRU_0_0_0_all              NA  0.0005
## GNS_DEF_120-219_0_0_all        NA  0.0058
## GNS_DEF_all_0_0_all        0.3133  0.0126
## GTR_DEF_90-99_0_0_all      0.0679  0.3975
## GTR_DEF_all_0_0_all        0.0014      NA
## LLS_FIF_0_0_0_all          0.0030  0.0002
## MIS_MIS_0_0_0_HC           0.0463  0.2914
## OTB_CRU_100-119_0_0_all    0.0011  0.1804
## OTB_CRU_16-31_0_0_all      0.0062      NA
## OTB_CRU_70-99_0_0_all      1.9581  6.8995
## OTB_DEF_>=120_0_0_all      0.0740      NA
## OTB_DEF_100-119_0_0_all    0.8432  0.9431
## OTB_DEF_70-99_0_0_all      2.1603  0.5345
## OTM_DEF_100-119_0_0_all    0.1933  0.0161
## OTT_CRU_100-119_0_0        0.0031  0.5392
## OTT_CRU_70-99_0_0_all      0.0009      NA
## OTT_DEF_100-119_0_0        0.0447  2.2077
## SSC_DEF_100-119_0_0_all        NA  0.0202
## TBB_DEF_70-99_0_0_all     11.4145 70.8201
```

5. Proportion of landings by métier, ranked from largest to smallest, together with cumulative sum

```
L_F1<-L_F
L_F1$rank_Total<-L_F1$rank_Total*100
L_F1<-L_F1[rev(order(L_F1$rank_Total)),]
L_F1$cum<-cumsum(L_F1$rank_Total)
format(L_F1,scientific=4,digit=1)
```

```
##                         rank_Total                   Fleet cum
## TBB_DEF_70-99_0_0_all      82.2346   TBB_DEF_70-99_0_0_all  82
## OTB_CRU_70-99_0_0_all       8.8576   OTB_CRU_70-99_0_0_all  91
## OTB_DEF_70-99_0_0_all       2.6948   OTB_DEF_70-99_0_0_all  94
## OTT_DEF_100-119_0_0         2.2525     OTT_DEF_100-119_0_0  96
## OTB_DEF_100-119_0_0_all     1.7863 OTB_DEF_100-119_0_0_all  98
## OTT_CRU_100-119_0_0         0.5422     OTT_CRU_100-119_0_0  98
## GTR_DEF_90-99_0_0_all       0.4654   GTR_DEF_90-99_0_0_all  99
## MIS_MIS_0_0_0_HC            0.3376        MIS_MIS_0_0_0_HC  99
## GNS_DEF_all_0_0_all         0.3259     GNS_DEF_all_0_0_all  99
## OTM_DEF_100-119_0_0_all     0.2095 OTM_DEF_100-119_0_0_all 100
## OTB_CRU_100-119_0_0_all     0.1815 OTB_CRU_100-119_0_0_all 100
## OTB_DEF_>=120_0_0_all       0.0740   OTB_DEF_>=120_0_0_all 100
## SSC_DEF_100-119_0_0_all     0.0202 SSC_DEF_100-119_0_0_all 100
## OTB_CRU_16-31_0_0_all       0.0062   OTB_CRU_16-31_0_0_all 100
## GNS_DEF_120-219_0_0_all     0.0058 GNS_DEF_120-219_0_0_all 100
## LLS_FIF_0_0_0_all           0.0032       LLS_FIF_0_0_0_all 100
## GTR_DEF_all_0_0_all         0.0014     GTR_DEF_all_0_0_all 100
## OTT_CRU_70-99_0_0_all       0.0009   OTT_CRU_70-99_0_0_all 100
## FPO_CRU_0_0_0_all           0.0005       FPO_CRU_0_0_0_all 100
```

Section B: Age coverage

1. Total proportion of the landings/sampled discards that is covered for age composition

```
Lage_A_tot #(Lwt !Lagesamp / sum(Lwt))

## [1] 0.8284441

Dage_A_tot #(Dwt !Dagesamp / sum(Dwt))

## [1] 1
```

2. Proportion of landings/sampled discards by area and season that is covered for age composition

```
Lage_AS

##                  1         2         3         4 2011
## 27.7.f 0.927321 0.8280958 0.4800377 0.6165775   NA
## 27.7.g       NA 0.2281715 0.1580244        NA    1

Dage_AS

##        2011
## 27.7.f   NA
## 27.7.g    1
```

3. Proportion of landings/sampled discards in each métier-country stratum that is covered for age composition

```
Lage_FC

##                         Belgium France Ireland UK (England) UK(Scotland)
## FPO_CRU_0_0_0_all            NA     NA       0           NA           NA
## GNS_DEF_120-219_0_0_all      NA     NA       0           NA           NA
## GNS_DEF_all_0_0_all          NA     NA      NA    0.3038542           NA
## GTR_DEF_90-99_0_0_all        NA      0      NA           NA           NA
## GTR_DEF_all_0_0_all          NA     NA      NA    0.0000000           NA
## LLS_FIF_0_0_0_all            NA     NA      NA    0.0000000           NA
## MIS_MIS_0_0_0_HC             NA      0      NA    0.0000000           NA
## OTB_CRU_100-119_0_0_all      NA      0       0           NA           NA
## OTB_CRU_16-31_0_0_all        NA     NA      NA    0.0000000           NA
## OTB_CRU_70-99_0_0_all         0     NA       0           NA           NA
## OTB_DEF_>=120_0_0_all        NA     NA      NA    0.0000000           NA
## OTB_DEF_100-119_0_0_all      NA      0       0           NA           NA
## OTB_DEF_70-99_0_0_all        NA      0       0    0.9954633          NaN
## OTM_DEF_100-119_0_0_all      NA      0      NA           NA           NA
## OTT_CRU_100-119_0_0          NA      0      NA           NA           NA
## OTT_CRU_70-99_0_0_all        NA      0      NA           NA           NA
## OTT_DEF_100-119_0_0          NA      0      NA           NA           NA
## SSC_DEF_100-119_0_0_all      NA     NA       0           NA           NA
## TBB_DEF_70-99_0_0_all         1     NA       0    0.9488652           NA

Dage_FC #note: proportions shown prior to discard raising

##                         Belgium France Ireland UK (England) UK(Scotland)
## FPO_CRU_0_0_0_all            NA     NA     NaN           NA           NA
## GNS_DEF_120-219_0_0_all      NA     NA     NaN           NA           NA
```

```
## GNS_DEF_all_0_0_all          NA    NA      NA          NaN           NA
## GTR_DEF_90-99_0_0_all        NA   NaN      NA           NA           NA
## GTR_DEF_all_0_0_all          NA    NA      NA          NaN           NA
## LLS_FIF_0_0_0_all            NA    NA      NA          NaN           NA
## MIS_MIS_0_0_0_HC             NA   NaN      NA          NaN           NA
## OTB_CRU_100-119_0_0_all      NA   NaN     NaN           NA           NA
## OTB_CRU_16-31_0_0_all        NA    NA      NA          NaN           NA
## OTB_CRU_70-99_0_0_all       NaN    NA     NaN           NA           NA
## OTB_DEF_>=120_0_0_all        NA    NA      NA          NaN           NA
## OTB_DEF_100-119_0_0_all      NA   NaN     NaN           NA           NA
## OTB_DEF_70-99_0_0_all        NA   NaN     NaN          NaN          NaN
## OTM_DEF_100-119_0_0_all      NA   NaN      NA           NA           NA
## OTT_CRU_100-119_0_0          NA   NaN      NA           NA           NA
## OTT_CRU_70-99_0_0_all        NA   NaN      NA           NA           NA
## OTT_DEF_100-119_0_0          NA   NaN      NA           NA           NA
## SSC_DEF_100-119_0_0_all      NA    NA     NaN           NA           NA
## TBB_DEF_70-99_0_0_all         1    NA     NaN          NaN           NA
```

Section C: Discard ratio coverage (Lwt !Dwt / sum(Lwt))

1. Total proportion of the landings for which discard weights are available

```
Ldis_A_tot

## [1] 0.6755594
```

2. Proportion of landings for which discard weights are available by area and season

```
Ldis_AS

##          1 2 3 4 2011
## 27.7.f 0 0 0 0   NA
## 27.7.g 0 0 0 0    1
```

3. Proportion of landings for which discard weights are available in each métier-country stratum

```
Ldis_FC

##                         Belgium France Ireland UK (England) UK(Scotland)
## FPO_CRU_0_0_0_all            NA     NA       0           NA           NA
## GNS_DEF_120-219_0_0_all      NA     NA       0           NA           NA
## GNS_DEF_all_0_0_all          NA     NA      NA            0           NA
## GTR_DEF_90-99_0_0_all        NA      0      NA           NA           NA
## GTR_DEF_all_0_0_all          NA     NA      NA            0           NA
## LLS_FIF_0_0_0_all            NA     NA      NA            0           NA
## MIS_MIS_0_0_0_HC             NA      0      NA            0           NA
## OTB_CRU_100-119_0_0_all      NA      0       0           NA           NA
## OTB_CRU_16-31_0_0_all        NA     NA      NA            0           NA
## OTB_CRU_70-99_0_0_all         0     NA       0           NA           NA
## OTB_DEF_>=120_0_0_all        NA     NA      NA            0           NA
## OTB_DEF_100-119_0_0_all      NA      0       0           NA           NA
## OTB_DEF_70-99_0_0_all        NA      0       0            0          NaN
## OTM_DEF_100-119_0_0_all      NA      0      NA           NA           NA
## OTT_CRU_100-119_0_0          NA      0      NA           NA           NA
## OTT_CRU_70-99_0_0_all        NA      0      NA           NA           NA
## OTT_DEF_100-119_0_0          NA      0      NA           NA           NA
```

```
## SSC_DEF_100-119_0_0_all      NA      NA        0            NA            NA
## TBB_DEF_70-99_0_0_all         1      NA        0             0            NA
```

Section D: Landings age coverage ranked by landed weights

This section shows the proportion of landings covered for age composition, in total (Lage_tot), by métier and for the larger gear groups (Lage_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable age coverage for landings. Additionally, the proportion of landings for which discard age coverage is available is presented for the larger gear groups (Dage_gear).

```
Lage_tot<-sum(Lage_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Lage_AS = Lwt !Lagesamp / sum(Lwt); L_AS = Lwt / sum(Lwt))
Lage_tot

## [1] 0.8284441

format(Lage_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Lage_AS

##                        Fleet Total rank_Total
## 19     TBB_DEF_70-99_0_0_all   1.0   0.822346
## 10     OTB_CRU_70-99_0_0_all   0.0   0.088576
## 13     OTB_DEF_70-99_0_0_all   0.8   0.026948
## 17       OTT_DEF_100-119_0_0   0.0   0.022525
## 12 OTB_DEF_100-119_0_0_all   0.0   0.017863
## 15       OTT_CRU_100-119_0_0   0.0   0.005422
## 4      GTR_DEF_90-99_0_0_all   0.0   0.004654
## 7           MIS_MIS_0_0_0_HC   0.0   0.003376
## 3       GNS_DEF_all_0_0_all   0.3   0.003259
## 14 OTM_DEF_100-119_0_0_all   0.0   0.002095
## 8  OTB_CRU_100-119_0_0_all   0.0   0.001815
## 11     OTB_DEF_>=120_0_0_all   0.0   0.000740
## 18 SSC_DEF_100-119_0_0_all   0.0   0.000202
## 9      OTB_CRU_16-31_0_0_all   0.0   0.000062
## 2  GNS_DEF_120-219_0_0_all   0.0   0.000058
## 6          LLS_FIF_0_0_0_all   0.0   0.000032
## 5       GTR_DEF_all_0_0_all   0.0   0.000014
## 16     OTT_CRU_70-99_0_0_all   0.0   0.000009
## 1          FPO_CRU_0_0_0_all   0.0   0.000005

Lage_gear

##       GTR       OTB      REST       TBB
## 0.1240059 0.1288335 0.0000000 0.9804925

Dage_gear

##       GTR       OTB      REST       TBB
## 0.0000000 0.0000000 0.0000000 0.8215022
```

Section E: Discard ratio coverage ranked by landed weight

This section shows the proportion of landings for which discard weights are available, in total (Ldis_tot), by métier and for the larger gear groups (Ldis_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable discard ratio coverage.

```
Ldis_tot<-sum(Ldis_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Ldis_AS = Lwt !Dwt / sum(Lwt); L_AS = Lwt / sum(Lwt)
Ldis_tot

## [1] 0.6755594

format(Ldis_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Ldis_AS

##                        Fleet Total rank_Total
## 19    TBB_DEF_70-99_0_0_all   0.8   0.822346
## 10    OTB_CRU_70-99_0_0_all   0.0   0.088576
## 13    OTB_DEF_70-99_0_0_all   0.0   0.026948
## 17      OTT_DEF_100-119_0_0   0.0   0.022525
## 12 OTB_DEF_100-119_0_0_all   0.0   0.017863
## 15      OTT_CRU_100-119_0_0   0.0   0.005422
## 4     GTR_DEF_90-99_0_0_all   0.0   0.004654
## 7           MIS_MIS_0_0_0_HC   0.0   0.003376
## 3       GNS_DEF_all_0_0_all   0.0   0.003259
## 14 OTM_DEF_100-119_0_0_all   0.0   0.002095
## 8  OTB_CRU_100-119_0_0_all   0.0   0.001815
## 11    OTB_DEF_>=120_0_0_all   0.0   0.000740
## 18 SSC_DEF_100-119_0_0_all   0.0   0.000202
## 9     OTB_CRU_16-31_0_0_all   0.0   0.000062
## 2  GNS_DEF_120-219_0_0_all   0.0   0.000058
## 6         LLS_FIF_0_0_0_all   0.0   0.000032
## 5       GTR_DEF_all_0_0_all   0.0   0.000014
## 16    OTT_CRU_70-99_0_0_all   0.0   0.000009
## 1         FPO_CRU_0_0_0_all   0.0   0.000005

Ldis_gear

##       GTR       OTB      REST       TBB
## 0.0000000 0.0000000 0.0000000 0.8215022
```

InterCatch input for 2012

```
##                 1         2         3         4      2012
## 27.7.f 0.929595 0.8538809 0.1868075 0.3605620 1.0000000
## 27.7.g 0.302597 0.3387757 0.1849982 0.5275159 0.9575662
```

This appendix lists 5 sections of tables (A-E) for each InterCatch year. It provides a detailed summary of the InterCatch input data in terms of importance by landed weight and the proportional coverage for age data and discard ratios.

Section A: Importance by landed weight (Lwt / sum(Lwt))

1. Proportion of landings by area and season

```
L_AS*100

##                 1        2        3        4      2012
## 27.7.f 8.3375856 3.641797 2.314274 1.345158 71.478139
## 27.7.g 0.8847985 2.594372 4.291238 2.132610  2.980027
```

2. Proportion of landings by métier and country

```
format(data.frame(L_FC*100),scientific=3,digit=1)

##                          Belgium France Ireland UK..England.
## FPO_CRU_0_0_0_all             NA     NA   0.114           NA
## GNS_DEF_120-219_0_0_all       NA     NA   0.003           NA
## GNS_DEF_all_0_0_all           NA     NA      NA       0.3950
## GTR_DEF_90-99_0_0_all         NA   0.12      NA           NA
## GTR_DEF_all_0_0_all           NA     NA      NA       0.0015
## LLS_FIF_0_0_0_all             NA     NA      NA       0.0002
## MIS_MIS_0_0_0_HC              NA   0.03   0.003       0.0553
## OTB_CRU_100-119_0_0_all       NA   0.03      NA       0.0135
## OTB_CRU_16-31_0_0_all         NA     NA      NA       0.0327
## OTB_CRU_70-99_0_0_all          5     NA   1.751       0.0005
## OTB_DEF_>=120_0_0_all         NA     NA      NA       0.1090
## OTB_DEF_100-119_0_0_all       NA   1.53      NA           NA
## OTB_DEF_70-99_0_0_all         NA   0.07      NA       1.8461
## OTM_DEF_100-119_0_0_all       NA   0.00      NA           NA
## OTT_CRU_100-119_0_0           NA   0.27      NA           NA
## OTT_DEF_100-119_0_0           NA   2.46      NA           NA
## SSC_DEF_100-119_0_0_all       NA     NA      NA           NA
## SSC_DEF_70-99_0_0_all         NA     NA   0.007           NA
## TBB_DEF_>=120_0_0_all         NA     NA      NA       0.0143
## TBB_DEF_70-99_0_0_all         71     NA   1.102      13.4394
##                          UK.Northern.Ireland. UK.Scotland.
## FPO_CRU_0_0_0_all                          NA           NA
## GNS_DEF_120-219_0_0_all                    NA           NA
## GNS_DEF_all_0_0_all                        NA           NA
## GTR_DEF_90-99_0_0_all                      NA           NA
## GTR_DEF_all_0_0_all                        NA           NA
## LLS_FIF_0_0_0_all                          NA           NA
## MIS_MIS_0_0_0_HC                           NA           NA
## OTB_CRU_100-119_0_0_all                    NA           NA
```

```
## OTB_CRU_16-31_0_0_all                        NA           NA
## OTB_CRU_70-99_0_0_all                   0.02535           NA
## OTB_DEF_>=120_0_0_all                        NA           NA
## OTB_DEF_100-119_0_0_all                      NA         0.02
## OTB_DEF_70-99_0_0_all                        NA           NA
## OTM_DEF_100-119_0_0_all                 0.00254           NA
## OTT_CRU_100-119_0_0                          NA           NA
## OTT_DEF_100-119_0_0                          NA           NA
## SSC_DEF_100-119_0_0_all                 0.00009           NA
## SSC_DEF_70-99_0_0_all                        NA           NA
## TBB_DEF_>=120_0_0_all                        NA           NA
## TBB_DEF_70-99_0_0_all                        NA           NA
```

3. Proportion of landings by country

```
apply(L_FC*100,2,function(x) sum(x,na.rm=T))
```

```
##             Belgium                  France                Ireland
##         76.54420400              4.52121298             2.98002726
##         UK (England) UK(Northern Ireland)            UK(Scotland)
##         15.90749888              0.02797977             0.01907712
```

4. Proportion of landings by fleet and area

```
format(data.frame(L_FA*100),scientific=4,digit=1)
```

```
##                           X27.7.f X27.7.g
## FPO_CRU_0_0_0_all              NA 0.11392
## GNS_DEF_120-219_0_0_all        NA 0.00282
## GNS_DEF_all_0_0_all        0.3915 0.00345
## GTR_DEF_90-99_0_0_all      0.0054 0.11369
## GTR_DEF_all_0_0_all        0.0015      NA
## LLS_FIF_0_0_0_all          0.0002 0.00000
## MIS_MIS_0_0_0_HC           0.0693 0.02346
## OTB_CRU_100-119_0_0_all    0.0011 0.04611
## OTB_CRU_16-31_0_0_all      0.0327      NA
## OTB_CRU_70-99_0_0_all      0.4956 6.34741
## OTB_DEF_>=120_0_0_all      0.0997 0.00936
## OTB_DEF_100-119_0_0_all    1.0322 0.51679
## OTB_DEF_70-99_0_0_all      1.8763 0.04186
## OTM_DEF_100-119_0_0_all    0.0000 0.00254
## OTT_CRU_100-119_0_0        0.0005 0.26708
## OTT_DEF_100-119_0_0        0.0366 2.42743
## SSC_DEF_100-119_0_0_all        NA 0.00009
## SSC_DEF_70-99_0_0_all          NA 0.00718
## TBB_DEF_>=120_0_0_all      0.0143      NA
## TBB_DEF_70-99_0_0_all     83.0601 2.95986
```

5. Proportion of landings by métier, ranked from largest to smallest, together with cumulative sum

```
L_F1<-L_F
L_F1$rank_Total<-L_F1$rank_Total*100
L_F1<-L_F1[rev(order(L_F1$rank_Total)),]
L_F1$cum<-cumsum(L_F1$rank_Total)
format(L_F1,scientific=4,digit=1)
```

```
##                          rank_Total                    Fleet cum
## TBB_DEF_70-99_0_0_all     86.01999   TBB_DEF_70-99_0_0_all  86
## OTB_CRU_70-99_0_0_all      6.84296   OTB_CRU_70-99_0_0_all  93
## OTT_DEF_100-119_0_0        2.46408     OTT_DEF_100-119_0_0  95
## OTB_DEF_70-99_0_0_all      1.91812   OTB_DEF_70-99_0_0_all  97
## OTB_DEF_100-119_0_0_all    1.54899 OTB_DEF_100-119_0_0_all  99
## GNS_DEF_all_0_0_all        0.39499     GNS_DEF_all_0_0_all  99
## OTT_CRU_100-119_0_0        0.26758     OTT_CRU_100-119_0_0  99
## GTR_DEF_90-99_0_0_all      0.11912   GTR_DEF_90-99_0_0_all 100
## FPO_CRU_0_0_0_all          0.11392       FPO_CRU_0_0_0_all 100
## OTB_DEF_>=120_0_0_all      0.10901   OTB_DEF_>=120_0_0_all 100
## MIS_MIS_0_0_0_HC           0.09271        MIS_MIS_0_0_0_HC 100
## OTB_CRU_100-119_0_0_all    0.04721 OTB_CRU_100-119_0_0_all 100
## OTB_CRU_16-31_0_0_all      0.03270   OTB_CRU_16-31_0_0_all 100
## TBB_DEF_>=120_0_0_all      0.01426   TBB_DEF_>=120_0_0_all 100
## SSC_DEF_70-99_0_0_all      0.00718   SSC_DEF_70-99_0_0_all 100
## GNS_DEF_120-219_0_0_all    0.00282 GNS_DEF_120-219_0_0_all 100
## OTM_DEF_100-119_0_0_all    0.00254 OTM_DEF_100-119_0_0_all 100
## GTR_DEF_all_0_0_all        0.00154     GTR_DEF_all_0_0_all 100
## LLS_FIF_0_0_0_all          0.00018       LLS_FIF_0_0_0_all 100
## SSC_DEF_100-119_0_0_all    0.00009 SSC_DEF_100-119_0_0_all 100
```

Section B: Age coverage

1. Total proportion of the landings/sampled discards that is covered for age composition

```
Lage_A_tot #(Lwt !Lagesamp / sum(Lwt))

## [1] 0.8917479

Dage_A_tot #(Dwt !Dagesamp / sum(Dwt))

## [1] 1
```

2. Proportion of landings/sampled discards by area and season that is covered for age composition

```
Lage_AS

##                 1         2         3         4      2012
## 27.7.f 0.929595 0.8538809 0.1868075 0.3605620 1.0000000
## 27.7.g 0.302597 0.3387757 0.1849982 0.5275159 0.9575662

Dage_AS

##          4 2012
## 27.7.f NaN    1
## 27.7.g  NA   NA
```

3. Proportion of landings/sampled discards in each métier-country stratum that is covered for age composition

```
Lage_FC

##                          Belgium   France Ireland UK (England)
## FPO_CRU_0_0_0_all             NA       NA       0           NA
## GNS_DEF_120-219_0_0_all       NA       NA       0           NA
```

```
## GNS_DEF_all_0_0_all          NA        NA       NA    0.3751150
## GTR_DEF_90-99_0_0_all        NA 0.000000       NA           NA
## GTR_DEF_all_0_0_all          NA        NA       NA    0.0000000
## LLS_FIF_0_0_0_all            NA        NA       NA    0.0000000
## MIS_MIS_0_0_0_HC             NA 0.000000        0    0.0000000
## OTB_CRU_100-119_0_0_all      NA 0.000000       NA    0.0000000
## OTB_CRU_16-31_0_0_all        NA        NA       NA    0.0000000
## OTB_CRU_70-99_0_0_all         0        NA        1    0.0000000
## OTB_DEF_>=120_0_0_all        NA        NA       NA    0.0000000
## OTB_DEF_100-119_0_0_all      NA 0.000000       NA           NA
## OTB_DEF_70-99_0_0_all        NA 0.000000       NA    0.9923236
## OTM_DEF_100-119_0_0_all      NA       NaN       NA           NA
## OTT_CRU_100-119_0_0          NA 0.000000       NA           NA
## OTT_DEF_100-119_0_0          NA 0.887389       NA           NA
## SSC_DEF_100-119_0_0_all      NA        NA       NA           NA
## SSC_DEF_70-99_0_0_all        NA        NA        0           NA
## TBB_DEF_>=120_0_0_all        NA        NA       NA    0.0000000
## TBB_DEF_70-99_0_0_all         1        NA        1    0.7944099
##                         UK(Northern Ireland) UK(Scotland)
## FPO_CRU_0_0_0_all                         NA           NA
## GNS_DEF_120-219_0_0_all                   NA           NA
## GNS_DEF_all_0_0_all                       NA           NA
## GTR_DEF_90-99_0_0_all                     NA           NA
## GTR_DEF_all_0_0_all                       NA           NA
## LLS_FIF_0_0_0_all                         NA           NA
## MIS_MIS_0_0_0_HC                          NA           NA
## OTB_CRU_100-119_0_0_all                   NA           NA
## OTB_CRU_16-31_0_0_all                     NA           NA
## OTB_CRU_70-99_0_0_all                      0           NA
## OTB_DEF_>=120_0_0_all                     NA           NA
## OTB_DEF_100-119_0_0_all                   NA            0
## OTB_DEF_70-99_0_0_all                     NA           NA
## OTM_DEF_100-119_0_0_all                    0           NA
## OTT_CRU_100-119_0_0                       NA           NA
## OTT_DEF_100-119_0_0                       NA           NA
## SSC_DEF_100-119_0_0_all                    0           NA
## SSC_DEF_70-99_0_0_all                     NA           NA
## TBB_DEF_>=120_0_0_all                     NA           NA
## TBB_DEF_70-99_0_0_all                     NA           NA
```

```
Dage_FC #note: proportions shown prior to discard raising
```

```
##                         Belgium France Ireland UK (England)
## FPO_CRU_0_0_0_all            NA     NA     NaN           NA
## GNS_DEF_120-219_0_0_all      NA     NA     NaN           NA
## GNS_DEF_all_0_0_all          NA     NA      NA          NaN
## GTR_DEF_90-99_0_0_all        NA    NaN      NA           NA
## GTR_DEF_all_0_0_all          NA     NA      NA          NaN
## LLS_FIF_0_0_0_all            NA     NA      NA          NaN
## MIS_MIS_0_0_0_HC             NA    NaN     NaN          NaN
## OTB_CRU_100-119_0_0_all      NA    NaN      NA          NaN
## OTB_CRU_16-31_0_0_all        NA     NA      NA          NaN
## OTB_CRU_70-99_0_0_all       NaN     NA     NaN          NaN
## OTB_DEF_>=120_0_0_all        NA     NA      NA          NaN
```

```
## OTB_DEF_100-119_0_0_all      NA    NaN      NA           NA
## OTB_DEF_70-99_0_0_all        NA    NaN      NA          NaN
## OTM_DEF_100-119_0_0_all      NA    NaN      NA           NA
## OTT_CRU_100-119_0_0          NA    NaN      NA           NA
## OTT_DEF_100-119_0_0          NA    NaN      NA           NA
## SSC_DEF_100-119_0_0_all      NA     NA      NA           NA
## SSC_DEF_70-99_0_0_all        NA     NA     NaN           NA
## TBB_DEF_>=120_0_0_all        NA     NA      NA          NaN
## TBB_DEF_70-99_0_0_all         1     NA     NaN          NaN
##                          UK(Northern Ireland) UK(Scotland)
## FPO_CRU_0_0_0_all                          NA           NA
## GNS_DEF_120-219_0_0_all                    NA           NA
## GNS_DEF_all_0_0_all                        NA           NA
## GTR_DEF_90-99_0_0_all                      NA           NA
## GTR_DEF_all_0_0_all                        NA           NA
## LLS_FIF_0_0_0_all                          NA           NA
## MIS_MIS_0_0_0_HC                           NA           NA
## OTB_CRU_100-119_0_0_all                    NA           NA
## OTB_CRU_16-31_0_0_all                      NA           NA
## OTB_CRU_70-99_0_0_all                     NaN           NA
## OTB_DEF_>=120_0_0_all                      NA           NA
## OTB_DEF_100-119_0_0_all                    NA          NaN
## OTB_DEF_70-99_0_0_all                      NA           NA
## OTM_DEF_100-119_0_0_all                   NaN           NA
## OTT_CRU_100-119_0_0                        NA           NA
## OTT_DEF_100-119_0_0                        NA           NA
## SSC_DEF_100-119_0_0_all                   NaN           NA
## SSC_DEF_70-99_0_0_all                      NA           NA
## TBB_DEF_>=120_0_0_all                      NA           NA
## TBB_DEF_70-99_0_0_all                      NA           NA
```

Section C: Discard ratio coverage (Lwt !Dwt / sum(Lwt))

1. Total proportion of the landings for which discard weights are available

```
Ldis_A_tot

## [1] 0.7152311
```

2. Proportion of landings for which discard weights are available by area and season

```
Ldis_AS

##         1 2 3          4 2012
## 27.7.f 0 0 0 0.03342914    1
## 27.7.g 0 0 0 0.00000000    0
```

3. Proportion of landings for which discard weights are available in each métier-country stratum

```
Ldis_FC

##                          Belgium France Ireland UK (England)
## FPO_CRU_0_0_0_all             NA     NA       0           NA
## GNS_DEF_120-219_0_0_all       NA     NA       0           NA
## GNS_DEF_all_0_0_all           NA     NA      NA    0.1138454
## GTR_DEF_90-99_0_0_all         NA      0      NA           NA
```

```
## GTR_DEF_all_0_0_all          NA      NA      NA    0.0000000
## LLS_FIF_0_0_0_all            NA      NA      NA    0.0000000
## MIS_MIS_0_0_0_HC             NA       0       0    0.0000000
## OTB_CRU_100-119_0_0_all      NA       0      NA    0.0000000
## OTB_CRU_16-31_0_0_all        NA      NA      NA    0.0000000
## OTB_CRU_70-99_0_0_all         0      NA       0    0.0000000
## OTB_DEF_>=120_0_0_all        NA      NA      NA    0.0000000
## OTB_DEF_100-119_0_0_all      NA       0      NA           NA
## OTB_DEF_70-99_0_0_all        NA       0      NA    0.0000000
## OTM_DEF_100-119_0_0_all      NA     NaN      NA           NA
## OTT_CRU_100-119_0_0          NA       0      NA           NA
## OTT_DEF_100-119_0_0          NA       0      NA           NA
## SSC_DEF_100-119_0_0_all      NA      NA      NA           NA
## SSC_DEF_70-99_0_0_all        NA      NA       0           NA
## TBB_DEF_>=120_0_0_all        NA      NA      NA    0.0000000
## TBB_DEF_70-99_0_0_all         1      NA       0    0.0000000
##                         UK(Northern Ireland) UK(Scotland)
## FPO_CRU_0_0_0_all                         NA           NA
## GNS_DEF_120-219_0_0_all                   NA           NA
## GNS_DEF_all_0_0_all                       NA           NA
## GTR_DEF_90-99_0_0_all                     NA           NA
## GTR_DEF_all_0_0_all                       NA           NA
## LLS_FIF_0_0_0_all                         NA           NA
## MIS_MIS_0_0_0_HC                          NA           NA
## OTB_CRU_100-119_0_0_all                   NA           NA
## OTB_CRU_16-31_0_0_all                     NA           NA
## OTB_CRU_70-99_0_0_all                      0           NA
## OTB_DEF_>=120_0_0_all                     NA           NA
## OTB_DEF_100-119_0_0_all                   NA            0
## OTB_DEF_70-99_0_0_all                     NA           NA
## OTM_DEF_100-119_0_0_all                    0           NA
## OTT_CRU_100-119_0_0                       NA           NA
## OTT_DEF_100-119_0_0                       NA           NA
## SSC_DEF_100-119_0_0_all                    0           NA
## SSC_DEF_70-99_0_0_all                     NA           NA
## TBB_DEF_>=120_0_0_all                     NA           NA
## TBB_DEF_70-99_0_0_all                     NA           NA
```

Section D: Landings age coverage ranked by landed weights

This section shows the proportion of landings covered for age composition, in total (Lage_tot), by métier and for the larger gear groups (Lage_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable age coverage for landings. Additionally, the proportion of landings for which discard age coverage is available is presented for the larger gear groups (Dage_gear).

```
Lage_tot<-sum(Lage_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Lage_AS = Lwt !Lagesamp / sum(Lwt); L_AS = Lwt / sum(Lwt))
Lage_tot

## [1] 0.8917479

format(Lage_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Lage_AS
```

```
##                        Fleet Total rank_Total
## 20   TBB_DEF_70-99_0_0_all   1.0  0.8601999
## 10   OTB_CRU_70-99_0_0_all   0.3  0.0684296
## 16     OTT_DEF_100-119_0_0   0.9  0.0246408
## 13   OTB_DEF_70-99_0_0_all   1.0  0.0191812
## 12 OTB_DEF_100-119_0_0_all   0.0  0.0154899
## 3      GNS_DEF_all_0_0_all   0.4  0.0039499
## 15     OTT_CRU_100-119_0_0   0.0  0.0026758
## 4    GTR_DEF_90-99_0_0_all   0.0  0.0011912
## 1        FPO_CRU_0_0_0_all   0.0  0.0011392
## 11   OTB_DEF_>=120_0_0_all   0.0  0.0010901
## 7          MIS_MIS_0_0_0_HC   0.0  0.0009271
## 8  OTB_CRU_100-119_0_0_all   0.0  0.0004721
## 9    OTB_CRU_16-31_0_0_all   0.0  0.0003270
## 19   TBB_DEF_>=120_0_0_all   0.0  0.0001426
## 18   SSC_DEF_70-99_0_0_all   0.0  0.0000718
## 2  GNS_DEF_120-219_0_0_all   0.0  0.0000282
## 14 OTM_DEF_100-119_0_0_all   0.0  0.0000254
## 5      GTR_DEF_all_0_0_all   0.0  0.0000154
## 6        LLS_FIF_0_0_0_all   0.0  0.0000018
## 17 SSC_DEF_100-119_0_0_all   0.0  0.0000009
```

```
Lage_gear
```

```
##       GTR       OTB      REST       TBB
## 0.2857769 0.4358418 0.0000000 0.9677191
```

```
Dage_gear
```

```
##       GTR       OTB      REST       TBB
## 0.0000000 0.0000000 0.0000000 0.8308103
```

Section E: Discard ratio coverage ranked by landed weight

This section shows the proportion of landings for which discard weights are available, in total (Ldis_tot), by métier and for the larger gear groups (Ldis_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable discard ratio coverage.

```
Ldis_tot<-sum(Ldis_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Ldis_AS = Lwt !Dwt / sum(Lwt); L_AS = Lwt / sum(Lwt)
Ldis_tot
```

```
## [1] 0.7152311
```

```
format(Ldis_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Ldis_AS
```

```
##                        Fleet Total rank_Total
## 20   TBB_DEF_70-99_0_0_all   0.8  0.8601999
## 10   OTB_CRU_70-99_0_0_all   0.0  0.0684296
## 16     OTT_DEF_100-119_0_0   0.0  0.0246408
## 13   OTB_DEF_70-99_0_0_all   0.0  0.0191812
## 12 OTB_DEF_100-119_0_0_all   0.0  0.0154899
## 3      GNS_DEF_all_0_0_all   0.1  0.0039499
## 15     OTT_CRU_100-119_0_0   0.0  0.0026758
```

```
## 4    GTR_DEF_90-99_0_0_all   0.0  0.0011912
## 1        FPO_CRU_0_0_0_all   0.0  0.0011392
## 11   OTB_DEF_>=120_0_0_all   0.0  0.0010901
## 7          MIS_MIS_0_0_0_HC   0.0  0.0009271
## 8  OTB_CRU_100-119_0_0_all   0.0  0.0004721
## 9    OTB_CRU_16-31_0_0_all   0.0  0.0003270
## 19   TBB_DEF_>=120_0_0_all   0.0  0.0001426
## 18   SSC_DEF_70-99_0_0_all   0.0  0.0000718
## 2  GNS_DEF_120-219_0_0_all   0.0  0.0000282
## 14 OTM_DEF_100-119_0_0_all   0.0  0.0000254
## 5      GTR_DEF_all_0_0_all   0.0  0.0000154
## 6        LLS_FIF_0_0_0_all   0.0  0.0000018
## 17 SSC_DEF_100-119_0_0_all   0.0  0.0000009
```

```
Ldis_gear
```

```
##        GTR        OTB       REST        TBB
## 0.08673179 0.00000000 0.00000000 0.83081026
```

<u>InterCatch input for 2013</u>

```
##                   1         2         3        4 2013
## 27.7.f 0.85680649 0.8920542 0.1721051 0.337161    1
## 27.7.g 0.09379608 0.2595806 0.3935706       NA    1
```

This appendix lists 5 sections of tables (A-E) for each InterCatch year. It provides a detailed summary of the InterCatch input data in terms of importance by landed weight and the proportional coverage for age data and discard ratios.

Section A: Importance by landed weight (Lwt / sum(Lwt))

1. Proportion of landings by area and season

```
L_AS*100

##                 1        2        3        4      2013
## 27.7.f 9.668902 5.967791 2.785437 1.159127 68.465534
## 27.7.g 1.285788 1.562659 2.789967 1.623857  4.690937
```

2. Proportion of landings by métier and country

```
format(data.frame(L_FC*100),scientific=3,digit=1)

##                         Belgium France Ireland UK..England.
## GNS_DEF_>=220_0_0_all        NA     NA    0.02           NA
## GNS_DEF_all_0_0_all          NA     NA      NA       0.2291
## GTR_DEF_90-99_0_0_all        NA   0.09      NA           NA
## GTR_DEF_all_0_0_all          NA     NA      NA       0.0005
## LLS_FIF_0_0_0_all            NA     NA      NA       0.0003
## MIS_MIS_0_0_0_HC             NA   0.03    1.68       0.1865
## OTB_CRU_100-119_0_0_all      NA   0.05    0.04       0.0003
## OTB_CRU_16-31_0_0_all        NA     NA      NA       0.0043
## OTB_CRU_70-99_0_0_all         4     NA    0.68       0.0005
## OTB_DEF_>=120_0_0_all        NA     NA      NA       0.1061
## OTB_DEF_100-119_0_0_all      NA   1.82    0.61           NA
## OTB_DEF_70-99_0_0_all        NA   0.08    0.18       1.9280
## OTM_DEF_100-119_0_0_all      NA     NA      NA           NA
## OTT_CRU_100-119_0_0          NA   0.32      NA           NA
## OTT_DEF_100-119_0_0          NA   1.89      NA           NA
## PTM_DEF_100-119_0_0_all      NA     NA      NA           NA
## SSC_DEF_100-119_0_0_all      NA     NA    0.01           NA
## TBB_DEF_70-99_0_0_all        68     NA    1.46      16.3646
##                         UK.Northern.Ireland. UK.Scotland.
## GNS_DEF_>=220_0_0_all                     NA           NA
## GNS_DEF_all_0_0_all                       NA           NA
## GTR_DEF_90-99_0_0_all                     NA           NA
## GTR_DEF_all_0_0_all                       NA           NA
## LLS_FIF_0_0_0_all                         NA           NA
## MIS_MIS_0_0_0_HC                          NA           NA
## OTB_CRU_100-119_0_0_all                   NA           NA
## OTB_CRU_16-31_0_0_all                     NA           NA
## OTB_CRU_70-99_0_0_all                 0.0625           NA
## OTB_DEF_>=120_0_0_all                     NA        0.003
```

```
## OTB_DEF_100-119_0_0_all                       NA            NA
## OTB_DEF_70-99_0_0_all                         NA            NA
## OTM_DEF_100-119_0_0_all                   0.0047            NA
## OTT_CRU_100-119_0_0                           NA            NA
## OTT_DEF_100-119_0_0                           NA            NA
## PTM_DEF_100-119_0_0_all                   0.0007            NA
## SSC_DEF_100-119_0_0_all                   0.0032            NA
## TBB_DEF_70-99_0_0_all                         NA            NA
```

3. Proportion of landings by country

```
apply(L_FC*100,2,function(x) sum(x,na.rm=T))
```

```
##              Belgium               France              Ireland
##         72.128518475          4.286221504          4.690936850
##         UK (England) UK(Northern Ireland)         UK(Scotland)
##         18.820113676          0.071098370          0.003111126
```

4. Proportion of landings by fleet and area

```
format(data.frame(L_FA*100),scientific=4,digit=1)
```

```
##                           X27.7.f X27.7.g
## GNS_DEF_>=220_0_0_all          NA 0.01693
## GNS_DEF_all_0_0_all       0.21952 0.00961
## GTR_DEF_90-99_0_0_all          NA 0.09234
## GTR_DEF_all_0_0_all       0.00009 0.00037
## LLS_FIF_0_0_0_all         0.00018 0.00009
## MIS_MIS_0_0_0_HC          0.21083 1.69074
## OTB_CRU_100-119_0_0_all   0.00207 0.08291
## OTB_CRU_16-31_0_0_all     0.00430      NA
## OTB_CRU_70-99_0_0_all     0.84421 3.56517
## OTB_DEF_>=120_0_0_all     0.10596 0.00329
## OTB_DEF_100-119_0_0_all   1.17086 1.26525
## OTB_DEF_70-99_0_0_all     1.89413 0.29526
## OTM_DEF_100-119_0_0_all        NA 0.00467
## OTT_CRU_100-119_0_0       0.00236 0.31747
## OTT_DEF_100-119_0_0       0.08830 1.80516
## PTM_DEF_100-119_0_0_all        NA 0.00073
## SSC_DEF_100-119_0_0_all        NA 0.01336
## TBB_DEF_70-99_0_0_all    83.50398 2.78986
```

5. Proportion of landings by métier, ranked from largest to smallest, together with cumulative sum

```
L_F1<-L_F
L_F1$rank_Total<-L_F1$rank_Total*100
L_F1<-L_F1[rev(order(L_F1$rank_Total)),]
L_F1$cum<-cumsum(L_F1$rank_Total)
format(L_F1,scientific=4,digit=1)
```

```
##                          rank_Total                   Fleet cum
## TBB_DEF_70-99_0_0_all       86.2938   TBB_DEF_70-99_0_0_all  86
## OTB_CRU_70-99_0_0_all        4.4094   OTB_CRU_70-99_0_0_all  91
## OTB_DEF_100-119_0_0_all      2.4361 OTB_DEF_100-119_0_0_all  93
## OTB_DEF_70-99_0_0_all        2.1894   OTB_DEF_70-99_0_0_all  95
## MIS_MIS_0_0_0_HC             1.9016        MIS_MIS_0_0_0_HC  97
```

```
## OTT_DEF_100-119_0_0        1.8935     OTT_DEF_100-119_0_0  99
## OTT_CRU_100-119_0_0        0.3198     OTT_CRU_100-119_0_0  99
## GNS_DEF_all_0_0_all        0.2291     GNS_DEF_all_0_0_all 100
## OTB_DEF_>=120_0_0_all      0.1093   OTB_DEF_>=120_0_0_all 100
## GTR_DEF_90-99_0_0_all      0.0923   GTR_DEF_90-99_0_0_all 100
## OTB_CRU_100-119_0_0_all    0.0850 OTB_CRU_100-119_0_0_all 100
## GNS_DEF_>=220_0_0_all      0.0169   GNS_DEF_>=220_0_0_all 100
## SSC_DEF_100-119_0_0_all    0.0134 SSC_DEF_100-119_0_0_all 100
## OTM_DEF_100-119_0_0_all    0.0047 OTM_DEF_100-119_0_0_all 100
## OTB_CRU_16-31_0_0_all      0.0043   OTB_CRU_16-31_0_0_all 100
## PTM_DEF_100-119_0_0_all    0.0007 PTM_DEF_100-119_0_0_all 100
## GTR_DEF_all_0_0_all        0.0005     GTR_DEF_all_0_0_all 100
## LLS_FIF_0_0_0_all          0.0003       LLS_FIF_0_0_0_all 100
```

Section B: Age coverage

1. Total proportion of the landings/sampled discards that is covered for age composition

```
Lage_A_tot #(Lwt !Lagesamp / sum(Lwt))

## [1] 0.8925893

Dage_A_tot #(Dwt !Dagesamp / sum(Dwt))

## [1] 1
```

2. Proportion of landings/sampled discards by area and season that is covered for age composition

```
Lage_AS

##                   1         2         3        4 2013
## 27.7.f 0.85680649 0.8920542 0.1721051 0.337161    1
## 27.7.g 0.09379608 0.2595806 0.3935706       NA    1

Dage_AS

##         1   3 2013
## 27.7.f  1  NA    1
## 27.7.g NA NaN   NA
```

3. Proportion of landings/sampled discards in each métier-country stratum that is covered for age composition

```
Lage_FC

##                          Belgium    France Ireland UK (England)
## GNS_DEF_>=220_0_0_all         NA        NA       1           NA
## GNS_DEF_all_0_0_all           NA        NA      NA    0.2983227
## GTR_DEF_90-99_0_0_all         NA 0.0000000      NA           NA
## GTR_DEF_all_0_0_all           NA        NA      NA    0.0000000
## LLS_FIF_0_0_0_all             NA        NA      NA    0.0000000
## MIS_MIS_0_0_0_HC              NA 0.0000000       1    0.0000000
## OTB_CRU_100-119_0_0_all       NA 0.0000000       1    0.0000000
## OTB_CRU_16-31_0_0_all         NA        NA      NA    0.0000000
## OTB_CRU_70-99_0_0_all          0        NA       1    0.0000000
## OTB_DEF_>=120_0_0_all         NA        NA      NA    0.0000000
```

```
## OTB_DEF_100-119_0_0_all      NA 0.0000000       1          NA
## OTB_DEF_70-99_0_0_all        NA 0.0000000       1   0.6277646
## OTM_DEF_100-119_0_0_all      NA        NA      NA          NA
## OTT_CRU_100-119_0_0          NA 0.0000000      NA          NA
## OTT_DEF_100-119_0_0          NA 0.2597567      NA          NA
## PTM_DEF_100-119_0_0_all      NA        NA      NA          NA
## SSC_DEF_100-119_0_0_all      NA        NA       1          NA
## TBB_DEF_70-99_0_0_all         1        NA       1   0.8757891
##                          UK(Northern Ireland) UK(Scotland)
## GNS_DEF_>=220_0_0_all                      NA           NA
## GNS_DEF_all_0_0_all                        NA           NA
## GTR_DEF_90-99_0_0_all                      NA           NA
## GTR_DEF_all_0_0_all                        NA           NA
## LLS_FIF_0_0_0_all                          NA           NA
## MIS_MIS_0_0_0_HC                           NA           NA
## OTB_CRU_100-119_0_0_all                    NA           NA
## OTB_CRU_16-31_0_0_all                      NA           NA
## OTB_CRU_70-99_0_0_all                       0           NA
## OTB_DEF_>=120_0_0_all                      NA            0
## OTB_DEF_100-119_0_0_all                    NA           NA
## OTB_DEF_70-99_0_0_all                      NA           NA
## OTM_DEF_100-119_0_0_all                     0           NA
## OTT_CRU_100-119_0_0                        NA           NA
## OTT_DEF_100-119_0_0                        NA           NA
## PTM_DEF_100-119_0_0_all                     0           NA
## SSC_DEF_100-119_0_0_all                     0           NA
## TBB_DEF_70-99_0_0_all                      NA           NA
```

```
Dage_FC #note: proportions shown prior to discard raising
```

```
##                          Belgium France Ireland UK (England)
## GNS_DEF_>=220_0_0_all         NA     NA     NaN           NA
## GNS_DEF_all_0_0_all           NA     NA      NA          NaN
## GTR_DEF_90-99_0_0_all         NA    NaN      NA           NA
## GTR_DEF_all_0_0_all           NA     NA      NA          NaN
## LLS_FIF_0_0_0_all             NA     NA      NA          NaN
## MIS_MIS_0_0_0_HC              NA    NaN     NaN          NaN
## OTB_CRU_100-119_0_0_all       NA    NaN     NaN          NaN
## OTB_CRU_16-31_0_0_all         NA     NA      NA          NaN
## OTB_CRU_70-99_0_0_all        NaN     NA     NaN          NaN
## OTB_DEF_>=120_0_0_all         NA     NA      NA          NaN
## OTB_DEF_100-119_0_0_all       NA    NaN     NaN           NA
## OTB_DEF_70-99_0_0_all         NA    NaN     NaN          NaN
## OTM_DEF_100-119_0_0_all       NA     NA      NA           NA
## OTT_CRU_100-119_0_0           NA    NaN      NA           NA
## OTT_DEF_100-119_0_0           NA    NaN      NA           NA
## PTM_DEF_100-119_0_0_all       NA     NA      NA           NA
## SSC_DEF_100-119_0_0_all       NA     NA     NaN           NA
## TBB_DEF_70-99_0_0_all          1     NA     NaN            1
##                          UK(Northern Ireland) UK(Scotland)
## GNS_DEF_>=220_0_0_all                      NA           NA
## GNS_DEF_all_0_0_all                        NA           NA
## GTR_DEF_90-99_0_0_all                      NA           NA
## GTR_DEF_all_0_0_all                        NA           NA
```

```
## LLS_FIF_0_0_0_all                        NA           NA
## MIS_MIS_0_0_0_HC                         NA           NA
## OTB_CRU_100-119_0_0_all                  NA           NA
## OTB_CRU_16-31_0_0_all                    NA           NA
## OTB_CRU_70-99_0_0_all                   NaN           NA
## OTB_DEF_>=120_0_0_all                    NA          NaN
## OTB_DEF_100-119_0_0_all                  NA           NA
## OTB_DEF_70-99_0_0_all                    NA           NA
## OTM_DEF_100-119_0_0_all                 NaN           NA
## OTT_CRU_100-119_0_0                      NA           NA
## OTT_DEF_100-119_0_0                      NA           NA
## PTM_DEF_100-119_0_0_all                 NaN           NA
## SSC_DEF_100-119_0_0_all                 NaN           NA
## TBB_DEF_70-99_0_0_all                    NA           NA
```

Section C: Discard ratio coverage (Lwt !Dwt / sum(Lwt))

1. Total proportion of the landings for which discard weights are available

```
Ldis_A_tot

## [1] 0.7790478
```

2. Proportion of landings for which discard weights are available by area and season

```
Ldis_AS

##                1 2         3 4 2013
## 27.7.f 0.9135509 0 0.0000000 0    1
## 27.7.g 0.0000000 0 0.2172829 0    0
```

3. Proportion of landings for which discard weights are available in each métier-country stratum

```
Ldis_FC

##                           Belgium France Ireland UK (England)
## GNS_DEF_>=220_0_0_all          NA     NA       0           NA
## GNS_DEF_all_0_0_all            NA     NA      NA    0.0000000
## GTR_DEF_90-99_0_0_all          NA      0      NA           NA
## GTR_DEF_all_0_0_all            NA     NA      NA    0.0000000
## LLS_FIF_0_0_0_all              NA     NA      NA    0.0000000
## MIS_MIS_0_0_0_HC               NA      0       0    0.0000000
## OTB_CRU_100-119_0_0_all        NA      0       0    0.0000000
## OTB_CRU_16-31_0_0_all          NA     NA      NA    0.0000000
## OTB_CRU_70-99_0_0_all           0     NA       0    0.0000000
## OTB_DEF_>=120_0_0_all          NA     NA      NA    0.0000000
## OTB_DEF_100-119_0_0_all        NA      0       0           NA
## OTB_DEF_70-99_0_0_all          NA      0       0    0.3200285
## OTM_DEF_100-119_0_0_all        NA     NA      NA           NA
## OTT_CRU_100-119_0_0            NA      0      NA           NA
## OTT_DEF_100-119_0_0            NA      0      NA           NA
## PTM_DEF_100-119_0_0_all        NA     NA      NA           NA
## SSC_DEF_100-119_0_0_all        NA     NA       0           NA
## TBB_DEF_70-99_0_0_all           1     NA       0    0.5391046
##                           UK(Northern Ireland) UK(Scotland)
## GNS_DEF_>=220_0_0_all                       NA           NA
```

```
## GNS_DEF_all_0_0_all                          NA            NA
## GTR_DEF_90-99_0_0_all                        NA            NA
## GTR_DEF_all_0_0_all                          NA            NA
## LLS_FIF_0_0_0_all                            NA            NA
## MIS_MIS_0_0_0_HC                             NA            NA
## OTB_CRU_100-119_0_0_all                      NA            NA
## OTB_CRU_16-31_0_0_all                        NA            NA
## OTB_CRU_70-99_0_0_all                         0            NA
## OTB_DEF_>=120_0_0_all                        NA             0
## OTB_DEF_100-119_0_0_all                      NA            NA
## OTB_DEF_70-99_0_0_all                        NA            NA
## OTM_DEF_100-119_0_0_all                       0            NA
## OTT_CRU_100-119_0_0                          NA            NA
## OTT_DEF_100-119_0_0                          NA            NA
## PTM_DEF_100-119_0_0_all                       0            NA
## SSC_DEF_100-119_0_0_all                       0            NA
## TBB_DEF_70-99_0_0_all                        NA            NA
```

Section D: Landings age coverage ranked by landed weights

This section shows the proportion of landings covered for age composition, in total (Lage_tot), by métier and for the larger gear groups (Lage_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable age coverage for landings. Additionally, the proportion of landings for which discard age coverage is available is presented for the larger gear groups (Dage_gear).

```
Lage_tot<-sum(Lage_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Lage_AS = Lwt !Lagesamp / sum(Lwt); L_AS = Lwt / sum(Lwt))
Lage_tot

## [1] 0.8925893

format(Lage_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Lage_AS

##                       Fleet Total rank_Total
## 18    TBB_DEF_70-99_0_0_all   1.0   0.862938
## 9     OTB_CRU_70-99_0_0_all   0.2   0.044094
## 11 OTB_DEF_100-119_0_0_all   0.3   0.024361
## 12    OTB_DEF_70-99_0_0_all   0.6   0.021894
## 6          MIS_MIS_0_0_0_HC   0.9   0.019016
## 15      OTT_DEF_100-119_0_0   0.3   0.018935
## 14      OTT_CRU_100-119_0_0   0.0   0.003198
## 2       GNS_DEF_all_0_0_all   0.3   0.002291
## 10    OTB_DEF_>=120_0_0_all   0.0   0.001093
## 3     GTR_DEF_90-99_0_0_all   0.0   0.000923
## 7  OTB_CRU_100-119_0_0_all   0.4   0.000850
## 1     GNS_DEF_>=220_0_0_all   1.0   0.000169
## 17 SSC_DEF_100-119_0_0_all   0.8   0.000134
## 13 OTM_DEF_100-119_0_0_all   0.0   0.000047
## 8     OTB_CRU_16-31_0_0_all   0.0   0.000043
## 16 PTM_DEF_100-119_0_0_all   0.0   0.000007
## 4       GTR_DEF_all_0_0_all   0.0   0.000005
## 5         LLS_FIF_0_0_0_all   0.0   0.000003
```

```
Lage_gear

##       GTR       OTB      REST       TBB
## 0.2516790 0.2818238 0.8822954 0.9764449

Dage_gear

##       GTR       OTB      REST       TBB
## 0.0000000 0.0000000 0.0000000 0.8886099
```

Section E: Discard ratio coverage ranked by landed weight

This section shows the proportion of landings for which discard weights are available, in total (Ldis_tot), by métier and for the larger gear groups (Ldis_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable discard ratio coverage.

```
Ldis_tot<-sum(Ldis_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Ldis_AS = Lwt !Dwt / sum(Lwt); L_AS = Lwt / sum(Lwt)
Ldis_tot

## [1] 0.7790478

format(Ldis_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Ldis_AS

##                      Fleet Total rank_Total
## 18   TBB_DEF_70-99_0_0_all   0.9   0.862938
## 9    OTB_CRU_70-99_0_0_all   0.0   0.044094
## 11 OTB_DEF_100-119_0_0_all   0.0   0.024361
## 12   OTB_DEF_70-99_0_0_all   0.3   0.021894
## 6          MIS_MIS_0_0_0_HC   0.0   0.019016
## 15     OTT_DEF_100-119_0_0   0.0   0.018935
## 14     OTT_CRU_100-119_0_0   0.0   0.003198
## 2      GNS_DEF_all_0_0_all   0.0   0.002291
## 10   OTB_DEF_>=120_0_0_all   0.0   0.001093
## 3    GTR_DEF_90-99_0_0_all   0.0   0.000923
## 7  OTB_CRU_100-119_0_0_all   0.0   0.000850
## 1    GNS_DEF_>=220_0_0_all   0.0   0.000169
## 17 SSC_DEF_100-119_0_0_all   0.0   0.000134
## 13 OTM_DEF_100-119_0_0_all   0.0   0.000047
## 8    OTB_CRU_16-31_0_0_all   0.0   0.000043
## 16 PTM_DEF_100-119_0_0_all   0.0   0.000007
## 4      GTR_DEF_all_0_0_all   0.0   0.000005
## 5        LLS_FIF_0_0_0_all   0.0   0.000003

Ldis_gear

##        GTR        OTB       REST        TBB
## 0.00000000 0.05383995 0.00000000 0.89563487
```

InterCatch input for 2014

```
##                  1         2 3 4     2014
## 27.7.f 0.9725008 0.8209208 0 0 1.000000
## 27.7.g 0.2950090 0.1987435 0 0 0.941819
```

This appendix lists 5 sections of tables (A-E) for each InterCatch year. It provides a detailed summary of the InterCatch input data in terms of importance by landed weight and the proportional coverage for age data and discard ratios.

Section A: Importance by landed weight (Lwt / sum(Lwt))

1. Proportion of landings by area and season

```
L_AS*100
```

```
##                  1         2        3         4     2014
## 27.7.f 13.549174 13.175077 1.328449 0.1166599 64.02746
## 27.7.g  0.995839  1.749511 1.378971 1.0150535  2.66381
```

2. Proportion of landings by métier and country

```
format(data.frame(L_FC*100),scientific=3,digit=1)
```

```
##                           Belgium France Ireland UK..England.
## GNS_DEF_120-219_0_0_all        NA     NA    0.02           NA
## GNS_DEF_all_0_0_all            NA     NA      NA       0.2450
## GTR_DEF_90-99_0_0_all          NA   0.05      NA           NA
## GTR_DEF_all_0_0_all            NA     NA      NA       0.0002
## MIS_MIS_0_0_0_HC               NA   0.05    0.13       0.0356
## OTB_CRU_100-119_0_0_all        NA   0.02      NA           NA
## OTB_CRU_16-31_0_0_all          NA     NA      NA       0.0009
## OTB_CRU_70-99_0_0_all           3     NA      NA       0.0258
## OTB_CRU_70-99_1_110_all        NA     NA    0.49           NA
## OTB_DEF_>=120_0_0_all          NA     NA      NA       0.3093
## OTB_DEF_100-119_0_0_all        NA   3.67    0.08           NA
## OTB_DEF_100-119_1_100_all      NA     NA    0.79           NA
## OTB_DEF_70-99_0_0_all          NA   0.11      NA       0.5155
## OTT_CRU_100-119_0_0            NA   0.28      NA           NA
## OTT_DEF_100-119_0_0            NA   1.35      NA           NA
## SSC_DEF_100-119_0_0_all        NA     NA      NA           NA
## TBB_DEF_>=120_0_0_all          NA     NA      NA       0.0100
## TBB_DEF_70-99_0_0_all          64     NA    1.14      23.1225
##                           UK.Northern.Ireland. UK.Scotland.
## GNS_DEF_120-219_0_0_all                     NA           NA
## GNS_DEF_all_0_0_all                         NA           NA
## GTR_DEF_90-99_0_0_all                       NA           NA
## GTR_DEF_all_0_0_all                         NA           NA
## MIS_MIS_0_0_0_HC                            NA           NA
## OTB_CRU_100-119_0_0_all                     NA           NA
## OTB_CRU_16-31_0_0_all                       NA           NA
## OTB_CRU_70-99_0_0_all                   0.0193        0.004
## OTB_CRU_70-99_1_110_all                     NA           NA
## OTB_DEF_>=120_0_0_all                       NA        0.003
```

```
## OTB_DEF_100-119_0_0_all                      NA          NA
## OTB_DEF_100-119_1_100_all                    NA          NA
## OTB_DEF_70-99_0_0_all                        NA          NA
## OTT_CRU_100-119_0_0                          NA          NA
## OTT_DEF_100-119_0_0                          NA          NA
## SSC_DEF_100-119_0_0_all                  0.0002          NA
## TBB_DEF_>=120_0_0_all                        NA          NA
## TBB_DEF_70-99_0_0_all                        NA          NA
```

3. Proportion of landings by country

```
apply(L_FC*100,2,function(x) sum(x,na.rm=T))
```

```
##             Belgium               France               Ireland
##         67.514769783          5.530253584          2.663809650
##         UK (England) UK(Northern Ireland)          UK(Scotland)
##         24.264664281          0.019492930          0.007009773
```

4. Proportion of landings by fleet and area

```
format(data.frame(L_FA*100),scientific=4,digit=1)
```

```
##                            X27.7.f X27.7.g
## GNS_DEF_120-219_0_0_all         NA  0.0208
## GNS_DEF_all_0_0_all         0.2352  0.0098
## GTR_DEF_90-99_0_0_all           NA  0.0460
## GTR_DEF_all_0_0_all             NA  0.0002
## MIS_MIS_0_0_0_HC            0.0610  0.1545
## OTB_CRU_100-119_0_0_all         NA  0.0196
## OTB_CRU_16-31_0_0_all       0.0009      NA
## OTB_CRU_70-99_0_0_all       1.3395  2.1971
## OTB_CRU_70-99_1_110_all         NA  0.4930
## OTB_DEF_>=120_0_0_all       0.3080  0.0040
## OTB_DEF_100-119_0_0_all     2.9155  0.8376
## OTB_DEF_100-119_1_100_all       NA  0.7925
## OTB_DEF_70-99_0_0_all       0.5801  0.0491
## OTT_CRU_100-119_0_0         0.0053  0.2783
## OTT_DEF_100-119_0_0         0.1568  1.1932
## SSC_DEF_100-119_0_0_all         NA  0.0002
## TBB_DEF_>=120_0_0_all       0.0100      NA
## TBB_DEF_70-99_0_0_all      86.5845  1.7074
```

5. Proportion of landings by métier, ranked from largest to smallest, together with cumulative sum

```
L_F1<-L_F
L_F1$rank_Total<-L_F1$rank_Total*100
L_F1<-L_F1[rev(order(L_F1$rank_Total)),]
L_F1$cum<-cumsum(L_F1$rank_Total)
format(L_F1,scientific=4,digit=1)
```

```
##                            rank_Total                     Fleet cum
## TBB_DEF_70-99_0_0_all         88.2919     TBB_DEF_70-99_0_0_all  88
## OTB_DEF_100-119_0_0_all        3.7530   OTB_DEF_100-119_0_0_all  92
## OTB_CRU_70-99_0_0_all          3.5367     OTB_CRU_70-99_0_0_all  96
## OTT_DEF_100-119_0_0            1.3500       OTT_DEF_100-119_0_0  97
## OTB_DEF_100-119_1_100_all      0.7925 OTB_DEF_100-119_1_100_all  98
```

```
## OTB_DEF_70-99_0_0_all          0.6292     OTB_DEF_70-99_0_0_all  98
## OTB_CRU_70-99_1_110_all        0.4930   OTB_CRU_70-99_1_110_all  99
## OTB_DEF_>=120_0_0_all          0.3121     OTB_DEF_>=120_0_0_all  99
## OTT_CRU_100-119_0_0            0.2836       OTT_CRU_100-119_0_0  99
## GNS_DEF_all_0_0_all            0.2450       GNS_DEF_all_0_0_all 100
## MIS_MIS_0_0_0_HC               0.2155          MIS_MIS_0_0_0_HC 100
## GTR_DEF_90-99_0_0_all          0.0460     GTR_DEF_90-99_0_0_all 100
## GNS_DEF_120-219_0_0_all        0.0208   GNS_DEF_120-219_0_0_all 100
## OTB_CRU_100-119_0_0_all        0.0196   OTB_CRU_100-119_0_0_all 100
## TBB_DEF_>=120_0_0_all          0.0100     TBB_DEF_>=120_0_0_all 100
## OTB_CRU_16-31_0_0_all          0.0009     OTB_CRU_16-31_0_0_all 100
## SSC_DEF_100-119_0_0_all        0.0002   SSC_DEF_100-119_0_0_all 100
## GTR_DEF_all_0_0_all            0.0002       GTR_DEF_all_0_0_all 100
```

Section B: Age coverage

1. Total proportion of the landings/sampled discards that is covered for age composition

```
Lage_A_tot #(Lwt !Lagesamp / sum(Lwt))

## [1] 0.9117005

Dage_A_tot #(Dwt !Dagesamp / sum(Dwt))

## [1] 1
```

2. Proportion of landings/sampled discards by area and season that is covered for age composition

```
Lage_AS

##                 1         2 3 4     2014
## 27.7.f 0.9725008 0.8209208 0 0 1.000000
## 27.7.g 0.2950090 0.1987435 0 0 0.941819

Dage_AS

##          2 2014
## 27.7.f   1    1
## 27.7.g NaN    1
```

3. Proportion of landings/sampled discards in each métier-country stratum that is covered for age composition

```
Lage_FC

##                           Belgium    France Ireland UK (England)
## GNS_DEF_120-219_0_0_all        NA        NA       0           NA
## GNS_DEF_all_0_0_all            NA        NA      NA    0.4163073
## GTR_DEF_90-99_0_0_all          NA 0.0000000      NA           NA
## GTR_DEF_all_0_0_all            NA        NA      NA    0.0000000
## MIS_MIS_0_0_0_HC               NA 0.0000000       0    0.0000000
## OTB_CRU_100-119_0_0_all        NA 0.0000000      NA           NA
## OTB_CRU_16-31_0_0_all          NA        NA      NA    0.0000000
## OTB_CRU_70-99_0_0_all           0        NA      NA    0.0000000
## OTB_CRU_70-99_1_110_all        NA        NA       1           NA
## OTB_DEF_>=120_0_0_all          NA        NA      NA    0.0000000
```

```
## OTB_DEF_100-119_0_0_all        NA 0.4495565        1           NA
## OTB_DEF_100-119_1_100_all      NA        NA        1           NA
## OTB_DEF_70-99_0_0_all          NA 0.0000000       NA    0.0000000
## OTT_CRU_100-119_0_0            NA 0.0000000       NA           NA
## OTT_DEF_100-119_0_0            NA 0.0000000       NA           NA
## SSC_DEF_100-119_0_0_all        NA        NA       NA           NA
## TBB_DEF_>=120_0_0_all          NA        NA       NA    0.0000000
## TBB_DEF_70-99_0_0_all           1        NA        1    0.9895639
##                            UK(Northern Ireland) UK(Scotland)
## GNS_DEF_120-219_0_0_all                      NA           NA
## GNS_DEF_all_0_0_all                          NA           NA
## GTR_DEF_90-99_0_0_all                        NA           NA
## GTR_DEF_all_0_0_all                          NA           NA
## MIS_MIS_0_0_0_HC                             NA           NA
## OTB_CRU_100-119_0_0_all                      NA           NA
## OTB_CRU_16-31_0_0_all                        NA           NA
## OTB_CRU_70-99_0_0_all                         0            0
## OTB_CRU_70-99_1_110_all                      NA           NA
## OTB_DEF_>=120_0_0_all                        NA            0
## OTB_DEF_100-119_0_0_all                      NA           NA
## OTB_DEF_100-119_1_100_all                    NA           NA
## OTB_DEF_70-99_0_0_all                        NA           NA
## OTT_CRU_100-119_0_0                          NA           NA
## OTT_DEF_100-119_0_0                          NA           NA
## SSC_DEF_100-119_0_0_all                       0           NA
## TBB_DEF_>=120_0_0_all                        NA           NA
## TBB_DEF_70-99_0_0_all                        NA           NA
```

```
Dage_FC #note: proportions shown prior to discard raising
```

```
##                            Belgium France Ireland UK (England)
## GNS_DEF_120-219_0_0_all         NA     NA     NaN           NA
## GNS_DEF_all_0_0_all             NA     NA      NA          NaN
## GTR_DEF_90-99_0_0_all           NA    NaN      NA           NA
## GTR_DEF_all_0_0_all             NA     NA      NA          NaN
## MIS_MIS_0_0_0_HC                NA    NaN     NaN          NaN
## OTB_CRU_100-119_0_0_all         NA    NaN      NA           NA
## OTB_CRU_16-31_0_0_all           NA     NA      NA          NaN
## OTB_CRU_70-99_0_0_all          NaN     NA      NA          NaN
## OTB_CRU_70-99_1_110_all         NA     NA       1           NA
## OTB_DEF_>=120_0_0_all           NA     NA      NA          NaN
## OTB_DEF_100-119_0_0_all         NA    NaN     NaN           NA
## OTB_DEF_100-119_1_100_all       NA     NA     NaN           NA
## OTB_DEF_70-99_0_0_all           NA    NaN      NA          NaN
## OTT_CRU_100-119_0_0             NA    NaN      NA           NA
## OTT_DEF_100-119_0_0             NA    NaN      NA           NA
## SSC_DEF_100-119_0_0_all         NA     NA      NA           NA
## TBB_DEF_>=120_0_0_all           NA     NA      NA          NaN
## TBB_DEF_70-99_0_0_all            1     NA       1            1
##                            UK(Northern Ireland) UK(Scotland)
## GNS_DEF_120-219_0_0_all                      NA           NA
## GNS_DEF_all_0_0_all                          NA           NA
## GTR_DEF_90-99_0_0_all                        NA           NA
## GTR_DEF_all_0_0_all                          NA           NA
```

```
## MIS_MIS_0_0_0_HC                           NA           NA
## OTB_CRU_100-119_0_0_all                    NA           NA
## OTB_CRU_16-31_0_0_all                      NA           NA
## OTB_CRU_70-99_0_0_all                     NaN          NaN
## OTB_CRU_70-99_1_110_all                    NA           NA
## OTB_DEF_>=120_0_0_all                      NA          NaN
## OTB_DEF_100-119_0_0_all                    NA           NA
## OTB_DEF_100-119_1_100_all                  NA           NA
## OTB_DEF_70-99_0_0_all                      NA           NA
## OTT_CRU_100-119_0_0                        NA           NA
## OTT_DEF_100-119_0_0                        NA           NA
## SSC_DEF_100-119_0_0_all                   NaN           NA
## TBB_DEF_>=120_0_0_all                      NA           NA
## TBB_DEF_70-99_0_0_all                      NA           NA
```

Section C: Discard ratio coverage (Lwt !Dwt / sum(Lwt))

1. Total proportion of the landings for which discard weights are available

```
Ldis_A_tot

## [1] 0.7682586
```

2. Proportion of landings for which discard weights are available by area and season

```
Ldis_AS

##        1         2 3 4      2014
## 27.7.f 0 0.8209208 0 0 1.0000000
## 27.7.g 0 0.1987435 0 0 0.6137847
```

3. Proportion of landings for which discard weights are available in each métier-country stratum

```
Ldis_FC

##                             Belgium France Ireland UK (England)
## GNS_DEF_120-219_0_0_all          NA     NA       0           NA
## GNS_DEF_all_0_0_all              NA     NA      NA    0.0000000
## GTR_DEF_90-99_0_0_all            NA      0      NA           NA
## GTR_DEF_all_0_0_all              NA     NA      NA    0.0000000
## MIS_MIS_0_0_0_HC                 NA      0       0    0.0000000
## OTB_CRU_100-119_0_0_all          NA      0      NA           NA
## OTB_CRU_16-31_0_0_all            NA     NA      NA    0.0000000
## OTB_CRU_70-99_0_0_all             0     NA      NA    0.0000000
## OTB_CRU_70-99_1_110_all          NA     NA       1           NA
## OTB_DEF_>=120_0_0_all            NA     NA      NA    0.0000000
## OTB_DEF_100-119_0_0_all          NA      0       0           NA
## OTB_DEF_100-119_1_100_all        NA     NA       0           NA
## OTB_DEF_70-99_0_0_all            NA      0      NA    0.0000000
## OTT_CRU_100-119_0_0              NA      0      NA           NA
## OTT_DEF_100-119_0_0              NA      0      NA           NA
## SSC_DEF_100-119_0_0_all          NA     NA      NA           NA
## TBB_DEF_>=120_0_0_all            NA     NA      NA    0.0000000
## TBB_DEF_70-99_0_0_all             1     NA       1    0.4827947
##                             UK(Northern Ireland) UK(Scotland)
## GNS_DEF_120-219_0_0_all                       NA           NA
```

```
## GNS_DEF_all_0_0_all                              NA           NA
## GTR_DEF_90-99_0_0_all                            NA           NA
## GTR_DEF_all_0_0_all                              NA           NA
## MIS_MIS_0_0_0_HC                                 NA           NA
## OTB_CRU_100-119_0_0_all                          NA           NA
## OTB_CRU_16-31_0_0_all                            NA           NA
## OTB_CRU_70-99_0_0_all                             0            0
## OTB_CRU_70-99_1_110_all                          NA           NA
## OTB_DEF_>=120_0_0_all                            NA            0
## OTB_DEF_100-119_0_0_all                          NA           NA
## OTB_DEF_100-119_1_100_all                        NA           NA
## OTB_DEF_70-99_0_0_all                            NA           NA
## OTT_CRU_100-119_0_0                              NA           NA
## OTT_DEF_100-119_0_0                              NA           NA
## SSC_DEF_100-119_0_0_all                           0           NA
## TBB_DEF_>=120_0_0_all                            NA           NA
## TBB_DEF_70-99_0_0_all                            NA           NA
```

Section D: Landings age coverage ranked by landed weights

This section shows the proportion of landings covered for age composition, in total (Lage_tot), by métier and for the larger gear groups (Lage_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable age coverage for landings. Additionally, the proportion of landings for which discard age coverage is available is presented for the larger gear groups (Dage_gear).

```
Lage_tot<-sum(Lage_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Lage_AS = Lwt !Lagesamp / sum(Lwt); L_AS = Lwt / sum(Lwt))
Lage_tot

## [1] 0.9117005

format(Lage_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Lage_AS

##                          Fleet Total rank_Total
## 18       TBB_DEF_70-99_0_0_all   1.0   0.882919
## 11     OTB_DEF_100-119_0_0_all   0.5   0.037530
## 8        OTB_CRU_70-99_0_0_all   0.0   0.035367
## 15         OTT_DEF_100-119_0_0   0.0   0.013500
## 12 OTB_DEF_100-119_1_100_all   1.0   0.007925
## 13       OTB_DEF_70-99_0_0_all   0.0   0.006292
## 9      OTB_CRU_70-99_1_110_all   1.0   0.004930
## 10       OTB_DEF_>=120_0_0_all   0.0   0.003121
## 14         OTT_CRU_100-119_0_0   0.0   0.002836
## 2          GNS_DEF_all_0_0_all   0.4   0.002450
## 5             MIS_MIS_0_0_0_HC   0.0   0.002155
## 3        GTR_DEF_90-99_0_0_all   0.0   0.000460
## 1      GNS_DEF_120-219_0_0_all   0.0   0.000208
## 6      OTB_CRU_100-119_0_0_all   0.0   0.000196
## 17       TBB_DEF_>=120_0_0_all   0.0   0.000100
## 7        OTB_CRU_16-31_0_0_all   0.0   0.000009
## 16     SSC_DEF_100-119_0_0_all   0.0   0.000002
## 4          GTR_DEF_all_0_0_all   0.0   0.000002
```

```
Lage_gear

##       GTR       OTB      REST       TBB
## 0.3268960 0.2701232 0.0000000 0.9971541

Dage_gear

##        GTR        OTB       REST        TBB
## 0.00000000 0.04413254 0.00000000 0.86051552
```

Section E: Discard ratio coverage ranked by landed weight

This section shows the proportion of landings for which discard weights are available, in total (Ldis_tot), by métier and for the larger gear groups (Ldis_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable discard ratio coverage.

```
Ldis_tot<-sum(Ldis_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Ldis_AS = Lwt !Dwt / sum(Lwt); L_AS = Lwt / sum(Lwt)
Ldis_tot

## [1] 0.7682586

format(Ldis_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Ldis_AS

##                        Fleet Total rank_Total
## 18      TBB_DEF_70-99_0_0_all   0.9   0.882919
## 11    OTB_DEF_100-119_0_0_all   0.0   0.037530
## 8       OTB_CRU_70-99_0_0_all   0.0   0.035367
## 15        OTT_DEF_100-119_0_0   0.0   0.013500
## 12 OTB_DEF_100-119_1_100_all   0.0   0.007925
## 13      OTB_DEF_70-99_0_0_all   0.0   0.006292
## 9     OTB_CRU_70-99_1_110_all   1.0   0.004930
## 10      OTB_DEF_>=120_0_0_all   0.0   0.003121
## 14        OTT_CRU_100-119_0_0   0.0   0.002836
## 2         GNS_DEF_all_0_0_all   0.0   0.002450
## 5            MIS_MIS_0_0_0_HC   0.0   0.002155
## 3       GTR_DEF_90-99_0_0_all   0.0   0.000460
## 1     GNS_DEF_120-219_0_0_all   0.0   0.000208
## 6     OTB_CRU_100-119_0_0_all   0.0   0.000196
## 17      TBB_DEF_>=120_0_0_all   0.0   0.000100
## 7       OTB_CRU_16-31_0_0_all   0.0   0.000009
## 16    SSC_DEF_100-119_0_0_all   0.0   0.000002
## 4         GTR_DEF_all_0_0_all   0.0   0.000002

Ldis_gear

##        GTR        OTB       REST        TBB
## 0.00000000 0.04413254 0.00000000 0.86445319
```

InterCatch input for 2015

```
##                   1         2         3         4      2015
## 27.7.f 0.03351204 0.9023206 0.6199286 0.4378537 1.0000000
## 27.7.g         NA 0.2017294        NA        NA 0.9406637
```

This appendix lists 5 sections of tables (A-E) for each InterCatch year. It provides a detailed summary of the InterCatch input data in terms of importance by landed weight and the proportional coverage for age data and discard ratios.

Section A: Importance by landed weight (Lwt / sum(Lwt))

1. Proportion of landings by area and season

```
L_AS*100

##                 1        2        3         4      2015
## 27.7.f 3.890621 5.091674 3.286256 0.9973707 77.069994
## 27.7.g 1.011600 1.645949 2.602204 1.1032311  3.301101
```

2. Proportion of landings by métier and country

```
format(data.frame(L_FC*100),scientific=3,digit=1)

##                         Belgium France Ireland UK..England.
## GNS_DEF_120-219_0_0_all      NA     NA    0.02           NA
## GNS_DEF_all_0_0_all          NA     NA      NA       0.3533
## GTR_DEF_90-99_0_0_all        NA   0.05      NA           NA
## GTR_DEF_all_0_0_all          NA     NA      NA       0.0006
## LLS_FIF_0_0_0_all            NA     NA      NA       0.0028
## MIS_MIS_0_0_0_HC             NA   0.01    0.17       0.0813
## OTB_CRU_100-119_0_0_all      NA   0.01      NA       0.0177
## OTB_CRU_70-99_0_0_all         4     NA      NA           NA
## OTB_DEF_>=120_0_0_all        NA     NA      NA       0.2434
## OTB_DEF_100-119_0_0_all      NA   1.30    1.61           NA
## OTB_DEF_70-99_0_0_all        NA   0.04      NA       1.4143
## OTT_CRU_100-119_0_0          NA   0.32      NA           NA
## OTT_DEF_100-119_0_0          NA   1.20      NA           NA
## SSC_DEF_100-119_0_0_all      NA     NA      NA           NA
## TBB_DEF_70-99_0_0_all        77     NA    1.50      10.4788
##                         UK.Northern.Ireland. UK.Scotland.
## GNS_DEF_120-219_0_0_all                   NA           NA
## GNS_DEF_all_0_0_all                       NA           NA
## GTR_DEF_90-99_0_0_all                     NA           NA
## GTR_DEF_all_0_0_all                       NA           NA
## LLS_FIF_0_0_0_all                         NA           NA
## MIS_MIS_0_0_0_HC                          NA           NA
## OTB_CRU_100-119_0_0_all                   NA           NA
## OTB_CRU_70-99_0_0_all                 0.0618           NA
## OTB_DEF_>=120_0_0_all                     NA        0.003
## OTB_DEF_100-119_0_0_all                   NA           NA
## OTB_DEF_70-99_0_0_all                     NA           NA
## OTT_CRU_100-119_0_0                       NA           NA
## OTT_DEF_100-119_0_0                       NA           NA
```

```
## SSC_DEF_100-119_0_0_all                   0.0004           NA
## TBB_DEF_70-99_0_0_all                         NA           NA
```

3. Proportion of landings by country

```
apply(L_FC*100,2,function(x) sum(x,na.rm=T))
```

```
##             Belgium              France             Ireland
##         81.117875599         2.923793108         3.301101007
##         UK (England) UK(Northern Ireland)        UK(Scotland)
##         12.592219543         0.062121376         0.002889366
```

4. Proportion of landings by fleet and area

```
format(data.frame(L_FA*100),scientific=4,digit=1)
```

```
##                          X27.7.f X27.7.g
## GNS_DEF_120-219_0_0_all       NA  0.0220
## GNS_DEF_all_0_0_all       0.3359  0.0175
## GTR_DEF_90-99_0_0_all         NA  0.0496
## GTR_DEF_all_0_0_all       0.0004  0.0002
## LLS_FIF_0_0_0_all         0.0026  0.0001
## MIS_MIS_0_0_0_HC          0.0925  0.1749
## OTB_CRU_100-119_0_0_all   0.0039  0.0259
## OTB_CRU_70-99_0_0_all     1.2228  2.8868
## OTB_DEF_>=120_0_0_all     0.2434  0.0029
## OTB_DEF_100-119_0_0_all   1.0598  1.8438
## OTB_DEF_70-99_0_0_all     1.4320  0.0210
## OTT_CRU_100-119_0_0       0.0036  0.3137
## OTT_DEF_100-119_0_0       0.0284  1.1694
## SSC_DEF_100-119_0_0_all       NA  0.0004
## TBB_DEF_70-99_0_0_all    85.9106  3.1357
```

5. Proportion of landings by métier, ranked from largest to smallest, together with cumulative sum

```
L_F1<-L_F
L_F1$rank_Total<-L_F1$rank_Total*100
L_F1<-L_F1[rev(order(L_F1$rank_Total)),]
L_F1$cum<-cumsum(L_F1$rank_Total)
format(L_F1,scientific=4,digit=1)
```

```
##                          rank_Total                   Fleet cum
## TBB_DEF_70-99_0_0_all       89.0463   TBB_DEF_70-99_0_0_all  89
## OTB_CRU_70-99_0_0_all        4.1096   OTB_CRU_70-99_0_0_all  93
## OTB_DEF_100-119_0_0_all      2.9035 OTB_DEF_100-119_0_0_all  96
## OTB_DEF_70-99_0_0_all        1.4531   OTB_DEF_70-99_0_0_all  98
## OTT_DEF_100-119_0_0          1.1979     OTT_DEF_100-119_0_0  99
## GNS_DEF_all_0_0_all          0.3533     GNS_DEF_all_0_0_all  99
## OTT_CRU_100-119_0_0          0.3173     OTT_CRU_100-119_0_0  99
## MIS_MIS_0_0_0_HC             0.2674        MIS_MIS_0_0_0_HC 100
## OTB_DEF_>=120_0_0_all        0.2463   OTB_DEF_>=120_0_0_all 100
## GTR_DEF_90-99_0_0_all        0.0496   GTR_DEF_90-99_0_0_all 100
## OTB_CRU_100-119_0_0_all      0.0298 OTB_CRU_100-119_0_0_all 100
## GNS_DEF_120-219_0_0_all      0.0220 GNS_DEF_120-219_0_0_all 100
## LLS_FIF_0_0_0_all            0.0028       LLS_FIF_0_0_0_all 100
```

```
## GTR_DEF_all_0_0_all          0.0006     GTR_DEF_all_0_0_all 100
## SSC_DEF_100-119_0_0_all      0.0004 SSC_DEF_100-119_0_0_all 100
```

Section B: Age coverage

1. Total proportion of the landings/sampled discards that is covered for age composition

```
Lage_A_tot #(Lwt !Lagesamp / sum(Lwt))

## [1] 0.8770591

Dage_A_tot #(Dwt !Dagesamp / sum(Dwt))

## [1] 1
```

2. Proportion of landings/sampled discards by area and season that is covered for age composition

```
Lage_AS

##                  1         2         3         4      2015
## 27.7.f 0.03351204 0.9023206 0.6199286 0.4378537 1.0000000
## 27.7.g         NA 0.2017294        NA        NA 0.9406637

Dage_AS

##        2015
## 27.7.f    1
## 27.7.g   NA
```

3. Proportion of landings/sampled discards in each métier-country stratum that is covered for age composition

```
Lage_FC

##                           Belgium    France Ireland UK (England)
## GNS_DEF_120-219_0_0_all        NA        NA       0           NA
## GNS_DEF_all_0_0_all            NA        NA      NA    0.7686542
## GTR_DEF_90-99_0_0_all          NA 0.0000000      NA           NA
## GTR_DEF_all_0_0_all            NA        NA      NA    0.0000000
## LLS_FIF_0_0_0_all              NA        NA      NA    0.0000000
## MIS_MIS_0_0_0_HC               NA 0.0000000       0    0.0000000
## OTB_CRU_100-119_0_0_all        NA 0.0000000      NA    0.0000000
## OTB_CRU_70-99_0_0_all           0        NA      NA           NA
## OTB_DEF_>=120_0_0_all          NA        NA      NA    0.0000000
## OTB_DEF_100-119_0_0_all        NA 0.3211041       1           NA
## OTB_DEF_70-99_0_0_all          NA 0.0000000      NA    0.9487572
## OTT_CRU_100-119_0_0            NA 0.0000000      NA           NA
## OTT_DEF_100-119_0_0            NA 0.0000000      NA           NA
## SSC_DEF_100-119_0_0_all        NA        NA      NA           NA
## TBB_DEF_70-99_0_0_all           1        NA       1    0.5249770
##                           UK(Northern Ireland) UK(Scotland)
## GNS_DEF_120-219_0_0_all                     NA           NA
## GNS_DEF_all_0_0_all                         NA           NA
## GTR_DEF_90-99_0_0_all                       NA           NA
## GTR_DEF_all_0_0_all                         NA           NA
## LLS_FIF_0_0_0_all                           NA           NA
```

```
## MIS_MIS_0_0_0_HC                                NA            NA
## OTB_CRU_100-119_0_0_all                         NA            NA
## OTB_CRU_70-99_0_0_all                            0            NA
## OTB_DEF_>=120_0_0_all                           NA             0
## OTB_DEF_100-119_0_0_all                         NA            NA
## OTB_DEF_70-99_0_0_all                           NA            NA
## OTT_CRU_100-119_0_0                             NA            NA
## OTT_DEF_100-119_0_0                             NA            NA
## SSC_DEF_100-119_0_0_all                          0            NA
## TBB_DEF_70-99_0_0_all                           NA            NA
```

```
Dage_FC #note: proportions shown prior to discard raising
```

```
##                           Belgium France Ireland UK (England)
## GNS_DEF_120-219_0_0_all        NA     NA     NaN           NA
## GNS_DEF_all_0_0_all            NA     NA      NA          NaN
## GTR_DEF_90-99_0_0_all          NA    NaN      NA           NA
## GTR_DEF_all_0_0_all            NA     NA      NA          NaN
## LLS_FIF_0_0_0_all              NA     NA      NA          NaN
## MIS_MIS_0_0_0_HC               NA    NaN     NaN          NaN
## OTB_CRU_100-119_0_0_all        NA    NaN      NA          NaN
## OTB_CRU_70-99_0_0_all         NaN     NA      NA           NA
## OTB_DEF_>=120_0_0_all          NA     NA      NA          NaN
## OTB_DEF_100-119_0_0_all        NA    NaN     NaN           NA
## OTB_DEF_70-99_0_0_all          NA    NaN      NA          NaN
## OTT_CRU_100-119_0_0            NA    NaN      NA           NA
## OTT_DEF_100-119_0_0            NA    NaN      NA           NA
## SSC_DEF_100-119_0_0_all        NA     NA      NA           NA
## TBB_DEF_70-99_0_0_all           1     NA     NaN          NaN
##                           UK(Northern Ireland) UK(Scotland)
## GNS_DEF_120-219_0_0_all                     NA           NA
## GNS_DEF_all_0_0_all                         NA           NA
## GTR_DEF_90-99_0_0_all                       NA           NA
## GTR_DEF_all_0_0_all                         NA           NA
## LLS_FIF_0_0_0_all                           NA           NA
## MIS_MIS_0_0_0_HC                            NA           NA
## OTB_CRU_100-119_0_0_all                     NA           NA
## OTB_CRU_70-99_0_0_all                      NaN           NA
## OTB_DEF_>=120_0_0_all                       NA          NaN
## OTB_DEF_100-119_0_0_all                     NA           NA
## OTB_DEF_70-99_0_0_all                       NA           NA
## OTT_CRU_100-119_0_0                         NA           NA
## OTT_DEF_100-119_0_0                         NA           NA
## SSC_DEF_100-119_0_0_all                    NaN           NA
## TBB_DEF_70-99_0_0_all                       NA           NA
```

Section C: Discard ratio coverage (Lwt !Dwt / sum(Lwt))

1. Total proportion of the landings for which discard weights are available

```
Ldis_A_tot

## [1] 0.7706999
```

2. Proportion of landings for which discard weights are available by area and season

```
Ldis_AS

##        1 2 3 4 2015
## 27.7.f 0 0 0 0    1
## 27.7.g 0 0 0 0    0
```

3. Proportion of landings for which discard weights are available in each métier-country stratum

```
Ldis_FC

##                           Belgium France Ireland UK (England)
## GNS_DEF_120-219_0_0_all      NA     NA       0           NA
## GNS_DEF_all_0_0_all          NA     NA      NA            0
## GTR_DEF_90-99_0_0_all        NA      0      NA           NA
## GTR_DEF_all_0_0_all          NA     NA      NA            0
## LLS_FIF_0_0_0_all            NA     NA      NA            0
## MIS_MIS_0_0_0_HC             NA      0       0            0
## OTB_CRU_100-119_0_0_all      NA      0      NA            0
## OTB_CRU_70-99_0_0_all         0     NA      NA           NA
## OTB_DEF_>=120_0_0_all        NA     NA      NA            0
## OTB_DEF_100-119_0_0_all      NA      0       0           NA
## OTB_DEF_70-99_0_0_all        NA      0      NA            0
## OTT_CRU_100-119_0_0          NA      0      NA           NA
## OTT_DEF_100-119_0_0          NA      0      NA           NA
## SSC_DEF_100-119_0_0_all      NA     NA      NA           NA
## TBB_DEF_70-99_0_0_all         1     NA       0            0
##                           UK(Northern Ireland) UK(Scotland)
## GNS_DEF_120-219_0_0_all                     NA           NA
## GNS_DEF_all_0_0_all                         NA           NA
## GTR_DEF_90-99_0_0_all                       NA           NA
## GTR_DEF_all_0_0_all                         NA           NA
## LLS_FIF_0_0_0_all                           NA           NA
## MIS_MIS_0_0_0_HC                            NA           NA
## OTB_CRU_100-119_0_0_all                     NA           NA
## OTB_CRU_70-99_0_0_all                        0           NA
## OTB_DEF_>=120_0_0_all                       NA            0
## OTB_DEF_100-119_0_0_all                     NA           NA
## OTB_DEF_70-99_0_0_all                       NA           NA
## OTT_CRU_100-119_0_0                         NA           NA
## OTT_DEF_100-119_0_0                         NA           NA
## SSC_DEF_100-119_0_0_all                      0           NA
## TBB_DEF_70-99_0_0_all                       NA           NA
```

Section D: Landings age coverage ranked by landed weights

This section shows the proportion of landings covered for age composition, in total (Lage_tot), by métier and for the larger gear groups (Lage_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable age coverage for landings. Additionally, the proportion of landings for which discard age coverage is available is presented for the larger gear groups (Dage_gear).

```
Lage_tot<-sum(Lage_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Lage_AS = Lwt !Lagesamp / sum(Lwt); L_AS = Lwt / sum(Lwt))
Lage_tot

## [1] 0.8770591

format(Lage_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Lage_AS

##                       Fleet Total rank_Total
## 15    TBB_DEF_70-99_0_0_all   0.9   0.890463
## 8     OTB_CRU_70-99_0_0_all   0.0   0.041096
## 10 OTB_DEF_100-119_0_0_all   0.7   0.029035
## 11    OTB_DEF_70-99_0_0_all   0.9   0.014531
## 13      OTT_DEF_100-119_0_0   0.0   0.011979
## 2       GNS_DEF_all_0_0_all   0.8   0.003533
## 12      OTT_CRU_100-119_0_0   0.0   0.003173
## 6          MIS_MIS_0_0_0_HC   0.0   0.002674
## 9     OTB_DEF_>=120_0_0_all   0.0   0.002463
## 3     GTR_DEF_90-99_0_0_all   0.0   0.000496
## 7  OTB_CRU_100-119_0_0_all   0.0   0.000298
## 1  GNS_DEF_120-219_0_0_all   0.0   0.000220
## 5         LLS_FIF_0_0_0_all   0.0   0.000028
## 4       GTR_DEF_all_0_0_all   0.0   0.000006
## 14 SSC_DEF_100-119_0_0_all   0.0   0.000004

Lage_gear

##       GTR       OTB      REST       TBB
## 0.6381372 0.3281029 0.0000000 0.9441004

Dage_gear

##       GTR       OTB      REST       TBB
## 0.0000000 0.0000000 0.0000000 0.8655048
```

Section E: Discard ratio coverage ranked by landed weight

This section shows the proportion of landings for which discard weights are available, in total (Ldis_tot), by métier and for the larger gear groups (Ldis_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable discard ratio coverage.

```
Ldis_tot<-sum(Ldis_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Ldis_AS = Lwt !Dwt / sum(Lwt); L_AS = Lwt / sum(Lwt)
Ldis_tot

## [1] 0.7706999

format(Ldis_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Ldis_AS

##                       Fleet Total rank_Total
## 15    TBB_DEF_70-99_0_0_all   0.9   0.890463
## 8     OTB_CRU_70-99_0_0_all   0.0   0.041096
## 10 OTB_DEF_100-119_0_0_all   0.0   0.029035
## 11    OTB_DEF_70-99_0_0_all   0.0   0.014531
```

```
## 13      OTT_DEF_100-119_0_0   0.0   0.011979
## 2       GNS_DEF_all_0_0_all   0.0   0.003533
## 12      OTT_CRU_100-119_0_0   0.0   0.003173
## 6          MIS_MIS_0_0_0_HC   0.0   0.002674
## 9     OTB_DEF_>=120_0_0_all   0.0   0.002463
## 3     GTR_DEF_90-99_0_0_all   0.0   0.000496
## 7  OTB_CRU_100-119_0_0_all   0.0   0.000298
## 1  GNS_DEF_120-219_0_0_all   0.0   0.000220
## 5         LLS_FIF_0_0_0_all   0.0   0.000028
## 4       GTR_DEF_all_0_0_all   0.0   0.000006
## 14 SSC_DEF_100-119_0_0_all   0.0   0.000004
```

```
Ldis_gear
```

```
##       GTR       OTB      REST       TBB
## 0.0000000 0.0000000 0.0000000 0.8655048
```

InterCatch input for 2016

```
##                   1        2         3         4 2016
## 27.7.f 0.7689347 0.782926 0.3357642 0.3626853    1
## 27.7.g        NA       NA 0.1091028 0.4957238    1
```

This appendix lists 5 sections of tables (A-E) for each InterCatch year. It provides a detailed summary of the InterCatch input data in terms of importance by landed weight and the proportional coverage for age data and discard ratios.

Section A: Importance by landed weight (Lwt / sum(Lwt))

1. Proportion of landings by area and season

```
L_AS*100

##                 1        2        3         4      2016
## 27.7.f 17.12681 5.016370 1.825555 0.9088888 63.167701
## 27.7.g  1.17177 1.856139 2.970972 3.3932952  2.562496
```

2. Proportion of landings by métier and country

```
format(data.frame(L_FC*100),scientific=3,digit=1)

##                          Belgium France Ireland UK..England.
## GNS_DEF_120-219_0_0_all       NA     NA   0.016           NA
## GNS_DEF_all_0_0_all           NA     NA      NA        0.518
## GTR_DEF_90-99_0_0_all         NA  0.000      NA           NA
## GTR_DEF_all_0_0_all           NA     NA      NA        0.003
## MIS_MIS_0_0_0_HC              NA  0.001      NA        0.030
## OTB_CRU_100-119_0_0_all       NA  0.049      NA        0.086
## OTB_CRU_16-31_0_0_all         NA     NA      NA        0.000
## OTB_CRU_70-99_0_0_all          5     NA      NA           NA
## OTB_DEF_>=120_0_0_all         NA     NA      NA        0.207
## OTB_DEF_100-119_0_0_all       NA  5.852   1.687           NA
## OTB_DEF_70-99_0_0_all         NA  0.078      NA        1.099
## OTT_CRU_100-119_0_0           NA  0.402      NA           NA
## OTT_DEF_100-119_0_0           NA  2.392      NA           NA
## SSC_DEF_100-119_0_0_all       NA     NA   0.005           NA
## TBB_CRU_16-31_0_0_all         NA     NA      NA        0.055
## TBB_DEF_>=120_0_0_all         NA     NA      NA           NA
## TBB_DEF_70-99_0_0_all         63     NA   0.855       18.840
##                          UK.Northern.Ireland. UK.Scotland.
## GNS_DEF_120-219_0_0_all                    NA           NA
## GNS_DEF_all_0_0_all                        NA           NA
## GTR_DEF_90-99_0_0_all                      NA           NA
## GTR_DEF_all_0_0_all                        NA           NA
## MIS_MIS_0_0_0_HC                           NA            0
## OTB_CRU_100-119_0_0_all                    NA           NA
## OTB_CRU_16-31_0_0_all                      NA           NA
## OTB_CRU_70-99_0_0_all                    0.10            0
## OTB_DEF_>=120_0_0_all                      NA            0
## OTB_DEF_100-119_0_0_all                  0.01           NA
## OTB_DEF_70-99_0_0_all                      NA           NA
```

```
## OTT_CRU_100-119_0_0                     NA            NA
## OTT_DEF_100-119_0_0                     NA            NA
## SSC_DEF_100-119_0_0_all                 NA            NA
## TBB_CRU_16-31_0_0_all                   NA            NA
## TBB_DEF_>=120_0_0_all                   NA             0
## TBB_DEF_70-99_0_0_all                   NA             0
```

3. Proportion of landings by country

```
apply(L_FC*100,2,function(x) sum(x,na.rm=T))
```

```
##             Belgium                France               Ireland
##          67.7181358             8.7736684             2.5624962
##         UK (England) UK(Northern Ireland)         UK(Scotland)
##          20.8375420             0.1081577             0.0000000
```

4. Proportion of landings by fleet and area

```
format(data.frame(L_FA*100),scientific=4,digit=1)
```

```
##                          X27.7.f X27.7.g
## GNS_DEF_120-219_0_0_all       NA  0.0155
## GNS_DEF_all_0_0_all        0.509  0.0084
## GTR_DEF_90-99_0_0_all         NA  0.0000
## GTR_DEF_all_0_0_all        0.003  0.0007
## MIS_MIS_0_0_0_HC           0.030  0.0012
## OTB_CRU_100-119_0_0_all    0.013  0.1221
## OTB_CRU_16-31_0_0_all      0.000      NA
## OTB_CRU_70-99_0_0_all      0.374  4.2721
## OTB_DEF_>=120_0_0_all      0.196  0.0111
## OTB_DEF_100-119_0_0_all    4.766  2.7857
## OTB_DEF_70-99_0_0_all      1.143  0.0345
## OTT_CRU_100-119_0_0        0.018  0.3844
## OTT_DEF_100-119_0_0        0.059  2.3321
## SSC_DEF_100-119_0_0_all       NA  0.0052
## TBB_CRU_16-31_0_0_all      0.055      NA
## TBB_DEF_>=120_0_0_all      0.000      NA
## TBB_DEF_70-99_0_0_all     80.880  1.9817
```

5. Proportion of landings by métier, ranked from largest to smallest, together with cumulative sum

```
L_F1<-L_F
L_F1$rank_Total<-L_F1$rank_Total*100
L_F1<-L_F1[rev(order(L_F1$rank_Total)),]
L_F1$cum<-cumsum(L_F1$rank_Total)
format(L_F1,scientific=4,digit=1)
```

```
##                          rank_Total                   Fleet cum
## TBB_DEF_70-99_0_0_all        82.862   TBB_DEF_70-99_0_0_all  83
## OTB_DEF_100-119_0_0_all       7.552 OTB_DEF_100-119_0_0_all  90
## OTB_CRU_70-99_0_0_all         4.646   OTB_CRU_70-99_0_0_all  95
## OTT_DEF_100-119_0_0           2.392     OTT_DEF_100-119_0_0  97
## OTB_DEF_70-99_0_0_all         1.177   OTB_DEF_70-99_0_0_all  99
## GNS_DEF_all_0_0_all           0.518     GNS_DEF_all_0_0_all  99
## OTT_CRU_100-119_0_0           0.402     OTT_CRU_100-119_0_0 100
## OTB_DEF_>=120_0_0_all         0.207   OTB_DEF_>=120_0_0_all 100
```

```
## OTB_CRU_100-119_0_0_all      0.135 OTB_CRU_100-119_0_0_all 100
## TBB_CRU_16-31_0_0_all        0.055   TBB_CRU_16-31_0_0_all 100
## MIS_MIS_0_0_0_HC             0.032        MIS_MIS_0_0_0_HC 100
## GNS_DEF_120-219_0_0_all      0.016 GNS_DEF_120-219_0_0_all 100
## SSC_DEF_100-119_0_0_all      0.005 SSC_DEF_100-119_0_0_all 100
## GTR_DEF_all_0_0_all          0.003     GTR_DEF_all_0_0_all 100
## TBB_DEF_>=120_0_0_all        0.000   TBB_DEF_>=120_0_0_all 100
## OTB_CRU_16-31_0_0_all        0.000   OTB_CRU_16-31_0_0_all 100
## GTR_DEF_90-99_0_0_all        0.000   GTR_DEF_90-99_0_0_all 100
```

Section B: Age coverage

1. Total proportion of the landings/sampled discards that is covered for age composition

```
Lage_A_tot #(Lwt !Lagesamp / sum(Lwt))

## [1] 0.8577592

Dage_A_tot #(Dwt !Dagesamp / sum(Dwt))

## [1] 0.8394875
```

2. Proportion of landings/sampled discards by area and season that is covered for age composition

```
Lage_AS

##                 1        2         3         4 2016
## 27.7.f 0.7689347 0.782926 0.3357642 0.3626853    1
## 27.7.g        NA       NA 0.1091028 0.4957238    1

Dage_AS

##         1  2   3   4 2016
## 27.7.f  1  0 NaN NaN    1
## 27.7.g NA NA  NA NaN   NA
```

3. Proportion of landings/sampled discards in each métier-country stratum that is covered for age composition

```
Lage_FC

##                         Belgium     France Ireland UK (England)
## GNS_DEF_120-219_0_0_all      NA         NA       1           NA
## GNS_DEF_all_0_0_all          NA         NA      NA    0.3173903
## GTR_DEF_90-99_0_0_all        NA        NaN      NA           NA
## GTR_DEF_all_0_0_all          NA         NA      NA    0.7407407
## MIS_MIS_0_0_0_HC             NA 0.00000000      NA    0.0000000
## OTB_CRU_100-119_0_0_all      NA 0.00000000      NA    0.0000000
## OTB_CRU_16-31_0_0_all        NA         NA      NA          NaN
## OTB_CRU_70-99_0_0_all         0         NA      NA           NA
## OTB_DEF_>=120_0_0_all        NA         NA      NA    0.0000000
## OTB_DEF_100-119_0_0_all      NA 0.07462074       1           NA
## OTB_DEF_70-99_0_0_all        NA 0.00000000      NA    0.9345212
## OTT_CRU_100-119_0_0          NA 0.24963377      NA           NA
## OTT_DEF_100-119_0_0          NA 0.70338154      NA           NA
## SSC_DEF_100-119_0_0_all      NA         NA       1           NA
```

```
## TBB_CRU_16-31_0_0_all        NA          NA       NA     0.0000000
## TBB_DEF_>=120_0_0_all        NA          NA       NA            NA
## TBB_DEF_70-99_0_0_all         1          NA        1     0.8828404
##                          UK(Northern Ireland) UK(Scotland)
## GNS_DEF_120-219_0_0_all                    NA           NA
## GNS_DEF_all_0_0_all                        NA           NA
## GTR_DEF_90-99_0_0_all                      NA           NA
## GTR_DEF_all_0_0_all                        NA           NA
## MIS_MIS_0_0_0_HC                           NA          NaN
## OTB_CRU_100-119_0_0_all                    NA           NA
## OTB_CRU_16-31_0_0_all                      NA           NA
## OTB_CRU_70-99_0_0_all                       0          NaN
## OTB_DEF_>=120_0_0_all                      NA          NaN
## OTB_DEF_100-119_0_0_all                     0           NA
## OTB_DEF_70-99_0_0_all                      NA           NA
## OTT_CRU_100-119_0_0                        NA           NA
## OTT_DEF_100-119_0_0                        NA           NA
## SSC_DEF_100-119_0_0_all                    NA           NA
## TBB_CRU_16-31_0_0_all                      NA           NA
## TBB_DEF_>=120_0_0_all                      NA          NaN
## TBB_DEF_70-99_0_0_all                      NA          NaN
```

```
Dage_FC #note: proportions shown prior to discard raising
```

```
##                          Belgium France Ireland UK (England)
## GNS_DEF_120-219_0_0_all       NA     NA     NaN           NA
## GNS_DEF_all_0_0_all           NA     NA      NA          NaN
## GTR_DEF_90-99_0_0_all         NA    NaN      NA           NA
## GTR_DEF_all_0_0_all           NA     NA      NA          NaN
## MIS_MIS_0_0_0_HC              NA    NaN      NA          NaN
## OTB_CRU_100-119_0_0_all       NA    NaN      NA          NaN
## OTB_CRU_16-31_0_0_all         NA     NA      NA          NaN
## OTB_CRU_70-99_0_0_all        NaN     NA      NA           NA
## OTB_DEF_>=120_0_0_all         NA     NA      NA          NaN
## OTB_DEF_100-119_0_0_all       NA    NaN     NaN           NA
## OTB_DEF_70-99_0_0_all         NA    NaN      NA          NaN
## OTT_CRU_100-119_0_0           NA    NaN      NA           NA
## OTT_DEF_100-119_0_0           NA    NaN      NA           NA
## SSC_DEF_100-119_0_0_all       NA     NA     NaN           NA
## TBB_CRU_16-31_0_0_all         NA     NA      NA          NaN
## TBB_DEF_>=120_0_0_all         NA     NA      NA           NA
## TBB_DEF_70-99_0_0_all          1     NA     NaN    0.3664206
##                          UK(Northern Ireland) UK(Scotland)
## GNS_DEF_120-219_0_0_all                    NA           NA
## GNS_DEF_all_0_0_all                        NA           NA
## GTR_DEF_90-99_0_0_all                      NA           NA
## GTR_DEF_all_0_0_all                        NA           NA
## MIS_MIS_0_0_0_HC                           NA          NaN
## OTB_CRU_100-119_0_0_all                    NA           NA
## OTB_CRU_16-31_0_0_all                      NA           NA
## OTB_CRU_70-99_0_0_all                     NaN          NaN
## OTB_DEF_>=120_0_0_all                      NA          NaN
## OTB_DEF_100-119_0_0_all                   NaN           NA
## OTB_DEF_70-99_0_0_all                      NA           NA
```

```
## OTT_CRU_100-119_0_0                        NA            NA
## OTT_DEF_100-119_0_0                        NA            NA
## SSC_DEF_100-119_0_0_all                    NA            NA
## TBB_CRU_16-31_0_0_all                      NA            NA
## TBB_DEF_>=120_0_0_all                      NA           NaN
## TBB_DEF_70-99_0_0_all                      NA           NaN
```

Section C: Discard ratio coverage (Lwt !Dwt / sum(Lwt))

1. Total proportion of the landings for which discard weights are available

```
Ldis_A_tot

## [1] 0.8053038
```

2. Proportion of landings for which discard weights are available by area and season

```
Ldis_AS

##                1         2         3            4 2016
## 27.7.f 0.7593428 0.7231064 0.2191461 0.3600408831    1
## 27.7.g 0.0000000 0.0000000 0.0000000 0.0008499718    0
```

3. Proportion of landings for which discard weights are available in each métier-country stratum

```
Ldis_FC

##                         Belgium France Ireland UK (England)
## GNS_DEF_120-219_0_0_all      NA     NA       0           NA
## GNS_DEF_all_0_0_all          NA     NA      NA  0.005572324
## GTR_DEF_90-99_0_0_all        NA    NaN      NA           NA
## GTR_DEF_all_0_0_all          NA     NA      NA  0.000000000
## MIS_MIS_0_0_0_HC             NA      0      NA  0.000000000
## OTB_CRU_100-119_0_0_all      NA      0      NA  0.000000000
## OTB_CRU_16-31_0_0_all        NA     NA      NA          NaN
## OTB_CRU_70-99_0_0_all         0     NA      NA           NA
## OTB_DEF_>=120_0_0_all        NA     NA      NA  0.000000000
## OTB_DEF_100-119_0_0_all      NA      0       0           NA
## OTB_DEF_70-99_0_0_all        NA      0      NA  0.661565369
## OTT_CRU_100-119_0_0          NA      0      NA           NA
## OTT_DEF_100-119_0_0          NA      0      NA           NA
## SSC_DEF_100-119_0_0_all      NA     NA       0           NA
## TBB_CRU_16-31_0_0_all        NA     NA      NA  0.000000000
## TBB_DEF_>=120_0_0_all        NA     NA      NA           NA
## TBB_DEF_70-99_0_0_all         1     NA       0  0.882840357
##                         UK(Northern Ireland) UK(Scotland)
## GNS_DEF_120-219_0_0_all                   NA           NA
## GNS_DEF_all_0_0_all                       NA           NA
## GTR_DEF_90-99_0_0_all                     NA           NA
## GTR_DEF_all_0_0_all                       NA           NA
## MIS_MIS_0_0_0_HC                          NA          NaN
## OTB_CRU_100-119_0_0_all                   NA           NA
## OTB_CRU_16-31_0_0_all                     NA           NA
## OTB_CRU_70-99_0_0_all                      0          NaN
## OTB_DEF_>=120_0_0_all                     NA          NaN
## OTB_DEF_100-119_0_0_all                    0           NA
```

```
## OTB_DEF_70-99_0_0_all                       NA          NA
## OTT_CRU_100-119_0_0                         NA          NA
## OTT_DEF_100-119_0_0                         NA          NA
## SSC_DEF_100-119_0_0_all                     NA          NA
## TBB_CRU_16-31_0_0_all                       NA          NA
## TBB_DEF_>=120_0_0_all                       NA         NaN
## TBB_DEF_70-99_0_0_all                       NA         NaN
```

Section D: Landings age coverage ranked by landed weights

This section shows the proportion of landings covered for age composition, in total (Lage_tot), by métier and for the larger gear groups (Lage_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable age coverage for landings. Additionally, the proportion of landings for which discard age coverage is available is presented for the larger gear groups (Dage_gear).

```
Lage_tot<-sum(Lage_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Lage_AS = Lwt !Lagesamp / sum(Lwt); L_AS = Lwt / sum(Lwt))
Lage_tot

## [1] 0.8577592

format(Lage_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Lage_AS

##                       Fleet Total rank_Total
## 17    TBB_DEF_70-99_0_0_all   1.0    0.82862
## 10 OTB_DEF_100-119_0_0_all   0.3    0.07552
## 8     OTB_CRU_70-99_0_0_all   0.0    0.04646
## 13      OTT_DEF_100-119_0_0   0.7    0.02392
## 11    OTB_DEF_70-99_0_0_all   0.9    0.01177
## 2       GNS_DEF_all_0_0_all   0.3    0.00518
## 12      OTT_CRU_100-119_0_0   0.2    0.00402
## 9     OTB_DEF_>=120_0_0_all   0.0    0.00207
## 6  OTB_CRU_100-119_0_0_all   0.0    0.00135
## 15    TBB_CRU_16-31_0_0_all   0.0    0.00055
## 5          MIS_MIS_0_0_0_HC   0.0    0.00032
## 1  GNS_DEF_120-219_0_0_all   1.0    0.00016
## 14 SSC_DEF_100-119_0_0_all   1.0    0.00005
## 4       GTR_DEF_all_0_0_all   0.7    0.00003
## 16    TBB_DEF_>=120_0_0_all   NaN    0.00000
## 7     OTB_CRU_16-31_0_0_all   NaN    0.00000
## 3     GTR_DEF_90-99_0_0_all   NaN    0.00000

Lage_gear

##       GTR       OTB      REST       TBB
## 0.3396818 0.2990469 0.0000000 0.9727218

Dage_gear

##       GTR       OTB      REST       TBB
## 0.0000000 0.0000000 0.0000000 0.9186669
```

Section E: Discard ratio coverage ranked by landed weight

This section shows the proportion of landings for which discard weights are available, in total (Ldis_tot), by métier and for the larger gear groups (Ldis_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable discard ratio coverage.

```
Ldis_tot<-sum(Ldis_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Ldis_AS = Lwt !Dwt / sum(Lwt); L_AS = Lwt / sum(Lwt)
Ldis_tot

## [1] 0.8053038

format(Ldis_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Ldis_AS

##                        Fleet Total rank_Total
## 17    TBB_DEF_70-99_0_0_all 0.963    0.82862
## 10 OTB_DEF_100-119_0_0_all 0.000    0.07552
## 8     OTB_CRU_70-99_0_0_all 0.000    0.04646
## 13      OTT_DEF_100-119_0_0 0.000    0.02392
## 11    OTB_DEF_70-99_0_0_all 0.618    0.01177
## 2       GNS_DEF_all_0_0_all 0.006    0.00518
## 12      OTT_CRU_100-119_0_0 0.000    0.00402
## 9     OTB_DEF_>=120_0_0_all 0.000    0.00207
## 6  OTB_CRU_100-119_0_0_all 0.000    0.00135
## 15    TBB_CRU_16-31_0_0_all 0.000    0.00055
## 5          MIS_MIS_0_0_0_HC 0.000    0.00032
## 1  GNS_DEF_120-219_0_0_all 0.000    0.00016
## 14 SSC_DEF_100-119_0_0_all 0.000    0.00005
## 4       GTR_DEF_all_0_0_all 0.000    0.00003
## 16    TBB_DEF_>=120_0_0_all   NaN    0.00000
## 7     OTB_CRU_16-31_0_0_all   NaN    0.00000
## 3     GTR_DEF_90-99_0_0_all   NaN    0.00000

Ldis_gear

##         GTR         OTB        REST         TBB
## 0.005377549 0.044037906 0.000000000 0.962414035
```

InterCatch input for 2017

```
##                  1         2         3         4      2017
## 27.7.f 0.02762206 0.9364816 0.6662854 0.1051574        NA
## 27.7.g 0.07760125 0.5478794 0.4835091 0.5772087 0.9988656
```

This appendix lists 5 sections of tables (A-E) for each InterCatch year. It provides a detailed summary of the InterCatch input data in terms of importance by landed weight and the proportional coverage for age data and discard ratios.

Section A: Importance by landed weight (Lwt / sum(Lwt))

1. Proportion of landings by area and season

```
L_AS*100

##                1        2        3        4        2017
## 27.7.f 7.556158 6.806353 1.929321 1.150770  0.06468545
## 27.7.g 2.049270 2.513172 4.068715 2.781121 71.08043475
```

2. Proportion of landings by métier and country

```
format(data.frame(L_FC*100),scientific=3,digit=1)

##                          Belgium France Ireland UK..England.
## GNS_DEF_120-219_0_0_all       NA     NA   0.015           NA
## GNS_DEF_all_0_0_all           NA     NA      NA        0.573
## GTR_DEF_all_0_0_all           NA     NA      NA        0.001
## LLS_FIF_0_0_0_all             NA     NA      NA        0.005
## MIS_MIS_0_0_0_HC              NA 0.0005   0.004        0.172
## OTB_CRU_100-119_0_0_all       NA 0.0380   0.212        0.028
## OTB_CRU_70-99_0_0_all          3     NA   0.902           NA
## OTB_DEF_>=120_0_0_all         NA     NA      NA        0.473
## OTB_DEF_100-119_0_0_all       NA 2.2837   0.877           NA
## OTB_DEF_70-99_0_0_all         NA 0.0227   0.620        1.119
## OTM_DEF_100-119_0_0_all       NA 0.0890      NA           NA
## OTT_CRU_100-119_0_0           NA 0.6897      NA           NA
## OTT_DEF_100-119_0_0           NA 3.2570      NA           NA
## SSC_DEF_100-119_0_0_all       NA     NA   0.062           NA
## TBB_DEF_>=120_0_0_all         NA     NA      NA        0.100
## TBB_DEF_70-99_0_0_all         67     NA   0.952       16.573
##                          UK.Northern.Ireland. UK.Scotland.
## GNS_DEF_120-219_0_0_all                    NA           NA
## GNS_DEF_all_0_0_all                        NA           NA
## GTR_DEF_all_0_0_all                        NA           NA
## LLS_FIF_0_0_0_all                          NA           NA
## MIS_MIS_0_0_0_HC                           NA       0.0643
## OTB_CRU_100-119_0_0_all                    NA           NA
## OTB_CRU_70-99_0_0_all                  0.0508       0.0000
## OTB_DEF_>=120_0_0_all                      NA       0.0004
## OTB_DEF_100-119_0_0_all                0.0135           NA
## OTB_DEF_70-99_0_0_all                  0.0005           NA
## OTM_DEF_100-119_0_0_all                    NA           NA
## OTT_CRU_100-119_0_0                        NA           NA
```

```
## OTT_DEF_100-119_0_0                              NA          NA
## SSC_DEF_100-119_0_0_all                      0.0003          NA
## TBB_DEF_>=120_0_0_all                            NA      0.0000
## TBB_DEF_70-99_0_0_all                            NA      0.0000
```

3. Proportion of landings by country

```
apply(L_FC*100,2,function(x) sum(x,na.rm=T))

##             Belgium                France               Ireland
##         70.80111706            6.38048007            3.64463281
##         UK (England) UK(Northern Ireland)          UK(Scotland)
##         19.04401337            0.06507125            0.06468545
```

4. Proportion of landings by fleet and area

```
format(data.frame(L_FA*100),scientific=4,digit=1)

##                          X27.7.f X27.7.g
## GNS_DEF_120-219_0_0_all       NA  0.0148
## GNS_DEF_all_0_0_all       0.5606  0.0120
## GTR_DEF_all_0_0_all       0.0009  0.0005
## LLS_FIF_0_0_0_all         0.0045      NA
## MIS_MIS_0_0_0_HC          0.2362  0.0042
## OTB_CRU_100-119_0_0_all   0.0107  0.2671
## OTB_CRU_70-99_0_0_all     0.0265  4.2919
## OTB_DEF_>=120_0_0_all     0.4721  0.0013
## OTB_DEF_100-119_0_0_all   1.0080  2.1666
## OTB_DEF_70-99_0_0_all     1.0459  0.7171
## OTM_DEF_100-119_0_0_all   0.0544  0.0346
## OTT_CRU_100-119_0_0       0.0100  0.6797
## OTT_DEF_100-119_0_0       0.1105  3.1465
## SSC_DEF_100-119_0_0_all       NA  0.0624
## TBB_DEF_>=120_0_0_all     0.0611  0.0394
## TBB_DEF_70-99_0_0_all    13.9060 71.0547
```

5. Proportion of landings by métier, ranked from largest to smallest, together with cumulative sum

```
L_F1<-L_F
L_F1$rank_Total<-L_F1$rank_Total*100
L_F1<-L_F1[rev(order(L_F1$rank_Total)),]
L_F1$cum<-cumsum(L_F1$rank_Total)
format(L_F1,scientific=4,digit=1)

##                         rank_Total                   Fleet cum
## TBB_DEF_70-99_0_0_all       84.961   TBB_DEF_70-99_0_0_all  85
## OTB_CRU_70-99_0_0_all        4.318   OTB_CRU_70-99_0_0_all  89
## OTT_DEF_100-119_0_0          3.257     OTT_DEF_100-119_0_0  93
## OTB_DEF_100-119_0_0_all      3.175 OTB_DEF_100-119_0_0_all  96
## OTB_DEF_70-99_0_0_all        1.763   OTB_DEF_70-99_0_0_all  97
## OTT_CRU_100-119_0_0          0.690     OTT_CRU_100-119_0_0  98
## GNS_DEF_all_0_0_all          0.573     GNS_DEF_all_0_0_all  99
## OTB_DEF_>=120_0_0_all        0.473   OTB_DEF_>=120_0_0_all  99
## OTB_CRU_100-119_0_0_all      0.278 OTB_CRU_100-119_0_0_all  99
## MIS_MIS_0_0_0_HC             0.240        MIS_MIS_0_0_0_HC 100
## TBB_DEF_>=120_0_0_all        0.100   TBB_DEF_>=120_0_0_all 100
```

```
## OTM_DEF_100-119_0_0_all      0.089 OTM_DEF_100-119_0_0_all 100
## SSC_DEF_100-119_0_0_all      0.062 SSC_DEF_100-119_0_0_all 100
## GNS_DEF_120-219_0_0_all      0.015 GNS_DEF_120-219_0_0_all 100
## LLS_FIF_0_0_0_all            0.005       LLS_FIF_0_0_0_all 100
## GTR_DEF_all_0_0_all          0.001     GTR_DEF_all_0_0_all 100
```

Section B: Age coverage

1. Total proportion of the landings/sampled discards that is covered for age composition

```
Lage_A_tot #(Lwt !Lagesamp / sum(Lwt))

## [1] 0.8409752

Dage_A_tot #(Dwt !Dagesamp / sum(Dwt))

## [1] 1
```

2. Proportion of landings/sampled discards by area and season that is covered for age composition

```
Lage_AS

##                   1         2         3         4      2017
## 27.7.f 0.02762206 0.9364816 0.6662854 0.1051574        NA
## 27.7.g 0.07760125 0.5478794 0.4835091 0.5772087 0.9988656

Dage_AS

##         3 2017
## 27.7.f NA   NA
## 27.7.g  1    1
```

3. Proportion of landings/sampled discards in each métier-country stratum that is covered for age composition

```
Lage_FC

##                         Belgium    France Ireland UK (England)
## GNS_DEF_120-219_0_0_all      NA        NA       0           NA
## GNS_DEF_all_0_0_all          NA        NA      NA    0.6331986
## GTR_DEF_all_0_0_all          NA        NA      NA    0.0000000
## LLS_FIF_0_0_0_all            NA        NA      NA    0.0000000
## MIS_MIS_0_0_0_HC             NA 0.0000000       0    0.0000000
## OTB_CRU_100-119_0_0_all      NA 0.0000000       1    0.0000000
## OTB_CRU_70-99_0_0_all         0        NA       1           NA
## OTB_DEF_>=120_0_0_all        NA        NA      NA    0.0000000
## OTB_DEF_100-119_0_0_all      NA 0.0000000       1           NA
## OTB_DEF_70-99_0_0_all        NA 0.0000000       1    0.9281939
## OTM_DEF_100-119_0_0_all      NA 0.0000000      NA           NA
## OTT_CRU_100-119_0_0          NA 0.8165334      NA           NA
## OTT_DEF_100-119_0_0          NA 0.6983967      NA           NA
## SSC_DEF_100-119_0_0_all      NA        NA       0           NA
## TBB_DEF_>=120_0_0_all        NA        NA      NA    0.0000000
## TBB_DEF_70-99_0_0_all         1        NA       1    0.5345232
##                         UK(Northern Ireland) UK(Scotland)
## GNS_DEF_120-219_0_0_all                   NA           NA
```

```
## GNS_DEF_all_0_0_all                         NA           NA
## GTR_DEF_all_0_0_all                         NA           NA
## LLS_FIF_0_0_0_all                           NA           NA
## MIS_MIS_0_0_0_HC                            NA            0
## OTB_CRU_100-119_0_0_all                     NA           NA
## OTB_CRU_70-99_0_0_all                        0          NaN
## OTB_DEF_>=120_0_0_all                       NA            0
## OTB_DEF_100-119_0_0_all                      0           NA
## OTB_DEF_70-99_0_0_all                        0           NA
## OTM_DEF_100-119_0_0_all                     NA           NA
## OTT_CRU_100-119_0_0                         NA           NA
## OTT_DEF_100-119_0_0                         NA           NA
## SSC_DEF_100-119_0_0_all                      0           NA
## TBB_DEF_>=120_0_0_all                       NA          NaN
## TBB_DEF_70-99_0_0_all                       NA          NaN
```

```
Dage_FC #note: proportions shown prior to discard raising
```

```
##                           Belgium France Ireland UK (England)
## GNS_DEF_120-219_0_0_all        NA     NA     NaN           NA
## GNS_DEF_all_0_0_all            NA     NA      NA          NaN
## GTR_DEF_all_0_0_all            NA     NA      NA          NaN
## LLS_FIF_0_0_0_all              NA     NA      NA          NaN
## MIS_MIS_0_0_0_HC               NA    NaN     NaN          NaN
## OTB_CRU_100-119_0_0_all        NA    NaN       1          NaN
## OTB_CRU_70-99_0_0_all         NaN     NA       1           NA
## OTB_DEF_>=120_0_0_all          NA     NA      NA          NaN
## OTB_DEF_100-119_0_0_all        NA    NaN       1           NA
## OTB_DEF_70-99_0_0_all          NA    NaN       1          NaN
## OTM_DEF_100-119_0_0_all        NA    NaN      NA           NA
## OTT_CRU_100-119_0_0            NA    NaN      NA           NA
## OTT_DEF_100-119_0_0            NA    NaN      NA           NA
## SSC_DEF_100-119_0_0_all        NA     NA     NaN           NA
## TBB_DEF_>=120_0_0_all          NA     NA      NA          NaN
## TBB_DEF_70-99_0_0_all           1     NA       1            1
##                           UK(Northern Ireland) UK(Scotland)
## GNS_DEF_120-219_0_0_all                     NA           NA
## GNS_DEF_all_0_0_all                         NA           NA
## GTR_DEF_all_0_0_all                         NA           NA
## LLS_FIF_0_0_0_all                           NA           NA
## MIS_MIS_0_0_0_HC                            NA          NaN
## OTB_CRU_100-119_0_0_all                     NA           NA
## OTB_CRU_70-99_0_0_all                      NaN          NaN
## OTB_DEF_>=120_0_0_all                       NA          NaN
## OTB_DEF_100-119_0_0_all                    NaN           NA
## OTB_DEF_70-99_0_0_all                      NaN           NA
## OTM_DEF_100-119_0_0_all                     NA           NA
## OTT_CRU_100-119_0_0                         NA           NA
## OTT_DEF_100-119_0_0                         NA           NA
## SSC_DEF_100-119_0_0_all                    NaN           NA
## TBB_DEF_>=120_0_0_all                       NA          NaN
## TBB_DEF_70-99_0_0_all                       NA          NaN
```

Section C: Discard ratio coverage (Lwt !Dwt / sum(Lwt))

1. Total proportion of the landings for which discard weights are available

```
Ldis_A_tot

## [1] 0.7221391
```

2. Proportion of landings for which discard weights are available by area and season

```
Ldis_AS

##          1 2         3 4      2017
## 27.7.f 0 0 0.0000000 0 0.0000000
## 27.7.g 0 0 0.2984004 0 0.9988656
```

3. Proportion of landings for which discard weights are available in each métier-country stratum

```
Ldis_FC

##                          Belgium France Ireland UK (England)
## GNS_DEF_120-219_0_0_all      NA     NA       0           NA
## GNS_DEF_all_0_0_all          NA     NA      NA   0.00000000
## GTR_DEF_all_0_0_all          NA     NA      NA   0.00000000
## LLS_FIF_0_0_0_all            NA     NA      NA   0.00000000
## MIS_MIS_0_0_0_HC             NA      0       0   0.00000000
## OTB_CRU_100-119_0_0_all      NA      0       1   0.00000000
## OTB_CRU_70-99_0_0_all         0     NA       1           NA
## OTB_DEF_>=120_0_0_all        NA     NA      NA   0.00000000
## OTB_DEF_100-119_0_0_all      NA      0       1           NA
## OTB_DEF_70-99_0_0_all        NA      0       1   0.00000000
## OTM_DEF_100-119_0_0_all      NA      0      NA           NA
## OTT_CRU_100-119_0_0          NA      0      NA           NA
## OTT_DEF_100-119_0_0          NA      0      NA           NA
## SSC_DEF_100-119_0_0_all      NA     NA       0           NA
## TBB_DEF_>=120_0_0_all        NA     NA      NA   0.00000000
## TBB_DEF_70-99_0_0_all         1     NA       1   0.07325987
##                          UK(Northern Ireland) UK(Scotland)
## GNS_DEF_120-219_0_0_all                    NA           NA
## GNS_DEF_all_0_0_all                        NA           NA
## GTR_DEF_all_0_0_all                        NA           NA
## LLS_FIF_0_0_0_all                          NA           NA
## MIS_MIS_0_0_0_HC                           NA            0
## OTB_CRU_100-119_0_0_all                    NA           NA
## OTB_CRU_70-99_0_0_all                       0          NaN
## OTB_DEF_>=120_0_0_all                      NA            0
## OTB_DEF_100-119_0_0_all                     0           NA
## OTB_DEF_70-99_0_0_all                       0           NA
## OTM_DEF_100-119_0_0_all                    NA           NA
## OTT_CRU_100-119_0_0                        NA           NA
## OTT_DEF_100-119_0_0                        NA           NA
## SSC_DEF_100-119_0_0_all                     0           NA
## TBB_DEF_>=120_0_0_all                      NA          NaN
## TBB_DEF_70-99_0_0_all                      NA          NaN
```

Section D: Landings age coverage ranked by landed weights

This section shows the proportion of landings covered for age composition, in total (Lage_tot), by métier and for the larger gear groups (Lage_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable age coverage for landings. Additionally, the proportion of landings for which discard age coverage is available is presented for the larger gear groups (Dage_gear).

```
Lage_tot<-sum(Lage_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Lage_AS = Lwt !Lagesamp / sum(Lwt); L_AS = Lwt / sum(Lwt))
Lage_tot

## [1] 0.8409752

format(Lage_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Lage_AS

##                       Fleet Total rank_Total
## 16   TBB_DEF_70-99_0_0_all   0.9    0.84961
## 7    OTB_CRU_70-99_0_0_all   0.2    0.04318
## 13     OTT_DEF_100-119_0_0   0.7    0.03257
## 9  OTB_DEF_100-119_0_0_all   0.3    0.03175
## 10   OTB_DEF_70-99_0_0_all   0.9    0.01763
## 12     OTT_CRU_100-119_0_0   0.8    0.00690
## 2      GNS_DEF_all_0_0_all   0.6    0.00573
## 8    OTB_DEF_>=120_0_0_all   0.0    0.00473
## 6  OTB_CRU_100-119_0_0_all   0.8    0.00278
## 5          MIS_MIS_0_0_0_HC   0.0    0.00240
## 15   TBB_DEF_>=120_0_0_all   0.0    0.00100
## 11 OTM_DEF_100-119_0_0_all   0.0    0.00089
## 14 SSC_DEF_100-119_0_0_all   0.0    0.00062
## 1  GNS_DEF_120-219_0_0_all   0.0    0.00015
## 4        LLS_FIF_0_0_0_all   0.0    0.00005
## 3      GTR_DEF_all_0_0_all   0.0    0.00001

Lage_gear

##       GTR       OTB      REST       TBB
## 0.6157711 0.4629281 0.0000000 0.9081296

Dage_gear

##       GTR       OTB      REST       TBB
## 0.0000000 0.1863362 0.0000000 0.8182610
```

Section E: Discard ratio coverage ranked by landed weight

This section shows the proportion of landings for which discard weights are available, in total (Ldis_tot), by métier and for the larger gear groups (Ldis_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable discard ratio coverage.

```
Ldis_tot<-sum(Ldis_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Ldis_AS = Lwt !Dwt / sum(Lwt); L_AS = Lwt / sum(Lwt)
Ldis_tot
```

```
## [1] 0.7221391
format(Ldis_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Ldis_AS
##                       Fleet Total rank_Total
## 16   TBB_DEF_70-99_0_0_all   0.8    0.84961
## 7    OTB_CRU_70-99_0_0_all   0.2    0.04318
## 13     OTT_DEF_100-119_0_0   0.0    0.03257
## 9  OTB_DEF_100-119_0_0_all   0.3    0.03175
## 10   OTB_DEF_70-99_0_0_all   0.4    0.01763
## 12     OTT_CRU_100-119_0_0   0.0    0.00690
## 2      GNS_DEF_all_0_0_all   0.0    0.00573
## 8    OTB_DEF_>=120_0_0_all   0.0    0.00473
## 6  OTB_CRU_100-119_0_0_all   0.8    0.00278
## 5           MIS_MIS_0_0_0_HC   0.0    0.00240
## 15   TBB_DEF_>=120_0_0_all   0.0    0.00100
## 11 OTM_DEF_100-119_0_0_all   0.0    0.00089
## 14 SSC_DEF_100-119_0_0_all   0.0    0.00062
## 1  GNS_DEF_120-219_0_0_all   0.0    0.00015
## 4         LLS_FIF_0_0_0_all   0.0    0.00005
## 3      GTR_DEF_all_0_0_all   0.0    0.00001
Ldis_gear
##       GTR       OTB      REST       TBB
## 0.0000000 0.1863362 0.0000000 0.8182610
```

<u>**InterCatch input for 2018**</u>

```
##                  1         2         3          4      2018
## 27.7.f 0.8072315 0.8536846 0.7601637 0.71933077 0.9993000
## 27.7.g 0.2122749 0.2622757 0.2109789 0.09619507 0.9979405
```

This appendix lists 5 sections of tables (A-E) for each InterCatch year. It provides a detailed summary of the InterCatch input data in terms of importance by landed weight and the proportional coverage for age data and discard ratios.

Section A: Importance by landed weight (Lwt / sum(Lwt))

1. Proportion of landings by area and season

```
L_AS*100

##                 1        2        3        4      2018
## 27.7.f 7.322001 6.687387 4.386138 2.348549 67.053043
## 27.7.g 1.474969 2.333669 2.389328 2.749078  3.255837
```

2. Proportion of landings by métier and country

```
format(data.frame(L_FC*100),scientific=3,digit=1)

##                          Belgium France Ireland UK..England.
## GNS_DEF_120-219_0_0_all       NA     NA   0.021           NA
## GNS_DEF_all_0_0_all           NA     NA      NA       0.3407
## GTR_DEF_90-99_0_0_all         NA  0.000      NA           NA
## GTR_DEF_all_0_0_all           NA     NA      NA       0.0006
## LLS_FIF_0_0_0_all             NA     NA      NA       0.0087
## MIS_MIS_0_0_0_HC              NA  0.002   0.007       0.1835
## OTB_CRU_100-119_0_0_all       NA  0.001   0.338       0.0267
## OTB_CRU_16-31_0_0_all         NA     NA      NA       0.0002
## OTB_CRU_70-99_0_0_all          4     NA   0.489       0.0000
## OTB_DEF_>=120_0_0_all         NA     NA      NA       0.8206
## OTB_DEF_100-119_0_0_all       NA  2.405   0.896           NA
## OTB_DEF_70-99_0_0_all         NA  0.111   0.506       1.4034
## OTM_DEF_100-119_0_0_all       NA  0.314      NA           NA
## OTT_CRU_100-119_0_0           NA  0.398      NA           NA
## OTT_DEF_100-119_0_0           NA  2.033      NA           NA
## TBB_DEF_>=120_0_0_all         NA     NA      NA       0.5031
## TBB_DEF_70-99_0_0_all         67     NA   1.045      16.7256
##                          UK.Northern.Ireland.
## GNS_DEF_120-219_0_0_all                    NA
## GNS_DEF_all_0_0_all                        NA
## GTR_DEF_90-99_0_0_all                      NA
## GTR_DEF_all_0_0_all                        NA
## LLS_FIF_0_0_0_all                          NA
## MIS_MIS_0_0_0_HC                           NA
## OTB_CRU_100-119_0_0_all                    NA
## OTB_CRU_16-31_0_0_all                      NA
## OTB_CRU_70-99_0_0_all                    0.02
## OTB_DEF_>=120_0_0_all                      NA
## OTB_DEF_100-119_0_0_all                  0.02
```

```
## OTB_DEF_70-99_0_0_all                     NA
## OTM_DEF_100-119_0_0_all                   NA
## OTT_CRU_100-119_0_0                       NA
## OTT_DEF_100-119_0_0                       NA
## TBB_DEF_>=120_0_0_all                     NA
## TBB_DEF_70-99_0_0_all                     NA
```

3. Proportion of landings by country

```
apply(L_FC*100,2,function(x) sum(x,na.rm=T))

##              Belgium                France               Ireland
##          71.37596420            5.26334388            3.30277409
##          UK (England) UK(Northern Ireland)
##          20.01321580            0.04470203
```

4. Proportion of landings by fleet and area

```
format(data.frame(L_FA*100),scientific=4,digit=1)

##                          X27.7.f X27.7.g
## GNS_DEF_120-219_0_0_all       NA   0.021
## GNS_DEF_all_0_0_all       0.3175   0.023
## GTR_DEF_90-99_0_0_all         NA   0.000
## GTR_DEF_all_0_0_all       0.0006   0.000
## LLS_FIF_0_0_0_all         0.0087      NA
## MIS_MIS_0_0_0_HC          0.1850   0.007
## OTB_CRU_100-119_0_0_all       NA   0.366
## OTB_CRU_16-31_0_0_all     0.0002      NA
## OTB_CRU_70-99_0_0_all     0.0934   4.786
## OTB_DEF_>=120_0_0_all     0.8206   0.000
## OTB_DEF_100-119_0_0_all   1.9428   1.383
## OTB_DEF_70-99_0_0_all     1.5055   0.515
## OTM_DEF_100-119_0_0_all   0.3014   0.013
## OTT_CRU_100-119_0_0       0.0130   0.385
## OTT_DEF_100-119_0_0       0.0697   1.963
## TBB_DEF_>=120_0_0_all     0.2808   0.222
## TBB_DEF_70-99_0_0_all    82.2578   2.519
```

5. Proportion of landings by métier, ranked from largest to smallest, together with cumulative sum

```
L_F1<-L_F
L_F1$rank_Total<-L_F1$rank_Total*100
L_F1<-L_F1[rev(order(L_F1$rank_Total)),]
L_F1$cum<-cumsum(L_F1$rank_Total)
format(L_F1,scientific=4,digit=1)

##                          rank_Total                   Fleet cum
## TBB_DEF_70-99_0_0_all       84.7770   TBB_DEF_70-99_0_0_all  85
## OTB_CRU_70-99_0_0_all        4.8792   OTB_CRU_70-99_0_0_all  90
## OTB_DEF_100-119_0_0_all      3.3257 OTB_DEF_100-119_0_0_all  93
## OTT_DEF_100-119_0_0          2.0327     OTT_DEF_100-119_0_0  95
## OTB_DEF_70-99_0_0_all        2.0202   OTB_DEF_70-99_0_0_all  97
## OTB_DEF_>=120_0_0_all        0.8206   OTB_DEF_>=120_0_0_all  98
## TBB_DEF_>=120_0_0_all        0.5031   TBB_DEF_>=120_0_0_all  98
## OTT_CRU_100-119_0_0          0.3978     OTT_CRU_100-119_0_0  99
```

```
## OTB_CRU_100-119_0_0_all      0.3660 OTB_CRU_100-119_0_0_all  99
## GNS_DEF_all_0_0_all          0.3407     GNS_DEF_all_0_0_all  99
## OTM_DEF_100-119_0_0_all      0.3143 OTM_DEF_100-119_0_0_all 100
## MIS_MIS_0_0_0_HC             0.1917        MIS_MIS_0_0_0_HC 100
## GNS_DEF_120-219_0_0_all      0.0212 GNS_DEF_120-219_0_0_all 100
## LLS_FIF_0_0_0_all            0.0087       LLS_FIF_0_0_0_all 100
## GTR_DEF_all_0_0_all          0.0006     GTR_DEF_all_0_0_all 100
## OTB_CRU_16-31_0_0_all        0.0002   OTB_CRU_16-31_0_0_all 100
## GTR_DEF_90-99_0_0_all        0.0000   GTR_DEF_90-99_0_0_all 100
```

Section B: Age coverage

1. Total proportion of the landings/sampled discards that is covered for age composition

```
Lage_A_tot #(Lwt !Lagesamp / sum(Lwt))

## [1] 0.8859198

Dage_A_tot #(Dwt !Dagesamp / sum(Dwt))

## [1] 1
```

2. Proportion of landings/sampled discards by area and season that is covered for age composition

```
Lage_AS

##                 1         2         3          4      2018
## 27.7.f 0.8072315 0.8536846 0.7601637 0.71933077 0.9993000
## 27.7.g 0.2122749 0.2622757 0.2109789 0.09619507 0.9979405

Dage_AS

##         1 2   3   4 2018
## 27.7.f  1 1   1 NaN    1
## 27.7.g NA 1 NaN  NA    1
```

3. Proportion of landings/sampled discards in each métier-country stratum that is covered for age composition

```
Lage_FC

##                         Belgium    France   Ireland UK (England)
## GNS_DEF_120-219_0_0_all      NA        NA 1.0000000           NA
## GNS_DEF_all_0_0_all          NA        NA        NA    0.1412293
## GTR_DEF_90-99_0_0_all        NA       NaN        NA           NA
## GTR_DEF_all_0_0_all          NA        NA        NA    0.0000000
## LLS_FIF_0_0_0_all            NA        NA        NA    0.0000000
## MIS_MIS_0_0_0_HC             NA 0.0000000 0.0000000    0.0000000
## OTB_CRU_100-119_0_0_all      NA 0.0000000 1.0000000    0.0000000
## OTB_CRU_16-31_0_0_all        NA        NA        NA    0.0000000
## OTB_CRU_70-99_0_0_all         0        NA 1.0000000          NaN
## OTB_DEF_>=120_0_0_all        NA        NA        NA    0.0000000
## OTB_DEF_100-119_0_0_all      NA 0.0000000 0.9770341           NA
## OTB_DEF_70-99_0_0_all        NA 0.0000000 0.9478949    0.9570830
## OTM_DEF_100-119_0_0_all      NA 0.0000000        NA           NA
## OTT_CRU_100-119_0_0          NA 0.2351570        NA           NA
```

```
## OTT_DEF_100-119_0_0          NA 0.1540287        NA          NA
## TBB_DEF_>=120_0_0_all        NA        NA        NA   0.0000000
## TBB_DEF_70-99_0_0_all         1        NA 1.0000000   0.9888311
##                          UK(Northern Ireland)
## GNS_DEF_120-219_0_0_all                    NA
## GNS_DEF_all_0_0_all                        NA
## GTR_DEF_90-99_0_0_all                      NA
## GTR_DEF_all_0_0_all                        NA
## LLS_FIF_0_0_0_all                          NA
## MIS_MIS_0_0_0_HC                           NA
## OTB_CRU_100-119_0_0_all                    NA
## OTB_CRU_16-31_0_0_all                      NA
## OTB_CRU_70-99_0_0_all                       0
## OTB_DEF_>=120_0_0_all                      NA
## OTB_DEF_100-119_0_0_all                     0
## OTB_DEF_70-99_0_0_all                      NA
## OTM_DEF_100-119_0_0_all                    NA
## OTT_CRU_100-119_0_0                        NA
## OTT_DEF_100-119_0_0                        NA
## TBB_DEF_>=120_0_0_all                      NA
## TBB_DEF_70-99_0_0_all                      NA
```

```
Dage_FC #note: proportions shown prior to discard raising
```

```
##                          Belgium France Ireland UK (England)
## GNS_DEF_120-219_0_0_all       NA     NA     NaN           NA
## GNS_DEF_all_0_0_all           NA     NA      NA          NaN
## GTR_DEF_90-99_0_0_all         NA    NaN      NA           NA
## GTR_DEF_all_0_0_all           NA     NA      NA          NaN
## LLS_FIF_0_0_0_all             NA     NA      NA          NaN
## MIS_MIS_0_0_0_HC              NA    NaN     NaN          NaN
## OTB_CRU_100-119_0_0_all       NA    NaN       1          NaN
## OTB_CRU_16-31_0_0_all         NA     NA      NA          NaN
## OTB_CRU_70-99_0_0_all        NaN     NA       1          NaN
## OTB_DEF_>=120_0_0_all         NA     NA      NA          NaN
## OTB_DEF_100-119_0_0_all       NA    NaN       1           NA
## OTB_DEF_70-99_0_0_all         NA    NaN     NaN          NaN
## OTM_DEF_100-119_0_0_all       NA    NaN      NA           NA
## OTT_CRU_100-119_0_0           NA    NaN      NA           NA
## OTT_DEF_100-119_0_0           NA    NaN      NA           NA
## TBB_DEF_>=120_0_0_all         NA     NA      NA          NaN
## TBB_DEF_70-99_0_0_all          1     NA       1            1
##                          UK(Northern Ireland)
## GNS_DEF_120-219_0_0_all                    NA
## GNS_DEF_all_0_0_all                        NA
## GTR_DEF_90-99_0_0_all                      NA
## GTR_DEF_all_0_0_all                        NA
## LLS_FIF_0_0_0_all                          NA
## MIS_MIS_0_0_0_HC                           NA
## OTB_CRU_100-119_0_0_all                    NA
## OTB_CRU_16-31_0_0_all                      NA
## OTB_CRU_70-99_0_0_all                     NaN
## OTB_DEF_>=120_0_0_all                      NA
## OTB_DEF_100-119_0_0_all                   NaN
```

```
## OTB_DEF_70-99_0_0_all                     NA
## OTM_DEF_100-119_0_0_all                   NA
## OTT_CRU_100-119_0_0                       NA
## OTT_DEF_100-119_0_0                       NA
## TBB_DEF_>=120_0_0_all                     NA
## TBB_DEF_70-99_0_0_all                     NA
```

Section C: Discard ratio coverage (Lwt !Dwt / sum(Lwt))

1. Total proportion of the landings for which discard weights are available

```
Ldis_A_tot

## [1] 0.8465364
```

2. Proportion of landings for which discard weights are available by area and season

```
Ldis_AS

##                1         2           3         4      2018
## 27.7.f 0.8006604 0.8068050 0.604526331 0.1477631 0.9993000
## 27.7.g 0.0000000 0.2637376 0.002461715 0.0000000 0.8507064
```

3. Proportion of landings for which discard weights are available in each métier-country stratum

```
Ldis_FC

##                          Belgium France   Ireland UK (England)
## GNS_DEF_120-219_0_0_all       NA     NA 1.0000000           NA
## GNS_DEF_all_0_0_all           NA     NA        NA   0.02727901
## GTR_DEF_90-99_0_0_all         NA    NaN        NA           NA
## GTR_DEF_all_0_0_all           NA     NA        NA   0.00000000
## LLS_FIF_0_0_0_all             NA     NA        NA   0.00000000
## MIS_MIS_0_0_0_HC              NA      0 0.0000000   0.00000000
## OTB_CRU_100-119_0_0_all       NA      0 1.0000000   0.00000000
## OTB_CRU_16-31_0_0_all         NA     NA        NA   0.00000000
## OTB_CRU_70-99_0_0_all          0     NA 1.0000000          NaN
## OTB_DEF_>=120_0_0_all         NA     NA        NA   0.00000000
## OTB_DEF_100-119_0_0_all       NA      0 0.9770341           NA
## OTB_DEF_70-99_0_0_all         NA      0 0.0000000   0.24727578
## OTM_DEF_100-119_0_0_all       NA      0        NA           NA
## OTT_CRU_100-119_0_0           NA      0        NA           NA
## OTT_DEF_100-119_0_0           NA      0        NA           NA
## TBB_DEF_>=120_0_0_all         NA     NA        NA   0.00000000
## TBB_DEF_70-99_0_0_all          1     NA 1.0000000   0.86821635
##                          UK(Northern Ireland)
## GNS_DEF_120-219_0_0_all                    NA
## GNS_DEF_all_0_0_all                        NA
## GTR_DEF_90-99_0_0_all                      NA
## GTR_DEF_all_0_0_all                        NA
## LLS_FIF_0_0_0_all                          NA
## MIS_MIS_0_0_0_HC                           NA
## OTB_CRU_100-119_0_0_all                    NA
## OTB_CRU_16-31_0_0_all                      NA
## OTB_CRU_70-99_0_0_all                       0
## OTB_DEF_>=120_0_0_all                      NA
```

```
## OTB_DEF_100-119_0_0_all                         0
## OTB_DEF_70-99_0_0_all                          NA
## OTM_DEF_100-119_0_0_all                        NA
## OTT_CRU_100-119_0_0                            NA
## OTT_DEF_100-119_0_0                            NA
## TBB_DEF_>=120_0_0_all                          NA
## TBB_DEF_70-99_0_0_all                          NA
```

Section D: Landings age coverage ranked by landed weights

This section shows the proportion of landings covered for age composition, in total (Lage_tot), by métier and for the larger gear groups (Lage_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable age coverage for landings. Additionally, the proportion of landings for which discard age coverage is available is presented for the larger gear groups (Dage_gear).

```
Lage_tot<-sum(Lage_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Lage_AS = Lwt !Lagesamp / sum(Lwt); L_AS = Lwt / sum(Lwt))
Lage_tot

## [1] 0.8859198

format(Lage_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Lage_AS

##                       Fleet Total rank_Total
## 17   TBB_DEF_70-99_0_0_all   1.0   0.847770
## 9    OTB_CRU_70-99_0_0_all   0.1   0.048792
## 11 OTB_DEF_100-119_0_0_all   0.3   0.033257
## 15     OTT_DEF_100-119_0_0   0.2   0.020327
## 12   OTB_DEF_70-99_0_0_all   0.9   0.020202
## 10   OTB_DEF_>=120_0_0_all   0.0   0.008206
## 16   TBB_DEF_>=120_0_0_all   0.0   0.005031
## 14     OTT_CRU_100-119_0_0   0.2   0.003978
## 7  OTB_CRU_100-119_0_0_all   0.9   0.003660
## 2      GNS_DEF_all_0_0_all   0.1   0.003407
## 13 OTM_DEF_100-119_0_0_all   0.0   0.003143
## 6         MIS_MIS_0_0_0_HC   0.0   0.001917
## 1  GNS_DEF_120-219_0_0_all   1.0   0.000212
## 5        LLS_FIF_0_0_0_all   0.0   0.000087
## 4      GTR_DEF_all_0_0_all   0.0   0.000006
## 8    OTB_CRU_16-31_0_0_all   0.0   0.000002
## 3    GTR_DEF_90-99_0_0_all   NaN   0.000000

Lage_gear

##       GTR       OTB      REST       TBB
## 0.1911717 0.2840836 0.0000000 0.9919097

Dage_gear

##       GTR       OTB      REST       TBB
## 0.0000000 0.1230451 0.0000000 0.9682541
```

Section E: Discard ratio coverage ranked by landed weight

This section shows the proportion of landings for which discard weights are available, in total (Ldis_tot), by métier and for the larger gear groups (Ldis_gear). The métiers are ranked by landed weight, so it is easy to check whether the most important métiers have reasonable discard ratio coverage.

```
Ldis_tot<-sum(Ldis_AS*L_AS,na.rm=T)/sum(L_AS,na.rm=T)
#(Ldis_AS = Lwt !Dwt / sum(Lwt); L_AS = Lwt / sum(Lwt)
Ldis_tot

## [1] 0.8465364

format(Ldis_F_Tot,scientific=4,digit=1) #ranking by L_AS; total by Ldis_AS

##                         Fleet Total rank_Total
## 17   TBB_DEF_70-99_0_0_all  0.97   0.847770
## 9    OTB_CRU_70-99_0_0_all  0.10   0.048792
## 11 OTB_DEF_100-119_0_0_all  0.26   0.033257
## 15     OTT_DEF_100-119_0_0  0.00   0.020327
## 12   OTB_DEF_70-99_0_0_all  0.17   0.020202
## 10   OTB_DEF_>=120_0_0_all  0.00   0.008206
## 16   TBB_DEF_>=120_0_0_all  0.00   0.005031
## 14     OTT_CRU_100-119_0_0  0.00   0.003978
## 7  OTB_CRU_100-119_0_0_all  0.92   0.003660
## 2      GNS_DEF_all_0_0_all  0.03   0.003407
## 13 OTM_DEF_100-119_0_0_all  0.00   0.003143
## 6           MIS_MIS_0_0_0_HC  0.00   0.001917
## 1  GNS_DEF_120-219_0_0_all  1.00   0.000212
## 5         LLS_FIF_0_0_0_all  0.00   0.000087
## 4      GTR_DEF_all_0_0_all  0.00   0.000006
## 8    OTB_CRU_16-31_0_0_all  0.00   0.000002
## 3    GTR_DEF_90-99_0_0_all   NaN   0.000000

Ldis_gear

##        GTR        OTB       REST        TBB
## 0.08406362 0.14811475 0.00000000 0.96825410
```

Appendix 2: Overview age allocations using manual allocation scheme

Autoallocation scheme for landings 2018 as an example

	BE_27.7.f_TBB_DEF_70-99_0_0_all_2018_L	FR_27.7.g_OTT_CRU_100-119_0_0_3_L	FR_27.7.g_OTT_DEF_100-119_0_0_1_L	IE_27.7.g_GNS_DEF_120-219_0_0_all_2018_L	IE_27.7.g_OTB_CRU_100-119_0_0_all_2018_L	IE_27.7.g_OTB_CRU_70-99_0_0_all_2018_L	IE_27.7.g_OTB_DEF_100-119_0_0_all_2018_L	IE_27.7.g_OTB_DEF_70-99_0_0_all_2018_L	IE_27.7.g_TBB_DEF_70-99_0_0_all_2018_L	UKE_27.7.f_GNS_DEF_all_0_0_all_1_L	UKE_27.7.f_OTB_DEF_70-99_0_0_all_2_L	UKE_27.7.f_OTB_DEF_70-99_0_0_all_3_L	UKE_27.7.f_OTB_DEF_70-99_0_0_all_4_L	UKE_27.7.f_TBB_DEF_70-99_0_0_all_1_L	UKE_27.7.f_TBB_DEF_70-99_0_0_all_2_L	UKE_27.7.f_TBB_DEF_70-99_0_0_all_3_L	UKE_27.7.f_TBB_DEF_70-99_0_0_all_4_L	UKE_27.7.g_TBB_DEF_70-99_0_0_all_2_L	UKE_27.7.g_TBB_DEF_70-99_0_0_all_3_L	UKE_27.7.g_TBB_DEF_70-99_0_0_all_4_L	Grand Total
BE_27.7.f_OTB_CRU_70-99_0_0_all_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
BE_27.7.f_OTB_CRU_70-99_0_0_all_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
BE_27.7.g_OTB_CRU_70-99_0_0_all_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
BE_27.7.g_OTB_CRU_70-99_0_0_all_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
BE_27.7.g_OTB_CRU_70-99_0_0_all_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
BE_27.7.g_OTB_CRU_70-99_0_0_all_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_MIS_MIS_0_0_0_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_MIS_MIS_0_0_0_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_OTB_DEF_100-119_0_0_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20

FR_27.7.f_OTB_DEF_100-119_0_0_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_OTB_DEF_100-119_0_0_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_OTB_DEF_100-119_0_0_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_OTB_DEF_70-99_0_0_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_OTB_DEF_70-99_0_0_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_OTB_DEF_70-99_0_0_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_OTB_DEF_70-99_0_0_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_OTM_DEF_100-119_0_0_all_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_OTM_DEF_100-119_0_0_all_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_OTM_DEF_100-119_0_0_all_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_OTM_DEF_100-119_0_0_all_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_OTT_CRU_100-119_0_0_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_OTT_CRU_100-119_0_0_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_OTT_CRU_100-119_0_0_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_OTT_CRU_100-119_0_0_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_OTT_DEF_100-119_0_0_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_OTT_DEF_100-119_0_0_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_OTT_DEF_100-119_0_0_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_OTT_DEF_100-119_0_0_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_GTR_DEF_90-99_0_0_all_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_GTR_DEF_90-99_0_0_all_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_GTR_DEF_90-99_0_0_all_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_MIS_MIS_0_0_0_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_OTB_CRU_100-119_0_0_all_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_OTB_DEF_100-119_0_0_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_OTB_DEF_100-119_0_0_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_OTB_DEF_100-119_0_0_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_OTB_DEF_100-119_0_0_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_OTB_DEF_70-99_0_0_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_OTB_DEF_70-99_0_0_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20

FR_27.7.g_OTM_DEF_100-119_0_0_all_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_OTM_DEF_100-119_0_0_all_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_OTM_DEF_100-119_0_0_all_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_OTM_DEF_100-119_0_0_all_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_OTT_CRU_100-119_0_0_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_OTT_CRU_100-119_0_0_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_OTT_CRU_100-119_0_0_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_OTT_DEF_100-119_0_0_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_OTT_DEF_100-119_0_0_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_OTT_DEF_100-119_0_0_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
IE_27.7.f_OTB_DEF_100-119_0_0_all_2018_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
IE_27.7.f_OTB_DEF_70-99_0_0_all_2018_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
IE_27.7.g_MIS_MIS_0_0_0_HC_2018_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_GNS_DEF_all_0_0_all_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_GNS_DEF_all_0_0_all_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_GNS_DEF_all_0_0_all_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_GTR_DEF_all_0_0_all_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_GTR_DEF_all_0_0_all_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_GTR_DEF_all_0_0_all_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_GTR_DEF_all_0_0_all_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_LLS_FIF_0_0_0_all_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_LLS_FIF_0_0_0_all_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_LLS_FIF_0_0_0_all_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_MIS_MIS_0_0_0_HC_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_MIS_MIS_0_0_0_HC_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_MIS_MIS_0_0_0_HC_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_MIS_MIS_0_0_0_HC_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_OTB_CRU_16-31_0_0_all_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_OTB_DEF_>=120_0_0_all_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_OTB_DEF_>=120_0_0_all_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20

UKE_27.7.f_OTB_DEF_>=120_0_0_all_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_OTB_DEF_>=120_0_0_all_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_OTB_DEF_70-99_0_0_all_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_TBB_DEF_>=120_0_0_all_1_L	1								1					1	1	1	1	1	1	1	9
UKE_27.7.f_TBB_DEF_>=120_0_0_all_2_L	1								1					1	1	1	1	1	1	1	9
UKE_27.7.f_TBB_DEF_>=120_0_0_all_3_L	1								1					1	1	1	1	1	1	1	9
UKE_27.7.g_GNS_DEF_all_0_0_all_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.g_GNS_DEF_all_0_0_all_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.g_GNS_DEF_all_0_0_all_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.g_GNS_DEF_all_0_0_all_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.g_GTR_DEF_all_0_0_all_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.g_MIS_MIS_0_0_0_HC_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.g_MIS_MIS_0_0_0_HC_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.g_OTB_CRU_100-119_0_0_all_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.g_OTB_CRU_100-119_0_0_all_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.g_OTB_CRU_70-99_0_0_all_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.g_OTB_DEF_>=120_0_0_all_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.g_OTB_DEF_70-99_0_0_all_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.g_OTB_DEF_70-99_0_0_all_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.g_TBB_DEF_>=120_0_0_all_1_L	1								1					1	1	1	1	1	1	1	9
UKE_27.7.g_TBB_DEF_>=120_0_0_all_2_L	1								1					1	1	1	1	1	1	1	9
UKE_27.7.g_TBB_DEF_>=120_0_0_all_3_L	1								1					1	1	1	1	1	1	1	9
UKE_27.7.g_TBB_DEF_70-99_0_0_all_1_L	1								1					1	1	1	1	1	1	1	9
UKN_27.7.g_OTB_CRU_70-99_0_0_all_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKN_27.7.g_OTB_DEF_100-119_0_0_all_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
Grand Total	94	87	87	87	87	87	87	87	94	87	87	87	87	94	94	94	94	94	94	94	1803

Appendix 3: Overview age allocations using autoallocation scheme

Autoallocation scheme for landings 2018 as an example

	BE_27.7.f_TBB_DEF_70-99_0_0_all_2018_L	FR_27.7.g_OTT_CRU_100-119_0_0_3_L	FR_27.7.g_OTT_DEF_100-119_0_0_1_L	IE_27.7.g_GNS_DEF_120-219_0_0_all_2018_L	IE_27.7.g_OTB_CRU_100-119_0_0_all_2018_L	IE_27.7.g_OTB_CRU_70-99_0_0_all_2018_L	IE_27.7.g_OTB_DEF_100-119_0_0_all_2018_L	IE_27.7.g_OTB_DEF_70-99_0_0_all_2018_L	IE_27.7.g_TBB_DEF_70-99_0_0_all_2018_L	UKE_27.7.f_GNS_DEF_all_0_0_all_1_L	UKE_27.7.f_OTB_DEF_70-99_0_0_all_2_L	UKE_27.7.f_OTB_DEF_70-99_0_0_all_3_L	UKE_27.7.f_OTB_DEF_70-99_0_0_all_4_L	UKE_27.7.f_TBB_DEF_70-99_0_0_all_1_L	UKE_27.7.f_TBB_DEF_70-99_0_0_all_2_L	UKE_27.7.f_TBB_DEF_70-99_0_0_all_3_L	UKE_27.7.f_TBB_DEF_70-99_0_0_all_4_L	UKE_27.7.g_TBB_DEF_70-99_0_0_all_2_L	UKE_27.7.g_TBB_DEF_70-99_0_0_all_3_L	UKE_27.7.g_TBB_DEF_70-99_0_0_all_4_L	Grand Total
BE_27.7.f_OTB_CRU_70-99_0_0_all_2_L						1															1
BE_27.7.f_OTB_CRU_70-99_0_0_all_3_L						1															1
BE_27.7.g_OTB_CRU_70-99_0_0_all_1_L						1															1
BE_27.7.g_OTB_CRU_70-99_0_0_all_2_L						1															1
BE_27.7.g_OTB_CRU_70-99_0_0_all_3_L						1															1
BE_27.7.g_OTB_CRU_70-99_0_0_all_4_L						1															1
FR_27.7.f_MIS_MIS_0_0_0_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_MIS_MIS_0_0_0_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_OTB_DEF_100-119_0_0_1_L							1														1

FR_27.7.f_OTB_DEF_100-119_0_0_2_L							1														1
FR_27.7.f_OTB_DEF_100-119_0_0_3_L							1														1
FR_27.7.f_OTB_DEF_100-119_0_0_4_L							1														1
FR_27.7.f_OTB_DEF_70-99_0_0_1_L								1			1	1	1								4
FR_27.7.f_OTB_DEF_70-99_0_0_2_L											1										1
FR_27.7.f_OTB_DEF_70-99_0_0_3_L												1									1
FR_27.7.f_OTB_DEF_70-99_0_0_4_L													1								1
FR_27.7.f_OTM_DEF_100-119_0_0_all_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_OTM_DEF_100-119_0_0_all_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_OTM_DEF_100-119_0_0_all_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_OTM_DEF_100-119_0_0_all_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.f_OTT_CRU_100-119_0_0_1_L		1																			1
FR_27.7.f_OTT_CRU_100-119_0_0_2_L		1																			1
FR_27.7.f_OTT_CRU_100-119_0_0_3_L		1																			1
FR_27.7.f_OTT_CRU_100-119_0_0_4_L		1																			1
FR_27.7.f_OTT_DEF_100-119_0_0_1_L			1																		1
FR_27.7.f_OTT_DEF_100-119_0_0_2_L			1																		1
FR_27.7.f_OTT_DEF_100-119_0_0_3_L			1																		1
FR_27.7.f_OTT_DEF_100-119_0_0_4_L			1																		1
FR_27.7.g_GTR_DEF_90-99_0_0_all_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_GTR_DEF_90-99_0_0_all_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_GTR_DEF_90-99_0_0_all_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_MIS_MIS_0_0_0_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_OTB_CRU_100-119_0_0_all_1_L					1																1
FR_27.7.g_OTB_DEF_100-119_0_0_1_L							1														1
FR_27.7.g_OTB_DEF_100-119_0_0_2_L							1														1
FR_27.7.g_OTB_DEF_100-119_0_0_3_L							1														1
FR_27.7.g_OTB_DEF_100-119_0_0_4_L							1														1
FR_27.7.g_OTB_DEF_70-99_0_0_1_L								1			1	1	1								4
FR_27.7.g_OTB_DEF_70-99_0_0_3_L												1									1

FR_27.7.g_OTM_DEF_100-119_0_0_all_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_OTM_DEF_100-119_0_0_all_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_OTM_DEF_100-119_0_0_all_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_OTM_DEF_100-119_0_0_all_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
FR_27.7.g_OTT_CRU_100-119_0_0_1_L		1																			1
FR_27.7.g_OTT_CRU_100-119_0_0_2_L		1																			1
FR_27.7.g_OTT_CRU_100-119_0_0_4_L		1																			1
FR_27.7.g_OTT_DEF_100-119_0_0_2_L			1																		1
FR_27.7.g_OTT_DEF_100-119_0_0_3_L			1																		1
FR_27.7.g_OTT_DEF_100-119_0_0_4_L			1																		1
IE_27.7.f_OTB_DEF_100-119_0_0_all_2018_L							1														1
IE_27.7.f_OTB_DEF_70-99_0_0_all_2018_L								1													1
IE_27.7.g_MIS_MIS_0_0_0_HC_2018_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_GNS_DEF_all_0_0_all_2_L										1											1
UKE_27.7.f_GNS_DEF_all_0_0_all_3_L										1											1
UKE_27.7.f_GNS_DEF_all_0_0_all_4_L										1											1
UKE_27.7.f_GTR_DEF_all_0_0_all_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_GTR_DEF_all_0_0_all_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_GTR_DEF_all_0_0_all_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_GTR_DEF_all_0_0_all_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_LLS_FIF_0_0_0_all_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_LLS_FIF_0_0_0_all_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_LLS_FIF_0_0_0_all_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_MIS_MIS_0_0_0_HC_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_MIS_MIS_0_0_0_HC_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_MIS_MIS_0_0_0_HC_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_MIS_MIS_0_0_0_HC_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_OTB_CRU_16-31_0_0_all_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_OTB_DEF_>=120_0_0_all_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_OTB_DEF_>=120_0_0_all_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20

UKE_27.7.f_OTB_DEF_>=120_0_0_all_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_OTB_DEF_>=120_0_0_all_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_OTB_DEF_70-99_0_0_all_1_L								1			1	1	1								4
UKE_27.7.f_TBB_DEF_>=120_0_0_all_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_TBB_DEF_>=120_0_0_all_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.f_TBB_DEF_>=120_0_0_all_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.g_GNS_DEF_all_0_0_all_1_L										1											1
UKE_27.7.g_GNS_DEF_all_0_0_all_2_L										1											1
UKE_27.7.g_GNS_DEF_all_0_0_all_3_L										1											1
UKE_27.7.g_GNS_DEF_all_0_0_all_4_L										1											1
UKE_27.7.g_GTR_DEF_all_0_0_all_4_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.g_MIS_MIS_0_0_0_HC_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.g_MIS_MIS_0_0_0_HC_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.g_OTB_CRU_100-119_0_0_all_1_L					1																1
UKE_27.7.g_OTB_CRU_100-119_0_0_all_2_L					1																1
UKE_27.7.g_OTB_CRU_70-99_0_0_all_2_L						1															1
UKE_27.7.g_OTB_DEF_>=120_0_0_all_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.g_OTB_DEF_70-99_0_0_all_1_L								1			1	1	1								4
UKE_27.7.g_OTB_DEF_70-99_0_0_all_2_L											1										1
UKE_27.7.g_TBB_DEF_>=120_0_0_all_1_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.g_TBB_DEF_>=120_0_0_all_2_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.g_TBB_DEF_>=120_0_0_all_3_L	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20
UKE_27.7.g_TBB_DEF_70-99_0_0_all_1_L														1							1
UKN_27.7.g_OTB_CRU_70-99_0_0_all_2_L						1															1
UKN_27.7.g_OTB_DEF_100-119_0_0_all_2_L							1														1
Grand Total	41	48	48	41	44	49	51	46	41	48	47	47	46	42	41	41	41	41	41	41	885

Appendix 4: Intercatch output after discard raising and age allocation (based on script from Youen Vermard)

InterCatch output for 2004

This document uses Table 2 from CatchAndSampleDataTables.txt from the InterCatch outputs to describe the raising procedures that were made.

In the following tables, CATON=WECA*CANUM/1000000 (in tonnes).

Raised discards

In InterCatch, the first step consists in raising the discards volumes for strats with landings and no discards associated. These discards are called in the following table 'Raised_Discards'. The data called 'Imported_Data' are landings or discards volumes imported into InterCatch with or without age structure.

The proportion of Landings with Discards associated (same strata) is **82 percent**

The volumes (and associated proportion) of landings and discards imported (Imported_Data) or raised (Raised_Discards) are described in the following table.

Table 1: Summary of the imported/Raised data

CatchCategory	RaisedOrImported	CATON	perc
Discards	Raised_Discards	10179	7
Discards	Imported_Data	130605	93
Landings	Imported_Data	1390612	100

Age distribution

For the imported landings/discards and the raised discards without age distribution, the age distribution is then computed using the defined allocation scheme. Sampled_distribution means that the data (landings or discards) were input with age distribution. Estimated_distribution means that the inputed/raised volumes were estimated using the allocation scheme.

Table 2: Summary of the imported/Raised/SampledOrEstimated data

CatchCategory	RaisedOrImported	SampledOrEstimated	CATON	perc
Landings	Imported_Data	Sampled_Distribution	1227	88
Landings	Imported_Data	Estimated_Distribution	163.9	12
Discards	Imported_Data	Sampled_Distribution	130.6	93
Discards	Raised_Discards	Estimated_Distribution	10.13	7
Discards	Imported_Data	Estimated_Distribution	0	0

Impact of the raising on the age structure

Once the samples imported or raised are identified, it is possible to check the impact of the allocation scheme on the mean age/length of the final age/length distribution of the stock. The following figures compare the mean age (computed as the weighted mean of the age per stratum (“CatchCategory”,‘RaisedOrImported’,“SampledOrEstimated”,“Country”,“Area”,“Season”,“Fleet”,“Sex”)) of the estimated strata compared to the imported ones and the final distribution. Each individual included in the boxplot corresponds to the weighted mean age of a stratum.

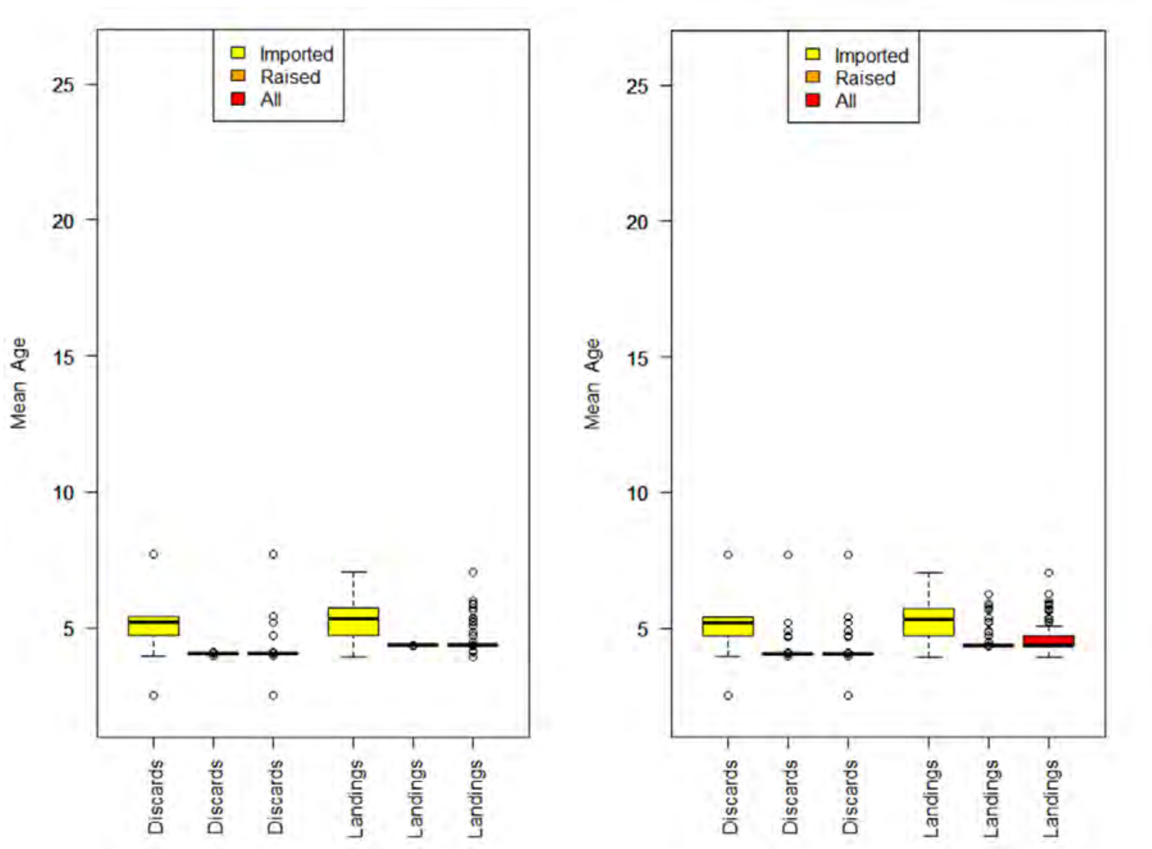


Figure 1: Mean Age per catch category (left: manual allocation; right: autoallocation)

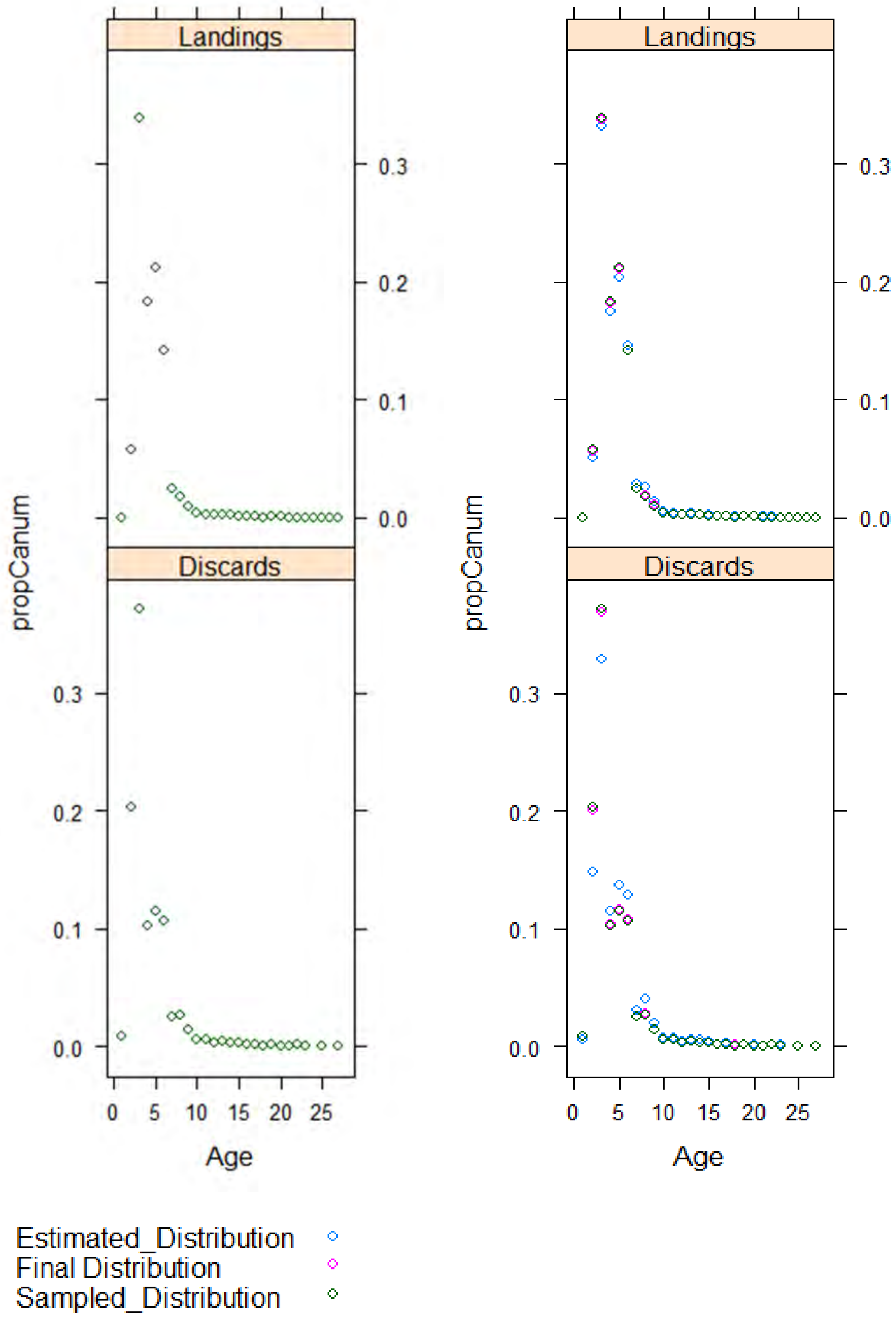


Figure 2: The percentage of each age for the sampled strata, estimated and the final age structure for the landing and discard fractions (left: manual allocation; right: autoallocation)

Impact of the raising on the mean weight

The CatchAndSampleData also provide the weight at age per stratum for the Sampled/Estimated strata. One should also check the sampled/estimated and resulting weight at age.

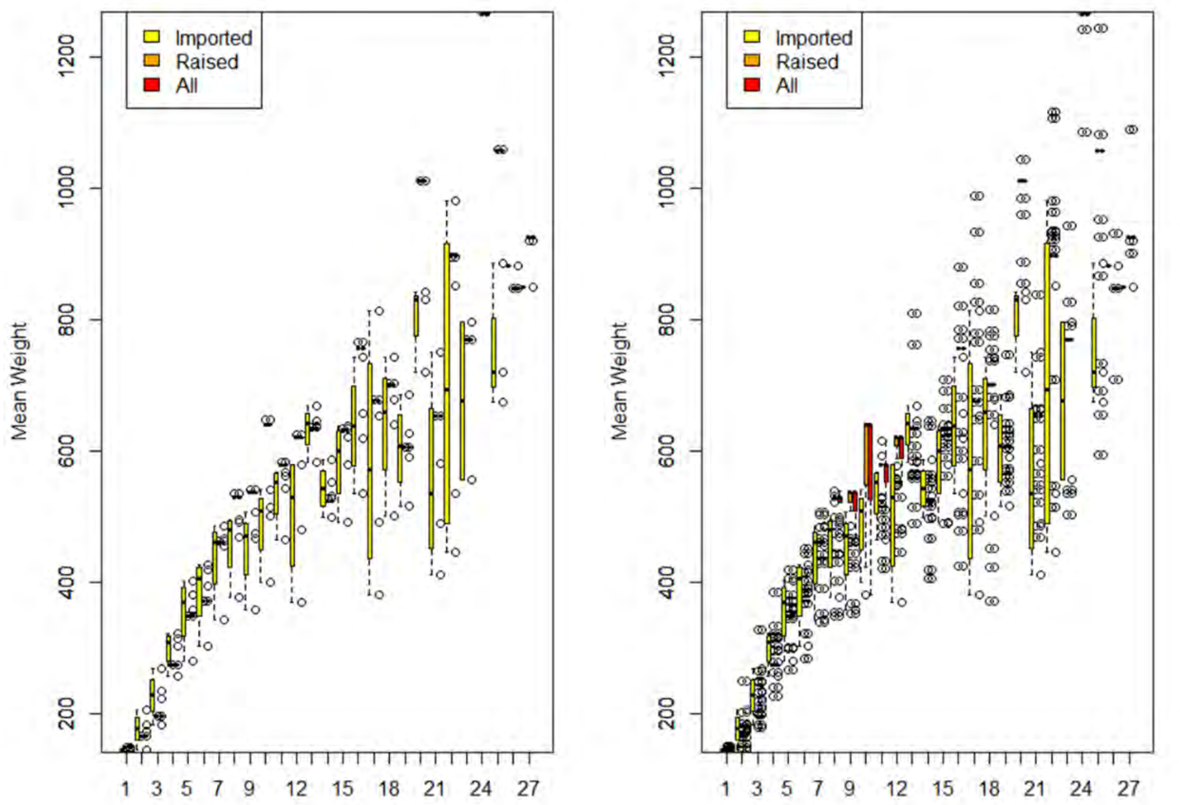


Figure 3a: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.g (left: manual allocation; right: autoallocation)

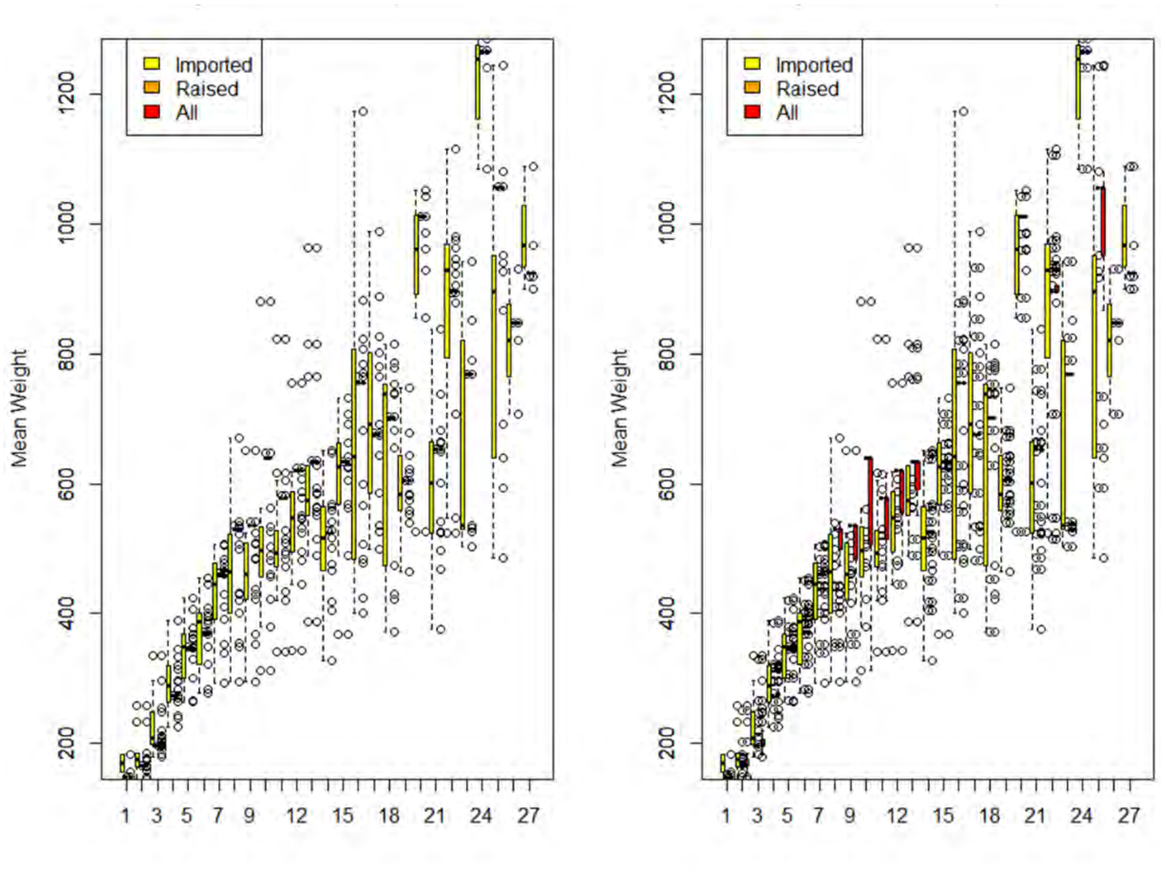


Figure 3b: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.f (left: manual allocation; right: autoallocation)

Table 3a: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for manual allocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
Ireland	TBB_DEF_70-99_0_0_all	Landings	1268	1266
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1268	1266
Ireland	TBB_DEF_70-99_0_0_all	Landings	1268	1266
Ireland	TBB_DEF_70-99_0_0_all	Landings	1268	1266
UK (England)	TBB_DEF_>=120_0_0_all	Landings	1268	1266
Ireland	TBB_DEF_70-99_0_0_all	Landings	1268	1266
UK (England)	TBB_DEF_>=120_0_0_all	Landings	1268	1266
UK (England)	GNS_DEF_all_0_0_all	Landings	1085	1263
UK (England)	OTB_CRU_16-31_0_0_all	Landings	422.2	688.9
UK (England)	OTB_CRU_16-31_0_0_all	Landings	747.1	604.7
UK (England)	OTB_CRU_16-31_0_0_all	Landings	837.4	641.4
UK (England)	OTB_CRU_16-31_0_0_all	Landings	535.1	755.5
UK (England)	OTB_CRU_16-31_0_0_all	Landings	930.9	846.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	266.9	346.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	283.3	370.9

UK (England)	OTB_DEF_70-99_0_0_all	Landings	339.2	454.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	348.5	515.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	372.3	688.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	503.4	755.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	707.9	846.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	429.3	688.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	532.8	755.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	145.6	166.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	302.7	275.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	402.2	348.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	427.5	371.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	582.2	634
UK (England)	TBB_DEF_70-99_0_0_all	Landings	535.8	750.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	501.8	697.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	684.7	605.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	555.4	766.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	881.7	848.8
Belgium	TBB_DEF_70-99_0_0_all	Landings	880.3	610.2
Belgium	TBB_DEF_70-99_0_0_all	Landings	823.6	564.5
Belgium	TBB_DEF_70-99_0_0_all	Landings	964.1	629.1
Belgium	TBB_DEF_70-99_0_0_all	Landings	1173	737.5
UK (England)	GNS_DEF_all_0_0_all	Landings	987.8	683.5
UK (England)	GNS_DEF_all_0_0_all	Landings	1088	927.7
UK (England)	OTB_CRU_16-31_0_0_all	Landings	264.9	346.8
UK (England)	OTB_CRU_16-31_0_0_all	Landings	277.2	370.9
UK (England)	OTB_CRU_16-31_0_0_all	Landings	293.7	454.2
UK (England)	OTB_CRU_16-31_0_0_all	Landings	294.5	515.5
UK (England)	OTB_CRU_16-31_0_0_all	Landings	294.4	518.9
UK (England)	OTB_CRU_16-31_0_0_all	Landings	311.9	610.2
UK (England)	OTB_CRU_16-31_0_0_all	Landings	340.6	564.5
UK (England)	OTB_CRU_16-31_0_0_all	Landings	344	604.1
UK (England)	OTB_CRU_16-31_0_0_all	Landings	387.8	629.1
UK (England)	OTB_CRU_16-31_0_0_all	Landings	328.1	522.2
UK (England)	OTB_CRU_16-31_0_0_all	Landings	368.4	628.2
UK (England)	OTB_CRU_16-31_0_0_all	Landings	401.4	737.5
UK (England)	OTB_CRU_16-31_0_0_all	Landings	464.2	604.7
UK (England)	OTB_CRU_16-31_0_0_all	Landings	526	998.1
UK (England)	OTB_CRU_16-31_0_0_all	Landings	376.4	641.4

UK (England)	OTB_CRU_16-31_0_0_all	Landings	526	755.5
UK (England)	OTB_CRU_16-31_0_0_all	Landings	486.6	1019
UK (England)	OTB_DEF_70-99_0_0_all	Landings	352.6	454.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	353.2	518.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	489.6	628.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	593.8	1019
UK (England)	TBB_DEF_70-99_0_0_all	Landings	639	1019
UK (England)	TBB_DEF_70-99_0_0_all	Landings	234.4	197.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	313.7	275.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	380.9	348.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	418.4	371.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	467.9	527.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	501.3	633.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	552.8	525.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	618.5	750.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	813.4	672
UK (England)	TBB_DEF_70-99_0_0_all	Landings	829.9	1003
UK (England)	TBB_DEF_70-99_0_0_all	Landings	674.6	1045
UK (England)	TBB_DEF_70-99_0_0_all	Landings	849.8	923.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	183.8	149.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	258.4	169.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	334.9	202.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	389.9	278.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	423.5	346.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	454.8	370.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	547.5	890.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	233.4	169.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	296.6	202.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	651	522.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	524.3	890.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	141.9	148.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	206.8	166.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	269.6	197.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	321.1	275.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	514.2	633.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	480.4	615.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	586.2	525.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	656.9	750.9

UK (England)	OTB_DEF_70-99_0_0_all	Landings	491.2	672
UK (England)	OTB_DEF_70-99_0_0_all	Landings	719.8	1003
UK (England)	OTB_DEF_70-99_0_0_all	Landings	489.9	648.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	534.7	886.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	719.8	1045
UK (England)	TBB_DEF_70-99_0_0_all	Landings	279.3	348.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	302.3	371.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	343.6	460.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	378	527.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	357.9	532.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	399.6	633.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	465.3	576.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	369	615.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	668	634
UK (England)	TBB_DEF_70-99_0_0_all	Landings	498.5	525.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	490.5	630.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	380.8	672
UK (England)	TBB_DEF_70-99_0_0_all	Landings	516.1	605.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	840.9	1003
UK (England)	TBB_DEF_70-99_0_0_all	Landings	411.9	648.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	445.6	886.5

AgeOrLength	Area
24	27.7.g
24	27.7.g
24	27.7.g
24	27.7.g
24	27.7.g
24	27.7.g
24	27.7.g
24	27.7.f
18	27.7.f
19	27.7.f
21	27.7.f
23	27.7.f
26	27.7.f
5	27.7.f
6	27.7.f
7	27.7.f

8	27.7.f
18	27.7.f
23	27.7.f
26	27.7.f
18	27.7.f
23	27.7.f
2	27.7.g
4	27.7.g
5	27.7.g
6	27.7.g
13	27.7.g
16	27.7.g
18	27.7.g
19	27.7.g
23	27.7.g
26	27.7.g
10	27.7.f
11	27.7.f
13	27.7.f
16	27.7.f
17	27.7.f
27	27.7.f
5	27.7.f
6	27.7.f
7	27.7.f
8	27.7.f
9	27.7.f
10	27.7.f
11	27.7.f
12	27.7.f
13	27.7.f
14	27.7.f
15	27.7.f
16	27.7.f
19	27.7.f
20	27.7.f
21	27.7.f
23	27.7.f

25	27.7.f
7	27.7.f
9	27.7.f
15	27.7.f
25	27.7.f
25	27.7.f
3	27.7.g
4	27.7.g
5	27.7.g
6	27.7.g
8	27.7.g
10	27.7.g
14	27.7.g
16	27.7.g
17	27.7.g
20	27.7.g
25	27.7.g
27	27.7.g
1	27.7.f
2	27.7.f
3	27.7.f
4	27.7.f
5	27.7.f
6	27.7.f
22	27.7.f
2	27.7.f
3	27.7.f
14	27.7.f
22	27.7.f
1	27.7.g
2	27.7.g
3	27.7.g
4	27.7.g
10	27.7.g
12	27.7.g
14	27.7.g
16	27.7.g
17	27.7.g

20	27.7.g
21	27.7.g
22	27.7.g
25	27.7.g
5	27.7.g
6	27.7.g
7	27.7.g
8	27.7.g
9	27.7.g
10	27.7.g
11	27.7.g
12	27.7.g
13	27.7.g
14	27.7.g
15	27.7.g
17	27.7.g
19	27.7.g
20	27.7.g
21	27.7.g
22	27.7.g

Table 3b: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for autoallocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
UK (England)	GNS_DEF_all_0_0_all	Landings	1085	1256
France	OTB_DEF_70-99_0_0	Landings	372.3	684.2
France	OTB_DEF_70-99_0_0	Landings	707.9	845
France	OTB_DEF_70-99_0_0	Landings	266.9	347.8
France	OTB_DEF_70-99_0_0	Landings	283.3	373.1
France	OTB_DEF_70-99_0_0	Landings	339.2	453.6
France	OTB_DEF_70-99_0_0	Landings	348.5	507.7
France	OTB_DEF_70-99_0_0	Landings	424.3	721.7
France	OTB_DEF_70-99_0_0	Landings	372.3	687.1
France	OTB_DEF_70-99_0_0	Landings	503.4	756.4
France	OTB_DEF_70-99_0_0	Landings	707.9	843.3
Ireland	OTB_DEF_70-99_0_0_all	Landings	266.9	347.8
Ireland	OTB_DEF_70-99_0_0_all	Landings	283.3	373.1
Ireland	OTB_DEF_70-99_0_0_all	Landings	339.2	453.6
Ireland	OTB_DEF_70-99_0_0_all	Landings	348.5	507.7

Ireland	OTB_DEF_70-99_0_0_all	Landings	424.3	721.7
Ireland	OTB_DEF_70-99_0_0_all	Landings	372.3	687.1
Ireland	OTB_DEF_70-99_0_0_all	Landings	503.4	756.4
Ireland	OTB_DEF_70-99_0_0_all	Landings	707.9	843.3
UK (England)	GNS_DEF_all_0_0_all	Landings	1085	1254
UK (England)	GNS_DEF_all_0_0_all	Landings	1088	936
UK (England)	GNS_DEF_all_0_0_all	Landings	1085	1256
UK (England)	GNS_DEF_all_0_0_all	Landings	1088	930.6
UK (England)	OTB_CRU_16-31_0_0_all	Landings	422.2	687.1
UK (England)	OTB_CRU_16-31_0_0_all	Landings	747.1	604.3
UK (England)	OTB_CRU_16-31_0_0_all	Landings	837.4	637.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	266.9	347.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	283.3	373.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	339.2	453.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	348.5	507.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	424.3	721.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	372.3	687.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	503.4	756.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	707.9	843.3
France	OTB_DEF_70-99_0_0	Landings	353.8	507.7
France	OTB_DEF_70-99_0_0	Landings	353.2	510.4
France	OTB_DEF_70-99_0_0	Landings	489.6	628.5
France	OTB_DEF_70-99_0_0	Landings	593.8	1004
Ireland	OTB_DEF_70-99_0_0_all	Landings	353.8	507.7
Ireland	OTB_DEF_70-99_0_0_all	Landings	353.2	510.4
Ireland	OTB_DEF_70-99_0_0_all	Landings	489.6	628.5
Ireland	OTB_DEF_70-99_0_0_all	Landings	593.8	1004
UK (England)	GNS_DEF_all_0_0_all	Landings	987.8	686
UK (England)	GNS_DEF_all_0_0_all	Landings	1088	930.6
France	OTB_DEF_70-99_0_0	Landings	249.7	171.9
France	OTB_DEF_70-99_0_0	Landings	328.6	208.4
France	OTB_DEF_70-99_0_0	Landings	385	282.6
France	OTB_DEF_70-99_0_0	Landings	249.7	169.8
France	OTB_DEF_70-99_0_0	Landings	328.6	204.8
France	OTB_DEF_70-99_0_0	Landings	385	280.9
France	OTB_DEF_70-99_0_0	Landings	646.2	524.4
Ireland	TBB_DEF_70-99_0_0_all	Landings	514.9	886.3
Ireland	OTB_DEF_70-99_0_0_all	Landings	249.7	169.8

Ireland	OTB_DEF_70-99_0_0_all	Landings	328.6	204.8
Ireland	OTB_DEF_70-99_0_0_all	Landings	385	280.9
Ireland	OTB_DEF_70-99_0_0_all	Landings	646.2	524.4
Ireland	TBB_DEF_70-99_0_0_all	Landings	809.5	622.4
Ireland	TBB_DEF_70-99_0_0_all	Landings	514.9	880.8
UK (England)	GNS_DEF_all_0_0_all	Landings	1085	1254
UK (England)	GNS_DEF_all_0_0_all	Landings	1088	936
UK (England)	OTB_CRU_16-31_0_0_all	Landings	526	981.3
UK (England)	GNS_DEF_all_0_0_all	Landings	1085	1256
UK (England)	GNS_DEF_all_0_0_all	Landings	1088	930.6
UK (England)	GNS_DEF_all_0_0_all	Landings	1085	1254
UK (England)	OTB_CRU_16-31_0_0_all	Landings	747.1	604.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	372.3	684.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	707.9	845
Belgium	TBB_DEF_70-99_0_0_all	Landings	880.3	582.1
Belgium	TBB_DEF_70-99_0_0_all	Landings	823.6	551.2
Belgium	TBB_DEF_70-99_0_0_all	Landings	964.1	623.3
Belgium	TBB_DEF_70-99_0_0_all	Landings	1173	716.3
UK (England)	GNS_DEF_all_0_0_all	Landings	987.8	693.7
UK (England)	GNS_DEF_all_0_0_all	Landings	1088	936
UK (England)	OTB_CRU_16-31_0_0_all	Landings	293.7	449.4
UK (England)	OTB_CRU_16-31_0_0_all	Landings	294.5	501.1
UK (England)	OTB_CRU_16-31_0_0_all	Landings	294.4	502.9
UK (England)	OTB_CRU_16-31_0_0_all	Landings	340.6	551.2
UK (England)	OTB_CRU_16-31_0_0_all	Landings	344	588
UK (England)	OTB_CRU_16-31_0_0_all	Landings	328.1	521
UK (England)	OTB_CRU_16-31_0_0_all	Landings	368.4	625.7
UK (England)	OTB_CRU_16-31_0_0_all	Landings	464.2	604.6
UK (England)	OTB_CRU_16-31_0_0_all	Landings	526	981.3
UK (England)	OTB_CRU_16-31_0_0_all	Landings	376.4	632.5
UK (England)	OTB_CRU_16-31_0_0_all	Landings	486.6	986.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	183.8	149.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	258.4	171.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	334.9	208.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	389.9	282.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	233.4	171.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	524.3	886.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	141.9	148.6

UK (England)	OTB_DEF_70-99_0_0_all	Landings	719.8	994.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	534.7	880.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	343.6	453.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	357.9	510.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	369	594.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	490.5	628.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	380.8	686
UK (England)	TBB_DEF_70-99_0_0_all	Landings	516.1	604.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	411.9	637.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	445.6	880.8

AgeOrLength	Area
24	27.7.g
18	27.7.f
26	27.7.f
5	27.7.g
6	27.7.g
7	27.7.g
8	27.7.g
16	27.7.g
18	27.7.g
23	27.7.g
26	27.7.g
5	27.7.g
6	27.7.g
7	27.7.g
8	27.7.g
16	27.7.g
18	27.7.g
23	27.7.g
26	27.7.g
24	27.7.f
27	27.7.f
24	27.7.g
27	27.7.g
18	27.7.g
19	27.7.g
21	27.7.g
5	27.7.g

6	27.7.g
7	27.7.g
8	27.7.g
16	27.7.g
18	27.7.g
23	27.7.g
26	27.7.g
8	27.7.g
9	27.7.g
15	27.7.g
25	27.7.g
8	27.7.g
9	27.7.g
15	27.7.g
25	27.7.g
17	27.7.g
27	27.7.g
2	27.7.f
3	27.7.f
4	27.7.f
2	27.7.g
3	27.7.g
4	27.7.g
14	27.7.g
22	27.7.f
2	27.7.g
3	27.7.g
4	27.7.g
14	27.7.g
13	27.7.g
22	27.7.g
24	27.7.f
27	27.7.f
20	27.7.f
24	27.7.g
27	27.7.g
24	27.7.f
19	27.7.f

18	27.7.f
26	27.7.f
10	27.7.f
11	27.7.f
13	27.7.f
16	27.7.f
17	27.7.f
27	27.7.f
7	27.7.f
8	27.7.f
9	27.7.f
11	27.7.f
12	27.7.f
14	27.7.f
15	27.7.f
19	27.7.f
20	27.7.f
21	27.7.f
25	27.7.f
1	27.7.f
2	27.7.f
3	27.7.f
4	27.7.f
2	27.7.f
22	27.7.f
1	27.7.g
20	27.7.g
22	27.7.g
7	27.7.g
9	27.7.g
12	27.7.g
15	27.7.g
17	27.7.g
19	27.7.g
21	27.7.g
22	27.7.g

InterCatch output for 2005

This document uses Table 2 from CatchAndSampleDataTables.txt from the InterCatch outputs to describe the raising procedures that were made.

In the following tables, CATON=WECA*CANUM/1000000 (in tonnes).

Raised discards

In InterCatch, the first step consists in raising the discards volumes for strats with landings and no discards associated. These discards are called in the following table 'Raised_Discards'. The data called 'Imported_Data' are landings or discards volumes imported into InterCatch with or without age structure.

The proportion of Landings with Discards associated (same strata) is **73 percent**

The volumes (and associated proportion) of landings and discards imported (Imported_Data) or raised (Raised_Discards) are described in the following table.

Table 1: Summary of the imported/Raised data

CatchCategory	RaisedOrImported	CATON	perc
Discards	Raised_Discards	6420	27
Discards	Imported_Data	16932	73
Landings	Imported_Data	1263192	100

Age distribution

For the imported landings/discards and the raised discards without age distribution, the age distribution is then computed using the defined allocation scheme. Sampled_distribution means that the data (landings or discards) were input with age distribution. Estimated_distribution means that the inputed/raised volumes were estimated using the allocation scheme.

Table 2a: Summary of the imported/Raised/SampledOrEstimated data for manual allocation

CatchCategory	RaisedOrImported	SampledOrEstimated	CATON	perc
Landings	Imported_Data	Sampled_Distribution	1140	90
Landings	Imported_Data	Estimated_Distribution	121.7	10
Discards	Imported_Data	Sampled_Distribution	16.93	73
Discards	Raised_Discards	Estimated_Distribution	6.371	27

Table 2b: Summary of the imported/Raised/SampledOrEstimated data for autoallocation

CatchCategory	RaisedOrImported	SampledOrEstimated	CATON	perc
Landings	Imported_Data	Sampled_Distribution	1140	91
Landings	Imported_Data	Estimated_Distribution	118.3	9
Discards	Imported_Data	Sampled_Distribution	16.93	73
Discards	Raised_Discards	Estimated_Distribution	6.371	27

Impact of the raising on the age structure

Once the samples imported or raised are identified, it is possible to check the impact of the allocation scheme on the mean age/length of the final age/length distribution of the stock. The following figures compare the mean age (computed as the weighted mean of the age per stratum ("CatchCategory",'RaisedOrImported',"SampledOrEstimated","Country","Area","Season","Fleet","Sex")) of the estimated strata compared to the imported ones and the final distribution. Each individual included in the boxplot corresponds to the weighted mean age of a stratum.

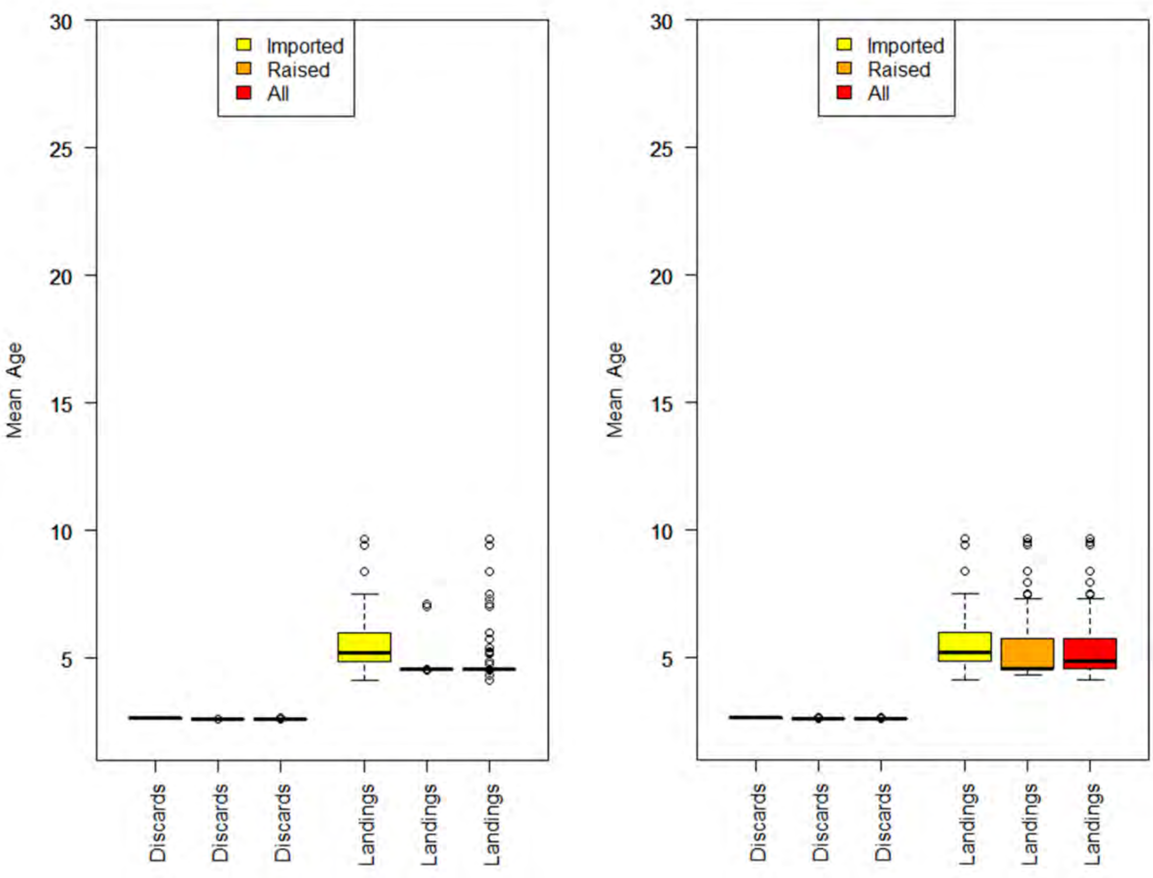


Figure 1: Mean Age per catch category (left: manual allocation; right: autoallocation)

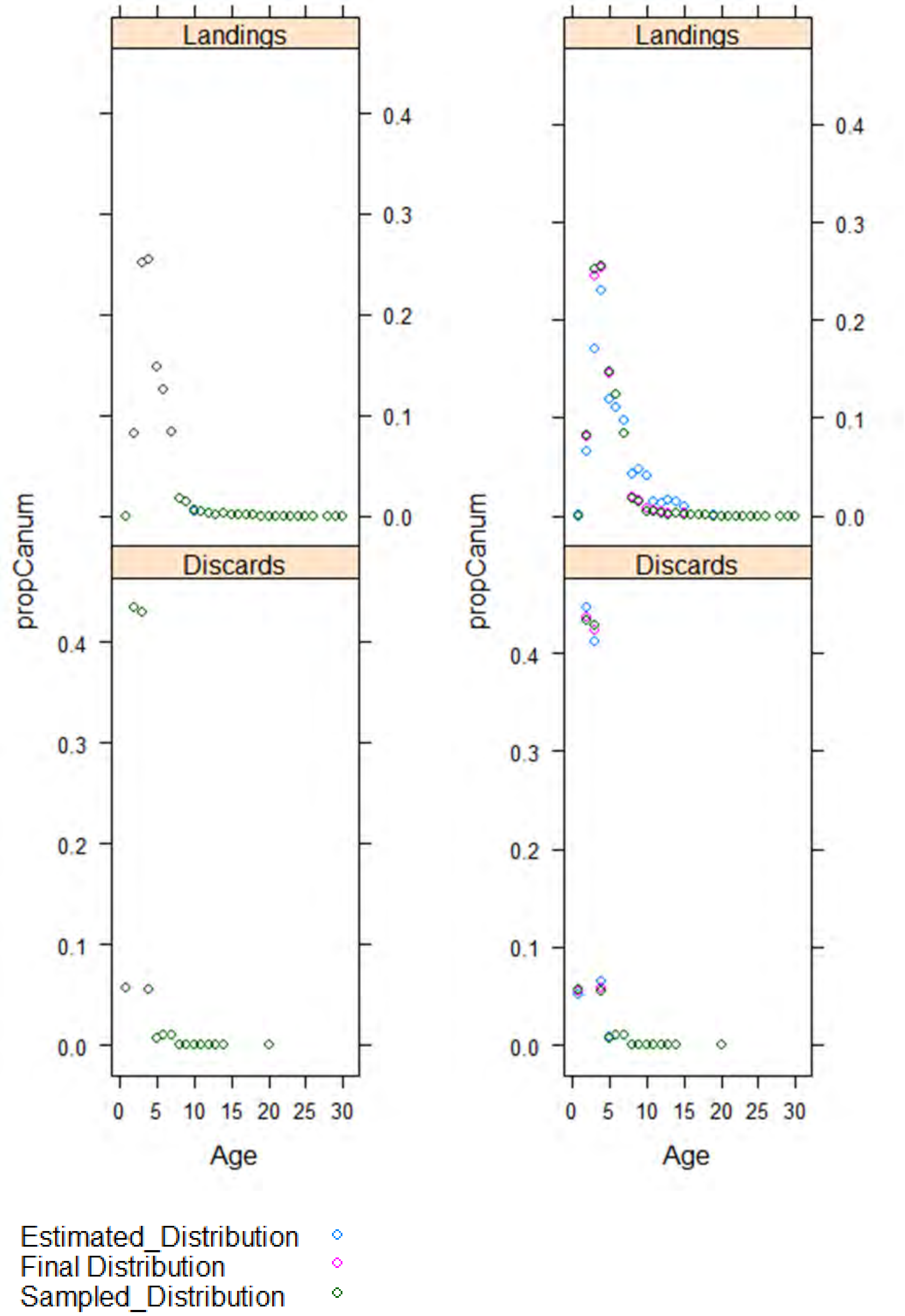


Figure 2: The percentage of each age for the sampled strata, estimated and the final age structure for the landing and discard fractions (left: manual allocation; right: autoallocation)

Impact of the raising on the mean weight

The CatchAndSampleData also provide the weight at age per stratum for the Sampled/Estimated strata. One should also check the sampled/estimated and resulting weight at age.

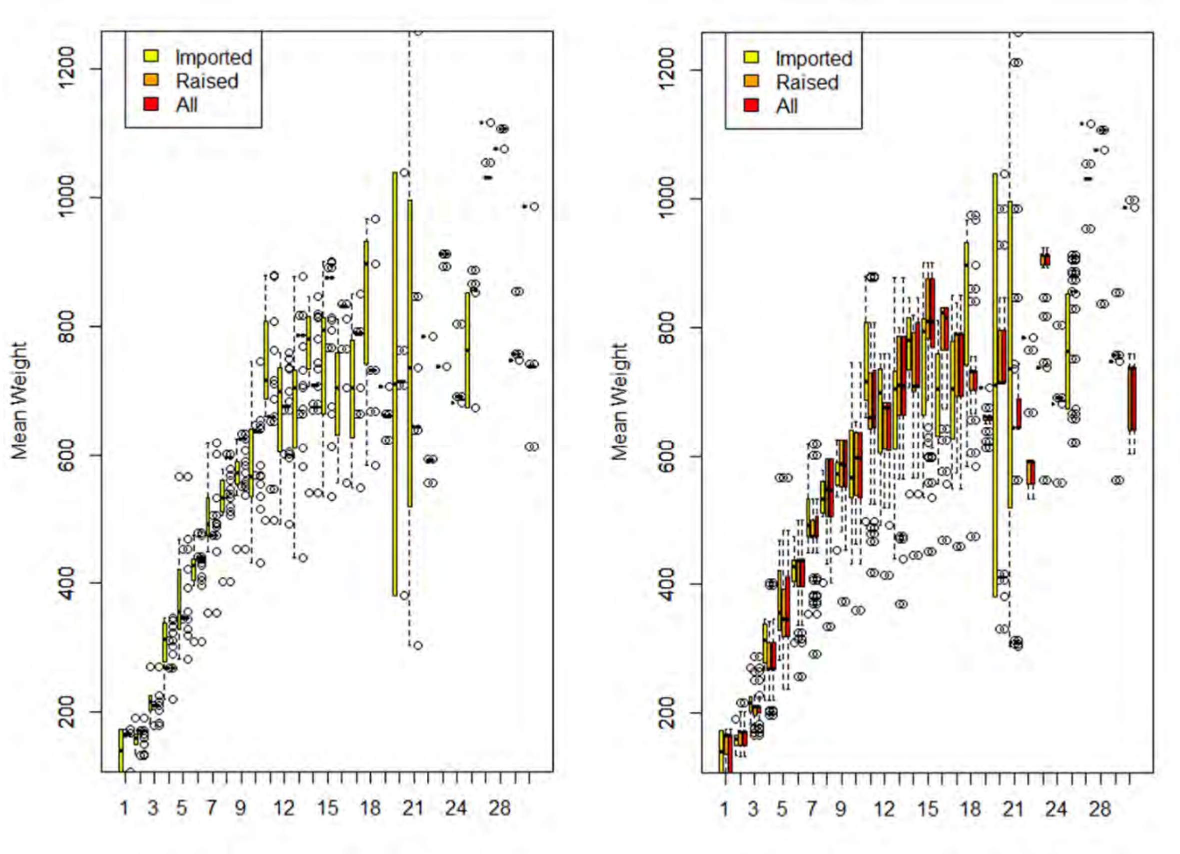


Figure 3a: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.g (left: manual allocation; right: autoallocation)

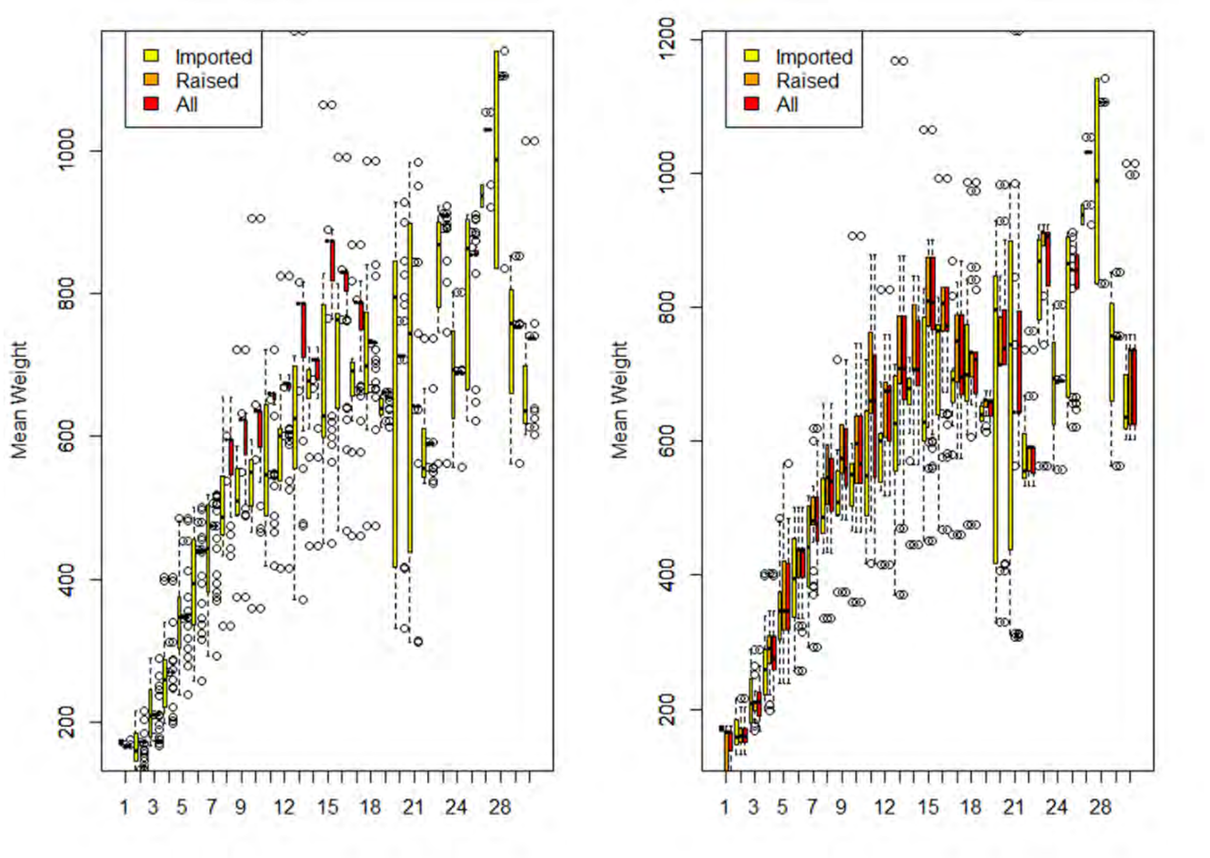


Figure 3b: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.f (left: manual allocation; right: autoallocation)

Table 3a: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for manual allocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
UK (England)	GNS_DEF_all_0_0_all	Landings	398.2	273.1
UK (England)	GTR_DEF_all_0_0_all	Landings	215.7	167.1
UK (England)	GTR_DEF_all_0_0_all	Landings	402.4	273.1
UK (England)	GTR_DEF_all_0_0_all	Landings	485.1	354.5
UK (England)	GTR_DEF_all_0_0_all	Landings	612.5	656
France	OTB_CRU_100-119_0_0_all	Landings	566.6	361.5
France	OTB_CRU_100-119_0_0_all	Landings	819	706.3
UK (England)	GNS_DEF_all_0_0_all	Landings	416.8	715.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	257	432.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	292.5	468.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	334.6	570
UK (England)	OTB_DEF_70-99_0_0_all	Landings	374.4	599
UK (England)	OTB_DEF_70-99_0_0_all	Landings	359.7	614.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	417.9	630.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	415	653.1

UK (England)	OTB_DEF_70-99_0_0_all	Landings	370.8	748.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	446	690.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	450.7	829.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	468.1	802.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	460.1	756.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	474.5	723.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	330.6	715.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	562.6	897.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	557.6	699.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	621.1	850.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	562.6	761.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	414.6	715.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	309.3	441.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	353.9	480.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	402.9	582.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	453.1	610.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	432.8	624.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	492.4	667
UK (England)	TBB_DEF_70-99_0_0_all	Landings	440.7	763.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	541.6	706.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	535.1	849.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	555.7	817.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	549.5	772.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	584.3	728.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	382	718.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	736.5	907.1
Belgium	TBB_DEF_70-99_0_0_all	Landings	905.9	614.3
Belgium	TBB_DEF_70-99_0_0_all	Landings	825.5	653.1
Belgium	TBB_DEF_70-99_0_0_all	Landings	1168	748.3
France	OTB_CRU_100-119_0_0_all	Landings	342.3	276.8
France	OTB_CRU_100-119_0_0_all	Landings	618.5	480.7
France	OTB_CRU_100-119_0_0_all	Landings	877.8	656
France	OTB_CRU_70-99_0_0_all	Landings	108.5	165.6
France	OTT_DEF_100-119_0_0	Landings	601.1	480.7
France	OTT_DEF_100-119_0_0	Landings	877.1	656
UK (England)	OTB_DEF_70-99_0_0_all	Landings	313.4	661.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	836	1100
UK (England)	TBB_DEF_70-99_0_0_all	Landings	985.8	723.6

UK (England)	TBB_DEF_70-99_0_0_all	Landings	311.3	661.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	736.9	588.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1015	722.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	967	728.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	705	658.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	302.9	669.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	782.9	589.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1075	1105
UK (England)	TBB_DEF_70-99_0_0_all	Landings	986.2	727
France	OTT_CRU_100-119_0_0	Landings	346.5	276.8
France	OTT_CRU_100-119_0_0	Landings	745	624.1
France	OTT_CRU_100-119_0_0	Landings	846.5	706.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	175.8	166.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	288.9	209.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	665.8	850.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	952.7	1029
UK (England)	TBB_DEF_70-99_0_0_all	Landings	647.3	850.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	922.1	1029
UK (England)	TBB_DEF_70-99_0_0_all	Landings	271.7	207.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	611.7	849.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	895.6	728.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1037	718.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1257	669.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	671.9	857.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1115	1034

AgeOrLength	Area
4	27.7.f
2	27.7.f
4	27.7.f
5	27.7.f
19	27.7.f
5	27.7.g
14	27.7.g
20	27.7.f
6	27.7.f
7	27.7.f
8	27.7.f
9	27.7.f

10	27.7.f
11	27.7.f
12	27.7.f
13	27.7.f
14	27.7.f
15	27.7.f
16	27.7.f
17	27.7.f
18	27.7.f
20	27.7.f
23	27.7.f
24	27.7.f
25	27.7.f
29	27.7.f
20	27.7.f
6	27.7.g
7	27.7.g
8	27.7.g
9	27.7.g
10	27.7.g
12	27.7.g
13	27.7.g
14	27.7.g
15	27.7.g
16	27.7.g
17	27.7.g
18	27.7.g
20	27.7.g
23	27.7.g
10	27.7.f
12	27.7.f
13	27.7.f
4	27.7.g
7	27.7.g
11	27.7.g
1	27.7.g
7	27.7.g
11	27.7.g

21	27.7.f
28	27.7.f
18	27.7.f
21	27.7.f
22	27.7.f
30	27.7.f
18	27.7.g
19	27.7.g
21	27.7.g
22	27.7.g
28	27.7.g
30	27.7.g
4	27.7.g
10	27.7.g
14	27.7.g
1	27.7.f
3	27.7.f
25	27.7.f
26	27.7.f
25	27.7.f
26	27.7.f
3	27.7.g
15	27.7.g
18	27.7.g
20	27.7.g
21	27.7.g
25	27.7.g
26	27.7.g

Table 3b: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for autoallocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
France	OTB_CRU_100-119_0_0_all	Landings	566.6	365.4
France	OTB_DEF_70-99_0_0	Landings	334.6	529.9
France	OTB_DEF_70-99_0_0	Landings	374.4	562.7
France	OTB_DEF_70-99_0_0	Landings	446	714.1
France	OTB_DEF_70-99_0_0	Landings	562.6	862.9
France	OTB_DEF_70-99_0_0	Landings	257	416.5
France	OTB_DEF_70-99_0_0	Landings	334.6	537.9

France	OTB_DEF_70-99_0_0	Landings	374.4	572.3
France	OTB_DEF_70-99_0_0	Landings	359.7	581.6
France	OTB_DEF_70-99_0_0	Landings	415	656.5
France	OTB_DEF_70-99_0_0	Landings	370.8	698.2
France	OTB_DEF_70-99_0_0	Landings	446	721.4
France	OTB_DEF_70-99_0_0	Landings	562.6	873.1
Ireland	OTB_CRU_100-119_0_0_all	Landings	566.6	363.3
Ireland	OTB_DEF_70-99_0_0_all	Landings	257	416.5
Ireland	OTB_DEF_70-99_0_0_all	Landings	334.6	537.9
Ireland	OTB_DEF_70-99_0_0_all	Landings	374.4	572.3
Ireland	OTB_DEF_70-99_0_0_all	Landings	359.7	581.6
Ireland	OTB_DEF_70-99_0_0_all	Landings	415	656.5
Ireland	OTB_DEF_70-99_0_0_all	Landings	370.8	698.2
Ireland	OTB_DEF_70-99_0_0_all	Landings	446	721.4
Ireland	OTB_DEF_70-99_0_0_all	Landings	562.6	873.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	257	416.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	334.6	537.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	374.4	572.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	359.7	581.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	415	656.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	370.8	698.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	446	721.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	562.6	873.1
Ireland	TBB_DEF_70-99_0_0_all	Landings	764	585.9
Ireland	TBB_DEF_70-99_0_0_all	Landings	764	593.2
Ireland	TBB_DEF_70-99_0_0_all	Landings	996.7	718.6
France	OTB_CRU_100-119_0_0_all	Landings	566.6	363.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	334.6	529.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	374.4	562.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	446	714.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	562.6	862.9
Belgium	TBB_DEF_70-99_0_0_all	Landings	905.9	581.3
Belgium	TBB_DEF_70-99_0_0_all	Landings	1168	696.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1015	703.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	782.9	593.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	986.2	718.6

AgeOrLength	Area
5	27.7.f

8	27.7.f
9	27.7.f
14	27.7.f
23	27.7.f
6	27.7.g
8	27.7.g
9	27.7.g
10	27.7.g
12	27.7.g
13	27.7.g
14	27.7.g
23	27.7.g
5	27.7.g
6	27.7.g
8	27.7.g
9	27.7.g
10	27.7.g
12	27.7.g
13	27.7.g
14	27.7.g
23	27.7.g
6	27.7.g
8	27.7.g
9	27.7.g
10	27.7.g
12	27.7.g
13	27.7.g
14	27.7.g
23	27.7.g
22	27.7.f
22	27.7.g
30	27.7.g
5	27.7.g
8	27.7.f
9	27.7.f
14	27.7.f
23	27.7.f
10	27.7.f

13	27.7.f
30	27.7.f
22	27.7.g
30	27.7.g

InterCatch output for 2006

This document uses Table 2 from CatchAndSampleDataTables.txt from the InterCatch outputs to describe the raising procedures that were made.

In the following tables, CATON=WECA*CANUM/1000000 (in tonnes).

Raised discards

In InterCatch, the first step consists in raising the discards volumes for strats with landings and no discards associated. These discards are called in the following table 'Raised_Discards'. The data called 'Imported_Data' are landings or discards volumes imported into InterCatch with or without age structure.

The proportion of Landings with Discards associated (same strata) is **65 percent**

The volumes (and associated proportion) of landings and discards imported (Imported_Data) or raised (Raised_Discards) are described in the following table.

Table 1: Summary of the imported/Raised data

CatchCategory	RaisedOrImported	CATON	perc
Discards	Raised_Discards	14458	35
Discards	Imported_Data	26672	65
Landings	Imported_Data	1057598	100

Age distribution

For the imported landings/discards and the raised discards without age distribution, the age distribution is then computed using the defined allocation scheme. Sampled_distribution means that the data (landings or discards) were input with age distribution. Estimated_distribution means that the inputed/raised volumes were estimated using the allocation scheme.

Table 2: Summary of the imported/Raised/SampledOrEstimated data

CatchCategory	RaisedOrImported	SampledOrEstimated	CATON	perc
Landings	Imported_Data	Sampled_Distribution	905.4	86
Landings	Imported_Data	Estimated_Distribution	152.2	14
Discards	Imported_Data	Sampled_Distribution	26.67	65
Discards	Raised_Discards	Estimated_Distribution	14.42	35
Discards	Imported_Data	Estimated_Distribution	0	0

Impact of the raising on the age structure

Once the samples imported or raised are identified, it is possible to check the impact of the allocation scheme on the mean age/length of the final age/length distribution of the stock. The following figures compare the mean age (computed as the weighted mean of the age per stratum ("CatchCategory",'RaisedOrImported',"SampledOrEstimated","Country","Area","Season","Fleet","Sex")) of the estimated strata compared to the imported ones and the final distribution. Each individual included in the boxplot corresponds to the weighted mean age of a stratum.

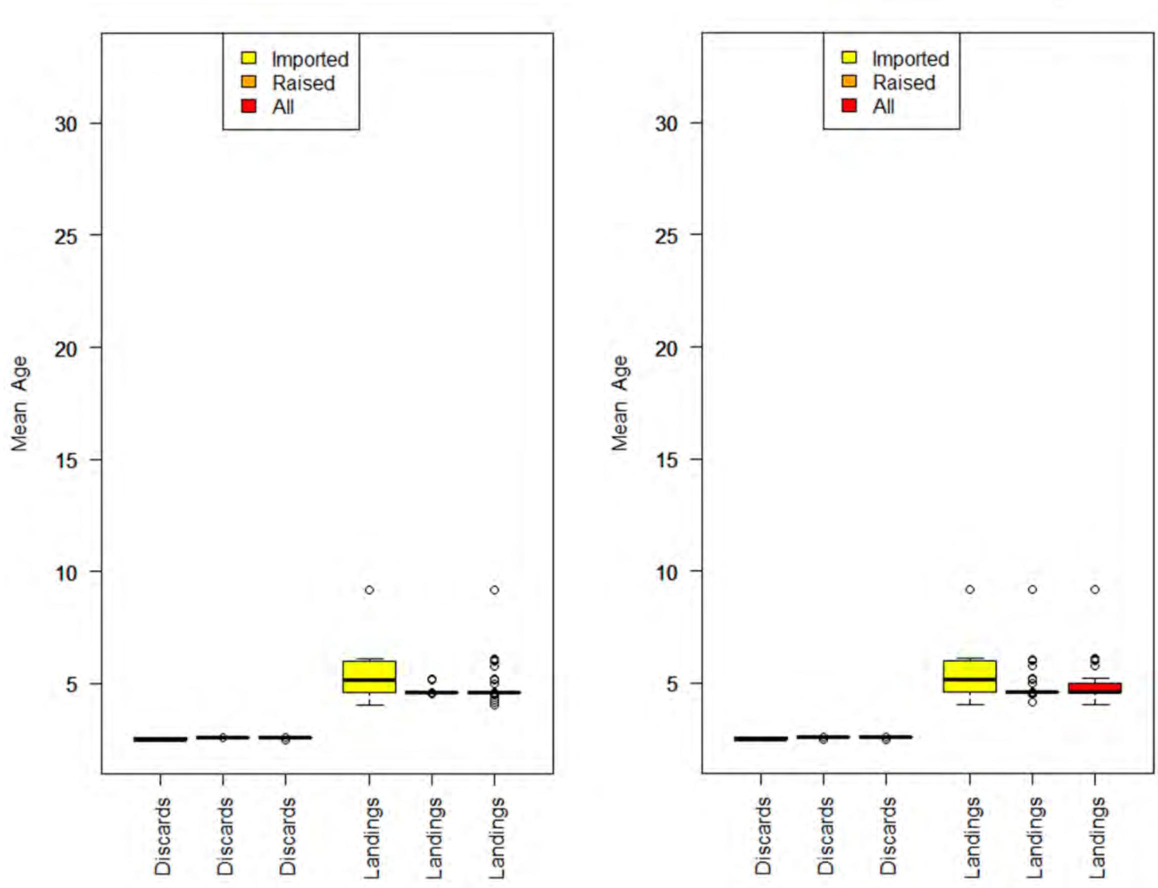


Figure 1: Mean Age per catch category (left: manual allocation; right: autoallocation)

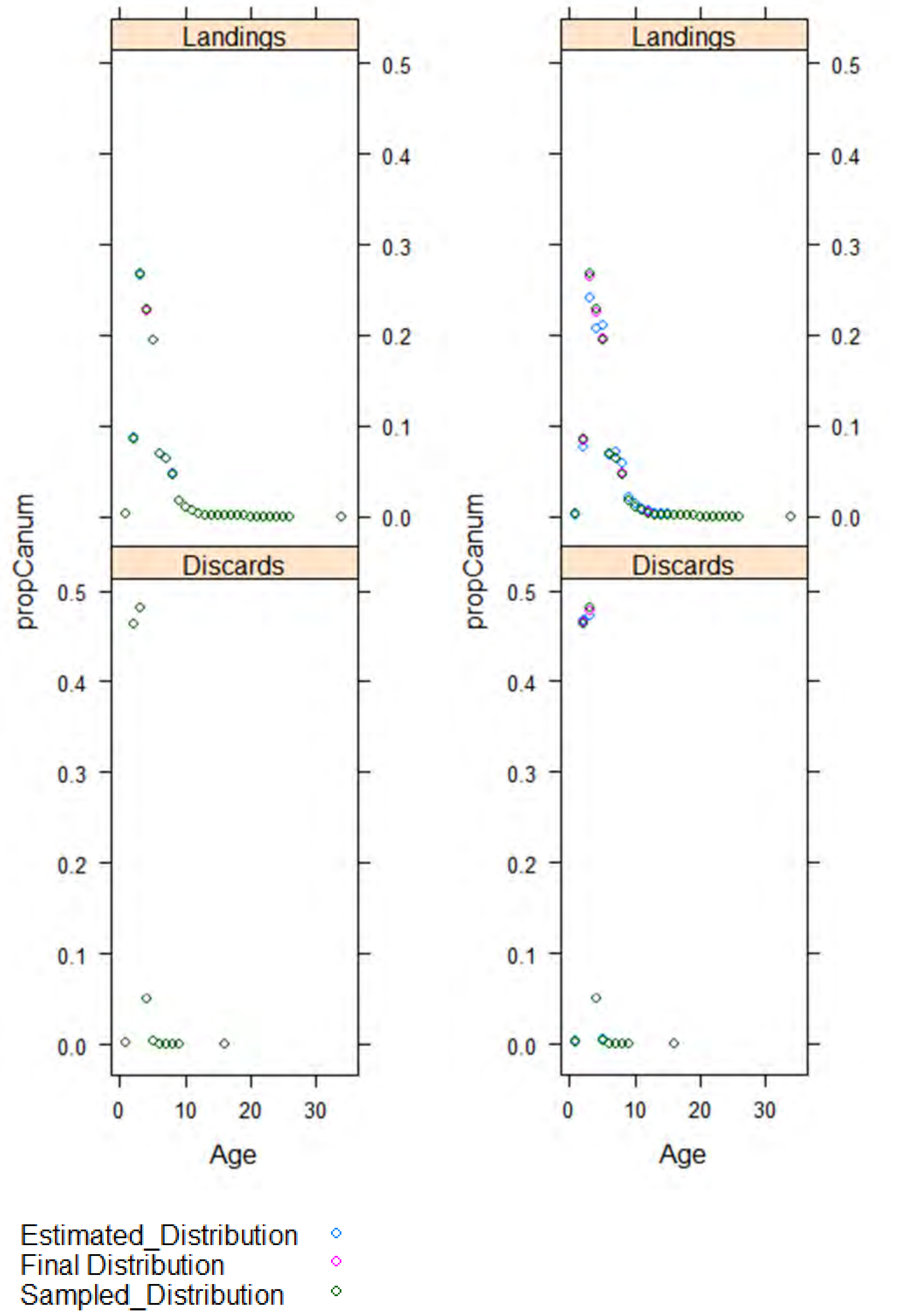


Figure 2: The percentage of each age for the sampled strata, estimated and the final age structure for the landing and discard fractions (left: manual allocation; right: autoallocation)

Impact of the raising on the mean weight

The CatchAndSampleData also provide the weight at age per stratum for the Sampled/Estimated strata. One should also check the sampled/estimated and resulting weight at age.

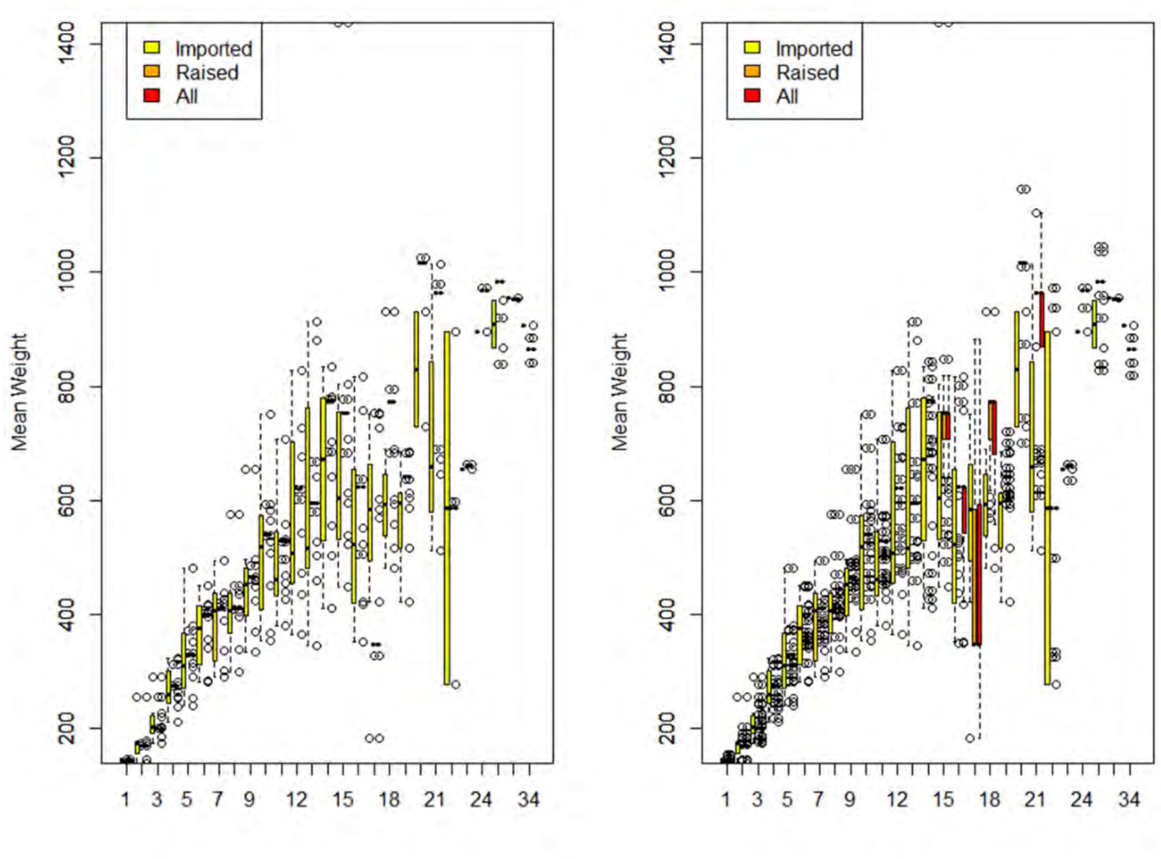


Figure 3a: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.g (left: manual allocation; right: autoallocation)

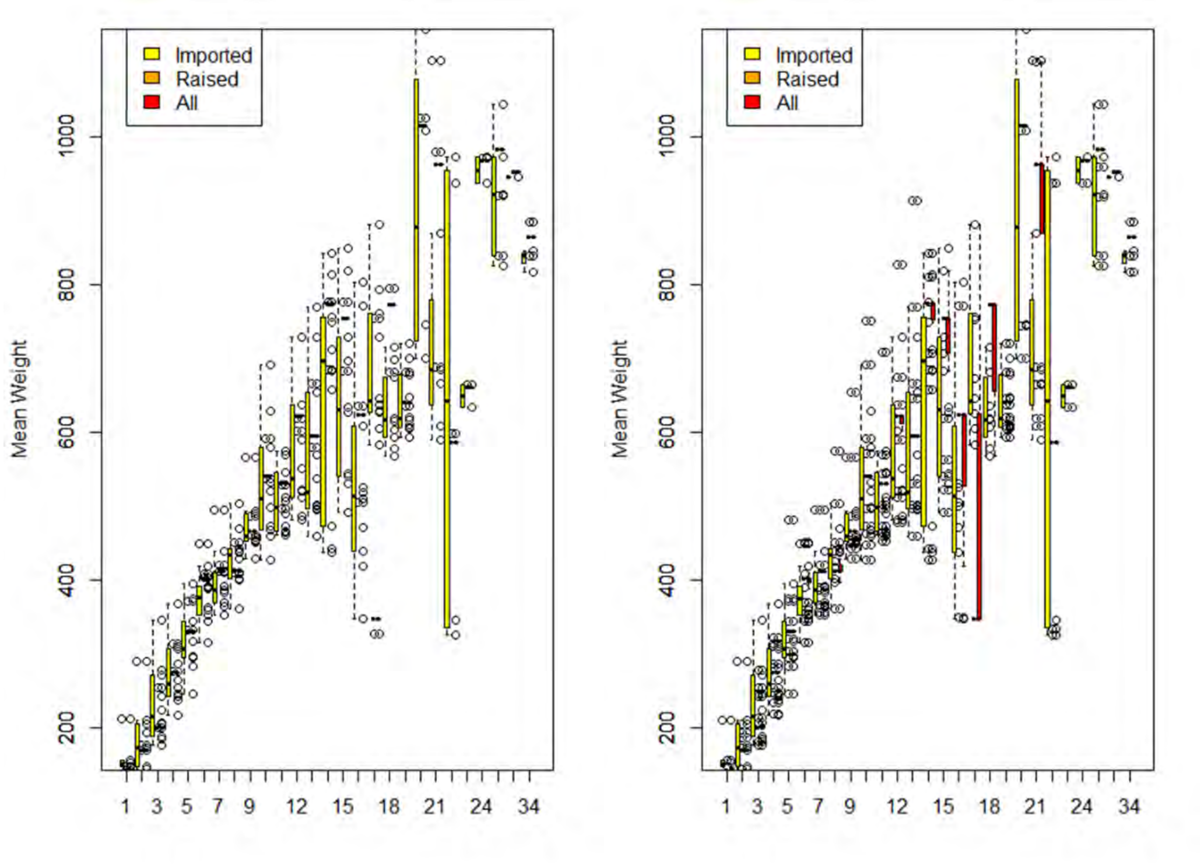


Figure 3b: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.f (left: manual allocation; right: autoallocation)

Table 3a: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for manual allocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
UK (England)	OTB_DEF_70-99_0_0_all	Landings	217.1	276.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	245.9	330.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	315.3	397.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	937.3	592.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	937.3	968.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	973	592.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	253.2	333.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	282.2	398.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	300.5	410
UK (England)	OTB_DEF_70-99_0_0_all	Landings	299.4	414.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	334.2	466.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	354.5	542.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	380.1	523.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	364	613.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	344.1	601.5

UK (England)	OTB_DEF_70-99_0_0_all	Landings	503.4	753.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	481.5	751.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	422.7	638.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	512.7	922.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	895	587.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	895	968
UK (England)	OTB_DEF_70-99_0_0_all	Landings	351.5	409.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	426.9	541.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	481.6	611.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	491.5	733.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	700.5	1007
UK (England)	OTB_DEF_70-99_0_0_all	Landings	634.3	660.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	826.7	965.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	530.6	733.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	746.2	1007
UK (England)	TBB_DEF_70-99_0_0_all	Landings	210.6	277.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	241	333.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	283.4	398.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	290	410
UK (England)	TBB_DEF_70-99_0_0_all	Landings	369.5	466.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	366.9	542.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	436	613.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	728.8	1010
UK (England)	TBB_DEF_70-99_0_0_all	Landings	277.9	587.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	653.4	661.2
Belgium	TBB_DEF_70-99_0_0_all	Landings	880.6	601.5
Belgium	TBB_DEF_70-99_0_0_all	Landings	1437	743.6
Belgium	TBB_DEF_70-99_0_0_all	Landings	817.2	606.1
France	OTB_CRU_100-119_0_0_all	Landings	481.2	333.8
France	OTB_CRU_100-119_0_0_all	Landings	494.5	410
France	OTB_CRU_100-119_0_0_all	Landings	574.9	414.8
France	OTB_CRU_100-119_0_0_all	Landings	653.6	466.3
France	OTB_CRU_100-119_0_0_all	Landings	750.7	542.8
France	OTB_CRU_100-119_0_0_all	Landings	708.1	523.2
France	OTB_CRU_100-119_0_0_all	Landings	827.2	613.5
France	OTB_CRU_100-119_0_0_all	Landings	914	601.5
UK (England)	GNS_DEF_all_0_0_all	Landings	210.4	144.5
UK (England)	GNS_DEF_all_0_0_all	Landings	289.9	172.1

UK (England)	GNS_DEF_all_0_0_all	Landings	346.1	207.8
UK (England)	GNS_DEF_all_0_0_all	Landings	367.5	276.4
UK (England)	GNS_DEF_all_0_0_all	Landings	394.2	330.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	495.3	409.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	504	416
UK (England)	OTB_DEF_70-99_0_0_all	Landings	565.6	467.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	692.5	541.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	769.8	594.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	720.8	642.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	485.7	611.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	346.6	604.6
UK (England)	GNS_DEF_all_0_0_all	Landings	255	170.4
UK (England)	GNS_DEF_all_0_0_all	Landings	289.6	206.1
UK (England)	GNS_DEF_all_0_0_all	Landings	556.6	753.2
UK (England)	GNS_DEF_all_0_0_all	Landings	516.2	751.2
UK (England)	GNS_DEF_all_0_0_all	Landings	516.2	638.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	350.9	606.1
UK (England)	GNS_DEF_all_0_0_all	Landings	729.6	611.1
UK (England)	GNS_DEF_all_0_0_all	Landings	472.9	750.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	442.8	750.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	818.1	863.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	460.7	524.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	436.5	750.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	590.3	922.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	945.7	952.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	335.7	410
UK (England)	TBB_DEF_70-99_0_0_all	Landings	411	753.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	954.1	953
UK (England)	TBB_DEF_70-99_0_0_all	Landings	907	864.6

AgeOrLength	Area
4	27.7.f
5	27.7.f
6	27.7.f
22	27.7.f
24	27.7.f
22	27.7.f
5	27.7.g
6	27.7.g

7	27.7.g
8	27.7.g
9	27.7.g
10	27.7.g
11	27.7.g
12	27.7.g
13	27.7.g
14	27.7.g
18	27.7.g
19	27.7.g
21	27.7.g
22	27.7.g
24	27.7.g
7	27.7.f
10	27.7.f
12	27.7.f
15	27.7.f
20	27.7.f
23	27.7.f
25	27.7.f
15	27.7.f
20	27.7.f
4	27.7.g
5	27.7.g
6	27.7.g
7	27.7.g
9	27.7.g
10	27.7.g
12	27.7.g
20	27.7.g
22	27.7.g
23	27.7.g
13	27.7.g
15	27.7.g
16	27.7.g
5	27.7.g
7	27.7.g
8	27.7.g

9	27.7.g
10	27.7.g
11	27.7.g
12	27.7.g
13	27.7.g
1	27.7.f
2	27.7.f
3	27.7.f
4	27.7.f
5	27.7.f
7	27.7.f
8	27.7.f
9	27.7.f
10	27.7.f
13	27.7.f
19	27.7.f
12	27.7.f
16	27.7.f
2	27.7.g
3	27.7.g
14	27.7.g
18	27.7.g
19	27.7.g
16	27.7.g
12	27.7.f
14	27.7.f
14	27.7.f
34	27.7.f
11	27.7.f
14	27.7.f
21	27.7.f
26	27.7.f
7	27.7.g
14	27.7.g
26	27.7.g
34	27.7.g

Table 3b: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for autoallocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
France	OTB_CRU_100-119_0_0_all	Landings	481.2	335.9
France	OTB_CRU_100-119_0_0_all	Landings	574.9	426.8
France	OTB_CRU_100-119_0_0_all	Landings	653.6	479.8
France	OTB_CRU_100-119_0_0_all	Landings	708.1	533.1
France	OTB_DEF_70-99_0_0	Landings	937.3	966.7
Ireland	OTB_DEF_70-99_0_0_all	Landings	937.3	966.7
France	OTB_CRU_100-119_0_0_all	Landings	481.2	335.9
France	OTB_CRU_100-119_0_0_all	Landings	574.9	426.8
France	OTB_CRU_100-119_0_0_all	Landings	653.6	479.8
France	OTB_CRU_100-119_0_0_all	Landings	708.1	533.1
France	OTB_DEF_70-99_0_0	Landings	700.5	991.1
France	OTB_DEF_70-99_0_0	Landings	634.3	659.9
France	OTB_DEF_70-99_0_0	Landings	700.5	985.2
France	OTB_DEF_70-99_0_0	Landings	634.3	658.8
Ireland	OTB_DEF_70-99_0_0_all	Landings	700.5	985.2
Ireland	OTB_DEF_70-99_0_0_all	Landings	634.3	658.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	700.5	985.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	634.3	658.8
UK(Scotland)	OTB_DEF_70-99_0_0_all	Landings	634.3	658.8
UK(Scotland)	OTB_DEF_70-99_0_0_all	Landings	818.1	862.4
France	OTB_CRU_100-119_0_0_all	Landings	481.2	335.9
France	OTB_CRU_100-119_0_0_all	Landings	574.9	426.8
France	OTB_CRU_100-119_0_0_all	Landings	653.6	479.8
France	OTB_CRU_100-119_0_0_all	Landings	708.1	533.1
France	OTB_DEF_70-99_0_0	Landings	720.8	639.9
France	OTB_DEF_70-99_0_0	Landings	155.2	143.7
Ireland	OTB_DEF_70-99_0_0_all	Landings	155.2	143.7
France	OTB_CRU_100-119_0_0_all	Landings	481.2	335.9
France	OTB_CRU_100-119_0_0_all	Landings	574.9	426.8
France	OTB_CRU_100-119_0_0_all	Landings	653.6	479.8
France	OTB_CRU_100-119_0_0_all	Landings	708.1	533.1
France	OTB_DEF_70-99_0_0	Landings	442.8	736.8
France	OTB_DEF_70-99_0_0	Landings	818.1	861.4
France	OTB_DEF_70-99_0_0	Landings	276.8	206.7
France	OTB_DEF_70-99_0_0	Landings	442.8	737.5
France	OTB_DEF_70-99_0_0	Landings	818.1	862.4

Ireland	TBB_DEF_70-99_0_0_all	Landings	427.2	736.8
Ireland	OTB_DEF_70-99_0_0_all	Landings	276.8	206.7
Ireland	OTB_DEF_70-99_0_0_all	Landings	442.8	737.5
Ireland	OTB_DEF_70-99_0_0_all	Landings	818.1	862.4
Ireland	TBB_DEF_70-99_0_0_all	Landings	427.2	737.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	937.3	966.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	282.2	395.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	422.7	634.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	895	965.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	700.5	991.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	634.3	659.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	283.4	395.1
Belgium	TBB_DEF_70-99_0_0_all	Landings	1437	718.6
UK (England)	GNS_DEF_all_0_0_all	Landings	210.4	145.3
UK (England)	GNS_DEF_all_0_0_all	Landings	289.9	172.3
UK (England)	GNS_DEF_all_0_0_all	Landings	346.1	209.6
UK (England)	GNS_DEF_all_0_0_all	Landings	367.5	276.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	720.8	639.9
UK (England)	GNS_DEF_all_0_0_all	Landings	255	171.1
UK (England)	GNS_DEF_all_0_0_all	Landings	289.6	206.7
UK (England)	GNS_DEF_all_0_0_all	Landings	516.2	634.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	442.8	736.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	818.1	861.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	436.5	736.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	945.7	952.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	411	737.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	954.1	953
UK (England)	TBB_DEF_70-99_0_0_all	Landings	907	862.4

AgeOrLength	Area
5	27.7.f
8	27.7.f
9	27.7.f
11	27.7.f
24	27.7.f
24	27.7.f
5	27.7.f
8	27.7.f
9	27.7.f

11	27.7.f
20	27.7.f
23	27.7.f
20	27.7.g
23	27.7.g
20	27.7.g
23	27.7.g
20	27.7.g
23	27.7.g
23	27.7.g
34	27.7.g
5	27.7.f
8	27.7.f
9	27.7.f
11	27.7.f
19	27.7.f
1	27.7.g
1	27.7.g
5	27.7.f
8	27.7.f
9	27.7.f
11	27.7.f
14	27.7.f
34	27.7.f
3	27.7.g
14	27.7.g
34	27.7.g
14	27.7.f
3	27.7.g
14	27.7.g
34	27.7.g
14	27.7.g
24	27.7.f
6	27.7.g
19	27.7.g
24	27.7.g
20	27.7.f
23	27.7.f

6	27.7.g
15	27.7.g
1	27.7.f
2	27.7.f
3	27.7.f
4	27.7.f
19	27.7.f
2	27.7.g
3	27.7.g
19	27.7.g
14	27.7.f
34	27.7.f
14	27.7.f
26	27.7.f
14	27.7.g
26	27.7.g
34	27.7.g

InterCatch output for 2007

This document uses Table 2 from CatchAndSampleDataTables.txt from the InterCatch outputs to describe the raising procedures that were made.

In the following tables, CATON=WECA*CANUM/1000000 (in tonnes).

Raised discards

In InterCatch, the first step consists in raising the discards volumes for strats with landings and no discards associated. These discards are called in the following table 'Raised_Discards'. The data called 'Imported_Data' are landings or discards volumes imported into InterCatch with or without age structure.

The proportion of Landings with Discards associated (same strata) is **62 percent**

The volumes (and associated proportion) of landings and discards imported (Imported_Data) or raised (Raised_Discards) are described in the following table.

Table 1: Summary of the imported/Raised data for manual allocation

CatchCategory	RaisedOrImported	CATON	perc
Discards	Raised_Discards	13856	38
Discards	Imported_Data	22394	62
Landings	Imported_Data	1050317	100

Age distribution

For the imported landings/discards and the raised discards without age distribution, the age distribution is then computed using the defined allocation scheme. Sampled_distribution means that the data (landings or discards) were input with age distribution. Estimated_distribution means that the inputed/raised volumes were estimated using the allocation scheme.

Table 2: Summary of the imported/Raised/SampledOrEstimated data

CatchCategory	RaisedOrImported	SampledOrEstimated	CATON	perc
Landings	Imported_Data	Sampled_Distribution	887.1	84
Landings	Imported_Data	Estimated_Distribution	164.3	16
Discards	Imported_Data	Sampled_Distribution	22.39	62
Discards	Raised_Discards	Estimated_Distribution	13.84	38

Impact of the raising on the age structure

Once the samples imported or raised are identified, it is possible to check the impact of the allocation scheme on the mean age/length of the final age/length distribution of the stock. The following figures compare the mean age (computed as the weighted mean of the age per stratum ("CatchCategory",'RaisedOrImported',"SampledOrEstimated","Country","Area","Season","Fleet","Sex")) of the estimated strata compared to the imported ones and the final distribution. Each individual included in the boxplot corresponds to the weighted mean age of a stratum.

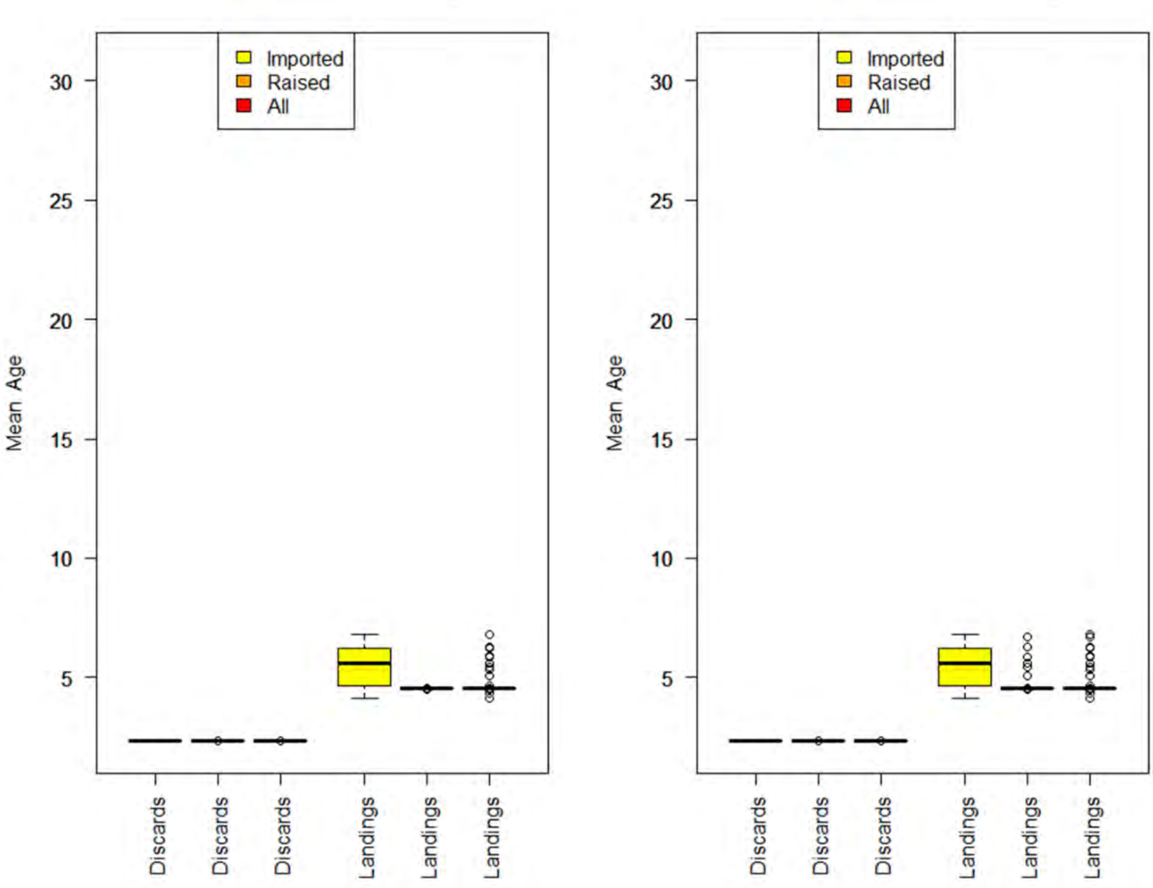


Figure 1: Mean Age per catch category (left: manual allocation; right: autoallocation)

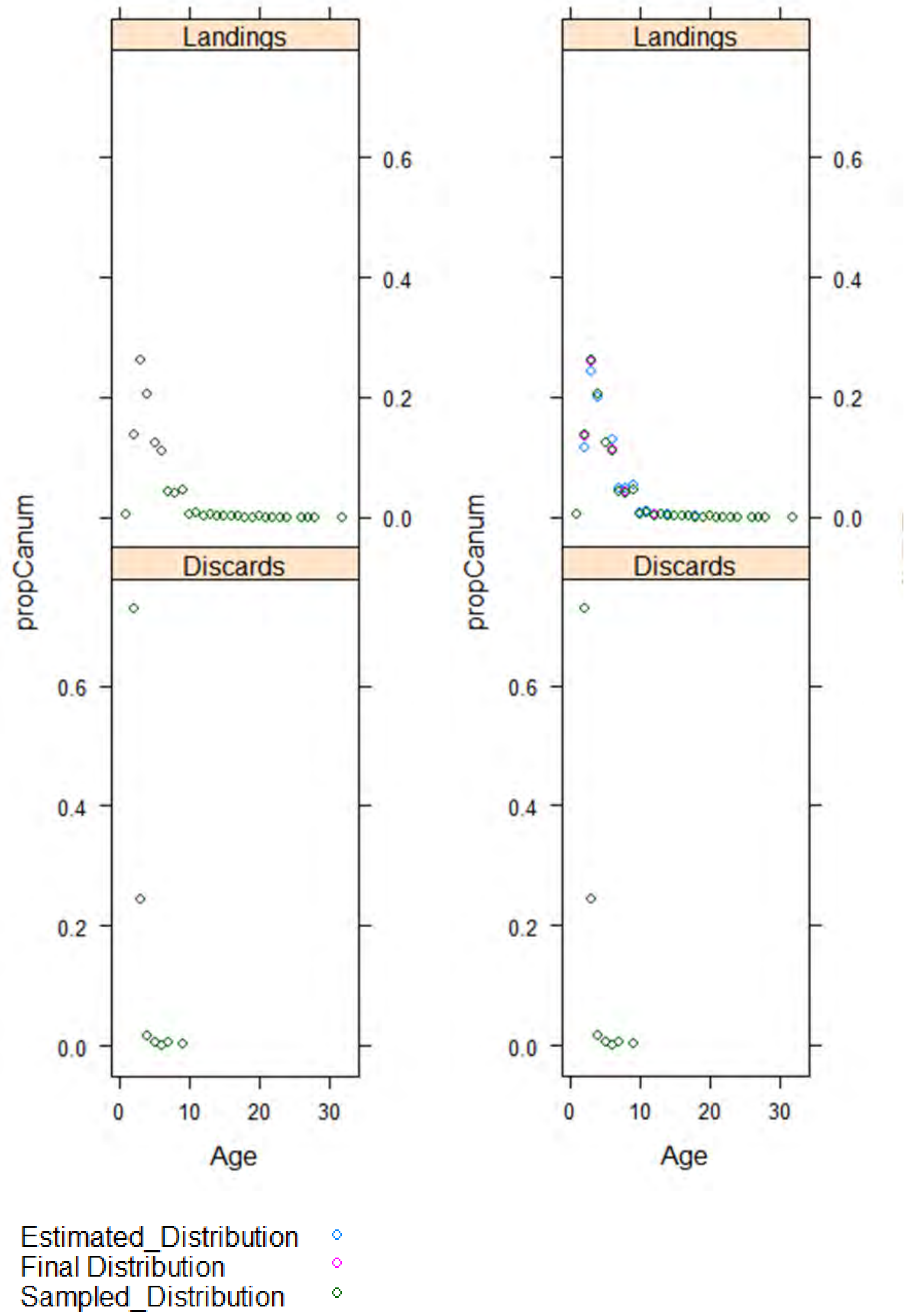


Figure 2: The percentage of each age for the sampled strata, estimated and the final age structure for the landing and discard fractions (left: manual allocation; right: autoallocation)

Impact of the raising on the mean weight

The CatchAndSampleData also provide the weight at age per stratum for the Sampled/Estimated strata. One should also check the sampled/estimated and resulting weight at age.

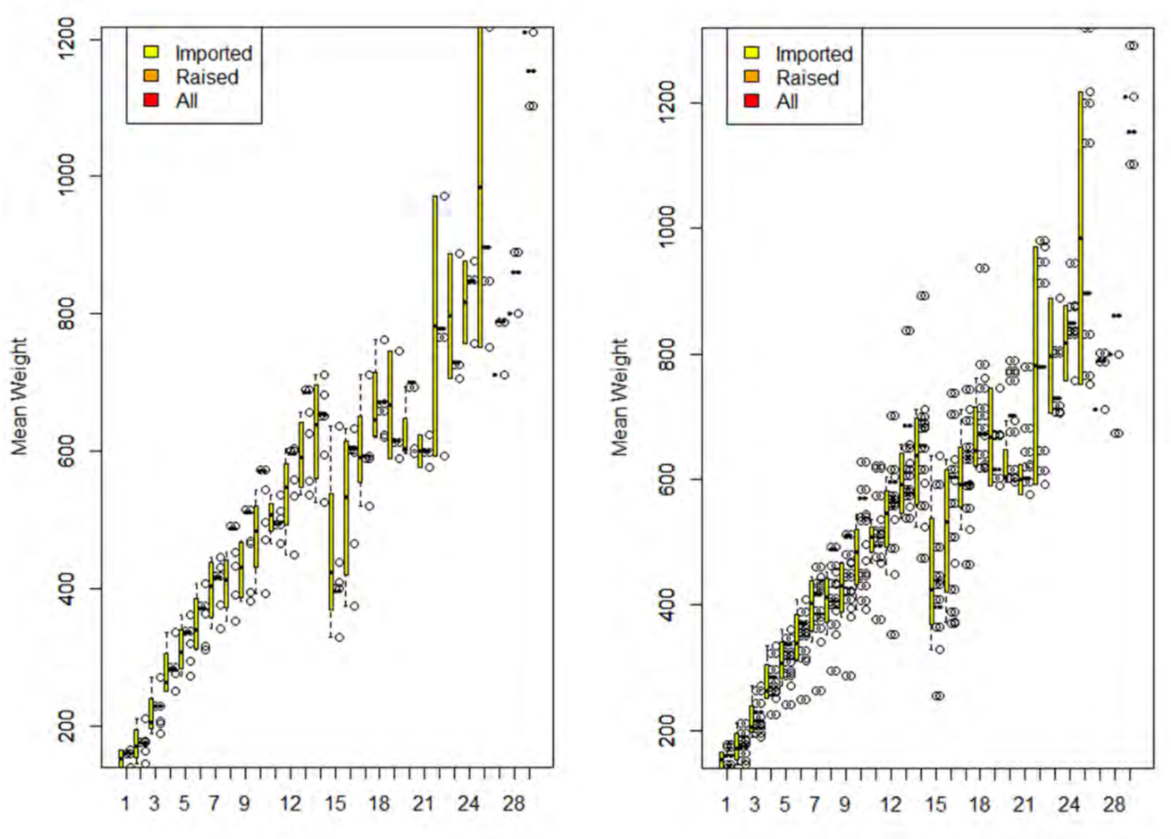


Figure 3a: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.g (left: manual allocation; right: autoallocation)

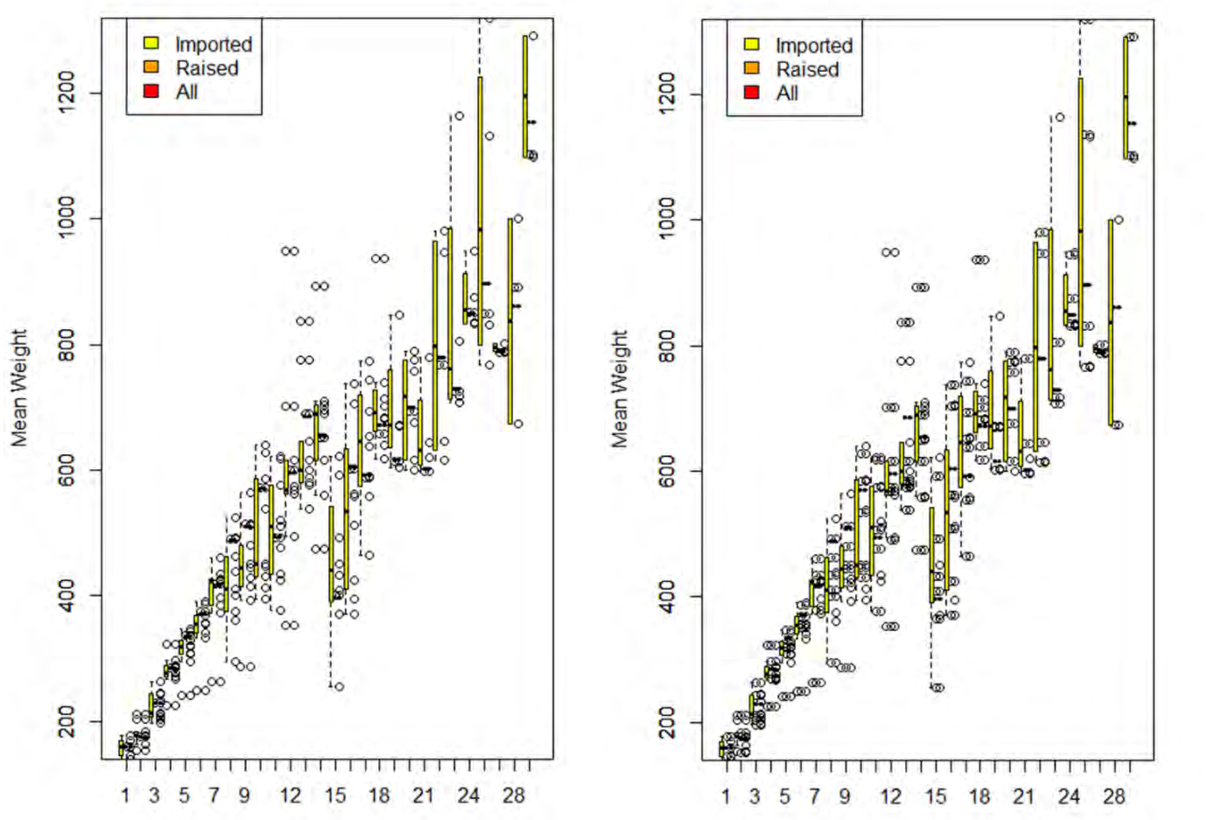


Figure 3b: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.f (left: manual allocation; right: autoallocation)

Table 3a: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for manual allocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
Ireland	TBB_DEF_70-99_0_0_all	Landings	890.7	861.7
Ireland	TBB_DEF_70-99_0_0_all	Landings	1103	1152
Ireland	TBB_DEF_70-99_0_0_all	Landings	890.7	861.7
Ireland	TBB_DEF_70-99_0_0_all	Landings	1103	1152
Ireland	TBB_DEF_70-99_0_0_all	Landings	890.7	861.7
Ireland	TBB_DEF_70-99_0_0_all	Landings	1103	1152
UK (England)	OTB_DEF_70-99_0_0_all	Landings	618.5	496.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	790	700.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	980.8	780.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1319	904.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	802.2	790.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1292	1153
UK (England)	TBB_DEF_70-99_0_0_all	Landings	947.3	780.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1133	904.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	536.4	495

UK (England)	TBB_DEF_70-99_0_0_all	Landings	535.6	593.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	537.6	681.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	594.2	651.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	619.9	670.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	971.2	779.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	757.2	847.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1217	898.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	711.6	789.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1209	1152
UK (England)	OTB_DEF_70-99_0_0_all	Landings	225.3	283.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	241.5	332.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	250.1	368.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	262.6	413.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	296	477.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	287.8	500.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	377	496.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	353.4	596.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	539.4	679.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	473.9	655
UK (England)	OTB_DEF_70-99_0_0_all	Landings	255.4	404.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	370.1	593.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	465.2	599.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	153.3	176.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	197.2	228.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	616.9	700.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	616.4	780.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	948.9	850.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	145.7	175.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	189.6	228.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	250.6	284.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	295.1	334.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	315.6	370.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	341.4	415.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	391.6	483.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	381.3	506.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	466.4	495
UK (England)	TBB_DEF_70-99_0_0_all	Landings	448.8	593.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	556	681.4

UK (England)	TBB_DEF_70-99_0_0_all	Landings	525.4	651.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	466.6	598.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	520.9	593.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	623.3	670.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	596.7	697.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	576.9	601.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	592.6	779.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	751.8	898.3
Belgium	TBB_DEF_70-99_0_0_all	Landings	948.9	596.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	146.7	160.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	621.6	496.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	837.4	679.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	893.6	655
UK (England)	OTB_DEF_70-99_0_0_all	Landings	425.2	593.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	744	599.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	937.3	677.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	779.9	605.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	140.8	160.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	412.4	560
UK (England)	TBB_DEF_70-99_0_0_all	Landings	395.7	593.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	600.9	700.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	140.7	160.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	204.1	228.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	250.6	284.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	271.9	334.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	310.4	370.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	375.8	415.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	352.9	483.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	395.4	506.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	393.3	565.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	711.8	651.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	373.9	598.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	761.8	670.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	603.6	697.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	624.3	601.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	177.8	160.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	211.1	176.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	263.7	228.6

UK (England)	OTB_DEF_70-99_0_0_all	Landings	323.1	283.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	592.6	404.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	673.9	861.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	203.7	176.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	361.6	477.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	394.4	560
UK (England)	TBB_DEF_70-99_0_0_all	Landings	622.4	404.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	773.8	599.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	846.7	621.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1163	737.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1001	861.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	211.8	175.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	270.6	228.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	335.7	284.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	408.1	370.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	470.4	565.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	637.3	399.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	711.2	593.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	745.1	617.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	888.4	730.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	800.2	861.7

AgeOrLength	Area
28	27.7.g
32	27.7.g
28	27.7.g
32	27.7.g
28	27.7.g
32	27.7.g
11	27.7.f
20	27.7.f
22	27.7.f
26	27.7.f
27	27.7.f
32	27.7.f
22	27.7.f
26	27.7.f
11	27.7.g
12	27.7.g

13	27.7.g
14	27.7.g
18	27.7.g
22	27.7.g
24	27.7.g
26	27.7.g
27	27.7.g
32	27.7.g
4	27.7.f
5	27.7.f
6	27.7.f
7	27.7.f
8	27.7.f
9	27.7.f
11	27.7.f
12	27.7.f
13	27.7.f
14	27.7.f
15	27.7.f
16	27.7.f
17	27.7.f
2	27.7.f
3	27.7.f
20	27.7.f
22	27.7.f
24	27.7.f
2	27.7.g
3	27.7.g
4	27.7.g
5	27.7.g
6	27.7.g
7	27.7.g
8	27.7.g
9	27.7.g
11	27.7.g
12	27.7.g
13	27.7.g
14	27.7.g

16	27.7.g
17	27.7.g
18	27.7.g
20	27.7.g
21	27.7.g
22	27.7.g
26	27.7.g
12	27.7.f
1	27.7.f
11	27.7.f
13	27.7.f
14	27.7.f
16	27.7.f
17	27.7.f
18	27.7.f
21	27.7.f
1	27.7.f
10	27.7.f
16	27.7.f
20	27.7.f
1	27.7.g
3	27.7.g
4	27.7.g
5	27.7.g
6	27.7.g
7	27.7.g
8	27.7.g
9	27.7.g
10	27.7.g
14	27.7.g
16	27.7.g
18	27.7.g
20	27.7.g
21	27.7.g
1	27.7.f
2	27.7.f
3	27.7.f
4	27.7.f

15	27.7.f
28	27.7.f
2	27.7.f
8	27.7.f
10	27.7.f
15	27.7.f
17	27.7.f
19	27.7.f
23	27.7.f
28	27.7.f
2	27.7.g
3	27.7.g
4	27.7.g
6	27.7.g
10	27.7.g
15	27.7.g
17	27.7.g
19	27.7.g
23	27.7.g
28	27.7.g

Table 3b: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for autoallocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
France	OTB_DEF_70-99_0_0	Landings	1319	914.7
France	OTB_DEF_70-99_0_0	Landings	802.2	790.8
France	OTB_DEF_70-99_0_0	Landings	1292	1157
Ireland	OTB_DEF_70-99_0_0_all	Landings	1319	917.1
Ireland	OTB_DEF_70-99_0_0_all	Landings	1292	1161
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1319	917.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1292	1161
France	OTB_DEF_70-99_0_0	Landings	225.3	281.9
France	OTB_DEF_70-99_0_0	Landings	241.5	328.2
France	OTB_DEF_70-99_0_0	Landings	250.1	363.3
France	OTB_DEF_70-99_0_0	Landings	262.6	408.8
France	OTB_DEF_70-99_0_0	Landings	296	466.3
France	OTB_DEF_70-99_0_0	Landings	287.8	488.3

France	OTB_DEF_70-99_0_0	Landings	353.4	587.7
France	OTB_DEF_70-99_0_0	Landings	225.3	282.7
France	OTB_DEF_70-99_0_0	Landings	241.5	328.5
France	OTB_DEF_70-99_0_0	Landings	250.1	363.5
France	OTB_DEF_70-99_0_0	Landings	262.6	409.4
France	OTB_DEF_70-99_0_0	Landings	296	465.1
France	OTB_DEF_70-99_0_0	Landings	287.8	487.8
France	OTB_DEF_70-99_0_0	Landings	353.4	584
Ireland	OTB_DEF_70-99_0_0_all	Landings	225.3	281.9
Ireland	OTB_DEF_70-99_0_0_all	Landings	241.5	328.2
Ireland	OTB_DEF_70-99_0_0_all	Landings	250.1	363.3
Ireland	OTB_DEF_70-99_0_0_all	Landings	262.6	408.8
Ireland	OTB_DEF_70-99_0_0_all	Landings	296	466.3
Ireland	OTB_DEF_70-99_0_0_all	Landings	287.8	488.3
Ireland	OTB_DEF_70-99_0_0_all	Landings	353.4	587.7
Ireland	TBB_DEF_70-99_0_0_all	Landings	945.8	853
Ireland	OTB_DEF_70-99_0_0_all	Landings	225.3	282.7
Ireland	OTB_DEF_70-99_0_0_all	Landings	241.5	328.5
Ireland	OTB_DEF_70-99_0_0_all	Landings	250.1	363.5
Ireland	OTB_DEF_70-99_0_0_all	Landings	262.6	409.4
Ireland	OTB_DEF_70-99_0_0_all	Landings	296	465.1
Ireland	OTB_DEF_70-99_0_0_all	Landings	287.8	487.8
Ireland	OTB_DEF_70-99_0_0_all	Landings	353.4	584
Ireland	TBB_DEF_70-99_0_0_all	Landings	945.8	849.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	225.3	282.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	241.5	328.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	250.1	363.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	262.6	409.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	296	465.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	287.8	487.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	353.4	584
UK(Scotland)	OTB_DEF_70-99_0_0_all	Landings	673.9	847.6
UK(Scotland)	OTB_DEF_70-99_0_0_all	Landings	1292	1161
France	OTB_DEF_70-99_0_0	Landings	893.6	651.4
France	OTB_DEF_70-99_0_0	Landings	937.3	682.7
France	OTB_DEF_70-99_0_0	Landings	779.9	611.2
France	OTB_DEF_70-99_0_0	Landings	893.6	653.5
France	OTB_DEF_70-99_0_0	Landings	744	599.7

France	OTB_DEF_70-99_0_0	Landings	937.3	684.7
France	OTB_DEF_70-99_0_0	Landings	779.9	612.9
Ireland	OTB_DEF_70-99_0_0_all	Landings	893.6	653.5
Ireland	OTB_DEF_70-99_0_0_all	Landings	744	599.7
Ireland	OTB_DEF_70-99_0_0_all	Landings	937.3	684.7
Ireland	OTB_DEF_70-99_0_0_all	Landings	779.9	612.9
Ireland	TBB_DEF_70-99_0_0_all	Landings	140.8	160.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	893.6	653.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	744	599.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	937.3	684.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	779.9	612.9
France	OTB_DEF_70-99_0_0	Landings	177.8	160.6
France	OTB_DEF_70-99_0_0	Landings	211.1	177.4
France	OTB_DEF_70-99_0_0	Landings	592.6	404.9
France	OTB_DEF_70-99_0_0	Landings	673.9	856.1
France	OTB_DEF_70-99_0_0	Landings	211.1	177.8
France	OTB_DEF_70-99_0_0	Landings	592.6	406.8
France	OTB_DEF_70-99_0_0	Landings	673.9	847.6
Ireland	OTB_DEF_70-99_0_0_all	Landings	211.1	177.8
Ireland	OTB_DEF_70-99_0_0_all	Landings	592.6	406.8
Ireland	OTB_DEF_70-99_0_0_all	Landings	673.9	847.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	211.1	177.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	592.6	406.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	673.9	847.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1319	914.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	802.2	790.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1292	1157
UK (England)	TBB_DEF_70-99_0_0_all	Landings	757.2	849.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	711.6	789.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	225.3	281.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	241.5	328.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	250.1	363.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	262.6	408.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	296	466.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	287.8	488.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	353.4	587.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	948.9	853
UK (England)	TBB_DEF_70-99_0_0_all	Landings	145.7	177.8

UK (England)	TBB_DEF_70-99_0_0_all	Landings	596.7	701.2
Belgium	TBB_DEF_70-99_0_0_all	Landings	948.9	587.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	893.6	651.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	937.3	682.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	779.9	611.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	140.8	160.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	600.9	702.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	140.7	160.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	177.8	160.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	211.1	177.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	592.6	404.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	673.9	856.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	622.4	404.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	773.8	600.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	846.7	625.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1163	740.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1001	856.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	211.8	177.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	270.6	228.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	335.7	282.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	637.3	406.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	745.1	623.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	888.4	734.5

AgeOrLength	Area
26	27.7.f
27	27.7.f
32	27.7.f
26	27.7.g
32	27.7.g
26	27.7.g
32	27.7.g
4	27.7.f
5	27.7.f
6	27.7.f
7	27.7.f
8	27.7.f
9	27.7.f
12	27.7.f

4	27.7.g
5	27.7.g
6	27.7.g
7	27.7.g
8	27.7.g
9	27.7.g
12	27.7.g
4	27.7.f
5	27.7.f
6	27.7.f
7	27.7.f
8	27.7.f
9	27.7.f
12	27.7.f
24	27.7.f
4	27.7.g
5	27.7.g
6	27.7.g
7	27.7.g
8	27.7.g
9	27.7.g
12	27.7.g
24	27.7.g
4	27.7.g
5	27.7.g
6	27.7.g
7	27.7.g
8	27.7.g
9	27.7.g
12	27.7.g
28	27.7.g
32	27.7.g
14	27.7.f
18	27.7.f
21	27.7.f
14	27.7.g
17	27.7.g
18	27.7.g

21	27.7.g
14	27.7.g
17	27.7.g
18	27.7.g
21	27.7.g
1	27.7.g
14	27.7.g
17	27.7.g
18	27.7.g
21	27.7.g
1	27.7.f
2	27.7.f
15	27.7.f
28	27.7.f
2	27.7.g
15	27.7.g
28	27.7.g
2	27.7.g
15	27.7.g
28	27.7.g
2	27.7.g
15	27.7.g
28	27.7.g
26	27.7.f
27	27.7.f
32	27.7.f
24	27.7.g
27	27.7.g
4	27.7.f
5	27.7.f
6	27.7.f
7	27.7.f
8	27.7.f
9	27.7.f
12	27.7.f
24	27.7.f
2	27.7.g
20	27.7.g

12	27.7.f
14	27.7.f
18	27.7.f
21	27.7.f
1	27.7.f
20	27.7.f
1	27.7.g
1	27.7.f
2	27.7.f
15	27.7.f
28	27.7.f
15	27.7.f
17	27.7.f
19	27.7.f
23	27.7.f
28	27.7.f
2	27.7.g
3	27.7.g
4	27.7.g
15	27.7.g
19	27.7.g
23	27.7.g

InterCatch output for 2008

This document uses Table 2 from CatchAndSampleDataTables.txt from the InterCatch outputs to describe the raising procedures that were made.

In the following tables, CATON=WECA*CANUM/1000000 (in tonnes).

Raised discards

In InterCatch, the first step consists in raising the discards volumes for strats with landings and no discards associated. These discards are called in the following table 'Raised_Discards'. The data called 'Imported_Data' are landings or discards volumes imported into InterCatch with or without age structure.

The proportion of Landings with Discards associated (same strata) is **54 percent**

The volumes (and associated proportion) of landings and discards imported (Imported_Data) or raised (Raised_Discards) are described in the following table.

Table 1: Summary of the imported/Raised data

CatchCategory	RaisedOrImported	CATON	perc
Discards	Raised_Discards	3907	46
Discards	Imported_Data	4548	54
Landings	Imported_Data	790154	100

Age distribution

For the imported landings/discards and the raised discards without age distribution, the age distribution is then computed using the defined allocation scheme. Sampled_distribution means that the data (landings or discards) were input with age distribution. Estimated_distribution means that the inputed/raised volumes were estimated using the allocation scheme.

Table 2: Summary of the imported/Raised/SampledOrEstimated data

CatchCategory	RaisedOrImported	SampledOrEstimated	CATON	perc
Landings	Imported_Data	Sampled_Distribution	624.1	79
Landings	Imported_Data	Estimated_Distribution	166	21
Discards	Imported_Data	Sampled_Distribution	4.548	54
Discards	Raised_Discards	Estimated_Distribution	3.856	46
Discards	Imported_Data	Estimated_Distribution	0	0

Impact of the raising on the age structure

Once the samples imported or raised are identified, it is possible to check the impact of the allocation scheme on the mean age/length of the final age/length distribution of the stock. The following figures compare the mean age (computed as the weighted mean of the age per stratum ("CatchCategory",'RaisedOrImported',"SampledOrEstimated","Country","Area","Season","Fleet","Sex")) of the estimated strata compared to the imported ones and the final distribution. Each individual included in the boxplot corresponds to the weighted mean age of a stratum.

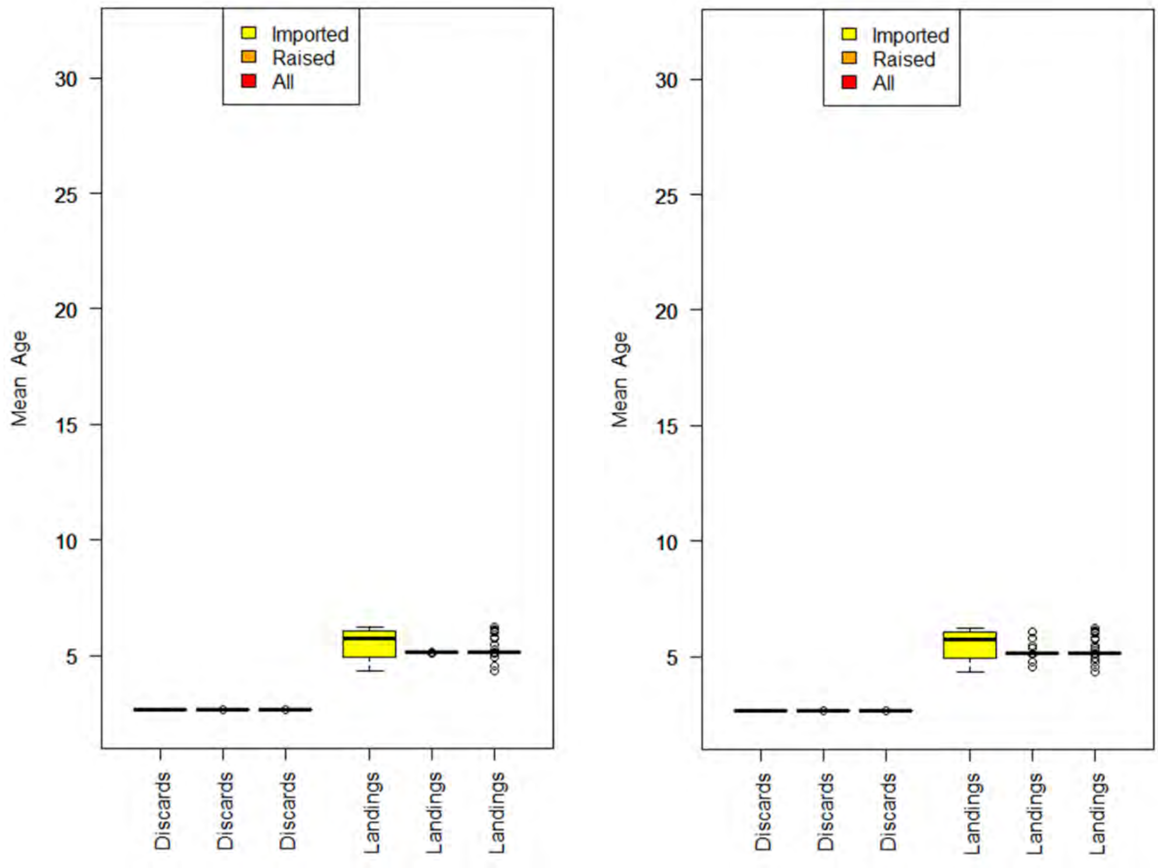


Figure 1: Mean Age per catch category (left: manual allocation; right: autoallocation)

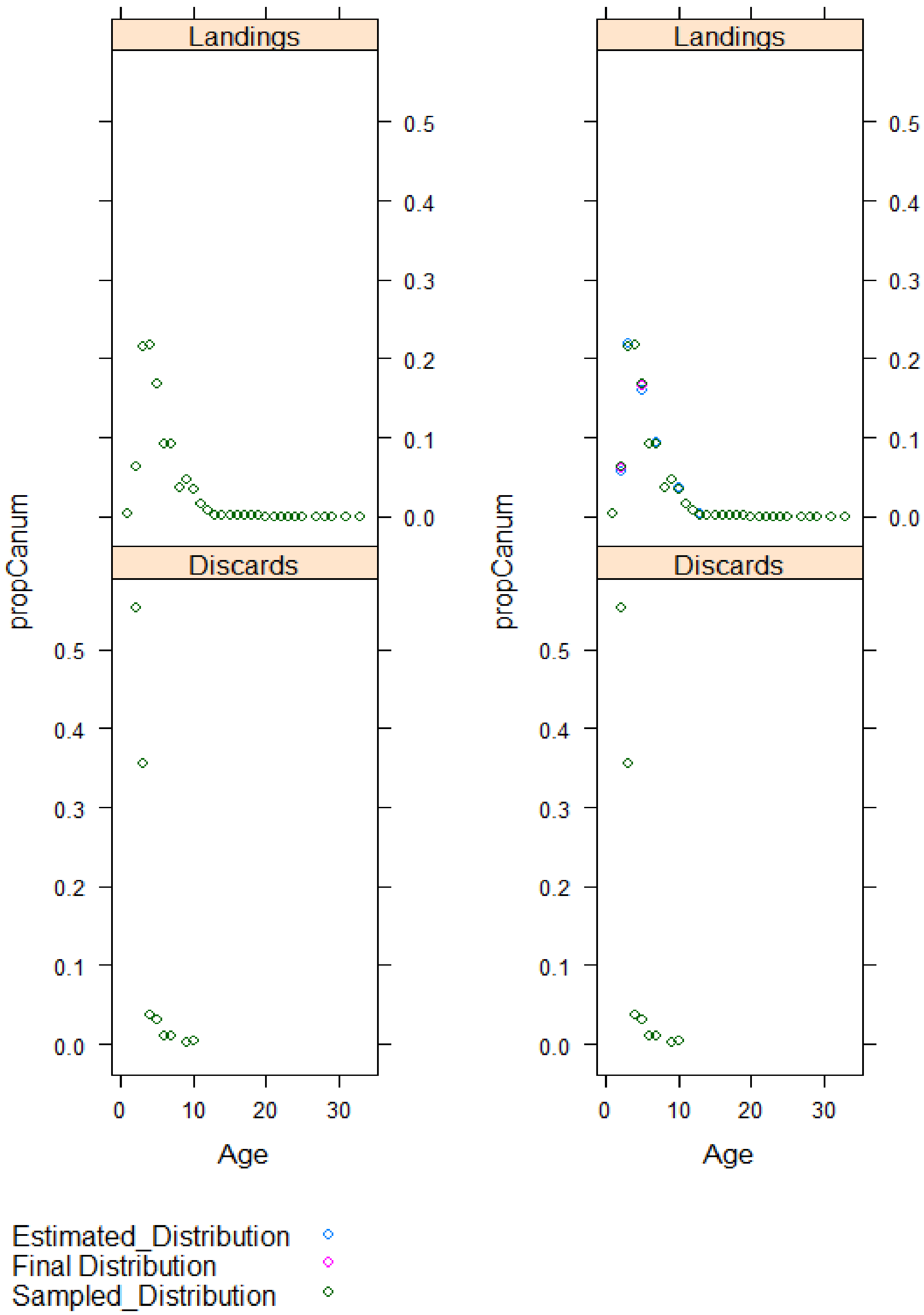


Figure 2: The percentage of each age for the sampled strata, estimated and the final age structure for the landing and discard fractions (left: manual allocation; right: autoallocation)

Impact of the raising on the mean weight

The CatchAndSampleData also provide the weight at age per stratum for the Sampled/Estimated strata. One should also check the sampled/estimated and resulting weight at age.

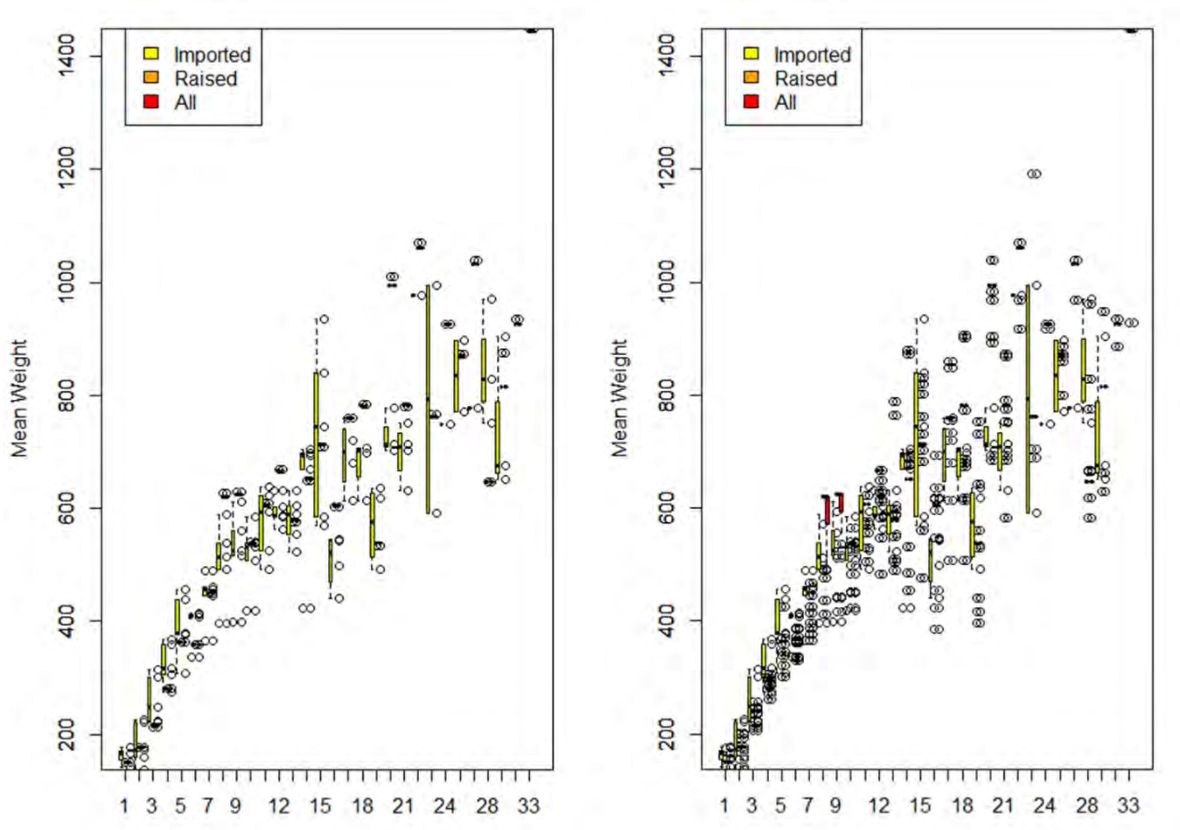
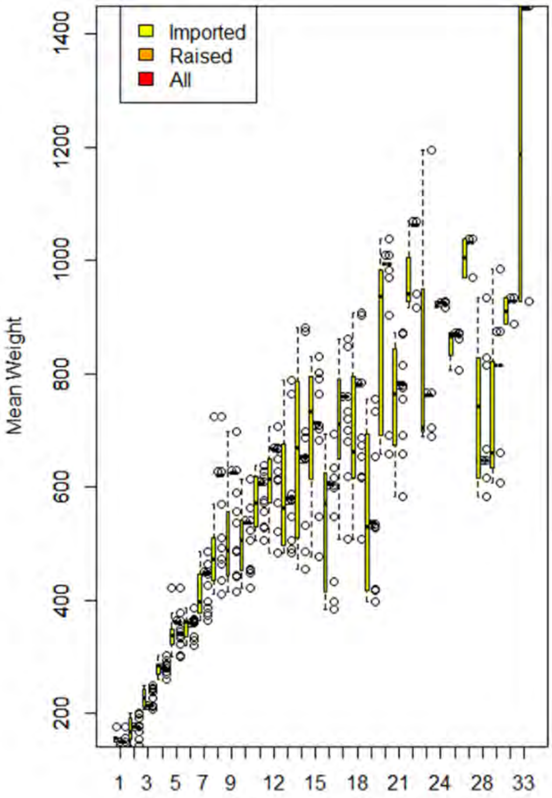


Figure 3a: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.g (left: manual allocation; right: autoallocation)



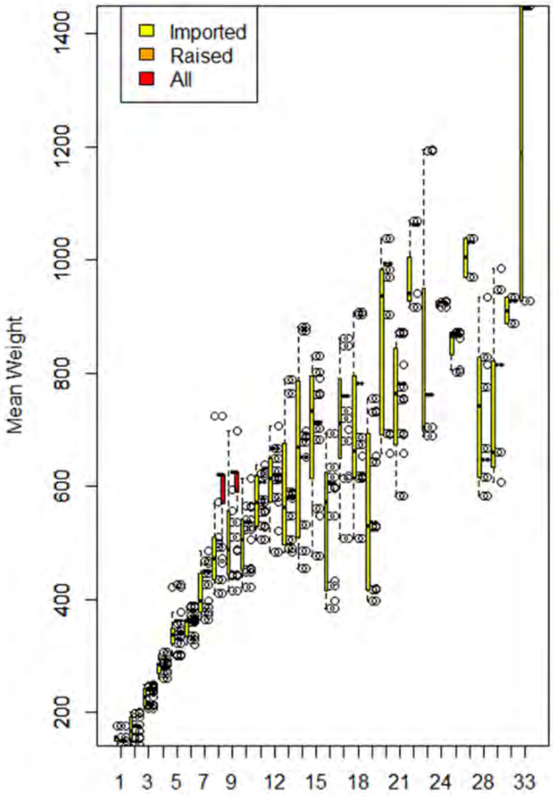


Figure 3b: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.f (left: manual allocation; right: autoallocation)

Table 3a: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for manual allocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
Ireland	TBB_DEF_70-99_0_0_all	Landings	934.5	927.5
Ireland	TBB_DEF_70-99_0_0_all	Landings	1449	1446
Ireland	TBB_DEF_70-99_0_0_all	Landings	934.5	927.5
Ireland	TBB_DEF_70-99_0_0_all	Landings	1449	1446
UK (England)	TBB_DEF_70-99_0_0_all	Landings	934.5	927.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1449	1446
Ireland	TBB_DEF_70-99_0_0_all	Landings	934.5	927.5
Ireland	TBB_DEF_70-99_0_0_all	Landings	1449	1446
Ireland	TBB_DEF_70-99_0_0_all	Landings	934.5	927.5
Ireland	TBB_DEF_70-99_0_0_all	Landings	1449	1446
UK (England)	TBB_CRU_16-31_0_0_all	Landings	934.5	927.5
UK (England)	TBB_CRU_16-31_0_0_all	Landings	1449	1446
UK (England)	OTB_DEF_70-99_0_0_all	Landings	385.3	358
UK (England)	OTB_DEF_70-99_0_0_all	Landings	788	580.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	880.1	652.6

UK (England)	OTB_DEF_70-99_0_0_all	Landings	754.2	539.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	916.9	925.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	968.7	1031
UK (England)	TBB_DEF_70-99_0_0_all	Landings	764.3	580.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	874.3	652.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	732.6	539.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	414.4	361.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	492.1	613.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	515	619
UK (England)	TBB_DEF_70-99_0_0_all	Landings	524.5	605.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	561.7	661.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	631.9	578.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	584.3	714
UK (England)	TBB_DEF_70-99_0_0_all	Landings	680.7	756.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	617.4	538.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	776.6	985.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	630.8	776.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	591.3	762.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	748.7	922.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	776.6	1029
UK (England)	OTB_DEF_70-99_0_0_all	Landings	261.1	280.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	301.8	359.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	377.2	443.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	440.7	608.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	449	532
UK (England)	OTB_DEF_70-99_0_0_all	Landings	916.7	1057
UK (England)	OTB_DEF_70-99_0_0_all	Landings	887.1	926.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	928.5	1436
UK (England)	TBB_DEF_70-99_0_0_all	Landings	141.9	175.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	260.9	280.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	300.1	359.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	329.5	358
UK (England)	TBB_DEF_70-99_0_0_all	Landings	364.3	443.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	411.3	602.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	415.5	608.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	422.4	532
UK (England)	TBB_DEF_70-99_0_0_all	Landings	528.7	602.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	454.4	652.6

UK (England)	MIS_MIS_0_0_0_HC	Landings	137.8	176.4
UK (England)	MIS_MIS_0_0_0_HC	Landings	308.5	364.4
UK (England)	MIS_MIS_0_0_0_HC	Landings	364.7	448.6
UK (England)	MIS_MIS_0_0_0_HC	Landings	395.8	613.4
UK (England)	MIS_MIS_0_0_0_HC	Landings	399.3	619
UK (England)	MIS_MIS_0_0_0_HC	Landings	418.2	536.1
UK (England)	MIS_MIS_0_0_0_HC	Landings	492.2	605.8
UK (England)	MIS_MIS_0_0_0_HC	Landings	601.9	661.6
UK (England)	MIS_MIS_0_0_0_HC	Landings	522.9	578.2
UK (England)	MIS_MIS_0_0_0_HC	Landings	423.1	650.8
UK (England)	MIS_MIS_0_0_0_HC	Landings	935.7	714
Belgium	TBB_DEF_70-99_0_0_all	Landings	613	532
UK (England)	OTB_DEF_70-99_0_0_all	Landings	244	215.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	442.7	608.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	505.5	602.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	482.8	656.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	476.4	710.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	384.2	594.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	506.9	752.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	506.9	770
UK (England)	OTB_DEF_70-99_0_0_all	Landings	581.7	777.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	546.3	710.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	396.6	594.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	617.3	752.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1194	767.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	815.6	657.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	984.6	815.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	407.8	361.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	513.7	613.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	524.1	619
UK (England)	TBB_DEF_70-99_0_0_all	Landings	586.6	661.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	568.8	714
UK (England)	TBB_DEF_70-99_0_0_all	Landings	440.3	598.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	613.2	756.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	612.4	776.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	636.4	538.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	995.2	762.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	174.9	150

UK (England)	OTB_DEF_70-99_0_0_all	Landings	243	215.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	301	280.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	422.3	359.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	690.9	982.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	805.1	869
UK (England)	OTB_DEF_70-99_0_0_all	Landings	827.6	657.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	659	815.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	200.3	175.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	249.5	215.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	318.7	358
UK (England)	TBB_DEF_70-99_0_0_all	Landings	372.9	443.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	528.4	602.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	520.7	656.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	432	594.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	657.9	982.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	657.9	777.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	940.1	1057
UK (England)	TBB_DEF_70-99_0_0_all	Landings	933.6	657.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	608	815.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	175.9	149.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	225.4	176.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	301.8	216.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	359.1	283.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	456	364.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	412	361.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	490.2	448.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	583.7	536.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	698.7	776.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	702.9	985.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	702.9	776.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	770.2	869.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	827.6	655.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	674.8	817.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	165.7	149.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	221.1	176.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	313.6	216.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	367.2	283.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	437.3	364.4

UK (England)	TBB_DEF_70-99_0_0_all	Landings	407.2	361.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	585.2	661.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	840.2	714
UK (England)	TBB_DEF_70-99_0_0_all	Landings	497.5	598.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	492	538.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	713	985.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	713	776.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	977.4	1061
UK (England)	TBB_DEF_70-99_0_0_all	Landings	971.1	655.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	651.4	817.2

AgeOrLength	Area
31	27.7.g
33	27.7.g
31	27.7.g
33	27.7.g
31	27.7.g
33	27.7.g
31	27.7.g
33	27.7.g
31	27.7.g
33	27.7.g
31	27.7.g
33	27.7.g
6	27.7.f
13	27.7.f
14	27.7.f
19	27.7.f
24	27.7.f
27	27.7.f
13	27.7.f
14	27.7.f
19	27.7.f
6	27.7.g
8	27.7.g
9	27.7.g
11	27.7.g
12	27.7.g
13	27.7.g

15	27.7.g
17	27.7.g
19	27.7.g
20	27.7.g
21	27.7.g
23	27.7.g
24	27.7.g
27	27.7.g
4	27.7.f
5	27.7.f
7	27.7.f
9	27.7.f
10	27.7.f
22	27.7.f
31	27.7.f
33	27.7.f
2	27.7.f
4	27.7.f
5	27.7.f
6	27.7.f
7	27.7.f
8	27.7.f
9	27.7.f
10	27.7.f
11	27.7.f
14	27.7.f
2	27.7.g
5	27.7.g
7	27.7.g
8	27.7.g
9	27.7.g
10	27.7.g
11	27.7.g
12	27.7.g
13	27.7.g
14	27.7.g
15	27.7.g
10	27.7.f

3	27.7.f
9	27.7.f
11	27.7.f
12	27.7.f
15	27.7.f
16	27.7.f
17	27.7.f
18	27.7.f
21	27.7.f
15	27.7.f
16	27.7.f
17	27.7.f
23	27.7.f
28	27.7.f
29	27.7.f
6	27.7.g
8	27.7.g
9	27.7.g
12	27.7.g
15	27.7.g
16	27.7.g
17	27.7.g
18	27.7.g
19	27.7.g
23	27.7.g
1	27.7.f
3	27.7.f
4	27.7.f
5	27.7.f
20	27.7.f
25	27.7.f
28	27.7.f
29	27.7.f
2	27.7.f
3	27.7.f
6	27.7.f
7	27.7.f
11	27.7.f

12	27.7.f
16	27.7.f
20	27.7.f
21	27.7.f
22	27.7.f
28	27.7.f
29	27.7.f
1	27.7.g
2	27.7.g
3	27.7.g
4	27.7.g
5	27.7.g
6	27.7.g
7	27.7.g
10	27.7.g
18	27.7.g
20	27.7.g
21	27.7.g
25	27.7.g
28	27.7.g
29	27.7.g
1	27.7.g
2	27.7.g
3	27.7.g
4	27.7.g
5	27.7.g
6	27.7.g
12	27.7.g
15	27.7.g
16	27.7.g
19	27.7.g
20	27.7.g
21	27.7.g
22	27.7.g
28	27.7.g
29	27.7.g

Table 3b: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for autoallocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
France	OTB_DEF_70-99_0_0	Landings	788	583.7
France	OTB_DEF_70-99_0_0	Landings	916.9	924.9
France	OTB_DEF_70-99_0_0	Landings	968.7	1029
France	OTB_DEF_70-99_0_0	Landings	788	582.1
France	OTB_DEF_70-99_0_0	Landings	754.2	541.3
Ireland	TBB_DEF_70-99_0_0_all	Landings	763.4	583.7
Ireland	OTB_DEF_70-99_0_0_all	Landings	788	582.1
Ireland	OTB_DEF_70-99_0_0_all	Landings	754.2	541.3
Ireland	TBB_DEF_70-99_0_0_all	Landings	763.4	582.1
Ireland	TBB_DEF_70-99_0_0_all	Landings	731.7	541.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	788	582.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	754.2	541.3
France	OTB_DEF_70-99_0_0	Landings	916.7	1050
France	OTB_DEF_70-99_0_0	Landings	887.1	924.6
France	OTB_DEF_70-99_0_0	Landings	928.5	1412
France	OTB_DEF_70-99_0_0	Landings	916.7	1050
France	OTB_DEF_70-99_0_0	Landings	887.1	924.6
France	OTB_DEF_70-99_0_0	Landings	928.5	1412
Ireland	OTB_DEF_70-99_0_0_all	Landings	916.7	1050
Ireland	OTB_DEF_70-99_0_0_all	Landings	887.1	924.6
Ireland	OTB_DEF_70-99_0_0_all	Landings	928.5	1412
Ireland	OTB_DEF_70-99_0_0_all	Landings	916.7	1050
Ireland	OTB_DEF_70-99_0_0_all	Landings	887.1	924.6
Ireland	OTB_DEF_70-99_0_0_all	Landings	928.5	1412
Ireland	TBB_DEF_70-99_0_0_all	Landings	422.4	525.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	916.7	1050
UK (England)	OTB_DEF_70-99_0_0_all	Landings	887.1	924.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	928.5	1412
UK (England)	TBB_DEF_70-99_0_0_all	Landings	422.4	525.7
UK(Scotland)	OTB_DEF_70-99_0_0_all	Landings	916.7	1050
UK(Scotland)	OTB_DEF_70-99_0_0_all	Landings	887.1	924.6
UK(Scotland)	OTB_DEF_70-99_0_0_all	Landings	928.5	1412
France	OTB_DEF_70-99_0_0	Landings	505.5	597
France	OTB_DEF_70-99_0_0	Landings	482.8	649.3
France	OTB_DEF_70-99_0_0	Landings	476.4	709.8

France	OTB_DEF_70-99_0_0	Landings	384.2	590.5
France	OTB_DEF_70-99_0_0	Landings	506.9	745.6
France	OTB_DEF_70-99_0_0	Landings	506.9	758
France	OTB_DEF_70-99_0_0	Landings	581.7	776.1
France	OTB_DEF_70-99_0_0	Landings	505.5	595.9
France	OTB_DEF_70-99_0_0	Landings	482.8	647.5
France	OTB_DEF_70-99_0_0	Landings	476.4	712
France	OTB_DEF_70-99_0_0	Landings	384.2	589.5
France	OTB_DEF_70-99_0_0	Landings	506.9	744.9
France	OTB_DEF_70-99_0_0	Landings	506.9	757.8
France	OTB_DEF_70-99_0_0	Landings	581.7	770.9
Ireland	TBB_DEF_70-99_0_0_all	Landings	1193	774.1
Ireland	OTB_DEF_70-99_0_0_all	Landings	505.5	595.9
Ireland	OTB_DEF_70-99_0_0_all	Landings	482.8	647.5
Ireland	OTB_DEF_70-99_0_0_all	Landings	476.4	712
Ireland	OTB_DEF_70-99_0_0_all	Landings	384.2	589.5
Ireland	OTB_DEF_70-99_0_0_all	Landings	506.9	744.9
Ireland	OTB_DEF_70-99_0_0_all	Landings	506.9	757.8
Ireland	OTB_DEF_70-99_0_0_all	Landings	581.7	770.9
Ireland	TBB_DEF_70-99_0_0_all	Landings	1193	764.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	505.5	595.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	482.8	647.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	476.4	712
UK (England)	OTB_DEF_70-99_0_0_all	Landings	384.2	589.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	506.9	744.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	506.9	757.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	581.7	770.9
France	OTB_DEF_70-99_0_0	Landings	174.9	150.5
France	OTB_DEF_70-99_0_0	Landings	305.8	280.3
France	OTB_DEF_70-99_0_0	Landings	425.9	355.8
France	OTB_DEF_70-99_0_0	Landings	692.6	971.8
France	OTB_DEF_70-99_0_0	Landings	800.6	867.3
France	OTB_DEF_70-99_0_0	Landings	174.9	151.1
France	OTB_DEF_70-99_0_0	Landings	692.6	964.9
France	OTB_DEF_70-99_0_0	Landings	800.6	867.1
Ireland	OTB_DEF_70-99_0_0_all	Landings	174.9	151.1
Ireland	OTB_DEF_70-99_0_0_all	Landings	692.6	964.9
Ireland	OTB_DEF_70-99_0_0_all	Landings	800.6	867.1

Ireland	TBB_DEF_70-99_0_0_all	Landings	685.4	964.9
Ireland	TBB_DEF_70-99_0_0_all	Landings	962	664.6
Ireland	TBB_DEF_70-99_0_0_all	Landings	628.4	804
UK (England)	OTB_DEF_70-99_0_0_all	Landings	788	583.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	916.9	924.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	968.7	1029
UK (England)	TBB_DEF_70-99_0_0_all	Landings	764.3	583.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	414.4	361.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	748.7	921.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	776.6	1024
UK (England)	OTB_DEF_70-99_0_0_all	Landings	916.7	1050
UK (England)	OTB_DEF_70-99_0_0_all	Landings	887.1	924.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	928.5	1412
UK (England)	MIS_MIS_0_0_0_HC	Landings	418.2	525.7
UK (England)	MIS_MIS_0_0_0_HC	Landings	492.2	595.9
UK (England)	MIS_MIS_0_0_0_HC	Landings	935.7	712
UK (England)	OTB_DEF_70-99_0_0_all	Landings	505.5	597
UK (England)	OTB_DEF_70-99_0_0_all	Landings	482.8	649.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	476.4	709.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	384.2	590.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	506.9	745.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	506.9	758
UK (England)	OTB_DEF_70-99_0_0_all	Landings	581.7	776.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	396.6	590.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1194	774.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	984.6	810.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	407.8	361.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	995.2	764.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	174.9	150.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	690.9	971.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	805.1	867.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	249.5	217.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	318.7	358
UK (England)	TBB_DEF_70-99_0_0_all	Landings	520.7	649.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	657.9	971.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	933.6	662.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	608	810.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	175.9	151.1

UK (England)	OTB_DEF_70-99_0_0_all	Landings	225.4	175.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	301.8	220.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	359.1	283.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	456	359.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	412	361.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	702.9	964.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	770.2	867.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	221.1	175.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	313.6	220.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	367.2	283.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	437.3	359.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	407.2	361.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	713	964.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	971.1	664.6

AgeOrLength	Area
13	27.7.f
24	27.7.f
27	27.7.f
13	27.7.g
19	27.7.g
13	27.7.f
13	27.7.g
19	27.7.g
13	27.7.g
19	27.7.g
13	27.7.g
19	27.7.g
22	27.7.f
31	27.7.f
33	27.7.f
22	27.7.g
31	27.7.g
33	27.7.g
22	27.7.f
31	27.7.f
33	27.7.f
22	27.7.g
31	27.7.g

33	27.7.g
10	27.7.g
22	27.7.g
31	27.7.g
33	27.7.g
10	27.7.g
22	27.7.g
31	27.7.g
33	27.7.g
11	27.7.f
12	27.7.f
15	27.7.f
16	27.7.f
17	27.7.f
18	27.7.f
21	27.7.f
11	27.7.g
12	27.7.g
15	27.7.g
16	27.7.g
17	27.7.g
18	27.7.g
21	27.7.g
23	27.7.f
11	27.7.g
12	27.7.g
15	27.7.g
16	27.7.g
17	27.7.g
18	27.7.g
21	27.7.g
23	27.7.g
11	27.7.g
12	27.7.g
15	27.7.g
16	27.7.g
17	27.7.g
18	27.7.g

21	27.7.g
1	27.7.f
4	27.7.f
5	27.7.f
20	27.7.f
25	27.7.f
1	27.7.g
20	27.7.g
25	27.7.g
1	27.7.g
20	27.7.g
25	27.7.g
20	27.7.g
28	27.7.g
29	27.7.g
13	27.7.f
24	27.7.f
27	27.7.f
13	27.7.f
6	27.7.g
24	27.7.g
27	27.7.g
22	27.7.f
31	27.7.f
33	27.7.f
10	27.7.g
11	27.7.g
15	27.7.g
11	27.7.f
12	27.7.f
15	27.7.f
16	27.7.f
17	27.7.f
18	27.7.f
21	27.7.f
16	27.7.f
23	27.7.f
29	27.7.f

6	27.7.g
23	27.7.g
1	27.7.f
20	27.7.f
25	27.7.f
3	27.7.f
6	27.7.f
12	27.7.f
20	27.7.f
28	27.7.f
29	27.7.f
1	27.7.g
2	27.7.g
3	27.7.g
4	27.7.g
5	27.7.g
6	27.7.g
20	27.7.g
25	27.7.g
2	27.7.g
3	27.7.g
4	27.7.g
5	27.7.g
6	27.7.g
20	27.7.g
28	27.7.g

<u>InterCatch output for 2009</u>

This document uses Table 2 from CatchAndSampleDataTables.txt from the InterCatch outputs to describe the raising procedures that were made.

In the following tables, CATON=WECA*CANUM/1000000 (in tonnes).

Raised discards

In InterCatch, the first step consists in raising the discards volumes for strats with landings and no discards associated. These discards are called in the following table 'Raised_Discards'. The data called 'Imported_Data' are landings or discards volumes imported into InterCatch with or without age structure.

The proportion of Landings with Discards associated (same strata) is **71 percent**

The volumes (and associated proportion) of landings and discards imported (Imported_Data) or raised (Raised_Discards) are described in the following table.

Table 1: Summary of the imported/Raised data

CatchCategory	RaisedOrImported	CATON	perc
Discards	Raised_Discards	8715	29
Discards	Imported_Data	21314	71
Landings	Imported_Data	771818	100

Age distribution

For the imported landings/discards and the raised discards without age distribution, the Age distribution is then computed using the defined allocation scheme. Sampled_distribution means that the data (landings or discards) were input with Age distribution. Estimated_distribution means that the inputed/raised valoumes were estimated using the allocation scheme.

Table 2a: Summary of the imported/Raised/SampledOrEstimated data for manual allocation

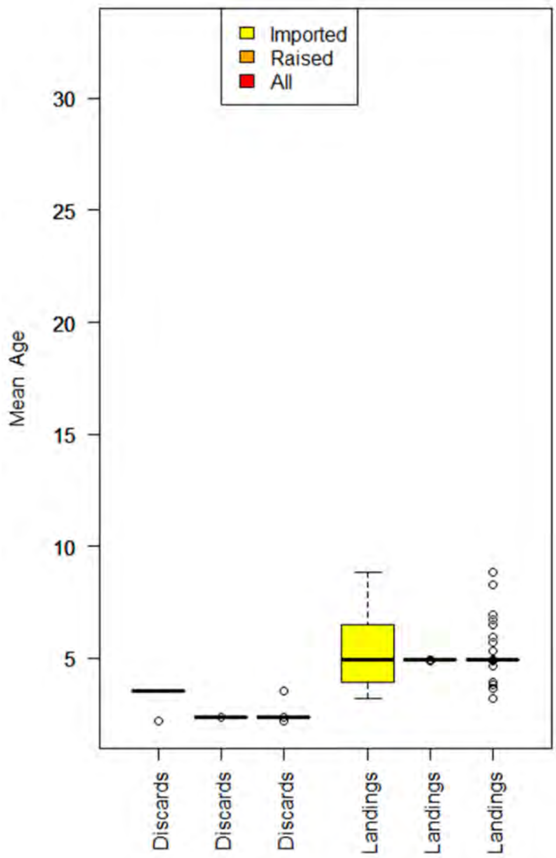
CatchCategory	RaisedOrImported	SampledOrEstimated	CATON	perc
Landings	Imported_Data	Sampled_Distribution	620.3	80
Landings	Imported_Data	Estimated_Distribution	151	20
Discards	Imported_Data	Sampled_Distribution	21.31	71
Discards	Raised_Discards	Estimated_Distribution	8.658	29
Discards	Imported_Data	Estimated_Distribution	0	0

Table 2b: Summary of the imported/Raised/SampledOrEstimated data for autoallocation

CatchCategory	RaisedOrImported	SampledOrEstimated	CATON	perc
Landings	Imported_Data	Sampled_Distribution	620.3	81
Landings	Imported_Data	Estimated_Distribution	149.5	19
Discards	Imported_Data	Sampled_Distribution	21.31	71
Discards	Raised_Discards	Estimated_Distribution	8.657	29
Discards	Imported_Data	Estimated_Distribution	0	0

Impact of the raising on the age structure

Once the samples imported or raised are identified, it is possible to check the impact of the allocation scheme on the mean age/length of the final age/length distribution of the stock. The following figures compare the mean age (computed as the weighted mean of the age per stratum (“CatchCategory”,‘RaisedOrImported’,“SampledOrEstimated”,“Country”,“Area”,“Season”,“Fleet”,“Sex”)) of the estimated strata compared to the imported ones and the final distribution. Each individual included in the boxplot corresponds to the weighted mean age of a stratum.



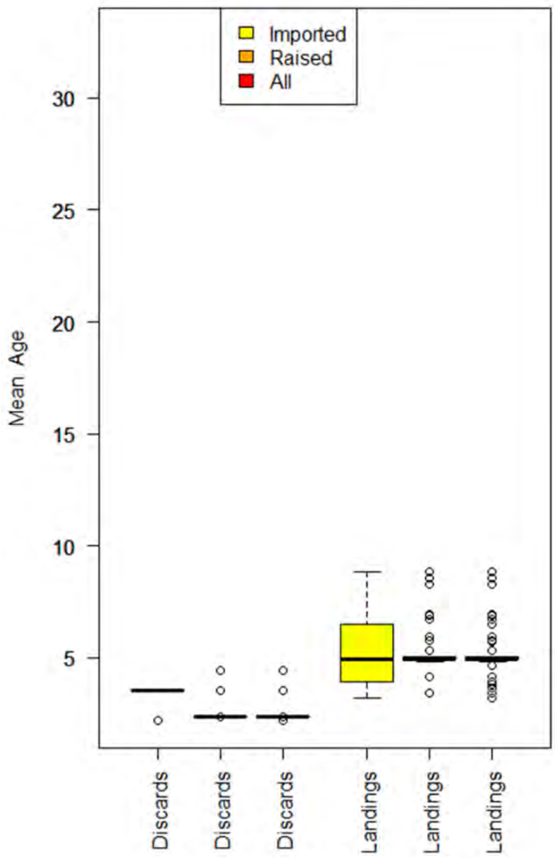


Figure 1: Mean Age per catch category (left: manual allocation; right: autoallocation)

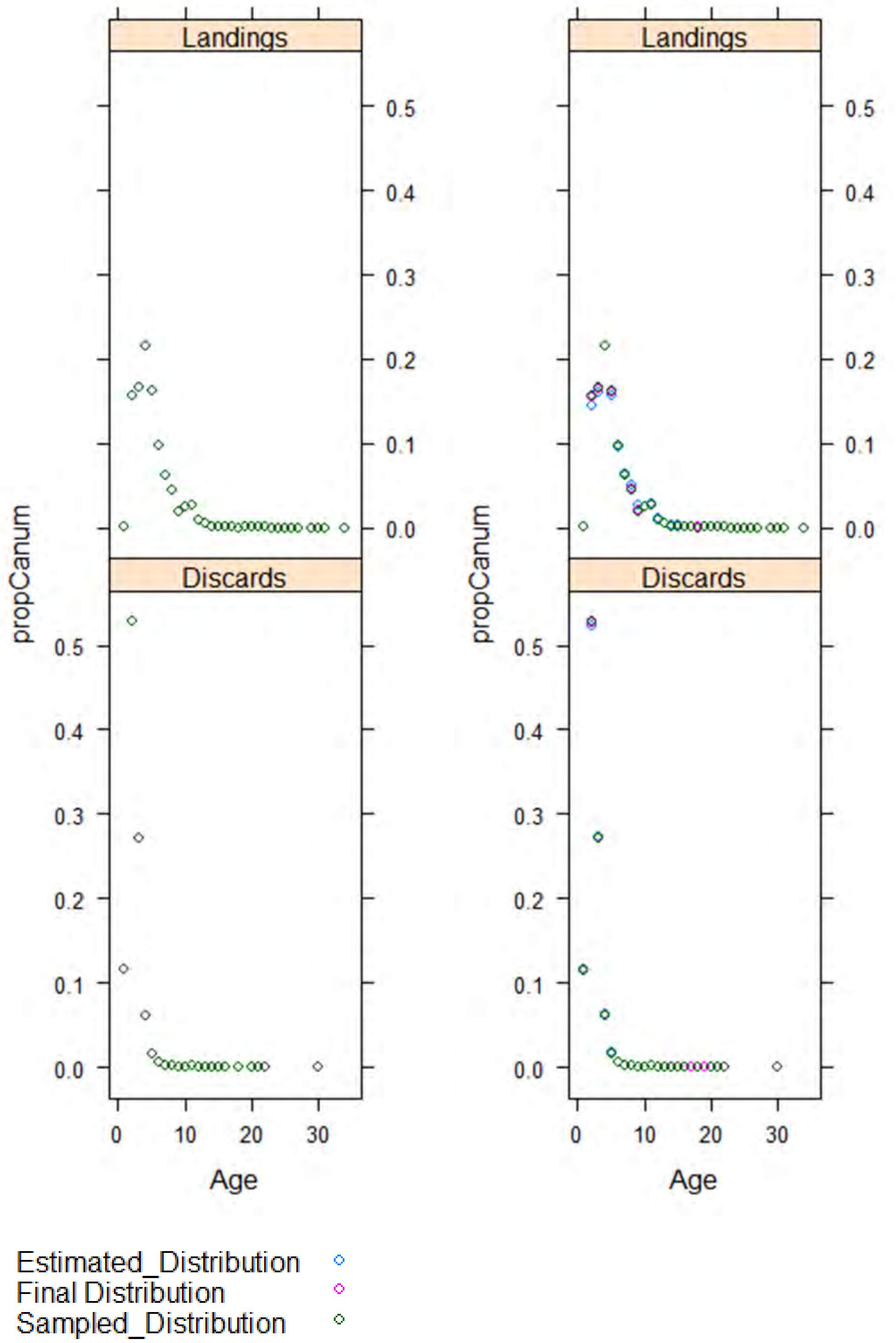


Figure 2: The percentage of each age for the sampled strata, estimated and the final age structure for the landing and discard fractions (left: manual allocation; right: autoallocation)

Impact of the raising on the mean weight

The CatchAndSampleData also provide the weight at age per stratum for the Sampled/Estimated strata. One should also check the sampled/estimated and resulting weight at age.

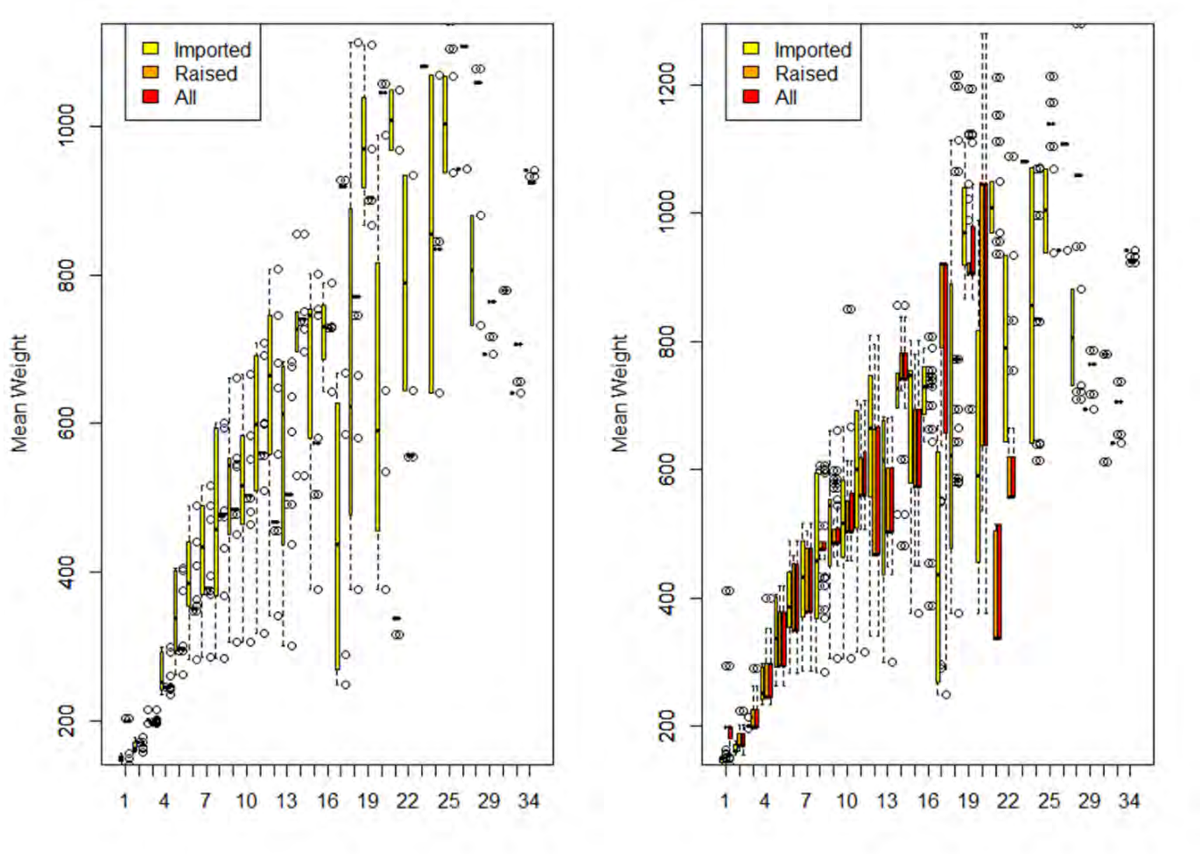


Figure 3a: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.g (left: manual allocation; right: autoallocation)

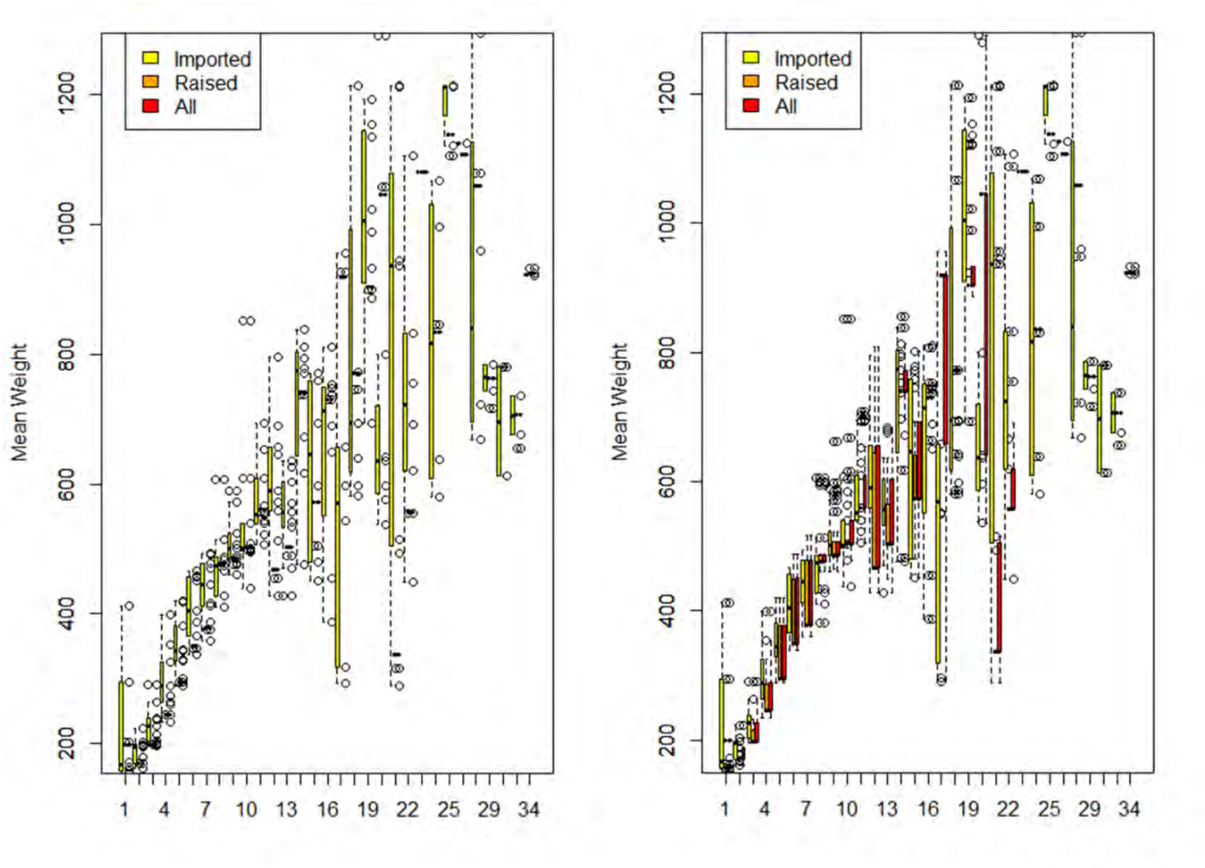


Figure 3b: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.f (left: manual allocation; right: a4toallocation)

Table 3a: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for manual allocation Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
Ireland	TBB_DEF_70-99_0_0_all	Landings	716.8	761.2
Ireland	TBB_DEF_70-99_0_0_all	Landings	656.1	704.1
Ireland	TBB_DEF_70-99_0_0_all	Landings	932.8	924.9
Ireland	TBB_DEF_70-99_0_0_all	Landings	780	779.6
Ireland	TBB_DEF_70-99_0_0_all	Landings	656.1	702.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	780	779.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	656.1	702.4
Ireland	TBB_DEF_70-99_0_0_all	Landings	716.8	761.2
Ireland	TBB_DEF_70-99_0_0_all	Landings	656.1	704.1
Ireland	TBB_DEF_70-99_0_0_all	Landings	932.8	924.9
Ireland	TBB_DEF_70-99_0_0_all	Landings	780	779.6
Ireland	TBB_DEF_70-99_0_0_all	Landings	656.1	702.4
Ireland	TBB_DEF_70-99_0_0_all	Landings	716.8	761.2
Ireland	TBB_DEF_70-99_0_0_all	Landings	656.1	704.1
Ireland	TBB_DEF_70-99_0_0_all	Landings	932.8	924.9

Ireland	TBB_DEF_70-99_0_0_all	Landings	780	779.6
Ireland	TBB_DEF_70-99_0_0_all	Landings	656.1	702.4
Ireland	TBB_DEF_70-99_0_0_all	Landings	780	779.6
Ireland	TBB_DEF_70-99_0_0_all	Landings	656.1	702.4
UK (England)	GNS_DEF_all_0_0_all	Landings	411.8	202
UK (England)	GNS_DEF_all_0_0_all	Landings	223.7	172.7
UK (England)	GNS_DEF_all_0_0_all	Landings	290.5	202.8
UK (England)	GNS_DEF_all_0_0_all	Landings	399.3	253.1
UK (England)	GNS_DEF_all_0_0_all	Landings	419.7	303.2
UK (England)	GNS_DEF_all_0_0_all	Landings	451.4	358.2
UK (England)	GNS_DEF_all_0_0_all	Landings	477.8	387.1
UK (England)	GNS_DEF_all_0_0_all	Landings	454.4	719.8
UK (England)	GNS_DEF_all_0_0_all	Landings	694.1	916.7
UK (England)	GNS_DEF_all_0_0_all	Landings	597.2	1009
UK (England)	GNS_DEF_all_0_0_all	Landings	613.1	776.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	626	510.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	387.7	719.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1295	1050
France	OTT_CRU_100-119_0_0	Landings	404.9	298.6
France	OTT_CRU_100-119_0_0	Landings	517.2	381.6
France	OTT_CRU_100-119_0_0	Landings	600.6	474.8
France	OTT_CRU_100-119_0_0	Landings	661.6	486.4
France	OTT_CRU_100-119_0_0	Landings	667.1	503.3
France	OTT_CRU_100-119_0_0	Landings	708	560.9
France	OTT_CRU_100-119_0_0	Landings	746.1	479.5
France	OTT_CRU_100-119_0_0	Landings	676.4	507
France	OTT_CRU_100-119_0_0	Landings	800.9	573.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	475.5	737.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	759.2	575.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1107	575.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1126	1108
UK (England)	TBB_DEF_70-99_0_0_all	Landings	156.3	169.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	292.7	246.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	375.5	298.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	441	352.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	471.6	381.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	681.1	479.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	529.6	738.2

UK (England)	TBB_DEF_70-99_0_0_all	Landings	754.1	573.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	789.7	729.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	935	563.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	939	1133
UK (England)	TBB_DEF_70-99_0_0_all	Landings	943	1106
UK (England)	TBB_DEF_70-99_0_0_all	Landings	881	1054
France	OTT_CRU_100-119_0_0	Landings	214.8	198.4
France	OTT_CRU_100-119_0_0	Landings	299.1	246.7
France	OTT_CRU_100-119_0_0	Landings	401.4	298.6
France	OTT_CRU_100-119_0_0	Landings	488.8	352.4
France	OTT_CRU_100-119_0_0	Landings	489.3	381.6
France	OTT_CRU_100-119_0_0	Landings	594.8	474.8
France	OTT_CRU_100-119_0_0	Landings	692.2	560.9
France	OTT_CRU_100-119_0_0	Landings	808.5	479.5
France	OTT_CRU_100-119_0_0	Landings	683	507
France	OTT_CRU_100-119_0_0	Landings	856.3	738.2
France	OTT_CRU_100-119_0_0	Landings	746	573.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	457.1	358.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	589.5	488.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	653.9	562.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	690.8	487
UK (England)	OTB_DEF_70-99_0_0_all	Landings	293.6	884
UK (England)	TBB_DEF_70-99_0_0_all	Landings	318.8	884
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1136	916.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	538	1009
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1068	835
UK (England)	OTB_DEF_70-99_0_0_all	Landings	141	197.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	161.4	169.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	282.6	352.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	285.8	381.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	284.2	474.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	305.7	486.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	305.8	503.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	316.7	560.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	301	507
UK (England)	OTB_DEF_70-99_0_0_all	Landings	376.7	573.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	248.6	895.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	376.7	765.3

UK (England)	OTB_DEF_70-99_0_0_all	Landings	376.7	1025
UK (England)	TBB_DEF_70-99_0_0_all	Landings	149	197.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	367.8	474.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	642.8	729.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	288.2	895.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1110	907
UK (England)	TBB_DEF_70-99_0_0_all	Landings	535.1	1025
UK (England)	TBB_DEF_70-99_0_0_all	Landings	968.8	354.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1070	836.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	693.5	759.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	640.7	702.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	942.2	925.3
France	OTB_DEF_100-119_0_0	Landings	458.8	358.2
France	OTB_DEF_100-119_0_0	Landings	493.2	387.1
France	OTB_DEF_100-119_0_0	Landings	606.7	476
France	OTB_DEF_100-119_0_0	Landings	851.2	509.5
France	OTB_DEF_100-119_0_0	Landings	694.7	562.5
France	OTB_DEF_100-119_0_0	Landings	795.1	487
France	OTB_DEF_100-119_0_0	Landings	603.3	510.3
France	OTB_DEF_100-119_0_0	Landings	771.8	575.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	202.6	172.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	263.3	202.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	353.5	253.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	417.4	303.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	466.3	358.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	491.8	387.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	572	488.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	636.8	510.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1214	775.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1194	916.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1211	390.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	638.7	835
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1212	1139
UK (England)	OTB_DEF_70-99_0_0_all	Landings	722.5	1050
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1214	775.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1154	916.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	576.1	1009
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1214	390.2

UK (England)	TBB_DEF_70-99_0_0_all	Landings	580.7	835
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1214	1139
UK (England)	TBB_DEF_70-99_0_0_all	Landings	668.6	1050
UK (England)	TBB_DEF_70-99_0_0_all	Landings	154.7	197.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	177.4	169.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	636.9	507
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1113	765.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	645.1	1025
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1050	354.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	641.6	836.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	731.8	1054

AgeOrLength	Area
29	27.7.f
31	27.7.f
34	27.7.f
30	27.7.g
31	27.7.g
30	27.7.g
31	27.7.g
29	27.7.f
31	27.7.f
34	27.7.f
30	27.7.g
31	27.7.g
29	27.7.f
31	27.7.f
34	27.7.f
30	27.7.g
31	27.7.g
30	27.7.g
31	27.7.g
1	27.7.f
2	27.7.f
3	27.7.f
4	27.7.f
5	27.7.f
6	27.7.f
7	27.7.f

16	27.7.f
19	27.7.f
20	27.7.f
30	27.7.f
13	27.7.f
16	27.7.f
27	27.7.f
5	27.7.g
7	27.7.g
8	27.7.g
9	27.7.g
10	27.7.g
11	27.7.g
12	27.7.g
13	27.7.g
15	27.7.g
14	27.7.f
15	27.7.f
22	27.7.f
26	27.7.f
2	27.7.g
4	27.7.g
5	27.7.g
6	27.7.g
7	27.7.g
12	27.7.g
14	27.7.g
15	27.7.g
16	27.7.g
22	27.7.g
25	27.7.g
26	27.7.g
27	27.7.g
3	27.7.g
4	27.7.g
5	27.7.g
6	27.7.g
7	27.7.g

8	27.7.g
11	27.7.g
12	27.7.g
13	27.7.g
14	27.7.g
15	27.7.g
6	27.7.f
9	27.7.f
11	27.7.f
12	27.7.f
17	27.7.f
17	27.7.f
19	27.7.f
20	27.7.f
24	27.7.f
1	27.7.g
2	27.7.g
6	27.7.g
7	27.7.g
8	27.7.g
9	27.7.g
10	27.7.g
11	27.7.g
13	27.7.g
15	27.7.g
17	27.7.g
18	27.7.g
20	27.7.g
1	27.7.g
8	27.7.g
16	27.7.g
17	27.7.g
19	27.7.g
20	27.7.g
21	27.7.g
24	27.7.g
29	27.7.g
31	27.7.g

34	27.7.g
6	27.7.f
7	27.7.f
8	27.7.f
10	27.7.f
11	27.7.f
12	27.7.f
13	27.7.f
15	27.7.f
2	27.7.f
3	27.7.f
4	27.7.f
5	27.7.f
6	27.7.f
7	27.7.f
9	27.7.f
13	27.7.f
18	27.7.f
19	27.7.f
21	27.7.f
24	27.7.f
25	27.7.f
27	27.7.f
18	27.7.f
19	27.7.f
20	27.7.f
21	27.7.f
24	27.7.f
25	27.7.f
27	27.7.f
1	27.7.g
2	27.7.g
13	27.7.g
18	27.7.g
20	27.7.g
21	27.7.g
24	27.7.g
27	27.7.g

Table 3b: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for autoallocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
France	OTB_DEF_100-119_0_0	Landings	851.2	539.7
Ireland	TBB_DEF_70-99_0_0_all	Landings	387.7	698.8
Ireland	TBB_DEF_70-99_0_0_all	Landings	387.7	703.5
UK (England)	GNS_DEF_all_0_0_all	Landings	411.8	204.7
UK (England)	GNS_DEF_all_0_0_all	Landings	290.5	213.1
UK (England)	GNS_DEF_all_0_0_all	Landings	613.1	765.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	387.7	703.5
France	OTB_DEF_100-119_0_0	Landings	851.2	539.7
France	OTT_CRU_100-119_0_0	Landings	661.6	508
Ireland	TBB_DEF_70-99_0_0_all	Landings	481.9	738.2
Ireland	TBB_DEF_70-99_0_0_all	Landings	1089	620
Ireland	TBB_DEF_70-99_0_0_all	Landings	481.9	744
Ireland	TBB_DEF_70-99_0_0_all	Landings	1089	616.3
UK (England)	GNS_DEF_all_0_0_all	Landings	411.8	210.8
UK (England)	GNS_DEF_all_0_0_all	Landings	411.8	204.7
UK (England)	GNS_DEF_all_0_0_all	Landings	290.5	213.1
UK (England)	GNS_DEF_all_0_0_all	Landings	613.1	765.5
France	OTB_DEF_100-119_0_0	Landings	851.2	539.7
Ireland	TBB_DEF_70-99_0_0_all	Landings	716.8	765.2
Ireland	TBB_DEF_70-99_0_0_all	Landings	656.1	709.2
Ireland	TBB_DEF_70-99_0_0_all	Landings	932.8	924.3
Ireland	TBB_DEF_70-99_0_0_all	Landings	1069	828.2
Ireland	TBB_DEF_70-99_0_0_all	Landings	716.8	764.8
Ireland	TBB_DEF_70-99_0_0_all	Landings	656.1	709.3
UK (England)	GNS_DEF_all_0_0_all	Landings	411.8	210.8
UK (England)	GNS_DEF_all_0_0_all	Landings	411.8	204.7
UK (England)	GNS_DEF_all_0_0_all	Landings	290.5	213.1
UK (England)	GNS_DEF_all_0_0_all	Landings	613.1	765.5
UK (England)	GNS_DEF_all_0_0_all	Landings	411.8	210.8
UK (England)	GNS_DEF_all_0_0_all	Landings	411.8	204.7
UK (England)	GNS_DEF_all_0_0_all	Landings	290.5	213.1
UK (England)	GNS_DEF_all_0_0_all	Landings	613.1	765.5
UK (England)	GNS_DEF_all_0_0_all	Landings	411.8	210.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	387.7	698.8
France	OTT_CRU_100-119_0_0	Landings	661.6	507.5

UK (England)	TBB_DEF_70-99_0_0_all	Landings	475.5	738.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1107	620
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1126	1108
UK (England)	TBB_DEF_70-99_0_0_all	Landings	529.6	744
UK (England)	TBB_DEF_70-99_0_0_all	Landings	939	1147
UK (England)	TBB_DEF_70-99_0_0_all	Landings	943	1104
UK (England)	OTB_DEF_70-99_0_0_all	Landings	284.2	491.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	305.7	507.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	316.7	584.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	301	544.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1070	828.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	693.5	764.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	640.7	709.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	942.2	924.6
France	OTB_DEF_100-119_0_0	Landings	851.2	539.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	580.7	838.1

AgeOrLength	Area
10	27.7.f
16	27.7.f
16	27.7.g
1	27.7.g
3	27.7.g
30	27.7.g
16	27.7.g
10	27.7.f
9	27.7.f
14	27.7.f
22	27.7.f
14	27.7.g
22	27.7.g
1	27.7.f
1	27.7.g
3	27.7.g
30	27.7.g
10	27.7.f
29	27.7.f
31	27.7.f
34	27.7.f

24	27.7.g
29	27.7.g
31	27.7.g
1	27.7.f
1	27.7.g
3	27.7.g
30	27.7.g
1	27.7.f
1	27.7.g
3	27.7.g
30	27.7.g
1	27.7.f
16	27.7.f
9	27.7.g
14	27.7.f
22	27.7.f
26	27.7.f
14	27.7.g
25	27.7.g
26	27.7.g
8	27.7.g
9	27.7.g
11	27.7.g
13	27.7.g
24	27.7.g
29	27.7.g
31	27.7.g
34	27.7.g
10	27.7.f
24	27.7.f

<u>InterCatch output for 2010</u>

This document uses Table 2 from CatchAndSampleDataTables.txt from the InterCatch outputs to describe the raising procedures that were made.

In the following tables, CATON=WECA*CANUM/1000000 (in tonnes).

Raised discards

In InterCatch, the first step consists in raising the discards volumes for strats with landings and no discards associated. These discards are called in the following table 'Raised_Discards'. The data called 'Imported_Data' are landings or discards volumes imported into InterCatch with or without age structure.

The proportion of Landings with Discards associated (same strata) is **73 percent**

The volumes (and associated proportion) of landings and discards imported (Imported_Data) or raised (Raised_Discards) are described in the following table.

Table 1: Summary of the imported/Raised data

CatchCategory	RaisedOrImported	CATON	perc
Discards	Raised_Discards	15300	27
Discards	Imported_Data	40781	73
Landings	Imported_Data	866797	100

Age distribution

For the imported landings/discards and the raised discards without age distribution, the age distribution is then computed using the defined allocation scheme. Sampled_distribution means that the data (landings or discards) were input with age distribution. Estimated_distribution means that the inputed/raised volumes were estimated using the allocation scheme.

Table 2: Summary of the imported/Raised/SampledOrEstimated data

CatchCategory	RaisedOrImported	SampledOrEstimated	CATON	perc
Landings	Imported_Data	Sampled_Distribution	713	82
Landings	Imported_Data	Estimated_Distribution	153.2	18
Discards	Imported_Data	Sampled_Distribution	40.78	73
Discards	Raised_Discards	Estimated_Distribution	15.24	27

Impact of the raising on the age structure

Once the samples imported or raised are identified, it is possible to check the impact of the allocation scheme on the mean age/length of the final age/length distribution of the stock. The following figures compare the mean age (computed as the weighted mean of the age per stratum ("CatchCategory",'RaisedOrImported',"SampledOrEstimated","Country","Area","Season","Fleet","Se x")) of the estimated strata compared to the imported ones and the final distribution. Each individual included in the boxplot corresponds to the weighted mean age of a stratum.

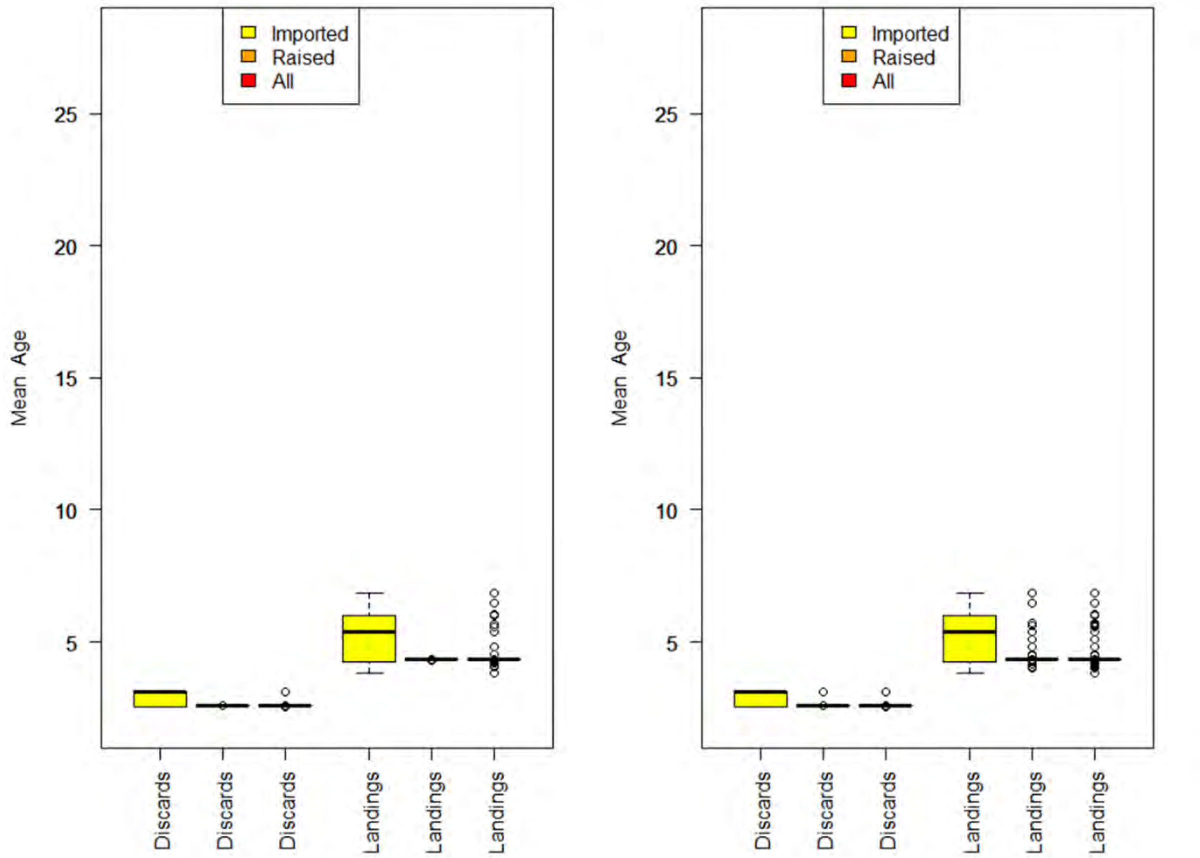


Figure 1: Mean Age per catch category (left: manual allocation; right: autoallocation)

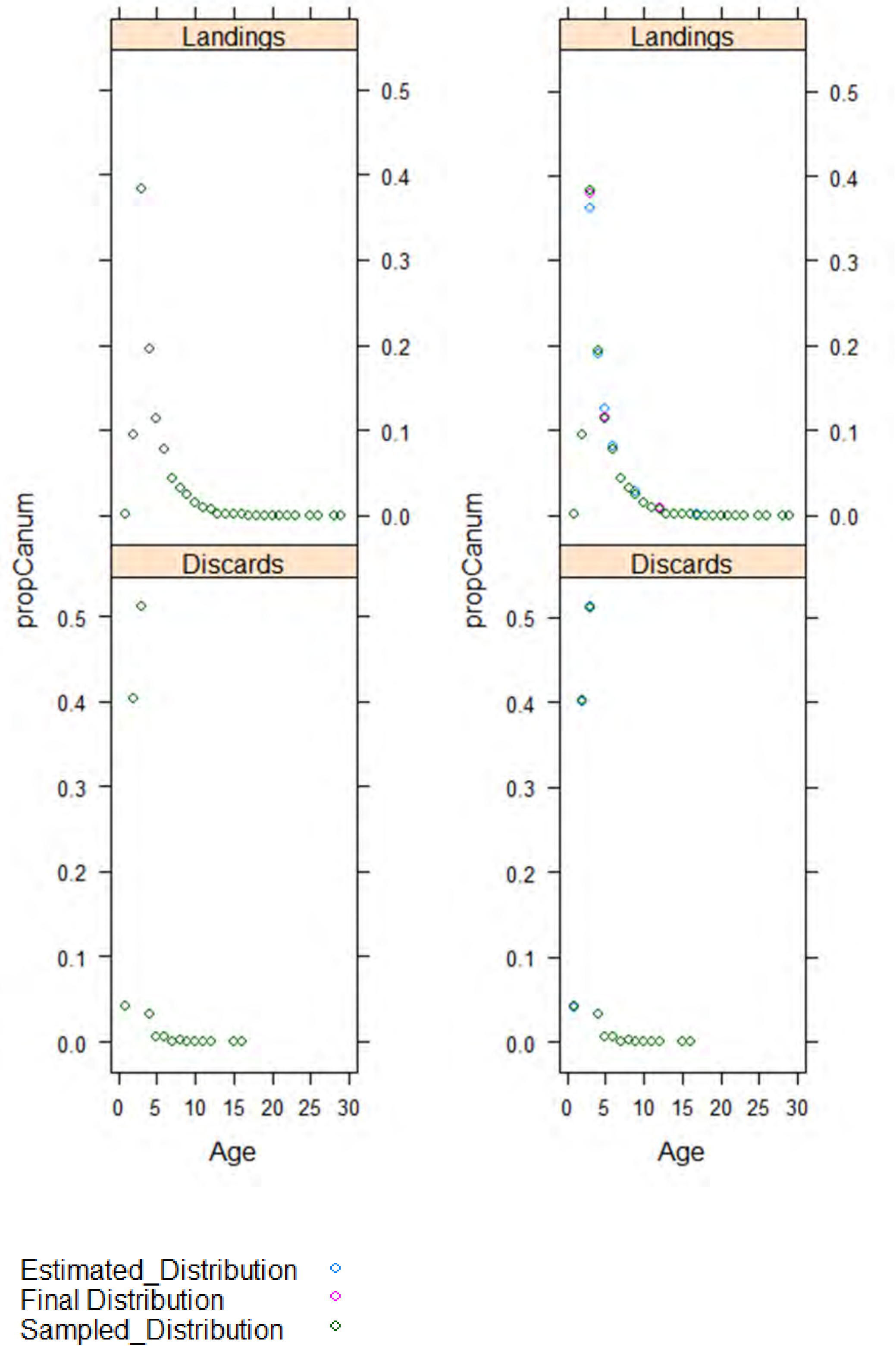


Figure 2: The percentage of each age for the sampled strata, estimated and the final age structure for the landing and discard fractions (left: manual allocation; right: autoallocation)

Impact of the raising on the mean weight

The CatchAndSampleData also provide the weight at age per stratum for the Sampled/Estimated strata. One should also check the sampled/estimated and resulting weight at age.

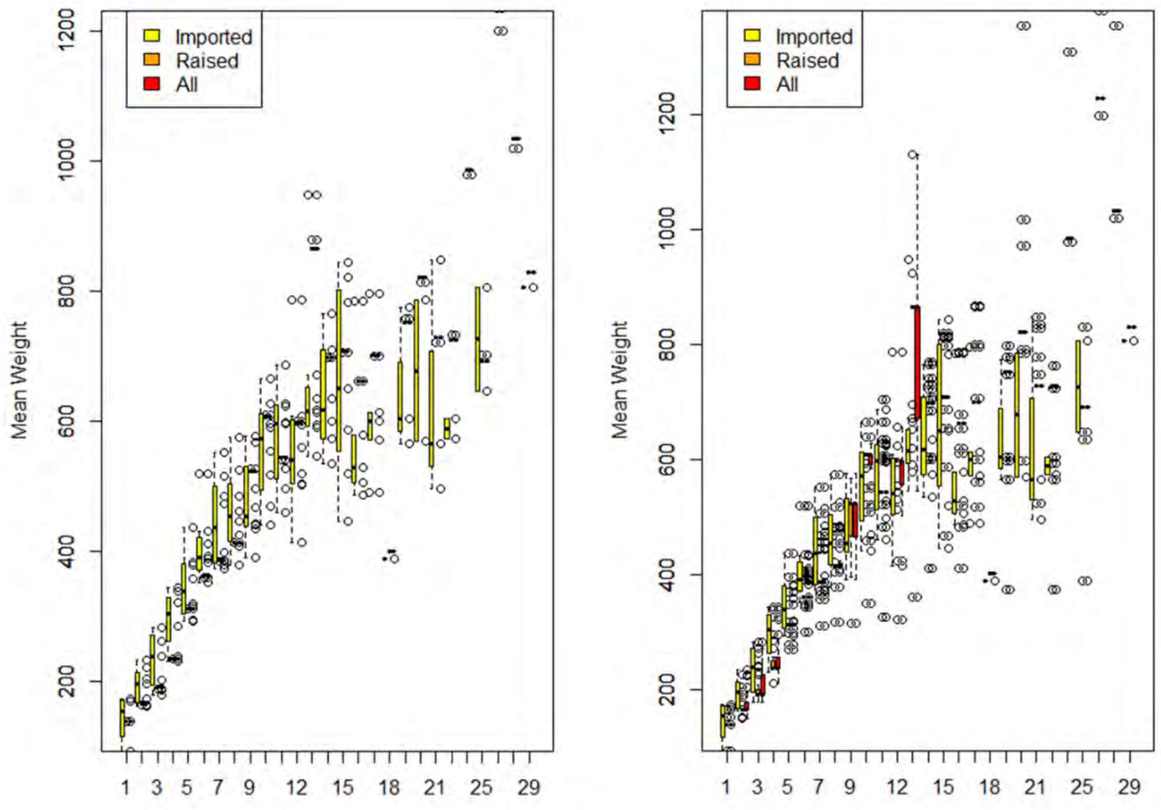


Figure 3a: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.g (left: manual allocation; right: autoallocation)

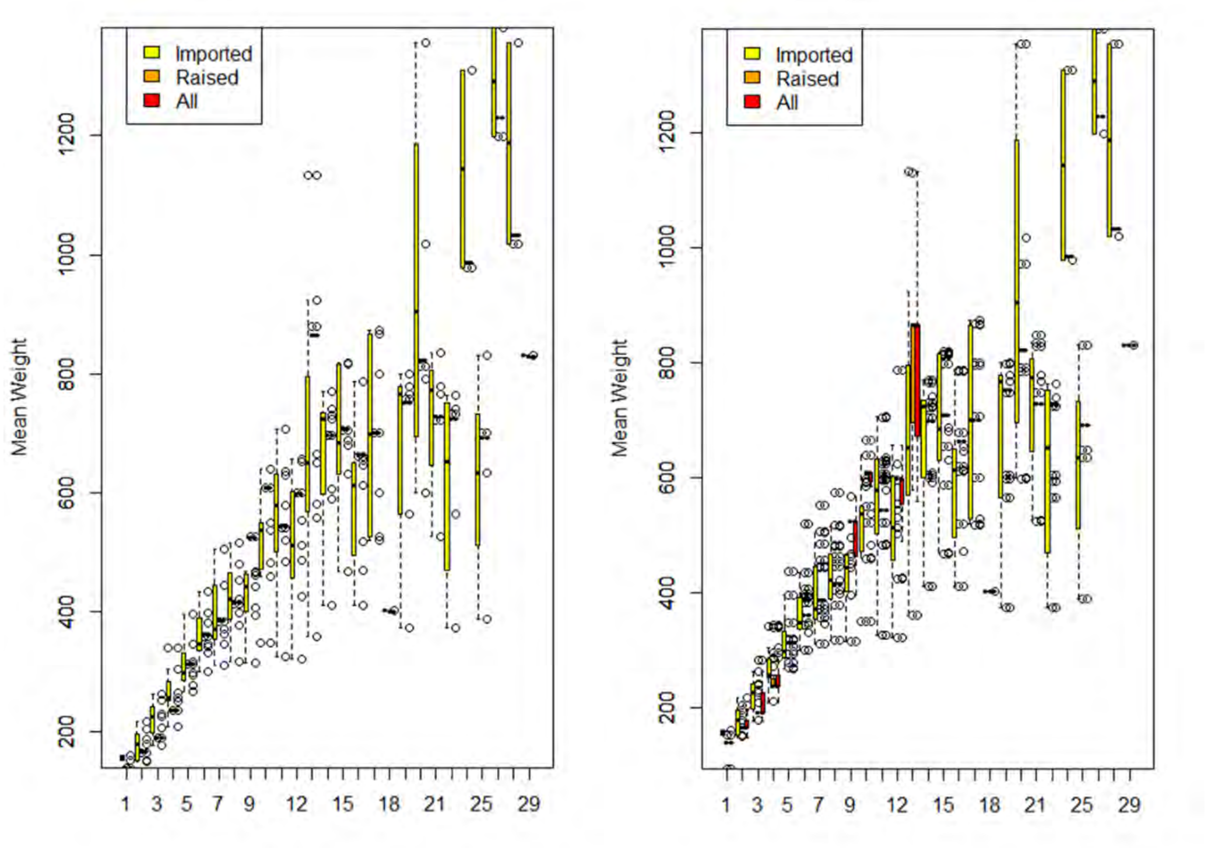


Figure 3b: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.f (left: manual allocation; right: autoallocation)

Table 3a: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for manual allocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
Ireland	TBB_DEF_70-99_0_0_all	Landings	977.4	985
Ireland	TBB_DEF_70-99_0_0_all	Landings	1199	1227
Ireland	TBB_DEF_70-99_0_0_all	Landings	1019	1032
UK (England)	TBB_DEF_70-99_0_0_all	Landings	977.4	985
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1199	1227
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1019	1032
Ireland	TBB_DEF_70-99_0_0_all	Landings	977.4	985
Ireland	TBB_DEF_70-99_0_0_all	Landings	1199	1227
Ireland	TBB_DEF_70-99_0_0_all	Landings	1019	1032
Ireland	TBB_DEF_70-99_0_0_all	Landings	977.4	985
Ireland	TBB_DEF_70-99_0_0_all	Landings	1199	1227
Ireland	TBB_DEF_70-99_0_0_all	Landings	1019	1032
Ireland	TBB_DEF_70-99_0_0_all	Landings	977.4	985
Ireland	TBB_DEF_70-99_0_0_all	Landings	1199	1227
Ireland	TBB_DEF_70-99_0_0_all	Landings	1019	1032

France	OTT_DEF_100-119_0_0	Landings	623.1	546.8
France	OTT_DEF_100-119_0_0	Landings	786.7	593.8
France	OTT_DEF_100-119_0_0	Landings	595	844.8
France	OTT_DEF_100-119_0_0	Landings	600.7	692.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	873.5	700.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1355	829.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1309	990.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1381	1230
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1355	1038
UK (England)	TBB_DEF_70-99_0_0_all	Landings	865.8	700.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	321.8	241.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	440.8	519.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	469.6	603.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	613.5	844.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	535.5	692.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	520	703.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	506.3	656.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	565.4	747.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	565.4	723.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	573.1	721.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	267	312.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	394.8	512.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	460.4	597
UK (England)	TBB_DEF_70-99_0_0_all	Landings	425.5	588.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	468.5	705
UK (England)	TBB_DEF_70-99_0_0_all	Landings	519.9	700.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	402	400.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	526.2	727.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	830.9	688.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	830.9	829.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	390.8	519.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	440.7	603.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	460.5	546.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	413.9	593.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	546.3	844.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	574	692.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	445.6	703.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	489.6	695.2

UK (England)	TBB_DEF_70-99_0_0_all	Landings	387.8	400.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	569.4	817.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	496.2	723.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	806.1	693.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	806.1	829.1
UK (England)	GNS_DEF_all_0_0_all	Landings	300.2	361
UK (England)	GNS_DEF_all_0_0_all	Landings	309.7	387.9
UK (England)	GNS_DEF_all_0_0_all	Landings	316	415.4
UK (England)	GNS_DEF_all_0_0_all	Landings	313.8	512.4
UK (England)	GNS_DEF_all_0_0_all	Landings	348.7	597
UK (England)	GNS_DEF_all_0_0_all	Landings	325.1	544.6
UK (England)	GNS_DEF_all_0_0_all	Landings	320.6	588.1
UK (England)	GNS_DEF_all_0_0_all	Landings	359.7	847.1
UK (England)	GNS_DEF_all_0_0_all	Landings	411	692.5
UK (England)	GNS_DEF_all_0_0_all	Landings	411	653.4
UK (England)	GNS_DEF_all_0_0_all	Landings	373.6	743.8
UK (England)	GNS_DEF_all_0_0_all	Landings	373.6	717.6
UK (England)	GNS_DEF_all_0_0_all	Landings	388.2	688.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	479.7	415.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	565.5	743.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	834.8	727.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	203.5	167.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	283	194.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	343.5	241.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	436.8	316.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	518.4	365.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	551.5	392.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	574.6	419.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	784.7	656.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	604.2	747.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	848.6	723.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	604.2	721.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	646.9	693.5
France	OTT_DEF_100-119_0_0	Landings	93.57	139.6
France	OTT_DEF_100-119_0_0	Landings	485.5	392.5
France	OTT_DEF_100-119_0_0	Landings	442.3	519.3
France	OTT_DEF_100-119_0_0	Landings	590.1	844.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	151.6	140

UK (England)	OTB_DEF_70-99_0_0_all	Landings	203.1	166.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	262	193.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	340.1	239.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	395.7	312.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	434.9	361
UK (England)	OTB_DEF_70-99_0_0_all	Landings	505	387.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	515.9	415.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	706.6	544.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	159.4	140
UK (England)	TBB_DEF_70-99_0_0_all	Landings	216.2	166.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	252.6	193.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	303.4	239.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	470.5	653.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	527.3	700.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	169.2	139.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	222.2	167.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	261.3	194.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	321.8	241.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	382.4	316.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	431.6	365.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	514.7	392.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	525.7	419.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	626.6	546.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	617.2	844.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	528.8	656.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	172.8	139.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	233.4	167.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	282.7	194.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	338.1	241.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	379.3	316.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	435.4	519.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	517.9	603.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	686.9	546.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	843.2	703.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	486.9	656.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	571.2	695.2

AgeOrLength	Area
23	27.7.g

26	27.7.g
28	27.7.g
23	27.7.g
26	27.7.g
28	27.7.g
23	27.7.g
26	27.7.g
28	27.7.g
23	27.7.g
26	27.7.g
28	27.7.g
23	27.7.g
26	27.7.g
28	27.7.g
11	27.7.g
12	27.7.g
13	27.7.g
14	27.7.g
17	27.7.f
20	27.7.f
23	27.7.f
26	27.7.f
28	27.7.f
17	27.7.f
4	27.7.g
9	27.7.g
10	27.7.g
13	27.7.g
14	27.7.g
15	27.7.g
16	27.7.g
19	27.7.g
21	27.7.g
22	27.7.g
5	27.7.f
9	27.7.f
10	27.7.f
12	27.7.f

15	27.7.f
17	27.7.f
18	27.7.f
21	27.7.f
25	27.7.f
29	27.7.f
9	27.7.g
10	27.7.g
11	27.7.g
12	27.7.g
13	27.7.g
14	27.7.g
15	27.7.g
17	27.7.g
18	27.7.g
20	27.7.g
21	27.7.g
25	27.7.g
29	27.7.g
6	27.7.f
7	27.7.f
8	27.7.f
9	27.7.f
10	27.7.f
11	27.7.f
12	27.7.f
13	27.7.f
14	27.7.f
16	27.7.f
19	27.7.f
22	27.7.f
25	27.7.f
8	27.7.f
19	27.7.f
21	27.7.f
2	27.7.g
3	27.7.g
4	27.7.g

5	27.7.g
6	27.7.g
7	27.7.g
8	27.7.g
16	27.7.g
19	27.7.g
21	27.7.g
22	27.7.g
25	27.7.g
1	27.7.g
7	27.7.g
9	27.7.g
13	27.7.g
1	27.7.f
2	27.7.f
3	27.7.f
4	27.7.f
5	27.7.f
6	27.7.f
7	27.7.f
8	27.7.f
11	27.7.f
1	27.7.f
2	27.7.f
3	27.7.f
4	27.7.f
16	27.7.f
17	27.7.f
1	27.7.g
2	27.7.g
3	27.7.g
4	27.7.g
5	27.7.g
6	27.7.g
7	27.7.g
8	27.7.g
11	27.7.g
13	27.7.g

16	27.7.g
1	27.7.g
2	27.7.g
3	27.7.g
4	27.7.g
5	27.7.g
9	27.7.g
10	27.7.g
11	27.7.g
15	27.7.g
16	27.7.g
17	27.7.g

Table 3b: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for autoallocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
France	OTB_DEF_70-99_0_0	Landings	1355	841.4
France	OTB_DEF_70-99_0_0	Landings	1309	1015
France	OTB_DEF_70-99_0_0	Landings	1381	1243
France	OTB_DEF_70-99_0_0	Landings	1355	1062
France	OTB_DEF_70-99_0_0	Landings	1355	841.6
France	OTB_DEF_70-99_0_0	Landings	1309	1014
France	OTB_DEF_70-99_0_0	Landings	1381	1242
France	OTB_DEF_70-99_0_0	Landings	1355	1061
Ireland	OTB_DEF_70-99_0_0_all	Landings	1355	841.6
Ireland	OTB_DEF_70-99_0_0_all	Landings	1309	1014
Ireland	OTB_DEF_70-99_0_0_all	Landings	1381	1242
Ireland	OTB_DEF_70-99_0_0_all	Landings	1355	1061
UK (England)	GNS_DEF_all_0_0_all	Landings	348.7	580
UK (England)	GNS_DEF_all_0_0_all	Landings	325.1	545
UK (England)	GNS_DEF_all_0_0_all	Landings	411	676.8
UK (England)	GNS_DEF_all_0_0_all	Landings	373.6	707.8
UK (England)	GNS_DEF_all_0_0_all	Landings	373.6	683
UK (England)	GNS_DEF_all_0_0_all	Landings	388.2	667.2
UK (England)	GNS_DEF_all_0_0_all	Landings	313.8	494.6
UK (England)	GNS_DEF_all_0_0_all	Landings	348.7	582.4
UK (England)	GNS_DEF_all_0_0_all	Landings	325.1	549.1

UK (England)	GNS_DEF_all_0_0_all	Landings	320.6	570.5
UK (England)	GNS_DEF_all_0_0_all	Landings	411	681
UK (England)	GNS_DEF_all_0_0_all	Landings	373.6	709.4
UK (England)	GNS_DEF_all_0_0_all	Landings	373.6	686.1
UK (England)	GNS_DEF_all_0_0_all	Landings	388.2	670
France	OTB_DEF_70-99_0_0	Landings	1309	1015
France	OTB_DEF_70-99_0_0	Landings	1381	1243
France	OTB_DEF_70-99_0_0	Landings	1355	1062
France	OTT_DEF_100-119_0_0	Landings	93.57	138
France	OTB_DEF_70-99_0_0	Landings	1309	1014
France	OTB_DEF_70-99_0_0	Landings	1381	1242
France	OTB_DEF_70-99_0_0	Landings	1355	1061
France	OTT_DEF_100-119_0_0	Landings	93.57	139.6
Ireland	TBB_DEF_70-99_0_0_all	Landings	466.5	704.2
Ireland	TBB_DEF_70-99_0_0_all	Landings	523.7	735
Ireland	OTB_DEF_70-99_0_0_all	Landings	1309	1014
Ireland	OTB_DEF_70-99_0_0_all	Landings	1381	1242
Ireland	OTB_DEF_70-99_0_0_all	Landings	1355	1061
Ireland	TBB_DEF_70-99_0_0_all	Landings	466.5	708.7
Ireland	TBB_DEF_70-99_0_0_all	Landings	523.7	734
UK (England)	GNS_DEF_all_0_0_all	Landings	348.7	580
UK (England)	GNS_DEF_all_0_0_all	Landings	325.1	545
UK (England)	GNS_DEF_all_0_0_all	Landings	411	676.8
UK (England)	GNS_DEF_all_0_0_all	Landings	373.6	707.8
UK (England)	GNS_DEF_all_0_0_all	Landings	373.6	683
UK (England)	GNS_DEF_all_0_0_all	Landings	388.2	667.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1309	1015
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1381	1243
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1355	1062
UK (England)	GNS_DEF_all_0_0_all	Landings	313.8	494.6
UK (England)	GNS_DEF_all_0_0_all	Landings	348.7	582.4
UK (England)	GNS_DEF_all_0_0_all	Landings	325.1	549.1
UK (England)	GNS_DEF_all_0_0_all	Landings	320.6	570.5
UK (England)	GNS_DEF_all_0_0_all	Landings	411	681
UK (England)	GNS_DEF_all_0_0_all	Landings	373.6	709.4
UK (England)	GNS_DEF_all_0_0_all	Landings	373.6	686.1
UK (England)	GNS_DEF_all_0_0_all	Landings	388.2	670
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1309	1014

UK (England)	OTB_DEF_70-99_0_0_all	Landings	1381	1242
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1355	1061
France	OTT_DEF_100-119_0_0	Landings	93.57	138
France	OTT_DEF_100-119_0_0	Landings	93.57	139.6
Ireland	TBB_DEF_70-99_0_0_all	Landings	283	204
Ireland	TBB_DEF_70-99_0_0_all	Landings	436.8	316.7
Ireland	TBB_DEF_70-99_0_0_all	Landings	518.4	367.8
Ireland	TBB_DEF_70-99_0_0_all	Landings	551.5	397.4
Ireland	TBB_DEF_70-99_0_0_all	Landings	574.6	422.7
Ireland	TBB_DEF_70-99_0_0_all	Landings	436.8	319.2
Ireland	TBB_DEF_70-99_0_0_all	Landings	518.4	369.5
Ireland	TBB_DEF_70-99_0_0_all	Landings	551.5	399.5
Ireland	TBB_DEF_70-99_0_0_all	Landings	574.6	425.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	283	204
UK (England)	TBB_DEF_70-99_0_0_all	Landings	436.8	316.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	518.4	367.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	551.5	397.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	574.6	422.7
UK (England)	GNS_DEF_all_0_0_all	Landings	313.8	494.6
UK (England)	GNS_DEF_all_0_0_all	Landings	348.7	582.4
UK (England)	GNS_DEF_all_0_0_all	Landings	325.1	549.1
UK (England)	GNS_DEF_all_0_0_all	Landings	320.6	570.5
UK (England)	GNS_DEF_all_0_0_all	Landings	411	681
UK (England)	GNS_DEF_all_0_0_all	Landings	373.6	709.4
UK (England)	GNS_DEF_all_0_0_all	Landings	373.6	686.1
UK (England)	GNS_DEF_all_0_0_all	Landings	388.2	670
France	OTT_DEF_100-119_0_0	Landings	93.57	138
Ireland	TBB_DEF_70-99_0_0_all	Landings	225.5	172.7
UK (England)	GNS_DEF_all_0_0_all	Landings	348.7	580
UK (England)	GNS_DEF_all_0_0_all	Landings	325.1	545
UK (England)	GNS_DEF_all_0_0_all	Landings	411	676.8
UK (England)	GNS_DEF_all_0_0_all	Landings	373.6	707.8
UK (England)	GNS_DEF_all_0_0_all	Landings	373.6	683
UK (England)	GNS_DEF_all_0_0_all	Landings	388.2	667.2
UK (England)	GNS_DEF_all_0_0_all	Landings	313.8	494.6
UK (England)	GNS_DEF_all_0_0_all	Landings	348.7	582.4
UK (England)	GNS_DEF_all_0_0_all	Landings	325.1	549.1
UK (England)	GNS_DEF_all_0_0_all	Landings	320.6	570.5

UK (England)	GNS_DEF_all_0_0_all	Landings	411	681
UK (England)	GNS_DEF_all_0_0_all	Landings	373.6	709.4
UK (England)	GNS_DEF_all_0_0_all	Landings	373.6	686.1
UK (England)	GNS_DEF_all_0_0_all	Landings	388.2	670
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1355	841.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1309	1015
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1381	1243
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1355	1062
UK (England)	TBB_DEF_70-99_0_0_all	Landings	468.5	704.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	402	400.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	526.2	735
UK (England)	TBB_DEF_70-99_0_0_all	Landings	830.9	829.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	445.6	708.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	489.6	702.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	387.8	400.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	496.2	734
UK (England)	TBB_DEF_70-99_0_0_all	Landings	806.1	829
UK (England)	GNS_DEF_all_0_0_all	Landings	348.7	580
UK (England)	GNS_DEF_all_0_0_all	Landings	325.1	545
UK (England)	GNS_DEF_all_0_0_all	Landings	411	676.8
UK (England)	GNS_DEF_all_0_0_all	Landings	373.6	707.8
UK (England)	GNS_DEF_all_0_0_all	Landings	373.6	683
UK (England)	GNS_DEF_all_0_0_all	Landings	388.2	667.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	436.8	319.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	518.4	369.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	551.5	399.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	574.6	425.3
France	OTT_DEF_100-119_0_0	Landings	93.57	139.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	233.4	172.7

AgeOrLength	Area
20	27.7.f
23	27.7.f
26	27.7.f
28	27.7.f
20	27.7.g
23	27.7.g
26	27.7.g
28	27.7.g

20	27.7.g
23	27.7.g
26	27.7.g
28	27.7.g
10	27.7.f
11	27.7.f
14	27.7.f
19	27.7.f
22	27.7.f
25	27.7.f
9	27.7.g
10	27.7.g
11	27.7.g
12	27.7.g
14	27.7.g
19	27.7.g
22	27.7.g
25	27.7.g
23	27.7.f
26	27.7.f
28	27.7.f
1	27.7.f
23	27.7.g
26	27.7.g
28	27.7.g
1	27.7.g
15	27.7.f
21	27.7.f
23	27.7.g
26	27.7.g
28	27.7.g
15	27.7.g
21	27.7.g
10	27.7.f
11	27.7.f
14	27.7.f
19	27.7.f
22	27.7.f

25	27.7.f
23	27.7.f
26	27.7.f
28	27.7.f
9	27.7.g
10	27.7.g
11	27.7.g
12	27.7.g
14	27.7.g
19	27.7.g
22	27.7.g
25	27.7.g
23	27.7.g
26	27.7.g
28	27.7.g
1	27.7.f
1	27.7.g
3	27.7.f
5	27.7.f
6	27.7.f
7	27.7.f
8	27.7.f
5	27.7.g
6	27.7.g
7	27.7.g
8	27.7.g
3	27.7.f
5	27.7.f
6	27.7.f
7	27.7.f
8	27.7.f
9	27.7.g
10	27.7.g
11	27.7.g
12	27.7.g
14	27.7.g
19	27.7.g
22	27.7.g

25	27.7.g
1	27.7.f
2	27.7.g
10	27.7.f
11	27.7.f
14	27.7.f
19	27.7.f
22	27.7.f
25	27.7.f
9	27.7.g
10	27.7.g
11	27.7.g
12	27.7.g
14	27.7.g
19	27.7.g
22	27.7.g
25	27.7.g
20	27.7.f
23	27.7.f
26	27.7.f
28	27.7.f
15	27.7.f
18	27.7.f
21	27.7.f
29	27.7.f
15	27.7.g
17	27.7.g
18	27.7.g
21	27.7.g
29	27.7.g
10	27.7.f
11	27.7.f
14	27.7.f
19	27.7.f
22	27.7.f
25	27.7.f
5	27.7.g
6	27.7.g

7	27.7.g
8	27.7.g
1	27.7.g
2	27.7.g

<u>InterCatch output for 2011</u>

This document uses Table 2 from CatchAndSampleDataTables.txt from the InterCatch outputs to describe the raising procedures that were made.

In the following tables, CATON=WECA*CANUM/1000000 (in tonnes).

Raised discards

In InterCatch, the first step consists in raising the discards volumes for strats with landings and no discards associated. These discards are called in the following table 'Raised_Discards'. The data called 'Imported_Data' are landings or discards volumes imported into InterCatch with or without age structure.

The proportion of Landings with Discards associated (same strata) is **68 percent**

The volumes (and associated proportion) of landings and discards imported (Imported_Data) or raised (Raised_Discards) are described in the following table.

Table 1: Summary of the imported/Raised data

CatchCategory	RaisedOrImported	CATON	perc
Discards	Raised_Discards	8827	32
Discards	Imported_Data	18728	68
Landings	Imported_Data	1020978	100

Age distribution

For the imported landings/discards and the raised discards without age distribution, the age distribution is then computed using the defined allocation scheme. Sampled_distribution means that the data (landings or discards) were input with age distribution. Estimated_distribution means that the inputed/raised volumes were estimated using the allocation scheme.

Table 2: Summary of the imported/Raised/SampledOrEstimated data

CatchCategory	RaisedOrImported	SampledOrEstimated	CATON	perc
Landings	Imported_Data	Sampled_Distribution	850.8	83
Landings	Imported_Data	Estimated_Distribution	176.2	17
Discards	Imported_Data	Sampled_Distribution	18.73	68
Discards	Raised_Discards	Estimated_Distribution	8.931	32

Impact of the raising on the age structure

Once the samples imported or raised are identified, it is possible to check the impact of the allocation scheme on the mean age/length of the final age/length distribution of the stock. The following figures compare the mean age (computed as the weighted mean of the age per stratum ("CatchCategory",'RaisedOrImported',"SampledOrEstimated","Country","Area","Season","Fleet","Sex")) of the estimated strata compared to the imported ones and the final distribution. Each individual included in the boxplot corresponds to the weighted mean age of a stratum.

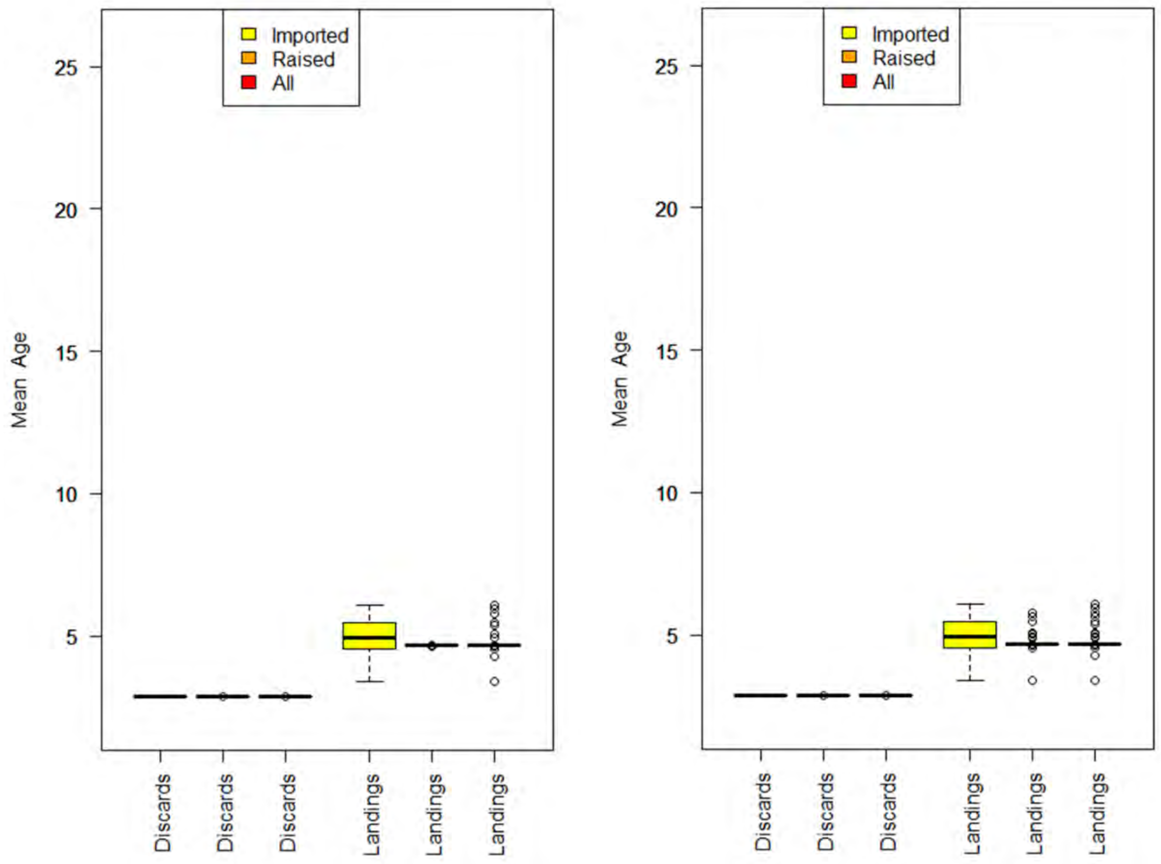


Figure 1: Mean Age per catch category (left: manual allocation; right: autoallocation)

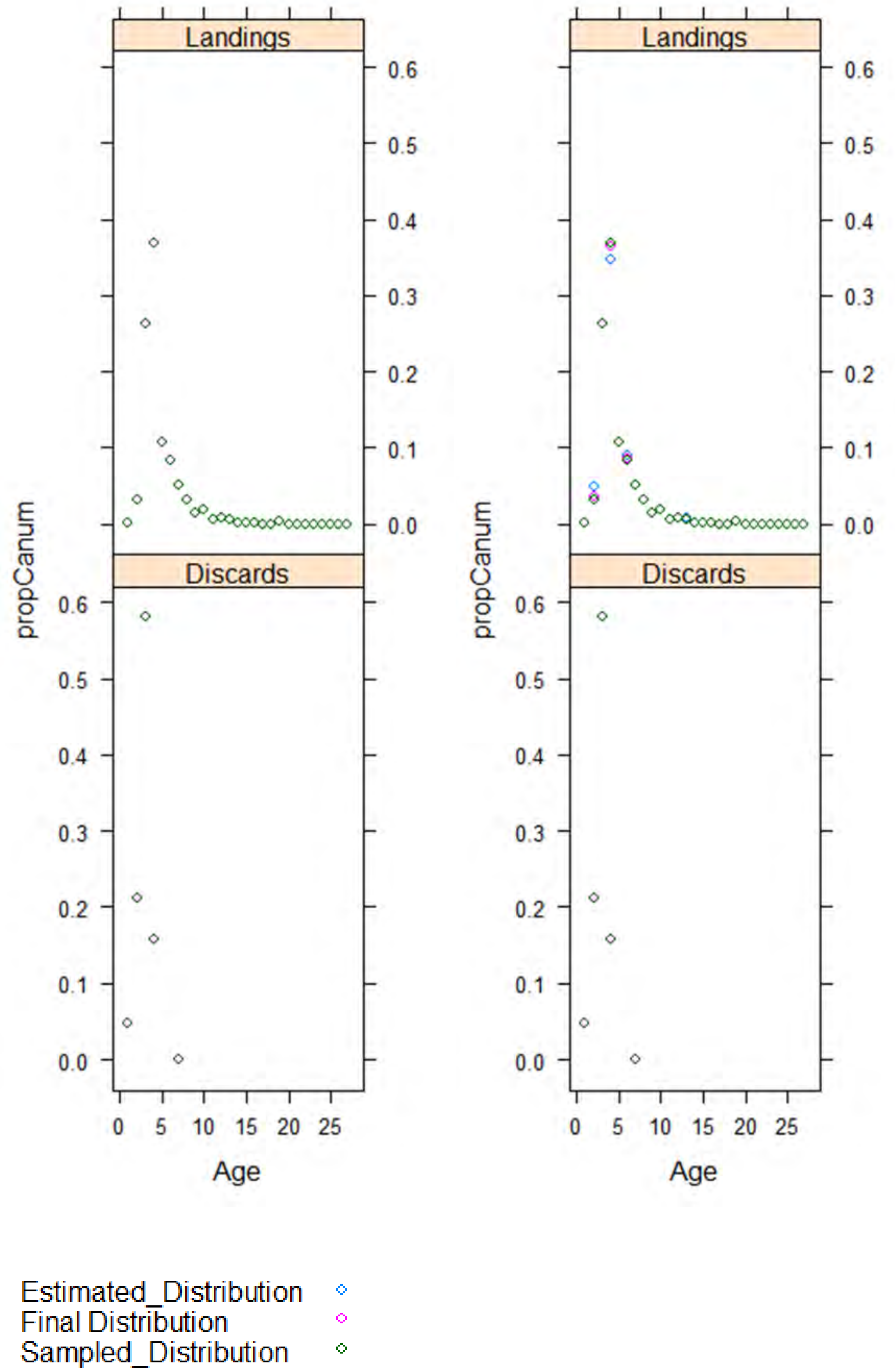


Figure 2: The percentage of each age for the sampled strata, estimated and the final age structure for the landing and discard fractions (left: manual allocation; right: autoallocation)

Impact of the raising on the mean weight

The CatchAndSampleData also provide the weight at age per stratum for the Sampled/Estimated strata. One should also check the sampled/estimated and resulting weight at age.

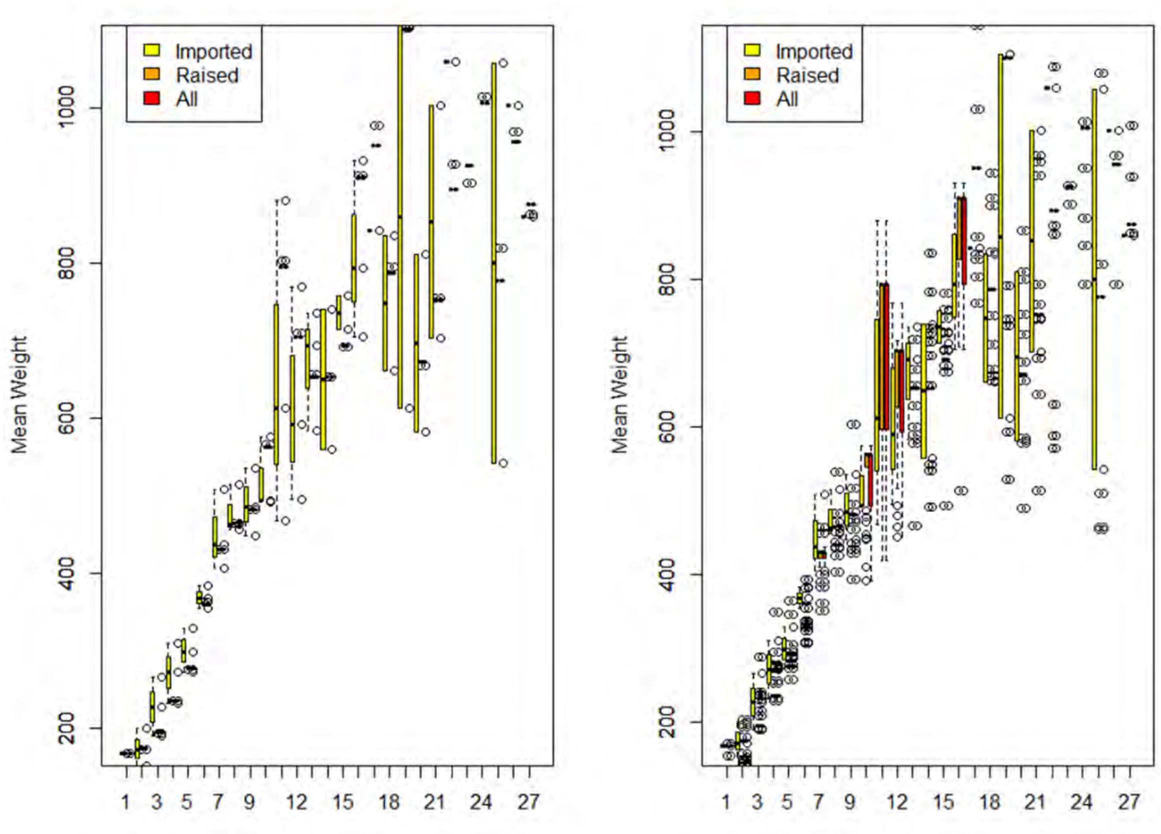


Figure 3a: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.g (left: manual allocation; right: autoallocation)

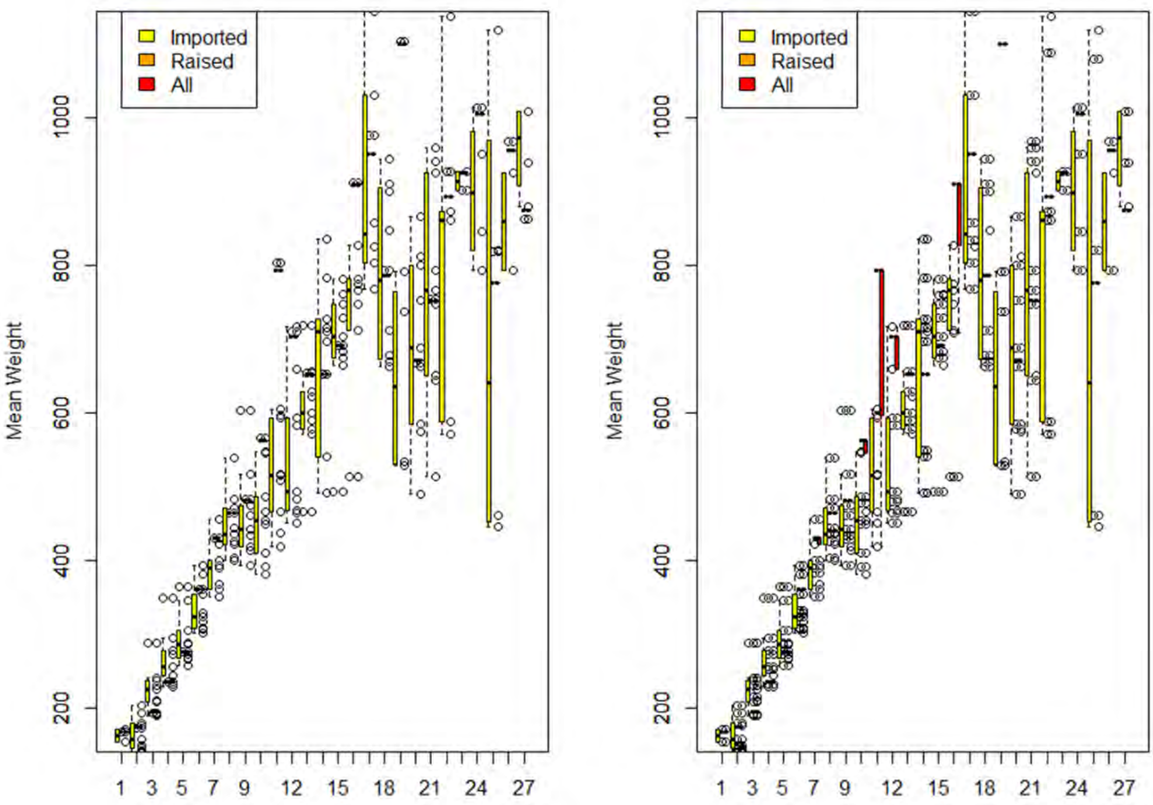


Figure 3b: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.f (left: manual allocation; right: autoallocation)

Table 3a: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for manual allocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
Ireland	TBB_DEF_70-99_0_0_all	Landings	902.4	924.3
Ireland	TBB_DEF_70-99_0_0_all	Landings	902.4	923.9
Ireland	TBB_DEF_70-99_0_0_all	Landings	1014	1007
UK (England)	TBB_DEF_70-99_0_0_all	Landings	902.4	923.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1014	1007
Ireland	TBB_DEF_70-99_0_0_all	Landings	902.4	924.3
Ireland	TBB_DEF_70-99_0_0_all	Landings	902.4	923.9
Ireland	TBB_DEF_70-99_0_0_all	Landings	1014	1007
Ireland	TBB_DEF_70-99_0_0_all	Landings	902.4	923.9
Ireland	TBB_DEF_70-99_0_0_all	Landings	1014	1007
Ireland	TBB_DEF_70-99_0_0_all	Landings	902.4	924.3
Ireland	TBB_DEF_70-99_0_0_all	Landings	902.4	923.9
Ireland	TBB_DEF_70-99_0_0_all	Landings	1014	1007
UK (England)	TBB_DEF_70-99_0_0_all	Landings	902.4	923.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1014	1007

UK (England)	GNS_DEF_all_0_0_all	Landings	295.4	240.6
UK (England)	GNS_DEF_all_0_0_all	Landings	346.4	279.8
UK (England)	GNS_DEF_all_0_0_all	Landings	465	681.8
UK (England)	GNS_DEF_all_0_0_all	Landings	466.4	646.5
UK (England)	GNS_DEF_all_0_0_all	Landings	491.5	655.3
UK (England)	GNS_DEF_all_0_0_all	Landings	493	692.9
UK (England)	GNS_DEF_all_0_0_all	Landings	514	886.2
UK (England)	GNS_DEF_all_0_0_all	Landings	490.7	674.7
UK (England)	GNS_DEF_all_0_0_all	Landings	514	756.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	362.2	424.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1145	947.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	944.9	788
UK (England)	OTB_DEF_70-99_0_0_all	Landings	141.8	173
UK (England)	OTB_DEF_70-99_0_0_all	Landings	307.3	357.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	351.9	424.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	403.3	462.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	394.3	479.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	418.4	754.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	451.6	681.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	769.3	947.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	794.7	953.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	143	173
UK (England)	TBB_DEF_70-99_0_0_all	Landings	437.6	754.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	467.6	681.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	926.8	756.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1138	888.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1120	775.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	152.6	174.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	227.5	196.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	272.4	237.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	298.9	278.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	447.7	482.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	493.9	562
UK (England)	TBB_DEF_70-99_0_0_all	Landings	468.6	789.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	495.8	701.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	583.1	654.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	558.9	652.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	757.6	694

UK (England)	TBB_DEF_70-99_0_0_all	Landings	705	906.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	842.3	951.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	661.9	786.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	581.9	672.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1002	756.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1060	899.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1058	781.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1002	958.1
Belgium	TBB_DEF_70-99_0_0_all	Landings	168.8	168.7
Belgium	TBB_DEF_70-99_0_0_all	Landings	735.6	654.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	410.8	548.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	529.3	1070
UK (England)	OTB_DEF_70-99_0_0_all	Landings	866	674.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	461.1	775.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	302.9	357.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	400.3	462.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	382.7	548.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	534	1070
UK (England)	TBB_DEF_70-99_0_0_all	Landings	446.2	775.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	200.7	174.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	266	196.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	310.6	237.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	329.4	278.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	383.6	361.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	508.4	431.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	515	465.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	535.9	482.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	492.3	562
UK (England)	TBB_DEF_70-99_0_0_all	Landings	612.4	789.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	591.2	701.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	740.3	652.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	793.5	906.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	835.4	786.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	612.4	1095
UK (England)	TBB_DEF_70-99_0_0_all	Landings	810.3	672.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	542.1	781.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	860.2	874.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	204.6	173

UK (England)	OTB_DEF_70-99_0_0_all	Landings	288.6	199.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	349.1	240.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	364.5	279.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	540.2	462.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	604.1	479.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	836.6	655.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	959.5	756.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	588.8	888.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	846.6	999
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1009	880.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	155.5	168.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	309.6	357.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	361.8	424.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	391.9	548.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	804.6	947.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	941	756.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	571.7	888.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	902.4	924.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	794.4	999
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1009	880.6

AgeOrLength	Area
23	27.7.f
23	27.7.g
24	27.7.g
23	27.7.g
24	27.7.g
23	27.7.f
23	27.7.g
24	27.7.g
23	27.7.g
24	27.7.g
23	27.7.f
23	27.7.g
24	27.7.g
23	27.7.g
24	27.7.g
4	27.7.f
5	27.7.f

12	27.7.f
13	27.7.f
14	27.7.f
15	27.7.f
16	27.7.f
20	27.7.f
21	27.7.f
7	27.7.f
17	27.7.f
18	27.7.f
2	27.7.f
6	27.7.f
7	27.7.f
8	27.7.f
9	27.7.f
11	27.7.f
12	27.7.f
17	27.7.f
26	27.7.f
2	27.7.f
11	27.7.f
12	27.7.f
21	27.7.f
22	27.7.f
25	27.7.f
2	27.7.g
3	27.7.g
4	27.7.g
5	27.7.g
9	27.7.g
10	27.7.g
11	27.7.g
12	27.7.g
13	27.7.g
14	27.7.g
15	27.7.g
16	27.7.g
17	27.7.g

18	27.7.g
20	27.7.g
21	27.7.g
22	27.7.g
25	27.7.g
26	27.7.g
1	27.7.g
13	27.7.g
10	27.7.f
19	27.7.f
20	27.7.f
25	27.7.f
6	27.7.f
8	27.7.f
10	27.7.f
19	27.7.f
25	27.7.f
2	27.7.g
3	27.7.g
4	27.7.g
5	27.7.g
6	27.7.g
7	27.7.g
8	27.7.g
9	27.7.g
10	27.7.g
11	27.7.g
12	27.7.g
14	27.7.g
16	27.7.g
18	27.7.g
19	27.7.g
20	27.7.g
25	27.7.g
27	27.7.g
2	27.7.f
3	27.7.f
4	27.7.f

5	27.7.f
8	27.7.f
9	27.7.f
14	27.7.f
21	27.7.f
22	27.7.f
24	27.7.f
27	27.7.f
1	27.7.f
6	27.7.f
7	27.7.f
10	27.7.f
17	27.7.f
21	27.7.f
22	27.7.f
23	27.7.f
24	27.7.f
27	27.7.f

Table 3b: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for autoallocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
Ireland	TBB_DEF_70-99_0_0_all	Landings	1145	941.3
Ireland	TBB_DEF_70-99_0_0_all	Landings	1145	939.4
UK (England)	GNS_DEF_all_0_0_all	Landings	466.4	637.1
UK (England)	GNS_DEF_all_0_0_all	Landings	493	689.8
UK (England)	GNS_DEF_all_0_0_all	Landings	514	851.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1145	939.4
France	OTB_DEF_70-99_0_0	Landings	794.7	949.2
France	OTB_DEF_70-99_0_0	Landings	794.7	945.7
Ireland	OTB_DEF_70-99_0_0_all	Landings	794.7	945.7
UK (England)	GNS_DEF_all_0_0_all	Landings	466.4	633.7
UK (England)	GNS_DEF_all_0_0_all	Landings	493	687
UK (England)	GNS_DEF_all_0_0_all	Landings	514	850.6
UK (England)	GNS_DEF_all_0_0_all	Landings	466.4	637.1
UK (England)	GNS_DEF_all_0_0_all	Landings	493	689.8
UK (England)	GNS_DEF_all_0_0_all	Landings	514	851.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	794.7	945.7
UK(Scotland)	OTB_DEF_70-99_0_0_all	Landings	794.7	945.7

France	OTB_DEF_70-99_0_0	Landings	529.3	1040
France	OTB_DEF_70-99_0_0	Landings	461.1	773
UK (England)	GNS_DEF_all_0_0_all	Landings	466.4	633.7
UK (England)	GNS_DEF_all_0_0_all	Landings	493	687
UK (England)	GNS_DEF_all_0_0_all	Landings	514	850.6
UK (England)	GNS_DEF_all_0_0_all	Landings	466.4	637.1
UK (England)	GNS_DEF_all_0_0_all	Landings	493	689.8
UK (England)	GNS_DEF_all_0_0_all	Landings	514	851.6
France	OTB_DEF_70-99_0_0	Landings	288.6	204.4
France	OTB_DEF_70-99_0_0	Landings	349.1	247.1
France	OTB_DEF_70-99_0_0	Landings	364.5	285
France	OTB_DEF_70-99_0_0	Landings	540.2	460.3
France	OTB_DEF_70-99_0_0	Landings	604.1	476.5
France	OTB_DEF_70-99_0_0	Landings	588.8	876.7
France	OTB_DEF_70-99_0_0	Landings	1009	888.7
France	OTB_DEF_70-99_0_0	Landings	288.6	205.2
France	OTB_DEF_70-99_0_0	Landings	349.1	247.8
France	OTB_DEF_70-99_0_0	Landings	364.5	285.2
France	OTB_DEF_70-99_0_0	Landings	540.2	461.8
France	OTB_DEF_70-99_0_0	Landings	604.1	477.6
France	OTB_DEF_70-99_0_0	Landings	588.8	872.9
France	OTB_DEF_70-99_0_0	Landings	1009	888.3
Ireland	TBB_DEF_70-99_0_0_all	Landings	155.5	168.3
Ireland	TBB_DEF_70-99_0_0_all	Landings	571.7	876.7
Ireland	TBB_DEF_70-99_0_0_all	Landings	902.4	925
Ireland	TBB_DEF_70-99_0_0_all	Landings	794.4	989.5
Ireland	TBB_DEF_70-99_0_0_all	Landings	1009	888.7
Ireland	OTB_DEF_70-99_0_0_all	Landings	288.6	205.2
Ireland	OTB_DEF_70-99_0_0_all	Landings	349.1	247.8
Ireland	OTB_DEF_70-99_0_0_all	Landings	364.5	285.2
Ireland	OTB_DEF_70-99_0_0_all	Landings	540.2	461.8
Ireland	OTB_DEF_70-99_0_0_all	Landings	604.1	477.6
Ireland	OTB_DEF_70-99_0_0_all	Landings	588.8	872.9
Ireland	OTB_DEF_70-99_0_0_all	Landings	1009	888.3
Ireland	TBB_DEF_70-99_0_0_all	Landings	155.5	168.4
Ireland	TBB_DEF_70-99_0_0_all	Landings	571.7	872.9
Ireland	TBB_DEF_70-99_0_0_all	Landings	902.4	925.2
Ireland	TBB_DEF_70-99_0_0_all	Landings	794.4	988.7

Ireland	TBB_DEF_70-99_0_0_all	Landings	1009	888.3
UK (England)	GNS_DEF_all_0_0_all	Landings	466.4	633.7
UK (England)	GNS_DEF_all_0_0_all	Landings	493	687
UK (England)	GNS_DEF_all_0_0_all	Landings	514	850.6
UK (England)	GNS_DEF_all_0_0_all	Landings	466.4	637.1
UK (England)	GNS_DEF_all_0_0_all	Landings	493	689.8
UK (England)	GNS_DEF_all_0_0_all	Landings	514	851.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	155.5	168.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	571.7	872.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	902.4	925.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	794.4	988.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1009	888.3
UK (England)	GNS_DEF_all_0_0_all	Landings	466.4	633.7
UK (England)	GNS_DEF_all_0_0_all	Landings	493	687
UK (England)	GNS_DEF_all_0_0_all	Landings	514	850.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1145	941.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	794.7	949.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1120	773
UK (England)	OTB_DEF_70-99_0_0_all	Landings	529.3	1040
UK (England)	OTB_DEF_70-99_0_0_all	Landings	461.1	773
UK (England)	TBB_DEF_70-99_0_0_all	Landings	534	1040
UK (England)	TBB_DEF_70-99_0_0_all	Landings	446.2	773
UK (England)	TBB_DEF_70-99_0_0_all	Landings	508.4	420.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	288.6	204.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	349.1	247.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	364.5	285
UK (England)	OTB_DEF_70-99_0_0_all	Landings	540.2	460.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	604.1	476.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	588.8	876.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1009	888.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	155.5	168.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	571.7	876.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	902.4	925
UK (England)	TBB_DEF_70-99_0_0_all	Landings	794.4	989.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1009	888.7

AgeOrLength	Area
17	27.7.f
17	27.7.g

13	27.7.g
15	27.7.g
16	27.7.g
17	27.7.g
26	27.7.f
26	27.7.g
26	27.7.g
13	27.7.f
15	27.7.f
16	27.7.f
13	27.7.g
15	27.7.g
16	27.7.g
26	27.7.g
26	27.7.g
19	27.7.f
25	27.7.f
13	27.7.f
15	27.7.f
16	27.7.f
13	27.7.g
15	27.7.g
16	27.7.g
3	27.7.f
4	27.7.f
5	27.7.f
8	27.7.f
9	27.7.f
22	27.7.f
27	27.7.f
3	27.7.g
4	27.7.g
5	27.7.g
8	27.7.g
9	27.7.g
22	27.7.g
27	27.7.g
1	27.7.f

22	27.7.f
23	27.7.f
24	27.7.f
27	27.7.f
3	27.7.g
4	27.7.g
5	27.7.g
8	27.7.g
9	27.7.g
22	27.7.g
27	27.7.g
1	27.7.g
22	27.7.g
23	27.7.g
24	27.7.g
27	27.7.g
13	27.7.f
15	27.7.f
16	27.7.f
13	27.7.g
15	27.7.g
16	27.7.g
1	27.7.g
22	27.7.g
23	27.7.g
24	27.7.g
27	27.7.g
13	27.7.f
15	27.7.f
16	27.7.f
17	27.7.f
26	27.7.f
25	27.7.f
19	27.7.f
25	27.7.f
19	27.7.f
25	27.7.f
7	27.7.g

3	27.7.f
4	27.7.f
5	27.7.f
8	27.7.f
9	27.7.f
22	27.7.f
27	27.7.f
1	27.7.f
22	27.7.f
23	27.7.f
24	27.7.f
27	27.7.f

InterCatch output for 2012

This document uses Table 2 from CatchAndSampleDataTables.txt from the InterCatch outputs to describe the raising procedures that were made.

In the following tables, CATON=WECA*CANUM/1000000 (in tonnes).

Raised discards

In InterCatch, the first step consists in raising the discards volumes for strats with landings and no discards associated. These discards are called in the following table 'Raised_Discards'. The data called 'Imported_Data' are landings or discards volumes imported into InterCatch with or without age structure.

The proportion of Landings with Discards associated (same strata) is **72 percent**

The volumes (and associated proportion) of landings and discards imported (Imported_Data) or raised (Raised_Discards) are described in the following table.

Table 1: Summary of the imported/Raised data

CatchCategory	RaisedOrImported	CATON	perc
Discards	Raised_Discards	8984	28
Discards	Imported_Data	22601	72
Landings	Imported_Data	1100498	100

Age distribution

For the imported landings/discards and the raised discards without age distribution, the age distribution is then computed using the defined allocation scheme. Sampled_distribution means that the data (landings or discards) were input with age distribution. Estimated_distribution means that the inputed/raised volumes were estimated using the allocation scheme.

Table 2: Summary of the imported/Raised/SampledOrEstimated data

CatchCategory	RaisedOrImported	SampledOrEstimated	CATON	perc
Landings	Imported_Data	Sampled_Distribution	980.6	89
Landings	Imported_Data	Estimated_Distribution	119.1	11
Discards	Imported_Data	Sampled_Distribution	22.6	72
Discards	Raised_Discards	Estimated_Distribution	8.952	28
Discards	Imported_Data	Estimated_Distribution	0	0

Impact of the raising on the age structure

Once the samples imported or raised are identified, it is possible to check the impact of the allocation scheme on the mean age/length of the final age/length distribution of the stock. The following figures compare the mean age (computed as the weighted mean of the age per stratum ("CatchCategory",'RaisedOrImported',"SampledOrEstimated","Country","Area","Season","Fleet","Se x")) of the estimated strata compared to the imported ones and the final distribution. Each individual included in the boxplot corresponds to the weighted mean age of a stratum.

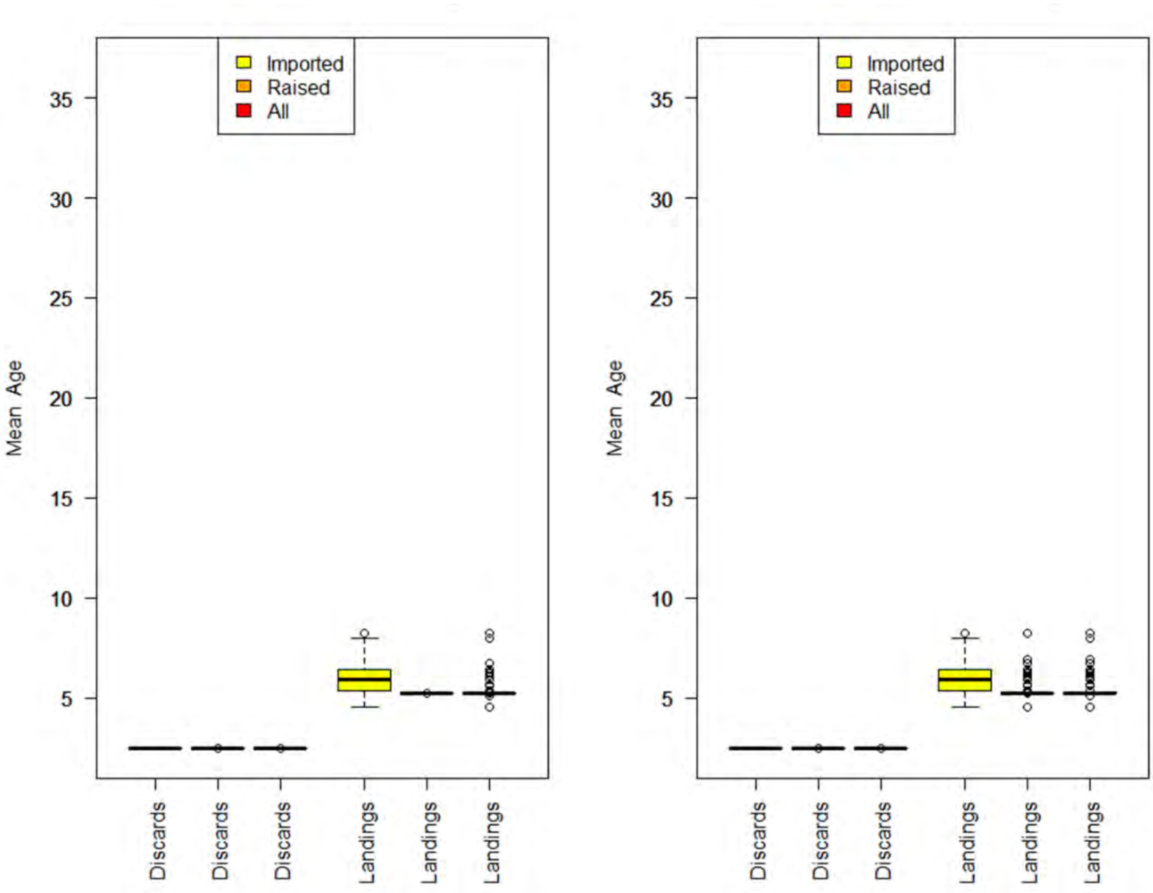


Figure 1: Mean Age per catch category (left: manual allocation; right: autoallocation)

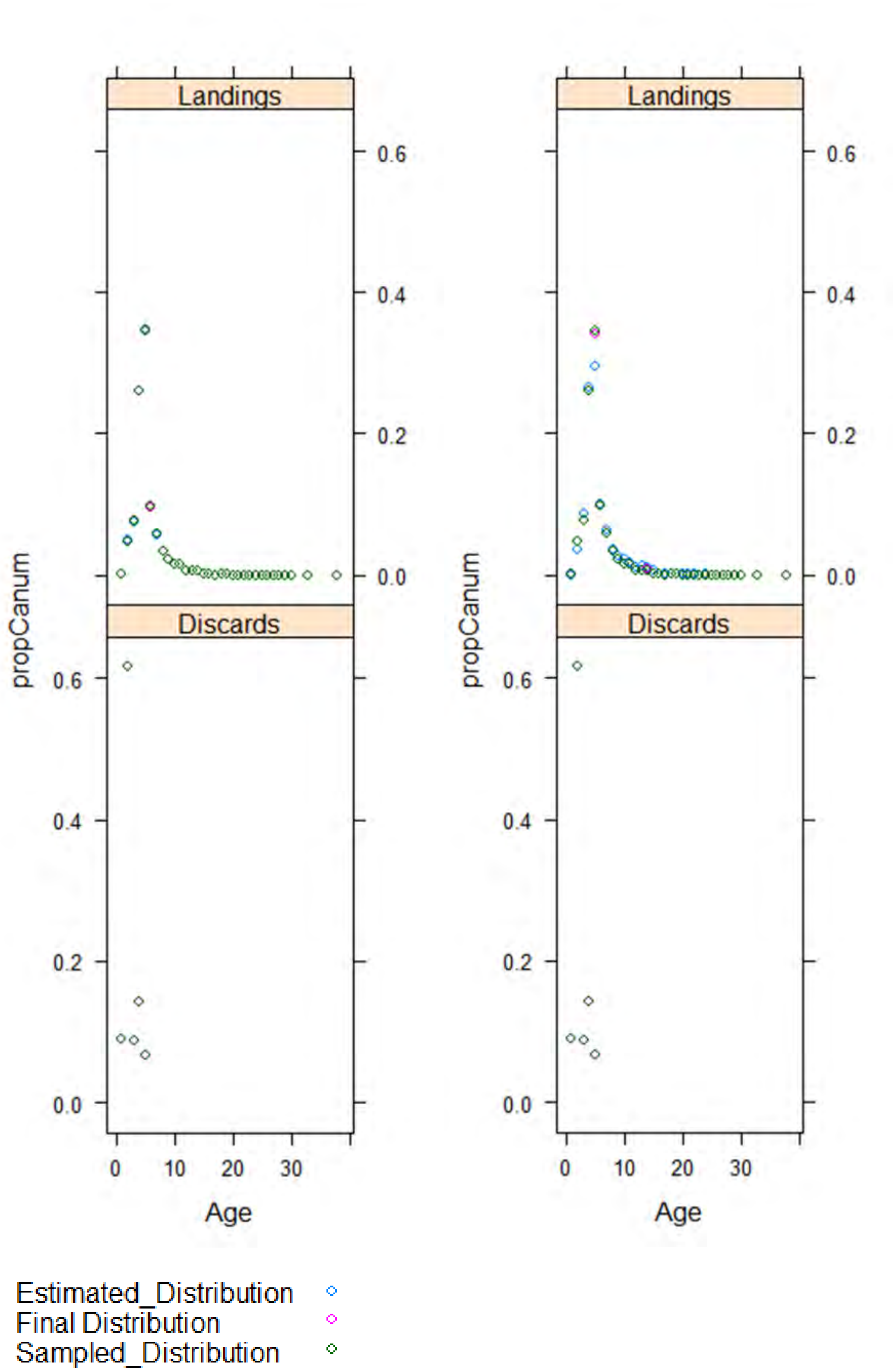


Figure 2: The percentage of each age for the sampled strata, estimated and the final age structure for the landing and discard fractions (left: manual allocation; right: autoallocation)

Impact of the raising on the mean weight

The CatchAndSampleData also provide the weight at age per stratum for the Sampled/Estimated strata. One should also check the sampled/estimated and resulting weight at age.

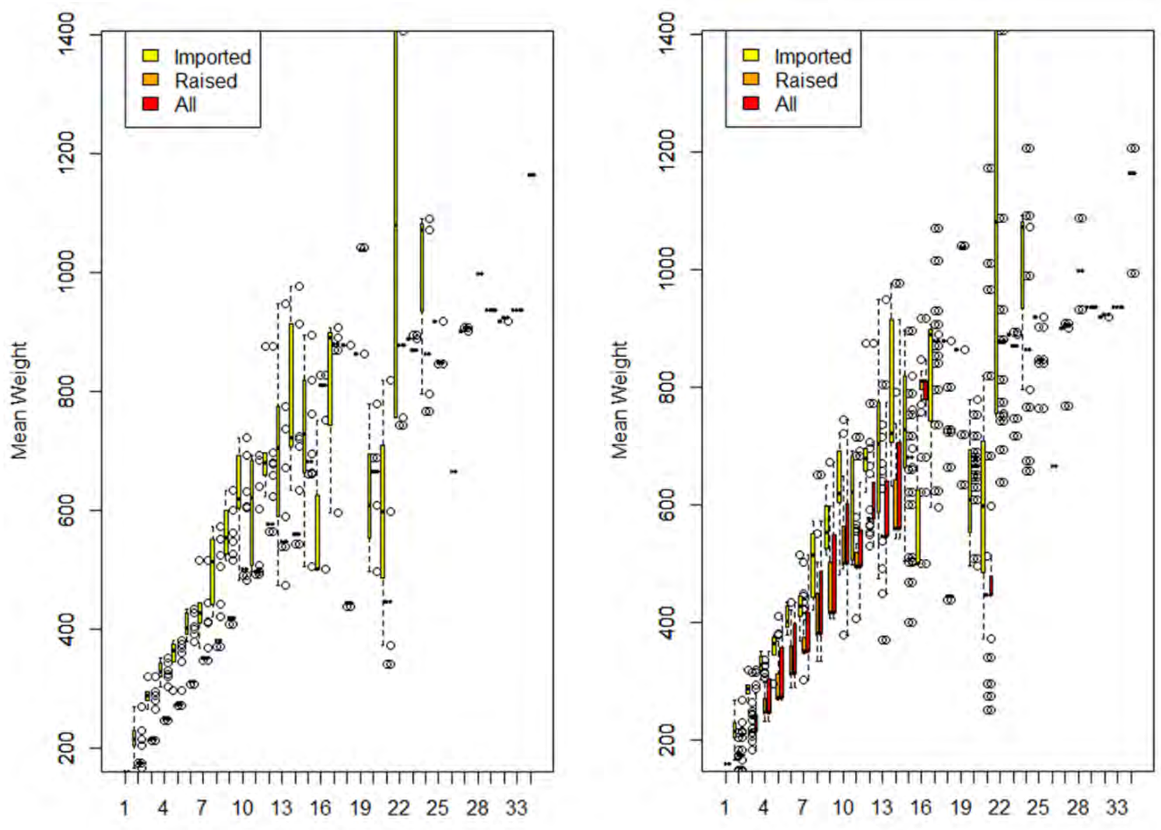


Figure 3a: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.g (left: manual allocation; right: autoallocation)

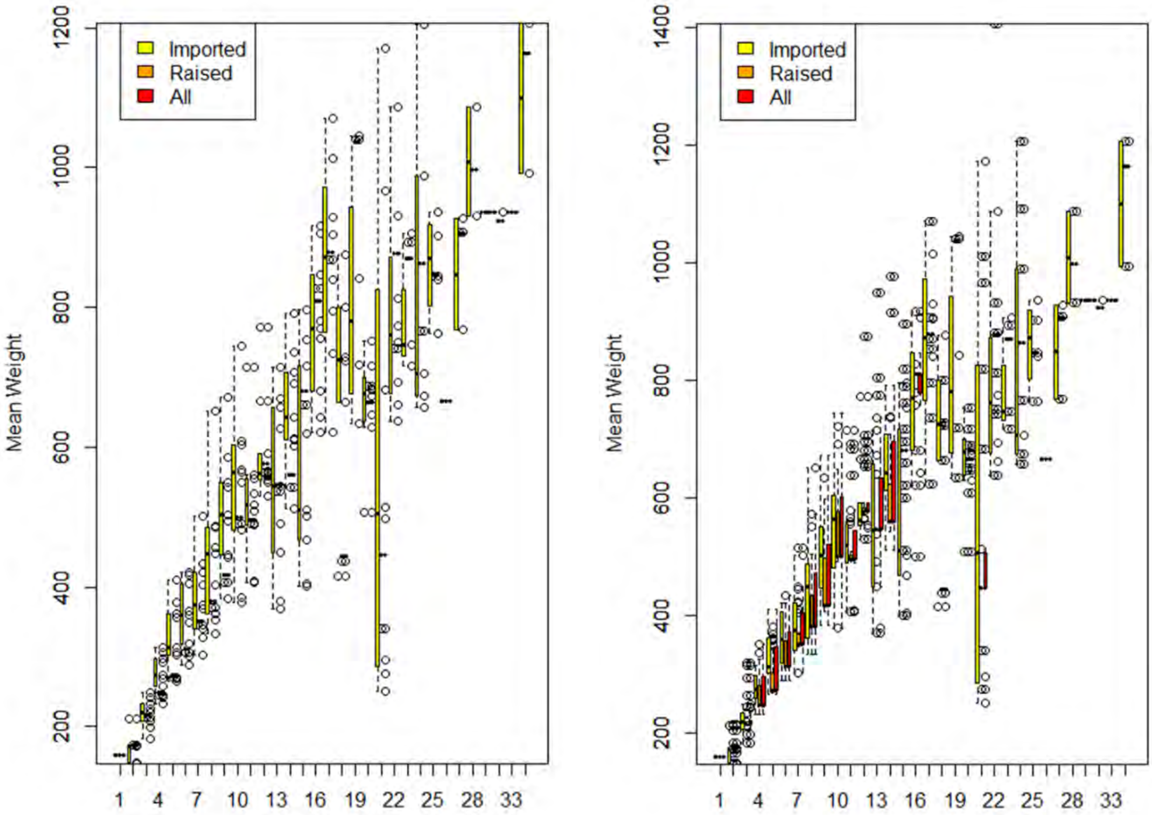


Figure 3b: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.f (left: manual allocation; right: autoallocation)

Table 3a: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for manual allocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
UK (England)	TBB_DEF_70-99_0_0_all	Landings	893.2	871.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	893.2	871.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	893.2	871.3
France	OTT_DEF_100-119_0_0	Landings	690.9	506.5
UK (England)	GNS_DEF_all_0_0_all	Landings	242.1	215.1
UK (England)	GNS_DEF_all_0_0_all	Landings	314.2	252.4
UK (England)	GNS_DEF_all_0_0_all	Landings	377.8	281.7
UK (England)	GNS_DEF_all_0_0_all	Landings	421.5	319
UK (England)	GNS_DEF_all_0_0_all	Landings	762.7	848.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	405.7	319
UK (England)	OTB_DEF_70-99_0_0_all	Landings	585.8	432.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	715.2	546
UK (England)	OTB_DEF_70-99_0_0_all	Landings	736.8	574.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1070	876.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	147.9	173.4

UK (England)	OTB_DEF_70-99_0_0_all	Landings	183.1	215.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	369.6	546
UK (England)	OTB_DEF_70-99_0_0_all	Landings	400.4	662.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	621.8	804.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	718.9	1020
UK (England)	OTB_DEF_70-99_0_0_all	Landings	637.9	858.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	746.2	866.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	767.7	904.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	379	546
UK (England)	TBB_DEF_70-99_0_0_all	Landings	404.3	662.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	642.4	804.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	876.4	472.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	935.7	848.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	935.7	923.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	229.9	177.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	287.6	220.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	343.5	255.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	379.7	280.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	503.9	683.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	878.1	450.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	862.3	1035
UK (England)	TBB_DEF_70-99_0_0_all	Landings	779	664.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	888.6	871.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	918.1	848.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	900.3	906.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	918.1	923.2
Ireland	OTB_CRU_70-99_0_0_all	Landings	368.1	280.3
Ireland	OTB_CRU_70-99_0_0_all	Landings	433.2	320.5
Ireland	OTB_CRU_70-99_0_0_all	Landings	444.3	358
Ireland	OTB_CRU_70-99_0_0_all	Landings	551.6	391
Ireland	OTB_CRU_70-99_0_0_all	Landings	598.5	430.9
Ireland	OTB_CRU_70-99_0_0_all	Landings	721.5	511
Ireland	OTB_CRU_70-99_0_0_all	Landings	683.4	506.5
Ireland	OTB_CRU_70-99_0_0_all	Landings	975.2	580.3
Ireland	OTB_CRU_70-99_0_0_all	Landings	894.2	683.6
Ireland	OTB_CRU_70-99_0_0_all	Landings	500.1	799.5
Ireland	OTB_CRU_70-99_0_0_all	Landings	818.7	448.1
Ireland	OTB_CRU_70-99_0_0_all	Landings	1405	877.9

Ireland	OTB_CRU_70-99_0_0_all	Landings	1090	863.9
Ireland	TBB_DEF_70-99_0_0_all	Landings	268.9	177.1
Ireland	TBB_DEF_70-99_0_0_all	Landings	329.8	255.5
Ireland	TBB_DEF_70-99_0_0_all	Landings	373.5	280.3
Ireland	TBB_DEF_70-99_0_0_all	Landings	427.1	320.5
Ireland	TBB_DEF_70-99_0_0_all	Landings	443.1	358
Ireland	TBB_DEF_70-99_0_0_all	Landings	523.4	391
Ireland	TBB_DEF_70-99_0_0_all	Landings	500.1	799.5
Ireland	TBB_DEF_70-99_0_0_all	Landings	594.5	874.3
Ireland	TBB_DEF_70-99_0_0_all	Landings	496.7	664.5
Ireland	TBB_DEF_70-99_0_0_all	Landings	1072	863.9
France	OTT_DEF_100-119_0_0	Landings	293.3	220.4
France	OTT_DEF_100-119_0_0	Landings	515.3	358
France	OTT_DEF_100-119_0_0	Landings	572.6	391
France	OTT_DEF_100-119_0_0	Landings	633.2	430.9
France	OTT_DEF_100-119_0_0	Landings	691.2	511
France	OTT_DEF_100-119_0_0	Landings	638.6	506.5
France	OTT_DEF_100-119_0_0	Landings	774.1	560.8
France	OTT_DEF_100-119_0_0	Landings	817.8	683.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	149.8	173.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	622.1	876.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	633.8	1020
UK (England)	OTB_DEF_70-99_0_0_all	Landings	752.8	665.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	716.4	866.3
France	OTT_DEF_100-119_0_0	Landings	319.6	220.4
France	OTT_DEF_100-119_0_0	Landings	350.2	255.5
France	OTT_DEF_100-119_0_0	Landings	360.1	280.3
France	OTT_DEF_100-119_0_0	Landings	874.3	588
France	OTT_DEF_100-119_0_0	Landings	947.3	560.8
France	OTT_DEF_100-119_0_0	Landings	913.7	580.3
UK (England)	GNS_DEF_all_0_0_all	Landings	212.1	173.4
UK (England)	GNS_DEF_all_0_0_all	Landings	249.4	215.1
UK (England)	GNS_DEF_all_0_0_all	Landings	306.3	252.4
UK (England)	GNS_DEF_all_0_0_all	Landings	410.8	281.7
UK (England)	GNS_DEF_all_0_0_all	Landings	418.2	319
UK (England)	GNS_DEF_all_0_0_all	Landings	502.3	355.9
UK (England)	GNS_DEF_all_0_0_all	Landings	651.4	389.4
UK (England)	GNS_DEF_all_0_0_all	Landings	671	432.4

UK (England)	GNS_DEF_all_0_0_all	Landings	744.5	506.2
UK (England)	GNS_DEF_all_0_0_all	Landings	715.3	500.3
UK (England)	GNS_DEF_all_0_0_all	Landings	772.5	578.9
UK (England)	GNS_DEF_all_0_0_all	Landings	791.6	574.8
UK (England)	GNS_DEF_all_0_0_all	Landings	800.4	472.4
UK (England)	GNS_DEF_all_0_0_all	Landings	1171	459.9
UK (England)	GNS_DEF_all_0_0_all	Landings	1087	858.2
UK (England)	GNS_DEF_all_0_0_all	Landings	1206	855.4
UK (England)	GNS_DEF_all_0_0_all	Landings	1087	998.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	507.3	665.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	966.3	459.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	930.7	998.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	992.5	1161

AgeOrLength	Area
23	27.7.g
23	27.7.g
23	27.7.g
11	27.7.g
3	27.7.f
4	27.7.f
5	27.7.f
6	27.7.f
25	27.7.f
6	27.7.f
9	27.7.f
13	27.7.f
14	27.7.f
17	27.7.f
2	27.7.f
3	27.7.f
13	27.7.f
15	27.7.f
16	27.7.f
19	27.7.f
22	27.7.f
23	27.7.f
27	27.7.f
13	27.7.f

15	27.7.f
16	27.7.f
18	27.7.f
25	27.7.f
30	27.7.f
2	27.7.g
3	27.7.g
4	27.7.g
5	27.7.g
15	27.7.g
18	27.7.g
19	27.7.g
20	27.7.g
23	27.7.g
25	27.7.g
27	27.7.g
30	27.7.g
5	27.7.g
6	27.7.g
7	27.7.g
8	27.7.g
9	27.7.g
10	27.7.g
11	27.7.g
14	27.7.g
15	27.7.g
16	27.7.g
21	27.7.g
22	27.7.g
24	27.7.g
2	27.7.g
4	27.7.g
5	27.7.g
6	27.7.g
7	27.7.g
8	27.7.g
16	27.7.g
17	27.7.g

20	27.7.g
24	27.7.g
3	27.7.g
7	27.7.g
8	27.7.g
9	27.7.g
10	27.7.g
11	27.7.g
13	27.7.g
15	27.7.g
2	27.7.f
17	27.7.f
19	27.7.f
20	27.7.f
23	27.7.f
3	27.7.g
4	27.7.g
5	27.7.g
12	27.7.g
13	27.7.g
14	27.7.g
2	27.7.f
3	27.7.f
4	27.7.f
5	27.7.f
6	27.7.f
7	27.7.f
8	27.7.f
9	27.7.f
10	27.7.f
11	27.7.f
12	27.7.f
14	27.7.f
18	27.7.f
21	27.7.f
22	27.7.f
24	27.7.f
28	27.7.f

20	27.7.f
21	27.7.f
28	27.7.f
38	27.7.f

Table 3b: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for autoallocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
Belgium	OTB_CRU_70-99_0_0_all	Landings	1405	893.3
UK (England)	GNS_DEF_all_0_0_all	Landings	762.7	845.4
Belgium	OTB_CRU_70-99_0_0_all	Landings	1405	893.3
France	OTB_DEF_70-99_0_0	Landings	767.7	899.6
France	OTT_DEF_100-119_0_0	Landings	315.7	224.7
France	OTB_DEF_70-99_0_0	Landings	746.2	861.2
France	OTB_DEF_70-99_0_0	Landings	767.7	903.2
France	OTT_DEF_100-119_0_0	Landings	315.7	228.2
UK (England)	GNS_DEF_all_0_0_all	Landings	762.7	845.4
UK (England)	GNS_DEF_all_0_0_all	Landings	1087	1003
Belgium	OTB_CRU_70-99_0_0_all	Landings	1405	893.3
France	OTB_DEF_70-99_0_0	Landings	622.1	871.5
France	OTB_DEF_70-99_0_0	Landings	633.8	996.2
France	OTB_DEF_70-99_0_0	Landings	716.4	857.3
France	OTT_DEF_100-119_0_0	Landings	515.3	373.6
France	OTB_DEF_70-99_0_0	Landings	622.1	872.7
France	OTB_DEF_70-99_0_0	Landings	633.8	1008
France	OTB_DEF_70-99_0_0	Landings	716.4	861.2
UK (England)	GNS_DEF_all_0_0_all	Landings	762.7	845.4
UK (England)	GNS_DEF_all_0_0_all	Landings	1087	1003
UK (England)	OTB_DEF_70-99_0_0_all	Landings	622.1	872.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	633.8	1008
UK (England)	OTB_DEF_70-99_0_0_all	Landings	716.4	861.2
Belgium	OTB_CRU_70-99_0_0_all	Landings	1405	893.3
France	OTB_DEF_70-99_0_0	Landings	507.3	659.7
France	OTB_DEF_70-99_0_0	Landings	992.5	1158
France	OTT_DEF_100-119_0_0	Landings	319.6	224.7
France	OTT_DEF_100-119_0_0	Landings	874.3	602.1
France	OTT_DEF_100-119_0_0	Landings	947.3	578.1
France	OTB_DEF_70-99_0_0	Landings	507.3	659.2
France	OTB_DEF_70-99_0_0	Landings	992.5	1163

UK (England)	GNS_DEF_all_0_0_all	Landings	651.4	425.5
UK (England)	GNS_DEF_all_0_0_all	Landings	1171	525.7
UK (England)	GNS_DEF_all_0_0_all	Landings	1087	1003
UK (England)	OTB_DEF_70-99_0_0_all	Landings	767.7	899.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	935.7	845.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	935.7	923.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	878.1	496.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	918.1	923.1
Ireland	TBB_DEF_70-99_0_0_all	Landings	268.9	181.4
Ireland	TBB_DEF_70-99_0_0_all	Landings	594.5	872.7
Ireland	TBB_DEF_70-99_0_0_all	Landings	496.7	659.2
France	OTT_DEF_100-119_0_0	Landings	515.3	378.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	622.1	871.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	633.8	996.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	716.4	857.3
France	OTT_DEF_100-119_0_0	Landings	319.6	228.2
France	OTT_DEF_100-119_0_0	Landings	874.3	606.6
France	OTT_DEF_100-119_0_0	Landings	947.3	589.5
UK (England)	GNS_DEF_all_0_0_all	Landings	651.4	418.6
UK (England)	GNS_DEF_all_0_0_all	Landings	1171	527.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	507.3	659.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	992.5	1158

AgeOrLength	Area
22	27.7.f
25	27.7.g
22	27.7.f
27	27.7.f
3	27.7.f
23	27.7.g
27	27.7.g
3	27.7.g
25	27.7.g
28	27.7.g
22	27.7.f
17	27.7.f
19	27.7.f
23	27.7.f
7	27.7.f

17	27.7.g
19	27.7.g
23	27.7.g
25	27.7.g
28	27.7.g
17	27.7.g
19	27.7.g
23	27.7.g
22	27.7.f
20	27.7.f
38	27.7.f
3	27.7.f
12	27.7.f
13	27.7.f
20	27.7.g
38	27.7.g
8	27.7.g
21	27.7.g
28	27.7.g
27	27.7.f
25	27.7.f
30	27.7.f
18	27.7.g
30	27.7.g
2	27.7.g
17	27.7.g
20	27.7.g
7	27.7.g
17	27.7.f
19	27.7.f
23	27.7.f
3	27.7.g
12	27.7.g
13	27.7.g
8	27.7.f
21	27.7.f
20	27.7.f
38	27.7.f

InterCatch output for 2013

This document uses Table 2 from CatchAndSampleDataTables.txt from the InterCatch outputs to describe the raising procedures that were made.

In the following tables, CATON=WECA*CANUM/1000000 (in tonnes).

Raised discards

In InterCatch, the first step consists in raising the discards volumes for strats with landings and no discards associated. These discards are called in the following table 'Raised_Discards'. The data called 'Imported_Data' are landings or discards volumes imported into InterCatch with or without age structure.

The proportion of Landings with Discards associated (same strata) is **78 percent**

The volumes (and associated proportion) of landings and discards imported (Imported_Data) or raised (Raised_Discards) are described in the following table.

Table 1: Summary of the imported/Raised data

CatchCategory	RaisedOrImported	CATON	perc
Discards	Raised_Discards	5693	22
Discards	Imported_Data	20236	78
Landings	Imported_Data	1092348	100

Age distribution

For the imported landings/discards and the raised discards without age distribution, the age distribution is then computed using the defined allocation scheme. Sampled_distribution means that the data (landings or discards) were input with age distribution. Estimated_distribution means that the inputed/raised volumes were estimated using the allocation scheme.

Table 2: Summary of the imported/Raised/SampledOrEstimated data

CatchCategory	RaisedOrImported	SampledOrEstimated	CATON	perc
Landings	Imported_Data	Sampled_Distribution	975.2	89
Landings	Imported_Data	Estimated_Distribution	117.3	11
Discards	Imported_Data	Sampled_Distribution	20.24	78
Discards	Raised_Discards	Estimated_Distribution	5.707	22
Discards	Imported_Data	Estimated_Distribution	0	0

Impact of the raising on the age structure

Once the samples imported or raised are identified, it is possible to check the impact of the allocation scheme on the mean age/length of the final age/length distribution of the stock. The following figures compare the mean age (computed as the weighted mean of the age per stratum ("CatchCategory",'RaisedOrImported',"SampledOrEstimated","Country","Area","Season","Fleet","Se x")) of the estimated strata compared to the imported ones and the final distribution. Each individual included in the boxplot corresponds to the weighted mean age of a stratum.

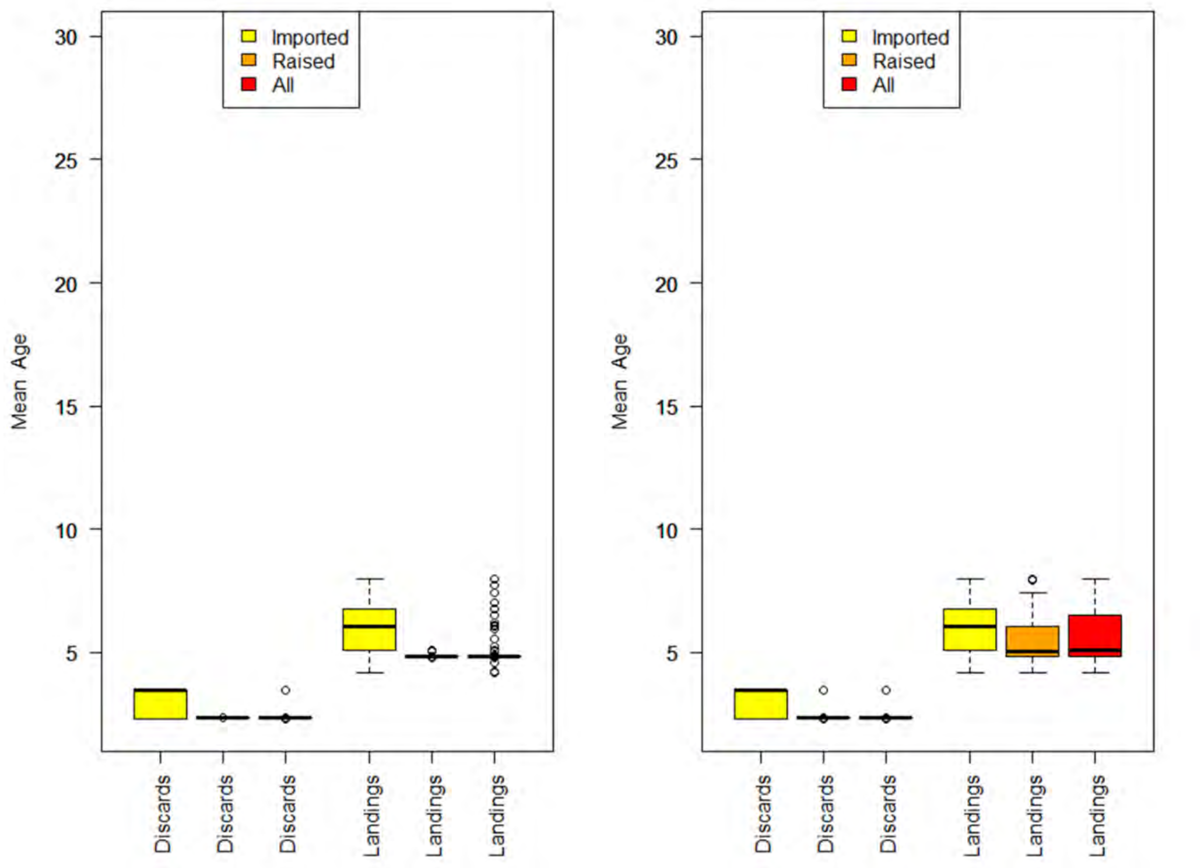


Figure 1: Mean Age per catch category (left: manual allocation; right: autoallocation)

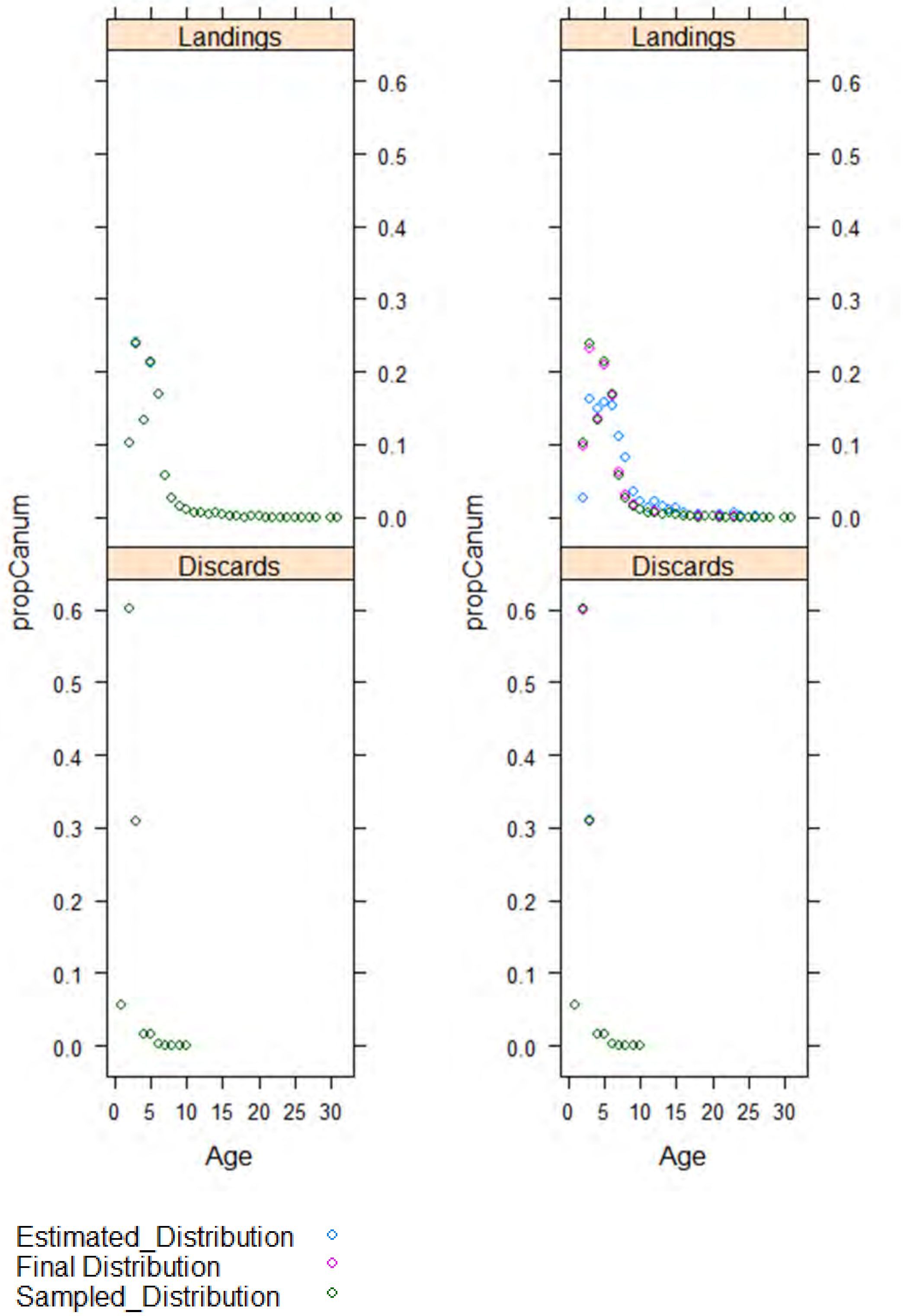


Figure 2: The percentage of each age for the sampled strata, estimated and the final age structure for the landing and discard fractions (left: manual allocation; right: autoallocation)

Impact of the raising on the mean weight

The CatchAndSampleData also provide the weight at age per stratum for the Sampled/Estimated strata. One should also check the sampled/estimated and resulting weight at age.

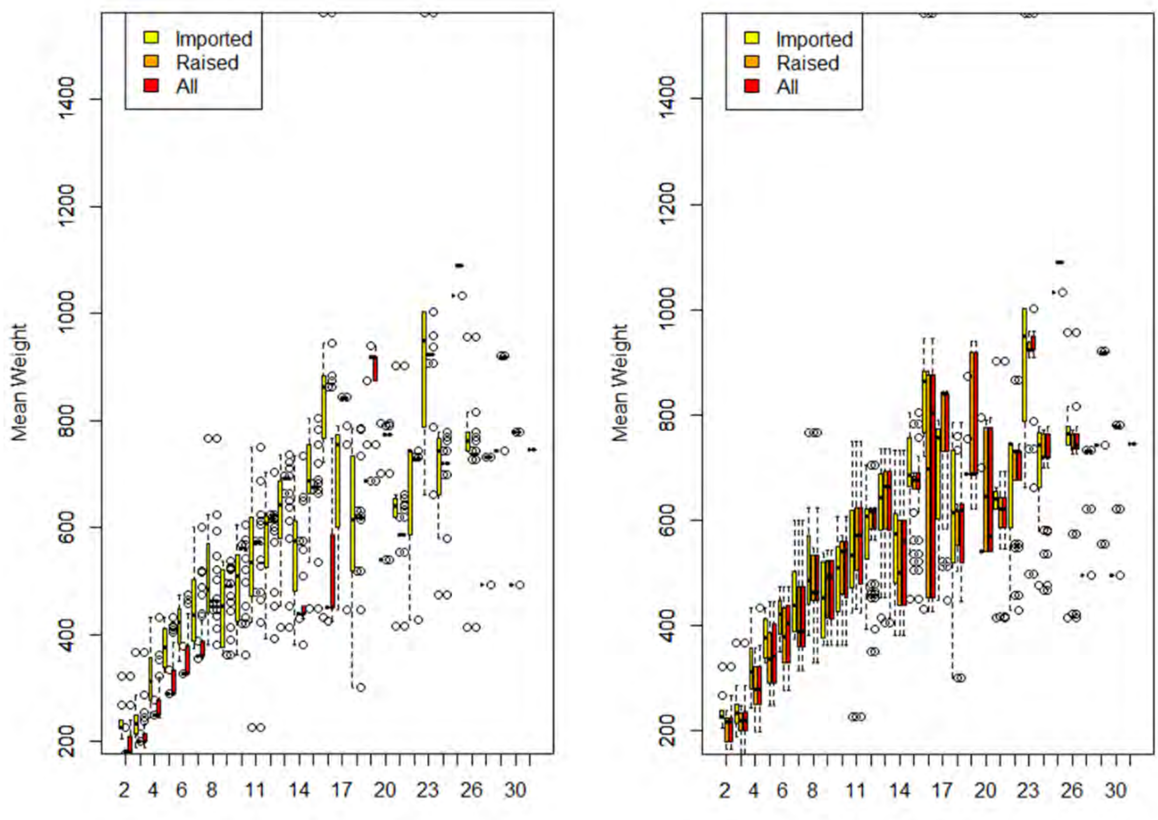
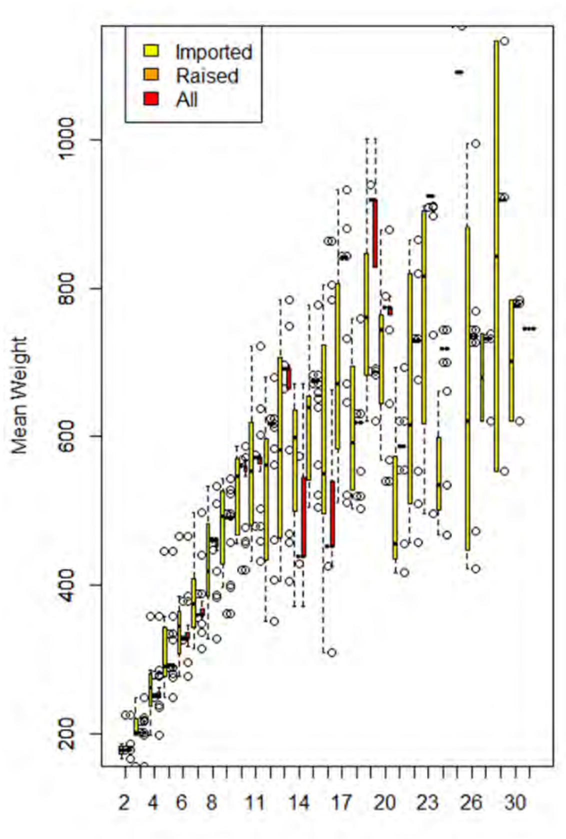


Figure 3a: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.g (left: manual allocation; right: autoallocation)



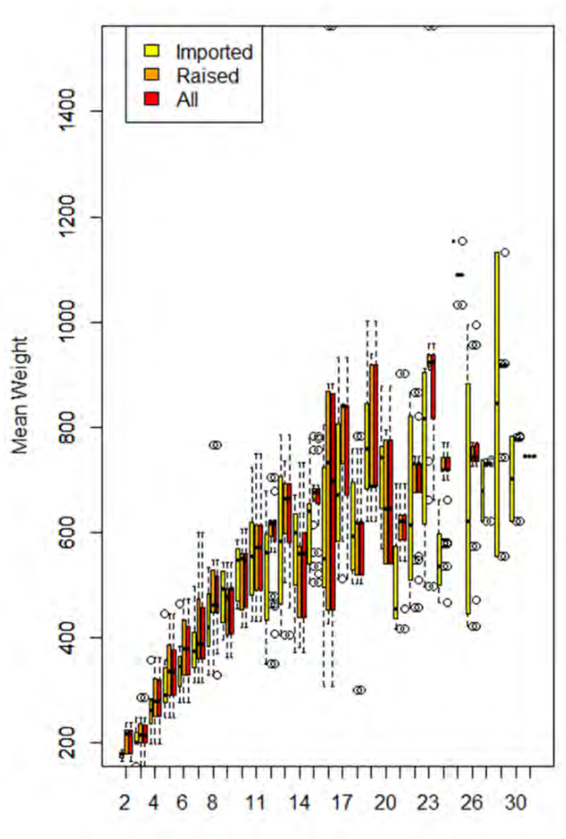


Figure 3b: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.f (left: manual allocation; right: autoallocation)

Table 3a: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for manual allocation Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
UK (England)	GNS_DEF_all_0_0_all	Landings	248.9	205.2
UK (England)	GNS_DEF_all_0_0_all	Landings	357.6	257.2
UK (England)	GNS_DEF_all_0_0_all	Landings	446.4	302.4
UK (England)	GNS_DEF_all_0_0_all	Landings	465.4	339.8
UK (England)	GNS_DEF_all_0_0_all	Landings	497.8	368.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	722.7	554.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1153	1092
UK (England)	TBB_DEF_70-99_0_0_all	Landings	995	730.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	156.9	205.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	328.2	455.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	351.9	604.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	404.9	672.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	505.4	667.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	511.5	815.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	416.7	587.3

UK (England)	OTB_DEF_70-99_0_0_all	Landings	457.1	717.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	535.7	711.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	421.7	730.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	620.7	728.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	620.9	774
UK (England)	TBB_DEF_70-99_0_0_all	Landings	407.5	604.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	457.6	672.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	455.9	587.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	509.4	717.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	472.2	730.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	393.5	610.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	413.7	675.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	449.9	676.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	447.1	830.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	415.3	598.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	428.1	725
UK (England)	TBB_DEF_70-99_0_0_all	Landings	475.5	719.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	415.1	738.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	494.5	726.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	494.5	772.4
Ireland	GNS_DEF_>=220_0_0_all	Landings	321.7	193.5
Ireland	GNS_DEF_>=220_0_0_all	Landings	367.1	210.9
Ireland	GNS_DEF_>=220_0_0_all	Landings	433.6	266
Ireland	GNS_DEF_>=220_0_0_all	Landings	432.8	311.8
Ireland	GNS_DEF_>=220_0_0_all	Landings	624.7	470.2
Ireland	GNS_DEF_>=220_0_0_all	Landings	804.7	676.5
Ireland	OTB_CRU_100-119_0_0_all	Landings	480	610.2
Ireland	OTB_CRU_100-119_0_0_all	Landings	535.3	676.5
Ireland	OTB_CRU_100-119_0_0_all	Landings	1562	565
Ireland	OTB_CRU_100-119_0_0_all	Landings	301.7	604.5
Ireland	OTB_CRU_100-119_0_0_all	Landings	1562	930.6
Ireland	OTB_CRU_70-99_0_0_all	Landings	474.4	350.5
Ireland	OTB_CRU_70-99_0_0_all	Landings	601	380.6
Ireland	OTB_CRU_70-99_0_0_all	Landings	767.1	470.2
Ireland	OTB_CRU_70-99_0_0_all	Landings	733.6	473.9
Ireland	SSC_DEF_100-119_0_0_all	Landings	362.3	533.6
Ireland	SSC_DEF_100-119_0_0_all	Landings	226.3	555.3
Ireland	SSC_DEF_100-119_0_0_all	Landings	454	610.2

Ireland	SSC_DEF_100-119_0_0_all	Landings	454	675.9
Ireland	TBB_DEF_70-99_0_0_all	Landings	518.7	380.6
France	OTT_DEF_100-119_0_0	Landings	750.1	555.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	469.6	672.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	521.9	667.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	521.7	815.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	497.1	904.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	467.4	711.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	554.4	914.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	286.9	210.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	901.8	598.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	579.4	719.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1033	1089
UK (England)	TBB_DEF_70-99_0_0_all	Landings	955.5	738.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	742.8	915.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	758.7	601.3

AgeOrLength	Area
3	27.7.f
4	27.7.f
5	27.7.f
6	27.7.f
7	27.7.f
11	27.7.f
25	27.7.f
26	27.7.f
3	27.7.f
8	27.7.f
12	27.7.f
13	27.7.f
15	27.7.f
17	27.7.f
21	27.7.f
22	27.7.f
24	27.7.f
26	27.7.f
27	27.7.f
30	27.7.f
12	27.7.f

13	27.7.f
21	27.7.f
22	27.7.f
26	27.7.f
12	27.7.g
13	27.7.g
15	27.7.g
17	27.7.g
21	27.7.g
22	27.7.g
24	27.7.g
26	27.7.g
27	27.7.g
30	27.7.g
2	27.7.g
3	27.7.g
4	27.7.g
5	27.7.g
8	27.7.g
15	27.7.g
12	27.7.g
15	27.7.g
16	27.7.g
18	27.7.g
23	27.7.g
6	27.7.g
7	27.7.g
8	27.7.g
14	27.7.g
10	27.7.g
11	27.7.g
12	27.7.g
13	27.7.g
7	27.7.g
11	27.7.g
13	27.7.f
15	27.7.f
17	27.7.f

23	27.7.f
24	27.7.f
28	27.7.f
3	27.7.g
21	27.7.g
24	27.7.g
25	27.7.g
26	27.7.g
28	27.7.g
18	27.7.f

Table 3b: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for autoallocation
Table continues below

Country	Fleet	CatchCategory	WECA
Belgium	OTB_CRU_70-99_0_0_all	Landings	767.1
France	OTB_CRU_100-119_0_0_all	Landings	1562
Belgium	OTB_CRU_70-99_0_0_all	Landings	767.1
France	OTB_DEF_70-99_0_0	Landings	351.9
France	OTB_DEF_70-99_0_0	Landings	416.7
France	OTB_DEF_70-99_0_0	Landings	421.7
UK(Northern Ireland)	SSC_DEF_100-119_0_0_all	Landings	226.3
Belgium	OTB_CRU_70-99_0_0_all	Landings	767.1
France	OTB_CRU_100-119_0_0_all	Landings	1562
UK (England)	TBB_DEF_70-99_0_0_all	Landings	901.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	467.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	415.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	475.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	415.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	494.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	494.5
Ireland	GNS_DEF_>=220_0_0_all	Landings	321.7
Ireland	GNS_DEF_>=220_0_0_all	Landings	367.1
Ireland	SSC_DEF_100-119_0_0_all	Landings	226.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	901.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1033

AverageWtSize	AgeOrLength	Area
479.8	8	27.7.f
703.5	16	27.7.f

479.8	8	27.7.f
591.3	12	27.7.g
617.8	21	27.7.g
735.6	26	27.7.g
557.2	11	27.7.g
479.8	8	27.7.f
703.5	16	27.7.f
606.4	21	27.7.f
714.2	24	27.7.g
617.8	21	27.7.g
714.2	24	27.7.g
735.6	26	27.7.g
705.6	27	27.7.g
744.1	30	27.7.g
209.6	2	27.7.g
223.3	3	27.7.g
557.2	11	27.7.g
617.8	21	27.7.g
1087	25	27.7.g

InterCatch output for 2014

This document uses Table 2 from CatchAndSampleDataTables.txt from the InterCatch outputs to describe the raising procedures that were made.

In the following tables, CATON=WECA*CANUM/1000000 (in tonnes).

Raised discards

In InterCatch, the first step consists in raising the discards volumes for strats with landings and no discards associated. These discards are called in the following table 'Raised_Discards'. The data called 'Imported_Data' are landings or discards volumes imported into InterCatch with or without Age structure.

The proportion of Landings with Discards associated (same strata) is **77 percent**

The volumes (and associated proportion) of landings and discards imported (Imported_Data) or raised (Raised_Discards) are described in the following table.

Table 1: Summary of the imported/Raised data

CatchCategory	RaisedOrImported	CATON	perc
Discards	Raised_Discards	5443	20
Discards	Imported_Data	21289	80
Landings	Imported_Data	1041351	100

Age distribution

For the imported landings/discards and the raised discards without age distribution, the age distribution is then computed using the defined allocation scheme. Sampled_distribution means that the data (landings or discards) were input with age distribution. Estimated_distribution means that the inputed/raised volumes were estimated using the allocation scheme.

Table 2: Summary of the imported/Raised/SampledOrEstimated data

CatchCategory	RaisedOrImported	SampledOrEstimated	CATON	perc
Landings	Imported_Data	Sampled_Distribution	948.4	91
Landings	Imported_Data	Estimated_Distribution	91.84	9
Discards	Imported_Data	Sampled_Distribution	21.29	80
Discards	Raised_Discards	Estimated_Distribution	5.404	20
Discards	Imported_Data	Estimated_Distribution	0	0

Impact of the raising on the age structure

Once the samples imported or raised are identified, it is possible to check the impact of the allocation scheme on the mean age/length of the final age/length distribution of the stock. The following figures compare the mean age (computed as the weighted mean of the age per stratum ("CatchCategory",'RaisedOrImported',"SampledOrEstimated","Country","Area","Season","Fleet","Se x")) of the estimated strata compared to the imported ones and the final distribution. Each individual included in the boxplot corresponds to the weighted mean age of a stratum.

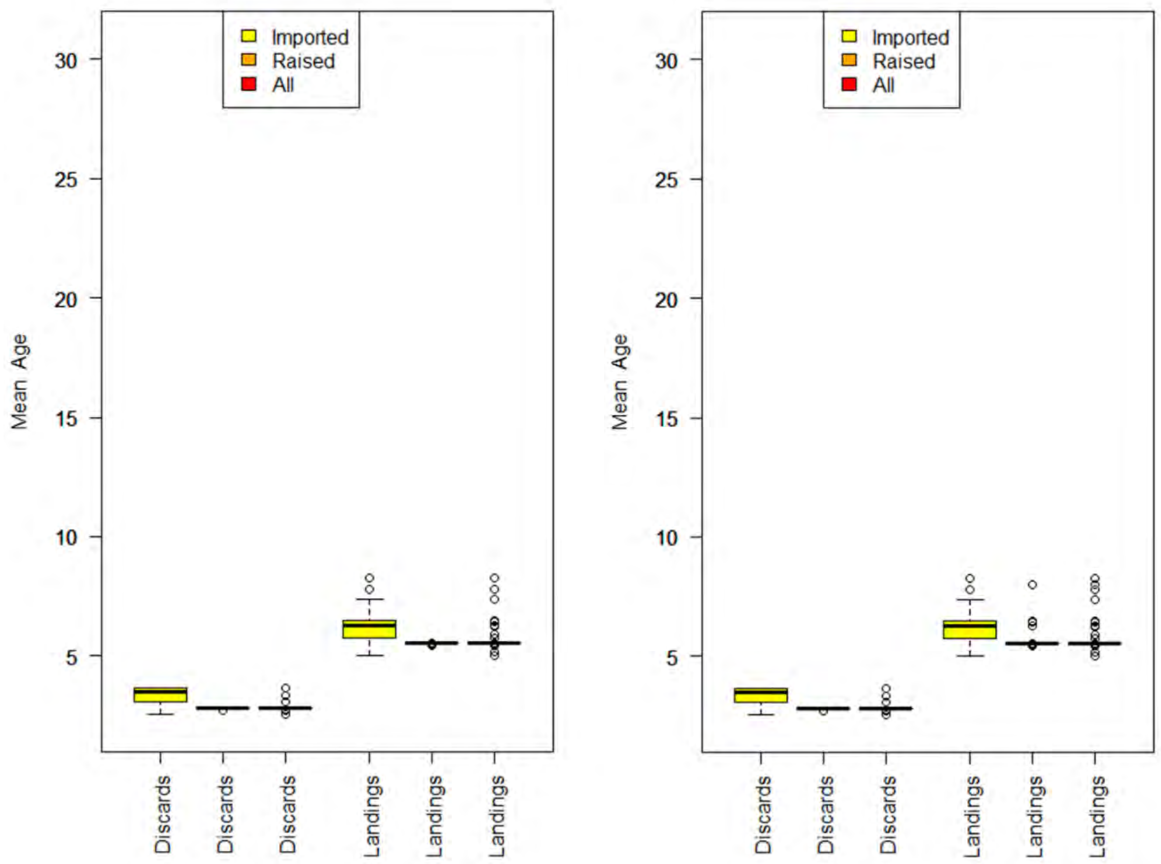


Figure 1: Mean Age per catch category (left: manual allocation; right: autoallocation)

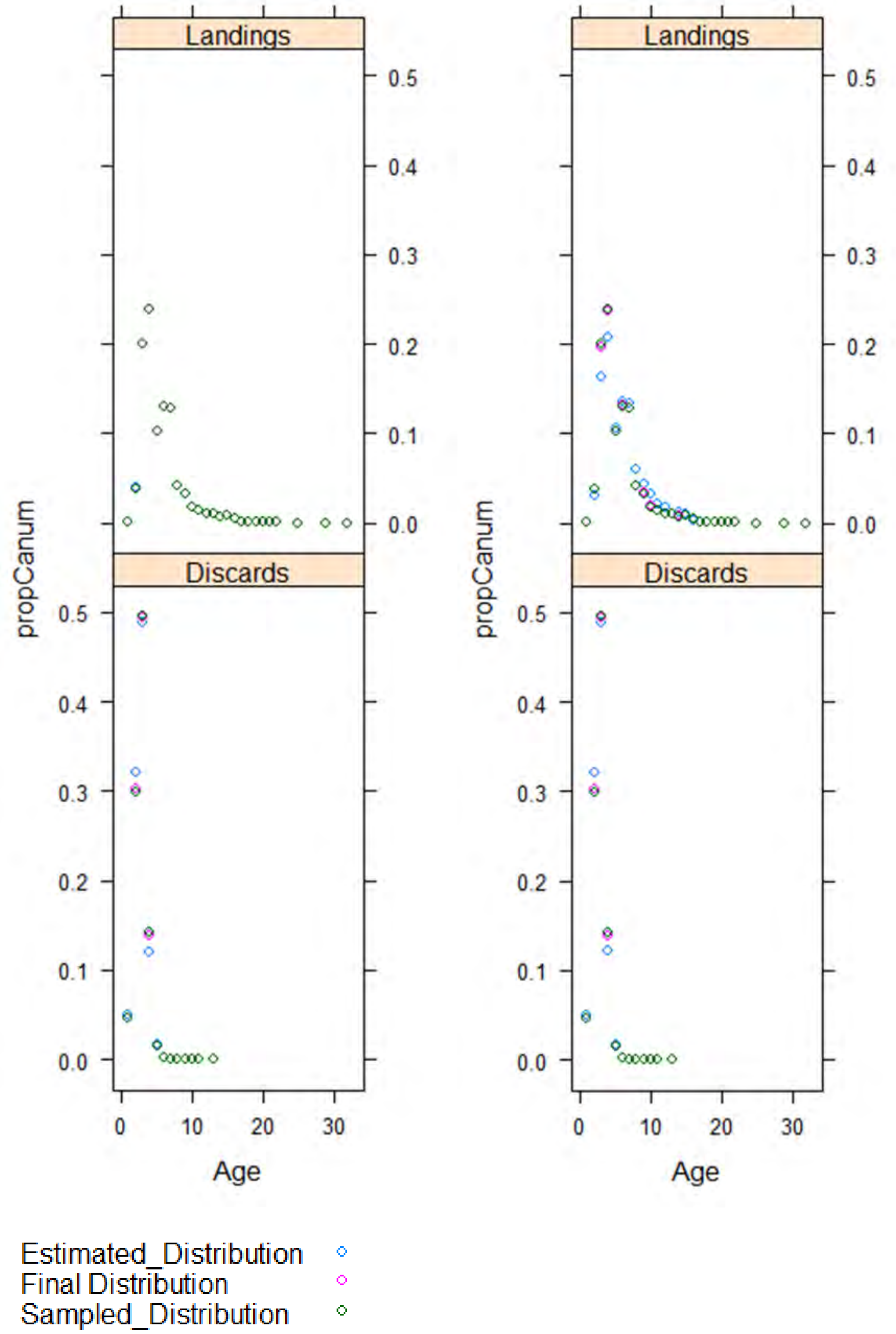


Figure 2: The percentage of each age for the sampled strata, estimated and the final age structure for the landing and discard fractions (left: manual allocation; right: autoallocation)

Impact of the raising on the mean weight

The CatchAndSampleData also provide the weight at age per stratum for the Sampled/Estimated strata. One should also check the sampled/estimated and resulting weight at age.

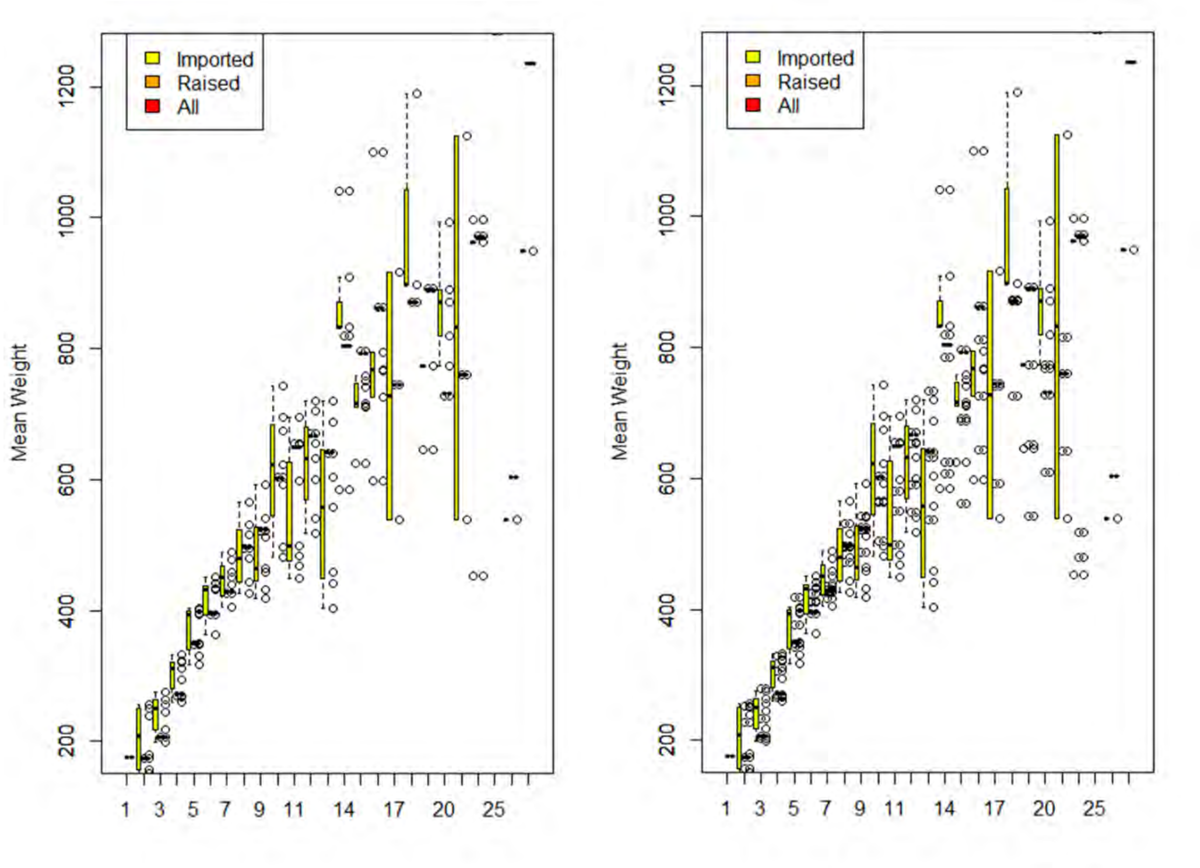


Figure 3a: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.g (left: manual allocation; right: autoallocation)

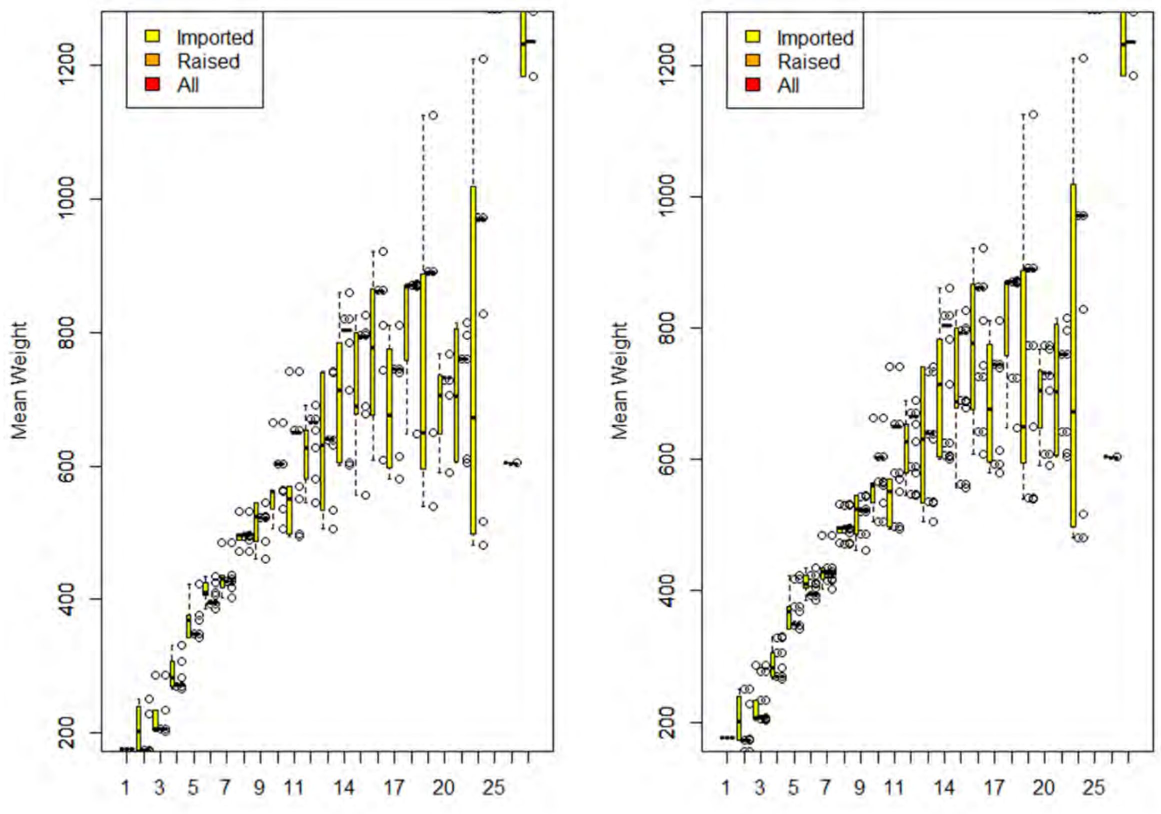


Figure 3b: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.f (left: manual allocation; right: autoallocation)

Table 3a: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for manual allocation Table continues below

Country	Fleet	CatchCategory	WECA
France	OTB_DEF_100-119_0_0	Landings	287.3
France	OTB_DEF_100-119_0_0	Landings	330.6
France	OTB_DEF_100-119_0_0	Landings	423.1
France	OTB_DEF_100-119_0_0	Landings	532
France	OTB_DEF_100-119_0_0	Landings	579.8
France	OTB_DEF_100-119_0_0	Landings	742.1
France	OTB_DEF_100-119_0_0	Landings	604
France	OTB_DEF_100-119_0_0	Landings	331.8
France	OTB_DEF_100-119_0_0	Landings	401.7
UK (England)	GNS_DEF_all_0_0_all	Landings	251.4
UK (England)	GNS_DEF_all_0_0_all	Landings	306.1
UK (England)	GNS_DEF_all_0_0_all	Landings	424.3
UK (England)	GNS_DEF_all_0_0_all	Landings	472.5
UK (England)	GNS_DEF_all_0_0_all	Landings	486.8
UK (England)	GNS_DEF_all_0_0_all	Landings	505.2

UK (England)	GNS_DEF_all_0_0_all	Landings	498.8
UK (England)	GNS_DEF_all_0_0_all	Landings	545.6
UK (England)	GNS_DEF_all_0_0_all	Landings	534.1
UK (England)	GNS_DEF_all_0_0_all	Landings	601.3
UK (England)	GNS_DEF_all_0_0_all	Landings	556.8
UK (England)	GNS_DEF_all_0_0_all	Landings	608.9
UK (England)	GNS_DEF_all_0_0_all	Landings	580.5
UK (England)	GNS_DEF_all_0_0_all	Landings	648.1
UK (England)	GNS_DEF_all_0_0_all	Landings	540
UK (England)	GNS_DEF_all_0_0_all	Landings	590.6
UK (England)	GNS_DEF_all_0_0_all	Landings	609.6
UK (England)	GNS_DEF_all_0_0_all	Landings	480.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	228.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	650.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	517
UK (England)	GNS_DEF_all_0_0_all	Landings	256.5
UK (England)	GNS_DEF_all_0_0_all	Landings	443.5
UK (England)	GNS_DEF_all_0_0_all	Landings	497.5
UK (England)	GNS_DEF_all_0_0_all	Landings	484
UK (England)	GNS_DEF_all_0_0_all	Landings	1040
UK (England)	GNS_DEF_all_0_0_all	Landings	1101
UK (England)	GNS_DEF_all_0_0_all	Landings	916.9
UK (England)	GNS_DEF_all_0_0_all	Landings	1189
UK (England)	GNS_DEF_all_0_0_all	Landings	645.4
UK (England)	GNS_DEF_all_0_0_all	Landings	993.2
UK (England)	GNS_DEF_all_0_0_all	Landings	1124
UK (England)	GNS_DEF_all_0_0_all	Landings	452.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	434.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	484.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	461.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	534.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	493.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	506.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	613.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	604.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	604.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1184
UK (England)	TBB_DEF_70-99_0_0_all	Landings	442.5

UK (England)	TBB_DEF_70-99_0_0_all	Landings	418.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	480.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	448.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	540.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	458.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	584.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	624.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	598.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	537.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	539.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	539.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	948.2
Belgium	TBB_DEF_70-99_0_0_all	Landings	664
Belgium	TBB_DEF_70-99_0_0_all	Landings	740.7
Belgium	TBB_DEF_70-99_0_0_all	Landings	1126
Belgium	TBB_DEF_70-99_0_0_all	Landings	1281
Ireland	OTB_CRU_70-99_1_110_all	Landings	425.3
Ireland	OTB_CRU_70-99_1_110_all	Landings	431.8
Ireland	OTB_CRU_70-99_1_110_all	Landings	468.1
Ireland	OTB_CRU_70-99_1_110_all	Landings	440.4
Ireland	OTB_DEF_100-119_0_0_all	Landings	264.5
Ireland	OTB_DEF_100-119_0_0_all	Landings	322.4
Ireland	OTB_DEF_100-119_0_0_all	Landings	394.7
Ireland	OTB_DEF_100-119_0_0_all	Landings	434.2
Ireland	OTB_DEF_100-119_0_0_all	Landings	497.7
Ireland	OTB_DEF_100-119_0_0_all	Landings	517
Ireland	OTB_DEF_100-119_0_0_all	Landings	402.9
Ireland	OTB_DEF_100-119_1_100_all	Landings	249.5
Ireland	OTB_DEF_100-119_1_100_all	Landings	275.2
Ireland	OTB_DEF_100-119_1_100_all	Landings	320.9
Ireland	OTB_DEF_100-119_1_100_all	Landings	402.9
Ireland	OTB_DEF_100-119_1_100_all	Landings	451
Ireland	OTB_DEF_100-119_1_100_all	Landings	489.6
Ireland	OTB_DEF_100-119_1_100_all	Landings	565
Ireland	OTB_DEF_100-119_1_100_all	Landings	591
Ireland	OTB_DEF_100-119_1_100_all	Landings	742.1
Ireland	OTB_DEF_100-119_1_100_all	Landings	889.2
Ireland	TBB_DEF_70-99_0_0_all	Landings	239.1

Ireland	TBB_DEF_70-99_0_0_all	Landings	256.1
Ireland	TBB_DEF_70-99_0_0_all	Landings	394.2
Ireland	TBB_DEF_70-99_0_0_all	Landings	441.8
Ireland	TBB_DEF_70-99_0_0_all	Landings	477.5

AverageWtSize	AgeOrLength	Area
208.3	3	27.7.f
272.7	4	27.7.f
351.1	5	27.7.f
496.1	8	27.7.f
661.2	12	27.7.f
639.6	13	27.7.f
795.4	14	27.7.f
273.8	4	27.7.g
351.1	5	27.7.g
176	2	27.7.f
272.7	4	27.7.f
396.2	6	27.7.f
496.1	8	27.7.f
521.5	9	27.7.f
598.5	10	27.7.f
641.6	11	27.7.f
661.2	12	27.7.f
639.6	13	27.7.f
795.4	14	27.7.f
784.8	15	27.7.f
853.9	16	27.7.f
740.2	17	27.7.f
865.8	18	27.7.f
881.6	19	27.7.f
729.1	20	27.7.f
755.9	21	27.7.f
952.8	22	27.7.f
176	2	27.7.f
881.6	19	27.7.f
952.8	22	27.7.f
176.2	2	27.7.g
495	8	27.7.g
603.6	10	27.7.g

639	11	27.7.g
808.3	14	27.7.g
855.1	16	27.7.g
744.6	17	27.7.g
877	18	27.7.g
877.9	19	27.7.g
742.9	20	27.7.g
762.8	21	27.7.g
962.6	22	27.7.g
396.2	6	27.7.f
427.6	7	27.7.f
521.5	9	27.7.f
598.5	10	27.7.f
641.6	11	27.7.f
639.6	13	27.7.f
740.2	17	27.7.f
755.9	21	27.7.f
602.8	29	27.7.f
1236	32	27.7.f
495	8	27.7.g
518.8	9	27.7.g
603.6	10	27.7.g
639	11	27.7.g
661.4	12	27.7.g
631.2	13	27.7.g
808.3	14	27.7.g
785.2	15	27.7.g
855.1	16	27.7.g
744.6	17	27.7.g
762.8	21	27.7.g
601.7	29	27.7.g
1231	32	27.7.g
598.5	10	27.7.f
639.6	13	27.7.f
881.6	19	27.7.f
1236	32	27.7.f
495	8	27.7.g
518.8	9	27.7.g

639	11	27.7.g
631.2	13	27.7.g
209.6	3	27.7.g
273.8	4	27.7.g
351.1	5	27.7.g
396.7	6	27.7.g
639	11	27.7.g
661.4	12	27.7.g
631.2	13	27.7.g
176.2	2	27.7.g
209.6	3	27.7.g
273.8	4	27.7.g
351.1	5	27.7.g
396.7	6	27.7.g
429	7	27.7.g
495	8	27.7.g
518.8	9	27.7.g
603.6	10	27.7.g
742.9	20	27.7.g
176.2	2	27.7.g
209.6	3	27.7.g
351.1	5	27.7.g
396.7	6	27.7.g
429	7	27.7.g

Table 3b: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for autoallocation Table continues below

Country	Fleet	CatchCategory	WECA
UK (England)	TBB_DEF_70-99_0_0_all	Landings	517
France	OTB_DEF_100-119_0_0	Landings	278
France	OTB_DEF_100-119_0_0	Landings	417.7
UK (England)	GNS_DEF_all_0_0_all	Landings	562.2
UK (England)	GNS_DEF_all_0_0_all	Landings	542.5
UK (England)	GNS_DEF_all_0_0_all	Landings	479.9
France	OTB_DEF_100-119_0_0	Landings	278
France	OTB_DEF_100-119_0_0	Landings	417.7
UK (England)	GNS_DEF_all_0_0_all	Landings	562.2
UK (England)	GNS_DEF_all_0_0_all	Landings	542.5

UK (England)	GNS_DEF_all_0_0_all	Landings	479.9
France	OTB_DEF_100-119_0_0	Landings	278
France	OTB_DEF_100-119_0_0	Landings	417.7
UK (England)	GNS_DEF_all_0_0_all	Landings	562.2
UK (England)	GNS_DEF_all_0_0_all	Landings	542.5
UK (England)	GNS_DEF_all_0_0_all	Landings	479.9
France	OTB_DEF_100-119_0_0	Landings	287.3
France	OTB_DEF_100-119_0_0	Landings	423.1
UK (England)	GNS_DEF_all_0_0_all	Landings	608.9
UK (England)	GNS_DEF_all_0_0_all	Landings	648.1
UK (England)	GNS_DEF_all_0_0_all	Landings	590.6
UK (England)	GNS_DEF_all_0_0_all	Landings	609.6
UK (England)	GNS_DEF_all_0_0_all	Landings	256.5
UK (England)	GNS_DEF_all_0_0_all	Landings	1040
UK (England)	GNS_DEF_all_0_0_all	Landings	1101
UK (England)	GNS_DEF_all_0_0_all	Landings	916.9
UK (England)	GNS_DEF_all_0_0_all	Landings	1189
UK (England)	GNS_DEF_all_0_0_all	Landings	993.2
UK (England)	GNS_DEF_all_0_0_all	Landings	1124
UK (England)	GNS_DEF_all_0_0_all	Landings	452.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	434.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	484.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	461.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	604.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	604.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1184
UK (England)	TBB_DEF_70-99_0_0_all	Landings	418.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	480.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	448.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	458.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	598.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	537.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	539.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	539.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	948.2
Belgium	TBB_DEF_70-99_0_0_all	Landings	1281
Ireland	OTB_CRU_70-99_1_110_all	Landings	425.3
Ireland	OTB_CRU_70-99_1_110_all	Landings	431.8

Ireland	OTB_CRU_70-99_1_110_all	Landings	440.4
Ireland	OTB_DEF_100-119_0_0_all	Landings	517
Ireland	OTB_DEF_100-119_0_0_all	Landings	402.9
Ireland	OTB_DEF_100-119_1_100_all	Landings	451
Ireland	OTB_DEF_100-119_1_100_all	Landings	489.6
Ireland	OTB_DEF_100-119_1_100_all	Landings	565
Ireland	OTB_DEF_100-119_1_100_all	Landings	591
Ireland	OTB_DEF_100-119_1_100_all	Landings	742.1
Ireland	TBB_DEF_70-99_0_0_all	Landings	441.8
Ireland	TBB_DEF_70-99_0_0_all	Landings	477.5

AverageWtSize	AgeOrLength	Area
930.1	22	27.7.g
214.2	3	27.7.g
355.5	5	27.7.g
768.1	15	27.7.g
852	19	27.7.g
930.1	22	27.7.g
214.2	3	27.7.g
355.5	5	27.7.g
768.1	15	27.7.g
852	19	27.7.g
930.1	22	27.7.g
214.2	3	27.7.g
355.5	5	27.7.g
768.1	15	27.7.g
852	19	27.7.g
930.1	22	27.7.g
214.6	3	27.7.f
357.1	5	27.7.f
831.2	16	27.7.f
855.3	18	27.7.f
723.9	20	27.7.f
747.5	21	27.7.f
179.9	2	27.7.g
790.4	14	27.7.g
837.7	16	27.7.g
736.5	17	27.7.g
870	18	27.7.g

739.6	20	27.7.g
757.7	21	27.7.g
930.1	22	27.7.g
399.2	6	27.7.f
427.5	7	27.7.f
520.5	9	27.7.f
747.5	21	27.7.f
602.8	29	27.7.f
1235	32	27.7.f
518.1	9	27.7.g
596.8	10	27.7.g
627.2	11	27.7.g
630.5	13	27.7.g
837.7	16	27.7.g
736.5	17	27.7.g
757.7	21	27.7.g
601.5	29	27.7.g
1230	32	27.7.g
1235	32	27.7.f
495.4	8	27.7.g
518.1	9	27.7.g
630.5	13	27.7.g
652.3	12	27.7.g
630.5	13	27.7.g
399.1	6	27.7.g
428.9	7	27.7.g
495.4	8	27.7.g
518.1	9	27.7.g
596.8	10	27.7.g
399.1	6	27.7.g
428.9	7	27.7.g

InterCatch output for 2015

This document uses Table 2 from CatchAndSampleDataTables.txt from the InterCatch outputs to describe the raising procedures that were made.

In the following tables, CATON=WECA*CANUM/1000000 (in tonnes).

Raised discards

In InterCatch, the first step consists in raising the discards volumes for strats with landings and no discards associated. These discards are called in the following table 'Raised_Discards'. The data called 'Imported_Data' are landings or discards volumes imported into InterCatch with or without age structure.

The proportion of Landings with Discards associated (same strata) is **77 percent**

The volumes (and associated proportion) of landings and discards imported (Imported_Data) or raised (Raised_Discards) are described in the following table.

Table 1: Summary of the imported/Raised data

CatchCategory	RaisedOrImported	CATON	perc
Discards	Raised_Discards	3831	23
Discards	Imported_Data	12884	77
Landings	Imported_Data	830624	100

Age distribution

For the imported landings/discards and the raised discards without age distribution, the age distribution is then computed using the defined allocation scheme. Sampled_distribution means that the data (landings or discards) were input with age distribution. Estimated_distribution means that the inputed/raised volumes were estimated using the allocation scheme.

Table 2: Summary of the imported/Raised/SampledOrEstimated data

CatchCategory	RaisedOrImported	SampledOrEstimated	CATON	perc
Landings	Imported_Data	Sampled_Distribution	728.6	88
Landings	Imported_Data	Estimated_Distribution	102.1	12
Discards	Imported_Data	Sampled_Distribution	12.89	77
Discards	Raised_Discards	Estimated_Distribution	3.798	23

Impact of the raising on the age structure

Once the samples imported or raised are identified, it is possible to check the impact of the allocation scheme on the mean age/length of the final age/length distribution of the stock. The following figures compare the mean age (computed as the weighted mean of the age per stratum ("CatchCategory",'RaisedOrImported',"SampledOrEstimated","Country","Area","Season","Fleet","Se x")) of the estimated strata compared to the imported ones and the final distribution. Each individual included in the boxplot corresponds to the weighted mean age of a stratum.

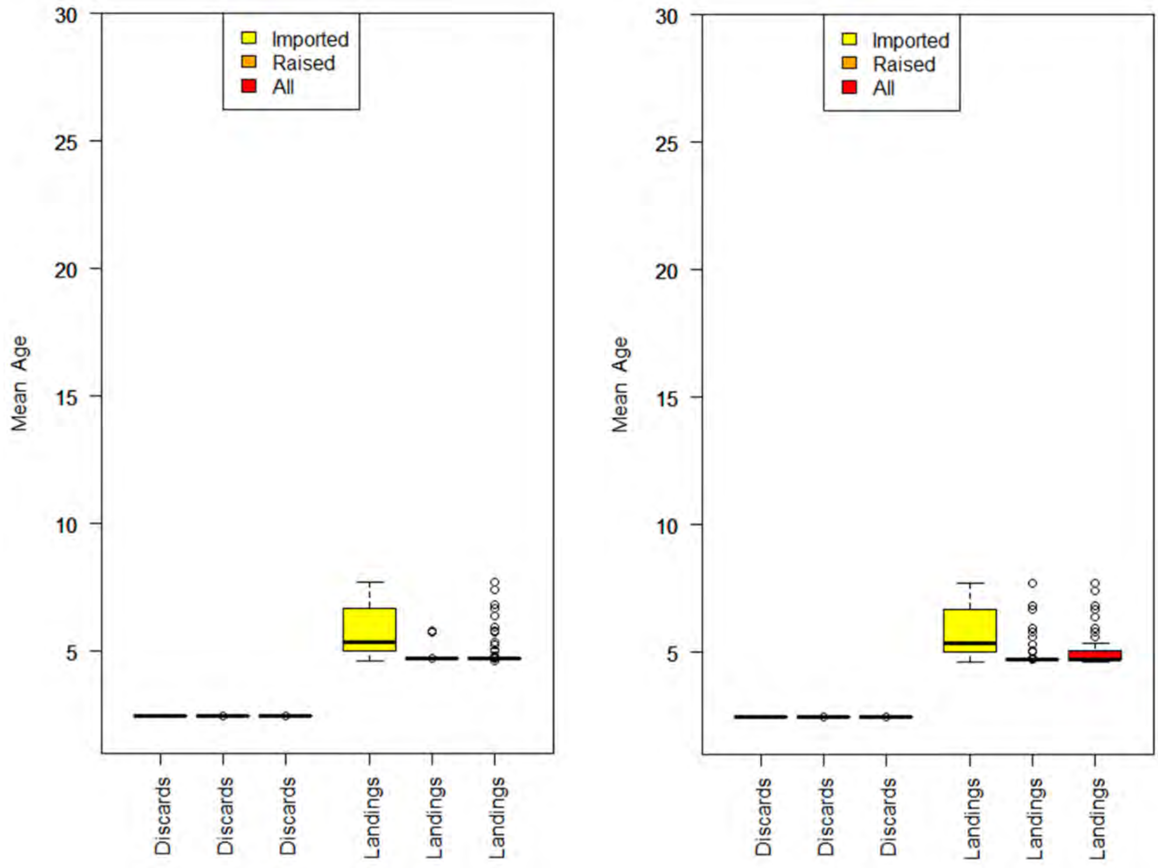


Figure 1: Mean Age per catch category (left: manual allocation; right: autoallocation)

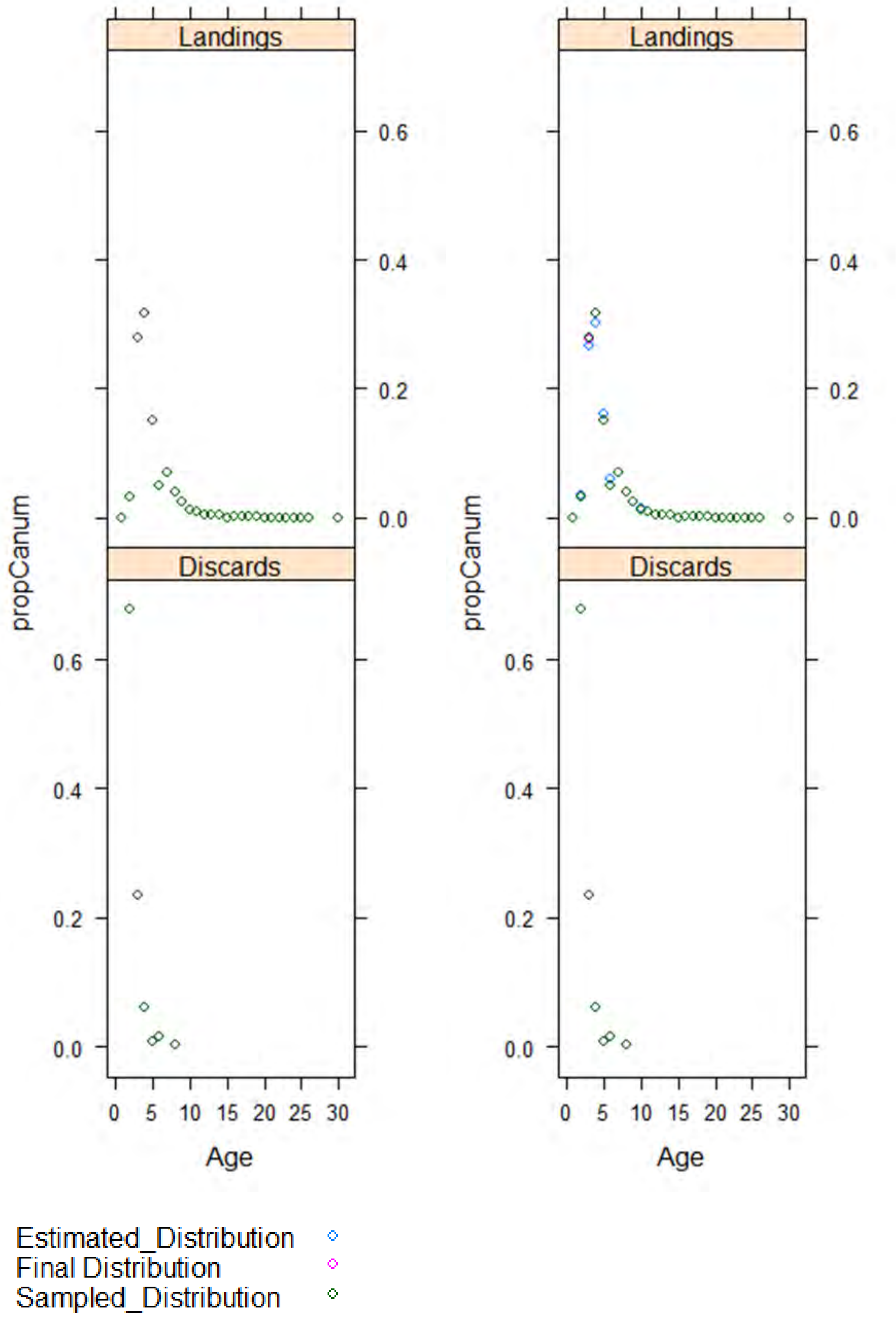


Figure 2: The percentage of each age for the sampled strata, estimated and the final age structure for the landing and discard fractions (left: manual allocation; right: autoallocation)

Impact of the raising on the mean weight

The CatchAndSampleData also provide the weight at age per stratum for the Sampled/Estimated strata. One should also check the sampled/estimated and resulting weight at age.

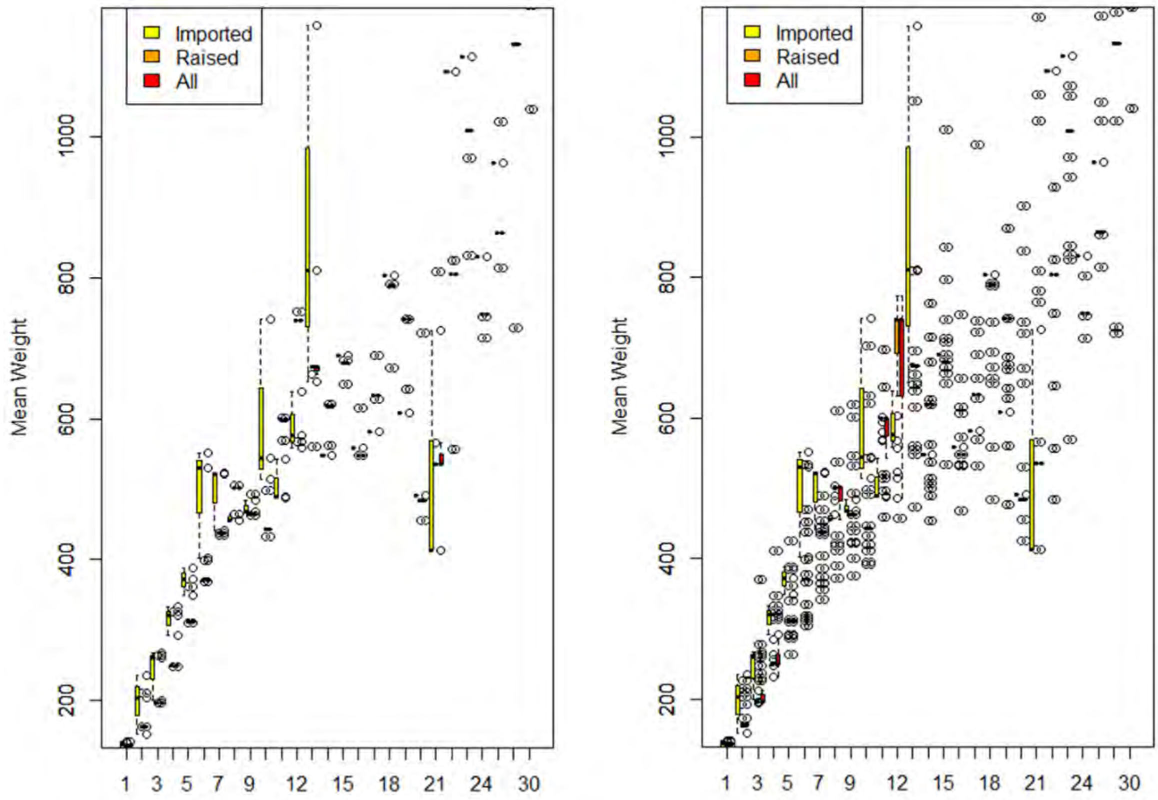


Figure 3a: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.g (left: manual allocation; right: autoallocation)

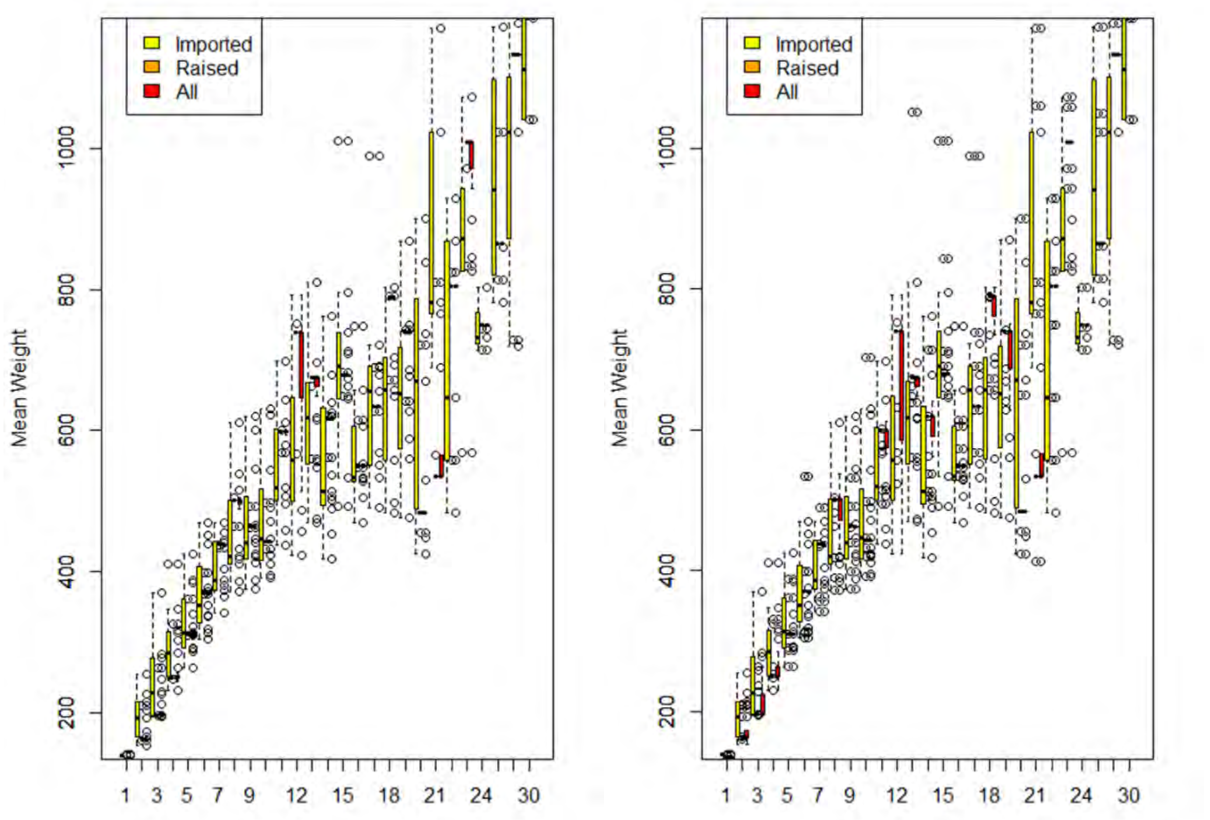


Figure 3b: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.f (left: manual allocation; right: autoallocation)

Table 3a: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for manual allocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
UK (England)	TBB_DEF_70-99_0_0_all	Landings	649.3	678.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	649.3	678.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	649.3	678.1
UK (England)	GNS_DEF_all_0_0_all	Landings	370.7	212.7
UK (England)	GNS_DEF_all_0_0_all	Landings	411.2	265.8
UK (England)	GNS_DEF_all_0_0_all	Landings	425.8	319.4
France	OTB_DEF_100-119_0_0	Landings	619.7	466.7
France	OTB_DEF_100-119_0_0	Landings	621.3	455.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	341.6	429.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	802.8	745.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1093	767
UK (England)	TBB_DEF_70-99_0_0_all	Landings	830.7	744.2
Ireland	OTB_DEF_100-119_0_0_all	Landings	551.3	382.4
Ireland	OTB_DEF_100-119_0_0_all	Landings	523.8	440.9
Ireland	OTB_DEF_100-119_0_0_all	Landings	741.9	460.9

Ireland	OTB_DEF_100-119_0_0_all	Landings	487.2	588.7
Ireland	OTB_DEF_100-119_0_0_all	Landings	1158	665.5
Ireland	TBB_DEF_70-99_0_0_all	Landings	530.4	382.4
Ireland	TBB_DEF_70-99_0_0_all	Landings	521	440.9
Ireland	TBB_DEF_70-99_0_0_all	Landings	488.9	588.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1010	682.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	988.5	642.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	900.7	531.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1170	605.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1171	887
UK (England)	TBB_DEF_70-99_0_0_all	Landings	483.3	750.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	476.3	716.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	568.6	968.9
France	OTB_DEF_100-119_0_0	Landings	469.8	372.7
France	OTB_DEF_100-119_0_0	Landings	610.7	487.7
France	OTB_DEF_100-119_0_0	Landings	600.5	466.7
France	OTB_DEF_100-119_0_0	Landings	630.8	455.2
UK (England)	GNS_DEF_all_0_0_all	Landings	747.1	558.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	255.4	173.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	437.3	585.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	470	650.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	418.4	599.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	498	750.5

AgeOrLength	Area
15	27.7.g
15	27.7.g
15	27.7.g
3	27.7.f
4	27.7.f
5	27.7.f
9	27.7.f
10	27.7.f
7	27.7.f
24	27.7.f
22	27.7.g
24	27.7.g
6	27.7.g
7	27.7.g

10	27.7.g
11	27.7.g
13	27.7.g
6	27.7.g
7	27.7.g
11	27.7.g
15	27.7.f
17	27.7.f
20	27.7.f
21	27.7.f
25	27.7.f
18	27.7.f
19	27.7.f
23	27.7.f
6	27.7.f
8	27.7.f
9	27.7.f
10	27.7.f
16	27.7.f
2	27.7.f
11	27.7.f
13	27.7.f
14	27.7.f
18	27.7.f

Table 3b: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for autoallocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
France	OTB_DEF_100-119_0_0	Landings	534	372.9
France	OTB_DEF_100-119_0_0	Landings	703.3	460.8
France	OTB_DEF_100-119_0_0	Landings	1050	671.7
France	OTB_DEF_100-119_0_0	Landings	703.3	469.3
France	OTB_DEF_100-119_0_0	Landings	1050	689.1
UK (England)	GNS_DEF_all_0_0_all	Landings	370.7	212.2
UK (England)	GNS_DEF_all_0_0_all	Landings	411.2	266.1
UK (England)	GNS_DEF_all_0_0_all	Landings	425.8	320.5
UK (England)	GNS_DEF_all_0_0_all	Landings	720.2	1112
France	OTB_DEF_100-119_0_0	Landings	619.7	466.1

UK (England)	GNS_DEF_all_0_0_all	Landings	728.4	1110
UK (England)	GNS_DEF_all_0_0_all	Landings	1040	1175
UK (England)	GNS_DEF_all_0_0_all	Landings	728.4	1112
UK (England)	GNS_DEF_all_0_0_all	Landings	1040	1176
France	OTB_DEF_100-119_0_0	Landings	534	372.9
France	OTB_DEF_100-119_0_0	Landings	703.3	460.8
France	OTB_DEF_100-119_0_0	Landings	1050	671.7
France	OTB_DEF_70-99_0_0	Landings	1010	697.4
France	OTB_DEF_70-99_0_0	Landings	988.5	650.3
France	OTB_DEF_70-99_0_0	Landings	900.7	533.1
France	OTB_DEF_70-99_0_0	Landings	1171	893.3
France	OTB_DEF_100-119_0_0	Landings	703.3	469.3
France	OTB_DEF_100-119_0_0	Landings	1050	689.1
UK (England)	GNS_DEF_all_0_0_all	Landings	558.8	764.9
UK (England)	GNS_DEF_all_0_0_all	Landings	1040	1176
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1010	693.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	988.5	644.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	900.7	519.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1170	595.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1171	887.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	483.3	764.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	476.3	718.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	483.3	793
UK (England)	TBB_DEF_70-99_0_0_all	Landings	568.6	988.8
France	OTB_DEF_100-119_0_0	Landings	600.5	466.1
UK (England)	GNS_DEF_all_0_0_all	Landings	747.1	556.1
UK (England)	GNS_DEF_all_0_0_all	Landings	837.5	519.6
UK (England)	GNS_DEF_all_0_0_all	Landings	370.7	213.4
UK (England)	GNS_DEF_all_0_0_all	Landings	411.2	265
UK (England)	GNS_DEF_all_0_0_all	Landings	425.8	317
UK (England)	GNS_DEF_all_0_0_all	Landings	720.2	1110
France	OTB_DEF_100-119_0_0	Landings	619.7	462.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1093	793
UK (England)	TBB_DEF_70-99_0_0_all	Landings	830.7	754.3
Ireland	OTB_DEF_100-119_0_0_all	Landings	551.3	381.9
Ireland	OTB_DEF_100-119_0_0_all	Landings	741.9	469.3
Ireland	OTB_DEF_100-119_0_0_all	Landings	1158	689.1
UK (England)	GNS_DEF_all_0_0_all	Landings	1040	1175

UK (England)	OTB_DEF_70-99_0_0_all	Landings	1010	697.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	988.5	650.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	900.7	533.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1171	893.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	483.3	751.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	476.3	714.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	483.3	781.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	568.6	982.5
France	OTB_DEF_100-119_0_0	Landings	600.5	462.7
UK (England)	GNS_DEF_all_0_0_all	Landings	747.1	556.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	255.4	174.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	437.3	579.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	498	751.3

AgeOrLength	Area
6	27.7.f
10	27.7.f
13	27.7.f
10	27.7.g
13	27.7.g
3	27.7.g
4	27.7.g
5	27.7.g
26	27.7.g
9	27.7.g
26	27.7.f
30	27.7.f
26	27.7.g
30	27.7.g
6	27.7.f
10	27.7.f
13	27.7.f
15	27.7.f
17	27.7.f
20	27.7.f
25	27.7.f
10	27.7.g
13	27.7.g
18	27.7.g

30	27.7.g
15	27.7.g
17	27.7.g
20	27.7.g
21	27.7.g
25	27.7.g
18	27.7.g
19	27.7.g
22	27.7.g
23	27.7.g
9	27.7.g
16	27.7.g
20	27.7.g
3	27.7.f
4	27.7.f
5	27.7.f
26	27.7.f
9	27.7.f
22	27.7.g
24	27.7.g
6	27.7.g
10	27.7.g
13	27.7.g
30	27.7.f
15	27.7.f
17	27.7.f
20	27.7.f
25	27.7.f
18	27.7.f
19	27.7.f
22	27.7.f
23	27.7.f
9	27.7.f
16	27.7.f
2	27.7.f
11	27.7.f
18	27.7.f

InterCatch output for 2016

This document uses Table 2 from CatchAndSampleDataTables.txt from the InterCatch outputs to describe the raising procedures that were made.

In the following tables, CATON=WECA*CANUM/1000000 (in tonnes).

Raised discards

In InterCatch, the first step consists in raising the discards volumes for strats with landings and no discards associated. These discards are called in the following table 'Raised_Discards'. The data called 'Imported_Data' are landings or discards volumes imported into InterCatch with or without age structure.

The proportion of Landings with Discards associated (same strata) is **81 percent**

The volumes (and associated proportion) of landings and discards imported (Imported_Data) or raised (Raised_Discards) are described in the following table.

Table 1: Summary of the imported/Raised data

CatchCategory	RaisedOrImported	CATON	perc
Discards	Raised_Discards	6081	19
Discards	Imported_Data	25132	81
Landings	Imported_Data	832110	100

Age distribution

For the imported landings/discards and the raised discards without age distribution, the age distribution is then computed using the defined allocation scheme. Sampled_distribution means that the data (landings or discards) were input with age distribution. Estimated_distribution means that the inputed/raised volumes were estimated using the allocation scheme.

Table 2: Summary of the imported/Raised/SampledOrEstimated data

CatchCategory	RaisedOrImported	SampledOrEstimated	CATON	perc
Landings	Imported_Data	Sampled_Distribution	713	86
Landings	Imported_Data	Estimated_Distribution	118.2	14
Discards	Imported_Data	Sampled_Distribution	21.14	68
Discards	Raised_Discards	Estimated_Distribution	6.06	19
Discards	Imported_Data	Estimated_Distribution	4.042	13

Impact of the raising on the age structure

Once the samples imported or raised are identified, it is possible to check the impact of the allocation scheme on the mean age/length of the final age/length distribution of the stock. The following figures compare the mean age (computed as the weighted mean of the age per stratum ("CatchCategory",'RaisedOrImported',"SampledOrEstimated","Country","Area","Season","Fleet","Se x")) of the estimated strata compared to the imported ones and the final distribution. Each individual included in the boxplot corresponds to the weighted mean age of a stratum.

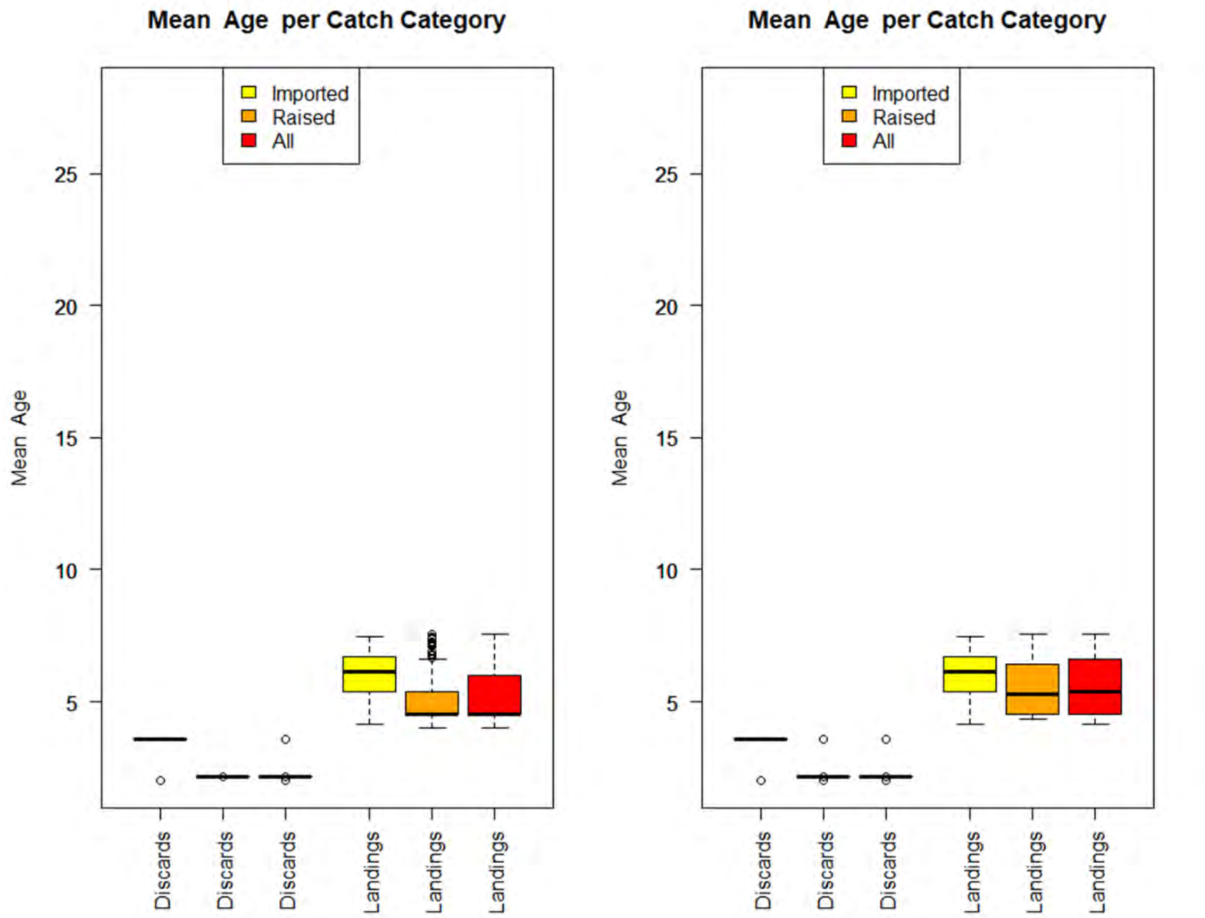


Figure 1: Mean Age per catch category (left: manual allocation; right: autoallocation)

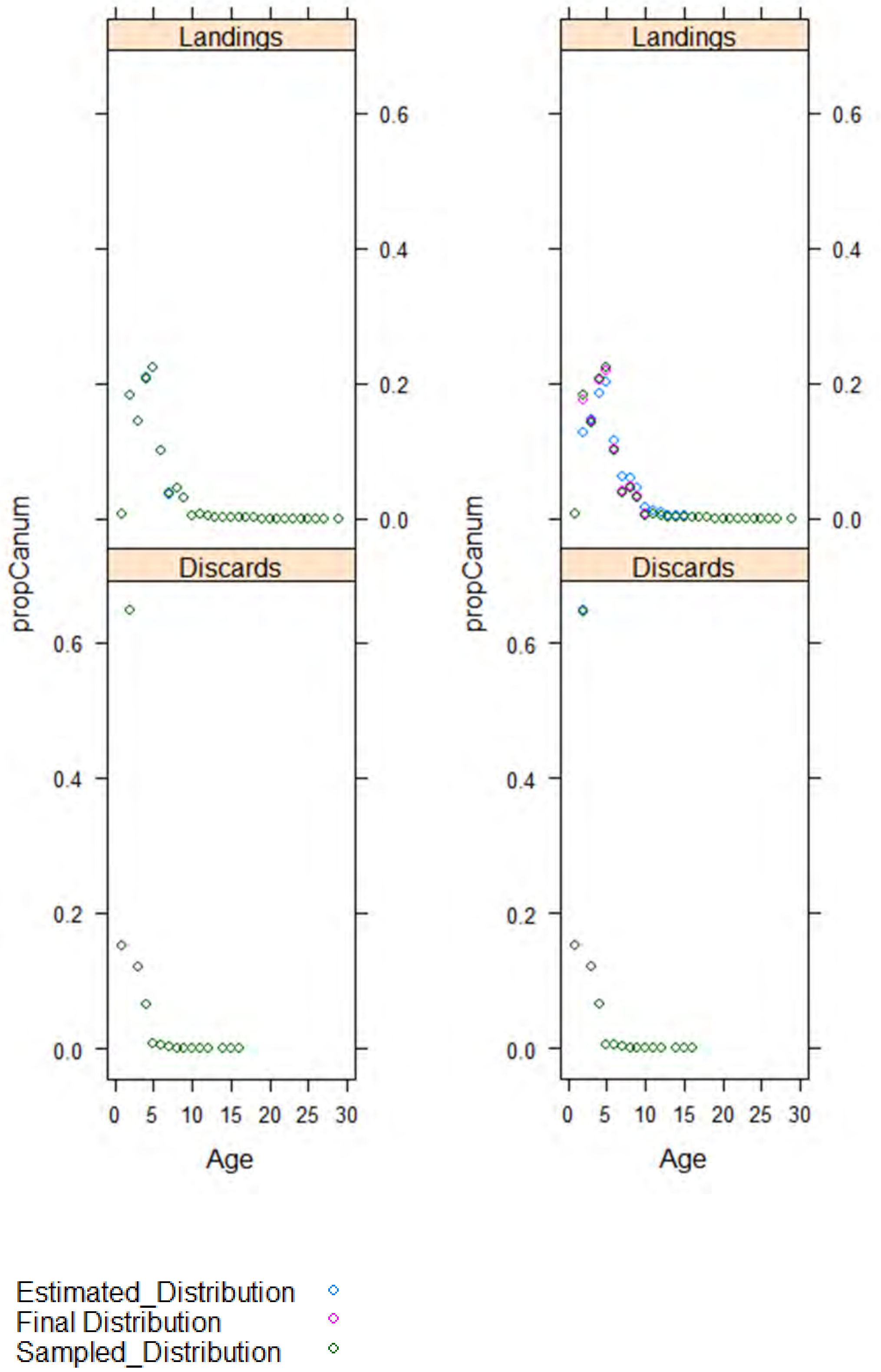


Figure 2: The percentage of each age for the sampled strata, estimated and the final age structure for the landing and discard fractions (left: manual allocation; right: autoallocation)

Impact of the raising on the mean weight

The CatchAndSampleData also provide the weight at age per stratum for the Sampled/Estimated strata. One should also check the sampled/estimated and resulting weight at age.

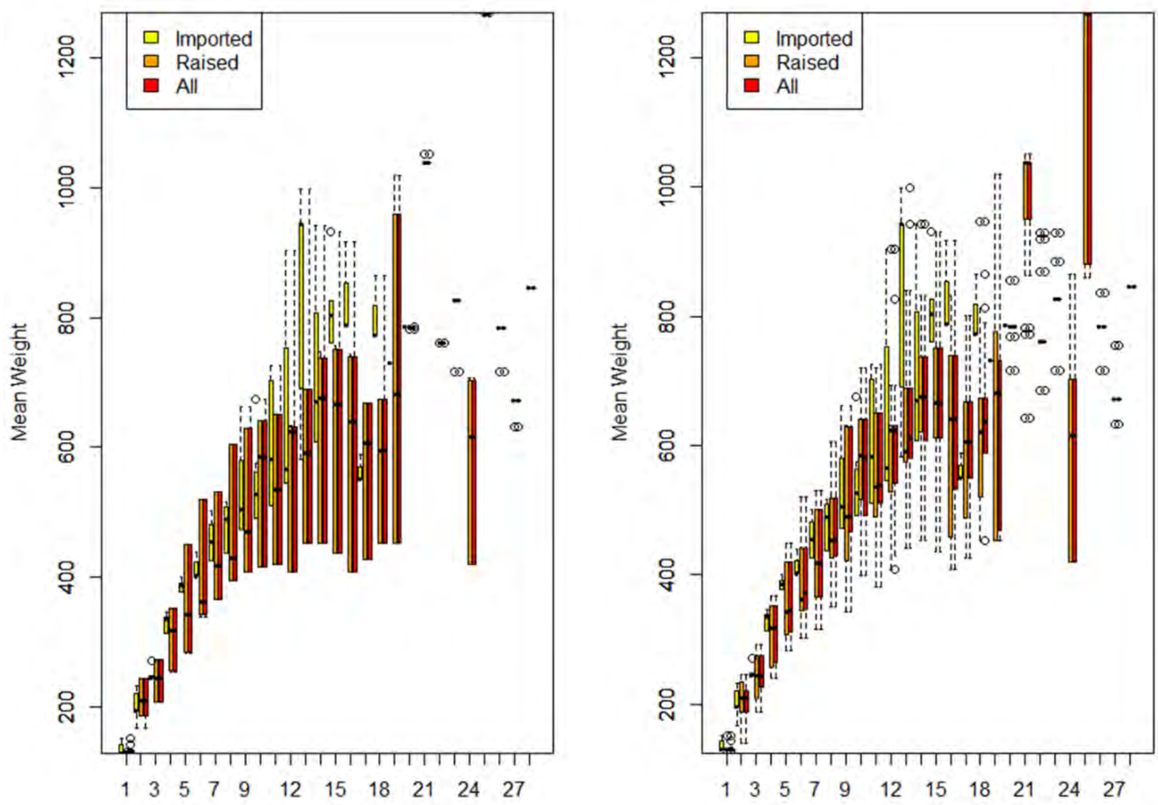


Figure 3a: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.g (left: manual allocation; right: autoallocation)

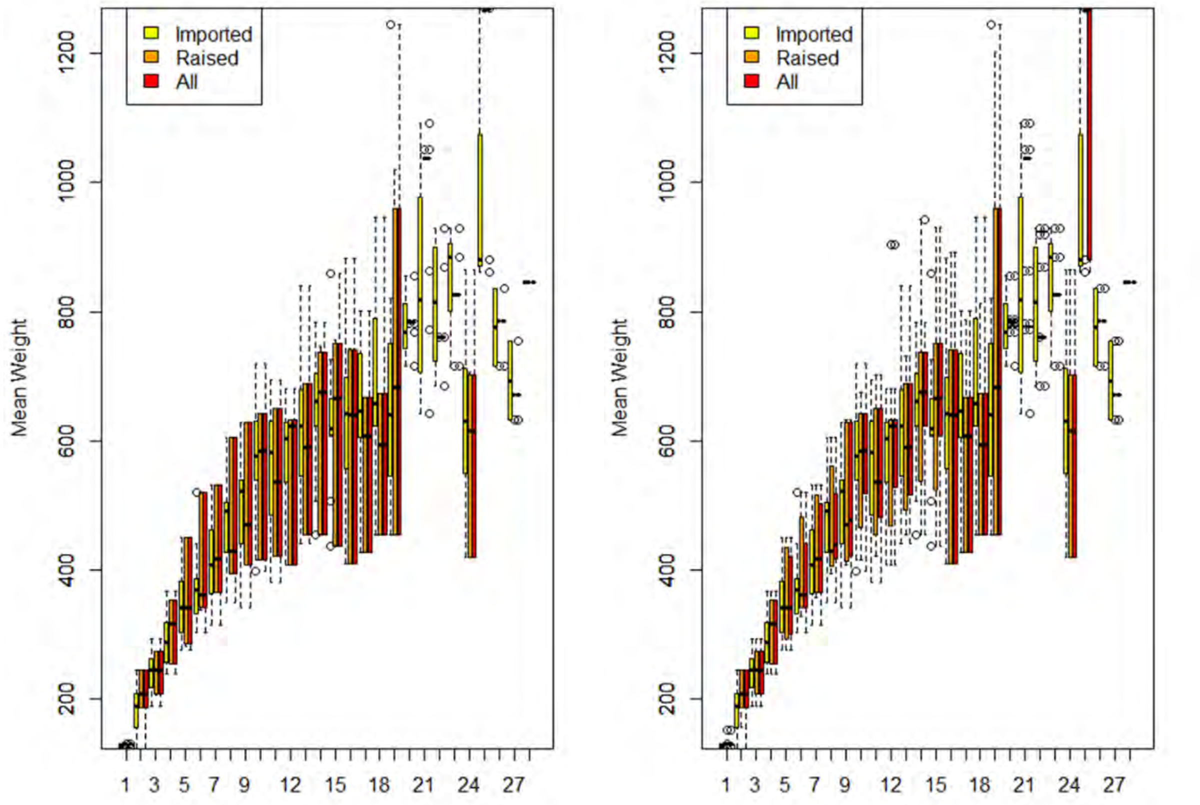


Figure 3b: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.f (left: manual allocation; right: autoallocation)

Table 3a: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for manual allocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1052	1039
UK (England)	TBB_DEF_70-99_0_0_all	Landings	760.6	760.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	716.5	817.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1269	1268
UK (England)	TBB_DEF_70-99_0_0_all	Landings	716.5	778.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	632.5	668
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1052	1039
UK (England)	TBB_DEF_70-99_0_0_all	Landings	760.6	760.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	716.5	817.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1269	1268
UK (England)	TBB_DEF_70-99_0_0_all	Landings	716.5	778.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	632.5	668
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1052	1039

UK (England)	TBB_DEF_70-99_0_0_all	Landings	760.6	760.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	716.5	817.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1269	1268
UK (England)	TBB_DEF_70-99_0_0_all	Landings	716.5	778.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	632.5	668
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1052	1039
UK (England)	TBB_DEF_70-99_0_0_all	Landings	760.6	760.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	716.5	817.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1269	1268
UK (England)	TBB_DEF_70-99_0_0_all	Landings	716.5	778.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	632.5	668
UK (England)	GNS_DEF_all_0_0_all	Landings	880.7	1251
UK (England)	TBB_DEF_70-99_0_0_all	Landings	947.2	583.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	855.1	783.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	771.6	1023
UK (England)	OTB_DEF_70-99_0_0_all	Landings	929.6	764.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	754.4	668
UK (England)	TBB_DEF_70-99_0_0_all	Landings	716.5	783.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	641.9	1023
Ireland	GNS_DEF_120-219_0_0_all	Landings	943.5	590.1
Ireland	GNS_DEF_120-219_0_0_all	Landings	786.6	783.7
Ireland	OTB_DEF_100-119_0_0_all	Landings	943.5	590.1
Ireland	OTB_DEF_100-119_0_0_all	Landings	786.6	783.7
Ireland	SSC_DEF_100-119_0_0_all	Landings	943.5	590.1
Ireland	SSC_DEF_100-119_0_0_all	Landings	786.6	783.7
Ireland	TBB_DEF_70-99_0_0_all	Landings	142.4	130.6
Ireland	TBB_DEF_70-99_0_0_all	Landings	998.7	590.1
Ireland	TBB_DEF_70-99_0_0_all	Landings	786.6	783.7
France	OTB_DEF_100-119_0_0	Landings	124.6	129.9
France	OTB_DEF_100-119_0_0	Landings	123.7	210.4
France	OTT_CRU_100-119_0_0	Landings	903.1	561.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	869.7	764.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	860.1	1251
France	OTT_DEF_100-119_0_0	Landings	151.3	130.6

AgeOrLength	Area
21	27.7.g
22	27.7.g
23	27.7.g

25	27.7.g
26	27.7.g
27	27.7.g
21	27.7.g
22	27.7.g
23	27.7.g
25	27.7.g
26	27.7.g
27	27.7.g
21	27.7.g
22	27.7.g
23	27.7.g
25	27.7.g
26	27.7.g
27	27.7.g
21	27.7.g
22	27.7.g
23	27.7.g
25	27.7.g
26	27.7.g
27	27.7.g
25	27.7.f
18	27.7.f
20	27.7.f
21	27.7.f
22	27.7.f
27	27.7.f
20	27.7.f
21	27.7.f
13	27.7.g
20	27.7.g
13	27.7.g
20	27.7.g
13	27.7.g
20	27.7.g
1	27.7.g
13	27.7.g
20	27.7.g

1	27.7.f
2	27.7.f
12	27.7.g
22	27.7.f
25	27.7.f
1	27.7.g

Table 3b: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for autoallocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
France	OTB_DEF_70-99_0_0	Landings	855.1	785.3
France	OTB_DEF_70-99_0_0	Landings	855.1	786.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	855.1	786.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	716.5	786.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	855.1	785.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	716.5	785.3
Ireland	TBB_DEF_70-99_0_0_all	Landings	998.7	620.8
France	OTB_DEF_100-119_0_0	Landings	123.7	207.3

AgeOrLength	Area
20	27.7.f
20	27.7.g
20	27.7.g
20	27.7.g
20	27.7.f
20	27.7.f
13	27.7.g
2	27.7.f

InterCatch output for 2017

This document uses Table 2 from CatchAndSampleDataTables.txt from the InterCatch outputs to describe the raising procedures that were made.

In the following tables, CATON=WECA*CANUM/1000000 (in tonnes).

Raised discards

In InterCatch, the first step consists in raising the discards volumes for strats with landings and no discards associated. These discards are called in the following table ‘Raised_Discards’. The data called ‘Imported_Data’ are landings or discards volumes imported into InterCatch with or without age structure.

The proportion of Landings with Discards associated (same strata) is **72 percent**

The volumes (and associated proportion) of landings and discards imported (Imported_Data) or raised (Raised_Discards) are described in the following table.

Table 1: Summary of the imported/Raised data

CatchCategory	RaisedOrImported	CATON	perc
Discards	Raised_Discards	12352	19
Discards	Imported_Data	53184	81
Landings	Imported_Data	777429	100

Age distribution

For the imported landings/discards and the raised discards without age distribution, the age distribution is then computed using the defined allocation scheme. Sampled_distribution means that the data (landings or discards) were input with age distribution. Estimated_distribution means that the inputed/raised volumes were estimated using the allocation scheme.

Table 2: Summary of the imported/Raised/SampledOrEstimated data

CatchCategory	RaisedOrImported	SampledOrEstimated	CATON	perc
Landings	Imported_Data	Sampled_Distribution	652.9	84
Landings	Imported_Data	Estimated_Distribution	123.5	16
Discards	Imported_Data	Sampled_Distribution	53.18	81
Discards	Raised_Discards	Estimated_Distribution	12.31	19

Impact of the raising on the age structure

Once the samples imported or raised are identified, it is possible to check the impact of the allocation scheme on the mean age/length of the final age/length distribution of the stock. The following figures compare the mean age (computed as the weighted mean of the age per stratum (“CatchCategory”,‘RaisedOrImported’,“SampledOrEstimated”,“Country”,“Area”,“Season”,“Fleet”,“Se x”)) of the estimated strata compared to the imported ones and the final distribution. Each individual included in the boxplot corresponds to the weighted mean age of a stratum.

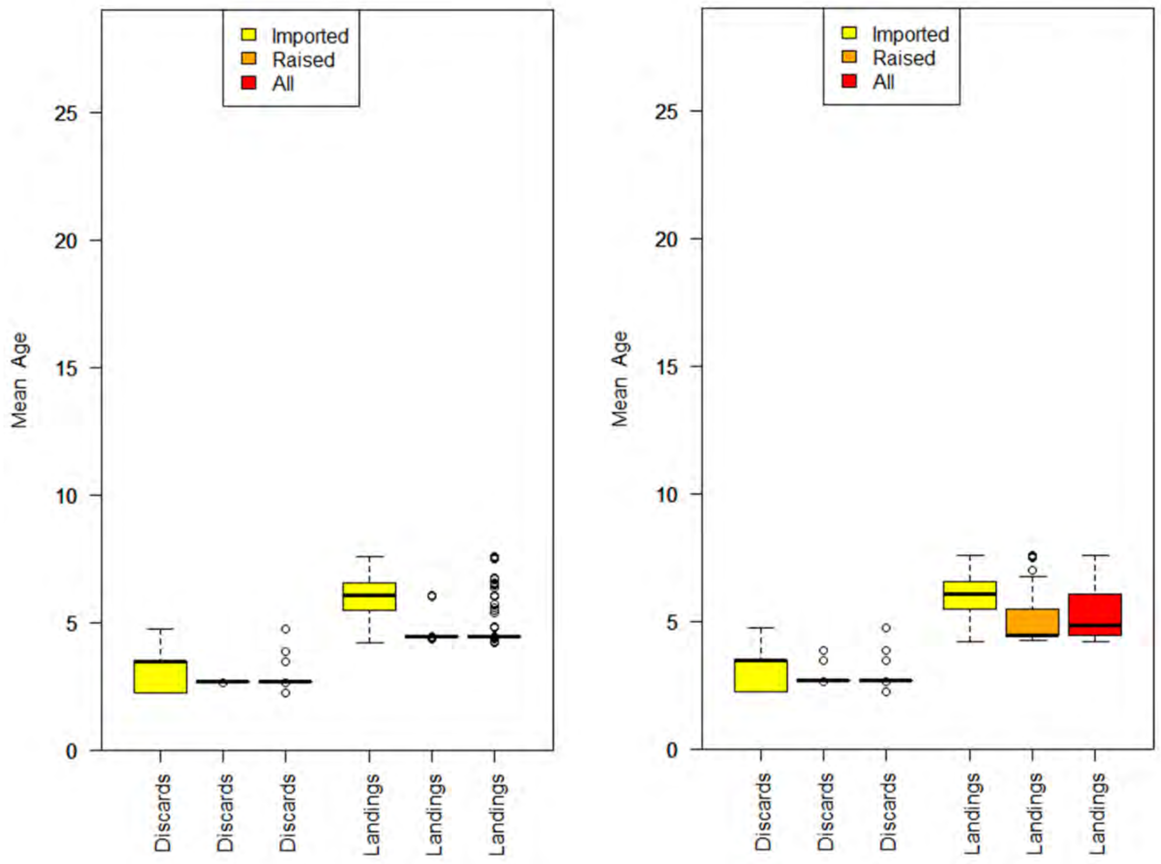


Figure 1: Mean Age per catch category (left: manual allocation; right: autoallocation)

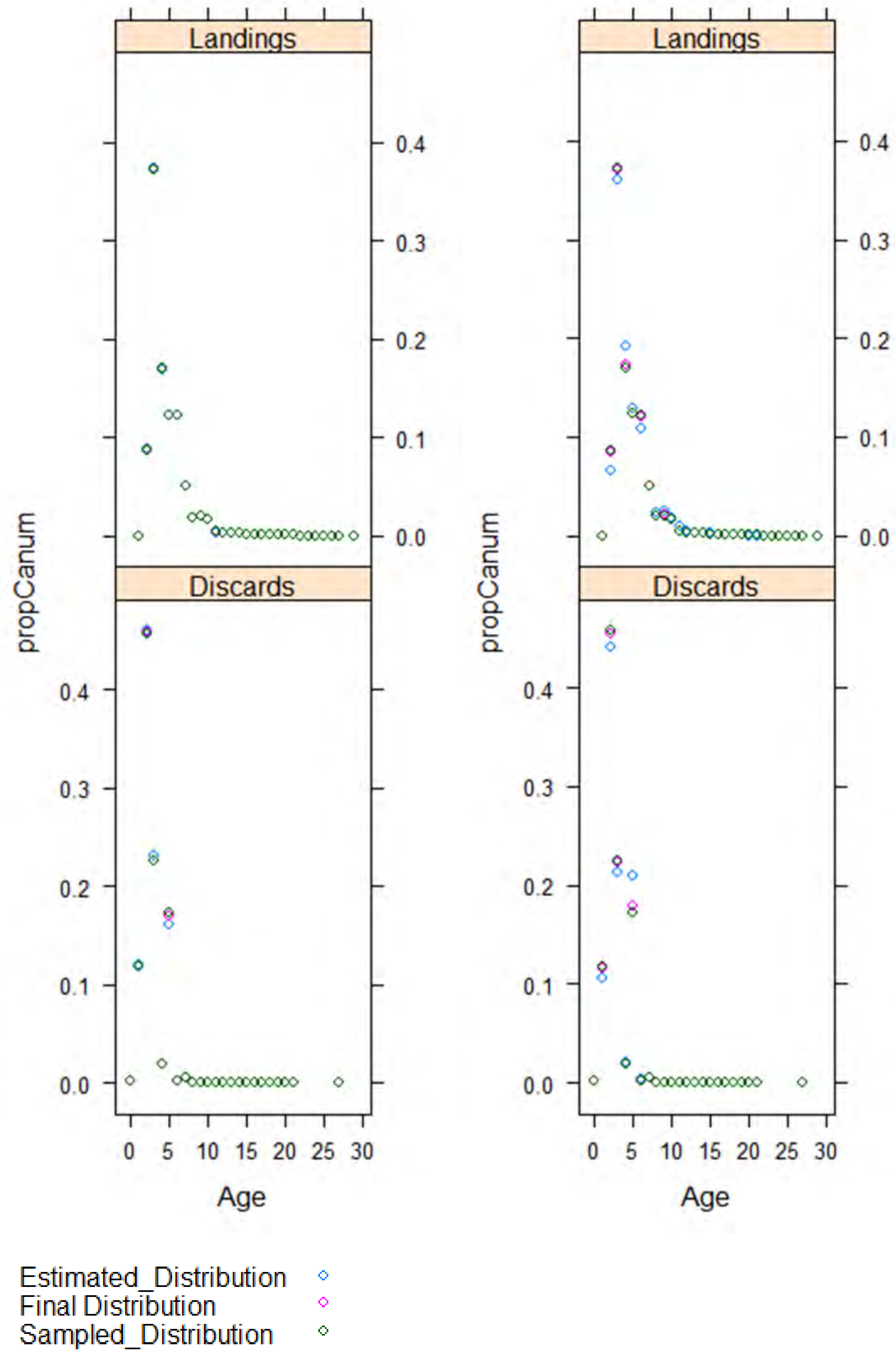


Figure 2: The percentage of each age for the sampled strata, estimated and the final age structure for the landing and discard fractions (left: manual allocation; right: autoallocation)

Impact of the raising on the mean weight

The CatchAndSampleData also provide the weight at age per stratum for the Sampled/Estimated strata. One should also check the sampled/estimated and resulting weight at age.

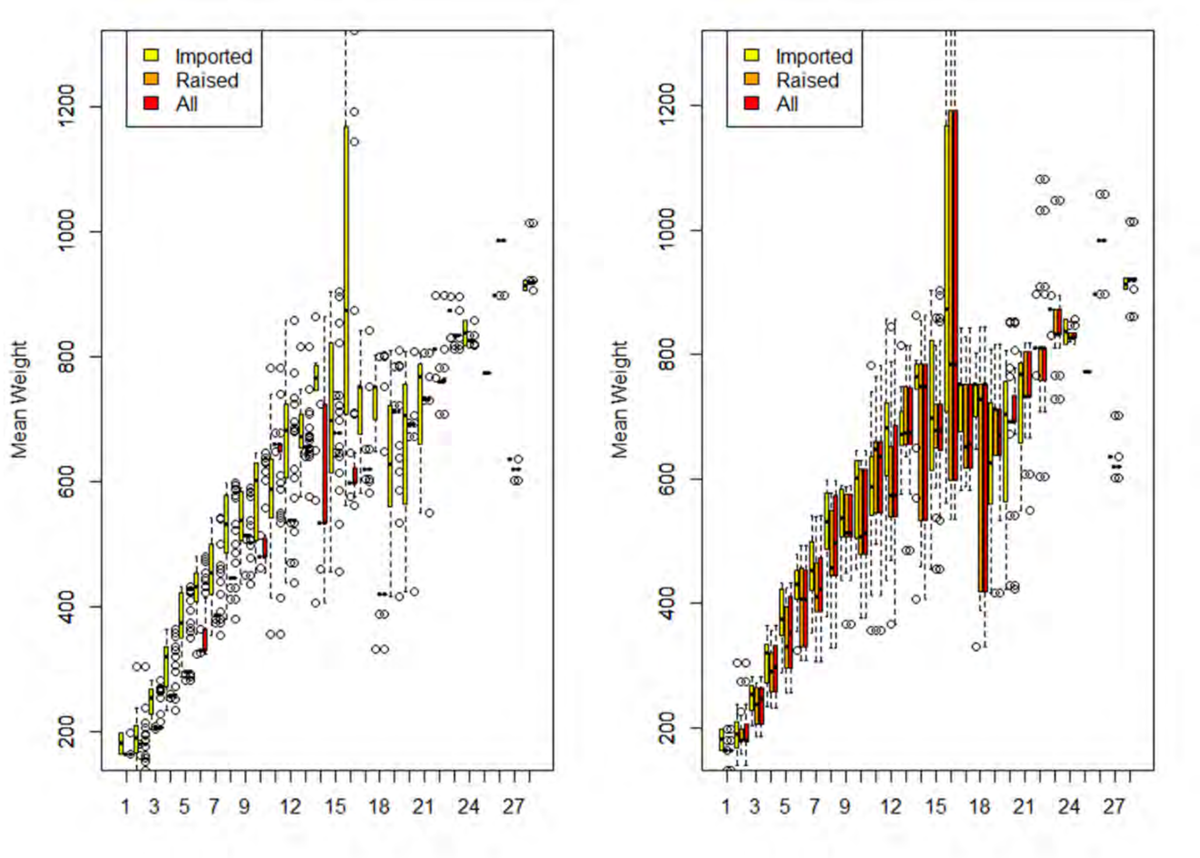


Figure 3a: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.g (left: manual allocation; right: autoallocation)

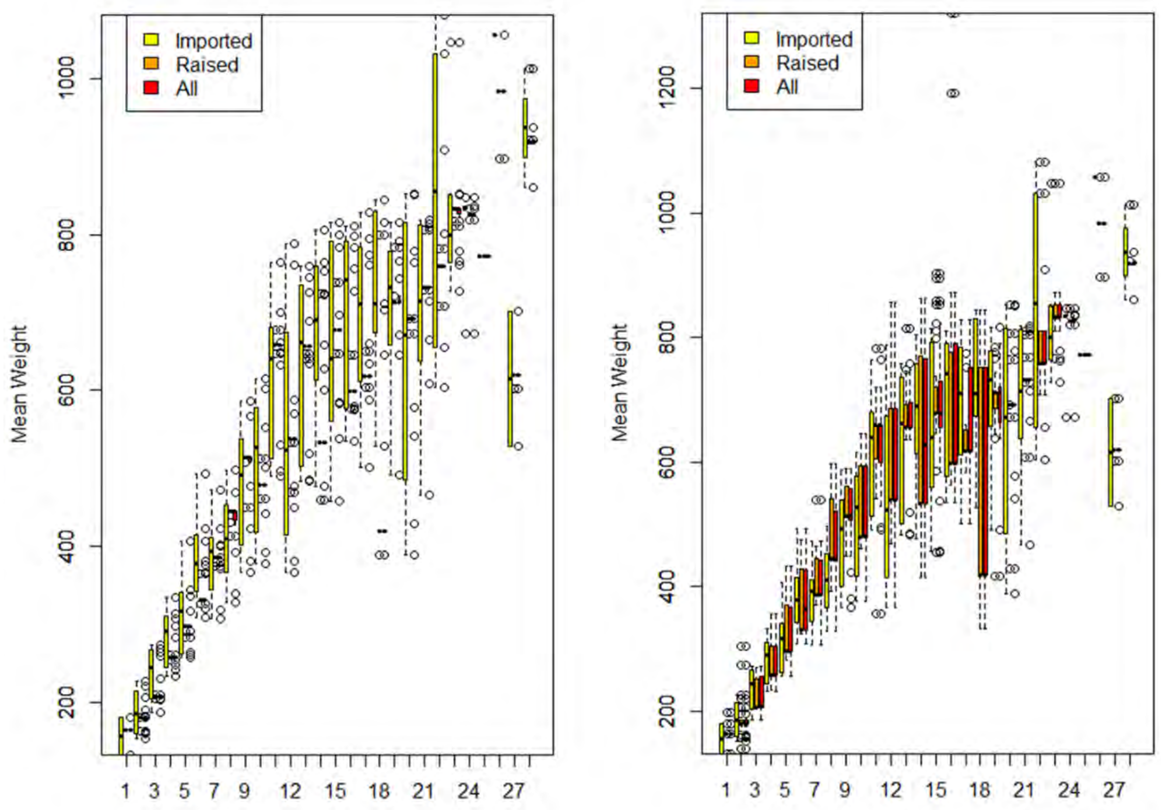


Figure 3b: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.f (left: manual allocation; right: autoallocation)

Table 3a: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for manual allocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
UK (England)	TBB_DEF_70-99_0_0_all	Landings	602	619.2
UK (England)	GNS_DEF_all_0_0_all	Landings	1013	927.5
UK (England)	GNS_DEF_all_0_0_all	Landings	1013	927.5
UK (England)	GTR_DEF_all_0_0_all	Landings	1013	927.5
UK (England)	TBB_DEF_>=120_0_0_all	Landings	602	619.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	602	619.2
UK (England)	GNS_DEF_all_0_0_all	Landings	273	210.7
UK (England)	GNS_DEF_all_0_0_all	Landings	333.6	261.1
UK (England)	GNS_DEF_all_0_0_all	Landings	406.8	297.9
UK (England)	GNS_DEF_all_0_0_all	Landings	493.4	340.5
UK (England)	GNS_DEF_all_0_0_all	Landings	472.7	384.5
UK (England)	GNS_DEF_all_0_0_all	Landings	603.1	483.1
UK (England)	GNS_DEF_all_0_0_all	Landings	788.7	533.1
UK (England)	GNS_DEF_all_0_0_all	Landings	810.8	614.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	226.4	180.4

UK (England)	OTB_DEF_70-99_0_0_all	Landings	268.6	210.7
UK (England)	OTB_DEF_70-99_0_0_all	Landings	760.6	533.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	798	614.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1033	766.1
UK (England)	GNS_DEF_all_0_0_all	Landings	307.3	384.5
UK (England)	GNS_DEF_all_0_0_all	Landings	327.6	436.9
UK (England)	GNS_DEF_all_0_0_all	Landings	366.4	503.7
UK (England)	GNS_DEF_all_0_0_all	Landings	496	653.6
UK (England)	GNS_DEF_all_0_0_all	Landings	485.9	650.5
UK (England)	GNS_DEF_all_0_0_all	Landings	1013	927.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	616	483.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	784.3	614.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	829.6	630.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	317.5	384.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	339	436.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	380.6	503.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	530.4	653.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	795.2	630.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	842.4	635.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	857.5	827.4
Ireland	OTB_CRU_100-119_0_0_all	Landings	357.6	269.1
Ireland	OTB_CRU_100-119_0_0_all	Landings	539.9	400.4
Ireland	OTB_CRU_100-119_0_0_all	Landings	814.7	660.7
Ireland	OTB_CRU_70-99_0_0_all	Landings	356.2	641.1
Ireland	OTB_CRU_70-99_0_0_all	Landings	455.6	687.4
Ireland	OTB_CRU_70-99_0_0_all	Landings	1321	652.7
Ireland	OTB_CRU_70-99_0_0_all	Landings	416.1	708.6
Ireland	OTB_DEF_100-119_0_0_all	Landings	540.3	400.4
Ireland	OTB_DEF_100-119_0_0_all	Landings	1192	652.7
Ireland	OTB_DEF_70-99_0_0_all	Landings	282.4	215.8
Ireland	OTB_DEF_70-99_0_0_all	Landings	364.3	269.1
Ireland	OTB_DEF_70-99_0_0_all	Landings	541.7	400.4
Ireland	TBB_DEF_70-99_0_0_all	Landings	413.8	641.1
Ireland	TBB_DEF_70-99_0_0_all	Landings	1144	652.7
France	OTT_DEF_100-119_0_0	Landings	304	181.7
France	OTT_DEF_100-119_0_0	Landings	894.8	687.4
UK (England)	OTB_DEF_70-99_0_0_all	Landings	132.5	164
UK (England)	OTB_DEF_70-99_0_0_all	Landings	428.2	684.6

UK (England)	OTB_DEF_70-99_0_0_all	Landings	1082	766.1
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1048	829
UK (England)	OTB_DEF_70-99_0_0_all	Landings	701.5	617.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	263.5	210.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	313.8	261.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	490.6	653.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	483.9	650.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	457.1	675.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	492.1	716.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	388.5	684.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	466.6	731.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	673.1	824
UK (England)	TBB_DEF_70-99_0_0_all	Landings	529.1	617.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	423.2	687
UK (England)	TBB_DEF_70-99_0_0_all	Landings	549.9	739.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	897.1	766.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	894.8	834.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	636.2	619.2
France	OTT_CRU_100-119_0_0	Landings	198.9	165.3
France	OTT_CRU_100-119_0_0	Landings	903.7	687.4
France	OTT_DEF_100-119_0_0	Landings	857.7	562.3
UK (England)	OTB_DEF_70-99_0_0_all	Landings	220.3	180.4

AgeOrLength	Area
27	27.7.g
29	27.7.f
29	27.7.f
29	27.7.f
27	27.7.g
27	27.7.g
3	27.7.f
4	27.7.f
5	27.7.f
6	27.7.f
7	27.7.f
10	27.7.f
12	27.7.f
16	27.7.f
2	27.7.f

3	27.7.f
12	27.7.f
16	27.7.f
22	27.7.f
7	27.7.f
8	27.7.f
9	27.7.f
11	27.7.f
13	27.7.f
29	27.7.f
10	27.7.f
16	27.7.f
17	27.7.f
7	27.7.f
8	27.7.f
9	27.7.f
11	27.7.f
17	27.7.f
17	27.7.g
24	27.7.g
4	27.7.g
7	27.7.g
13	27.7.g
11	27.7.g
15	27.7.g
16	27.7.g
19	27.7.g
7	27.7.g
16	27.7.g
3	27.7.g
4	27.7.g
7	27.7.g
11	27.7.g
16	27.7.g
2	27.7.g
15	27.7.g
1	27.7.f
20	27.7.f

22	27.7.f
23	27.7.f
27	27.7.f
3	27.7.f
4	27.7.f
11	27.7.f
13	27.7.f
15	27.7.f
19	27.7.f
20	27.7.f
21	27.7.f
24	27.7.f
27	27.7.f
20	27.7.g
21	27.7.g
22	27.7.g
23	27.7.g
27	27.7.g
1	27.7.g
15	27.7.g
12	27.7.g
2	27.7.f

Table 3b: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for autoallocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
Belgium	OTB_CRU_70-99_0_0_all	Landings	356.2	627.3
Belgium	OTB_CRU_70-99_0_0_all	Landings	416.1	694.1
UK (England)	GNS_DEF_all_0_0_all	Landings	366.4	530.7
UK (England)	GNS_DEF_all_0_0_all	Landings	485.9	690.8
UK(Scotland)	OTB_CRU_70-99_0_0_all	Landings	356.2	627.3
UK(Scotland)	OTB_CRU_70-99_0_0_all	Landings	416.1	694.1
France	OTB_DEF_70-99_0_0	Landings	1048	840.7
France	OTT_DEF_100-119_0_0	Landings	304	188.5
France	OTB_DEF_70-99_0_0	Landings	1082	811.6
France	OTB_DEF_70-99_0_0	Landings	1048	853.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1082	811.6

UK (England)	OTB_DEF_70-99_0_0_all	Landings	1048	853.8
UK (England)	GNS_DEF_all_0_0_all	Landings	366.4	519.6
UK (England)	GNS_DEF_all_0_0_all	Landings	485.9	671.8
France	OTT_DEF_100-119_0_0	Landings	304	188.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1048	840.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	483.9	671.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	466.6	729.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	673.1	823.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	529.1	621.6

AgeOrLength	Area
11	27.7.f
19	27.7.f
9	27.7.g
13	27.7.g
11	27.7.f
19	27.7.f
23	27.7.f
2	27.7.f
22	27.7.g
23	27.7.g
22	27.7.g
23	27.7.g
9	27.7.f
13	27.7.f
2	27.7.g
23	27.7.f
13	27.7.f
21	27.7.f
24	27.7.f
27	27.7.f

InterCatch output for 2018

This document uses Table 2 from CatchAndSampleDataTables.txt from the InterCatch outputs to describe the raising procedures that were made.

In the following tables, CATON=WECA*CANUM/1000000 (in tonnes).

Raised discards

In InterCatch, the first step consists in raising the discards volumes for strats with landings and no discards associated. These discards are called in the following table 'Raised_Discards'. The data called 'Imported_Data' are landings or discards volumes imported into InterCatch with or without age structure.

The proportion of Landings with Discards associated (same strata) is **85 percent**

The volumes (and associated proportion) of landings and discards imported (Imported_Data) or raised (Raised_Discards) are described in the following table.

Table 1: Summary of the imported/Raised data

CatchCategory	RaisedOrImported	CATON	perc
Discards	Raised_Discards	11969	8
Discards	Imported_Data	129203	92
Landings	Imported_Data	848888	100

Age distribution

For the imported landings/discards and the raised discards without age distribution, the age distribution is then computed using the defined allocation scheme. Sampled_distribution means that the data (landings or discards) were input with age distribution. Estimated_distribution means that the inputed/raised volumes were estimated using the allocation scheme.

Table 2: Summary of the imported/Raised/SampledOrEstimated data

CatchCategory	RaisedOrImported	SampledOrEstimated	CATON	perc
Landings	Imported_Data	Sampled_Distribution	752.7	89
Landings	Imported_Data	Estimated_Distribution	96.91	11
Discards	Imported_Data	Sampled_Distribution	129.2	92
Discards	Raised_Discards	Estimated_Distribution	11.93	8
Discards	Imported_Data	Estimated_Distribution	0	0

Impact of the raising on the age structure

Once the samples imported or raised are identified, it is possible to check the impact of the allocation scheme on the mean age/length of the final age/length distribution of the stock. The following figures compare the mean age (computed as the weighted mean of the age per stratum ("CatchCategory",'RaisedOrImported',"SampledOrEstimated","Country","Area","Season","Fleet","Se x")) of the estimated strata compared to the imported ones and the final distribution. Each individual included in the boxplot corresponds to the weighted mean age of a stratum.

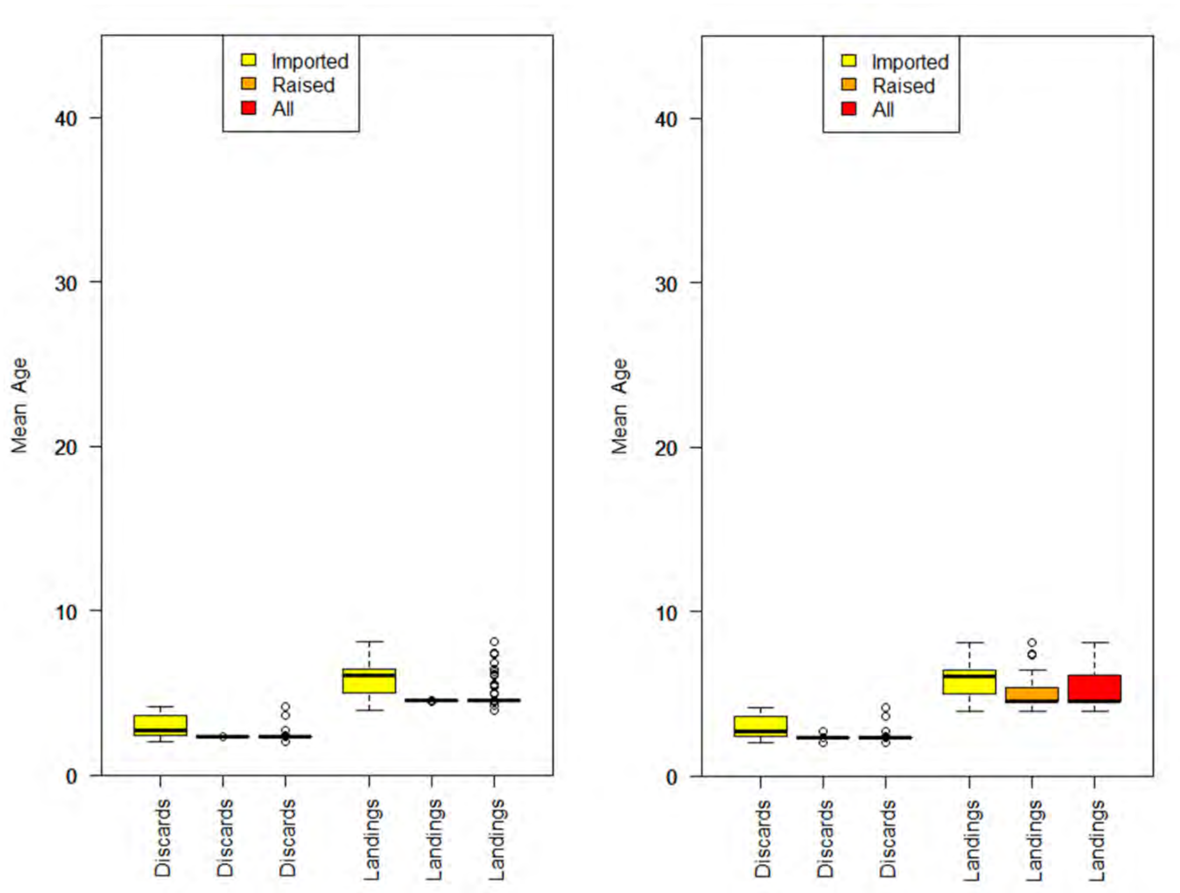


Figure 1: Mean Age per catch category (left: manual allocation; right: autoallocation)

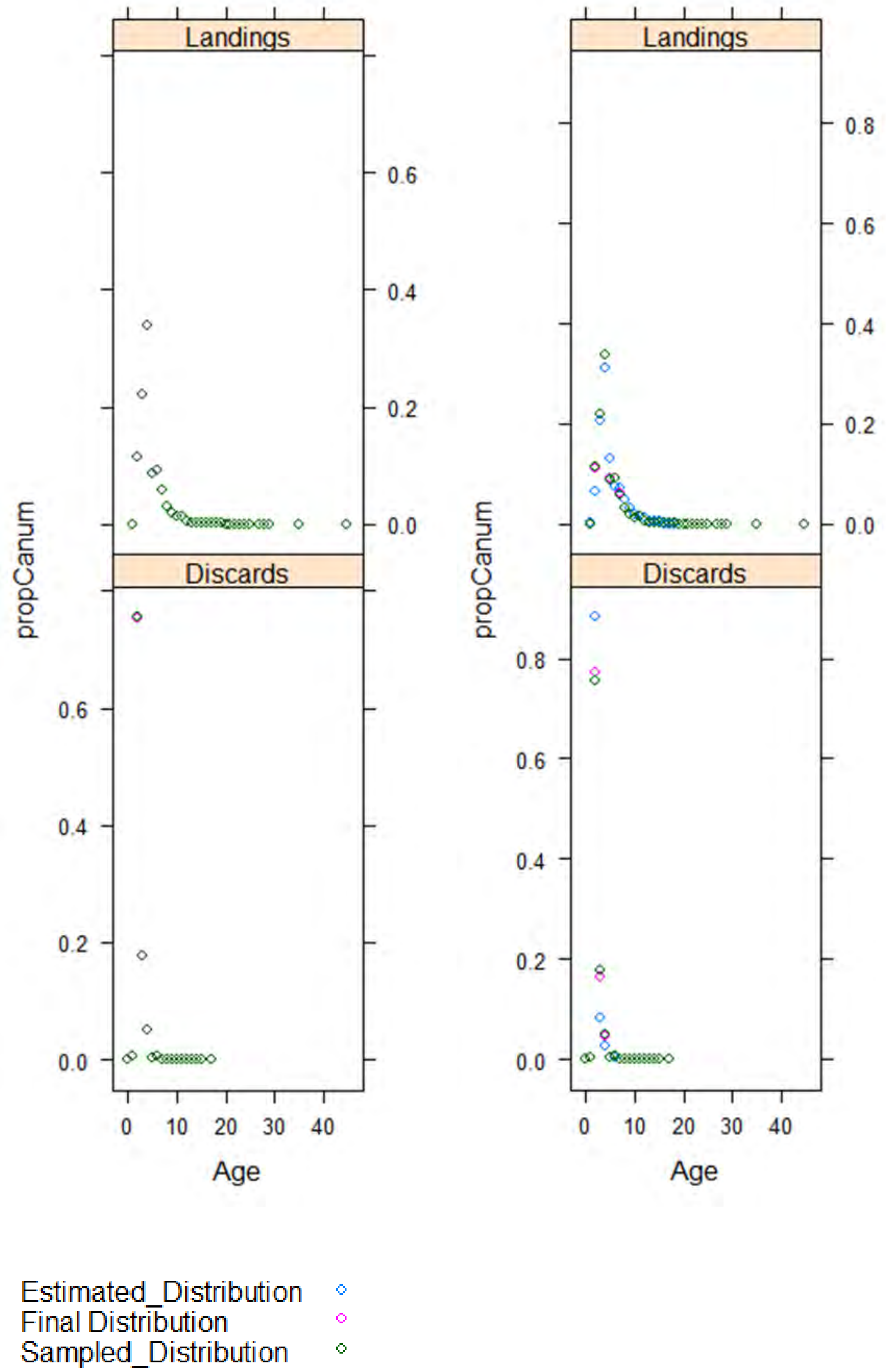


Figure 2: The percentage of each age for the sampled strata, estimated and the final age structure for the landing and discard fractions (left: manual allocation; right: autoallocation)

Impact of the raising on the mean weight

The CatchAndSampleData also provide the weight at age per stratum for the Sampled/Estimated strata. One should also check the sampled/estimated and resulting weight at age.

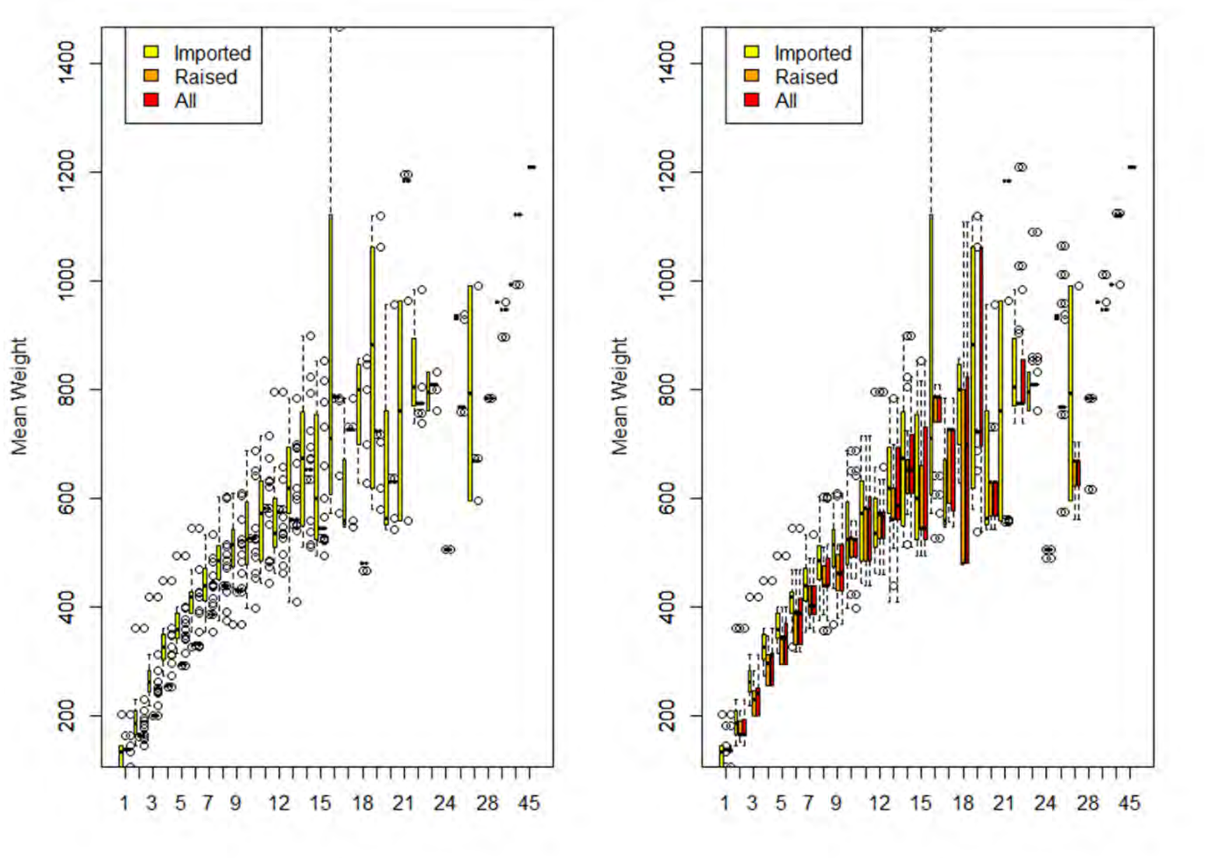


Figure 3a: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.g (left: manual allocation; right: autoallocation)

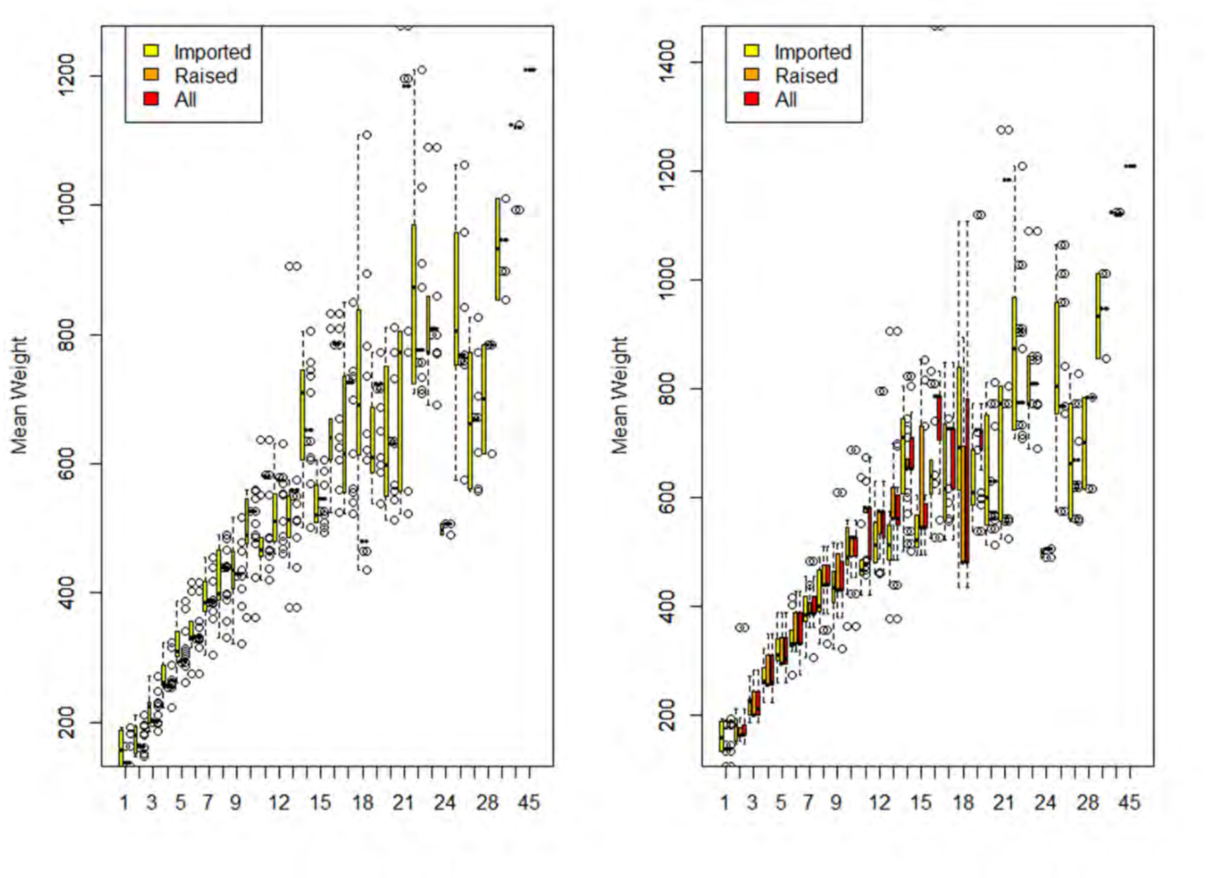


Figure 3b: Each boxplot represents the distribution of the weight at age for the different strata in ICES division 7.f (left: manual allocation; right: autoallocation)

Table 3a: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for manual allocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
UK (England)	TBB_DEF_>=120_0_0_all	Landings	993	1114
UK (England)	TBB_DEF_>=120_0_0_all	Landings	506.9	506.7
UK (England)	TBB_DEF_>=120_0_0_all	Landings	784.8	784.1
UK (England)	TBB_DEF_>=120_0_0_all	Landings	897.7	942.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	506.9	506.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	784.8	784.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	897.7	942.3
UK (England)	TBB_DEF_>=120_0_0_all	Landings	993	1114
UK (England)	TBB_DEF_>=120_0_0_all	Landings	506.9	506.7
UK (England)	TBB_DEF_>=120_0_0_all	Landings	784.8	784.1
UK (England)	TBB_DEF_>=120_0_0_all	Landings	897.7	942.3
UK (England)	TBB_DEF_>=120_0_0_all	Landings	993	1114
UK (England)	TBB_DEF_>=120_0_0_all	Landings	506.9	506.7
UK (England)	TBB_DEF_>=120_0_0_all	Landings	784.8	784.1
UK (England)	TBB_DEF_>=120_0_0_all	Landings	897.7	942.3

UK (England)	GNS_DEF_all_0_0_all	Landings	315.4	257.6
UK (England)	GNS_DEF_all_0_0_all	Landings	388.1	298.8
UK (England)	GNS_DEF_all_0_0_all	Landings	416.2	332.5
UK (England)	GNS_DEF_all_0_0_all	Landings	439.1	387
UK (England)	GNS_DEF_all_0_0_all	Landings	525.5	765.4
UK (England)	GNS_DEF_all_0_0_all	Landings	555.4	713.9
UK (England)	GNS_DEF_all_0_0_all	Landings	537.9	709.5
UK (England)	GNS_DEF_all_0_0_all	Landings	489.4	506.3
UK (England)	GNS_DEF_all_0_0_all	Landings	575.9	774.8
UK (England)	GNS_DEF_all_0_0_all	Landings	561.8	670.5
UK (England)	GNS_DEF_all_0_0_all	Landings	616.1	780.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	438	567.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	805.2	654
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1108	514.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1210	788
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1089	810.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	423.2	520.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1064	774.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	274.4	332.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	304.5	387
UK (England)	TBB_DEF_70-99_0_0_all	Landings	331.3	435.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	321.9	429.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	362.9	520.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	420.6	567.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	480.4	567.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	377	557.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	501.9	654
UK (England)	TBB_DEF_70-99_0_0_all	Landings	559.4	765.4
UK (England)	TBB_DEF_70-99_0_0_all	Landings	540.4	713.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	397.9	527.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	444.1	579.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	409.5	572
UK (England)	TBB_DEF_70-99_0_0_all	Landings	546	720.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	761.4	807.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	937.6	775.2
Belgium	TBB_DEF_70-99_0_0_all	Landings	905.6	557.3
Belgium	TBB_DEF_70-99_0_0_all	Landings	494.3	544.3
Ireland	GNS_DEF_120-219_0_0_all	Landings	418.3	215.1

Ireland	GNS_DEF_120-219_0_0_all	Landings	448.7	270
Ireland	GNS_DEF_120-219_0_0_all	Landings	494	309.9
Ireland	GNS_DEF_120-219_0_0_all	Landings	545.3	346.7
Ireland	GNS_DEF_120-219_0_0_all	Landings	533.5	397.4
Ireland	GNS_DEF_120-219_0_0_all	Landings	599.2	448.2
Ireland	OTB_CRU_100-119_0_0_all	Landings	489.4	397.4
Ireland	OTB_CRU_100-119_0_0_all	Landings	603	448.2
Ireland	OTB_CRU_100-119_0_0_all	Landings	604.5	444.6
Ireland	OTB_CRU_100-119_0_0_all	Landings	651.5	527.5
Ireland	OTB_CRU_100-119_0_0_all	Landings	715.5	579.8
Ireland	OTB_CRU_100-119_0_0_all	Landings	783.4	572
Ireland	OTB_CRU_100-119_0_0_all	Landings	898	654.8
Ireland	OTB_CRU_100-119_0_0_all	Landings	1063	739
Ireland	OTB_DEF_100-119_0_0_all	Landings	817.2	563
Ireland	OTB_DEF_100-119_0_0_all	Landings	1467	791.8
Ireland	OTB_DEF_100-119_0_0_all	Landings	846.3	513.8
Ireland	OTB_DEF_100-119_0_0_all	Landings	1120	739
Ireland	TBB_DEF_70-99_0_0_all	Landings	776.1	563
Ireland	TBB_DEF_70-99_0_0_all	Landings	1063	739
France	OTT_CRU_100-119_0_0	Landings	361.5	169
France	OTT_CRU_100-119_0_0	Landings	609.4	444.6
France	OTT_CRU_100-119_0_0	Landings	687.8	527.5
France	OTT_CRU_100-119_0_0	Landings	795	573.8
France	OTT_CRU_100-119_0_0	Landings	852.2	563
UK (England)	OTB_DEF_70-99_0_0_all	Landings	356.7	435.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	460.1	567.6
UK (England)	OTB_DEF_70-99_0_0_all	Landings	894.4	514.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	556.9	1149
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1028	788
UK (England)	OTB_DEF_70-99_0_0_all	Landings	958.8	774.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	1011	942.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	247.9	203.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	468.9	567.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	522.1	713.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	523.5	1149
UK (England)	TBB_DEF_70-99_0_0_all	Landings	557.4	670.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	854.5	942.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	558.6	720.3

UK (England)	TBB_DEF_70-99_0_0_all	Landings	856.6	513.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	559.4	1168
UK (England)	TBB_DEF_70-99_0_0_all	Landings	984.4	778.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	928.4	775.2
UK (England)	OTB_DEF_70-99_0_0_all	Landings	182.7	140.8
UK (England)	OTB_DEF_70-99_0_0_all	Landings	194.9	163.9
UK (England)	OTB_DEF_70-99_0_0_all	Landings	538.9	709.5
UK (England)	OTB_DEF_70-99_0_0_all	Landings	772.5	632.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	192.5	140.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	211.4	163.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	271.5	203.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	322.5	257.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	375.8	298.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	402.9	332.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	454.6	387
UK (England)	TBB_DEF_70-99_0_0_all	Landings	516.8	429.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	605.6	544.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	811	632.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	827.6	670.5
UK (England)	TBB_DEF_70-99_0_0_all	Landings	202.8	139.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	957.5	634.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	831.8	807.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	990.5	675.4

AgeOrLength	Area
35	27.7.f
24	27.7.g
28	27.7.g
29	27.7.g
24	27.7.g
28	27.7.g
29	27.7.g
35	27.7.f
24	27.7.g
28	27.7.g
29	27.7.g
35	27.7.f
24	27.7.g
28	27.7.g

29	27.7.g
4	27.7.f
5	27.7.f
6	27.7.f
7	27.7.f
16	27.7.f
17	27.7.f
19	27.7.f
24	27.7.f
25	27.7.f
27	27.7.f
28	27.7.f
11	27.7.f
14	27.7.f
18	27.7.f
22	27.7.f
23	27.7.f
10	27.7.f
25	27.7.f
6	27.7.f
7	27.7.f
8	27.7.f
9	27.7.f
10	27.7.f
11	27.7.f
12	27.7.f
13	27.7.f
14	27.7.f
16	27.7.f
17	27.7.f
10	27.7.g
11	27.7.g
13	27.7.g
17	27.7.g
23	27.7.g
25	27.7.g
13	27.7.f
15	27.7.f

3	27.7.g
4	27.7.g
5	27.7.g
6	27.7.g
7	27.7.g
8	27.7.g
7	27.7.g
8	27.7.g
9	27.7.g
10	27.7.g
11	27.7.g
13	27.7.g
14	27.7.g
19	27.7.g
15	27.7.g
16	27.7.g
18	27.7.g
19	27.7.g
15	27.7.g
19	27.7.g
2	27.7.g
9	27.7.g
10	27.7.g
12	27.7.g
15	27.7.g
8	27.7.f
12	27.7.f
18	27.7.f
21	27.7.f
22	27.7.f
25	27.7.f
29	27.7.f
3	27.7.f
12	27.7.f
17	27.7.f
21	27.7.f
27	27.7.f
29	27.7.f

17	27.7.g
18	27.7.g
21	27.7.g
22	27.7.g
25	27.7.g
1	27.7.f
2	27.7.f
19	27.7.f
20	27.7.f
1	27.7.f
2	27.7.f
3	27.7.f
4	27.7.f
5	27.7.f
6	27.7.f
7	27.7.f
9	27.7.f
15	27.7.f
20	27.7.f
27	27.7.f
1	27.7.g
20	27.7.g
23	27.7.g
27	27.7.g

Table 3b: Samples that are higher or lower than the average weigth at age +/- 3*standard deviation (outliers) for autoallocation
Table continues below

Country	Fleet	CatchCategory	WECA	AverageWtSize
France	OTT_CRU_100-119_0_0	Landings	361.5	181.9
France	OTT_CRU_100-119_0_0	Landings	795	564.4
France	OTT_CRU_100-119_0_0	Landings	361.5	187.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1210	828.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1089	826.5
France	OTT_CRU_100-119_0_0	Landings	361.5	181.9
France	OTT_CRU_100-119_0_0	Landings	795	564.4
France	OTT_CRU_100-119_0_0	Landings	361.5	187.3
France	OTT_CRU_100-119_0_0	Landings	361.5	181.9
France	OTT_CRU_100-119_0_0	Landings	795	564.4

France	OTT_CRU_100-119_0_0	Landings	361.5	181.9
France	OTT_CRU_100-119_0_0	Landings	795	564.4
France	OTT_CRU_100-119_0_0	Landings	361.5	187.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1210	812.1
UK (England)	TBB_DEF_70-99_0_0_all	Landings	1089	815.6
UK (England)	TBB_DEF_70-99_0_0_all	Landings	993	1116
Belgium	TBB_DEF_70-99_0_0_all	Landings	905.6	577
Ireland	GNS_DEF_120-219_0_0_all	Landings	418.3	237.2
Ireland	GNS_DEF_120-219_0_0_all	Landings	448.7	297.8
Ireland	GNS_DEF_120-219_0_0_all	Landings	494	340.4
Ireland	GNS_DEF_120-219_0_0_all	Landings	545.3	380.7
France	OTT_CRU_100-119_0_0	Landings	361.5	187.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	854.5	951.9
UK (England)	TBB_DEF_70-99_0_0_all	Landings	811	626.3
UK (England)	TBB_DEF_70-99_0_0_all	Landings	827.6	660.8
UK (England)	TBB_DEF_70-99_0_0_all	Landings	202.8	136.2
UK (England)	TBB_DEF_70-99_0_0_all	Landings	957.5	623.7
UK (England)	TBB_DEF_70-99_0_0_all	Landings	990.5	658.5

AgeOrLength	Area
2	27.7.f
12	27.7.f
2	27.7.g
22	27.7.g
23	27.7.g
2	27.7.f
12	27.7.f
2	27.7.g
2	27.7.f
12	27.7.f
2	27.7.f
12	27.7.f
2	27.7.g
22	27.7.f
23	27.7.f
35	27.7.g
13	27.7.f
3	27.7.g
4	27.7.g

5	27.7.g
6	27.7.g
2	27.7.g
29	27.7.f
20	27.7.f
27	27.7.f
1	27.7.g
20	27.7.g
27	27.7.g

WD: UK Commercial Index for Bristol Channel (7FG) Sole

Paul J. Dolder, Hayley Bannister, Johnathan Ball & Lisa Readdy

30/09/2019

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1 Introduction

In 2013 the UK moved to the EU electronic logbook system for vessels > 12m, replacing the previous paper-based logbook system. As there is no longer a requirement to record KW hours fished under the new system (it is an optional field), the time-series of KW hours fishing effort previously used to derive the commercial LPUE index for the UK(E&W)-CBT fleet is considered unreliable no longer available to provide a consistent measure of fishing effort for the fishery. As such, the UK(E&W)-CBT tuning indices were excluded from the Sole 7FG assessment for the six most recent years (2013 - 2018).

There is a need to derive a new index as input to the assessment. This document sets out the data processing, exploration and model development to provide a standardised Landings Per Unit Effort (LPUE) index for 7FG Sole based on UK Commercial data to replace the UK(E&W)-CBT indices from 2012.

2 Data processing

Previously the data used in the index provided has been compiled using SQL queries and consisted of an unmodelled effort series from a beam trawl fleet between specific overall lengths and engine power. The migration of this data to a new database has necessitated a change in this process as the structure and availability of data fields has changed. The base data is still retrieved using SQL; however, it is now processed in R to increasing transparency and traceability of any changes or alterations made to the data during the preparation of the index. MMO landings for 27.7.f and 27.7.g were retrieved from the old and new databases using the RODBC (Ripley and Lapsley, 2017) package in R (R Core Team, 2019). The old and new databases overlap between 2000 and 2016. The overlapping years were used to test if the data retrieved could form a continuous timeseries linking the old database (FAD) to the new database (IFish2). After adjusting for the differences in the two databases', data was retrieved from the FAD from 1986 to 2016 and from IFish2 for 2017 to present. All voyages in 27.7.f and 27.7.g not landing sole were treated as zero catch for sole.

Data were obtained from two UK landings database sources:

- FAD: 1982 - 2016
- IFISH: 2017 - 2018

The total number of records for each dataset per year and number of activity days per record is provided in Table 1 and Table 2. This identified a problem with records in 1982 and 1983 where, for these years, the days activity is recorded as zero. Due to the missing data, these years were excluded from the dataset and further analysis, along with the records with zero activity day in 1985 and a number of records that have no associated engine power (in 1987/88).

From 2007 activity days is always recorded as 1, reflecting the requirement to record landings on a daily basis from this period, and these records are kept for this analysis.

The number of trips with zero landings of sole are given in Table 3. On average the data shows 10% of trips by beam trawlers do not land sole (Table 4).

2.1 Data exploration and potential covariates

This section explores potential covariates to explain variance in the data. We explored:

- Seasonal effects
- Spatial effects
- Vessel and vessel attribute effects

2.1.1 Seasonal effect

There appear to be a higher LPUE during late winter - Spring (months 2-4) as indicated by the average LPUE by month over all years (Figure 1). This indicates there may be a strong seasonal component to the fishery, with increased targeting or availability during this period.

2.1.2 Spatial effect

We also observed a spatial effect in the raw data, where a higher LPUE was observed along coastal areas and in particular along the tip of Cornwall (Figure 2), which is also where a higher number of days at sea (Figure 3) and landings are taken by the English vessels (Figure 4).

2.1.3 Vessel and vessel attribute effects

Differences in LPUE between vessel can be seen (Figure 5), and there is evidence that longer trips as well as having higher landings (Figure 6) have slightly higher LPUE (Figure 7). No strong effect of either length (Figure 8) or KW engine power (Figure 9) was observed in the data.

2.2 Age composition data

The age composition data (numbers at age) were taken from the UK beam trawl fleet operating in 27.7.f & 27.7.g (Table 5), with the landings weights-at-age from the latest assessment input values (Table 6; REF WGCSE). Note that the numbers at age start from 1987 and only go to age 14, so we are missing 3 years of age-data and the oldest age-group.

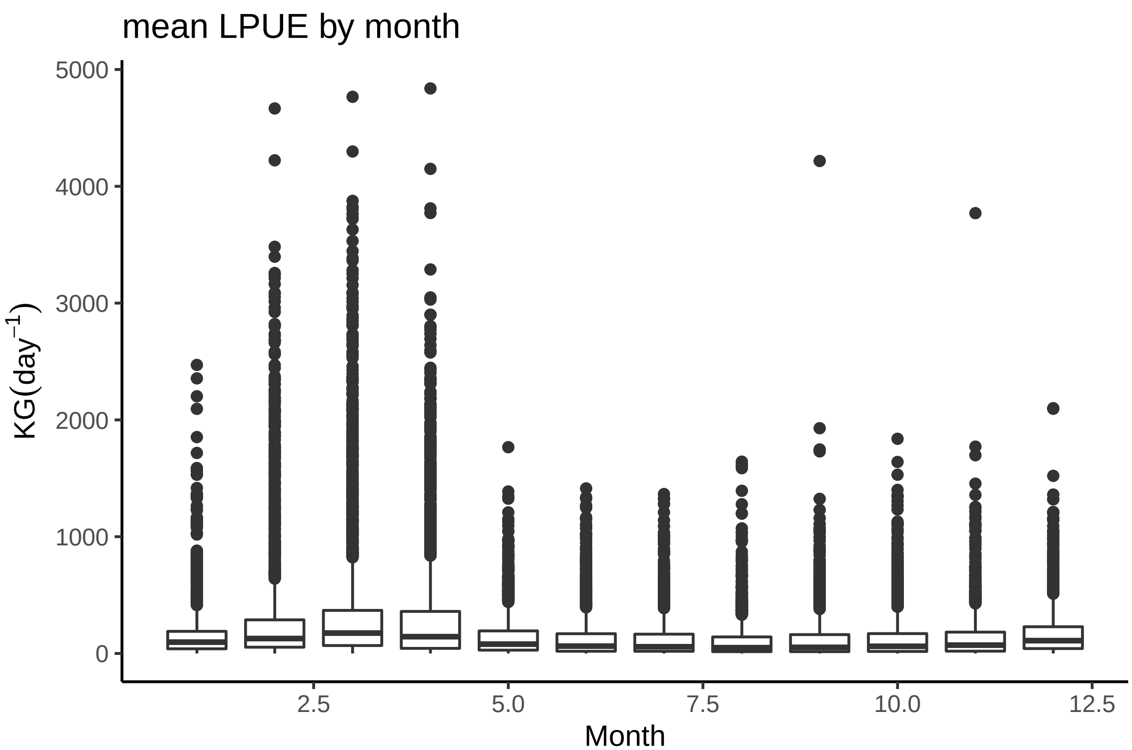

Figure 1: Raw LPUE by month

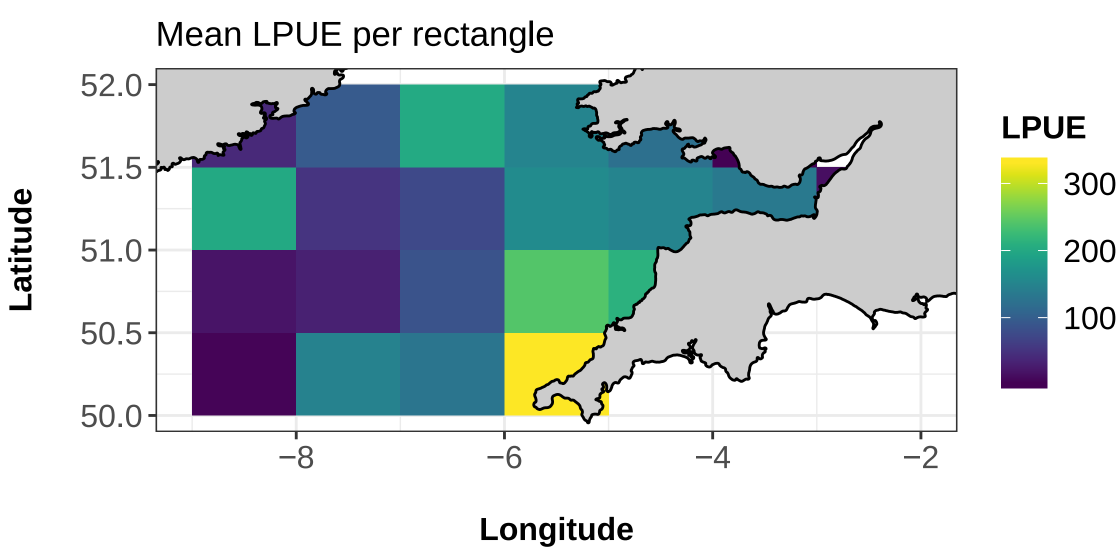

Figure 2: Mean LPUE per rectangle

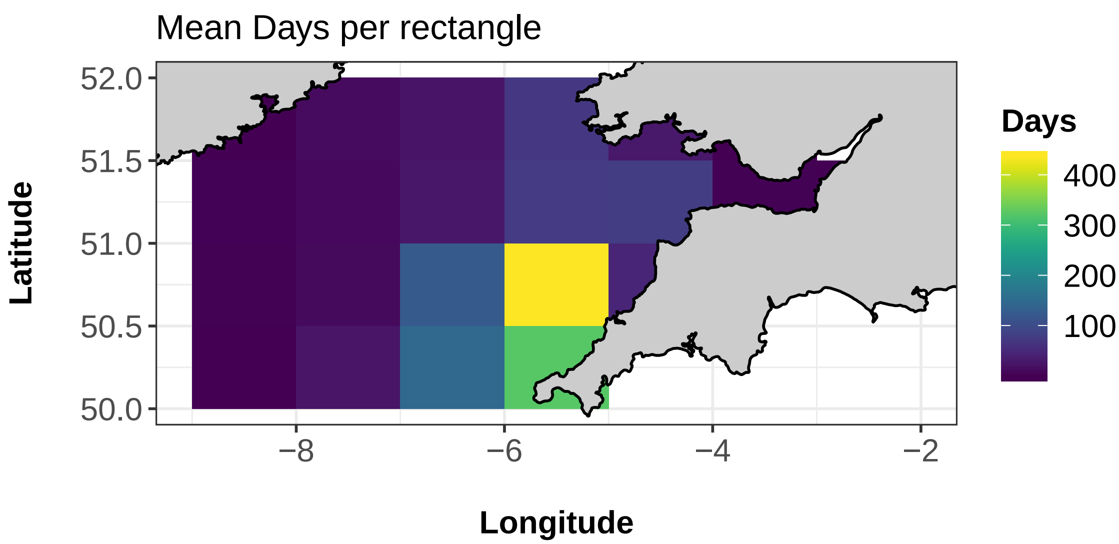

Figure 3: Mean Days at sea per year per rectangle

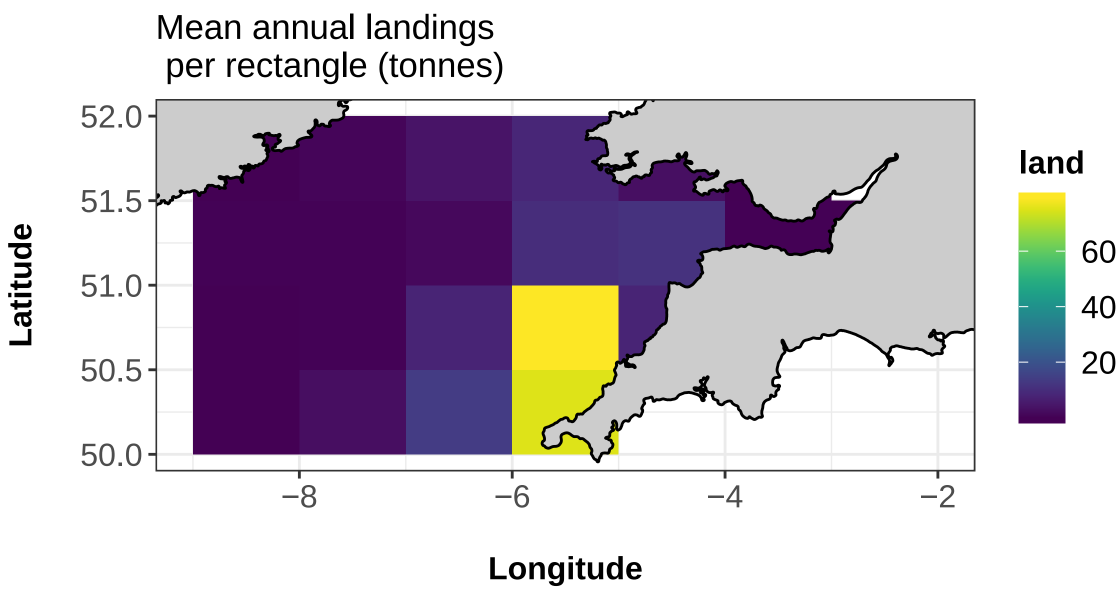

Figure 4: Mean landings (tonnes) per year rectangle

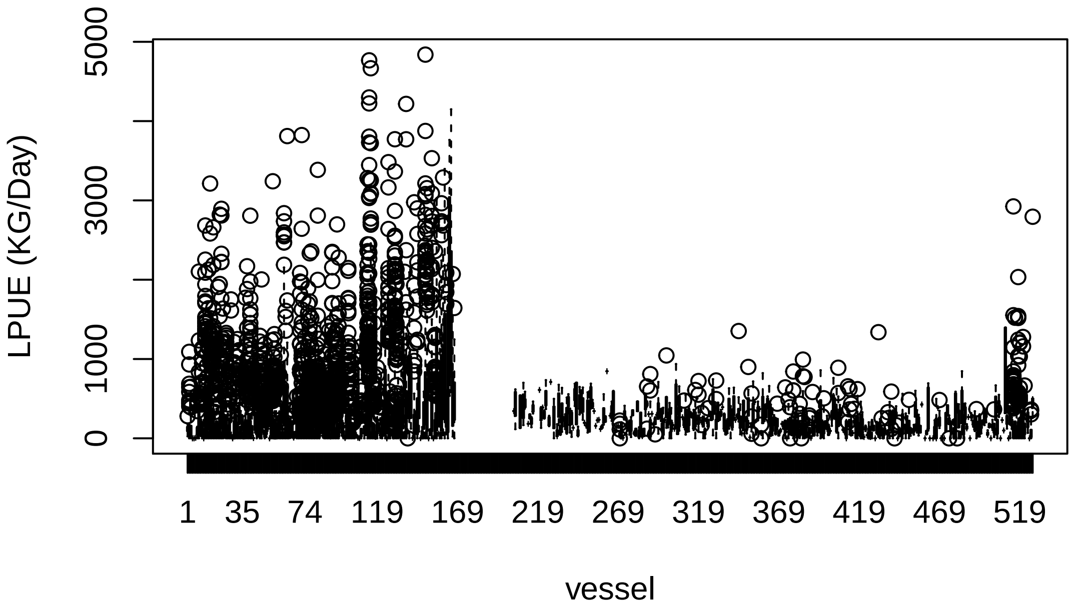

Figure 5: LPUE by vessel

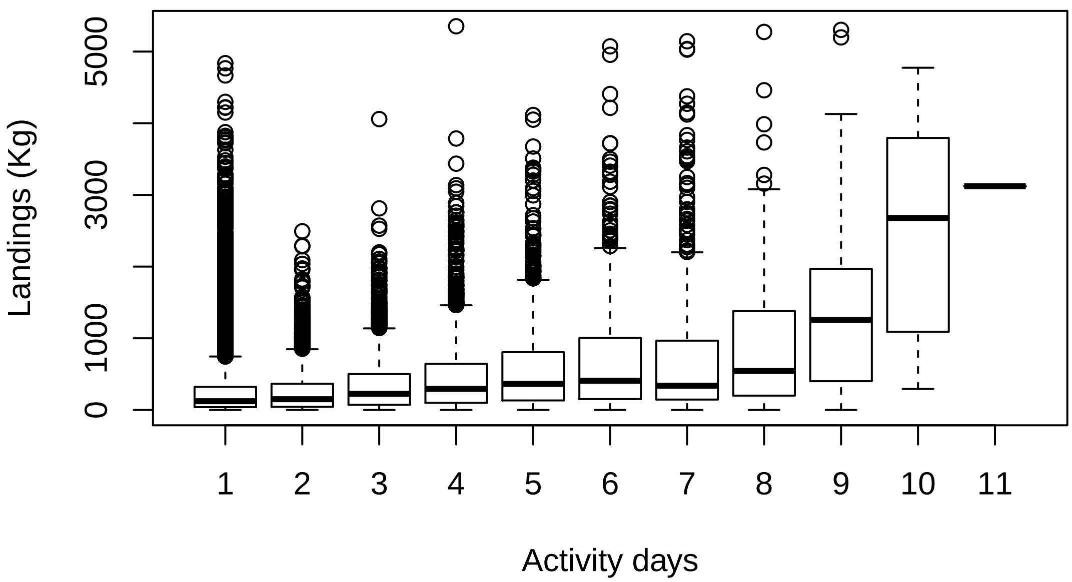

Figure 6: Landings by activity days

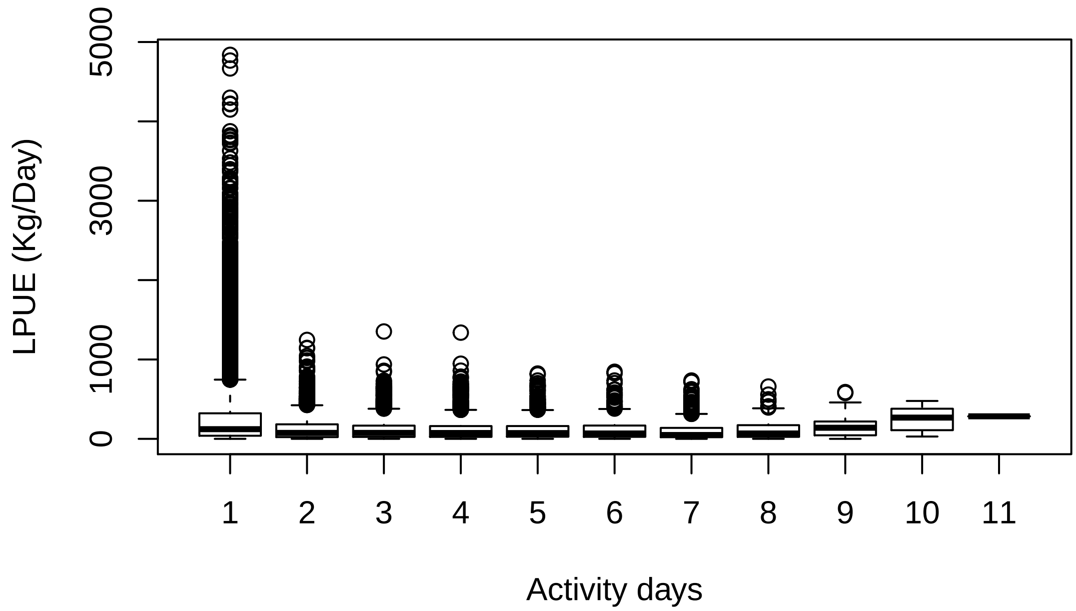

Figure 7: LPUE by activity days

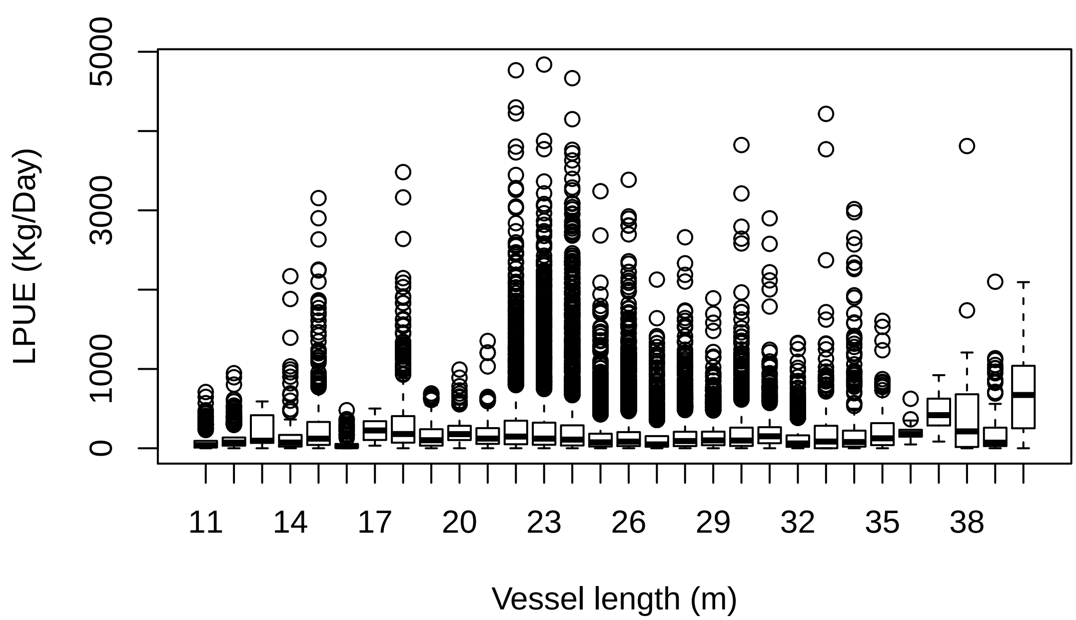

Figure 8: LPUE by vessel length

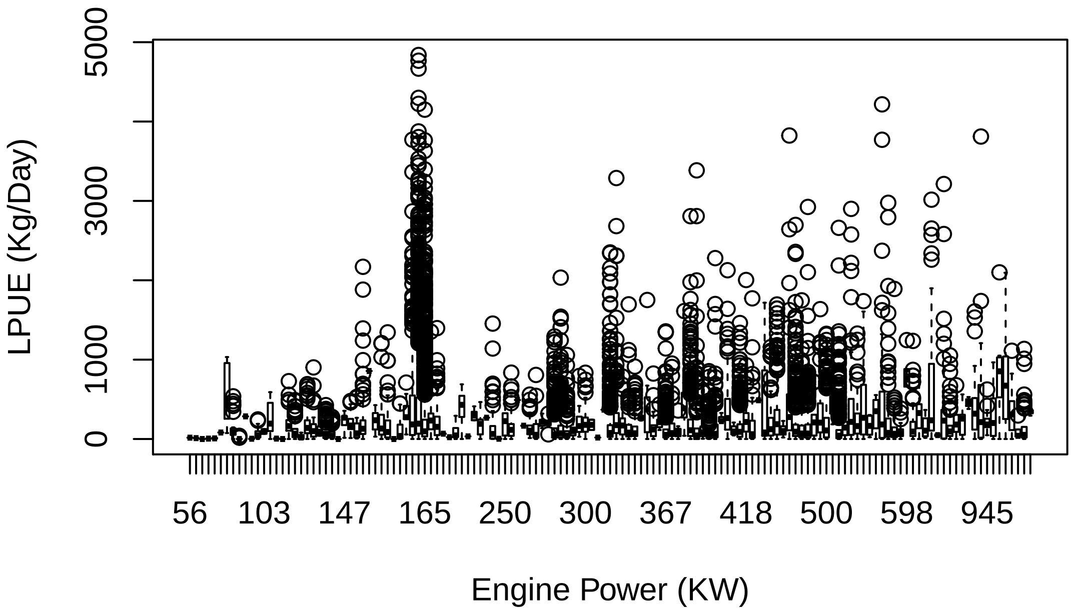

Figure 9: LPUE by engine power

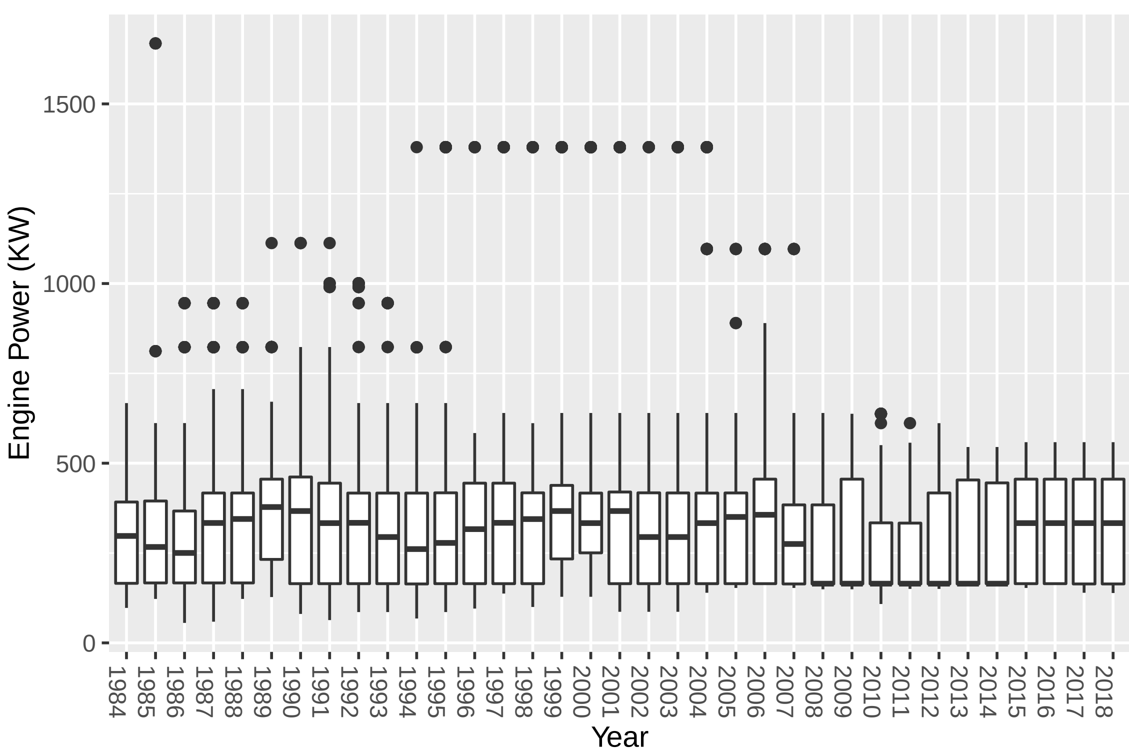

Figure 10: Average KW Engine Power by year

Table 1: Records per year and activity days in FAD

Year	0	1	2	3	4	5	6	7	8	9	10	11
1982	2504	0	0	0	0	0	0	0	0	0	0	0
1983	3165	0	28	71	155	182	212	115	88	65	23	0
1984	0	112	573	885	1058	559	513	313	414	157	18	0
1985	12	909	1506	1264	748	914	655	437	448	148	48	23
1986	0	1969	1629	1388	1417	718	632	409	109	0	0	0
1987	0	1880	2200	1610	1843	1636	1235	511	290	65	0	0
1988	0	1449	2391	1377	1237	1057	639	372	24	0	0	0
1989	0	1153	1518	1090	885	674	269	166	95	51	0	0
1990	0	1407	1927	1352	806	440	357	274	186	49	2	0
1991	0	1611	2689	1829	1668	1053	667	465	121	8	0	0
1992	0	3204	3820	3048	2076	1130	1161	735	107	40	0	0
1993	0	4077	4821	2865	2390	1244	891	818	241	62	0	0
1994	0	4549	3249	2506	1373	1267	604	770	122	0	0	0
1995	0	4495	3269	2359	1432	1220	624	588	65	0	0	0
1996	0	4411	3776	2652	1750	1158	703	427	133	28	0	0
1997	0	10410	2656	1312	738	492	441	189	49	0	0	0
1998	0	12761	1398	616	248	167	66	0	0	0	0	0
1999	0	13882	1288	520	184	55	210	0	0	0	0	0
2000	0	10226	2068	1448	1202	784	598	283	99	0	0	0
2001	0	7873	3097	2058	2089	1118	778	821	437	41	0	0
2002	0	6292	2360	2002	1364	783	405	447	70	65	0	0
2003	0	10306	1358	1186	855	544	227	402	158	57	16	0
2004	0	12733	1580	1182	765	567	318	176	18	17	0	0
2005	0	7943	1090	745	698	484	318	100	55	23	43	0
2006	0	6730	217	136	70	69	106	135	64	0	0	0
2007	0	8538	0	0	0	0	0	0	0	0	0	0
2008	0	7306	0	0	0	0	0	0	0	0	0	0
2009	0	6185	0	0	0	0	0	0	0	0	0	0
2010	0	6927	0	0	0	0	0	0	0	0	0	0
2011	0	5068	0	0	0	0	0	0	0	0	0	0
2012	0	8184	0	0	0	0	0	0	0	0	0	0
2013	0	9043	0	0	0	0	0	0	0	0	0	0
2014	0	5497	0	0	0	0	0	0	0	0	0	0
2015	0	5575	0	0	0	0	0	0	0	0	0	0
2016	0	6559	0	0	0	0	0	0	0	0	0	0

Table 2: Records per year and activity days in IFISH

Year	1
2017	7336
2018	7103

Table 3: Percentage of non-zeros and zero per year in the data

	FALSE	TRUE
1984	0.98	0.02
1985	0.97	0.03
1986	0.95	0.05
1987	0.96	0.04
1988	0.87	0.13
1989	0.95	0.05
1990	0.97	0.03
1991	0.95	0.05
1992	0.92	0.08
1993	0.90	0.10
1994	0.84	0.16
1995	0.85	0.15
1996	0.77	0.23
1997	0.82	0.18
1998	0.83	0.17
1999	0.81	0.19
2000	0.83	0.17
2001	0.84	0.16
2002	0.84	0.16
2003	0.81	0.19
2004	0.83	0.17
2005	0.85	0.15
2006	0.92	0.08
2007	0.93	0.07
2008	0.94	0.06
2009	0.93	0.07
2010	0.97	0.03
2011	0.97	0.03
2012	0.95	0.05
2013	0.95	0.05
2014	0.91	0.09
2015	0.96	0.04
2016	0.92	0.08
2017	0.87	0.13
2018	0.87	0.13

Table 4: Mean percentage of non-zeros and zero in the data across all years

	x
FALSE	0.898
TRUE	0.102

Table 5: Age composition of landings from UK beam trawlers

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1984	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1985	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1986	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1987	0.000	60519.000	230305.00	289544.00	181001.00	60815.00	70962.00	42271.00	25302.000	9461.000	14262.000	17987.000	14572.000	4800.000
1988	112.000	66254.000	81207.00	108616.00	113369.00	155262.00	26157.00	11953.00	19506.000	30768.000	14344.000	6990.000	27578.000	3724.000
1989	0.000	141081.000	240465.00	61413.00	50839.00	21545.00	15568.00	9390.00	7060.000	2151.000	2302.000	1560.000	1506.000	2122.000
1990	0.000	12009.000	115203.00	315854.00	137967.00	131870.00	43768.00	38267.00	23812.000	14535.000	7207.000	1141.000	2734.000	3778.000
1991	0.000	65045.739	123499.75	238159.38	215698.00	75317.95	84109.99	29474.55	25603.806	20519.870	16750.393	5693.599	4534.625	4709.546
1992	0.000	25794.000	319295.00	149229.00	120488.00	100450.00	32558.00	30986.00	14193.000	19448.000	7686.000	3739.000	1525.000	1463.000
1993	2734.000	8355.000	118484.00	283126.00	109814.00	71053.00	58339.00	15769.00	33714.000	12218.000	7064.000	6036.000	3922.000	5557.000
1994	0.000	34914.112	120166.07	88716.40	173976.72	53723.51	47117.41	29044.25	17167.042	23050.772	11935.138	6918.720	6510.287	5694.890
1995	0.000	22653.616	123716.10	103935.19	79721.86	149540.95	34329.00	43337.40	32110.082	11589.745	11523.681	5810.660	6844.897	3832.101
1996	297.362	28165.070	121711.99	162823.75	89275.58	56902.96	66592.43	18421.54	16682.330	15261.130	4718.564	11677.448	6024.672	2748.018
1997	0.000	12287.357	76818.37	109771.99	87460.87	67253.54	34493.70	49313.60	13963.164	14298.617	5807.678	5819.279	4029.269	2100.983
1998	0.000	14706.377	118192.52	85655.26	89265.46	58821.40	19336.30	15469.50	22987.728	7597.917	6493.219	4401.028	2177.064	1515.752
1999	499.000	38668.000	252143.00	132756.00	64951.00	61433.00	34705.00	16179.00	6896.000	12708.000	4551.000	2298.000	1025.000	50.000
2000	88.000	87177.000	183198.00	180831.00	91078.00	32531.00	33792.00	23527.00	11023.000	4837.000	9375.000	2967.000	2109.000	2367.000
2001	0.000	47163.000	343867.00	124599.00	112424.00	60906.00	24094.00	21116.00	13364.000	10851.000	4281.000	9064.000	1629.000	2929.000
2002	0.000	13290.000	180863.00	454399.00	108640.00	76859.00	34402.00	22090.00	16507.000	10370.000	6689.000	4336.000	4240.000	1103.000
2003	99.714	22347.227	125814.02	219801.06	461952.25	96193.43	56405.31	22219.86	6998.247	8531.913	3123.352	4769.306	717.878	2280.580
2004	0.000	24238.000	116688.00	83720.00	145879.00	230876.00	43885.00	34327.00	18646.000	8397.000	3972.000	6328.000	1041.000	652.000
2005	0.000	32531.181	92318.33	149510.94	64693.35	71250.01	136886.73	17291.15	15989.838	4255.408	5706.499	2375.734	2065.621	1109.637
2006	0.000	19070.000	103929.00	114129.00	125522.00	38718.00	47840.00	83675.00	16063.000	9401.000	4605.000	2672.000	1984.000	888.000
2007	1046.355	20239.781	87349.77	101377.81	87718.14	93053.23	36179.71	45906.28	86476.779	9226.854	8457.179	4460.227	1805.351	3656.175
2008	0.000	13641.939	85971.79	113467.04	75963.74	58881.79	61199.14	21427.72	35801.928	47914.005	11344.173	5500.293	2687.946	3474.887
2009	0.000	25358.093	60252.96	81261.91	81335.32	70726.08	30861.99	32729.16	12944.098	13559.249	32660.093	4029.184	3216.969	1359.060
2010	0.000	2192.901	121097.60	80893.43	59631.42	56597.75	42616.79	23411.77	21817.431	6630.415	5554.260	15704.909	1792.423	1612.210
2011	473.901	8569.521	69346.88	151200.88	49611.32	41681.90	27134.96	23358.41	14693.277	14992.788	4615.710	8647.015	19923.909	1133.331
2012	0.000	3976.343	19988.33	118929.18	153174.05	37211.15	25833.56	23702.31	12703.965	9952.541	8506.908	1650.766	4205.239	4502.333
2013	0.000	810.179	46005.54	24085.84	109525.53	120565.86	55446.02	26254.35	25140.587	16967.256	13069.356	8157.654	3776.681	6571.040
2014	0.000	0.000	39356.18	98938.21	28235.19	97598.68	92935.91	51502.44	31759.682	24405.559	10507.643	11269.357	7689.640	4800.503
2015	0.000	1337.015	15320.01	51418.48	49916.66	25201.01	27095.94	21621.10	9898.634	4874.553	3940.712	3840.240	3136.125	2199.519
2016	0.000	1643.756	13669.90	59746.34	101463.28	50981.87	29080.23	40946.28	25117.676	9621.001	6200.640	3499.371	1751.569	1623.827
2017	0.000	1942.340	61985.48	60334.33	31919.71	66090.91	30779.83	18381.99	21197.815	13768.536	3572.354	1772.251	1359.599	3955.682
2018	0.000	937.219	22861.45	99250.27	58136.57	51018.92	48075.80	32154.28	13001.800	19940.847	17815.709	11918.912	4722.497	697.376

Table 6: Landings weight-at-age from Assessment

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1984	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1985	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1986	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1987	0.048	0.146	0.236	0.320	0.396	0.466	0.528	0.584	0.632	0.674	0.708	0.736	0.756	0.770
1988	0.074	0.157	0.235	0.309	0.378	0.442	0.502	0.557	0.608	0.654	0.696	0.733	0.765	0.793
1989	0.013	0.109	0.198	0.280	0.355	0.424	0.487	0.543	0.592	0.634	0.670	0.700	0.723	0.739
1990	0.049	0.134	0.214	0.291	0.363	0.430	0.494	0.553	0.609	0.660	0.706	0.749	0.787	0.822
1991	0.054	0.150	0.239	0.320	0.393	0.459	0.516	0.566	0.608	0.642	0.669	0.687	0.698	0.701
1992	0.073	0.147	0.216	0.281	0.342	0.398	0.451	0.499	0.543	0.583	0.618	0.650	0.677	0.700
1993	0.057	0.134	0.207	0.275	0.338	0.396	0.450	0.500	0.545	0.585	0.620	0.651	0.678	0.700
1994	0.081	0.151	0.216	0.276	0.331	0.380	0.425	0.465	0.500	0.530	0.554	0.574	0.589	0.599
1995	0.068	0.147	0.220	0.288	0.351	0.409	0.462	0.510	0.553	0.591	0.624	0.653	0.676	0.694
1996	0.027	0.124	0.214	0.296	0.372	0.439	0.500	0.552	0.598	0.636	0.667	0.690	0.706	0.714
1997	0.074	0.156	0.234	0.307	0.376	0.440	0.500	0.555	0.605	0.651	0.692	0.728	0.760	0.787
1998	0.079	0.163	0.244	0.320	0.393	0.462	0.528	0.589	0.647	0.701	0.751	0.797	0.840	0.878
1999	0.015	0.122	0.222	0.315	0.400	0.478	0.549	0.613	0.670	0.719	0.761	0.796	0.824	0.845
2000	0.078	0.166	0.248	0.322	0.390	0.451	0.506	0.553	0.594	0.628	0.655	0.675	0.689	0.695
2001	0.066	0.148	0.225	0.296	0.363	0.425	0.482	0.533	0.579	0.620	0.657	0.687	0.714	0.734
2002	0.054	0.130	0.202	0.271	0.336	0.399	0.457	0.513	0.564	0.613	0.658	0.700	0.738	0.773
2003	0.123	0.171	0.218	0.266	0.313	0.361	0.408	0.454	0.501	0.547	0.594	0.640	0.685	0.731
2004	0.066	0.130	0.194	0.256	0.317	0.377	0.435	0.493	0.549	0.604	0.658	0.710	0.762	0.812
2005	0.068	0.145	0.219	0.288	0.354	0.415	0.473	0.528	0.578	0.625	0.667	0.706	0.742	0.773
2006	0.085	0.139	0.192	0.245	0.297	0.349	0.400	0.451	0.501	0.550	0.599	0.647	0.694	0.741
2007	0.075	0.139	0.200	0.258	0.313	0.365	0.414	0.460	0.503	0.543	0.580	0.614	0.645	0.673
2008	0.128	0.164	0.198	0.258	0.309	0.305	0.412	0.521	0.532	0.488	0.600	0.584	0.525	0.604
2009	0.128	0.179	0.221	0.252	0.320	0.394	0.417	0.463	0.481	0.545	0.635	0.562	0.703	0.707
2010	0.127	0.160	0.186	0.230	0.310	0.346	0.404	0.404	0.530	0.523	0.556	0.574	0.708	0.613
2011	0.140	0.162	0.184	0.223	0.272	0.354	0.420	0.447	0.475	0.570	0.740	0.675	0.541	0.661
2012	0.110	0.162	0.213	0.247	0.279	0.324	0.341	0.377	0.409	0.510	0.476	0.600	0.581	0.500
2013	0.125	0.179	0.205	0.253	0.285	0.334	0.350	0.475	0.412	0.551	0.564	0.588	0.620	0.481
2014	0.073	0.170	0.208	0.273	0.366	0.393	0.425	0.484	0.530	0.561	0.658	0.618	0.712	0.798
2015	0.134	0.163	0.200	0.254	0.319	0.352	0.443	0.516	0.436	0.459	0.469	0.657	0.561	0.636
2016	0.130	0.187	0.211	0.262	0.293	0.353	0.462	0.434	0.476	0.544	0.546	0.631	0.614	0.687
2017	0.110	0.181	0.216	0.263	0.323	0.353	0.394	0.504	0.468	0.459	0.354	0.710	0.719	0.529
2018	0.124	0.162	0.208	0.258	0.303	0.347	0.398	0.485	0.483	0.534	0.527	0.597	0.647	0.690

3 Model

The following section describes the model formulation and variants fitted. All models were fit using Template Model Builder (TMB) and model code is provided at Appendix A.

3.1 Formulation

We adapted a delta-Generalised Linear Mixed Model (delta-GLMM) developed to provide an index for 7D sole (WD REF). This model was chosen as it can treat zeros and non-zero (positive catches) seperately, while incorporating random effects to describe the distribution of catches. The model is formulated to describe the landings per days of activity in 7FG. The landings $l_{i,j,t}$ per activity day $a_{i,j,t}$ for the ith vessel on the jth voyage in the tth year was:

$$logl_{i,j,t} - loga_{i,j,t} \sim \begin{cases} N\left(\eta_{i,j,t}, \frac{\sigma^2}{a_{i,j,t}}\right) & wp\left(1-\left(1-p_{i,j,t}\right)^{a_{i,j,t}}\right), \\ 0 & otherwise, \end{cases}$$

with

$$p_{i,j,t} = logit^{-1}\left(\eta_{i,j,t} + \theta\right),$$

where $\eta_{i,j,t}$ was the expected log landings per activity day,

$$\eta_{i,j,t} = \omega_t,$$

with ω_t following a random walk,

$$\omega_t \sim N\left(\omega_{t-1}, \sigma_\omega^2\right),$$

3.2 Model variants

We fit several model variants including combinations of a vessel effect, spatial (rectangle) effect and seasonal effect and a model adjusted for KW power of the vessel (Table 7).

Table 7: Model variants fitted

model	Formula	
0.	$\eta_{i,j,t} = \omega_t$	
1.	$\eta_{i,j,t} = \omega_t + v_i$	where v_i is a vessel random effect with $v_i \sim N(0, \sigma^2)$
2.	$\eta_{i,j,t} = \omega_t + v_i + \lambda_{r_{i,j,t}}$	where $r_{i,j,t}$ is a rectangle random effect with $\lambda_k \sim N(0, \sigma^2_\lambda)$ for $k = 1, 2...$ number of rectangles.
3.	$\eta_{i,j,t} = \omega_t + v_i + \beta_k$	where β_k is a fixed effect for rectangle k
4.	$\eta_{i,j,t} = \omega_t + v_i + \beta_k + \beta_m$	where β_m is the fixed effect of month m for $m = 1, 2, ...12$
5.	$\eta_{i,j,t} = \omega_t + v_i + \beta_k + \beta_m$	with effort standardised by the KW power of the vessel to a 500 HP/368 KW vessel with $d = \frac{KW^\beta}{(368 \cdot KW^\beta)}$ and β estimated

4 Results

The following section compares the model fits and the best fitted model. The best model includes a random vessel effect and fixed effects for month of the year and ICES rectangle (Model 4).

4.1 Model comparison

Comparison of the models was done by maximum likelihood and AIC values from the model fits (Table 8) as well as model diagnostics.

4.2 Diagnostics

As a sense check for the uncertainty estimates the model was refitted using the MCMC algorithms in the TMBStan package, which estimated very similar values to the TMB model (not shown). Plots of standardised residuals show a good fit to the data (Figures 12, 13, 14) and a good fit in relation to the treatment of activity days (Figure 15), engine power (Figure 16), ICES rectangle (Figure 17) and month effects (Figure 18).

4.3 Age-disaggregation of the index

The LPUE index generated was disaggregated by age using the sampled catch-at-age from the beam trawl fleet and the mean weight at age taken from the assessment (as shown in Section 2.3).

The numbers sampled, $N_{a,t}$ at age a and time t was multiplied by the mean weight at age from the assessment, $\bar{w}_{a,t}$ to get the weight caught at age $w_{g,t}$. Using this we set the landings at age by $\omega\hat{q}_{a,t}$ where

Table 8: Model MLE and AIC comparison

Model	MLE	AIC	AICdelta
M0	42646.82	85369.64	NA
M1	40254.05	80586.10	-2392.766
M2	39517.18	79114.36	-3129.640
M3	39479.61	79083.22	-3167.206
M4	38709.83	77569.66	-3936.989
M5	38709.83	77571.66	-3936.986

$$\hat{q}_{a,t} = \frac{w_{k,t}}{\sum_{k=1}^{15} w_{k,t}}$$

Using the mean weight at age from the assessment $\bar{w}_{a,t}$, we calculated the numbers at age by $\omega_t \hat{q}_{a,t}/\bar{w}_{a,t}$.

5 LPUE index

The final modelled LPUE index and 95% CIs is provided at Figure 19 and Table 9, with the median LPUE at-age index is at Table 10 and shown in Figure 20.

\begin{table}[t]

\caption{Standardised Index and 5%/95% quantiles}

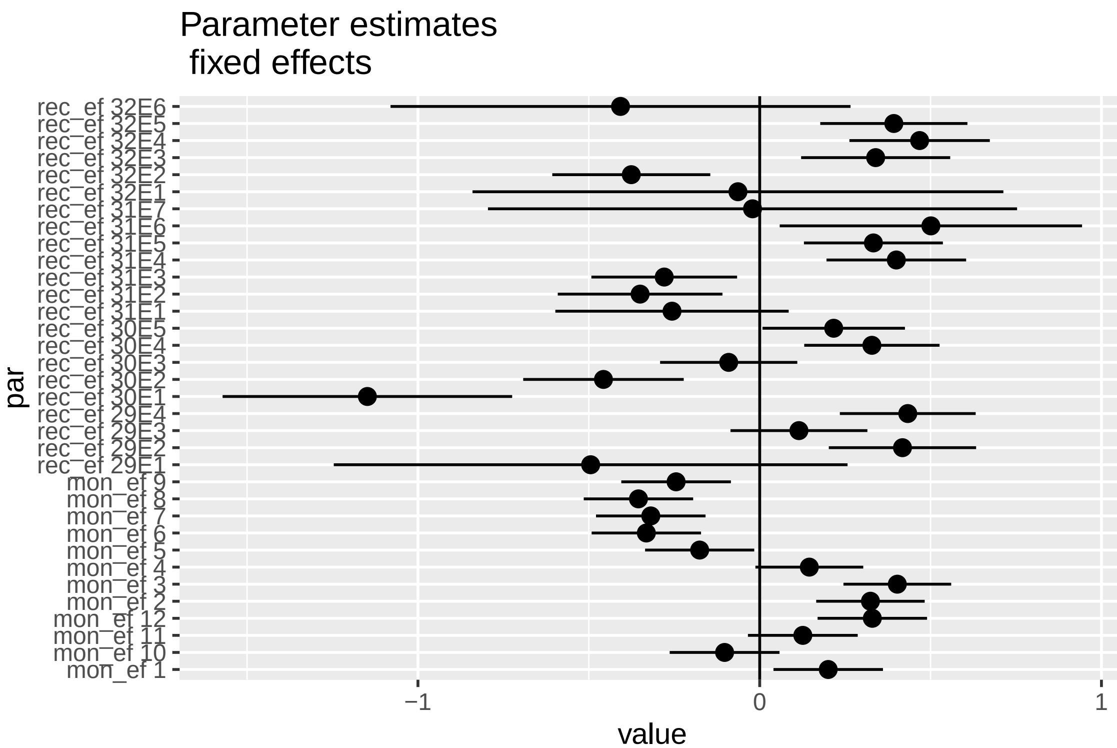

Figure 11: Parameter estimates for fixed effects

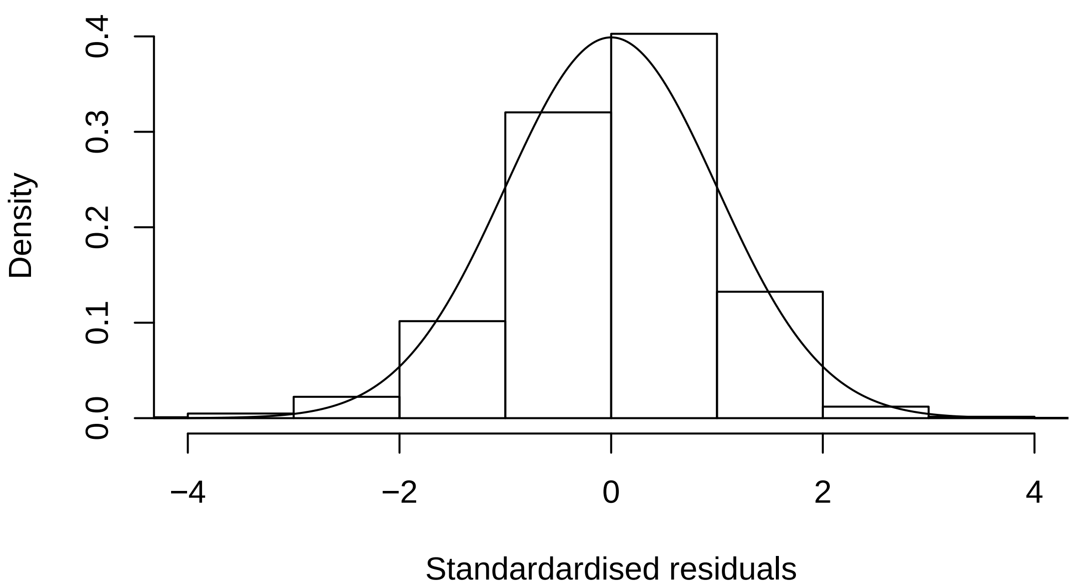

Figure 12: Histogram of standardised residuals

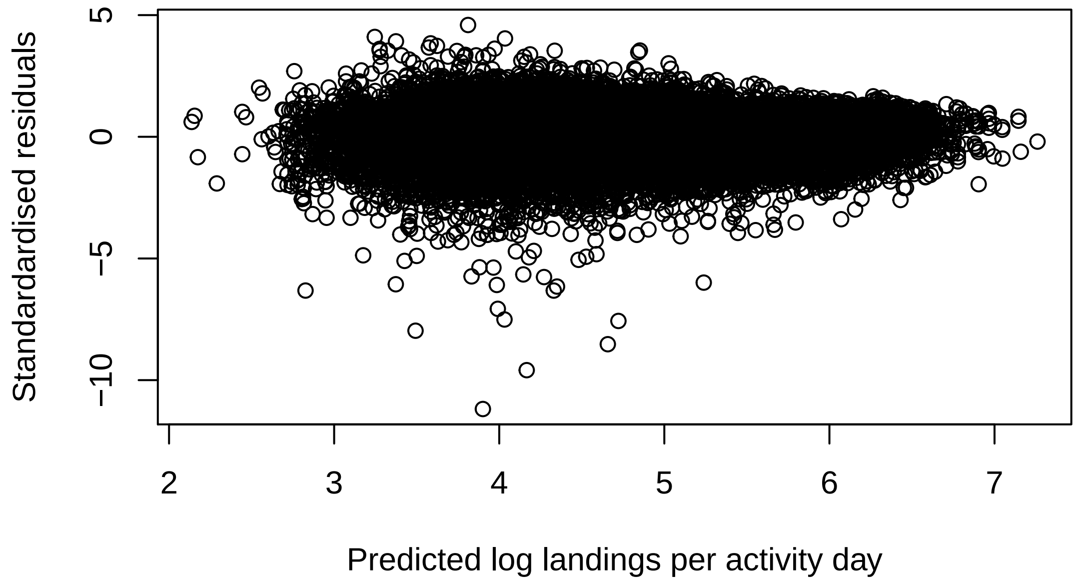

Figure 13: Standardised residuals vs predicted landings

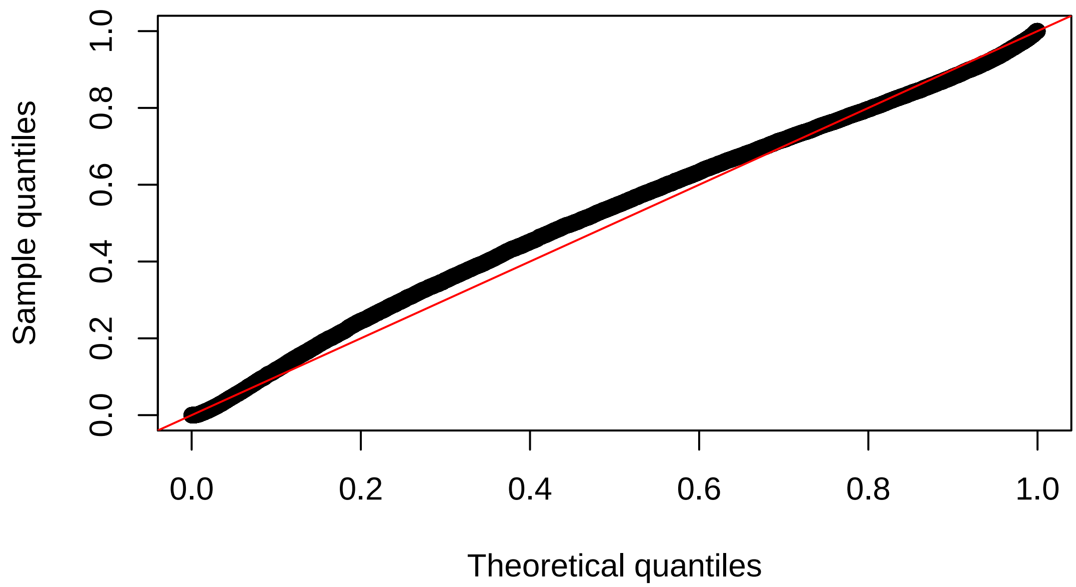

Figure 14: QQ plot of standardised residuals

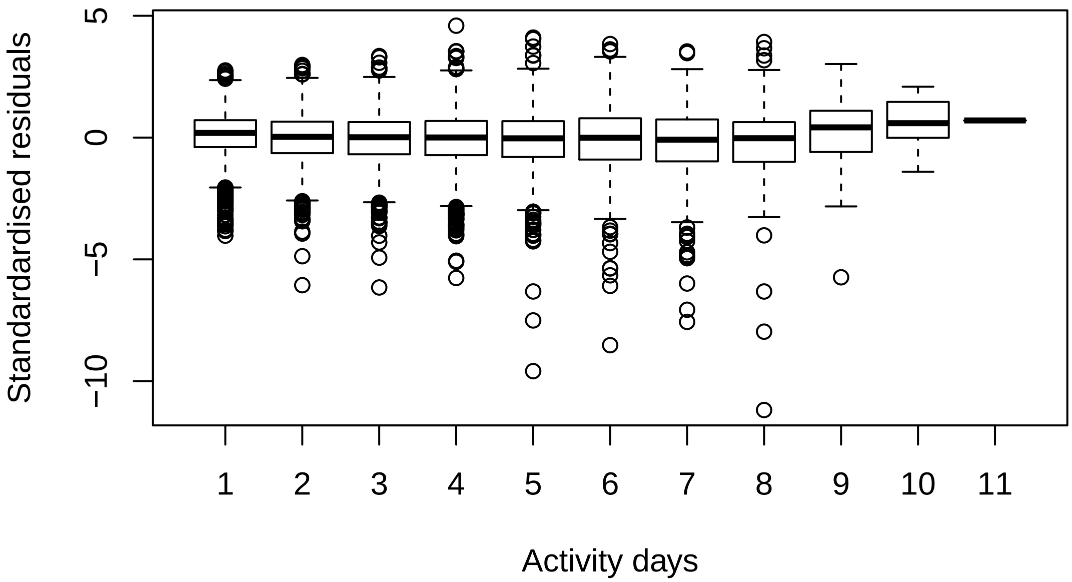

Figure 15: Standardised residuals vs Activity Days

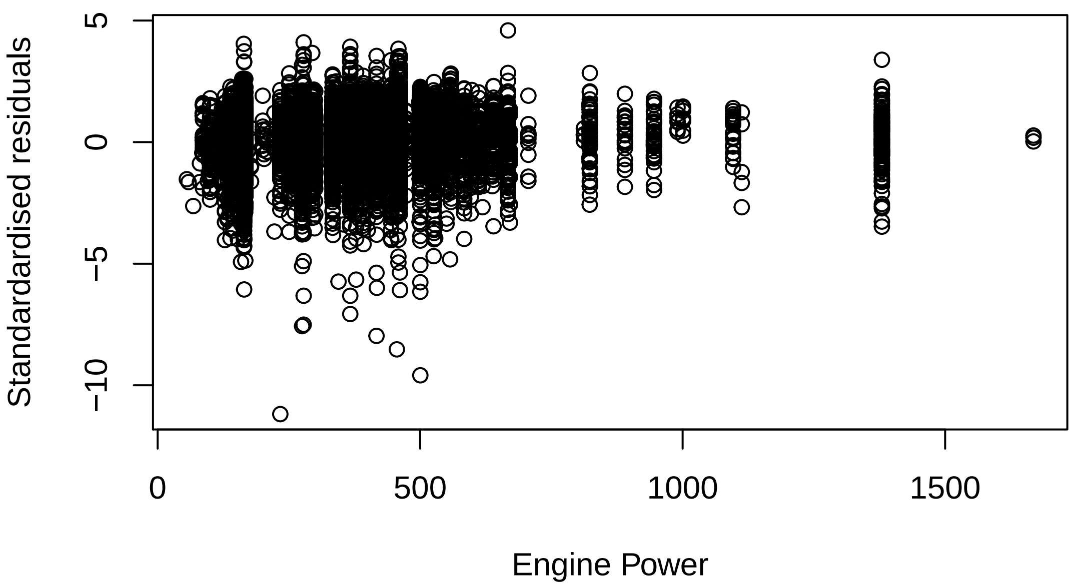

Figure 16: Standardised residuals vs Engine Power

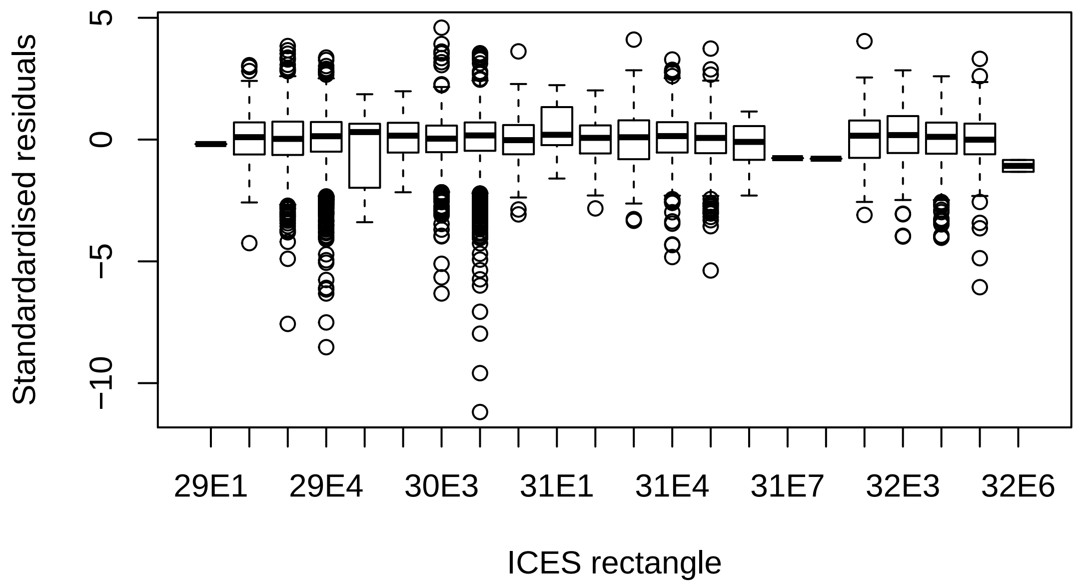

Figure 17: Standardised residuals vs ICES rectangle

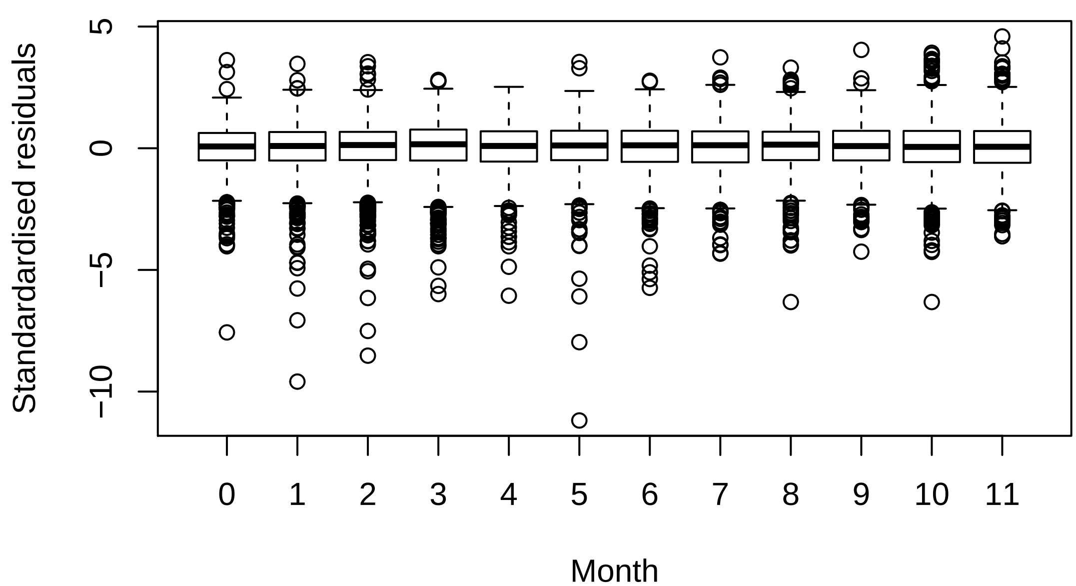

Figure 18: Standardised residuals vs Month

year	lo	mean	up
1984	108.11	143.84	191.38
1985	96.21	126.19	165.53
1986	105.44	138.66	182.33
1987	78.18	102.40	134.12
1988	66.95	88.03	115.73
1989	52.98	69.56	91.34
1990	67.81	88.70	116.01
1991	51.01	66.58	86.89
1992	40.30	52.58	68.61
1993	32.48	42.36	55.23
1994	33.56	43.82	57.21
1995	35.08	45.81	59.81
1996	30.47	39.78	51.95
1997	40.84	53.41	69.85
1998	56.12	73.55	96.41
1999	61.15	80.05	104.78
2000	42.71	55.82	72.94
2001	38.92	50.81	66.34
2002	46.51	60.85	79.59
2003	54.57	71.40	93.43
2004	59.85	78.31	102.47
2005	63.11	82.85	108.77
2006	95.39	126.35	167.35
2007	159.26	211.96	282.10
2008	173.94	232.70	311.32
2009	148.97	200.08	268.72
2010	167.29	224.03	300.01
2011	200.48	271.02	366.39
2012	179.00	238.77	318.48
2013	154.25	205.10	272.73
2014	213.18	287.98	389.01
2015	168.32	226.11	303.72
2016	143.99	192.69	257.87
2017	130.51	173.85	231.59
2018	151.37	202.54	271.01

\end{table}

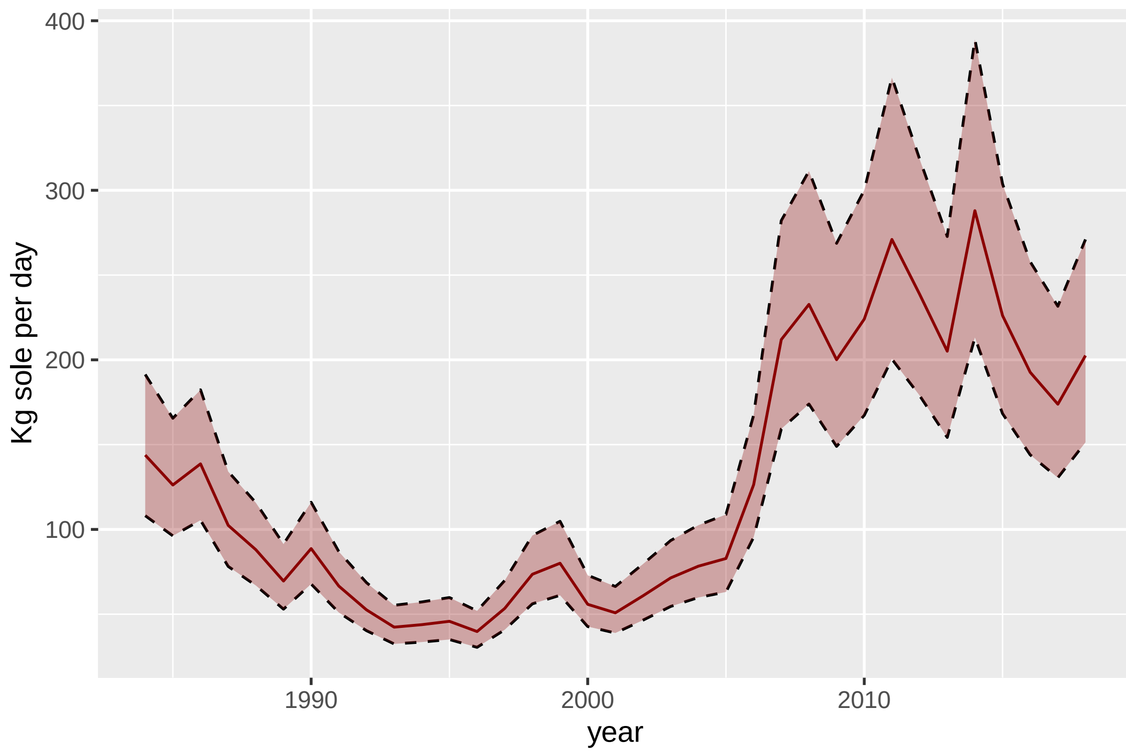

Figure 19: Standardised index and 95% confidence intervals

Table 9: LPUE in Numbers at age (thousands)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1984	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1985	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1986	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1987	0.000	16.376	62.318	78.348	48.977	16.456	19.202	11.438	6.846	2.560	3.859	4.867	3.943	1.299
1988	0.037	21.969	26.928	36.016	37.592	51.484	8.673	3.964	6.468	10.202	4.756	2.318	9.145	1.235
1989	0.000	74.982	127.802	32.640	27.020	11.451	8.274	4.991	3.752	1.143	1.223	0.829	0.800	1.128
1990	0.000	3.515	33.719	92.449	40.382	38.598	12.811	11.201	6.970	4.254	2.109	0.334	0.800	1.106
1991	0.000	12.544	23.817	45.930	41.598	14.525	16.221	5.684	4.938	3.957	3.230	1.098	0.875	0.908
1992	0.000	5.333	66.018	30.855	24.912	20.769	6.732	6.407	2.935	4.021	1.589	0.773	0.315	0.302
1993	0.476	1.454	20.617	49.265	19.108	12.363	10.151	2.744	5.866	2.126	1.229	1.050	0.682	0.967
1994	0.000	7.432	25.578	18.884	37.032	11.435	10.029	6.182	3.654	4.906	2.540	1.473	1.386	1.212
1995	0.000	4.503	24.590	20.658	15.845	29.723	6.823	8.614	6.382	2.304	2.290	1.155	1.360	0.762
1996	0.055	5.175	22.365	29.920	16.405	10.456	12.237	3.385	3.065	2.804	0.867	2.146	1.107	0.505
1997	0.000	3.428	21.434	30.628	24.403	18.765	9.624	13.759	3.896	3.990	1.620	1.624	1.124	0.586
1998	0.000	6.290	50.553	36.636	38.180	25.159	8.270	6.617	9.832	3.250	2.777	1.882	0.931	0.648
1999	0.193	14.969	97.610	51.393	25.144	23.782	13.435	6.263	2.670	4.920	1.762	0.890	0.397	0.019
2000	0.022	22.192	46.636	46.033	23.185	8.281	8.602	5.989	2.806	1.231	2.387	0.755	0.537	0.603
2001	0.000	10.085	73.533	26.644	24.041	13.024	5.152	4.515	2.858	2.320	0.915	1.938	0.348	0.626
2002	0.000	2.860	38.925	97.795	23.381	16.541	7.404	4.754	3.553	2.232	1.440	0.933	0.913	0.237
2003	0.022	5.028	28.305	49.449	103.927	21.641	12.690	4.999	1.574	1.919	0.703	1.073	0.162	0.513
2004	0.000	7.900	38.033	27.288	47.548	75.252	14.304	11.189	6.077	2.737	1.295	2.063	0.339	0.213
2005	0.000	12.588	35.722	57.852	25.032	27.569	52.967	6.691	6.187	1.647	2.208	0.919	0.799	0.429
2006	0.000	13.538	73.782	81.023	89.111	27.487	33.963	59.403	11.404	6.674	3.269	1.897	1.408	0.630
2007	1.088	21.049	90.841	105.430	91.225	96.773	37.626	47.741	89.934	9.596	8.795	4.639	1.878	3.802
2008	0.000	17.414	109.742	144.839	96.967	75.162	78.120	27.352	45.701	61.162	14.481	7.021	3.431	4.436
2009	0.000	31.692	75.303	101.559	101.651	88.392	38.571	40.904	16.177	16.946	40.818	5.036	4.020	1.699
2010	0.000	3.623	200.048	133.633	98.509	93.497	70.401	38.675	36.042	10.953	9.175	25.944	2.961	2.663
2011	0.956	17.290	139.919	305.074	100.099	84.100	54.749	47.130	29.646	30.251	9.313	17.447	40.200	2.287
2012	0.000	7.486	37.632	223.909	288.383	70.058	48.637	44.625	23.918	18.738	16.016	3.108	7.917	8.477
2013	0.000	1.062	60.329	31.585	143.625	158.103	72.709	34.428	32.968	22.250	17.138	10.697	4.953	8.617
2014	0.000	0.000	56.102	141.035	40.249	139.125	132.479	73.416	45.273	34.790	14.978	16.064	10.961	6.843
2015	0.000	3.857	44.195	148.331	143.998	72.699	78.166	62.372	28.555	14.062	11.368	11.078	9.047	6.345
2016	0.000	2.580	21.458	93.788	159.273	80.029	45.649	64.276	39.429	15.103	9.734	5.493	2.750	2.549
2017	0.000	3.172	101.212	98.515	52.119	107.915	50.258	30.015	34.612	22.482	5.833	2.894	2.220	6.459
2018	0.000	1.380	33.668	146.167	85.618	75.136	70.802	47.354	19.148	29.367	26.237	17.553	6.955	1.027

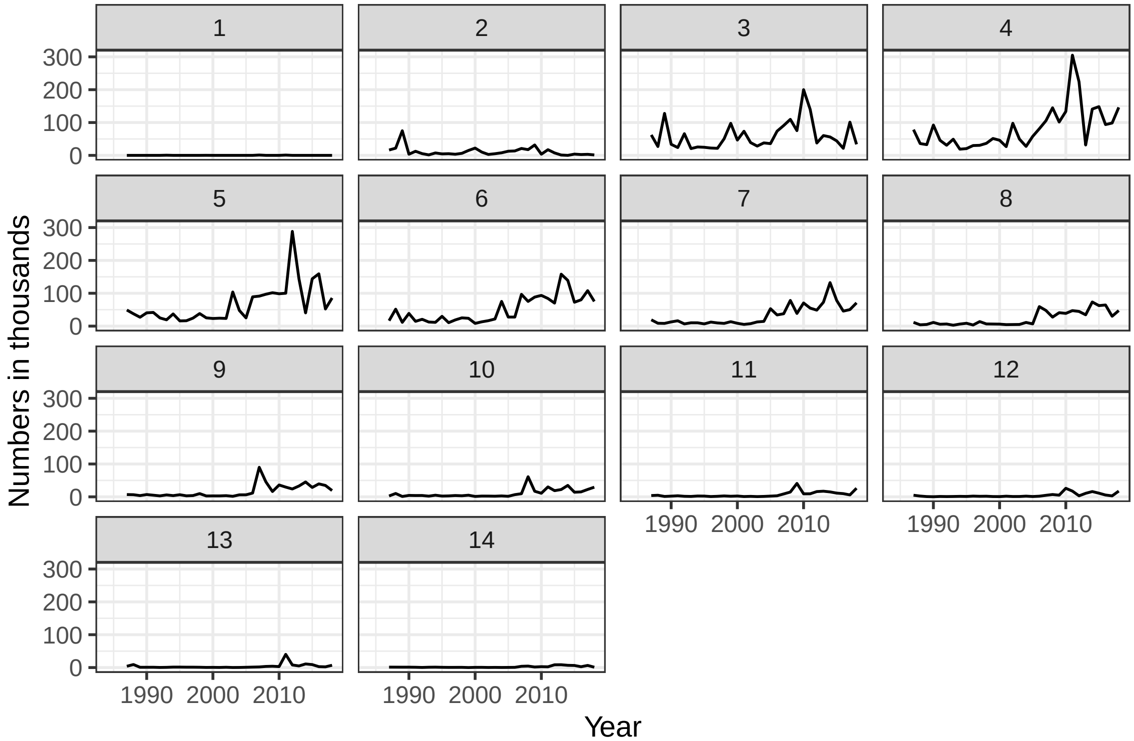

Figure 20: LPUE (in numbers, thousands) by age

6 Appendices

6.0.1 A: Template Model Builder Code for fitting the delta-GLMM

```
## #include <TMB.hpp>
##
## template<class Type>
## Type trans(Type x){
##   return exp(x)/(Type(1)+exp(x));
## }
##
## template<class Type>
## Type objective_function<Type>::operator() ()
## {
##   DATA_VECTOR(lw);
##   DATA_VECTOR(ep);
##   DATA_VECTOR(ol);
##   DATA_IVECTOR(yr);
##   DATA_IVECTOR(mn);
##   DATA_IVECTOR(day);
##   DATA_VECTOR(ad);
##   DATA_INTEGER(EfType);
```

```
##   DATA_IVECTOR(ves);
##   DATA_IVECTOR(rec);
##
##   DATA_ARRAY(comp);
##   DATA_ARRAY(wt);
##
##   PARAMETER_VECTOR(inter_ar);
##   PARAMETER(p);
##
##   PARAMETER(sigma_sq_log);
##   PARAMETER(sigma_sq_log_ar);
##
##   PARAMETER_VECTOR(ves_ef);
##   PARAMETER_VECTOR(rec_ef);
##   PARAMETER(sigma_sq_log_ves);
##   PARAMETER(sigma_sq_log_rec);
##
##   PARAMETER_VECTOR(mon_ef);
##   PARAMETER(sigma_sq_log_mon);
##
##   PARAMETER(beta);
##   Type beta_trans = trans(beta); // constrain
##
##   int minYear=yr.minCoeff();
##   int maxYear=yr.maxCoeff();
##   int ny=maxYear-minYear+1;
##
##   vector<Type> l_ep = log(ep);
##   vector<Type> l_ad = log(ad);
##   vector<Type> l_ol = log(ol);
##   vector<Type> l_lw = log(lw) - l_ad;
##   Type sigma = exp(Type(0.5) * sigma_sq_log);
##   Type sigma_ar = exp(Type(0.5) * sigma_sq_log_ar);
##   Type sigma_ves = exp(Type(0.5) * sigma_sq_log_ves);
##   Type sigma_rec = exp(Type(0.5) * sigma_sq_log_rec);
##   Type sigma_mon = exp(Type(0.5) * sigma_sq_log_mon);
##
##   // Adjusted KW days
##   vector<Type> aad = ad * (pow(ep,beta_trans)/pow(368.0,beta_trans)); //standard 500
##   vector<Type> l_aad = log(aad);
##   vector<Type> l_alw = log(lw) - l_aad;
##
##   vector<Type> pred(lw.size());
##
##   Type predic =0;
```

```
##   Type nll = 0;
##   vector<Type> residuals(lw.size());
##   residuals.setZero();
##
##   // begin loop
##   for (int i=0; i<lw.size(); ++i){
##
##     pred(i) = inter_ar(yr(i) - minYear) + ves_ef(ves(i)) +
##      rec_ef(rec(i)) + mon_ef(mn(i));
##
##     switch(EfType) {
##
## case 0:  // activity days
##
##     if( lw(i) == 0){
##       nll += - ad(i) * log(1 - trans(p + pred(i)));
##     }else{
##       predic = (l_lw(i) - pred(i))/ (sigma / sqrt(ad(i)));
##       nll += - log(1 - pow(1 - trans(p + pred(i)),ad(i))) -
##        log(1 / (sigma / sqrt(ad(i)))) -
##        dnorm(predic,Type(0),Type(1),true);
##     }
##
##
##     // lognormal residuals
##     residuals(i) = (l_lw(i) - pred(i)) /(sigma  /sqrt(ad(i)));
##
##     break;
##
## case 1: // adjusted for KW days
##
##     if(lw(i) == 0){
##       nll += - aad(i) * log(1 - trans(p + pred(i)));
##     }else{
##       predic = (l_alw(i) - pred(i))/ (sigma / sqrt(aad(i)));
##       nll += - log(1 - pow(1 - trans(p + pred(i)), aad(i))) -
##        log(1 / (sigma/(sqrt(aad(i))))) -
##        dnorm(predic,Type(0),Type(1),true);
##     }
##
##     // lognormal residuals
##     residuals(i) = (l_alw(i) - pred(i)) /(sigma  /sqrt(aad(i)));
##
##     break;
##
```

```
##     }
##
##
##   }
##
##   /// likelihood
##   nll += -sum(dnorm(ves_ef,Type(0),sigma_ves,true));
##   nll += -sum(dnorm(rec_ef,Type(0),sigma_rec,true));
##   nll += -sum(dnorm(mon_ef, Type(0), sigma_mon, true));
##
##   for (int i=1; i<ny; ++i){
##     nll += -dnorm(inter_ar(i),inter_ar(i-1),sigma_ar,true) ;
##   }
##
##   // Derived quantities
##   // LPUE in numbers by age
##
## //int ncols = wt.matrix().cols();
## //int nrows = wt.matrix().rows();
##
## vector<Type> lpue = exp(inter_ar); // on normal scale
## //array<Type>  wt_at = comp * wt;
## //vector<Type> pq_at = wt_at.matrix().rowwise().sum();
##
## //matrix<Type> pq_at_n(nrows,ncols);  // sure you can do this vectorised..
##
## //for(int j = 0; j++; j < ncols){
## //   for(int i = 0; i++; i < nrows) {
## //       pq_at_n(i,j) = pq_at(i);
## //   }
## //       }
##
## //matrix<Type> q_at = wt_at.rowwise() / pq_at.array().transpose();// proportions
## //  matrix<Type> N_at = (lpue.transpose().array() * q_at)/wt;
## //  matrix<Type> N_atw = N_at.array() / wt;
##
##   REPORT(pred);
##   REPORT(sigma);
##   REPORT(residuals);
##   REPORT(lpue);
## //  REPORT(pq_at);
##  // REPORT(pq_at_n);
## //  REPORT(N_atw);
##
##   return nll;
```

```
## }
```

Development of an index for sole in ICES Divisions 7.f and 7.g using the UK-quarter 1 South-West ecosystem survey (UK-Q1SWECOS).

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Workshop: WKFlatNSCS
Date: 17th February – 21st February 2020
Location: ICES headquarters, Copenhagen, Denmark

Contents

Abstract

Introduction

This working document describes the methods used to calculate the provided standardised index of abundance at age for sole in ICES Divisions 7.f and 7.g (Table 1) using the UK-Q1SWECOS survey (also known as the UK-Q1SWBeam survey). The original survey, known as the UK-Q1SWBeam survey, was conducted over a two week period in the first quarter of each year using a stratified random sampling design in ICES Division 7.e, it was then spatially and temporally expanded in 2014 to cover a much wider area. The expanded survey, UK-Q1SWECOS survey, is conducted using the same survey design to sample ICES Divisions 7.e-h and parts of 7.a and 7.k, figure 1. The survey continues to use two 4-meter beam trawls and the area covered by the survey is split into 28 strata, with five stations randomly selected in each strata, with extra stations selected for specific strata (ICES, 2012).

As the extended survey (UK-Q1SWECOS) has been conducted over the last 5 years it now provides the potential to develop independent indices of abundance/biomass timeseries in both the Western Channel and Celtic Sea. This opens up the opportunity for independent fisheries data to be included into fish, cephalopod and shellfish stock assessments previously not considered.

For sole, otoliths and other biological information are collected routinely as part of the surveys specific aims which provide age, length, weight, maturity and sex information. The numbers at age from the survey are standardised to numbers at age per km^2 and raised using the calculated area where the ICES Divisions 7.f and 7.g overlap the stratum, table 1.

Table 1. UK-Q1SWECOS survey stratum, coverage and station frequency within ICES division 7.f and 7.g.

Stratum	Stratum Area (km^2)	Number of stations fished per stratum in ICES Divisions 7.f and 7.g					
		2014	2015	2016	2017	2018	2019
Stratum1	2 898	2	1	3	3	0	1
Stratum2	909	0	0	2	1	0	2
StratumA	1 163	4	4	0	0	0	0
StratumB	2 186	5	4	6	4	5	4
StratumC	2 749	5	5	6	5	5	5
StratumD	4 758	5	5	5	5	5	3
StratumE	3 722	0	4	4	2	5	4
StratumF	9 674	3	5	4	5	5	3

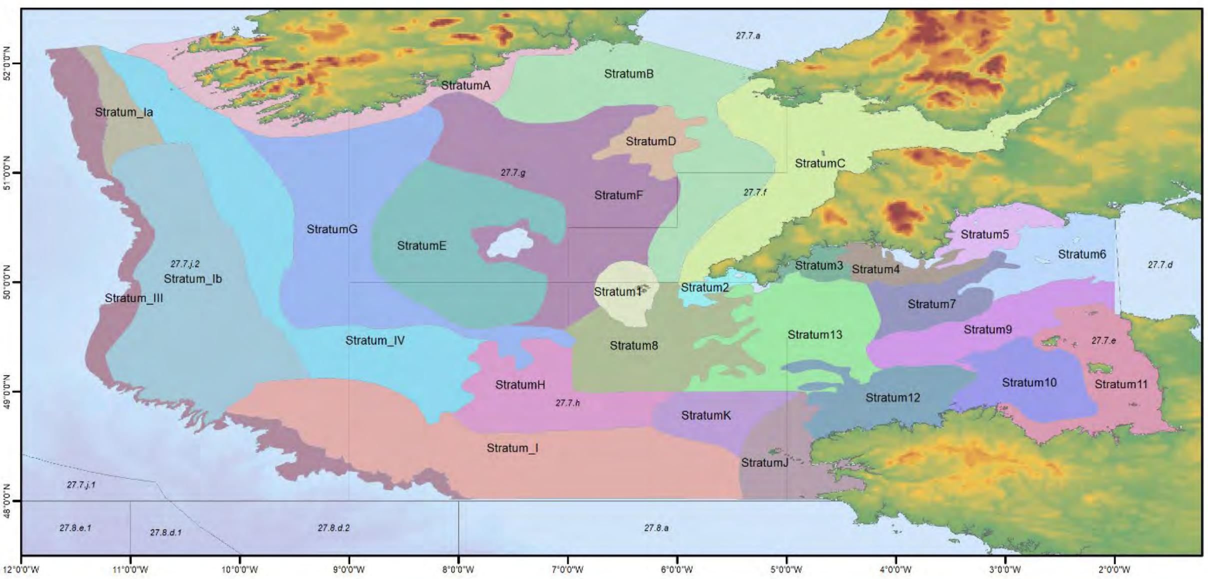


Figure 1. Stratification of the UK-Q1SWECOS trawl survey - based on fishermen's knowledge and environmental information.

Methods

Station selection

Stratum where first constructed using both industry knowledge and ecosystem-based data such as community structures, species biology, epifauna, plankton, sediment type, bathymetry and other oceanographic/biological features. Each stratum are then split into a grid consisting of hexagons of around 1/15th the size of the respective stratum area. The stratum grid design is then intersected with squares of 2x2 nautical miles and additionally with the ICES rectangles to ensure reporting by ICES rectangle and division is possible, termed micro-grid.

Stations are selected randomly from the gridded stratum design via two stages selection process. Firstly a set of grids (hexagons) is selected from each stratum weighted by the proportion of the area of the grid to the stratum area, so that large grids have a higher probability of being selected than small ones. From the resulting selected grids, micro-grids are randomly selected again proportional to the percentage area of the micro-grid in the grid. An excess of possible sampling stations, up to the total number of grids, are selected in each stratum and the order in which grids are selected is retained as the priority.

The sampling position is the geographic centre of the micro-Grid, but for practical reasons any tow transecting are contained within a 1 nautical mile radius of that position is considered sufficient.

Species sampling

All sole caught are sampled for length measurements, biological information such as age, sex and maturity have a target number of fish per length group for each strata split between each of the stations within the strata.

Index calculation

The age length composition from the survey was applied to the numbers-at-length by sex (where available), strata and year. The resultant numbers-at-age were then standardised to numbers per km^2. Finally, standardised numbers-at age by station where averaged over the stratum and year, multiplied by the stratum area (Table 1) and then dividing by the total area to give a weighted average. Stations included in the calculation are only those with valid hauls for both gears used.

Strata B-D and F were considered most appropriate to use in the index calculation as the survey design and station selection is random stratified and these strata have a large proportion of the area with in ICES Divisions 7.f and 7.g. This is so that all stations with in a stratum are used in the calculation without compromising on a reduction in sampling area due to stations being outside of ICES Divisions 7.f and 7.g.

Table 1. Stratum used in the calculation of the index and associated area.

Stratum	Area km^2
Stratum B	20 338
Stratum C	18 496
Stratum D	3 229
Stratum F	23 348
Total	65 411

Results

The sole index of weighted mean abundance per km^2 for ages 1 to 28 over the years 2014 to 2019 are presented in table 2. Data for age 1 sole is noisy with some years reporting zero catch of sole in the strata used for the index, this is also true for sole older than 10, with the older age groups increasing the number of years with reported catches at zero. The maximum age recorded in the survey for the strata is 28 and the highest numbers caught are within the age-groups 2-7 years.

The catch-at-age matrix and residuals, figure 2, show some patterns across cohorts, however the within cohort correlation matrix shows that there are no significant correlations across cohorts with the exception of the 4-7 year olds, although there are only 3 data points contributing to it.

Table XX. Sole index of abundance in ICES Divisions 7.f and 7.g, numbers per 1000m²

Year	Age																											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
2014	3.61	6.26	78.81	86.42	24.10	58.91	51.99	14.96	12.86	0.26	2.83	3.01	2.16	0.00	1.28	6.02	0.83	0.00	0.00	0.00	0.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2015	8.03	10.88	29.51	26.02	9.68	0.39	22.30	5.73	4.53	1.28	3.17	0.47	1.85	3.48	2.61	0.00	2.54	0.59	0.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2016	0.00	18.56	25.27	28.81	35.83	30.75	6.85	11.30	11.59	5.06	0.00	0.86	2.28	0.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2017	26.88	16.63	63.13	24.26	17.51	19.31	10.18	3.34	8.66	12.48	3.08	0.88	0.33	1.43	0.00	0.33	2.00	0.00	1.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2018	0.00	99.87	132.24	183.56	60.58	50.12	42.06	22.25	7.98	17.31	20.09	3.59	3.46	1.08	1.08	1.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10
2019	22.96	49.71	136.77	47.78	86.23	16.19	33.99	14.63	11.55	4.68	10.43	4.59	1.59	2.36	0.00	0.00	0.00	2.39	0.00	0.95	1.14	0.00	0.00	0.00	1.14	0.00	0.00	0.00

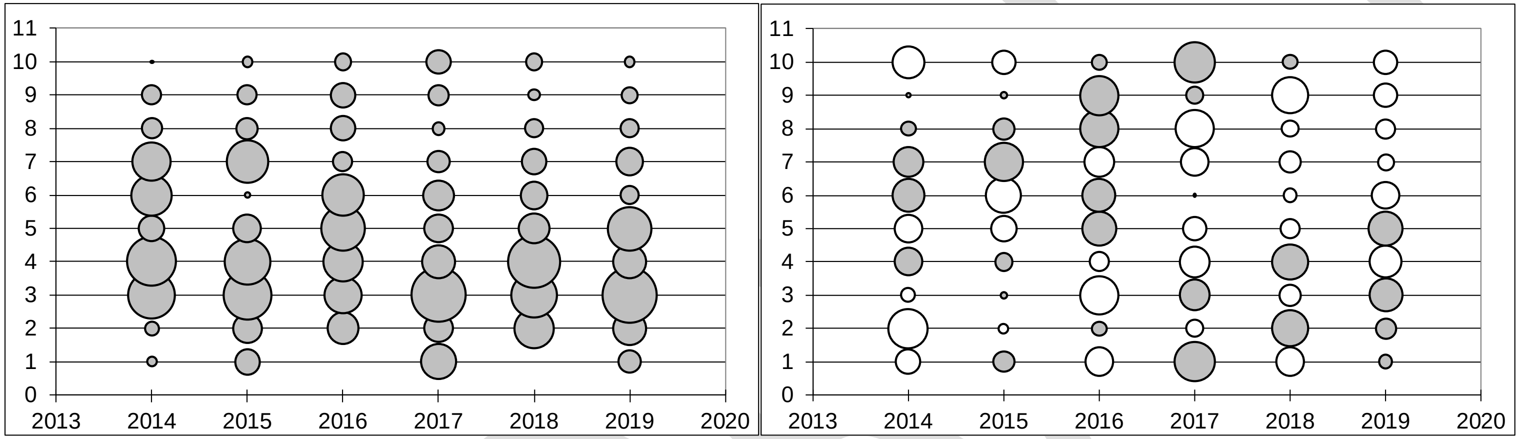


Figure 2. Catch-at-age matrix, expressed as average numbers per km² standardised to the mean of the year (left). Within year-class residuals (right).

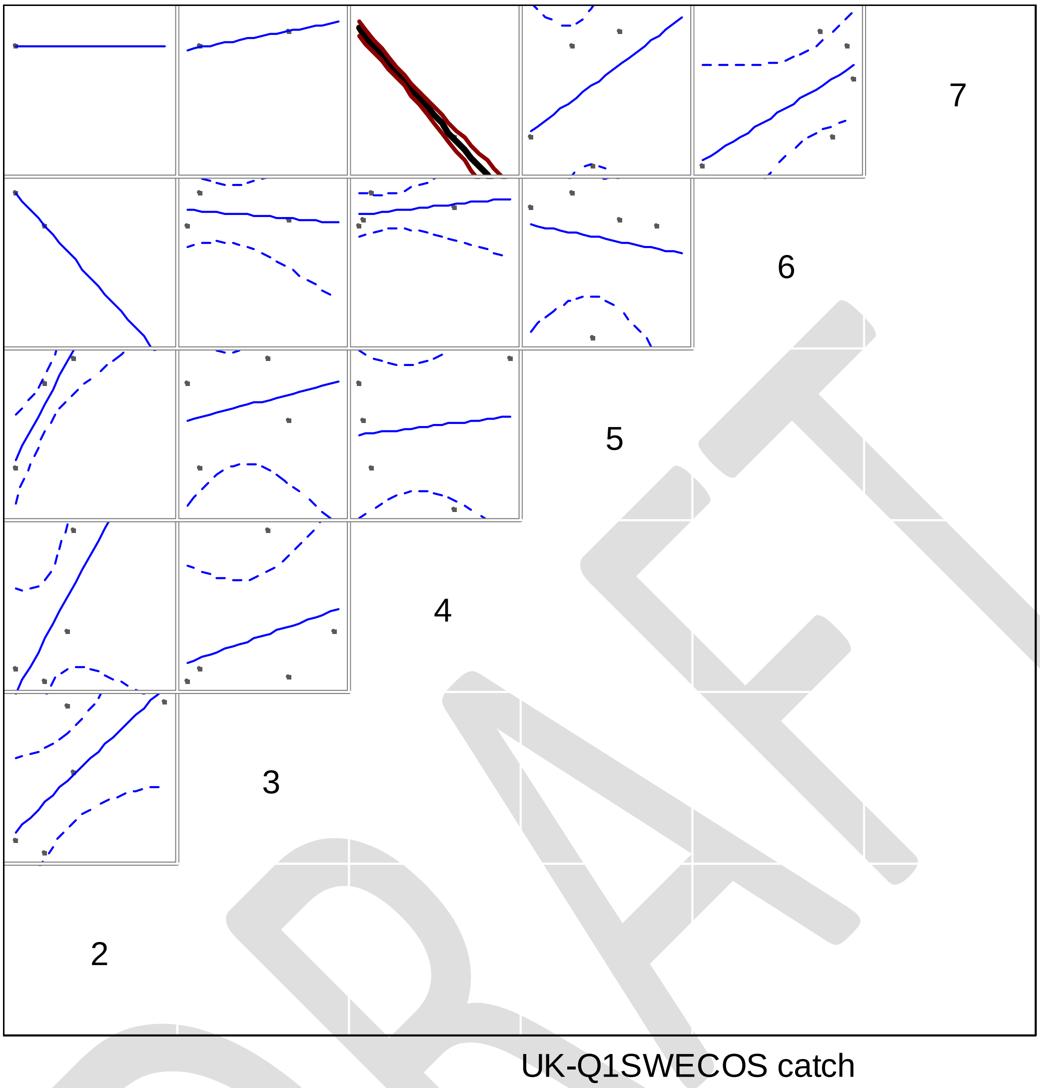


Figure 3. Within-cohort consistency in the catch-at-age matrix, shown by plotting the log-catch of a cohort at a particular age against the log-catch of the same cohort at subsequent ages. Thick lines represent a significant (p<0.05) regression and the curved lines are approximate 95% confidence intervals.

Conclusions

The analysis presented provides an age disaggregated index of abundance for sole in 7.f and 7.g. Although it includes the whole of strata B-D and F which extends further that the stock unit a large proportion of the area is contained within 7.f and 7.g. and allows for a more robust calculation making full use of the survey stratified random design.

With only six years of data and the index at age showing a lot of variation in all age groups it is difficult to show good cohort tracking when assessing the catch-at-age matrix, figure 2. Correlation between year-classes, figure 3, is weak but again with only 6 years of data it is too soon for any strong conclusions to be made on the indexes usefulness in a stock assessment.

References

ICES. 2012. Working document 17 in the Report of the Benchmark Workshop on Flatfish Species and Anglerfish (WKFLAT), 1–8 March 2012, Bilbao, Spain. ICES CM 2012/ACOM:46. 283 pp.

Working document: Assessment models for sole in the Bristol channel and the Celtic Sea (ICES divisions 7.f and 7.g).

Sofie Nimmegeers, Klaas Sys, Bart Vanelslander and Lies Vansteenbrugge

1. Introduction

The current model used to assess sole in ICES divisions 7.f and 7.g is an extended survival analysis (XSA). One of the aims of the WKFLATNSCS benchmark is to assess the performance of the current model against the new data and alternative stock assessment models.

2. XSA

2019 WGCSE-current assessment (baserun)

Data

Landings

The landings have fluctuated around an average of 1150 t in 1971-1999. After the increase in 2003 (1547 t), the landings dropped to 772 t in 2009. In 2012, the landings increased to the average level of the 70s – '90s (1101 t). In the most recent years, among the lowest levels of the time series were recorded. Over the last ca. 20 years, the contribution to the landings of the main countries involved in this fishery has remained rather stable over time (~70% Belgium, ~20% UK, ~7% France and ~3% Ireland).

For the period 2002–2005 the landings estimates were corrected for a substantial misreporting of Belgian landings into 7.h (WKCELT, ICES 2014).

Discards

Discards are not included in the assessment but the 3 year average (2016-2018) discard rate (8.9%), is used for topping up the landings advice to catch advice.

Catch numbers-at-age and weights-at-age in the catch

For the period 2003-2005, the catch numbers at age were corrected for a substantial misreporting of Belgian landings into 7.h (WKCELT, ICES 2014).

From 2012 onwards, the total international landings numbers at age and the mean landing weights at age were exported from InterCatch. The weighting algorithm for 'Mean weight weighted by numbers at age or length' was applied.

Numbers at age 1 in the catch are low in most years, therefore these were not considered to add useful information and are replaced by zeros.

Life history

Natural mortality

Natural mortality is assumed constant over ages and years at 0.1

Maturity

The maturity ogive is based on samples taken during the UK(E&W) beam trawl survey of March 1993 and 1994 and is applied to all years of the assessment.

Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Maturity	0.00	0.14	0.45	0.88	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Weight-at-age

For the period 2002-2004 the stock weights at age are the catch weights of the Belgian beam trawl fleet (BEL-BEAM) in the first quarter, smoothed by fitting a Gompertz function.

For the period 2005-2007, the stock weights were calculated as the weighted mean of the 1st quarter weights at age data supplied by Belgium and UK(E&W) (weighted by landed numbers) and smoothed using a quadratic fit through these points. The values for 2001 showed a strange convergence and were replaced by the mean of the 2000 and the 2002 weights.

For the period 2008-2018, the stock weights were obtained using the Rivard weight calculator (http://nft.nefsc.noaa.gov./), that conducts a cohort interpolation of the catch weights.

Proportion mortality before spawning

Both the proportion of natural mortality before spawning (Mprop) and the proportion of fishing mortality (F) before spawning (Fprop) are set to 0.

Tuning series

Two commercial (both beam trawl: BE_CBT and UK(E&W)_CBT) and one survey (UK(E&W)-BTS_Q3) data series are used for the calibration of the assessment of 7.fg sole. During the 2019 IBP, the Belgian commercial beam trawl tuning fleet (BE-CBT) was substantially revised. Prior to the IBP, the BE-CBT tuning series consisted of two parts, which were included separately in the assessment: one with the original data from 1971 up to 1996 and one series with data from 1997 up to 2017. For the latter, the effort was corrected for engine power, based on a study carried out by IMARES and CEFAS in the mid 90's (applicable to sole and plaice effort in the beam trawls fisheries). Currently, this method is outdated and during the IBP, a more realistic conversion factor for engine power was investigated to convert nominal fishing effort to effective effort. During the IBP, it was decided to include the new Belgian tuning series (BE_CBT3) from 2006 up until the last data year with ages 2-9. The old Belgian CBT from 1971-1996 was trimmed to ages 3-9. The BE_CBT2 series running from 1997 up until the last data year was excluded. Finally, the UK(E&W)-CBT from 1991-2012 was also trimmed to ages 3-8. Due to effort reporting issues, the 2013-2018 UK-CBT indices were not available and could not be used in the assessment. Settings for the UK(E&W)-BTS-Q3 survey remained unchanged.

XSA configuration

	2019 assessment		
Fleets:	Years	Ages	α–β
BEL-CBT commercial	1971–1996	3–9	0–1
BEL-CBT3 commercial	1997–2018	2–9	0–1
UK(E&W)-CBT commercial	1991–2012	3–8	0–1
UK(E&W)-BTS-Q3 survey	1988– 2018	1–5	0.75–0.85

-First data year	1971
-Last data year	assessment year-1
-First age	1
-Last age	10+
Time-series weights	None
-Model	Mean q model all ages
-Q plateau set at age	7
-Survivors estimates shrunk towards mean F	5 years / 5 ages
-s.e. of the means	1.5
-Min s.e. for pop. Estimates	0.3
-Prior weighting	None
Fbar	Ages 4-8

Figures 1-15 present the model output for the baserun (2019 WGCSE – current assessment).

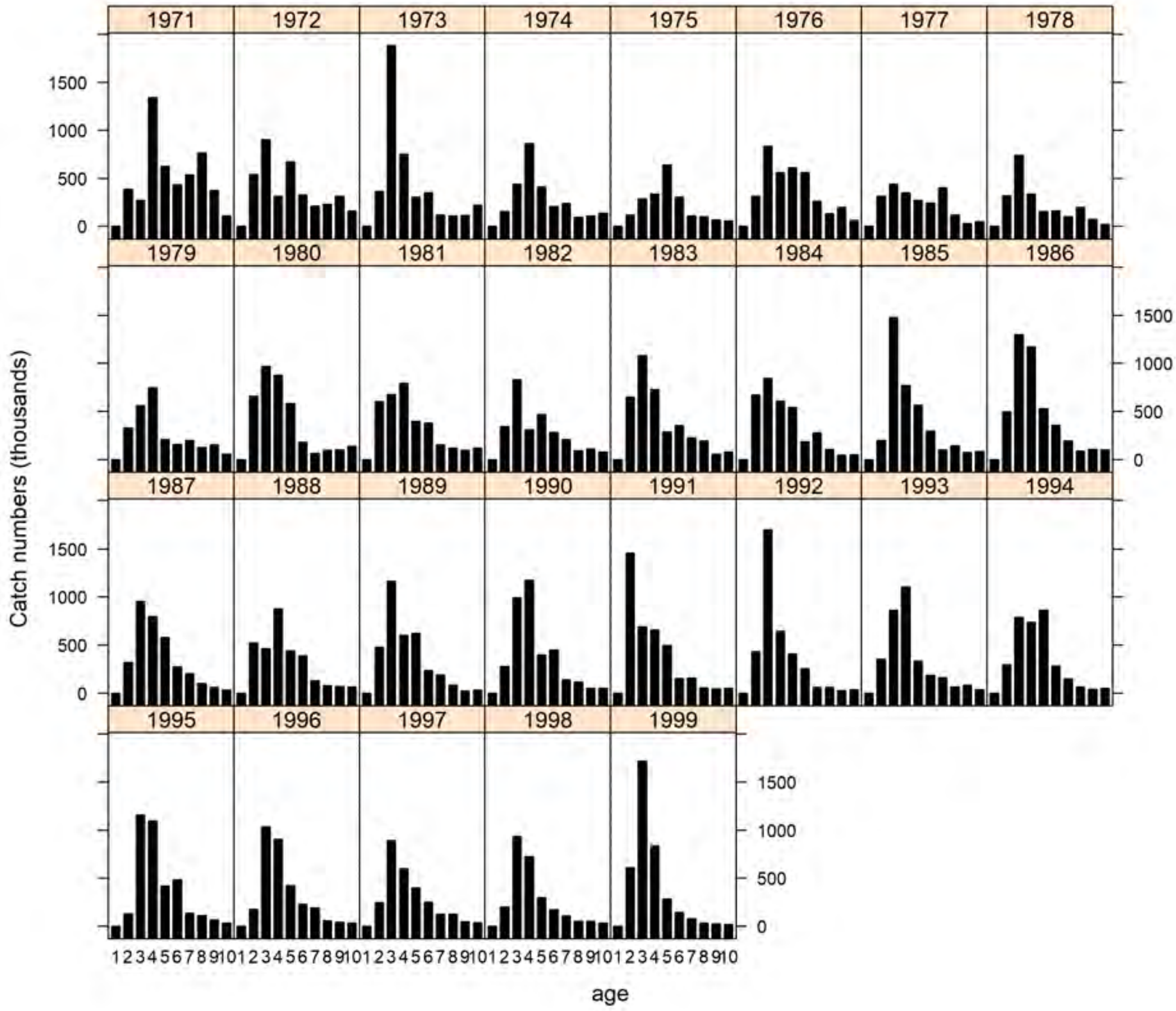


Figure 1a: Catch numbers (landings only) at age for sole in ICES divisions 7.f and 7.g for the period 1971-1999.

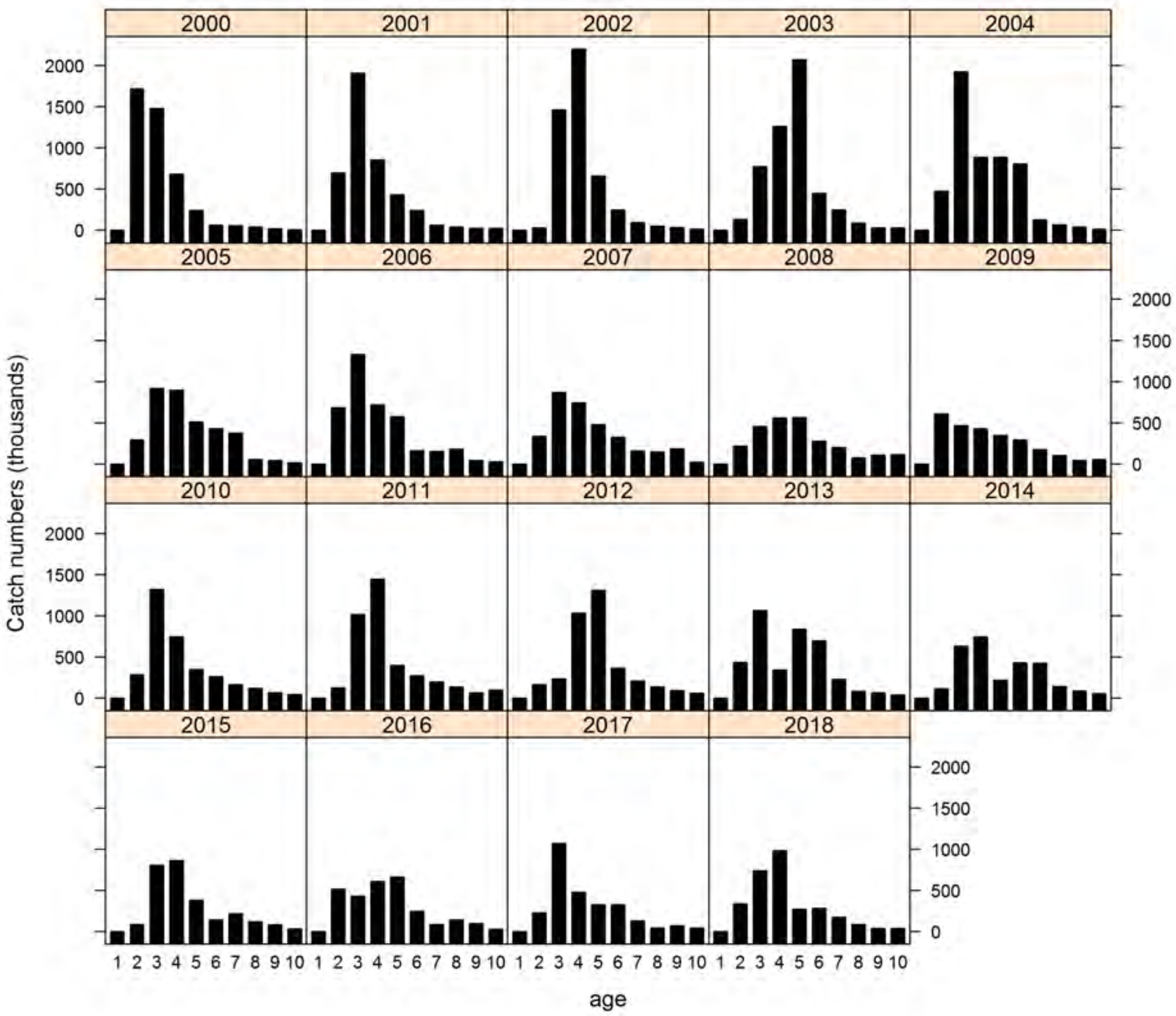


Figure 1b: Catch numbers (landings only) at age for sole in ICES divisions 7.f and 7.g for the period 2000-2018.

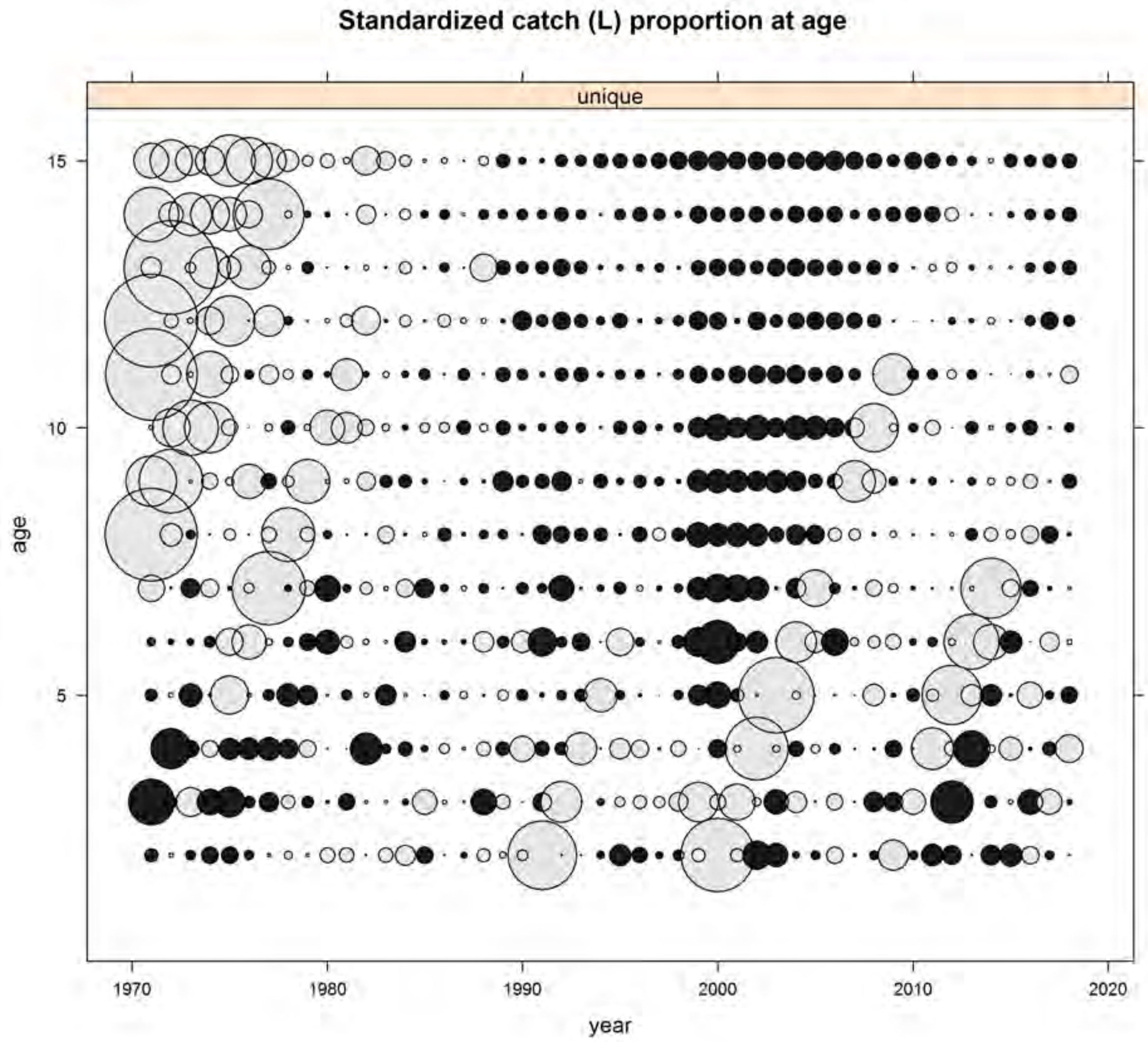


Figure 2: Standardized catch (landings only) proportions at age for sole in ICES divisions 7.f and 7.g.

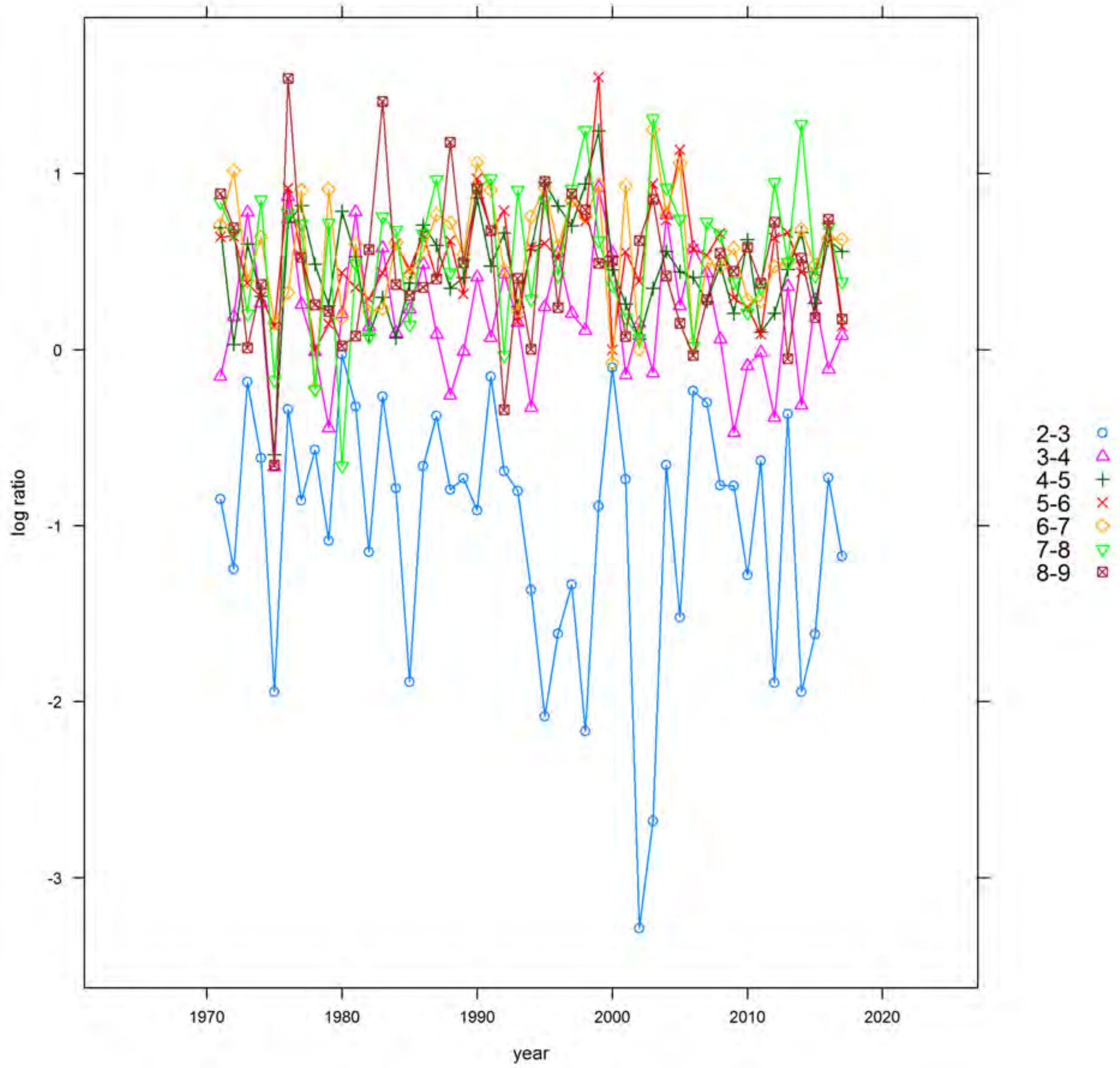


Figure 3: Log ratio of the catch (landings only) numbers at age for sole in ICES divisions 7.f and 7.g.

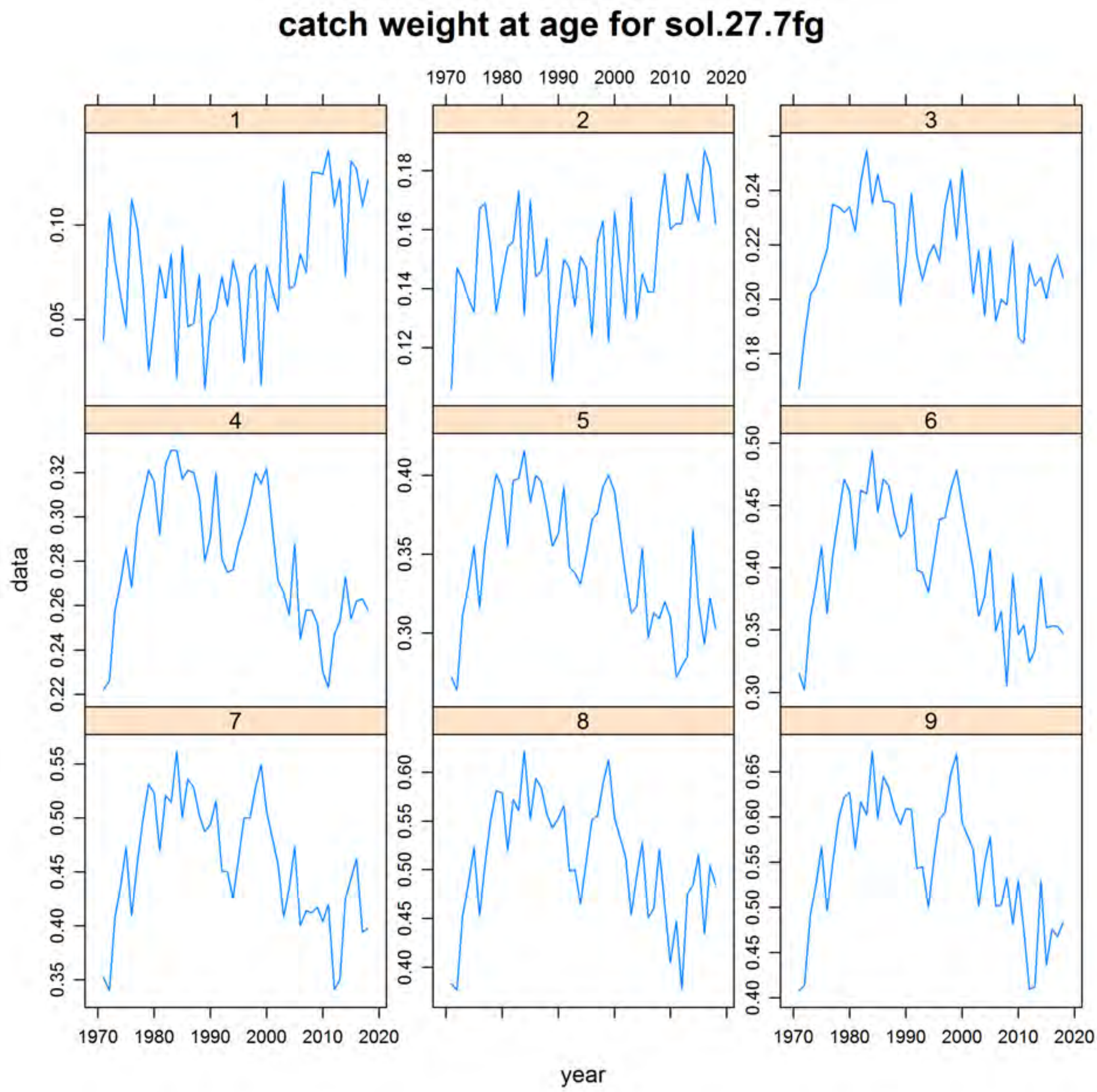


Figure 4: Catch (landings only) weights at age for sole in ICES divisions 7.f and 7.g.

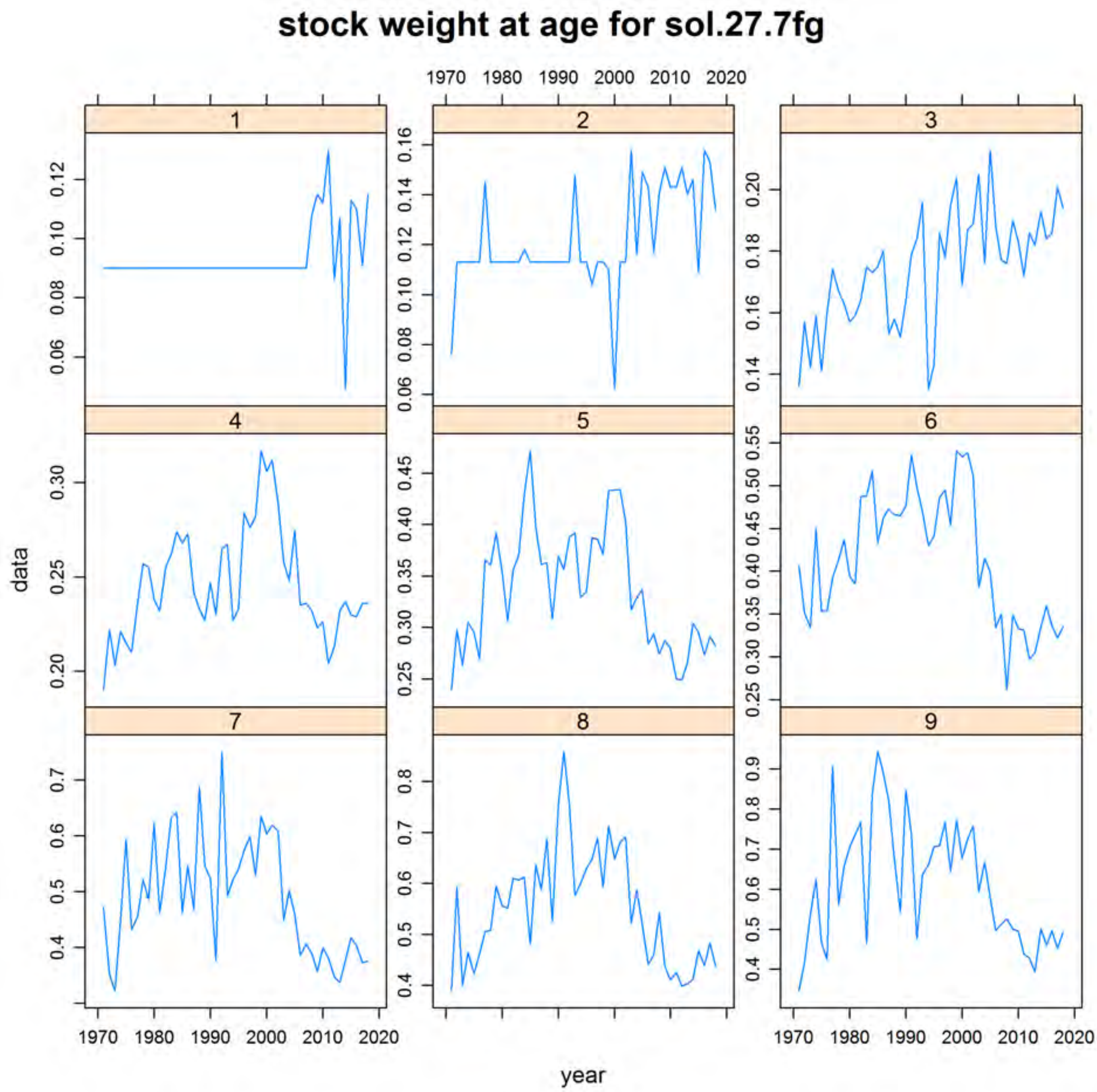


Figure 5: Stock weights at age for sole in ICES divisions 7.f and 7.g.

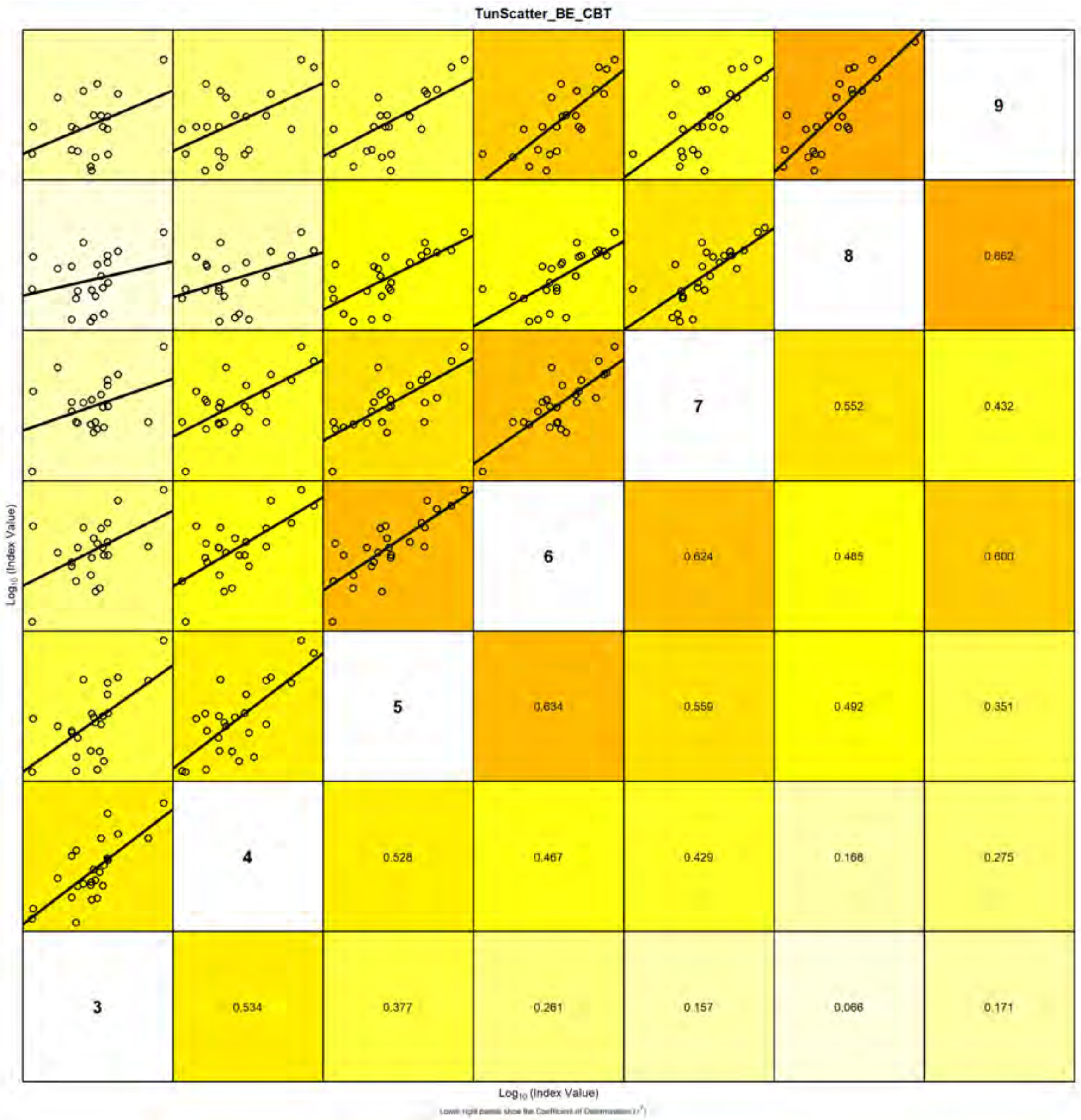


Figure 6: Internal consistency plot of the BE-CBT (1971–1996) tuning series for sole in ICES divisions 7.f and 7.g.

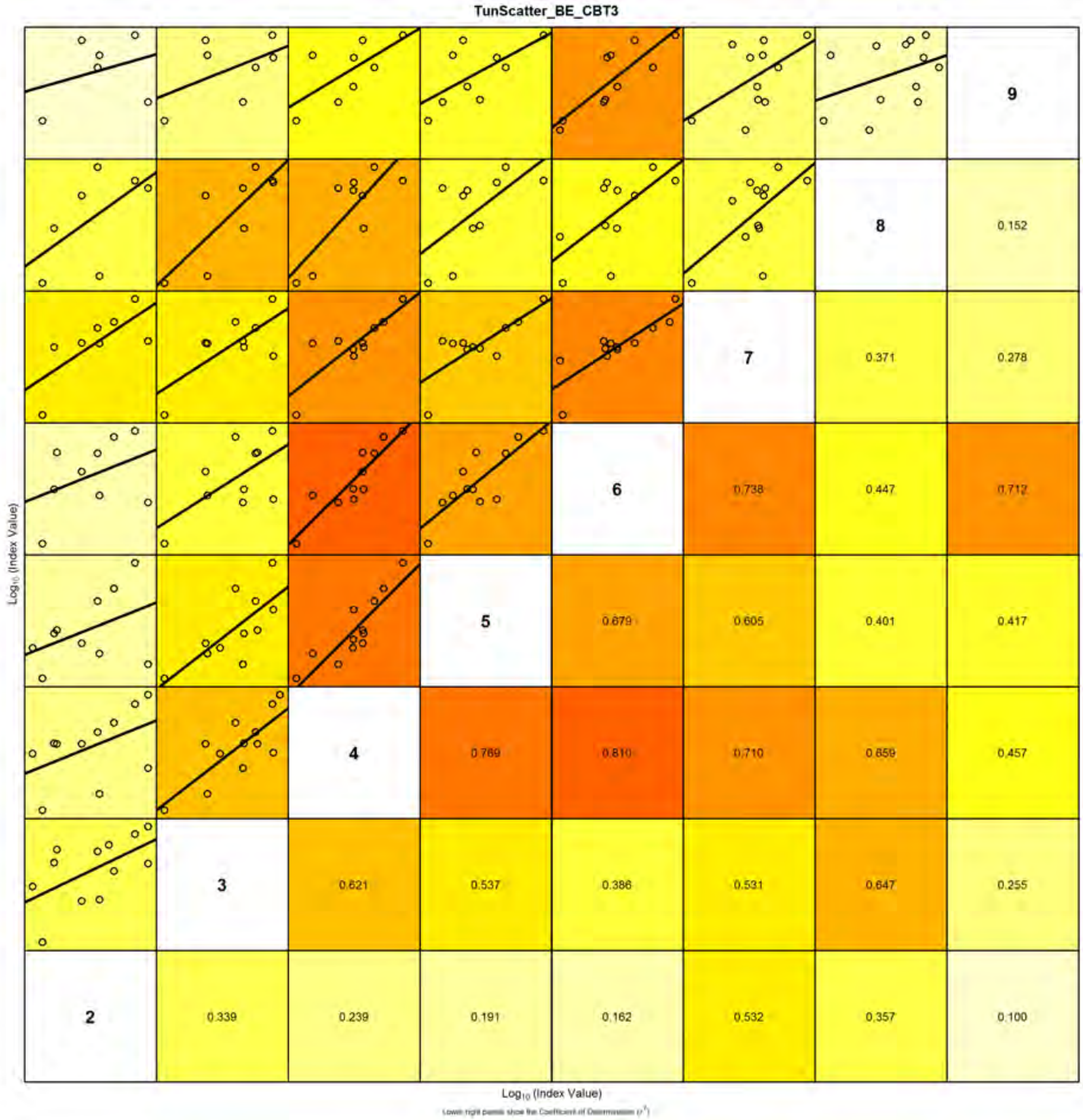


Figure 7: Internal consistency plot of the BE-CBT3 (2006–2018) tuning series for sole in ICES divisions 7.f and 7.g.

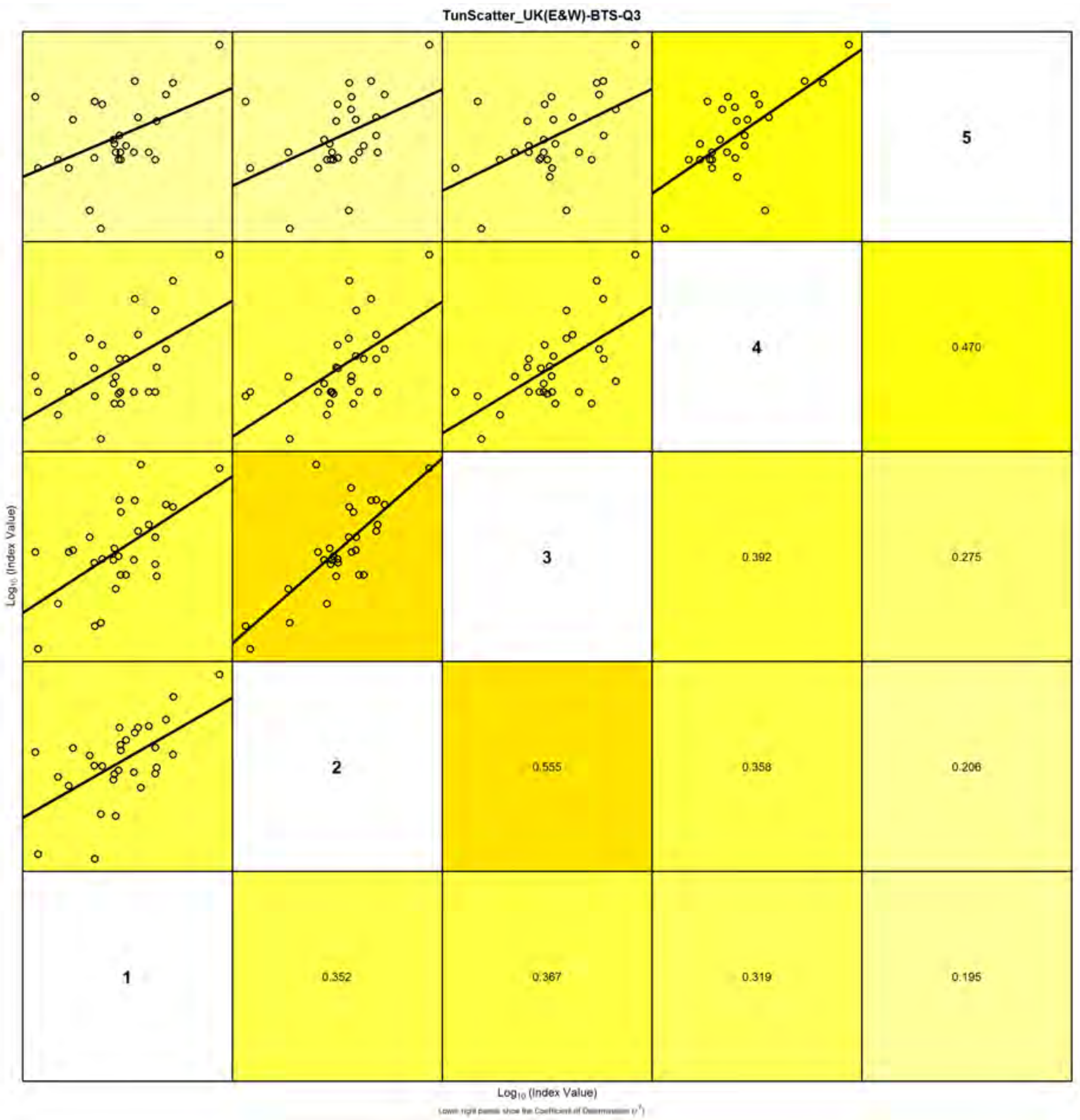


Figure 8: Internal consistency plot of the UK(E&W)-BTS-Q3 (1988–2018) tuning series for sole in ICES divisions 7.f and 7.g.

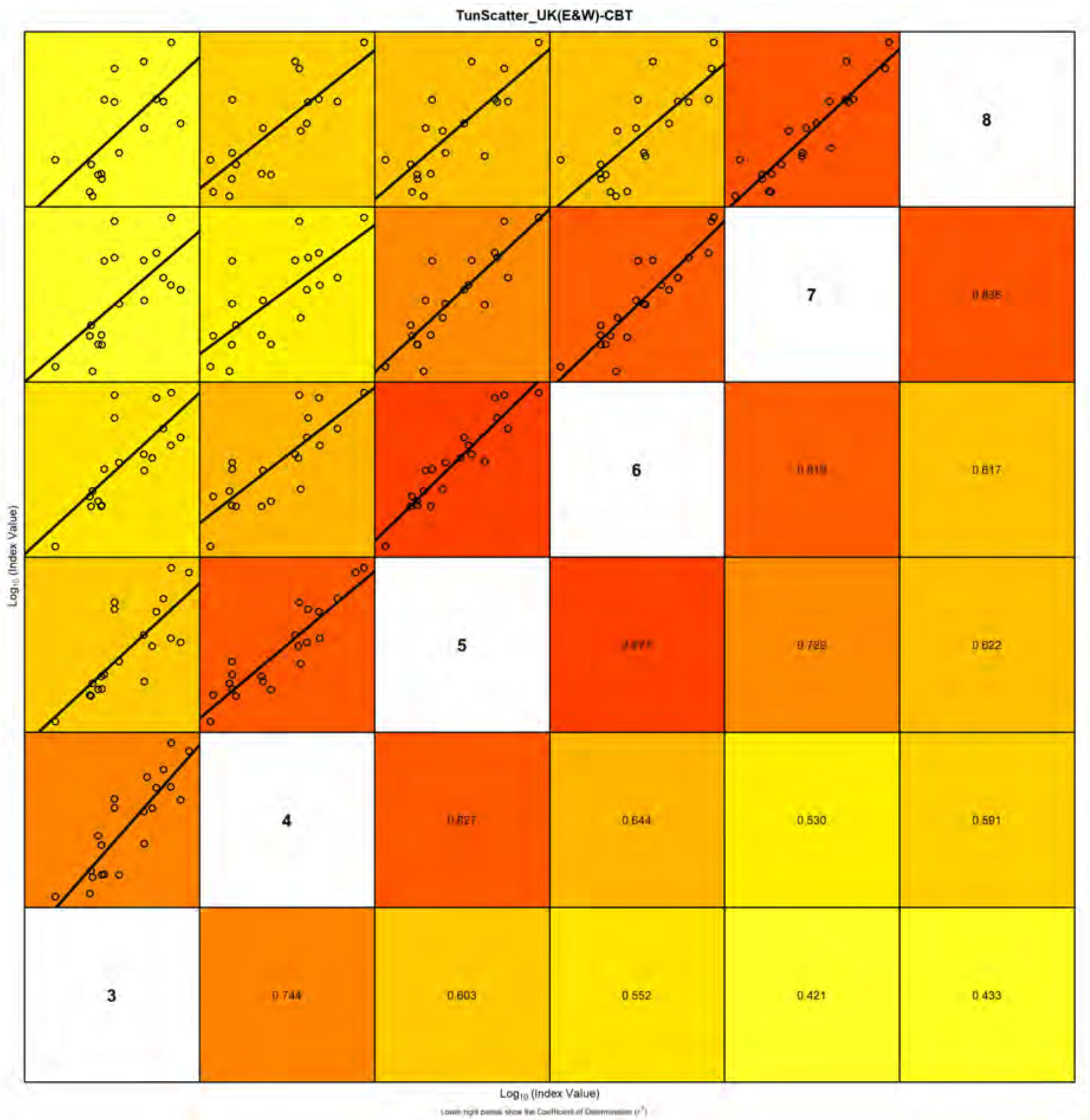


Figure 9: Internal consistency plot of the UK(E&W)-CBT (1991–2012) tuning series for sole in ICES divisions 7.f and 7.g.

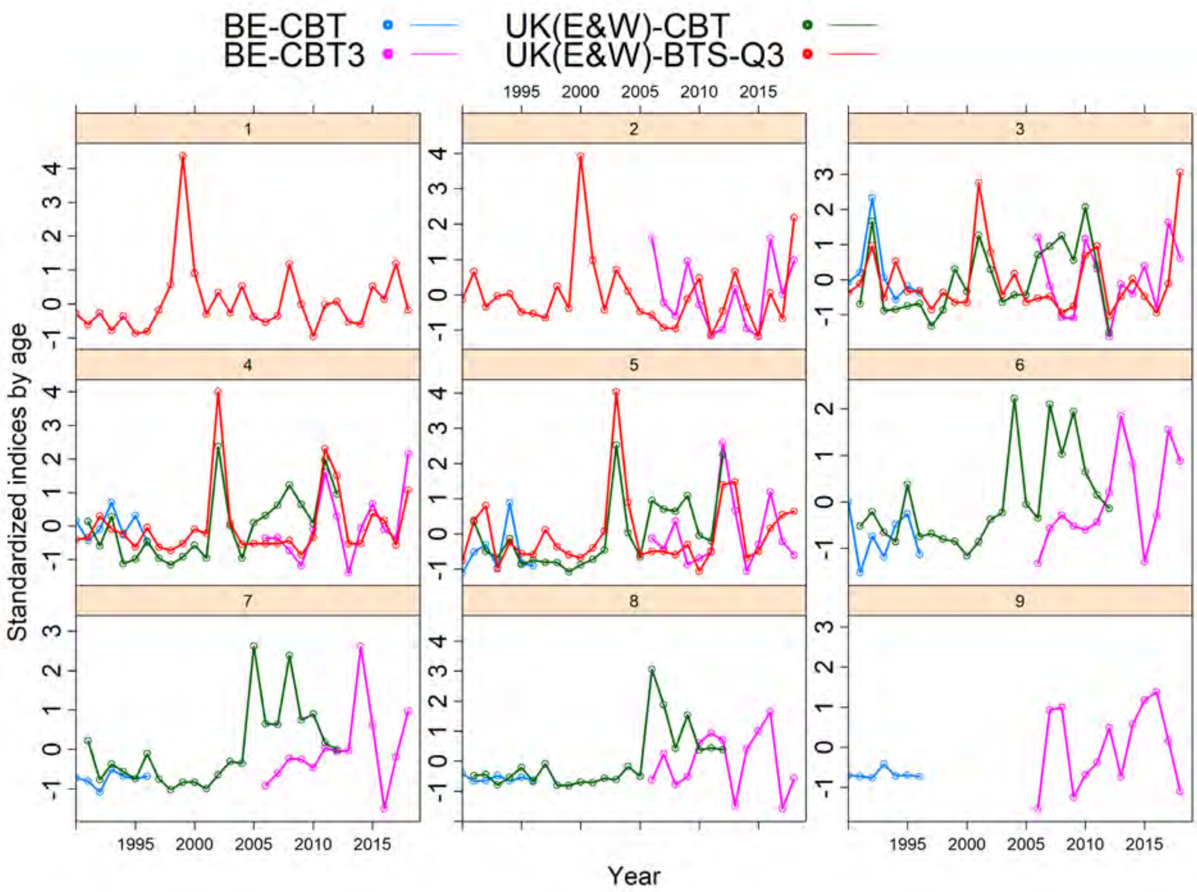


Figure 10: Standardized indices by age of the tuning series for sole in ICES divisions 7.f and 7.g.

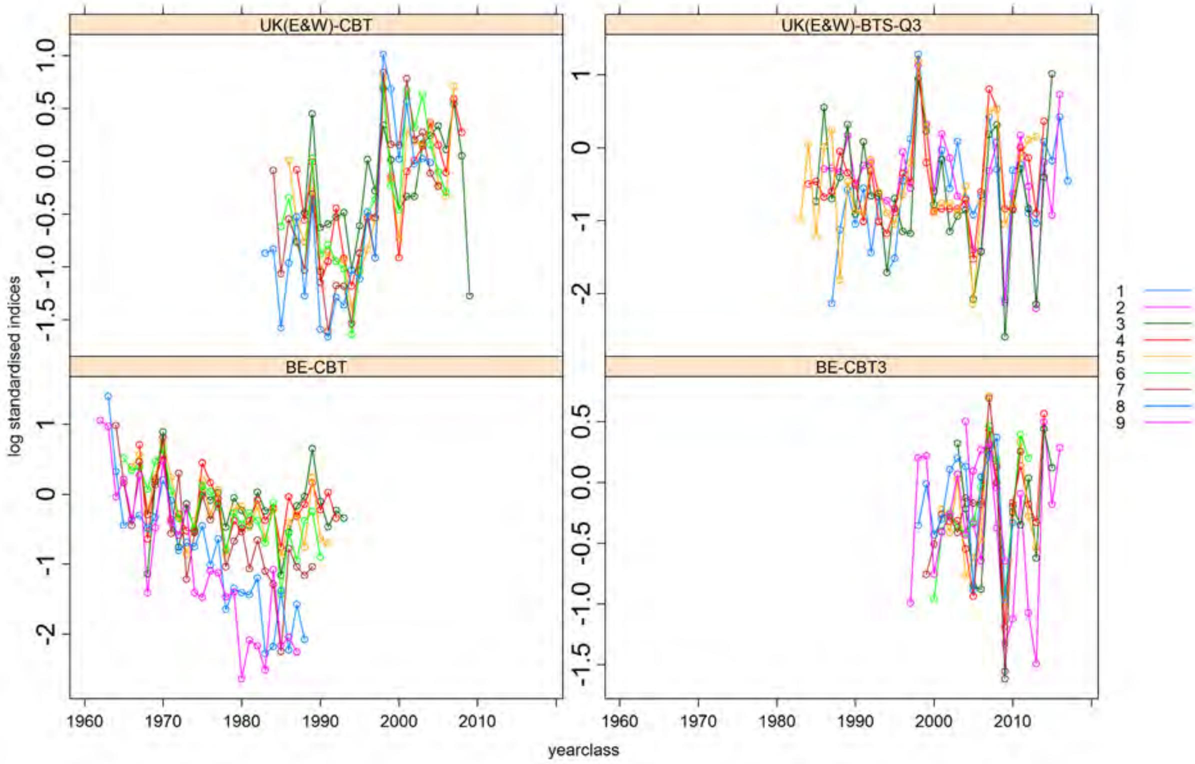


Figure 11: Log standardized indices by age of the tuning series for sole in ICES divisions 7.f and 7.g.

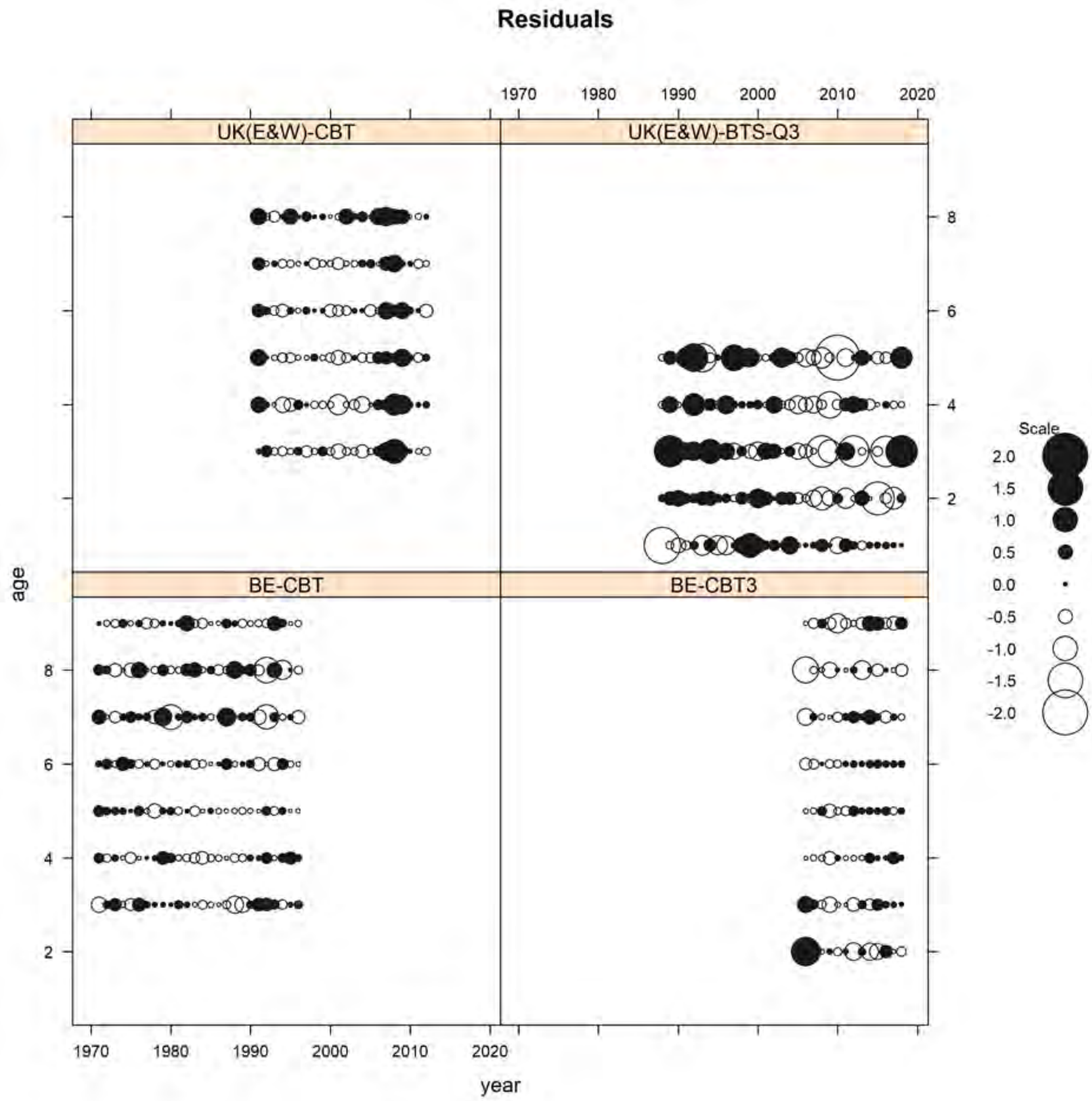


Figure 12: Catchability residuals of the tuning series for sole in ICES divisions 7.f and 7.g.

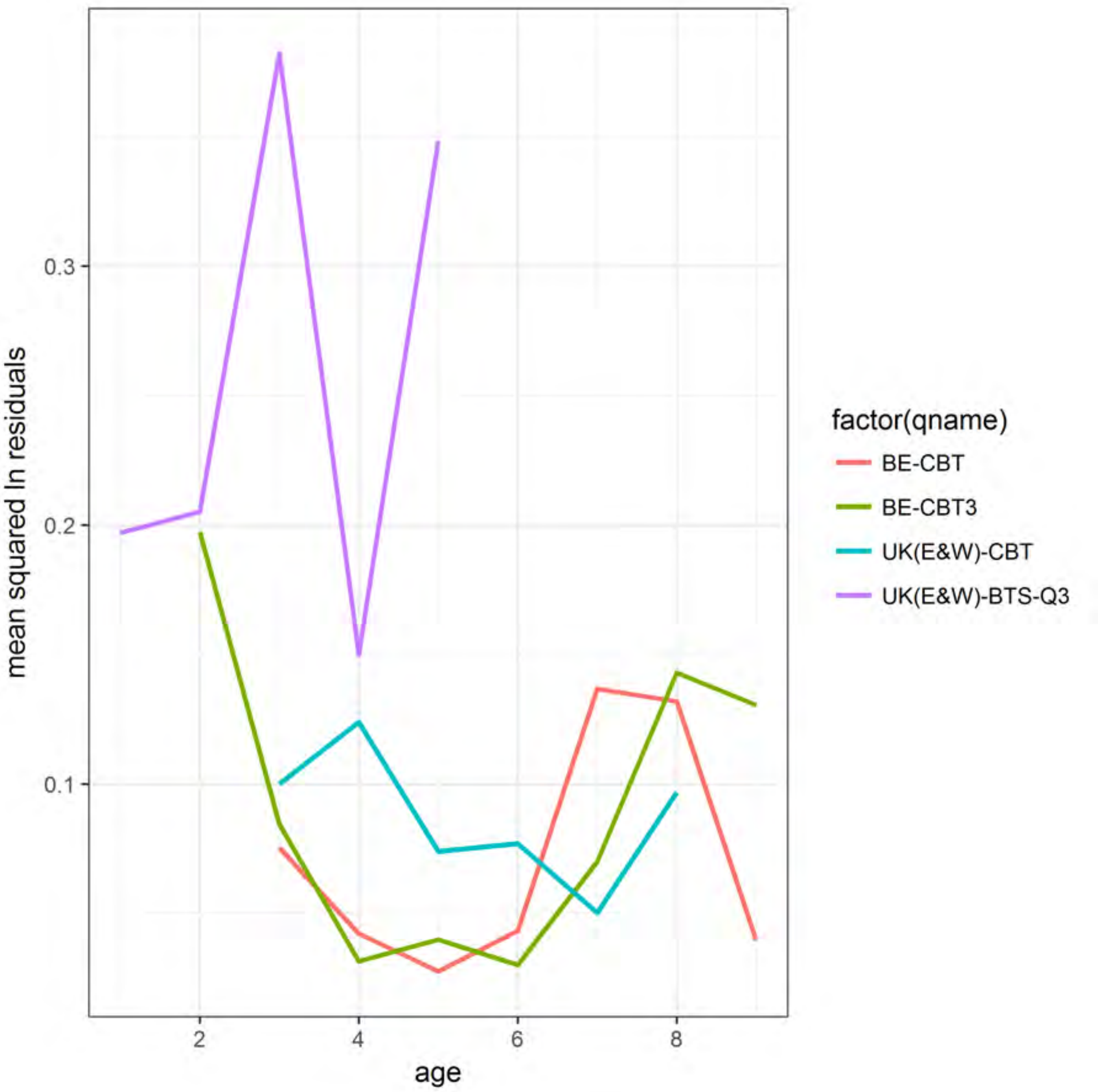


Figure 13: Mean squared residuals of the tuning series by age for sole in ICES divisions 7.f and 7.g.

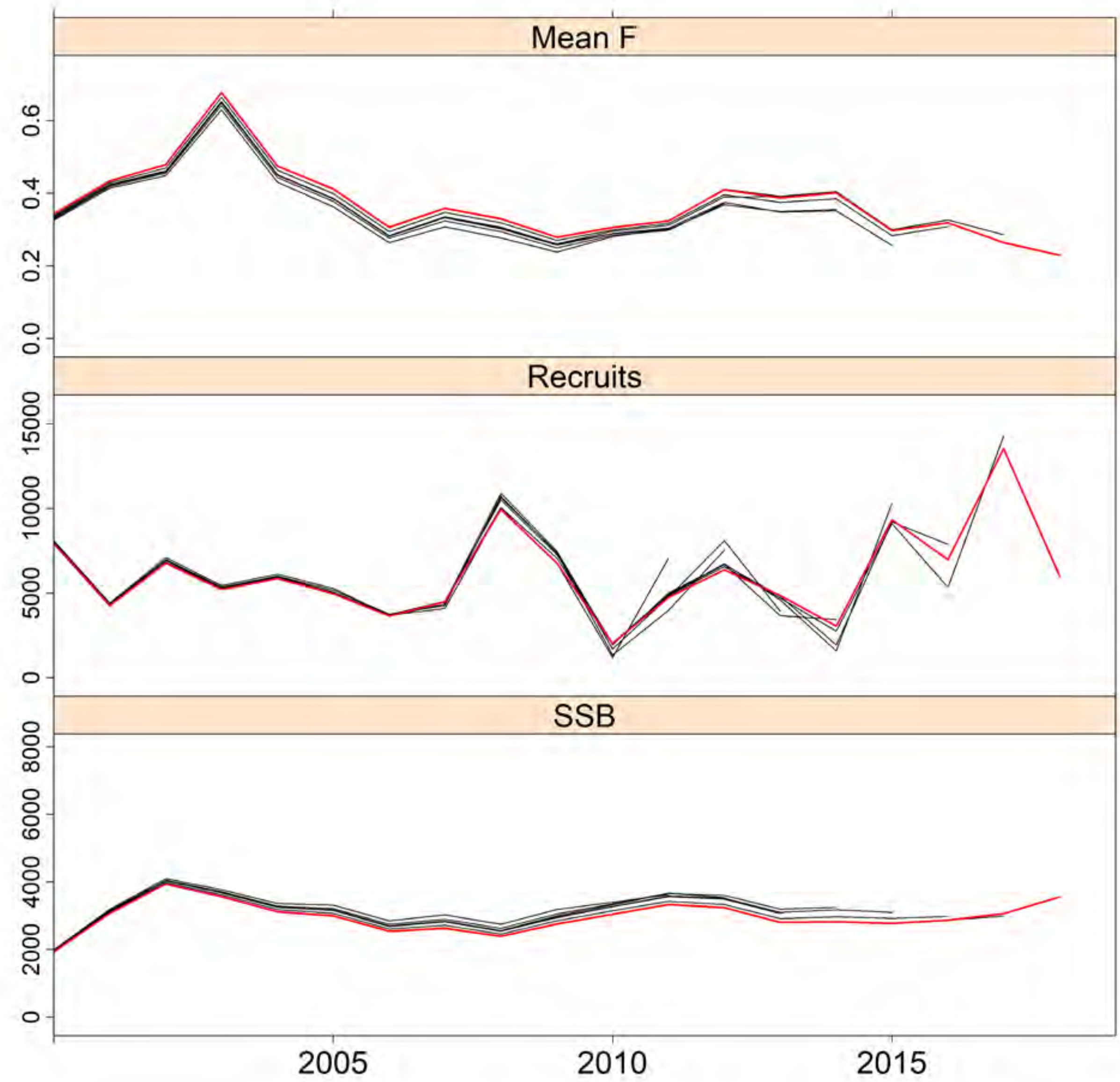


Figure 14: Retrospective pattern for sole in ICES divisions 7.f and 7.g.

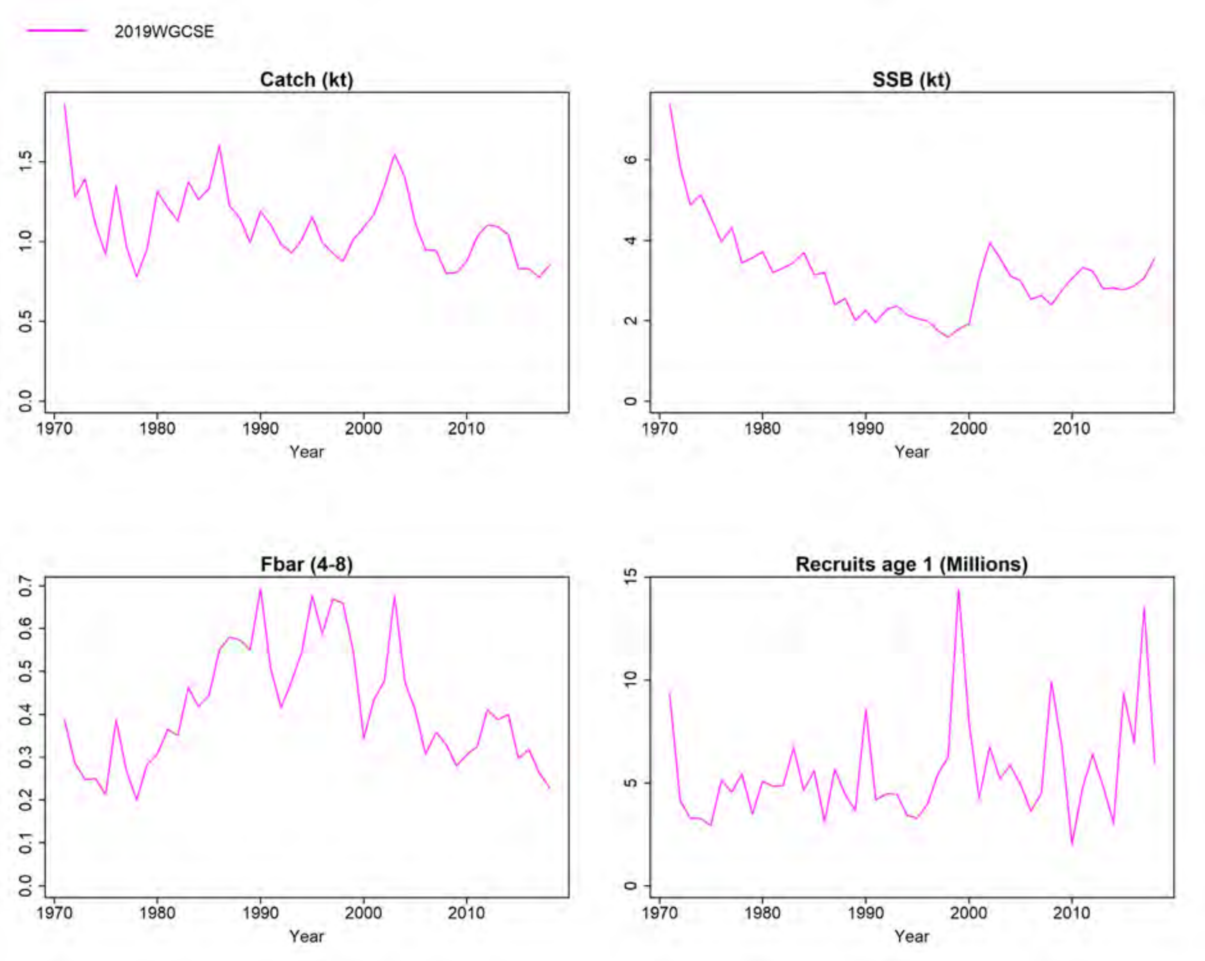


Figure 15: Summary plots

2020 WKFLATNSCS-RUN 1

Data

Data submitters from each nation were tasked to upload data for 2002-2018 in InterCatch, disaggregated by quarter and métier (fleet). However, not every country could upload data for 2002. Belgium could not provide quarterly data for the TBB_DEF_70-99 métier, but uploaded data on a yearly basis. For that year, all the age information is provided by one country (the UK) and covers only 26% of the total landings. Therefore, it was not possible to process the catch data for 2002 and 2003. More detailed information on the preparation of the catch data is provided in the working document (Working document: Preparation of Catch Data for Sole (Solea solea) in divisions 7.f and 7.g (Bristol Channel, Celtic Sea)).

Landings

Landing figures (total weight) of the years 2004-2018 were extracted from InterCatch.

The Belgian sole TBB_DEF_70-99_0_0_all landings data in the period 2004-2007 and sole in the Bristol channel and the Celtic Sea (ICES divisions 7.f and 7.g)), were adjusted to take into account misreporting (see Working document: Belgian commercial beam trawl landings data for sole in the eastern English Channel (ICES division 7.d).

Discards

Discards are not included in this assessment run.

Catch numbers-at-age and weights-at-age in the catch

Although InterCatch was previously used to estimate the 2012-2018 landings mean weight- and number-at-age data, these years were re-calculated in InterCatch following the 2019 benchmark data call. The landings mean weight- and number-at-age data for the years 2004-2011 have now been processed through InterCatch for the first time.

From 2014 onwards the numbers at age 1 in the catch were not replaced by zeros.

Life history

Natural mortality

Same as the 2019 WGCSE assessment (baserun)

Maturity

Same as the 2019 WGCSE assessment (baserun)

Weight-at-age

For the period 2004-2018, the stock weights were obtained using the Rivard weight calculator, that conducts a cohort interpolation of the catch weights.

Proportion mortality before spawning

Same as the 2019 WGCSE assessment (baserun)

Tuning series

The commercial Belgian beam trawl tuning series (BE_CBT3) from 2006–2018 with ages 2-9, was updated according to the new set of national age distributions and total landings for 2004-2018. The other tuning fleets were the same as used in the 2019 WGCSE assessment (baserun).

XSA diagnostics

Same XSA diagnostics as applied in the 2019 WGCSE assessment (baserun)

Figures 16-27 present the model output for this first run.

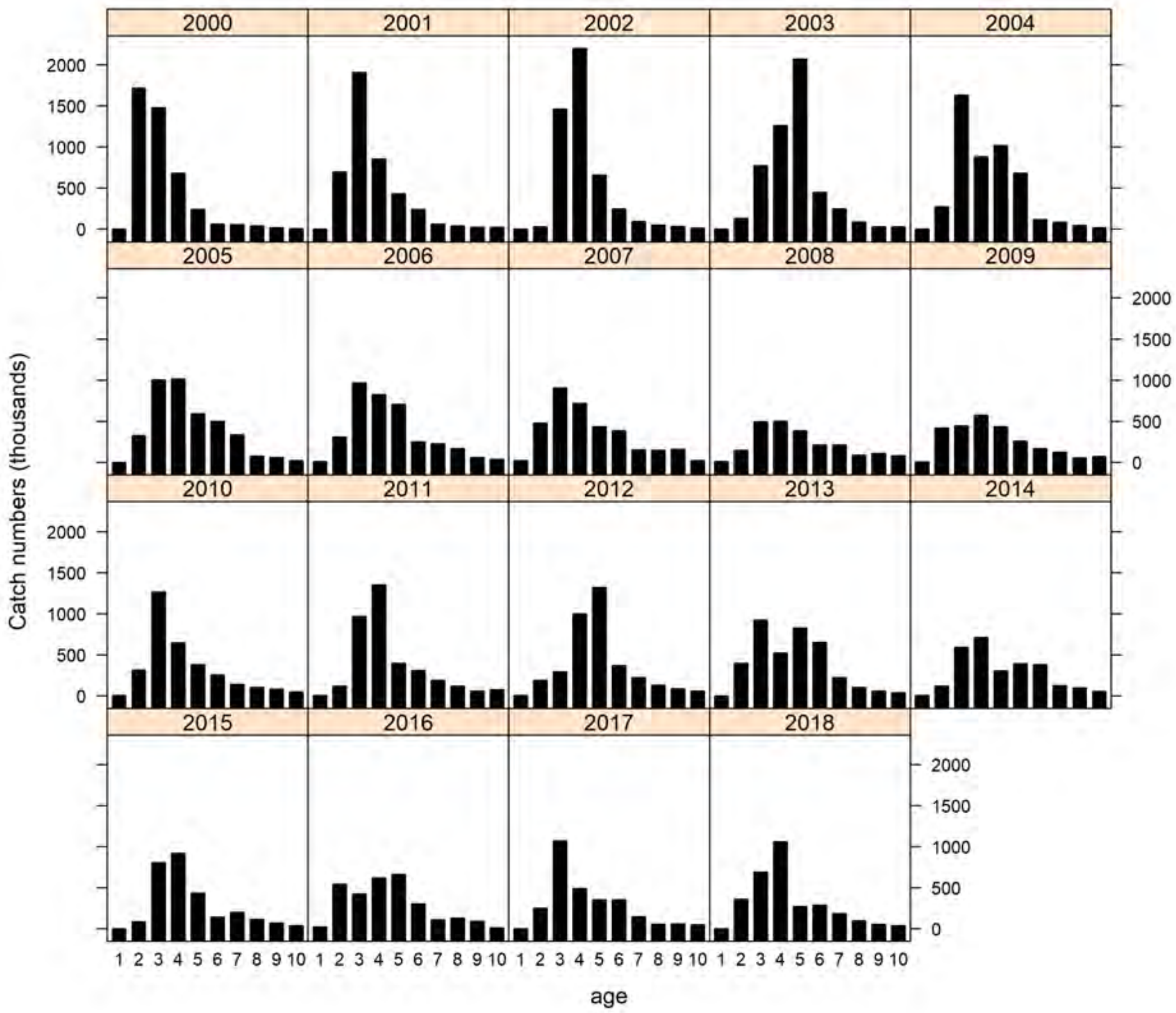


Figure 16: Catch numbers (landings only) at age for sole in ICES divisions 7.f and 7.g for the period 2000-2018.

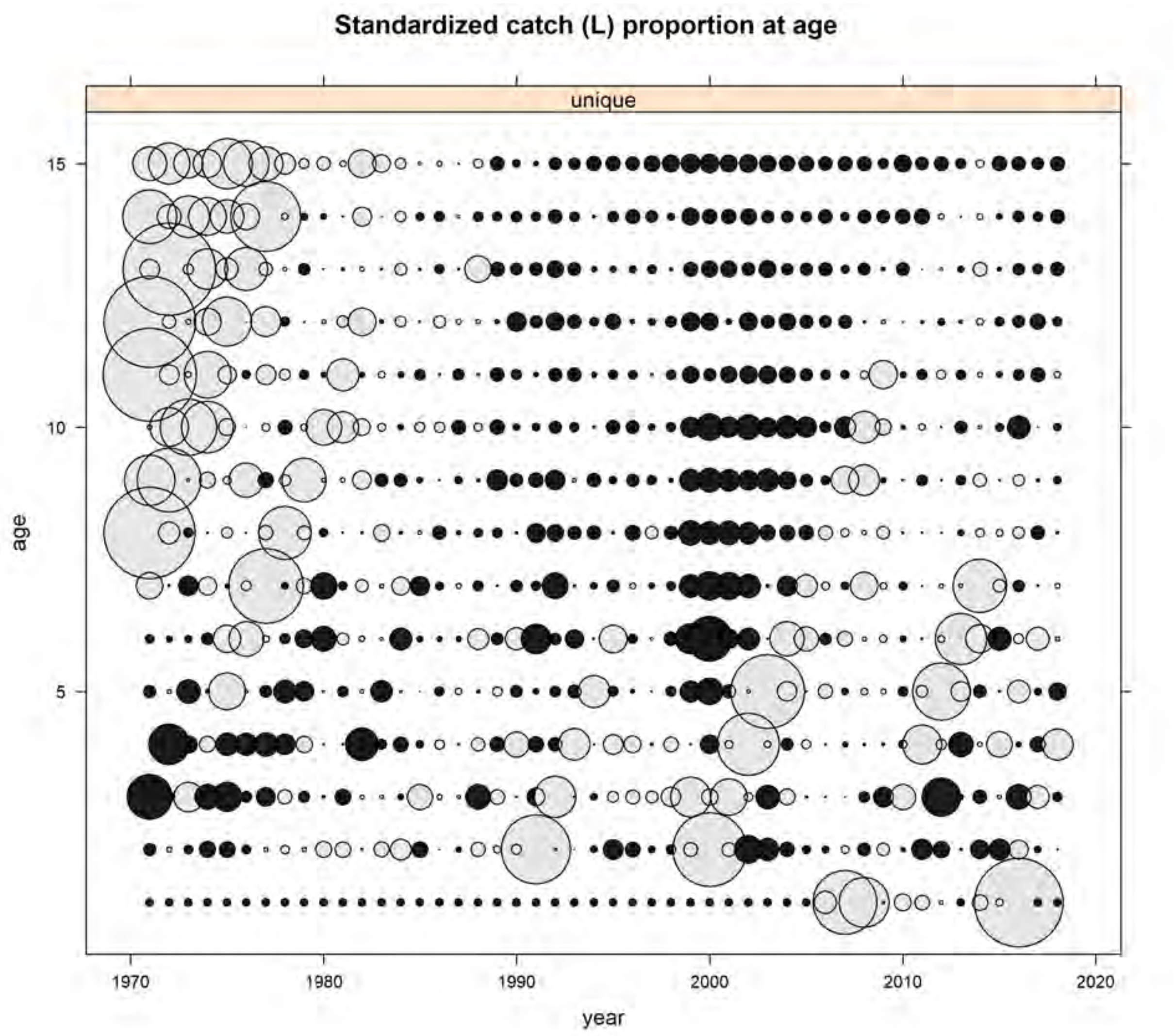


Figure 17: Standardized catch (landings only) proportions at age for sole in ICES divisions 7.f and 7.g.

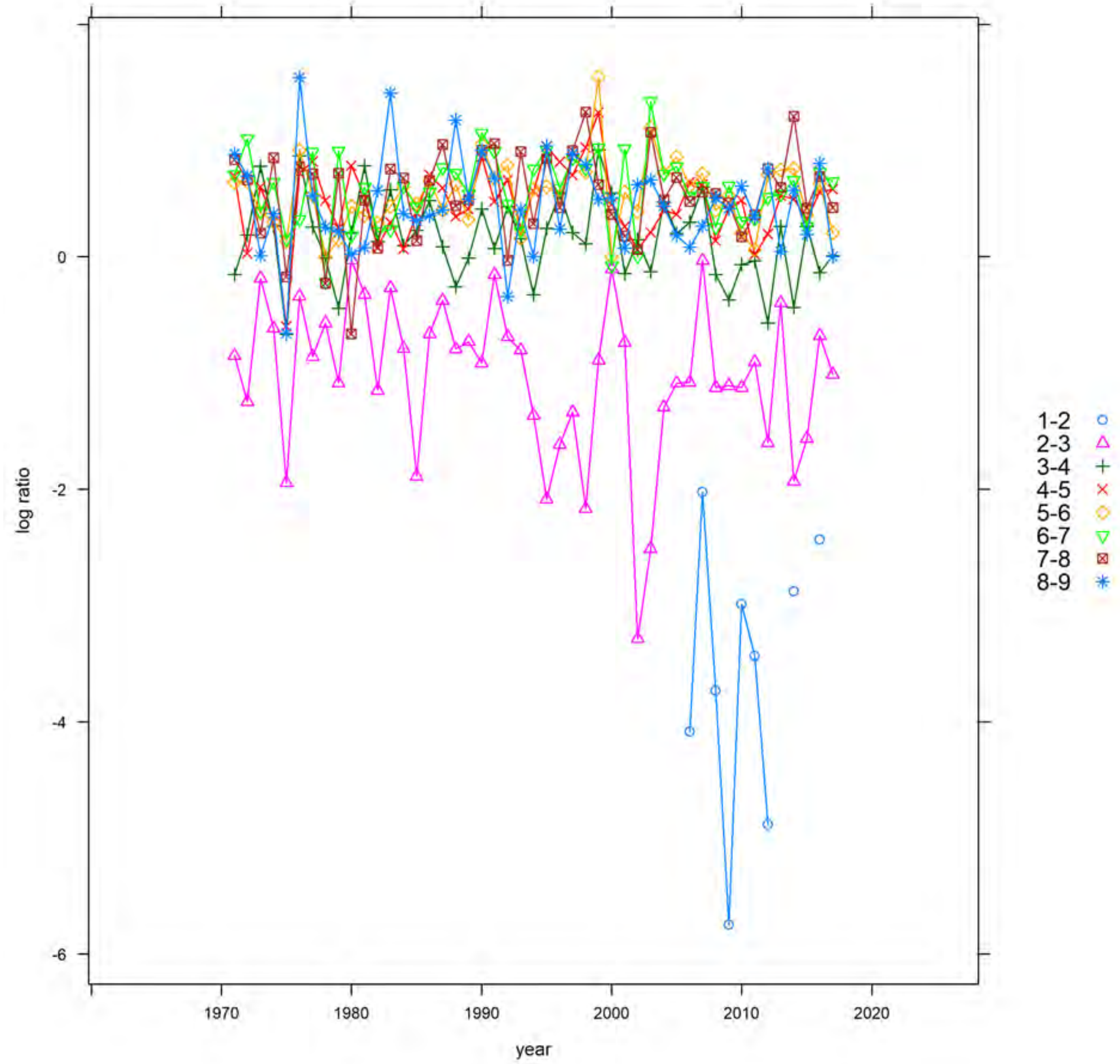


Figure 18: Log ratio of the catch (landings only) numbers at age for sole in ICES divisions 7.f and 7.g.

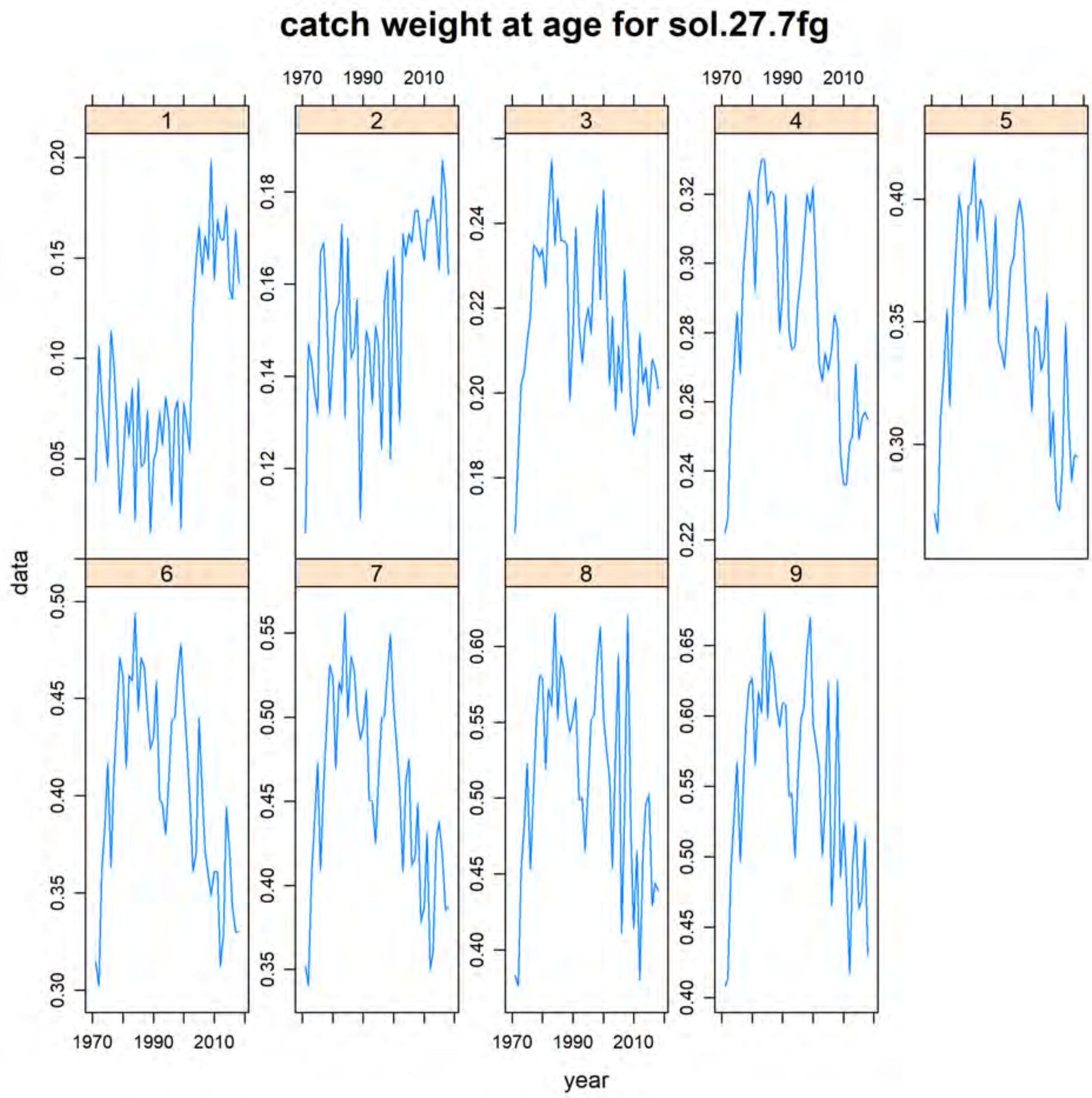


Figure 19: Catch (landings only) weights at age for sole in ICES divisions 7.f and 7.g.

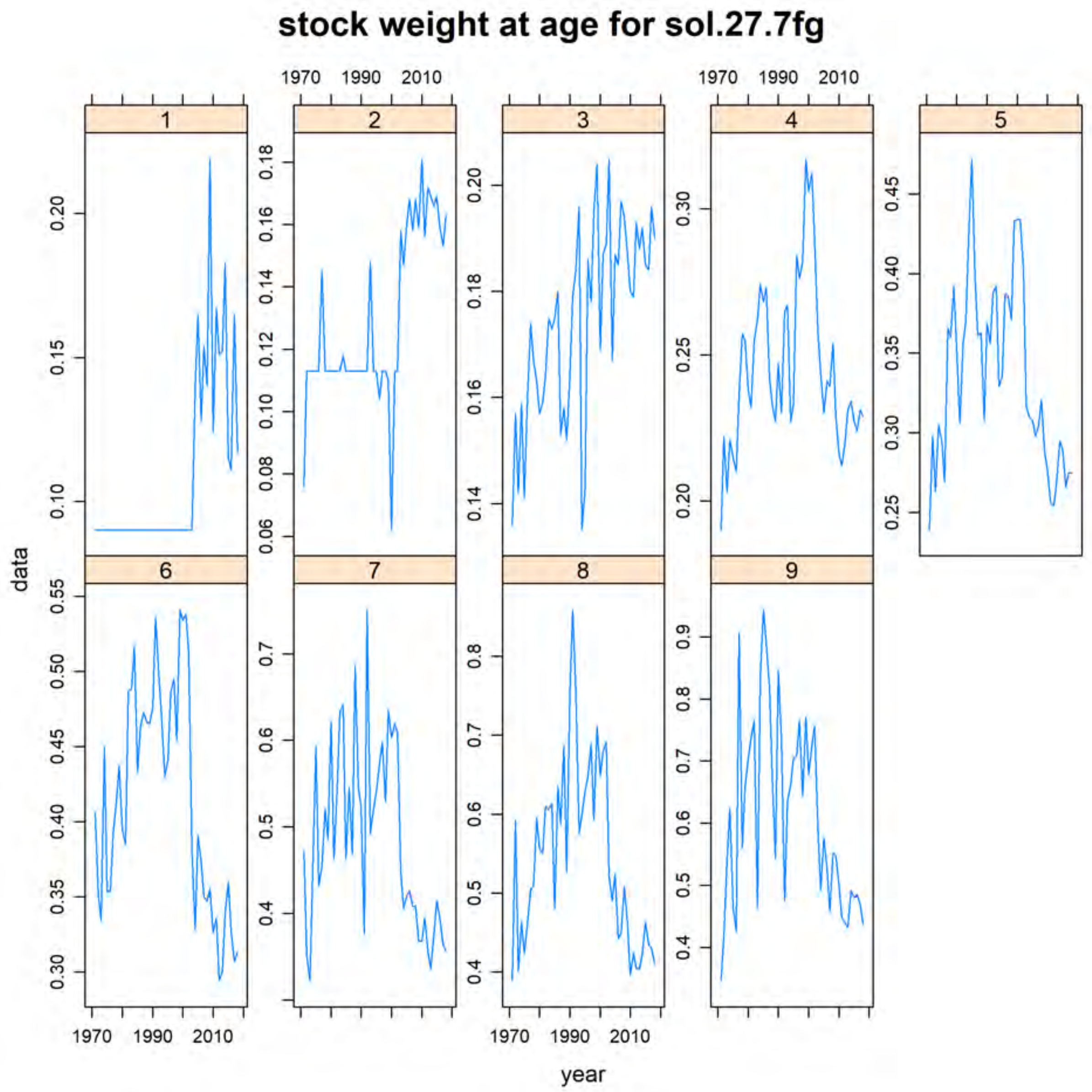


Figure 20: Stock weights at age for sole in ICES divisions 7.f and 7.g.

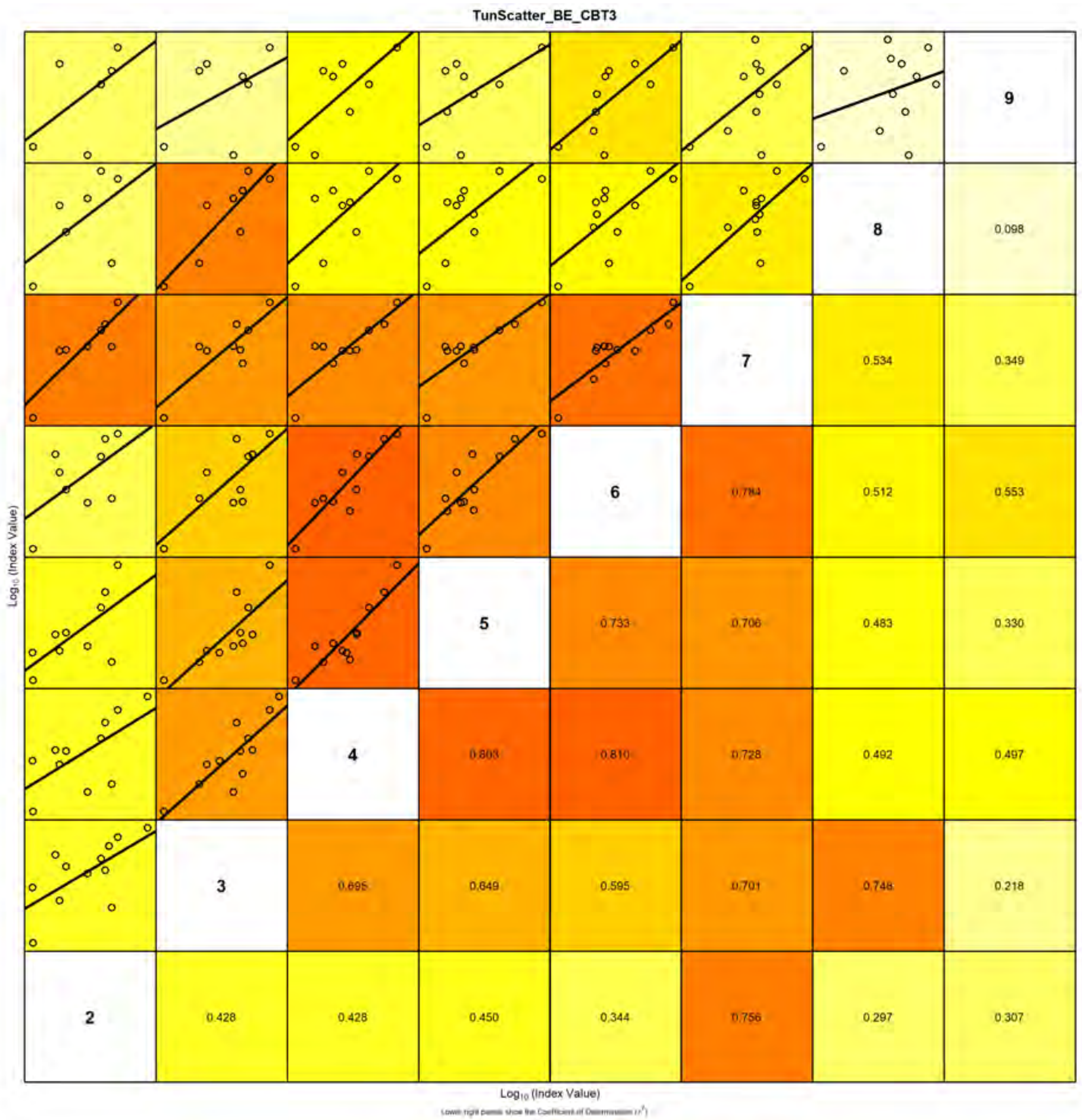


Figure 21: Internal consistency plot of the BE-CBT3 (2006–2018) tuning series for sole in ICES divisions 7.f and 7.g.

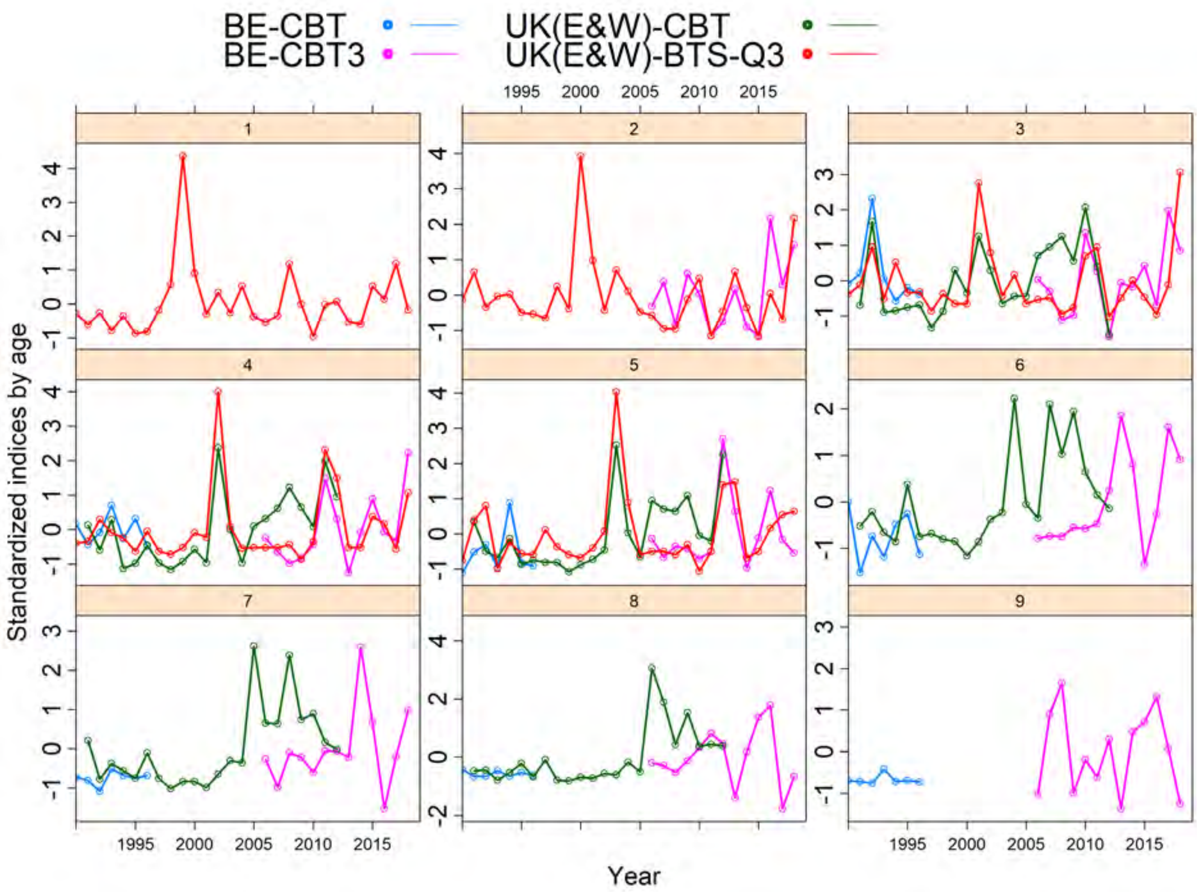


Figure 22: Standardized indices by age of the tuning series for sole in ICES divisions 7.f and 7.g.

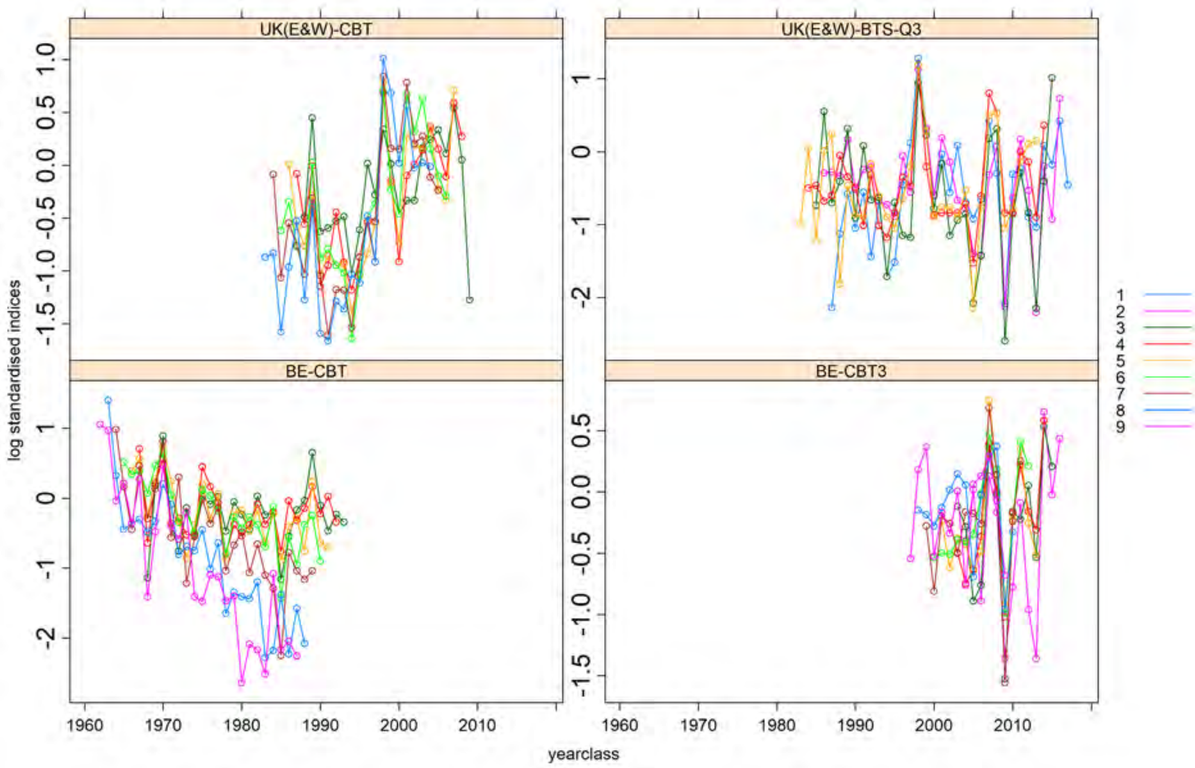


Figure 23: Log standardized indices by age of the tuning series for sole in ICES divisions 7.f and 7.g.

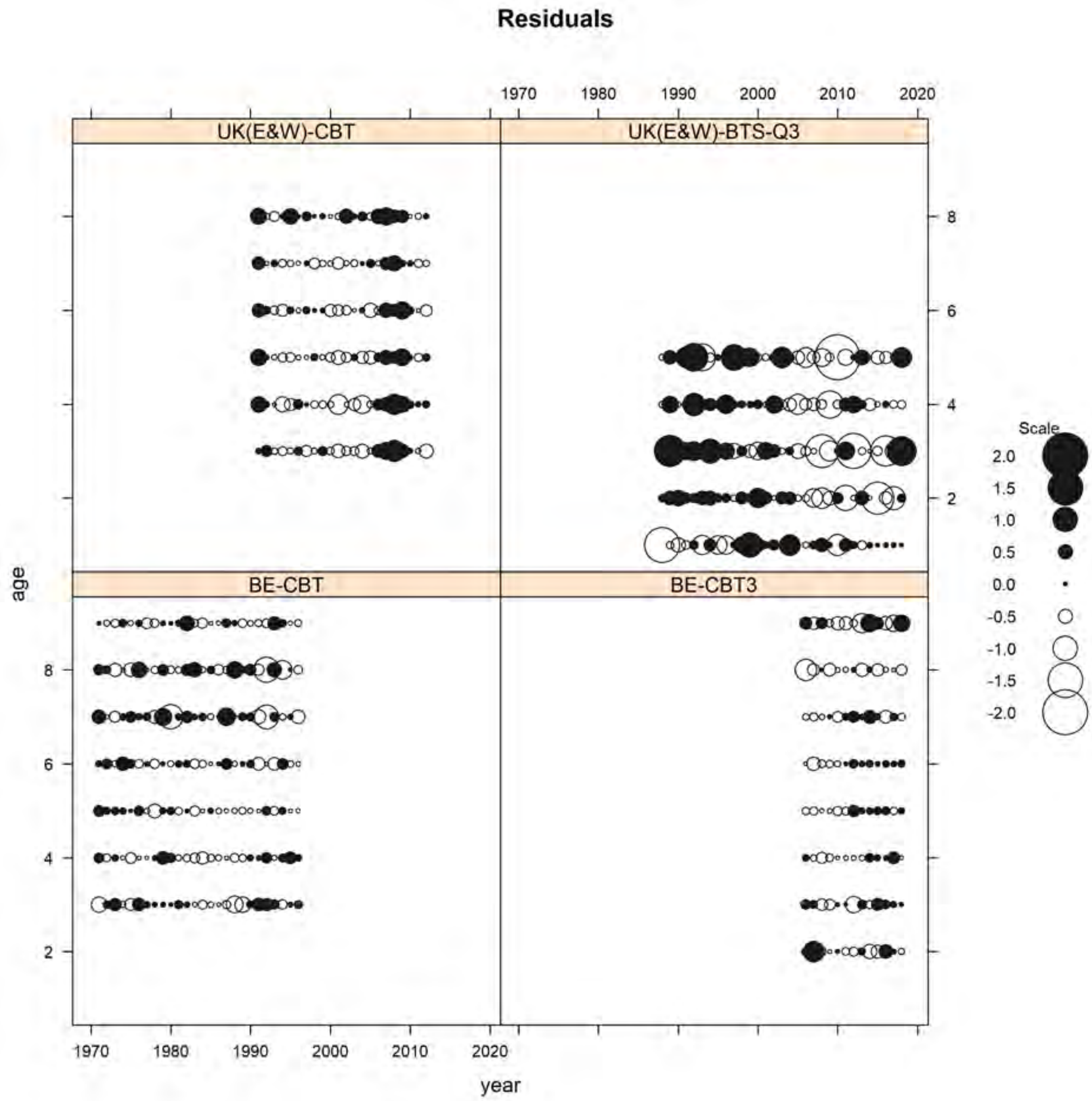


Figure 24: Catchability residuals of the tuning series for sole in ICES divisions 7.f and 7.g.

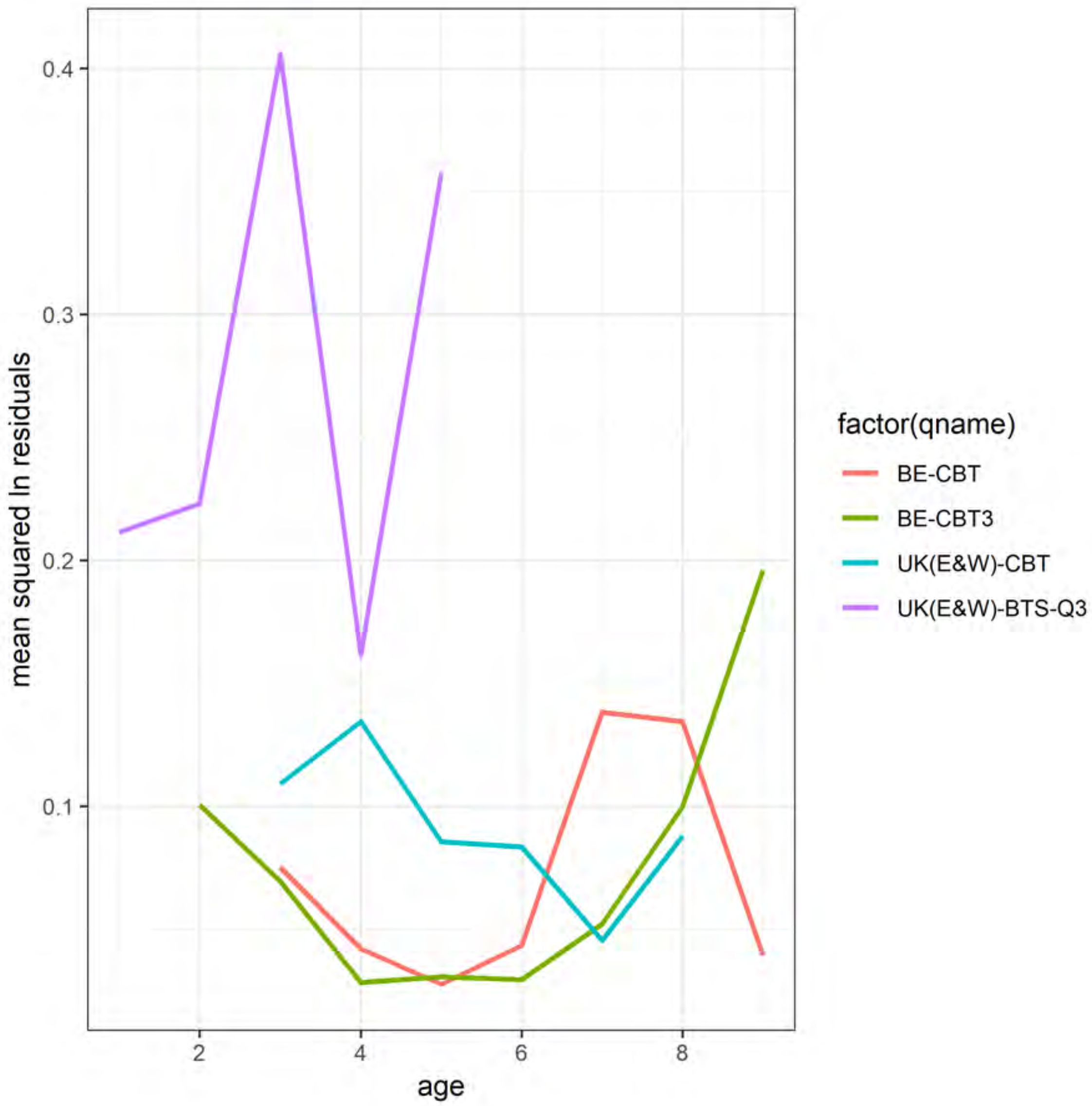


Figure 25: Mean squared residuals of the tuning series by age for sole in ICES divisions 7.f and 7.g.

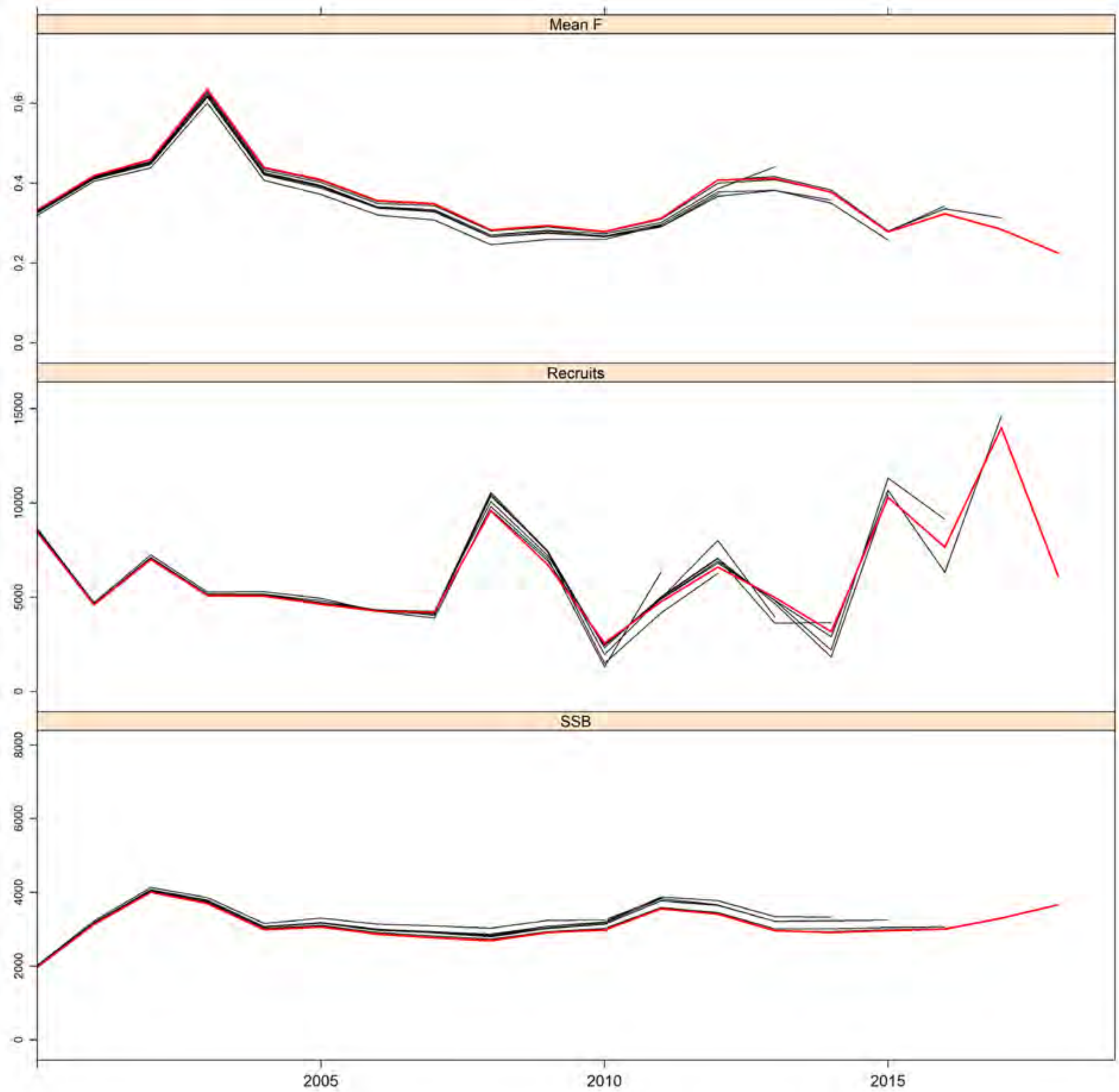


Figure 26: Retrospective pattern for sole in ICES divisions 7.f and 7.g.

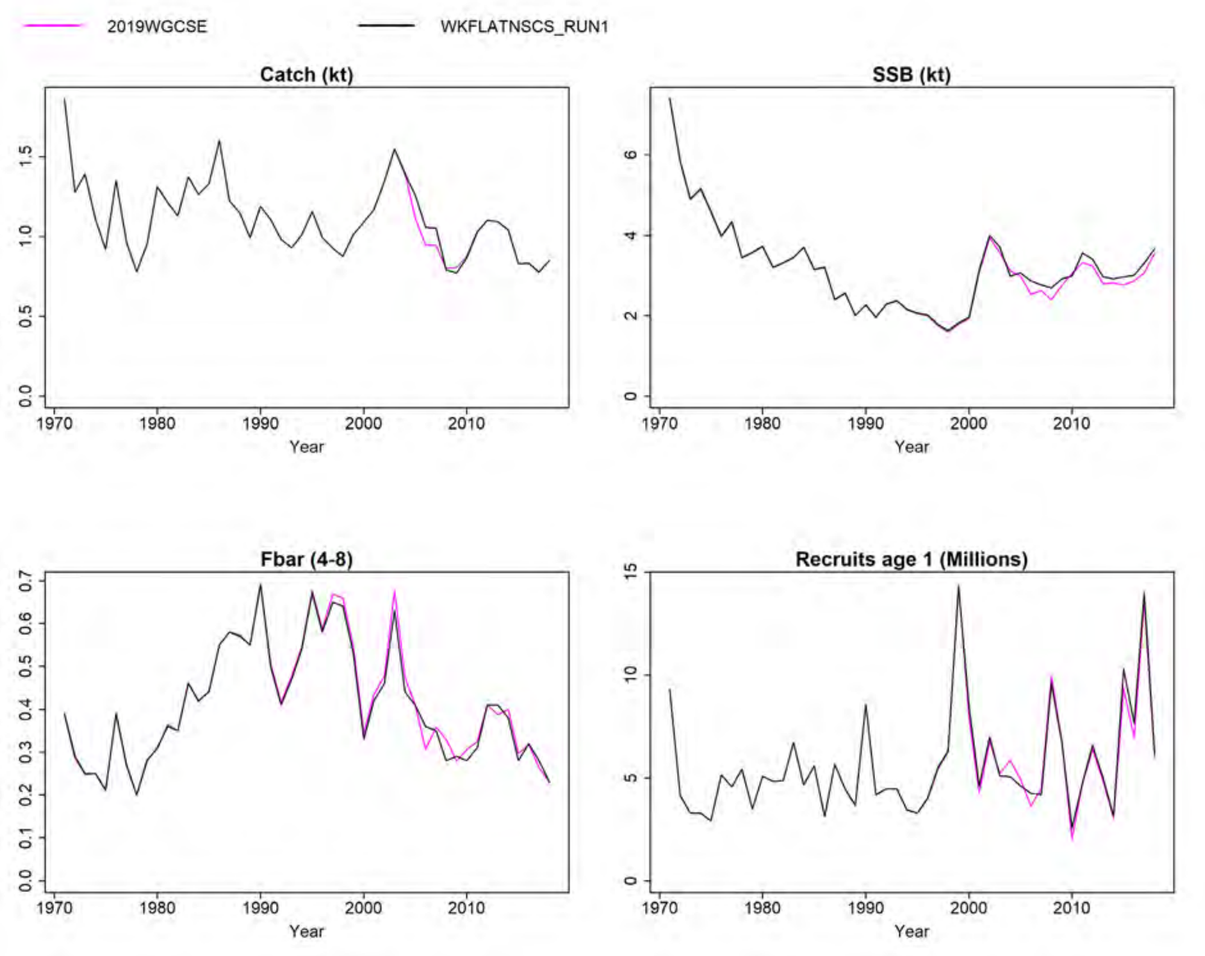


Figure 27: Comparison of the summary plots between the 2019 WGCSE assessment (baserun) and the 2020 WKFLATNSCS run1.

2020 WKFLATNSCS-RUN 2

Data

Landings

Same landings data as in the 2020 WKFLATNSCS-RUN 1.

Discards

Discard estimates (total weight) for the years 2004-2018 have now been processed through InterCatch for the first time. The discard volumes for the years prior to 2004 were derived from the estimated mean weights at age and the numbers at age for those years.

Catch numbers-at-age and weights-at-age in the catch

The discard mean weight- and number-at-age data for the years 2004-2018 have now been processed through InterCatch for the first time. To estimate discards mean weights- and numbers-at-age prior to 2004, a constant ratio of discards to landings by age was applied using data from 2004-2018 (Figures 28-29). Average discards (2004-2018) to average landings (2004-2018) ratios for discard mean weight- and number-at-age were:

	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8
number	2.7693	0.5806	0.124	0.0267	0.0212	0.0145	0.007	0.0097
weight	0.6597	0.6542	0.6198	0.5754	0.6155	0.5779	0.6275	0.3906

	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15
number	0.008	0.0047	0.0066	0.0037	0.0106	0.014	0.0178
weight	0.5598	0.4051	0.416	0.3475	0.2382	0.2322	0.4516

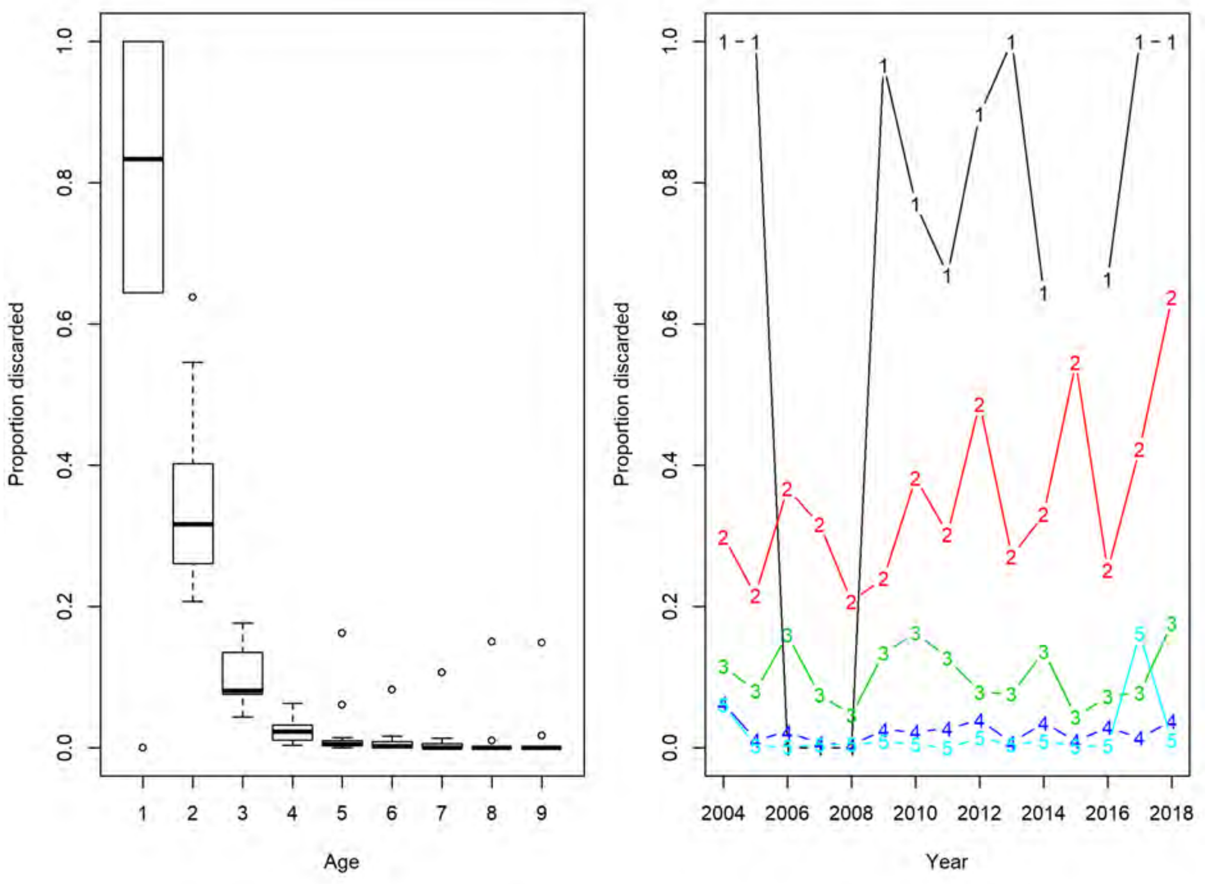


Figure 28: Proportion discarded (discard numbers/catch numbers) at age for sole in ICES divisions 7.f and 7.g from 2004-2018.

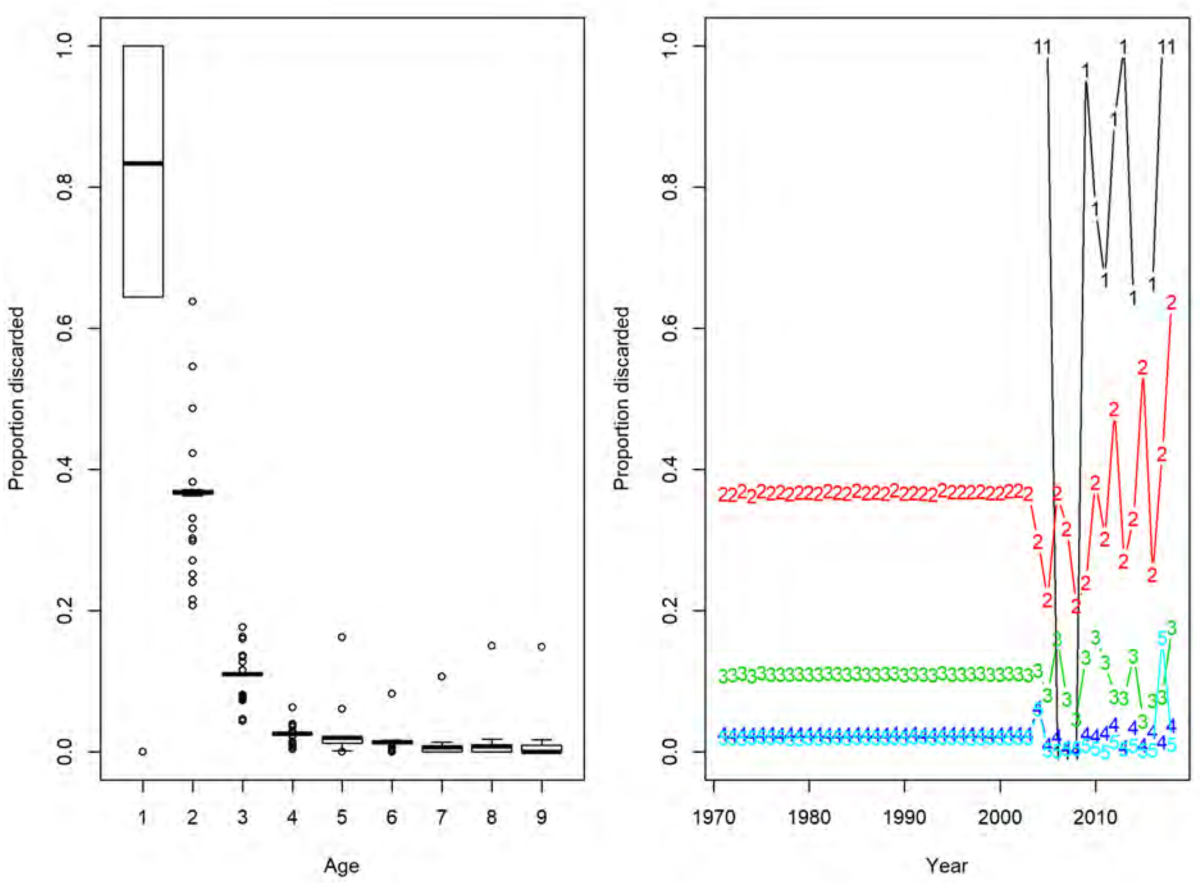


Figure 29: Proportion discarded (discard numbers/catch numbers) (data before 2004 are estimated based on an average ratio from 2004-2018 at age for sole in ICES divisions 7.f and 7.g.

Life history

<u>Natural mortality</u>

Same as the 2019 WGCSE assessment (baserun)

<u>Maturity</u>

Same as the 2019 WGCSE assessment (baserun)

<u>Weight-at-age</u>

The stock weights were obtained using the Rivard weight calculator, that conducts a cohort interpolation of the catch weights. For 2004-2018, the stock weights were calculated for age 1-15. For 1971-2003, the stock weights were calculated for age 2-15. Because the catch weight for age 1 is zero, the stock weight for age 1 was set at the mean of the stock weight calculated for age 1 of 2004-2018.

<u>Proportion mortality before spawning</u>

Same as the 2019 WGCSE assessment (baserun)

Tuning series

Same set of tuning fleets as used in the 2020 WKFLATNSCS-RUN 1

XSA diagnostics

Same XSA diagnostics as applied in the 2019WGCSE assessment (baserun)

Figures 30-38 present the model output for this second run.

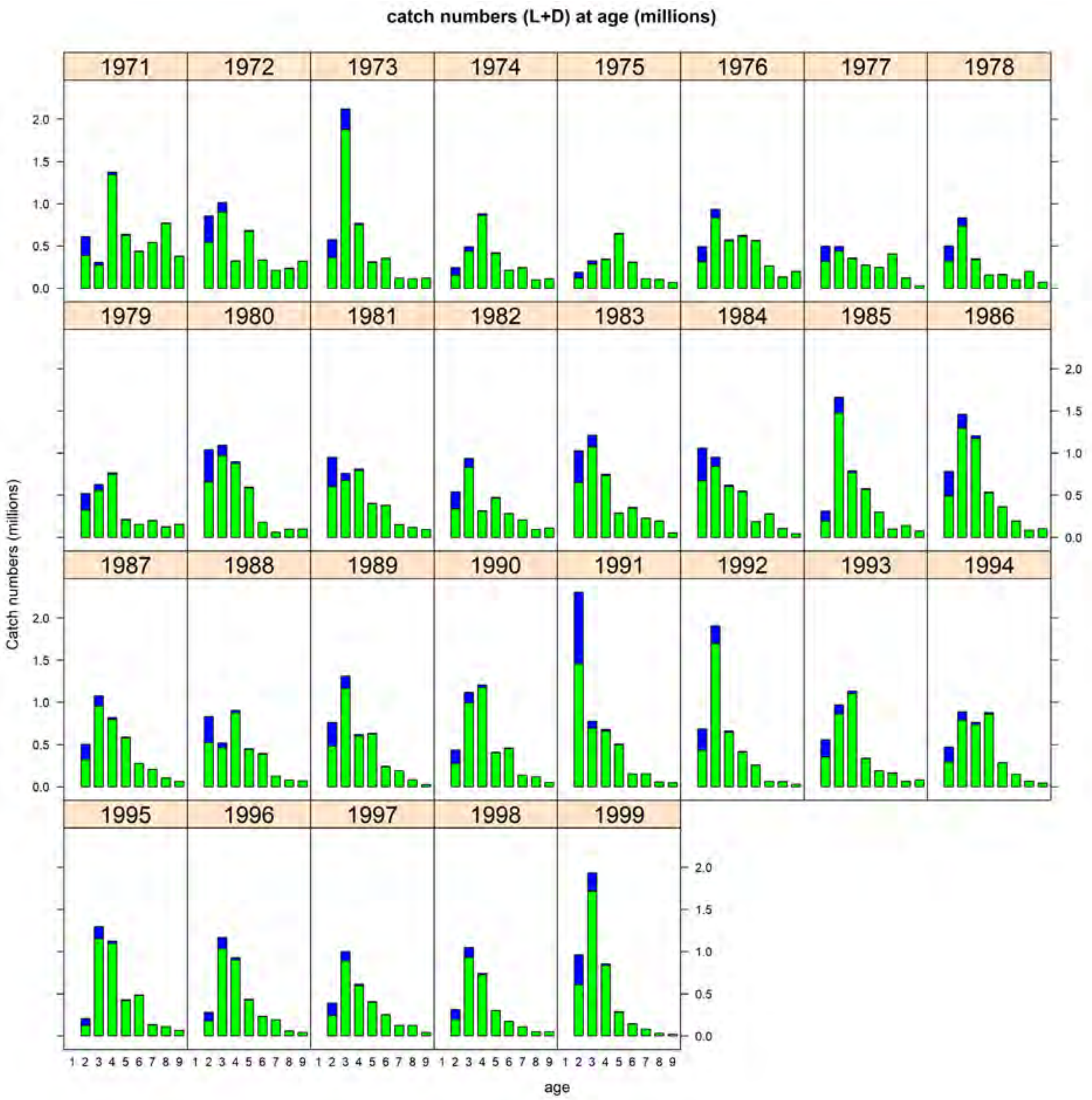


Figure 30a: Catch numbers at age (landings (green) and discards (blue)) for sole in ICES divisions 7.f and 7.g for the period 1971-1999.

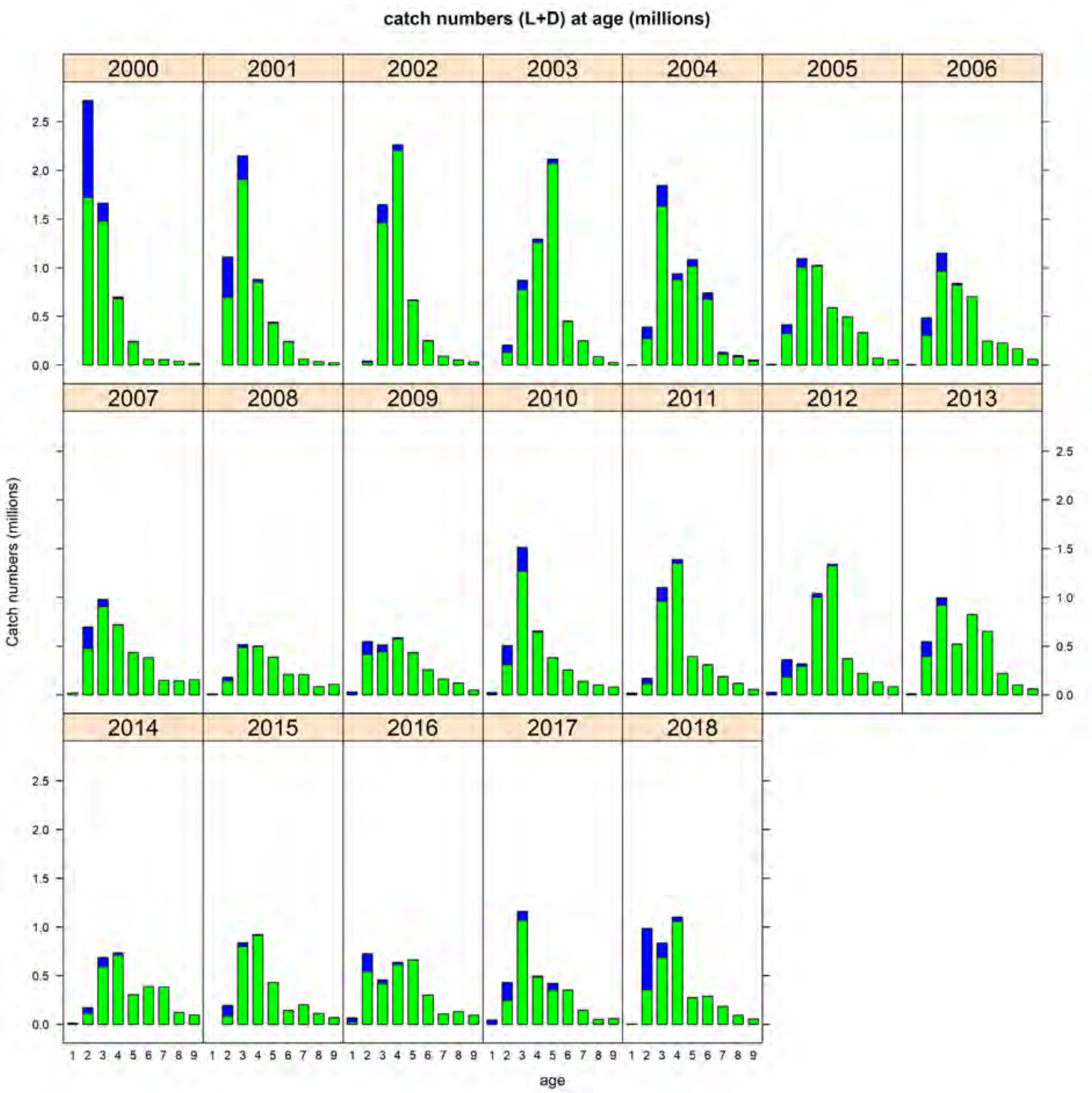


Figure 30b: Catch numbers at age (landings (green) and discards (blue)) for sole in ICES divisions 7.f and 7.g for the period 2000-2018.

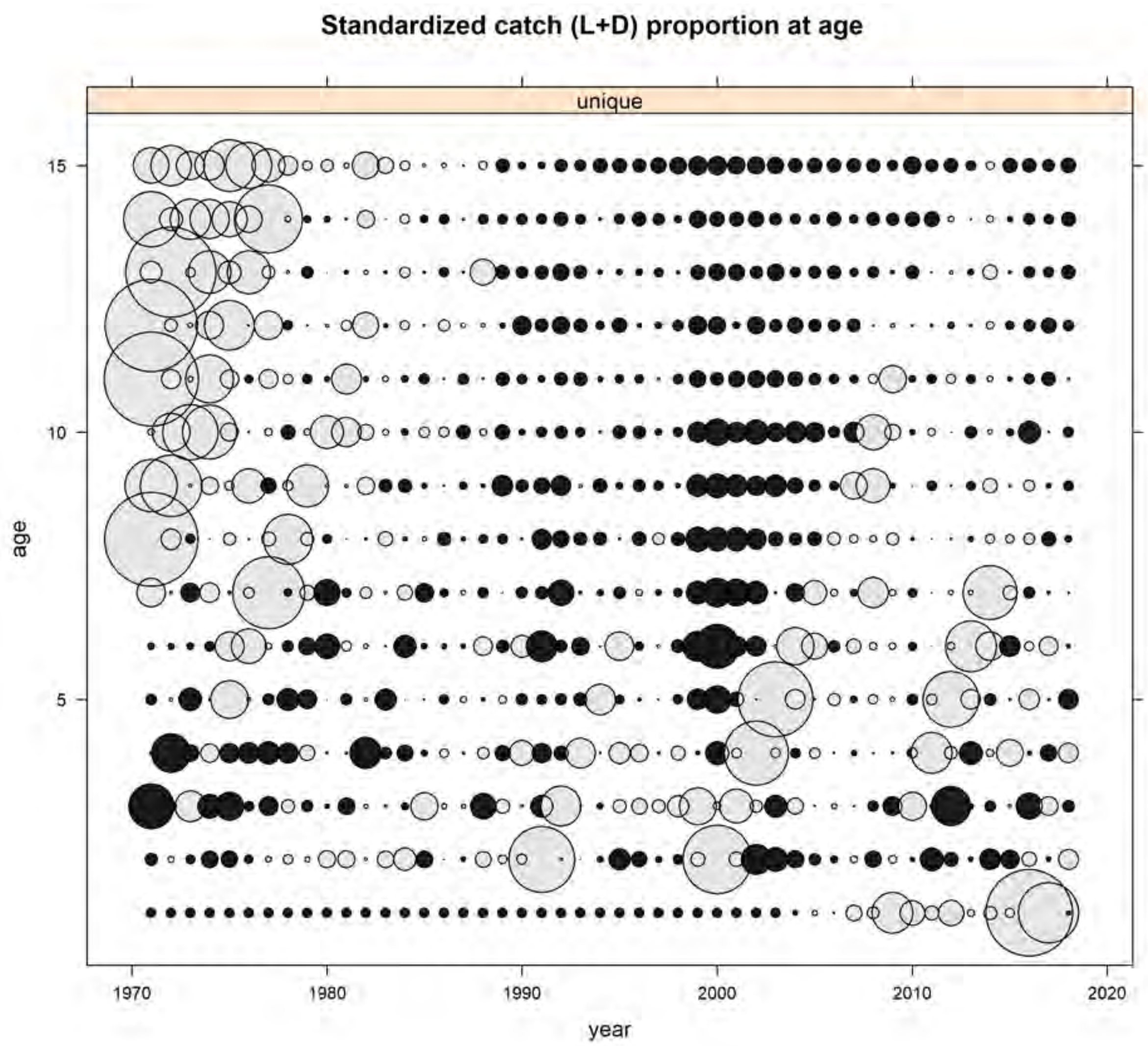


Figure 31: Standardized catch proportions at age for sole in ICES divisions 7.f and 7.g.

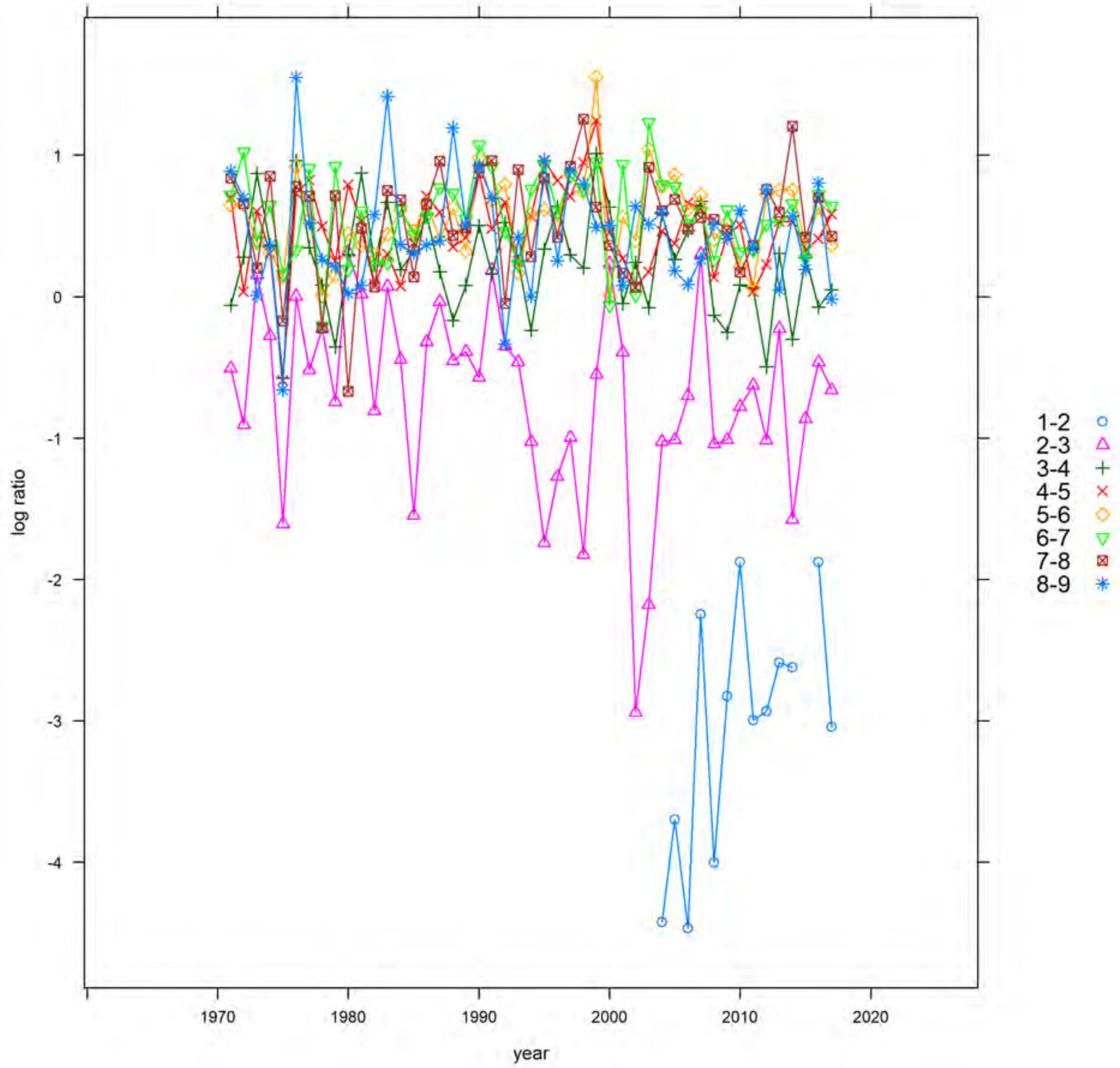


Figure 32: Log ratio of the catch numbers at age for sole in ICES divisions 7.f and 7.g.

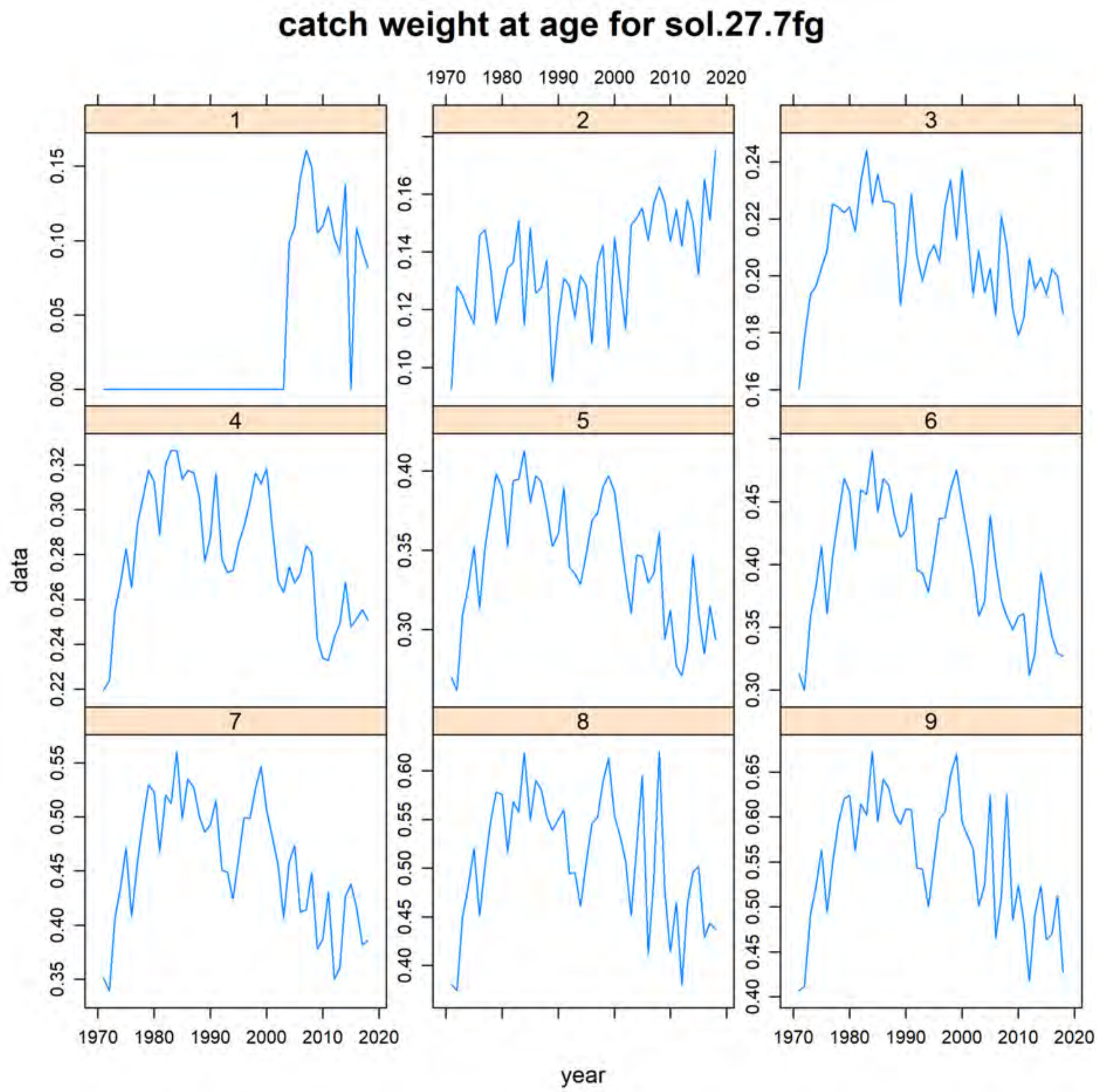


Figure 33: Catch weights at age for sole in ICES divisions 7.f and 7.g.

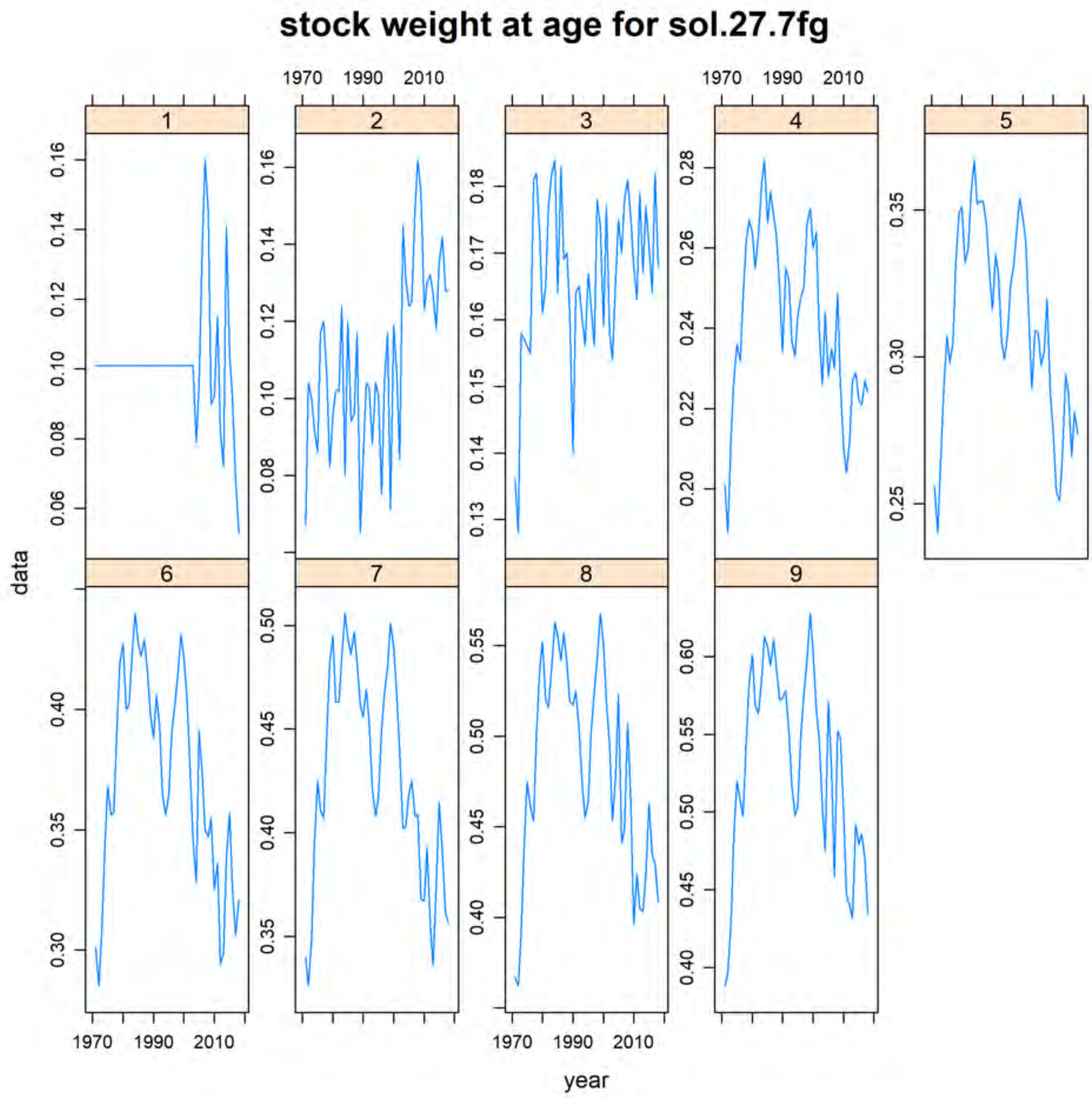


Figure 34: Stock weights at age for sole in ICES divisions 7.f and 7.g.

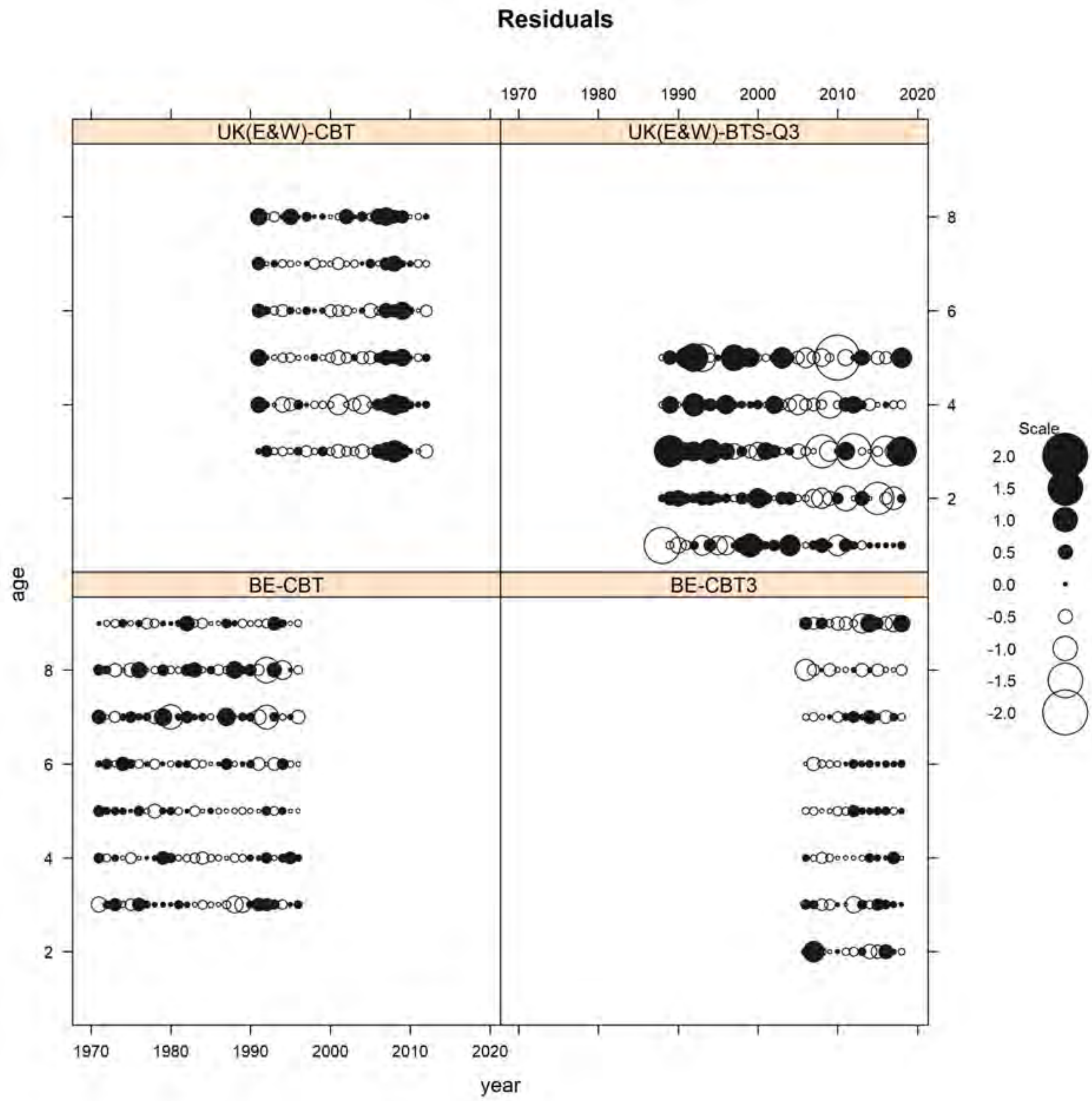


Figure 35: Catchability residuals of the tuning series for sole in ICES divisions 7.f and 7.g.

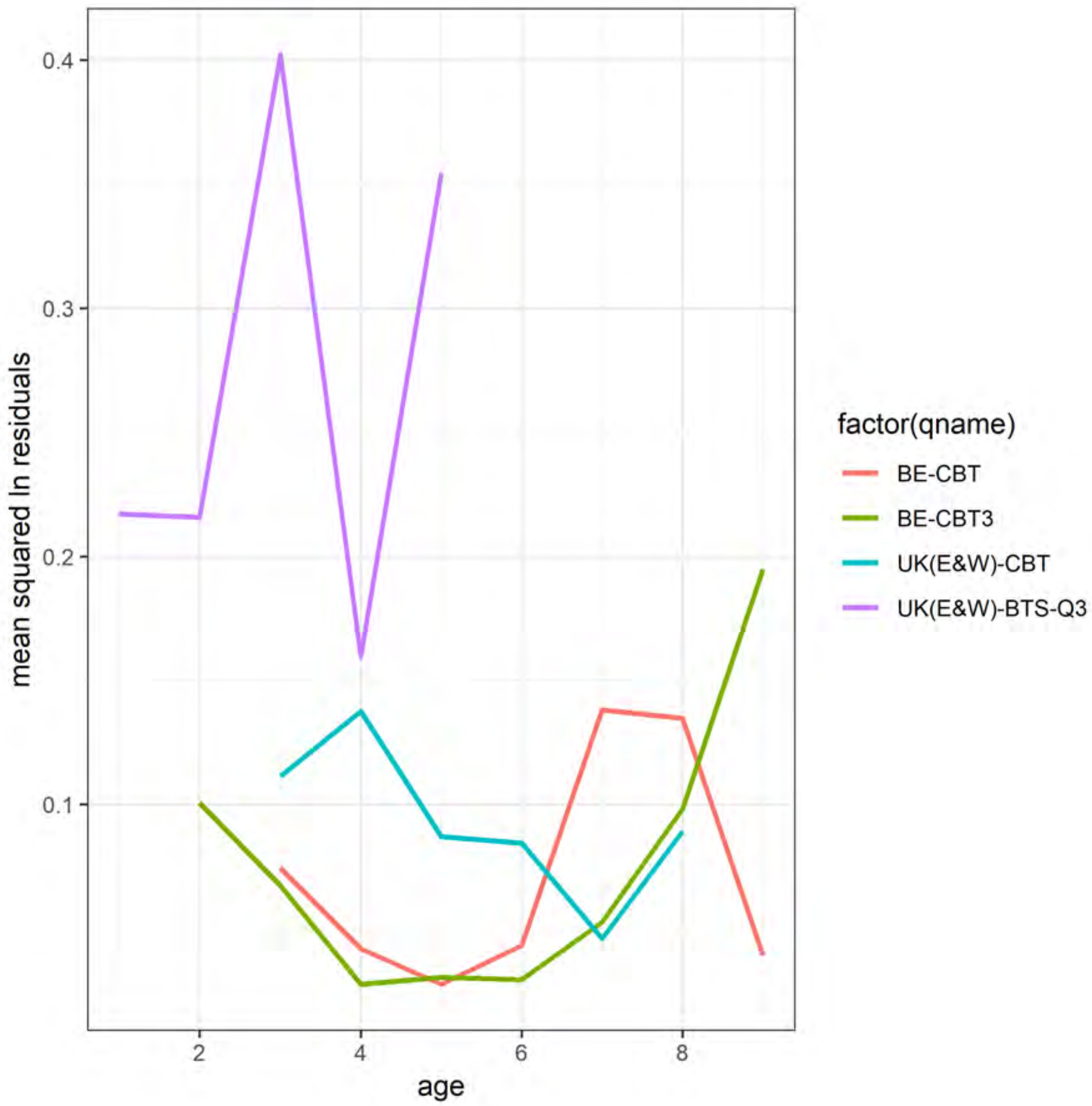


Figure 36: Mean squared residuals of the tuning series by age for sole in ICES divisions 7.f and 7.g.

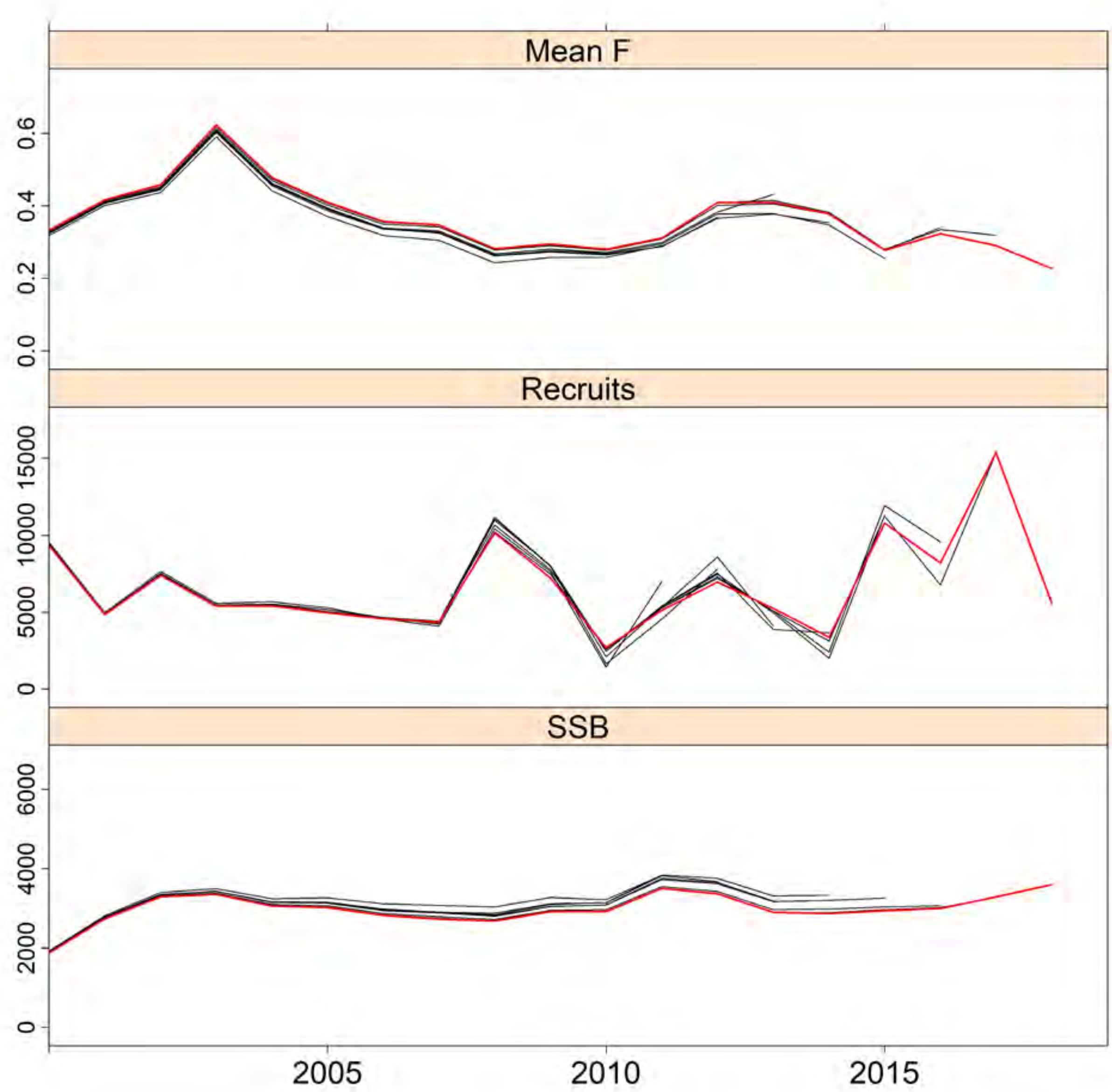


Figure 37: Retrospective pattern for sole in ICES divisions 7.f and 7.g.

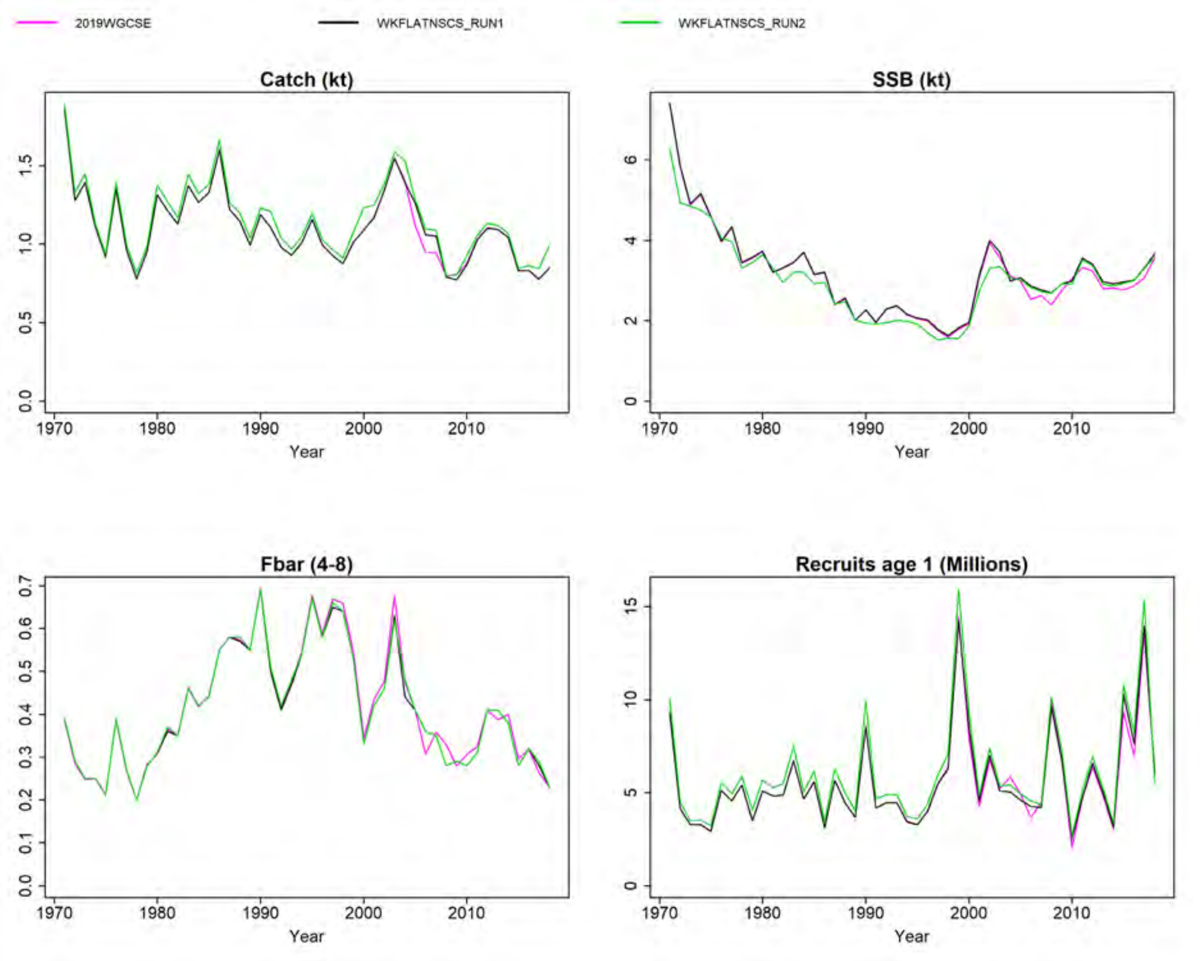


Figure 38: Comparison of the summary plots between the 2020 WKFLATNSCS run2, the 2020 WKFLATNSCS run1 and the 2019 WGCSE assessment (baserun).

2020 WKFLATNSCS-RUN 3

Data

Same catch data (total weight, mean weight- and number-at-age for landings and discards) as used in the 2020 WKFLATNSCS-RUN 2.

Life history

Natural mortality

Same as the 2019 WGCSE assessment (baserun)

Maturity

A new maturity ogive was obtained by estimating the maturity at age using a length based model with sex specific ALK based on UK(E&W)-Q1SWECOS data from 2013 to 2019. More detailed information on the calculation of the maturity ogive is provided in the working document (Working document: Investigating maturity of Sole (*Solea solea* L.) in the Bristol Channel and Celtic Sea (ICES Division 27.7.fg)).

Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Maturity	0.09	0.67	0.91	0.98	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Weight-at-age

Same as the 2020 WKFLATNSCS-RUN 2

Proportion mortality before spawning

Same as the 2019 WGCSE assessment (baserun)

Tuning series

Same set of tuning fleets as used in the 2020 WKFLATNSCS-RUN 1

XSA diagnostics

Same XSA diagnostics as applied in the 2019WGCSE assessment (baserun)

Figure 39 presents the model output for run 3.

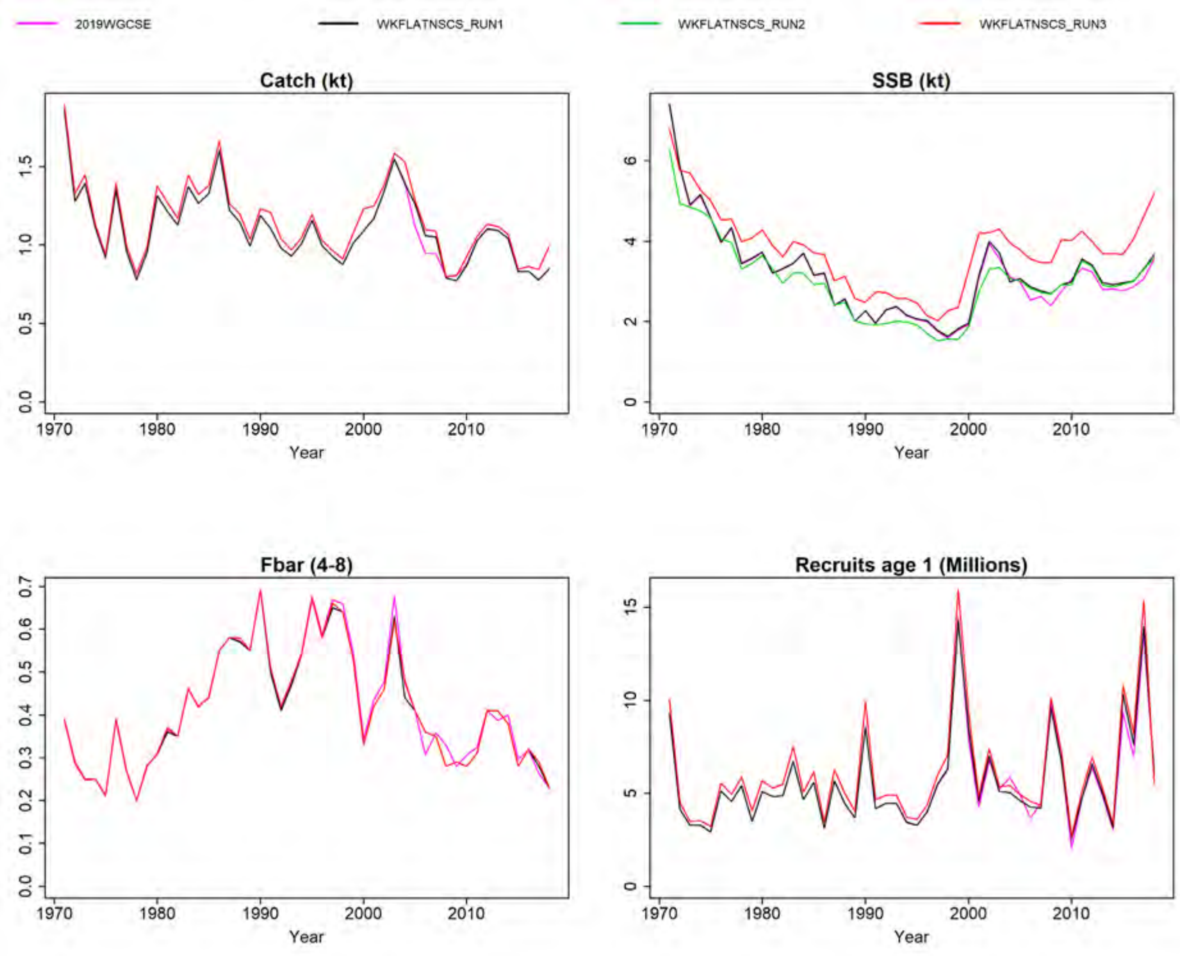


Figure 39: Comparison of the summary plots between the 2020 WKFLATNSCS run3, 2020 WKFLATNSCS run2, the 2020 WKFLATNSCS run1 and the 2019 WGCSE assessment (baserun).

2020 WKFLATNSCS-RUN 4

Data

Same catch data (total weight, mean weight- and number-at-age for landings and discards) as used in the 2020 WKFLATNSCS-RUN 2.

Life history

Natural mortality

Same as the 2019 WGCSE assessment (baserun)

Maturity

Given the substantial difference between the current maturity ogive (based on data from 1992-1993), and the new maturity ogive (based on UK(E&W)-Q1SWECOS data from 2013 to 2019), a further analysis was performed to quantify the temporal trends underlying the maturity ogive. Therefore, the *length-based* method as presented above, was applied to an extended dataset that comprised observations from the NWGF and UK(E&W)-Q1SWECOS surveys. This combined dataset provides a time series from 1988 until 2019 with overlap between both survey from 2013 until 2019. Due to missing years at the start of the time series, the analysis was performed on data from 1993 until 2019 (Figure 40). More detailed information on the calculation of the maturity ogive is provided in the working document (Working document: Investigating maturity of Sole (*Solea solea* L.) in the Bristol Channel and Celtic Sea (ICES Division 27.7.fg)).

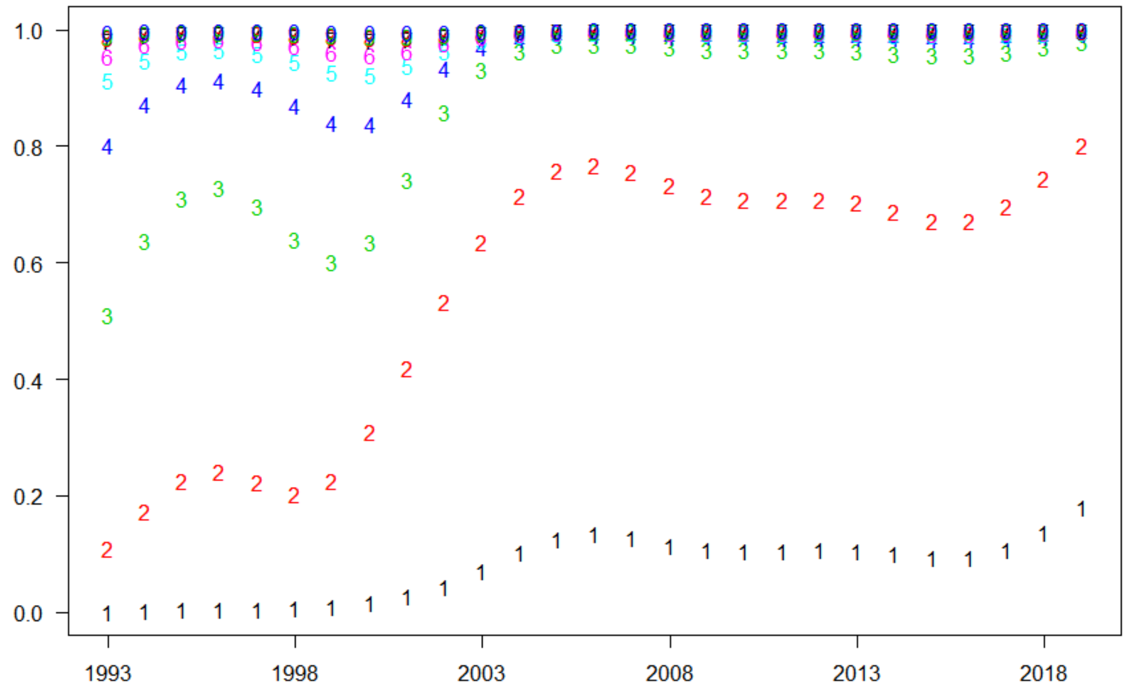


Figure 40: Maturity ogive over the period 1993 - 2019. The numbers correspond to the age class.

Weight-at-age

Same as the 2020 WKFLATNSCS-RUN 2

Proportion mortality before spawning

Same as the 2019 WGCSE assessment (baserun)

Tuning series

Same set of tuning fleets as used in the 2020 WKFLATNSCS-RUN 1

XSA diagnostics

Same XSA diagnostics as applied in the 2019WGCSE assessment (baserun)

Figure 41 presents the model output for run 4.

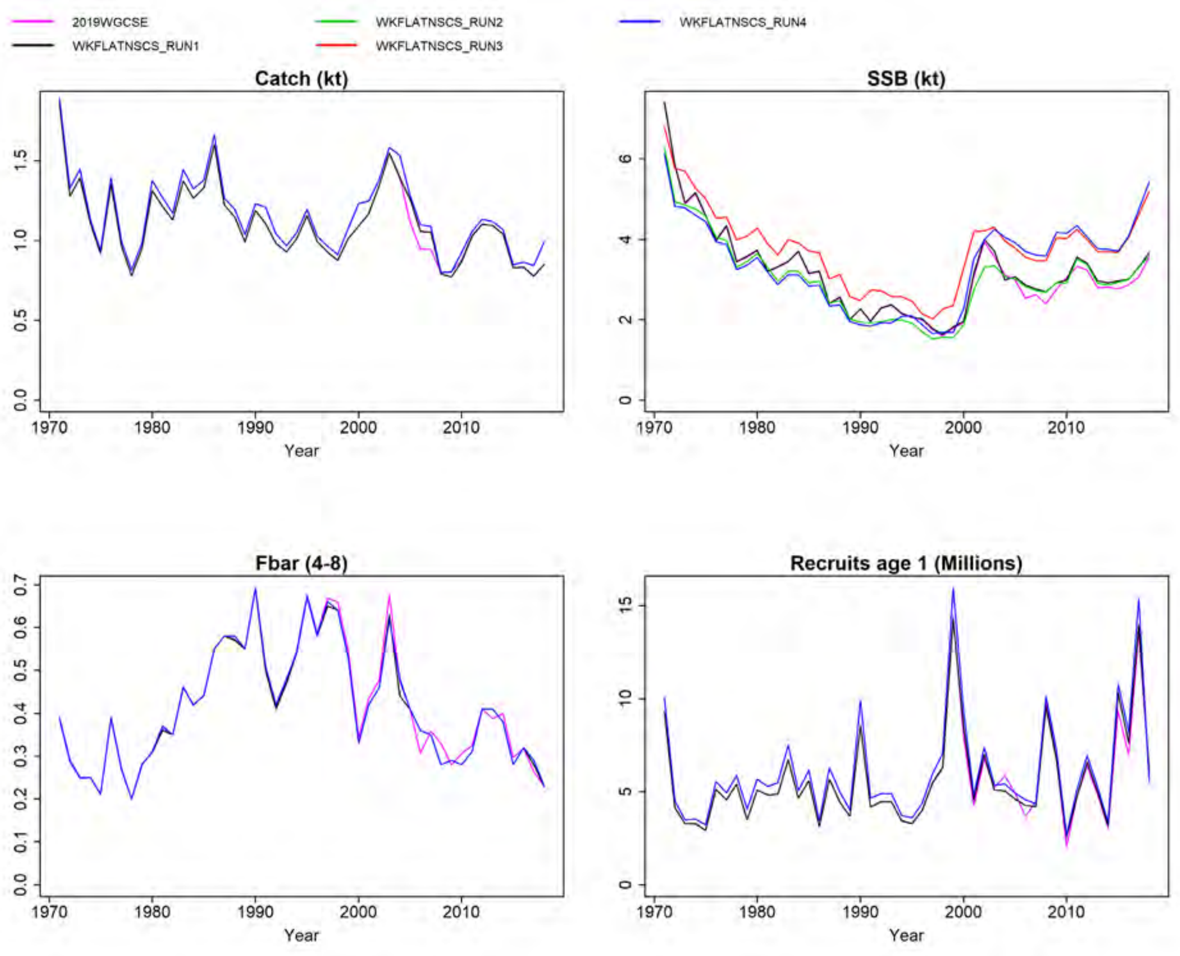


Figure 41: Comparison of the summary plots between the 2020 WKFLATNSCS run4, the 2020 WKFLATNSCS run3, the 2020 WKFLATNSCS run2, the 2020 WKFLATNSCS run1 and the 2019 WGCSE assessment (baserun).

2020 WKFLATNSCS-RUN 5 (A-C)

Data

Same catch data (total weight, mean weight- and number-at-age for landings and discards) as used in the 2020 WKFLATNSCS-RUN 2.

Life history

Natural mortality

Same as the 2019 WGCSE assessment (baserun)

Maturity

Same as the 2020 WKFLATNSCS-RUN 4

Weight-at-age

Same as the 2020 WKFLATNSCS-RUN 2

Proportion mortality before spawning

Same as the 2019 WGCSE assessment (baserun)

Tuning series

In this run (run 5), the new UK(E&W)-CBT series from 1987-2018 replaced the UK(E&W)-CBT series from 1991-2012. The old UK(E&W)-CBT series from 1991-2012 consisted of an unmodelled effort series (KWhours fished) from a beam trawl fleet between specific overall lengths and engine power. As the hours fished became an optional field in the logbooks and not consistently filled, this field is inappropriate to use as a metric for effort. The new UK(E&W)-CBT series from 1987-2018 was generated using a random effects model which was then disaggregated to LPUE-at-age using sampled catch-at-age from the beam trawl fleet and the weight-at-age from the latest assessment input. Activity days was used as an effort measure, since it is mandatory to record. More detailed information on the calculation of the new UK(E&W)-CBT series is provided in the working document (WD: UK Commercial Index for Bristol Channel (7FG) Sole). The other tuning fleets were the same as used in the 2020 WKFLATNSCS-RUN1.

In run 5A the new UK(E&W)-CBT series was trimmed to ages 2-9. Because of the very high (>1) mean squared residual for age 2 (Figure 42), this series was trimmed to ages 3-9 in the next run (run 5B). In run 5C the BEL-CBT3 series was trimmed to ages 2-8 because the mean squared residual for age 9 in run 5B was higher than 0.3 (Figure 43).

XSA configuration

	2020 WKFLATNSCS				
Fleets:	Years	Ages			α–β
		RUN 5A	RUN 5B	RUN 5C	
BEL-CBT commercial	1971–1996	3–9	3–9	3–9	0–1
BEL-CBT3 commercial	1997–2018	2–9	2–9	2–8	0–1
new UK(E&W)-CBT_days commercial	1987–2012	2–9	3–9	3–9	0–1
UK(E&W)-BTS-Q3 survey	1988– 2018	1–5	1–5	1–5	0.75–0.85

-First data year	1971
-Last data year	assessment year-1
-First age	1
-Last age	10+
Time-series weights	None
-Model	Mean q model all ages
-Q plateau set at age	7
-Survivors estimates shrunk towards mean F	5 years / 5 ages
-s.e. of the means	1.5
-Min s.e. for pop. Estimates	0.3
-Prior weighting	None
Fbar	Ages 4-8

Figures 42-43 present the model output for run 5A.

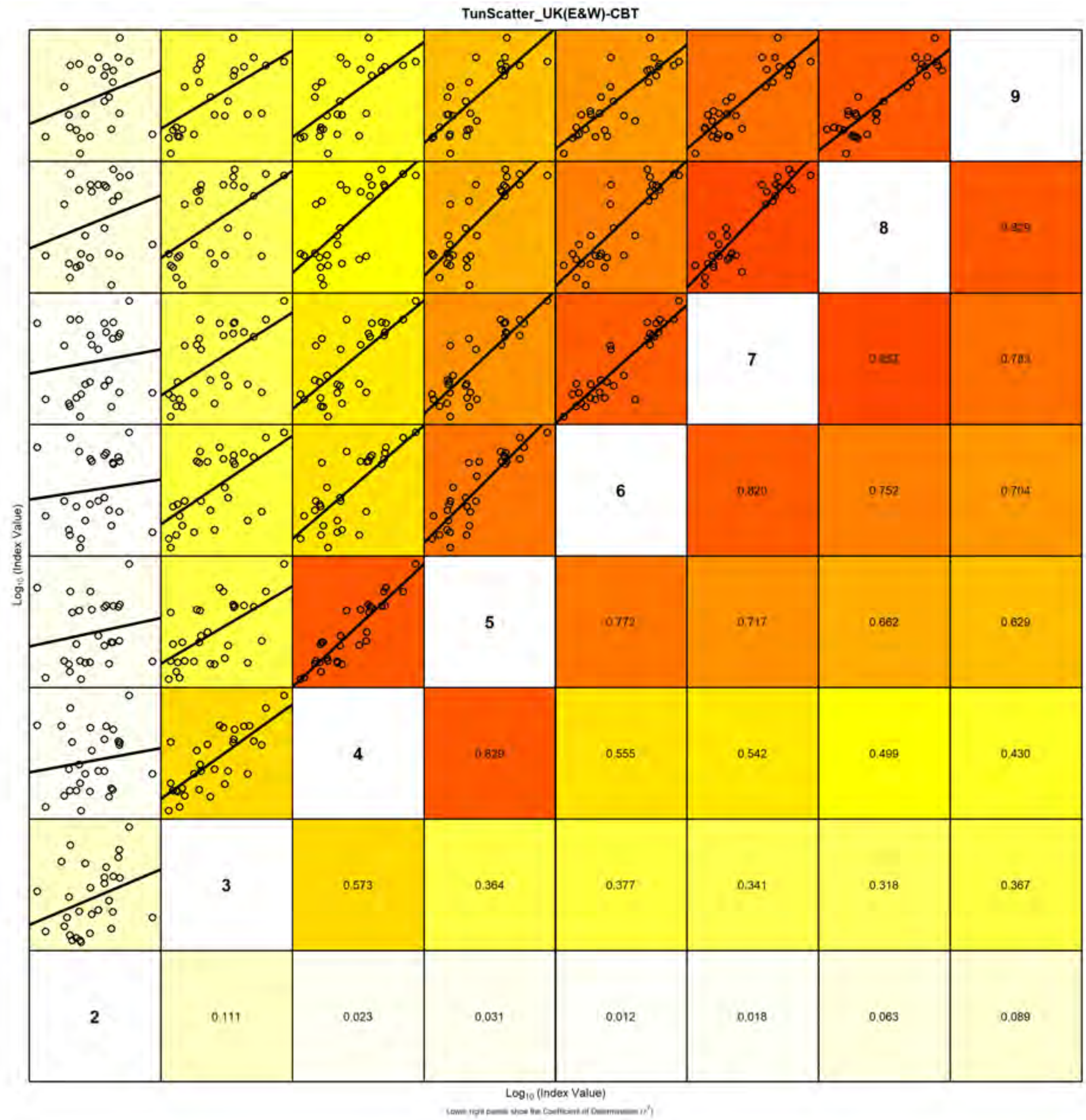


Figure 42: Internal consistency plot of the UK(E&W)-CBT (1987–2018) tuning series for sole in ICES divisions 7.f and 7.g.

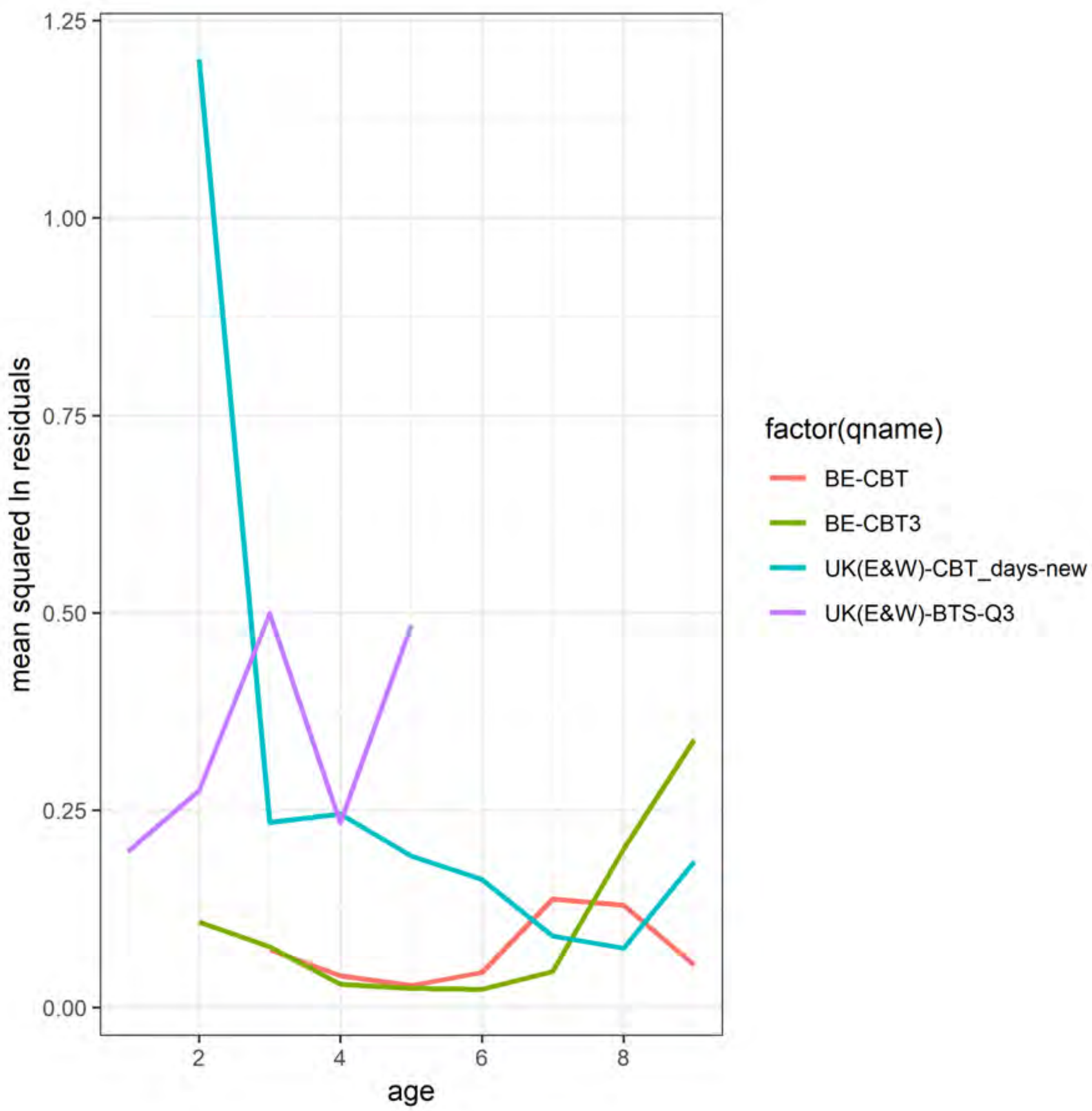


Figure 43: Mean squared residuals of the tuning series by age for sole in ICES divisions 7.f and 7.g.

Figure 44 presents the model output for run 5B.

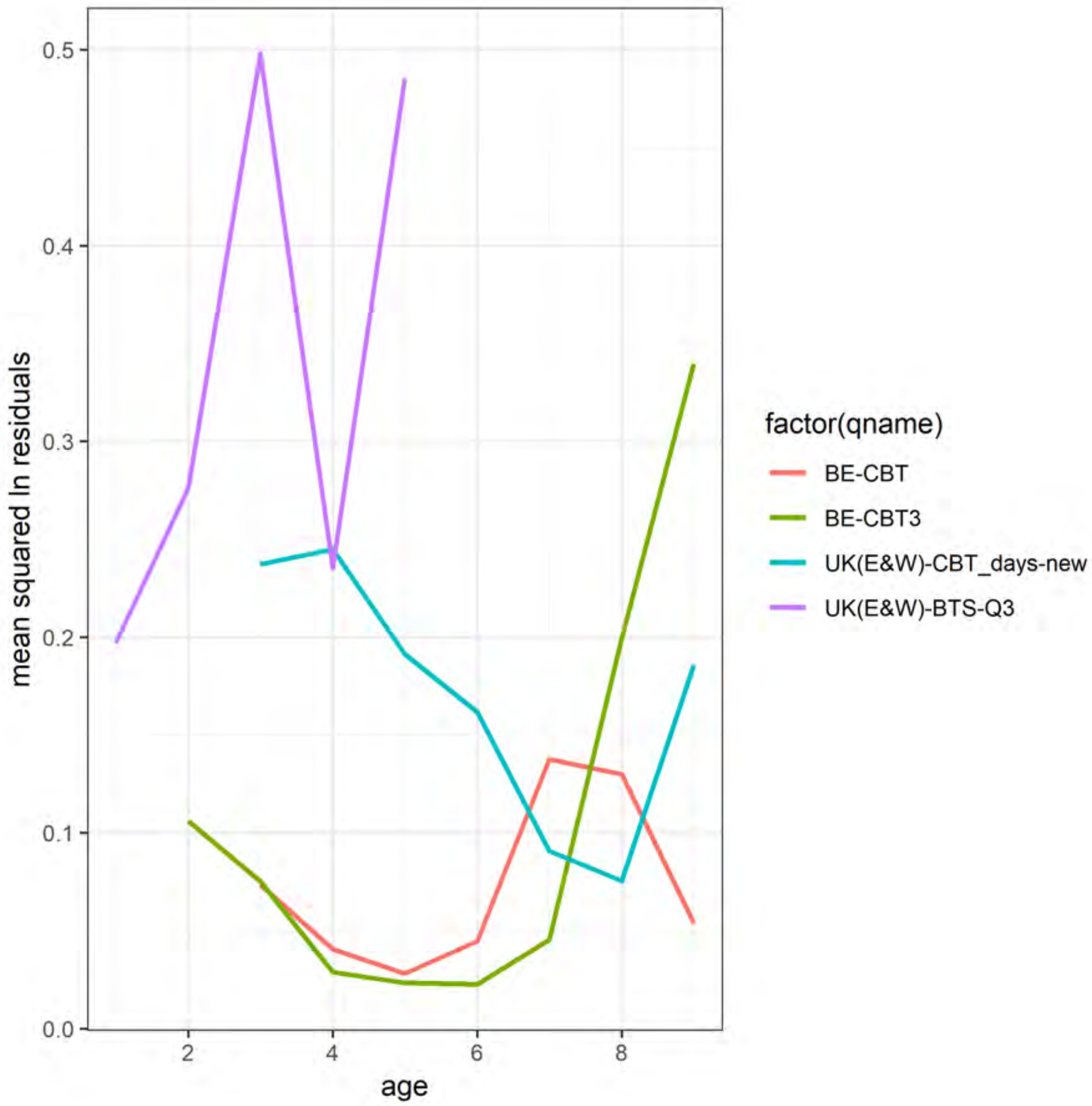


Figure 44: Mean squared residuals of the tuning series by age for sole in ICES divisions 7.f and 7.g.

Figures 45-48 present the model output for run 5C.

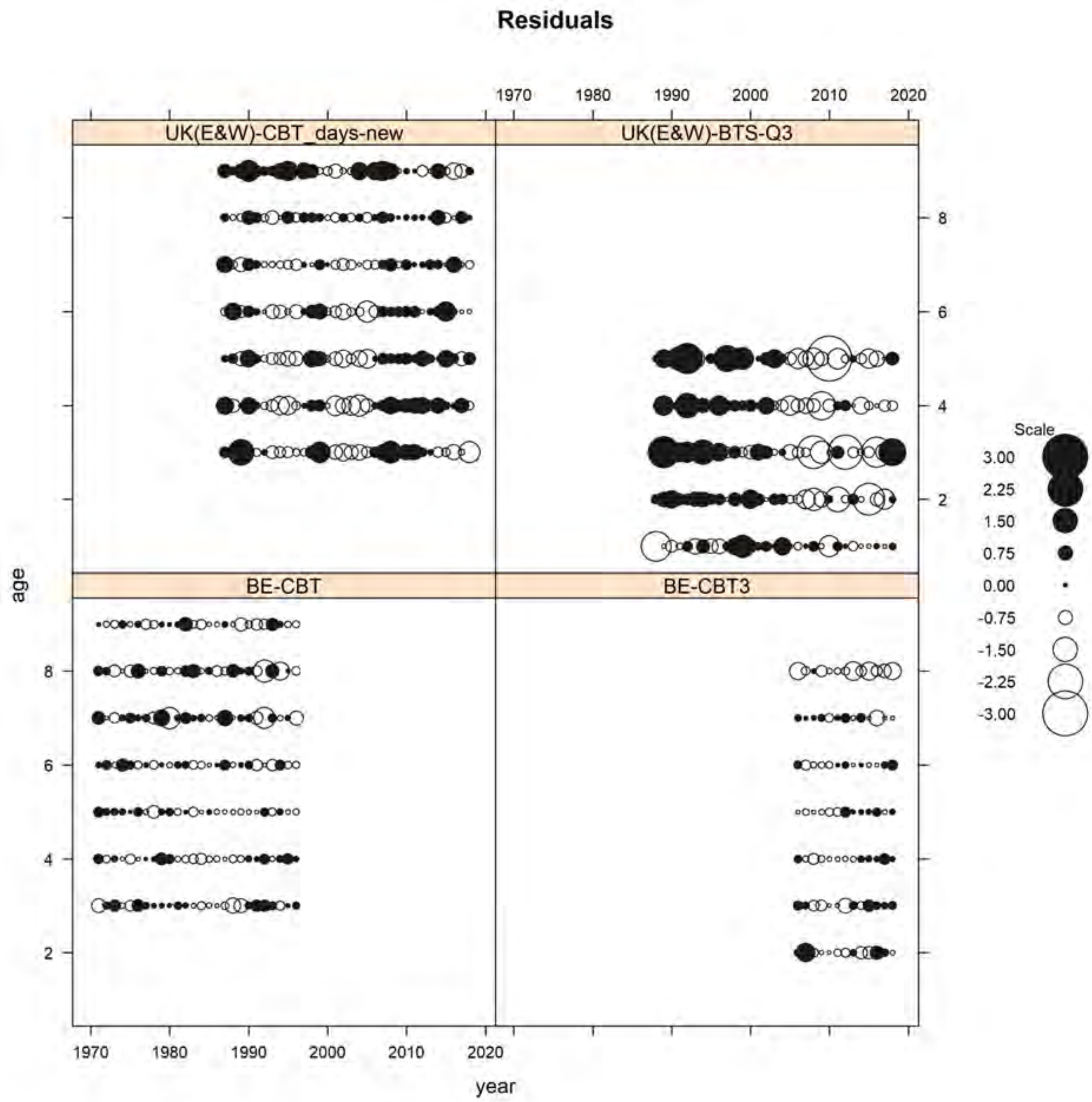


Figure 45: Catchability residuals of the tuning series for sole in ICES divisions 7.f and 7.g.

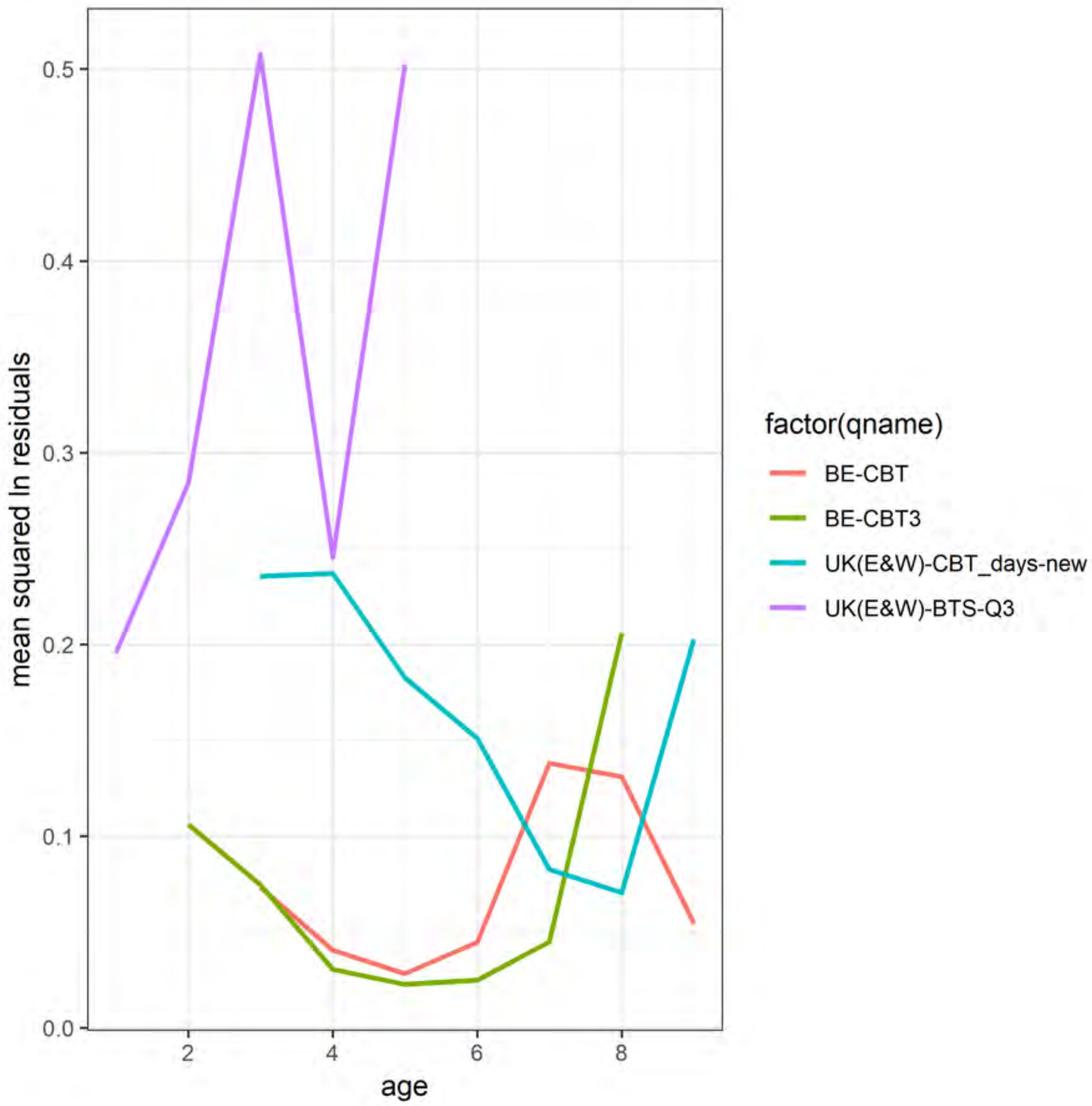


Figure 46: Mean squared residuals of the tuning series by age for sole in ICES divisions 7.f and 7.g.

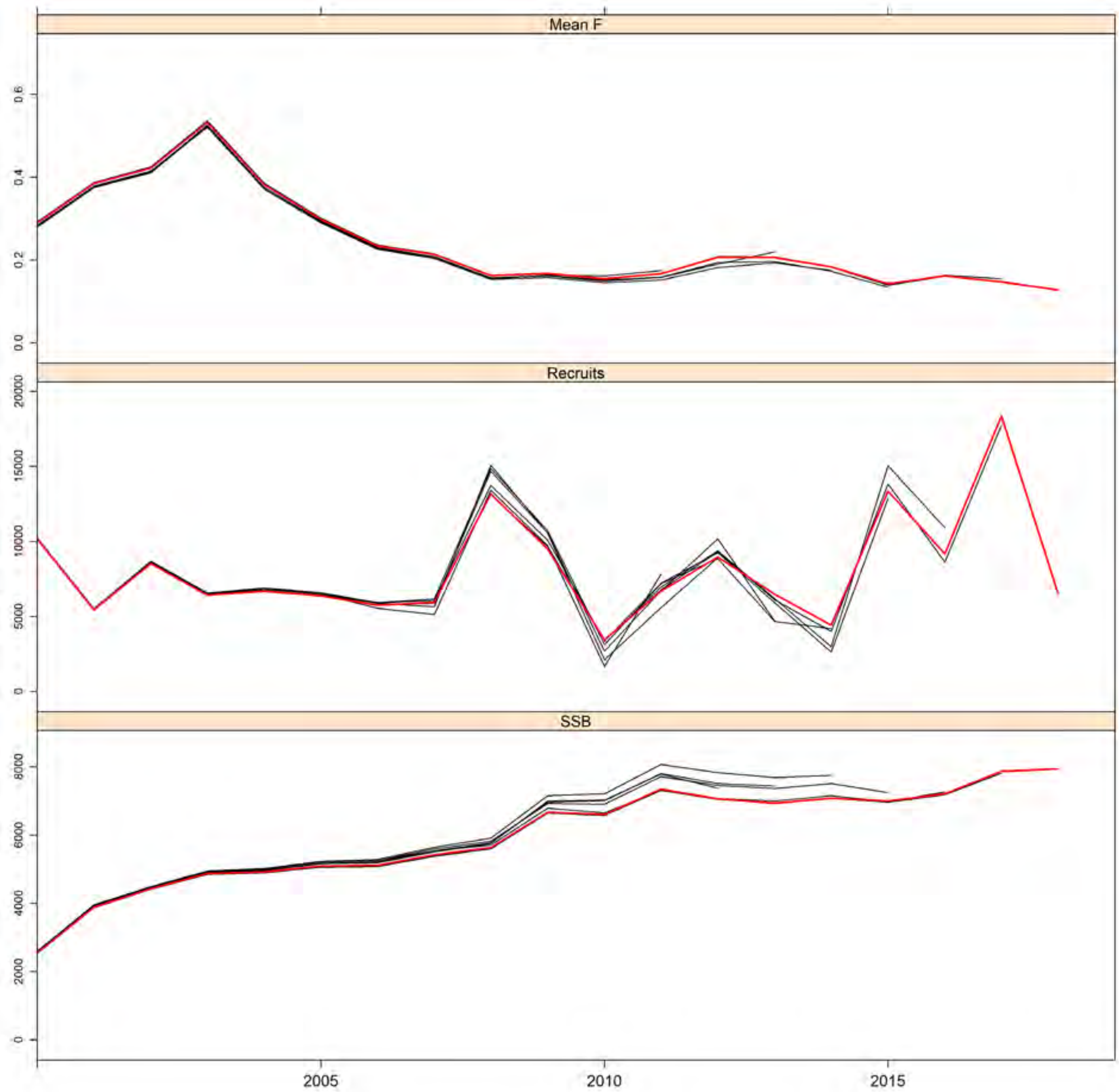


Figure 47: Retrospective pattern for sole in ICES divisions 7.f and 7.g.

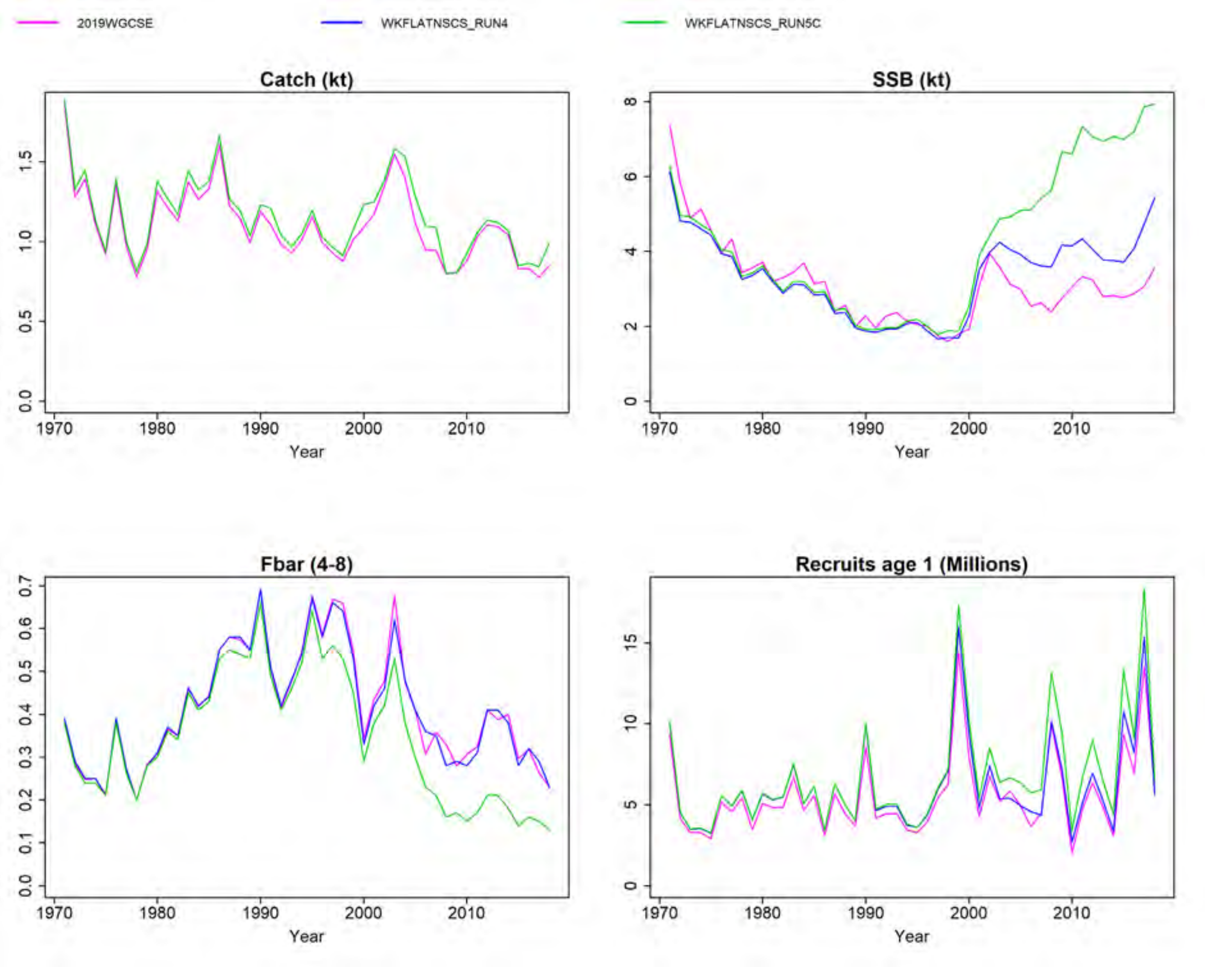


Figure 48: Comparison of the summary plots between the 2020 WKFLATNSCS run5C, the 2020 WKFLATNSCS run4 and the 2019 WGCSE.

2020 WKFLATNSCS-RUN 6

Data

Same catch data (total weight, mean weight- and number-at-age for landings and discards) as used in the 2020 WKFLATNSCS-RUN 2.

Life history

Same biological parameters as the 2020 WKFLATNSCS-RUN 5

Tuning series

In this run (run 6), the UK(E&W)-Q1SWECOS series from 2014-2018 was included to calibrate the assessment. More detailed information on the the methods used to calculate the standardized index of abundance at age for sole in ICES Divisions 7.f and 7.g, is provided in the working document (Development of an index for sole in ICES Divisions 7.f and 7.g using the UK quarter 1 South-West ecosystem survey (UK-Q1SWECOS)). The other tuning fleets were the same as used in the 2020 WKFLATNSCS-RUN5C.

In run 6A the UK(E&W)-Q1SWECOS series was trimmed to ages 1-9. Because of the very high mean squared residual for age 1 (Figure 50), this series was trimmed to ages 2-9 in the next run (run 6B). In run 6C the UK(E&W)-Q1SWECOS series was trimmed to ages 2-5 because the mean squared residual for age 6 in run 6B was higher than 2 (Figure 51).

XSA configuration

	2020 WKFLATNSCS				
Fleets:	Years	Ages			α–β
		RUN 6A	RUN 6B	RUN 6C	
BEL-CBT commercial	1971–1996	3–9	3–9	3–9	0–1
BEL-CBT3 commercial	1997–2018	2–9	2–9	2–8	0–1
new UK(E&W)-CBT_days commercial	1987–2012	2–9	3–9	3–9	0–1
UK(E&W)-BTS-Q3 survey	1988– 2018	1–5	1–5	1–5	0.75–0.85
UK(E&W)-Q1SWECOS	2014– 2018	1–9	2–9	2–5	0.1–0.3

-First data year	1971
-Last data year	assessment year-1
-First age	1
-Last age	10+
Time-series weights	None
-Model	Mean q model all ages
-Q plateau set at age	7
-Survivors estimates shrunk towards mean F	5 years / 5 ages
-s.e. of the means	1.5
-Min s.e. for pop. Estimates	0.3
-Prior weighting	None
Fbar	Ages 4-8

Figures 49-50 present the model output for run 6A.

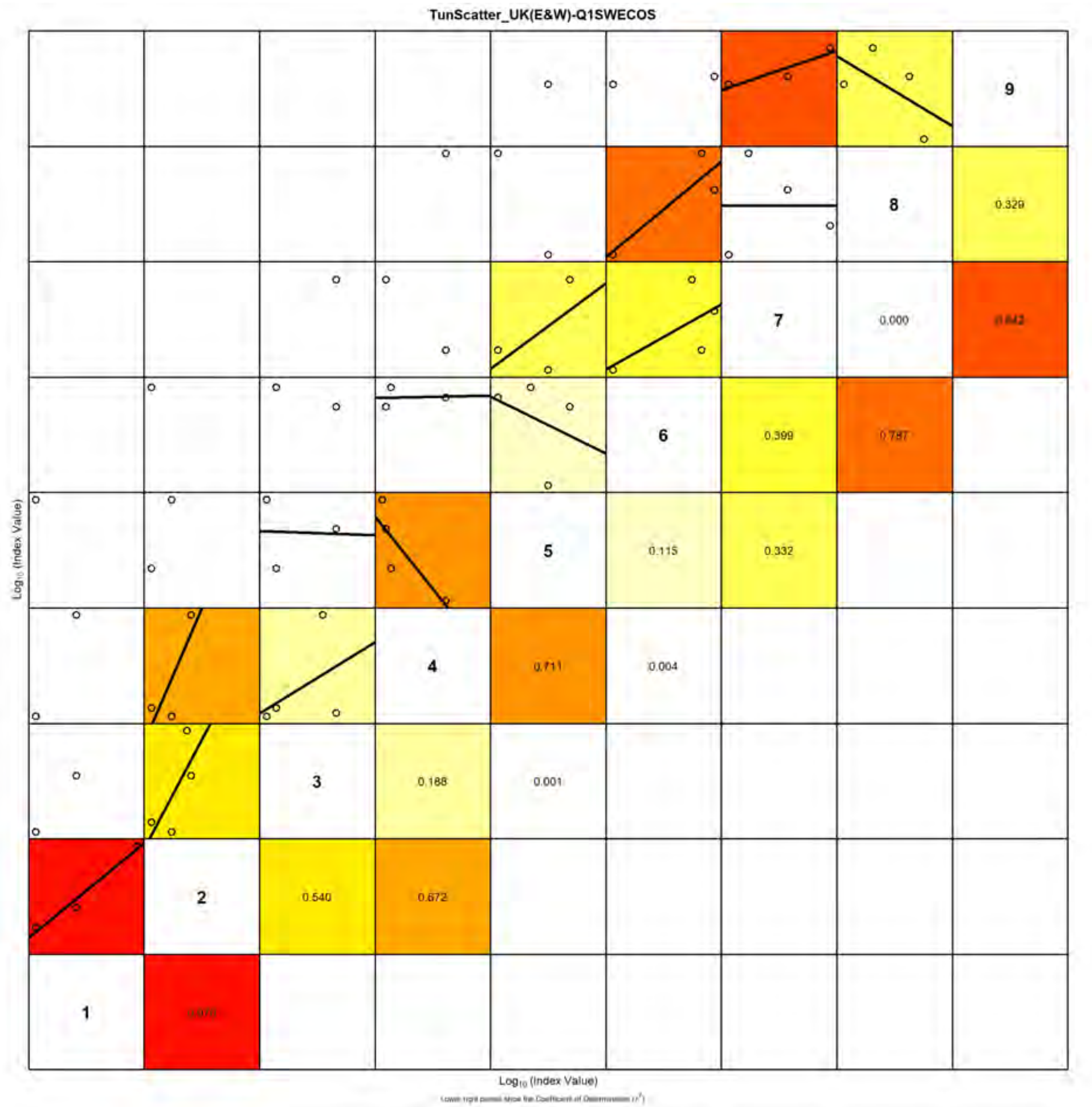


Figure 49: Internal consistency plot of the UK(E&W)-Q1SWECOS (2014–2018) tuning series for sole in ICES divisions 7.f and 7.g.

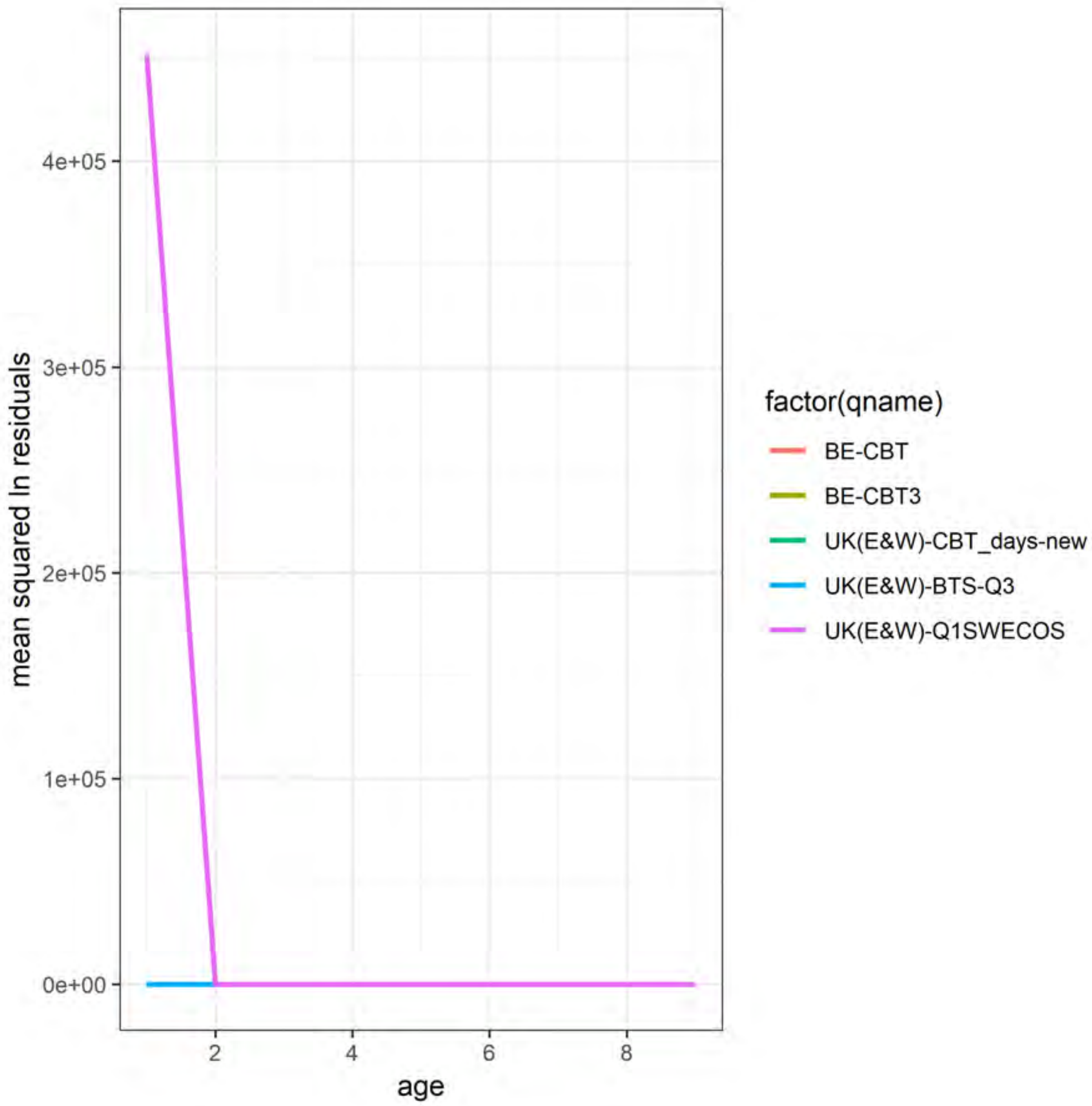


Figure 50: Mean squared residuals of the tuning series by age for sole in ICES divisions 7.f and 7.g.

Figure 51 presents the model output for run 6B.

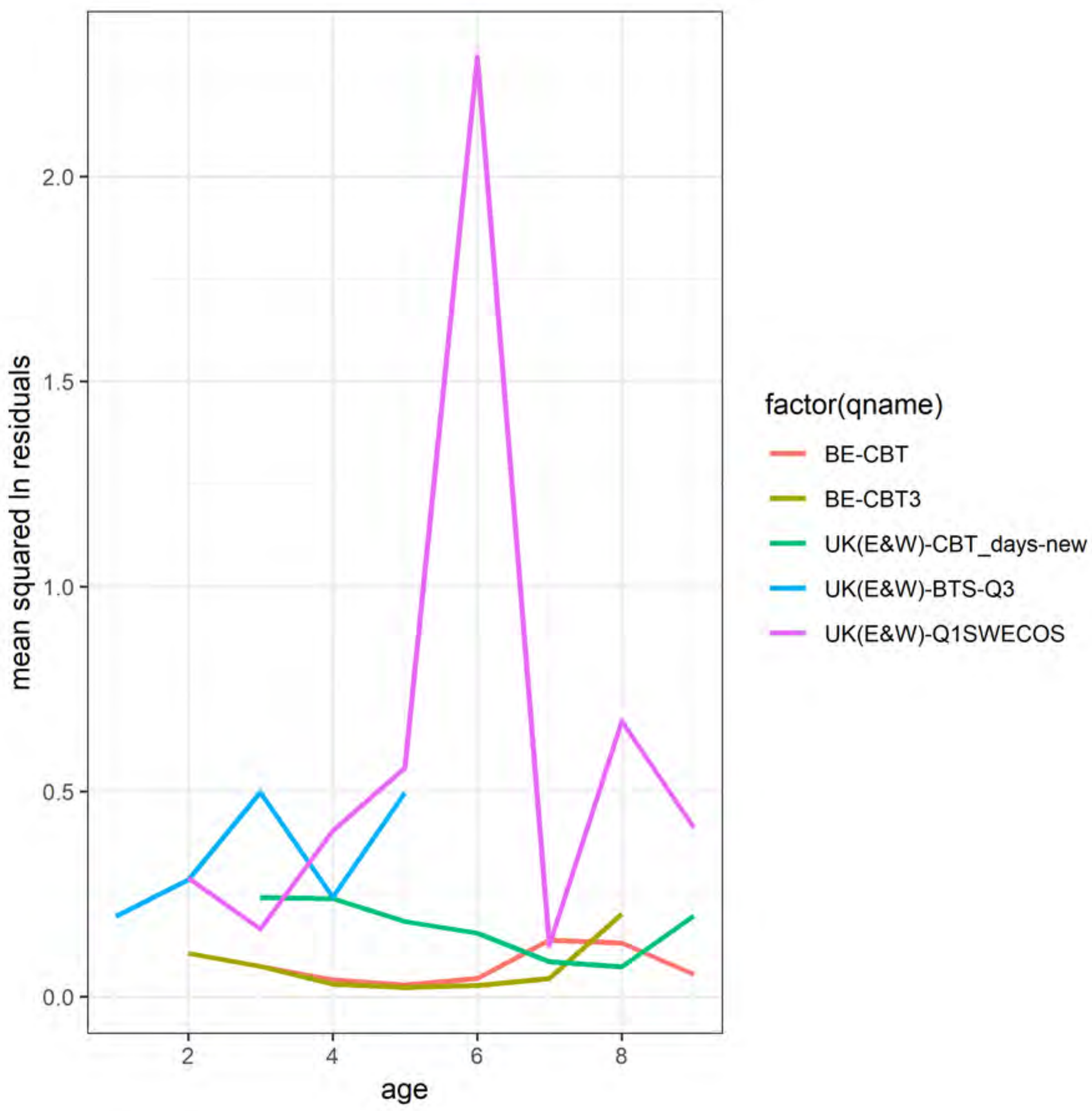


Figure 51: Mean squared residuals of the tuning series by age for sole in ICES divisions 7.f and 7.g.

Figures 52-55 present the model output for run 6C.

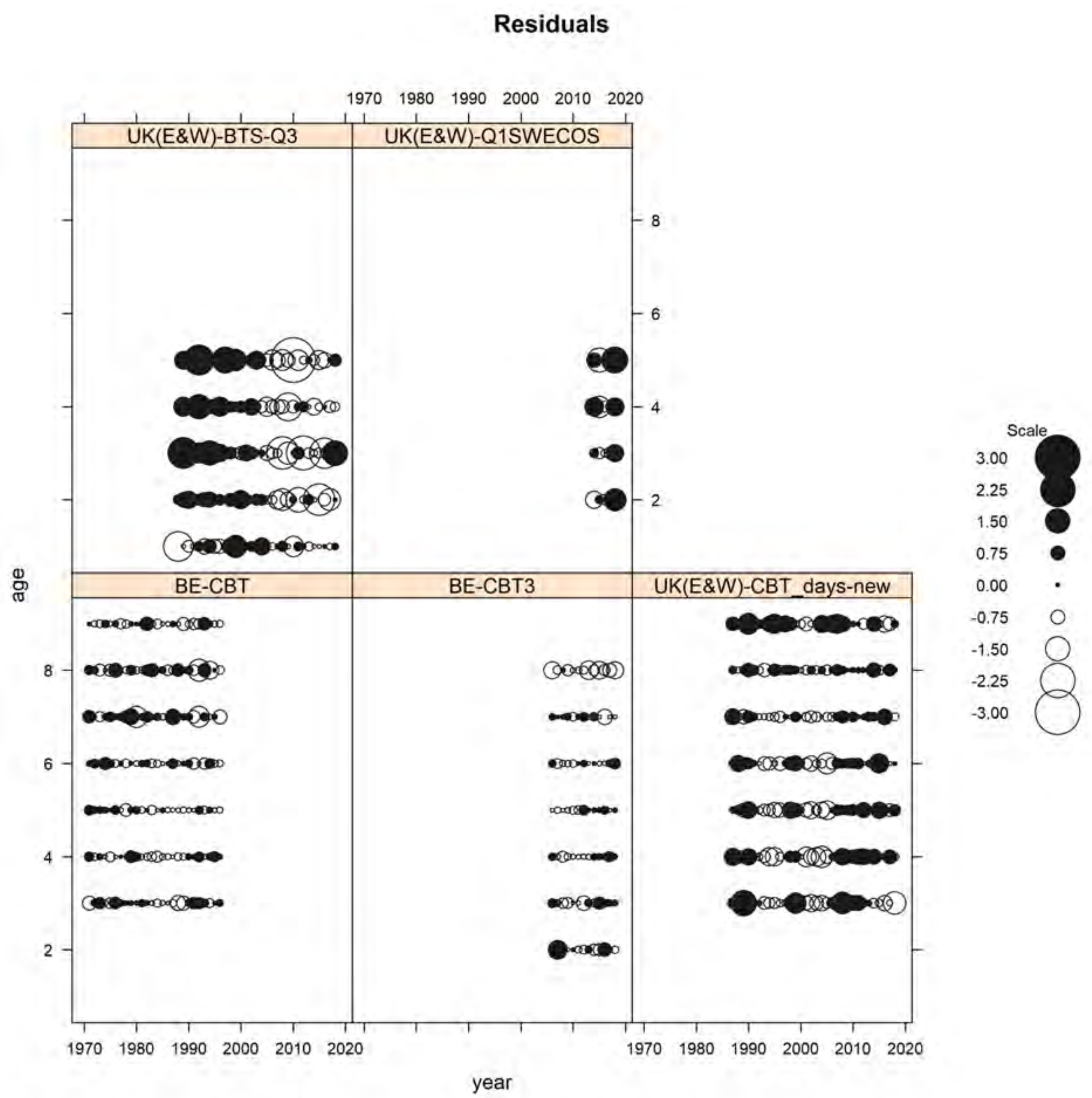


Figure 52: Catchability residuals of the tuning series for sole in ICES divisions 7.f and 7.g.

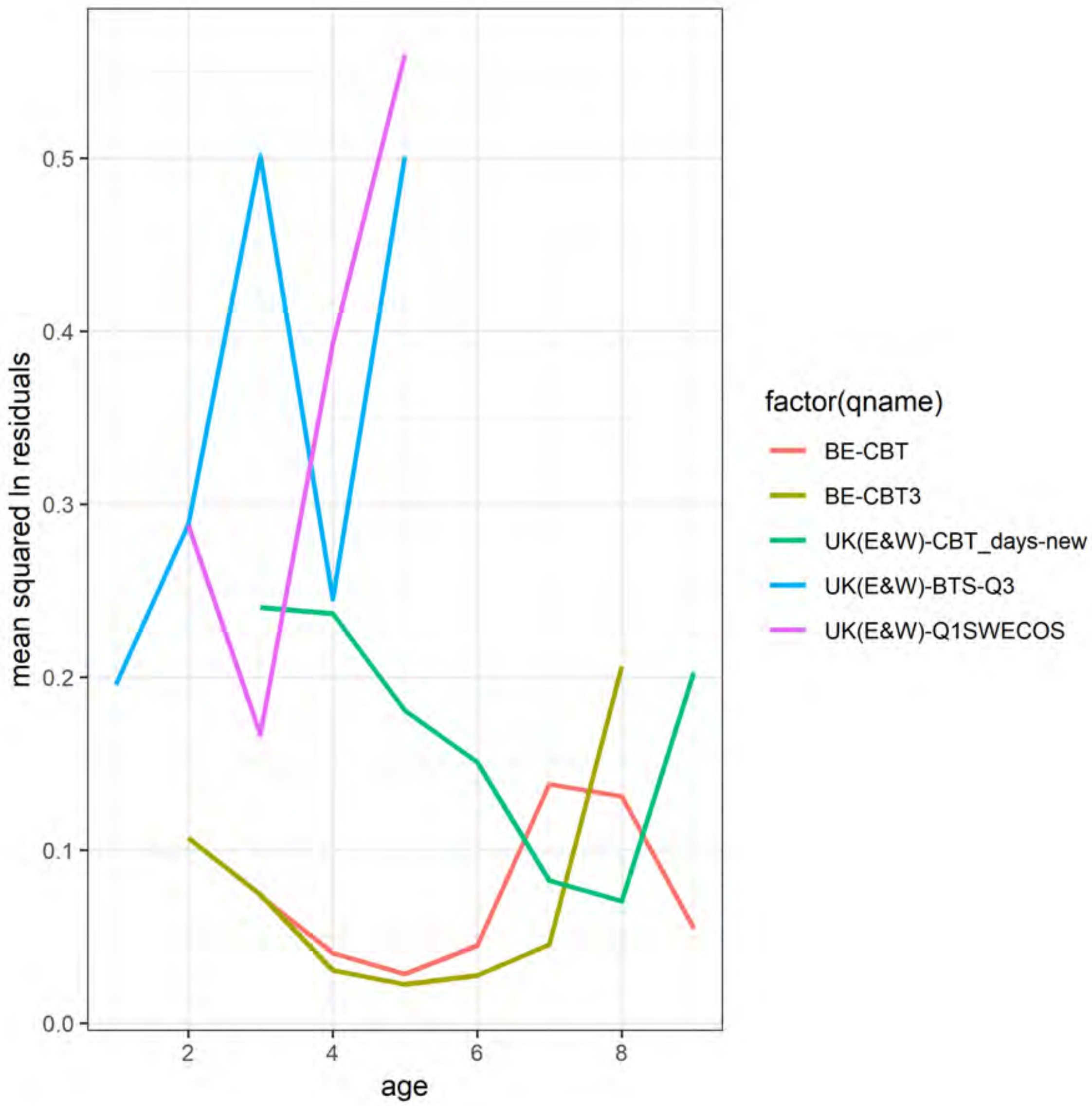


Figure 53: Mean squared residuals of the tuning series by age for sole in ICES divisions 7.f and 7.g.

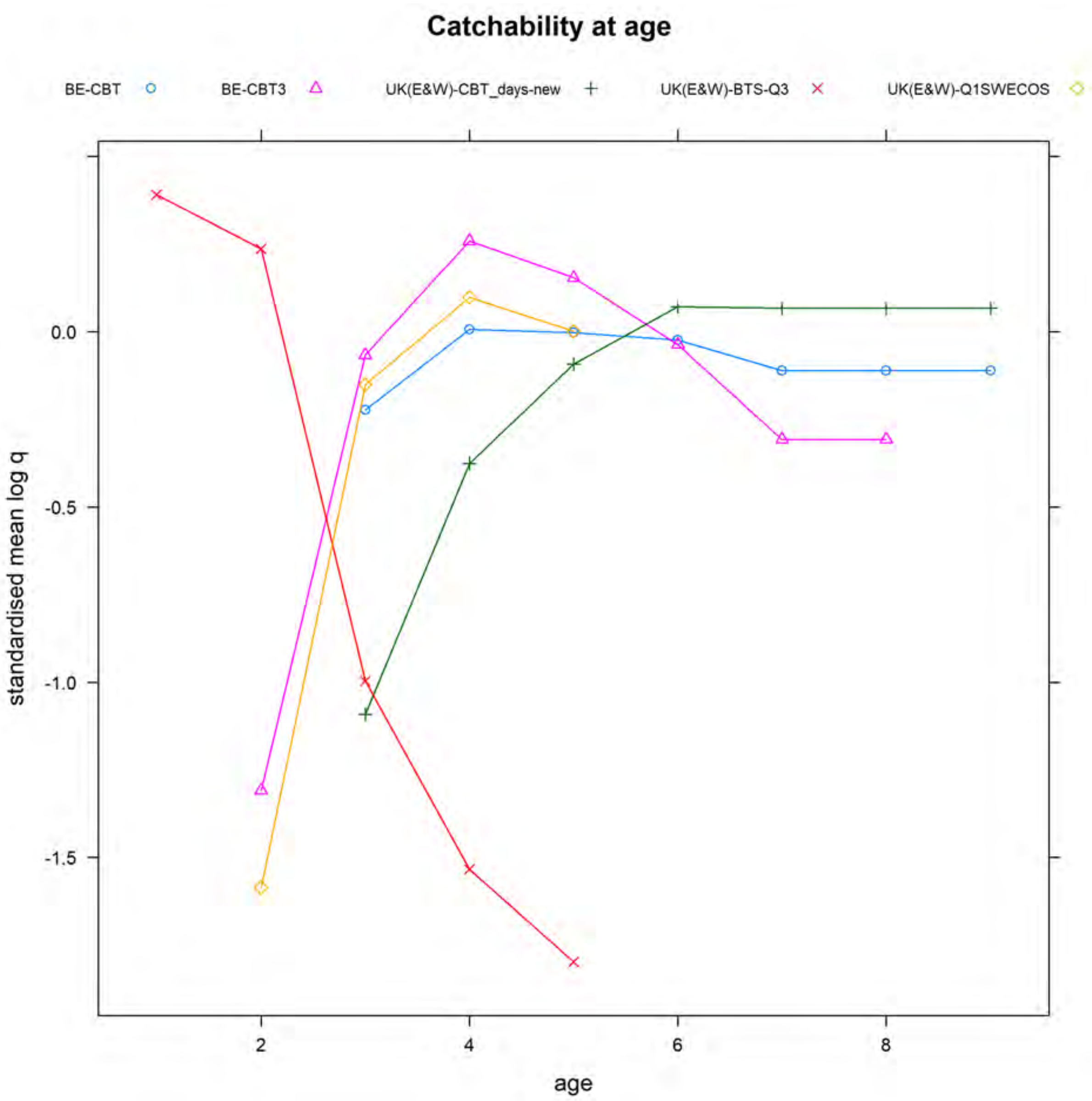


Figure 54: Catchability at age for the different tuning series for sole in ICES divisions 7.f and 7.g.

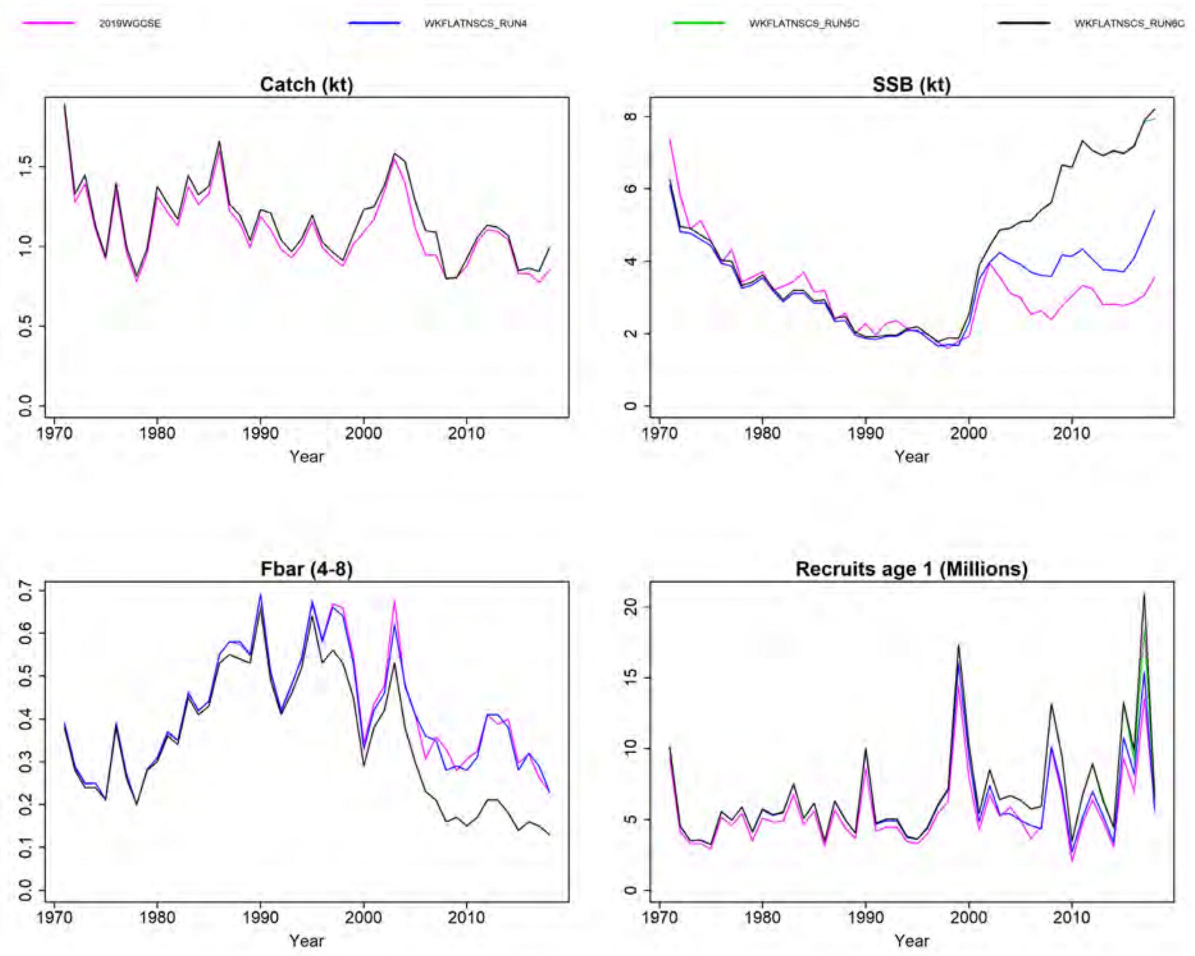


Figure 55: Comparison of the summary plots between the 2020 WKFLATNSCS run6C, the 2020 WKFLATNSCS run5C and the 2020 WKFLATNSCS run4 and the 2019 WGCSE.

Conclusion on XSA model runs from the benchmark

The updated landings data (total landings, numbers-at-age and mean weight-at-age), stock weights and the Belgian commercial beam trawl tuning series (BE-CBT3) for 2004-2018, resulted in a slightly higher SSB (spawning stock biomass) for this period and similar trends for F and recruitment compared to the baserun. In the second run, discards are included (observed discards for 2004-2018; for 1971-2003 discards were assumed using the mean ratio between landings and discards in 2004–2018) and stock weights were derived from the catch weights. This resulted in a minor upward shift of the catch and recruitment for the whole time series. The SSB tends to be lower compared to the baserun, except for the more recent period (2005-2018) where the opposite shift could be recorded. In the following runs, 2 new maturity ogives were explored. The SSB is significantly higher over the entire time series when using the fixed maturity ogive (based on the UK(E&W)-Q1SWECOS data from 2013 to 2019) over time. This is also the case for the SSB in the period 2003-2018 when using the temporal varying maturity ogive (based on samples from the NWGF and UK(E&W)-Q1SWECOS survey from 1993 to 2019). For the rest of the time series, the SSB is very similar to the second run where the original fixed maturity ogive over time (based on samples from the UK (E&W) beam trawl survey of March 1993 and 1994) was used. As the use of a temporal varying maturity ogive, adds more noise to the estimation of the SSB compared to a fixed maturity ogive, it was decided to use the latter in the SAM runs. However, in the following XSA runs, the temporal varying maturity ogive was applied. In the fifth run, the new UK commercial beam trawl tuning series (UK(E&W)-CBT) from 1987-2018 replaced the UK(E&W)-CBT

series from 1991-2012. This new UK(E&W)-CBT series is generated using a random effects model and uses activity days as a metric for effort. The use of this new tuning series results in higher SSB values over the entire time series, but especially from 2003 onwards, the upward shift in SSB enlarges through time. In 2014 the largest increase in SSB was recorded (89% compared to the fourth run). Consequently, a larger retrospective pattern in SSB is present compared to the previous run. Furthermore, higher recruitment values and lower fishing mortalities are recorded. Those shifts are also more pronounced in the more recent period of the time series. Overall the residuals are small and no apparent trend was recorded. It was noticed by the reviewers that the inclusion of commercial tuning indices by age in the XSA model is arguable as this creates a duplication of the same information. In the XSA model the catchability is assumed to be constant and the catch is granted as the 'truth'. Therefore, it was suggested to set up the SAM model as in contrast to XSA, SAM allows the inclusion of a commercial tuning series as a biomass index by year. In the last XSA run, the UK quarter 1 South-West ecosystem survey (UK(E&W)-Q1SWECOS) series from 2014-2018 was included to calibrate the assessment. This had a very limited impact on the assessment outcome. The strong 2016 year class was estimated to be a bit higher and the 2018 SSB to be slightly lower. It should be noted that the internal consistency is rather weak and that 6 years of data is too soon for any strong conclusion.

3. SAM

Introduction

The applicability of the XSA framework to the sole 7.fg stock was questioned for the following assumptions/limitations:

- XSA assumes that catch data is known without error (no observation model for the catch data) which is highly unlikely due to e.g. the fact that only a subsample of the catch numbers-at-age is observed, age reading of otoliths may cause bias, misreporting of landings by fishers may occur…
- XSA requires that tuning fleets have age-structured information causing that the catch-at-age information is used twice in the model thereby down weighting the information from other data sources
- XSA cannot handle missing data in catch or tuning series and requires to make assumptions on missing observations (e.g. catches equal landings if no discard information is available)

To overcome these shortcomings, the applicability of a state-space stock assessment model (SAM) was explored during the benchmark. This was done by using the *stock assessment* package which enables to interface a performant SAM implementation (https://github.com/fishfollower/SAM/) in *Template Model Builder* (TMB)[1] from the R statistical software.

The main feature of SAM is that is includes both process models on survival, recruitment and fishing mortality, describing the internal states of the system, and observation models for catch and tuning data. Additionally, tuning data can be introduced in different ways, e.g. as *SSB, TSB (total stock biomass) or landings indices*, while the random effects formulation arising from the hierarchical nature of the state-space modelling framework, can easily be used to handle missing observations as is the

[1] TMB offers a modelling framework for fast estimation of hierarchical models written in C code through the Laplace approximation. In addition, increased performance of nonlinear optimization procedures is achieved through the use of AUTODIFF (automatic differentiation), and performant C libraries for linear algebra (Eigen and CholMod).

case with catch information on age 1. Finally, SAM allows to specify different model configurations, and parametrization of both process and observation models.

Data

The catch data (total weight, mean weight- and numbers-at-age for landings and discards) used in the SAM runs is the same data as used in the 2020 WKFLATNSCS-RUN 2 (see XSA runs).

The Fbar calculates the mean fishing mortality for the set age range and should represent a significant part of the catch. The Fbar in the current assessment is set at age 4-8. However, as age 3 represents a large proportion of the catch (Figure 56), it was suggested to expand the Fbar to ages 3-8. The Fbar with ages 3-8 represents an average 77 % of the catch, with a minimum of 48% and a maximum of 97% (Figure 57). The adjusted Fbar setting was applied in all the SAM runs.

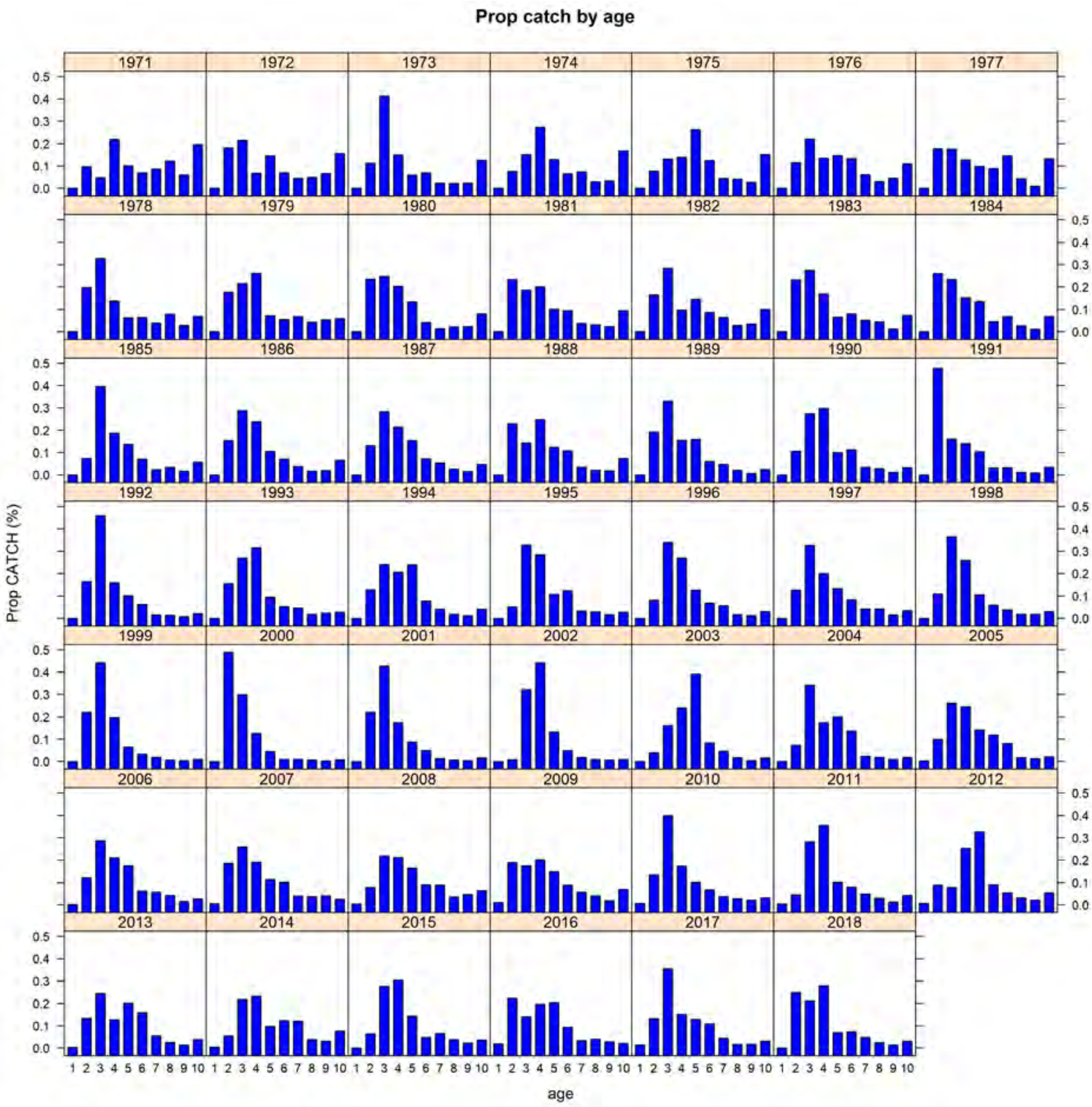


Figure 56: Catch proportions by age for sole in ICES divisions 7.f and 7.g for the period 1971-2018.

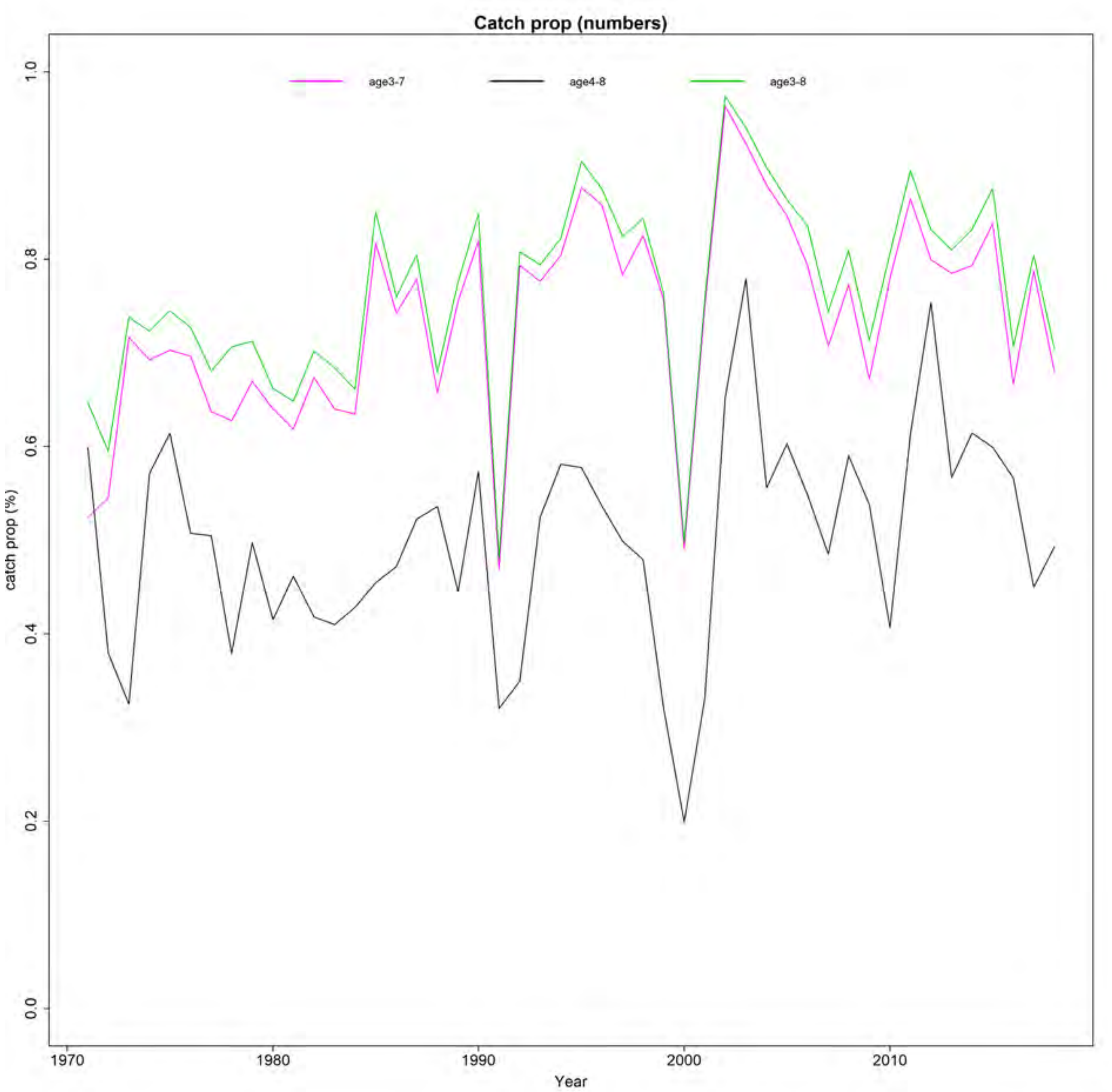


Figure 57: Comparison of the catch proportions represented by different age groupings for sole in ICES divisions 7.f and 7.g.

Life history

Natural mortality

Same as the 2019 WGCSE assessment (baserun), fixed at 0.1 for all ages and years considered in the assessment.

Maturity

The new maturity ogive obtained by using a length based model with sex specific ALK based on UK(E&W)-Q1SWECOS data from 2013 to 2019, was used for age 2-15. Because the 9% maturity at age 1 is not based on observations, is was suggested to set the maturity at age 1 to zero. More detailed information on the calculation of the maturity ogive is provided in the working document (Working document: Investigating maturity of Sole (*Solea solea* L.) in the Bristol Channel and Celtic Sea (ICES Division 27.7.fg)).

Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Maturity	0.00	0.67	0.91	0.98	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Weight-at-age

For the ages 2-15, the stock weights were obtained using the Rivard weight calculator (http://nft.nefsc.noaa.gov./), that conducts a cohort interpolation of the catch weights. A stock weight for age 1 was calculated for 2004-2018 but not for 1971-2003, as the catch weight for age 1 is zero for the latter. As there's a wide range of age 1 stock weights for 2004-2018 and some values are higher than the age 2 stock weight, the stock weight for age 1 was set to the lowest estimated stock weight for age 2 for the whole time series.

Proportion mortality before spawning

Both the proportion of natural mortality before spawning (Mprop) and the proportion of fishing mortality before spawning (Fprop) are set to 0.

Tuning series

The same set of tuning series as used in the XSA RUN 6 were available to test in the SAM runs. The commercial tuning series (all beam trawl: BEL-CBT, BEL-CBT3 and UK(E&W)-CBT_days) were included both as an age-structured and biomass index, whereas the UK survey indices (all beam trawl: UK(E&W)-BTS_Q3 and UK(E&W)-Q1SWECOS) were age-structured. It was not possible to access the mean weight-at-age of the Belgian beam trawl fleet all the way to the beginning of the time series (1971). Therefore, the numbers-at-age of the Belgian beam trawl fleet were multiplied with the mean weight-at-age of the catch (landings only). Then, the resulting weights-at-age were summed over the ages by year to have a biomass index by year of the BEL-CBT fleet. The Belgian beam trawl fleet takes around 65% of the total landings, therefore this fleet also represents the largest share of the mean weight-at-age of the catch.

Setup of the different SAM runs

Table 1 shows the different configurations of the SAM runs that were conducted during the WKFLATNSCS benchmark sole7fg. A first SAM model (RUN_1) was configured to maximally mimic the settings of the XSA model that is currently used to assess the sole 7.fg stock. Next, this model was adjusted by transforming the age-structured commercial tuning series into an SSB index (RUN_2). In a following step, the time series of the commercial tuning series were split in order to better account for changes in catchability due to e.g. technological creep (RUN_3). In RUN_4, the effect of including the UK(E&W)-Q1SWECOS survey was explored, and finally, in a fifth model (RUN_5), the model from RUN_3 was optimized in terms up of parameter configuration for the process and observation models.

Table 1: overview of the different configurations of the SAM runs

	Data & settings				
RUN	1	2	3	4	5
tuning indices					
UK(E&W)-BTS survey	Age (1-5)	Age (1-5)	Age (1-5)	Age (1-5)	Age (1-5)
UK(E&W)-Q1SWECOS survey	-	-	-	Age (1-9)	-
BE-CBT_1971-1996	Age (3-9)	Biomass	-	-	-
BE-CBT_1971-1983	-	-	Biomass	Biomass	Biomass
BE-CBT_1984-1996	-	-	Biomass	Biomass	Biomass
BE-CBT3_2006-2018	Age (2-9)	Biomass	Biomass	Biomass	Biomass
UK(E&W)-CBT_1984-2018	Age (2-9)	Biomass	-	-	-
UK(E&W)-CBT_1984-2005	-	-	Biomass	Biomass	Biomass
UK(E&W)-CBT_2006-2018	-	-	Biomass	Biomass	Biomass
catch numbers-at-age	see figure 58				
stock weights-at-age	see figure 58				
catch weights-at-age	see figure 58				
landing weights-at-age	see figure 58				
discard weights-at-age	see figure 58				
maturity ogive	Age1 = 0; Age2 = 0.67; Age3 = .91; Age4 = .98; Age5 = .99; Age6 = .99; Age6+ = 1				
natural mortality	0.1 for all ages and years				
prop. M < spawning	0 for all years				
prop. F < spawning	0 for all years				
Plus group	10				
Fbar	3-8				

	Model configuration				
RUN	1	2	3	4	5
stock-recruitment	plain random walk on logN(1)				
correlation F-at-age	ID	AR(1)	AR(1)	AR(1)	AR(1)
F parameters-at-age	9 = 0, 1, 2, 3, 4, 5, 6, 7, 8, 8				6 = 0, 1, 2, 3, 3, 3, 4, 4, 5, 5
q parameters (-at-age)					
UK(E&W)-BTS survey	4 = 0, 1, 2, 3, 3, -1, -1, -1, -1, -1				
UK(E&W)-Q1SWECOS survey	-	-	-	8 = 4, 5, 6, 7, 8, 9, 10, 11, 11, -1	-
BE-CBT_1971-1996	6 = -1, -1, 4, 5, 6, 7, 8, 9, 9,-1	1	-	-	-
BE-CBT_1971-1983	-	-	1	1	1
BE-CBT_1984-1996	-	-	1	1	1
BE-CBT3_2006-2018	7 = -1, 10, 11, 12, 13, 14, 15, 16, 16, -1	1	1	1	1
UK(E&W)-CBT_1984-2018	5 = -1, -1, 17, 18, 19, 20, 21, 21, -1, -1	1	-	-	-
UK(E&W)-CBT_1984-2005	-	-	1	1	1
UK(E&W)-CBT_2006-2018	-	-	1	1	1
σ² F parameters-at-age	1 = 0, 0, 0, 0, 0, 0, 0, 0, 0, 0				
σ² N parameters-at-age	2 = 0, 1, 1, 1, 1, 1, 1, 1, 1, 1				
σ² obs pars (-at-age)					
catch numbers-at-age	1	1	1	1	2 = 0, 0, 1, 1, 1, 1, 1, 1, 1, 1
UK(E&W)-BTS survey	1	1	1	1	3 = 2, 3, 3, 4, 4, -1, -1, -1, -1
UK(E&W)-Q1SWECOS survey	-	-	-	1	-
BE-CBT_1971-1996	1	1	-	-	-
BE-CBT_1971-1983	-	-	1	1	1

BE-CBT_1984-1996	-	-	1	1	1
BE-CBT3_2006-2018	1	1	1	1	1
UK(E&W)-CBT_1984-2018	1	1	-	-	-
UK(E&W)-CBT_1984-2005	-	-	1	1	1
UK(E&W)-CBT_2006-2018	-	-	1	1	1
ρ observations at-age					
catch numbers-at-age	"ID"	"ID"	"ID"	"ID"	"AR(1)" (single ρ for all ages)
UK(E&W)-BTS survey	"ID"	"ID"	"ID"	"ID"	"ID"
UK(E&W)-Q1SWECOS survey	-	-	-	"ID"	-
BE-CBT_1971-1996	"ID"	-	-	-	-
BE-CBT_1971-1983	-	-	-	-	-
BE-CBT_1984-1996	-	-	-	-	-
BE-CBT3_2006-2018	-	-	-	-	-
UK(E&W)-CBT_1984-2018	-	-	-	-	-
UK(E&W)-CBT_1984-2005	-	-	-	-	-
UK(E&W)-CBT_2006-2018	-	-	-	-	-

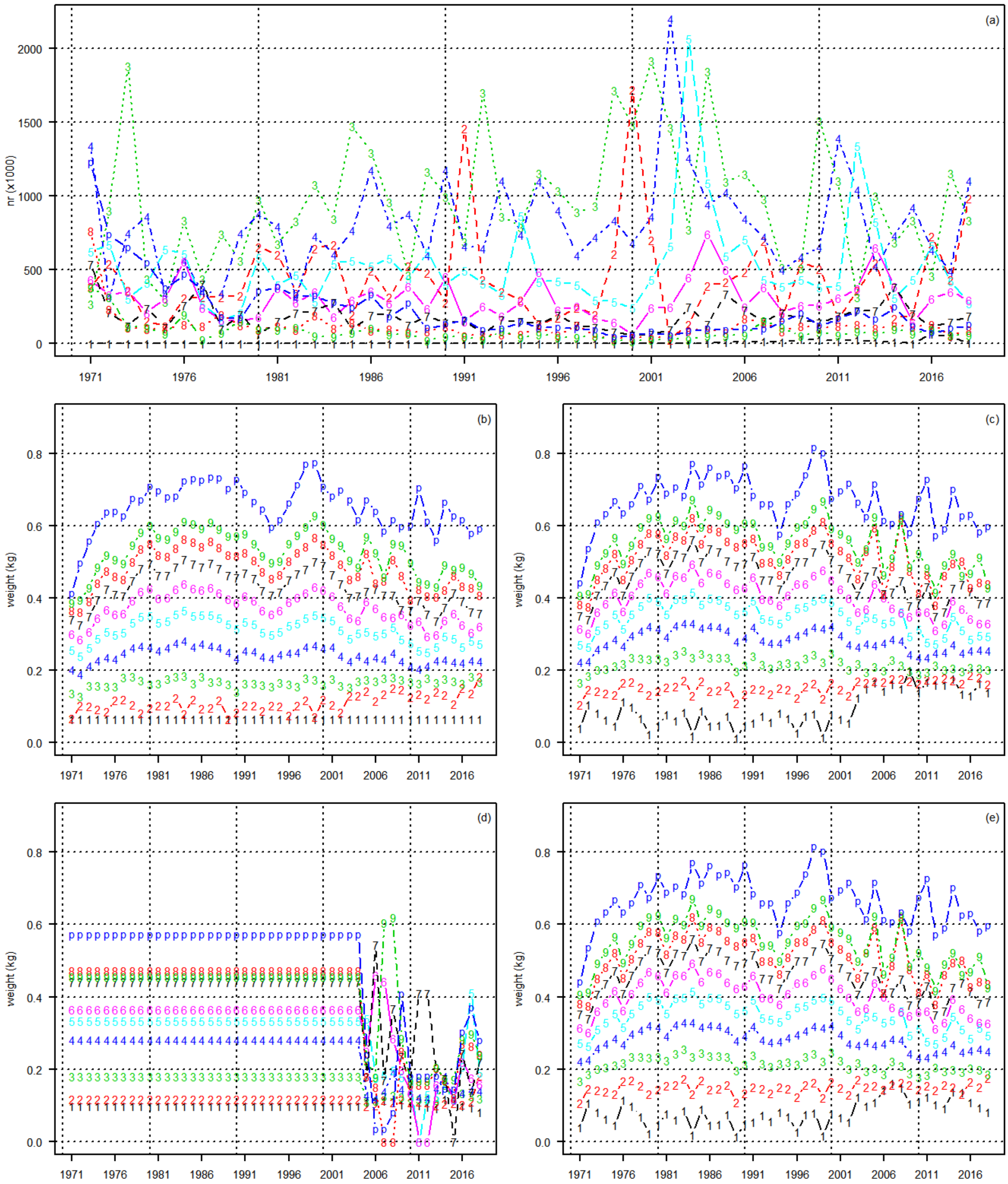


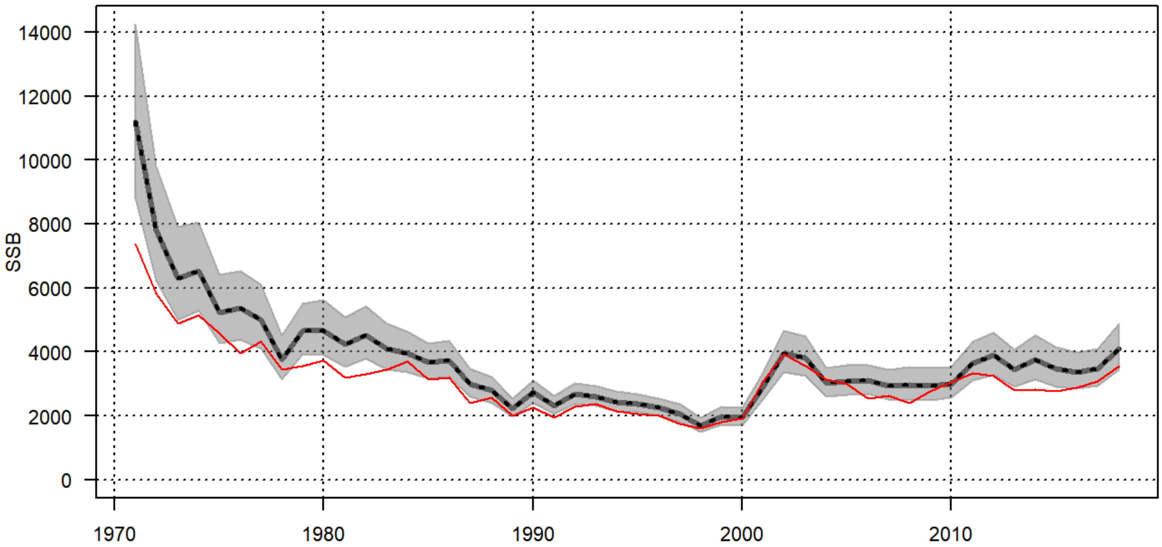
Figure 58: Catch numbers-at-age (a), stock weights-at-age (b), landing weights-at-age (c), discard weights-at-age (d), and catch weights-at-age (e) used in each of the SAM runs. Numbers refer to the age class with “p” indicating the plus group.

2020 WKFLATNSCS-RUN 1

i) Model output: SSB, Fbar, recruitment, catches, catchability

The difference between SAM and XSA, with similar settings, reveals minor differences with respect to the magnitude in SSB, Fbar, and recruitment (Figure 59). Only at the start of the time series, the XSA model estimates SSB to be significantly lower than the SAM estimate, whereas the opposite trend appears in the Fbar estimates at the start of the time series. Besides this, the major difference are found in the Fbar estimates. The estimates of the XSA model are much more variable compared to the SAM estimates which is related to the fact that SAM does not consider the catches as deterministic, and includes a process model on fishing mortality-at-age. Recruitment is very similar between both models, except from 2002 until 2012, where there seems to be a lag of order 1 between the recruitment estimates of both models.

The fishing mortality-at-age is slightly dome-shaped, with a peak on age 5, whereas fishing mortality on age 1 and 2 is considerable lower compared to the other age groups considered in the model (Figure 60). This patterns corroborates with the estimated catchability trends-at-age of the commercial tuning indices (BE-CBT; BE-CBT3; UK(E&W)-CBT (Figure 62). In contrast, the selectivity pattern of the survey, UK(E&W)-BTS-Q3, shows an opposite pattern with the highest values found for age 1 and 2. In general, the estimated catches from the SAM model are close to the observed catches (Figure 61). Only at the start of the time series, some observed catches do not fall within the confidence bounds of the estimated catches.



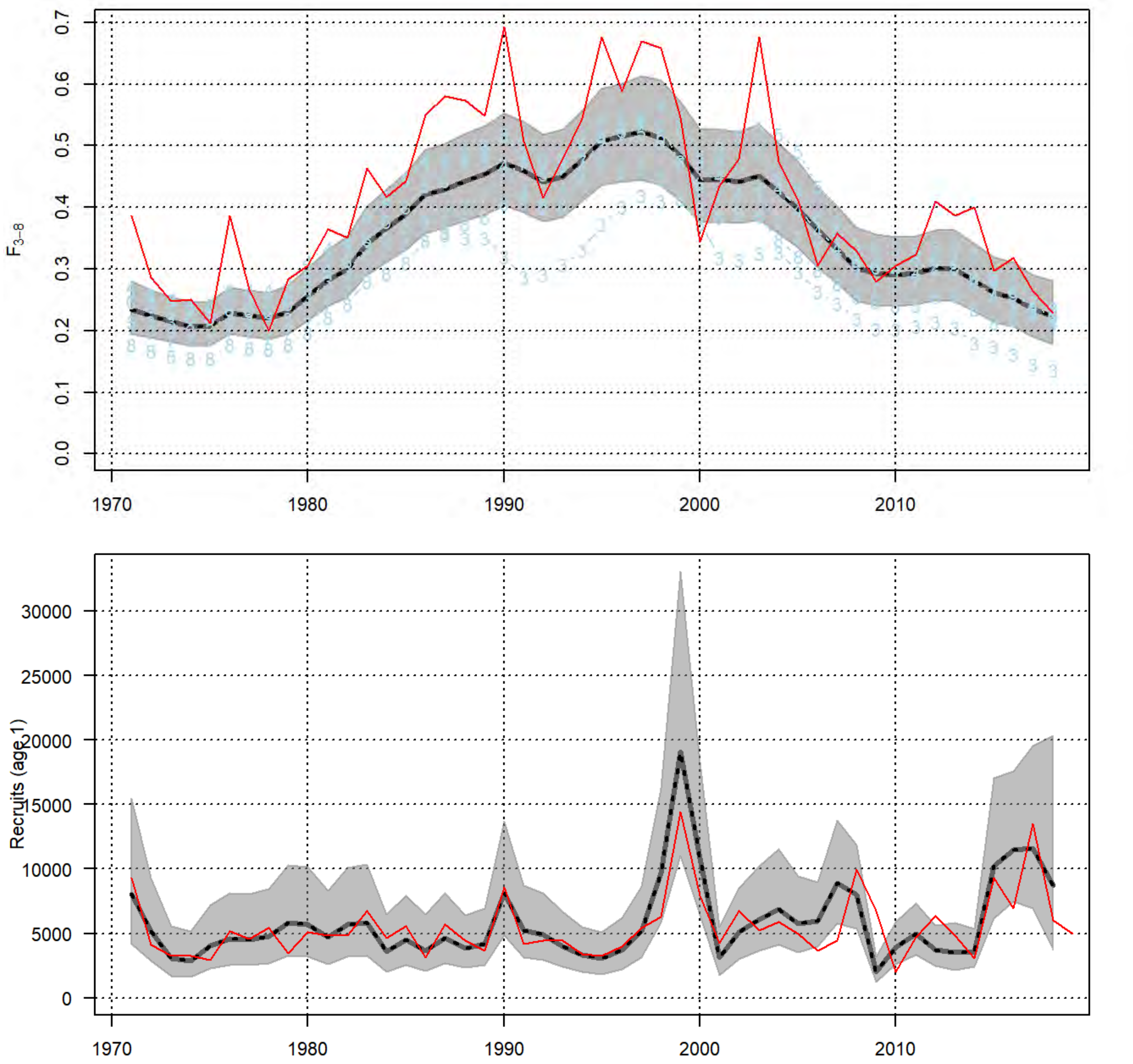


Figure 59: SSB (top panel), Fbar (middle panel) and recruitment (bottom panel) estimates of the SAM run with XSA configuration (solid black line). The red line corresponds to the estimates as provided by the XSA model currently used for advice. The shaded areas represent the 95% confidence interval.

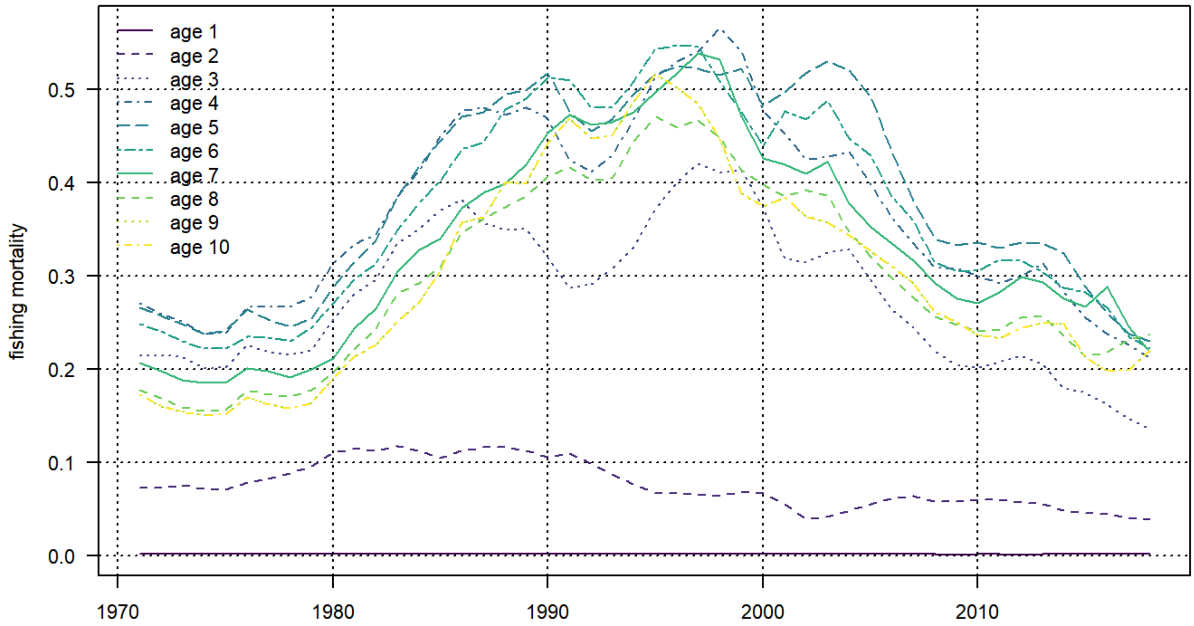


Figure 60: F estimates by age (RUN_1).

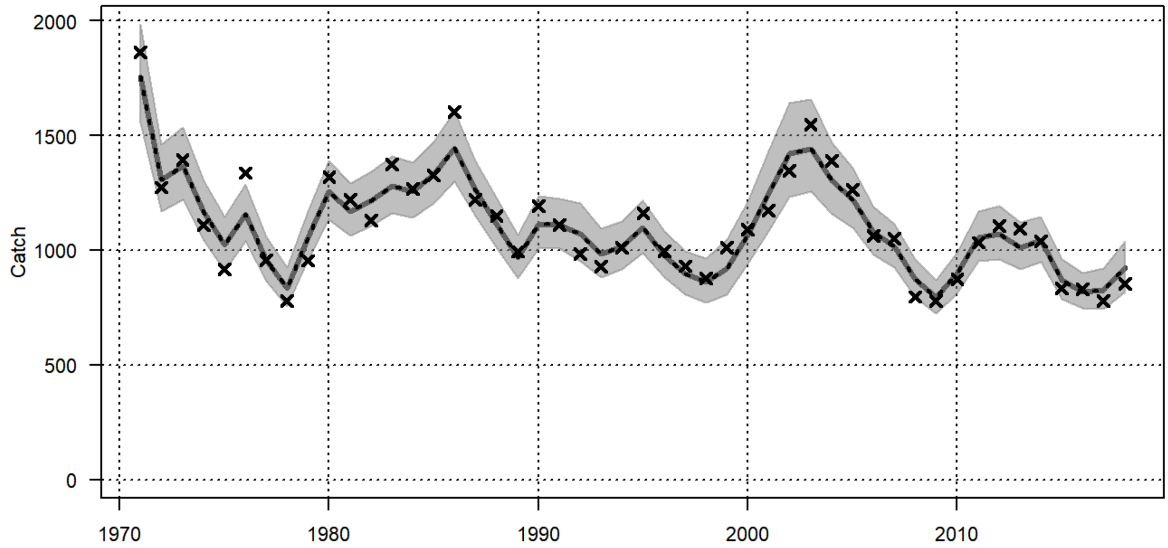


Figure 61: Reported (black cross) and estimated catches (solid line) with 95% confidence bounds (shaded area) (RUN_1).

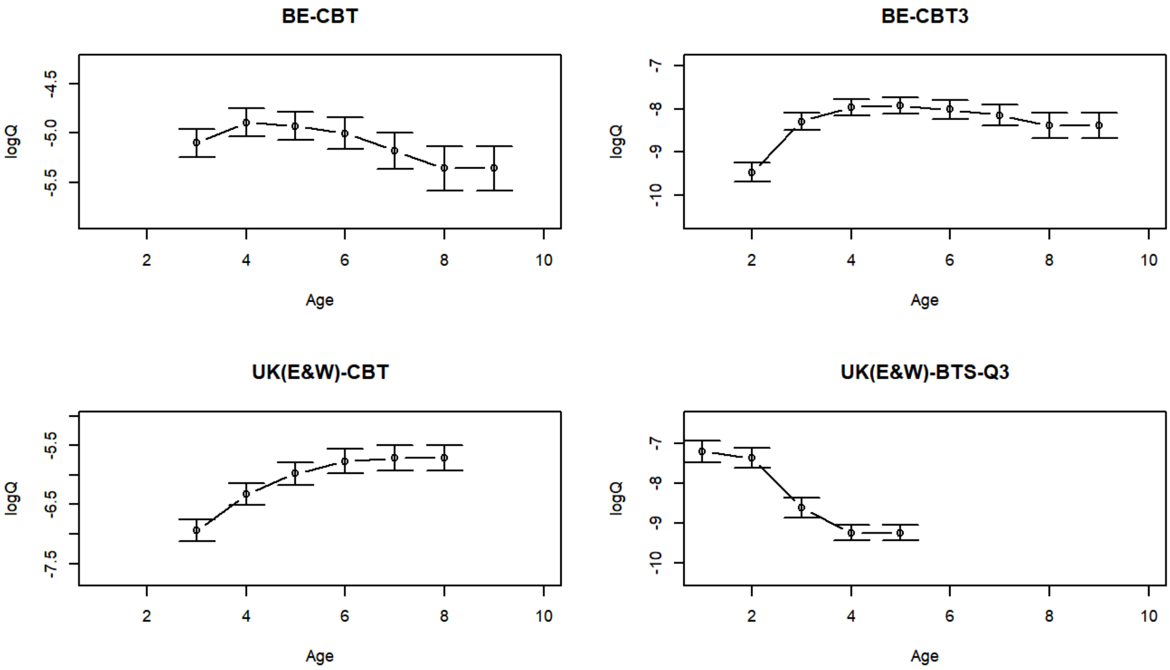


Figure 62: Log catchability by age of the different tuning fleets. Whiskers indicate the 95% confidence bounds (RUN_1).

ii) Model validation: residuals, retrospective patterns, leave-out tuning fleet, simulation

For all the fleets (catch data and tuning indices), the one-step-ahead observed residuals show significant autocorrelation at lag 1 with respect to the ages (Figures 63-64). The residuals of the tuning series indicate also the presence of strong patterns in the residuals over time. Whereas the quantile-quantile residual plots of the commercial tuning series indicate that the model cannot capture the dynamics found within these tuning series.

The process residuals have fewer patterns that indicate violation of model assumptions (Figure 65). However, both for the N and F processes, autocorrelation at lag 1 is problematic. Retrospective analysis did not indicate major problems with the SAM model (Figure 66). Refitting the model after removing one of the tuning series reveals that the BE-CBT, BE-CBT3, and UK(E&W)-CBT tuning series have a strong impact on SSB and F estimates of the model (Figure 67). Removing the historic Belgian commercial beam trawl tuning series (1971-1996) results in lower SSB estimates, and higher F estimates at the start of the time series, whereas removing the recent Belgian (2006-2018) and UK commercial beam trawl tuning series results in the same behaviour in the most recent years. The simulation study did not reveal problems with respect to the estimated SSB, Fbar and recruitment. However, the variance estimates on the N process are considerably lower estimated in the models fitted to simulated data (Figures 68-69).

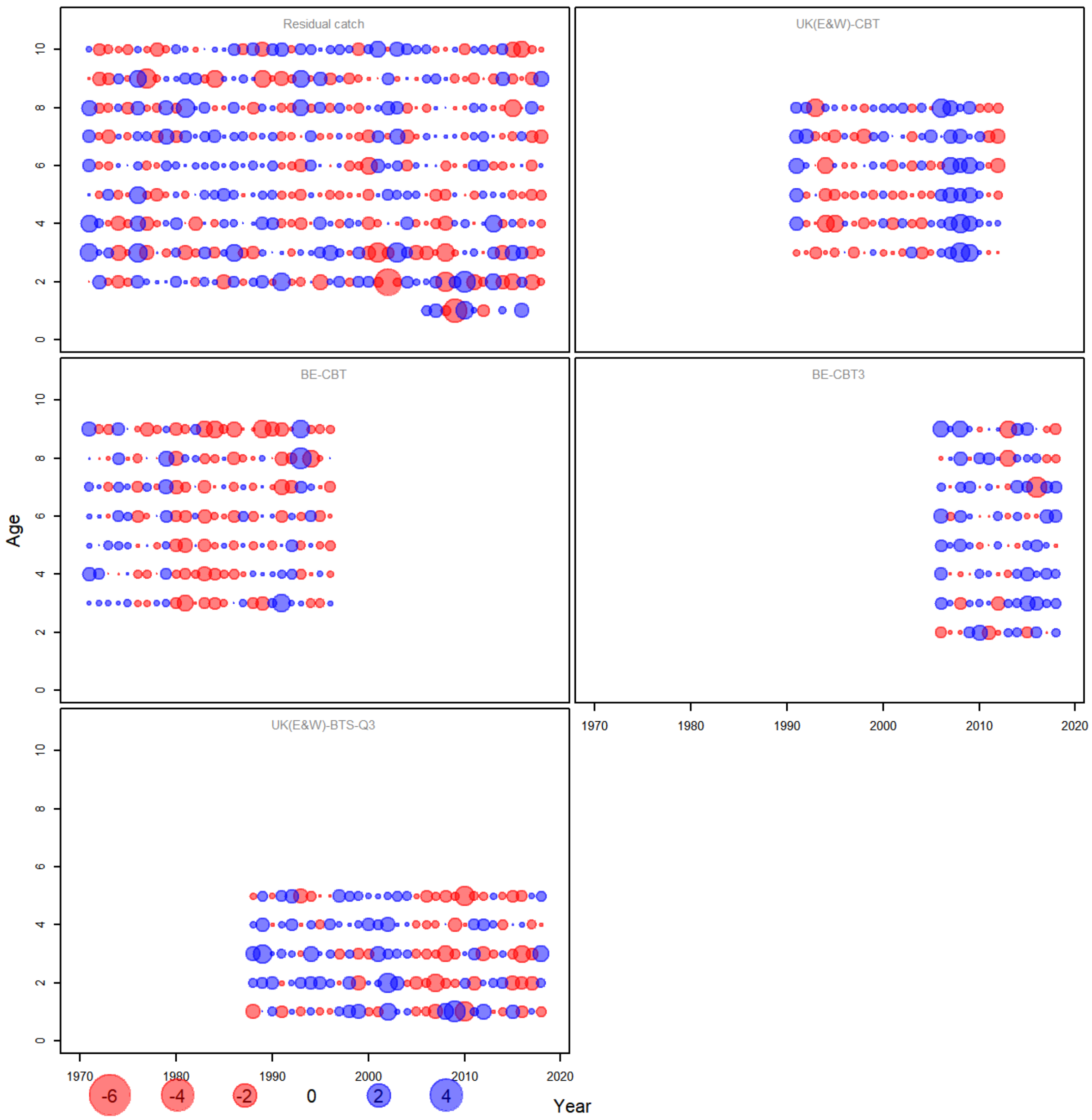


Figure 63: Normalized one-observation-ahead residuals. Each panel represents a specific observation category. Blue circles indicate a positive residual and red circles a negative residual (RUN_1).

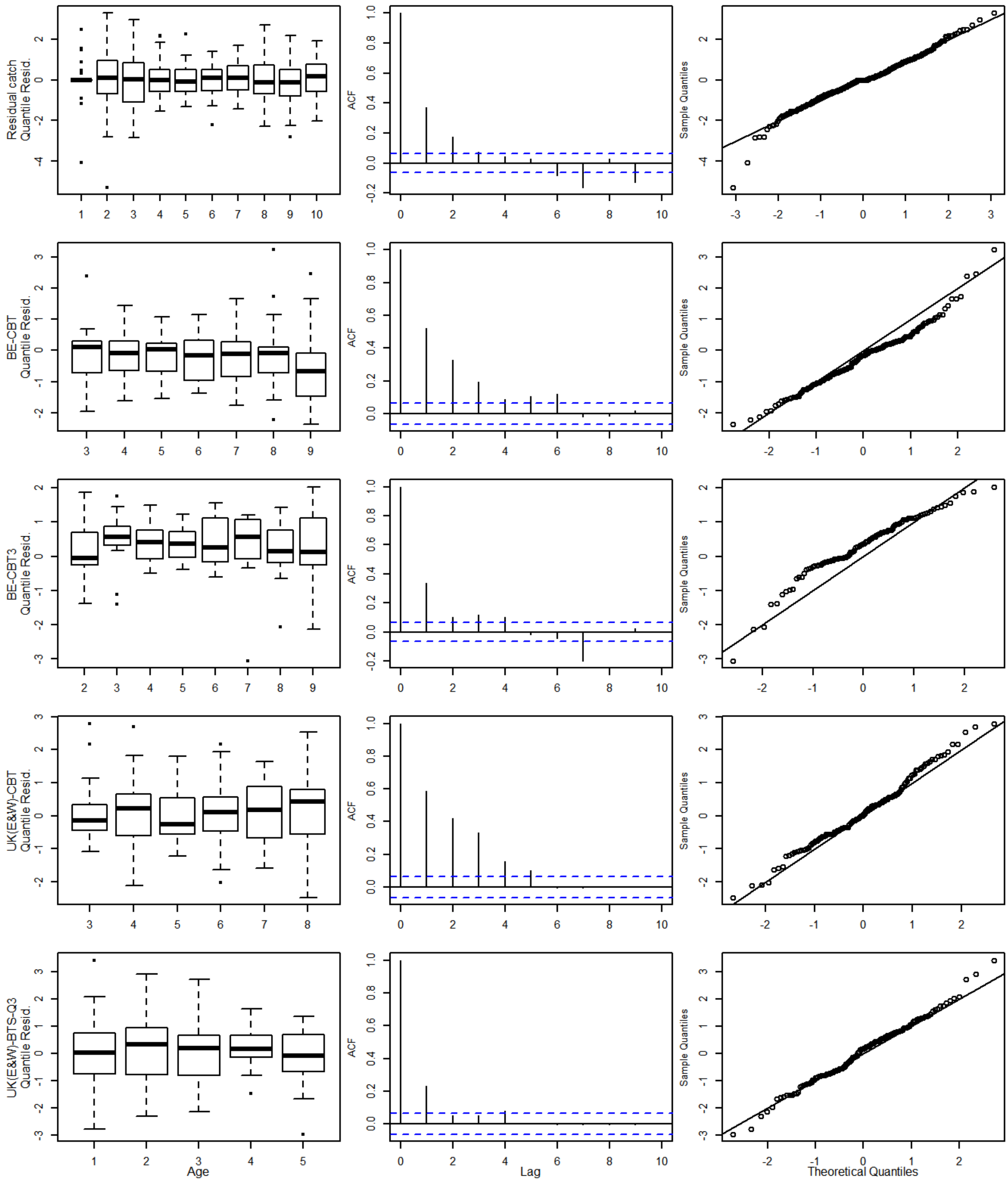


Figure 64: Boxplots, autocorrelation and normal Quantile Quantile plots of the normalized one-observation-ahead residuals. Panels are organized so that each row refers to a specific category of observations (RUN_1).

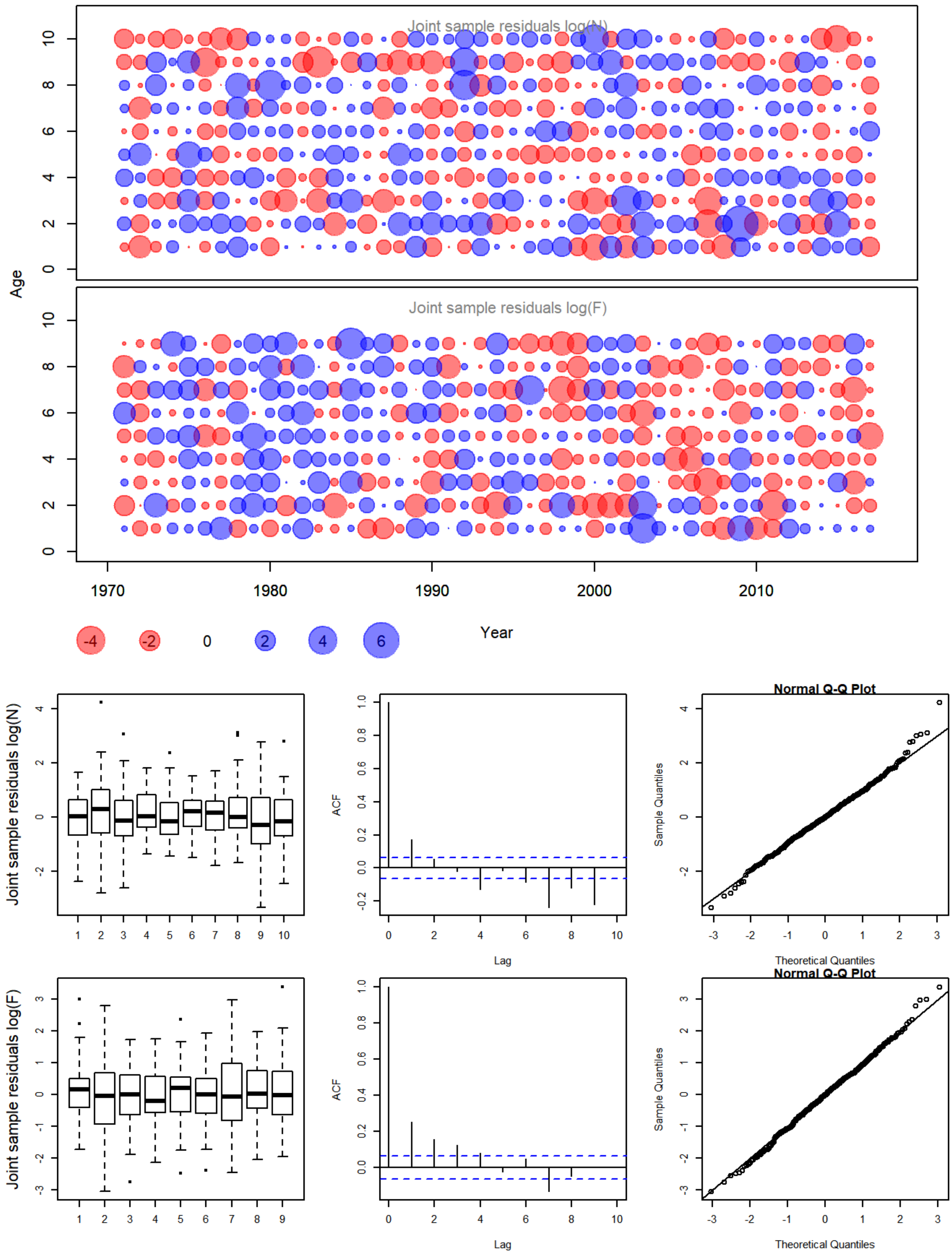


Figure 65: Normalized residuals for the recruitment and survival processes (RUN_1).

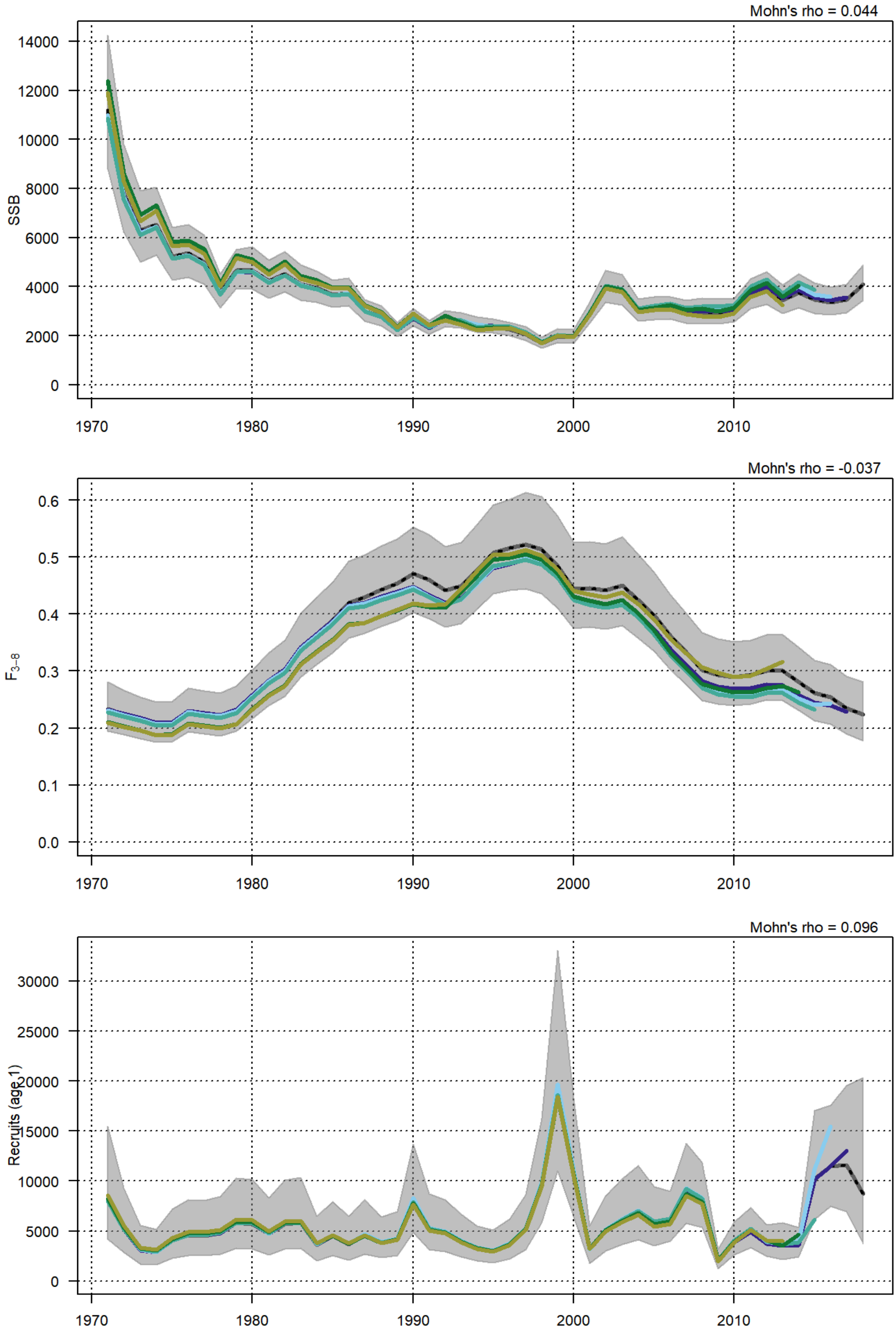


Figure 66: Retrospective estimates (5 years) from the SAM assessment. Estimated yearly SSB (top panel), Fbar (middle panel) and recruitment age 1 (bottom panel), together with corresponding point-wise 95% confidence intervals (shaded area) (RUN_1).

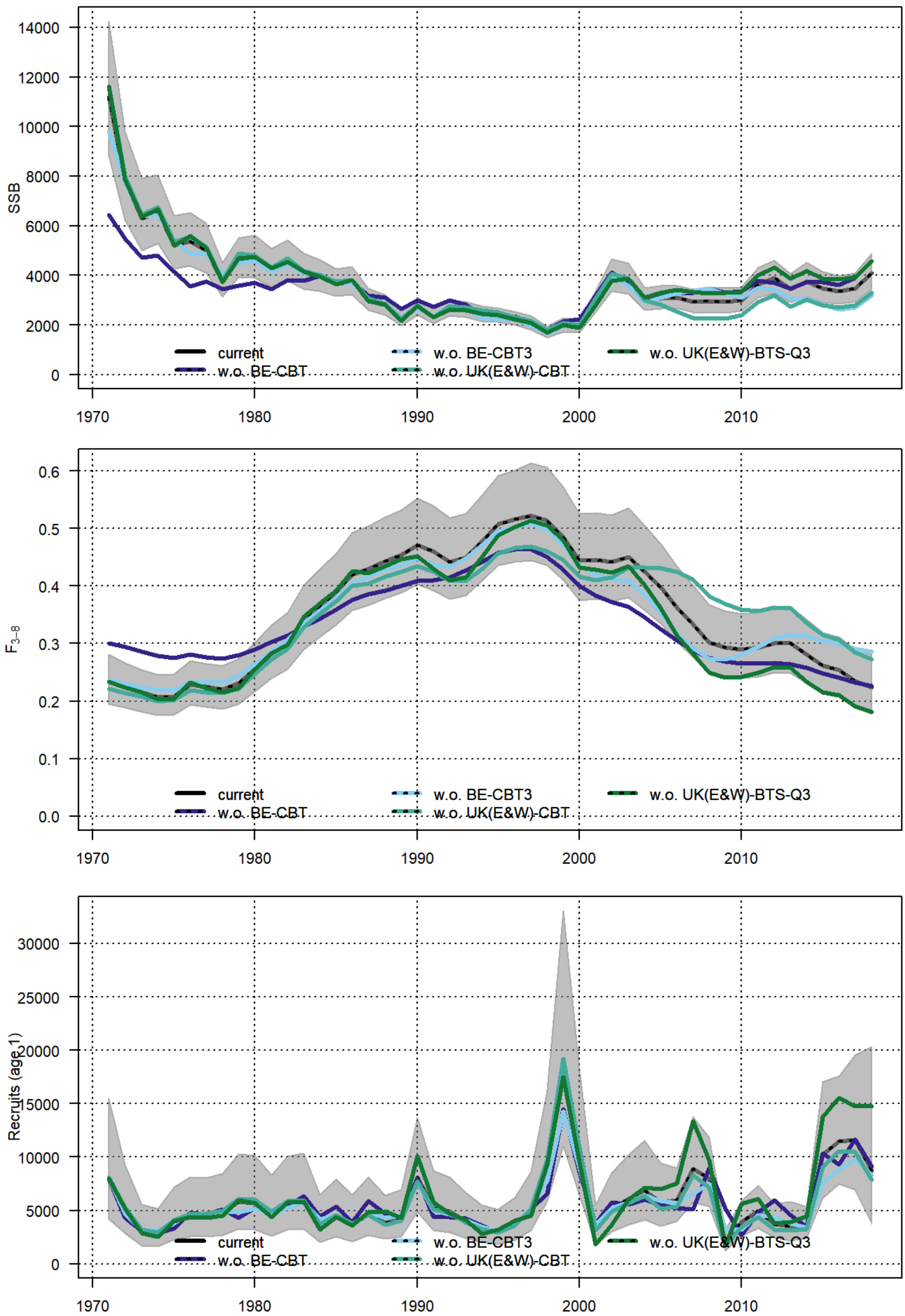


Figure 67: SSB (top panel), Fbar (middle panel), and recruitment (bottom panel) estimates (solid lines) from model fits in which one tuning series was removed from the data. The shaded area indicates the confidence bounds of the full model (RUN_1).

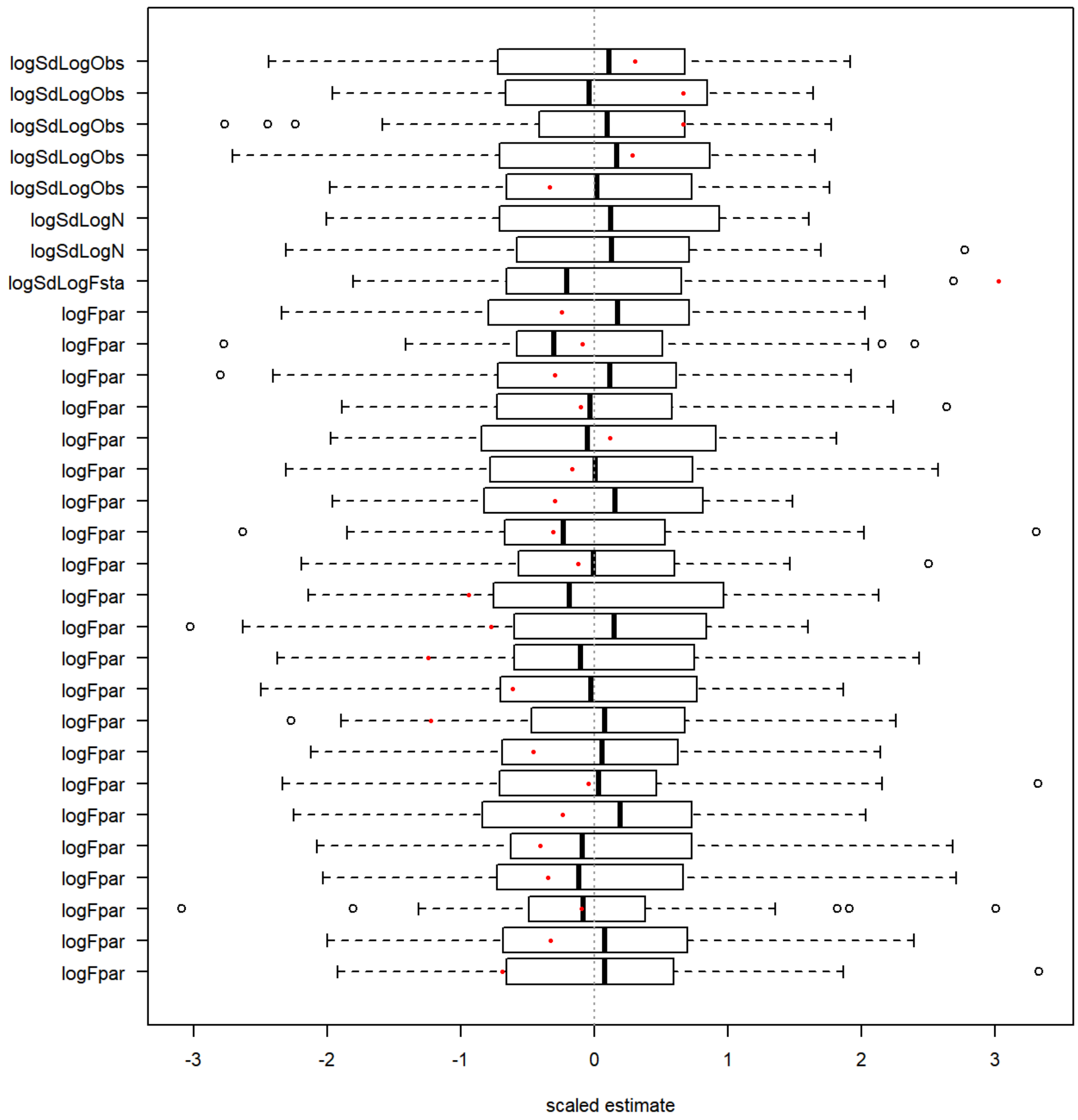


Figure 68: Boxplots of the estimated parameters after refitting the model 50 times to simulated data of the original fit. The red dots indicate the parameter estimates of the original fit. To facilitate visualization, all parameters were rescaled (RUN_1).

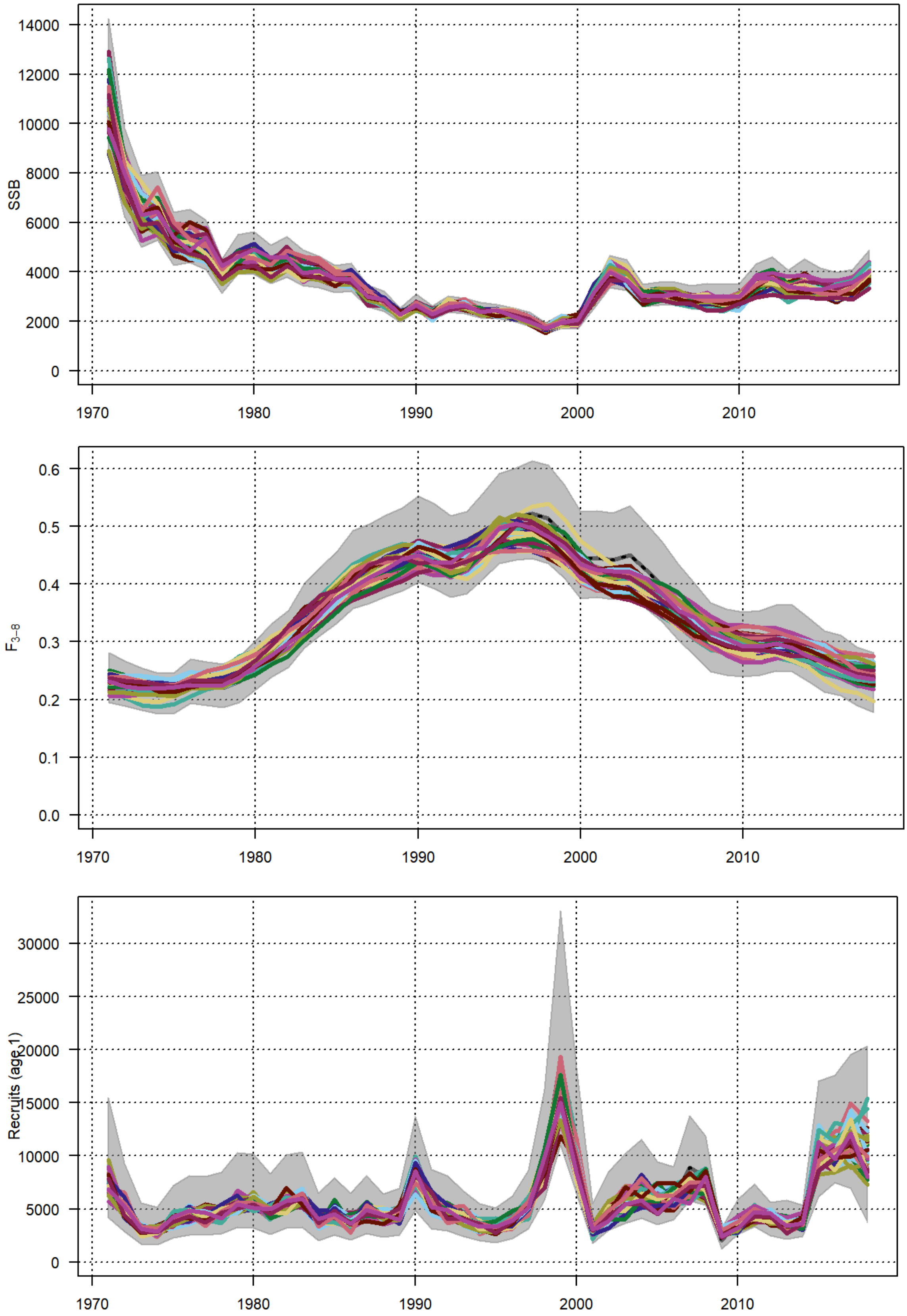


Figure 69: SSB (top panel), Fbar (middle panel) and recruitment (bottom panel) estimates from the refitted models on 50 simulated datasets based on the original plot. The shaded area indicates the confidence bounds of the original model (RUN_1).

2020 WKFLATNSCS-RUN 2

i) Model output: SSB, Fbar, recruitment, catches, catchability

The biomass indices of the commercial beam trawl tuning fleets indicate similar trends in the long run, but differ in some years (Figure 70). The major difference is found between the UK(E&W)-CBT and BE-CBT3 between 2006 and 2009. Both indices show a different trend, the UK(E&W)-CBT strongly increases whereas the BE-CBT3 declines. The SSB, Fbar and recruitment estimates match quite well with those estimated in RUN_1. However, at the start of the time series, the SSB of RUN_2 is considerably lower compared to RUN_1, and similar with the SSB estimates of the XSA model. Nevertheless, in the most recent years, an opposite trend occurs with higher SSB estimates compared to RUN_1 (and also to the current XSA assessment estimates) (Figure 71).

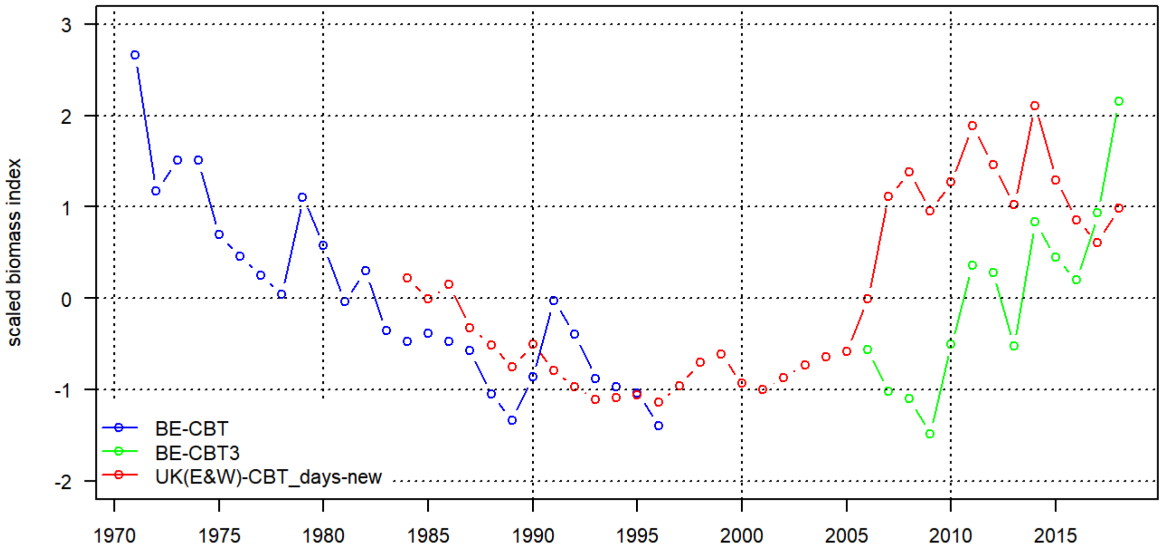
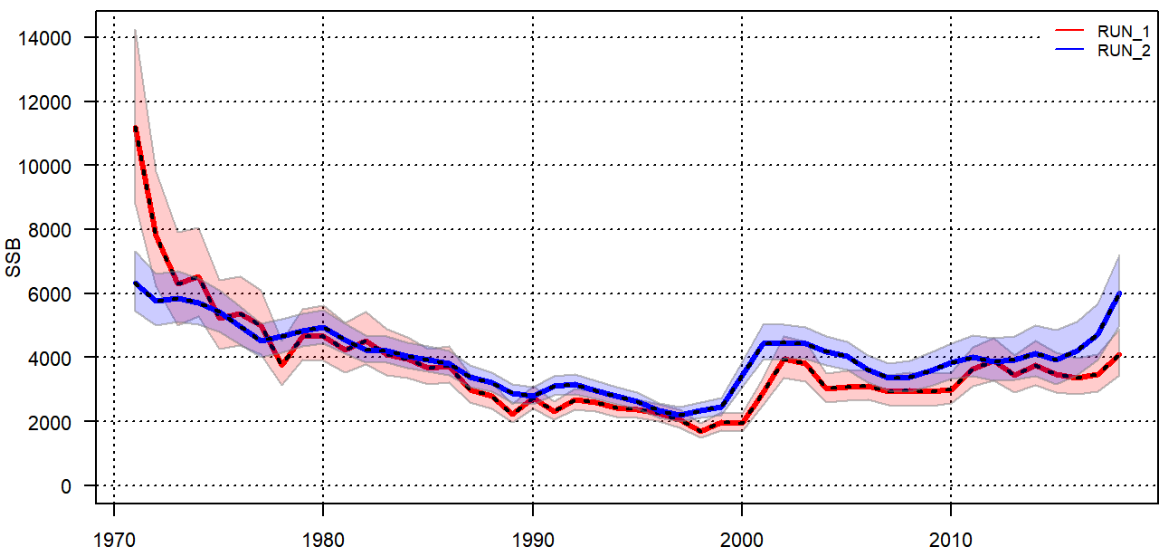
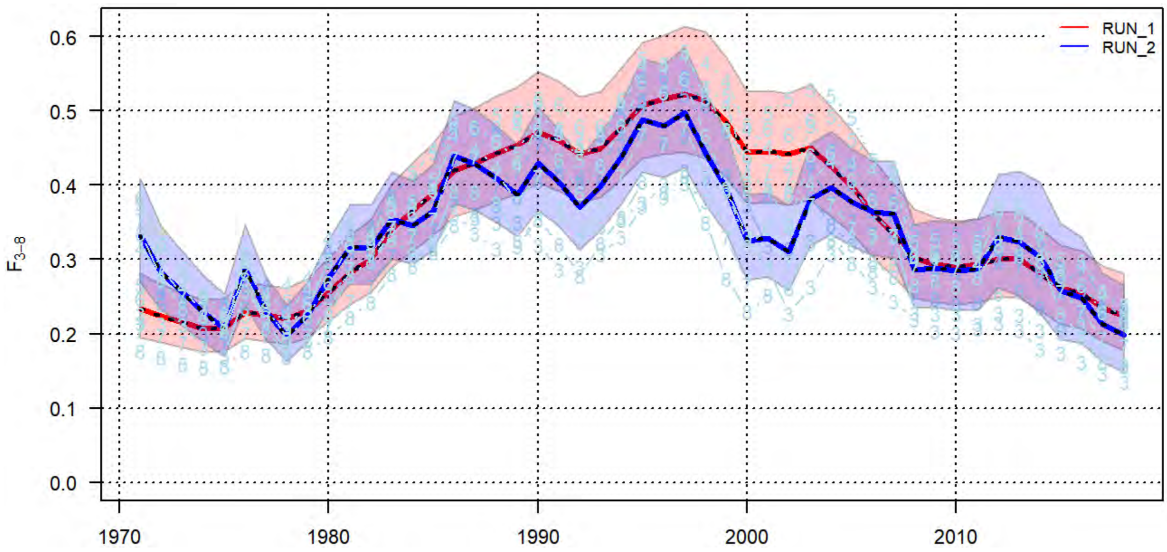


Figure 70: Scaled trends in commercial biomass indices (BE-CBT (blue) , BE-CBT3 (green), and UK(E&W)-CBT (red)).





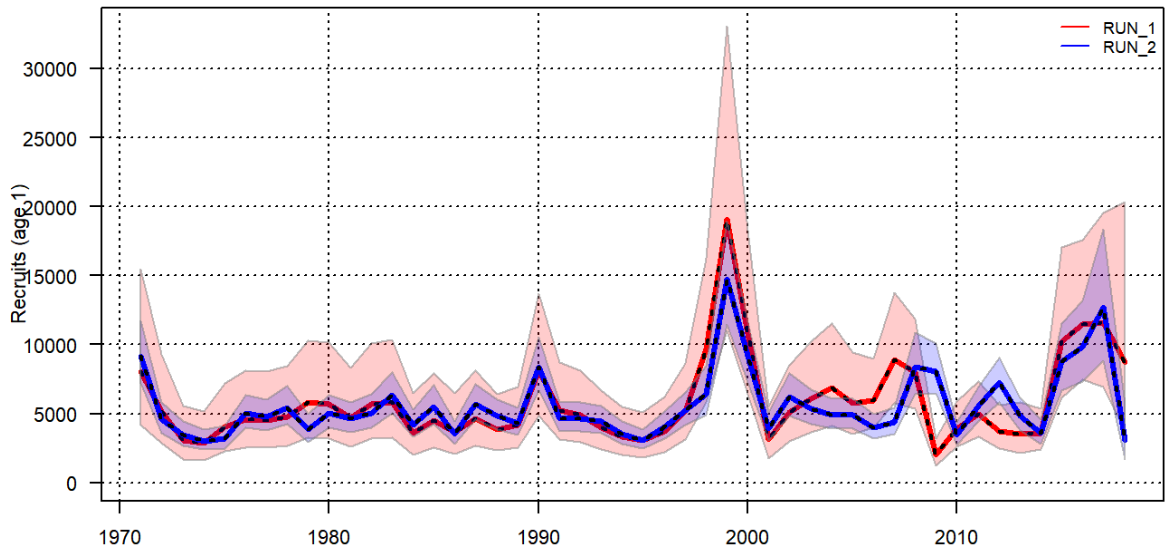


Figure 71: SSB (top panel), Fbar (middle panel) and recruitment (bottom panel) estimates of the SAM runs 1 and 2. The solid lines refer to the MLE estimates while the shaded areas represent the 95% confidence interval.

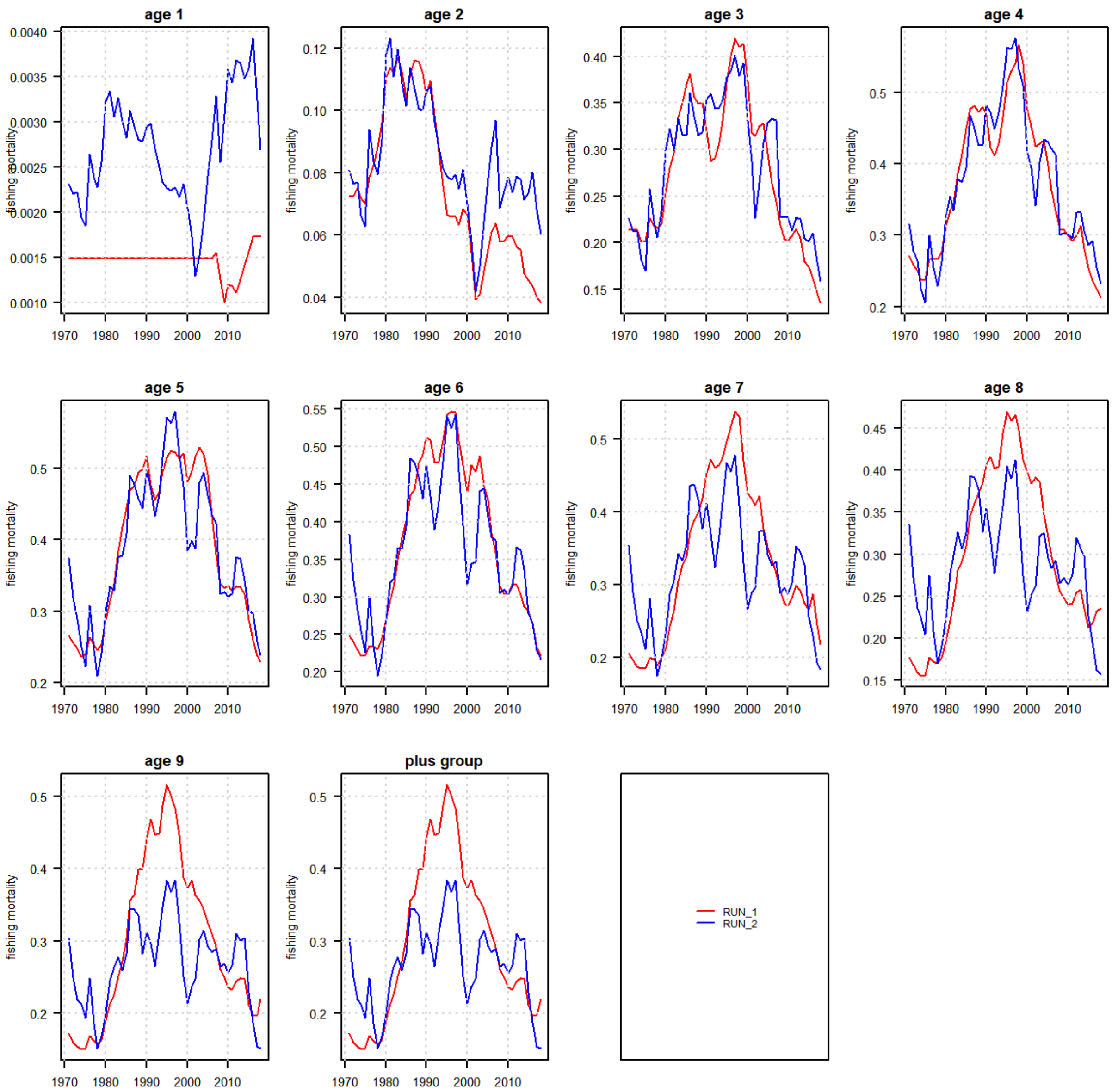


Figure 72: Fishing mortality by age (RUN_1 and RUN_2).

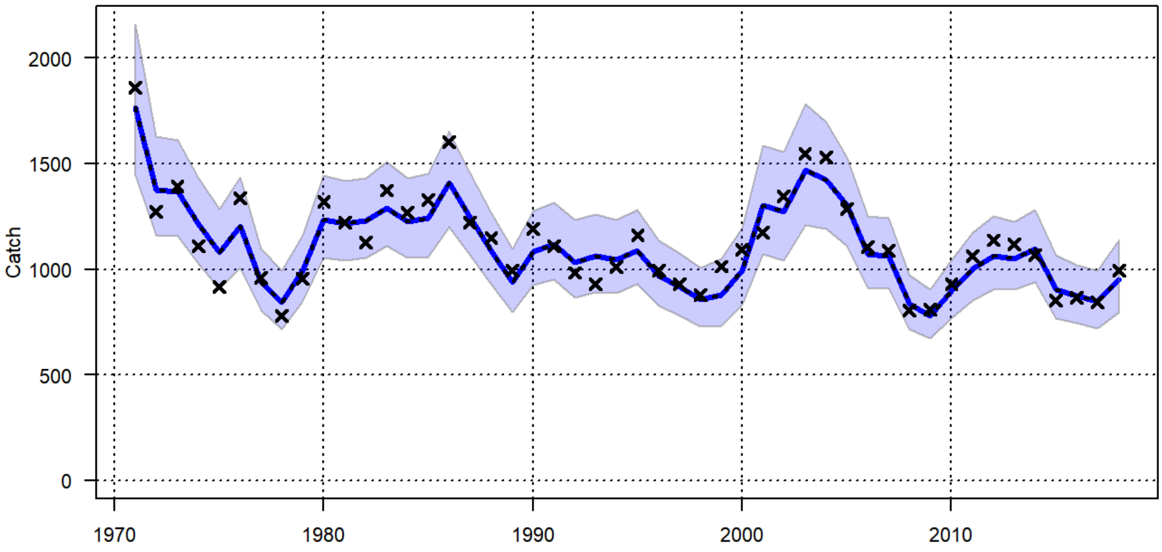


Figure 73: Reported (black cross) and estimated catches (solid line) with 95% confidence bounds (shaded area) (RUN_2).

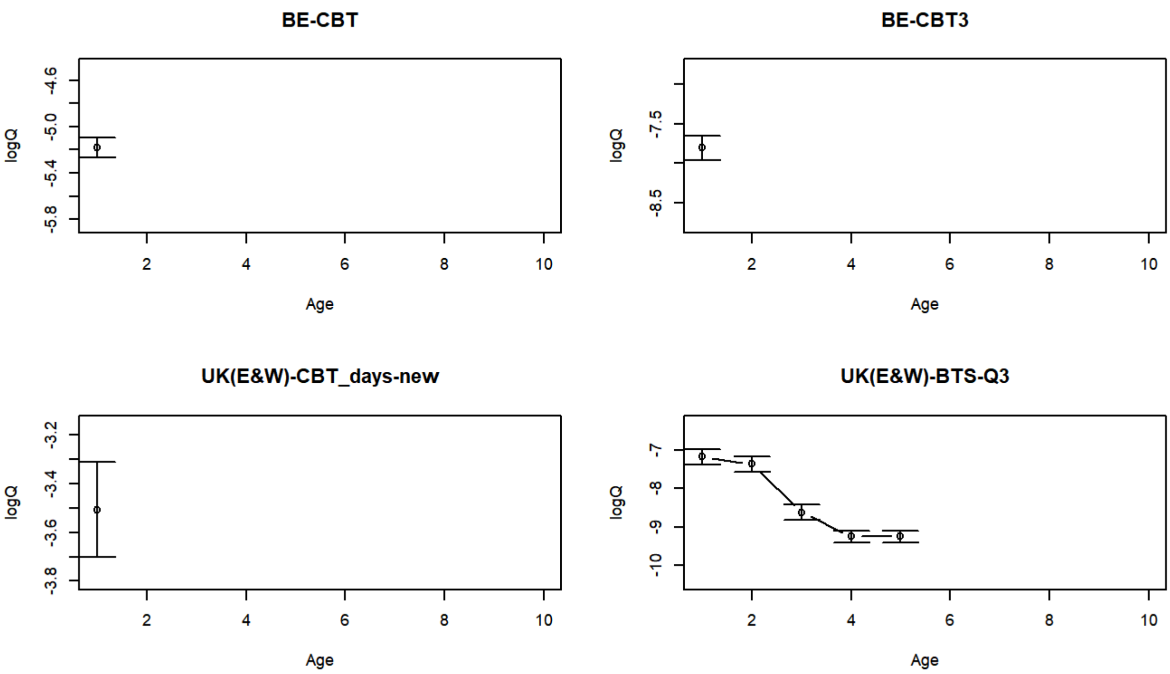


Figure 74: Log catchability by age of the different tuning fleets. Whiskers indicate the 95% confidence bounds (RUN_2).

ii) *Model validation: residuals, retrospective patterns, leave-out tuning fleet, simulation*

Figures 75 and 76 indicate that autocorrelation is still present (with respect to the age) in the one-prediction ahead (OSA) observation residuals at lag 1, and the BTS survey at lag 1 and 4. Additionally, strong annual patterns are left in the OSA residuals of the commercial tuning series. Except of autocorrelation at lag 1 for the F process, the residuals related to the process models (N and F) indicate minor problems (Figure 77). Retrospective analysis did not reveal problems (Figure 78), while the leave-one out runs show strong dependence on the age-structured survey (UK(E&W)-BTS-Q3) which controls the SSB increase in the most recent years of the assessment (Figure 79). The simulation study indicates minor problems (Figure 81). Only the variance parameters (logSd) for the F and age1 N processes indicate instability with respect to their estimates.

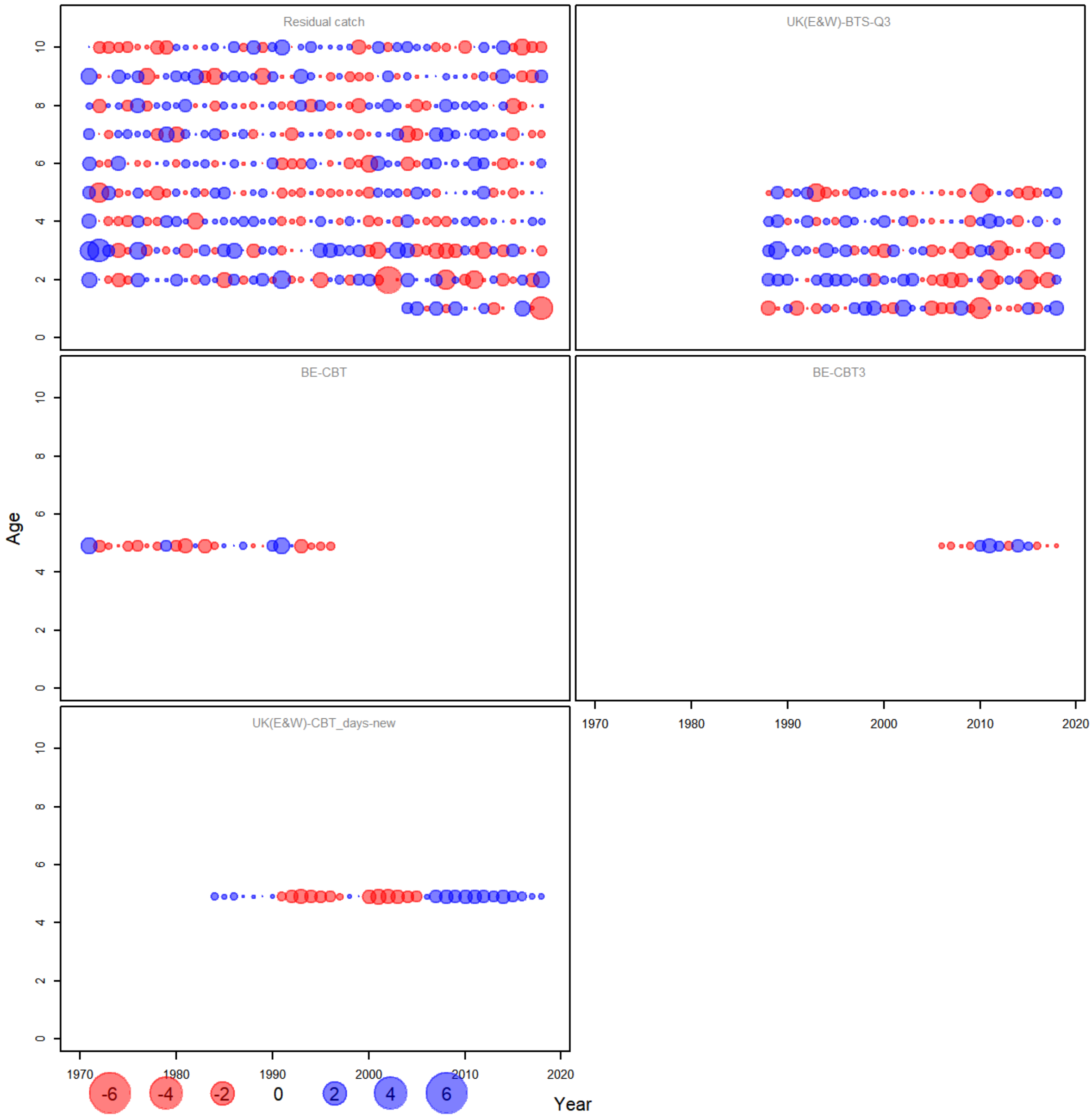


Figure 75: Normalized one-observation-ahead residuals. Each panel represents a specific observation category. Blue circles indicate a positive residual and red circles a negative residual (RUN_2).

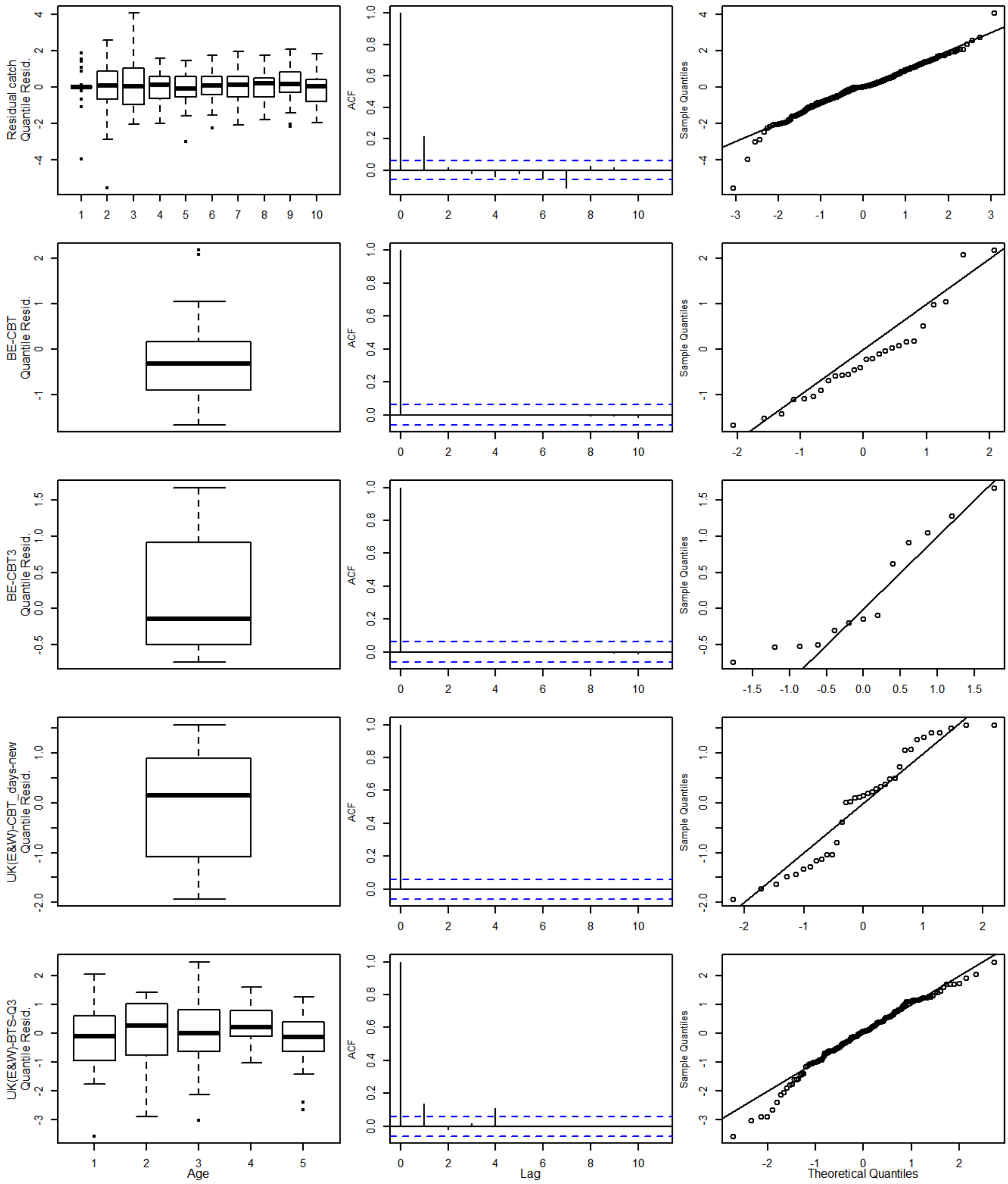


Figure 76: Boxplots, autocorrelation and normal Quantile Quantile plots of the normalized one-observation-ahead residuals. Panels are organized so that each row refers to a specific category of observations (RUN_2).

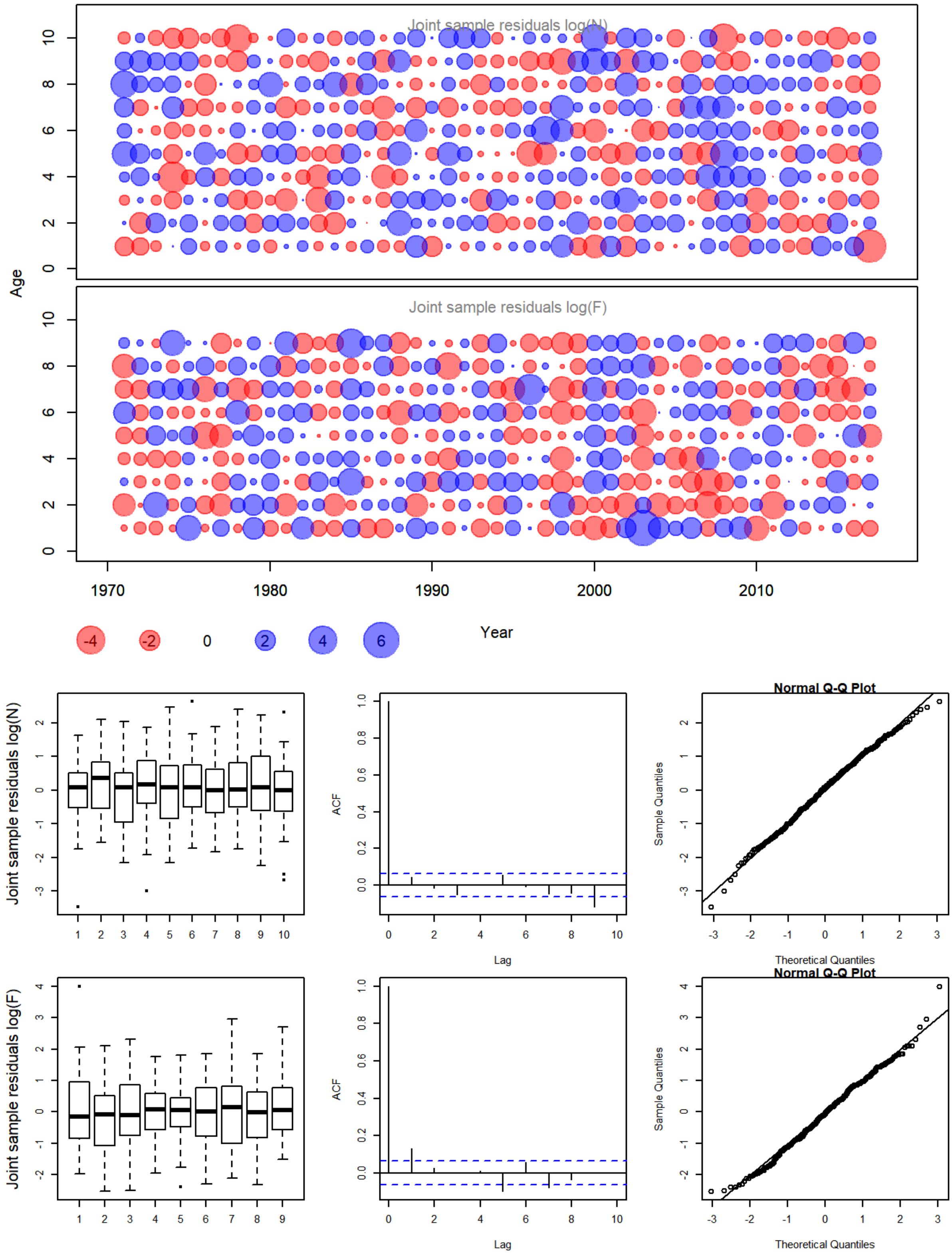


Figure 77: Normalized residuals for the recruitment and survival processes (RUN_2).

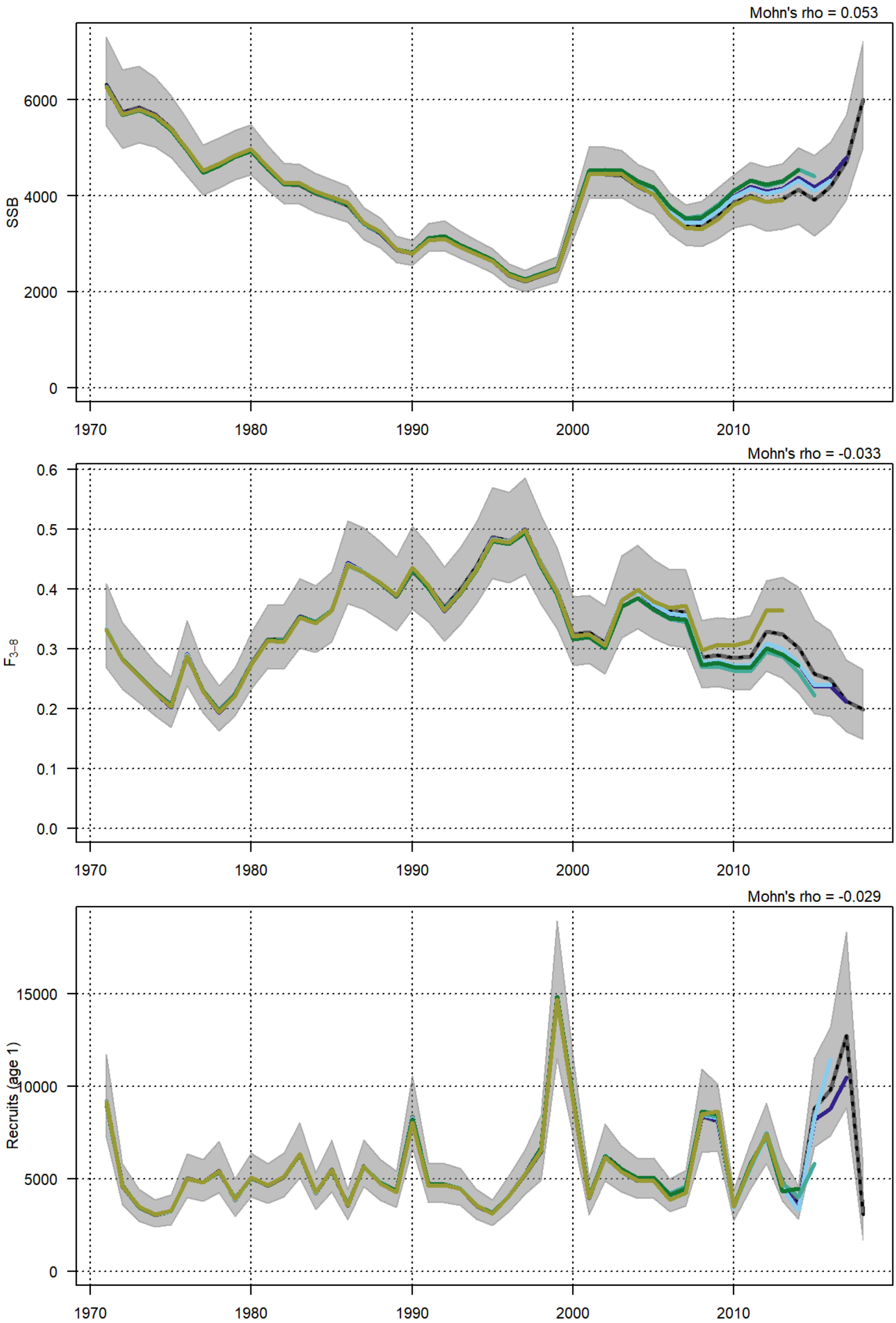


Figure 78: Retrospective estimates (5 years) from the SAM assessment. Estimated yearly SSB (top panel), Fbar (middle panel) and recruitment age 1 (bottom panel), together with corresponding point-wise 95% confidence intervals (shaded area) (RUN_2).

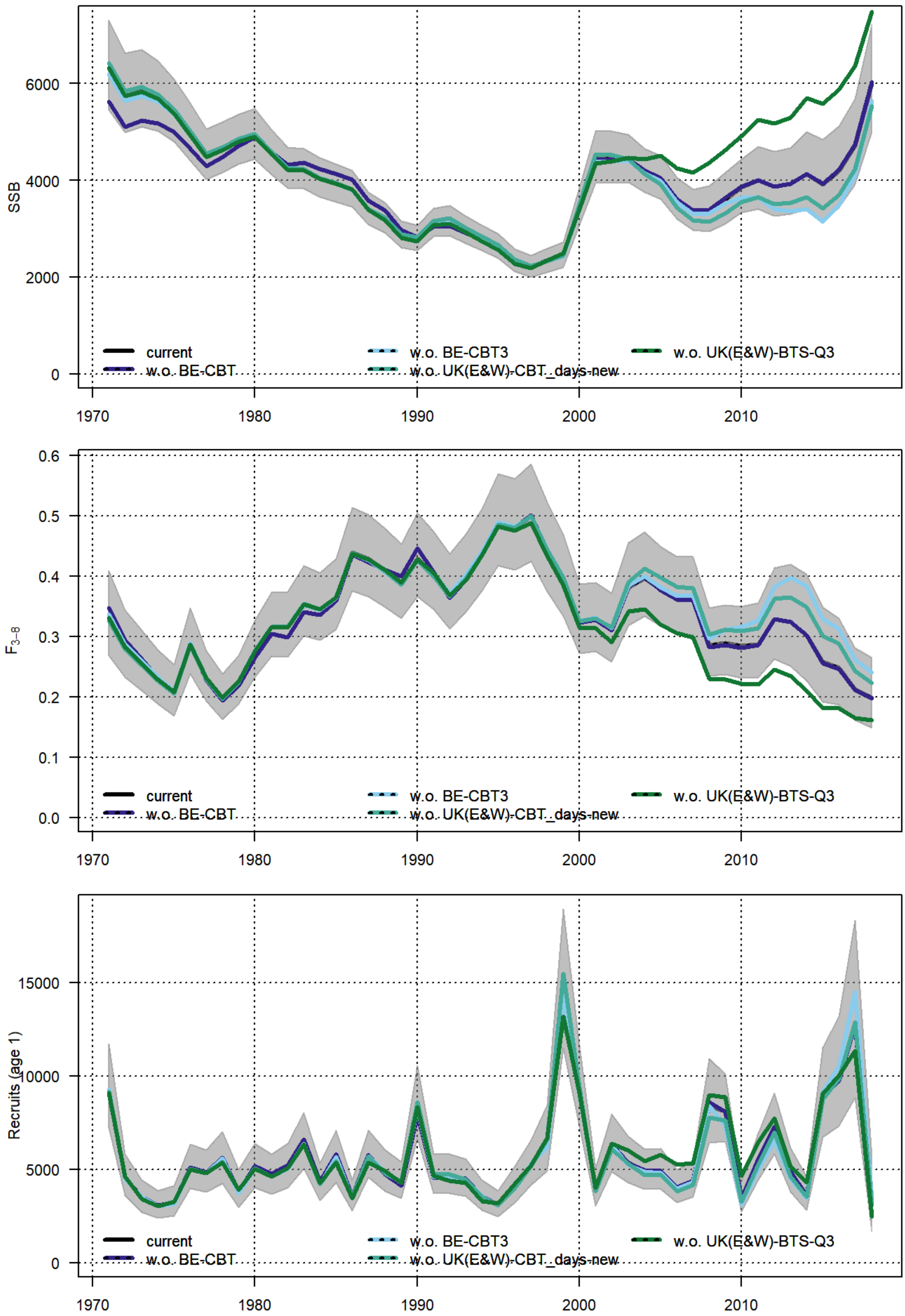


Figure 79: SSB (top panel), Fbar (middle panel), and recruitment (bottom panel) estimates (solid lines) from model fits in which one tuning series was removed from the data. The shaded area indicates the confidence bounds of the full model (RUN_2).

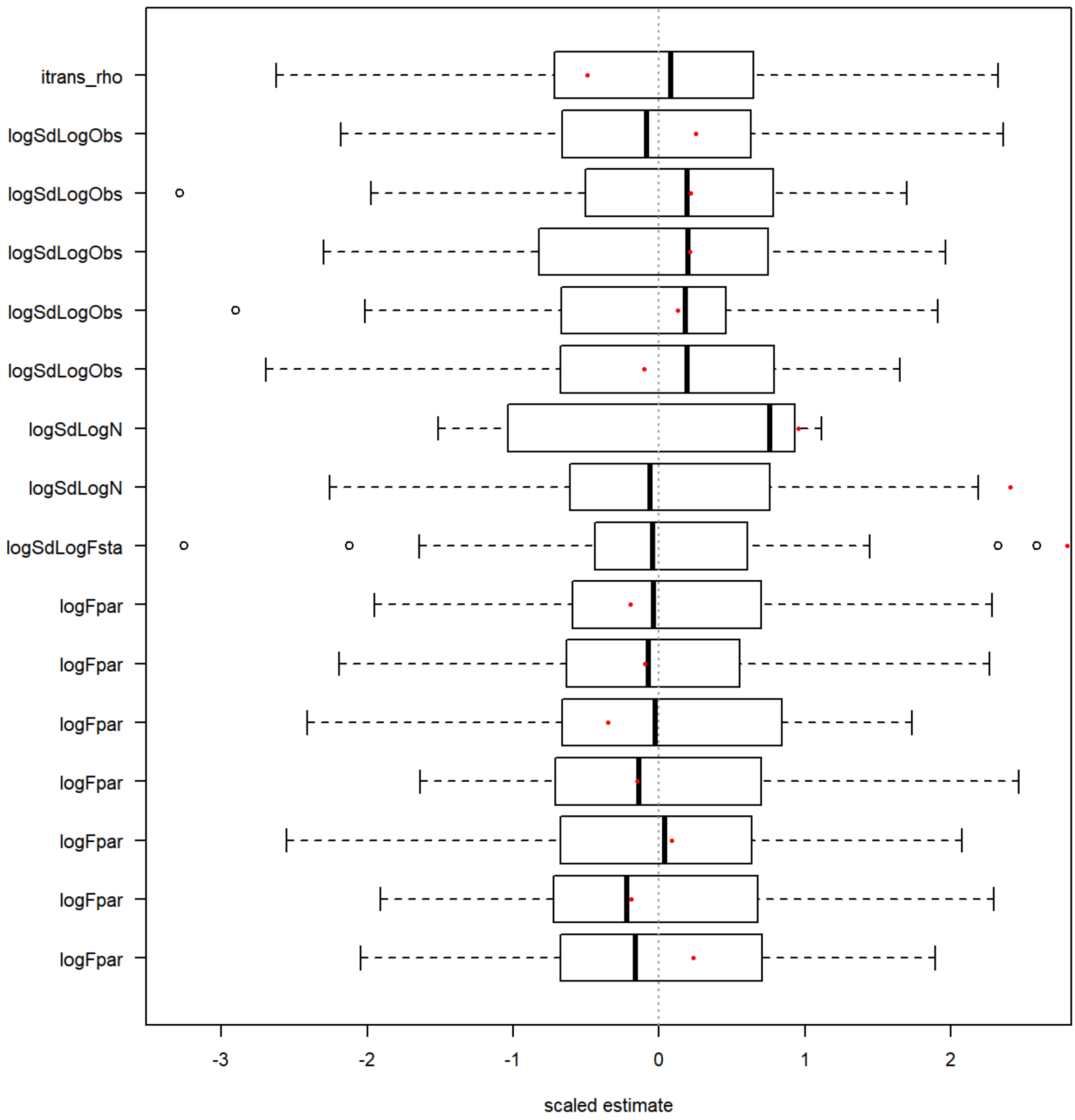


Figure 80: Boxplots of the estimated parameters after refitting the model 50 times to simulated data of the original fit. The red dots indicate the parameter estimates of the original fit. To facilitate visualization, all parameters were rescaled (RUN_2).

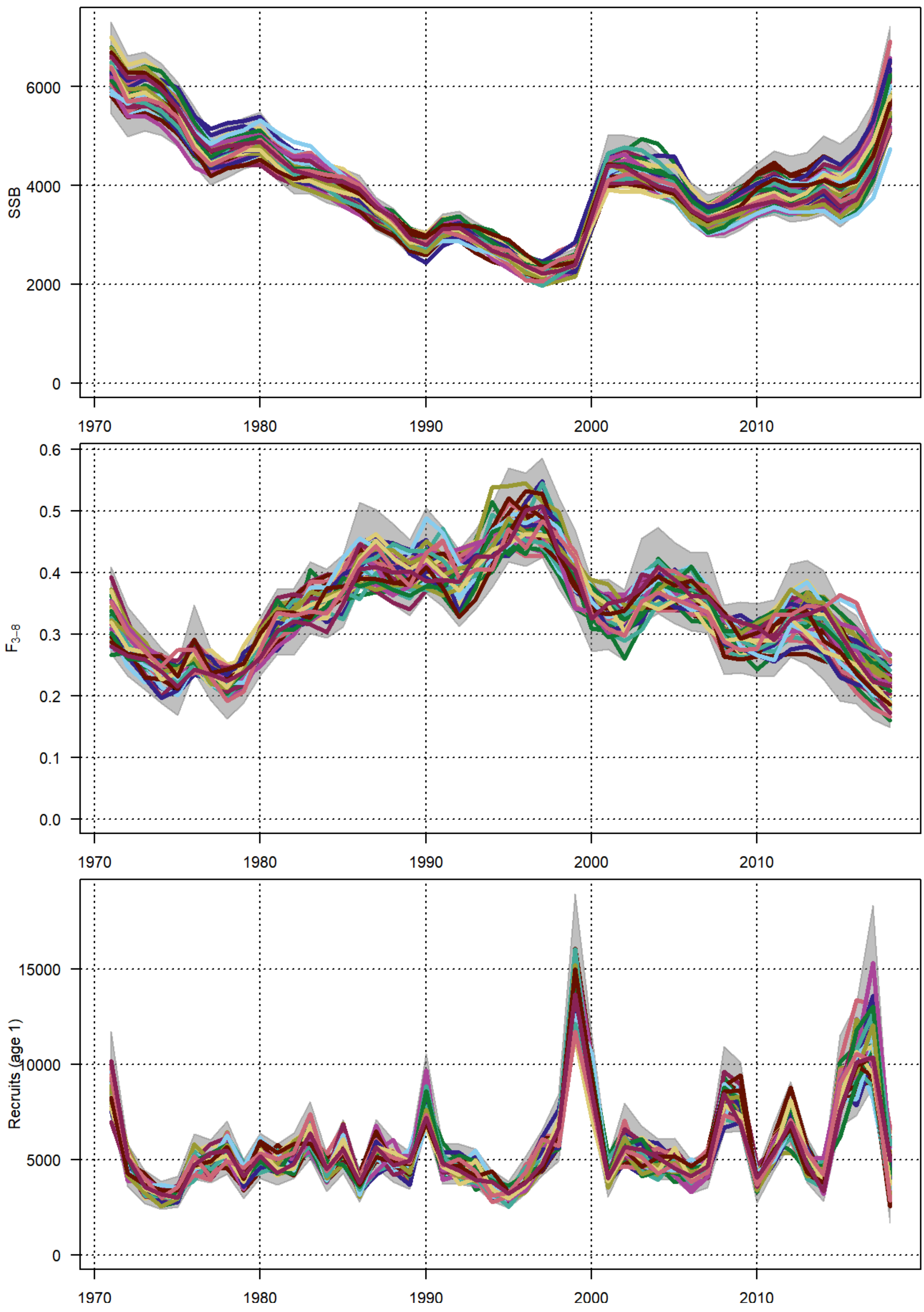


Figure 81: SSB (top panel), Fbar (middle panel) and recruitment (bottom panel) estimates from the refitted models on 50 simulated datasets based on the original plot. The shaded area indicates the confidence bounds of the original model (RUN_2).

2020 WKFLATNSCS-RUN 3

i) Model output: SSB, Fbar, recruitment, catches, catchability

RUN_3 resulted in a further reduction of the SSB estimates in the most recent years, and an increase in Fbar, but had little effect on the recruitment estimates (Figure 83). The F estimates at age (Figure 84) are almost identical to those in RUN_2, while the predicted catches correspond with the observed catches (Figure 85). Splitting the longest tuning indices of the commercial fleet (Figure 82), had little effect with respect to the catchability estimates of the Belgian commercial beam trawl fleet (BE-CBT), whereas catchability increased for the UK commercial beam trawl fleet (Figure 86). Accounting for this effect of technological creep explains the SSB correction of RUN_3, compared to RUN_2, in the middle of the time series (SSB 1984 – 2005: RUN_2 < RUN_3) and the most recent years of the assessment (SSB 2002 – 2018: RUN_2 > RUN_3) (Figure 83).

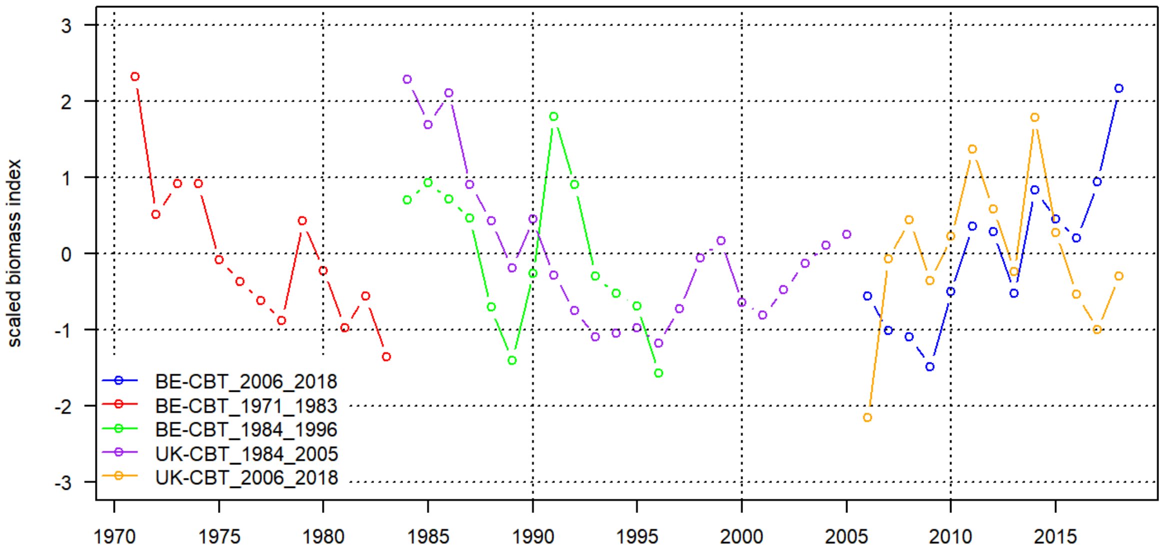
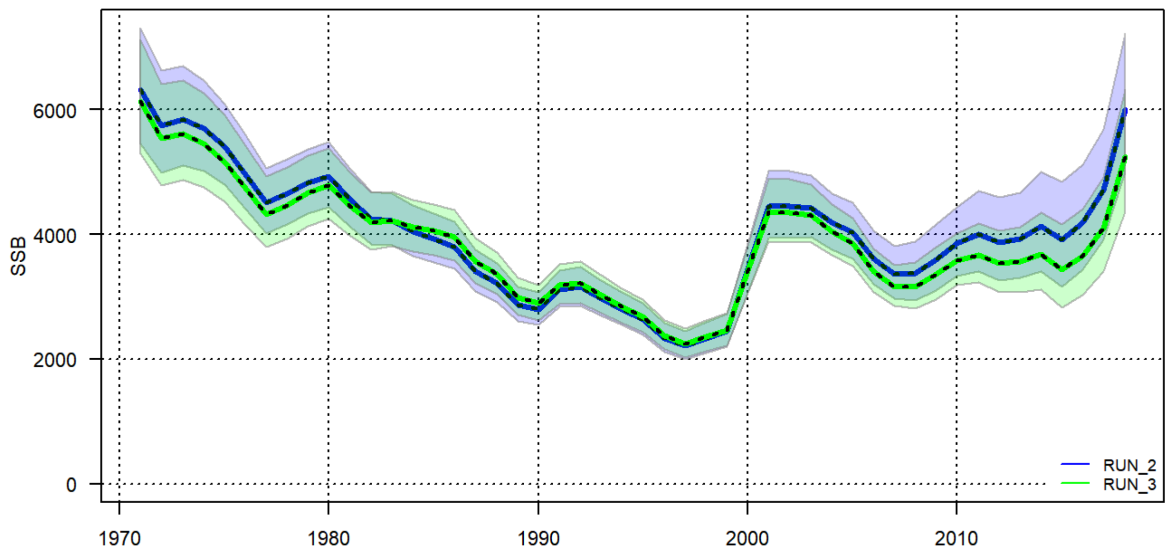


Figure 82: Scaled biomass indices of the commercial tuning fleets used in RUN_3, RUN_4 and RUN_5.



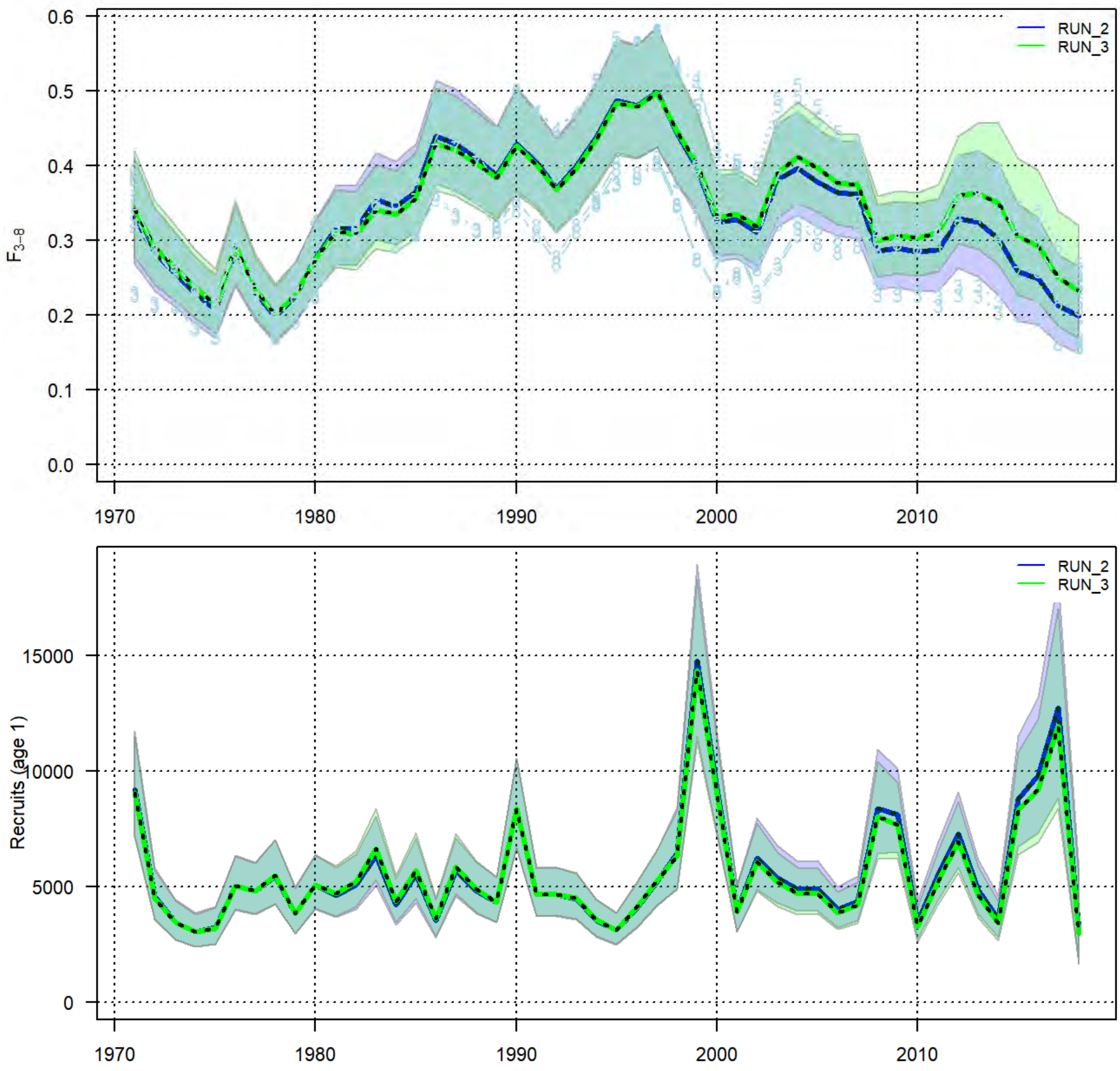


Figure 83: SSB (top panel), Fbar (middle panel) and recruitment (bottom panel) estimates of the SAM runs 2 and 3. The solid lines refer to the MLE estimates while the shaded areas represent the 95% confidence interval.

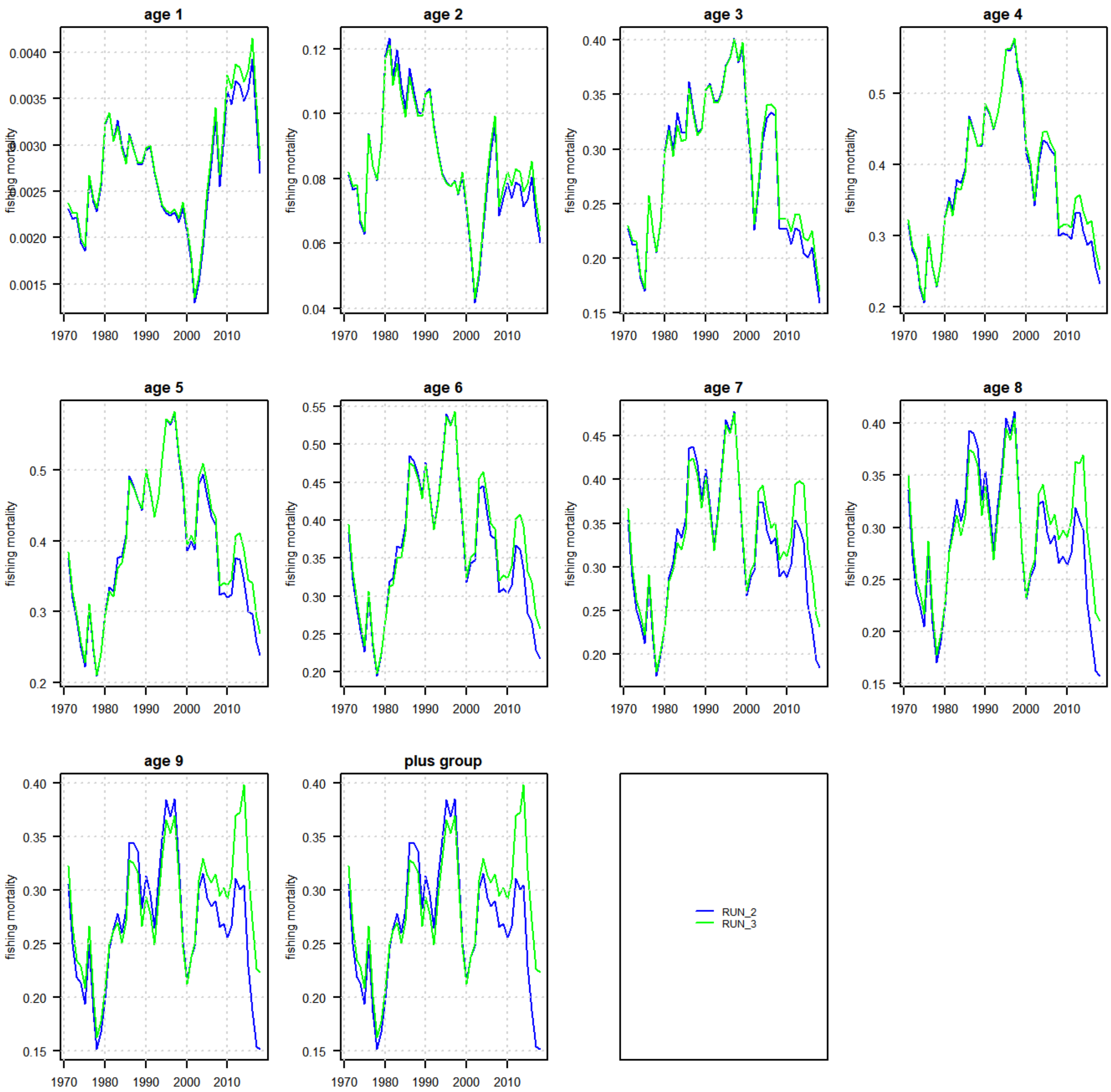


Figure 84: F estimates by age (RUN_2 and RUN_3).

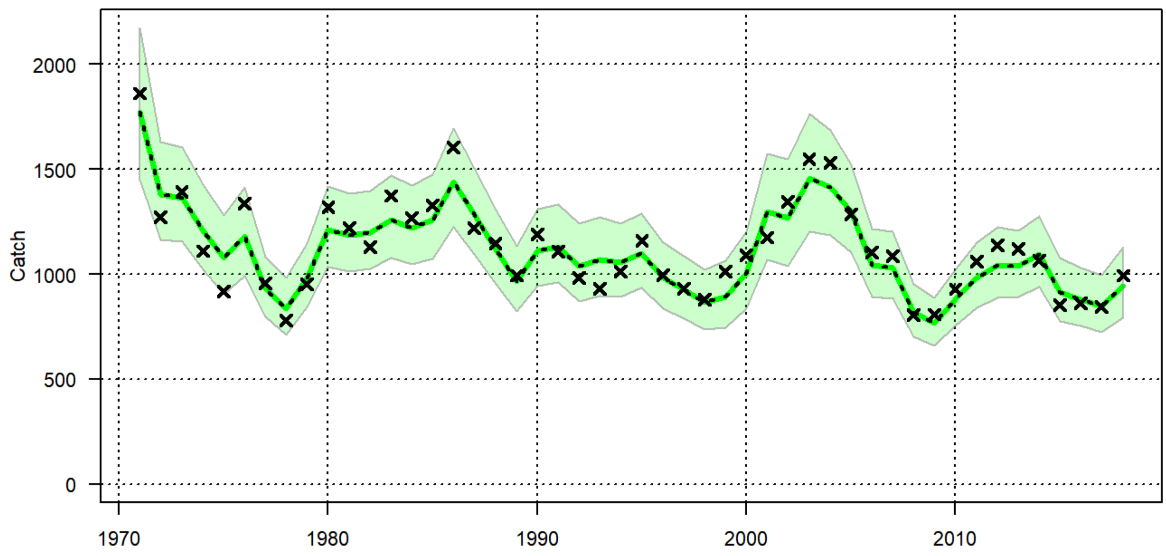


Figure 85: Reported (black cross) and estimated catches (solid line) with 95% confidence bounds (shaded area) (RUN_3).

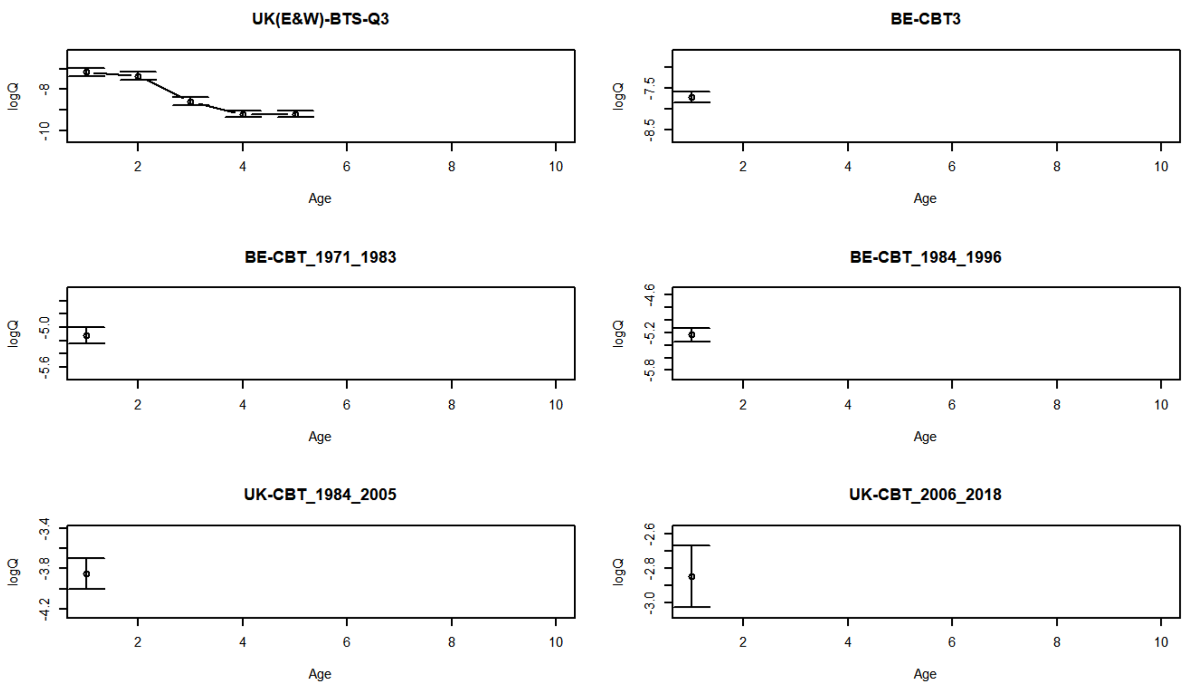


Figure 86: Log catchability by age of the different tuning fleets. Whiskers indicate the 95% confidence bounds (RUN_3).

ii) Model validation: residuals, retrospective patterns, leave-out tuning fleet, simulation

Although RUN_3 seems to better explain the trends in SSB and F, the OSA residuals show similar patterns as those found in RUN_2. Autocorrelation is still present in the catch-at-age and UK(E&W)-BTS-Q3 OSA residuals (Figures 87-88), whereas the process residuals do not indicate major problems except of autocorrelation in the F process residuals at age 1 (Figure 89). The retrospective patterns are within the confidence bounds (Figure 90), while the leave-one-out fits indicate again strong dependency of the model on the UK(E&W)-BTS-Q3 survey in the most recent years of the assessment model, although SSB seems to converge again to the estimated value in the final year (Figure 91). The simulation study reveals that the variance parameters (logSd) for the F and age1 N processes are still not in line with respect to the estimates of the real observations (Figure 92).

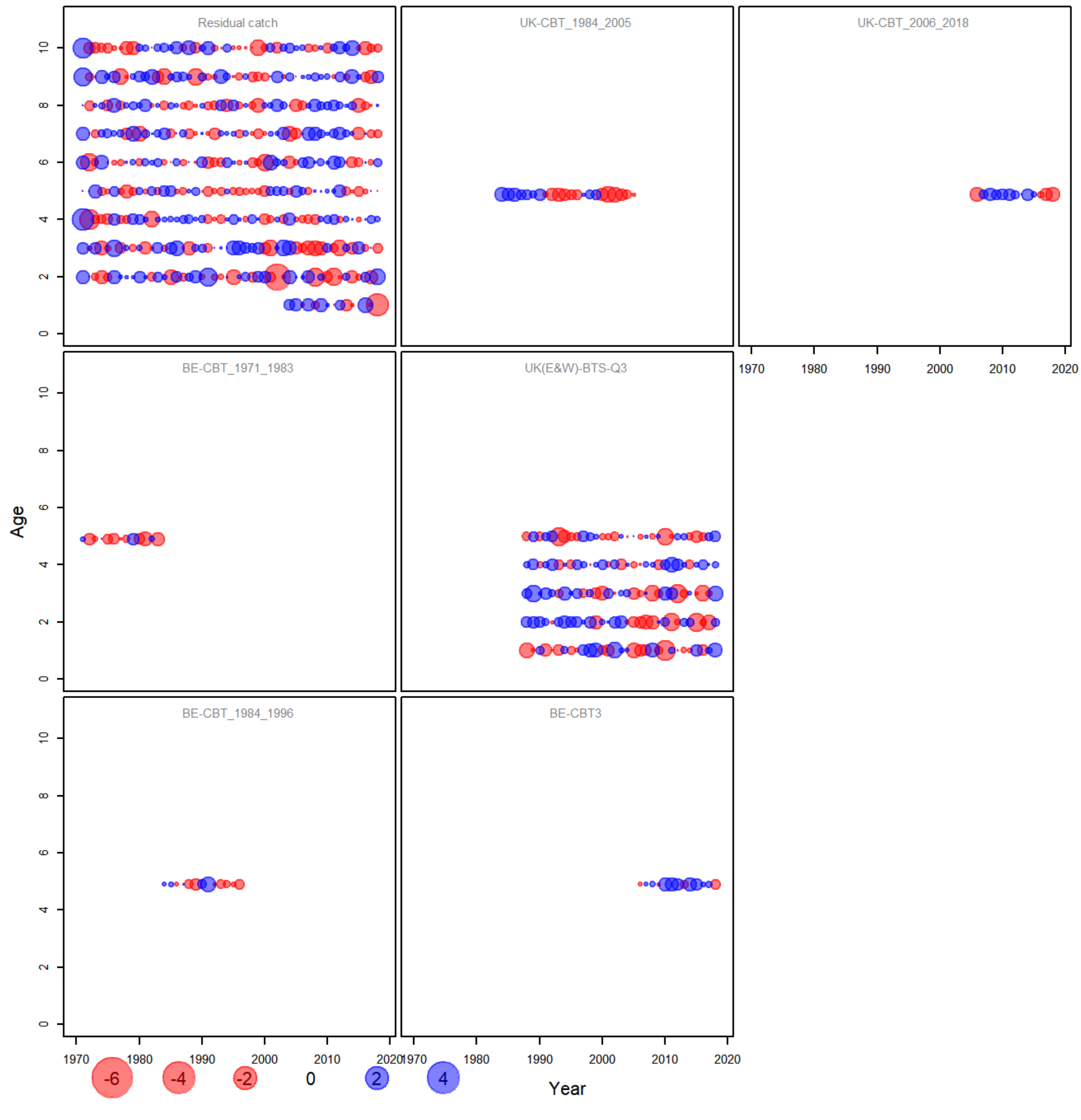


Figure 87: Normalized one-observation-ahead residuals. Each panel represents a specific observation category. Blue circles indicate a positive residual and red circles a negative residual (RUN_3).

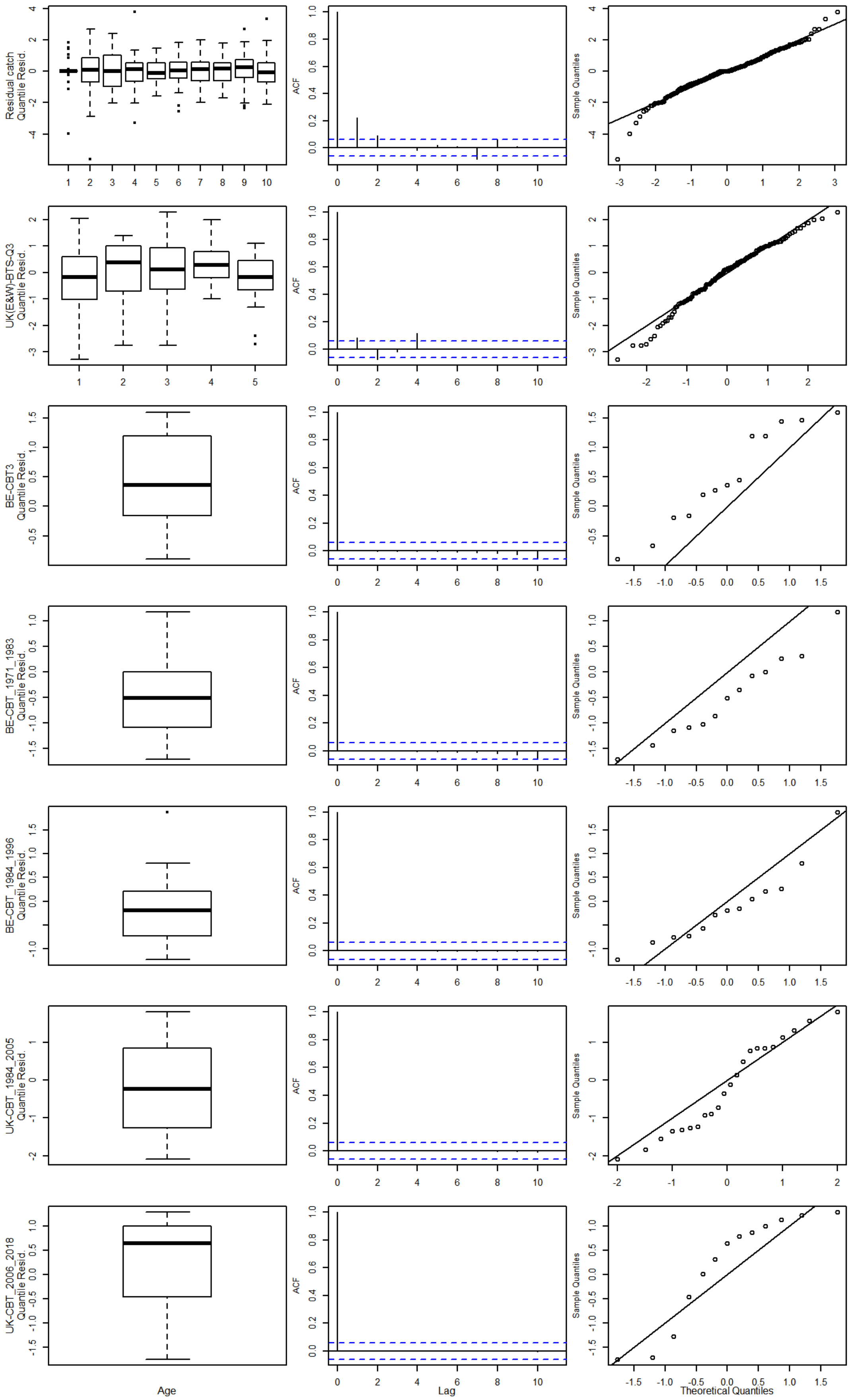


Figure 88: Boxplots, autocorrelation and normal Quantile Quantile plots of the normalized one-observation-ahead residuals. Panels are organized so that each row refers to a specific category of observations (RUN_3).

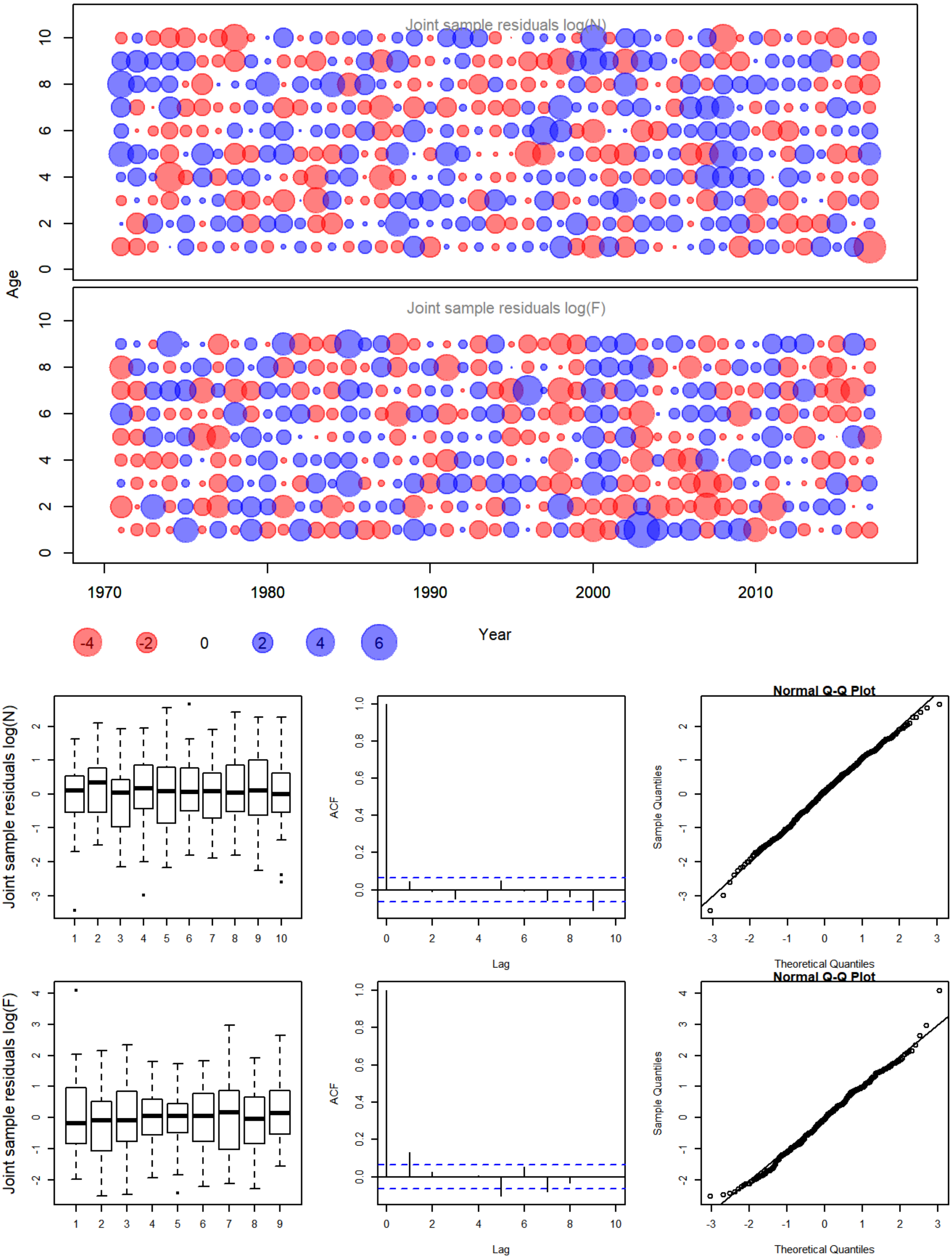


Figure 89: Normalized residuals for the recruitment and survival processes (RUN_3).

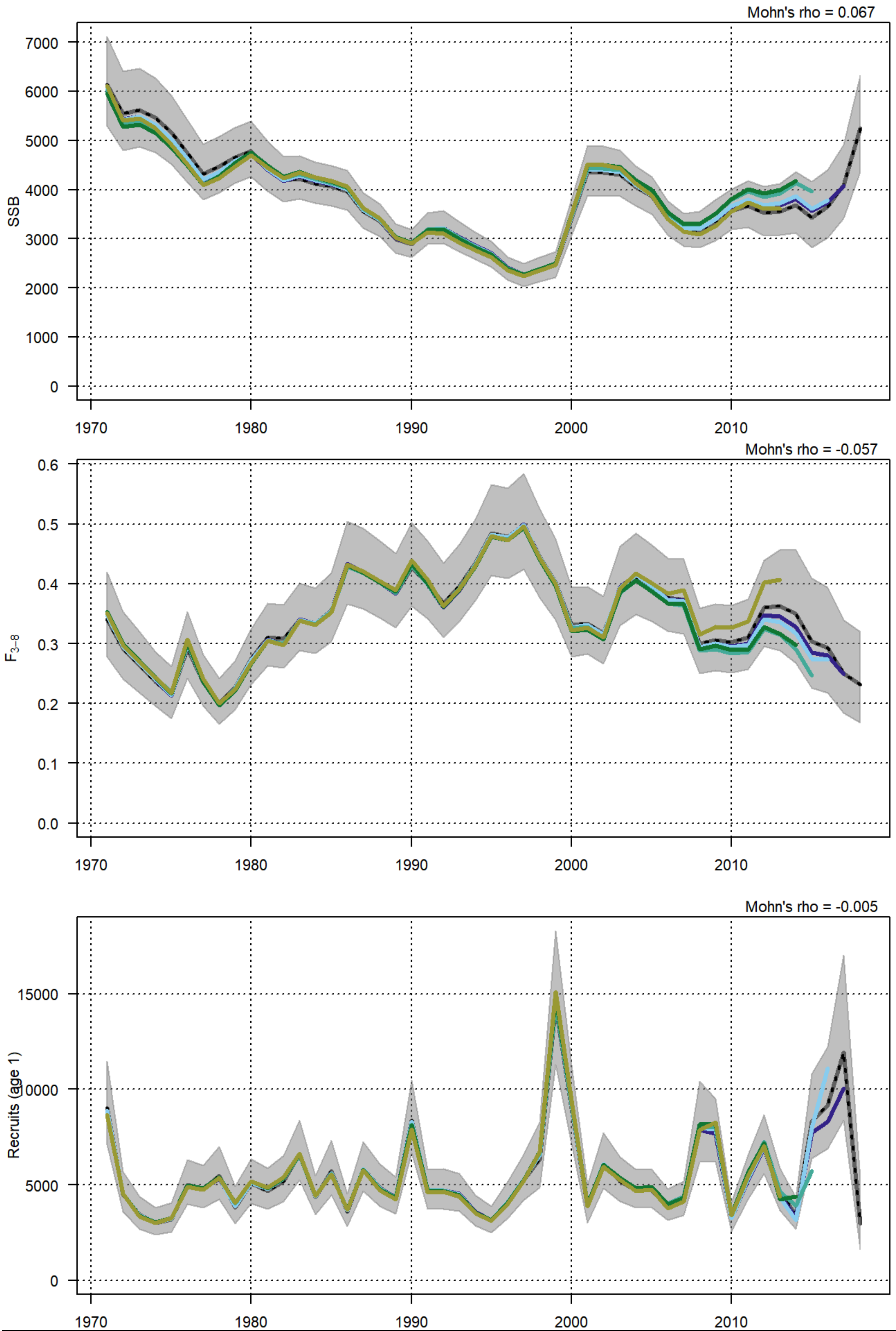


Figure 90: Retrospective estimates (5 years) from the SAM assessment. Estimated yearly SSB (top panel), Fbar (middle panel) and recruitment age 1 (bottom panel), together with corresponding point-wise 95% confidence intervals (shaded area) (RUN_3).

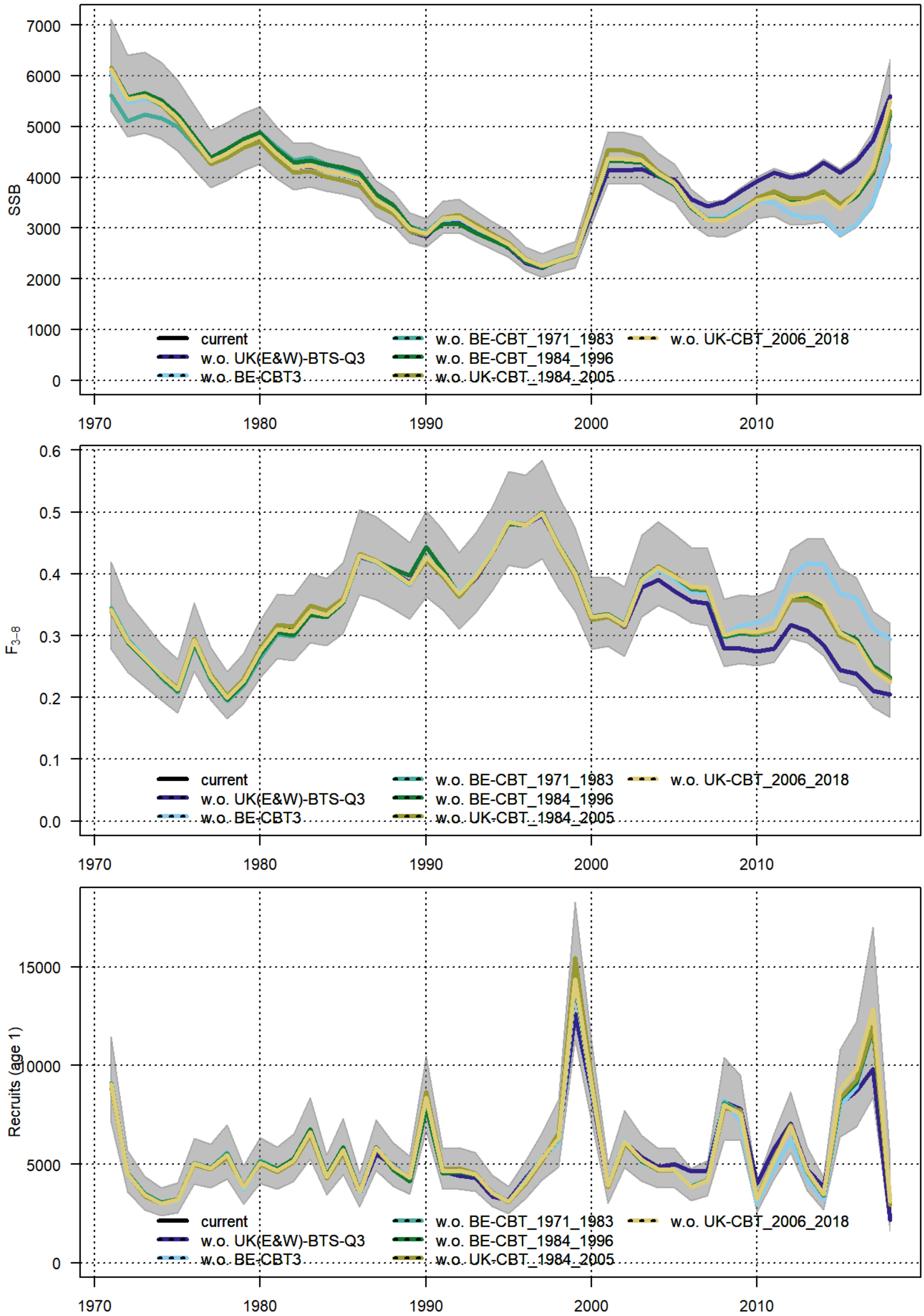


Figure 91: SSB (top panel), Fbar (middle panel), and recruitment (bottom panel) estimates (solid lines) from model fits in which one tuning series was removed from the data. The shaded area indicates the confidence bounds of the full model (RUN_3).

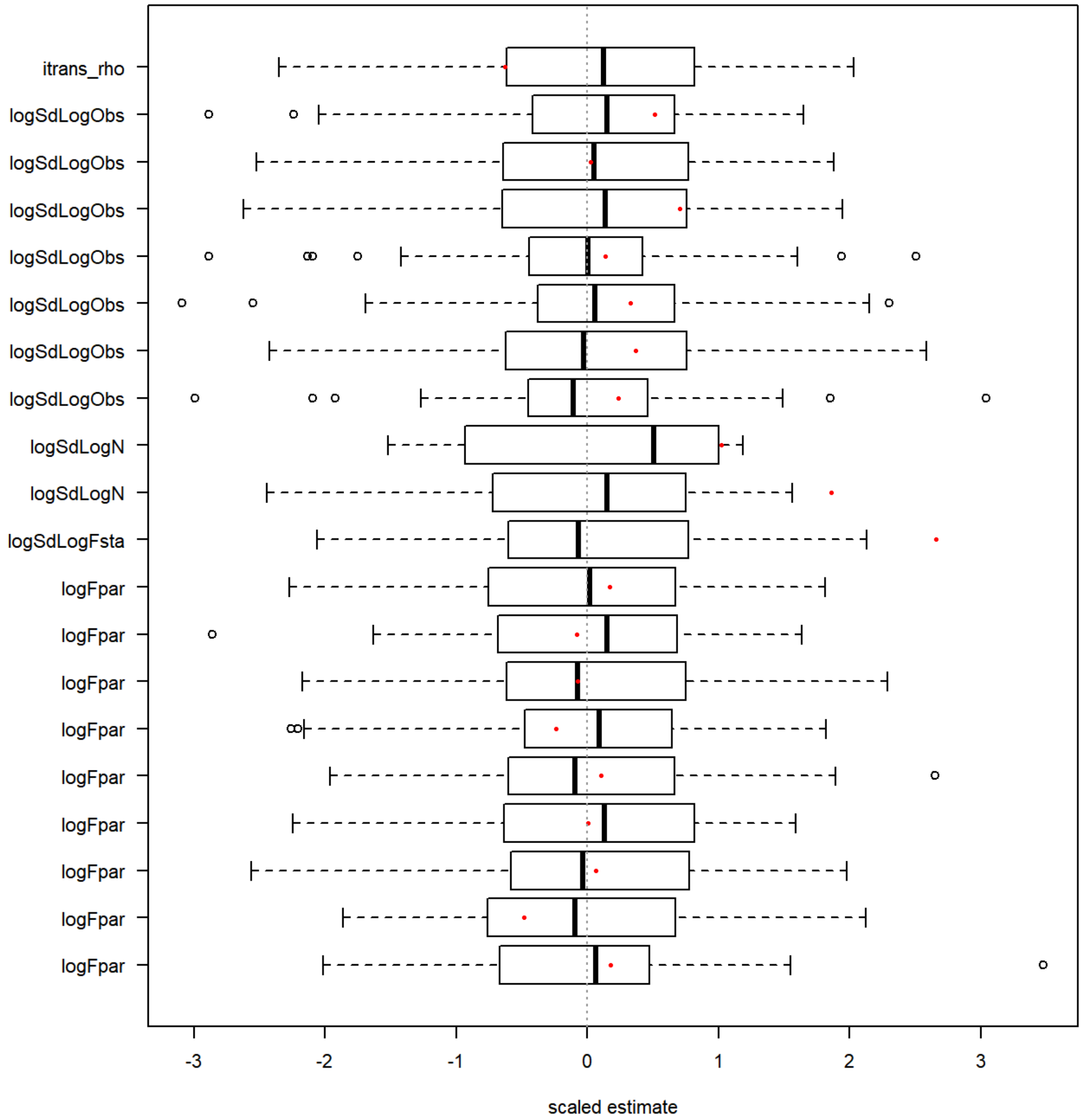


Figure 92: Boxplots of the estimated parameters after refitting the model 50 times to simulated data of the original fit. The red dots indicate the parameter estimates of the original fit. To facilitate visualization, all parameters were rescaled (RUN_3).

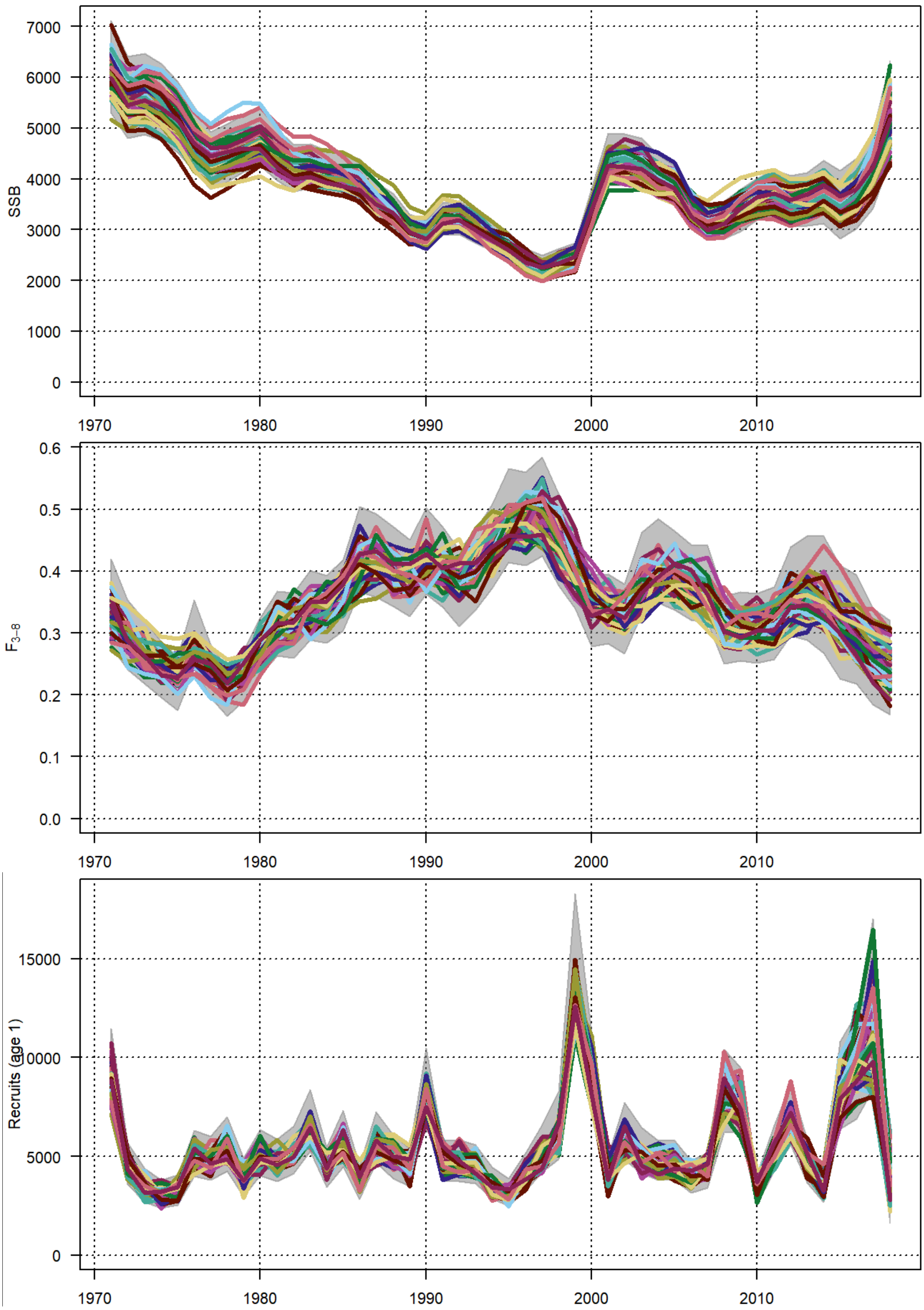


Figure 93: SSB (top panel), Fbar (middle panel) and recruitment (bottom panel) estimates from the refitted models on 50 simulated datasets based on the original plot. The shaded area indicates the confidence bounds of the original model (RUN_3).

2020 WKFLATNSCS-RUN 4

i) Model output: SSB, Fbar, recruitment, catches, catchability

Figures 94- 96 indicate that adding the information of the new UK(E&W)-Q1SWECOS survey has little effect on the SSB, Fbar, recruitment and catch estimates. The catchability pattern of this survey has an opposite trend compared to the UK (E&W)-BTS-Q3 survey implying that it seems mainly useful to monitor individuals of age >= 3 years (Figure 97).

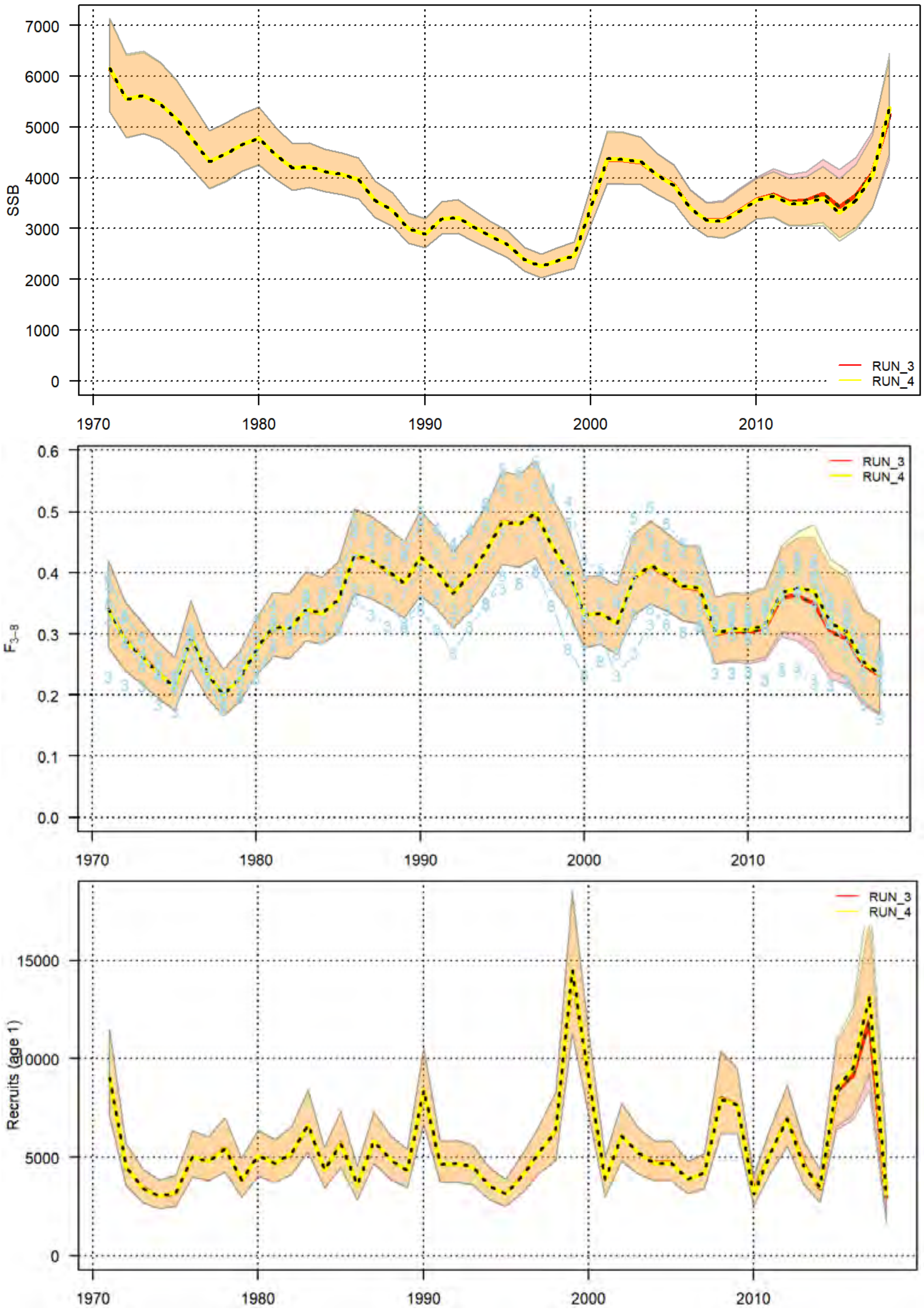


Figure 94: SSB (top panel), Fbar (middle panel) and recruitment (bottom panel) estimates of the SAM runs 3 and 4. The solid lines refer to the MLE estimates while the shaded areas represent the 95% confidence interval.

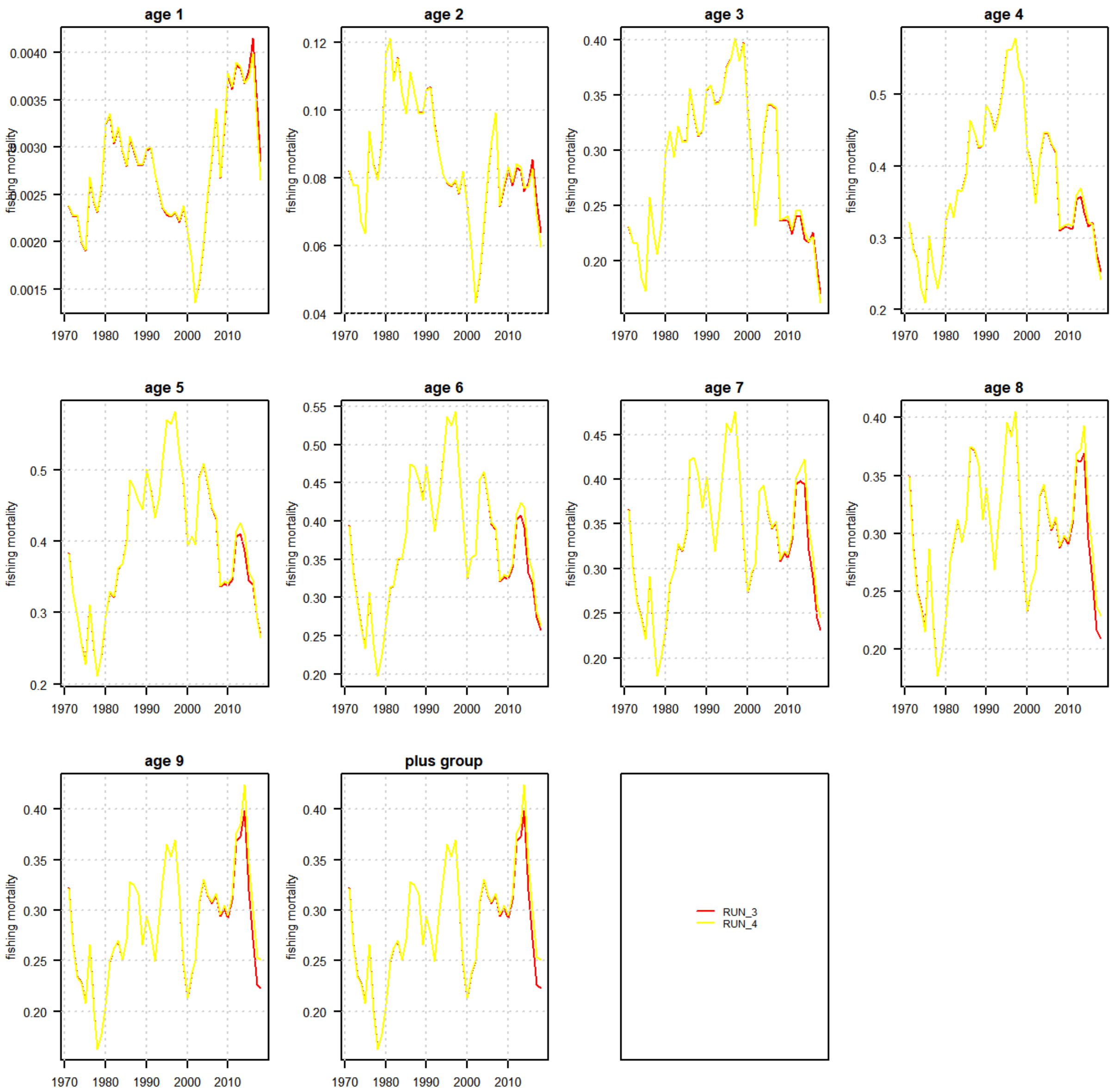


Figure 95: F estimates by age (RUN_3 and RUN_4).

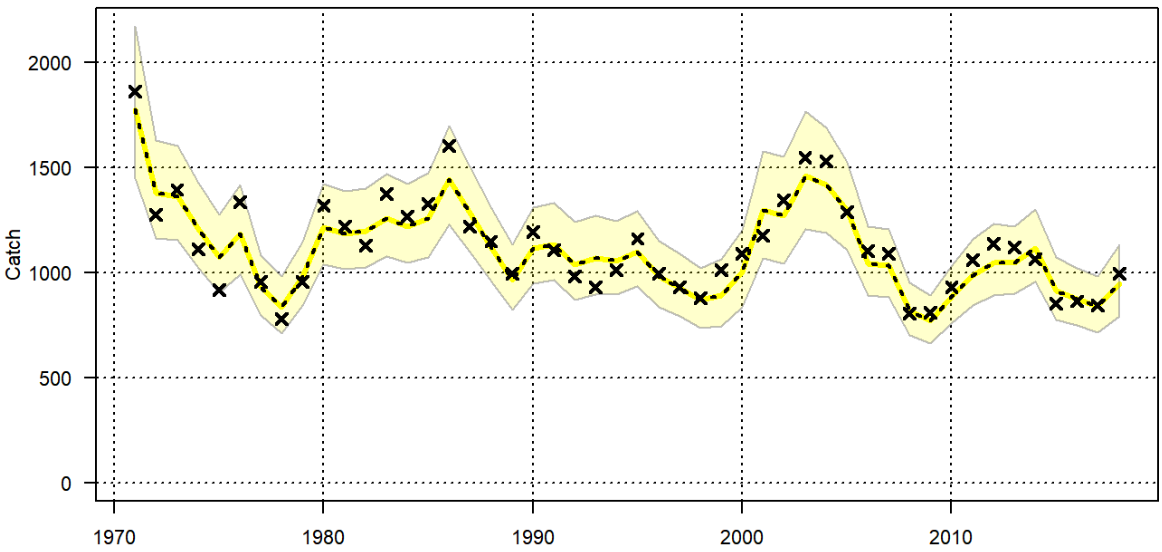


Figure 96: Reported (black cross) and estimated catches (solid line) with 95% confidence bounds (shaded area) (RUN_4).

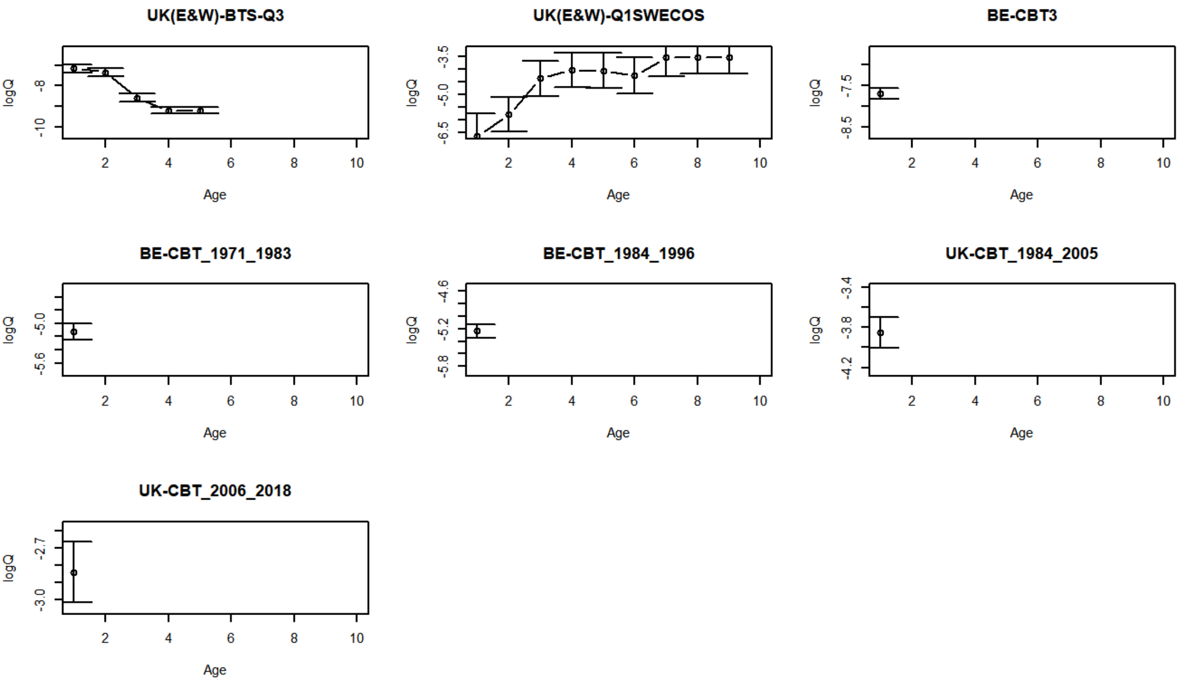


Figure 97: Log catchability by age of the different tuning fleets. Whiskers indicate the 95% confidence bounds (RUN_4).

ii) Model validation: residuals, retrospective patterns, leave-out tuning fleet, simulation

For those observation categories that are also included in RUN_3, the OSA residuals are very similar to those reported in RUN_3 (Figures 98-99). Nevertheless, strong autocorrelation is present in the OSA residuals related to the new survey (UK(E&W)-Q1SWECOS). The process residuals (Figure 100), retrospective patterns (Figure 101), leave-one-out fits (Figure 102) and simulation (Figures 103-104) study are very similar to those reported in RUN_3, indicating that adding the UK(E&W)-Q1SWECOS survey has little effect on the assessment model, and mainly adds extra parameters to be estimated by the model.

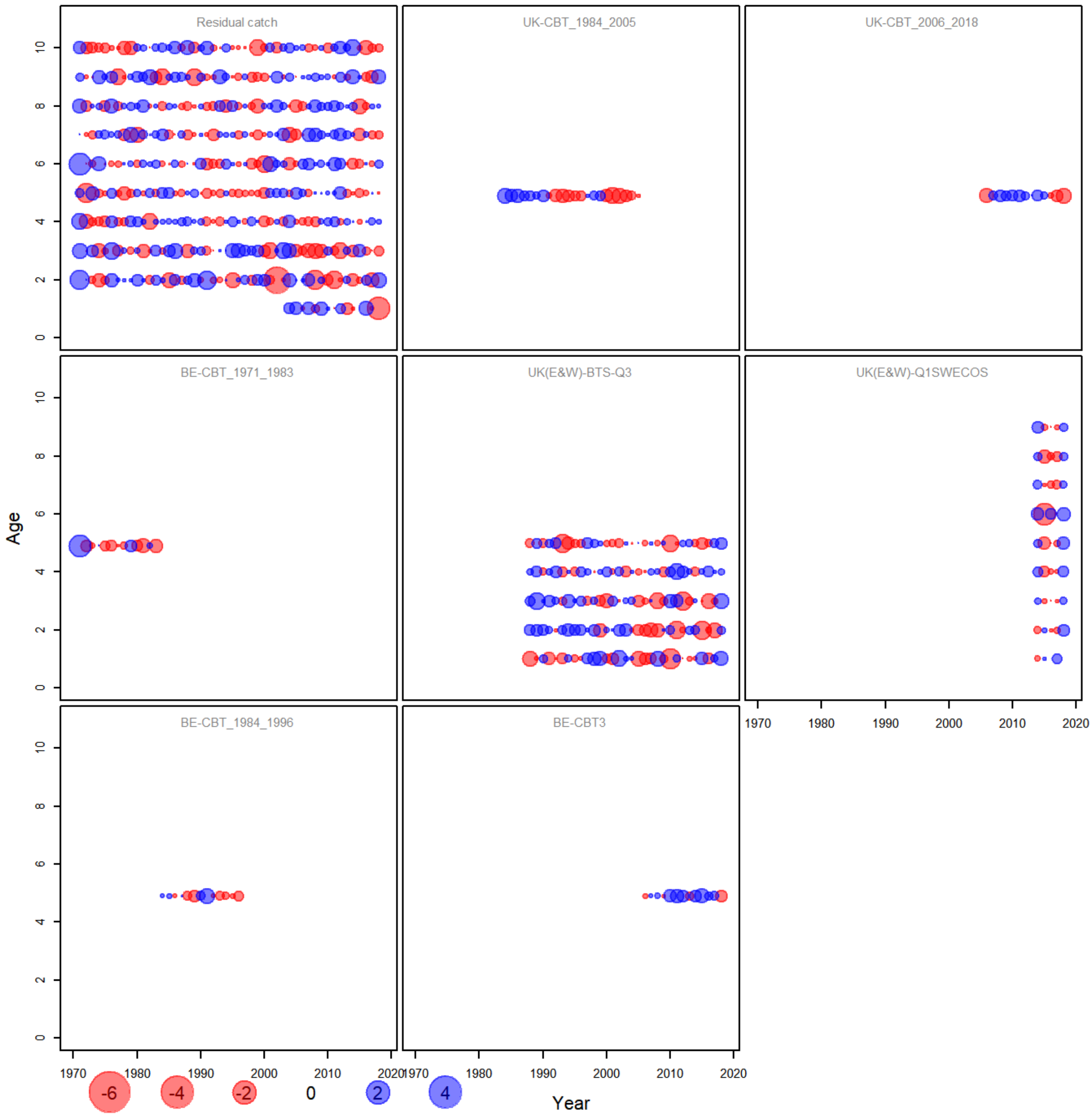
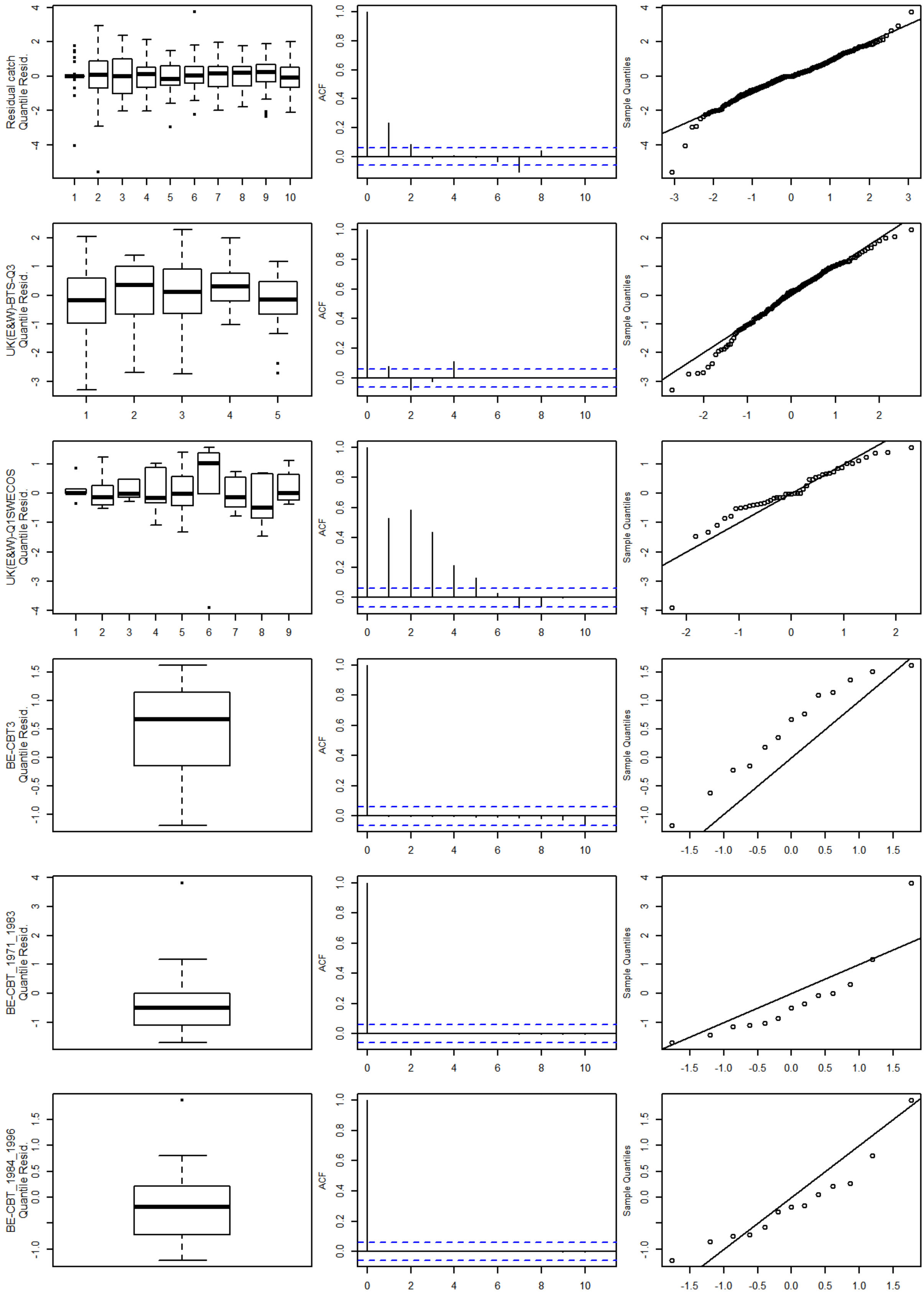


Figure 98: Normalized one-observation-ahead residuals. Each panel represents a specific observation category. Blue circles indicate a positive residual and red circles a negative residual (RUN_4).


Residual catch
Quantile Resid.
UK(E&W)-BTS-Q3
Quantile Resid.
UK(E&W)-Q1SWECOS
Quantile Resid.
BE-CBT3
Quantile Resid.
BE-CBT_1971_1983
Quantile Resid.
BE-CBT_1984_1996
Quantile Resid.
ACF
Sample Quantiles

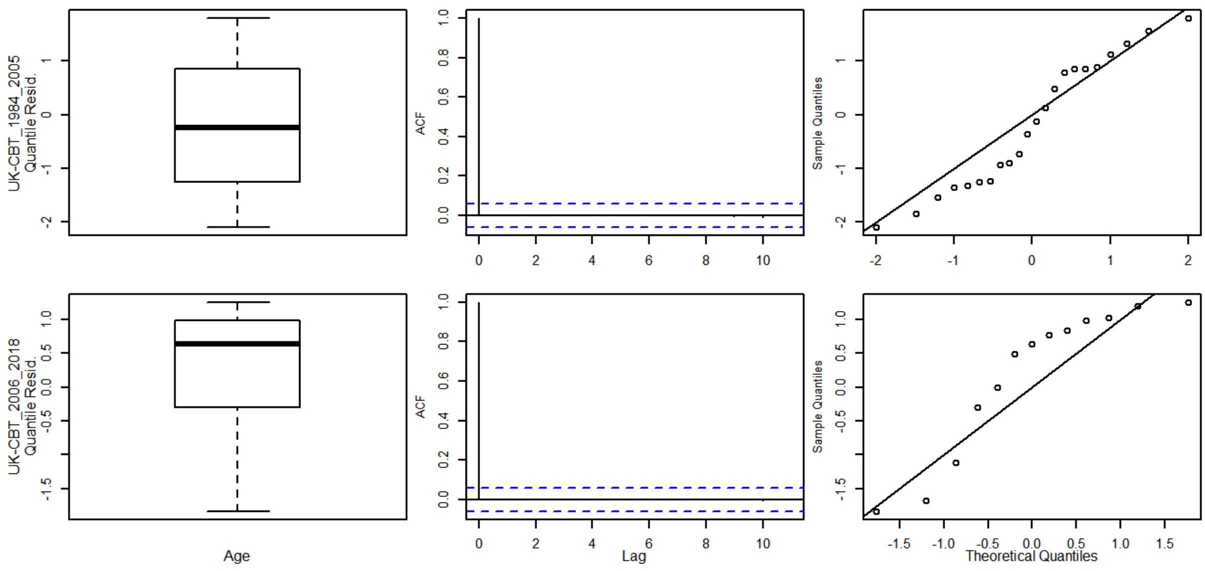


Figure 99: Boxplots, autocorrelation and normal Quantile Quantile plots of the normalized one-observation-ahead residuals. Panels are organized so that each row refers to a specific category of observations (RUN_4).

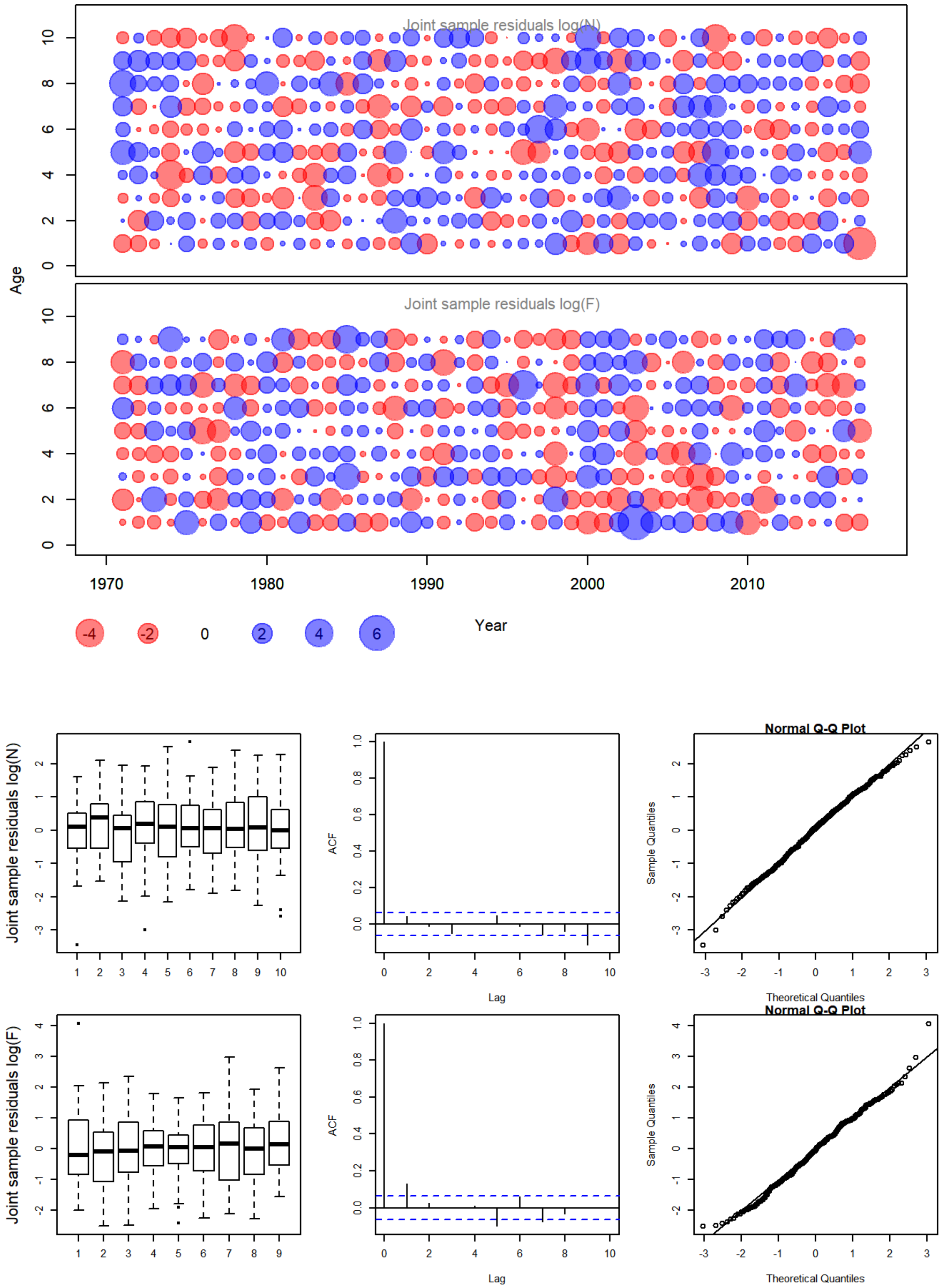


Figure 100: Normalized residuals for the recruitment and survival processes (RUN_4).

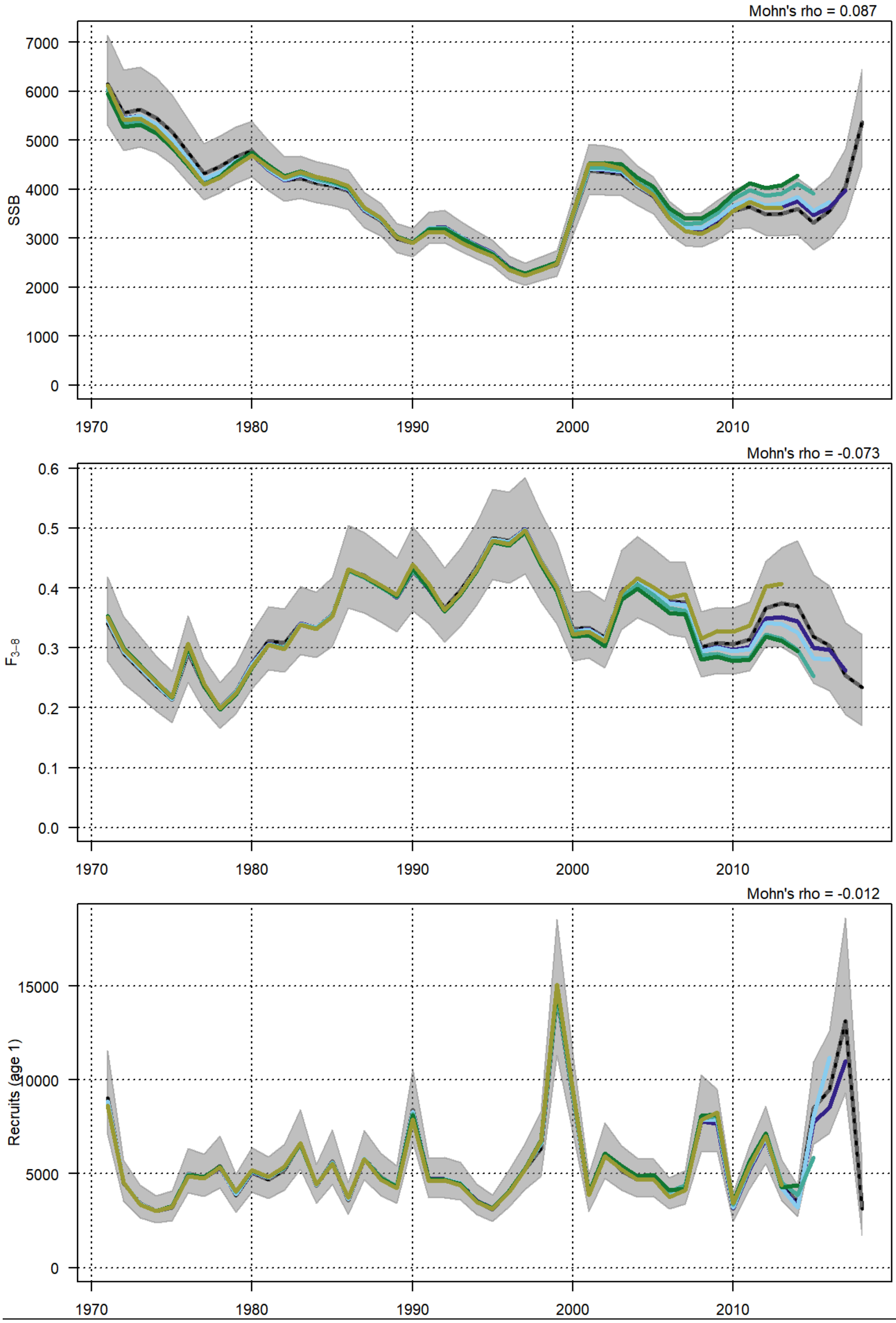


Figure 101: Retrospective estimates (5 years) from the SAM assessment. Estimated yearly SSB (top panel), Fbar (middle panel) and recruitment age 1 (bottom panel), together with corresponding point-wise 95% confidence intervals (shaded area) (RUN_4).

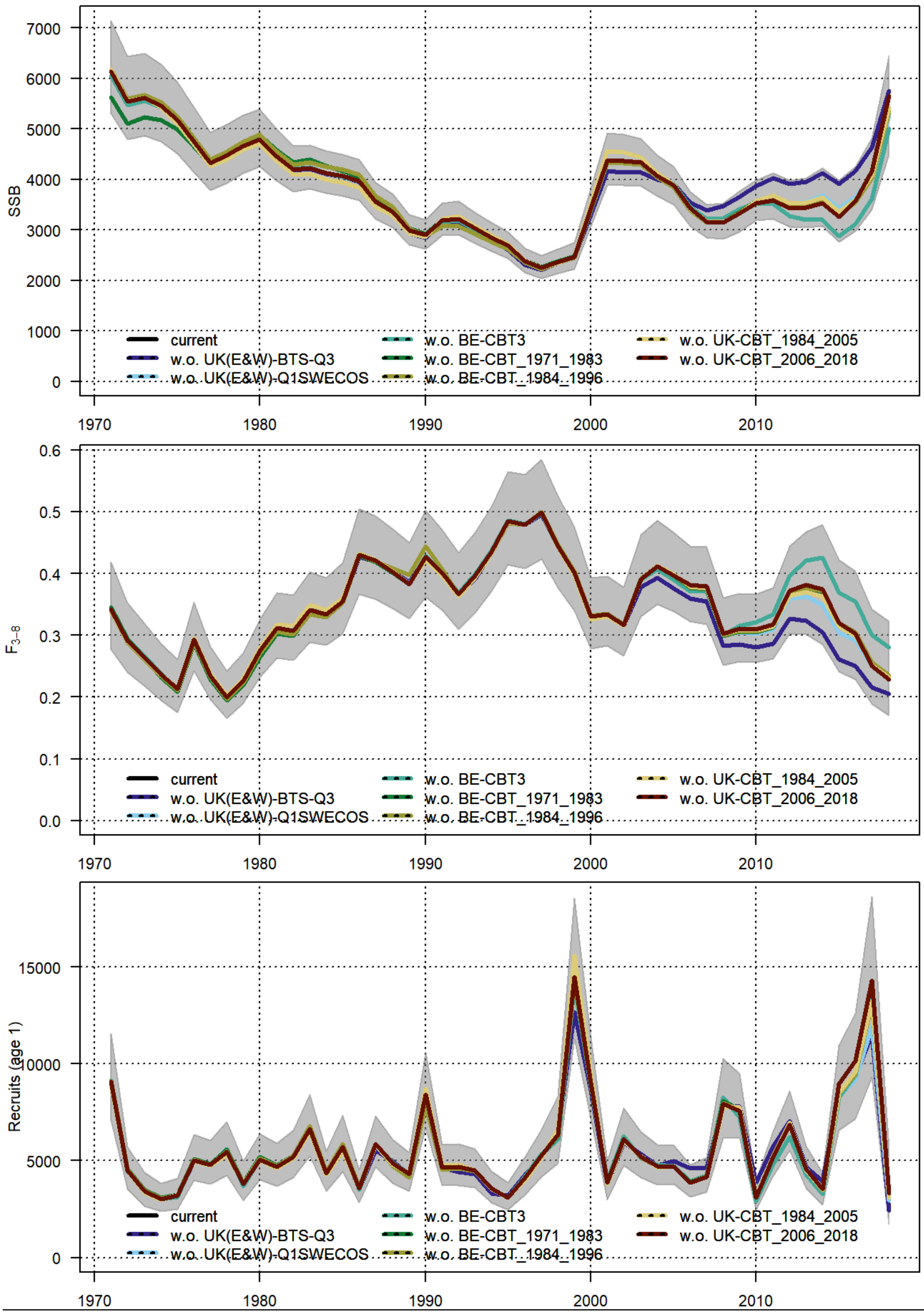


Figure 102: SSB (top panel), Fbar (middle panel), and recruitment (bottom panel) estimates (solid lines) from model fits in which one tuning series was removed from the data. The shaded area indicates the confidence bounds of the full model (RUN_4).

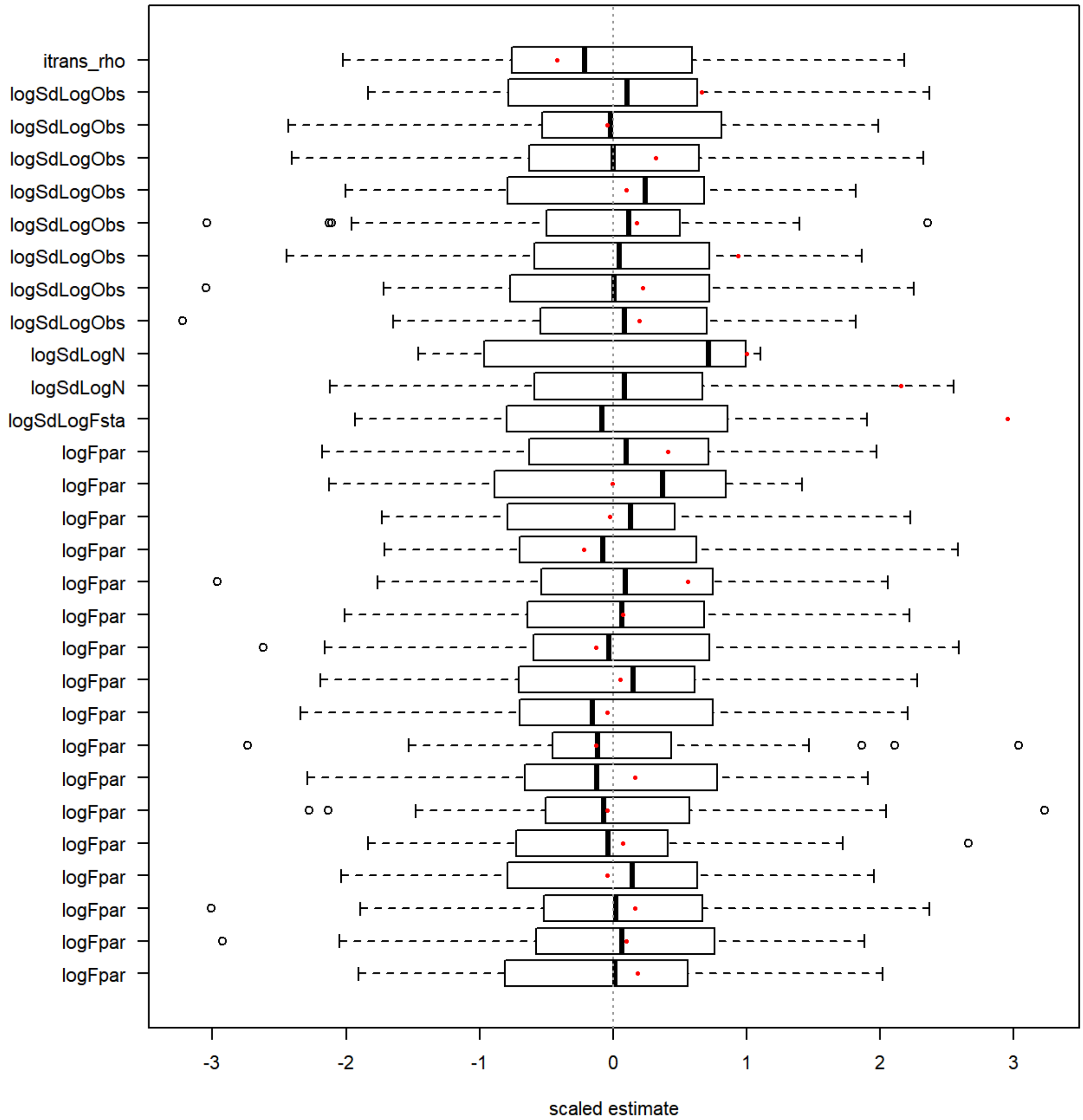


Figure 103: Boxplots of the estimated parameters after refitting the model 50 times to simulated data of the original fit. The red dots indicate the parameter estimates of the original fit. To facilitate visualization, all parameters were rescaled (RUN_4).

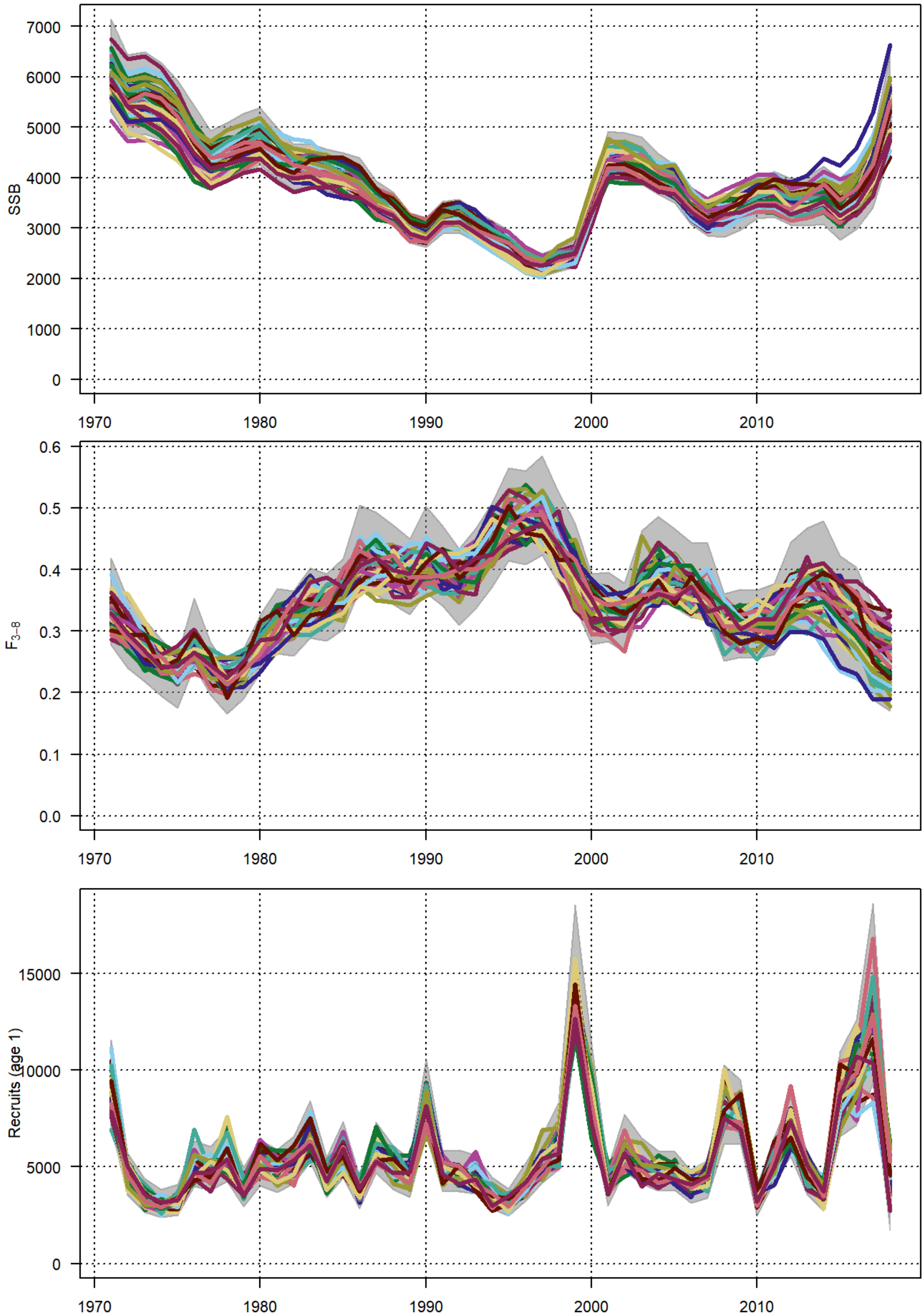


Figure 104: SSB (top panel), Fbar (middle panel) and recruitment (bottom panel) estimates from the refitted models on 50 simulated datasets based on the original plot. The shaded area indicates the confidence bounds of the original model (RUN_4).

2020 WKFLATNSCS-RUN 5

i) Model output: SSB, Fbar, recruitment, catches, catchability

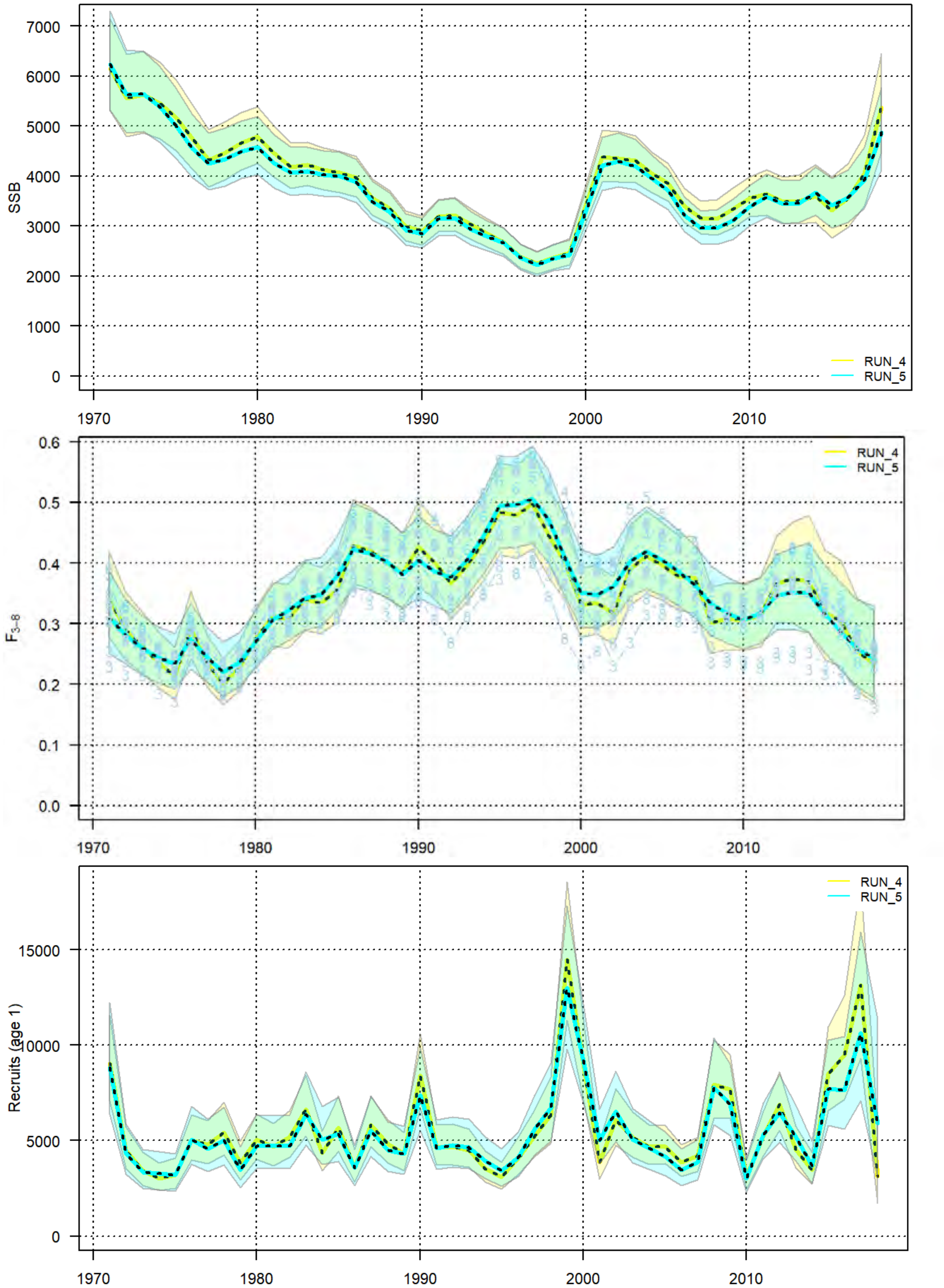


Figure 105: SSB (top panel), Fbar (middle panel) and recruitment (bottom panel) estimates of the SAM runs 4 and 5. The solid lines refer to the MLE estimates while the shaded areas represent the 95% confidence interval.

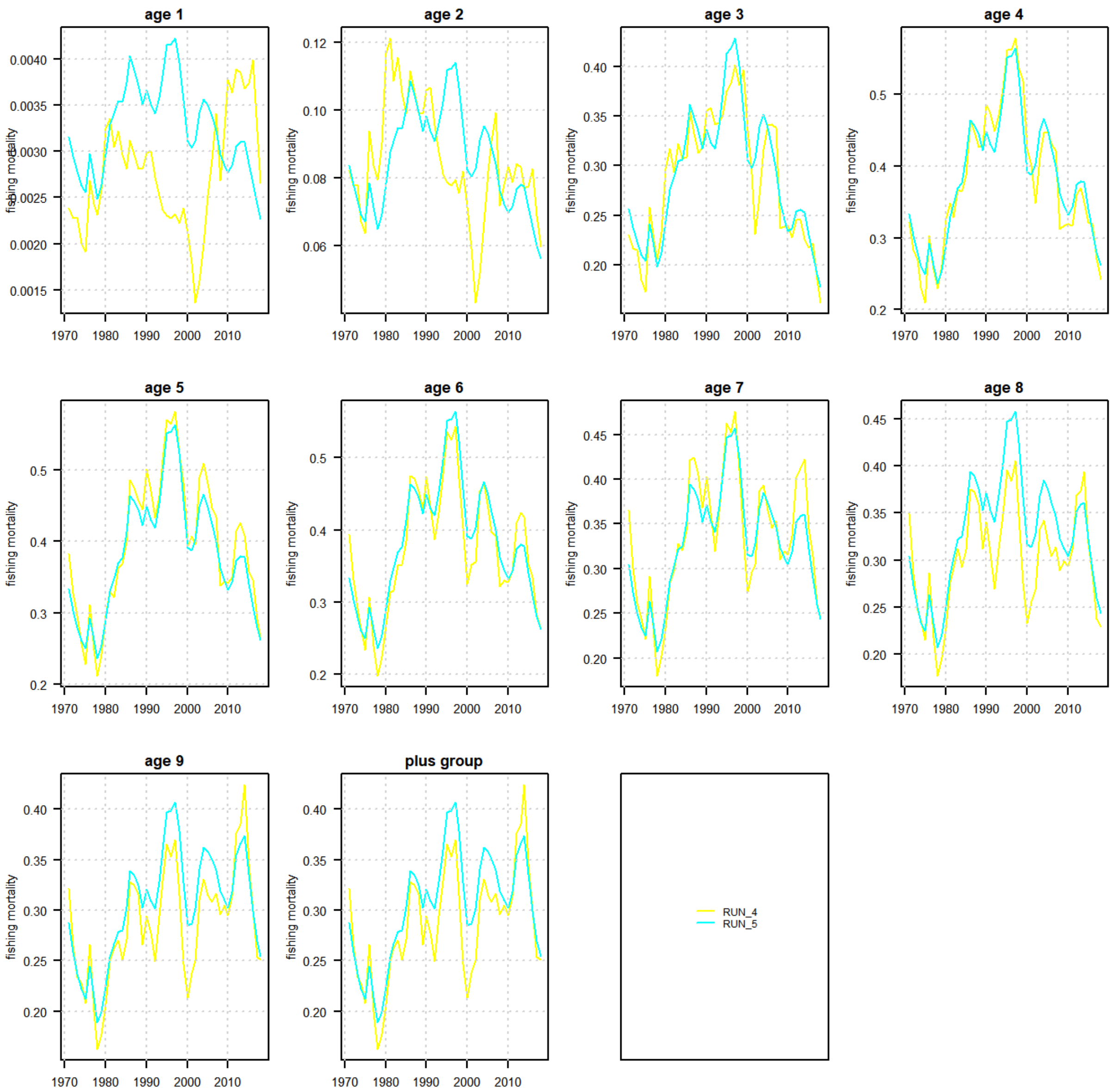


Figure 106: F estimates by age (RUN_4 and RUN_5).

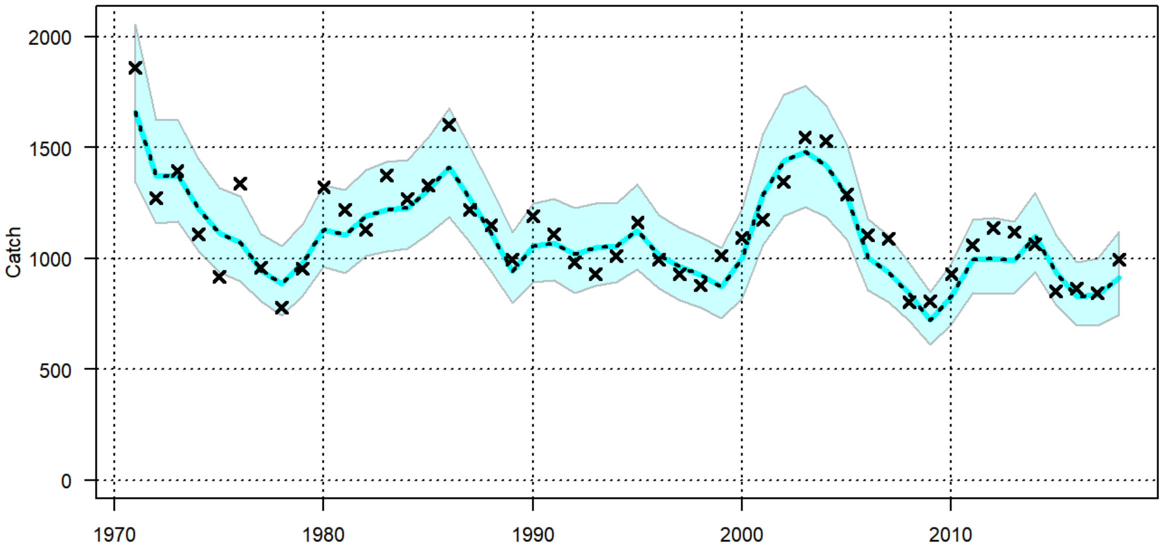


Figure 107: Reported (black cross) and estimated catches (solid line) with 95% confidence bounds (shaded area) (RUN_5).

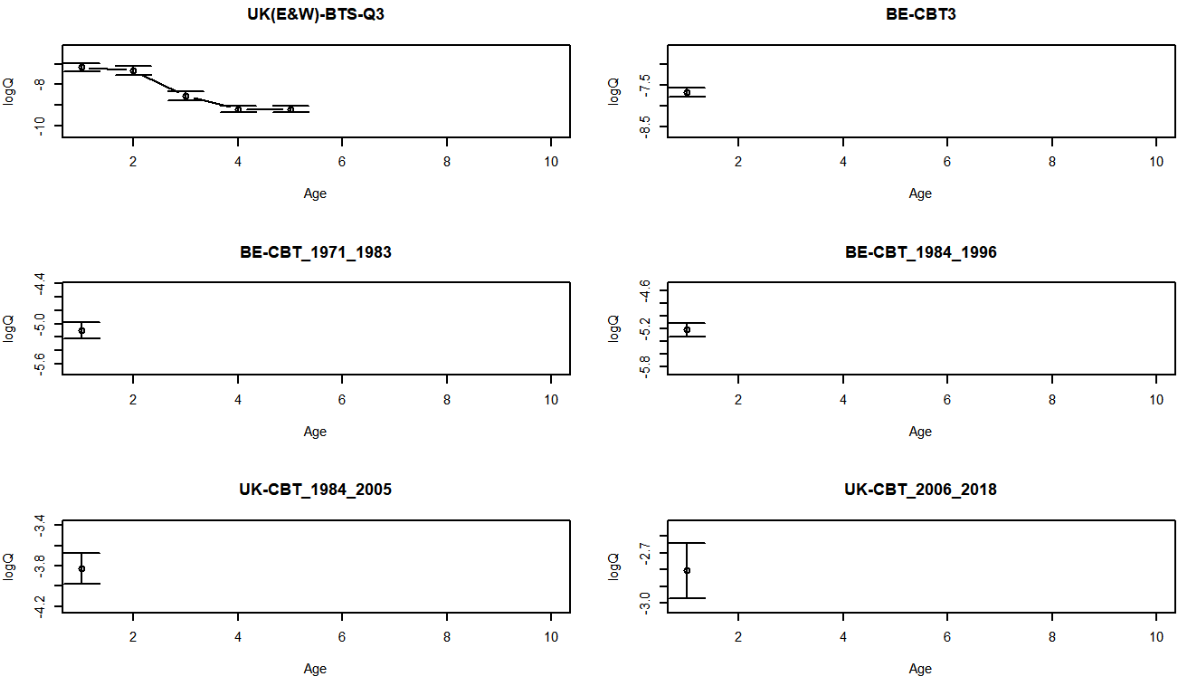


Figure 108: Log catchability by age of the different tuning fleets. Whiskers indicate the 95% confidence bounds (RUN_5).

ii) Model validation: residuals, retrospective patterns, leave-out tuning fleet, simulation

Changing the parameter configurations has little effect on the estimated SSB, Fbar, recruitment, catch and catchability values (Figures 105-108). In contrast, increasing the number of variance parameters on the N and F processes removed most of the autocorrelation in both the OSA and process residuals (Figures 109-111). Only at lags +3, autocorrelation appears significant in some cases. Nevertheless, these patterns can rather be considered as a data artefact than a model misspecification. Retrospective analysis does not indicate major problems (Figure 112), while the leave-one out runs show that the model is less dependent on the UK (E&W)-BTS-Q3 and BE-CBT3 tuning indices. In addition, increased robustness of this model configuration is revealed by the simulation study which shows that the variance parameters of the process model seems more robust compared to the previous RUNs (Figure 115).

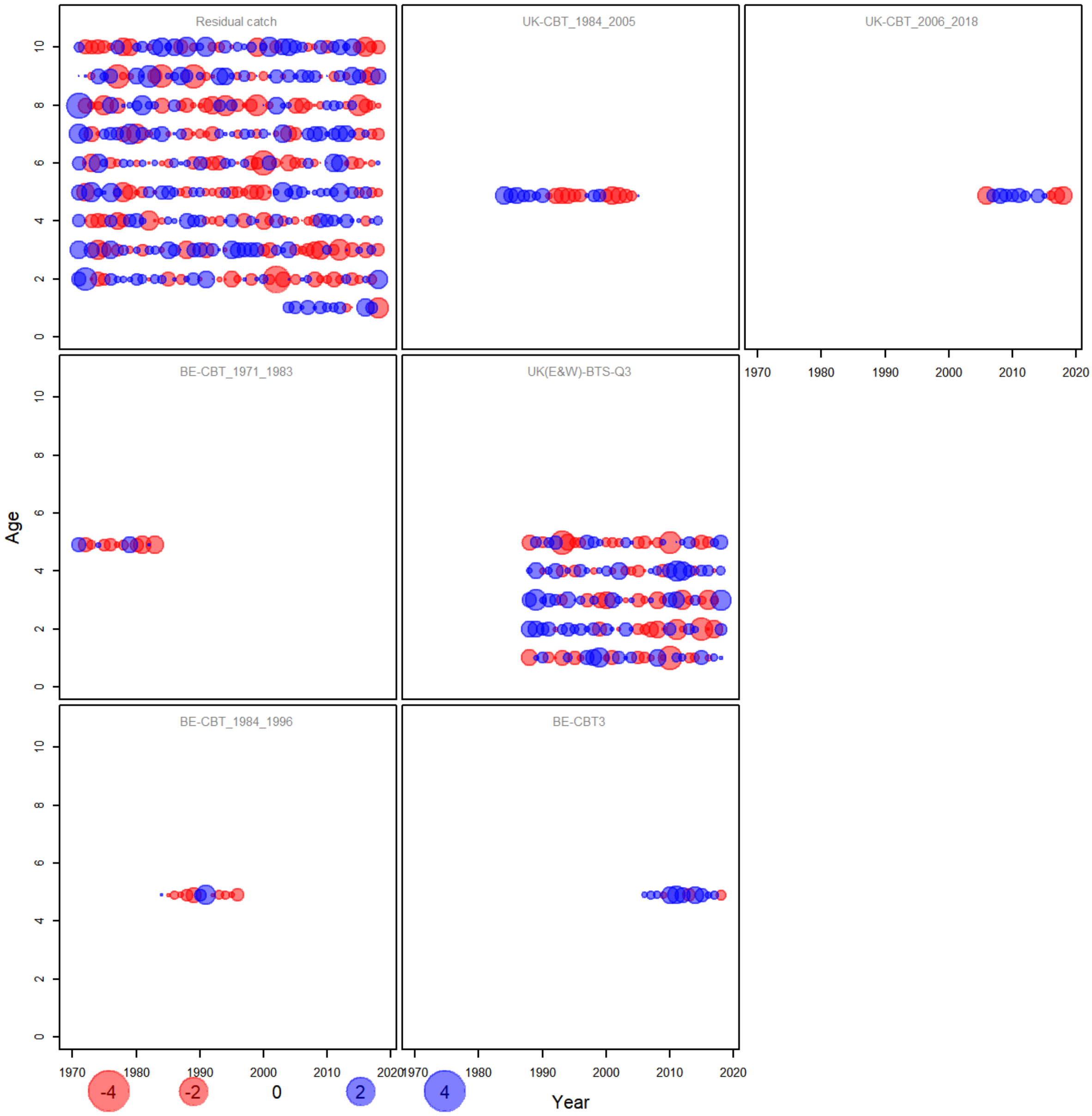


Figure 109: Normalized one-observation-ahead residuals. Each panel represents a specific observation category. Blue circles indicate a positive residual and red circles a negative residual (RUN_5).

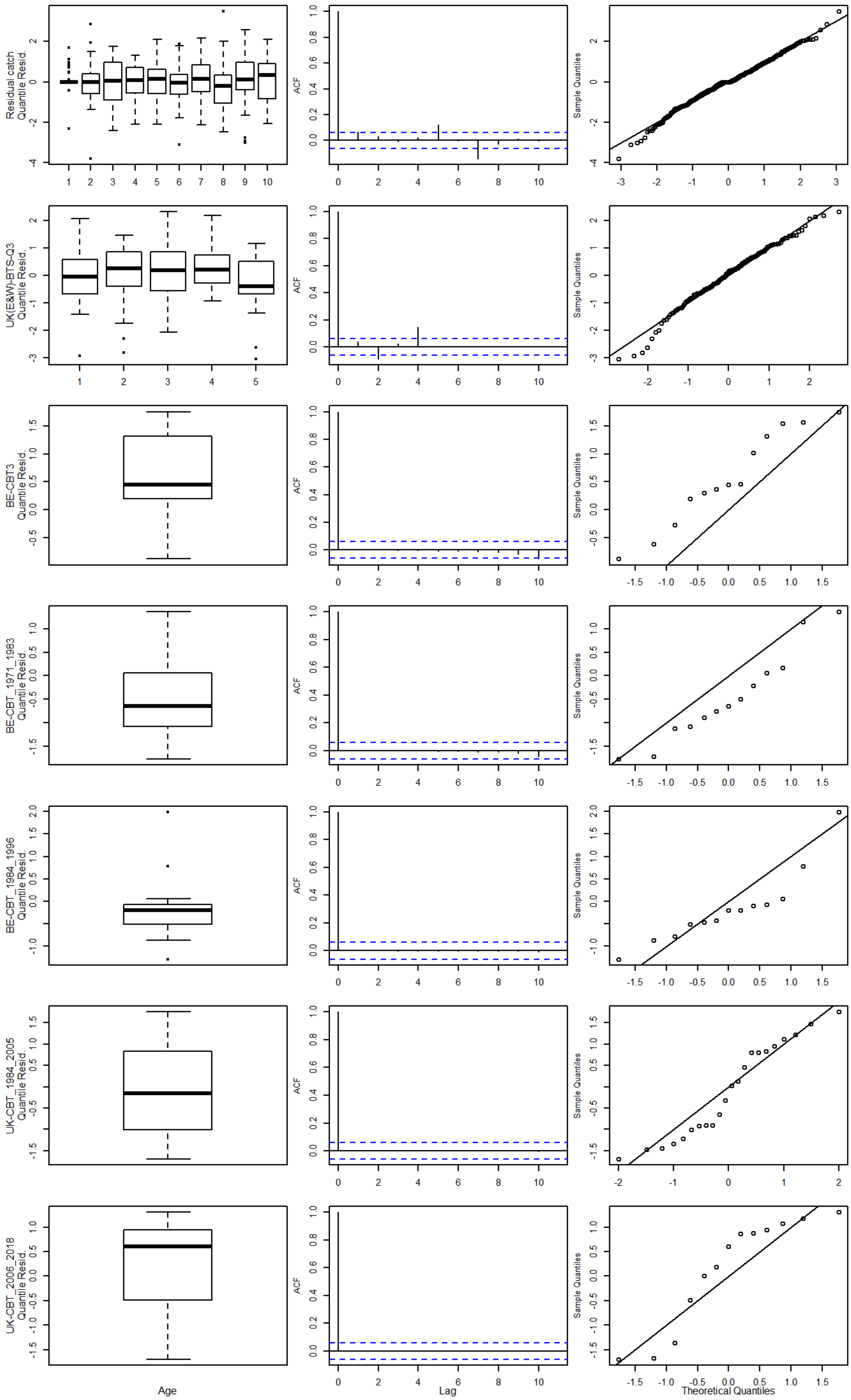


Figure 110: Boxplots, autocorrelation and normal Quantile Quantile plots of the normalized one-observation-ahead residuals. Panels are organized so that each row refers to a specific category of observations (RUN_5).

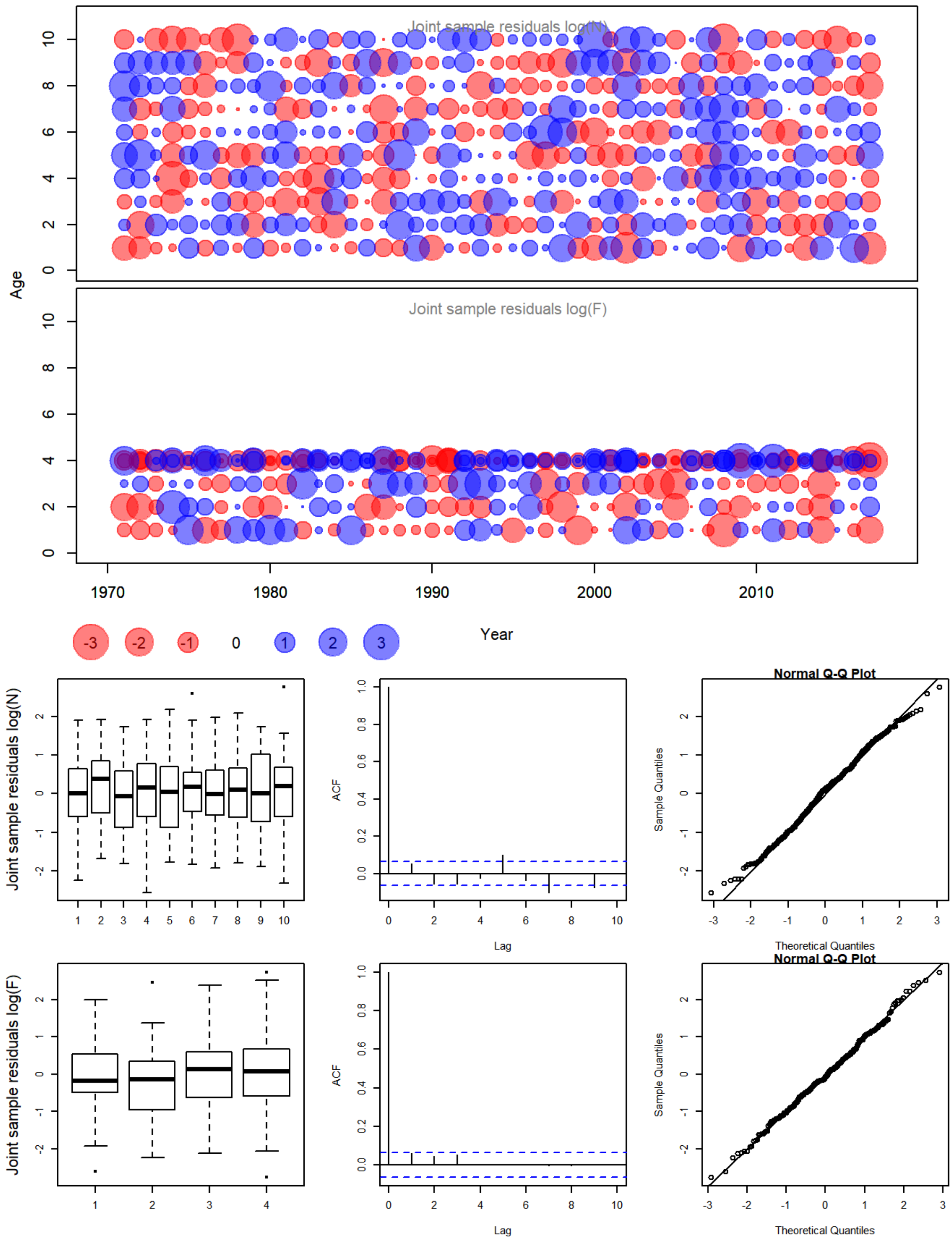


Figure 111: Normalized residuals for the recruitment and survival processes (RUN_5).

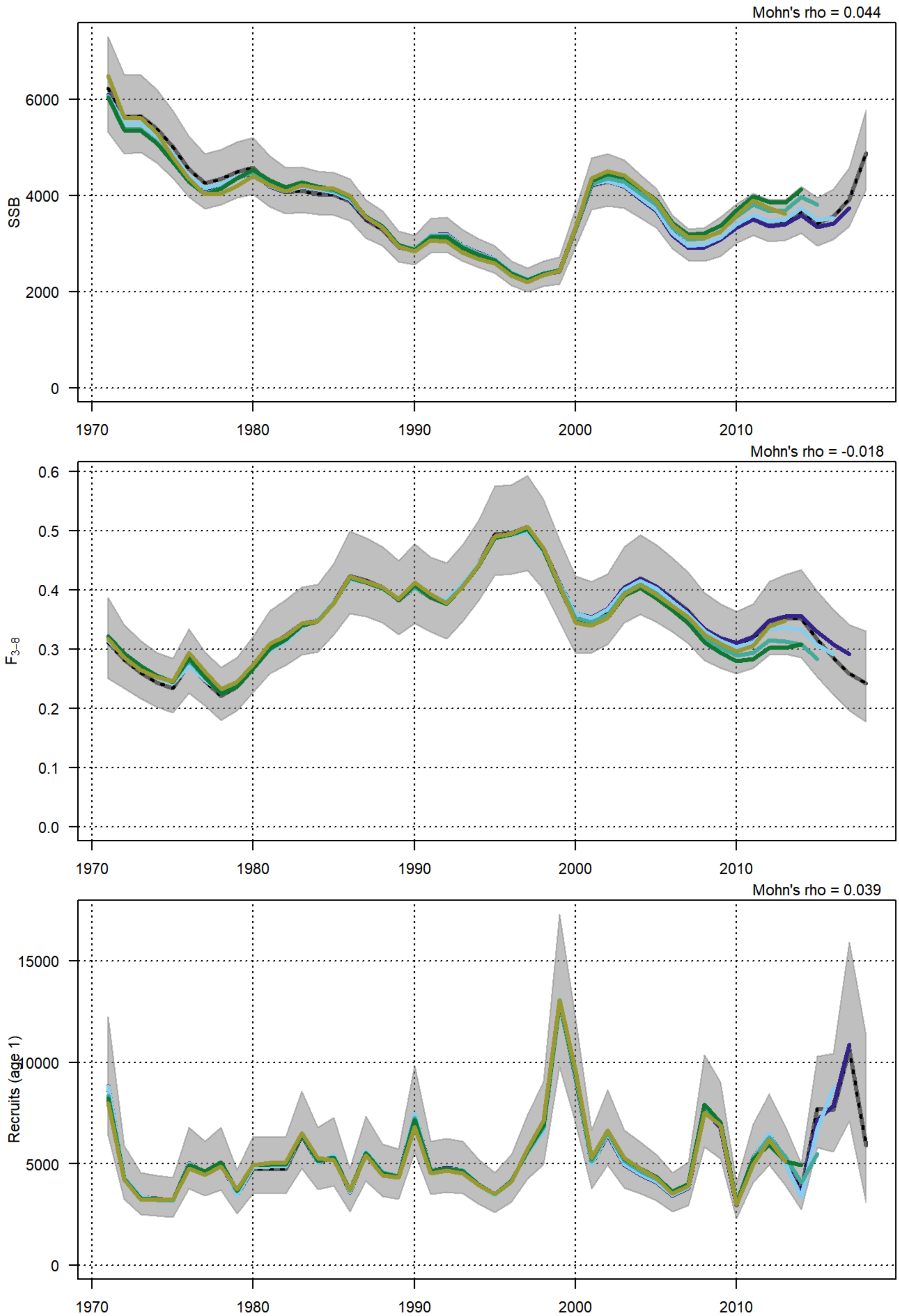


Figure 112: Retrospective estimates (5 years) from the SAM assessment. Estimated yearly SSB (top panel), Fbar (middle panel) and recruitment age 1 (bottom panel), together with corresponding point-wise 95% confidence intervals (shaded area) (RUN_5).

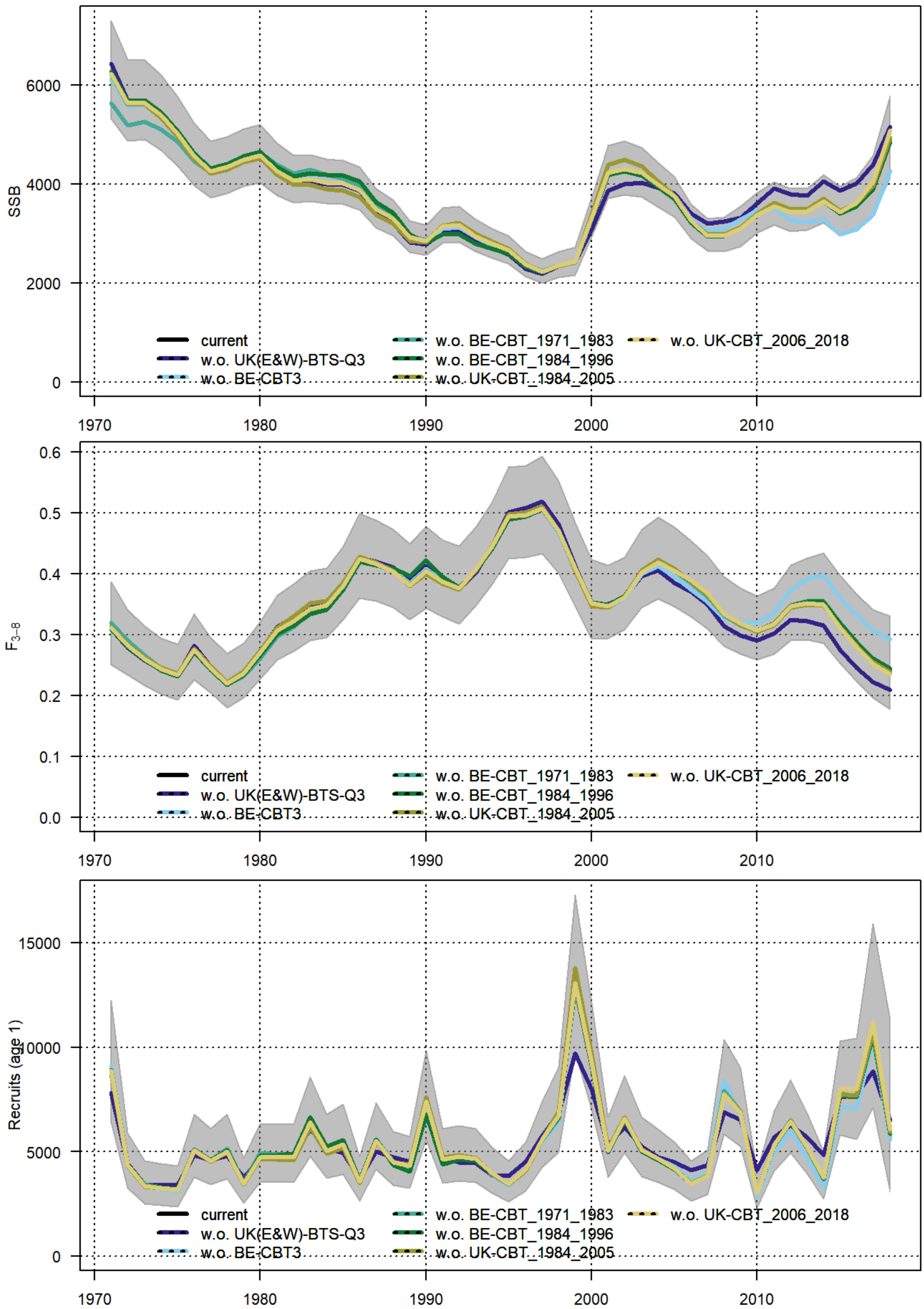


Figure 113: SSB (top panel), Fbar (middle panel), and recruitment (bottom panel) estimates (solid lines) from model fits in which one tuning series was removed from the data. The shaded area indicates the confidence bounds of the full model (RUN_5).

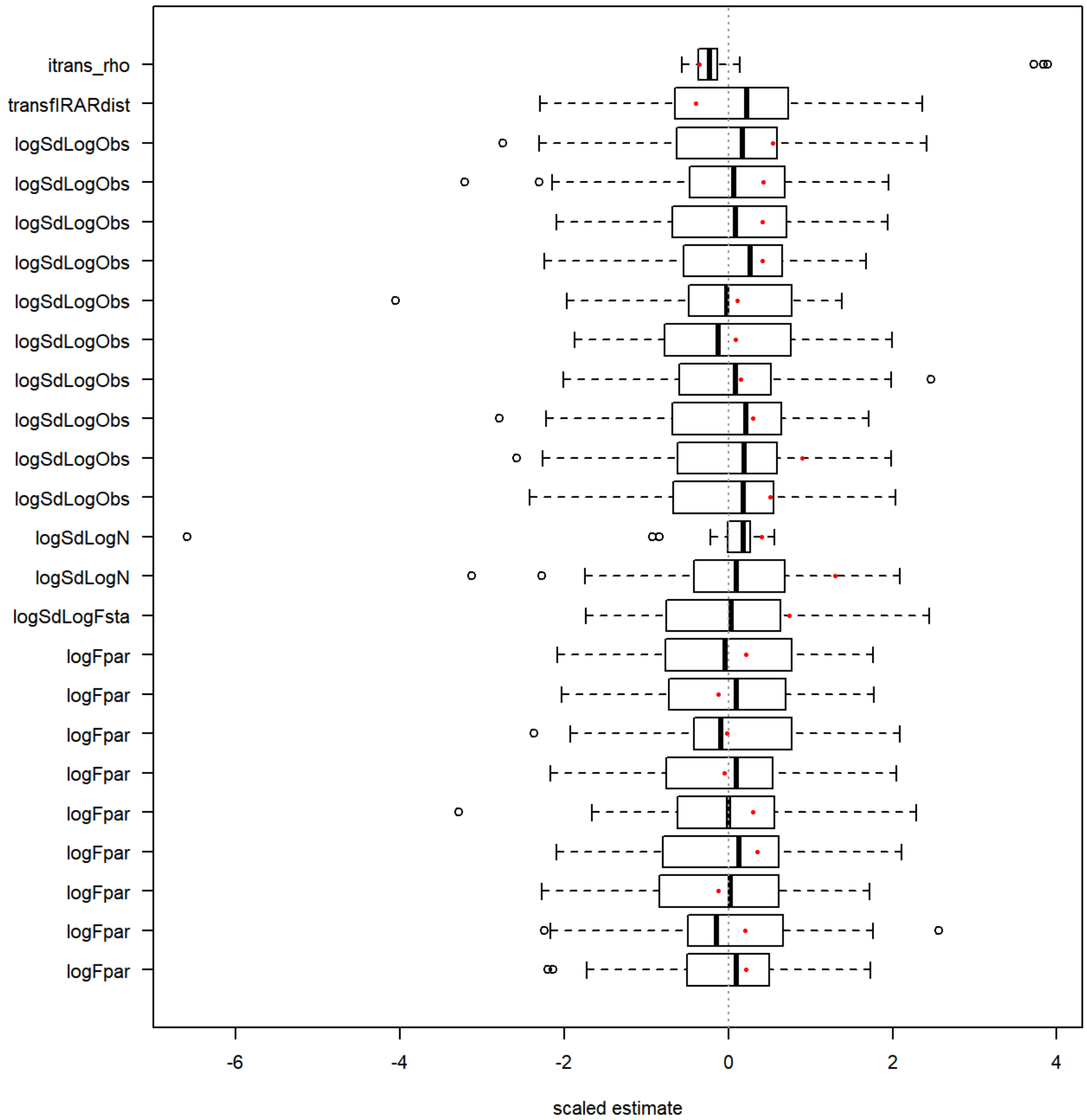


Figure 114: Boxplots of the estimated parameters after refitting the model 50 times to simulated data of the original fit. The red dots indicate the parameter estimates of the original fit. To facilitate visualization, all parameters were rescaled (RUN_5).

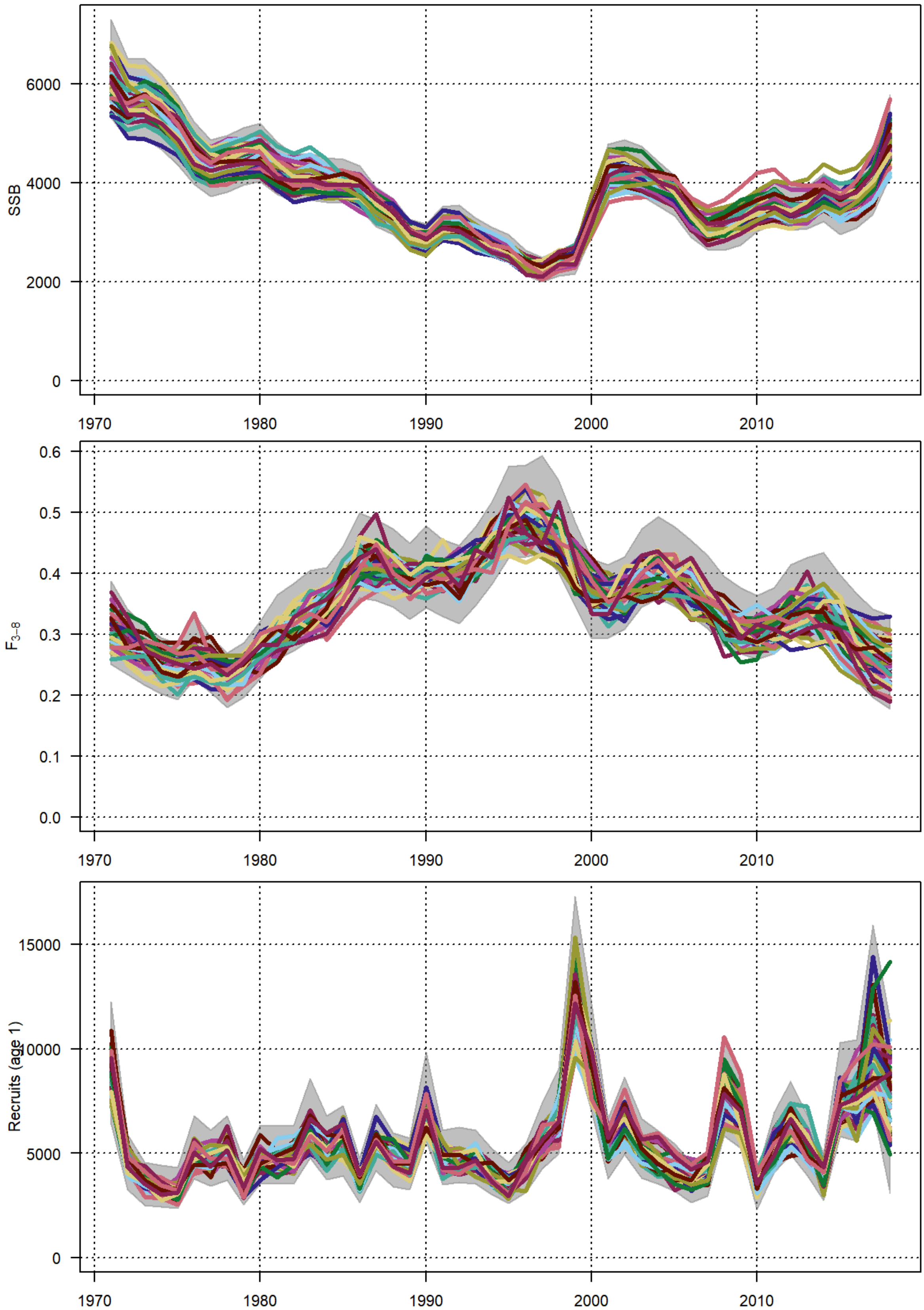


Figure 115: SSB (top panel), Fbar (middle panel) and recruitment (bottom panel) estimates from the refitted models on 50 simulated datasets based on the original plot. The shaded area indicates the confidence bounds of the original model (RUN_5).

Conclusion on SAM model runs from the benchmark

Both the reviewers and participants concluded that the final SAM run (RUN_5) provides the best framework to assess the sole 7.fg stock. The reasons for selecting this model are:

- It's ability to include biomass based indices for the commercial tuning fleets (thereby avoiding duplicated data usage)
- Splitting up the long commercial tuning series enables to account for changes in catchability over time
- The UK(E&W)-Q1SWECOS tuning series seems too short to provide new information to the model. In addition, a lack of information on the index calculation hampers proper model specification in order to reduce autocorrelation.
- Increasing the number of variance parameters in the process models increases the accuracy of the process models while a correlation structure between the observations removed the autocorrelation from the OSA residuals.

4. References

ICES. 2014. Report of the Benchmark Workshop on Celtic Sea stocks (WKCELT), 3–7 February 2014, ICES Headquarters, Copenhagen, Denmark. ICES CM 2014\ACOM:42. 194 pp.

Working document: Calculation of appropriate Reference points (MSY) for sole in Division 27.7.f and g

Authors: Lies Vansteenbrugge, Klaas Sys, Bart Vanelslander and Sofie Nimmegeers (ILVO, Belgium)

1. Introduction

During the WKFLATNSCS 2020 benchmark, the sole 7fg assessment was thoroughly revised. One of the ToRs was to re-examine and update MSY and PA reference points according to the ICES guidelines. This working document describes the calculation of the reference points.

2. Reference points prior to the benchmark

Reference points prior to the benchmark are listed in the table below. The management plan (MAP) that is referred to, is the EU multiannual plan (MAP) for the Western Waters (EU, 2019).

Framework	Reference point	Value	Technical basis
MSY approach	MSY $B_{trigger}$	2228 t	B_{pa}
	F_{MSY}	0.297	EQsim analysis, based on the recruitment period 1971-2017
Precautionary approach	B_{lim}	1592 t	B_{loss} estimated in 2018, corresponding to SSB in 1998
	B_{pa}	2228 t	B_{lim} x 1.4
	F_{lim}	0.578	EQsim analysis, based on the recruitment period 1971-2017
	F_{pa}	0.420	F_{lim}/1.4
Management plan	MAP MSY $B_{trigger}$	2228 t	MSY $B_{trigger}$
	MAP B_{pa}	2228 t	B_{pa}
	MAP B_{lim}	1592 t	B_{lim}
	MAP F_{MSY}	0.297	F_{MSY}
	MAP F_{lower}	0.165	Minimum F which produces at least 95% of maximum yield
	MAP F_{upper}	0.499	Maximum F which produces at least 95% of maximum yield

3. Source of data

Data used in the MSY analyses were taken from the FLStock object created in the assessment of sole in ICES division 7.f and g during the WKFLATNSCS 2020 benchmark (see Working document: Assessment models for sole in the Bristol channel and the Celtic Sea (ICES divisions 7.f and 7.g).

4. Methods and settings

All analyses were conducted with Eqsim and following the ICES technical guidelines as described in ICES (2017). The R code is included in Annex 1. Model and data selection settings are listed in Table 1.

Table 1: Model and data selection settings.

Data and parameters	**Settings**	**Comments**
SSB-recruitment data	Whole time series (1971-2018)	To be in line with the forecast, no years were removed as the SAM model was used to make catch predictions.
Exclusion of extreme values (option extreme.trim)	No	
Mean weights and proportion mature; natural mortality	2009-2018	There's no pattern in the mean weight-at-age over the past ten years. Therefore, the default 10-year-period was applied.
Exploitation pattern	2014-2018	There is a slight pattern in the exploitation of this stock with age 3 decreasing and age 9 and 10 increasing over the last 10 years. . Therefore, instead of taking the default 10-year-period, only the last 5 years were selected (Figure 1).
Assessment error in the advisory year. CV of F	0.212	Default value for stocks where these uncertainties cannot be estimated
Autocorrelation in assessment error in the advisory year	0.423	Default value for stocks where these uncertainties cannot be estimated.

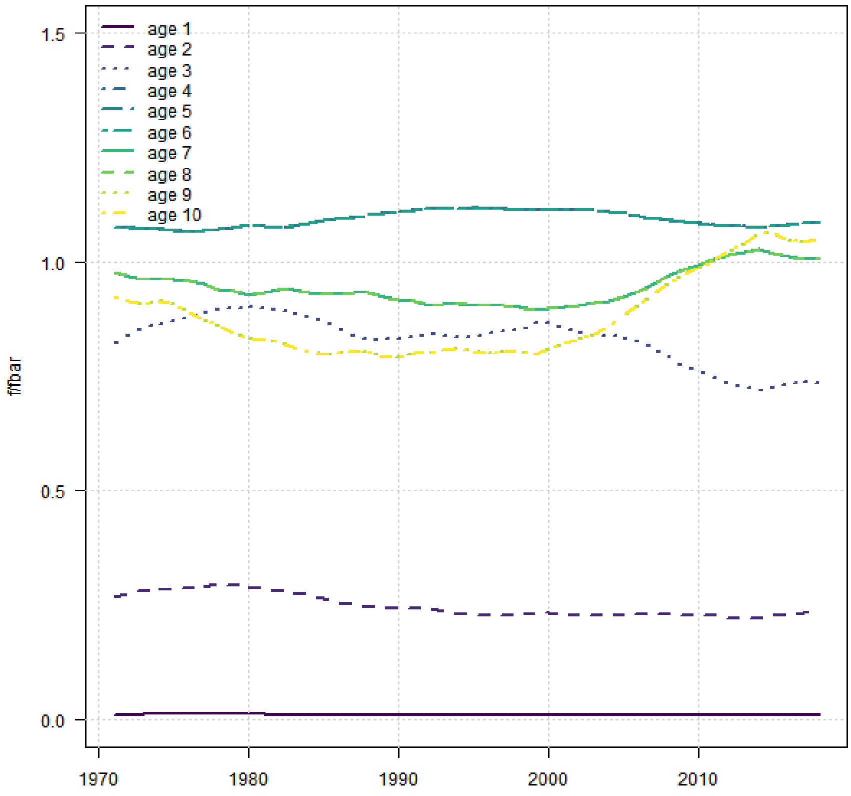


Figure 1: The exploitation pattern at age (the fishing mortality at age as estimated by the assessment divided by the Fbar (age 3-8) per year). Note that due to SAM model settings fishing mortalities overlap for certain ages (see Working document: Assessment models for sole in the Bristol channel and the Celtic Sea (ICES divisions 7.f and 7.g).

5. Results

5.1 Stock recruitment relation and new B_{lim} and B_{pa} reference points

Stock recruitment relationships were plotted and in a first step, three models were used: Ricker, Beverton-Holt and segmented regression, weighted by the default 'Buckland' method (Figure 2).

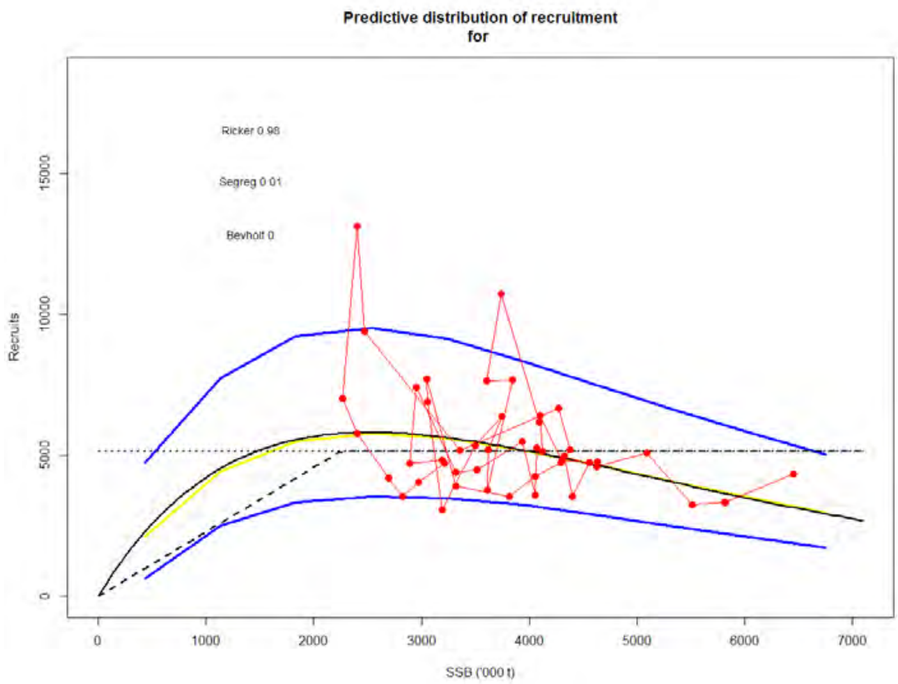


Figure 2: Stock recruitment relationships for sole in ICES divisions 7.f and 7.g showing the estimation of the three regression models over the entire time period (Ricker: full black line; Beverton-Holt: dotted line; segmented regression: dashed line; yellow line represents the best fit over the three models).

The stock-recruitment relationship was evaluated as **type 5**, showing a stock with no evidence of impaired recruitment or with no clear relation between stock and recruitment (no apparent S-R signal). Therefore, B_{lim} should be set to B_{loss}, being 2264 tonnes. B_{pa} was then derived using the standard multiplier of 1.4, resulting in 3170 tonnes.

5.2 Determine F_{lim} and F_{pa}

The preferred method to derive F_{lim} is simulating a stock with a segmented regression S-R relation (Figure 3) with the point of inflection fixed at B_{lim}, thus determining the fishing mortality (F) that, at equilibrium, gives a 50% probability of the SSB being larger than B_{lim}. This simulation was conducted based on a fixed F (*i.e.* without inclusion of a $B_{trigger}$) and without inclusion of assessment/advice errors (*i.e.* F_{cv} and F_{phi} set to zero).

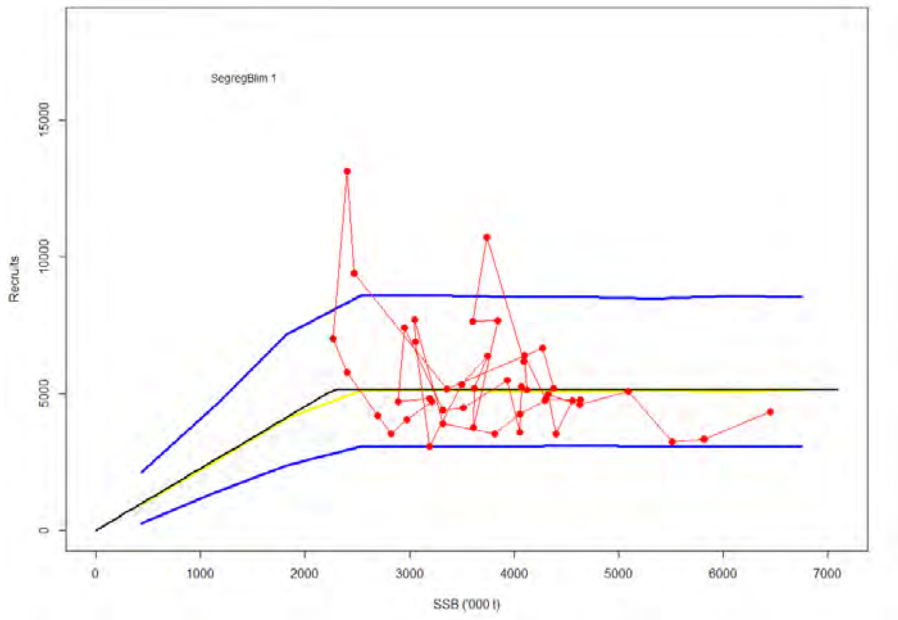


Figure 3: Stock recruitment relationship for sol in ICES divisions 7.f and 7.g based on segmented regression over the entire time period, where the inflection point was set to Blim.

F_{lim} was estimated at 0.521 (0.5208733) using the last 5 years of data (2014-2018) (see table below). F_{pa} was estimated at 0.372 (0.3720524) from the equation $F_{pa} = F_{lim}/1.4$.

	F05	F10	F50	medianMSY	meanMSY	Medlower	Meanlower	Medupper	Meanupper
catF	0.440	0.458	**0.521**	NA	0.280	NA	NA	NA	NA
lanF	NA	NA	NA	0.275	0.280	0.154	0.158	0.500	0.483
catch	921.039	914.732	845.219	NA	948.897	NA	NA	NA	NA
landings	NA	NA	NA	963.410	962.925	914.944	927.752	917.713	928.632
catB	2794.044	2694.781	2261.122	NA	4196.767	NA	NA	NA	NA
lanB	NA	NA	NA	4258.505	4196.767	6925.344	NA	2462.530	NA

5.3 Determine initial F_{MSY} and its ranges

The initial F_{MSY} was calculated using the fit by the segmented regression model using the whole time-series (Figure 4) (Beverton-Holt did not contribute much to the S-R relation and Ricker showed lower recruitment when biomass was high, which is unexpected and not fully supported by the raw data (Figure 2)).

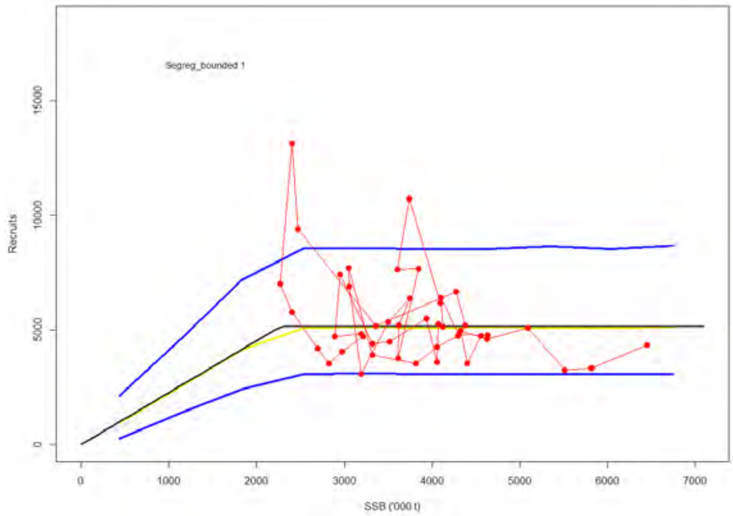


Figure 4: Stock recruitment relationship for sole in ICES divisions 7.f and 7.g, based on segmented regression over the entire time period.

For this simulation run, the assessment/advice errors were set to the default values (Table 1) and Btrigger was set to zero. This resulted in a median F_{MSY} of 0.285 (0.285282853) (<F_{pa}). The median of the SSB estimates at F_{MSY} was 4096 tonnes. The upper bound of the F_{MSY} range, giving at least 95% of the maximum yield, was estimated at 0.461 and the lower bound at 0.157. The results of the Eqsim simulations are shown in the table below and Figure 5-7.

	F05	F10	F50	medianMSY	meanMSY	Medlower	Meanlower	Medupper	Meanupper
catF	**0.389**	0.415	0.501	NA	0.260	NA	NA	NA	NA
lanF	NA	NA	NA	**0.285**	0.280	**0.157**	0.154	**0.461**	0.451
catch	920.118	910.601	803.288	NA	938.093	NA	NA	NA	NA
landings	NA	NA	NA	952.572	952.578	905.900	929.485	905.398	929.335
catB	3104.551	2923.084	2261.277	NA	4449.538	NA	NA	NA	NA
lanB	NA	NA	NA	**4095.724**	4166.639	6773.757	NA	2623.814	NA

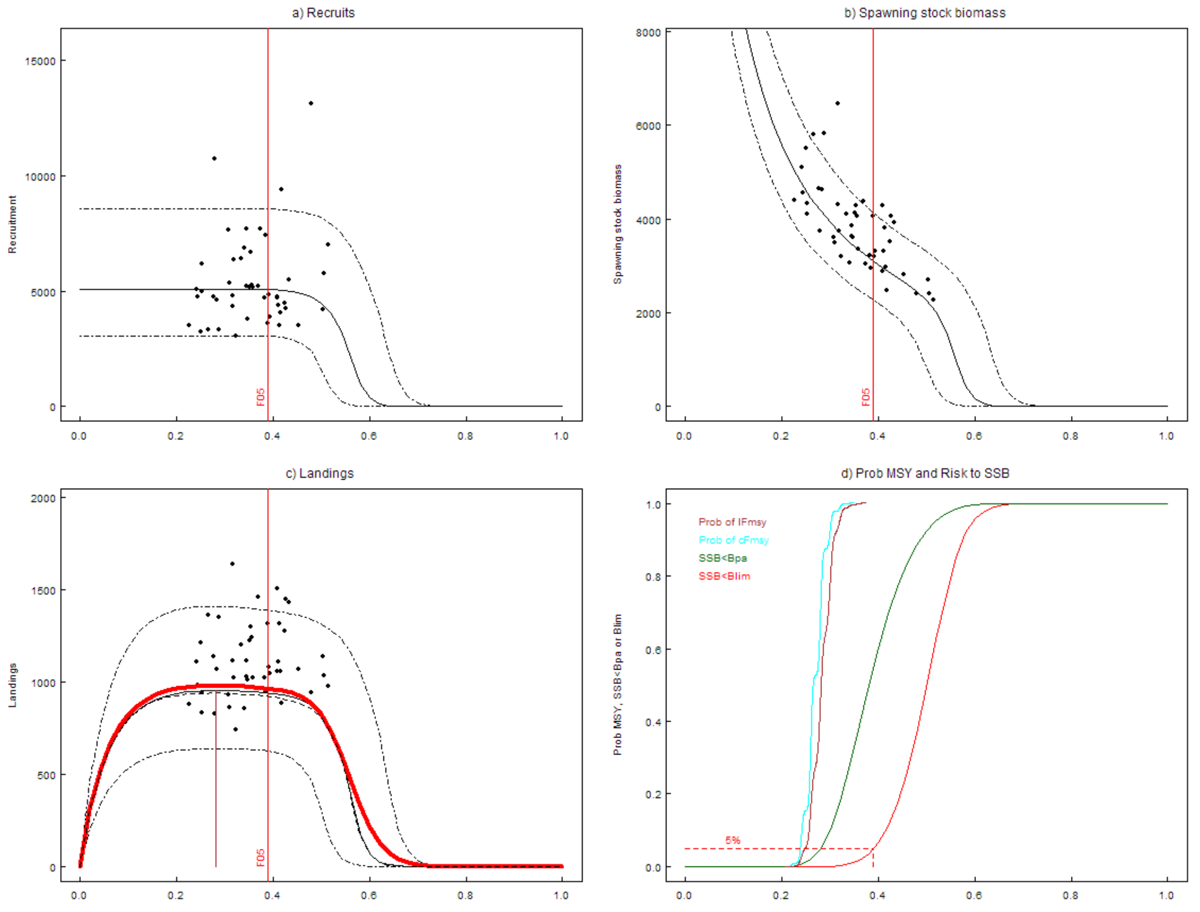


Figure 5: Eqsim summary plot for sole in ICES divisions 7.f and 7.g (without Btrigger). Panels a-c: historic values (dots) median (soid black line) and 90% intervals (dotted black lines) for recruitment, SSB and landings for exploitation at fixed values of F (on x-axis). Panel c also shows mean landings (red solid line). Panel d shows the probability of SSB<Blim(red), SSB<Bpa (green), and the cumulative distribution of FMSY based on yield as landings (brown) and catch (cyan).

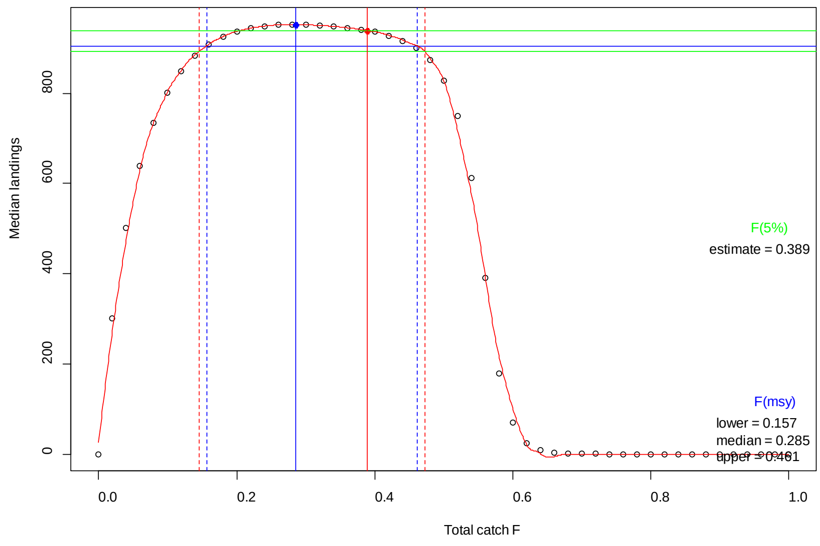


Figure 6: Median landings yield curve for sole in ICES divisions 7.f and 7.g, with estimated reference points (without Btrigger) and with a fixed F exploitation from F=0 to 1.0. Blue lines: FMSY estimate (solid line) and range at 95% of maximum yield (dotted lines). Green lines: Fp0.5 estimate (solid line) and range at 95% of yield implied by Fp0.5 (dotted lines).

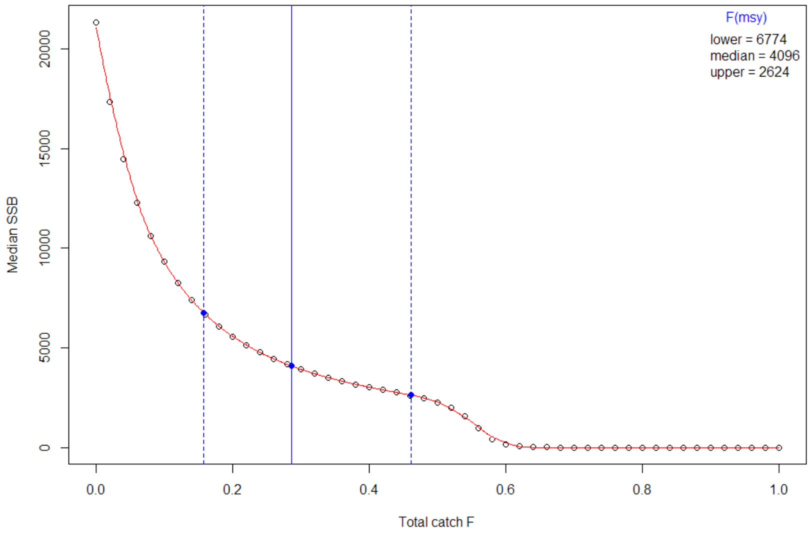


Figure 7: Median SSB curve over a range of target F values (without Btrigger) for sole in ICES divisions 7.f and 7.g. Blue lines: FMSY estimate (solid line) and range at 95% of maximum yield (dotted line).

5.4 Determine MSY $B_{trigger}$ and evaluate ICES MSY Advice rule

Since the stock has not been fished at F_{MSY} for 5 or more years, MSY $B_{trigger}$ should be set at B_{pa}: 3170 tonnes.

To evaluate the reference points when enforcing the $B_{trigger}$, a final Eqsim run was performed. When applying the ICES MSY advice rule with a $B_{trigger}$ of 3170 tonnes, median F_{MSY} increased a little bit to 0.292 with a lower bound of the range at 0.157 and an upper bound at 0.621. The $F_{p0.5}$ value (0.491) is larger than the initial F_{MSY} (0.285). Therefore, F_{MSY} stays at the value initially calculated. $F_{p0.5}$ is however lower than the estimate of the upper bound on F_{MSY} implying that fishing at this upper bound is not precautionary and should therefore be lowered to $F_{p0.5}$ (0.4910758).

The results of the Eqsim simulations are shown in the table below and in Figure 8-10.

	F05	F10	F50	medianMSY	meanMSY	Medlower	Meanlower	Medupper	Meanupper
catF	**0.491**	0.538	0.730	NA	0.280	NA	NA	NA	NA
lanF	NA	NA	NA	**0.292**	0.280	**0.157**	0.155	**0.621**	0.629
catch	911.915	902.637	842.904	NA	937.285	NA	NA	NA	NA
landings	NA	NA	NA	952.378	951.835	905.502	920.956	904.642	920.269
catB	2809.436	2680.782	2264.718	NA	4169.593	NA	NA	NA	NA
lanB	NA	NA	NA	4013.681	4169.593	6772.313	NA	2488.949	NA

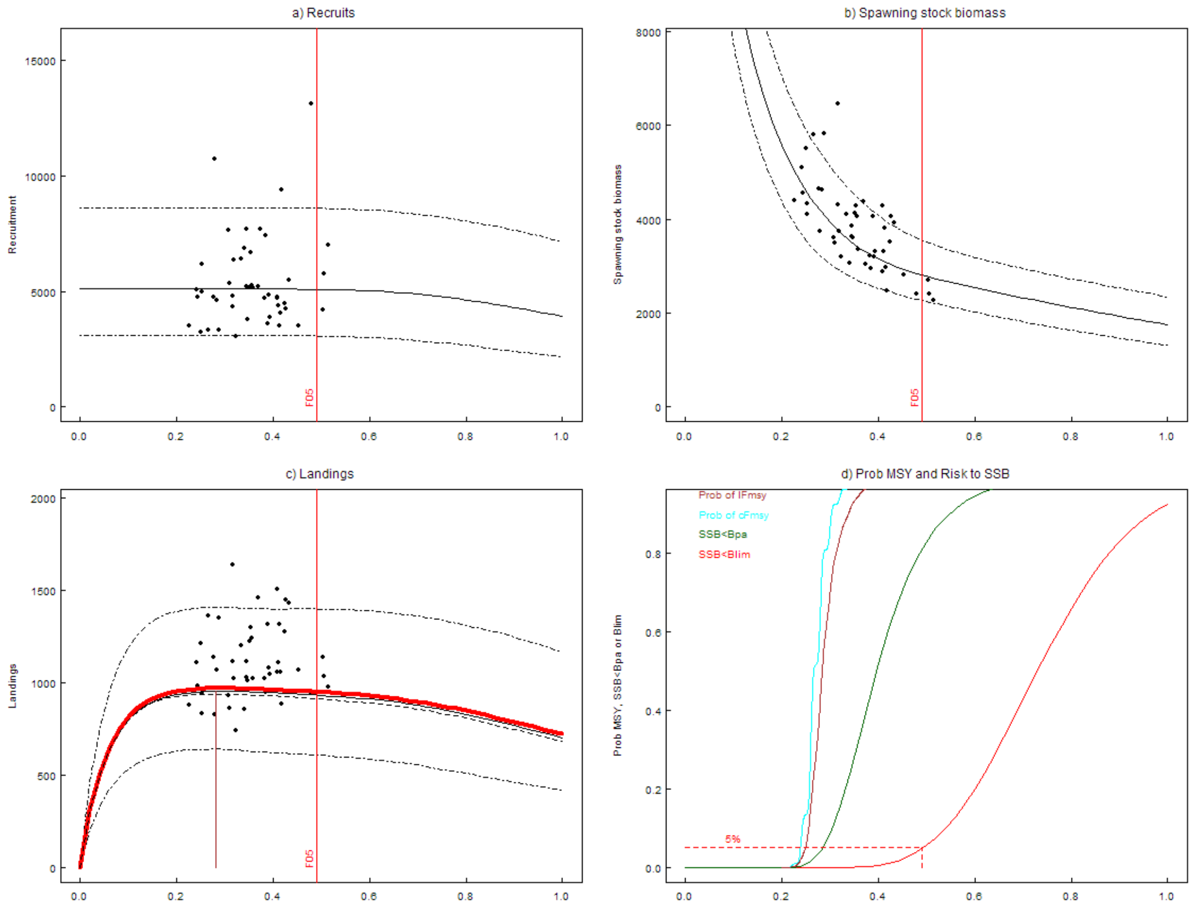


Figure 8: Eqsim summary plot for sole in ICES divisions 7.f and 7.g (with Btrigger = 3170 tonnes). Panels a-c: historic values (dots) median (soid black line) and 90% intervals (dotted black lines) for recruitment, SSB and landings for exploitation at fixed values of F (on x-axis). Panel c also shows mean landings (red solid line). Panel d shows the probability of SSB<Blim(red), SSB<Bpa (green), and the cumulative distribution of FMSY based on yield as landings (brown) and catch (cyan).

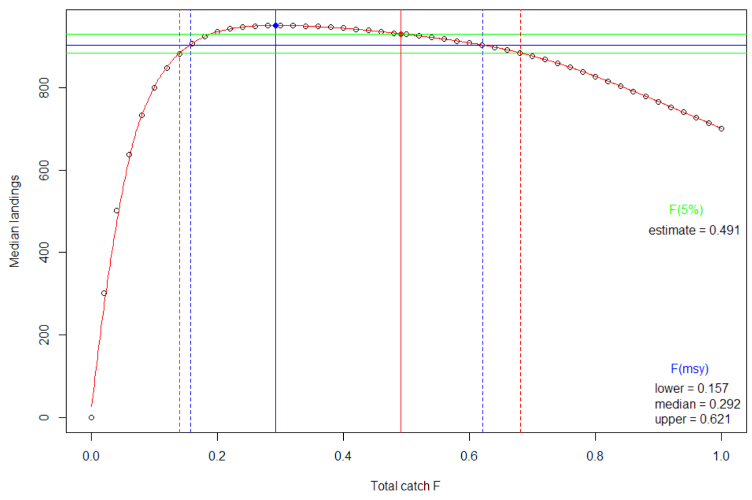


Figure 9: Median landings yield curve for sole in ICES divisions 7.f and 7.g, with estimated reference points (Btrigger = 3170 tonnes) and with a fixed F exploitation from F=0 to 1.0. Blue lines: FMSY estimate (solid line) and range at 95% of maximum yield (dotted lines). Green lines: Fp0.5 estimate (solid line) and range at 95% of yield implied by Fp0.5 (dotted lines).

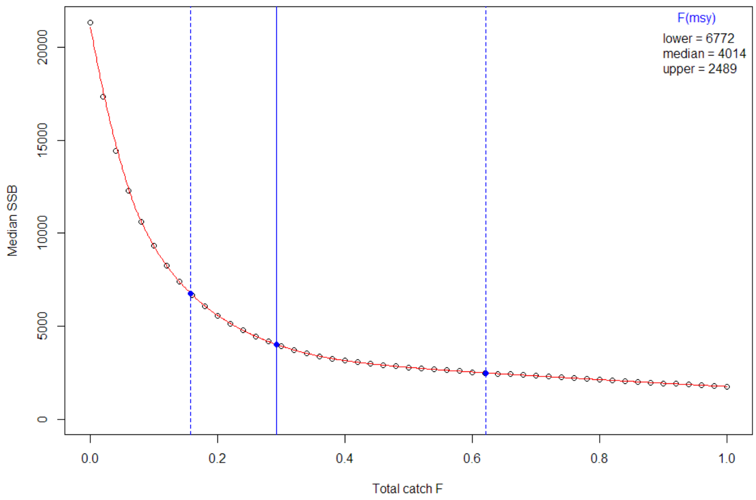


Figure 10: Median SSB curve over a range of target F values (Btrigger = 3170 tonnes) for sole in ICES divisions 7.f and 7.g. Blue lines: FMSY estimate (solid line) and range at 95% of maximum yield (dotted line).

6. Proposed reference points

Reference point	Value
B_{lim}	2264
$B_{pa\ (1.4)}$	3170
$B_{pa\ (sigma)}$	/
$B_{trigger}$	3170
F_{lim}	0.521
$F_{pa\ (1.4)}$	0.372
$F_{pa\ (sigma)}$	/
F_{MSY} without $B_{trigger}$	**0.285**
F_{MSY} without $B_{trigger}$ precautionary	0.285
F_{MSY} lower without $B_{trigger}$	0.157
F_{MSY} upper without $B_{trigger}$	0.461
New $F_{P.05}$ (5% risk to B_{lim} without $B_{trigger}$)	0.389
F_{MSY} upper precautionary without $B_{trigger}$	0.461
$F_{P.05}$ (5% risk to B_{lim} with $B_{trigger}$)	0.491
F_{MSY} lower with $B_{trigger}$	0.157
F_{MSY} upper with $B_{trigger}$	0.621
F_{MSY} upper precautionary with $B_{trigger}$	0.491

7. Sensitivity runs

A sensitivity analysis was conducted which involved running Eqsim with a moving window of 10 years of selectivity data starting with 1991–2000 and ending with 2009-2018 (bio data year range 2009–2018 remained constant). The effect on the estimate of median F_{MSY} is shown in Figure 11. The estimate varies between 0.285 and 0.297 depending on the year range chosen and is thus very stable over the entire time period.

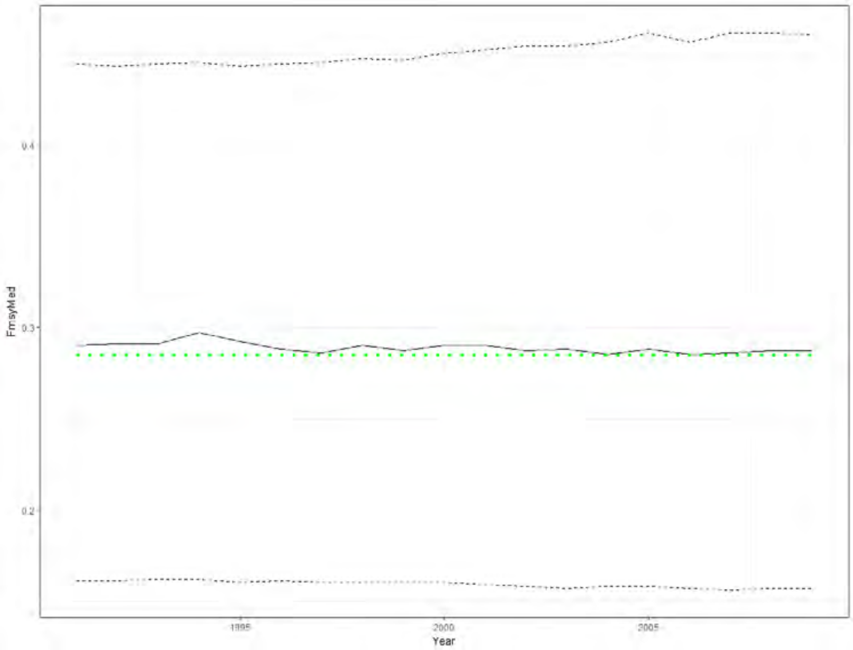


Figure 11: Sensitivity of F_{MSY} estimate (solid black line) to year range of selectivity data for sole in ICES divisions 7.f and 7.g (Year label is 1st year of a 10 year range). Dotted lines represent the 5th and 95th percentiles of FMSY. Green striped line represents the F_{MSY} value as estimated by the Eqsim analysis described above (=0.285).

8. References

- ICES, 2017b. ICES Advice Technical Guidelines, ICES fisheries management reference points for category 1 and 2 stocks. Published 20 January 2017.
- EU, 2019. REGULATION (EU) 2019/472 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing a multiannual plan for stocks fished in the Western Waters and adjacent waters, and for fisheries exploiting those stocks, amending Regulations (EU) 2016/1139 and (EU) 2018/973, and repealing Council Regulations (EC) No 811/2004, (EC) No 2166/2005, (EC) No 388/2006, (EC) No 509/2007 and (EC) No 1300/2008. 17pp. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019R0472

Annex 1: R script for the calculation of the reference points

```
##########################################
#
# Calculating Reference points for SOL 7fg
# WKFLATNSCS 2020 (feb 2020)
#
# script via Jan Jaap Poos and Helen Dobby
##########################################

rm(list=ls())

# open R versie 3.3.1
# install.packages("msy")
library(msy);

getwd()
setwd("~/Development/RStudio/D1VISBIO/NDGP")
path<-getwd()

setwd(paste0(path,"/ICES/ASSESSMENTS/SOL_7FG/WKFLATCSNS 2020/Refpoints_Lies/"))
load(file='sol7fg.Rdata')

setwd(paste0(path,"/ICES/ASSESSMENTS/SOL_7FG/WKFLATCSNS 2020/Refpoints_Lies/"))
source("eqsim functions.R")

######################

# name(sol7fg) <- "sole"

# when removing last data year, this is not visible in red dots, but model values change:
FIT1 <- eqsr_fit(sol7fg,
            nsamp = 1e3,
            models = c("Ricker", "Segreg", "Bevholt"))

eqsr_plot(FIT1,n=1e3)

# we choose type 5
# determine Blim = Bloss
Bloss <- min(ssb(sol7fg))
Bloss
Blim <- Bloss
Blim
```

```
# determine Bpa
print(Bpa <-  Blim *1.4)

###################### Estimate Flim (=F50)
# -> based on stock with segmented regression SR relationship with inflection point at Blim
# Fix function to do segmented regression:

B<-Blim
SegregBlim <- function (ab, ssb) {
  log(ifelse (ssb>=B, ab$a*B, ab$a*ssb))
}

FIT2 <- eqsr_fit(sol7fg, nsamp = 1e3, models = "SegregBlim")

FIT2$sr.det # gives b = 1
#print(Blim <-  FIT2b[["sr.det"]][,"b"])

eqsr_plot(FIT2,n=1e3)


#simulation
SIM101 <- eqsim_run(FIT2,  bio.years = c(2009, 2018), bio.const = FALSE,
                    sel.years = c(2014, 2018), sel.const = FALSE,
                    Fcv=0, Fphi=0,
                    Btrigger = 0,Blim=Blim,Bpa=NA,
                    Fscan = seq(0,1.2,len=61),verbose=FALSE) #in 61 steps from F=0 to F=1.2

eqsim_plot(SIM101,catch="FALSE")
Coby.fit(SIM101,outfile='sole no Btrigger Blim set to find Flim Fcv=0 and Fphi=0')
# from this table get F50, catF
print(Flim <- SIM101$Refs2[1,3])

print(Fpa <- Flim/1.4)

###################### Calculate Fmsy

Segreg_bounded <- function(ab, ssb) {
  ab$b <- ab$b + Bloss
  Segreg (ab, ssb)
}


FIT3 <- eqsr_fit(sol7fg,
                 nsamp = 1e3,
                 models = c("Segreg_bounded"))

eqsr_plot(FIT3,n=1e3)

SIM1a <- eqsim_run(FIT3,  bio.years = c(2009,2018), bio.const = FALSE,
                   sel.years = c(2014,2018), sel.const = FALSE,
                   Fcv=0.212, Fphi=0.423,  # these are defaults, taken from WKMSYREF4, as used in
Saithe assessments
                   Btrigger = 0,Blim=Blim, Bpa=Bpa,Fscan = seq(0,1.0,len=51),verbose=FALSE)# 51
steps from F=0 to F=1.0

eqsim_plot(SIM1a,catch="FALSE")

Coby.fit(SIM1a,outfile='sol sim1')
#get median MSY from lanF
```

```
print(Fmsy <- SIM1a$Refs2[2,4])
#also get F05 from catF
print(F05 <- SIM1a$Refs2[1,1])

#EVALUATE
# Since the stock has not been fished at FMSY for 5 or more years, MSY Btrigger should be set at Bpa.
# In order to evaluate the Advice rule, we have to do a run that includes the resulting Btrigger value:
SIM2 <- eqsim_run(FIT3,  bio.years = c(2009,2018), bio.const = FALSE,
            sel.years = c(2014,2018), sel.const = FALSE,
            Fcv=0.212, Fphi=0.423,  # these are defauts, taken from WKMSYREF4, as used in Saithe assessments
            Btrigger = Bpa,Blim=Blim,Bpa=Bpa,Fscan = seq(0,1.0,len=51),verbose=FALSE, extreme.trim=c(0.05,0.95))

eqsim_plot(SIM2,catch="FALSE")
Coby.fit(SIM2,outfile='sol sim2')

print(F05 <- SIM2$Refs2[1,1])
#SIM1$rbp

##########
#  Sensitivity to year range in selectivity
out <-NULL
# 2008-2018 was the default year range for the Fmsy calculation
# the eqsim resamples fishery selectivity from these years (default is usually last 10 years)
# You use the same year range for the bio data - which includes mean weights, M, etc
sel.years <-c(2009,2018)

for(y in 1991:2009){
  cat(y,'\n')
# What I am doing here is choosing different blocks of years (each 10 years long) from which to resample the fishery selectivity.
# The first block (which is labelled '1990' in the output data) has a selectivity data year range from 1990 to 1999, the
# next 1991 to 2000 and so on, until the last on is 2008 to 2018 (which is the same as your base run)
  sel.years[1] <- y
  sel.years[2] <-y+9
  #  setup$sel.years <- c(y-4,y)
  sim <- eqsim_run(FIT3, bio.years = c(2009,2018), bio.const = FALSE,
             sel.years = sel.years, sel.const = FALSE, Fscan = seq(0,1,0.02),
                   Fcv = 0.212, Fphi = 0.423, Blim = Blim, Bpa = Bpa,
                   Btrigger = 0, verbose = FALSE, extreme.trim = c(0.05,0.95))

# For each iteration (i.e different block of selectivity data) we save the estimate of Fmsy and lower and upper bounds
# So if selectivity has change significantly over time you might expect to see a significant change in your Fmsy
# estimate (FmsyMed)

  out0 <- data.frame(y,
             Fmsy05 = sim$Refs2[2,6],
             Fmsy95 = sim$Refs2[2,8],
             FmsyMed = sim$Refs2[2,4]
  )
  out <- rbind(out,out0)
}
```

```
################################

getwd()

save(out,file="out.rdata")
# save(out0,file="out0.rdata")
write.csv(out,file="out.csv")
# write.csv(out0,file="out0.csv")

out$Year <- out$y
out$FMSY <- 0.285 #adjust
library(ggplot2)
ggplot(out, aes(Year, FmsyMed))+geom_line()+theme_bw()+
  geom_line(aes(Year, Fmsy05), linetype=2)+
  geom_line(aes(Year, Fmsy95), linetype=2)+
  geom_line(aes(Year, FMSY), linetype=3, color="green", size=1.5)
```

Working Document on Data Evaluation for Sole 27.7h-k

Claire Moore

Marine Institute Ireland

WKFlatNsCs

General context

Sole in ICES divisions 7 h-k is considered a data poor stock and is currently categorised as 3.2. The main issue to be addressed by this benchmark is the lack of information on the current state of the stock across the whole area. Although the TAC for this stock is set at the level of 7hjk, the assessment is run on Sole in 7.jk only, as historically no age-disaggregated data were available for 7.h.

Historical development of the assessment

Landings of sole vary widely across the three ICES division (7h, j & k) covered by this stock (fig 1). The majority of landings have historically been taken in 7h, followed by 7j. Landings in 7k are considered negligible, and will therefore not be disused further in this document.

The sole fisheries7h and 7j are distinctly different, occurring in two geographically distinct area, being targeted by two very distinct gear types (fig 2). Sole in 7j is typically targeted by the Irish otter trawl fleet, which operate on sandy grounds off the southwest of Ireland, close to shore and this species is a small (but valuable) component (up to 5%) of the landings in a mixed fishery (fig 3). Whereas 7h sole are mostly targeted by the beam trawl fleet. Which operate close to the boundaries of other sol stocks (sol.27.7.fg & sol.27.7.e) (fig 2). Unfortunately, no VMS data was available to for sole in 7h for the purposes of this benchmark.

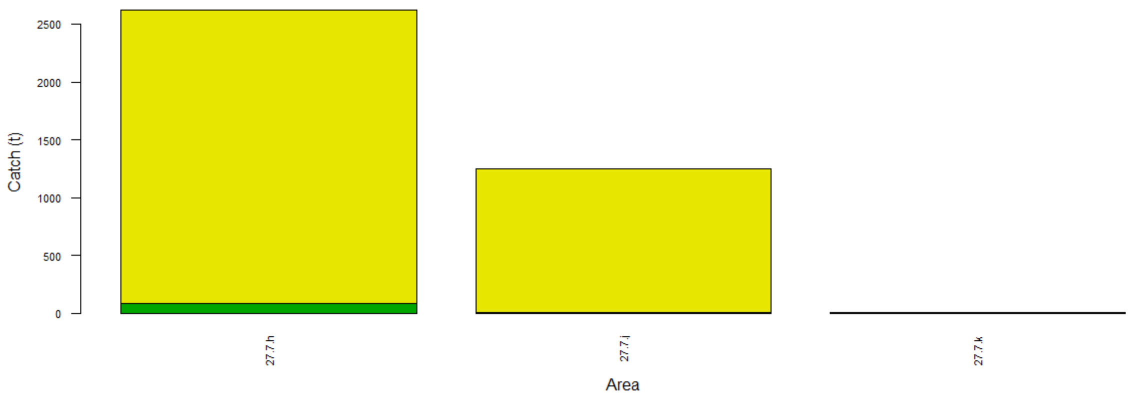


Figure 1 Total Landings of sole across the three ICES areas (27.7.h,j,k) from 2004 - 2018

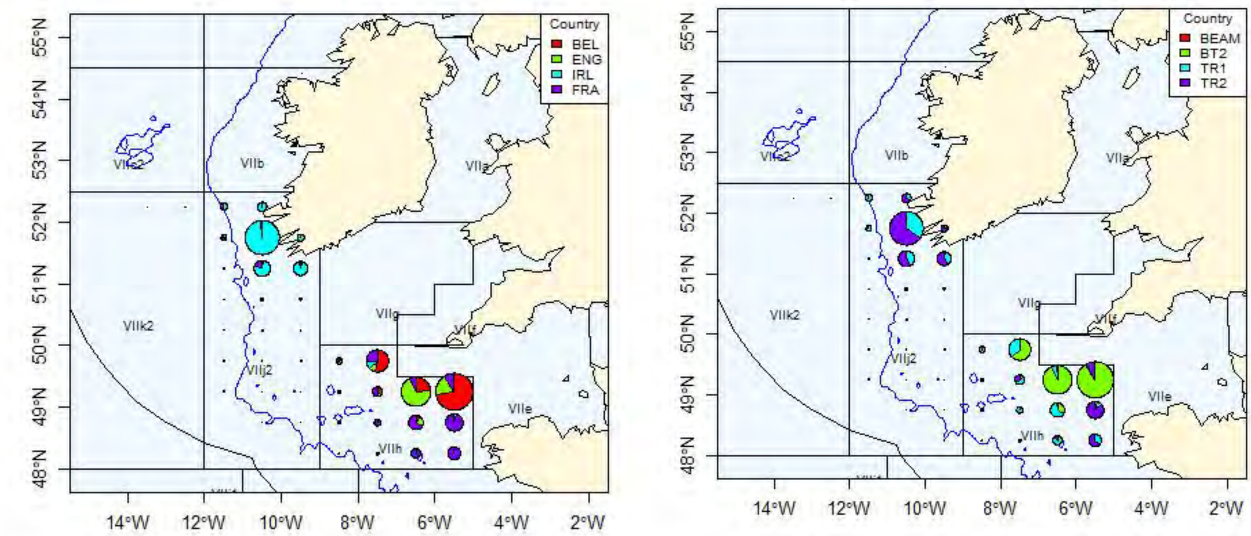


Figure 2 The spatial distribution of sole landings reported to the STECF fisheries dependant information data call in 2016 (the last data year available), disaggregated by Member State (left) and gear (right). Note Beam trawlers are described as beam and BT2, and otter trawlers are described as TR1 and TR2.

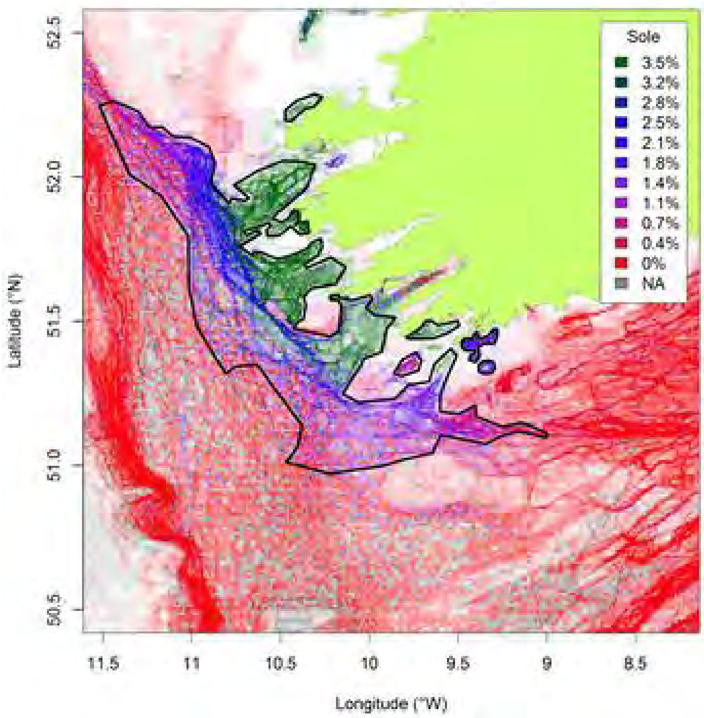


Figure 3 The proportion of sole in landings of Irish vessels with VMS over the years 2006–2018. The black line indicates the polygon inside which sole are caught. Effort and landings from the VMS/logbooks data inside the polygon were used as a tuning index.

Results of the Benchmark Data Call

Data was submitted to InterCatch by 5 Member States, from 2002 – 2018, dissagregated to the level of metier level 6 (fig 4). Varying levels of sampling coverage were available for 7h and 7j. Again showing the distinct difference in fisheries in the two areas.

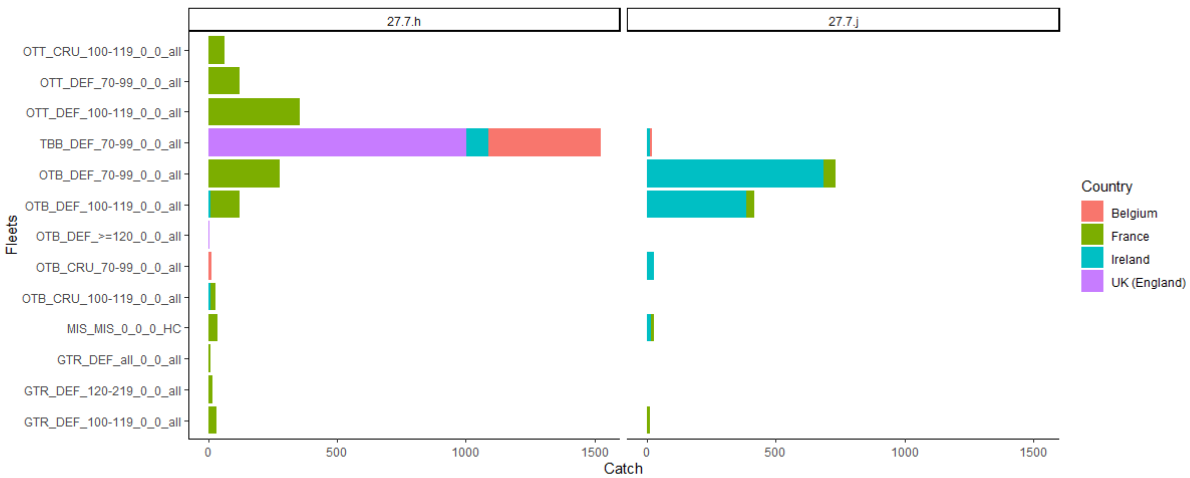


Figure 4 Total landings submitted to InterCatch, covering 2004 – 2018, disaggregated by fishing operation (métier level 6) and country.

Summary of Age Samples

Landings age samples were submitted by two Member States.

Sampling coverage

Age plots

Tuning fleet. – None submitted

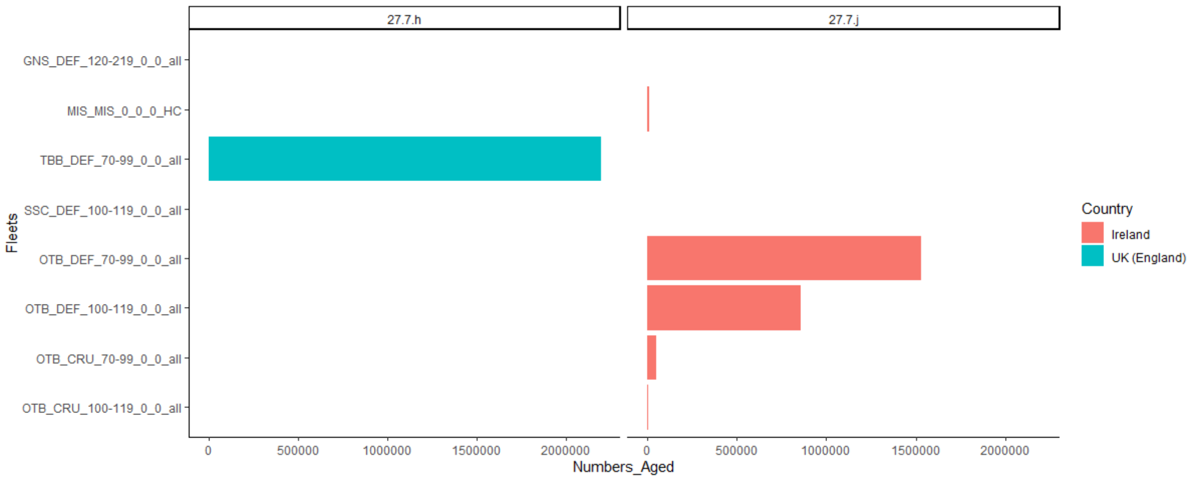


Figure 5 Landings age samples submitted to InterCacth (2004 – 2018)

Figure 6 Age sampling coverage of landings submitted to InterCatch

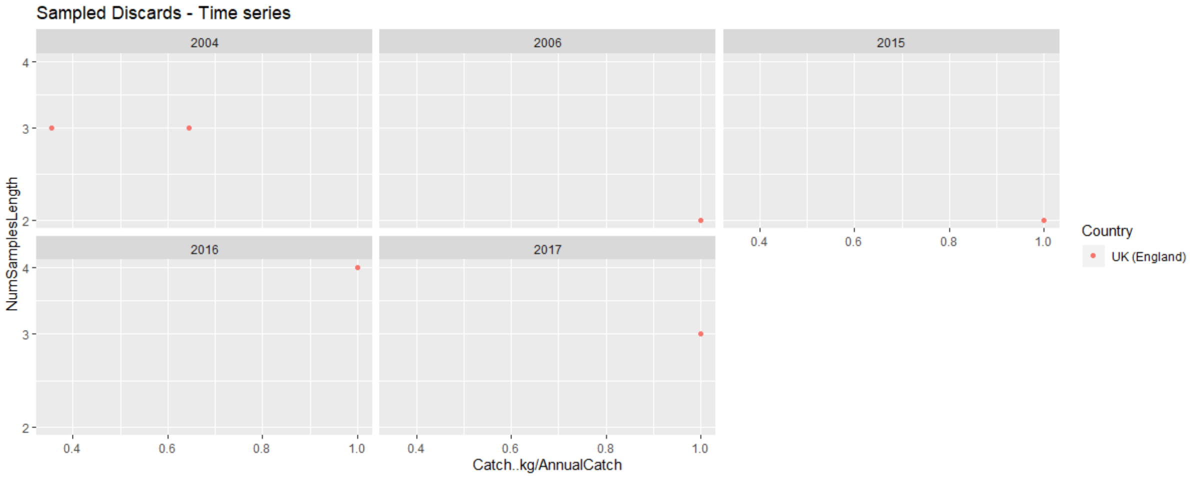
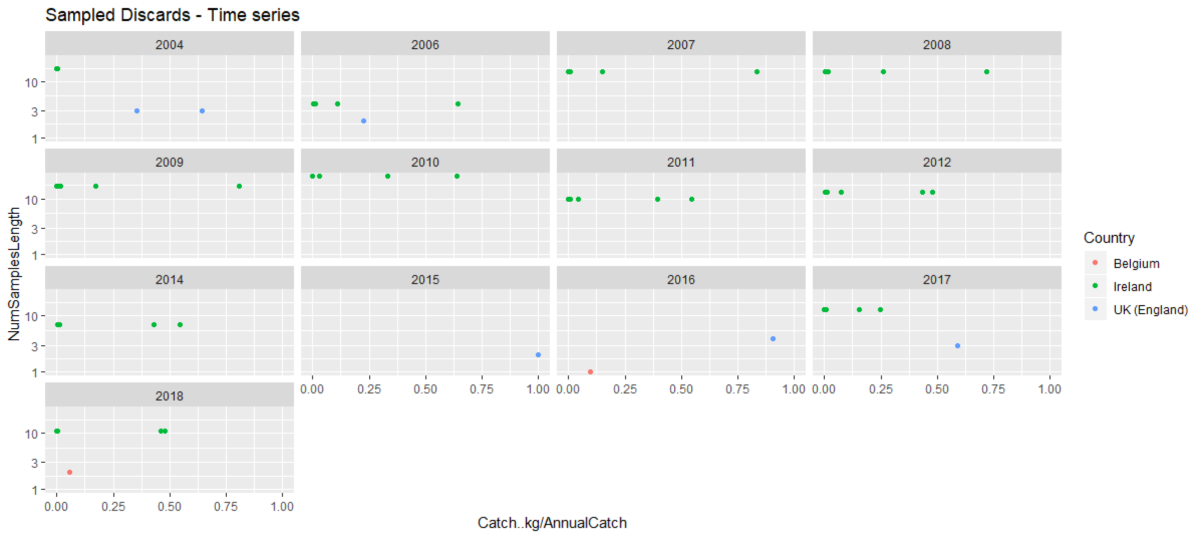
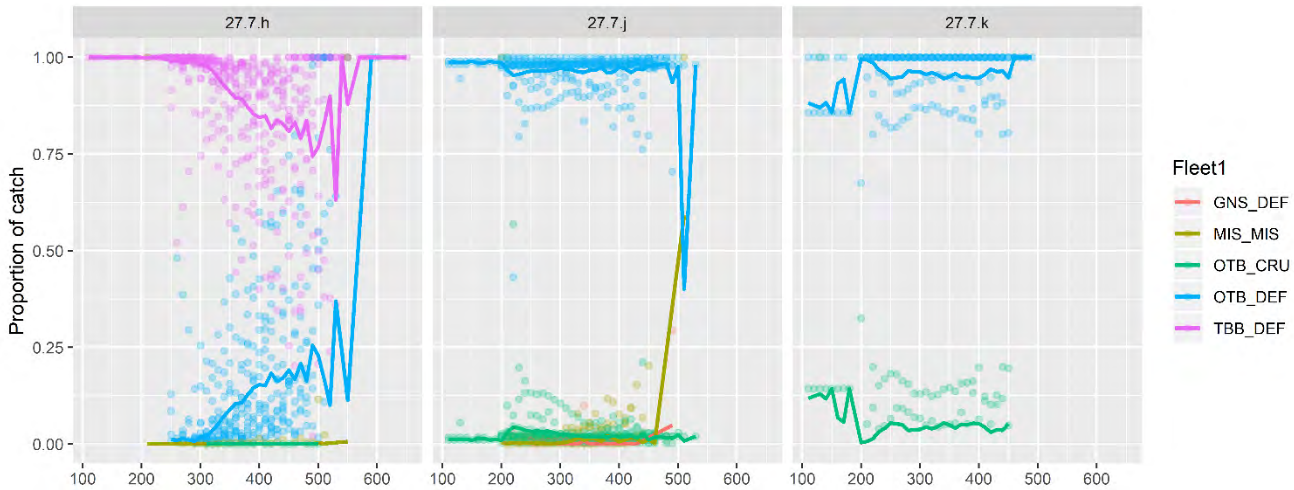


Figure 7 Age sampling coverage of Discards submitted to InterCatch

Summary of Length Samples

Figure 8 Length sampling coverage of landings submitted to InterCatch





Stock ID

Explain the basis for existing assumptions in stock structure and mixing rates between stock areas, or proposed new assumptions which form the basis of spatial aggregation of the fishery and survey and/ or adjustments to datasets to account for stock mixing.

To date no work has been done on stock identity in this management unit. The stock sol.27.7 h-k only exists because of historical management reasons. Historically the TAC and effort has fluctuated in these four stock has fluctuated. No work has been done on eth connectivity of these regions.

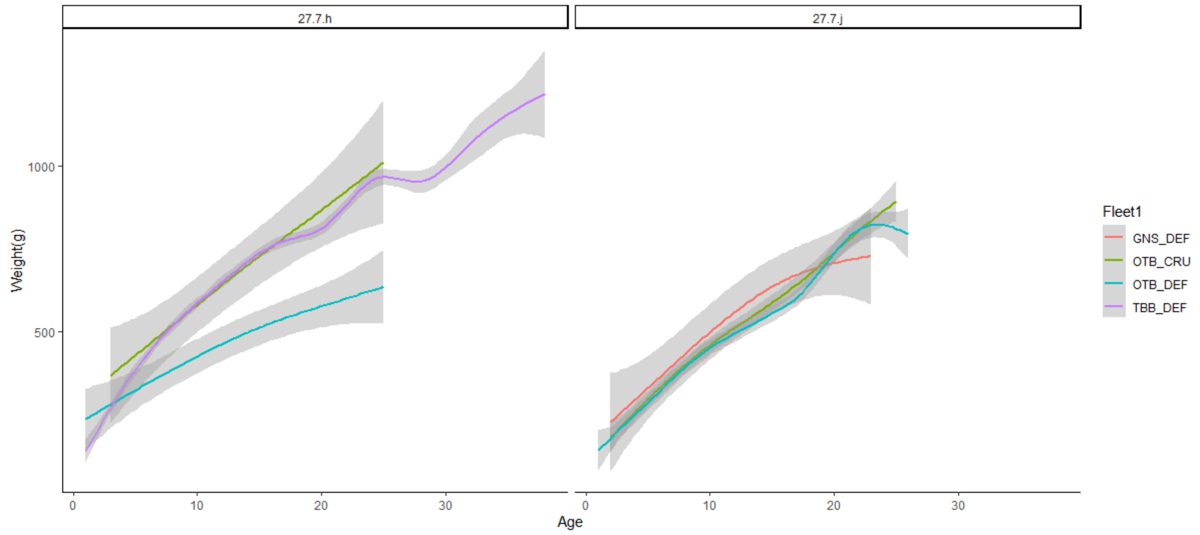


Figure 9 Age weight relationship for teh two ICES areas.

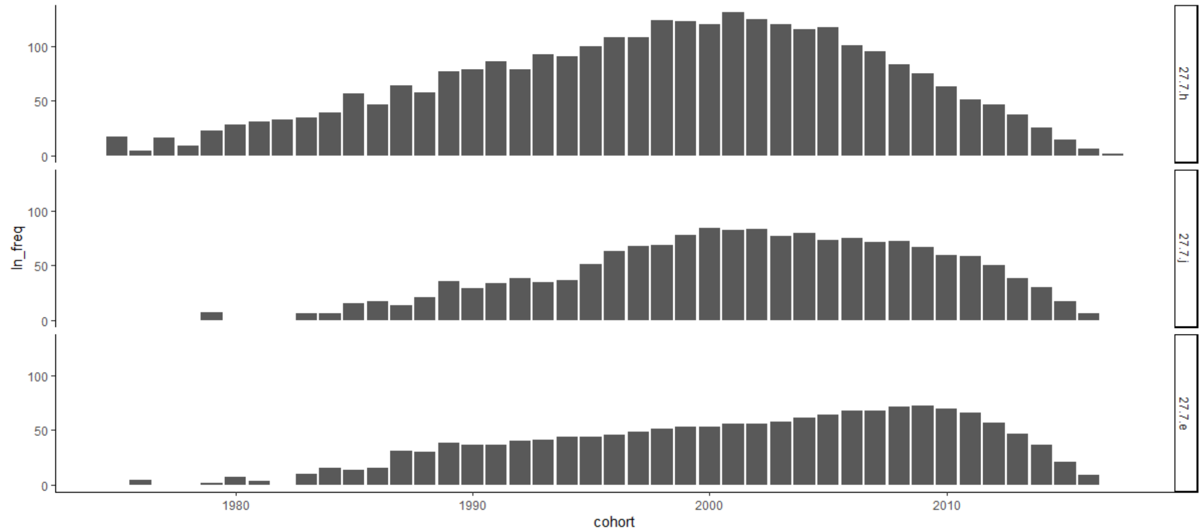


Figure 10 Very crude cohort analysis looking for matching patterns in recruitment.

Biology

What is the typical habitat of sole?

Do they migrate?

How variable is their condition? Length at age? Weight at age?

Fishery

Describe effort trends ……the activity of the gear and countries in the respective areas.

Misreporting

Refer to documents by Sofie et al.

Recommendation to get UK and France to do the same….. use VMS to identify trends in behaviour, perhaps provide figures for misreporting, and a tuning index?

Natural Mortality

Maturity

Surveys

The use of a commercial tuning fleet has the potential to introduce bias if the behaviour or efficiency of the fleet changes. E.g. changes to the gear, vessel power, towing speed, etc. can influence the catch rates. By limiting the index to an area where sole is known to be caught, some of the potential bias due to changes in spatial effort distribution will be avoided. The working group applied a spatial stratification to check that changes in effort distribution within the sole area did not affect the index and this did not appear to be the case. Because the stratified estimate is likely to be less precise, the final tuning index was based on the un-stratified estimate. More sophisticated modelling approaches to standardise the commercial index could be investigated for a future benchmark.

Neither IAMS nor IBTS indices are usable. The IBTS doesn't make ground contact and therefore could not be used – check Hans document that came about what not to use for an indice. IAMS bottom trawl survey has now been discontinued, and swapped out for a deepwater survey so only 3 years of data available.

Discards

Future……

- XSA as normal

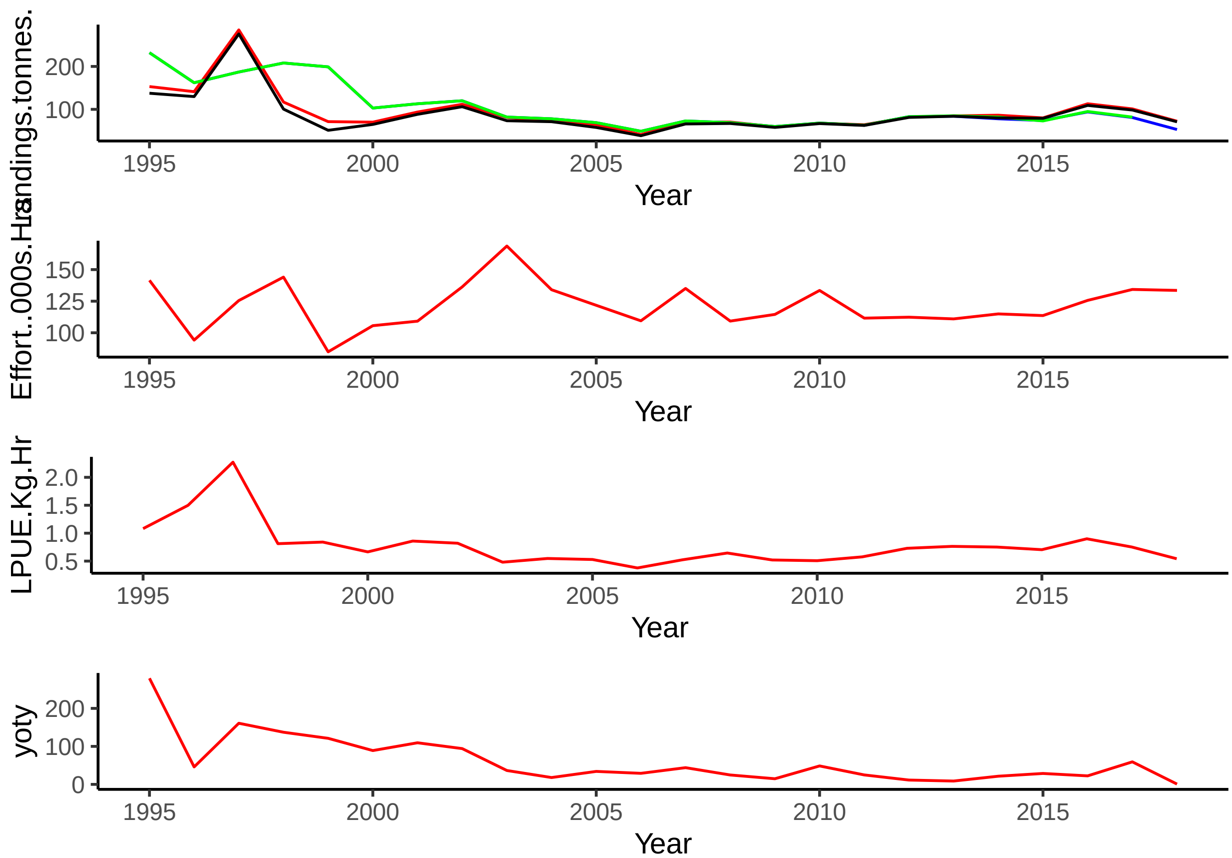
- **XSA 7jk + no assessment**
- **XSA 7jk + length based assessment?**

References

Assessment of sole (*Solea solea*) in Divisions 7.h-k (sol.27.7h-k)"

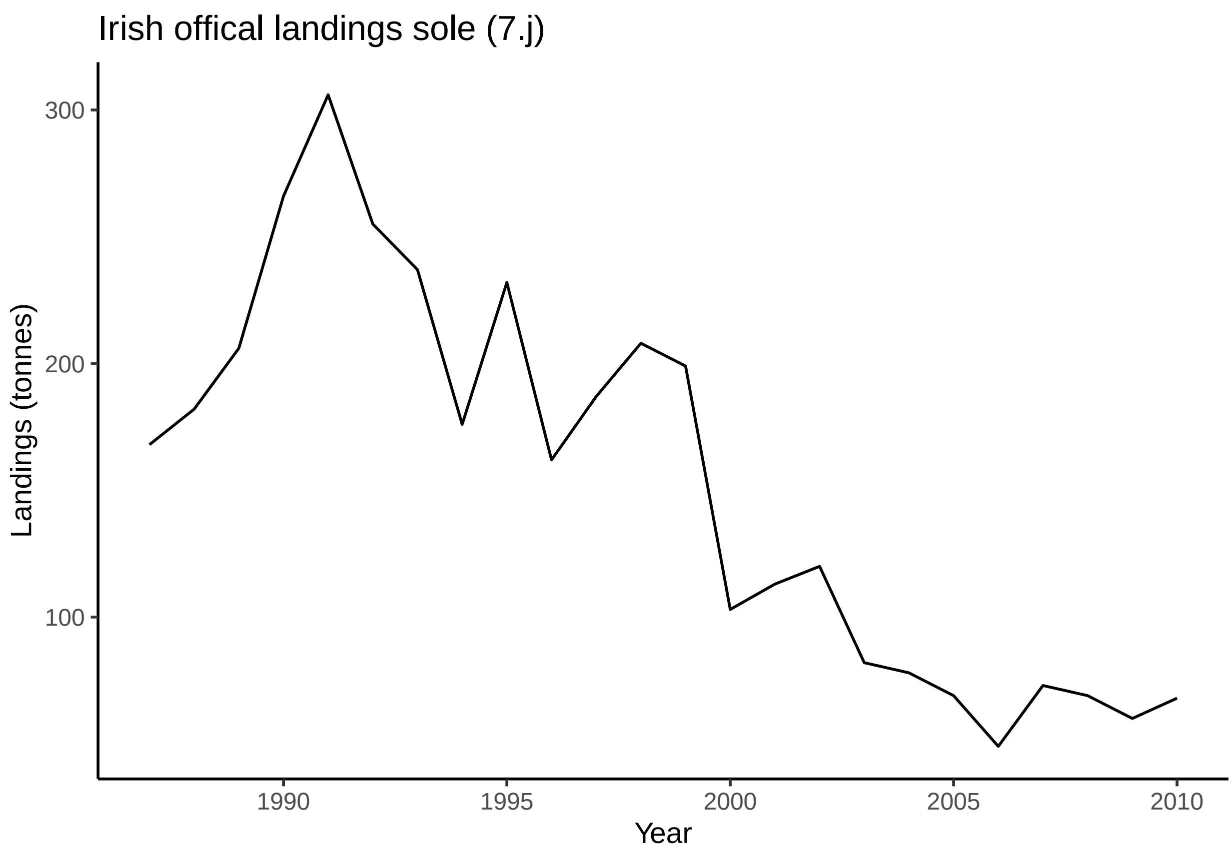
Alexandros Kokkalis

Contents

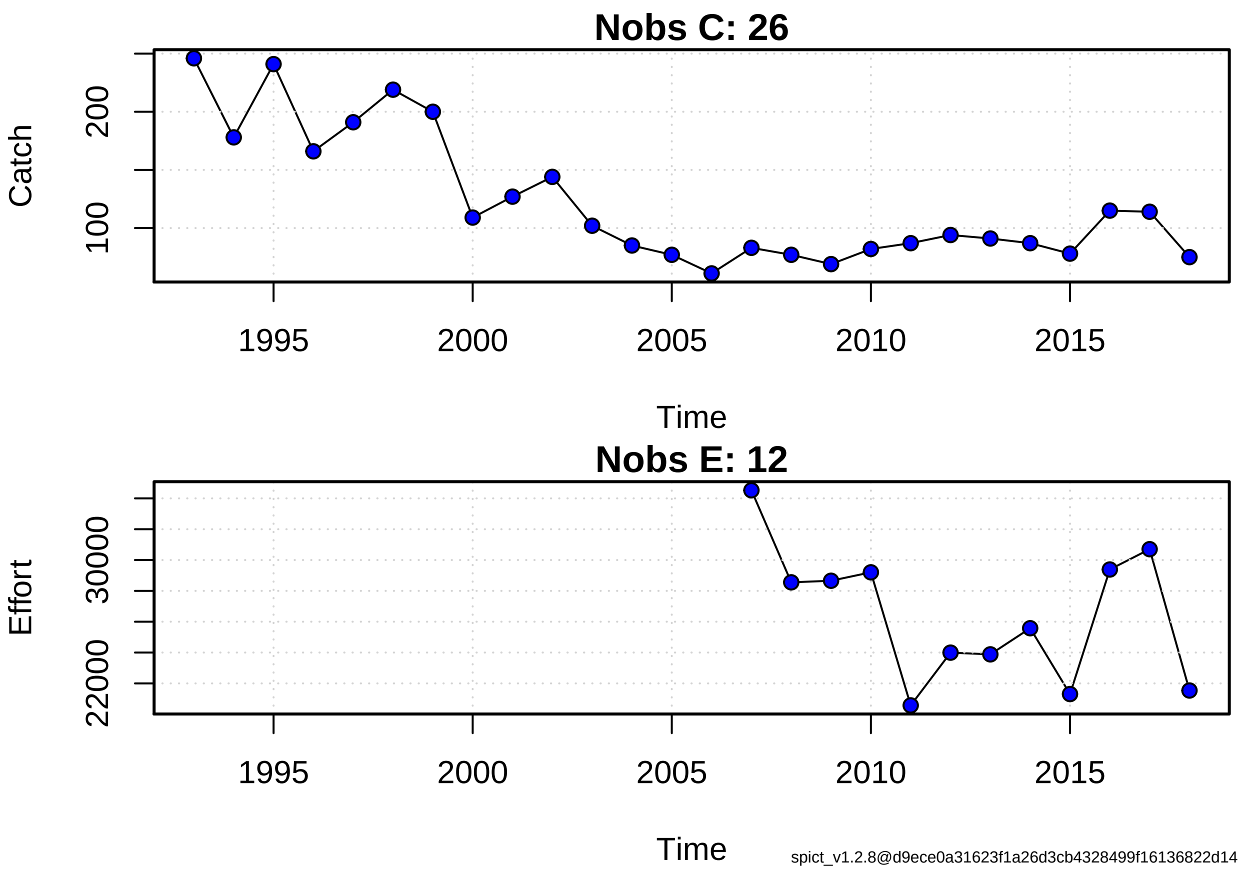


Conclusion: this high point in landings in 1995 is driven by high age 3's the year before. However caution needs to be taken that this model doe snot incorporate discards. It is my opinon that this is not an issue as the repoted landings were taken from self decalred logbooks. Also MCRS is 24cm so age 3 and 5 would be fully captured in this fishery.

Given historical time series, we can assume that we are currently at half of current carrying capacity

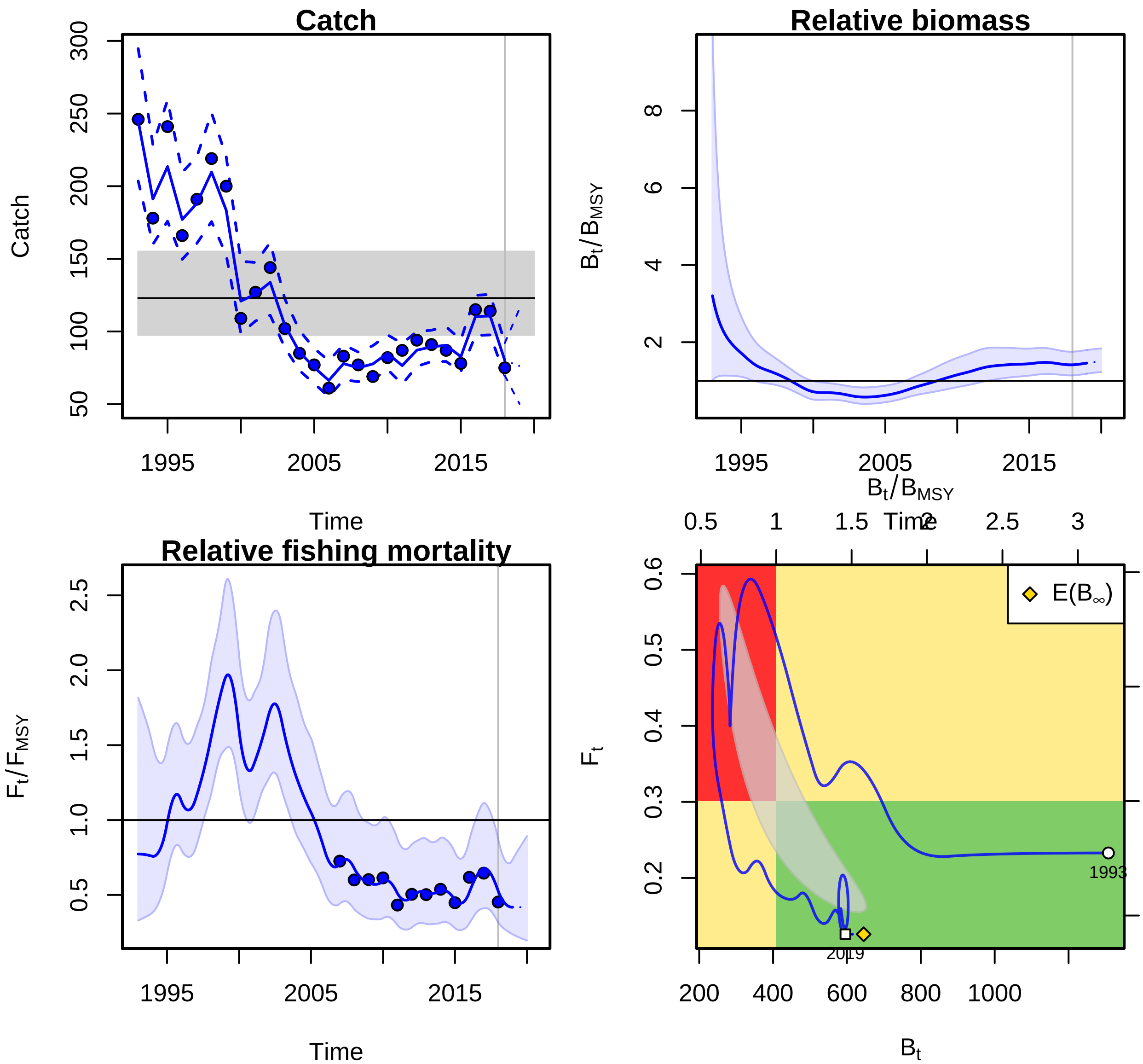

Irish offical landings sole (7.j)
Landings (tonnes)
300
200
100
1990
1995
2000
2005
2010
Year

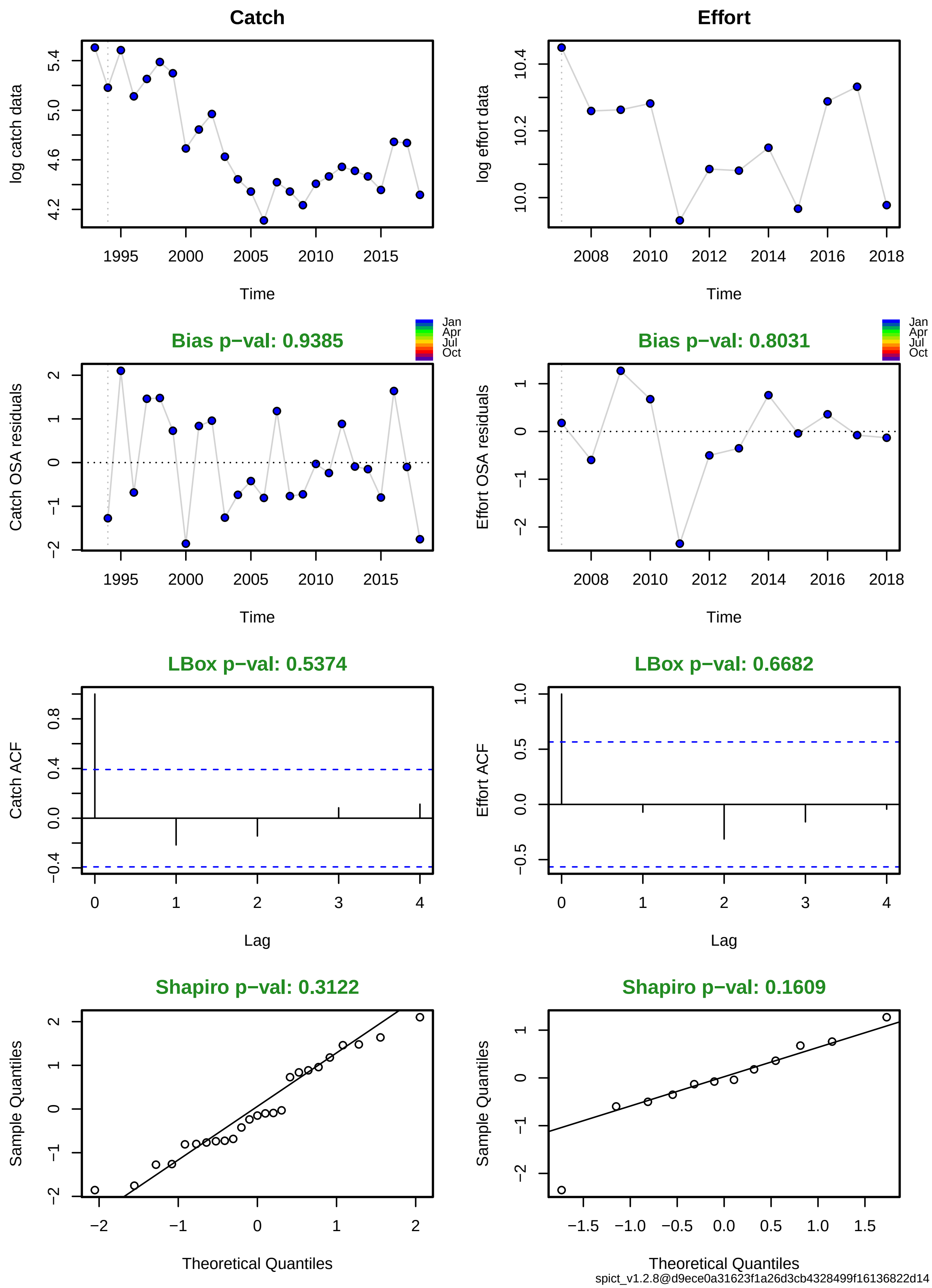
Scenario 1: Full catch time series from 1995 - 2018, effort from 2007 - 2018. Shaefer model (n = 2).

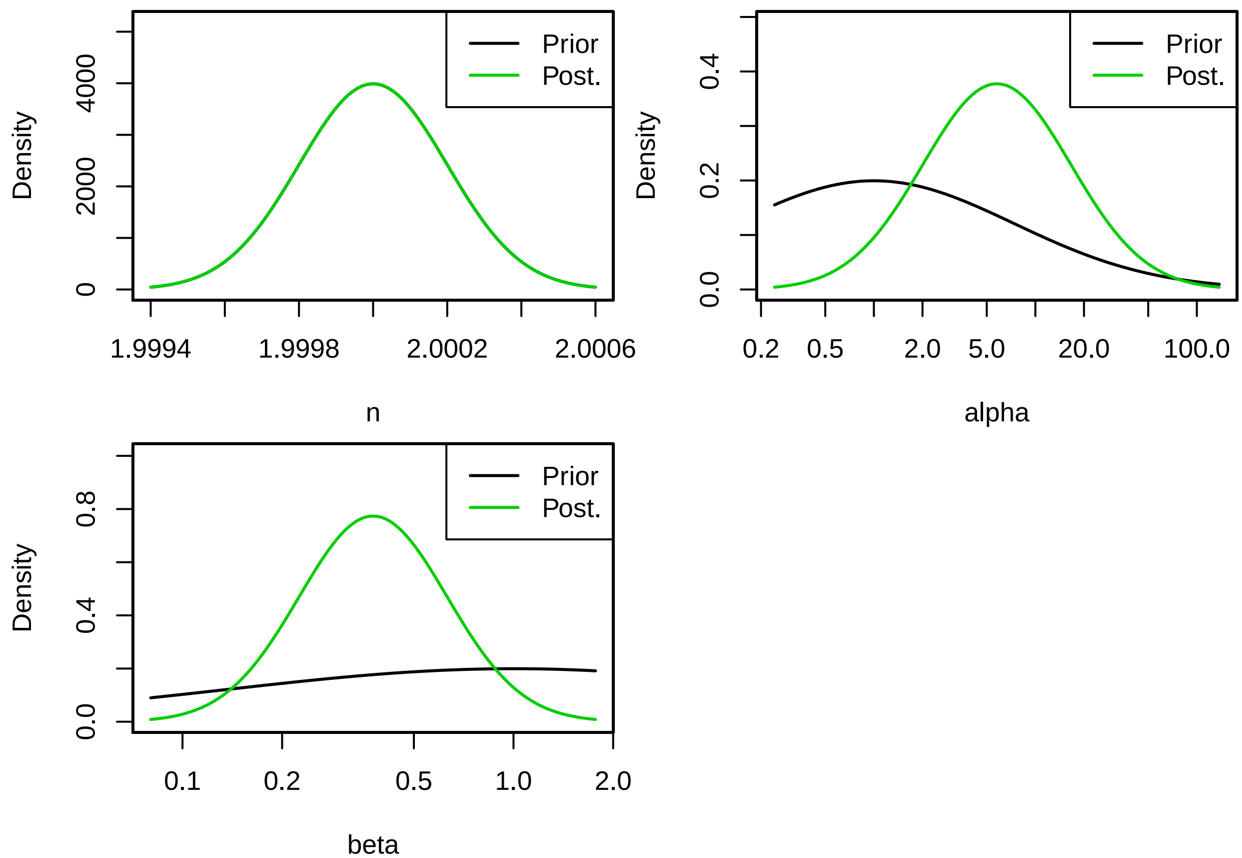


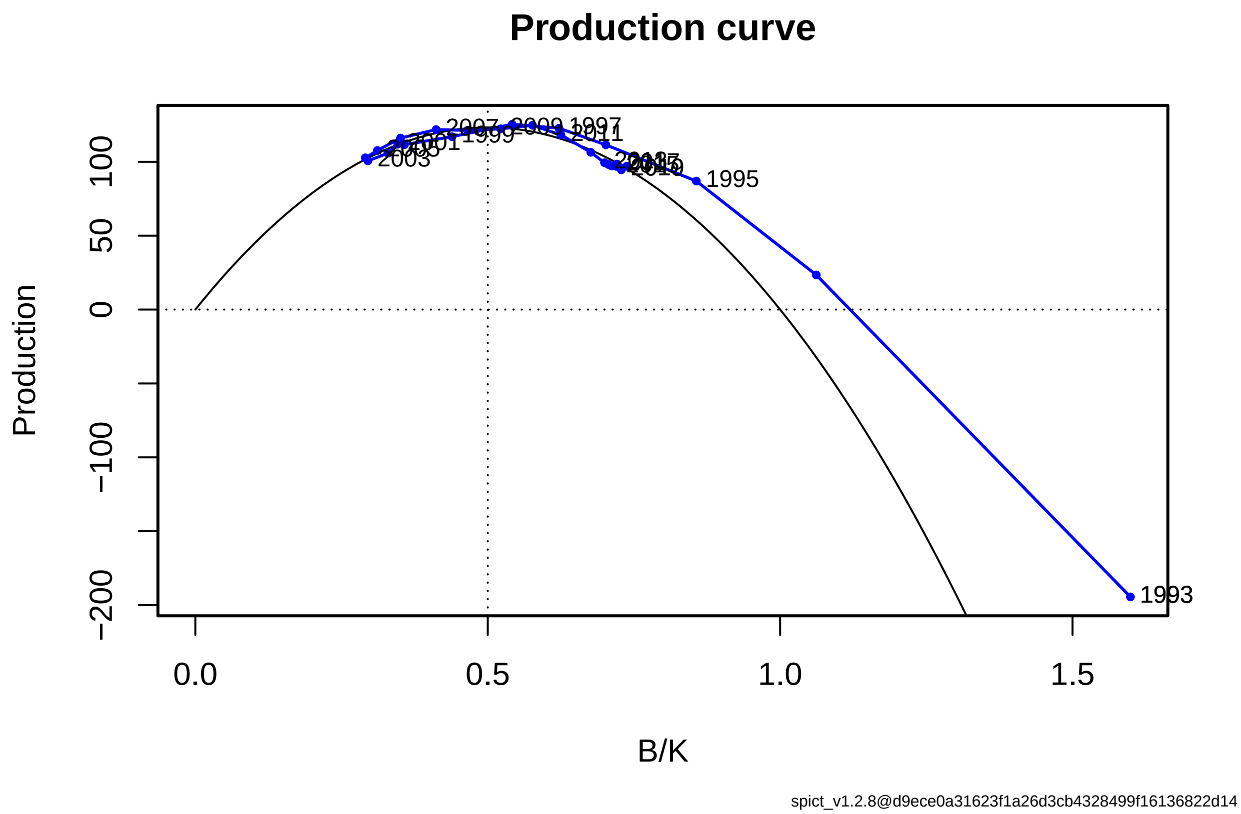

```
## Convergence: 0  MSG: relative convergence (4)
## Objective function at optimum: -4.1433988
## Euler time step (years):  1/16 or 0.0625
## Nobs C: 26,  Nobs E: 12
##
## Priors
##      logn  ~  dnorm[log(2), 0^2] (fixed)
##  logalpha  ~  dnorm[log(1), 2^2]
##   logbeta  ~  dnorm[log(1), 2^2]
##
## Model parameter estimates w 95% CI
##            estimate       cilow        ciupp     log.est
##  beta     0.3766291   0.1370672    1.0348902  -0.9764945
##  r        0.6027633   0.3545057    1.0248737  -0.5062307
##  rc       0.6027633   0.3545057    1.0248737  -0.5062307
##  rold     0.6027633   0.3545057    1.0248737  -0.5062307
##  m      123.2540276  97.8262424  155.2912077   4.8142475
##  K      817.9265700 561.8472341 1190.7220208   6.7067726
##  qf       0.0000063   0.0000045    0.0000089 -11.9703037
##  n        2.0000000   1.9996081    2.0003921   0.6931472
##  sdb      0.0346189   0.0043596    0.2749004  -3.3633551
##  sdf      0.2580027   0.1591756    0.4181883  -1.3547854
```

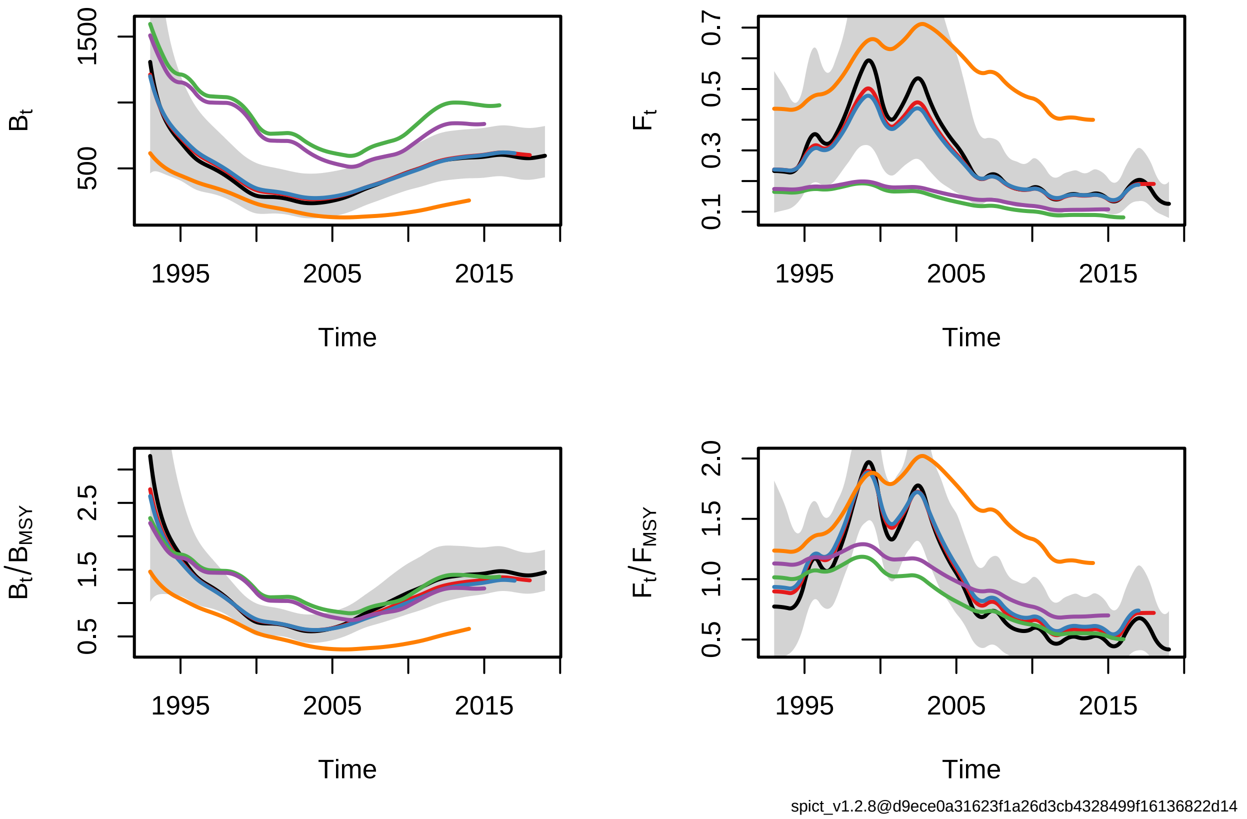
```
## sde      0.0692516   0.0246893    0.1942451  -2.6700095
## sdc      0.0971713   0.0492935    0.1915517  -2.3312798
##
## Deterministic reference points (Drp)
##           estimate       cilow       ciupp   log.est
## Bmsyd 408.9632865 280.9236166 595.3610157  6.013625
## Fmsyd   0.3013816   0.1772529   0.5124368 -1.199378
## MSYd  123.2540276  97.8262424 155.2912077  4.814247
## Stochastic reference points (Srp)
##           estimate       cilow       ciupp   log.est  rel.diff.Drp
## Bmsys 408.3996452 280.7192075 594.1533949  6.012246 -0.0013801219
## Fmsys   0.3010915   0.1769818   0.5122338 -1.200341 -0.0009636405
## MSYs  122.9654814  97.5664745 154.9764883  4.811904 -0.0023465626
##
## States w 95% CI (inp$msytype: s)
##                    estimate       cilow       ciupp    log.est
## B_2018.00      577.6873779 413.7967090 806.4895136  6.3590329
## F_2018.00        0.1586359   0.1062506   0.2368491 -1.8411437
## B_2018.00/Bmsy   1.4145149   1.1412194   1.7532582  0.3467866
## F_2018.00/Fmsy   0.5268695   0.3180384   0.8728237 -0.6408025
##
## Predictions w 95% CI (inp$msytype: s)
##                  prediction       cilow       ciupp    log.est
## B_2019.00      595.8102947 431.9920368 821.7510441  6.3899223
## F_2019.00        0.1259424   0.0798705   0.1985900 -2.0719308
## B_2019.00/Bmsy   1.4588903   1.1843327   1.7970972  0.3776761
## F_2019.00/Fmsy   0.4182861   0.2376927   0.7360904 -0.8715896
## Catch_2019.00   76.2017810  50.1796830 115.7183761  4.3333848
## E(B_inf)       645.2348427          NA          NA  6.4696143
```


Catch
Catch
Time
Relative biomass
B_t/B_{MSY}
Time
Relative fishing mortality
F_t/F_{MSY}
Time
B_t/B_{MSY}
F_t
B_t
$E(B_\infty)$
1993
2019


Catch
log catch data
Time
Effort
log effort data
Time
Bias p−val: 0.9385
Catch OSA residuals
Jan
Apr
Jul
Oct
Bias p−val: 0.8031
Effort OSA residuals
LBox p−val: 0.5374
Catch ACF
Lag
LBox p−val: 0.6682
Effort ACF
Lag
Shapiro p−val: 0.3122
Sample Quantiles
Theoretical Quantiles
Shapiro p−val: 0.1609
Sample Quantiles
Theoretical Quantiles
spict_v1.2.8@d9ece0a31623f1a26d3cb4328499f16136822d14

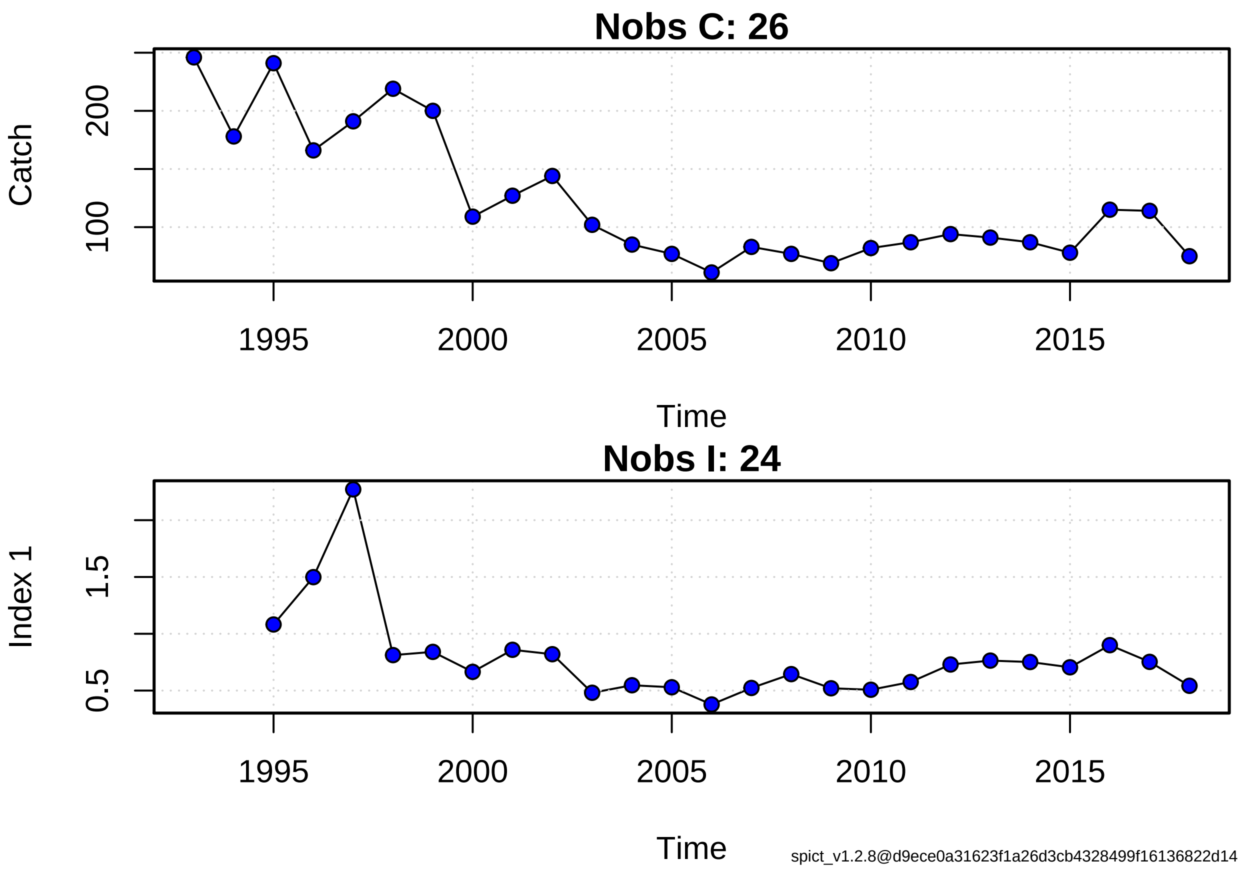

Prior
Post.
Density
0
2000
4000
1.9994
1.9998
2.0002
2.0006
n
Prior
Post.
Density
0.0
0.2
0.4
0.2
0.5
2.0
5.0
20.0
100.0
alpha
Prior
Post.
Density
0.0
0.4
0.8
0.1
0.2
0.5
1.0
2.0
beta


Production curve
Production
100
50
0
−100
−200
0.0
0.5
1.0
1.5
B/K
2007
2009
1997
2011
1999
2001
2003
1995
1993
spict_v1.2.8@d9ece0a31623f1a26d3cb4328499f16136822d14



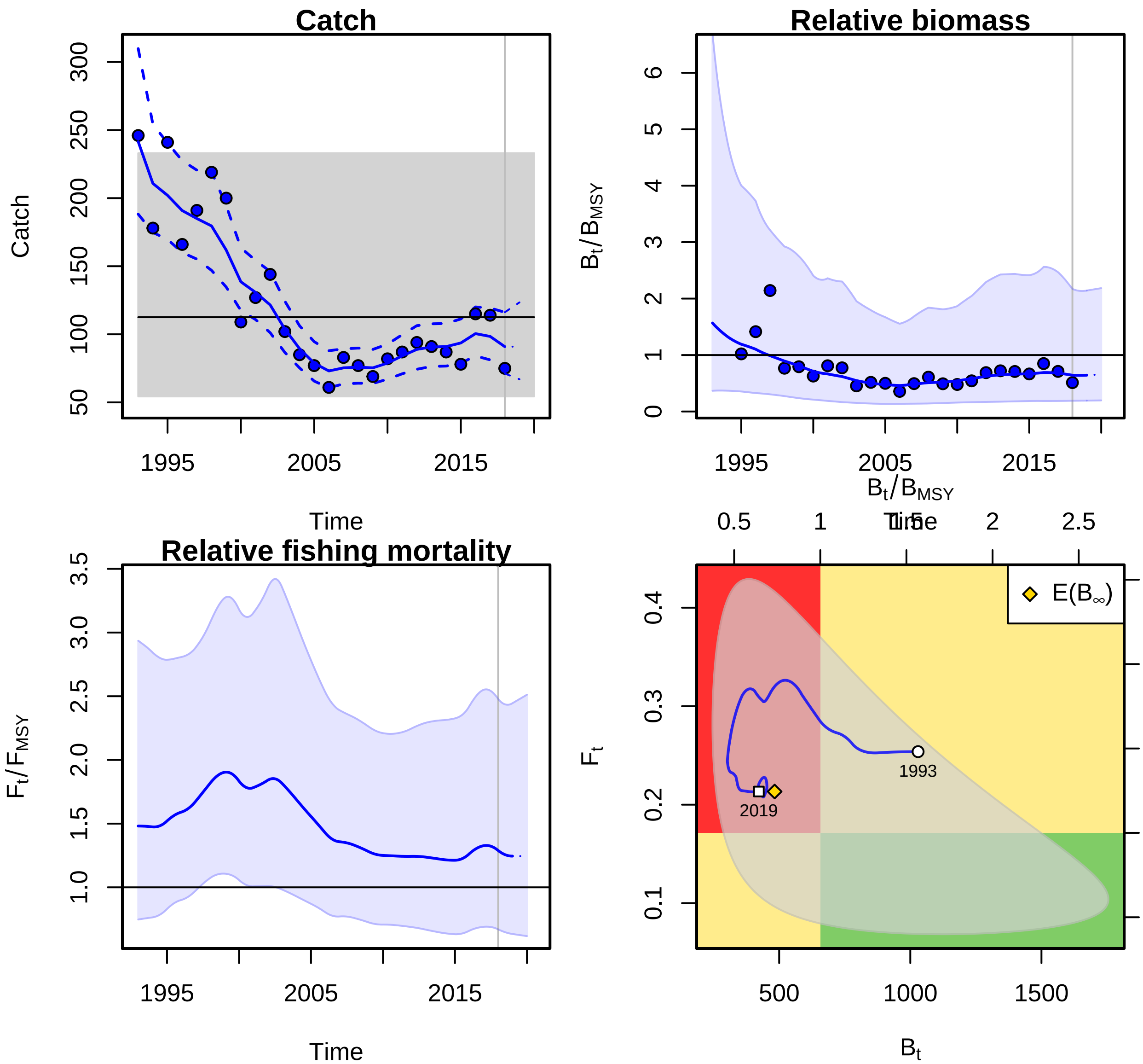
B_t
1500
500
1995
2005
2015
Time
F_t
0.7
0.5
0.3
0.1
1995
2005
2015
Time
B_t/B_MSY
2.5
1.5
0.5
1995
2005
2015
Time
F_t/F_MSY
2.0
1.5
1.0
0.5
1995
2005
2015
Time
spict_v1.2.8@d9ece0a31623f1a26d3cb4328499f16136822d14

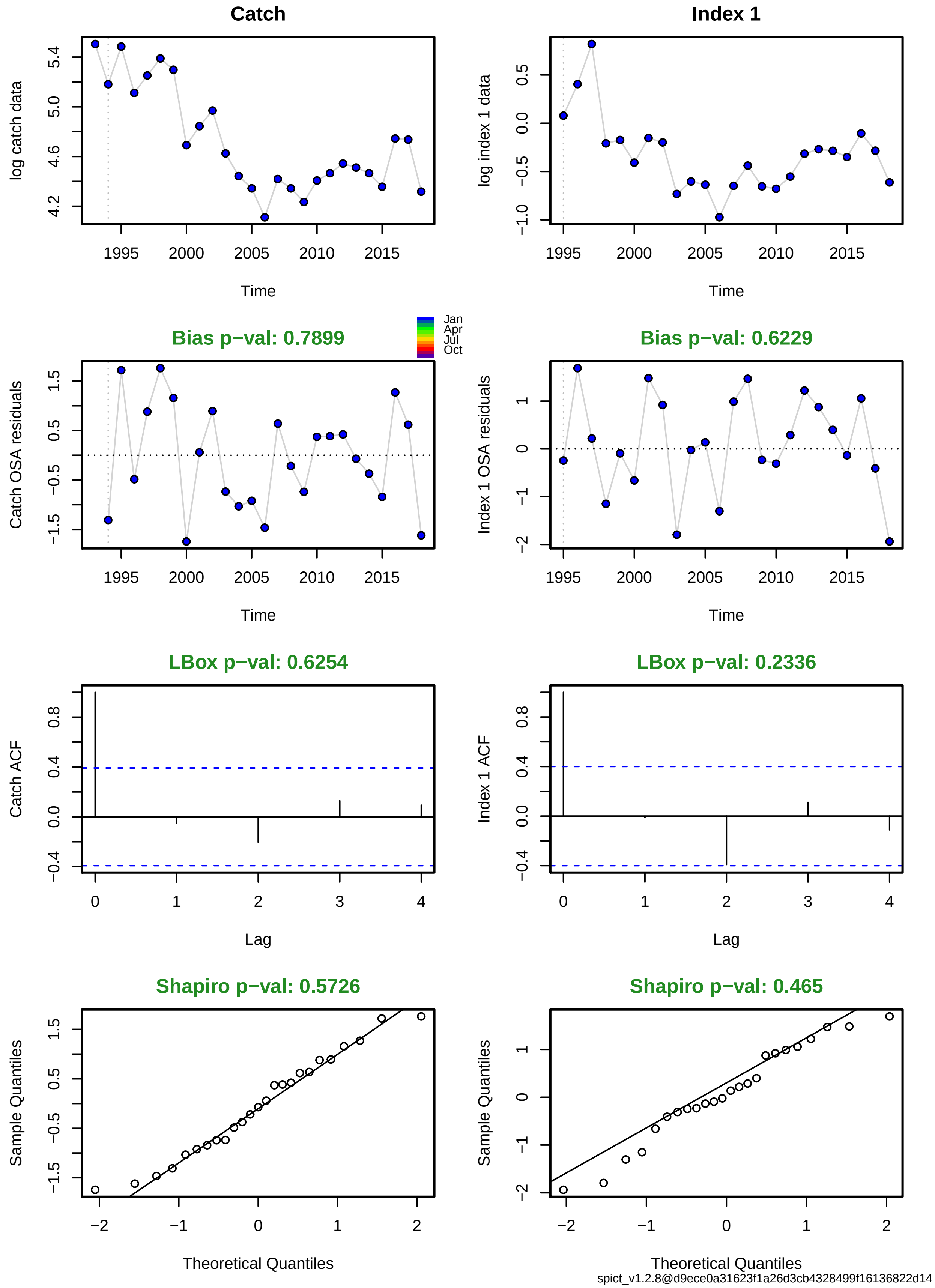
Scenario 2: Full catch time series from 1995 - 2018, lpue from 1995-2018. Shaefer model (n = 2).Peak in LPUE weighted (*20)

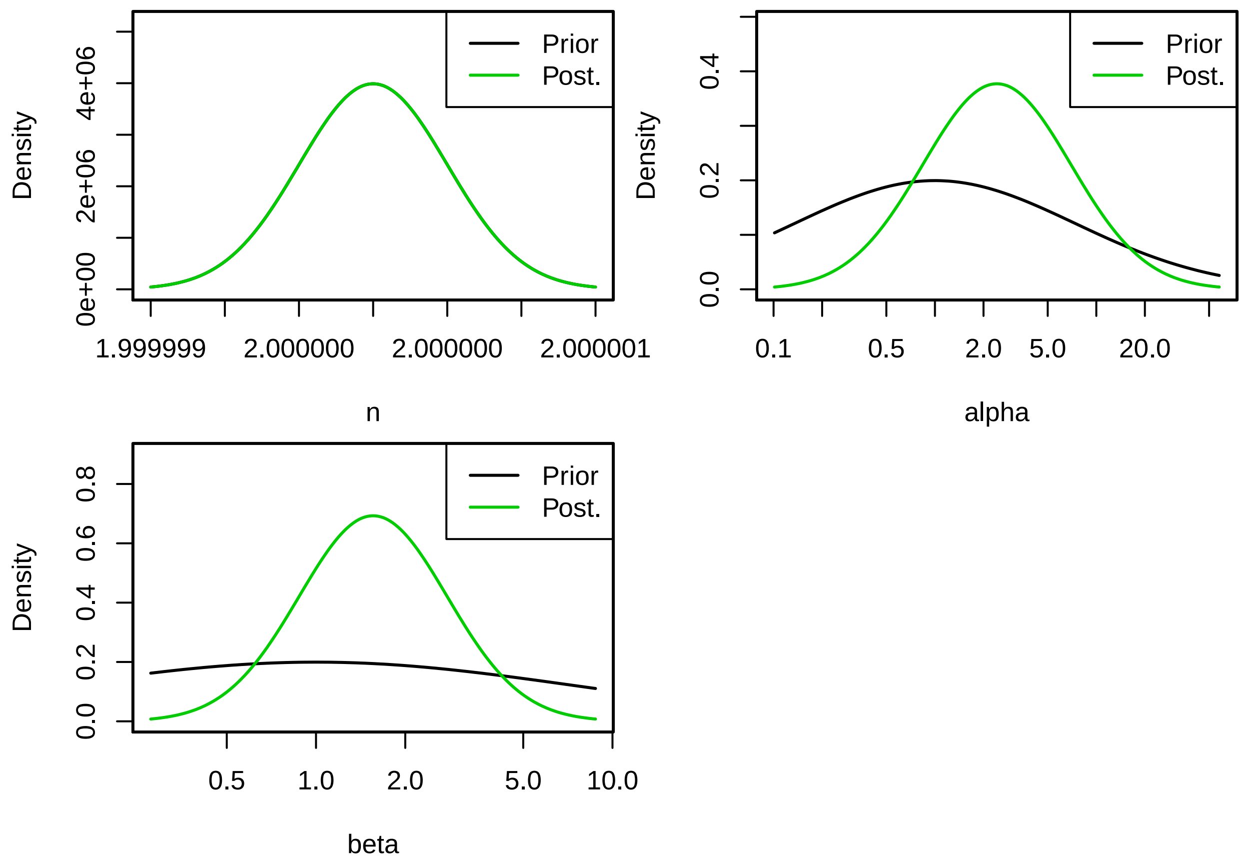


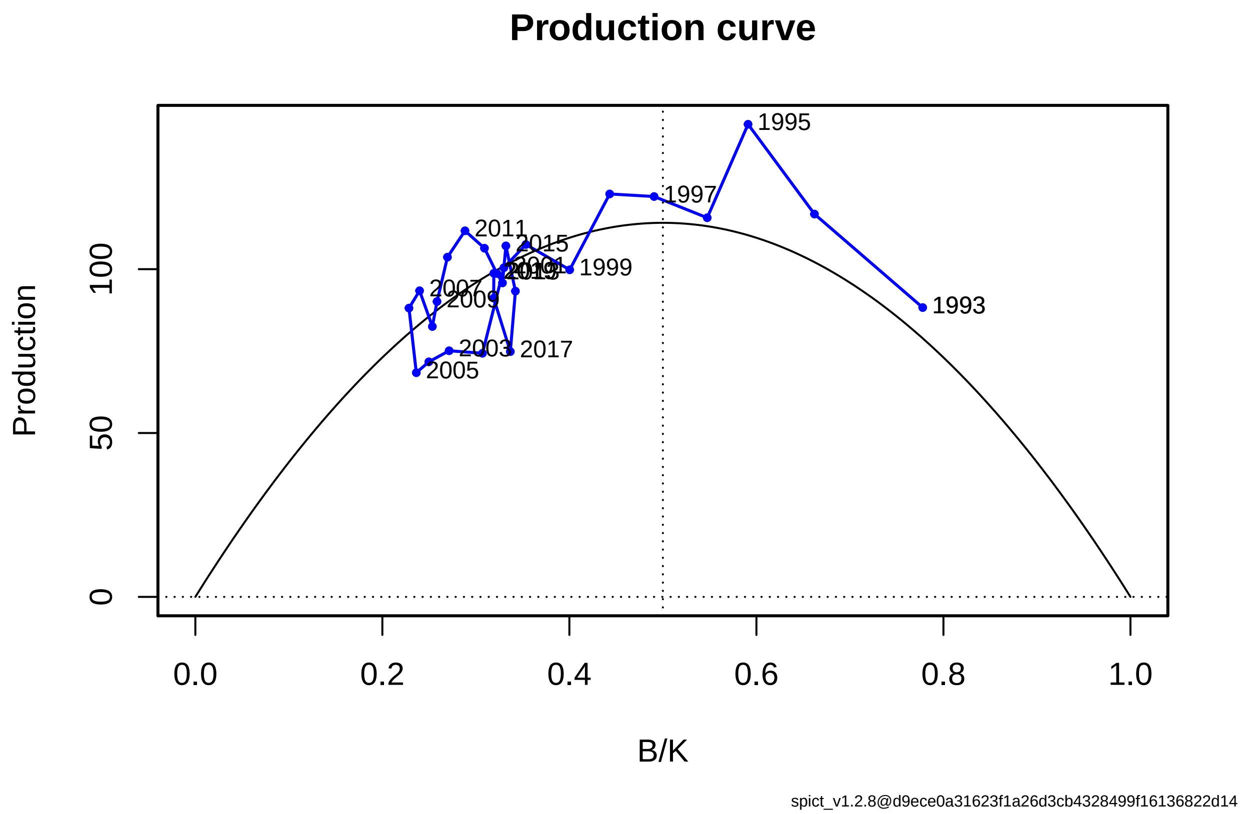

```
## Convergence: 0  MSG: relative convergence (4)
## Objective function at optimum: -7.9777835
## Euler time step (years):  1/16 or 0.0625
## Nobs C: 26,  Nobs I1: 24
##
## Priors
##      logn  ~  dnorm[log(2), 0^2] (fixed)
##  logalpha  ~  dnorm[log(1), 2^2]
##   logbeta  ~  dnorm[log(1), 2^2]
##
## Model parameter estimates w 95% CI
##             estimate       cilow        ciupp    log.est
##  alpha     2.4202535   0.3044137   19.2423226  0.8838723
##  beta      1.5582720   0.5041203    4.8167306  0.4435775
##  r         0.3449103   0.1670252    0.7122467 -1.0644709
##  rc        0.3449103   0.1670252    0.7122467 -1.0644709
##  rold      0.3449103   0.1670252    0.7122467 -1.0644709
##  m       114.1381024  56.6339974  230.0297880  4.7374091
##  K      1323.6844246 604.3748967 2899.0953551  7.1881744
##  q         0.0016137   0.0005884    0.0044257 -6.4292222
##  n         2.0000000   1.9999996    2.0000004  0.6931472
##  sdb       0.0663566   0.0102992    0.4275300 -2.7127116
##  sdf       0.0977342   0.0364703    0.2619111 -2.3255034
```

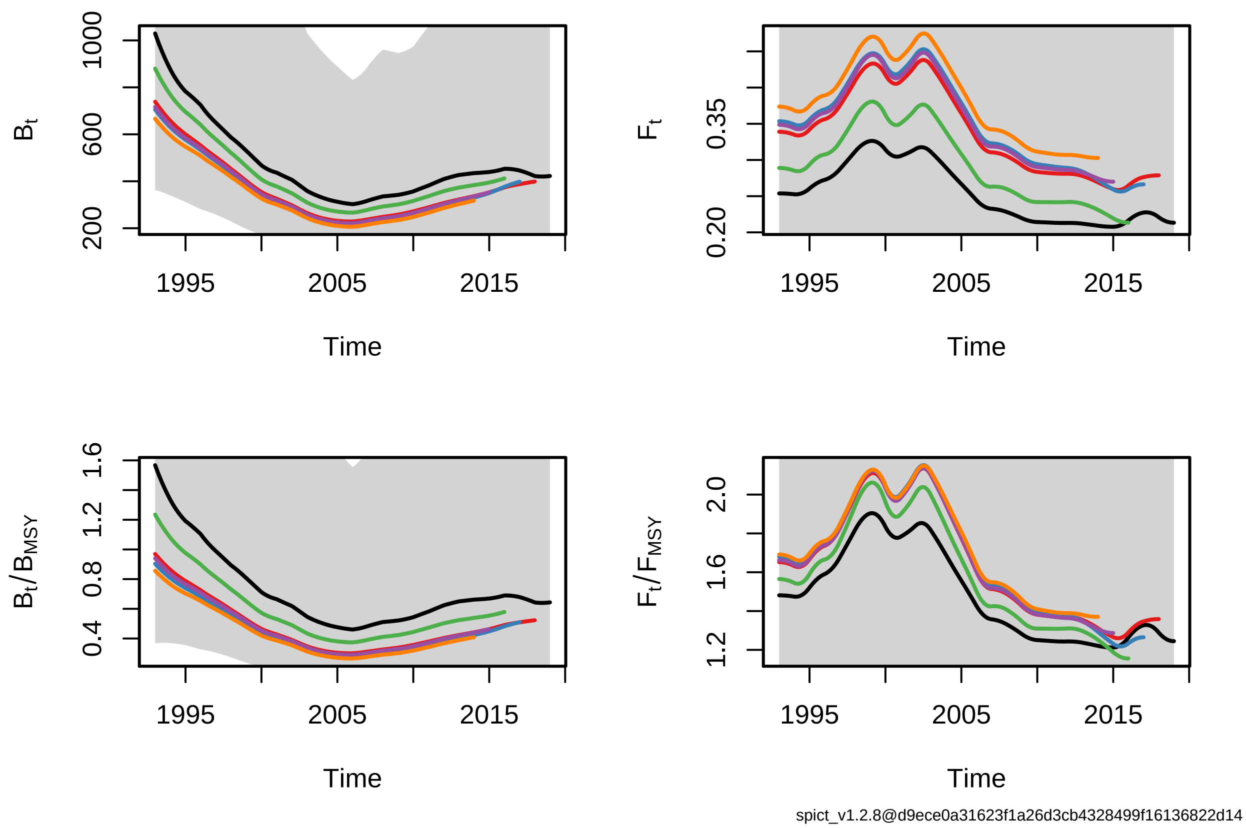
```
## sdi       0.1605999   0.1100403    0.2343898 -1.8288393
## sdc       0.1522965   0.1053632    0.2201360 -1.8819258
##
## Deterministic reference points (Drp)
##           estimate       cilow        ciupp   log.est
## Bmsyd 661.8422123 302.1874484 1449.5476775  6.495027
## Fmsyd   0.1724552   0.0835126    0.3561233 -1.757618
## MSYd  114.1381024  56.6339974  230.0297880  4.737409
## Stochastic reference points (Srp)
##           estimate       cilow        ciupp   log.est rel.diff.Drp
## Bmsys 656.7826744 298.9339871 1443.0058140  6.487353 -0.007703519
## Fmsys   0.1713642   0.0821673    0.3573889 -1.763964 -0.006366304
## MSYs  112.5434902  54.3500671  233.0454748  4.723340 -0.014168853
##
## States w 95% CI (inp$msytype: s)
##                    estimate       cilow        ciupp    log.est
## B_2018.00      422.3033627 157.9271009 1129.2560250  6.0457239
## F_2018.00        0.2208633   0.0750515    0.6499622 -1.5102112
## B_2018.00/Bmsy   0.6429880   0.1904273    2.1710836 -0.4416293
## F_2018.00/Fmsy   1.2888537   0.6700933    2.4789741  0.2537532
##
## Predictions w 95% CI (inp$msytype: s)
##                  prediction       cilow        ciupp    log.est
## B_2019.00      422.5218217 160.2179132 1114.2617343  6.0462411
## F_2019.00        0.2133397   0.0723562    0.6290242 -1.5448697
## B_2019.00/Bmsy   0.6433206   0.1932024    2.1421132 -0.4411121
## F_2019.00/Fmsy   1.2449492   0.6337751    2.4455022  0.2190947
## Catch_2019.00   90.9341036  66.9851625  123.4454152  4.5101351
## E(B_inf)       482.7178456          NA           NA  6.1794323
```


Catch
Relative biomass
Relative fishing mortality
Catch
Time
B_t/B_{MSY}
F_t/F_{MSY}
F_t
B_t
1993
2019
$E(B_\infty)$


Catch
log catch data
Time
Index 1
log index 1 data
Time
Bias p−val: 0.7899
Jan
Apr
Jul
Oct
Catch OSA residuals
Time
Bias p−val: 0.6229
Index 1 OSA residuals
Time
LBox p−val: 0.6254
Catch ACF
Lag
LBox p−val: 0.2336
Index 1 ACF
Lag
Shapiro p−val: 0.5726
Sample Quantiles
Theoretical Quantiles
Shapiro p−val: 0.465
Sample Quantiles
Theoretical Quantiles
spict_v1.2.8@d9ece0a31623f1a26d3cb4328499f16136822d14

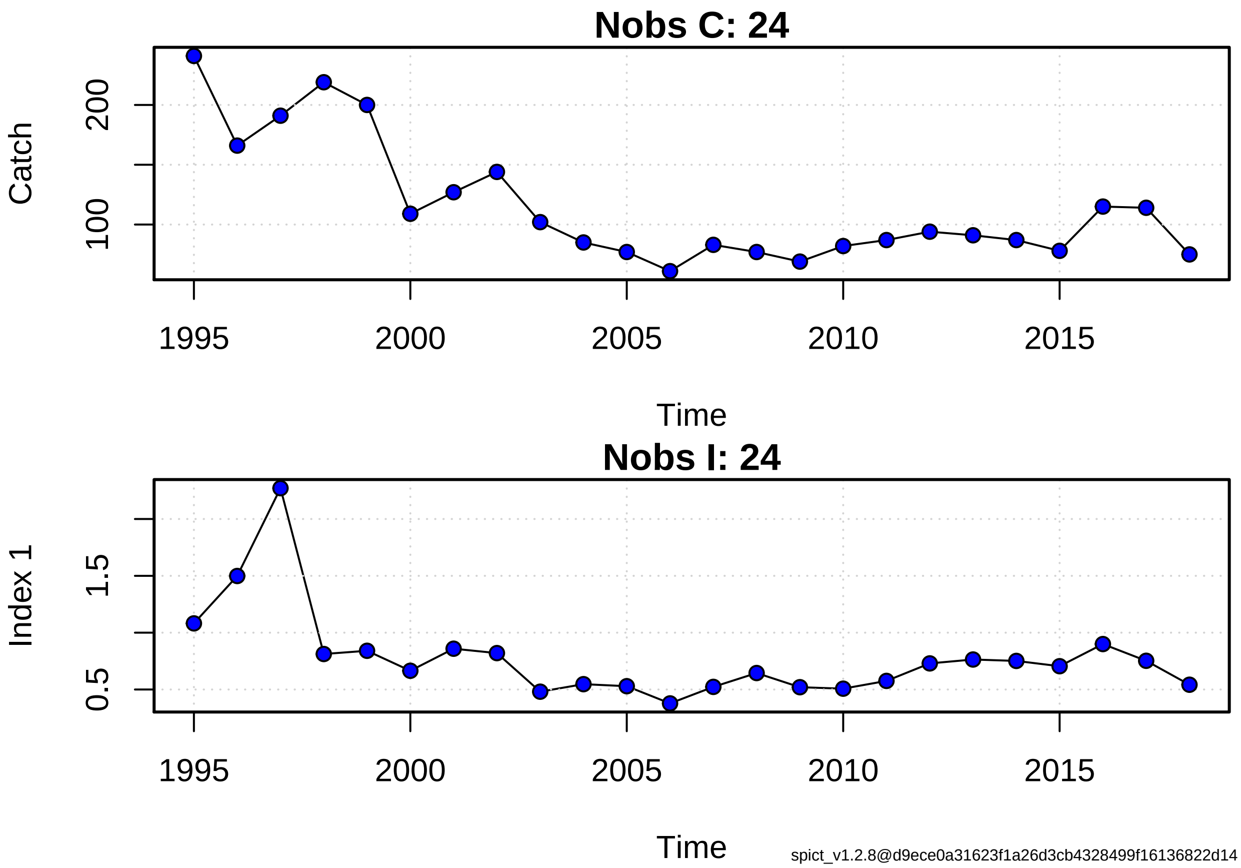

Prior
Post.
Density
0e+00
2e+06
4e+06
1.999999
2.000000
2.000000
2.000001
n
Prior
Post.
Density
0.0
0.2
0.4
0.1
0.5
2.0
5.0
20.0
alpha
Prior
Post.
Density
0.0
0.2
0.4
0.6
0.8
0.5
1.0
2.0
5.0
10.0
beta


Production curve
Production
0
50
100
0.0
0.2
0.4
0.6
0.8
1.0
B/K
1995
1997
2011
2015
2001
2013
2019
1999
2007
2009
1993
2003
2017
2005
spict_v1.2.8@d9ece0a31623f1a26d3cb4328499f16136822d14



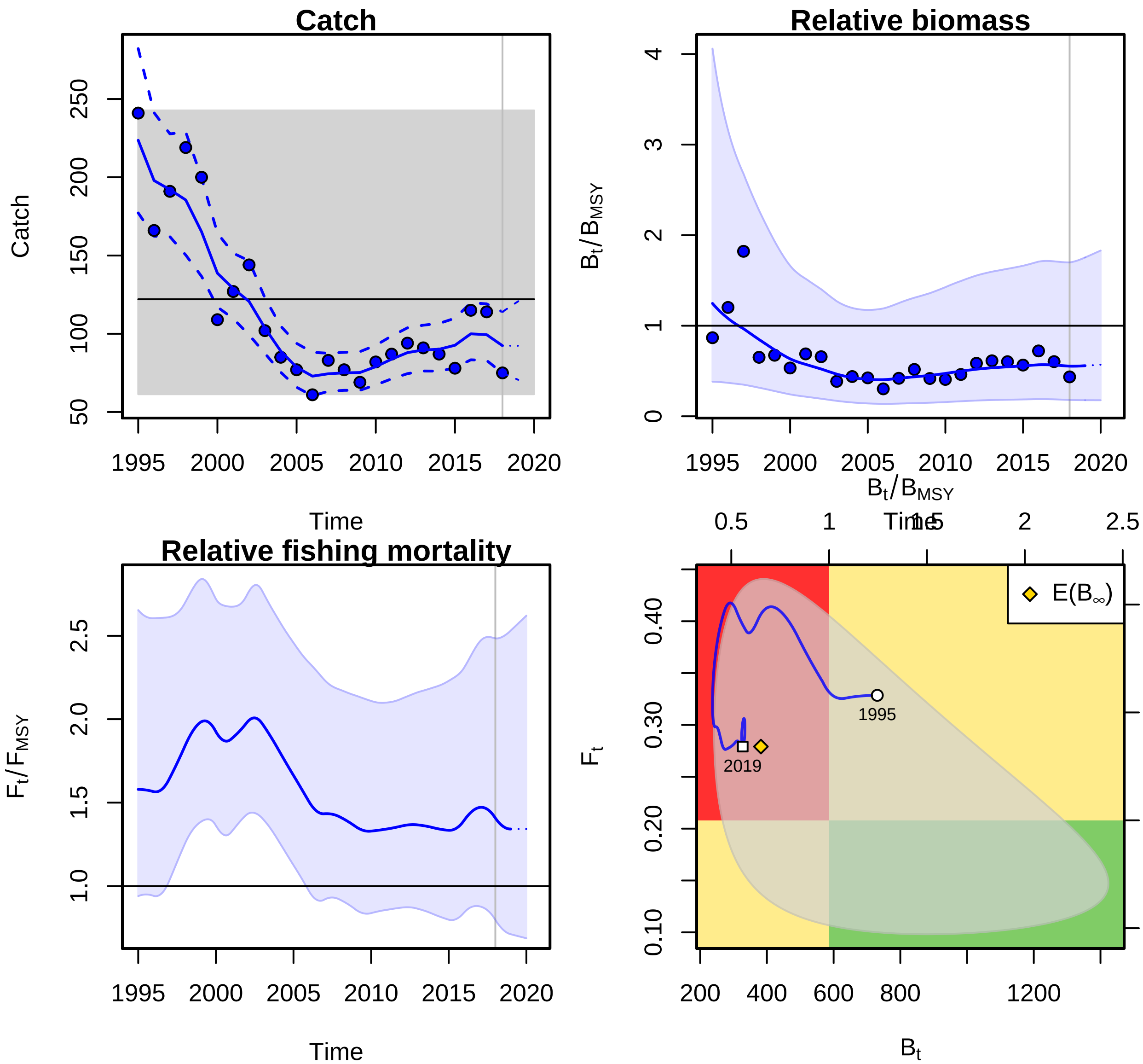
B_t
1000
600
200
1995
2005
2015
Time
F_t
0.35
0.20
1995
2005
2015
Time
B_t/B_{MSY}
1.6
1.2
0.8
0.4
1995
2005
2015
Time
F_t/F_{MSY}
2.0
1.6
1.2
1995
2005
2015
Time
spict_v1.2.8@d9ece0a31623f1a26d3cb4328499f16136822d14

Scenario 3: Catch time series from 1995 - 2018, lpue from 1995-2018. Shaefer model (n = 2). No downweighting of LPUE peak, and no assption of depletion prior to timeseries

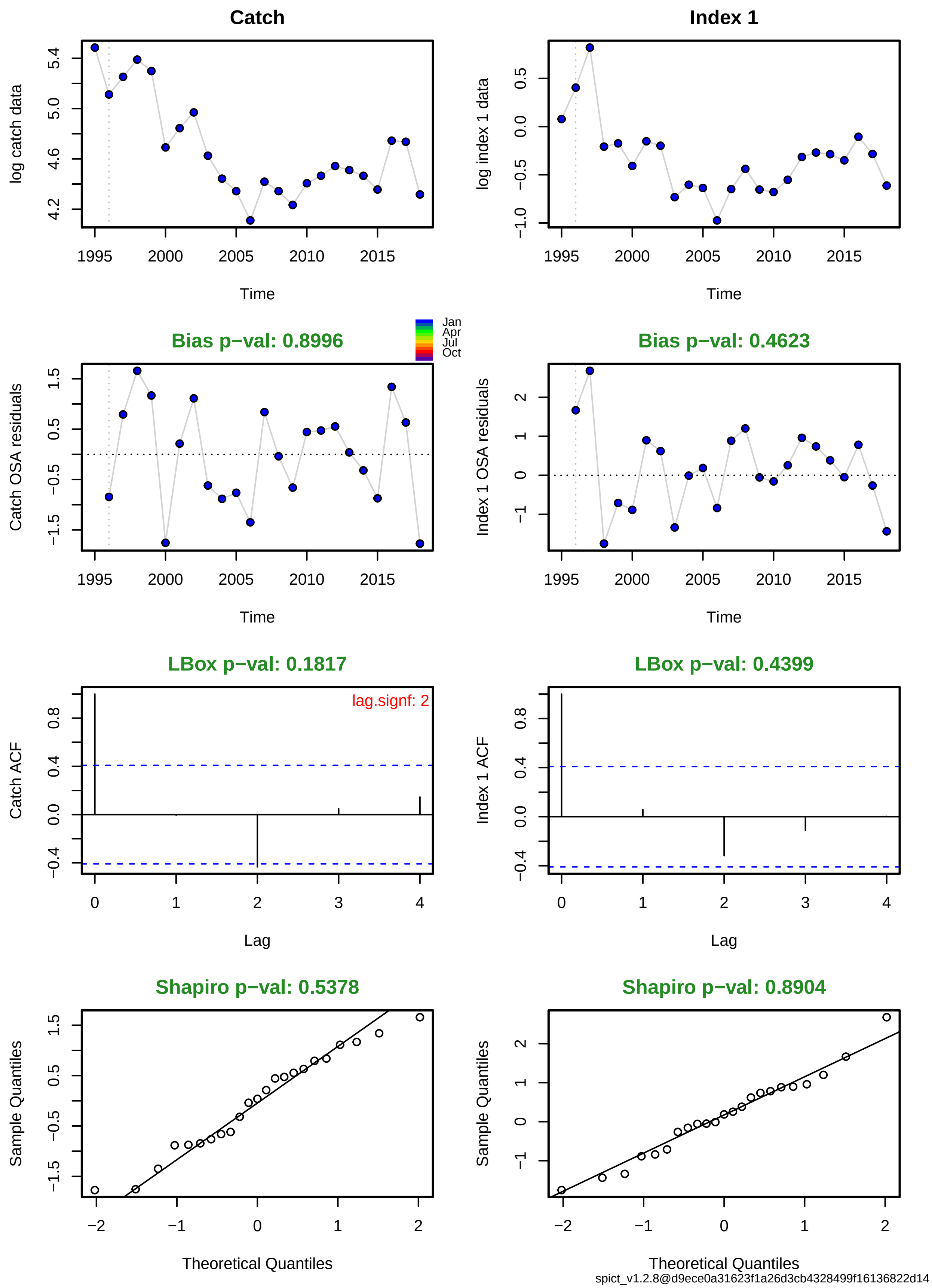


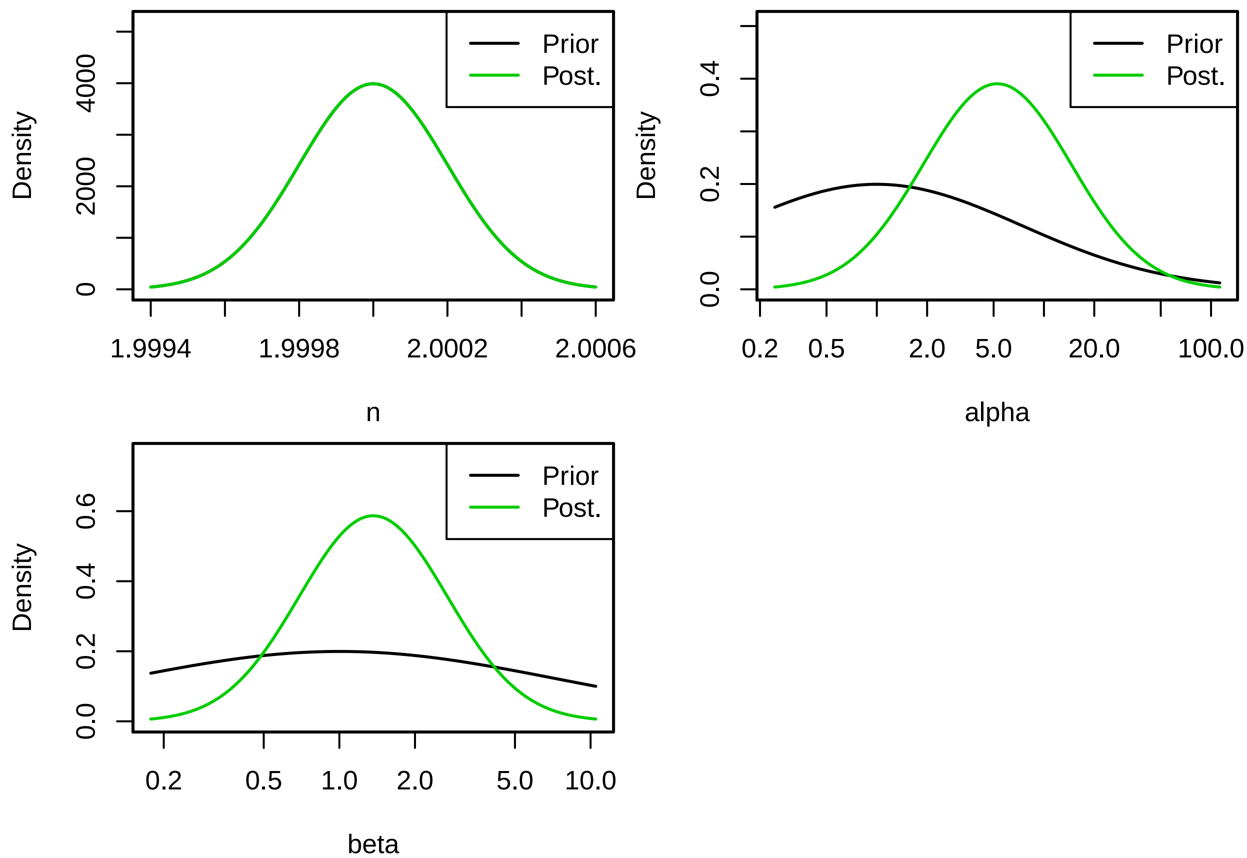

```
## Convergence: 0  MSG: both X-convergence and relative convergence (5)
## Objective function at optimum: 2.4385841
## Euler time step (years):  1/16 or 0.0625
## Nobs C: 24,  Nobs I1: 24
##
## Priors
##      logn  ~  dnorm[log(2), 0^2] (fixed)
##  logalpha  ~  dnorm[log(1), 2^2]
##   logbeta  ~  dnorm[log(1), 2^2]
##
## Model parameter estimates w 95% CI
##             estimate       cilow        ciupp    log.est
##  alpha     5.2572785   0.7094878   38.9562389  1.6596135
##  beta      1.3645632   0.3600536    5.1715439  0.3108344
##  r         0.4169413   0.2289428    0.7593166 -0.8748098
##  rc        0.4169413   0.2289428    0.7593166 -0.8748098
##  rold      0.4169413   0.2289428    0.7593166 -0.8748098
##  m       122.6301176  61.7471574  243.5439358  4.8091727
##  K      1176.4736068 578.0112748 2394.5729224  7.0702768
##  q         0.0021255   0.0009696    0.0046594 -6.1537618
##  n         2.0000000   1.9996080    2.0003920  0.6931472
##  sdb       0.0426416   0.0059257    0.3068499 -3.1549244
##  sdf       0.1080270   0.0364271    0.3203611 -2.2253745
```

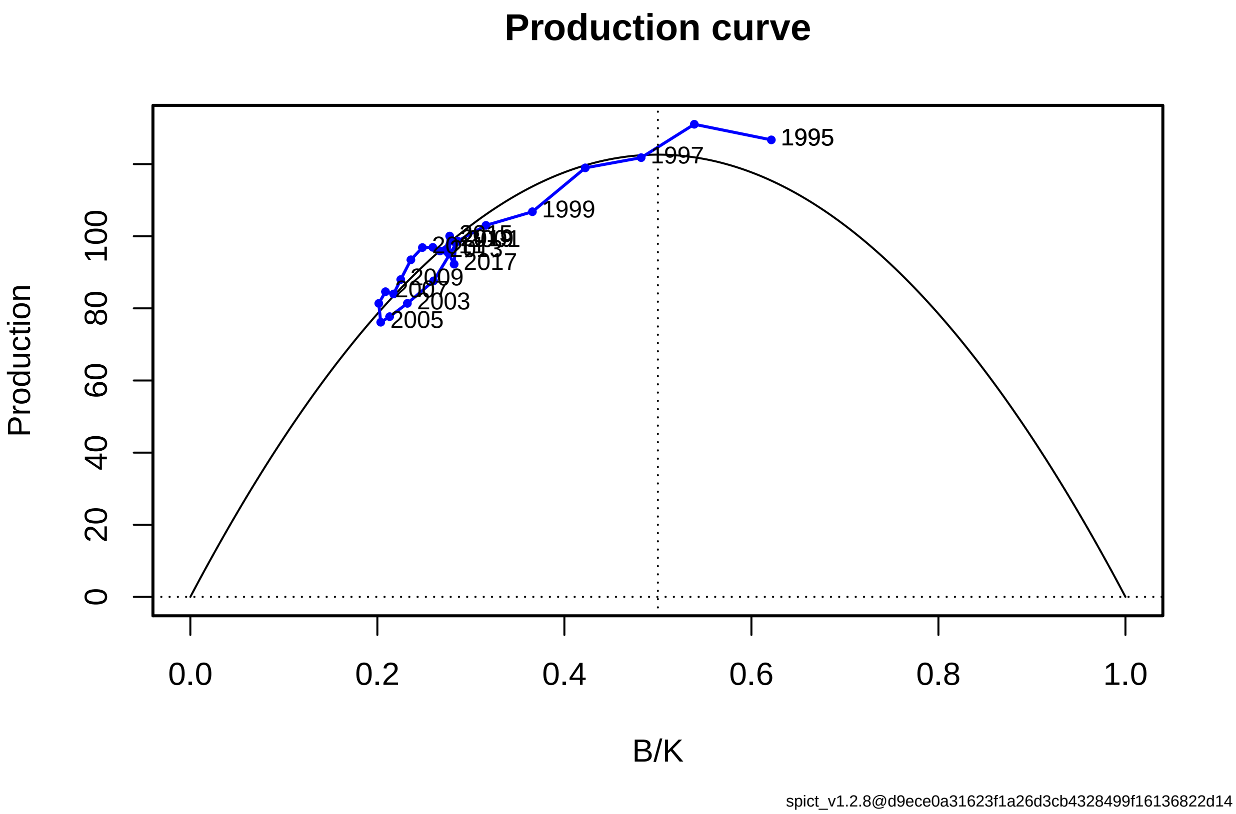
```
## sdi       0.2241789   0.1652937    0.3040417 -1.4953109
## sdc       0.1474096   0.0975050    0.2228563 -1.9145401
##
## Deterministic reference points (Drp)
##          estimate       cilow        ciupp   log.est
## Bmsyd 588.2368016 289.0056390 1197.2864469  6.377130
## Fmsyd   0.2084707   0.1144714    0.3796583 -1.567957
## MSYd  122.6301176  61.7471574  243.5439358  4.809173
## Stochastic reference points (Srp)
##          estimate       cilow        ciupp   log.est rel.diff.Drp
## Bmsys 586.6382492 288.4205018 1193.2037885  6.374408 -0.002724937
## Fmsys   0.2080222   0.1140371    0.3794665 -1.570110 -0.002155855
## MSYs  122.0330882  61.3580845  242.7076193  4.804292 -0.004892357
##
## States w 95% CI (inp$msytype: s)
##                   estimate       cilow       ciupp    log.est
## B_2018.00      324.7466341 139.0217829 758.5888638  5.7830453
## F_2018.00        0.2928188   0.1183852   0.7242699 -1.2282014
## B_2018.00/Bmsy   0.5535722   0.1803981   1.6987000 -0.5913631
## F_2018.00/Fmsy   1.4076320   0.7974832   2.4846012  0.3419088
##
## Predictions w 95% CI (inp$msytype: s)
##                 prediction       cilow       ciupp    log.est
## B_2019.00      327.640974 137.3328828 781.6671823  5.7919184
## F_2019.00        0.279126   0.1077023   0.7233949 -1.2760921
## B_2019.00/Bmsy   0.558506   0.1778991   1.7534040 -0.5824899
## F_2019.00/Fmsy   1.341808   0.7111508   2.5317405  0.2940181
## Catch_2019.00   92.320332  70.5597052 120.7919397  4.5252644
## E(B_inf)       382.030428          NA          NA  5.9455003
```

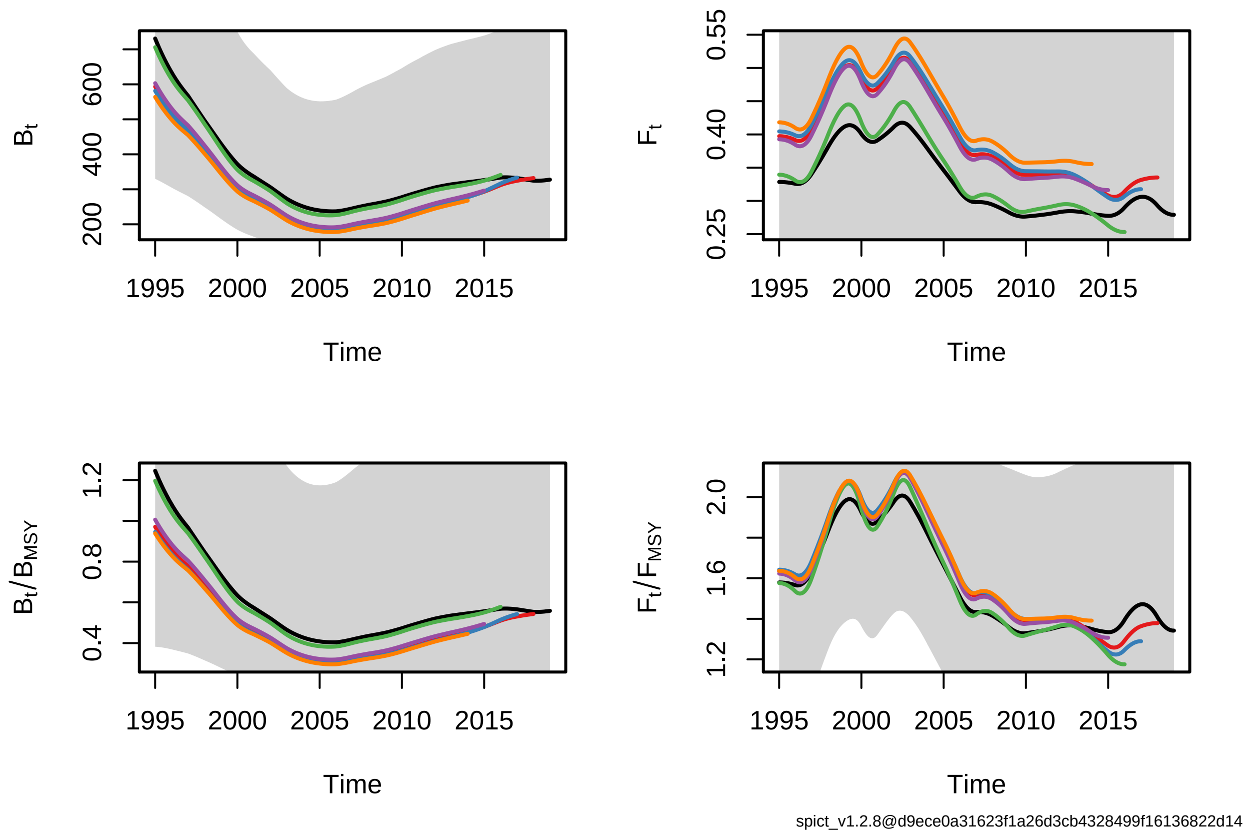


Catch
Relative biomass
Relative fishing mortality
Time
Catch
B_t/B_{MSY}
F_t/F_{MSY}
F_t
B_t
1995
2019
E(B∞)


Catch
log catch data
Time
Index 1
log index 1 data
Bias p−val: 0.8996
Jan
Apr
Jul
Oct
Catch OSA residuals
Bias p−val: 0.4623
Index 1 OSA residuals
LBox p−val: 0.1817
lag.signf: 2
Catch ACF
Lag
LBox p−val: 0.4399
Index 1 ACF
Shapiro p−val: 0.5378
Sample Quantiles
Theoretical Quantiles
Shapiro p−val: 0.8904
spict_v1.2.8@d9ece0a31623f1a26d3cb4328499f16136822d14

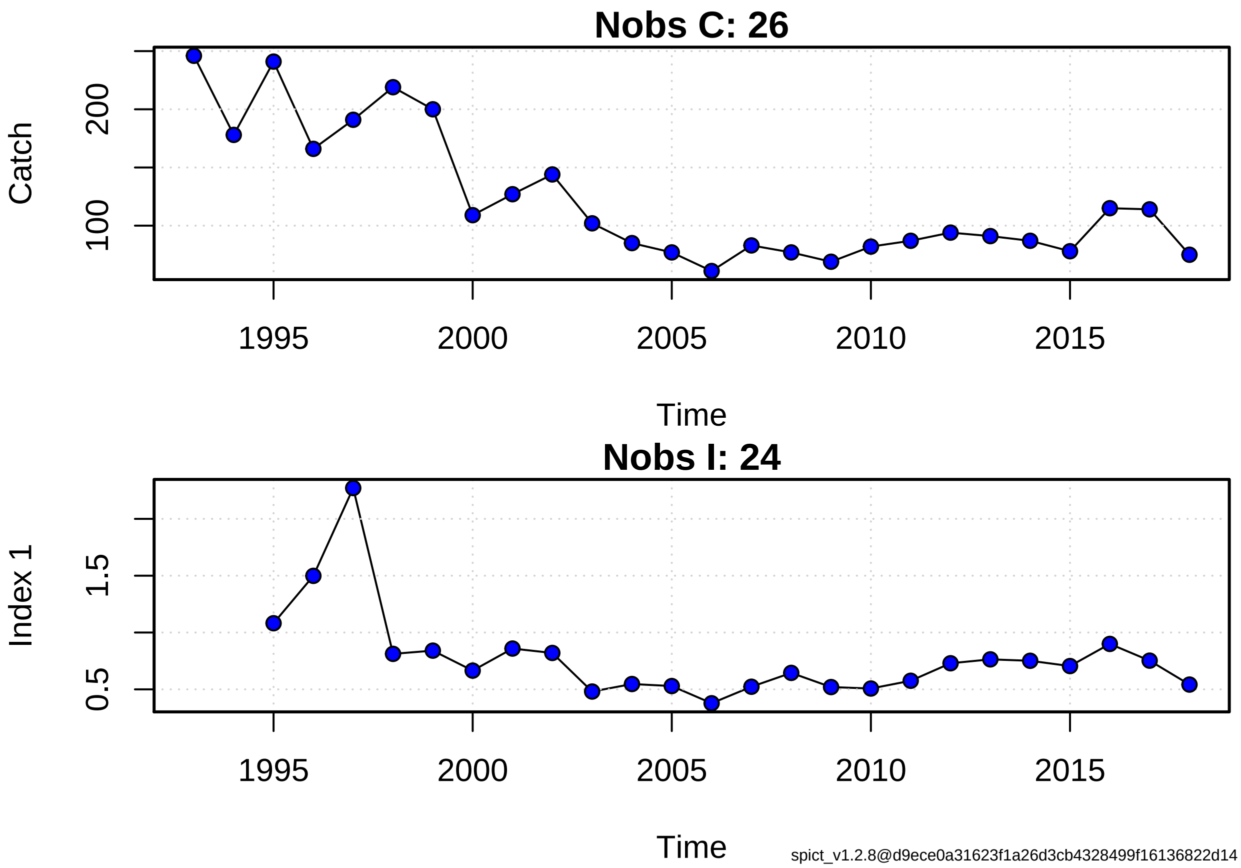

Prior
Post.
Density
0
2000
4000
1.9994
1.9998
2.0002
2.0006
n
Prior
Post.
Density
0.0
0.2
0.4
0.2
0.5
2.0
5.0
20.0
100.0
alpha
Prior
Post.
Density
0.0
0.2
0.4
0.6
0.2
0.5
1.0
2.0
5.0
10.0
beta


Production curve
Production
0
20
40
60
80
100
0.0
0.2
0.4
0.6
0.8
1.0
B/K
1995
1997
1999
2017
2009
2007
2003
2005
spict_v1.2.8@d9ece0a31623f1a26d3cb4328499f16136822d14



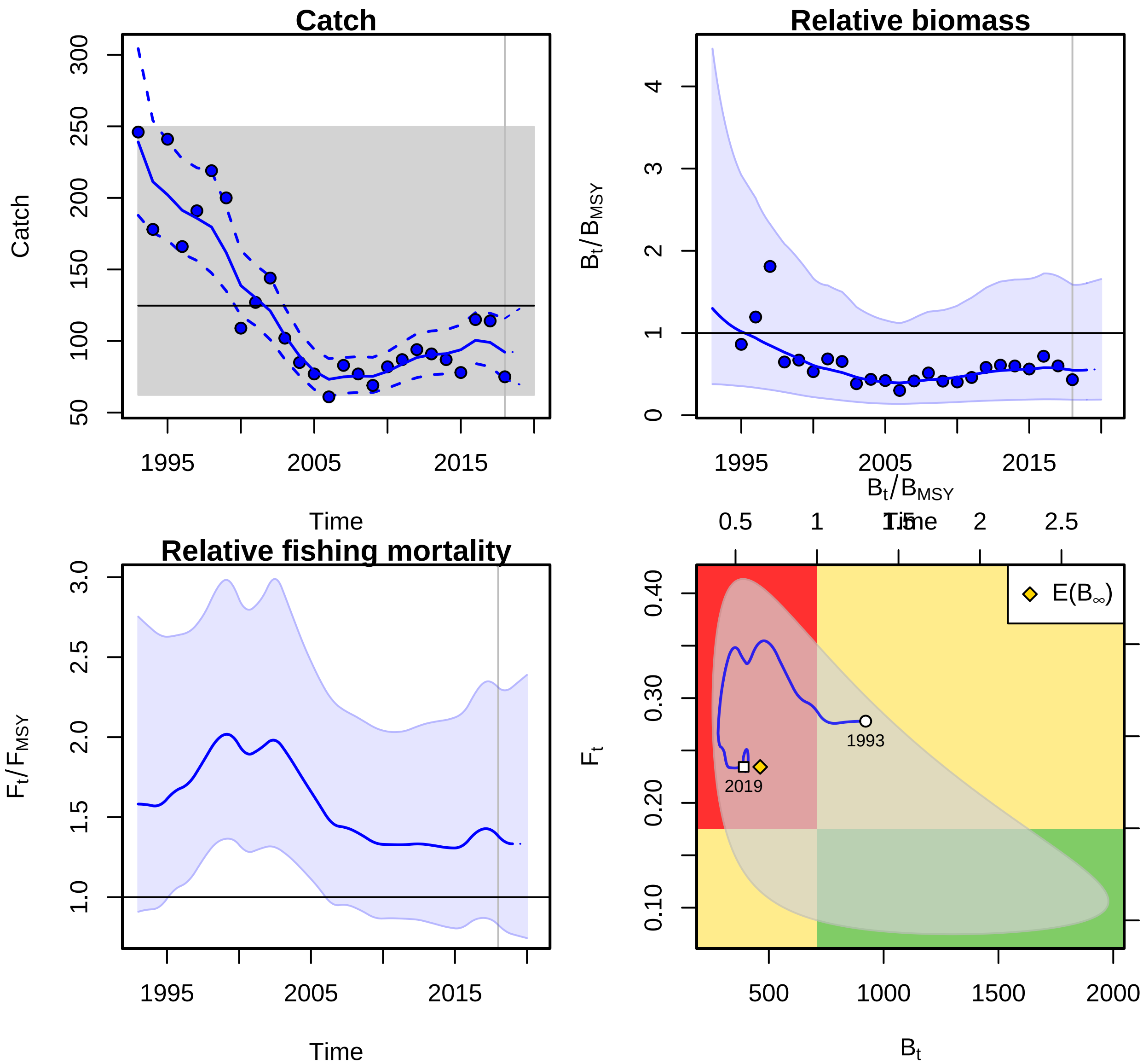
Bt
200
400
600
1995
2000
2005
2010
2015
Time
Ft
0.25
0.40
0.55
Bt/BMSY
0.4
0.8
1.2
Ft/FMSY
1.2
1.6
2.0
spict_v1.2.8@d9ece0a31623f1a26d3cb4328499f16136822d14

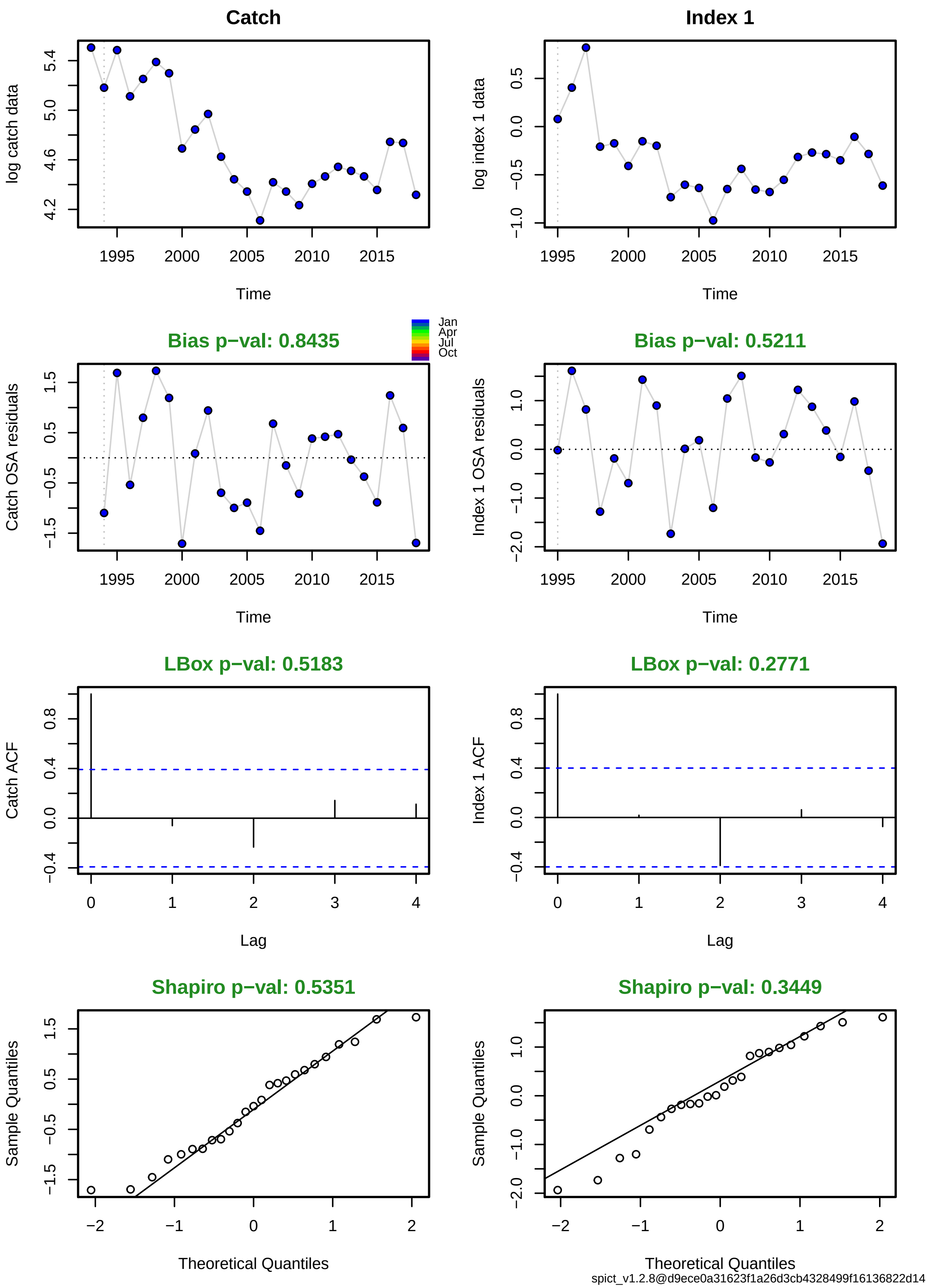
Scenario 4: Full catch time series from 1995 - 2018, lpue from 1995-2018. Shaefer model (n = 2). Assumption of depletion level in the beginning of the time series (half of carrying capacity), and downweighting of peak in LPUE (*5)

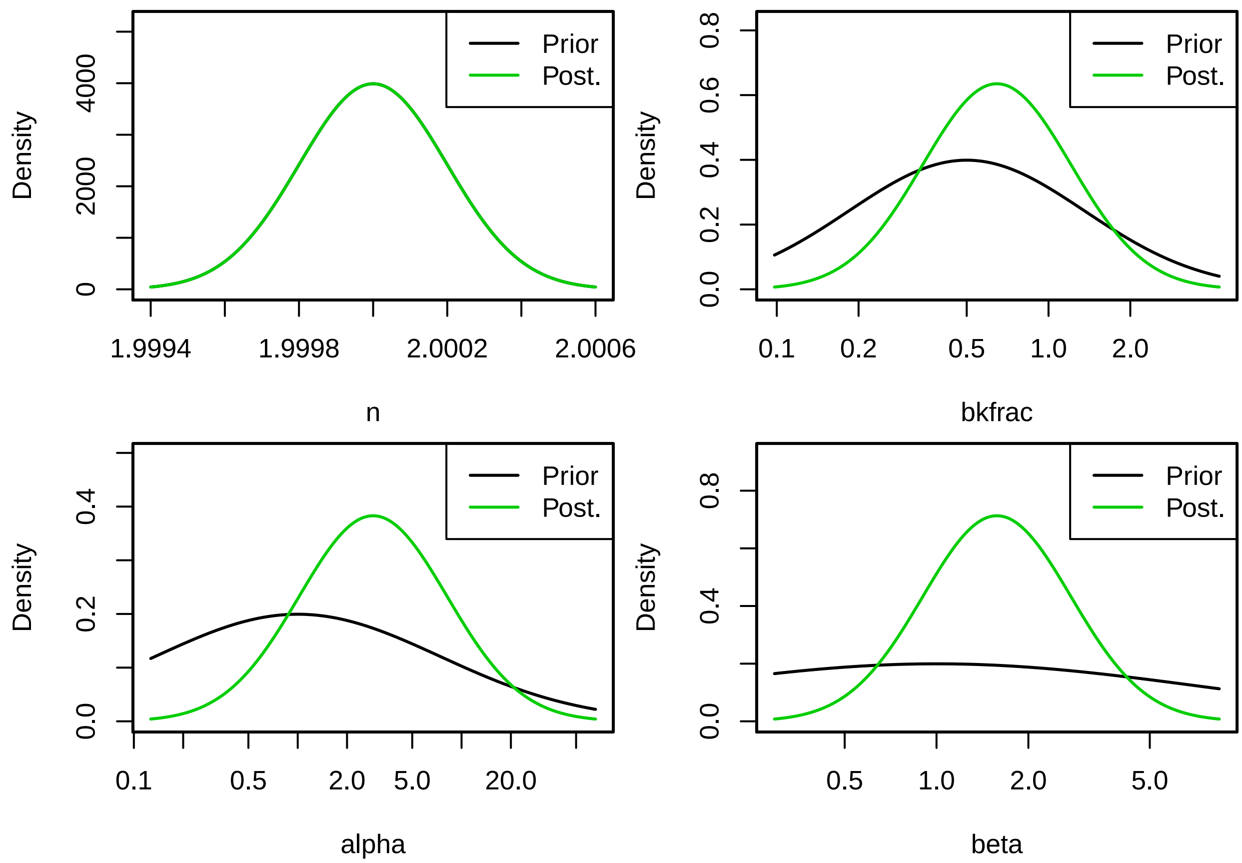


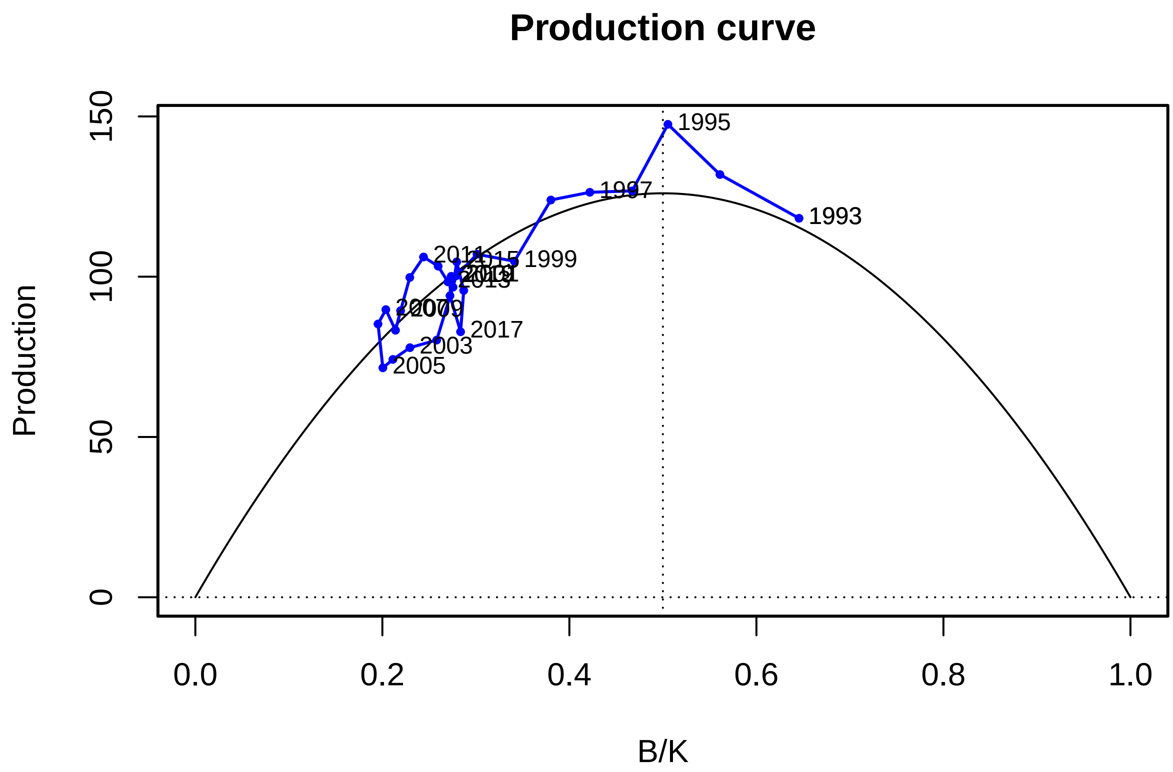

```
## Convergence: 0  MSG: both X-convergence and relative convergence (5)
## Objective function at optimum: -4.2810081
## Euler time step (years):  1/16 or 0.0625
## Nobs C: 26,  Nobs I1: 24
##
## Priors
##       logn  ~  dnorm[log(2), 0^2] (fixed)
##  logbkfrac  ~  dnorm[log(0.5), 1^2]
##   logalpha  ~  dnorm[log(1), 2^2]
##    logbeta  ~  dnorm[log(1), 2^2]
##
## Model parameter estimates w 95% CI
##             estimate       cilow        ciupp    log.est
##  alpha     2.8856167   0.3744904   22.2349720  1.0597386
##  beta      1.5769971   0.5267526    4.7212293  0.4555225
##  r         0.3530824   0.1789437    0.6966839 -1.0410538
##  rc        0.3530824   0.1789437    0.6966839 -1.0410538
##  rold      0.3530824   0.1789437    0.6966839 -1.0410538
##  m       126.0211513  63.6781154  249.4001348  4.8364498
##  K      1427.6684540 627.8662606 3246.2919931  7.2637979
##  q         0.0017679   0.0007865    0.0039737 -6.3379894
##  n         2.0000000   1.9996080    2.0003920  0.6931472
```

```
##  sdb       0.0574626   0.0086953    0.3797408 -2.8566211
##  sdf       0.0969235   0.0373594    0.2514542 -2.3338331
##  sdi       0.1658150   0.1174505    0.2340953 -1.7968825
##  sdc       0.1528481   0.1067438    0.2188655 -1.8783106
##
## Deterministic reference points (Drp)
##           estimate       cilow       ciupp   log.est
##  Bmsyd 713.8342260 313.9331328 1623.145979  6.570651
##  Fmsyd   0.1765412   0.0894718    0.348342 -1.734201
##  MSYd  126.0211513  63.6781154  249.400135  4.836450
## Stochastic reference points (Srp)
##           estimate       cilow        ciupp   log.est rel.diff.Drp
##  Bmsys 709.8188167 312.2942681 1613.3589504  6.565010 -0.005656950
##  Fmsys   0.1757235   0.0885347    0.3487753 -1.738844 -0.004653336
##  MSYs  124.7285283  62.3471348  249.5255930  4.826140 -0.010363491
##
## States w 95% CI (inp$msytype: s)
##                    estimate       cilow       ciupp    log.est
##  B_2018.00      388.7751355 170.2665814 887.7027117  5.9630011
##  F_2018.00        0.2429353   0.0989223   0.5966053 -1.4149602
##  B_2018.00/Bmsy   0.5477104   0.1889469   1.5876771 -0.6020086
##  F_2018.00/Fmsy   1.3824864   0.8271099   2.3107797  0.3238836
##
## Predictions w 95% CI (inp$msytype: s)
##                  prediction       cilow       ciupp    log.est
##  B_2019.00      390.6162301 170.2166526 896.3931375  5.9677256
##  F_2019.00        0.2343231   0.0939374   0.5845092 -1.4510544
##  B_2019.00/Bmsy   0.5503041   0.1885798   1.6058700 -0.5972842
##  F_2019.00/Fmsy   1.3334764   0.7683884   2.3141414  0.2877894
##  Catch_2019.00   92.3911941  69.6724320 122.5180822  4.5260317
##  E(B_inf)       462.3733235          NA          NA  6.1363726
```

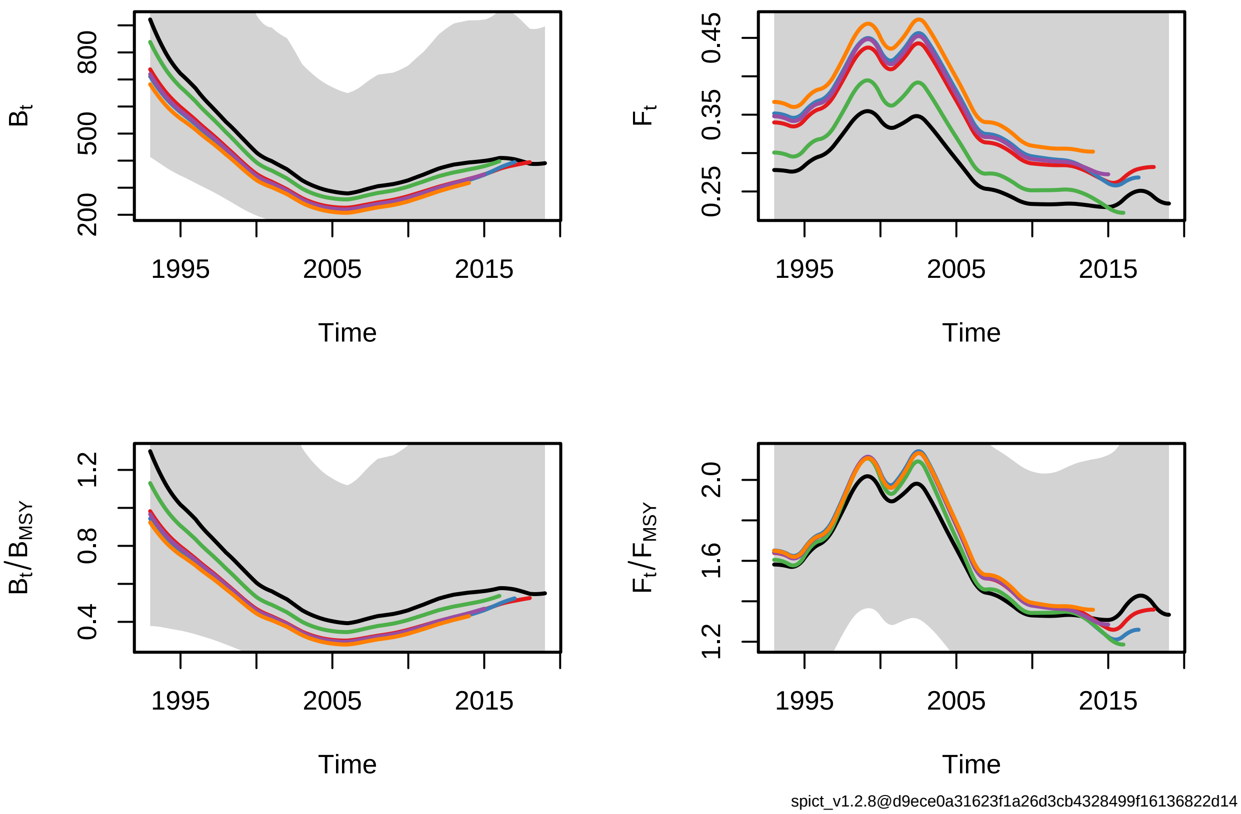

Catch
Catch
Time
Relative biomass
B_t/B_{MSY}
Time
Relative fishing mortality
F_t/F_{MSY}
Time
B_t/B_{MSY}
F_t
B_t
$E(B_\infty)$
1993
2019


Catch
log catch data
Time
Index 1
log index 1 data
Bias p−val: 0.8435
Catch OSA residuals
Jan
Apr
Jul
Oct
Bias p−val: 0.5211
Index 1 OSA residuals
LBox p−val: 0.5183
Catch ACF
Lag
LBox p−val: 0.2771
Index 1 ACF
Shapiro p−val: 0.5351
Sample Quantiles
Theoretical Quantiles
Shapiro p−val: 0.3449
spict_v1.2.8@d9ece0a31623f1a26d3cb4328499f16136822d14

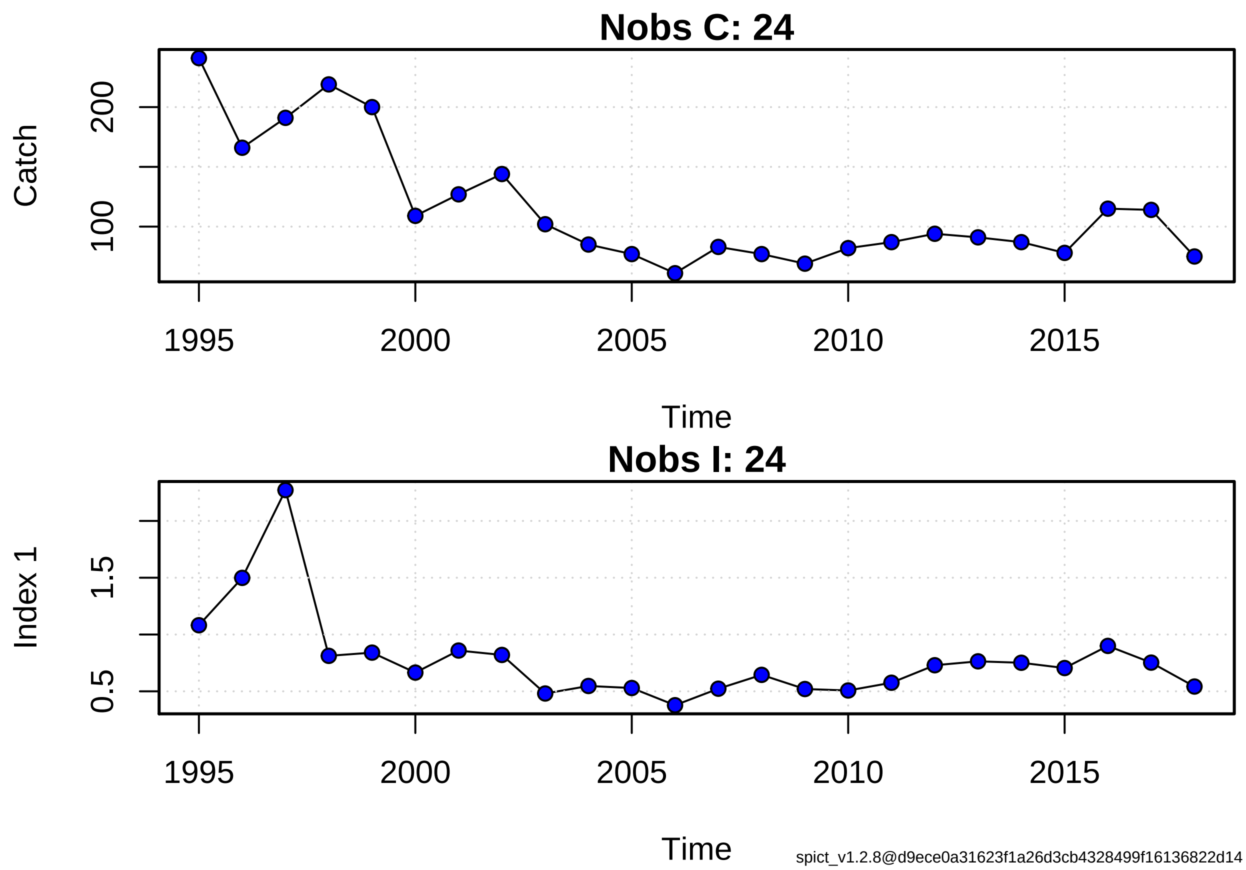

Prior
Post.
Density
0
2000
4000
1.9994
1.9998
2.0002
2.0006
n
Prior
Post.
Density
0.0
0.2
0.4
0.6
0.8
0.1
0.2
0.5
1.0
2.0
bkfrac
Prior
Post.
Density
0.0
0.2
0.4
0.1
0.5
2.0
5.0
20.0
alpha
Prior
Post.
Density
0.0
0.4
0.8
0.5
1.0
2.0
5.0
beta



spict_v1.2.8@d9ece0a31623f1a26d3cb4328499f16136822d14

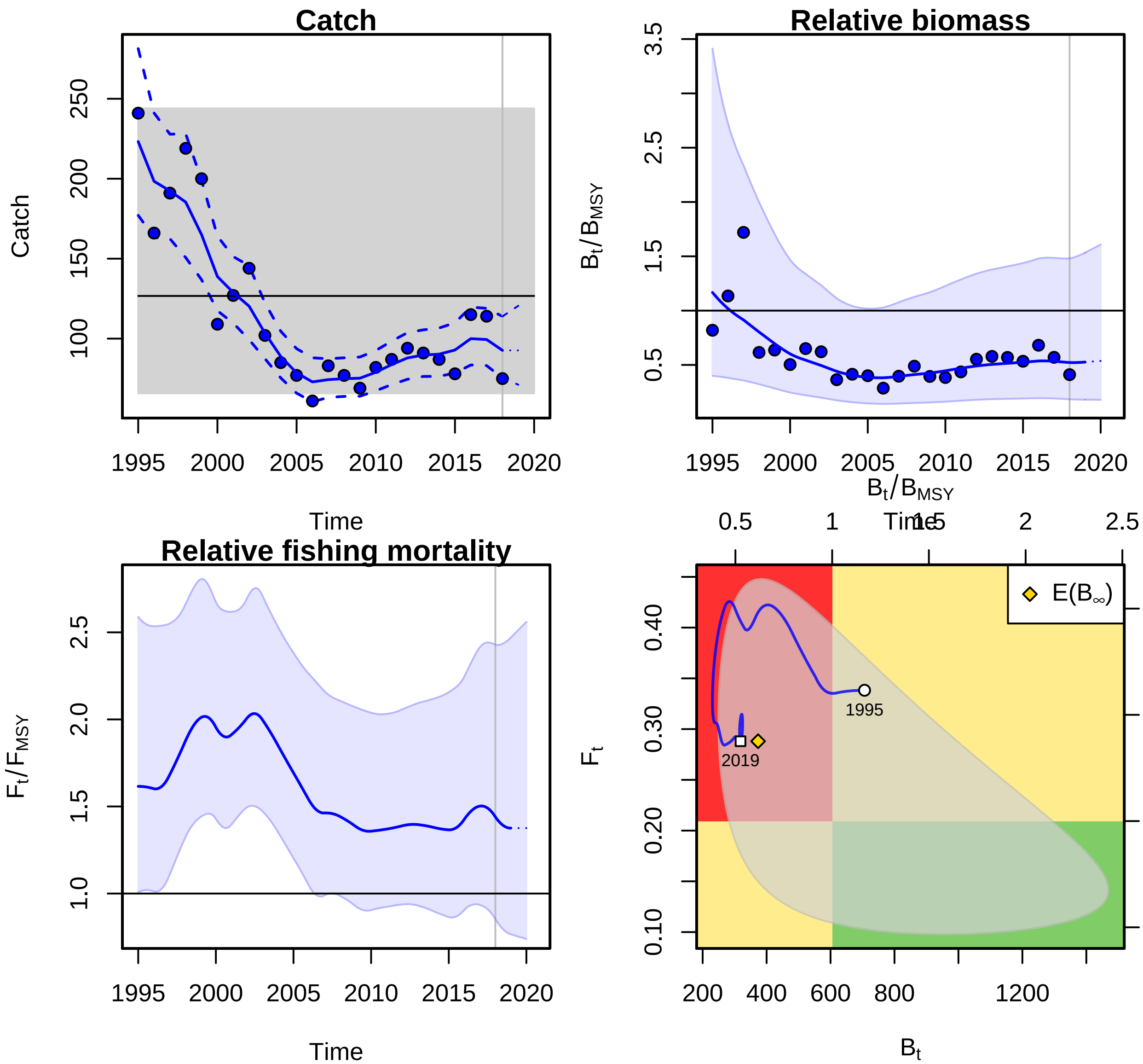

Bt
200
500
800
1995
2005
2015
Time
Ft
0.25
0.35
0.45
1995
2005
2015
Time
Bt/BMSY
0.4
0.8
1.2
1995
2005
2015
Time
Ft/FMSY
1.2
1.6
2.0
1995
2005
2015
Time
spict_v1.2.8@d9ece0a31623f1a26d3cb4328499f16136822d14

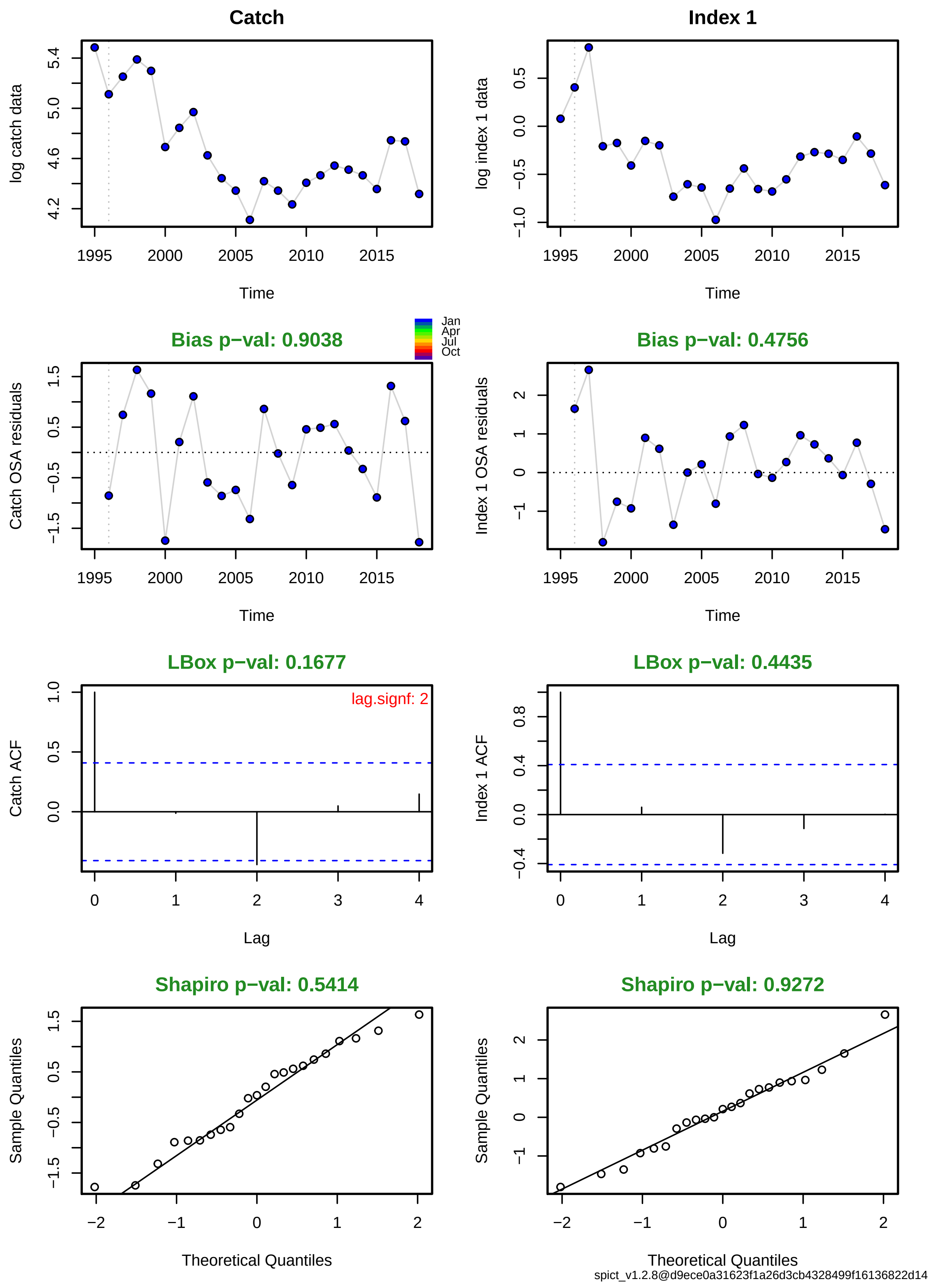
Scenario 5: Full catch time series from 1995 - 2018, lpue from 1995 - 2018. Shaefer model (n = 2). Additional assumption about depletion level in the beginning of the time serieshalf of carrying capacity. No weighting on peak in LPUE

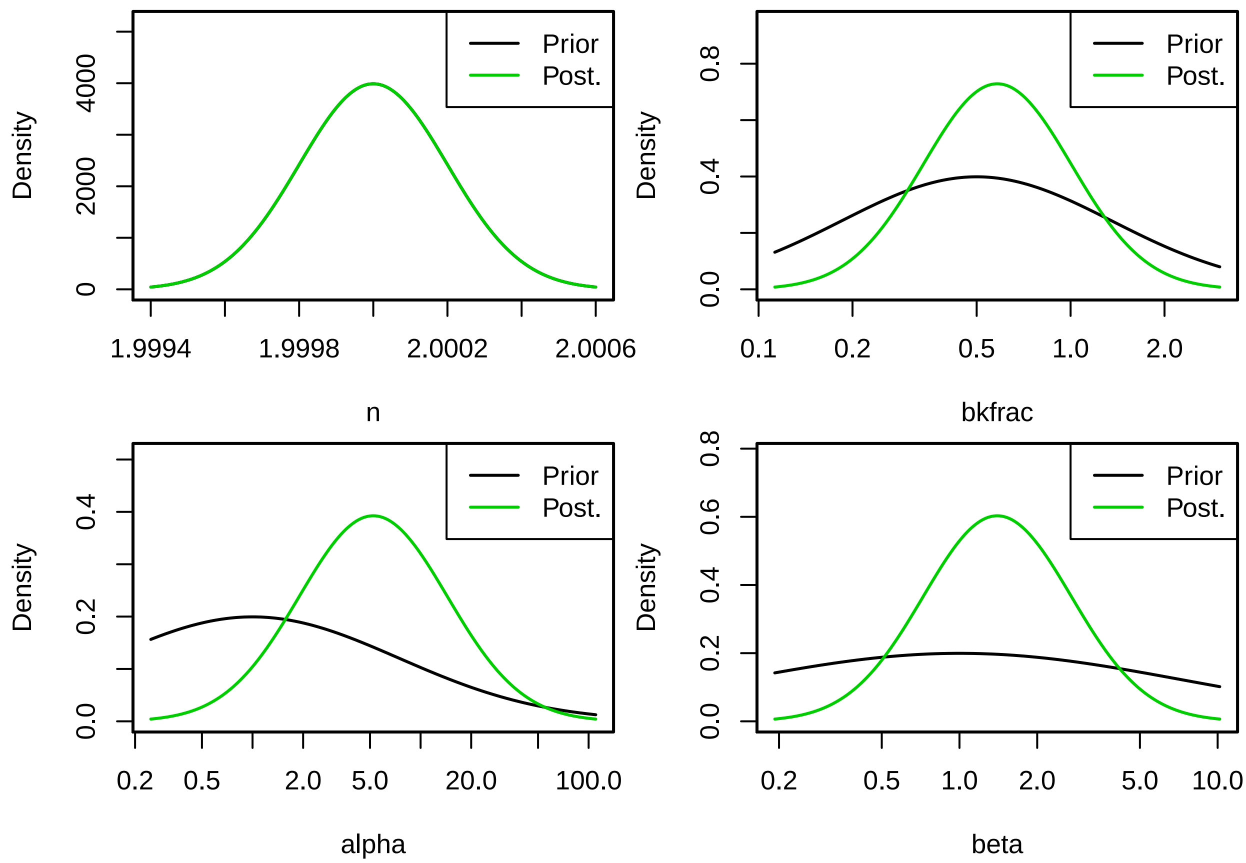



```
## Convergence: 0  MSG: relative convergence (4)
## Objective function at optimum: 0.1578722
## Euler time step (years):  1/16 or 0.0625
## Nobs C: 24,  Nobs I1: 24
##
## Priors
##       logn  ~  dnorm[log(2), 0^2] (fixed)
##  logbkfrac  ~  dnorm[log(0.5), 1^2]
##   logalpha  ~  dnorm[log(1), 2^2]
##    logbeta  ~  dnorm[log(1), 2^2]
##
## Model parameter estimates w 95% CI
##              estimate       cilow        ciupp    log.est
##  alpha      5.2299246   0.7136524   38.3269406  1.6543969
##  beta       1.4008964   0.3831689    5.1217895  0.3371123
##  r          0.4196474   0.2286226    0.7702824 -0.8683404
##  rc         0.4196474   0.2286226    0.7702824 -0.8683404
##  rold       0.4196474   0.2286226    0.7702824 -0.8683404
##  m        127.3057132  66.1849280  244.8706239  4.8465914
```

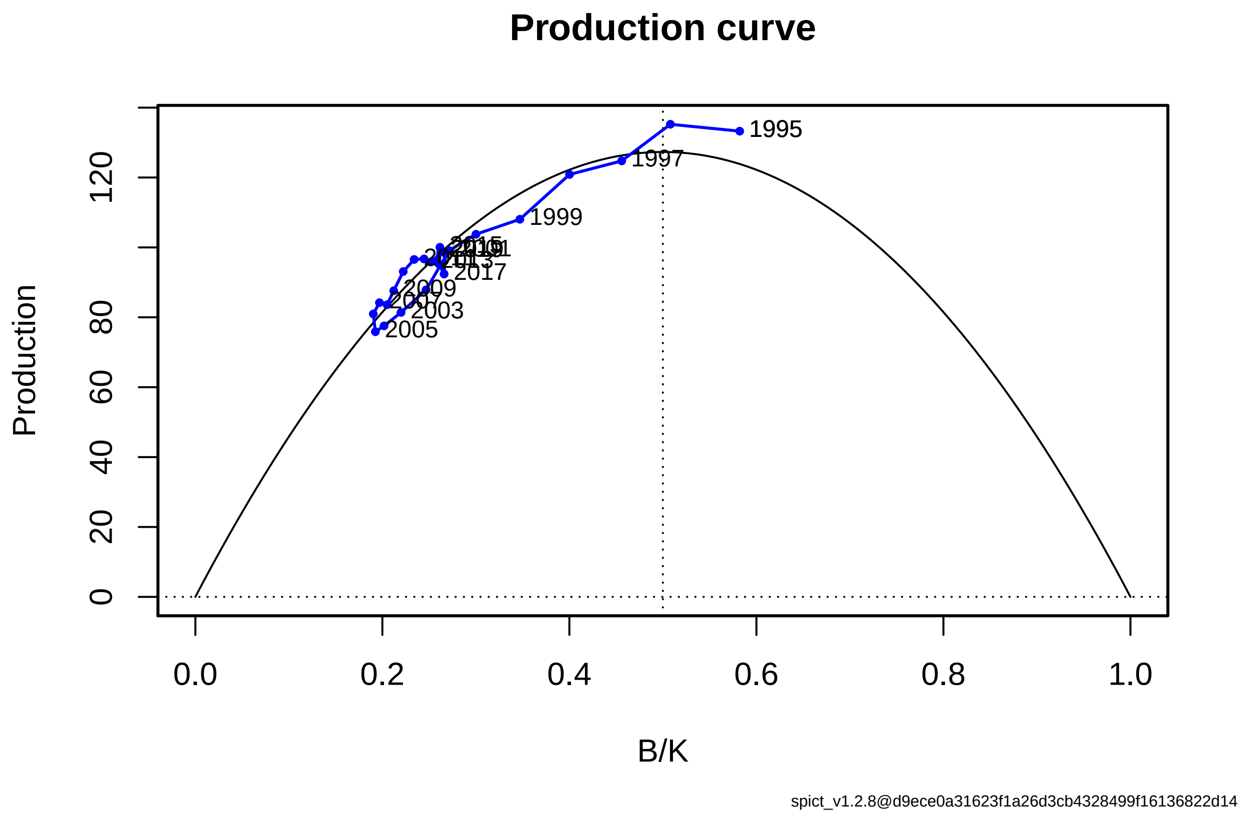
```
##  K      1213.4540146 595.9717987 2470.7052394  7.1012261
##  q         0.0021821   0.0010350    0.0046006 -6.1274732
##  n         2.0000000   1.9996080    2.0003920  0.6931472
##  sdb       0.0427526   0.0060095    0.3041479 -3.1523252
##  sdf       0.1055831   0.0364429    0.3058973 -2.2482568
##  sdi       0.2235929   0.1651192    0.3027739 -1.4979284
##  sdc       0.1479110   0.0986941    0.2216715 -1.9111446
##
## Deterministic reference points (Drp)
##          estimate       cilow        ciupp   log.est
##  Bmsyd 606.7270051 297.9859008 1235.3526050  6.408079
##  Fmsyd   0.2098237   0.1143113    0.3851412 -1.561488
##  MSYd  127.3057132  66.1849280  244.8706239  4.846591
## Stochastic reference points (Srp)
##         estimate       cilow        ciupp   log.est rel.diff.Drp
##  Bmsys 605.077809 297.3997139 1231.0676105  6.405357 -0.002725593
##  Fmsys   0.209373   0.1138861    0.3849202 -1.563638 -0.002152681
##  MSYs  126.686240  65.7801606  243.9854698  4.841714 -0.004889823
##
## States w 95% CI (inp$msytype: s)
##                   estimate       cilow       ciupp    log.est
##  B_2018.00      315.8179300 139.5232953 714.8696188  5.7551659
##  F_2018.00        0.3015811   0.1263855   0.7196331 -1.1987162
##  B_2018.00/Bmsy   0.5219460   0.1841092   1.4797063 -0.6501912
##  F_2018.00/Fmsy   1.4404010   0.8540420   2.4293360  0.3649216
##
## Predictions w 95% CI (inp$msytype: s)
##                 prediction       cilow       ciupp    log.est
##  B_2019.00      318.5137179 137.1780218 739.5571622  5.7636655
##  F_2019.00        0.2880492   0.1156545   0.7174155 -1.2446241
##  B_2019.00/Bmsy   0.5264013   0.1806707   1.5337204 -0.6416915
##  F_2019.00/Fmsy   1.3757701   0.7662196   2.4702361  0.3190137
##  Catch_2019.00   92.6082940  71.1667589 120.5098594  4.5283787
##  E(B_inf)       373.4400636          NA          NA  5.9227575
```

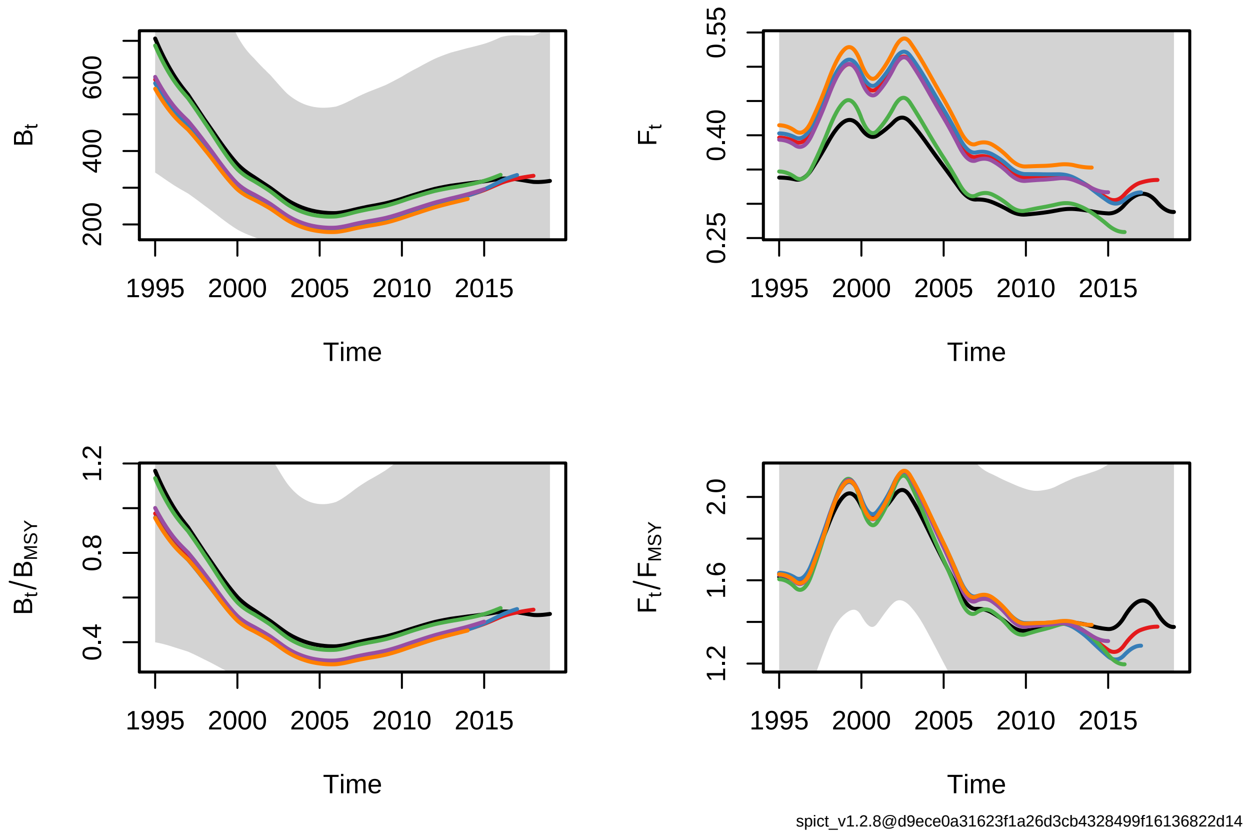

Catch
Relative biomass
Relative fishing mortality
Catch
Time
Bt/BMSY
Ft/FMSY
Ft
Bt
E(B∞)
1995
2019


Catch
log catch data
Time
Index 1
log index 1 data
Time
Bias p−val: 0.9038
Jan
Apr
Jul
Oct
Catch OSA residuals
Time
Bias p−val: 0.4756
Index 1 OSA residuals
Time
LBox p−val: 0.1677
lag.signf: 2
Catch ACF
Lag
LBox p−val: 0.4435
Index 1 ACF
Lag
Shapiro p−val: 0.5414
Sample Quantiles
Theoretical Quantiles
Shapiro p−val: 0.9272
Sample Quantiles
Theoretical Quantiles
spict_v1.2.8@d9ece0a31623f1a26d3cb4328499f16136822d14

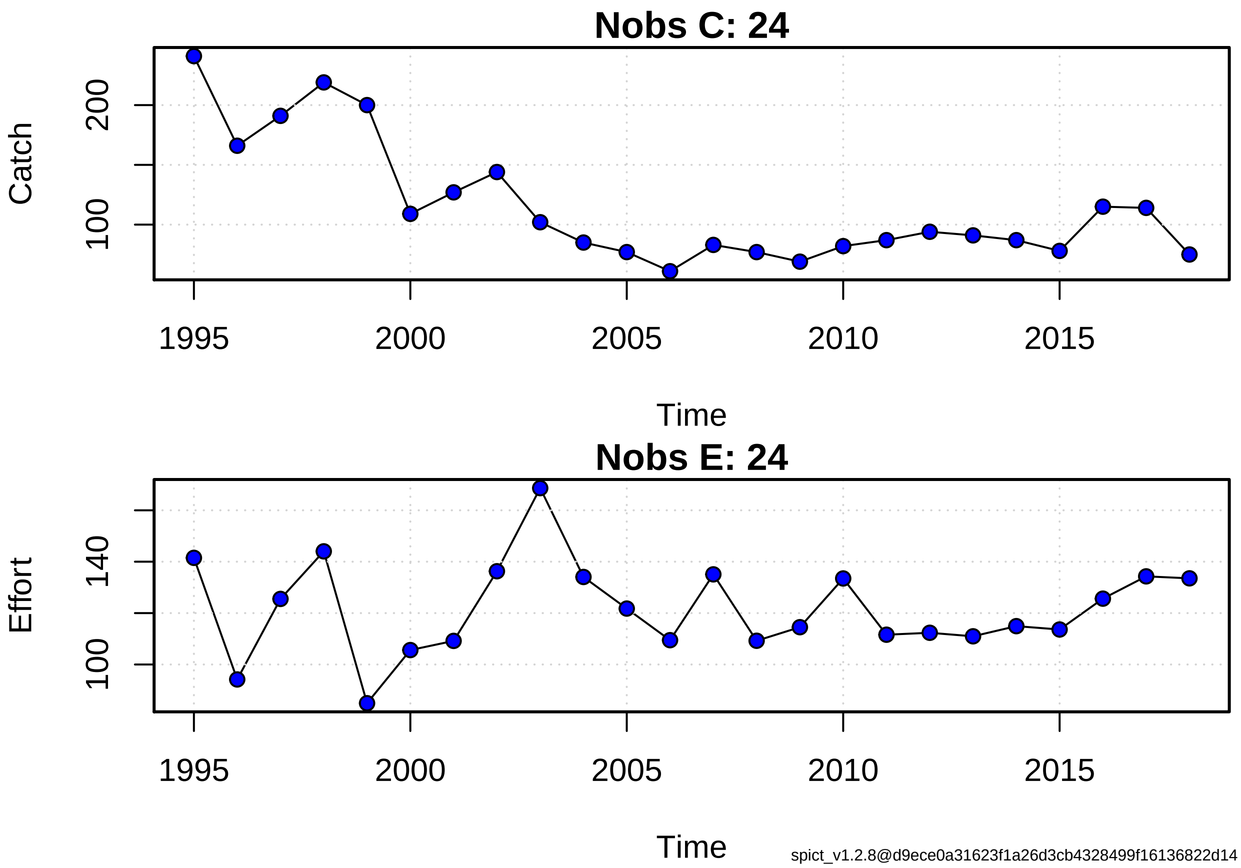


Density
Prior
Post.
n
bkfrac
alpha
beta


Production curve
Production
120
80
60
40
20
0
0.0
0.2
0.4
0.6
0.8
1.0
B/K
1995
1997
1999
2017
2009
2003
2005
spict_v1.2.8@d9ece0a31623f1a26d3cb4328499f16136822d14

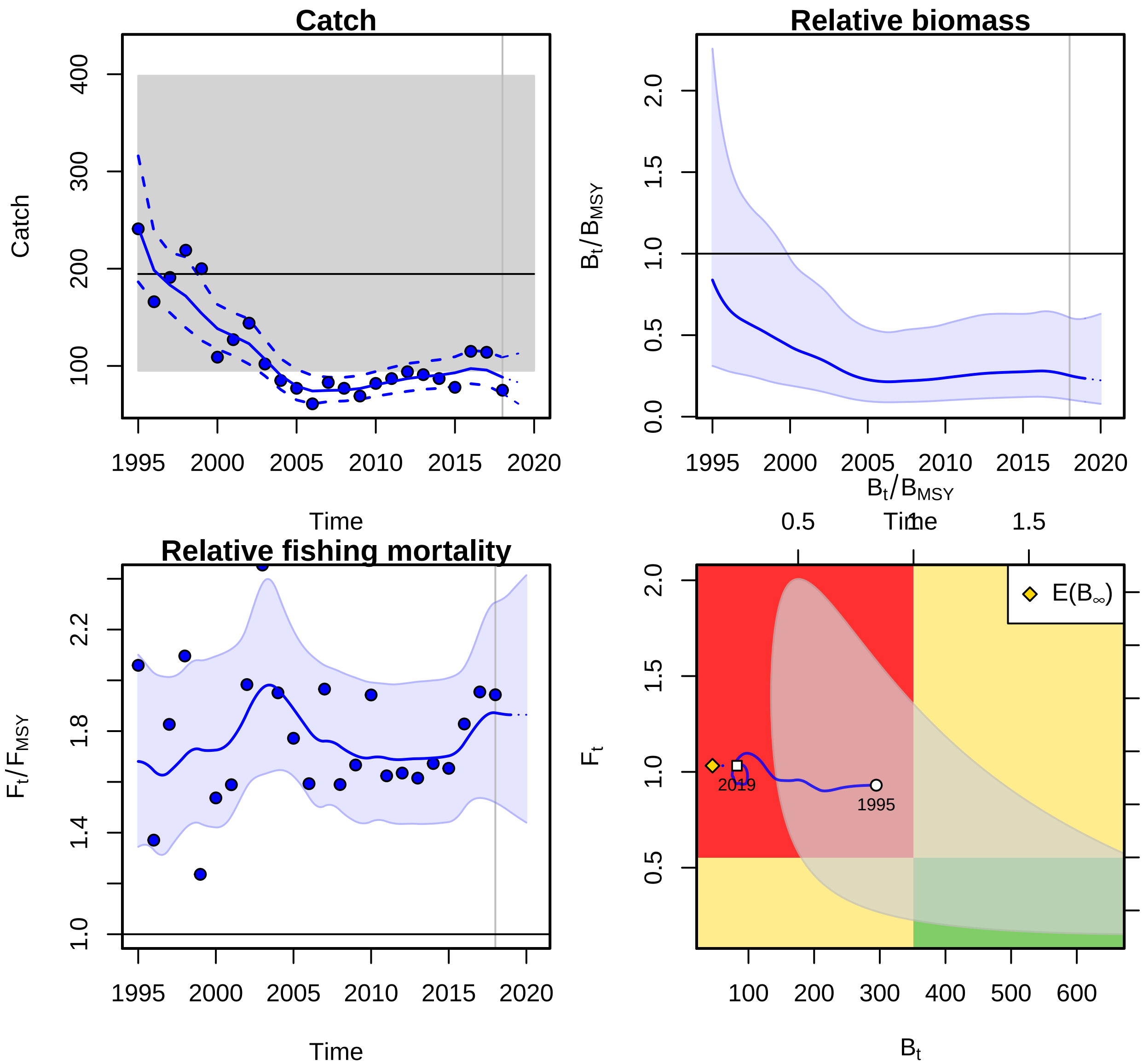

B_t
200
400
600
1995
2000
2005
2010
2015
Time
F_t
0.25
0.40
0.55
B_t/B_MSY
0.4
0.8
1.2
F_t/F_MSY
1.2
1.6
2.0
spict_v1.2.8@d9ece0a31623f1a26d3cb4328499f16136822d14

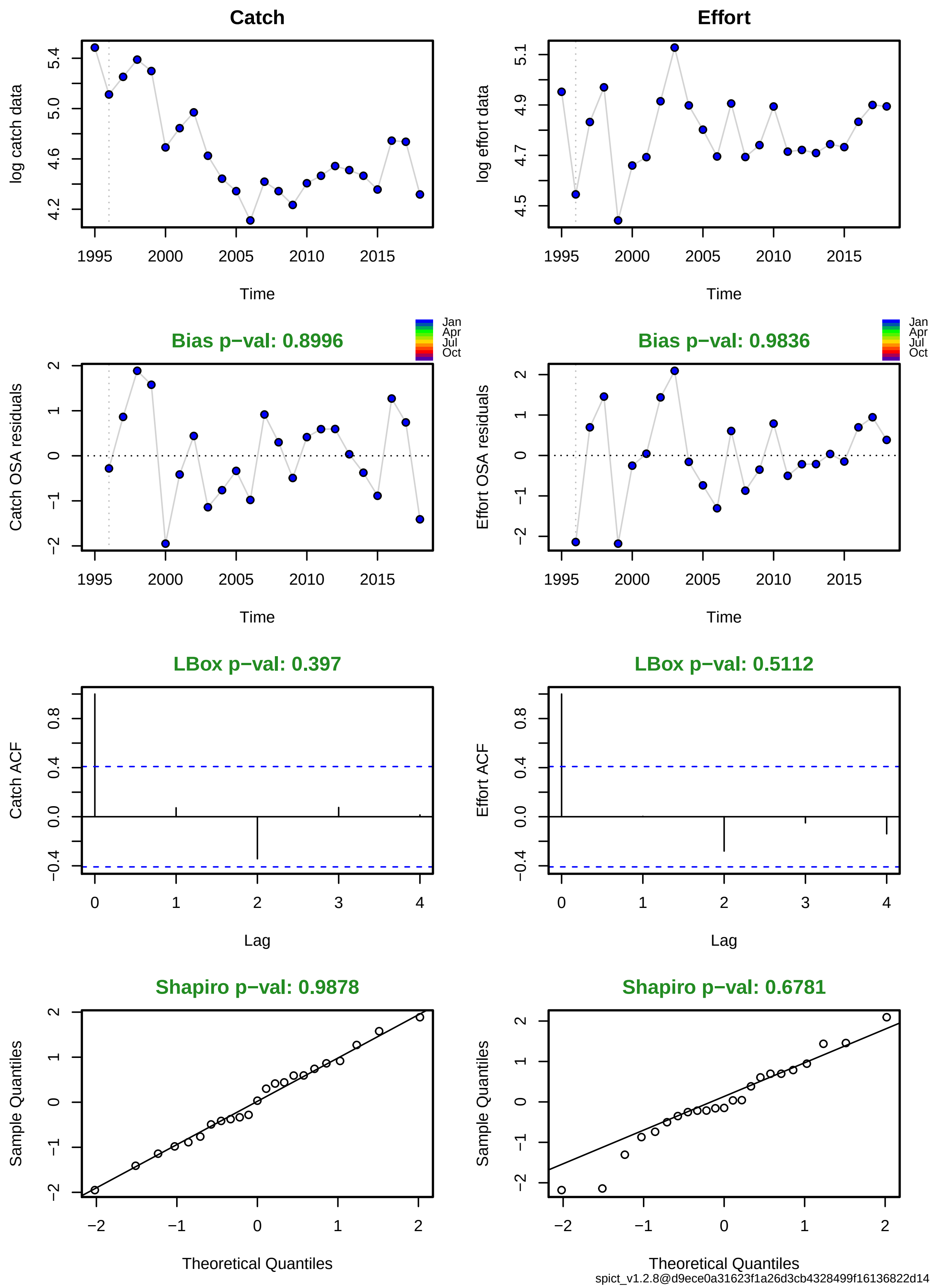
Scenario 6: Full catch time series from 1995 - 2018, effort from 1995 - 2018. Shaefer model (n = 2). Additional assumption about depletion level in the beginning of the time serieshalf of carrying capacity. No weighting on peak in LPUE

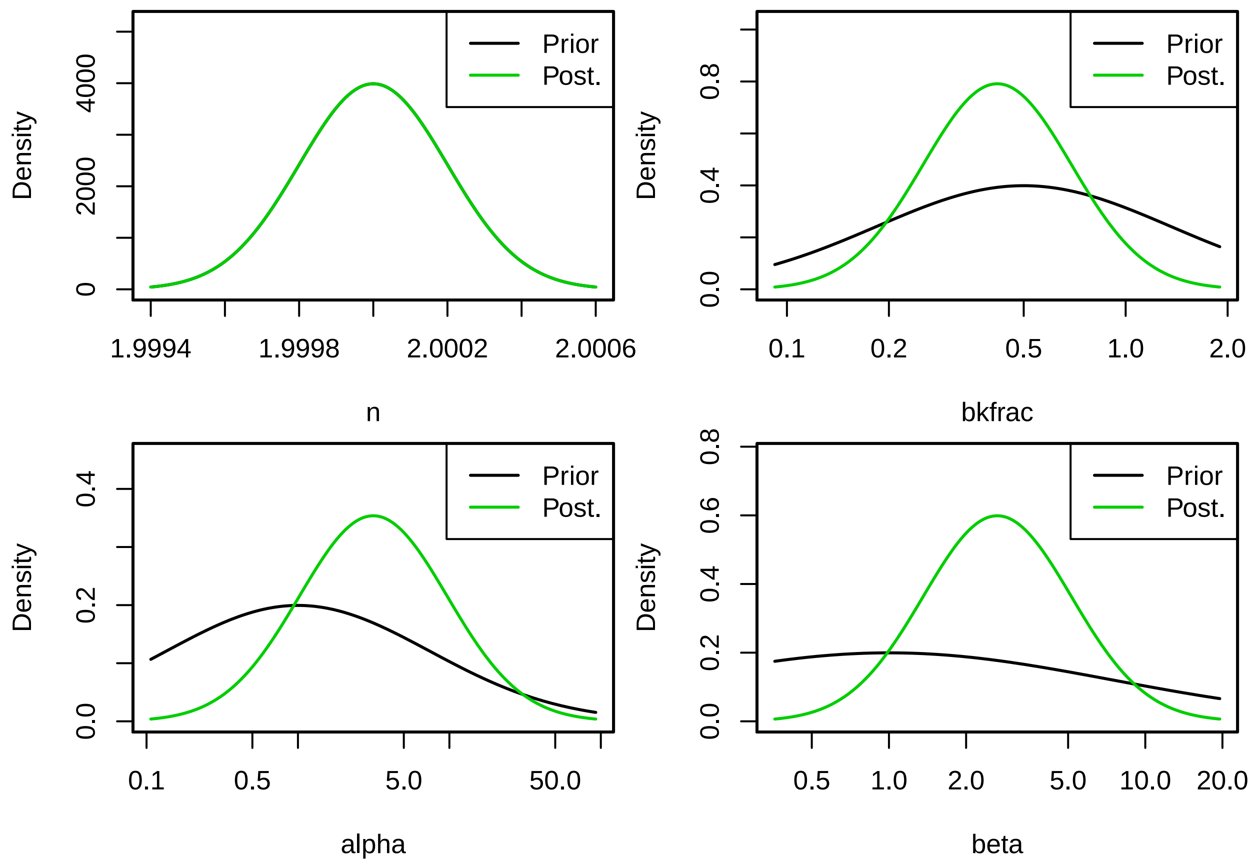


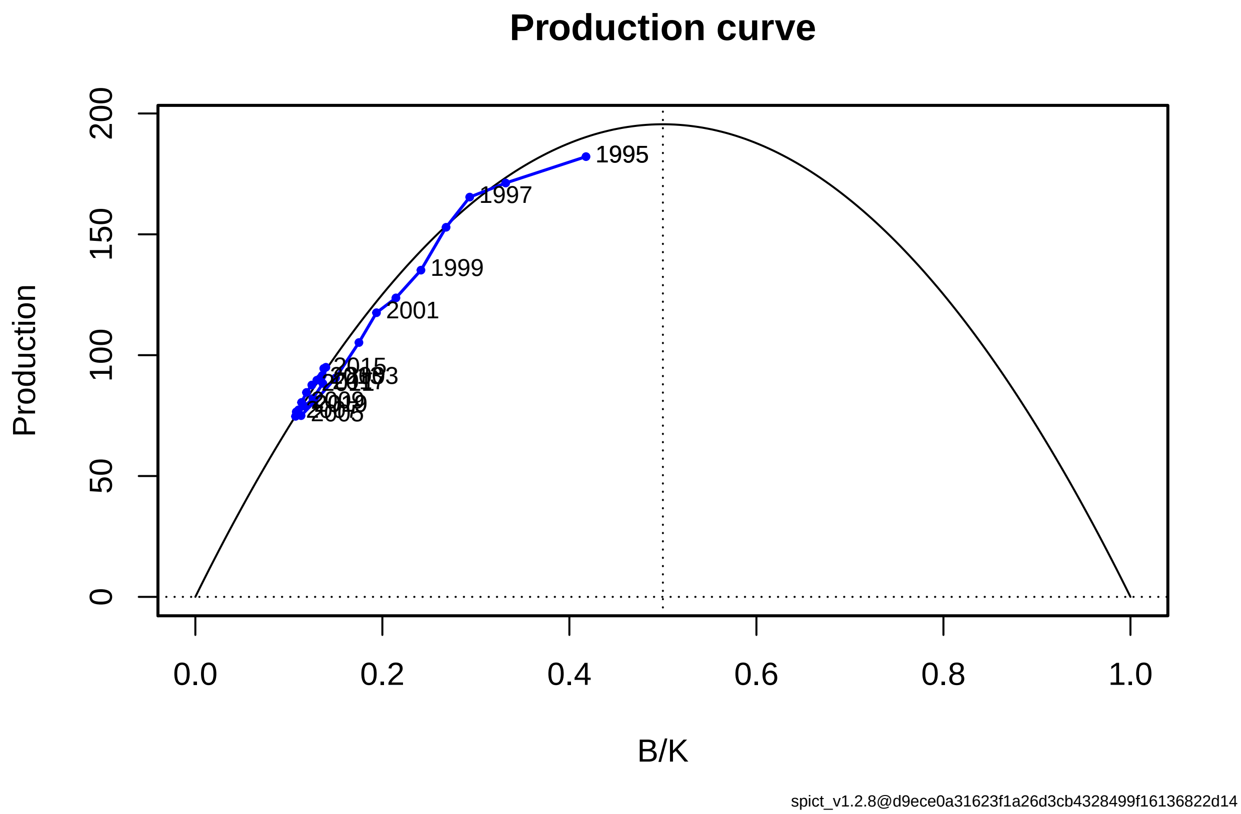

```
## Convergence: 0  MSG: relative convergence (4)
## Objective function at optimum: -10.7678053
## Euler time step (years):  1/16 or 0.0625
## Nobs C: 24,  Nobs E: 24
##
## Priors
##       logn  ~  dnorm[log(2), 0^2] (fixed)
##  logbkfrac  ~  dnorm[log(0.5), 1^2]
##   logalpha  ~  dnorm[log(1), 2^2]
##    logbeta  ~  dnorm[log(1), 2^2]
##
## Model parameter estimates w 95% CI
##            estimate       cilow        ciupp    log.est
##  beta      2.6459694   0.7169625    9.7650215  0.9730375
##  r         1.1091287   0.3967071    3.1009439  0.1035748
##  rc        1.1091287   0.3967071    3.1009438  0.1035748
##  rold      1.1091287   0.3967071    3.1009438  0.1035748
##  m       195.5355385  96.1298335  397.7344538  5.2757421
##  K       705.1860973 326.9605582 1520.9401237  6.5584617
```

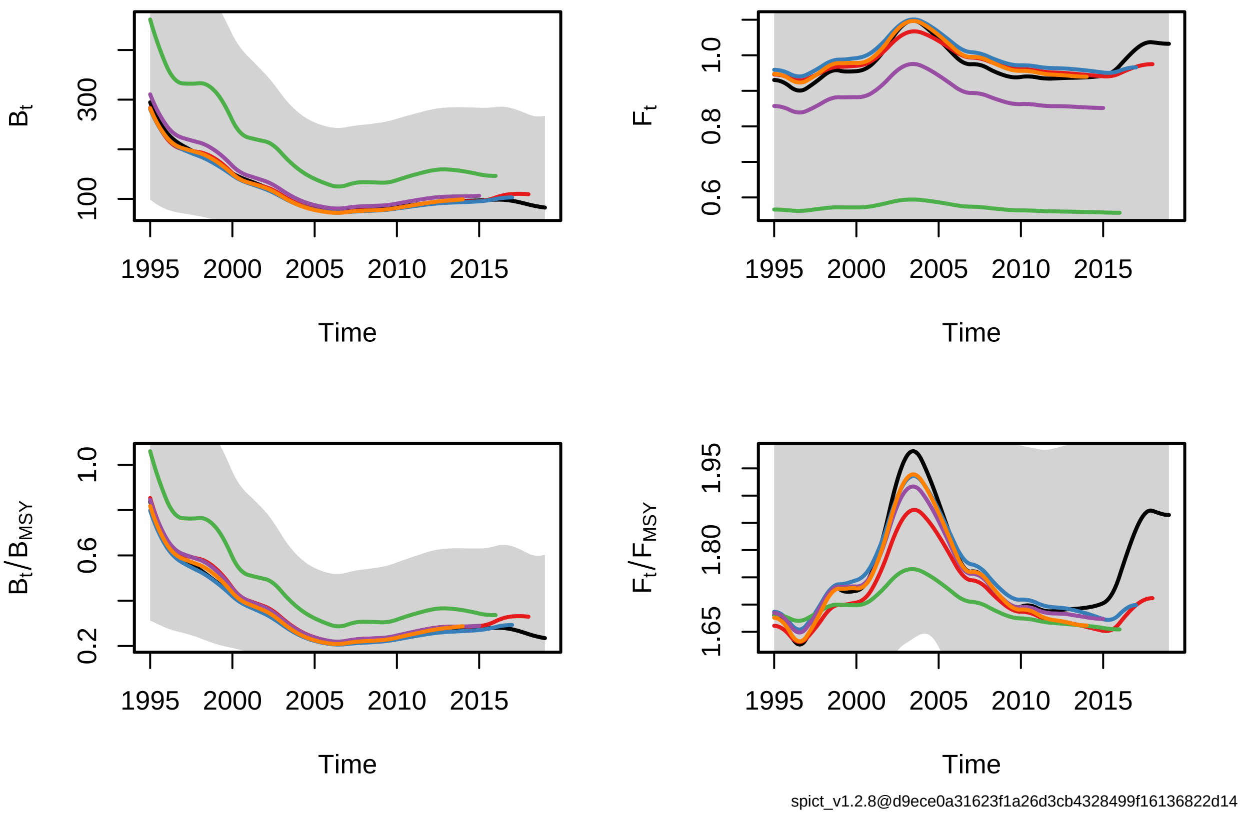
```
##  qf       0.0080578   0.0027222    0.0238510 -4.8211142
##  n        2.0000000   1.9996080    2.0003920  0.6931472
##  sdb      0.0636370   0.0069794    0.5802339 -2.7545597
##  sdf      0.0594337   0.0180449    0.1957543 -2.8228936
##  sde      0.1338793   0.0958074    0.1870801 -2.0108169
##  sdc      0.1572598   0.1065432    0.2321184 -1.8498561
##
## Deterministic reference points (Drp)
##           estimate       cilow      ciupp    log.est
##  Bmsyd 352.5930479 163.4802828 760.470041  5.8653146
##  Fmsyd   0.5545644   0.1983536   1.550472 -0.5895724
##  MSYd  195.5355385  96.1298335 397.734454  5.2757421
## Stochastic reference points (Srp)
##          estimate       cilow      ciupp    log.est rel.diff.Drp
##  Bmsys 351.360669 162.7975046 758.330543  5.8618132 -0.003507446
##  Fmsys   0.553701   0.1974626   1.552622 -0.5911305 -0.001559256
##  MSYs  194.547680  94.9908091 398.446966  5.2706773 -0.005077720
##
## States w 95% CI (inp$msytype: s)
##                   estimate      cilow       ciupp    log.est
##  B_2018.00      88.7229360 29.1323969 270.2063748  4.4855184
##  F_2018.00       1.0364785  0.3489991   3.0781963  0.0358289
##  B_2018.00/Bmsy  0.2525124  0.1048836   0.6079359 -1.3762948
##  F_2018.00/Fmsy  1.8719102  1.5189735   2.3068526  0.6269594
##
## Predictions w 95% CI (inp$msytype: s)
##                 prediction      cilow       ciupp    log.est
##  B_2019.00      82.4499143 25.4335479 267.2843133  4.4121910
##  F_2019.00       1.0323345  0.3437845   3.0999496  0.0318228
##  B_2019.00/Bmsy  0.2346589  0.0913043   0.6030909 -1.4496222
##  F_2019.00/Fmsy  1.8644261  1.4802466   2.3483145  0.6229533
##  Catch_2019.00  83.0401350 61.1330314 112.7976783  4.4193240
##  E(B_inf)       45.2235353         NA          NA  3.8116176
```


Catch
Relative biomass
Relative fishing mortality
Time
E(B∞)
2019
1995


Catch
log catch data
Time
Effort
log effort data
Time
Bias p−val: 0.8996
Catch OSA residuals
Jan
Apr
Jul
Oct
Bias p−val: 0.9836
Effort OSA residuals
LBox p−val: 0.397
Catch ACF
Lag
LBox p−val: 0.5112
Effort ACF
Lag
Shapiro p−val: 0.9878
Sample Quantiles
Theoretical Quantiles
Shapiro p−val: 0.6781
Sample Quantiles
Theoretical Quantiles
spict_v1.2.8@d9ece0a31623f1a26d3cb4328499f16136822d14

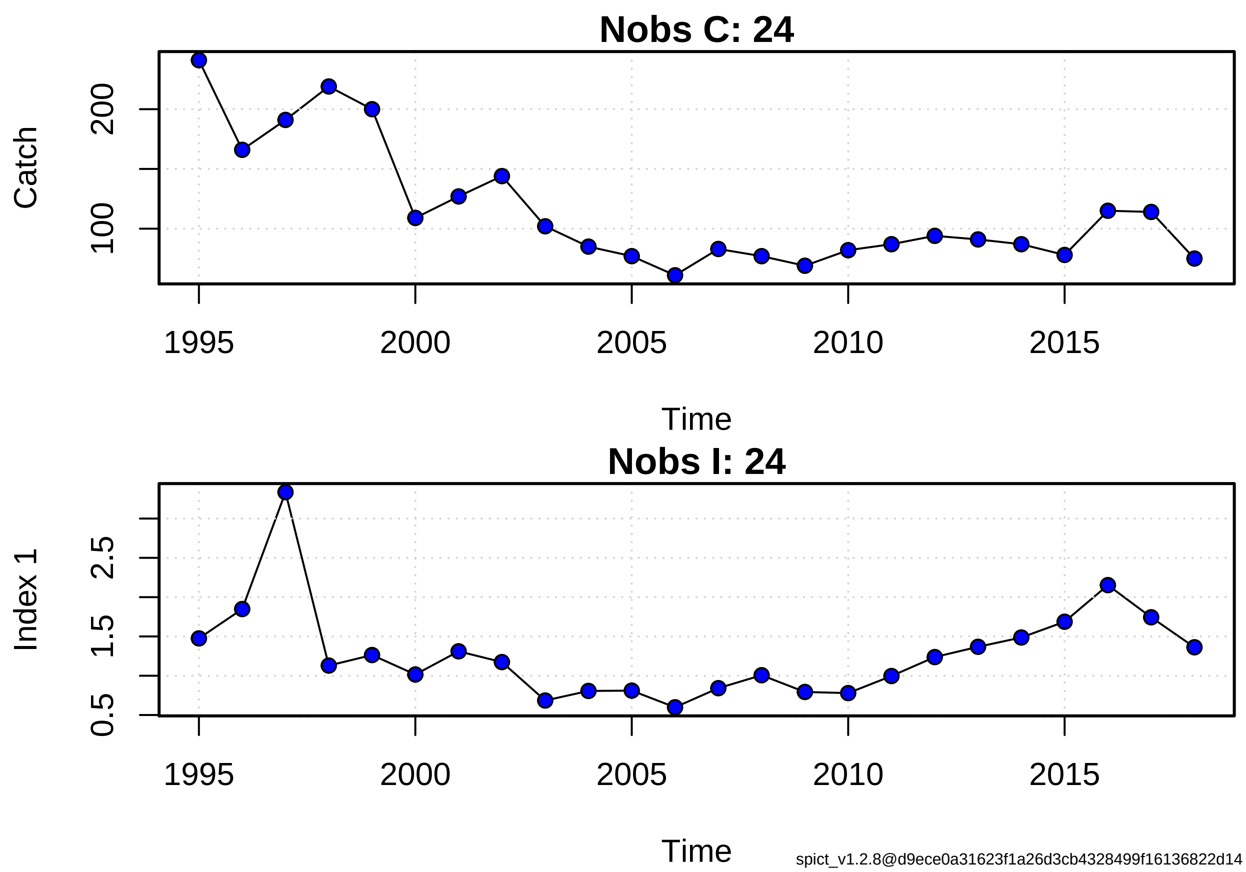

Prior
Post.
Density
0
2000
4000
1.9994
1.9998
2.0002
2.0006
n
0.0
0.4
0.8
0.1
0.2
0.5
1.0
2.0
bkfrac
0.0
0.2
0.4
0.1
0.5
5.0
50.0
alpha
0.0
0.2
0.4
0.6
0.8
0.5
1.0
2.0
5.0
10.0
20.0
beta


Production curve
Production
200
150
100
50
0
1995
1997
1999
2001
2015
2003
2005
2019
0.0
0.2
0.4
0.6
0.8
1.0
B/K
spict_v1.2.8@d9ece0a31623f1a26d3cb4328499f16136822d14



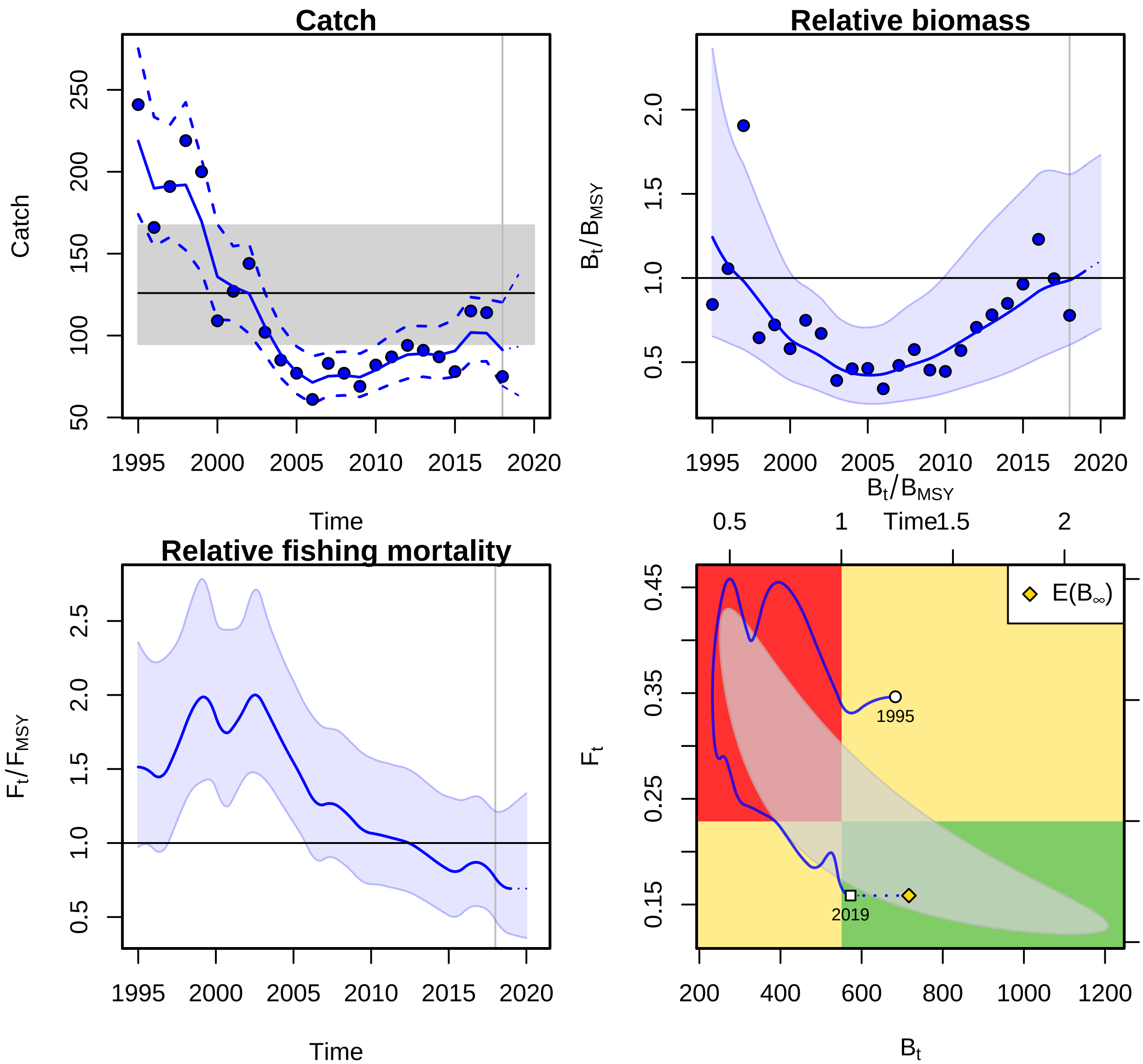
Scenario 7: Full catch time series from 1995 - 2018, effort from 1995 - 2018. Shaefer model (n = 2). Additional assumption about depletion level in the beginning of the time serieshalf of carrying capacity. No weighting on peak in LPUE - OTB Fleet Only!!!

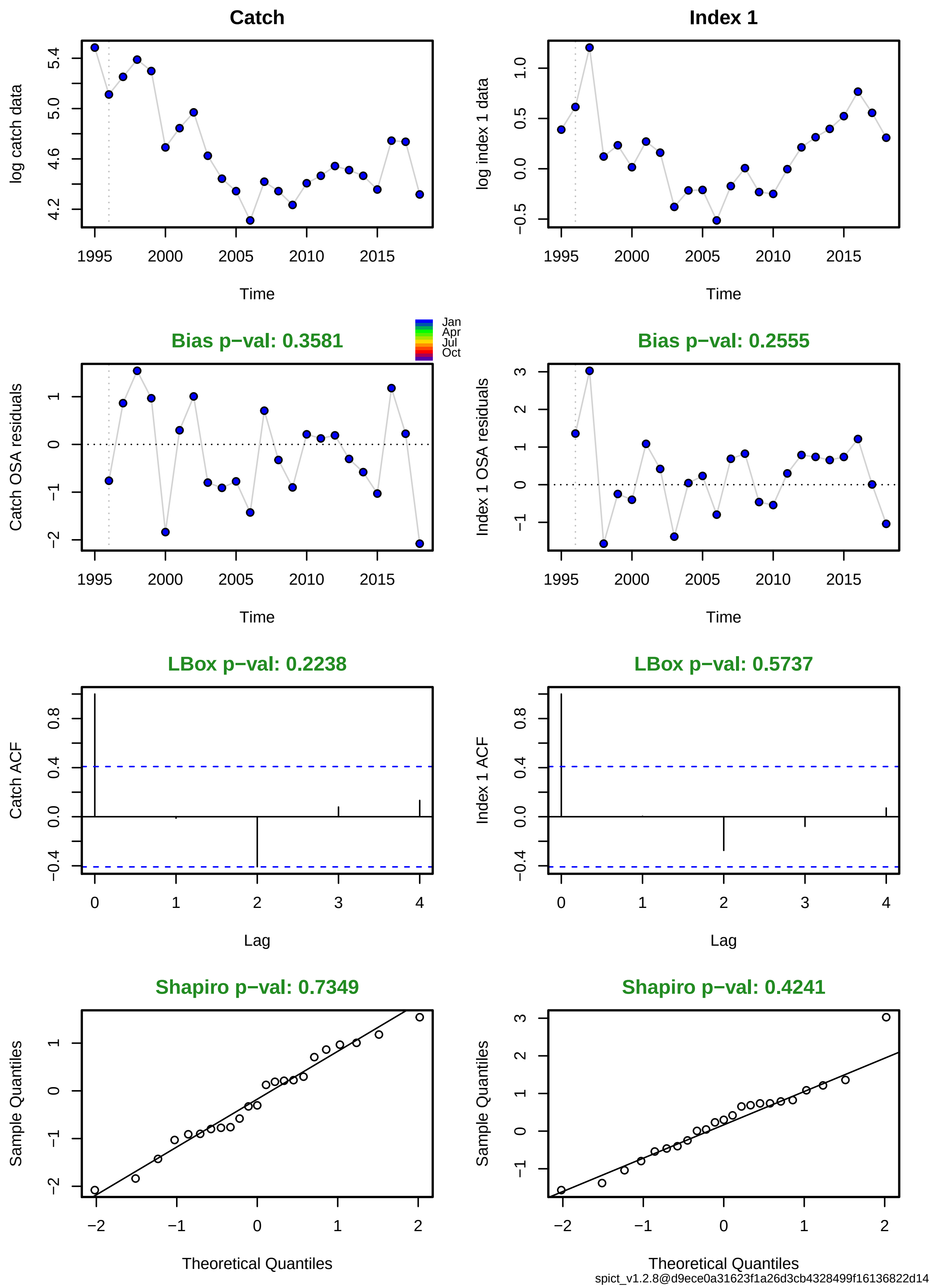
This fleet constitutes the majority of the catch in this area. Although there is some OTB_CRU in this area but mostly OTB_DEF so this is valid. . .

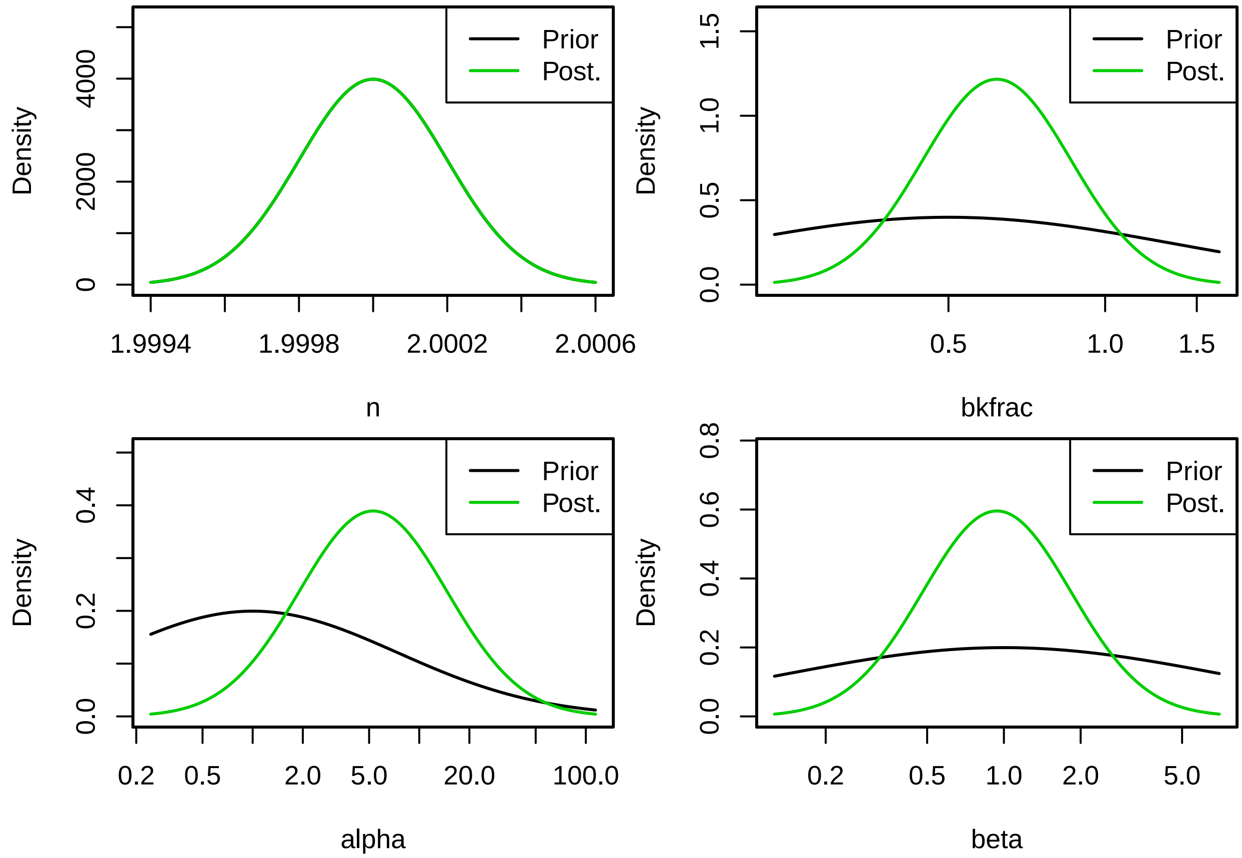


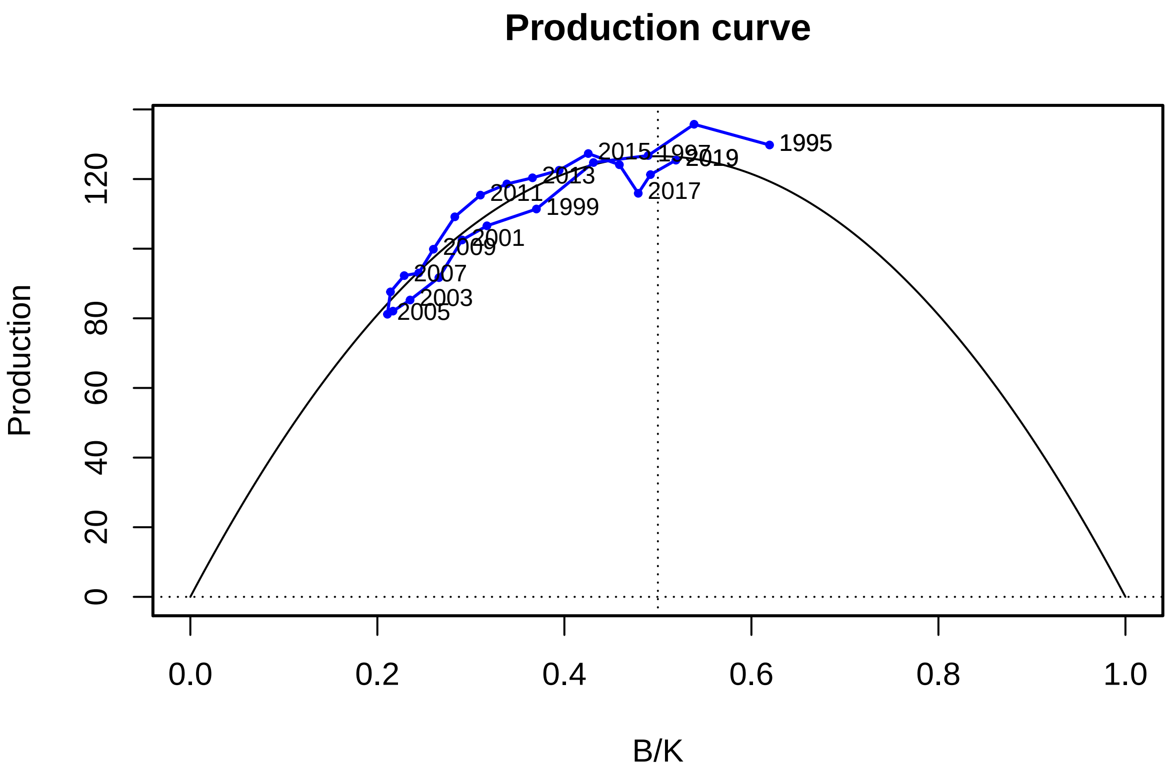

```
## Convergence: 0  MSG: relative convergence (4)
## Objective function at optimum: 2.2877484
## Euler time step (years):  1/16 or 0.0625
## Nobs C: 24,  Nobs I1: 24
##
## Priors
##       logn  ~  dnorm[log(2), 0^2] (fixed)
##  logbkfrac  ~  dnorm[log(0.5), 1^2]
##   logalpha  ~  dnorm[log(1), 2^2]
##    logbeta  ~  dnorm[log(1), 2^2]
##
## Model parameter estimates w 95% CI
##             estimate       cilow        ciupp    log.est
##  alpha     5.2856572   0.7093017   39.3882742  1.6649970
##  beta      0.9384873   0.2526296    3.4863621 -0.0634860
##  r         0.4588862   0.2773165    0.7593364 -0.7789531
##  rc        0.4588862   0.2773165    0.7593364 -0.7789531
##  rold      0.4588862   0.2773165    0.7593364 -0.7789531
##  m       126.5464055  95.5421133  167.6118751  4.8406091
##  K      1103.0744764 587.4102195 2071.4200399  7.0058565
##  q         0.0031833   0.0019856    0.0051034 -5.7498374
##  n         2.0000000   1.9996080    2.0003920  0.6931472
##  sdb       0.0442915   0.0061377    0.3196215 -3.1169615
##  sdf       0.1484062   0.0601181    0.3663518 -1.9078023
##  sdi       0.2341099   0.1726338    0.3174781 -1.4519646
##  sdc       0.1392773   0.0808093    0.2400486 -1.9712883
```

```
##
## Deterministic reference points (Drp)
##          estimate       cilow        ciupp   log.est
##  Bmsyd 551.5372380 293.7051128 1035.7100085  6.312709
##  Fmsyd   0.2294431   0.1386583    0.3796682 -1.472100
##  MSYd  126.5464055  95.5421133  167.6118751  4.840609
## Stochastic reference points (Srp)
##          estimate       cilow        ciupp   log.est rel.diff.Drp
##  Bmsys 550.0329821 292.8934349 1032.9227130  6.309978 -0.002734847
##  Fmsys   0.2289609   0.1382239    0.3792621 -1.474204 -0.002105972
##  MSYs  125.9353136  94.7935316  167.3078631  4.835768 -0.004852427
##
## States w 95% CI (inp$msytype: s)
##                   estimate       cilow       ciupp    log.est
##  B_2018.00      542.7939224 349.0090723 844.1764570  6.2967297
##  F_2018.00        0.1749218   0.1041318   0.2938357 -1.7434163
##  B_2018.00/Bmsy   0.9868389   0.6028969   1.6152860 -0.0132485
##  F_2018.00/Fmsy   0.7639811   0.4808500   1.2138238 -0.2692122
##
## Predictions w 95% CI (inp$msytype: s)
##                 prediction       cilow       ciupp    log.est
##  B_2019.00      572.8304919 367.1345059 893.7726287  6.3505898
##  F_2019.00        0.1584911   0.0862362   0.2912865 -1.8420568
##  B_2019.00/Bmsy   1.0414475   0.6503331   1.6677805  0.0406116
##  F_2019.00/Fmsy   0.6922192   0.3837252   1.2487252 -0.3678527
##  Catch_2019.00   93.2592440  63.4870993 136.9929747  4.5353832
##  E(B_inf)       716.5638680          NA          NA  6.5744674
```

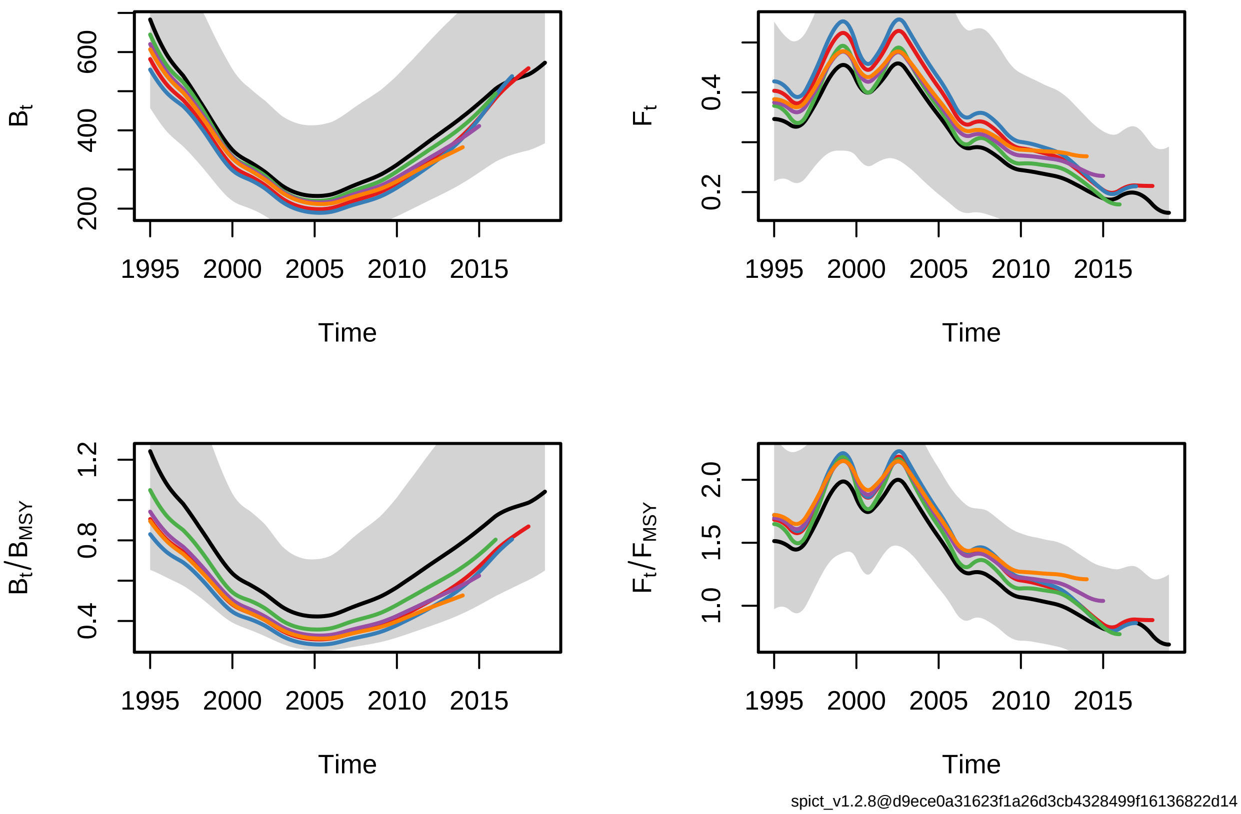

Catch
Relative biomass
Relative fishing mortality
Catch
Time
B_t/B_{MSY}
F_t/F_{MSY}
F_t
B_t
$E(B_\infty)$
1995
2019


Catch
log catch data
Time
Index 1
log index 1 data
Time
Bias p−val: 0.3581
Jan
Apr
Jul
Oct
Catch OSA residuals
Time
Bias p−val: 0.2555
Index 1 OSA residuals
Time
LBox p−val: 0.2238
Catch ACF
Lag
LBox p−val: 0.5737
Index 1 ACF
Lag
Shapiro p−val: 0.7349
Sample Quantiles
Theoretical Quantiles
Shapiro p−val: 0.4241
Sample Quantiles
Theoretical Quantiles
spict_v1.2.8@d9ece0a31623f1a26d3cb4328499f16136822d14

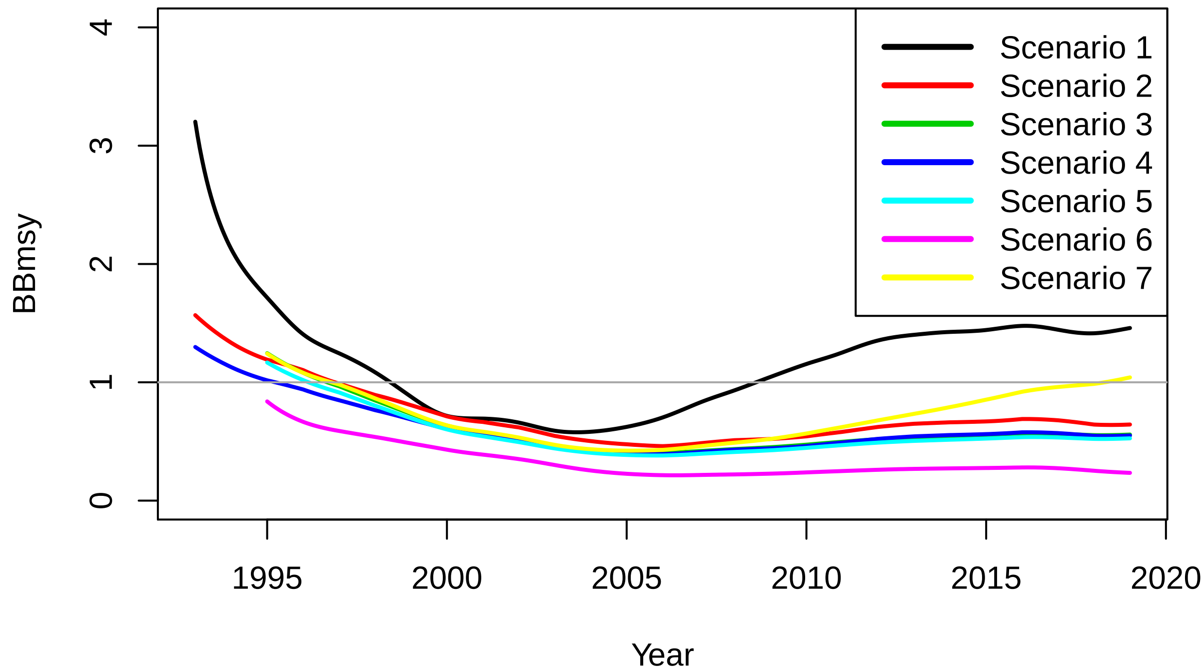

Prior
Post.
Density
0
2000
4000
1.9994
1.9998
2.0002
2.0006
n
Prior
Post.
Density
0.0
0.5
1.0
1.5
0.5
1.0
1.5
bkfrac
Prior
Post.
Density
0.0
0.2
0.4
0.2
0.5
2.0
5.0
20.0
100.0
alpha
Prior
Post.
Density
0.0
0.2
0.4
0.6
0.8
0.2
0.5
1.0
2.0
5.0
beta

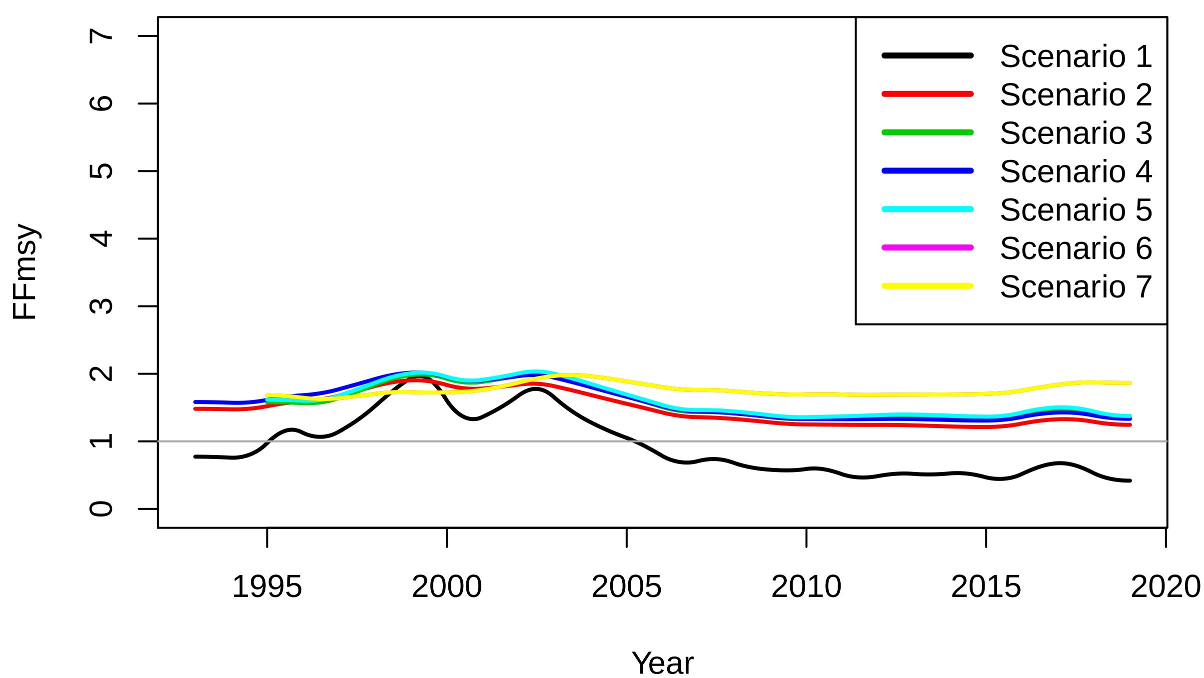


spict_v1.2.8@d9ece0a31623f1a26d3cb4328499f16136822d14


B_t
200
400
600
1995 2000 2005 2010 2015
Time
F_t
0.2
0.4
1995 2000 2005 2010 2015
Time
B_t/B_{MSY}
0.4
0.8
1.2
1995 2000 2005 2010 2015
Time
F_t/F_{MSY}
1.0
1.5
2.0
1995 2000 2005 2010 2015
Time
spict_v1.2.8@d9ece0a31623f1a26d3cb4328499f16136822d14

All B/Bmsy and F/Fmsy results in one plot





Turbot in Subdivision 3a (tur.27.3a) Commercial catches

Alexandros Kokkalis

02 March 2020

Contents

Introduction

This working document describes available data on commercial landings and discards for turbot (*Psetta maxima* or *Scophthalmus maximus*) in ICES subdivision 3a (Skagerrak and Kattegat). Specifically, it presents (i) available landings data, (ii) available discard information, and (iii) reconstruction of catch series back in time.

Available data

Data and information from various sources were collated in this report, the most important sources are described below:

Intercatch: Detailed information of the landings (and discards) per country, metier, quarter, and subdivision. There are available data from 2002 onward. The data were downloaded from the web interface https://intercatch.ices.dk/.

Official nominal catches: Annual landings from the Northeast Atlantic (FAO major fishing area 27) are officially submitted into a common data base by 20 ICES member countries since 1904. Currently, collection and coordination is done in collaboration with the Statistical Office of the European Union (EUROSTAT) and FAO. This dataset is not as detailed as Intercatch, i.e. it contains only the landings per species, area, country, and year. Nevertheless, it is a valuable resource of information that goes back more than a century. The data were downloaded from the ICES website (ICES 2020).

Landings

Intercatch landings

The data in Intercatch are available from 2002 to 2018. Data from some countries were not uploaded to Intercatch for all years - most important being landings and discards from Norway and the Netherlands. Available landings by country are shown in Figure 1. Denmark is responsible for the majority of the landings, followed by the Netherlands, Sweden, and Norway with significantly less landings, Table 1 shows the total landings and the corresponding percentage during the last four years in the data, where there is information uploaded by all countries. There is a negligible amount of landings from Germany, and UK for some years.

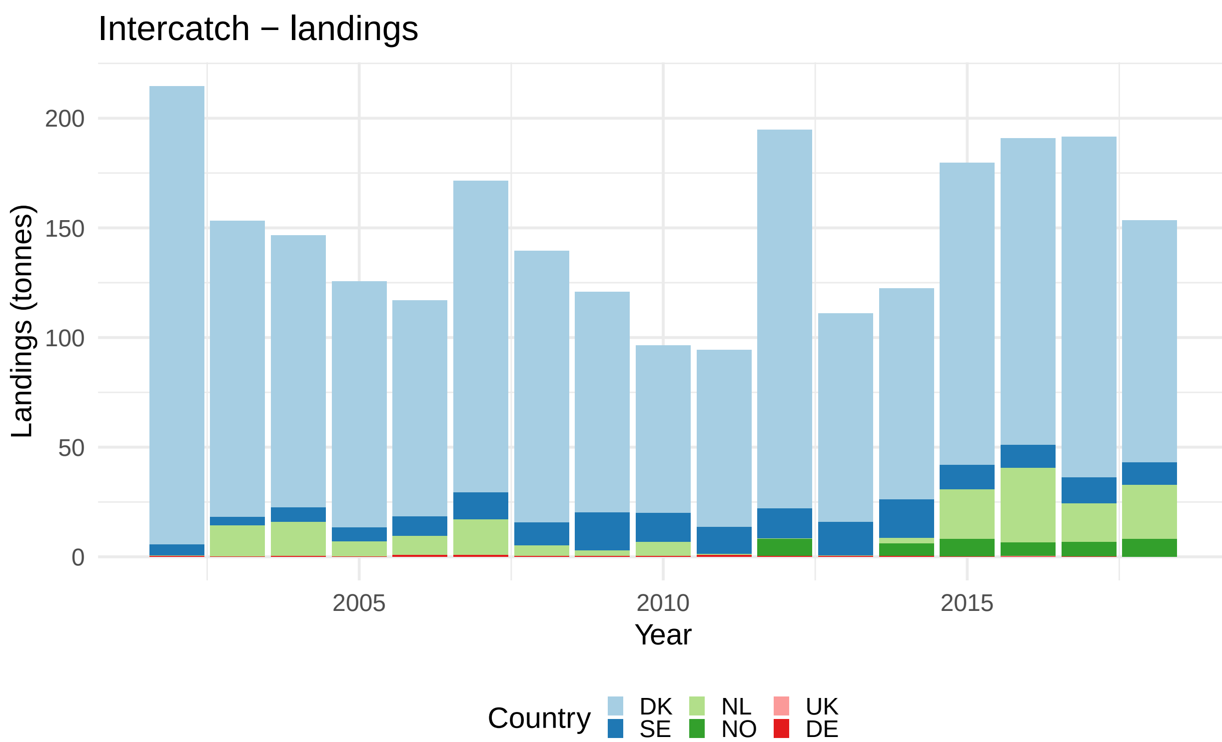


Figure 1: Turbot in subdivision 3a (tur.27.3a). Landings per country for all years available in Intercatch (2002 - 2018).

Table 1: Turbot in Division 3a (tur.27.3a). Total landings (tonnes) and average percent of landings per country in the years 2015 - 2018.

Country	Total (2015-2018)	%
DK	543	75.87
NL	98.89	13.82
SE	43.72	6.11
NO	28.79	4.02
DE	0.893	0.12
UK	0.372	0.05

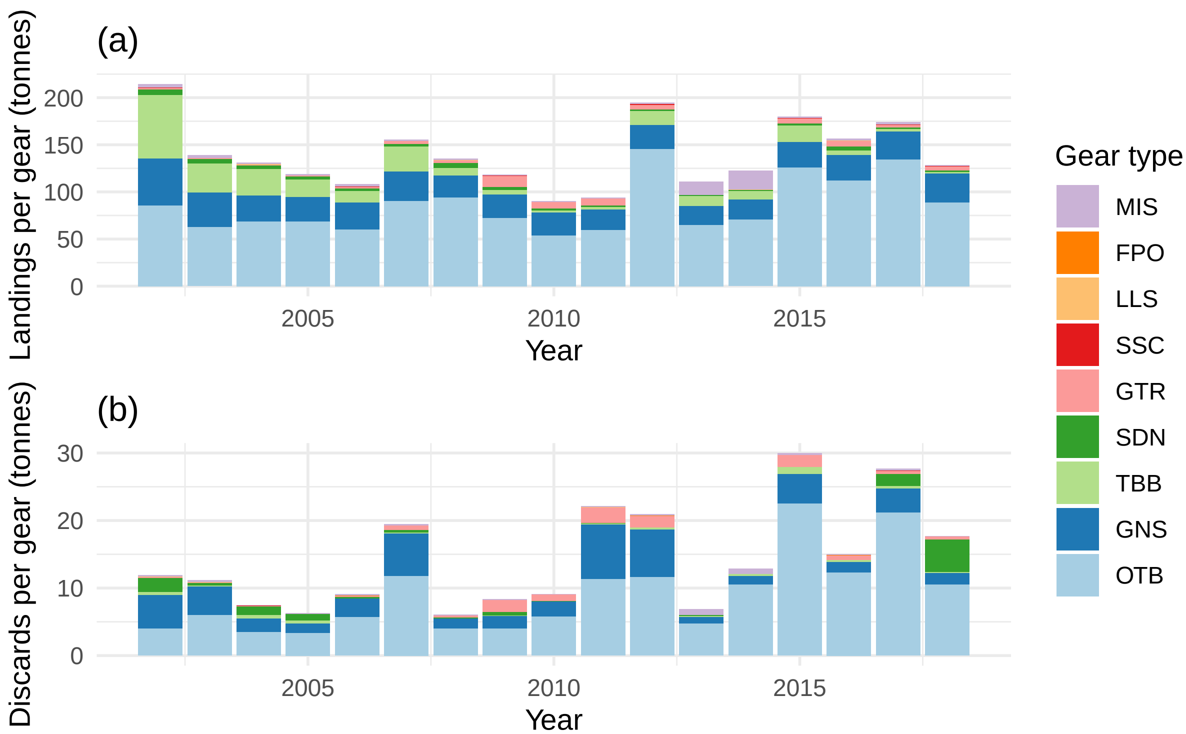
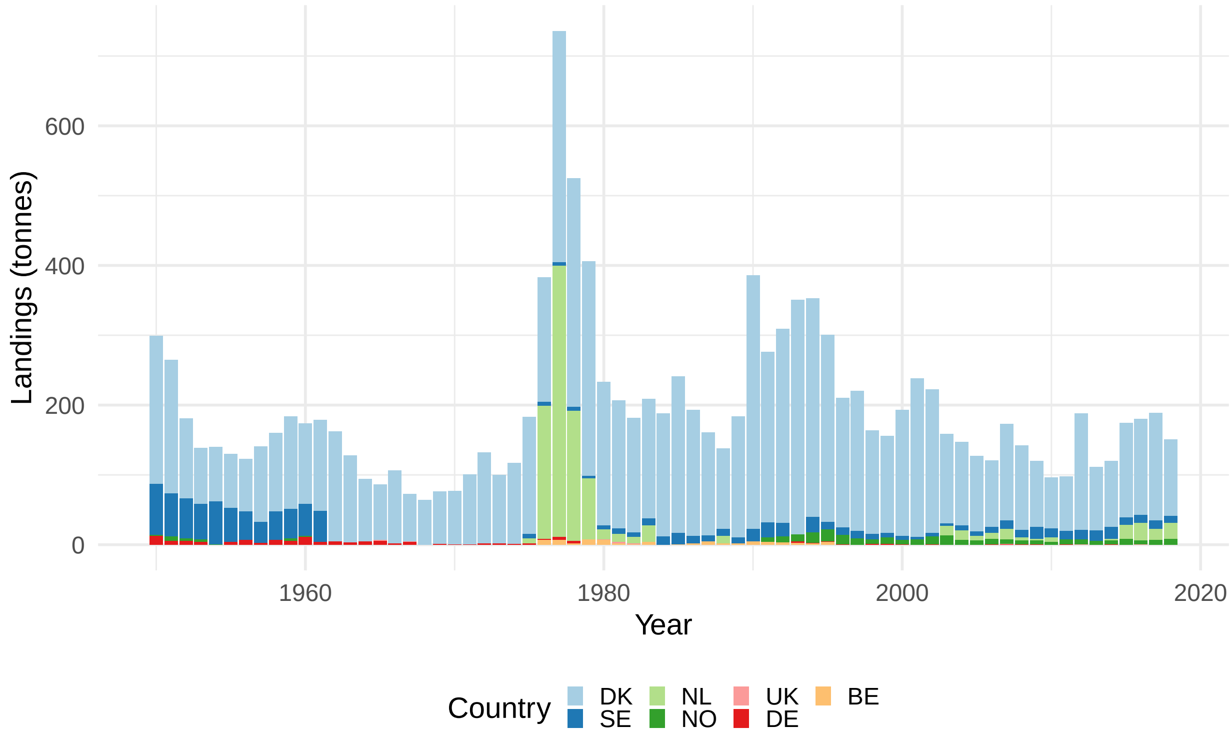


Figure 2: Landings (a) and discards (b) per gear type in tonnes (OTB: otter trawl, GNS: gillnet, TBB: beam trawl, SDN: Danish seine, GTR: trammel net, SSC: seines, LLS: longlines, FPO: pots, MIS: other gears).

Official landings



Comparison between Intercatch and official landings

There are small differences in the reported landings between Intercatch and the Official catch statistics (Figure 3). For reconstructing the catch series, Intercatch data are used if both sources are available. For Norway, the whole catch series of landings is taken from the official landings and is assumed to have no discards.

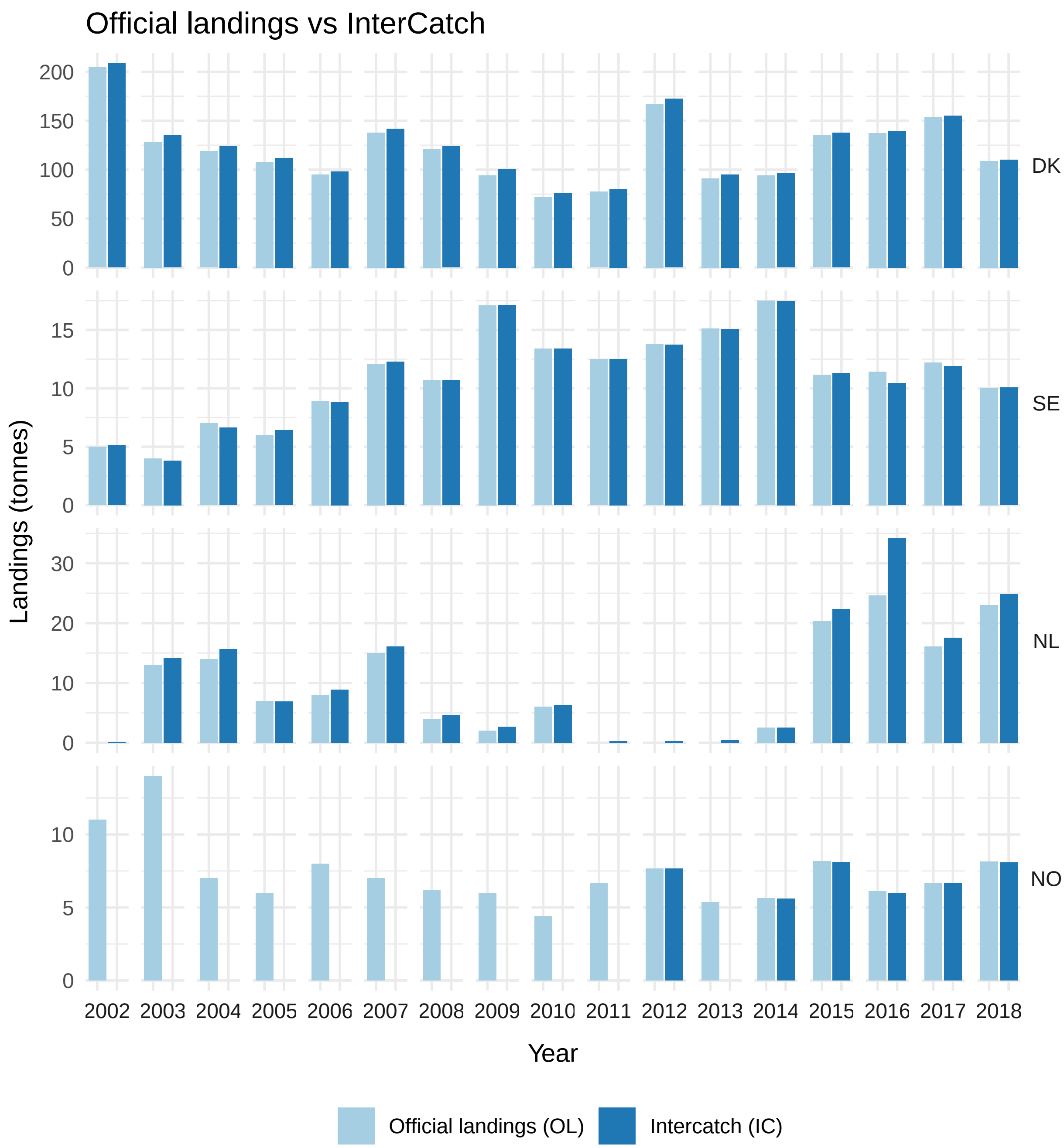


Figure 3: Comparison of landings reported in the Official Nominal Catches (OL) and in Intercatch (IC) for Denmark (DK), Sweden (SE), the Netherlands (NL), and Norway (NO)

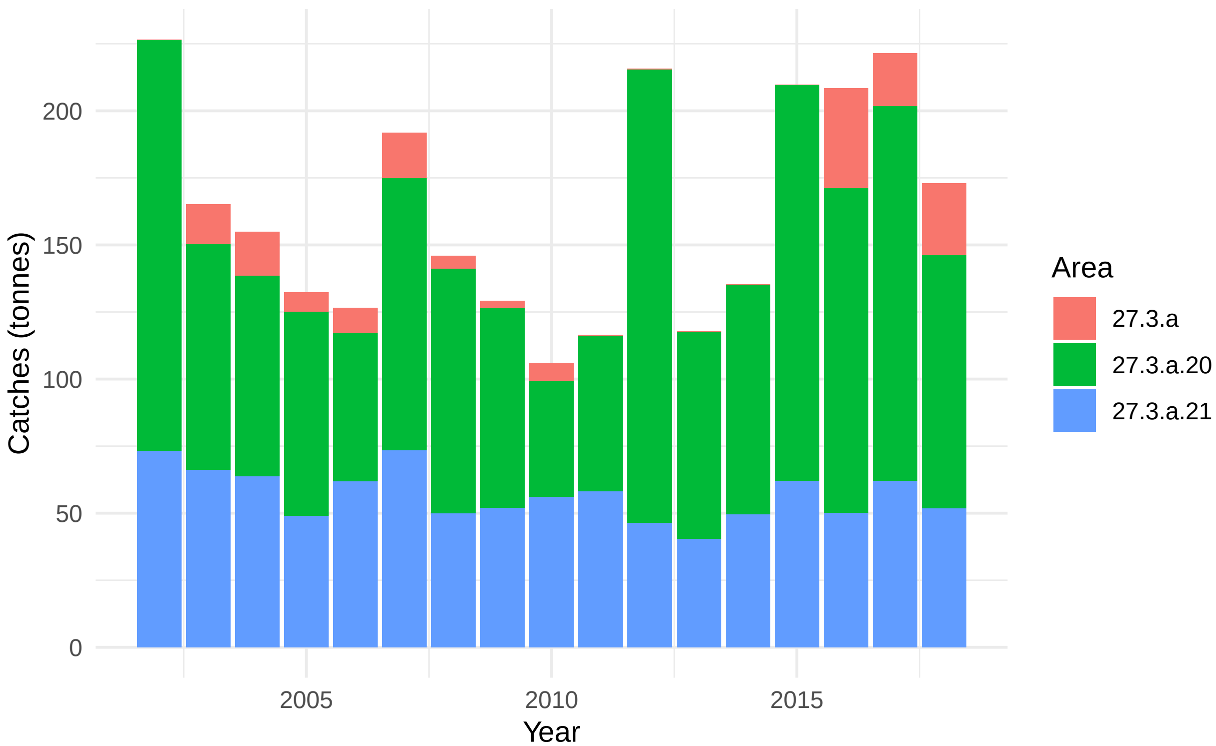


Figure 4: Catches of Turbot in Division 3a, per subdivision. The part of the catches that is not disagregated by subdivision is shown for the whole Division 27.3a.

Discards

Discard information is available for the years 2002–2018 in Intercatch and the discard coverage of the areas and metiers are shown in the following section. The calculation of discards for metiers that lack reported discards and scenarios for the raising of discards in the period prior to 2002 are presented in the last two sections of this chapter.

Discard reporting coverage

There is a relatively high coverage of discard for Turbot in Division 3a, higher in Skagerrak than in Kattegat (Figure 5). The metiers that have the highest discard coverage are the otter trawls (OTB), which are responsible for most of the catches of turbot in the area, and seines (SDN). report also dicards (Figure 6). Gillnets (GNS) that are the second

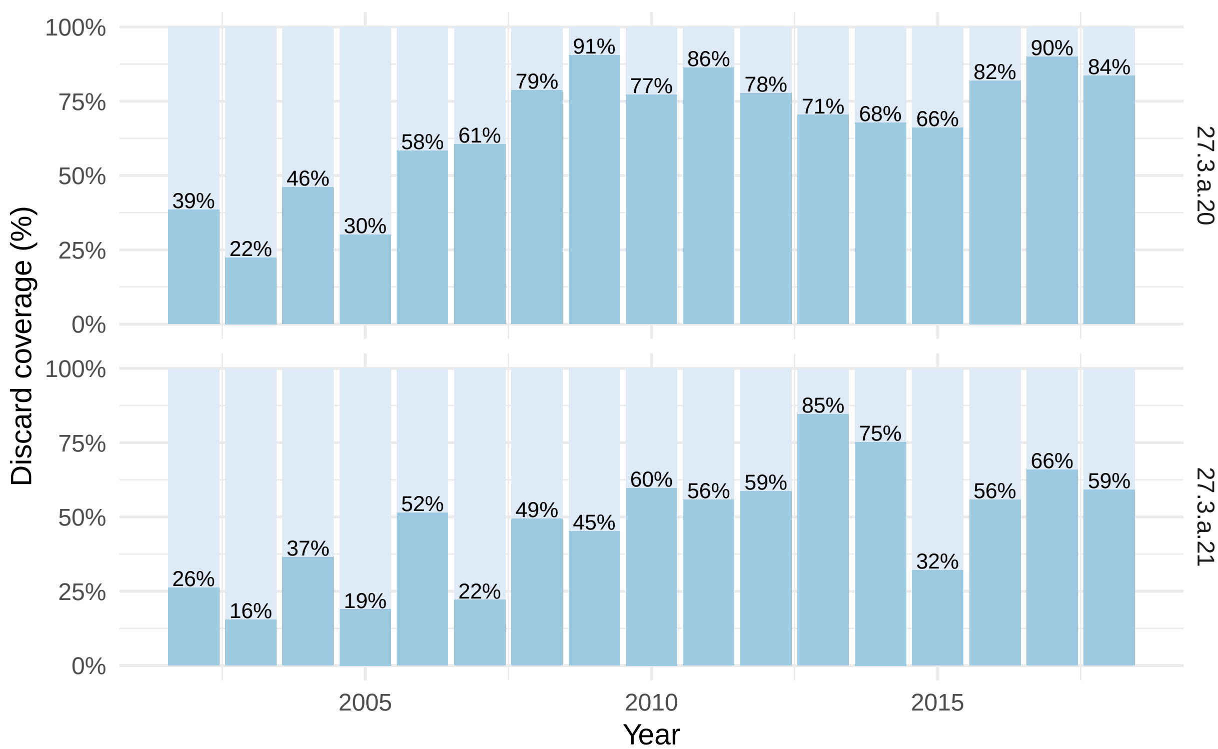


Figure 5: Percent discard reporting coverage of landings of turbot in Division 3a per subdivision with Skagerrak in the top and Kattegat in the bottom. Numbers on the bars are rounded to the nearest integer.

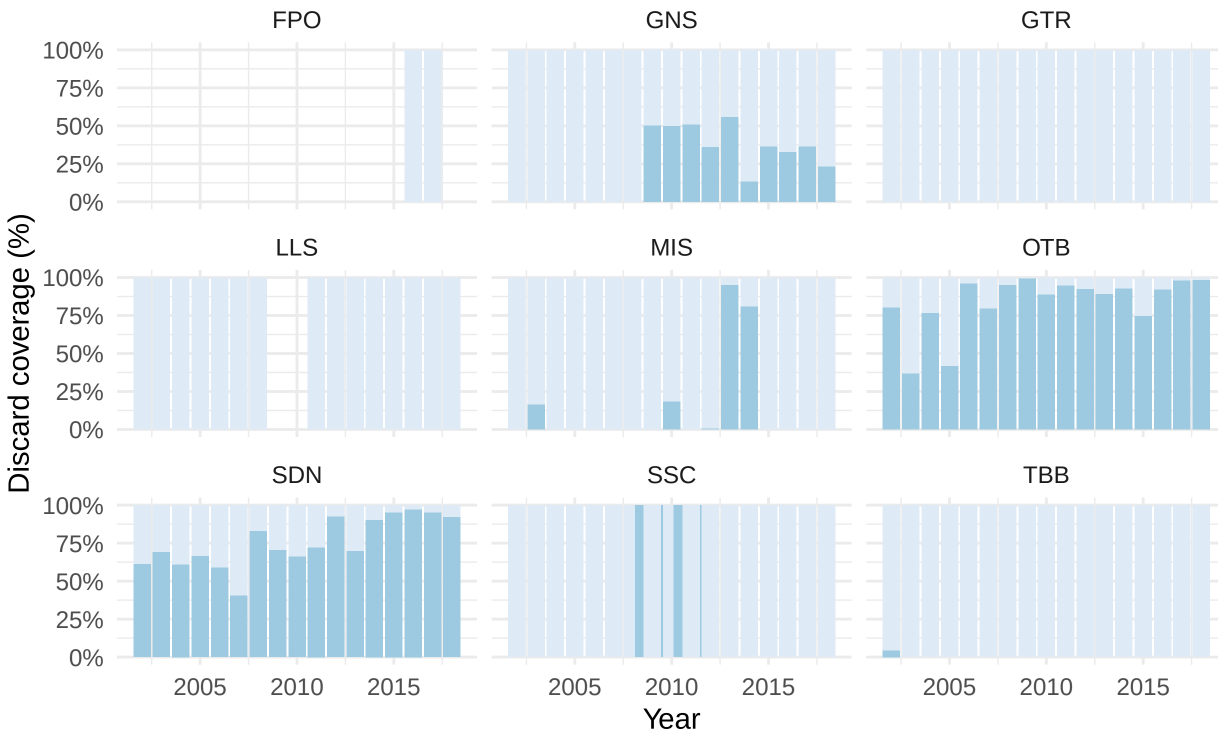


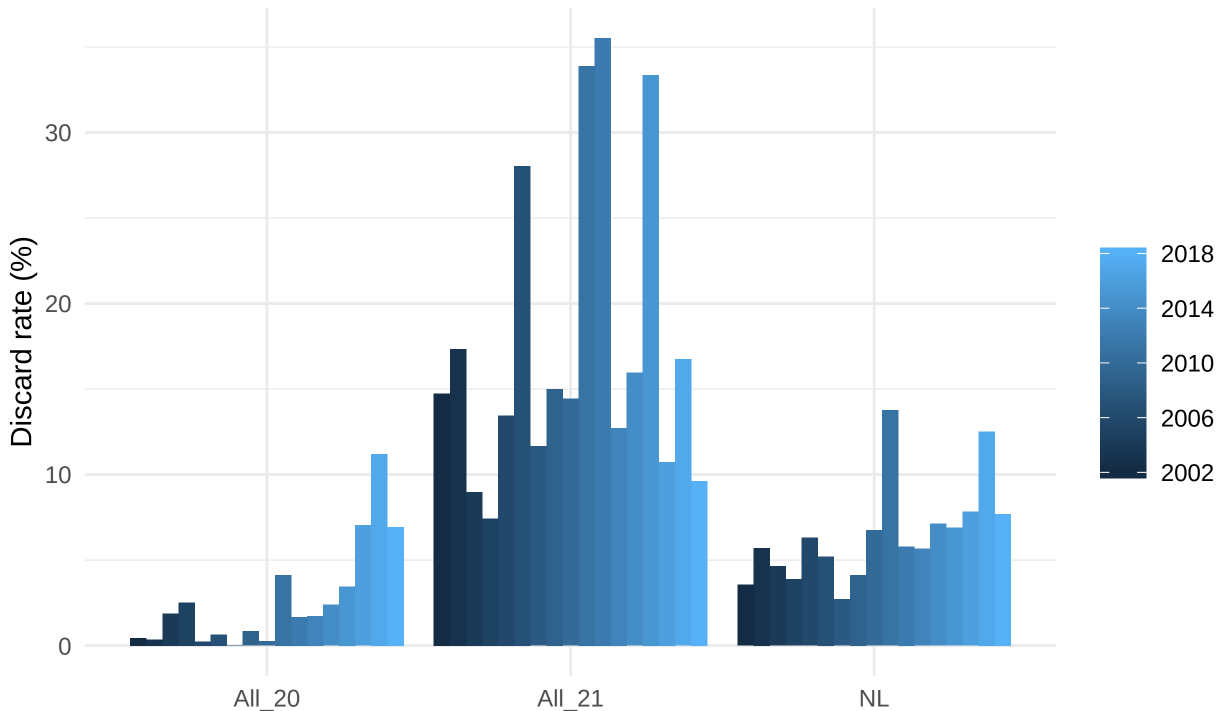
Figure 6: Percent discard reporting coverage of landings of turbot in Division 3a per gear category

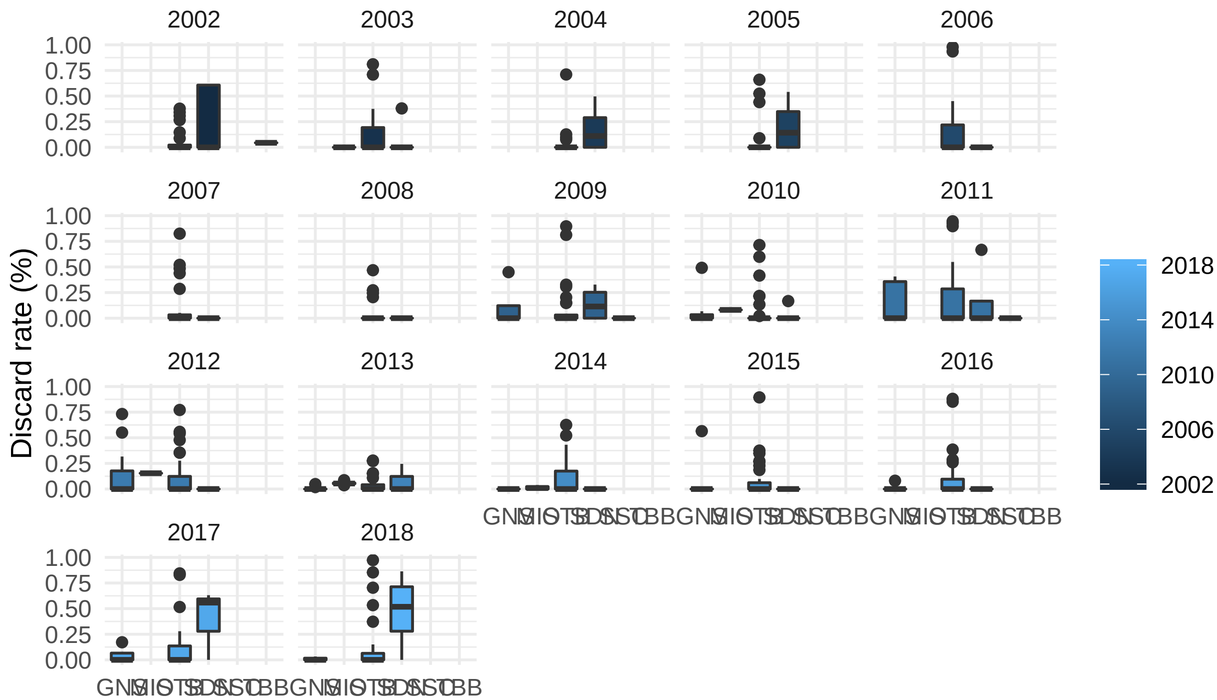
Discard raising

The raising of discards was done for the years 2002–2018 from Intercatch. The landing metiérs that have reported discards are split into 4 categories:

Group	Countries	Area	Raising assumption
All_20	Denmark, Sweden, Germany	Skagerrak (SD 20)	Weighted mean of imported ratios in SD 20
All_21	Denmark, Sweden, Germany	Kattegat (SD 21)	Weighted mean of imported ratios in SD 21
NL	Netherlands	3a (SDs 20 and 21)	Weighted mean of all imported ratios
NO	Norway	3a (SDs 20 and 21)	No raising of discards

All seasons and countries are grouped together. In each year and for each group, a weighted mean of discard rate is calculated, using the total landings of each metiér as weights (Figure **??**).





This leads to a full estimation of discards (imported + raised) for 2002–2018 (Figure 7).

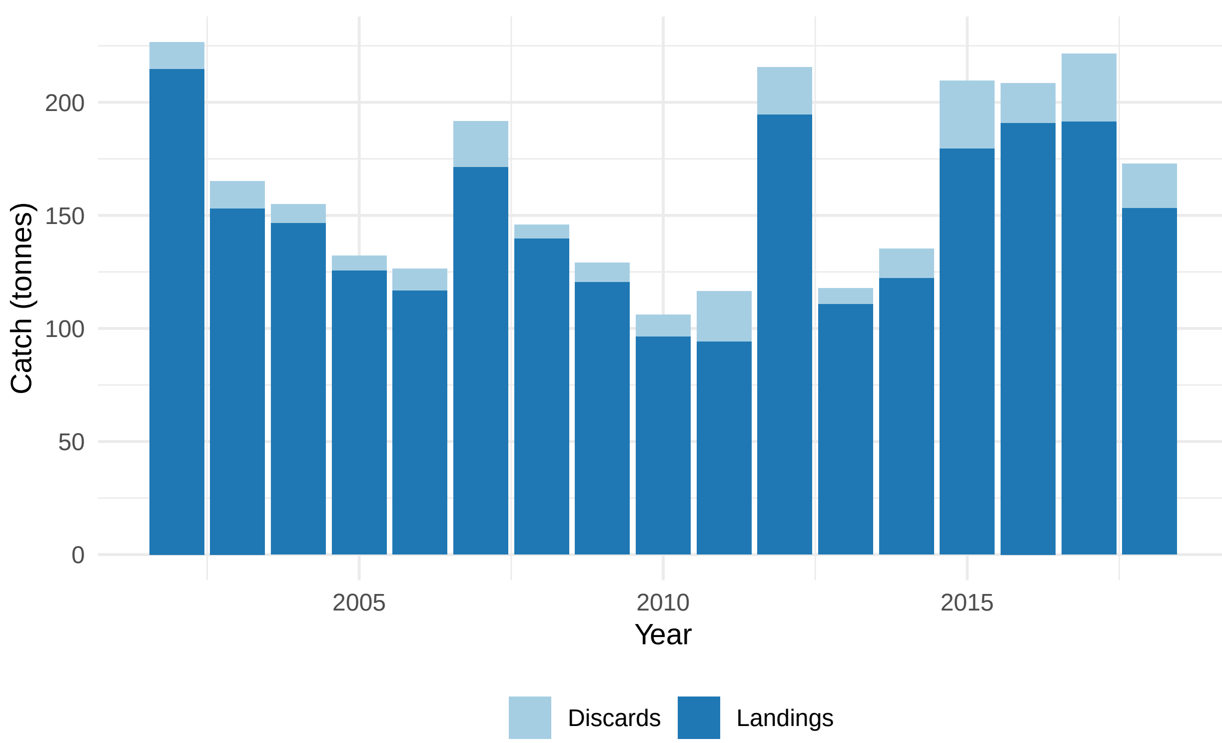


Figure 7: Landings and discards (imported and raised) of turbot in Division 3a from Intercatch for the years 2002–2018.

Discard reconstruction scenarios

Thre scenarios are assumed for the caclulation of discards in the period before 2002 based on the landing information which is available on the Division level and the observed discard rates (Figure 8). The discard rate of the whole period is assumed to be at a constant level. The three levels are equal to (i) the mean (8.97 %), (ii) the 10-th percentile (5.14 %), and (iii) the 90-th percentile (13.8 %) of the discard rate of 2002–2018 (Figure 8).

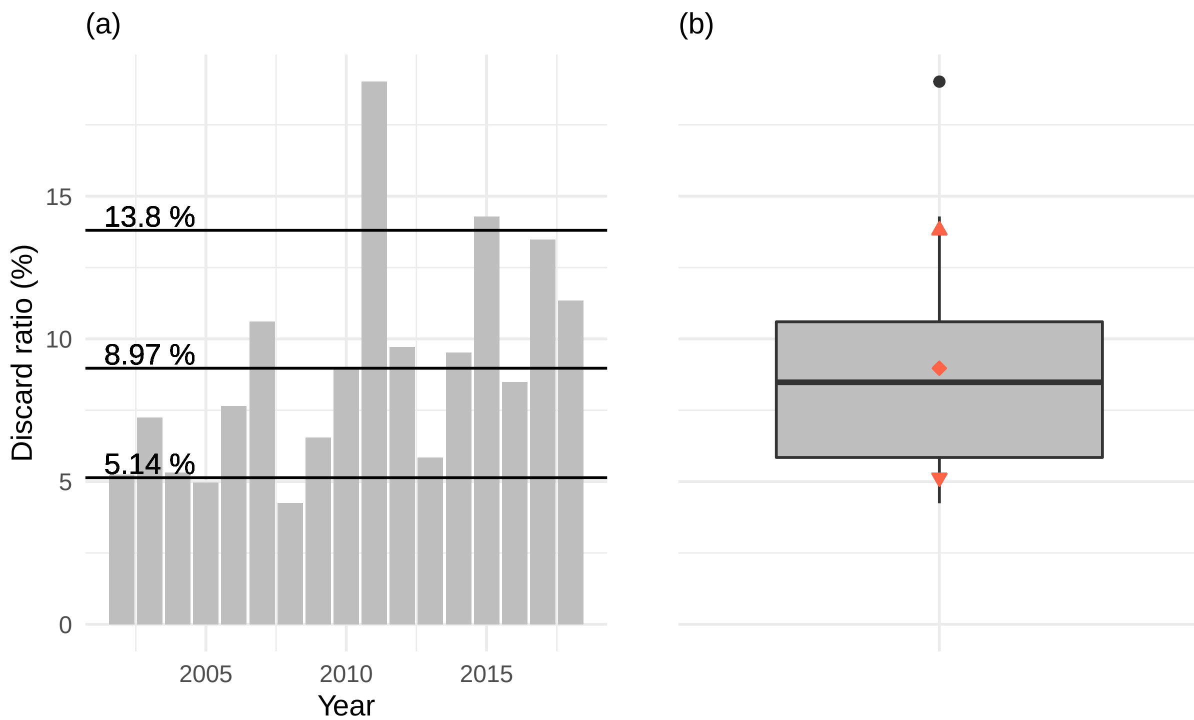


Figure 8: Discard ratio (%) of turbot in Division 3a from Intercatch per year (a) and ovarll in 2002–2018 (b). The horizonatal line (a) and dot (b) show the mean discard ratio.

Catches

Length distributions

The raw length distribtuions from Intercatch show that discarding is strongly connected to species length. There seems to be a clear split depending on size around 30 cm (Figure 10).

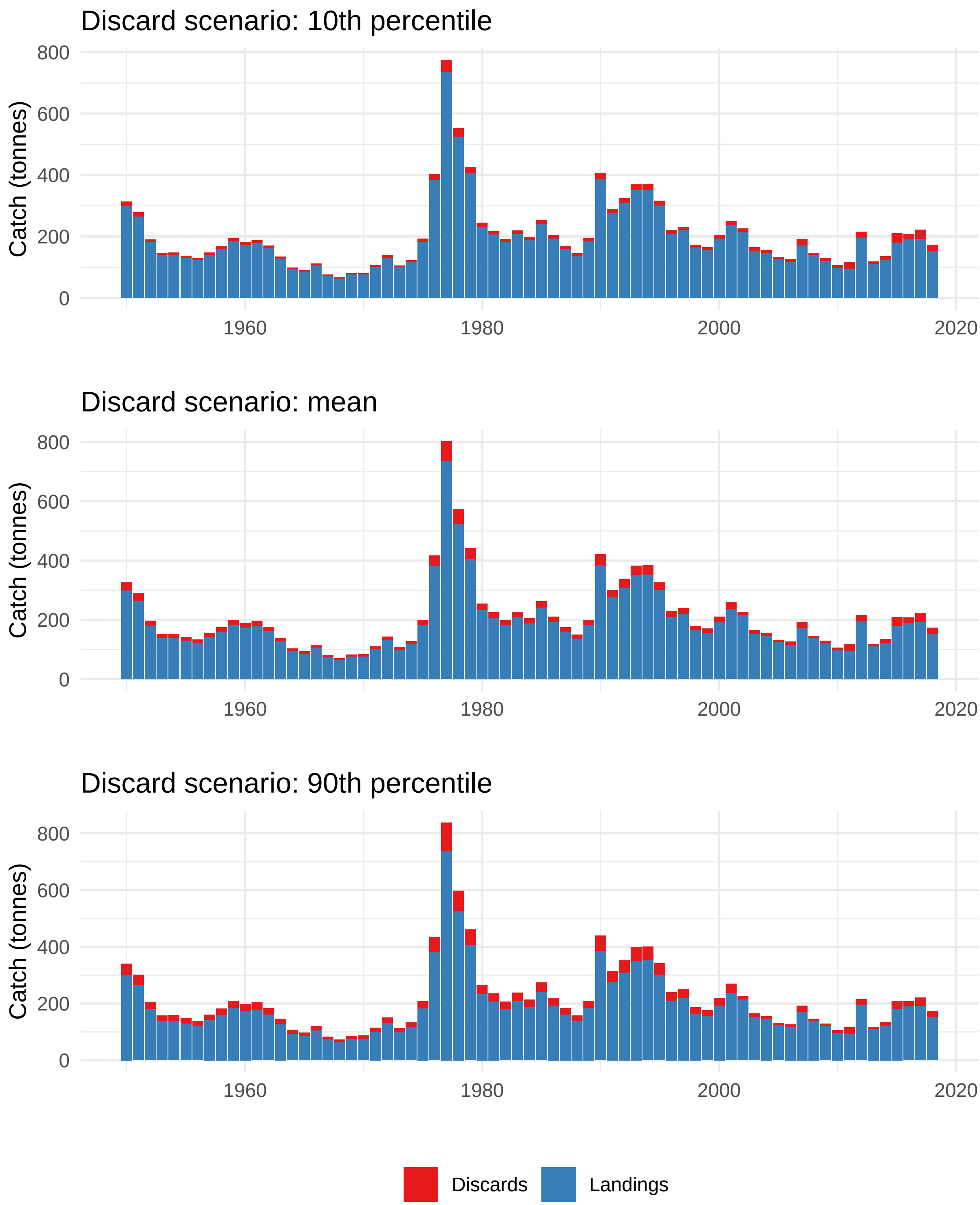


Figure 9: Landings and reconstructed discards undrer the three assumtptions for the years 1950–2001: discard rate equal to the 10th percentile,(top), the mean (middle) and 90th percentile (bottom) of the observed discard ratios in 2002–2018.

Figure 10: Length distributions of turbot in Division 3a by year. Almost all individuals less than 30 cm (vertical lines) seem to be discarded.

Tables

Table 3: Official landings in tonnes by Country (source: ICES 2020). The catches of England, Wales, N. Ireland and Scotland are shown under UK.

Year	DK	SE	NL	NO	UK	DE	BE	Total
1950	212.0	73.0		1.0		13.0		299.0
1951	191.0	62.0		6.0		6.0		265.0
1952	114.0	58.0		3.0		6.0		181.0
1953	80.0	51.0		4.0		4.0		139.0
1954	78.0	61.0		1.0				140.0
1955	77.0	49.0				4.0		130.0
1956	75.0	41.0				7.0		123.0
1957	108.0	30.0				3.0		141.0
1958	112.0	41.0				7.0		160.0
1959	132.0	43.0		3.0		6.0		184.0
1960	115.0	46.0		2.0		11.0		174.0
1961	130.0	45.0				4.0		179.0
1962	157.0					5.0		162.0
1963	124.0					4.0		128.0
1964	89.0					5.0		94.0
1965	79.0				1.0	6.0		86.0
1966	104.0					2.0		106.0
1967	68.0				1.0	4.0		73.0
1968	64.0							64.0
1969	75.0					1.0		76.0
1970	76.0					1.0		77.0
1971	100.0					1.0		101.0
1972	130.0					2.0		132.0
1973	98.0					2.0		100.0
1974	116.0					1.0		117.0
1975	167.0	7.0	7.0			2.0		183.0
1976	178.0	6.0	190.0			2.0	7	383.0
1977	331.0	5.0	389.0			4.0	7	736.0
1978	327.0	6.0	186.0			4.0	2	525.0
1979	307.0	4.0	87.0				8	406.0
1980	205.0	6.0	14.0		1.0		7	233.0
1981	183.0	8.0	12.0		2.0		2	207.0
1982	164.0	7.0	9.0		1.0		1	182.0
1983	171.0	10.0	24.0				4	209.0
1984	176.0	12.0						188.0
1985	224.0	16.0					1	241.0
1986	180.0	11.0					2	193.0
1987	147.0	9.0					5	161.0
1988	115.0	10.0	11.0				2	138.0
1989	173.0	9.0					2	184.0
1990	363.0	18.0					5	386.0
1991	244.0	21.0		7.0			4	276.0
1992	278.0	19.0		8.0			4	309.0
1993	336.0			10.0		2.0	3	351.0
1994	313.0	22.0		15.0		1.0	2	353.0
1995	268.0	11.0		17.0		1.0	4	301.0
1996	185.0	11.0		13.0		1.0		210.0
1997	200.0	11.0		9.0				220.0

Year	DK	SE	NL	NO	UK	DE	BE	Total
1998	148.0	8.0		7.0		1.0		164.0
1999	139.0	6.0		10.0		1.0		156.0
2000	180.0	6.0		6.0		1.0		193.0
2001	227.0	3.0		8.0				238.0
2002	205.0	5.0		11.0		1.0		222.0
2003	128.0	4.0	13.0	14.0				159.0
2004	119.0	7.0	14.0	7.0				147.0
2005	108.0	6.0	7.0	6.0				127.0
2006	95.0	8.9	8.0	8.0	0.0	0.8		120.7
2007	138.0	12.1	15.0	7.0	0.0	1.0		173.1
2008	121.0	10.7	4.0	6.2	0.0	0.5		142.4
2009	94.1	17.1	2.0	6.0	0.0	0.5		119.7
2010	72.4	13.4	6.0	4.4	0.0	0.0		96.2
2011	77.5	12.5	0.0	6.7	0.0	1.0		97.7
2012	166.8	13.8	0.0	7.7	0.0	0.2		188.5
2013	91.0	15.1	0.0	5.4	0.0	0.2		111.7
2014	94.1	17.5	2.5	5.6	0.0	0.5		120.2
2015	134.9	11.2	20.3	8.2	0.0	0.1		174.7
2016	137.4	11.4	24.6	6.1	0.4	0.2		180.1
2017	154.0	12.2	16.1	6.7	0.0	0.2		189.2
2018	109.1	10.1	23.0	8.1		0.2		150.5

References

ICES. 2020. "Official Nominal Catches 2006-2017," Version 15–01–2020.Accessed 15–01–2020via: http://ices.dk/marine-data/dataset-collections/Pages/Fish-catch-and-stock-assessment.aspx.

Survey Index Calculations for Turbot in Area IIIa and Adjacent Waters.

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January 30, 2020

1 Introduction

Getting accurate survey indices of abundance for Turbot in ICES area IIIa is problematic, because it is a relatively rare species and because most of the available trawl surveys do not cover the area very well. This report describes how five different bottom trawl surveys can be combined through a model in order to obtain high resolution standardized abundance maps and indices.

2 Data

The data set is a combination of five bottom trawl surveys. Three of these surveys are available in the DATRAS database hosted by ICES, namely the beam trawl survey (BTS), the North Sea International Bottom Trawl Survey (NS-IBTS), and the Baltic International Trawl Survey (BITS). The last two surveys (TN and TOR) are Danish national surveys that specifically cover the IIIa area. The data have been analyzed in R using [3] and [1]. The DATRAS surveys have been filtered to exclude hauls far from the area of interest in order to reduce the computation time. Specifically, hauls west of 5° longitude and east of ICES area 24 (approx. 15° longitude) are excluded. Also gear types with less than 100 hauls are not included. Care must be taken when analyzing Turbot and combining data sets because this species has been renamed from *Psetta Maxima* to *Scophthalmus maximus* and some surveys are using one or the other or a combination.

The ratio of total commercial catch at length to survey catch at length for the period 2012–2018 was used to down-weight the smaller length groups in the survey, such that the survey can be considered representative for the exploitable stock biomass and thus suitable for use in a biomass production model, see figure 7. The observed numbers-at-length are multiplied with a weighting factor (a number between 0 and 1, see figure 7 middle panel) before the numbers-at-length are converted to biomass by multiplying with a length-weight relationship and summing over length groups. The weighting factor turns out to be similar to the maturity-at-length curve for Turbot, so exploitable stock biomass and spawning stock biomass is roughly the same thing.

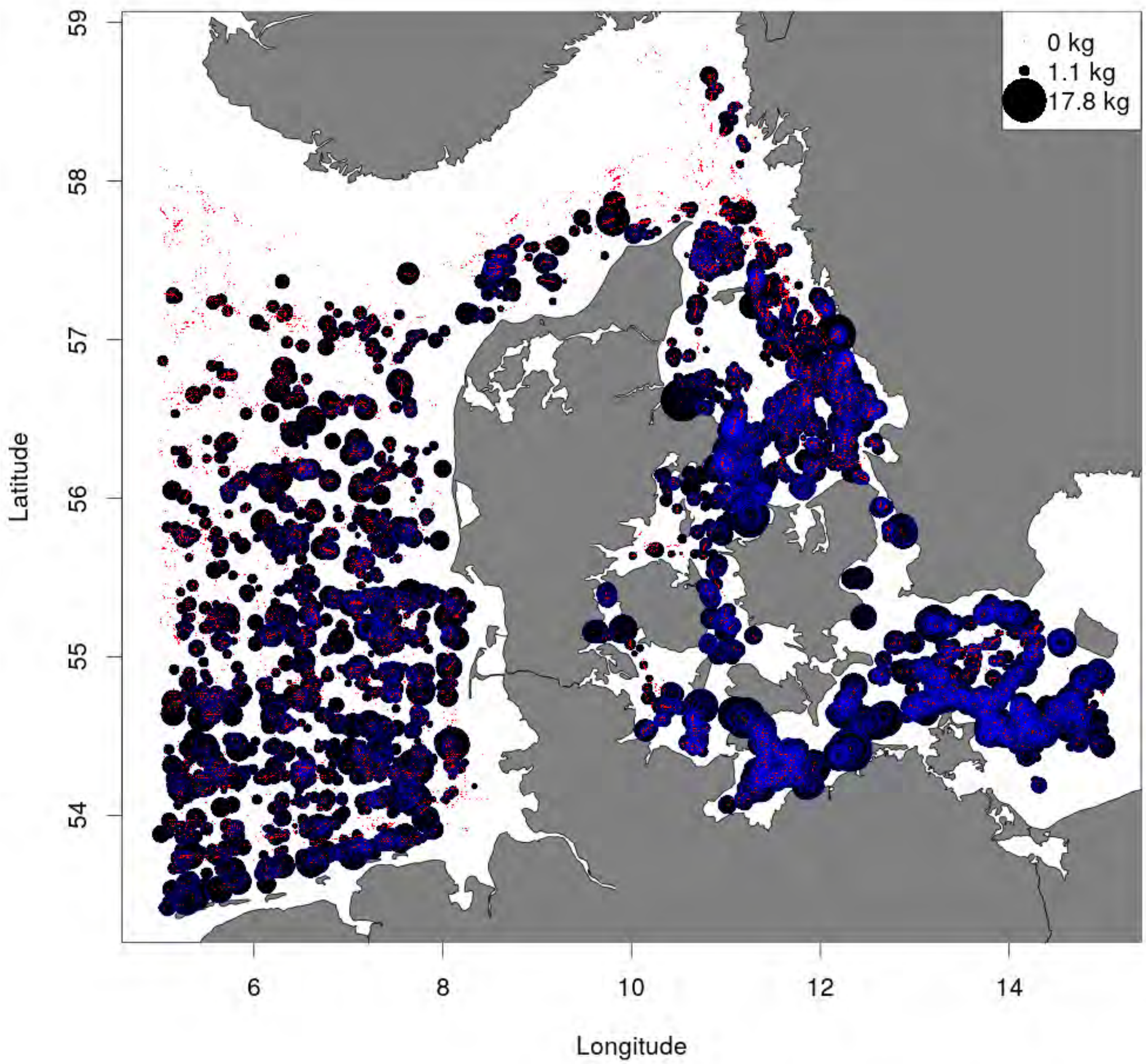


Figure 1: Biomass pr. haul. The black bubbles are given a thin blue edge to distinguish overlap.

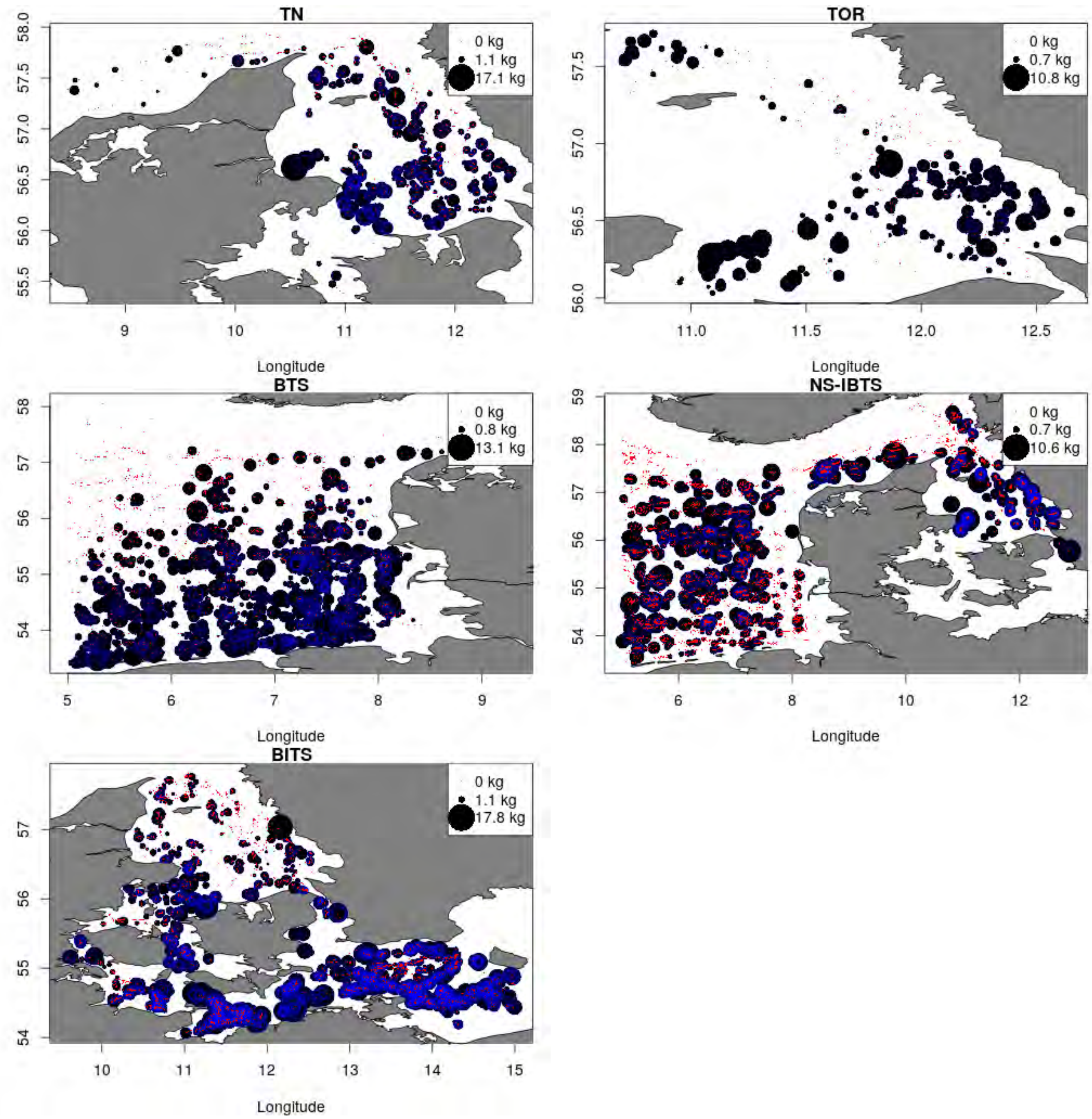


Figure 2: Biomass pr. haul and survey

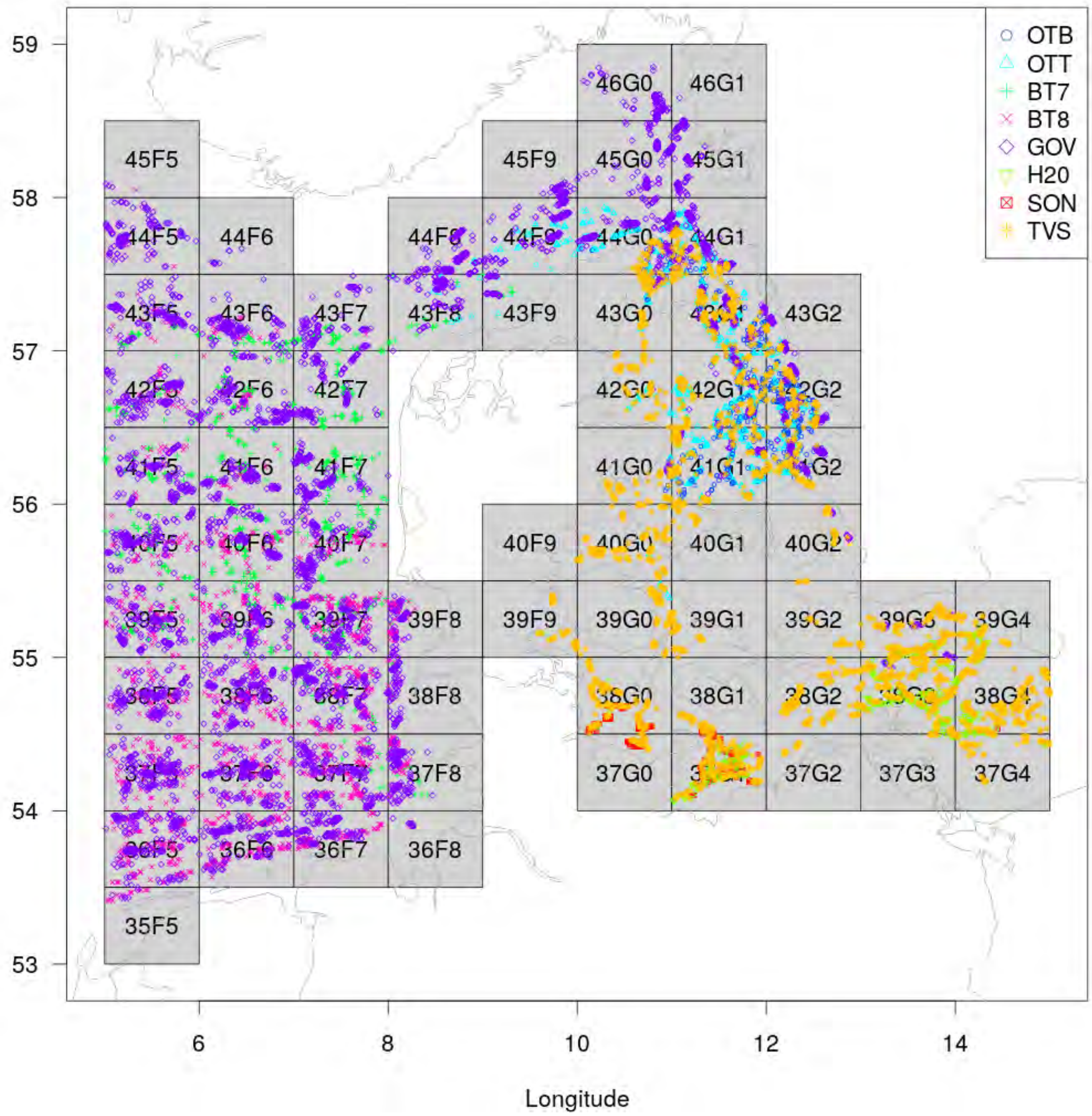


Figure 3: Spatial distribution of hauls colored by gear type

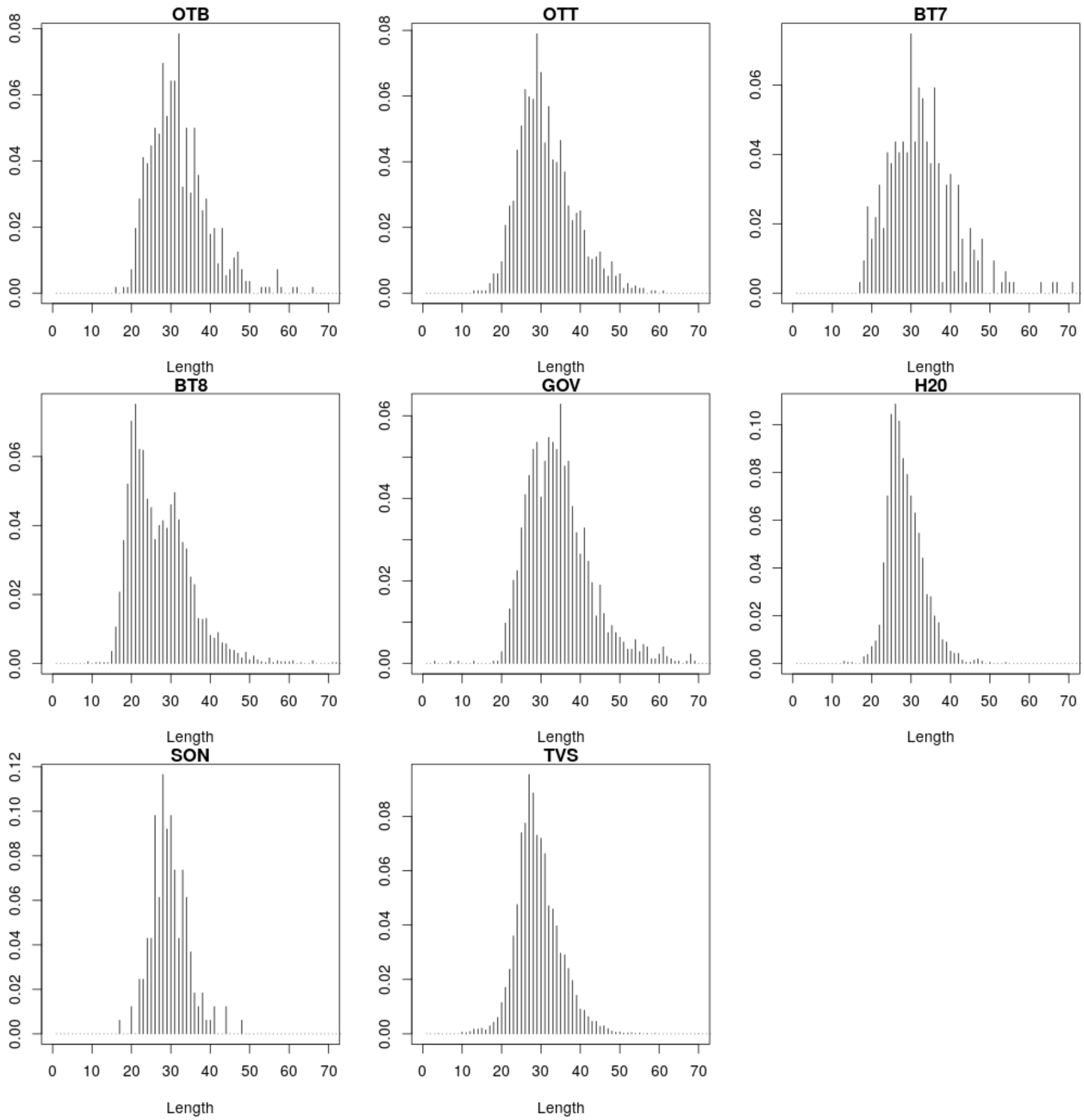


Figure 4: Length distribution by gear

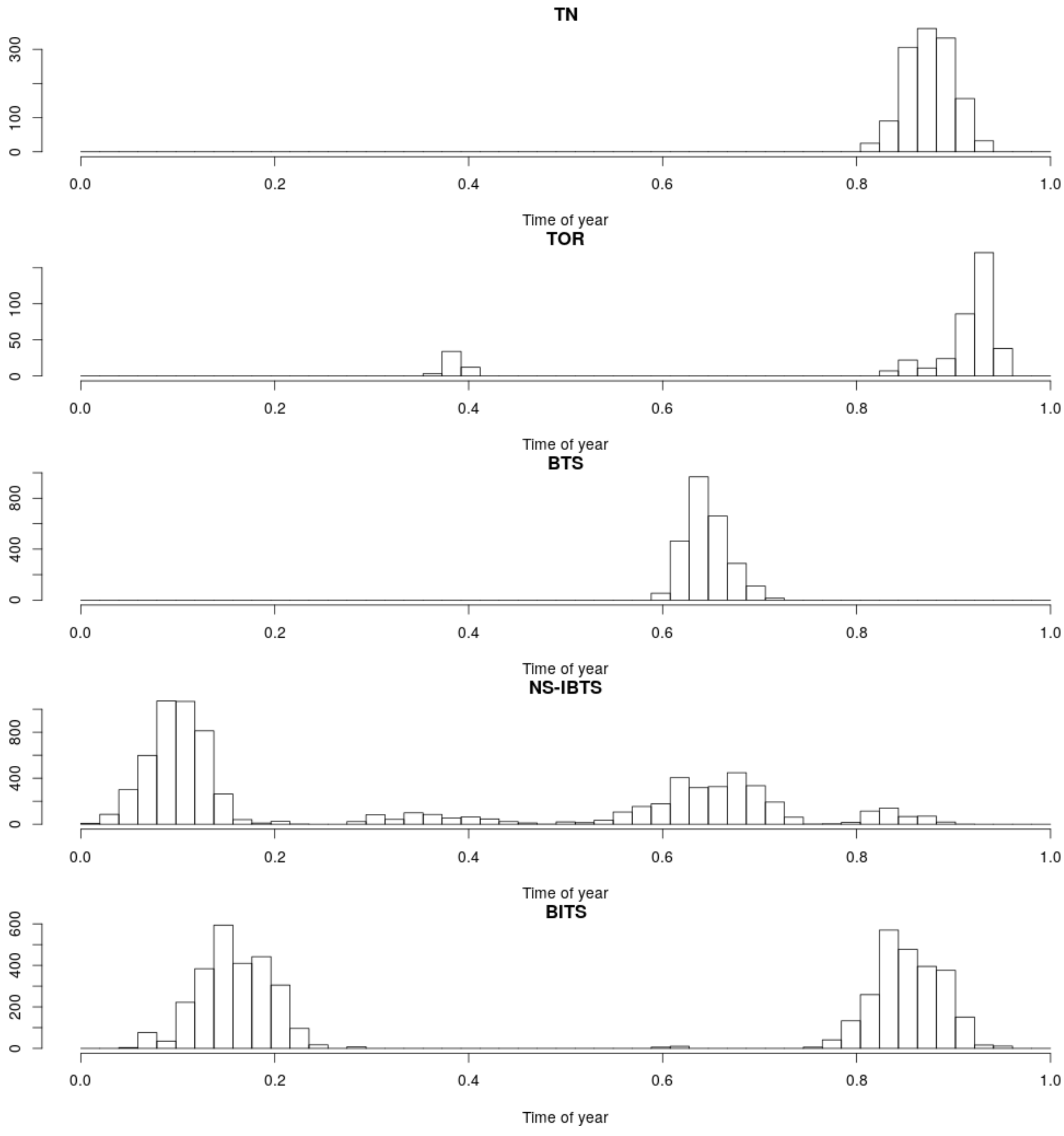


Figure 5: Seasonal distribution of sampling by survey (bin size: 1 week)

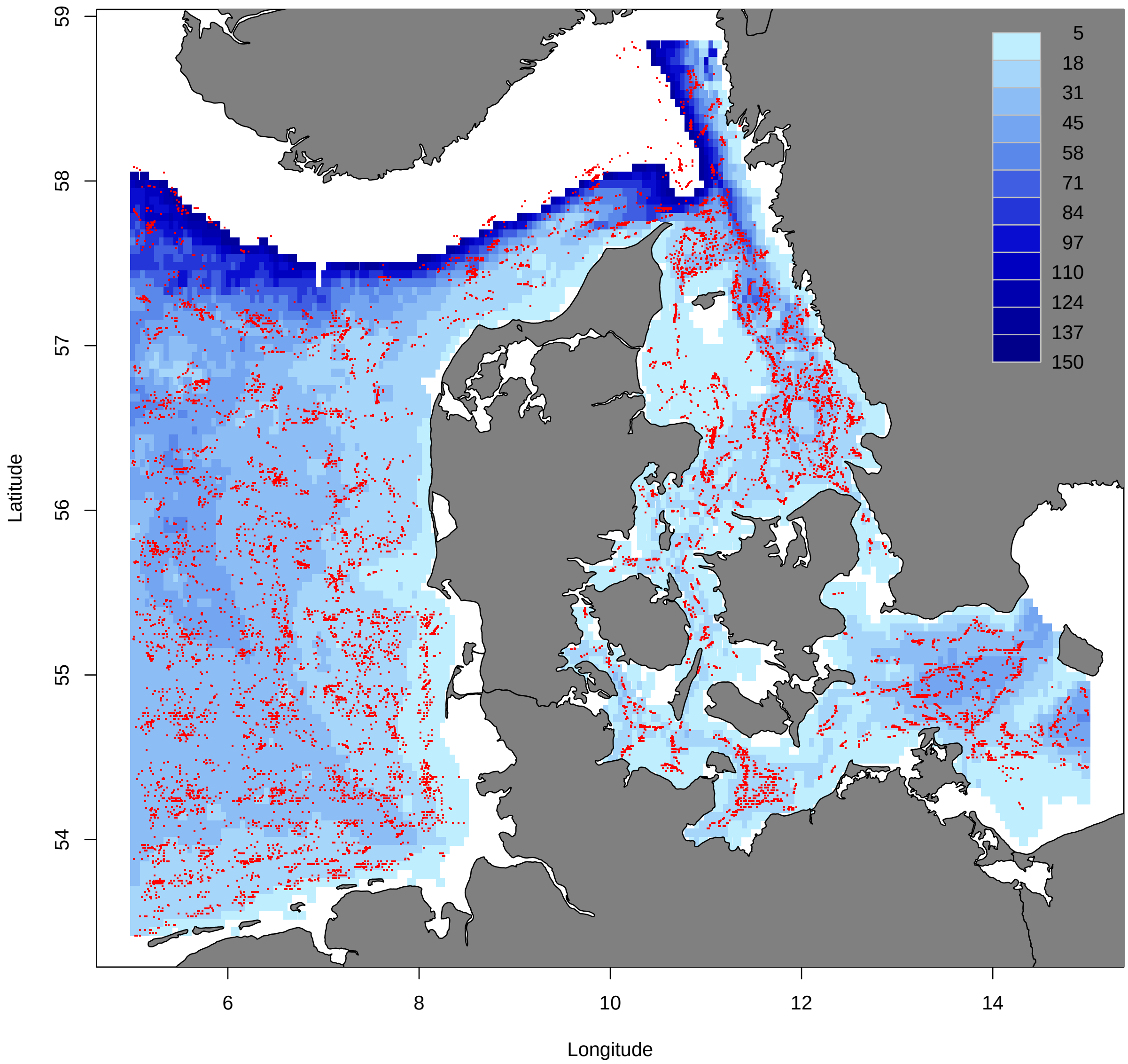


Figure 6: Bathymetric map. Red points are trawl hauls. Cells with depths outside the range 5-150 or with large distance to nearest haul are excluded. This map is used as the spatial prediction grid for all standardized maps and indices.

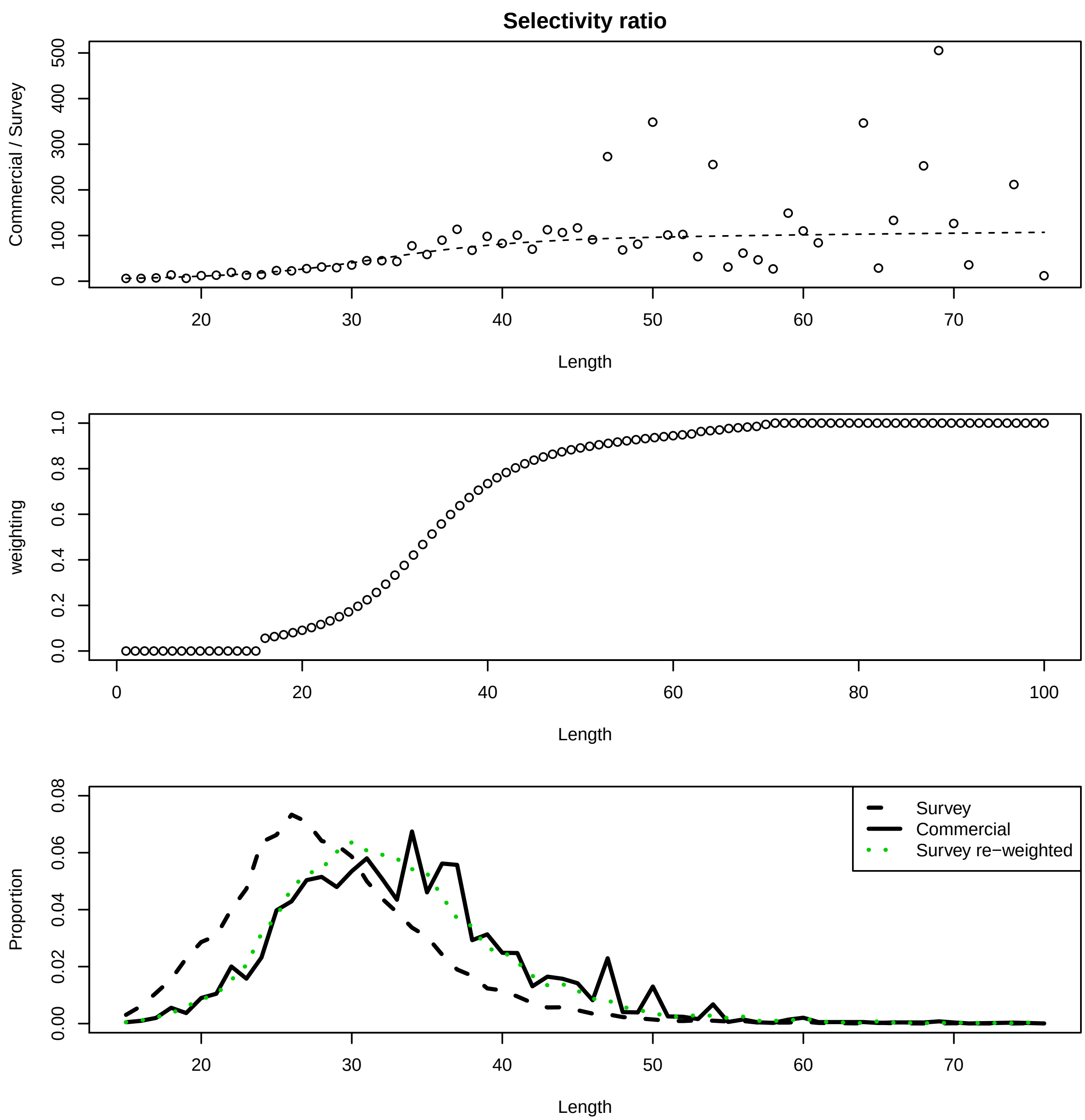


Figure 7: Top: Ratio of commercial to survey total catch at length and a model fit (dashed). Bottom: Commercial and survey length distribution (2012–2018) and the resulting survey length distribution after multiplying the modelled ratio (green dashed line).

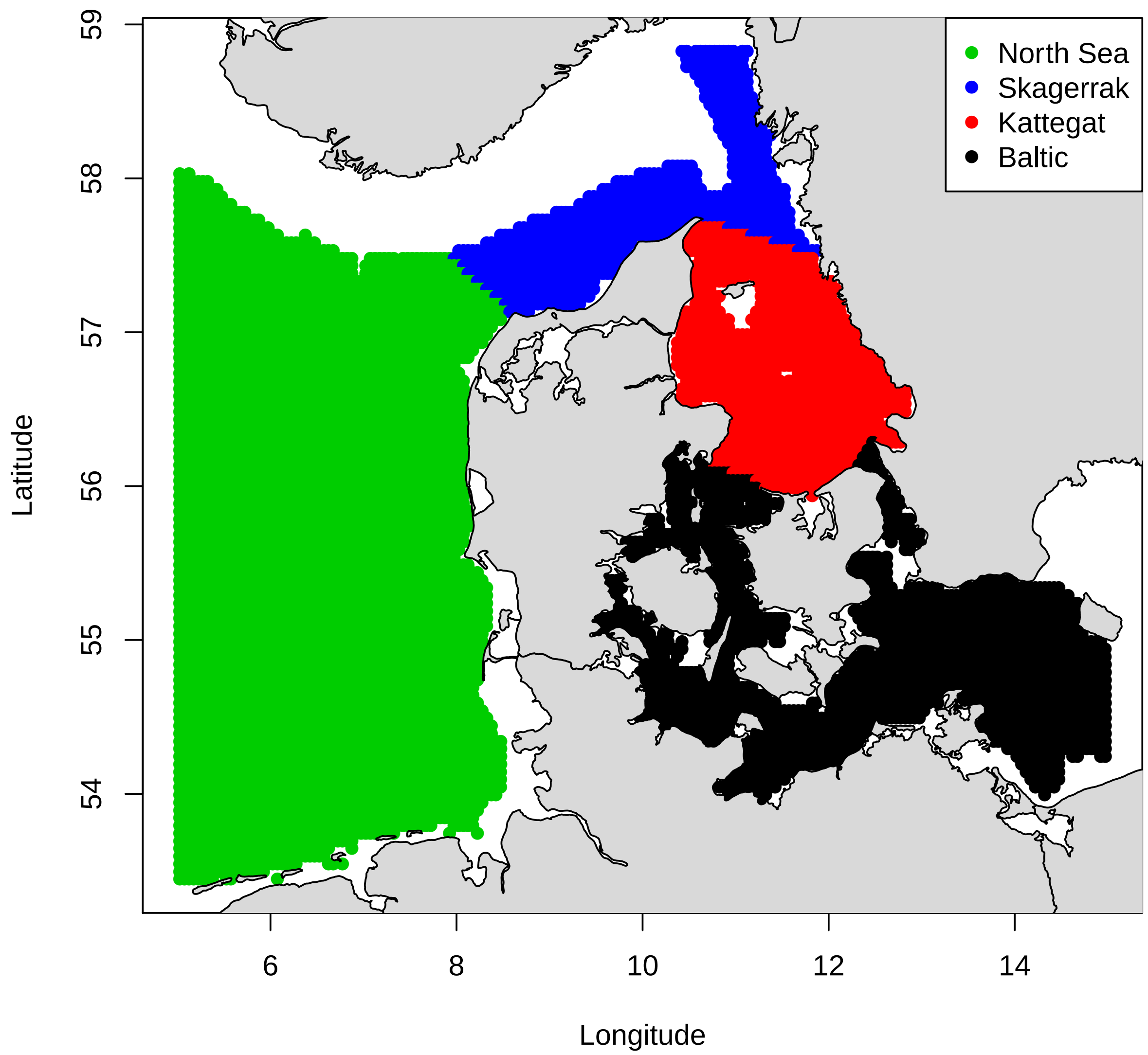


Figure 8: Map of areas considered. Area IIIa is the union of Skagerrak and Kattegat.

3 Survey Indices

Survey indices are calculated using the methodology described in [2], although the response variable is exploitable stock biomass of Turbot rather than numbers-at-age, and we consider a broader class of equations describing the observed abundance in each haul. While [2] considered a time-invariant spatial effect and a data set consisting almost exclusively of 30 min hauls, the following model classes contains space-time smoothers, which allows for smooth changes in the spatial distribution over time, as well as a haul duration effect. The space and time smoothers are decomposed into time-invariant spatial effect (f_1), a seasonal repeating pattern (f_2), and a space-time interaction effect (f_3) that can capture smooth changes in the spatial distribution over longer time-scales. Only the Tweedie distribution (compound Poisson-Gamma) is considered here, because it is simpler and easier to work with, and has a more consistent interpretation when sampling effort is not constant (see e.g. [4]).

The following equation describes the model:

$$g(\mu_i) = \text{Gear(i)} + f_1(\text{lon}_i, \text{lat}_i) + f_2(\text{timeOfYear}_i, \text{lon}_i, \text{lat}_i) + f_3(\text{time}_i, \text{lon}_i, \text{lat}_i) \tag{1}$$

$$+ f_4(\text{depth}_i) + \text{U(i)}_{\text{ship:gear}} + \log(\text{HaulDur}_i) \tag{2}$$

An offset is used for the effect of haul duration ($\log(\text{HaulDur}_i)$), i.e. the coefficient is not estimated but taken to be 1, which corresponds to the assumption that the catch is proportional to haul duration. All splines used for time, space and depth are Duchon splines with first derivative penalization. These splines distinguish themselves from conventional splines with second derivative penalization in that they do not follow linear trends beyond the data range but instead “go flat” similar to a random walk process. The only exception is the ’timeOfYear’ spline basis, which was chosen to be a cyclic cubic spline, because a repeated yearly pattern is expected. In addition to the splines, fixed effects are used to model differences in survey gear catchabilities, and normal distributed random effects are used for ships. The function g is the link function, which is the natural logarithm. The fitted model is then used to sum the expected catches over a fine grid for a given time to obtain the survey index. Nuisance variables such as Gear, ship, and haul duration are corrected for (set to constant) in this process.

4 Results

The results show that Turbot is mostly distributed at depths shallower than 50 meters, and there are very few Turbot occurences below 100 meters (figure 9). Area IIIa generally has lower Turbot densities than the surrounding waters, which may be explained by the fact that IIIa has less area with suitable depths for Turbot (figure 20). The parts of IIIa with the highest Turbot abundances are found near the borders towards the North Sea and the Baltic Sea, which is unfortunate, since this implies an increased risk that the abundance in IIIa is driven by inflows of individuals from the North Sea and/or Baltic Sea stocks, or that varying proportions of the IIIa stock are outside area IIIa during the time-series (figures 15–18). There is a strong seasonal pattern in the CPUE with roughly twice the catch rates in quarters 1 and 4 compared to 2 and 3. The total abundance in Kattegat is estimated to be around twice the amount in Skagerrak (figure 21). Figures 11–14 indicate that there is also substantial variation in the spatial distribution over the season.

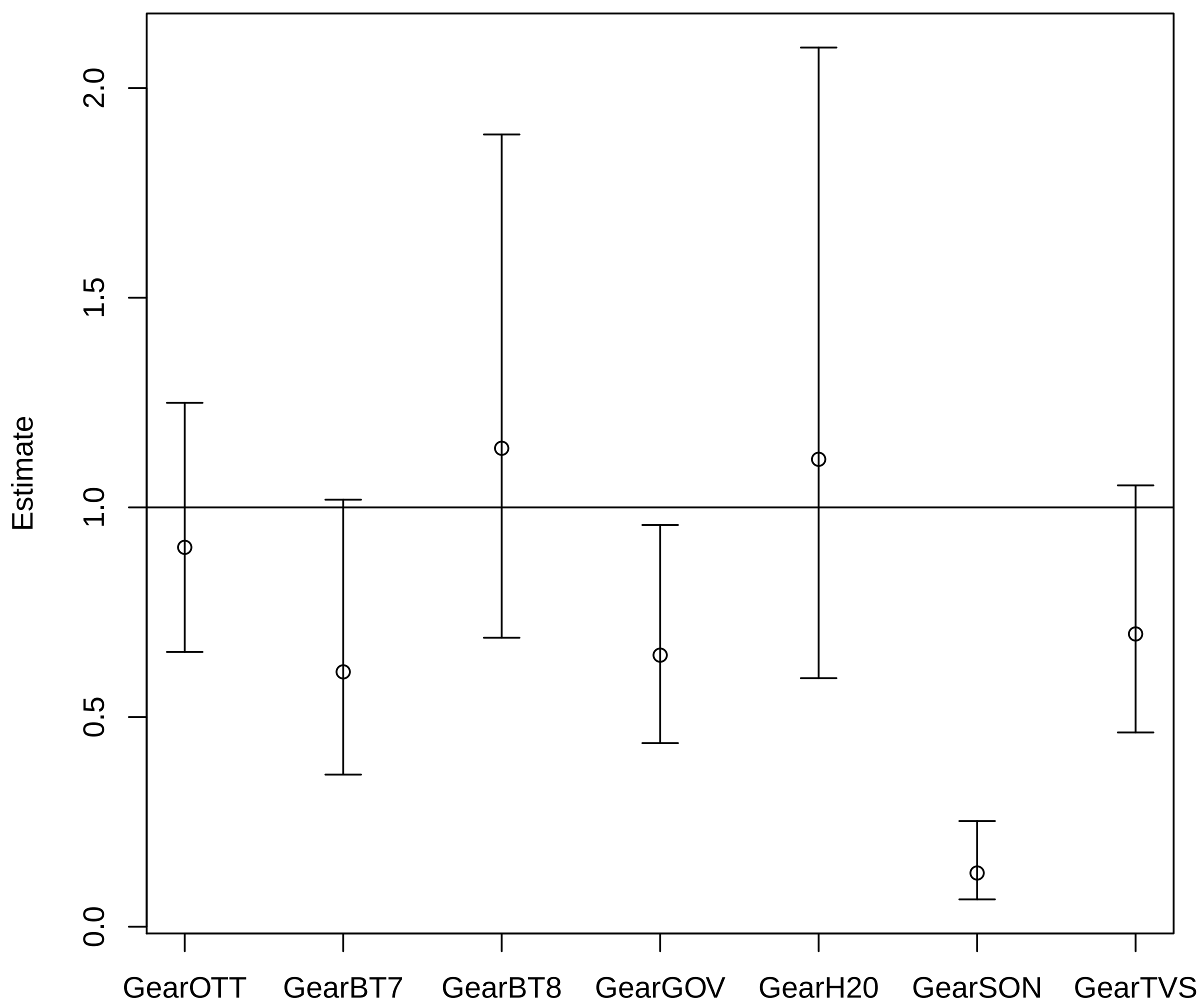


Figure 9: Gear effects (relative to OTB = 1)

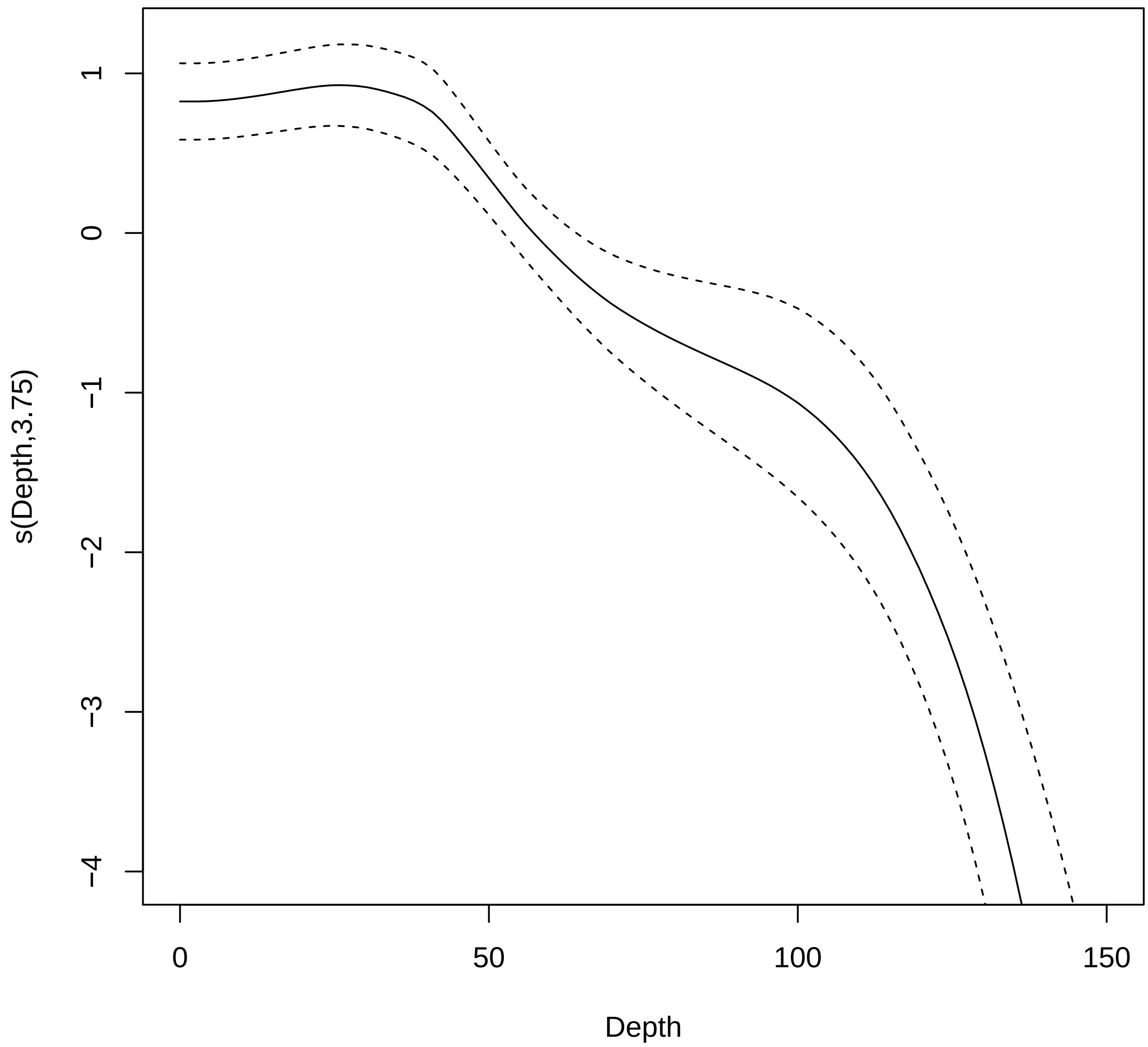


Figure 10: Depth effect (on log scale)

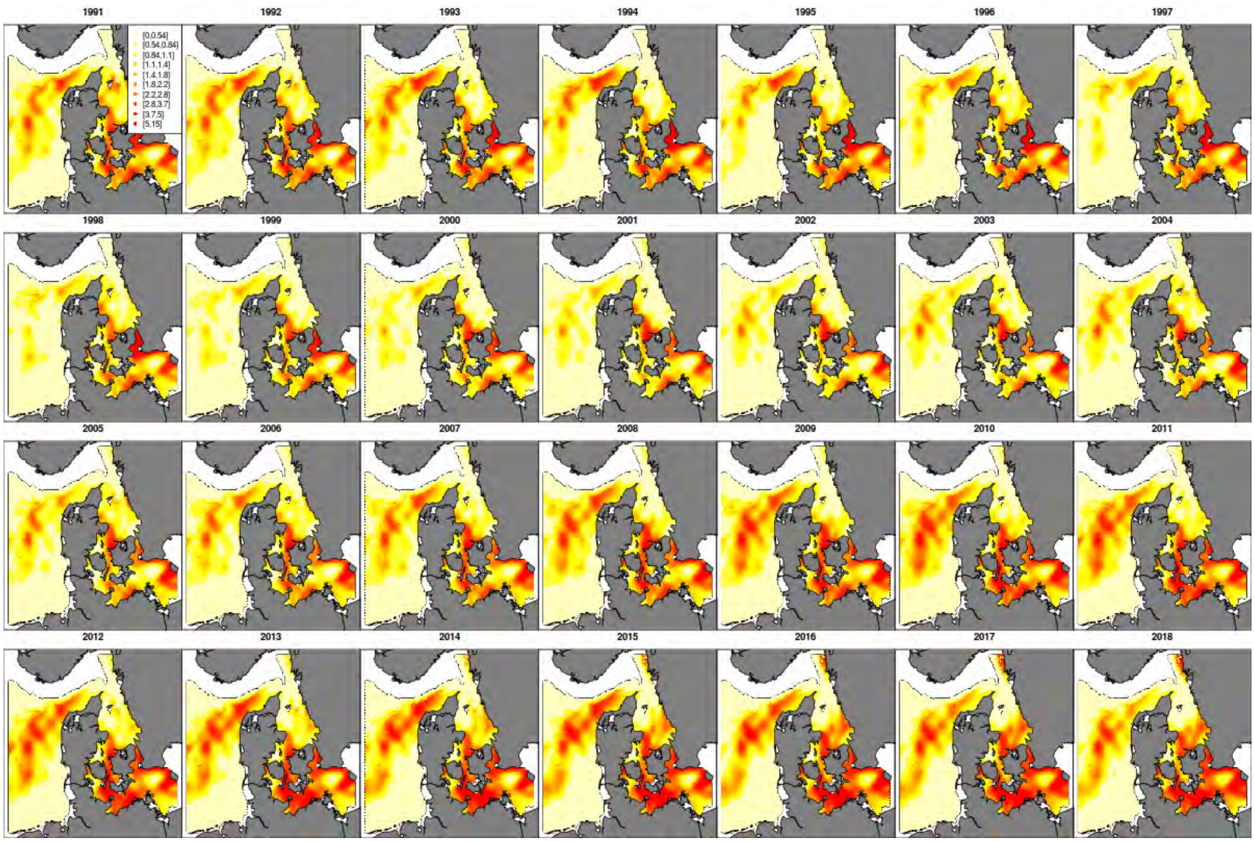


Figure 11: Absolute maps Q1. Absolute maps are comparable across years.

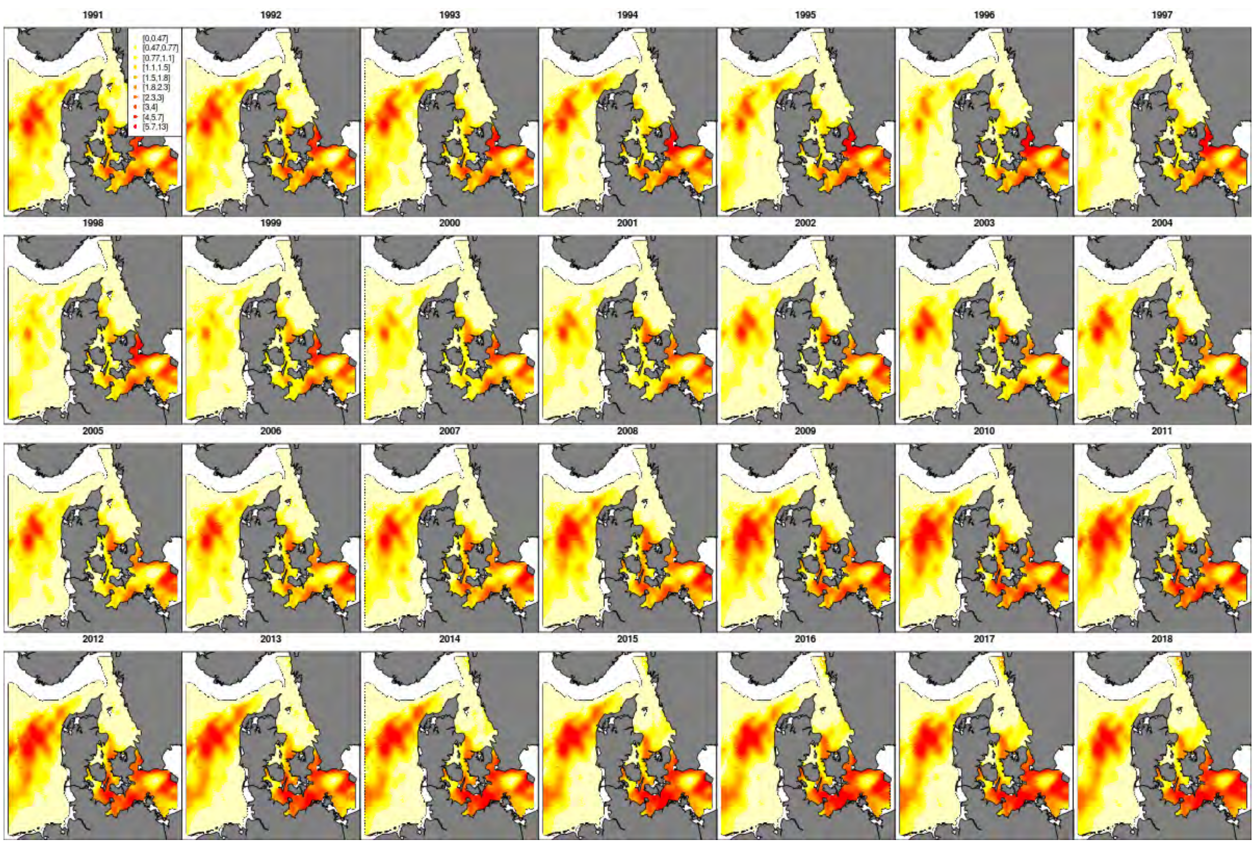


Figure 12: Absolute maps Q2

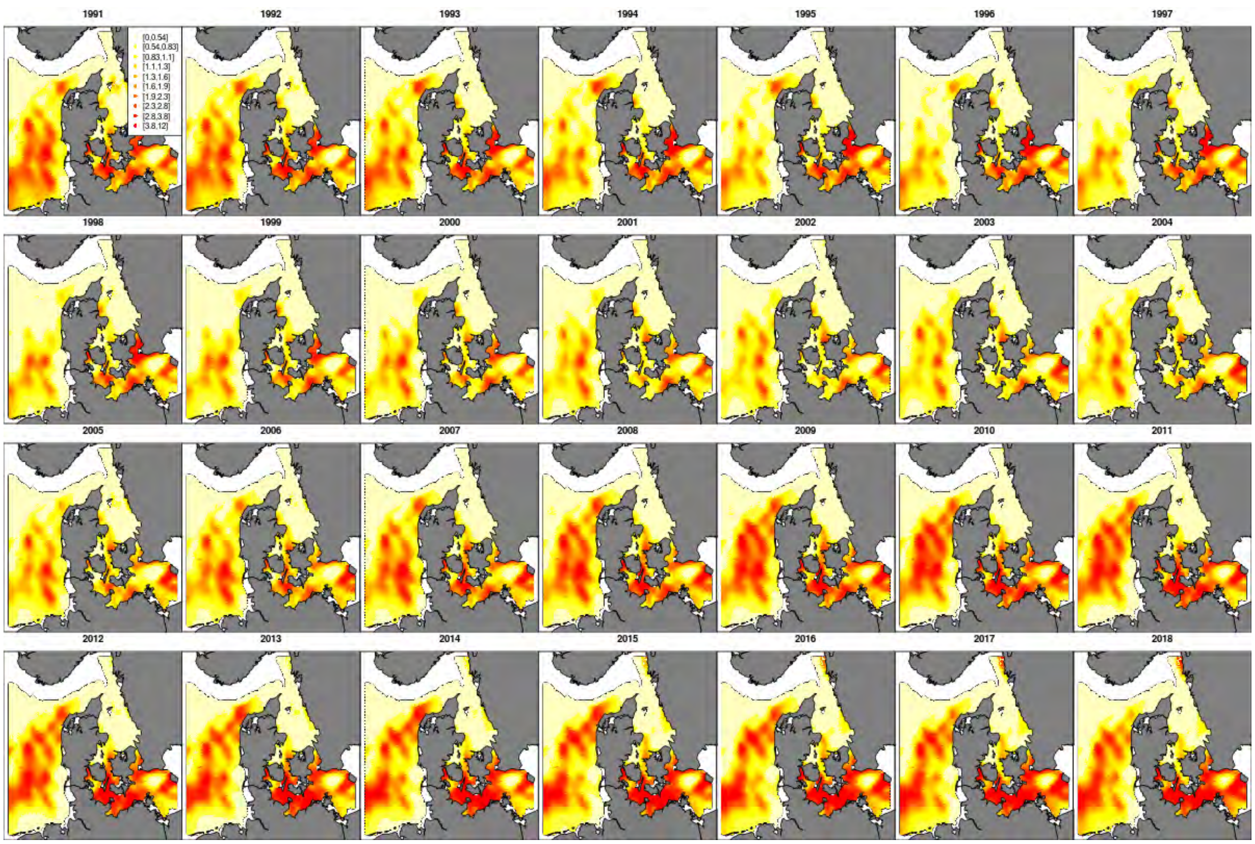


Figure 13: Absolute maps Q3

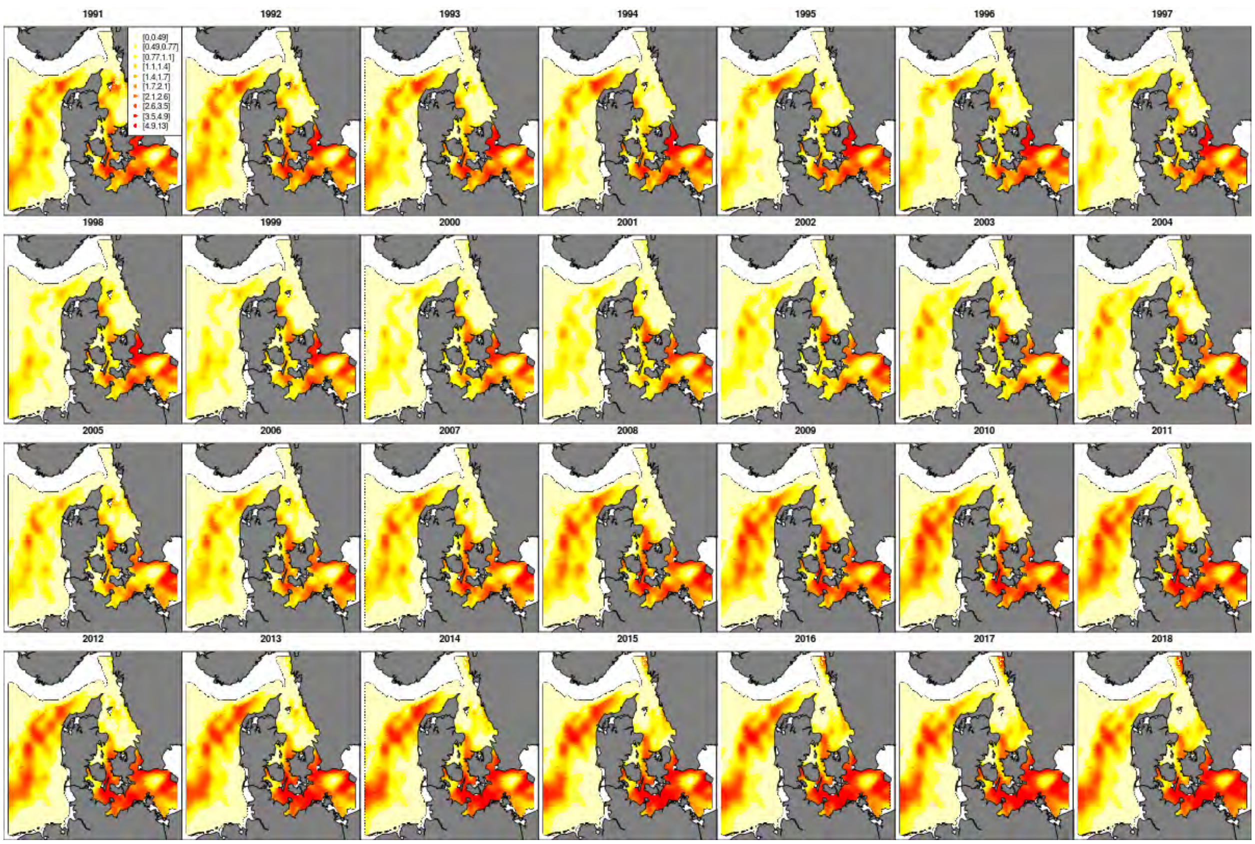


Figure 14: Absolute maps Q4

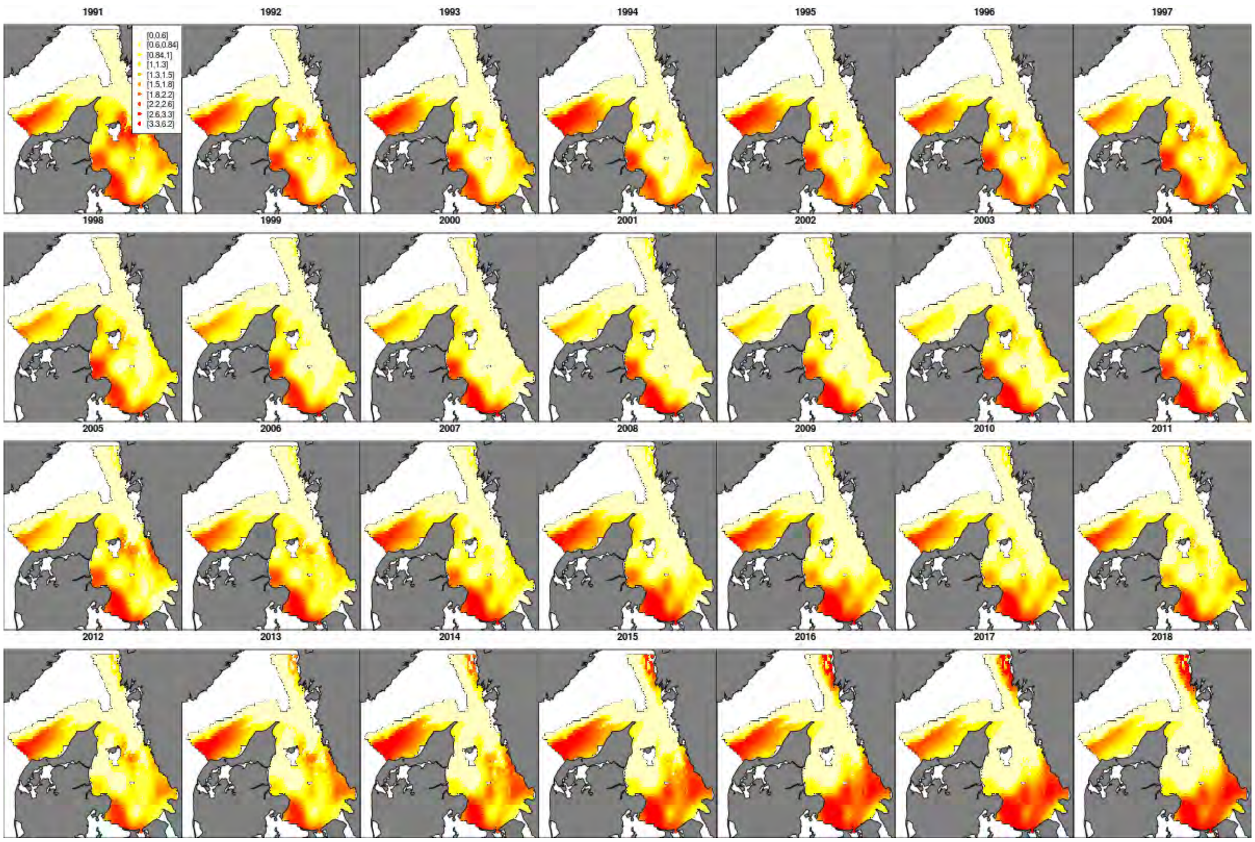


Figure 15: Absolute maps Q1 (area IIIa only)

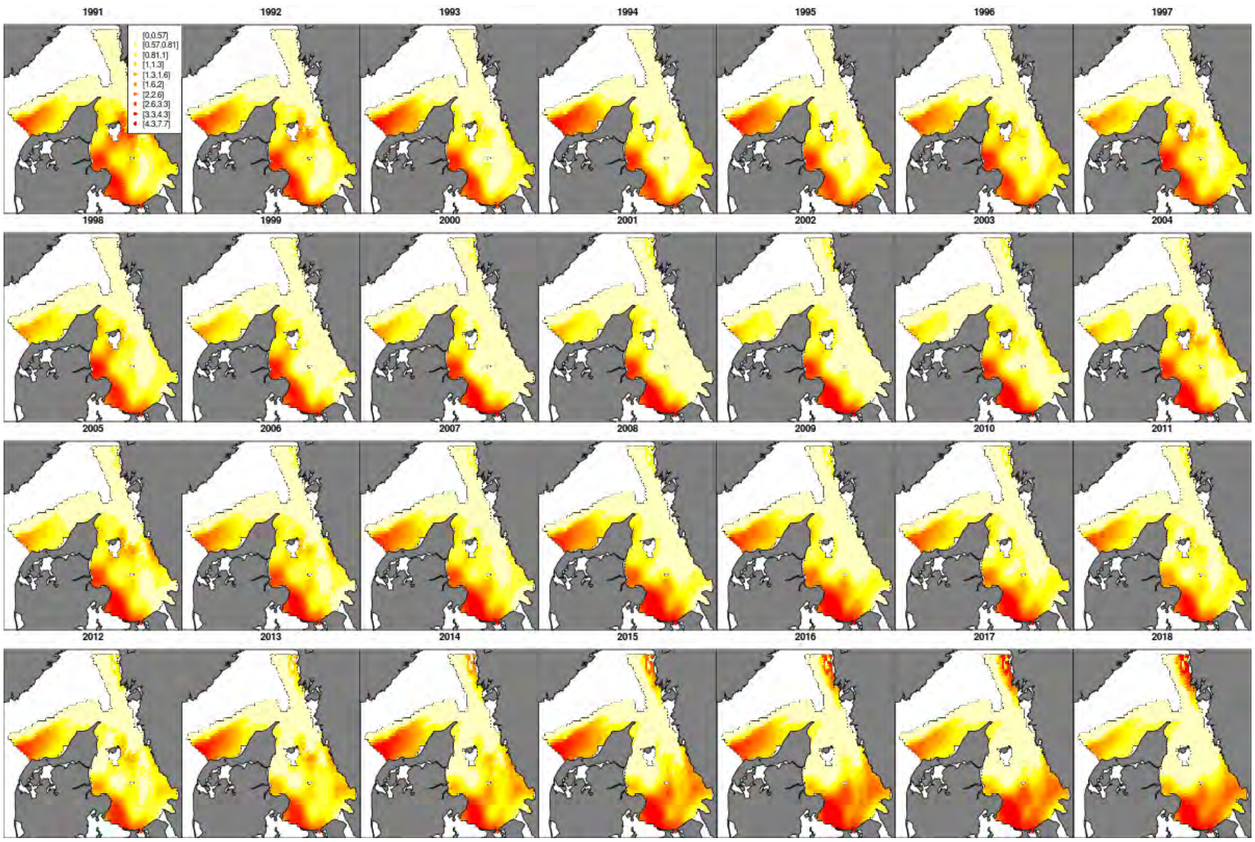


Figure 16: Absolute maps Q2 (area IIIa only)

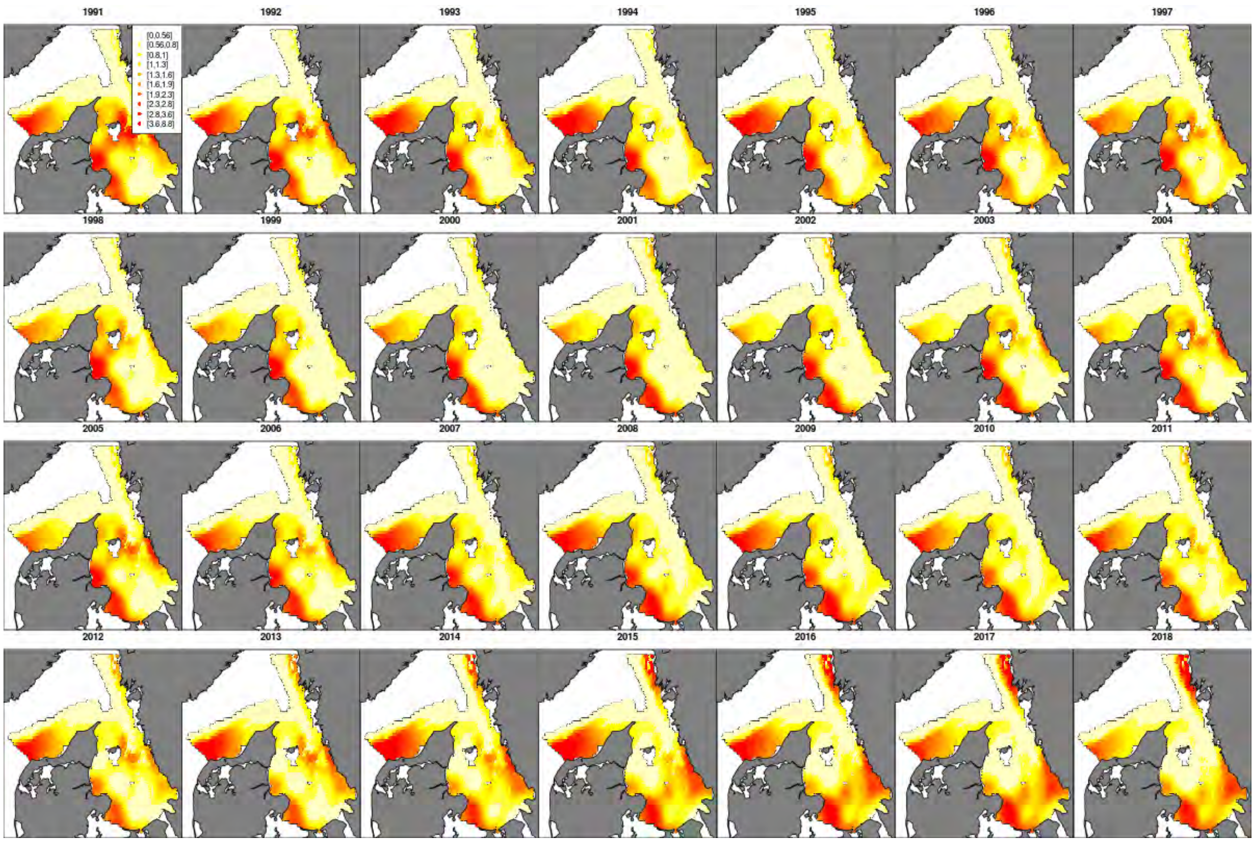


Figure 17: Absolute maps Q3 (area IIIa only)

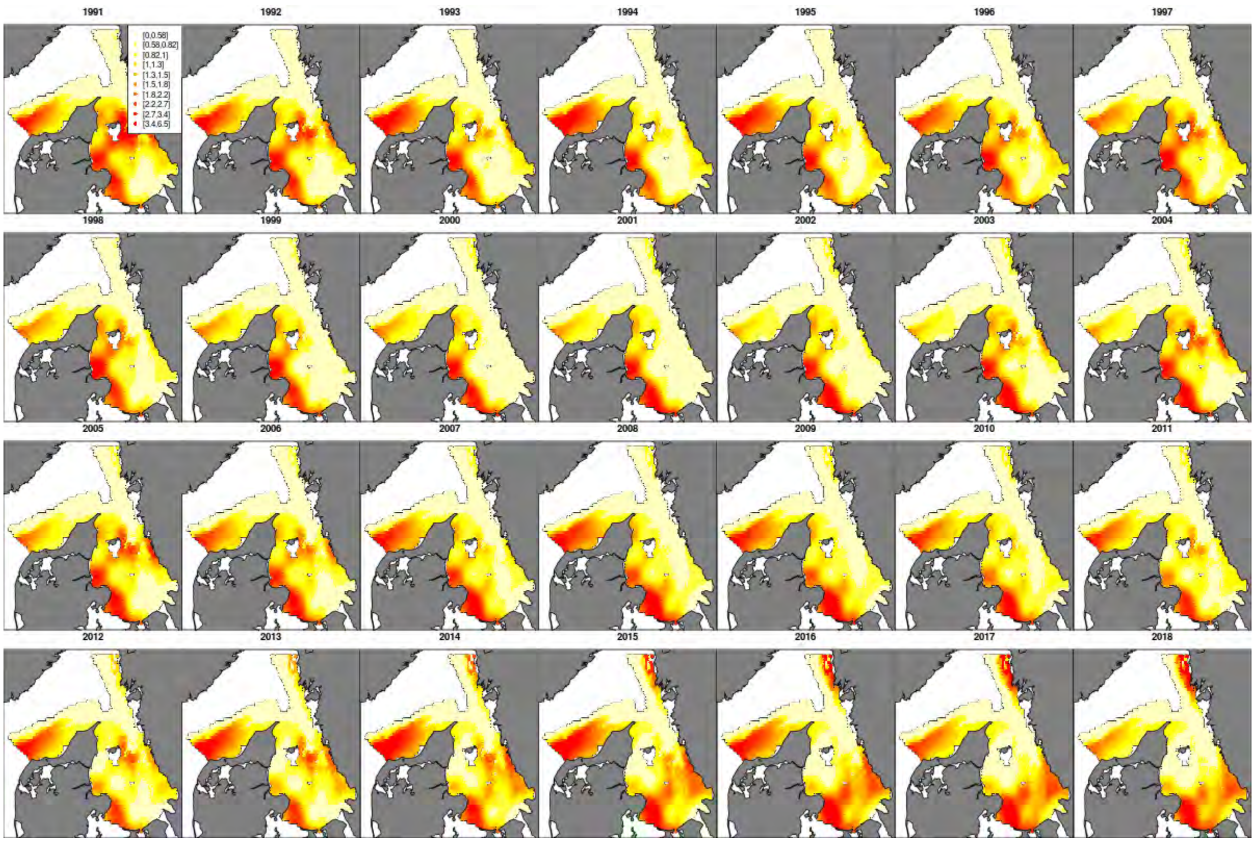


Figure 18: Absolute maps Q4 (area IIIa only)

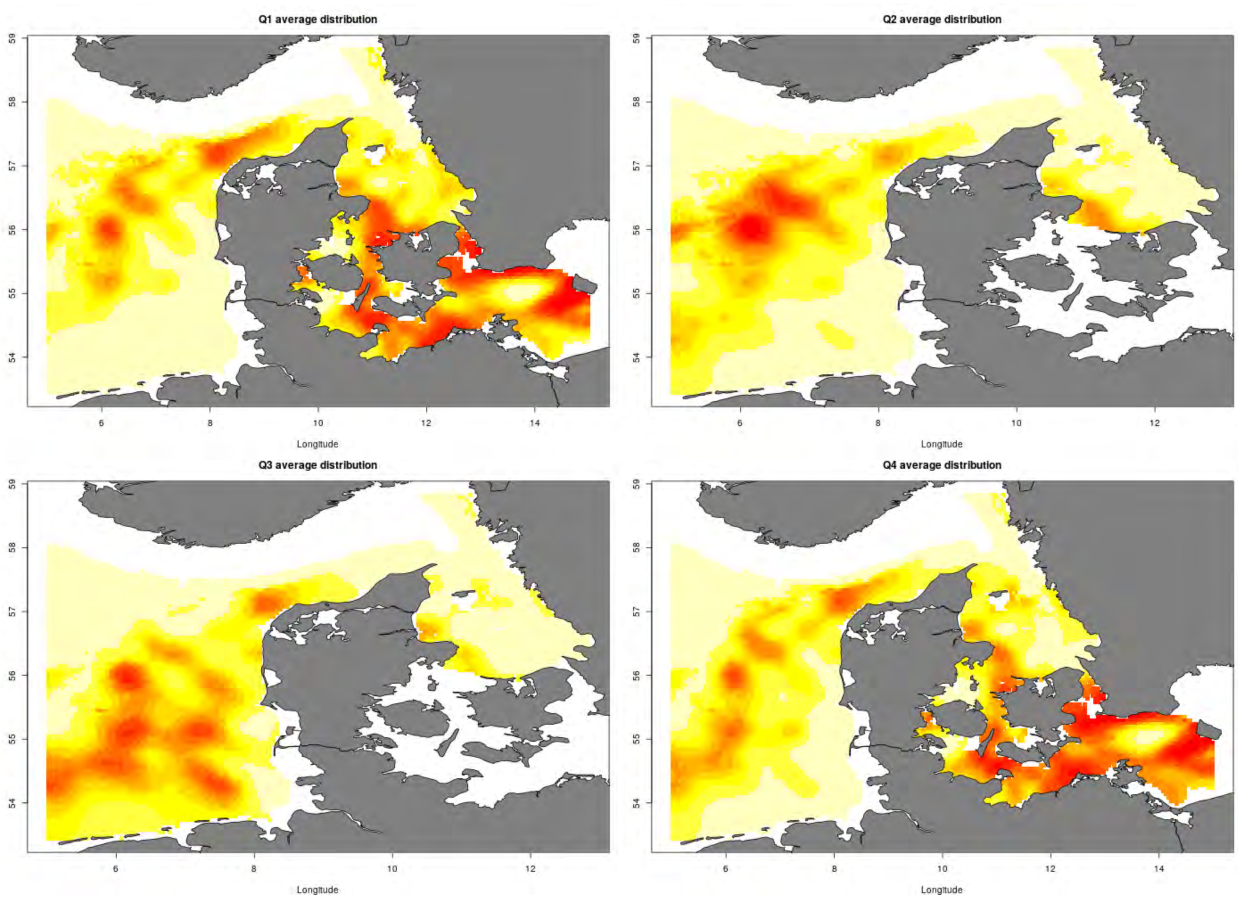


Figure 19: Average (all years) distribution maps by quarter. Estimates in Baltic area in quarters 2 and 3 are not shown because the area was almost never sampled at these times.

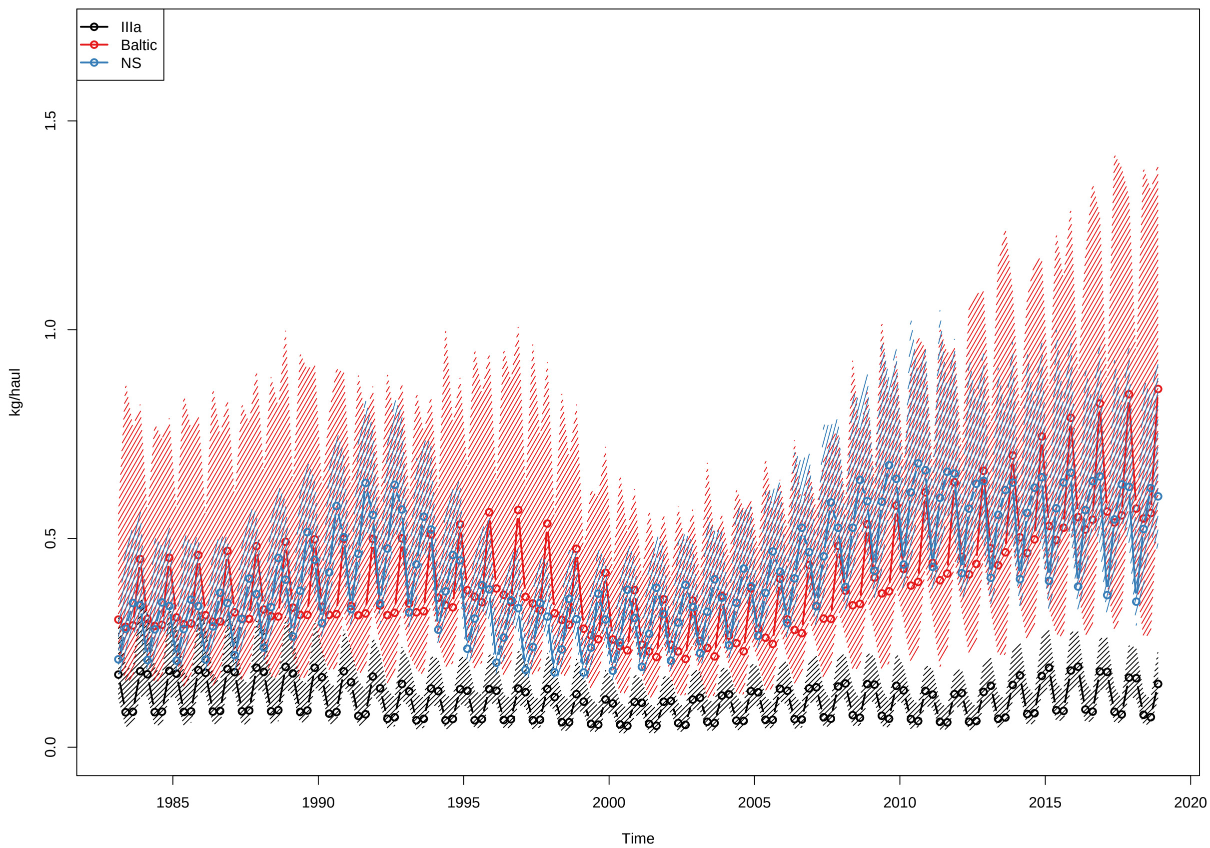


Figure 20: Standardized catch rate over time (quarterly time steps) by area (average haul within area). Shaded areas indicate 95% confidence intervals.

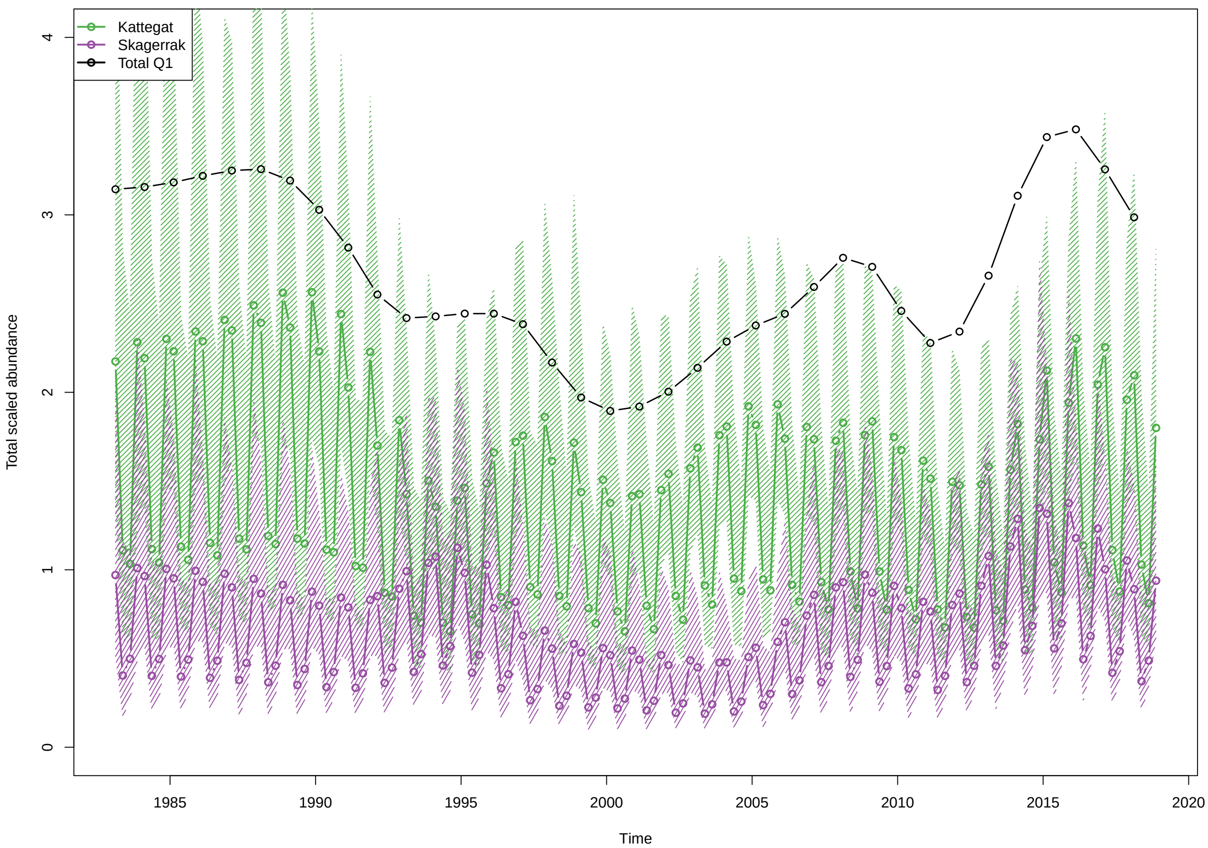


Figure 21: Total scaled abundance by subarea within IIIa. Shaded areas indicate 95% confidence intervals.

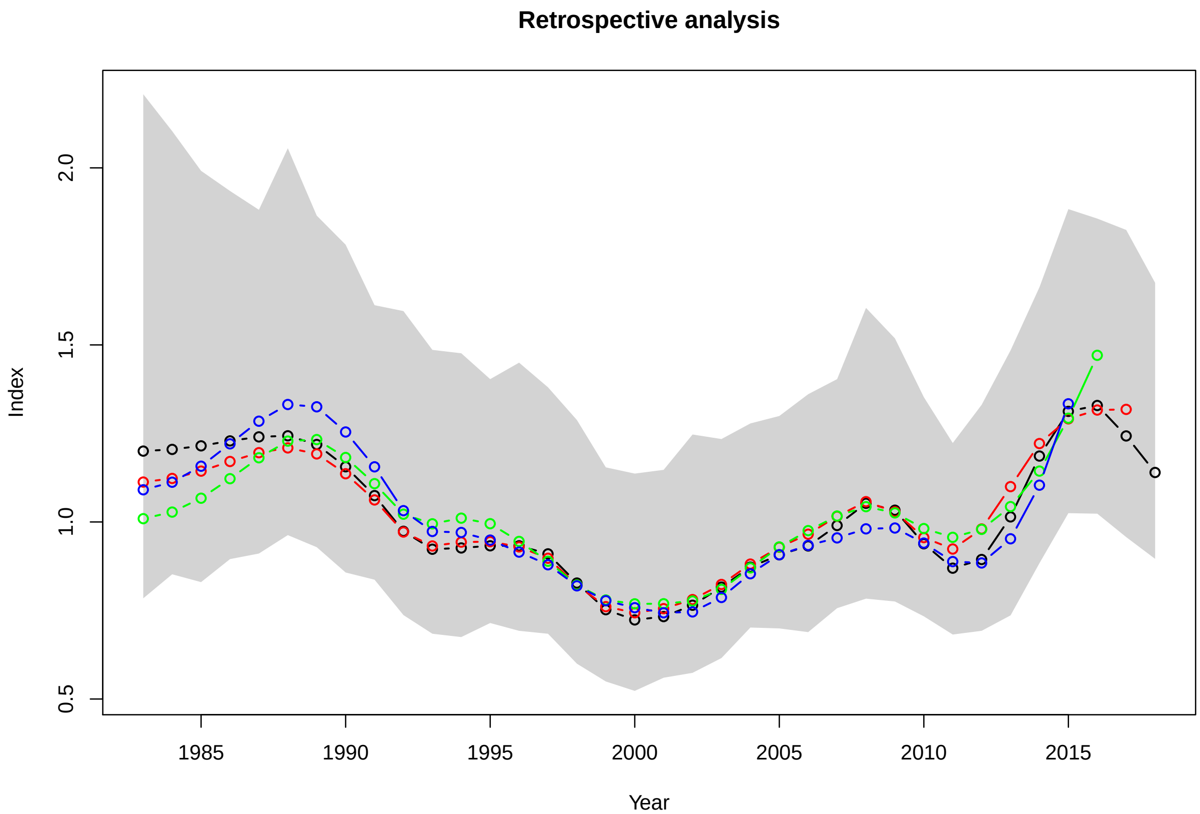


Figure 22: Retrospective analysis for IIIa index.

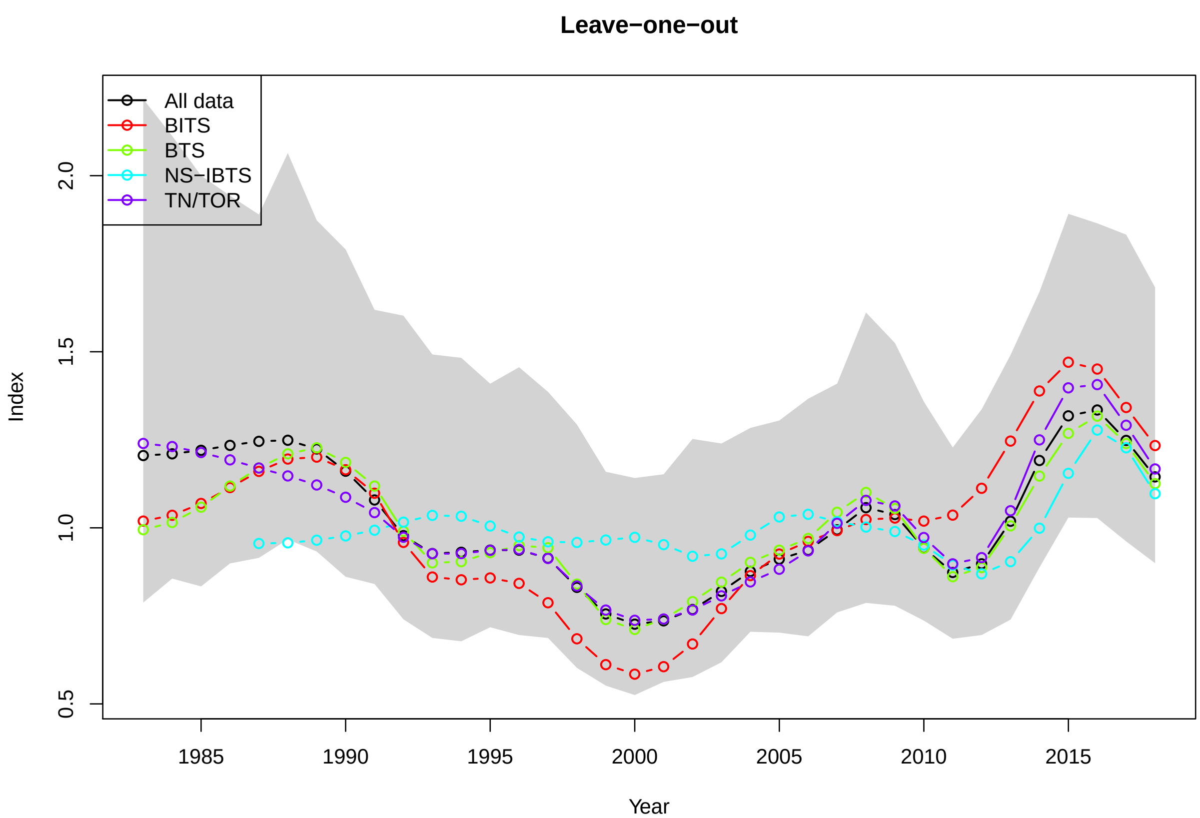


Figure 23: Leave-one-survey-out analysis for IIIa index.

4.1 Residuals

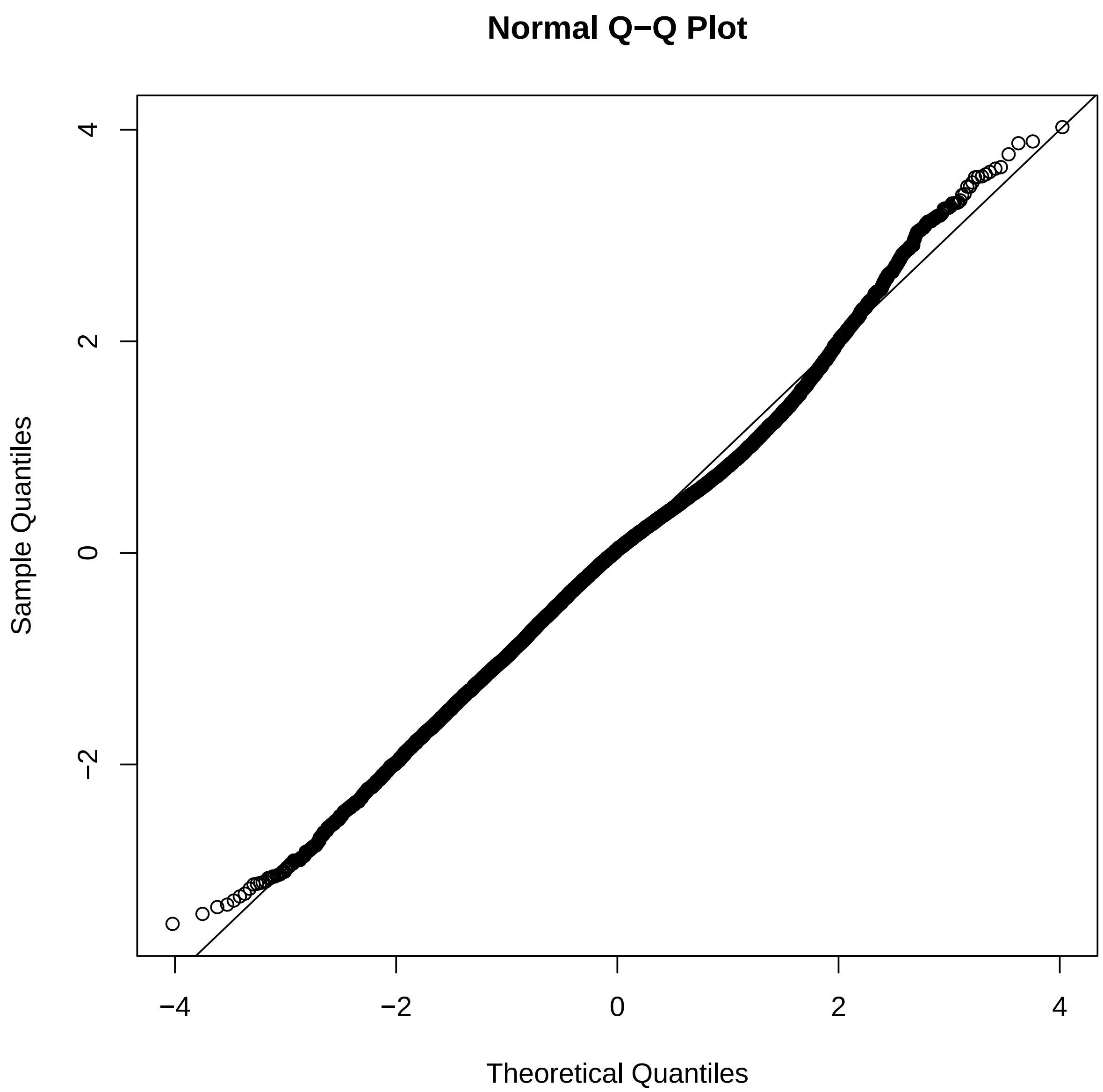


Figure 24: QQ-plot of model residuals (randomized quantile residuals transformed to Gaussian)

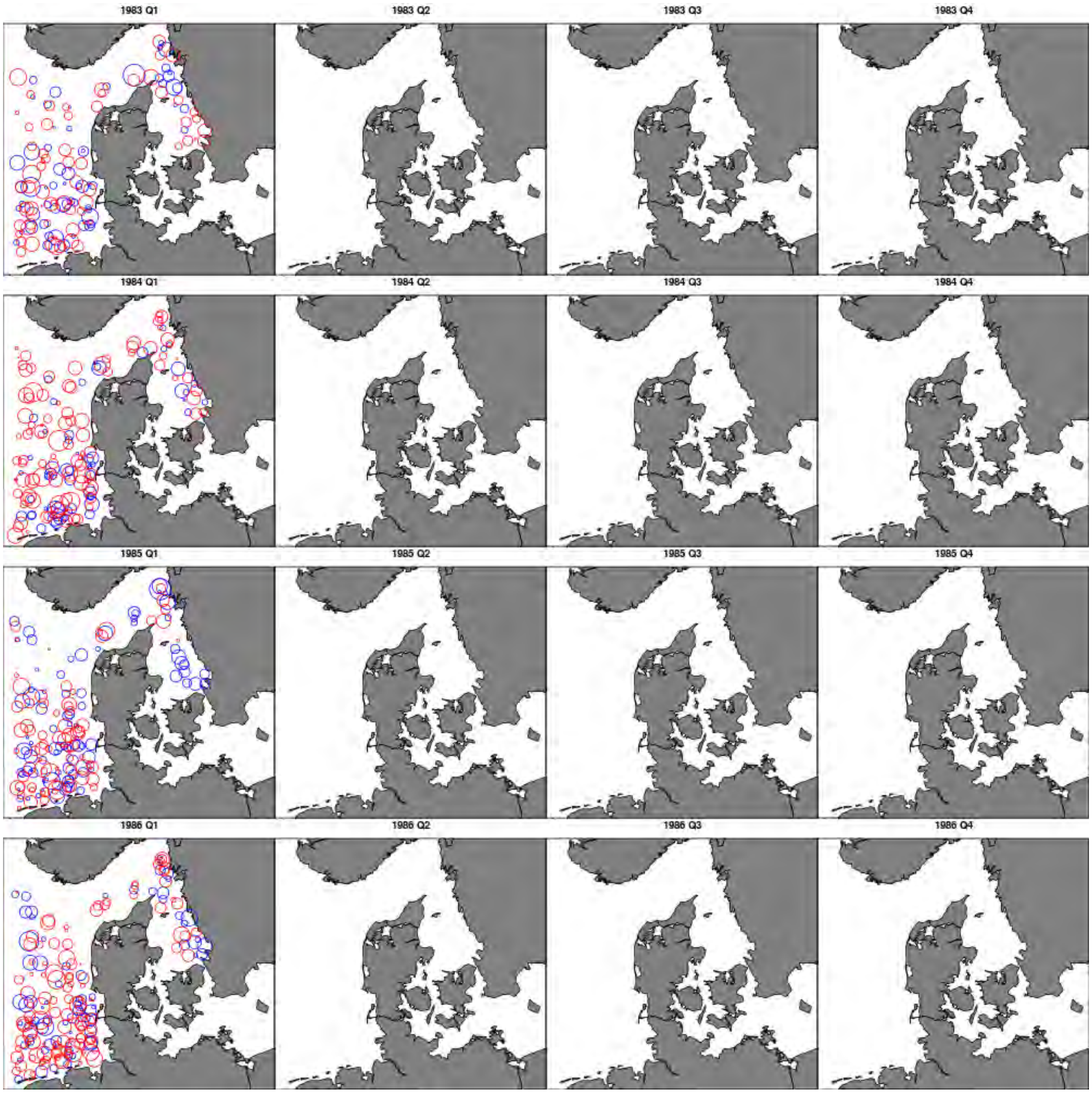


Figure 25: Model residuals (randomized quantile residuals transformed to Gaussian). Bubble areas are proportional to absolute value of residual. Blue bubbles are positive residuals and red are negative.

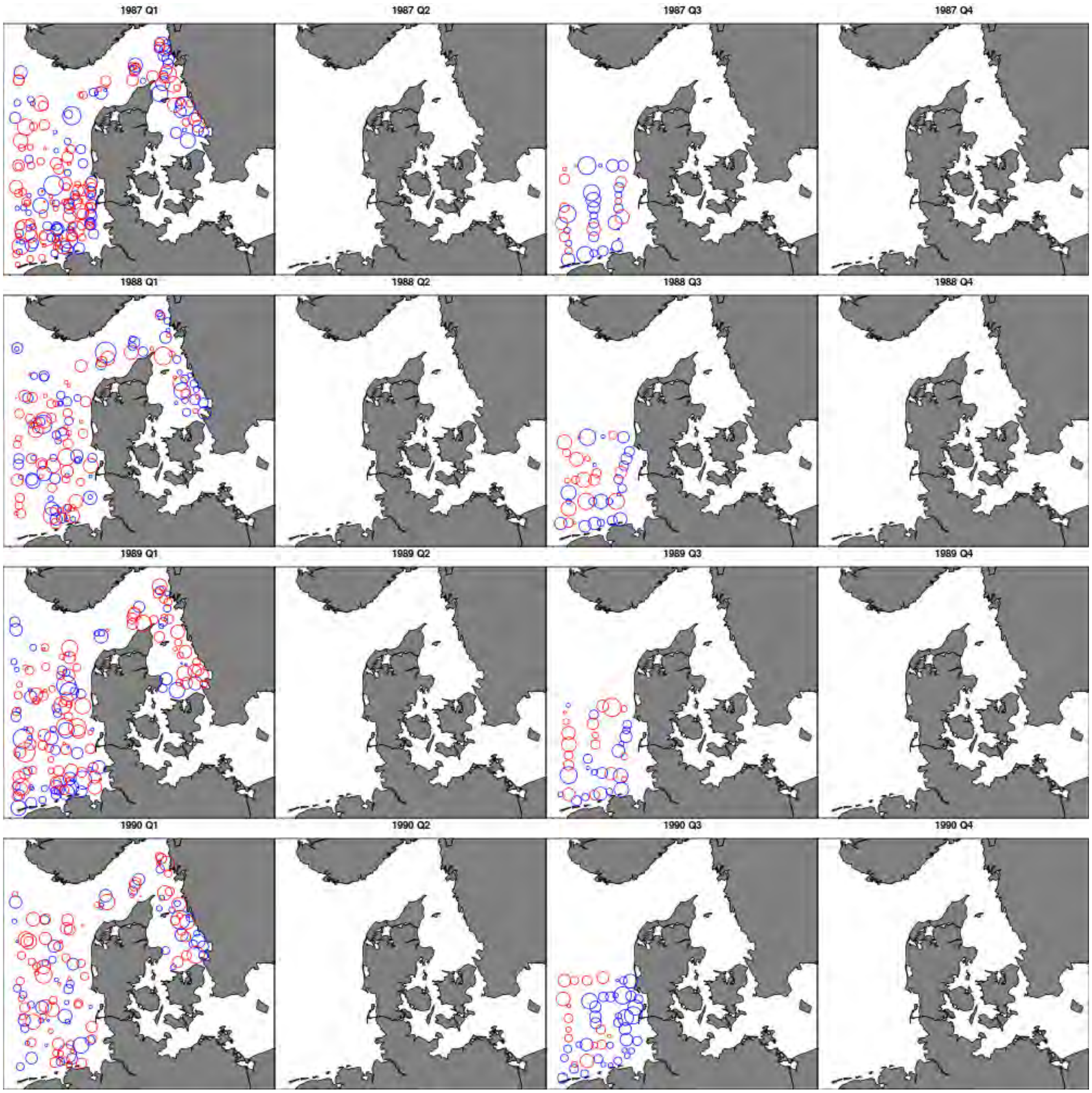


Figure 26: Model residuals (randomized quantile residuals transformed to Gaussian). Bubble areas are proportional to absolute value of residual. Blue bubbles are positive residuals and red are negative.

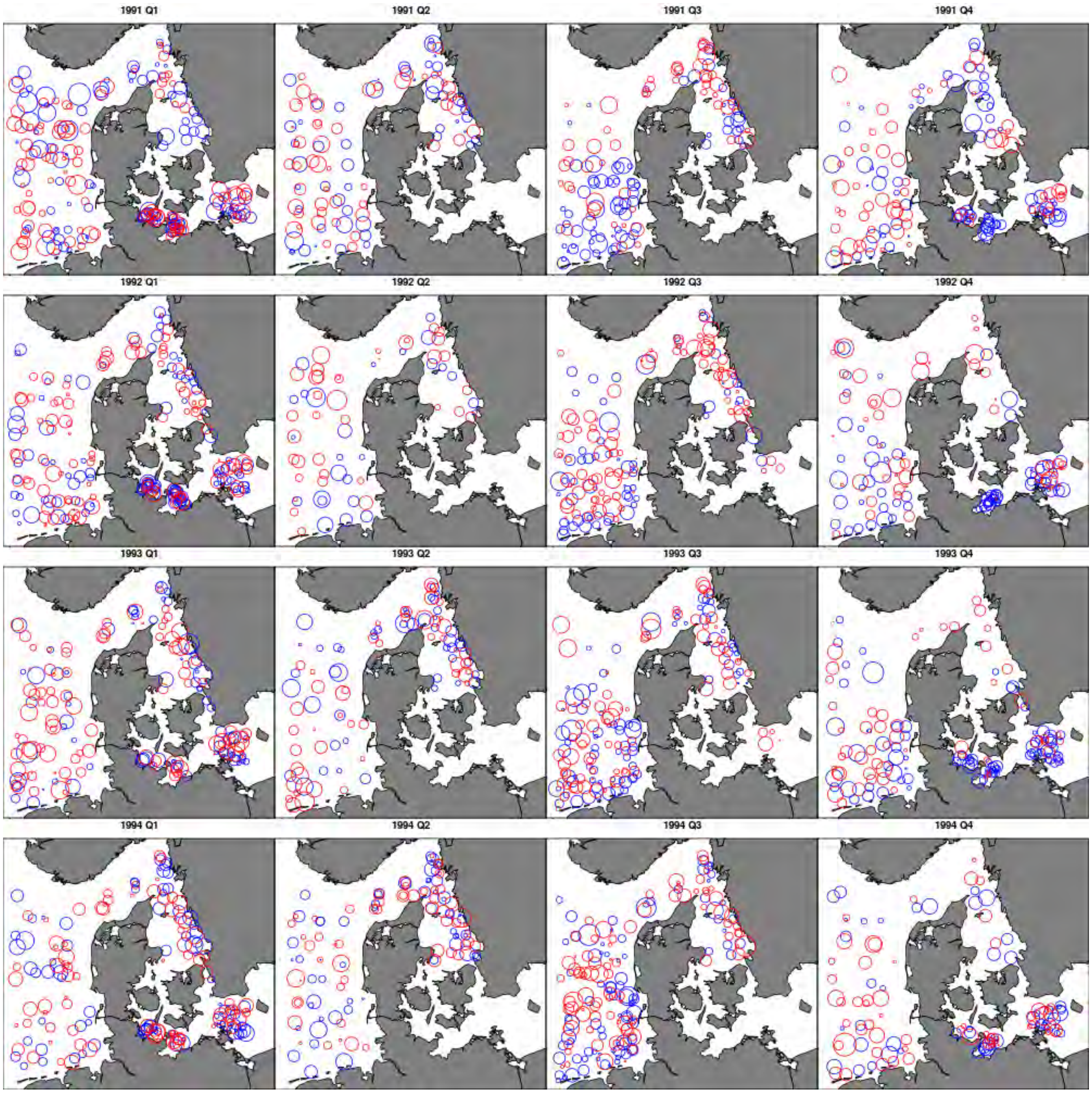


Figure 27: Model residuals (randomized quantile residuals transformed to Gaussian). Bubble areas are proportional to absolute value of residual. Blue bubbles are positive residuals and red are negative.

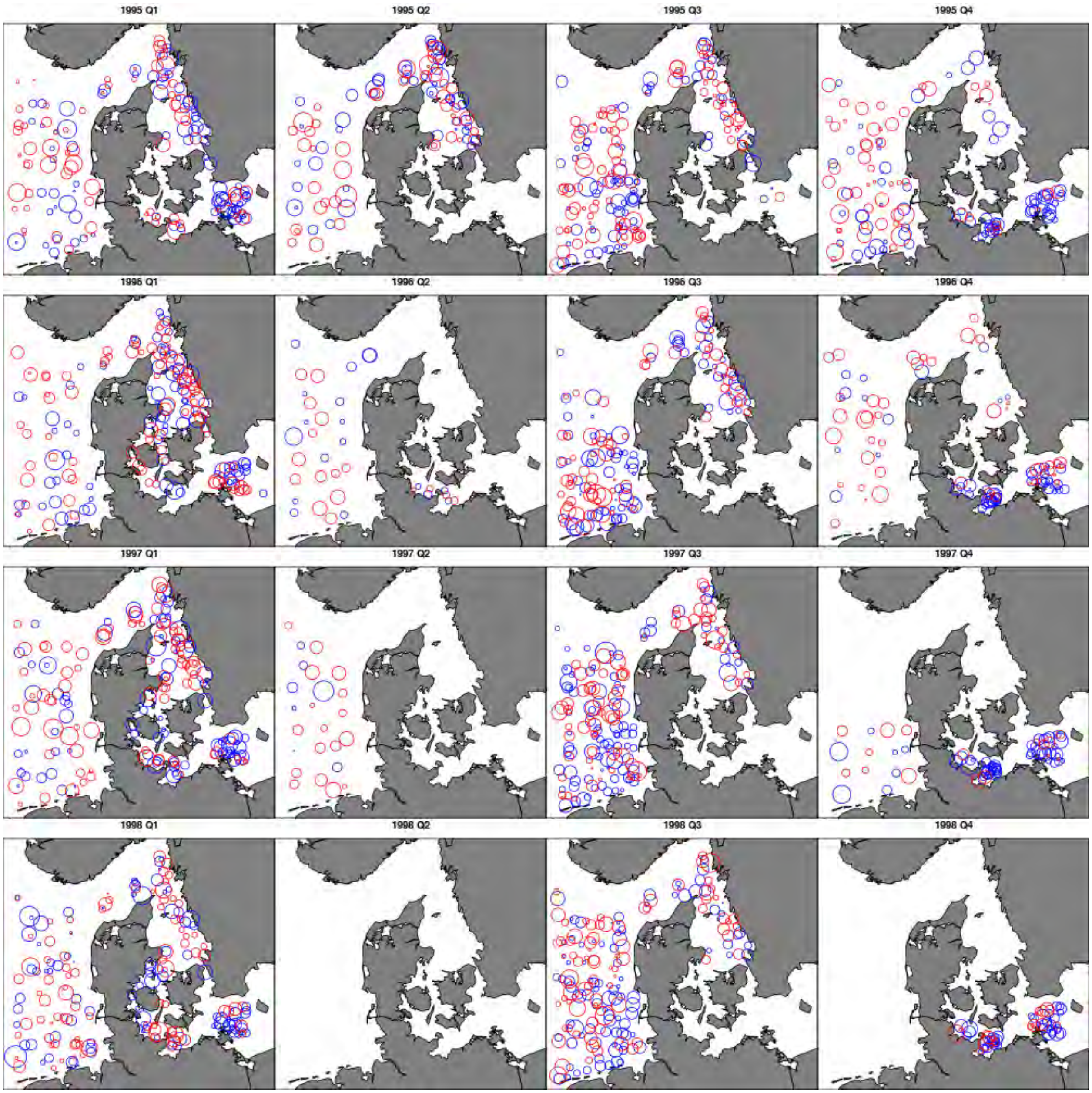


Figure 28: Model residuals (randomized quantile residuals transformed to Gaussian). Bubble areas are proportional to absolute value of residual. Blue bubbles are positive residuals and red are negative.

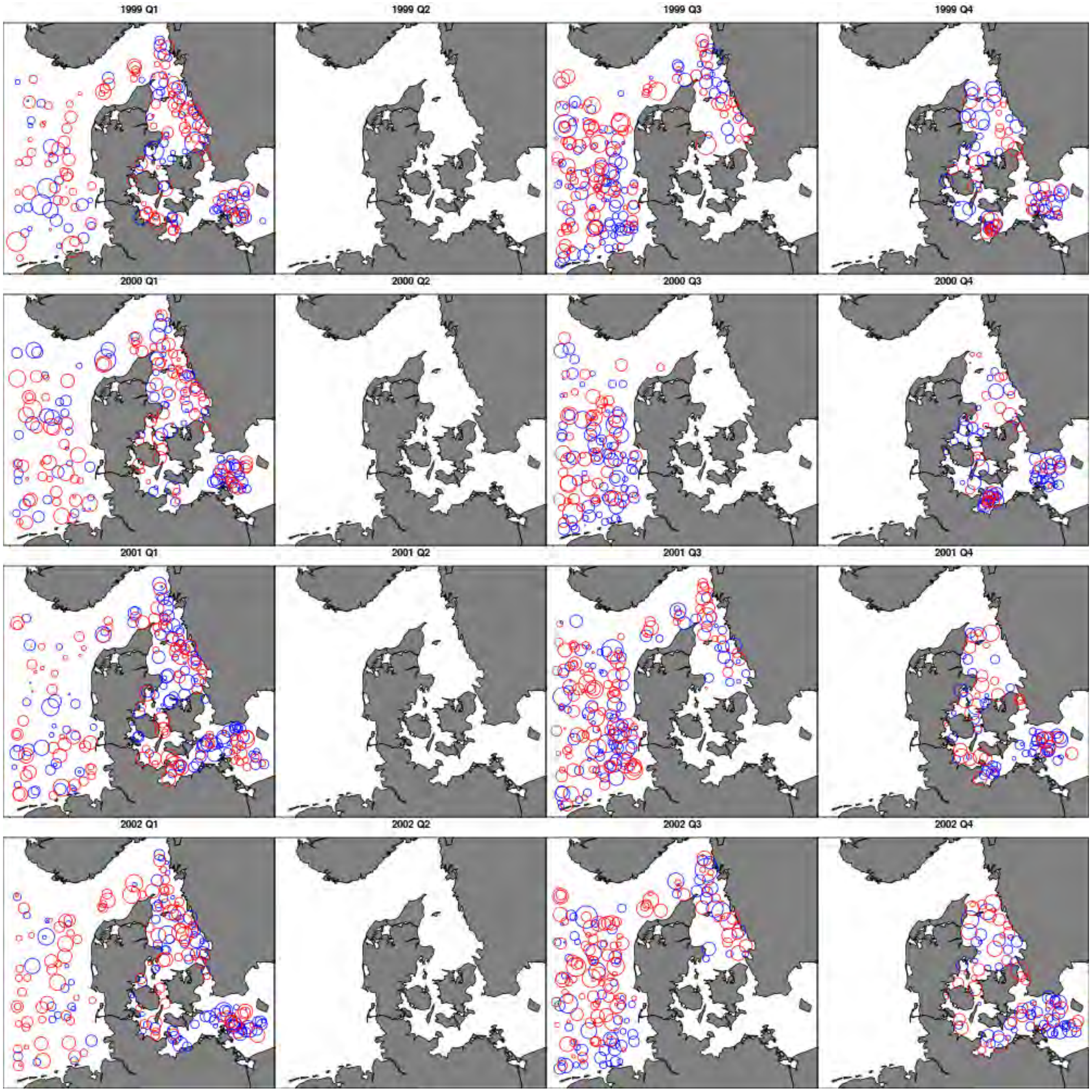


Figure 29: Model residuals (randomized quantile residuals transformed to Gaussian). Bubble areas are proportional to absolute value of residual. Blue bubbles are positive residuals and red are negative.

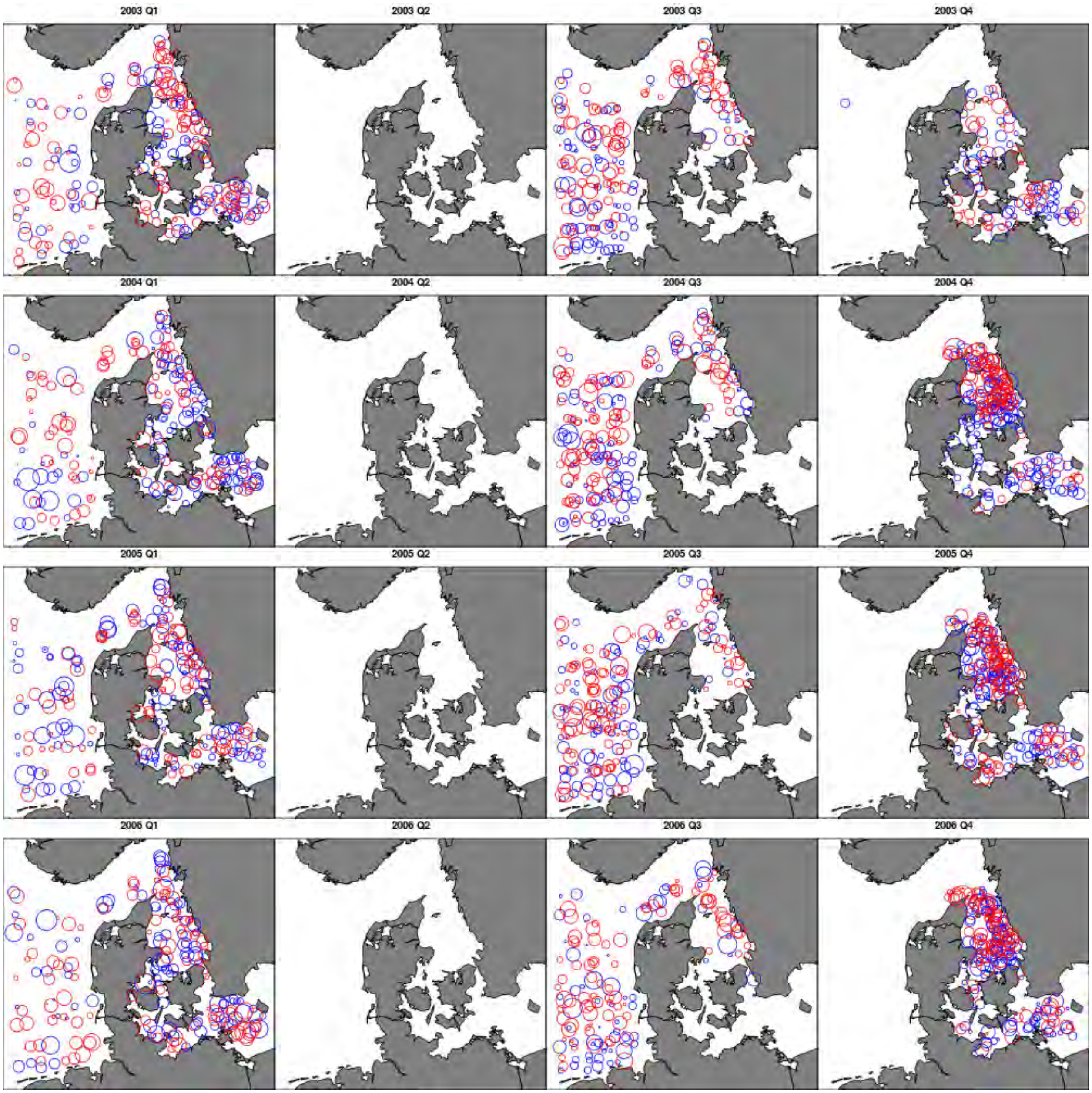


Figure 30: Model residuals (randomized quantile residuals transformed to Gaussian). Bubble areas are proportional to absolute value of residual. Blue bubbles are positive residuals and red are negative.

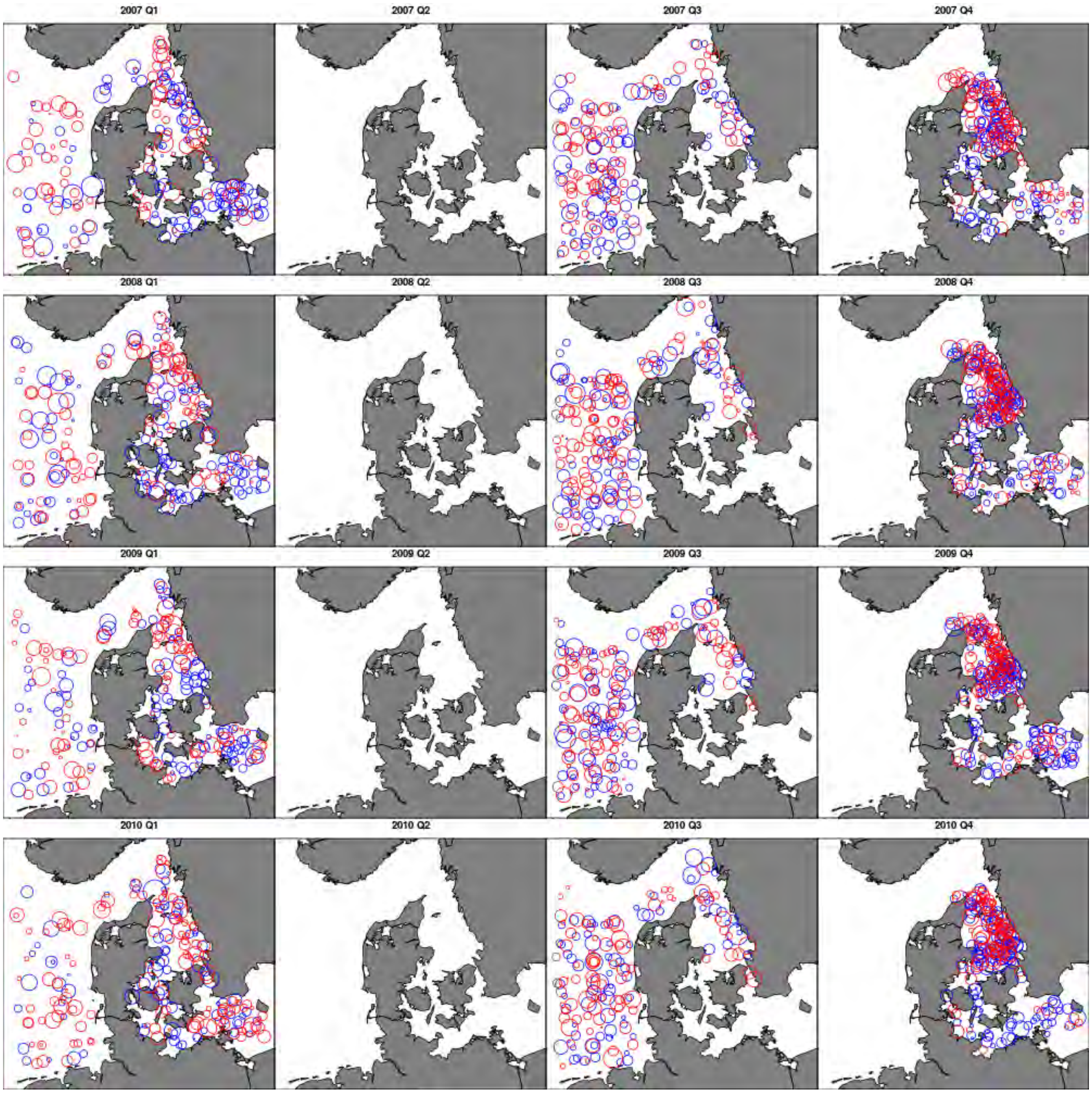


Figure 31: Model residuals (randomized quantile residuals transformed to Gaussian). Bubble areas are proportional to absolute value of residual. Blue bubbles are positive residuals and red are negative.

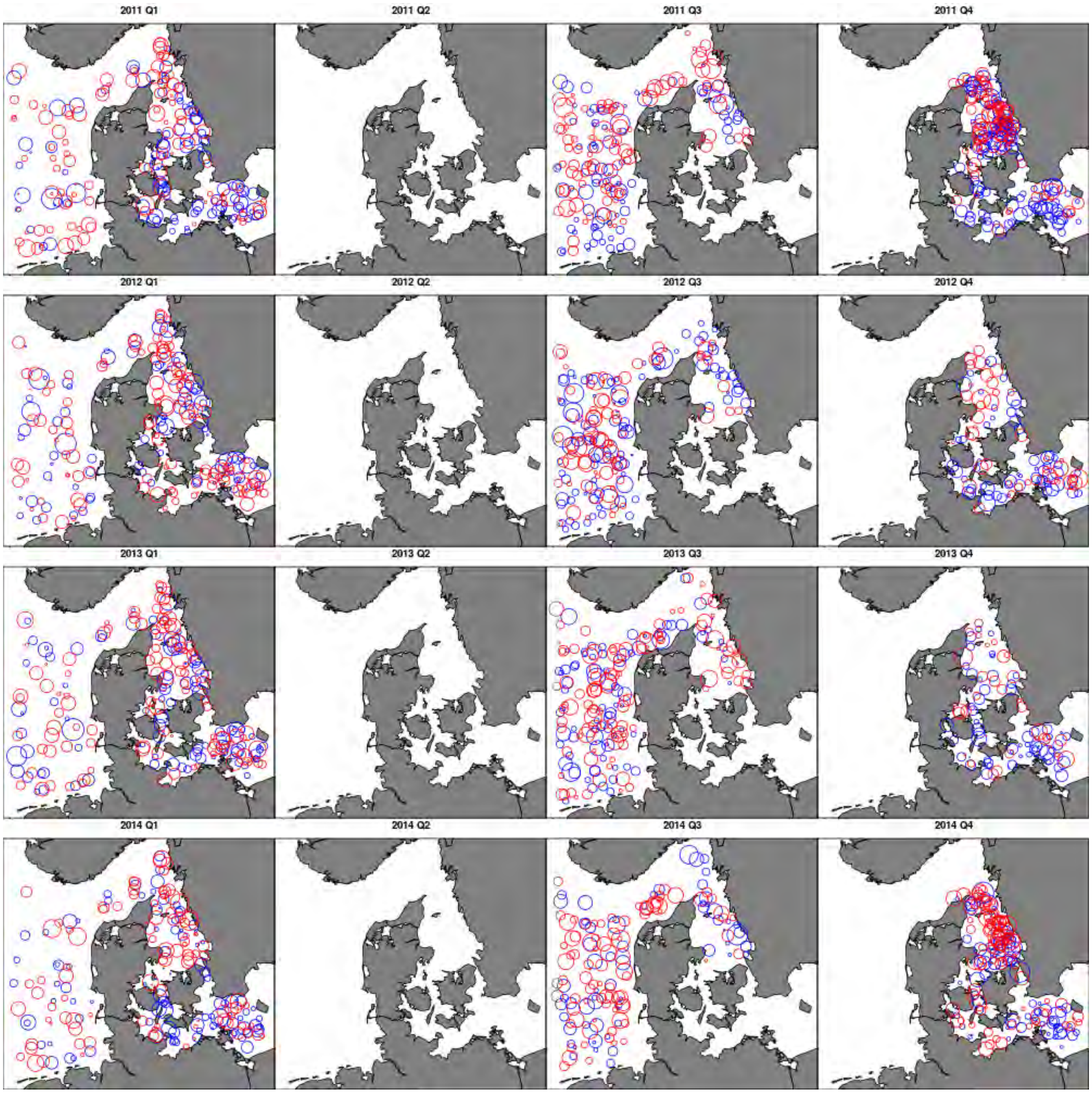


Figure 32: Model residuals (randomized quantile residuals transformed to Gaussian). Bubble areas are proportional to absolute value of residual. Blue bubbles are positive residuals and red are negative.

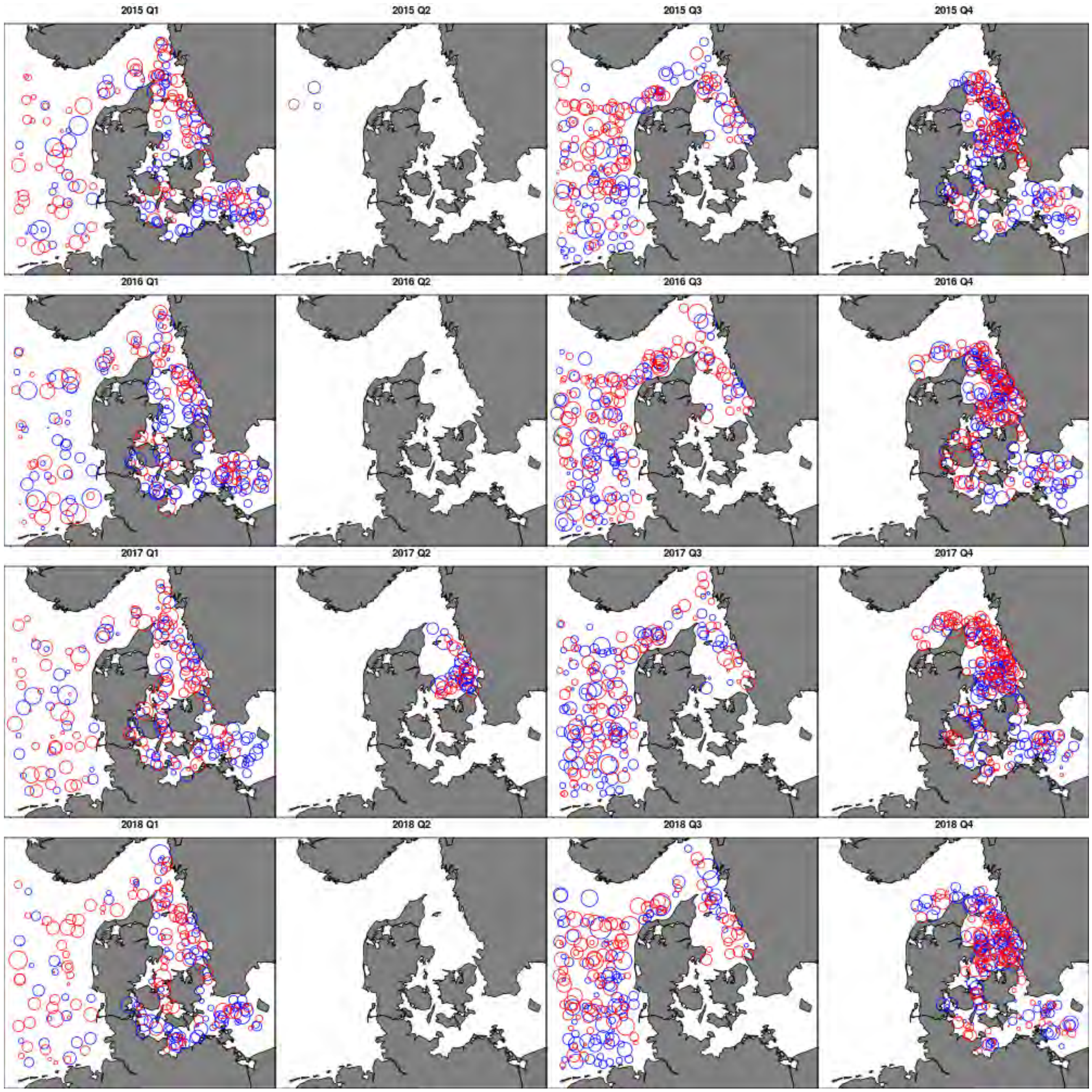


Figure 33: Model residuals (randomized quantile residuals transformed to Gaussian). Bubble areas are proportional to absolute value of residual. Blue bubbles are positive residuals and red are negative.

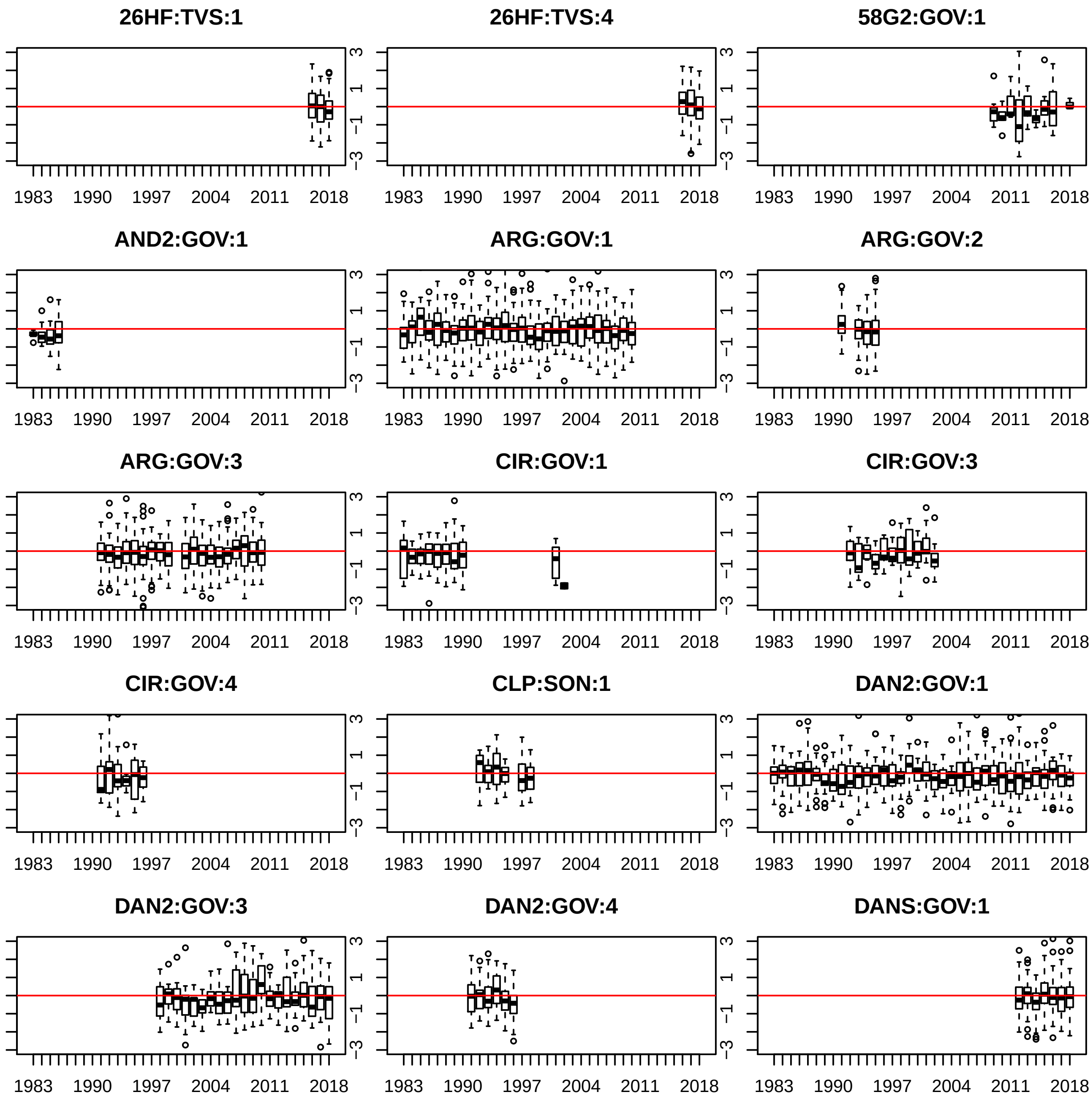


Figure 34: Residuals over time for each combination of ship, gear, and quarter with at least 30 hauls (1/5)

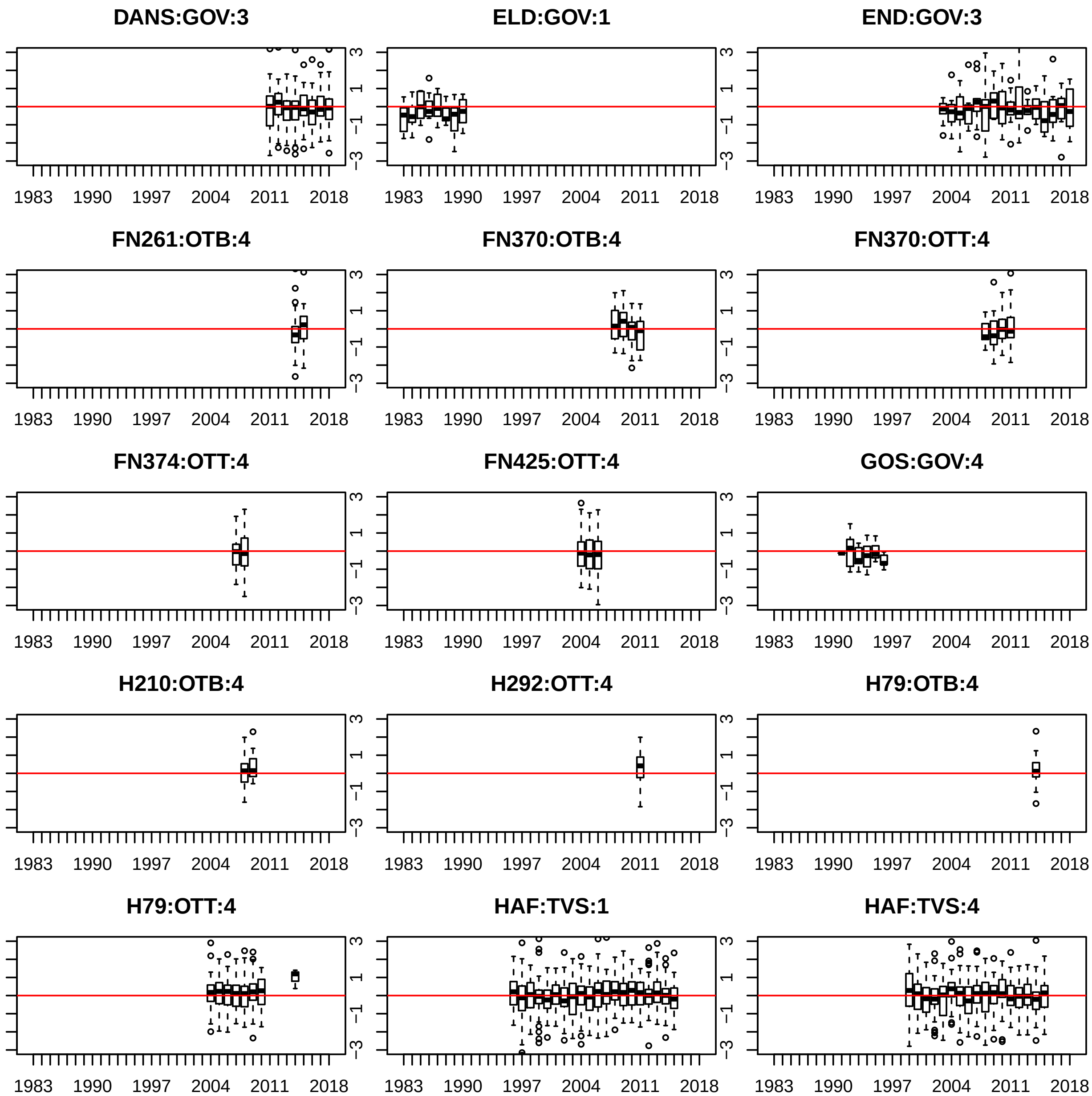


Figure 35: Residuals over time for each combination of ship, gear, and quarter with at least 30 hauls (2/5)

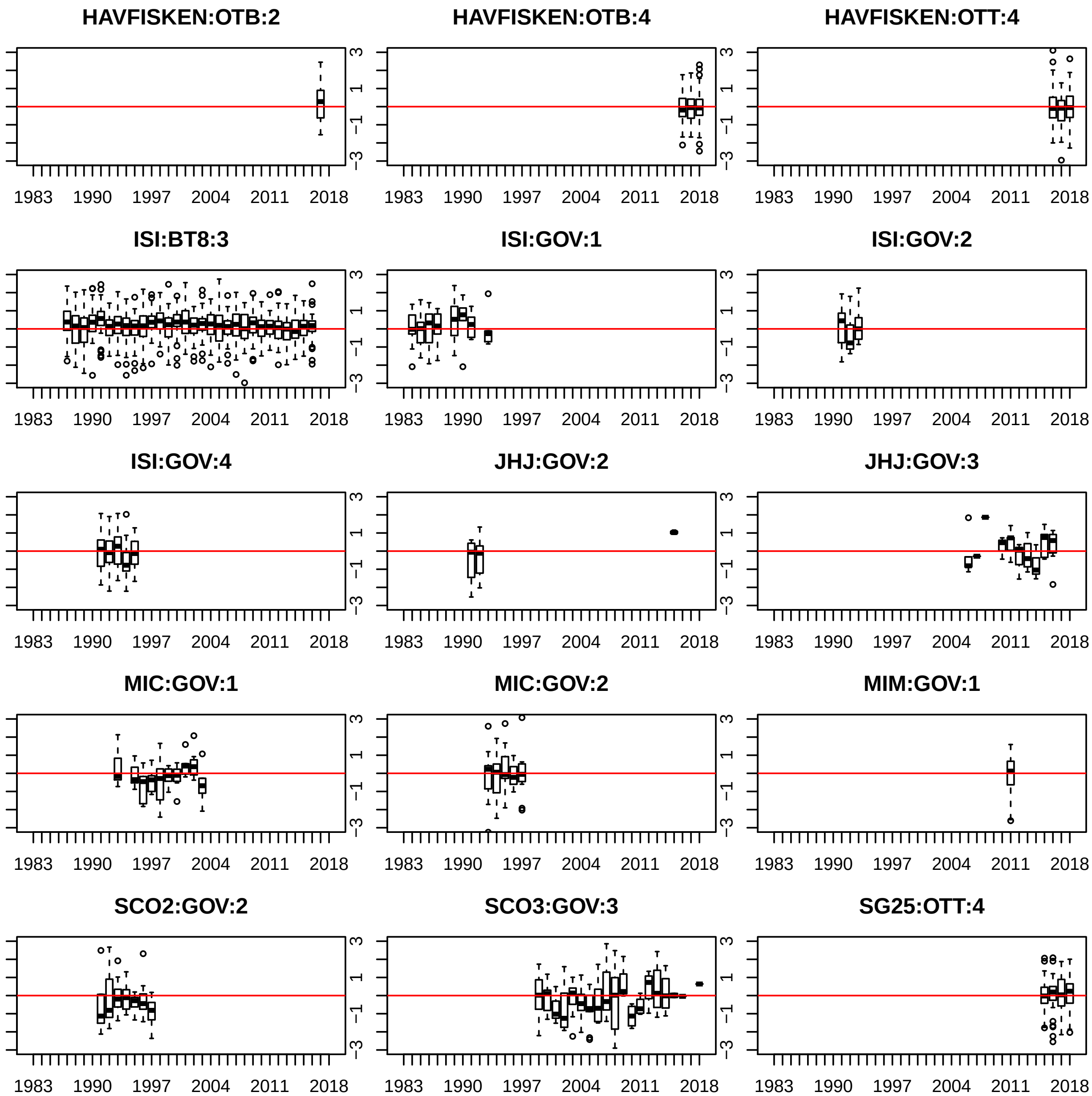


Figure 36: Residuals over time for each combination of ship, gear, and quarter with at least 30 hauls (3/5)

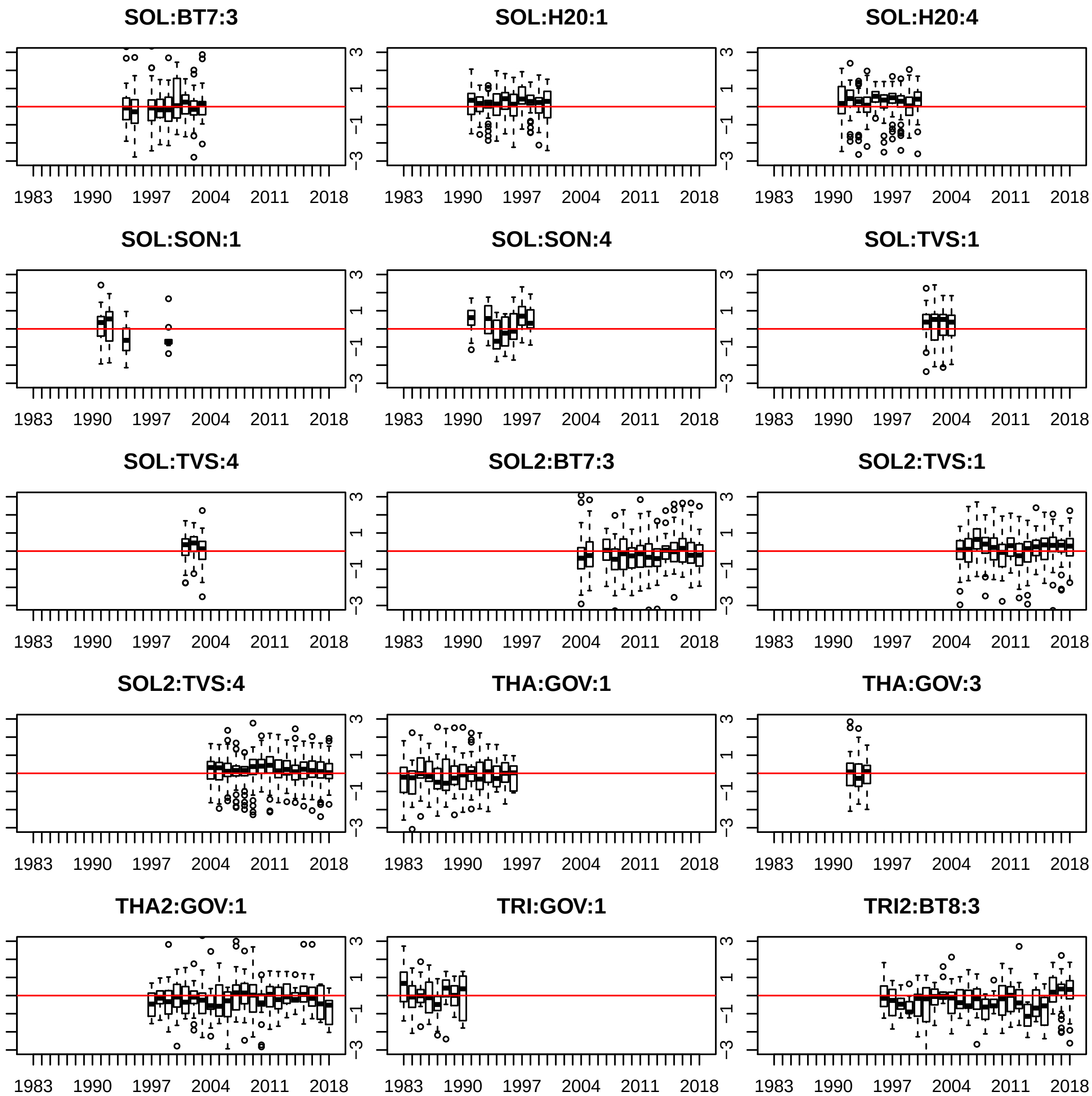


Figure 37: Residuals over time for each combination of ship, gear, and quarter with at least 30 hauls (4/5)

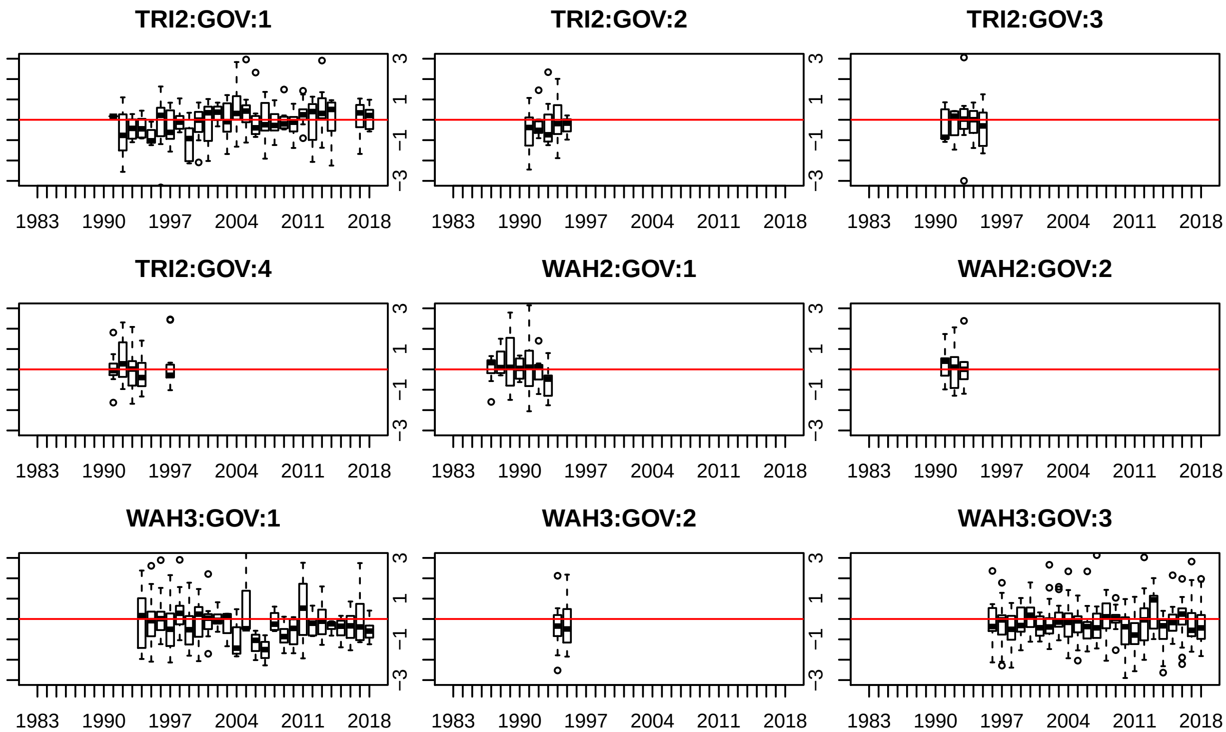


Figure 38: Residuals over time for each combination of ship, gear, and quarter with at least 30 hauls (5/5)

4.2 Model summary

```
Family: Tweedie(p=1.48)
Link function: log

Formula:
A1 ~ Gear + te(lon, lat, bs = c("ds", "ds"), k = c(20, 15), m = c(1,
    0)) + te(timeOfYear, lon, lat, bs = c("cc", "ds", "ds"),
    k = c(6, 6, 5), m = c(1, 0)) + te(ctime, lon, lat, bs = c("ds",
    "ds", "ds"), k = c(12, 8, 6), m = c(1, 0)) + s(Depth, bs = "ds",
    k = 5, m = c(1, 0)) + s(ShipG, bs = "re", by = dum) + offset(log(HaulDur))

Parametric coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   1.1054     0.1982   5.579 2.46e-08 ***
GearOTT      -0.1001     0.1614  -0.620   0.5351
GearBT7      -0.4979     0.2581  -1.930   0.0537 .
GearBT8       0.1320     0.2521   0.523   0.6007
GearGOV      -0.4344     0.1957  -2.219   0.0265 *
GearH20       0.1086     0.3158   0.344   0.7309
GearSON      -2.0544     0.3380  -6.078 1.24e-09 ***
GearTVS      -0.3592     0.2051  -1.751   0.0800 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Approximate significance of smooth terms:
                          edf Ref.df      F  p-value
te(lon,lat)           127.925    299  2.724  < 2e-16 ***
te(timeOfYear,lon,lat)  49.249    119  5.097  < 2e-16 ***
te(ctime,lon,lat)     166.244    513  1.820  < 2e-16 ***
s(Depth)                3.751      4 34.587  < 2e-16 ***
s(ShipG):dum           16.120     44  1.450 7.88e-14 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

R-sq.(adj) =   0.19   Deviance explained = 31.6%
-ML =  38026  Scale est. = 69.365    n = 17152
```

5 Tables

	Survey
TN	1303
TOR	408
BTS	2558
NS-IBTS	7839
BITS	5044

Table 1: Number of hauls survey

	TN	TOR	BTS	NS-IBTS	BITS
1983	0	0	0	137	0
1984	0	0	0	164	0
1985	0	0	0	166	0
1986	0	0	0	200	0
1987	0	0	36	191	0
1988	0	0	38	133	0
1989	0	0	36	154	0
1990	0	0	52	124	0
1991	0	0	51	398	127
1992	0	0	44	361	137
1993	0	0	51	385	135
1994	0	0	84	375	125
1995	0	0	94	360	102
1996	0	0	54	259	144
1997	0	0	101	211	140
1998	0	0	97	204	127
1999	0	0	105	211	181
2000	0	0	72	171	166
2001	0	0	96	218	198
2002	0	0	86	205	195
2003	0	0	88	202	194
2004	119	0	96	200	190
2005	114	0	96	212	198
2006	118	0	52	201	191
2007	114	0	90	198	192
2008	119	40	89	218	207
2009	118	40	98	204	200
2010	112	40	84	195	193
2011	80	40	87	198	211
2012	0	0	95	197	205
2013	0	0	104	190	199
2014	56	39	55	188	210
2015	78	40	108	210	208
2016	87	40	109	206	229
2017	98	89	103	196	222
2018	90	40	107	197	218

Table 2: Number of hauls by year and survey

	1	2	3	4
1983	137	0	0	0
1984	164	0	0	0
1985	166	0	0	0
1986	200	0	0	0
1987	191	0	36	0
1988	133	0	38	0
1989	154	0	36	0
1990	124	0	52	0
1991	208	103	126	139
1992	209	63	148	122
1993	173	96	158	144
1994	172	118	177	117
1995	156	100	172	128
1996	173	35	146	103
1997	180	24	173	75
1998	184	0	182	62
1999	196	0	210	91
2000	192	0	132	85
2001	224	0	200	88
2002	207	0	184	95
2003	202	0	184	98
2004	201	0	192	212
2005	205	0	197	218
2006	199	0	151	212
2007	199	0	182	213
2008	215	0	193	265
2009	209	0	191	260
2010	208	0	173	243
2011	208	0	181	227
2012	210	0	187	100
2013	209	0	193	91
2014	201	0	149	198
2015	214	3	208	219
2016	220	0	212	239
2017	215	49	197	247
2018	210	0	204	238

Table 3: Number of hauls by year and quarter

	Gear
OTB	500
OTT	1211
BT7	993
BT8	1565
GOV	7900
H20	770
SON	267
TVS	3946

Table 4: Number of hauls by gear

	TN	TOR	BTS	NS-IBTS	BITS
FN261	78	39	0	0	0
FN370	172	100	0	0	0
FN374	96	0	0	0	0
FN425	173	0	0	0	0
H292	40	20	0	0	0
H79	430	20	0	0	0
HAVFISKEN	164	169	0	0	0
SG25	150	20	0	0	0
H210	0	40	0	0	0
END	0	0	0	159	0
ISI	0	0	1266	323	0
SOL	0	0	367	27	1346
SOL2	0	0	626	0	1600
TRI2	0	0	299	350	0
EXP	0	0	0	20	0
TRI	0	0	0	126	0
GOS	0	0	0	48	0
CIR	0	0	0	346	0
AND2	0	0	0	46	0
ARG	0	0	0	2338	61
THA	0	0	0	343	0
MIC	0	0	0	172	0
DAN2	0	0	0	1232	0
ELD	0	0	0	69	0
SCO2	0	0	0	103	0
WAH2	0	0	0	100	0
JHJ	0	0	0	83	0
WAH3	0	0	0	600	0
THA2	0	0	0	391	0
SCO3	0	0	0	127	0
HAV	0	0	0	31	0
58G2	0	0	0	56	0
DANS	0	0	0	680	0
MIM	0	0	0	43	0
ENDN	0	0	0	13	0
58UO	0	0	0	11	0
ENDW	0	0	0	2	0
CLP	0	0	0	0	92
HAF	0	0	0	0	1610
26HF	0	0	0	0	335

Table 5: Number of hauls by ship and survey

	OTB	OTT	BT7	BT8	GOV	H20	SON	TVS
FN261	117	0	0	0	0	0	0	0
FN370	100	172	0	0	0	0	0	0
FN374	0	96	0	0	0	0	0	0
FN425	0	173	0	0	0	0	0	0
H292	20	40	0	0	0	0	0	0
H79	34	416	0	0	0	0	0	0
HAVFISKEN	169	164	0	0	0	0	0	0
SG25	20	150	0	0	0	0	0	0
H210	40	0	0	0	0	0	0	0
END	0	0	0	0	159	0	0	0
ISI	0	0	0	1266	323	0	0	0
SOL	0	0	367	0	27	770	175	401
SOL2	0	0	626	0	0	0	0	1600
TRI2	0	0	0	299	350	0	0	0
EXP	0	0	0	0	20	0	0	0
TRI	0	0	0	0	126	0	0	0
GOS	0	0	0	0	48	0	0	0
CIR	0	0	0	0	346	0	0	0
AND2	0	0	0	0	46	0	0	0
ARG	0	0	0	0	2399	0	0	0
THA	0	0	0	0	343	0	0	0
MIC	0	0	0	0	172	0	0	0
DAN2	0	0	0	0	1232	0	0	0
ELD	0	0	0	0	69	0	0	0
SCO2	0	0	0	0	103	0	0	0
WAH2	0	0	0	0	100	0	0	0
JHJ	0	0	0	0	83	0	0	0
WAH3	0	0	0	0	600	0	0	0
THA2	0	0	0	0	391	0	0	0
SCO3	0	0	0	0	127	0	0	0
HAV	0	0	0	0	31	0	0	0
58G2	0	0	0	0	56	0	0	0
DANS	0	0	0	0	680	0	0	0
MIM	0	0	0	0	43	0	0	0
ENDN	0	0	0	0	13	0	0	0
58UO	0	0	0	0	11	0	0	0
ENDW	0	0	0	0	2	0	0	0
CLP	0	0	0	0	0	0	92	0
HAF	0	0	0	0	0	0	0	1610
26HF	0	0	0	0	0	0	0	335

Table 6: Number of hauls by ship and gear

References

[1] Casper W. Berg. `surveyIndex`: R package for calculating survey indices by age from DATRAS exchange data. `https://github.com/casperwberg/surveyIndex`, 2014.

[2] Casper W Berg, Anders Nielsen, and Kasper Kristensen. Evaluation of alternative age-based methods for estimating relative abundance from survey data in relation to assessment models. *Fisheries Research*, 151:91–99, 2014.

[3] Kasper Kristensen and Casper W. Berg. DATRAS package for R. `https://github.com/DTUAqua/DATRAS`, 2012.

[4] James T Thorson. Three problems with the conventional delta-model for biomass sampling data, and a computationally efficient alternative. *Canadian Journal of Fisheries and Aquatic Sciences*, 75(9):1369–1382, 2017.

Assessment of turbot in Division 3a (tur.27.3a)

Alexandros Kokkalis

Contents

Assessment method

The surplus production model in continuous time (SPiCT) is considered for the assessment of whiting in Division 3a. The model is described in detail in Pedersen and Berg (2017). The input data consist of a time series of commercial catches and an exploitable biomass index; the calculation of these time series are discussed in separate working documents.

SPiCT is implemented as an R package that can be downloaded from https://github.com/DTUAqua/spict. This document was produced using spict version 1.3.0@95cc71.

Scenarios

Table 1 summarises the scenarios that were tested. These differ in the lengths of input time series and other options, e.g. prior distributions. The goal is to get a model with the best possible fit to the data (judging by residual and retrospective analyses), with as little extra information (priors) as possible.

Table 1: Scenarios for the assessment of turbot in Division 3a.

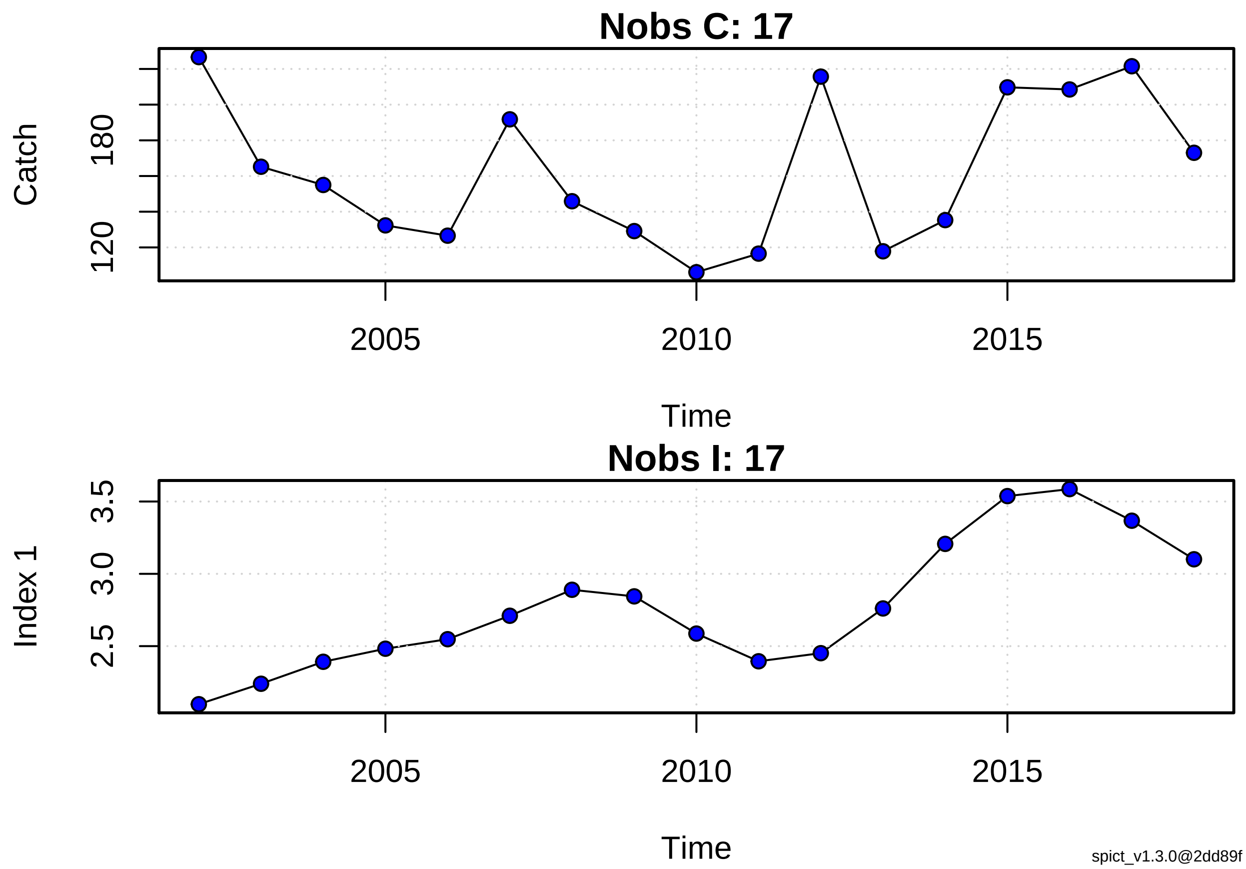
Nr	Catch	Index	Priors	Notes
1	2002–2018	2002–2018		Only period covered by Intercatch
1a			Default (α, β, n)	
1b			$log(n) \sim \mathcal{N}(log(2), 0.5^2)$, default α and β priors	
2	1983–2018	1983–2018		Period where catch and index are available
2a			Default (α, β, n)	
2b			No priors	
2c			Shaefer ($n = 2$)	
2d			Shaefer	Thinned index (every other year)
2e			Shaefer	Thinned index (every third year)
3	1975–2018	1983–2018		Including part of the historical catch series
3a			Default (α, β, n)	
4	1950–2018	1983–2018		Including complete historical catch series
4a			Default (α, β, n)	

Scenario 1

Only the period where Intercatch information is used, i.e. 2002–2018.

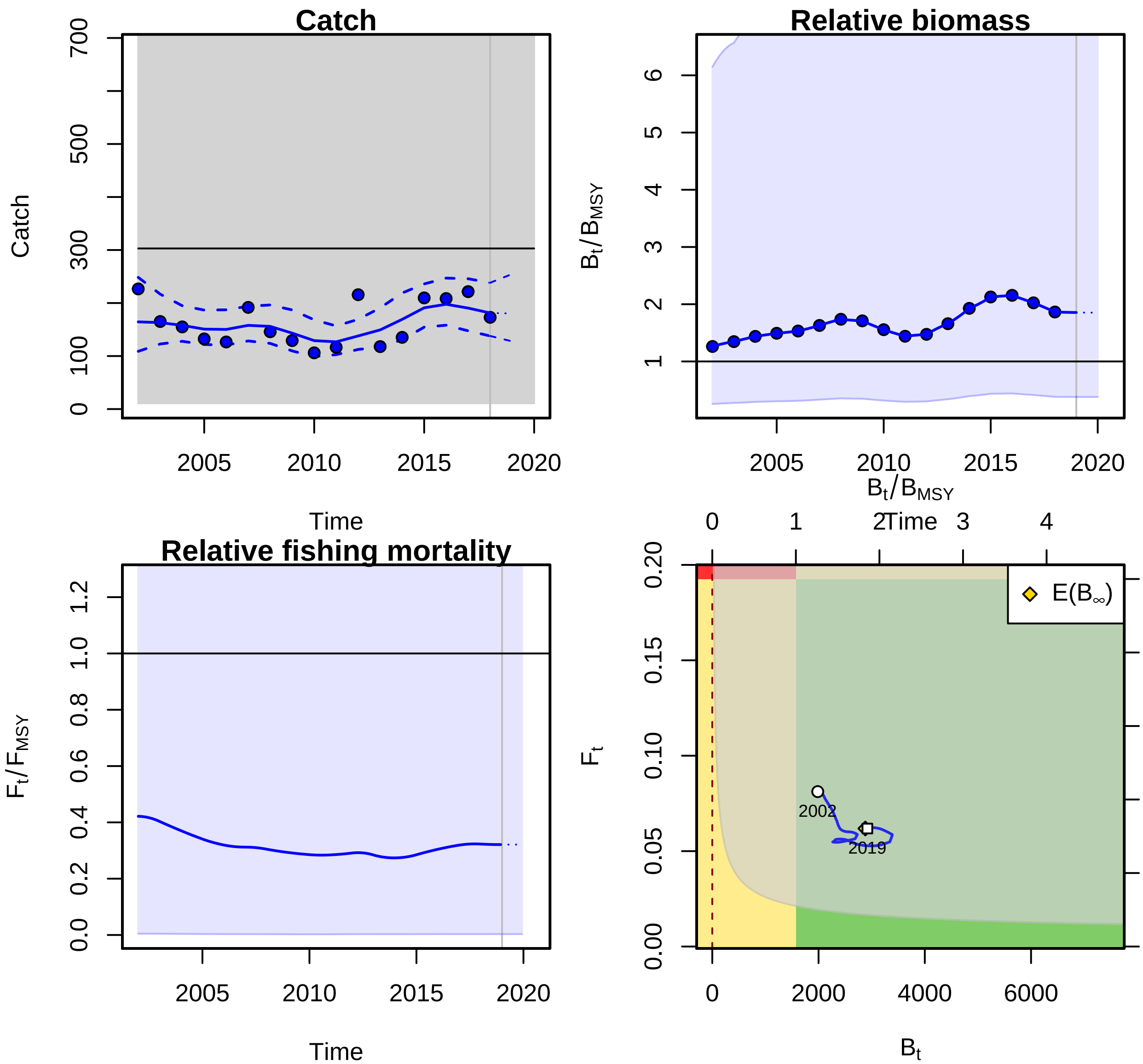
Scenario 1a

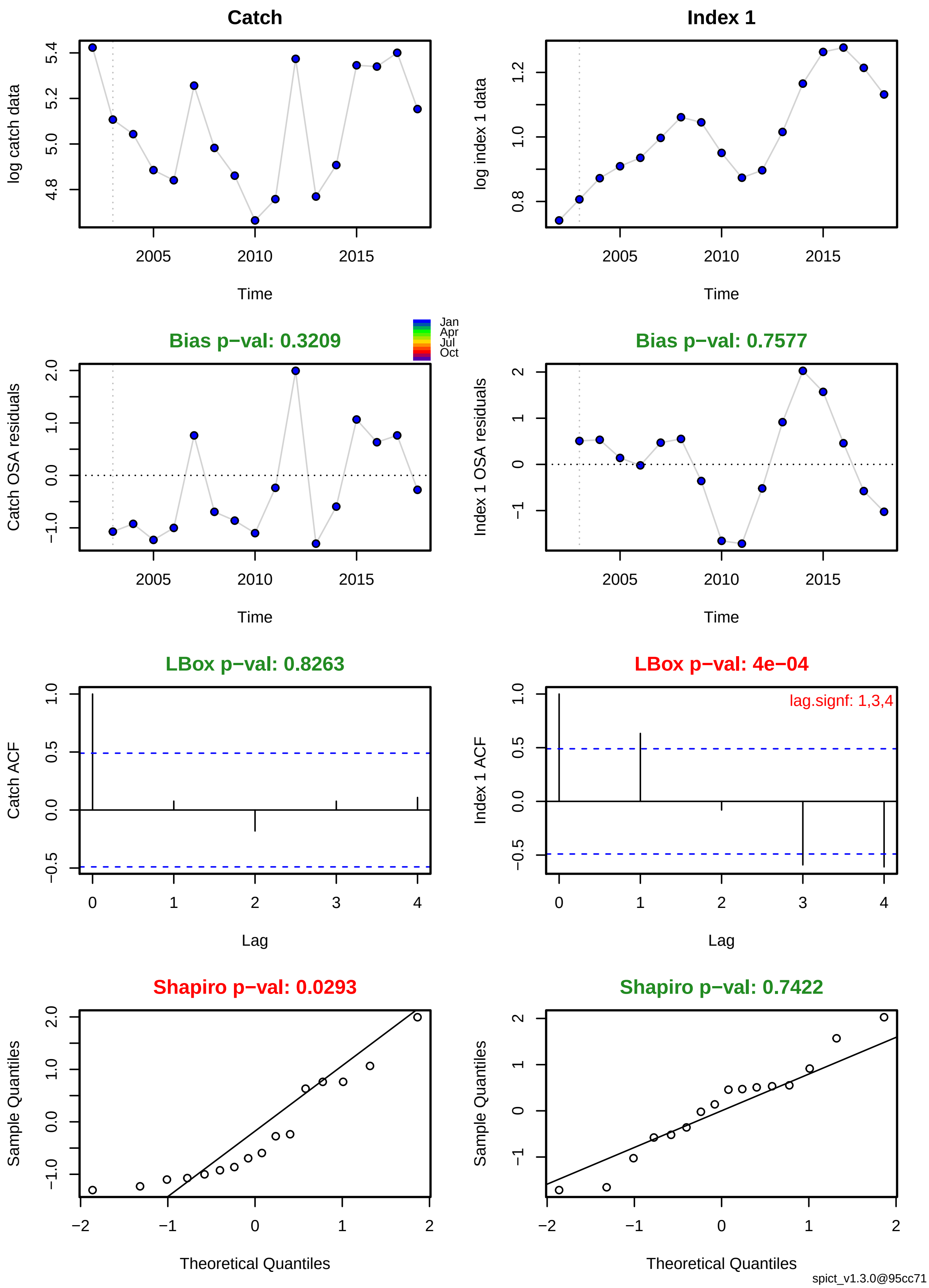
Default priors.

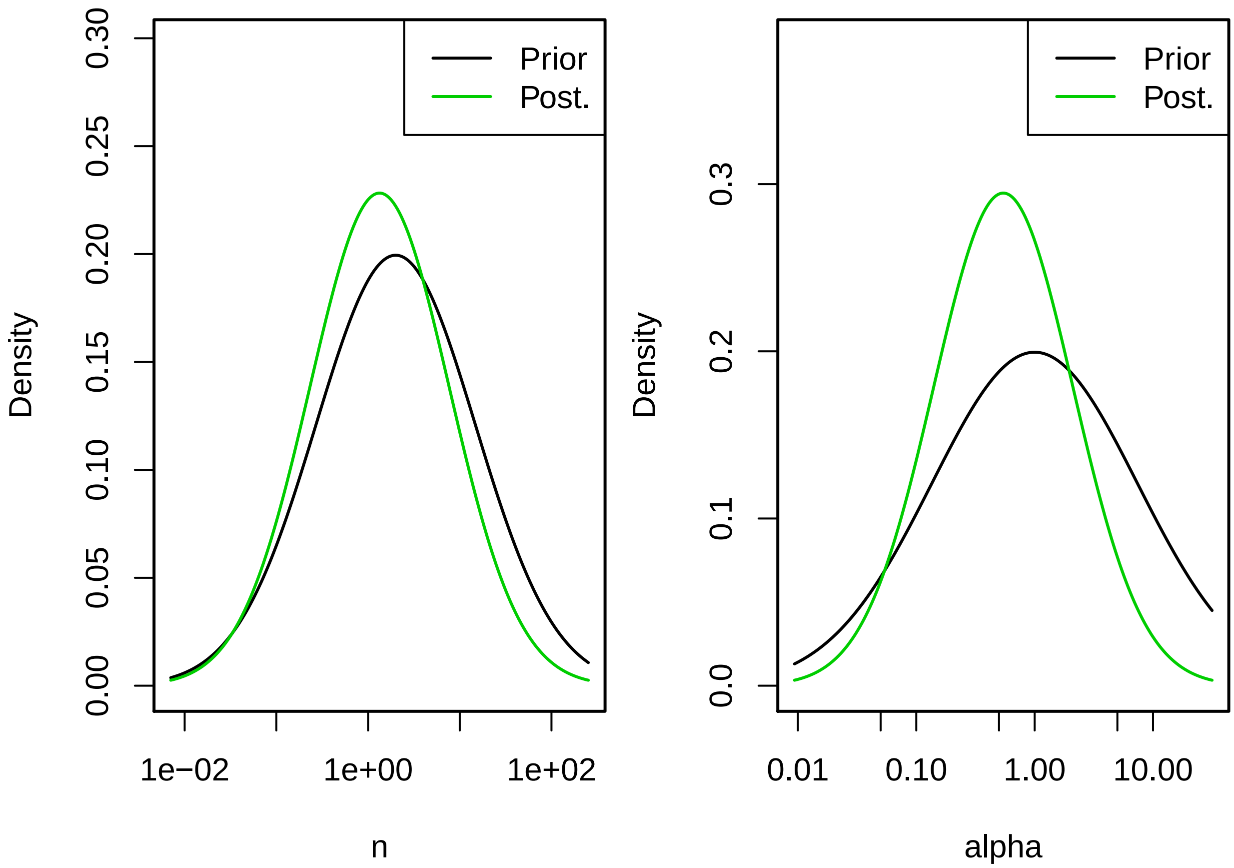


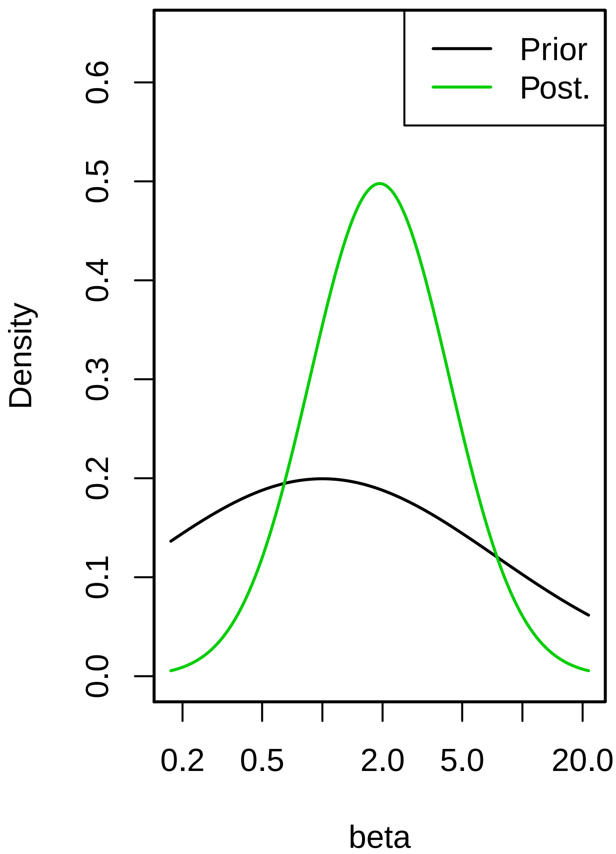

```
## Convergence: 0  MSG: relative convergence (4)
## Objective function at optimum: -4.0399553
## Euler time step (years):  1/16 or 0.0625
## Nobs C: 17,  Nobs I1: 17
##
## Priors
##      logn  ~  dnorm[log(2), 2^2]
##  logalpha  ~  dnorm[log(1), 2^2]
##   logbeta  ~  dnorm[log(1), 2^2]
##
## Model parameter estimates w 95% CI
##             estimate      cilow        ciupp    log.est
##  alpha     0.5434792  0.0382615 7.719769e+00 -0.6097639
##  beta      1.9349124  0.4022108 9.308267e+00  0.6600620
##  r         0.2574734  0.0422508 1.569026e+00 -1.3568388
##  rc        0.3860642  0.0262448 5.679044e+00 -0.9517515
##  rold      0.7712542  0.0000025 2.357290e+05 -0.2597372
##  m       306.0153742 10.9768736 8.531155e+03  5.7236353
##  K      3757.1253810 47.6896490 2.959970e+05  8.2314094
```

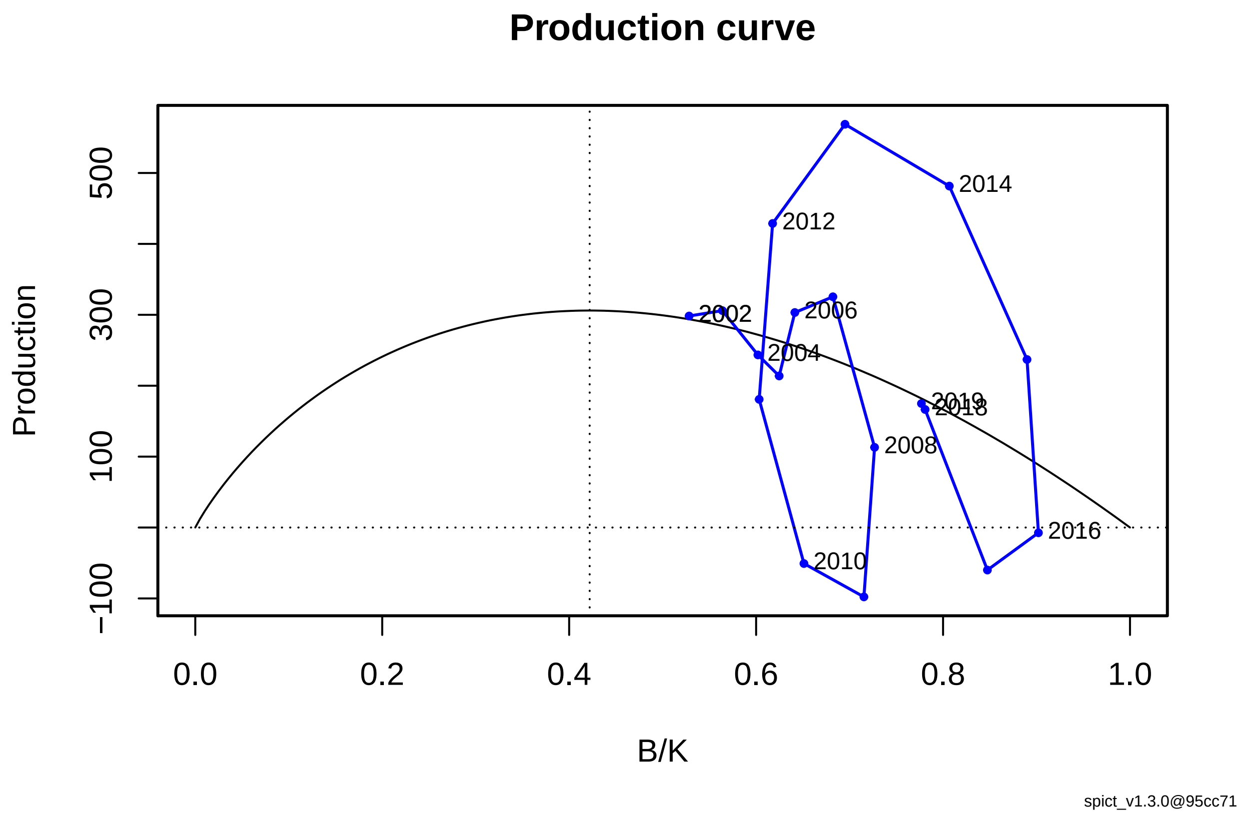
```
## q          0.0010575  0.0000046 2.432545e-01 -6.8518518
## n          1.3338373  0.0433998 4.099374e+01  0.2880600
## sdb        0.0721485  0.0498934 1.043307e-01 -2.6290284
## sdf        0.1106856  0.0297096 4.123679e-01 -2.2010616
## sdi        0.0392112  0.0027340 5.623737e-01 -3.2387922
## sdc        0.2141669  0.1348654 3.400981e-01 -1.5409995
##
## Deterministic reference points (Drp)
##            estimate      cilow        ciupp   log.est
## Bmsyd 1585.3081272 11.8195520 2.126309e+05  7.368534
## Fmsyd    0.1930321  0.0131224 2.839522e+00 -1.644899
## MSYd   306.0153742 10.9768736 8.531155e+03  5.723635
## Stochastic reference points (Srp)
##            estimate      cilow        ciupp   log.est rel.diff.Drp
## Bmsys 1573.0569729 11.9029906 2.078896e+05  7.360776 -0.007788119
## Fmsys    0.1926026  0.0126817 2.925133e+00 -1.647126 -0.002230037
## MSYs   302.9696463 10.9520700 8.381119e+03  5.713633 -0.010052914
##
## States w 95% CI (inp$msytype: s)
##                     estimate      cilow        ciupp    log.est
## B_2018.94      2919.1719611 12.3809096 6.882826e+05  7.9790553
## F_2018.94         0.0618454  0.0002612 1.464602e+01 -2.7831175
## B_2018.94/Bmsy    1.8557319  0.3805753 9.048775e+00  0.6182792
## F_2018.94/Fmsy    0.3211036  0.0033300 3.096343e+01 -1.1359914
##
## Predictions w 95% CI (inp$msytype: s)
##                   prediction       cilow        ciupp    log.est
## B_2020.00      2913.2834181  12.1032770 7.012333e+05  7.9770360
## F_2020.00         0.0618456   0.0002600 1.471295e+01 -2.7831147
## B_2020.00/Bmsy    1.8519885   0.3797683 9.031459e+00  0.6162599
## F_2020.00/Fmsy    0.3211045   0.0033119 3.113294e+01 -1.1359886
## Catch_2019.00   180.3473251 127.6606261 2.547783e+02  5.1948846
## E(B_inf)       2880.2815476          NA           NA  7.9656433
```


Catch
Catch
0
100
300
500
700
2005
2010
2015
2020
Time
Relative biomass
B_t/B_{MSY}
1
2
3
4
5
6
2005
2010
2015
2020
Time
Relative fishing mortality
F_t/F_{MSY}
0.0
0.2
0.4
0.6
0.8
1.0
1.2
2005
2010
2015
2020
Time
B_t/B_{MSY}
0
1
2
3
4
F_t
0.00
0.05
0.10
0.15
0.20
$E(B_\infty)$
2002
2019
0
2000
4000
6000
B_t


Catch
log catch data
Time
Index 1
log index 1 data
Time
Bias p−val: 0.3209
Jan
Apr
Jul
Oct
Catch OSA residuals
Time
Bias p−val: 0.7577
Index 1 OSA residuals
Time
LBox p−val: 0.8263
Catch ACF
Lag
LBox p−val: 4e−04
lag.signf: 1,3,4
Index 1 ACF
Lag
Shapiro p−val: 0.0293
Sample Quantiles
Theoretical Quantiles
Shapiro p−val: 0.7422
Sample Quantiles
Theoretical Quantiles
spict_v1.3.0@95cc71


Density
0.00
0.05
0.10
0.15
0.20
0.25
0.30
Prior
Post.
1e−02
1e+00
1e+02
n
Density
0.0
0.1
0.2
0.3
Prior
Post.
0.01
0.10
1.00
10.00
alpha


Prior
Post.
Density
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.2
0.5
2.0
5.0
20.0
beta

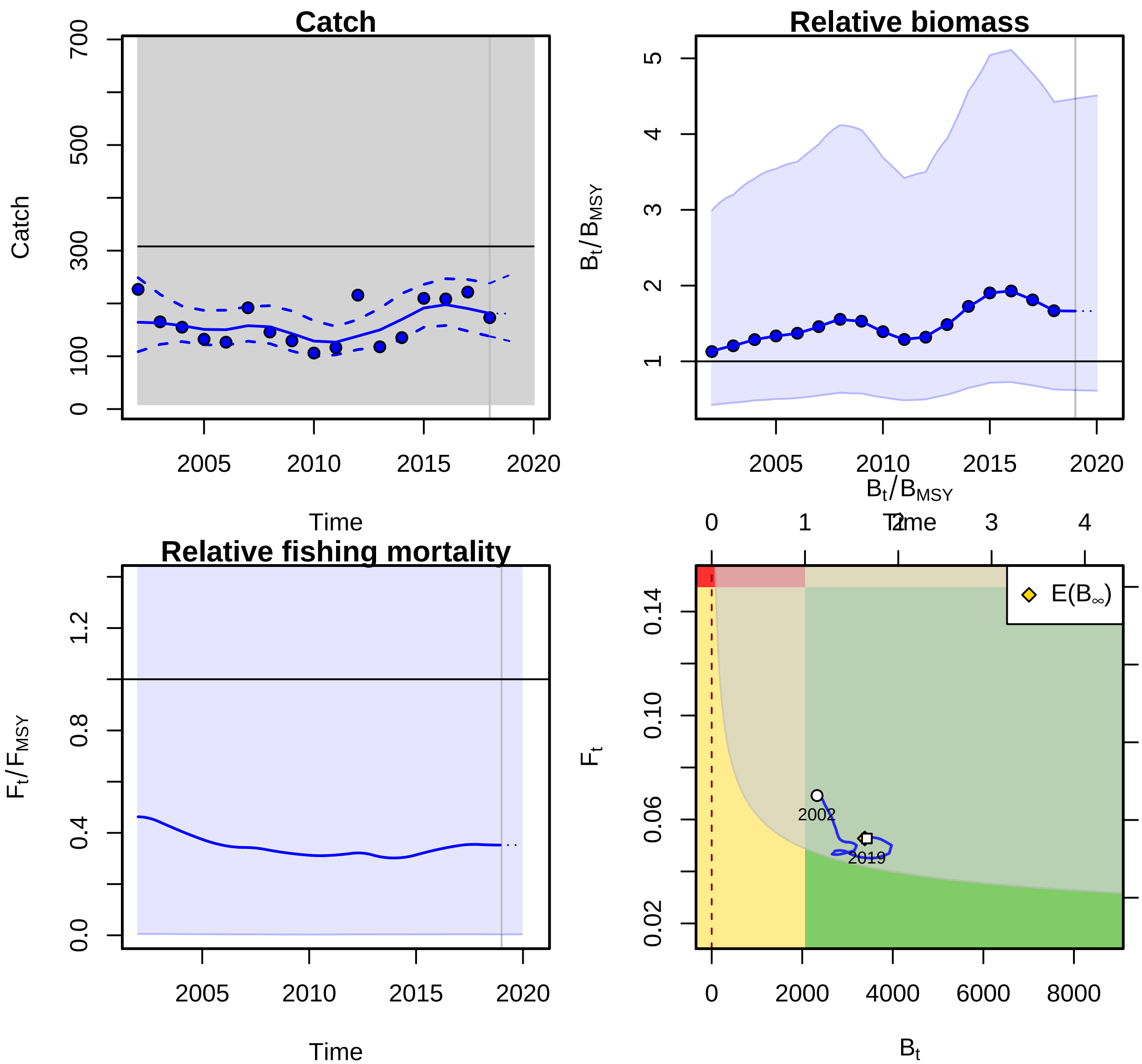

Production curve
Production
500
300
100
−100
2014
2012
2002
2006
2004
2019
2018
2008
2016
2010
0.0
0.2
0.4
0.6
0.8
1.0
B/K
spict_v1.3.0@95cc71

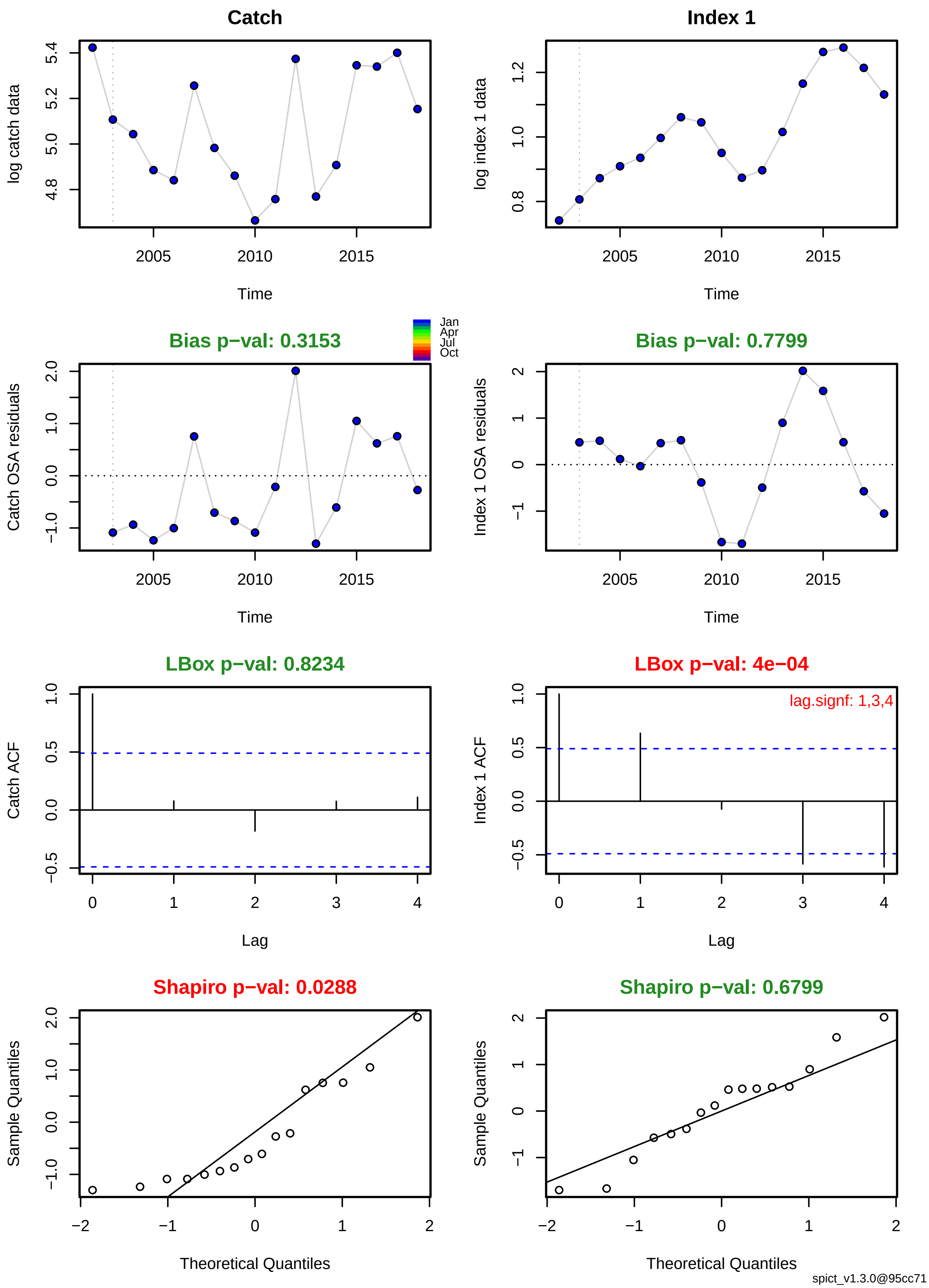
Scenario 1b

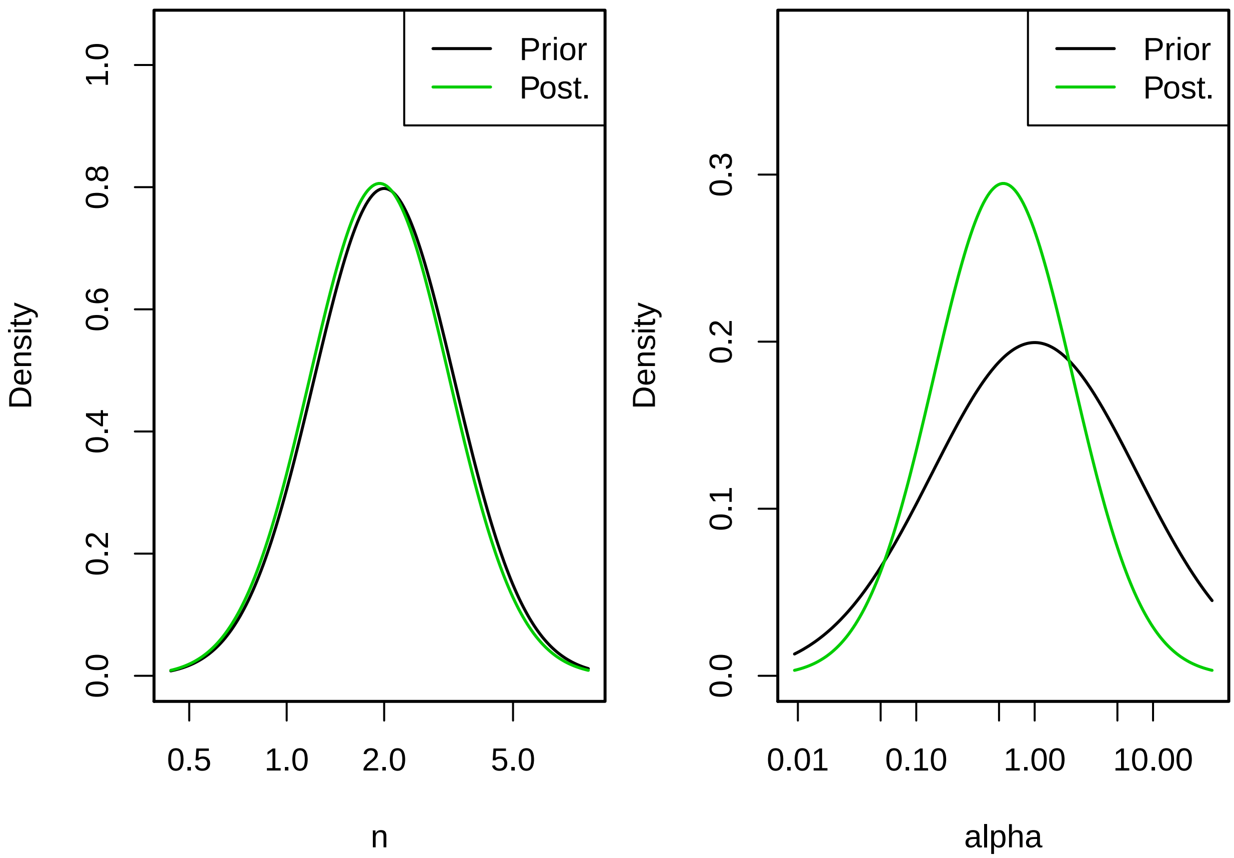
Tighter prior on shape parameter n around Shaefer: $log(n) \sim \mathcal{N}(log(2), 0.5^2)$.

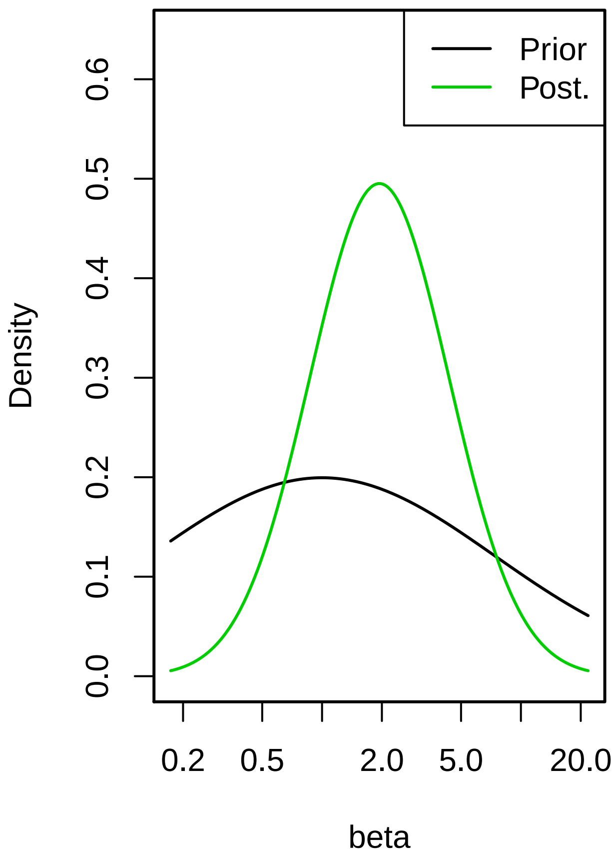
```
## Convergence: 0  MSG: relative convergence (4)
## Objective function at optimum: -5.4013413
## Euler time step (years):  1/16 or 0.0625
## Nobs C: 17,  Nobs I1: 17
##
## Priors
##      logn  ~  dnorm[log(2), 0.5^2]
##  logalpha  ~  dnorm[log(1), 2^2]
##   logbeta  ~  dnorm[log(1), 2^2]
##
## Model parameter estimates w 95% CI
##             estimate      cilow        ciupp    log.est
##  alpha     0.5432933  0.0382620 7.714373e+00 -0.6101059
##  beta      1.9425624  0.4004801 9.422562e+00  0.6640079
##  r         0.2916599  0.0536278 1.586218e+00 -1.2321670
##  rc        0.3014083  0.0506847 1.792393e+00 -1.1992896
##  rold      0.3118308  0.0293029 3.318395e+00 -1.1652944
##  m       313.6670170  8.9253981 1.102326e+04  5.7483320
##  K      4216.2538776 29.7037676 5.984694e+05  8.3467023
##  q         0.0009021  0.0000027 3.042774e-01 -7.0107820
##  n         1.9353143  0.7336219 5.105412e+00  0.6602698
##  sdb       0.0720711  0.0499052 1.040822e-01 -2.6301019
##  sdf       0.1103421  0.0294228 4.138072e-01 -2.2041701
##  sdi       0.0391558  0.0027316 5.612795e-01 -3.2402079
##  sdc       0.2143463  0.1348602 3.406815e-01 -1.5401621
##
## Deterministic reference points (Drp)
##            estimate      cilow        ciupp   log.est
##  Bmsyd 2081.3432664 14.0414938 3.085135e+05  7.640769
##  Fmsyd    0.1507041  0.0253424 8.961968e-01 -1.892437
##  MSYd   313.6670170  8.9253981 1.102326e+04  5.748332
## Stochastic reference points (Srp)
##            estimate      cilow        ciupp   log.est rel.diff.Drp
##  Bmsys 2060.4692398 14.0764669 3.016050e+05  7.630689 -0.010130715
##  Fmsys    0.1494976  0.0246619 9.062370e-01 -1.900475 -0.008070535
##  MSYs   308.0100805  8.9540985 1.059517e+04  5.730132 -0.018366076
##
## States w 95% CI (inp$msytype: s)
##                     estimate     cilow        ciupp    log.est
##  B_2018.94      3428.3854588 9.9694115 1.178989e+06  8.1398447
##  F_2018.94         0.0526919 0.0001521 1.825012e+01 -2.9432943
##  B_2018.94/Bmsy    1.6638858 0.6201210 4.464477e+00  0.5091557
##  F_2018.94/Fmsy    0.3524595 0.0039814 3.120175e+01 -1.0428196
##
## Predictions w 95% CI (inp$msytype: s)
##                   prediction       cilow        ciupp    log.est
##  B_2020.00      3426.9794627   9.8061341 1.197637e+06  8.1394345
##  F_2020.00         0.0526920   0.0001515 1.832754e+01 -2.9432911
##  B_2020.00/Bmsy    1.6632034   0.6136404 4.507926e+00  0.5087455
##  F_2020.00/Fmsy    0.3524606   0.0039595 3.137461e+01 -1.0428164
##  Catch_2019.00   180.6095509 127.7084289 2.554241e+02  5.1963375
```

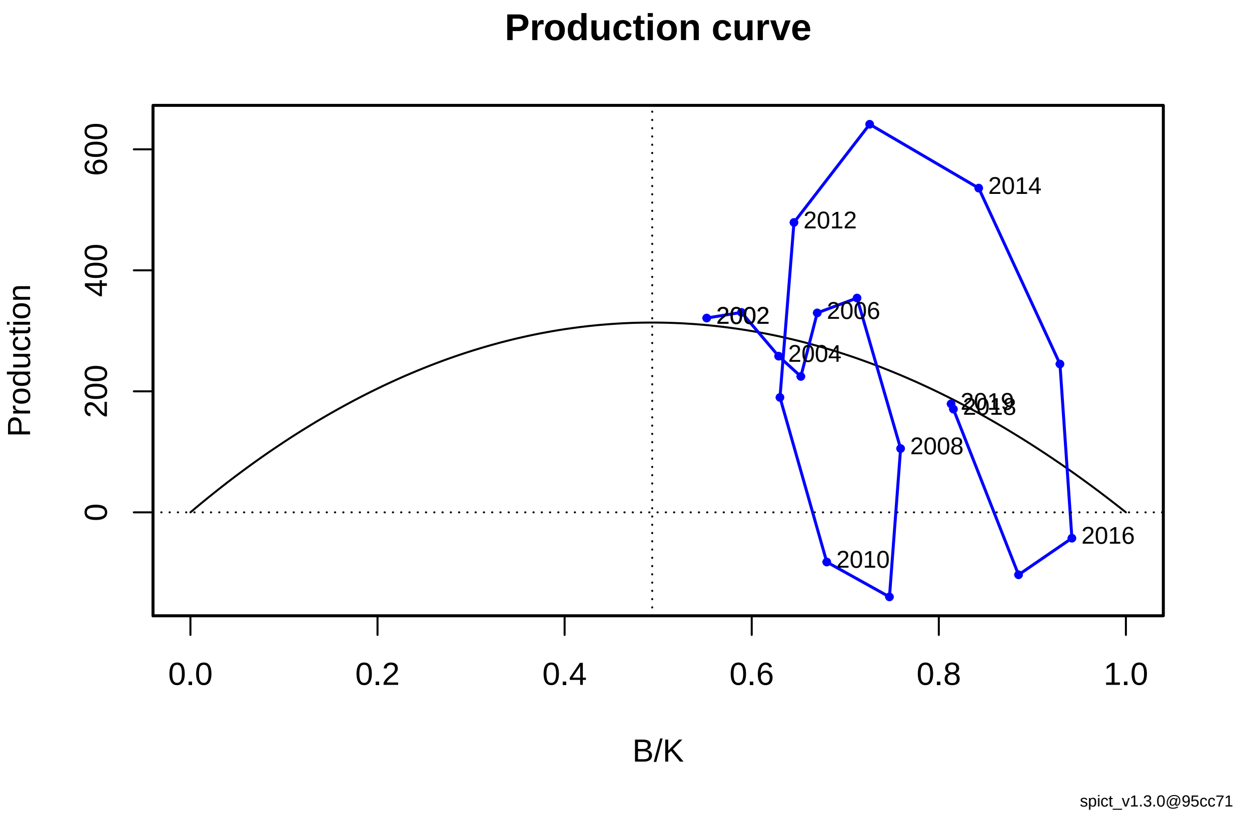
```
## E(B_inf)        3380.8647417          NA          NA  8.1258868
```




Catch
Index 1
log catch data
log index 1 data
Time
Bias p−val: 0.3153
Bias p−val: 0.7799
Jan
Apr
Jul
Oct
Catch OSA residuals
Index 1 OSA residuals
LBox p−val: 0.8234
LBox p−val: 4e−04
lag.signf: 1,3,4
Catch ACF
Index 1 ACF
Lag
Shapiro p−val: 0.0288
Shapiro p−val: 0.6799
Sample Quantiles
Theoretical Quantiles
spict_v1.3.0@95cc71


Prior
Post.
Density
1.0
0.8
0.6
0.4
0.2
0.0
0.5
1.0
2.0
5.0
n
Prior
Post.
Density
0.3
0.2
0.1
0.0
0.01
0.10
1.00
10.00
alpha


Prior
Post.
Density
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.2
0.5
2.0
5.0
20.0
beta


Production curve
Production
600
400
200
0
0.0
0.2
0.4
0.6
0.8
1.0
B/K
2002
2004
2006
2008
2010
2012
2014
2016
2018
2019
spict_v1.3.0@95cc71

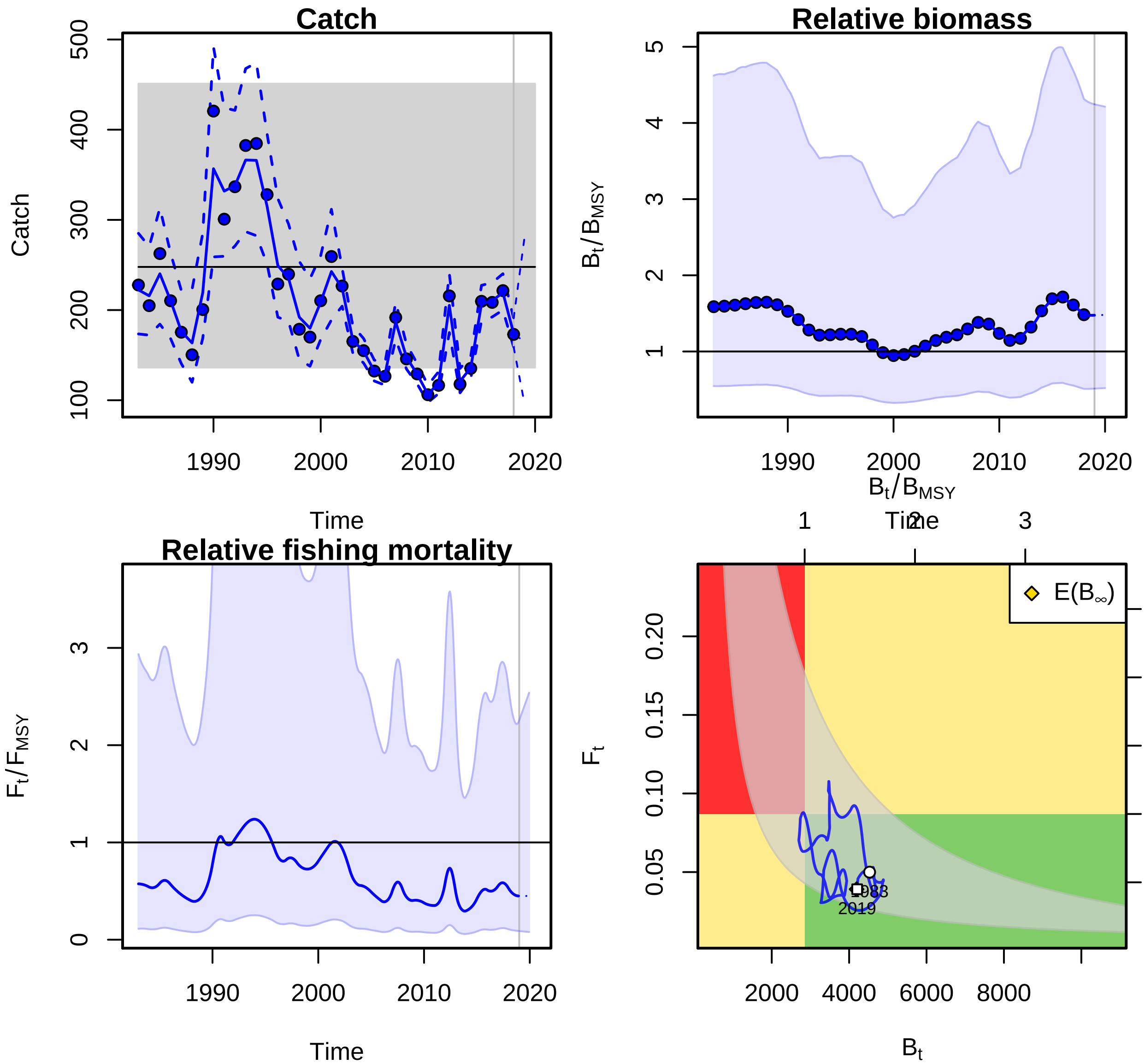
Scenario 2

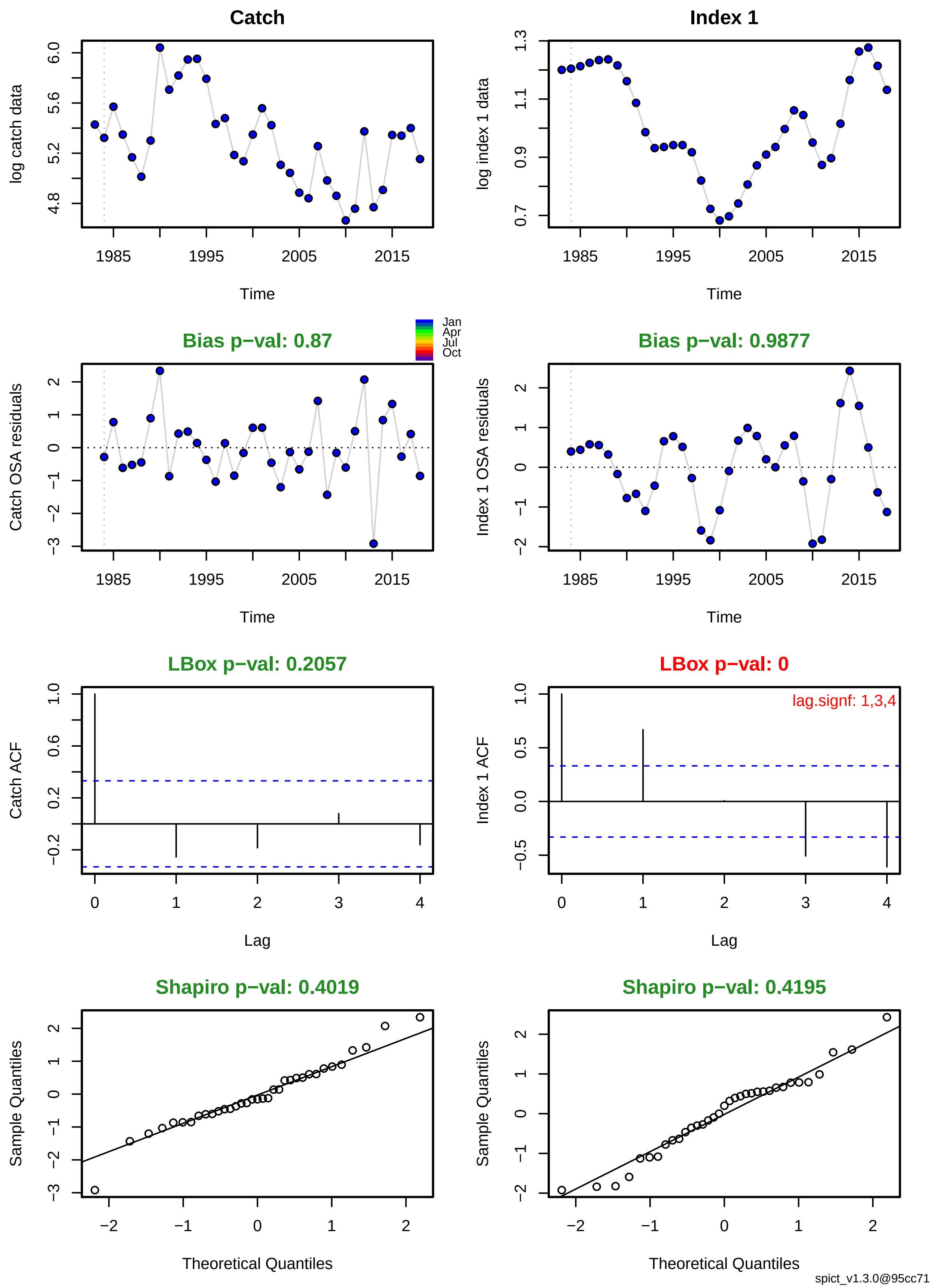
Scenario 2a

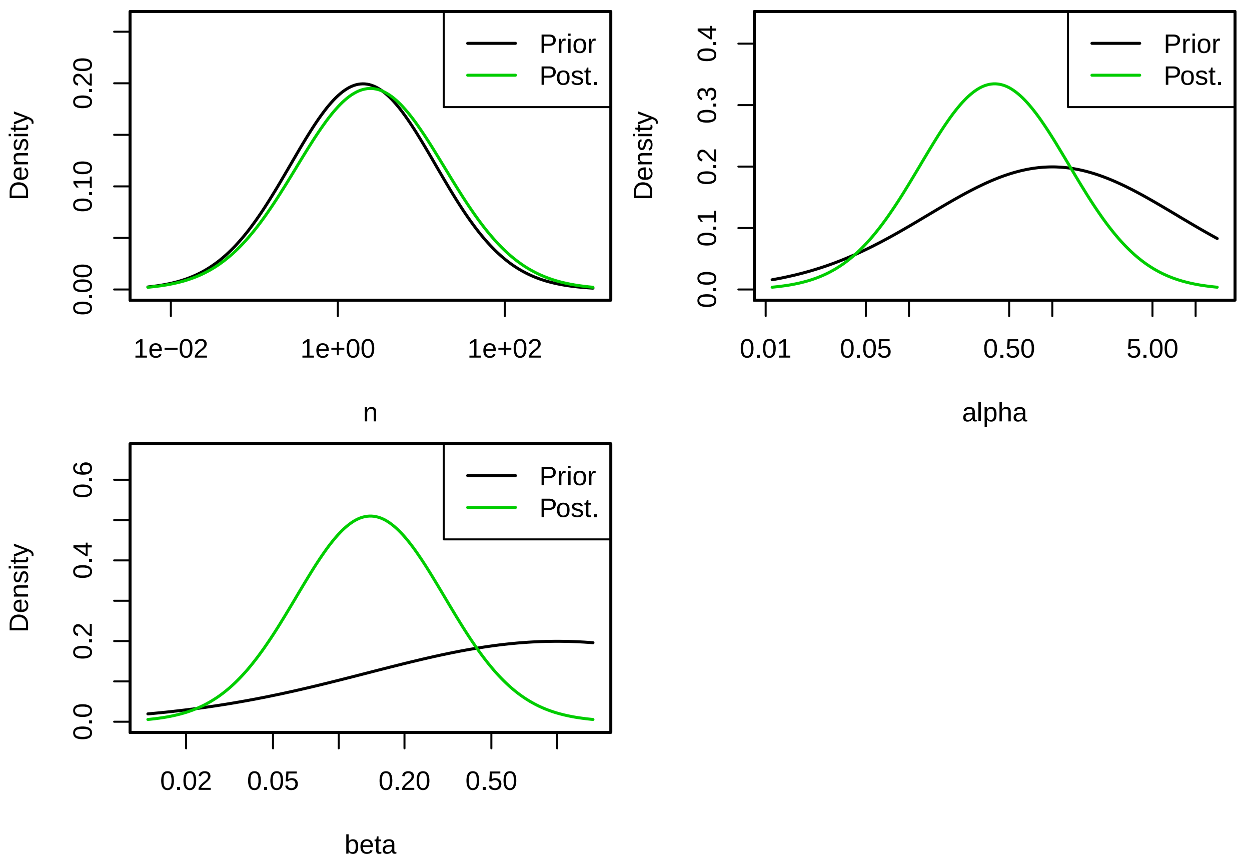
Default priors.

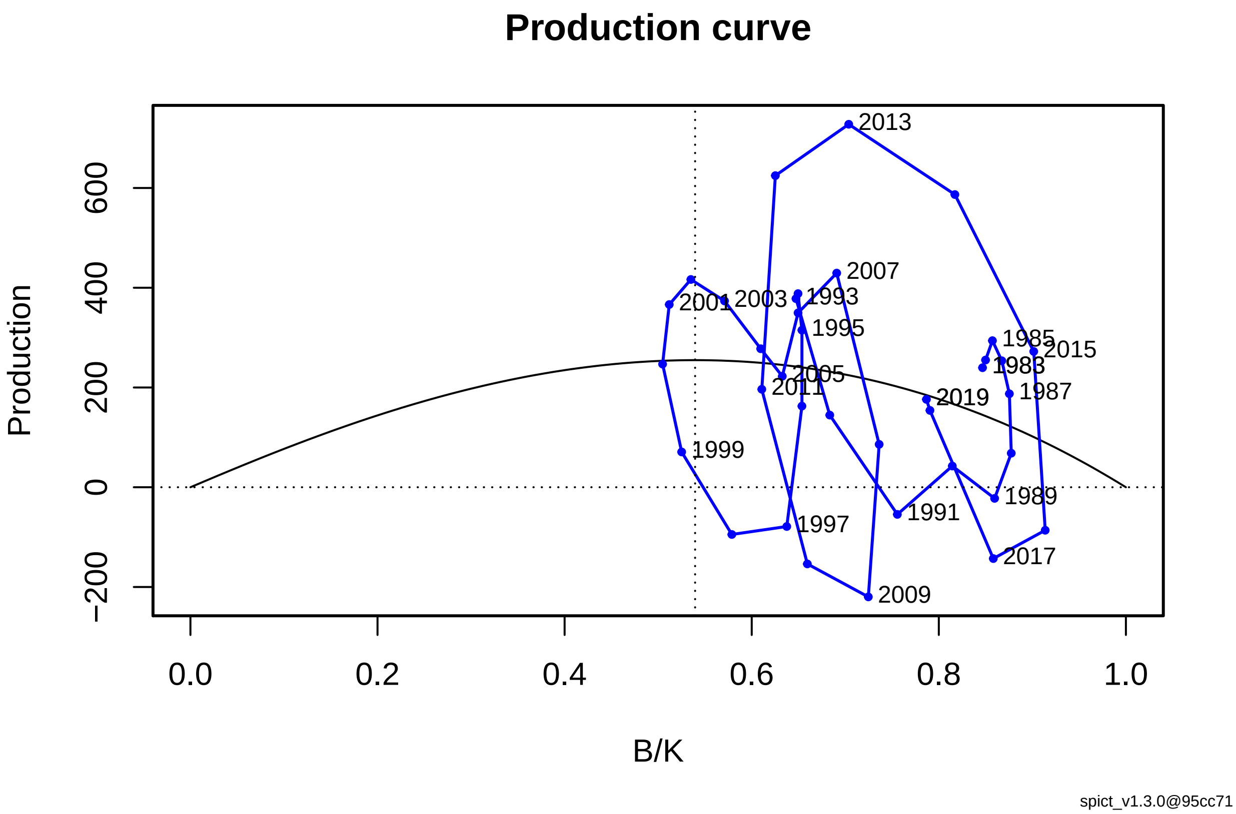
```
## Convergence: 0  MSG: relative convergence (4)
## Objective function at optimum: -26.5061256
## Euler time step (years):  1/16 or 0.0625
## Nobs C: 36,  Nobs I1: 36
##
## Priors
##      logn  ~  dnorm[log(2), 2^2]
##  logalpha  ~  dnorm[log(1), 2^2]
##   logbeta  ~  dnorm[log(1), 2^2]
##
## Model parameter estimates w 95% CI
##             estimate        cilow        ciupp    log.est
##  alpha     0.3962287    0.0383079 4.098303e+00 -0.9257636
##  beta      0.1396692    0.0301431 6.471623e-01 -1.9684789
##  r         0.2169435    0.0119755 3.930058e+00 -1.5281182
##  rc        0.1766596    0.0367171 8.499755e-01 -1.7335304
##  rold      0.1489933    0.0024034 9.236571e+00 -1.9038539
##  m       254.8395962  152.5007352 4.258551e+02  5.5406343
##  K      5347.7325693 1881.4703447 1.519994e+04  8.5844279
##  q         0.0007336    0.0002457 2.190000e-03 -7.2175364
##  n         2.4560622    0.0445162 1.355067e+02  0.8985593
##  sdb       0.0615864    0.0481253 7.881260e-02 -2.7873148
##  sdf       0.3310485    0.2287273 4.791432e-01 -1.1054903
##  sdi       0.0244023    0.0023467 2.537513e-01 -3.7130785
##  sdc       0.0462373    0.0129560 1.650114e-01 -3.0739692
##
## Deterministic reference points (Drp)
##            estimate       cilow        ciupp   log.est
##  Bmsyd 2885.0914956 702.9107172 1.184184e+04  7.967312
##  Fmsyd    0.0883298   0.0183585 4.249878e-01 -2.426678
##  MSYd   254.8395962 152.5007352 4.258551e+02  5.540634
## Stochastic reference points (Srp)
##            estimate      cilow        ciupp   log.est rel.diff.Drp
##  Bmsys 2850.5090237 708.111084 1.147476e+04  7.955253  -0.01213203
##  Fmsys    0.0869521   0.016158 4.679206e-01 -2.442398  -0.01584452
##  MSYs   247.8100858 136.161299 4.510080e+02  5.512663  -0.02836652
##
## States w 95% CI (inp$msytype: s)
##                     estimate        cilow        ciupp    log.est
##  B_2018.94      4206.6689673 1413.4031799 1.252018e+04  8.3444264
##  F_2018.94         0.0390829    0.0122789 1.243978e-01 -3.2420702
##  B_2018.94/Bmsy    1.4757606    0.5128092 4.246939e+00  0.3891735
##  F_2018.94/Fmsy    0.4494763    0.0902690 2.238075e+00 -0.7996723
##
## Predictions w 95% CI (inp$msytype: s)
##                   prediction        cilow        ciupp    log.est
##  B_2020.00      4218.9632419 1426.0382215 1.248189e+04  8.3473447
##  F_2020.00         0.0390831    0.0102635 1.488264e-01 -3.2420659
##  B_2020.00/Bmsy    1.4800736    0.5199211 4.213366e+00  0.3920918
```

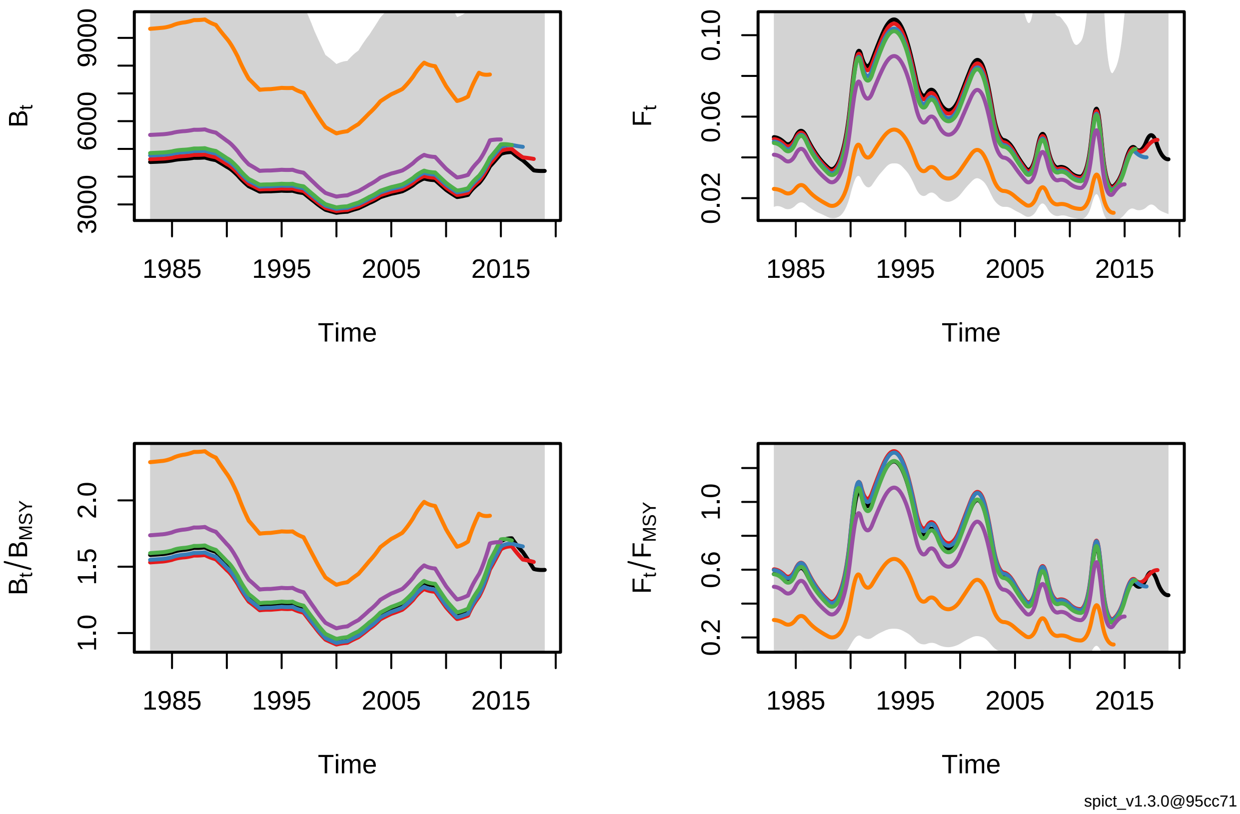
```
## F_2020.00/Fmsy      0.4494782     0.0789681 2.558383e+00 -0.7996680
## Catch_2019.00     164.6562228    97.0894030 2.792444e+02  5.1038598
## E(B_inf)         4194.0327571            NA           NA  8.3414180
```




Catch
log catch data
Time
Index 1
log index 1 data
Bias p−val: 0.87
Jan
Apr
Jul
Oct
Catch OSA residuals
Bias p−val: 0.9877
Index 1 OSA residuals
LBox p−val: 0.2057
Catch ACF
Lag
LBox p−val: 0
lag.signf: 1,3,4
Index 1 ACF
Shapiro p−val: 0.4019
Sample Quantiles
Theoretical Quantiles
Shapiro p−val: 0.4195
spict_v1.3.0@95cc71

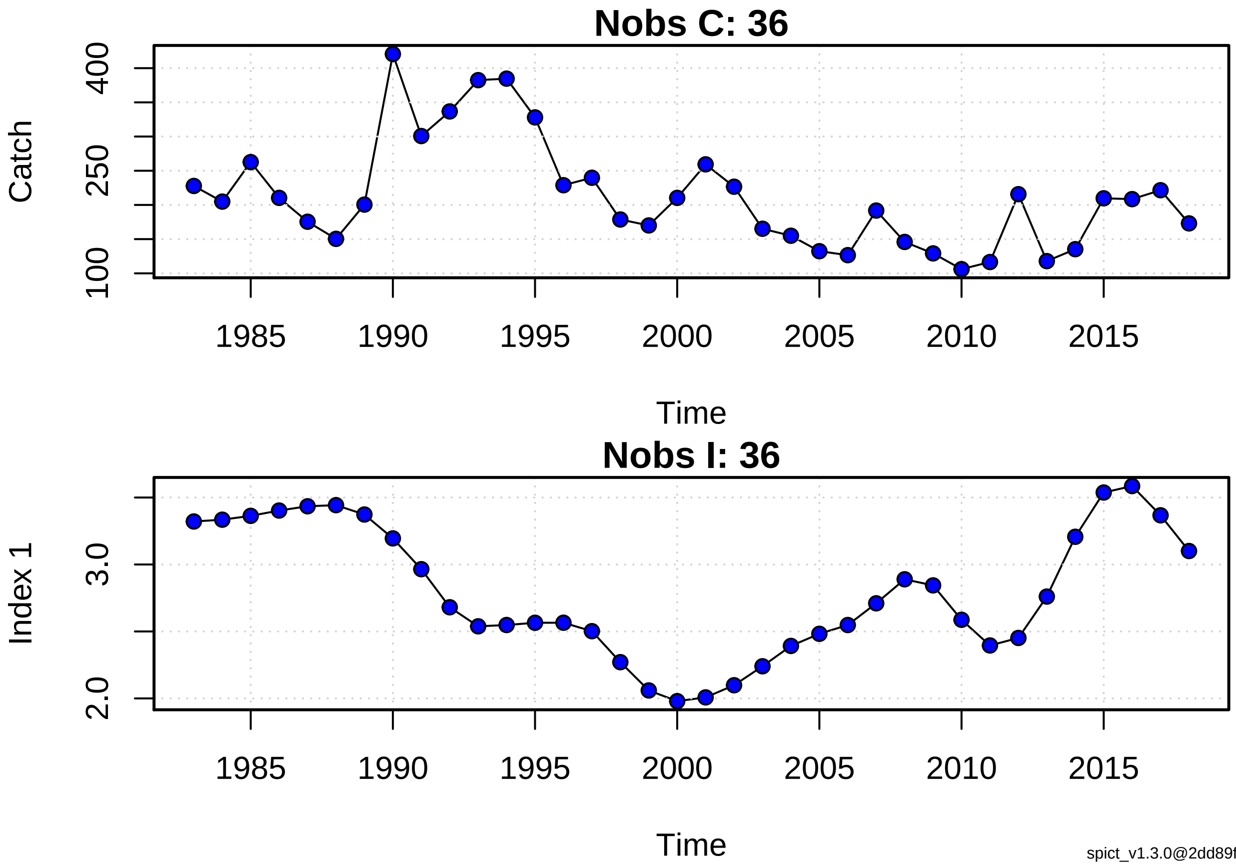

Prior
Post.
Density
0.00
0.10
0.20
1e−02
1e+00
1e+02
n
Prior
Post.
Density
0.0
0.1
0.2
0.3
0.4
0.01
0.05
0.50
5.00
alpha
Prior
Post.
Density
0.0
0.2
0.4
0.6
0.02
0.05
0.20
0.50
beta


Production curve
Production
B/K
600
400
200
0
−200
0.0
0.2
0.4
0.6
0.8
1.0
2013
2007
2001
2003
1993
1995
1985
2015
1983
2005
2011
1987
2019
1999
1989
1991
1997
2017
2009
spict_v1.3.0@95cc71


9000
6000
3000
B_t
1985
1995
2005
2015
Time
0.10
0.06
0.02
F_t
Time
B_t/B_{MSY}
2.0
1.5
1.0
F_t/F_{MSY}
1.0
0.6
0.2
spict_v1.3.0@95cc71

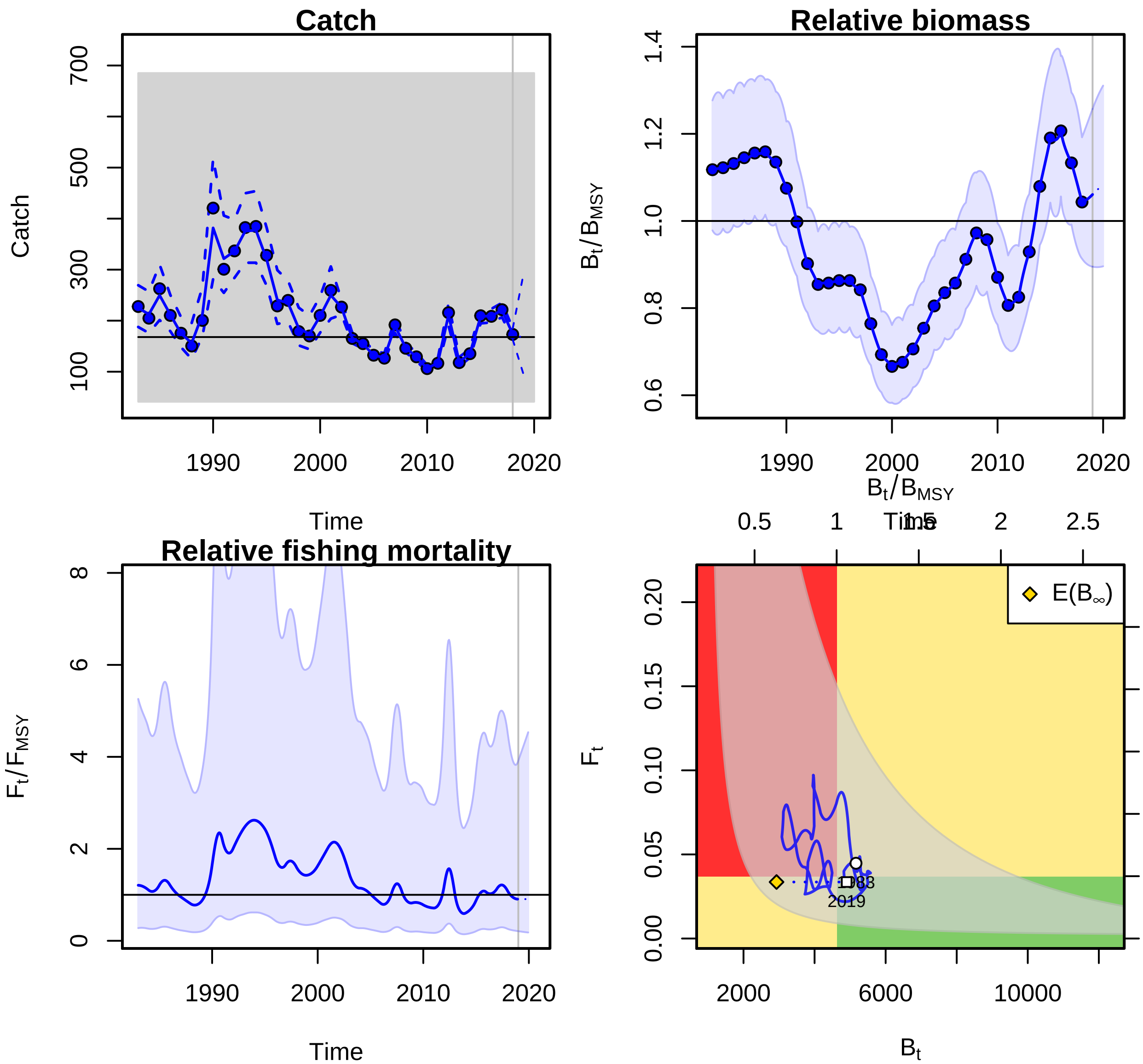
Scenario 2b

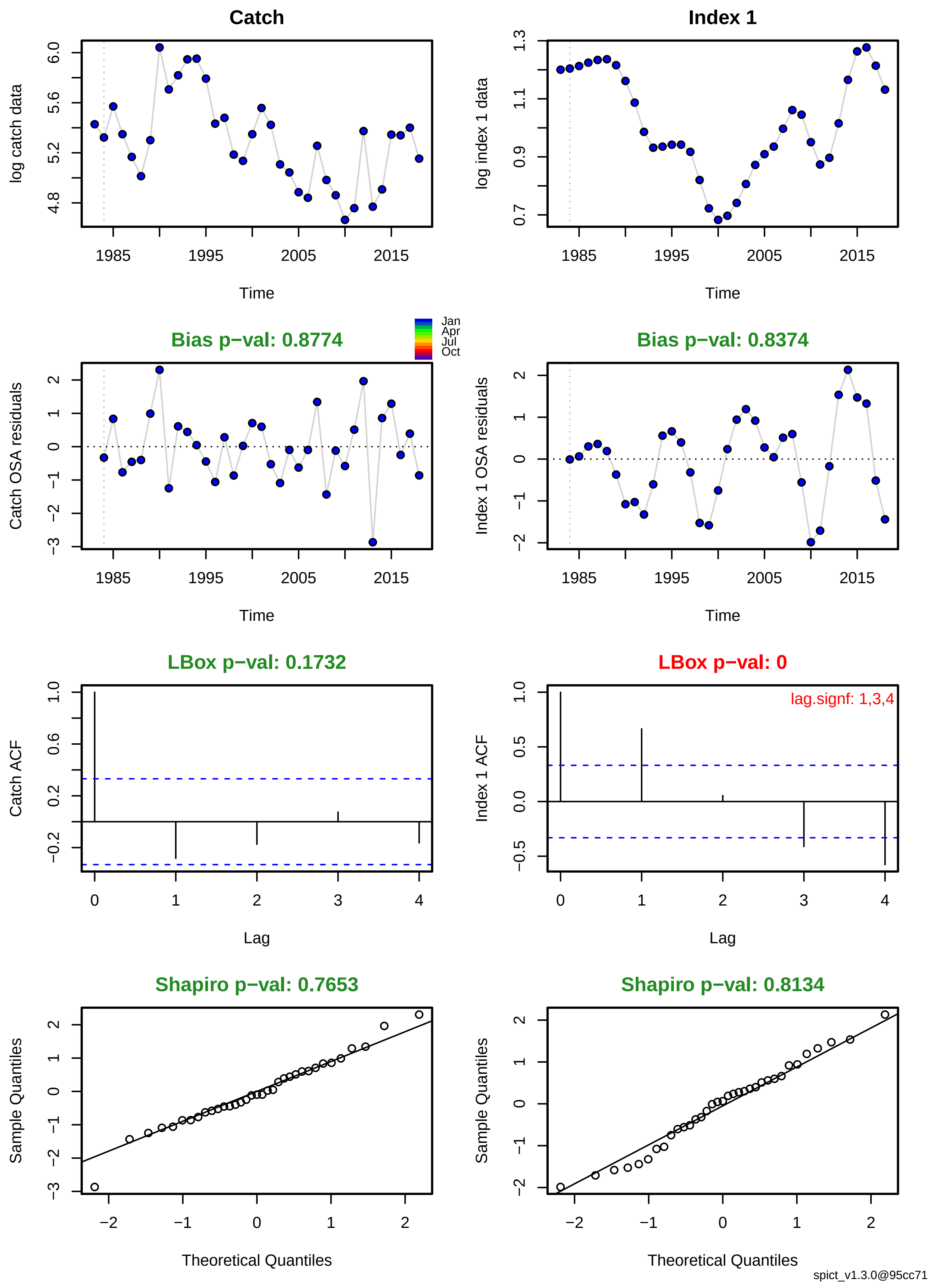
No priors.

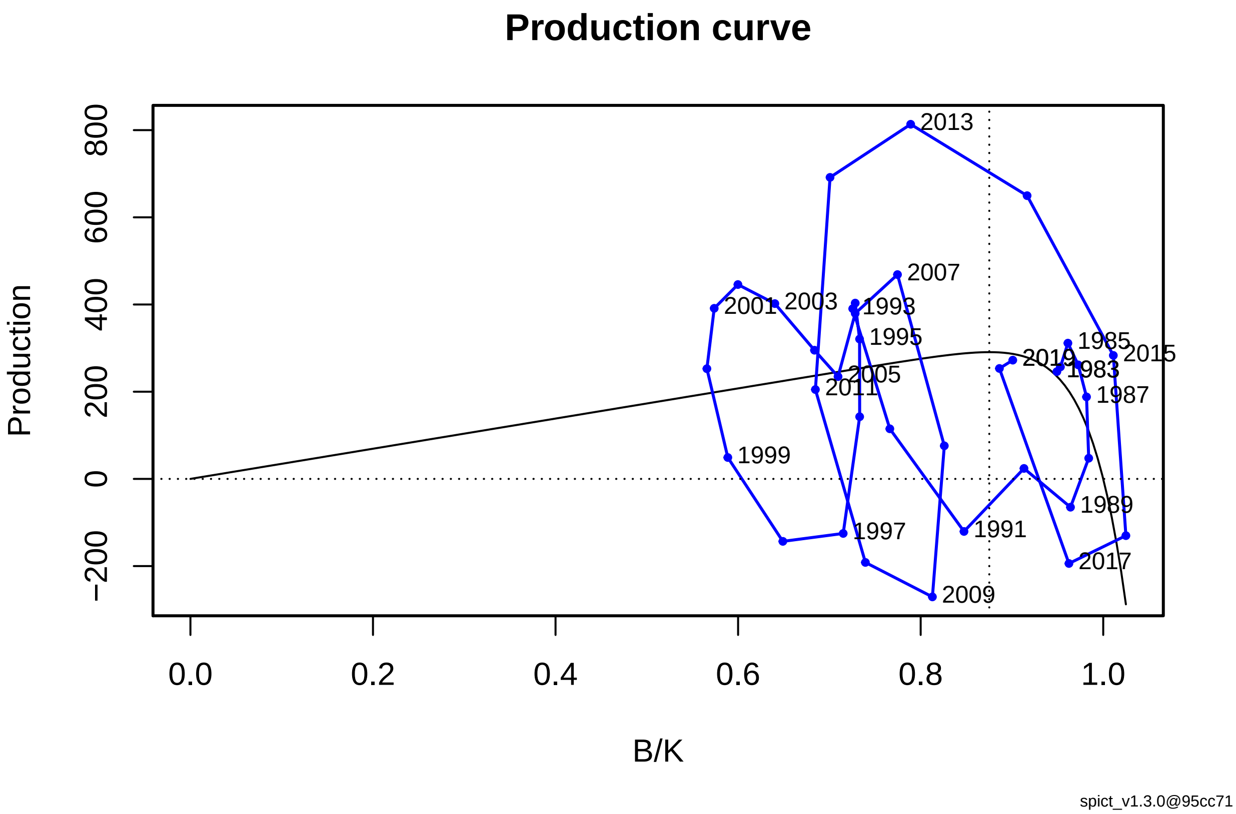


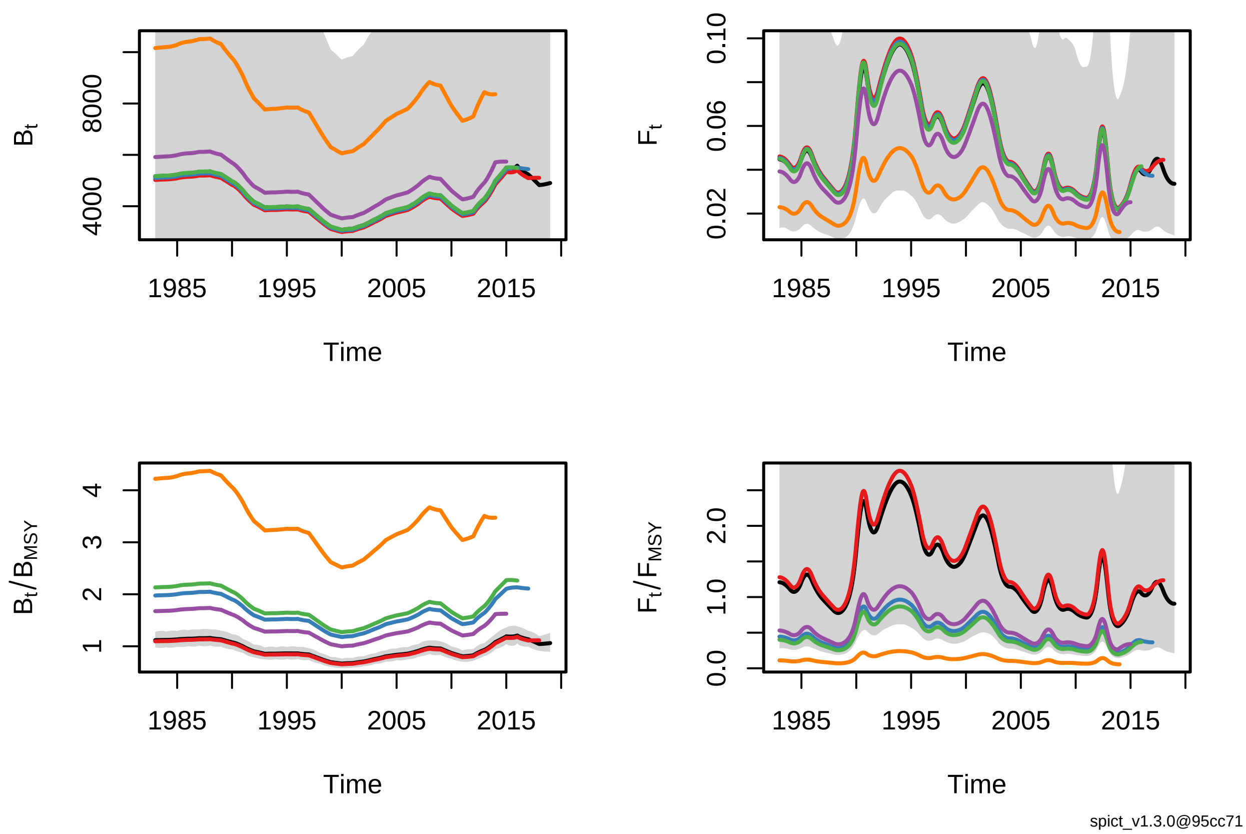

```
## Convergence: 0  MSG: both X-convergence and relative convergence (5)
## Objective function at optimum: -22.9419352
## Euler time step (years):  1/16 or 0.0625
## Nobs C: 36,  Nobs I1: 36
##
## No priors are used
##
## Model parameter estimates w 95% CI
##              estimate        cilow        ciupp   log.est
##  alpha      0.1166618    0.0000232 5.864833e+02 -2.148477
##  beta       0.0898913    0.0119379 6.768725e-01 -2.409154
##  r          1.5384402    0.2630646 8.997024e+00  0.430769
##  rc         0.1220945    0.0418816 3.559333e-01 -2.102960
##  rold       0.0635698    0.0215997 1.870909e-01 -2.755617
##  m        290.7401766  189.8583135 4.452260e+02  5.672430
##  K       5441.8531482 1768.5512644 1.674465e+04  8.601875
##  q          0.0006429    0.0002039 2.026800e-03 -7.349513
##  n         25.2008179    5.4035582 1.175302e+02  3.226876
##  sdb        0.0630061    0.0492250 8.064530e-02 -2.764524
##  sdf        0.3544095    0.2537702 4.949600e-01 -1.037302
##  sdi        0.0073504    0.0000015 3.698161e+01 -4.913001
##  sdc        0.0318583    0.0052680 1.926641e-01 -3.446457
##
```

```
## Deterministic reference points (Drp)
##           estimate       cilow       ciupp   log.est
##  Bmsyd 4762.5448588 1509.2236099 1.502881e+04  8.468537
##  Fmsyd    0.0610472    0.0209408 1.779667e-01 -2.796107
##  MSYd   290.7401766  189.8583135 4.452260e+02  5.672430
## Stochastic reference points (Srp)
##           estimate       cilow       ciupp   log.est rel.diff.Drp
##  Bmsys 4621.8315607 1492.7088858 1.431044e+04  8.438546  -0.03044535
##  Fmsys    0.0370532    0.0043425 3.161648e-01 -3.295402  -0.64755625
##  MSYs   167.8771612   41.1331428 6.851590e+02  5.123233  -0.73186260
##
## States w 95% CI (inp$msytype: s)
##                   estimate       cilow       ciupp    log.est
##  B_2018.94      4895.6615798 1569.2059538 1.527365e+04  8.4961047
##  F_2018.94         0.0335936    0.0100981 1.117568e-01 -3.3934201
##  B_2018.94/Bmsy    1.0592471    0.8954674 1.252982e+00  0.0575584
##  F_2018.94/Fmsy    0.9066323    0.2121541 3.874458e+00 -0.0980184
##
## Predictions w 95% CI (inp$msytype: s)
##                 prediction       cilow       ciupp    log.est
##  B_2020.00      5008.7025921 1624.1498956 1.544630e+04  8.5189322
##  F_2020.00         0.0335938    0.0082917 1.361053e-01 -3.3934151
##  B_2020.00/Bmsy    1.0837051    0.8960348 1.310682e+00  0.0803858
##  F_2020.00/Fmsy    0.9066368    0.1795428 4.578241e+00 -0.0980134
##  Catch_2019.00   166.4102577   95.2048510 2.908715e+02  5.1144562
##  E(B_inf)       2929.6460838          NA          NA  7.9826369
```


Catch
Relative biomass
Relative fishing mortality
Catch
Time
B_t/B_{MSY}
F_t/F_{MSY}
F_t
B_t
E(B_∞)
1983
2019

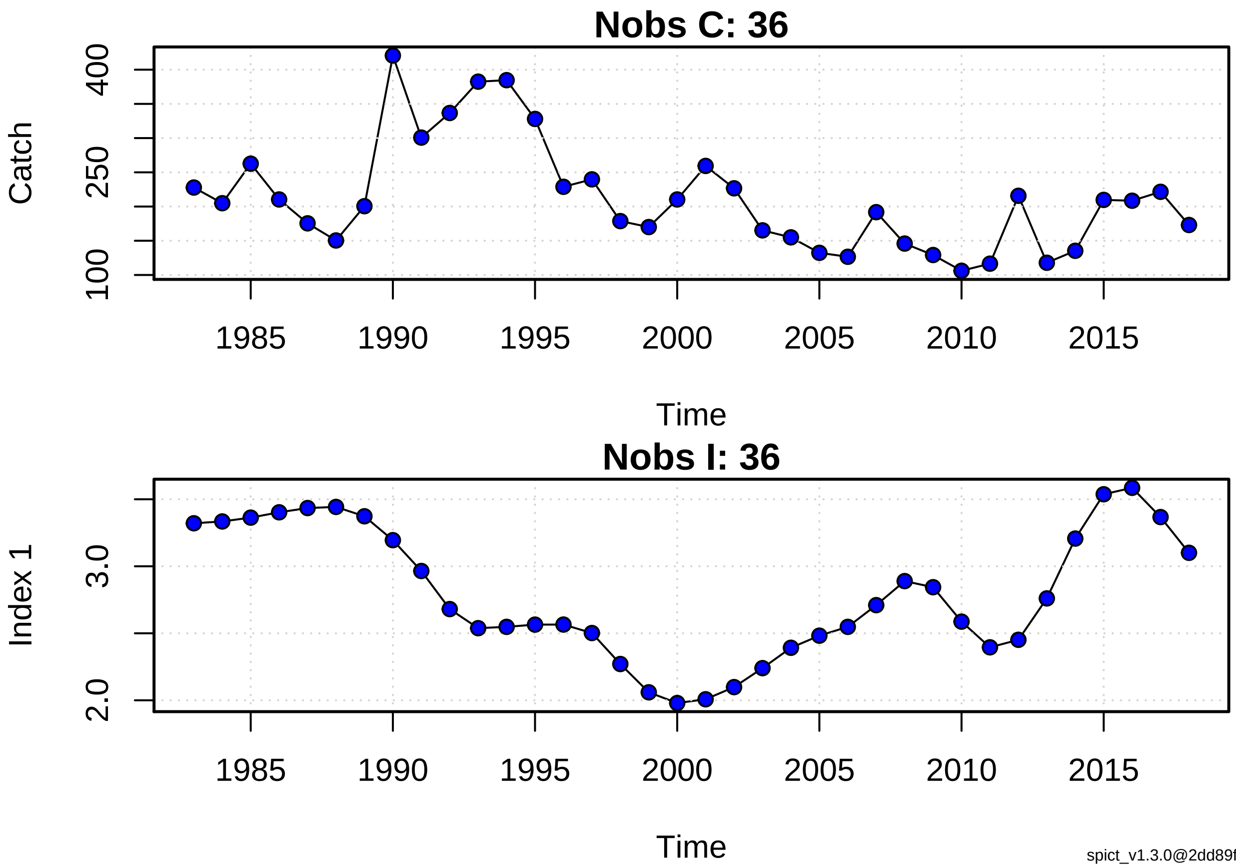

Catch
log catch data
Time
Index 1
log index 1 data
Bias p−val: 0.8774
Jan
Apr
Jul
Oct
Catch OSA residuals
Bias p−val: 0.8374
Index 1 OSA residuals
LBox p−val: 0.1732
Catch ACF
Lag
LBox p−val: 0
lag.signf: 1,3,4
Index 1 ACF
Shapiro p−val: 0.7653
Sample Quantiles
Theoretical Quantiles
Shapiro p−val: 0.8134
spict_v1.3.0@95cc71


Production curve
Production
800
600
400
200
0
−200
0.0
0.2
0.4
0.6
0.8
1.0
B/K
2013
2007
2001
2003
1993
1995
1985
2015
2019
1983
2005
2011
1987
1999
1989
1991
1997
2017
2009
spict_v1.3.0@95cc71


B_t
4000
8000
1985
1995
2005
2015
Time
F_t
0.02
0.06
0.10
1985
1995
2005
2015
Time
B_t/B_{MSY}
1
2
3
4
1985
1995
2005
2015
Time
F_t/F_{MSY}
0.0
1.0
2.0
1985
1995
2005
2015
Time
spict_v1.3.0@95cc71

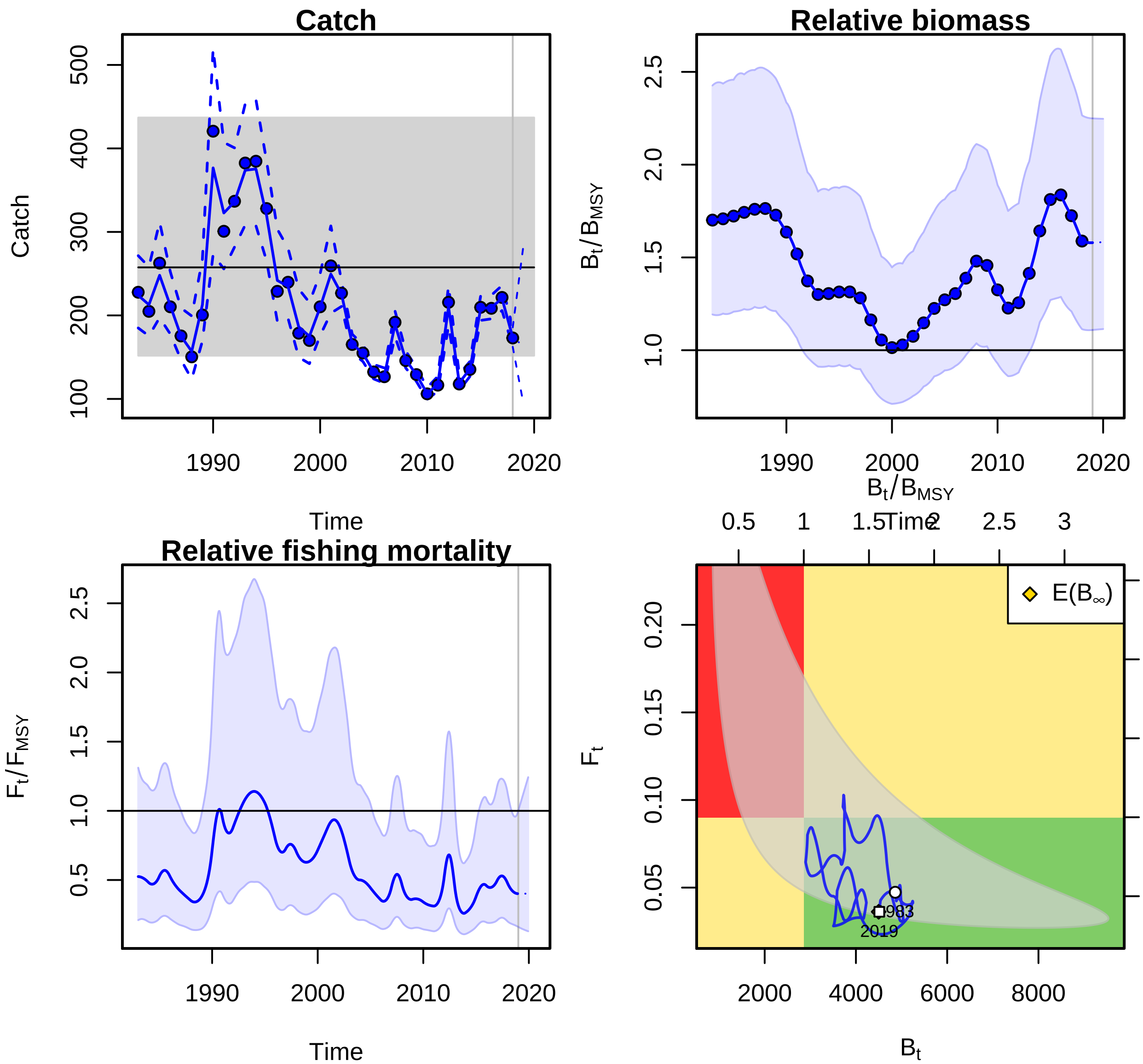
Scenario 2c

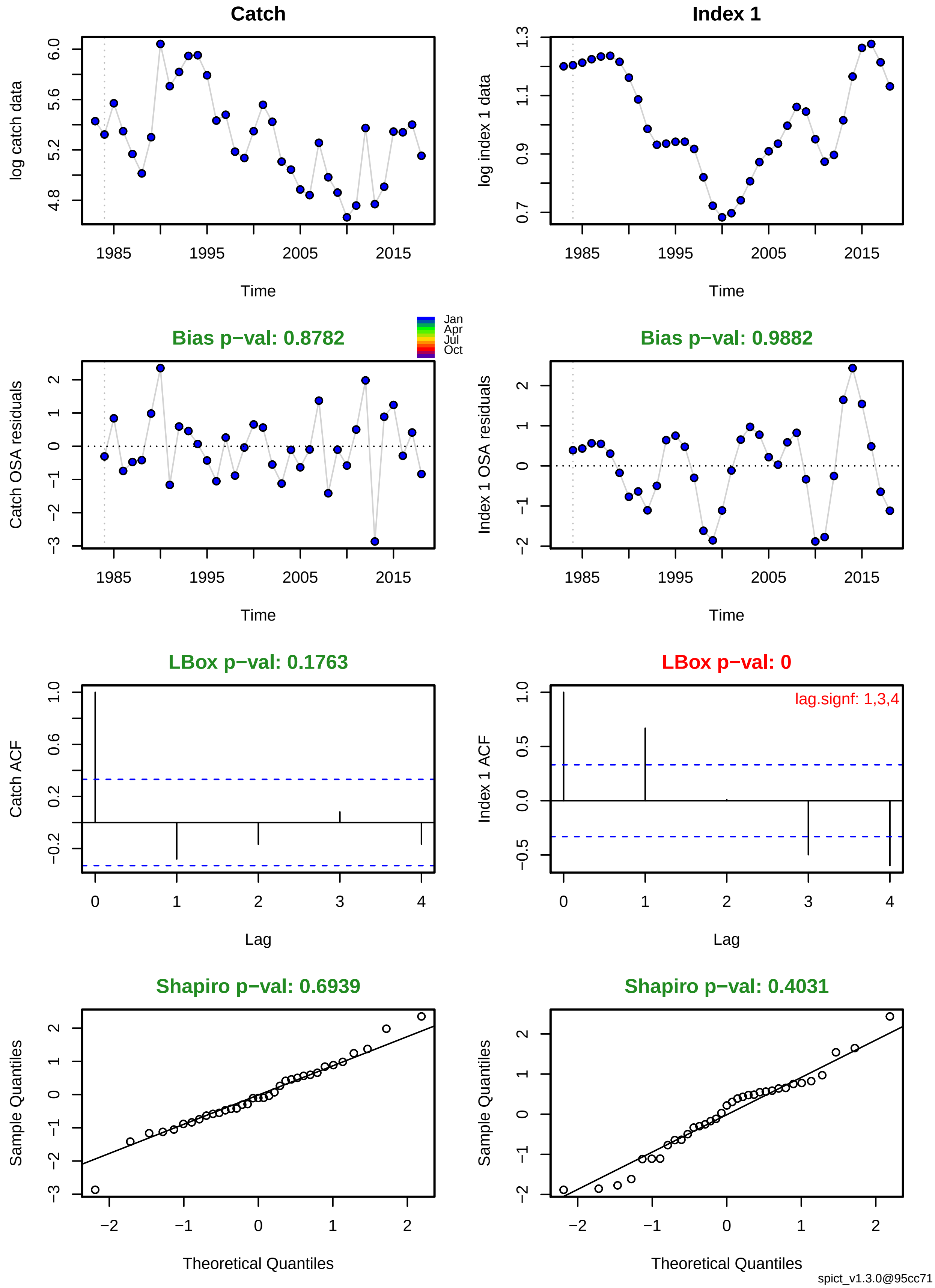
Schaefer model (n = 2).

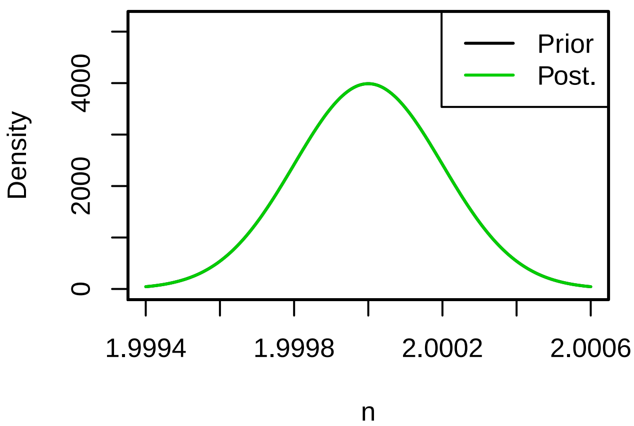


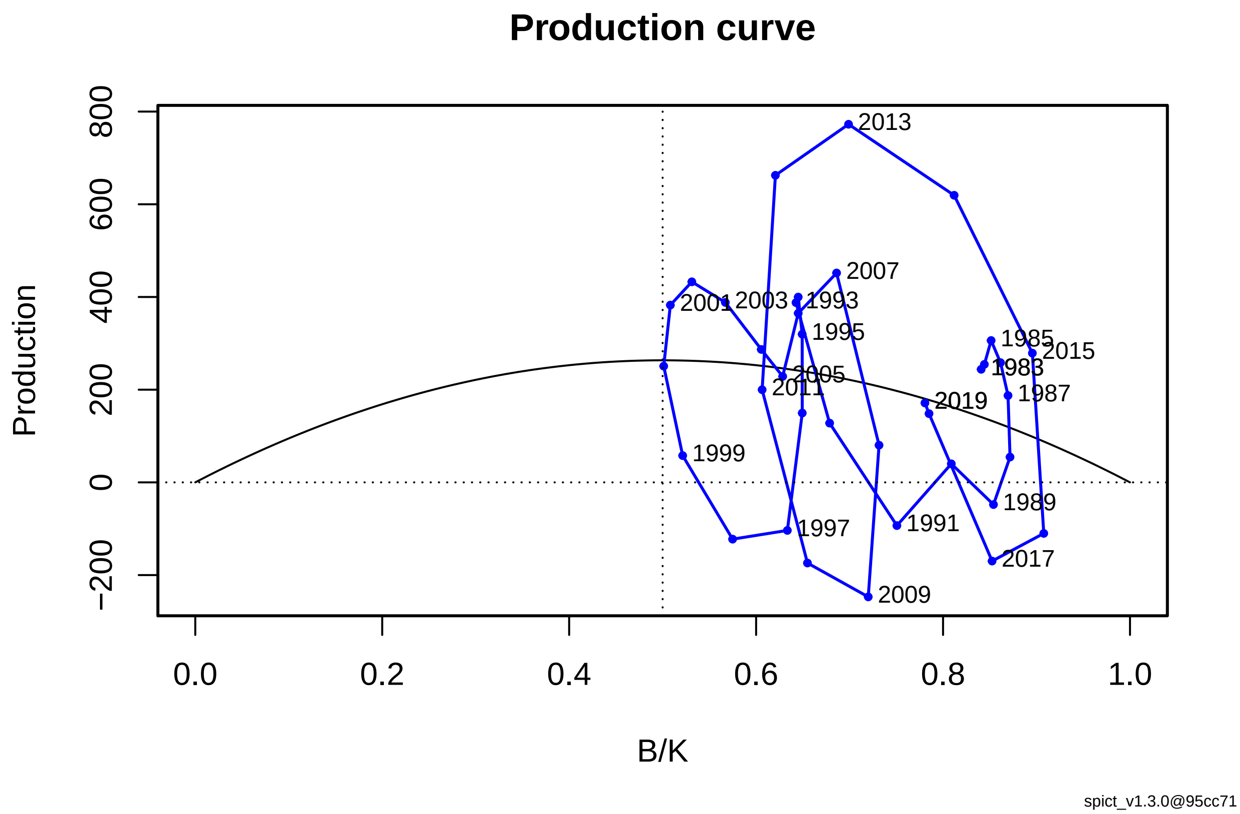

```
## Convergence: 0  MSG: relative convergence (4)
## Objective function at optimum: -33.9238806
## Euler time step (years):  1/16 or 0.0625
## Nobs C: 36,  Nobs I1: 36
##
## Priors
##  logn  ~  dnorm[log(2), 0^2] (fixed)
##
## Model parameter estimates w 95% CI
##            estimate        cilow        ciupp    log.est
##  alpha     0.1187931    0.0000230 6.147585e+02 -2.1303724
##  beta      0.0965802    0.0136528 6.832115e-01 -2.3373815
##  r         0.1822161    0.0700581 4.739312e-01 -1.7025617
##  rc        0.1822161    0.0700581 4.739312e-01 -1.7025617
##  rold      0.1822161    0.0700581 4.739313e-01 -1.7025617
##  m       263.3510079  155.7846658 4.451899e+02  5.5734878
##  K      5781.0686649 2185.5232165 1.529188e+04  8.6623438
##  q         0.0006833    0.0002248 2.076700e-03 -7.2886313
##  n         2.0000000    1.9996080 2.000392e+00  0.6931472
##  sdb       0.0619593    0.0485044 7.914650e-02 -2.7812772
##  sdf       0.3505396    0.2486572 4.941663e-01 -1.0482816
##  sdi       0.0073603    0.0000014 3.812918e+01 -4.9116495
##  sdc       0.0338552    0.0060346 1.899325e-01 -3.3856631
```

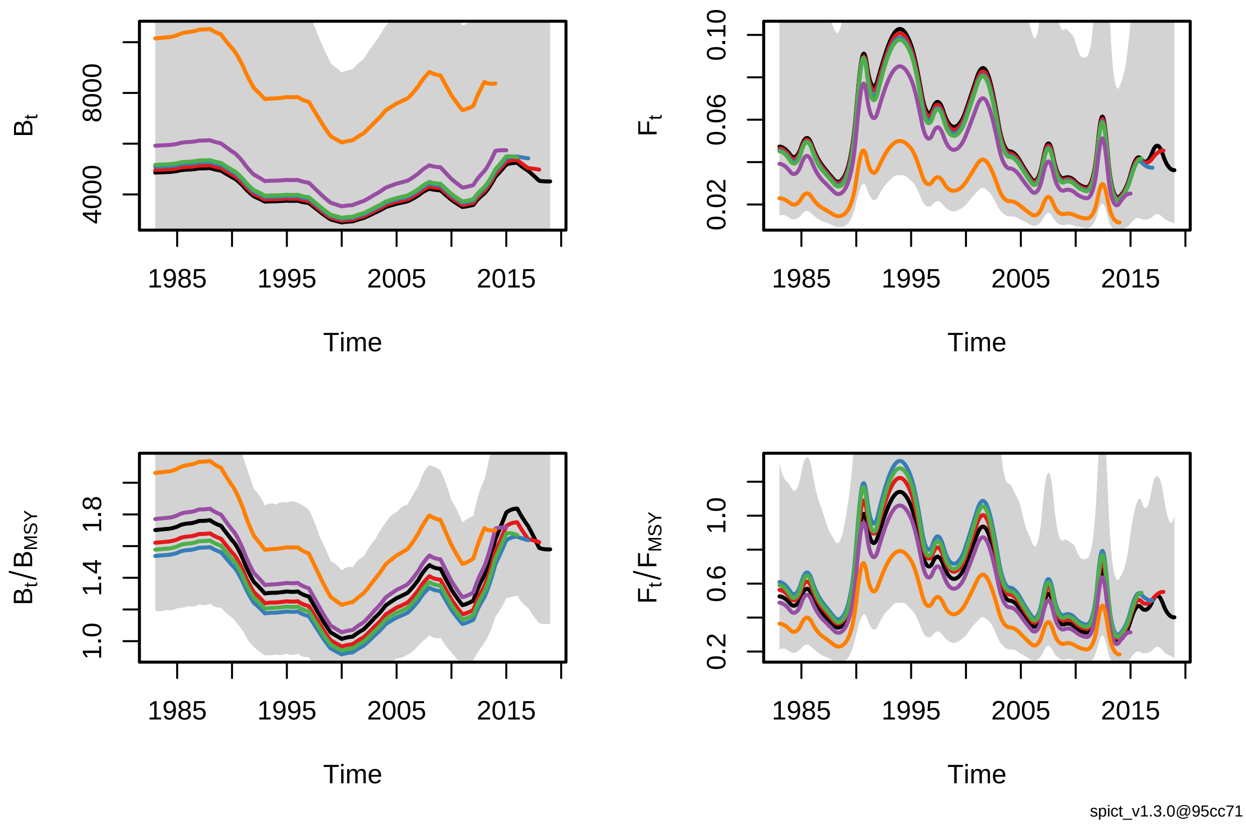
```
##
## Deterministic reference points (Drp)
##           estimate        cilow        ciupp   log.est
##  Bmsyd 2890.5343330 1092.7616069 7645.9391304  7.969197
##  Fmsyd    0.0911081    0.0350291    0.2369656 -2.395709
##  MSYd   263.3510079  155.7846658  445.1898588  5.573488
## Stochastic reference points (Srp)
##           estimate        cilow        ciupp   log.est rel.diff.Drp
##  Bmsys 2857.1092921 1088.6013668 7498.6801931  7.957566  -0.01169890
##  Fmsys    0.0901505    0.0343485    0.2366077 -2.406275  -0.01062192
##  MSYs   257.5378765  151.7880737  436.9629061  5.551167  -0.02257195
##
## States w 95% CI (inp$msytype: s)
##                    estimate        cilow        ciupp    log.est
##  B_2018.94      4512.2458027 1488.3324486 1.367998e+04  8.4145503
##  F_2018.94         0.0361881    0.0111944 1.169845e-01 -3.3190260
##  B_2018.94/Bmsy    1.5793046    1.1088602 2.249340e+00  0.4569846
##  F_2018.94/Fmsy    0.4014182    0.1635897 9.850047e-01 -0.9127514
##
## Predictions w 95% CI (inp$msytype: s)
##                  prediction        cilow        ciupp    log.est
##  B_2020.00      4520.6754898 1499.6839665 1.362721e+04  8.4164167
##  F_2020.00         0.0361882    0.0091913 1.424808e-01 -3.3190214
##  B_2020.00/Bmsy    1.5822550    1.1141869 2.246958e+00  0.4588511
##  F_2020.00/Fmsy    0.4014201    0.1279493 1.259391e+00 -0.9127468
##  Catch_2019.00   163.4463469   94.1009246 2.838942e+02  5.0964848
##  E(B_inf)       4497.6600224           NA           NA  8.4113125
```


Catch
Catch
100
200
300
400
500
1990
2000
2010
2020
Time
Relative biomass
B_t/B_{MSY}
1.0
1.5
2.0
2.5
1990
2000
2010
2020
Time
Relative fishing mortality
F_t/F_{MSY}
0.5
1.0
1.5
2.0
2.5
1990
2000
2010
2020
Time
B_t/B_{MSY}
0.5
1
1.5
2
2.5
3
$E(B_\infty)$
F_t
0.05
0.10
0.15
0.20
1983
2019
2000
4000
6000
8000
B_t


Catch
log catch data
Time
Index 1
log index 1 data
Time
Bias p−val: 0.8782
Jan
Apr
Jul
Oct
Catch OSA residuals
Time
Bias p−val: 0.9882
Index 1 OSA residuals
Time
LBox p−val: 0.1763
Catch ACF
Lag
LBox p−val: 0
lag.signf: 1,3,4
Index 1 ACF
Lag
Shapiro p−val: 0.6939
Sample Quantiles
Theoretical Quantiles
Shapiro p−val: 0.4031
Sample Quantiles
Theoretical Quantiles
spict_v1.3.0@95cc71

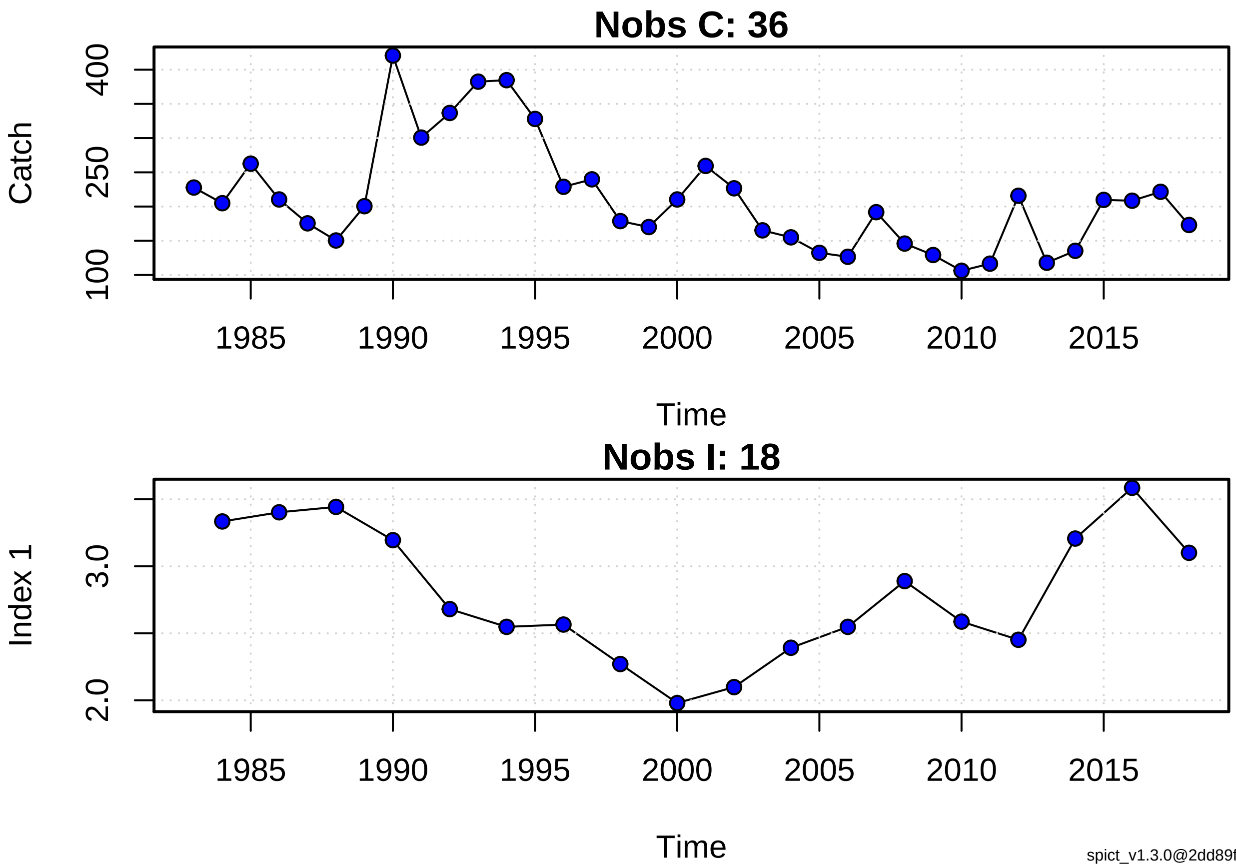

Prior
Post.
Density
0
2000
4000
1.9994
1.9998
2.0002
2.0006
n


Production curve
Production
B/K
800
600
400
200
0
−200
0.0
0.2
0.4
0.6
0.8
1.0
2013
2007
2001
2003
1993
1995
1985
2015
1983
2005
2011
2019
1987
1999
1989
1991
1997
2017
2009
spict_v1.3.0@95cc71


B_t
4000
8000
1985
1995
2005
2015
Time
F_t
0.02
0.06
0.10
B_t/B_MSY
1.0
1.4
1.8
F_t/F_MSY
0.2
0.6
1.0
spict_v1.3.0@95cc71

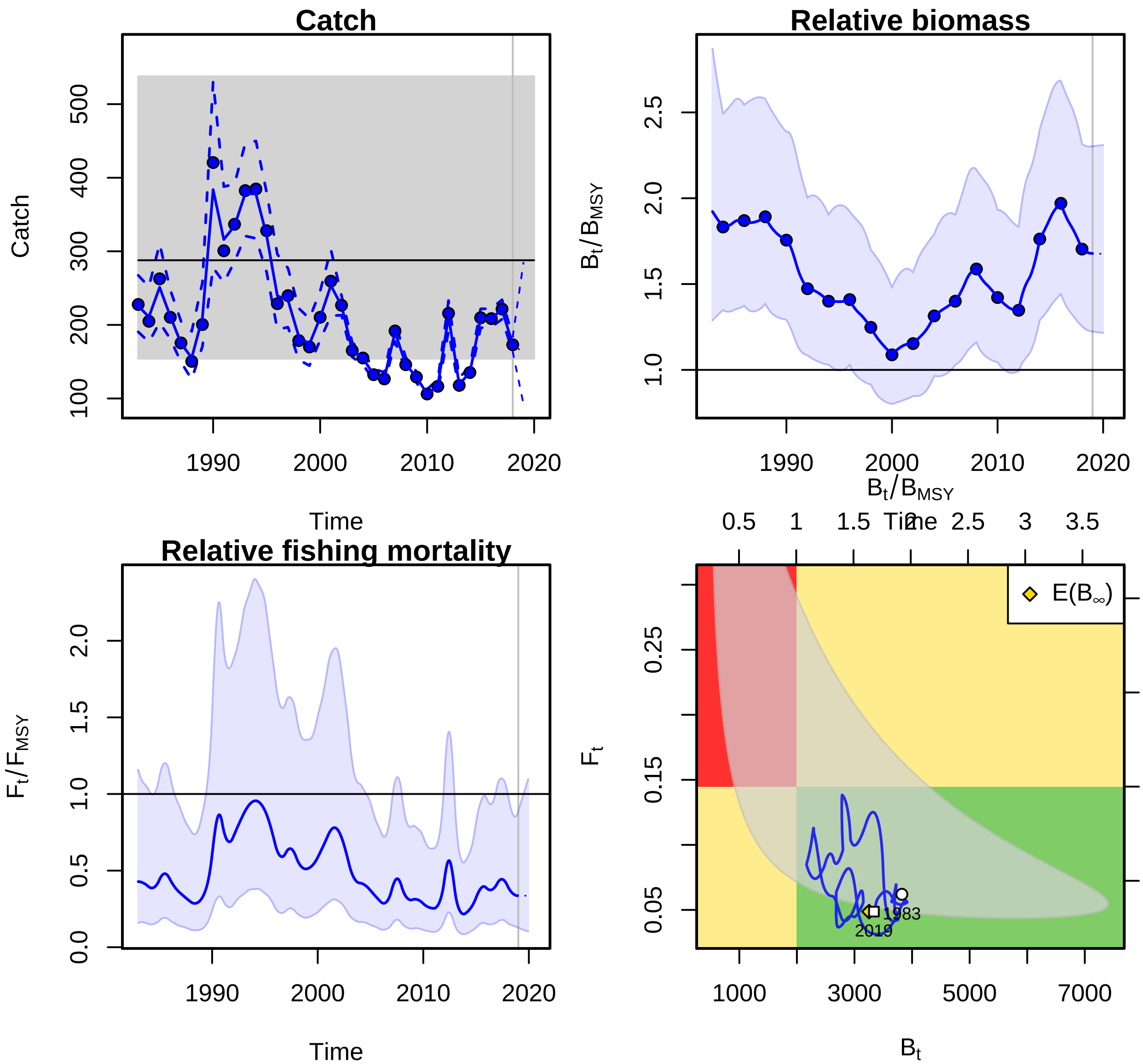
Scenario 2d

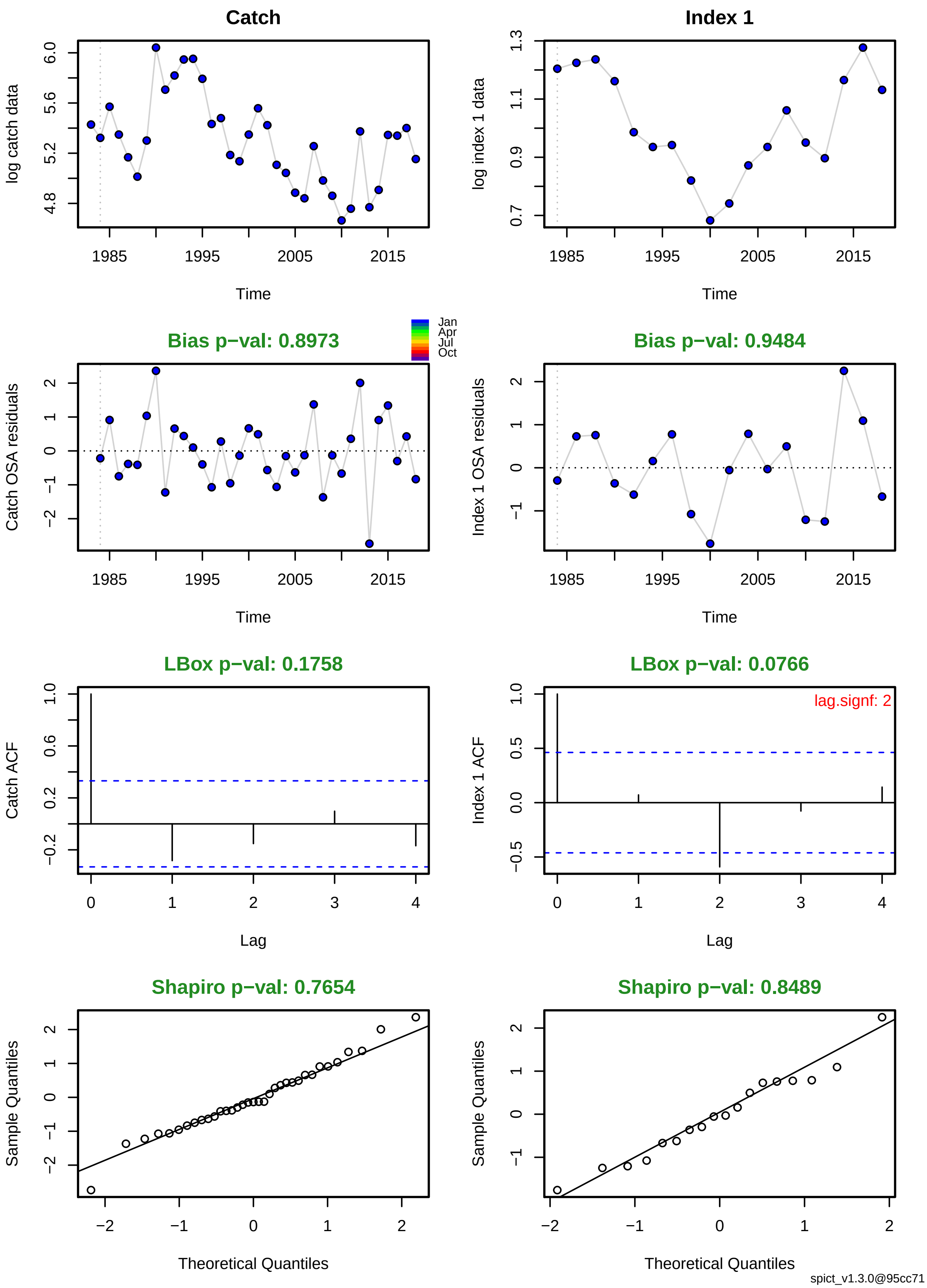
Schaefer model (n = 2). Thinned index series.

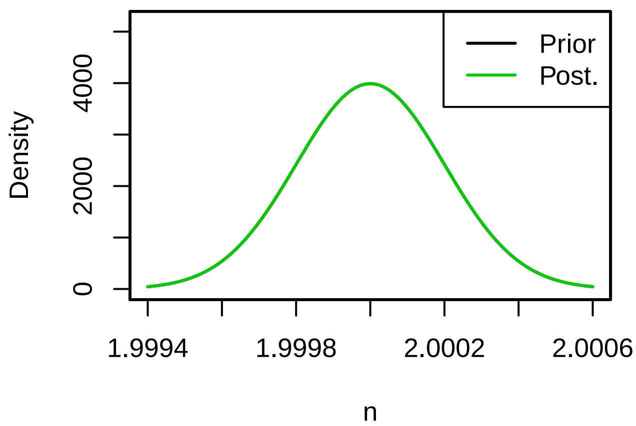


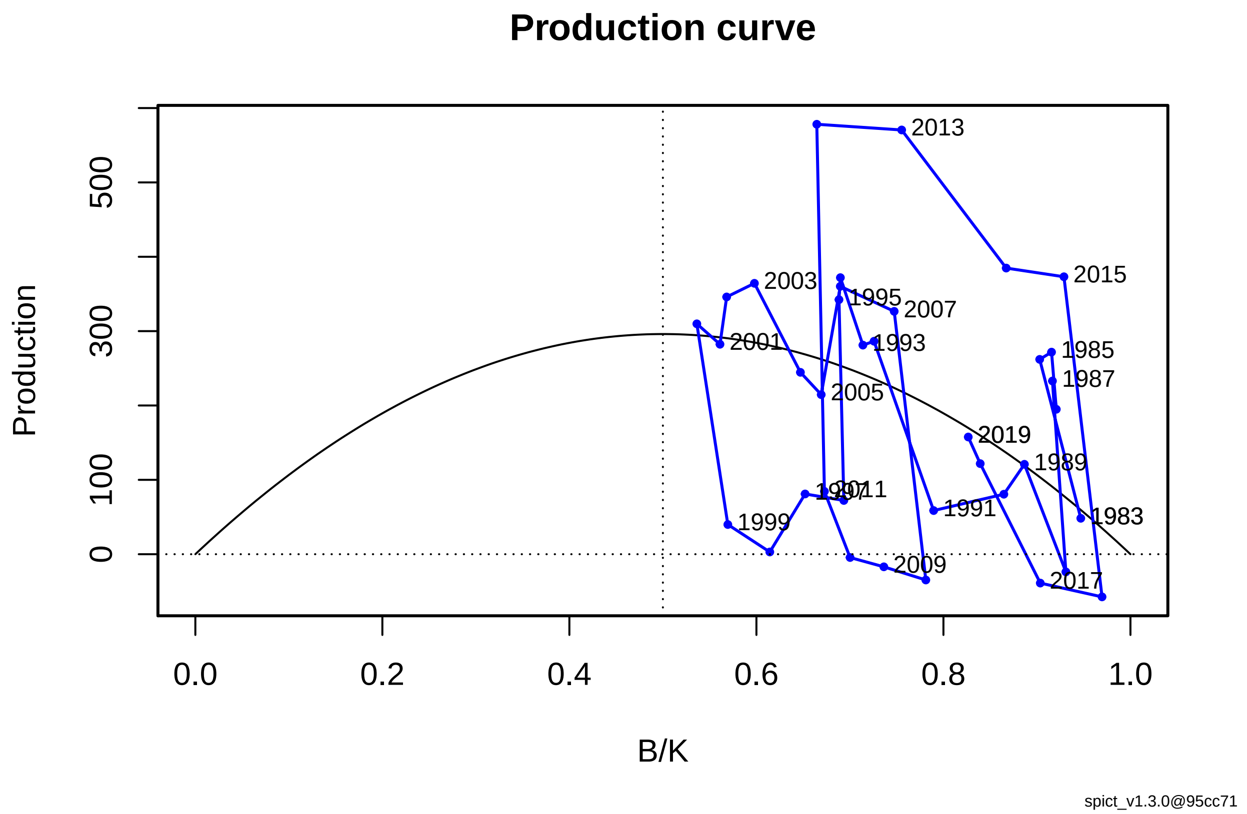

```
## Convergence: 0  MSG: relative convergence (4)
## Objective function at optimum: 0.8127949
## Euler time step (years):  1/16 or 0.0625
## Nobs C: 36,  Nobs I1: 18
##
## Priors
##  logn  ~  dnorm[log(2), 0^2] (fixed)
##
## Model parameter estimates w 95% CI
##             estimate        cilow        ciupp    log.est
##  alpha     0.5299904    0.0000010 2.892994e+05 -0.6348964
##  beta      0.0832889    0.0093477 7.421113e-01 -2.4854403
##  r         0.2933029    0.1129737 7.614747e-01 -1.2265494
##  rc        0.2933029    0.1129737 7.614746e-01 -1.2265494
##  rold      0.2933029    0.1129737 7.614747e-01 -1.2265494
##  m       296.0707370  158.1561791 5.542489e+02  5.6905984
##  K      4037.7470811 1399.6060912 1.164856e+04  8.3034422
##  q         0.0009152    0.0002722 3.077000e-03 -6.9964053
##  n         2.0000000    1.9996080 2.000392e+00  0.6931472
##  sdb       0.0869907    0.0572195 1.322518e-01 -2.4419536
##  sdf       0.3549486    0.2538977 4.962176e-01 -1.0357824
##  sdi       0.0461043    0.0000001 2.244845e+04 -3.0768500
##  sdc       0.0295633    0.0041165 2.123152e-01 -3.5212228
```

```
##
## Deterministic reference points (Drp)
##            estimate      cilow       ciupp   log.est
##  Bmsyd 2018.8735416 699.8030447 5824.2821428  7.610295
##  Fmsyd    0.1466515   0.0564868    0.3807373 -1.919697
##  MSYd   296.0707370 158.1561791  554.2488562  5.690598
## Stochastic reference points (Srp)
##            estimate     cilow       ciupp   log.est rel.diff.Drp
##  Bmsys 1988.5447885 693.54554 5701.5872237  7.595158  -0.01525173
##  Fmsys    0.1447715   0.05536    0.3785906 -1.932599  -0.01298565
##  MSYs   287.8274955 154.04138  537.8078748  5.662361  -0.02863952
##
## States w 95% CI (inp$msytype: s)
##                     estimate       cilow        ciupp    log.est
##  B_2018.94      3337.7209974 992.6503580 1.122287e+04  8.1130435
##  F_2018.94         0.0486800   0.0136842 1.731733e-01 -3.0224877
##  B_2018.94/Bmsy    1.6784741   1.2240657 2.301572e+00  0.5178851
##  F_2018.94/Fmsy    0.3362539   0.1293057 8.744140e-01 -1.0898888
##
## Predictions w 95% CI (inp$msytype: s)
##                   prediction       cilow        ciupp    log.est
##  B_2020.00      3332.6457789 997.6635741 1.113254e+04  8.1115218
##  F_2020.00         0.0486801   0.0113322 2.091167e-01 -3.0224843
##  B_2020.00/Bmsy    1.6759219   1.2162253 2.309370e+00  0.5163634
##  F_2020.00/Fmsy    0.3362551   0.1018047 1.110631e+00 -1.0898853
##  Catch_2019.00   162.3511954  92.7002645 2.843348e+02  5.0897619
##  E(B_inf)       3253.3615369          NA           NA  8.0874441
```


Catch
Catch
Time
Relative biomass
Bt/BMSY
Relative fishing mortality
Ft/FMSY
Time
Bt/BMSY
Ft
E(B∞)
1983
2019
Bt

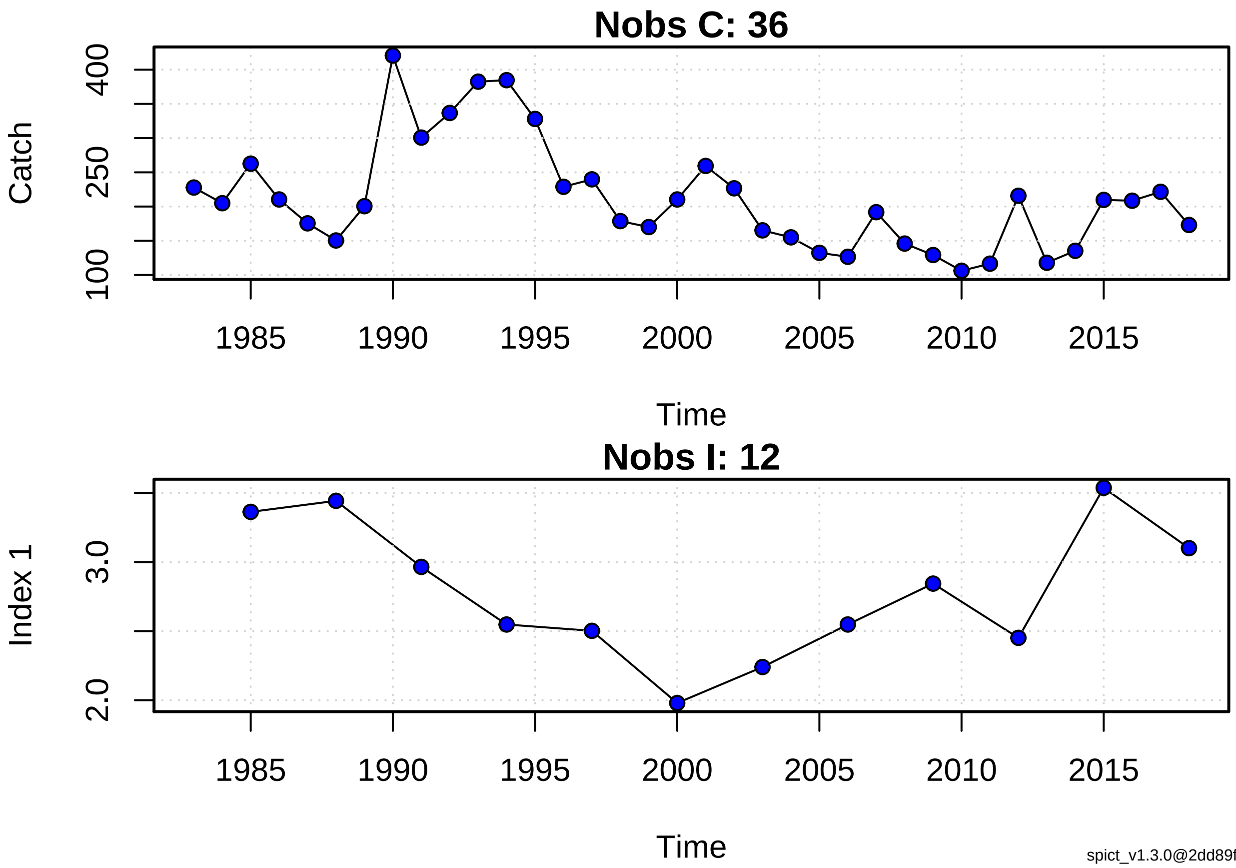

Catch
log catch data
Time
Index 1
log index 1 data
Bias p−val: 0.8973
Jan
Apr
Jul
Oct
Catch OSA residuals
Bias p−val: 0.9484
Index 1 OSA residuals
LBox p−val: 0.1758
Catch ACF
Lag
LBox p−val: 0.0766
lag.signf: 2
Index 1 ACF
Shapiro p−val: 0.7654
Sample Quantiles
Theoretical Quantiles
Shapiro p−val: 0.8489
spict_v1.3.0@95cc71


Prior
Post.
Density
0
2000
4000
1.9994
1.9998
2.0002
2.0006
n


Production curve
Production
B/K
0
100
300
500
0.0
0.2
0.4
0.6
0.8
1.0
2013
2015
2003
1995
2007
2001
1993
1985
1987
2005
2019
1989
1997
2011
1991
1983
1999
2009
2017
spict_v1.3.0@95cc71

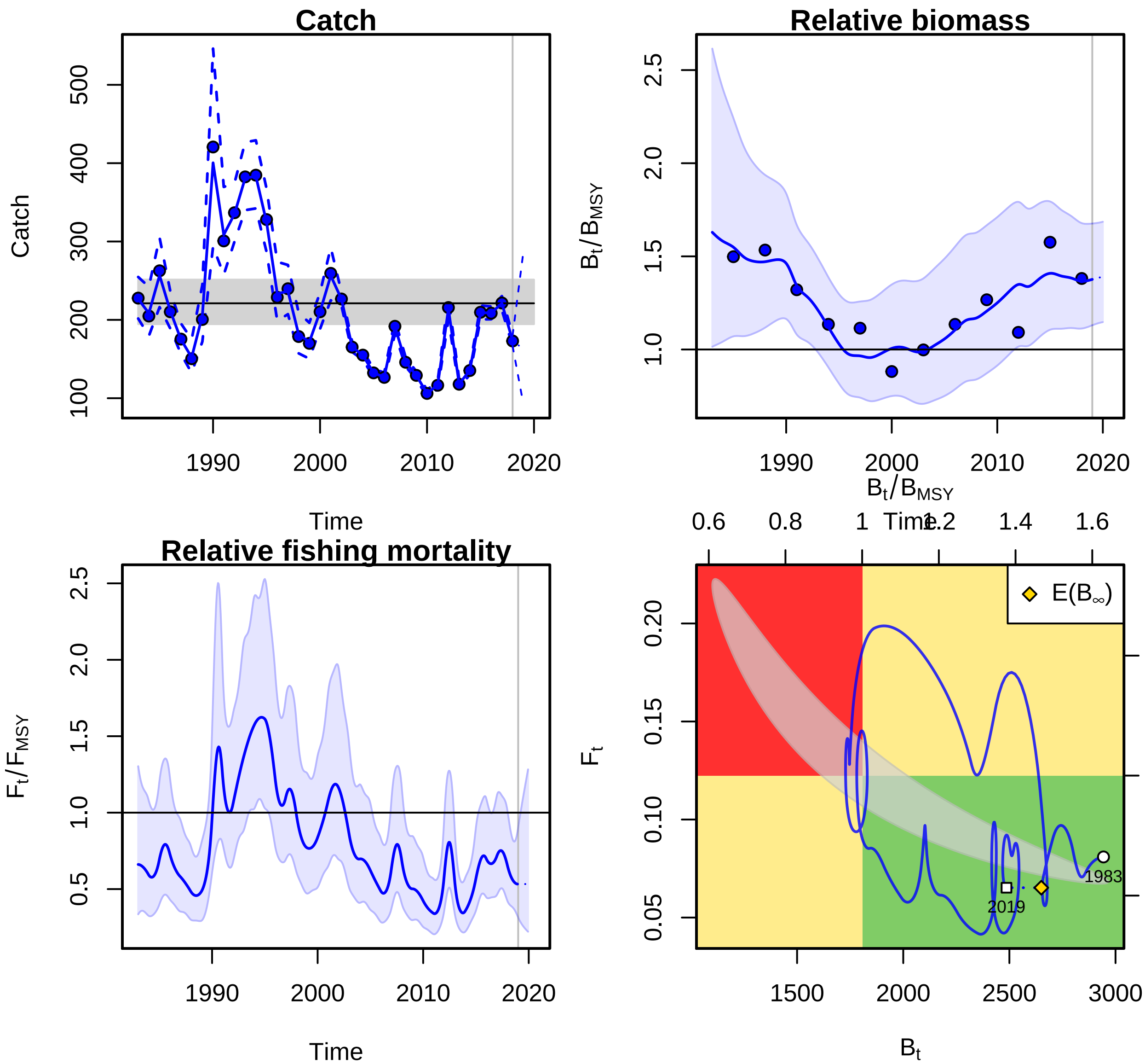
Scenario 2e

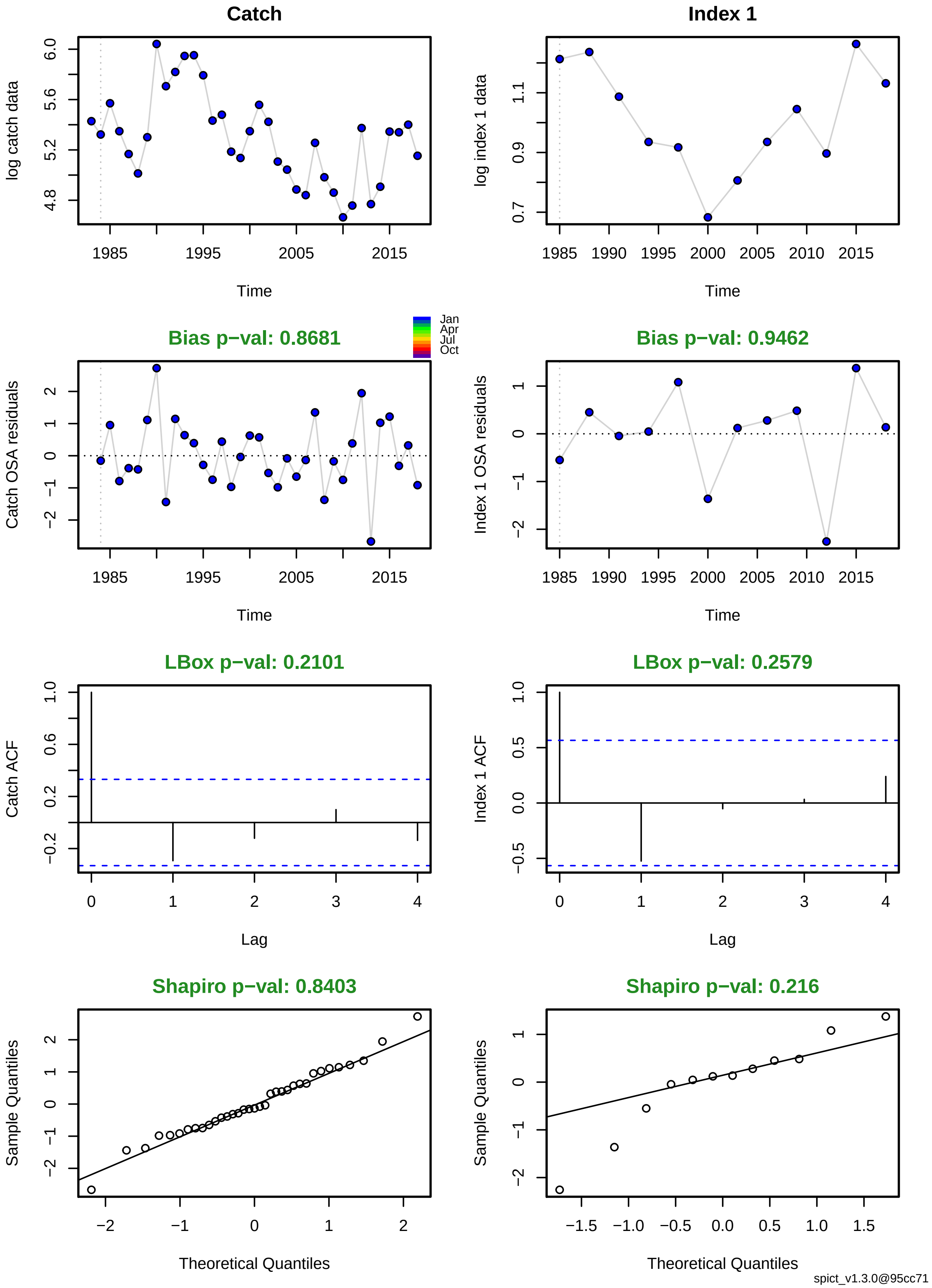
Schaefer model (n = 2). Thinned index series.

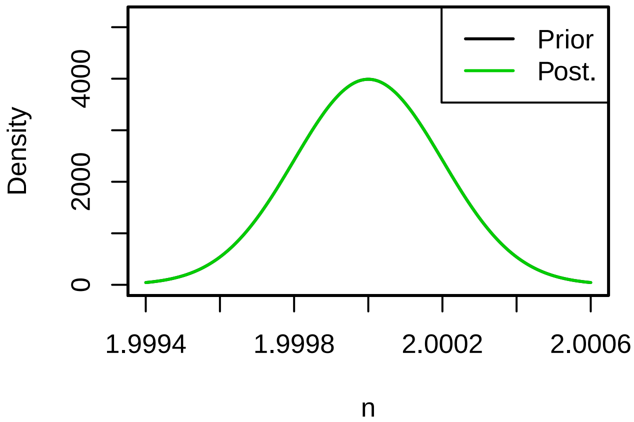


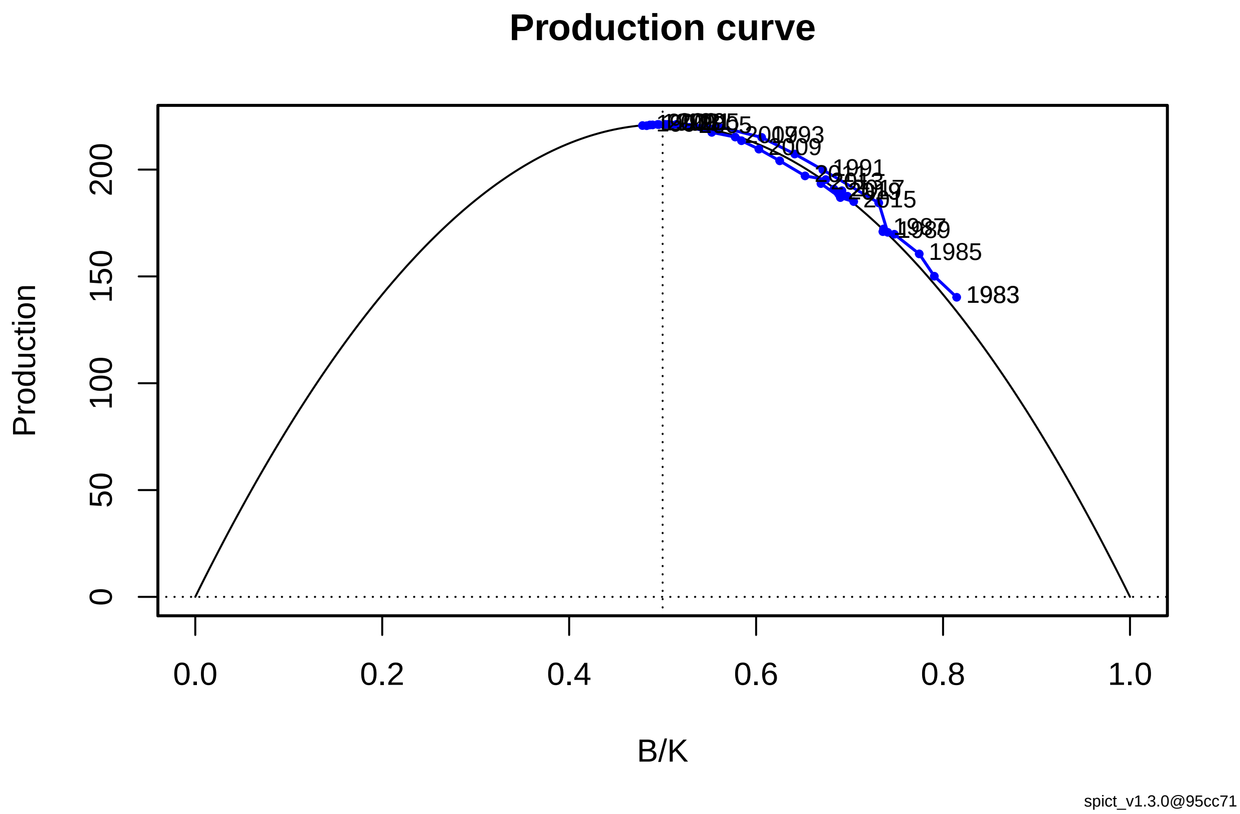

```
## Convergence: 0  MSG: both X-convergence and relative convergence (5)
## Objective function at optimum: 4.7625497
## Euler time step (years):  1/16 or 0.0625
## Nobs C: 36,  Nobs I1: 12
##
## Priors
##  logn  ~  dnorm[log(2), 0^2] (fixed)
##
## Model parameter estimates w 95% CI
##             estimate        cilow        ciupp    log.est
##  alpha   162.4892156    0.4253451 6.207370e+04  5.0906116
##  beta      0.0530530    0.0015561 1.808728e+00 -2.9364639
##  r         0.2448143    0.1516075 3.953237e-01 -1.4072553
##  rc        0.2448143    0.1516075 3.953237e-01 -1.4072553
##  rold      0.2448143    0.1516075 3.953237e-01 -1.4072553
##  m       221.1302725  194.5071909 2.513974e+02  5.3987520
##  K      3613.0287018 2429.6237442 5.372839e+03  8.1923017
##  q         0.0012427    0.0008685 1.778100e-03 -6.6904661
##  n         2.0000000    1.9996080 2.000392e+00  0.6931472
##  sdb       0.0034650    0.0000090 1.337122e+00 -5.6650456
##  sdf       0.3703691    0.2693098 5.093512e-01 -0.9932553
##  sdi       0.5630235    0.3644630 8.697602e-01 -0.5744339
##  sdc       0.0196492    0.0007102 5.436233e-01 -3.9297192
```

```
##
## Deterministic reference points (Drp)
##           estimate        cilow        ciupp   log.est
##  Bmsyd 1806.5143529 1214.8118738 2686.4193357  7.499155
##  Fmsyd    0.1224071    0.0758038    0.1976618 -2.100402
##  MSYd   221.1302725  194.5071909  251.3973762  5.398752
## Stochastic reference points (Srp)
##           estimate        cilow        ciupp   log.est  rel.diff.Drp
##  Bmsys 1806.4640913 1214.7768999 2686.3471913  7.499127 -2.782317e-05
##  Fmsys    0.1224042    0.0758021    0.1976566 -2.100427 -2.409670e-05
##  MSYs   221.1187209  194.5012909  251.3787364  5.398700 -5.224176e-05
##
## States w 95% CI (inp$msytype: s)
##                    estimate        cilow        ciupp    log.est
##  B_2018.94      2484.5673365 1809.8576045 3410.8069244  7.8178538
##  F_2018.94         0.0652157    0.0399200    0.1065403 -2.7300547
##  B_2018.94/Bmsy    1.3753760    1.1288931    1.6756761  0.3187271
##  F_2018.94/Fmsy    0.5327901    0.3246353    0.8744130 -0.6296277
##
## Predictions w 95% CI (inp$msytype: s)
##                  prediction        cilow        ciupp    log.est
##  B_2020.00      2512.0137525 1828.5599299 3450.9194856  7.8288400
##  F_2020.00         0.0652159    0.0266510    0.1595855 -2.7300520
##  B_2020.00/Bmsy    1.3905694    1.1471964    1.6855730  0.3297133
##  F_2020.00/Fmsy    0.5327915    0.2171787    1.3070656 -0.6296251
##  Catch_2019.00   162.9548369   92.7932199  286.1661540  5.0934731
##  E(B_inf)       2650.3560168           NA           NA  7.8824493
```


Catch
Catch
100
200
300
400
500
1990
2000
2010
2020
Time
Relative biomass
Bt/BMSY
1.0
1.5
2.0
2.5
1990
2000
2010
2020
Time
Relative fishing mortality
Ft/FMSY
0.5
1.0
1.5
2.0
2.5
1990
2000
2010
2020
Time
Bt/BMSY
0.6
0.8
1
1.2
1.4
1.6
E(B∞)
Ft
0.05
0.10
0.15
0.20
1983
2019
1500
2000
2500
3000
Bt

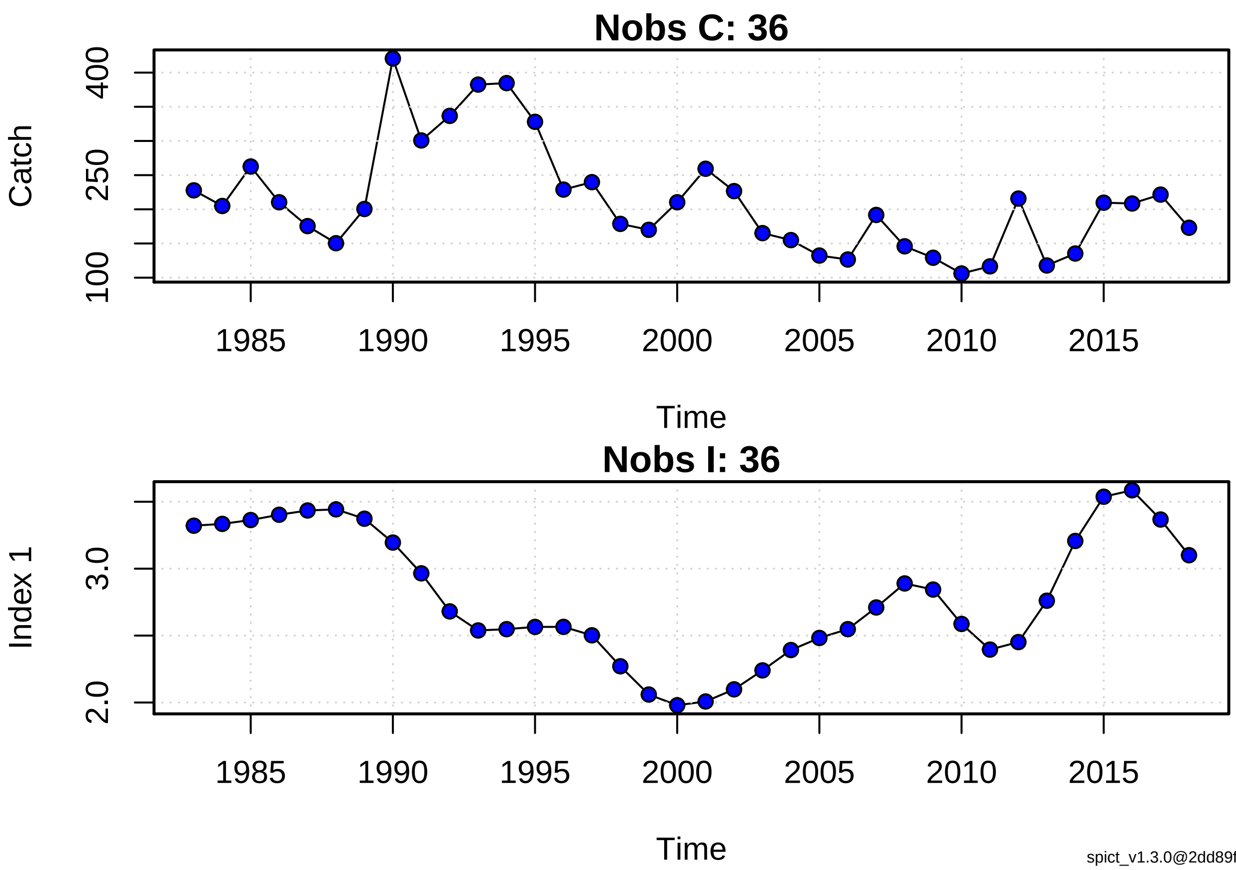

Catch
log catch data
Time
Index 1
log index 1 data
Time
Bias p−val: 0.8681
Jan
Apr
Jul
Oct
Catch OSA residuals
Time
Bias p−val: 0.9462
Index 1 OSA residuals
Time
LBox p−val: 0.2101
Catch ACF
Lag
LBox p−val: 0.2579
Index 1 ACF
Lag
Shapiro p−val: 0.8403
Sample Quantiles
Theoretical Quantiles
Shapiro p−val: 0.216
Sample Quantiles
Theoretical Quantiles
spict_v1.3.0@95cc71


Prior
Post.
Density
0
2000
4000
1.9994
1.9998
2.0002
2.0006
n


Production curve
Production
B/K
0
50
100
150
200
0.0
0.2
0.4
0.6
0.8
1.0
1983
1985
1987
1991
1993
2009
2015
spict_v1.3.0@95cc71

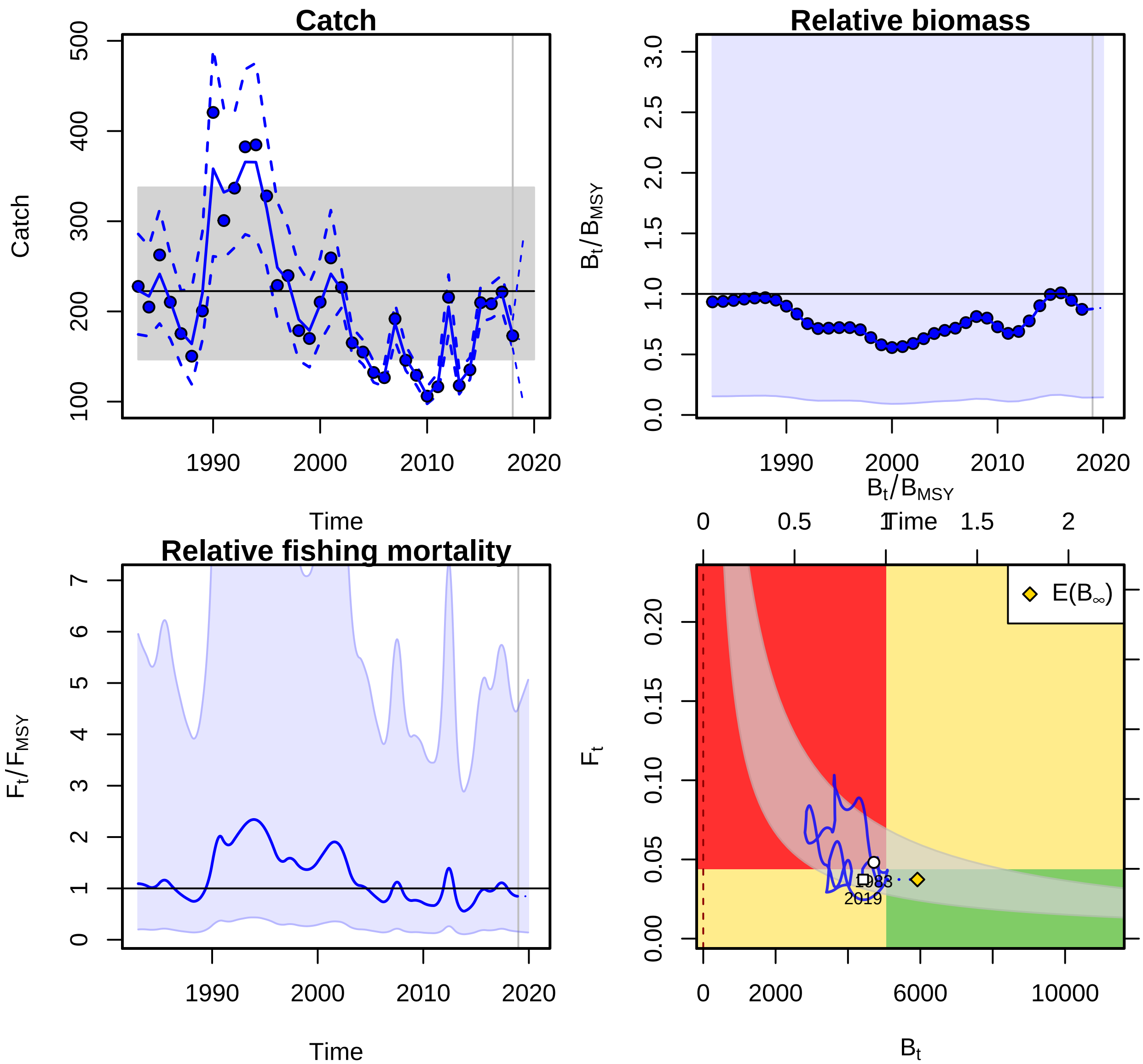
Scenario 2f

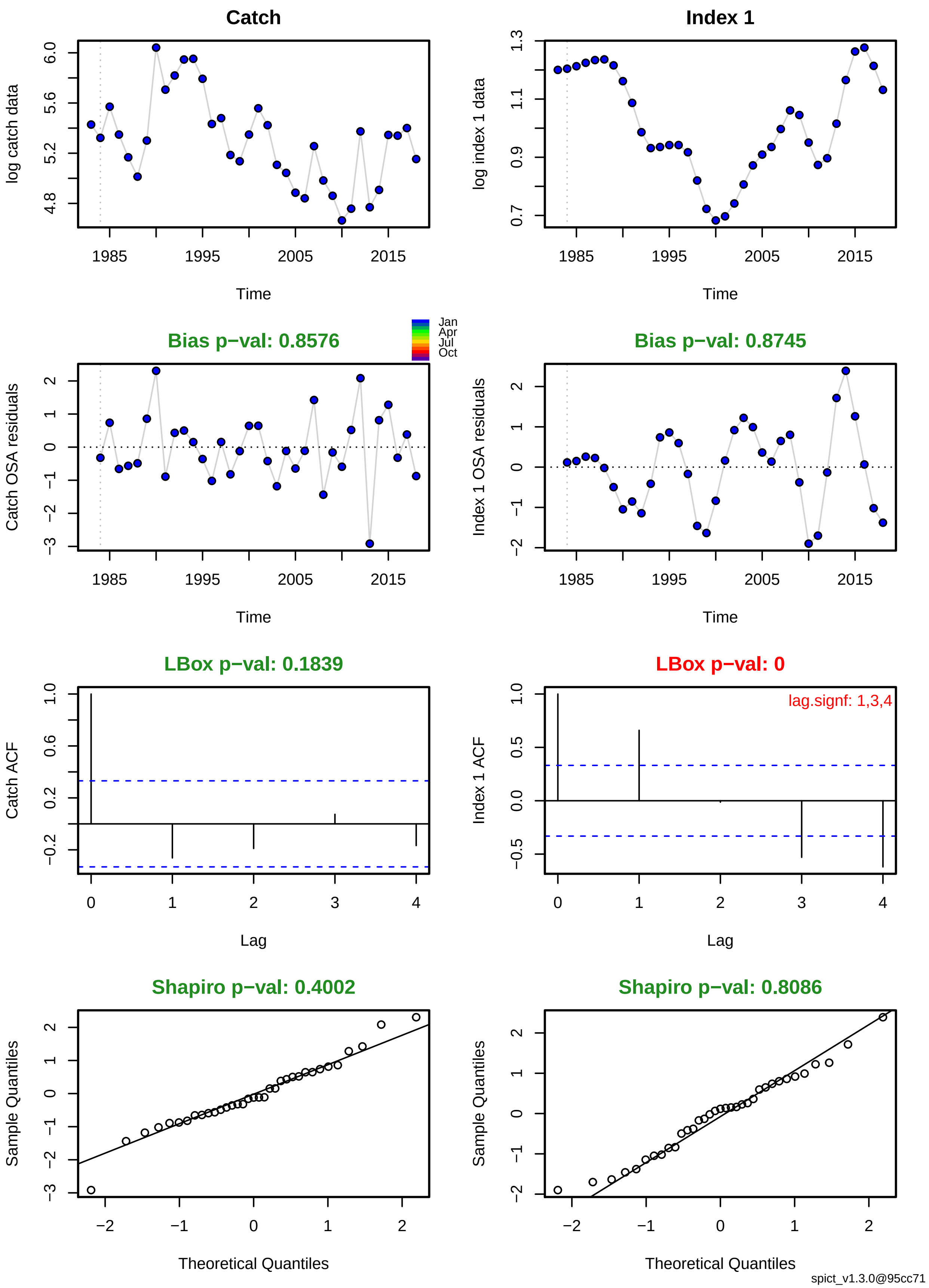
Delpetion level in the begin of the time series is around 0.2.

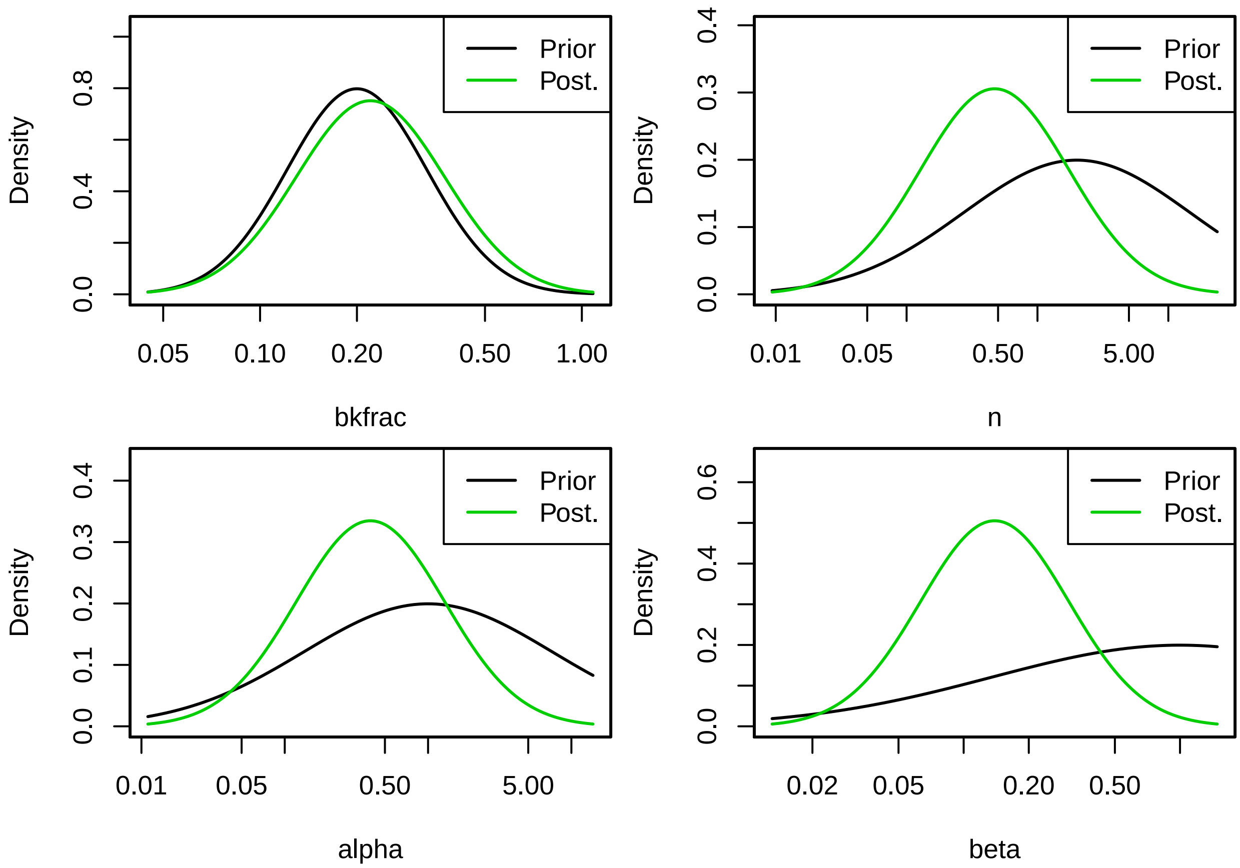


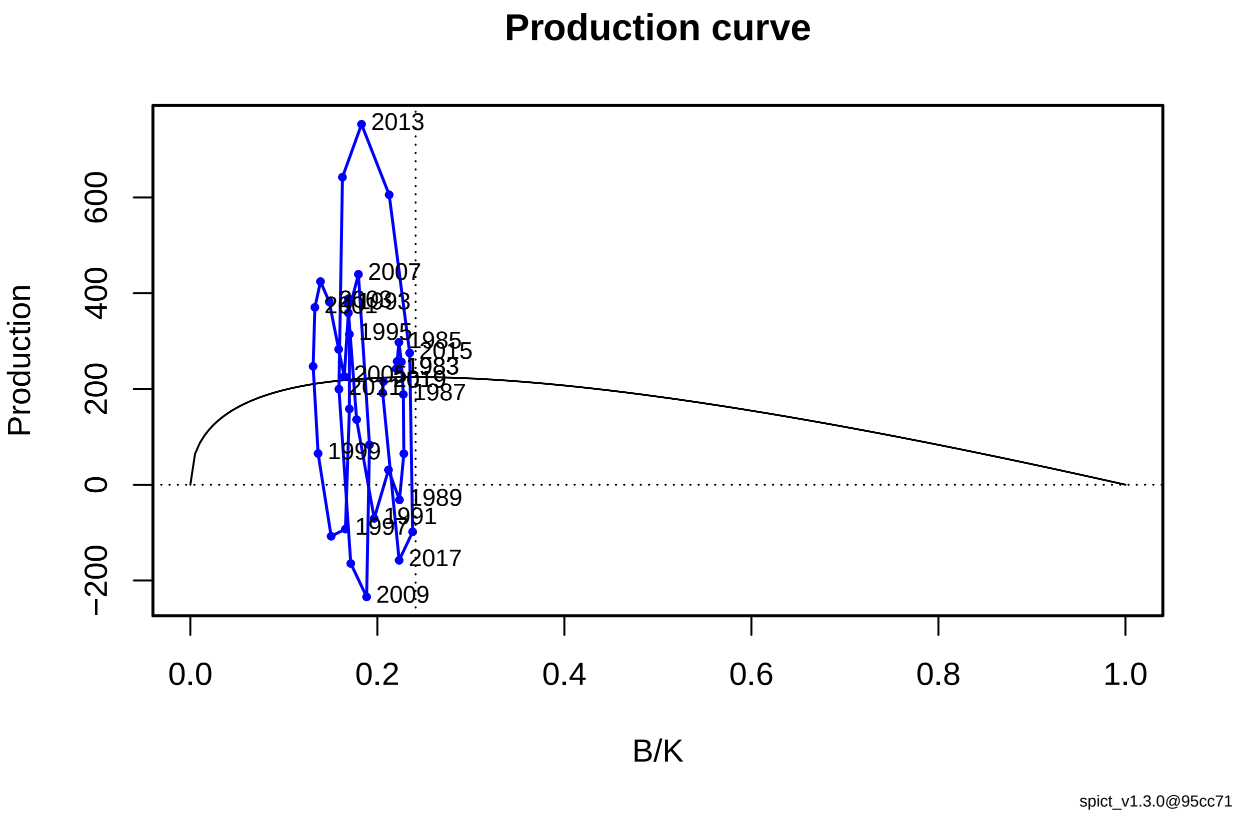

```
## Convergence: 0  MSG: relative convergence (4)
## Objective function at optimum: -28.3565828
## Euler time step (years):  1/16 or 0.0625
## Nobs C: 36,  Nobs I1: 36
##
## Priors
##  logbkfrac  ~  dnorm[log(0.2), 0.5^2]
##       logn  ~  dnorm[log(2), 2^2]
##   logalpha  ~  dnorm[log(1), 2^2]
##    logbeta  ~  dnorm[log(1), 2^2]
##
## Model parameter estimates w 95% CI
##             estimate        cilow        ciupp    log.est
##  alpha  3.960826e-01    0.0382951 4.096644e+00 -0.9261326
##  beta   1.391158e-01    0.0295977 6.538749e-01 -1.9724485
##  r      2.052810e-02    0.0032840 1.283216e-01 -3.8859620
##  rc     8.717360e-02    0.0094478 8.043391e-01 -2.4398538
##  rold   3.880320e-02    0.0010587 1.422189e+00 -3.2492519
##  m      2.248068e+02  145.0289172 3.484692e+02  5.4152414
##  K      2.140818e+04 4159.5290722 1.101832e+05  9.9715283
##  q      7.043000e-04    0.0002187 2.268300e-03 -7.2582765
##  n      4.709700e-01    0.0364562 6.084363e+00 -0.7529610
##  sdb    6.086170e-02    0.0478821 7.735970e-02 -2.7991514
```

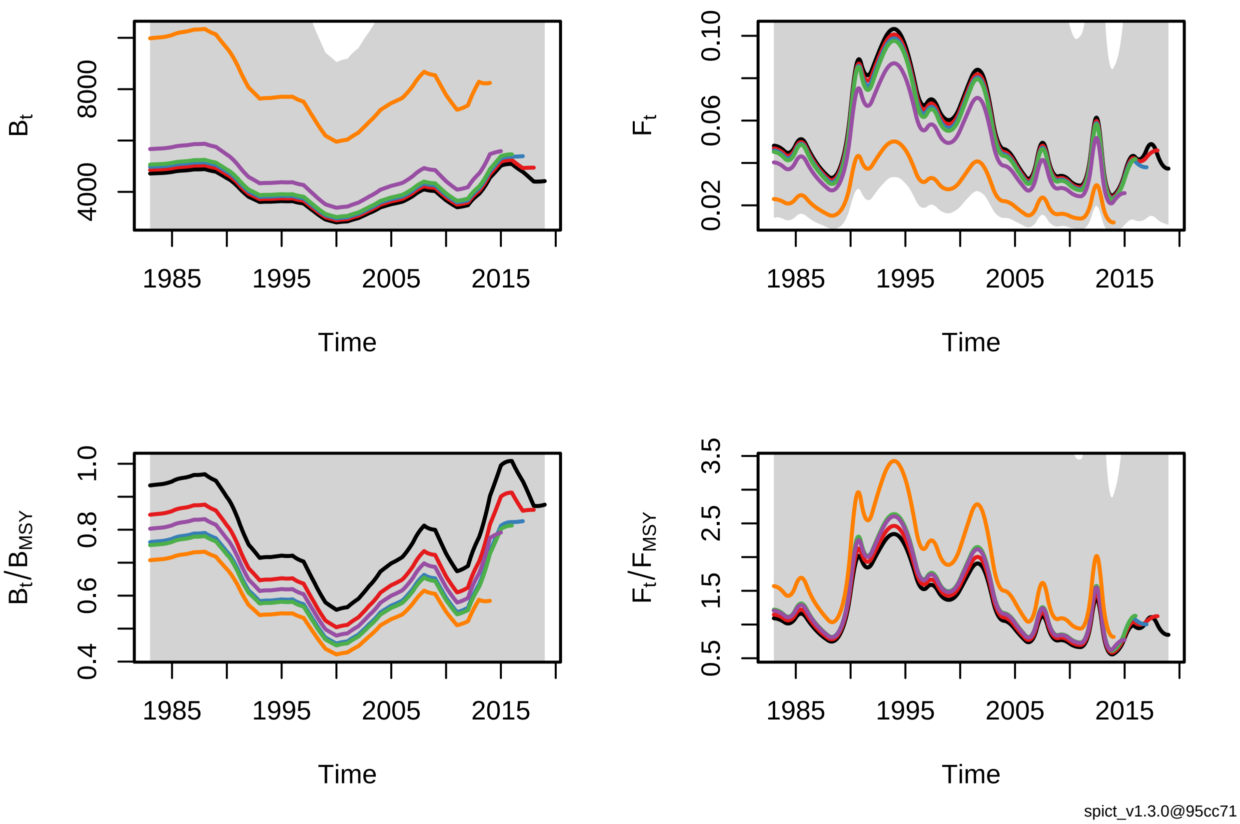
```
## sdf    3.314288e-01    0.2287087 4.802835e-01 -1.1043424
## sdi    2.410630e-02    0.0023197 2.505102e-01 -3.7252840
## sdc    4.610700e-02    0.0127603 1.665990e-01 -3.0767909
##
## Deterministic reference points (Drp)
##           estimate      cilow        ciupp   log.est
## Bmsyd 5157.6815106 450.8098238 5.900865e+04  8.548242
## Fmsyd    0.0435868   0.0047239 4.021695e-01 -3.133001
## MSYd   224.8068151 145.0289172 3.484692e+02  5.415241
## Stochastic reference points (Srp)
##           estimate     cilow        ciupp   log.est rel.diff.Drp
## Bmsys 5046.9814451 462.827957 5.503562e+04  8.526546  -0.02193392
## Fmsys    0.0440765   0.004808 4.040604e-01 -3.121830   0.01111031
## MSYs   222.5072530 146.698886 3.374905e+02  5.404960  -0.01033477
##
## States w 95% CI (inp$msytype: s)
##                    estimate        cilow        ciupp    log.est
## B_2018.94      4417.8076146 1374.5150443 1.419921e+04  8.3933988
## F_2018.94         0.0373322    0.0108960 1.279086e-01 -3.2878993
## B_2018.94/Bmsy    0.8753366    0.1440397 5.319466e+00 -0.1331468
## F_2018.94/Fmsy    0.8469872    0.1600756 4.481554e+00 -0.1660697
##
## Predictions w 95% CI (inp$msytype: s)
##                  prediction        cilow        ciupp    log.est
## B_2020.00      4470.5497903 1397.5489067 1.430062e+04  8.4052667
## F_2020.00         0.0373324    0.0091902 1.516516e-01 -3.2878948
## B_2020.00/Bmsy    0.8857868    0.1455335 5.391324e+00 -0.1212789
## F_2020.00/Fmsy    0.8469910    0.1406294 5.101307e+00 -0.1660652
## Catch_2019.00   165.9179422   97.7037483 2.817575e+02  5.1114933
## E(B_inf)       5919.6460648           NA           NA  8.6860319
```


Catch
Catch
Time
Relative biomass
B_t/B_{MSY}
Time
Relative fishing mortality
F_t/F_{MSY}
Time
B_t/B_{MSY}
F_t
$E(B_\infty)$
1988
2019
B_t


Catch
log catch data
Time
Index 1
log index 1 data
Bias p−val: 0.8576
Jan
Apr
Jul
Oct
Catch OSA residuals
Bias p−val: 0.8745
Index 1 OSA residuals
LBox p−val: 0.1839
Catch ACF
Lag
LBox p−val: 0
lag.signf: 1,3,4
Index 1 ACF
Shapiro p−val: 0.4002
Sample Quantiles
Theoretical Quantiles
Shapiro p−val: 0.8086
spict_v1.3.0@95cc71

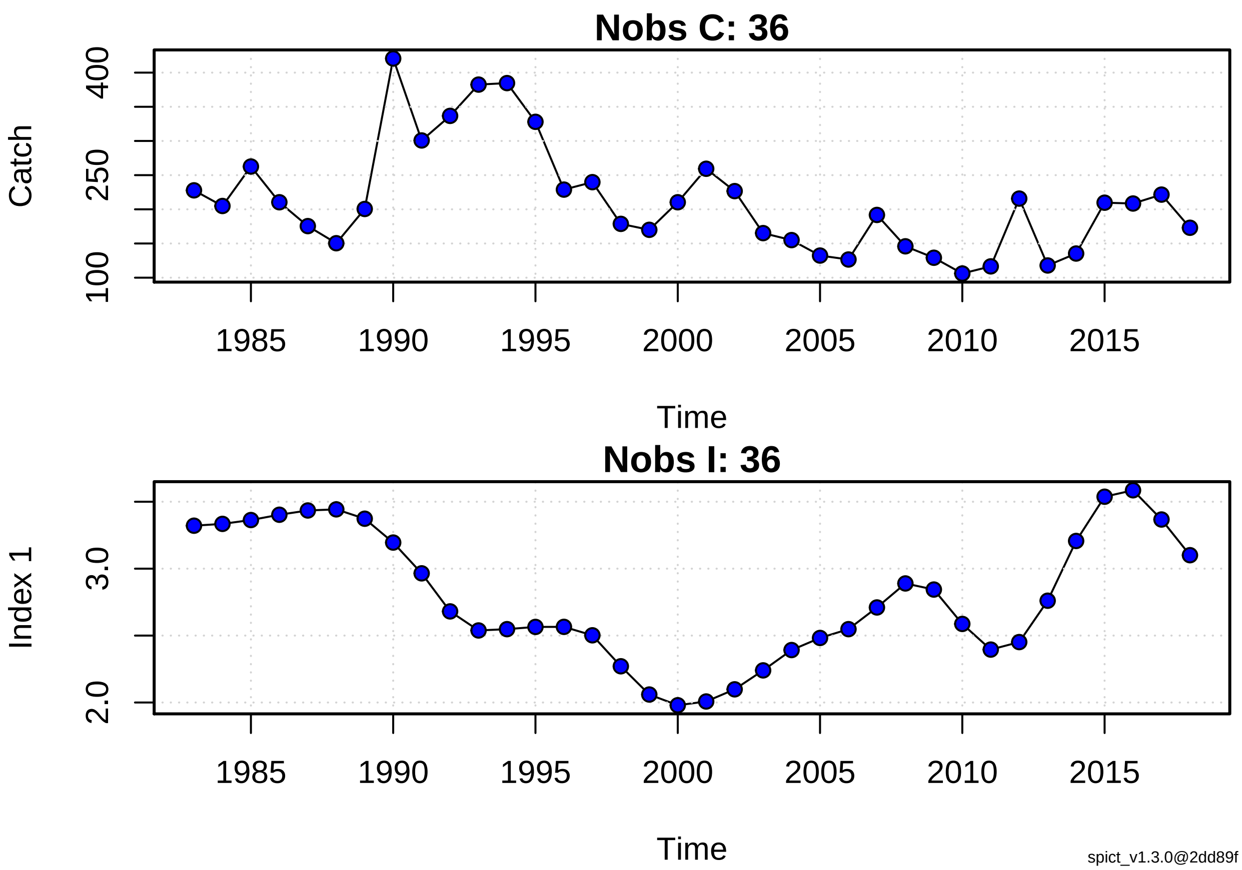

Prior
Post.
Density
0.0
0.4
0.8
0.05
0.10
0.20
0.50
1.00
bkfrac
Prior
Post.
Density
0.0
0.1
0.2
0.3
0.4
0.01
0.05
0.50
5.00
n
Prior
Post.
Density
0.0
0.1
0.2
0.3
0.4
0.01
0.05
0.50
5.00
alpha
Prior
Post.
Density
0.0
0.2
0.4
0.6
0.02
0.05
0.20
0.50
beta


Production curve
Production
B/K
2013
2007
1995
1985
2015
1983
1987
1999
1989
1991
1997
2017
2009
spict_v1.3.0@95cc71


B_t
4000
8000
1985
1995
2005
2015
Time
F_t
0.02
0.06
0.10
B_t/B_MSY
0.4
0.6
0.8
1.0
F_t/F_MSY
0.5
1.5
2.5
3.5
spict_v1.3.0@95cc71

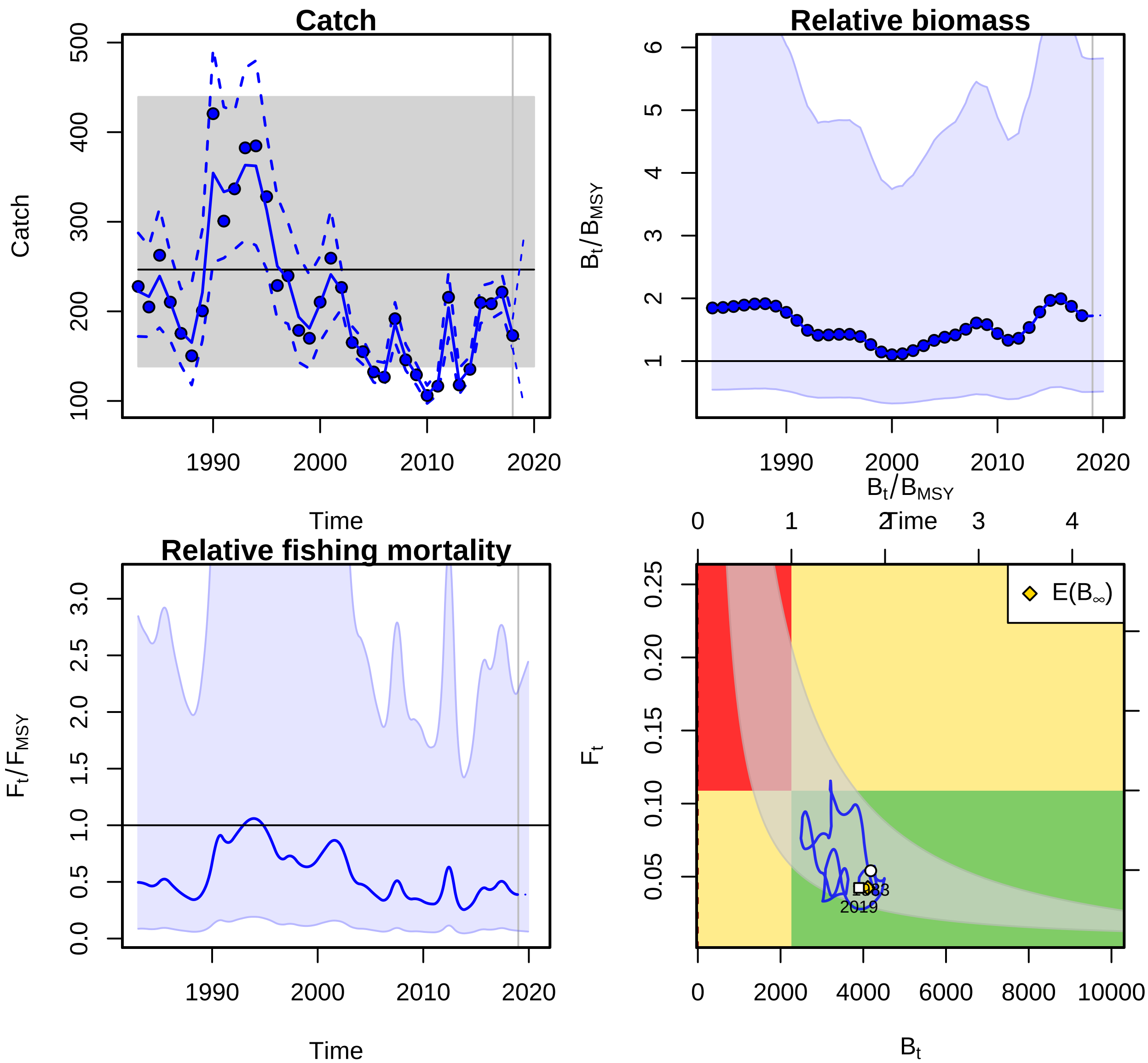
Scenario 2g

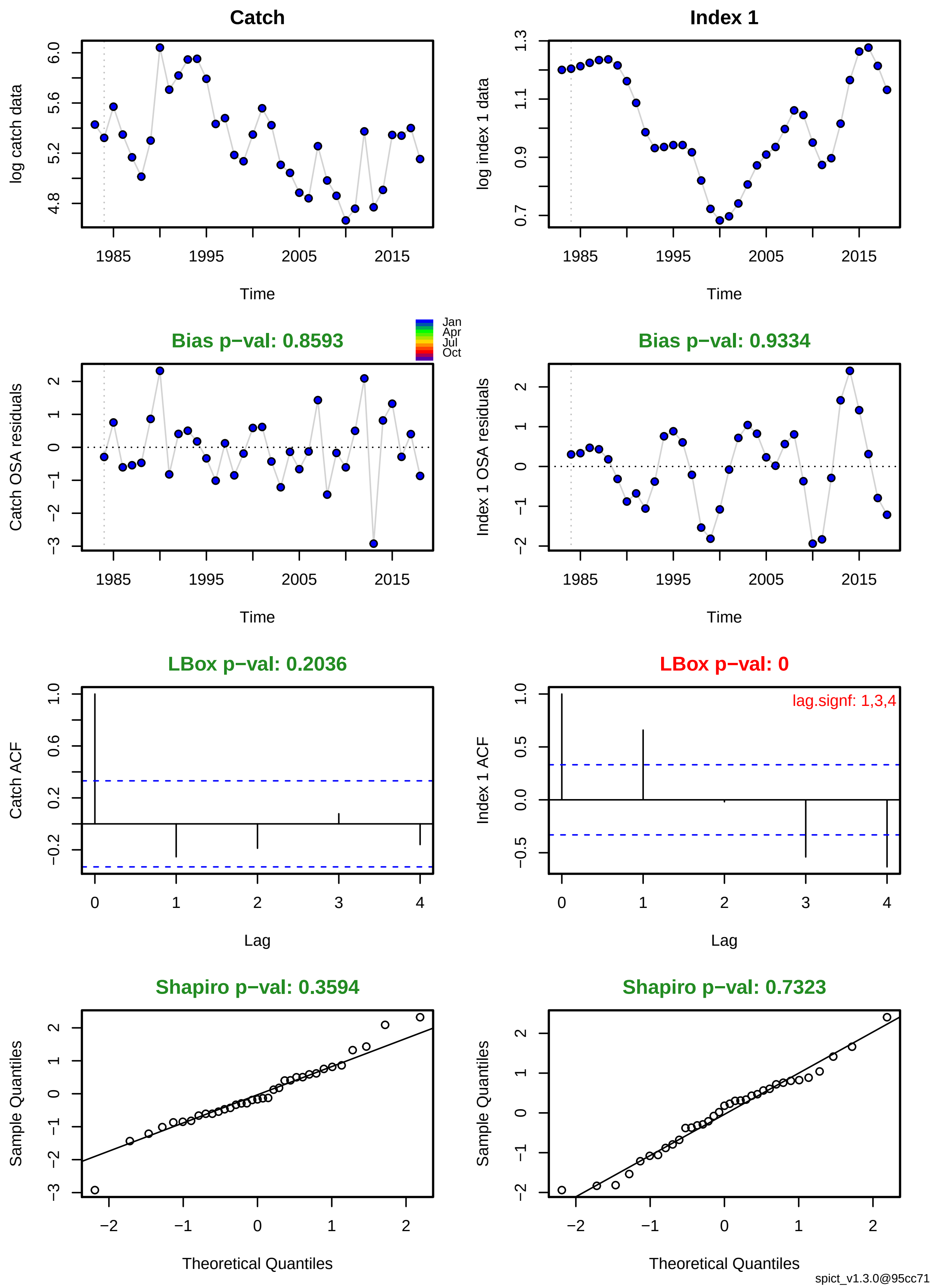
Depletion level in the

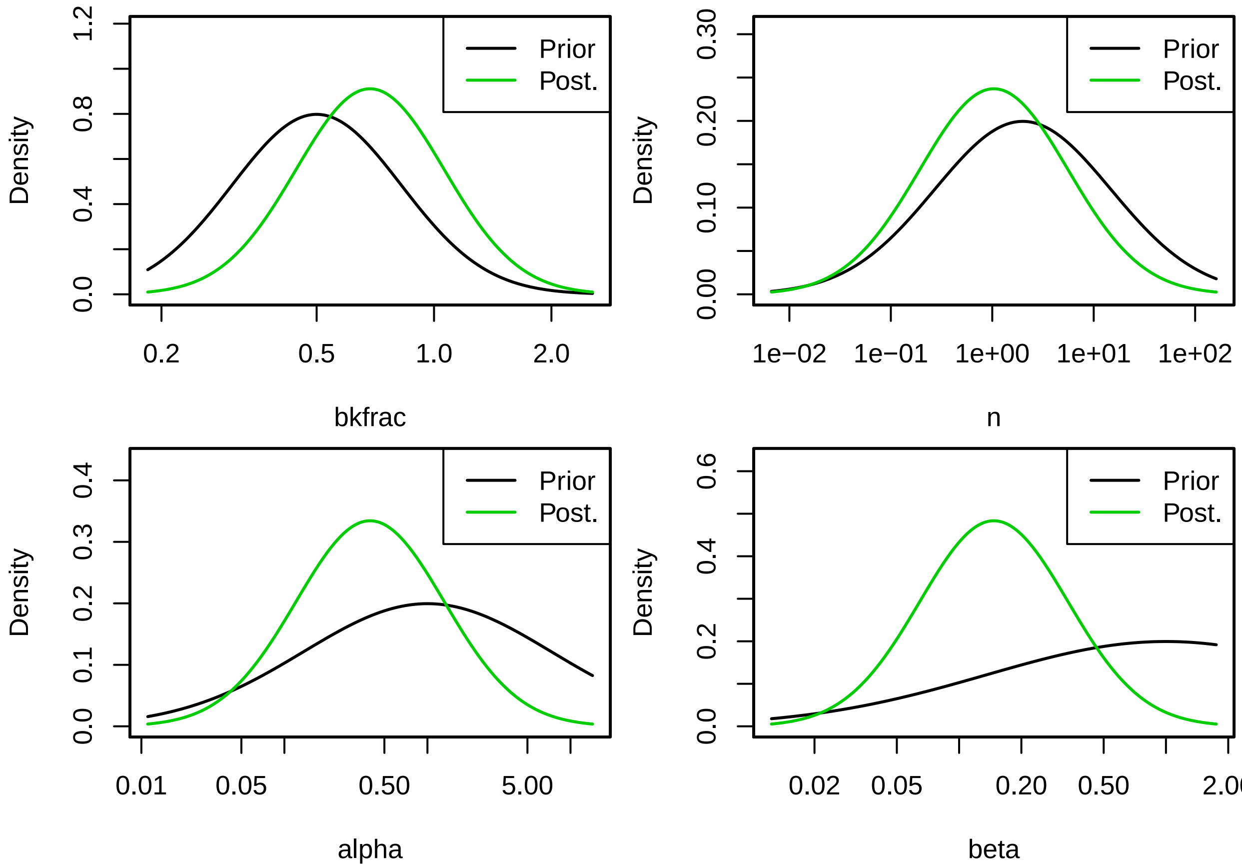


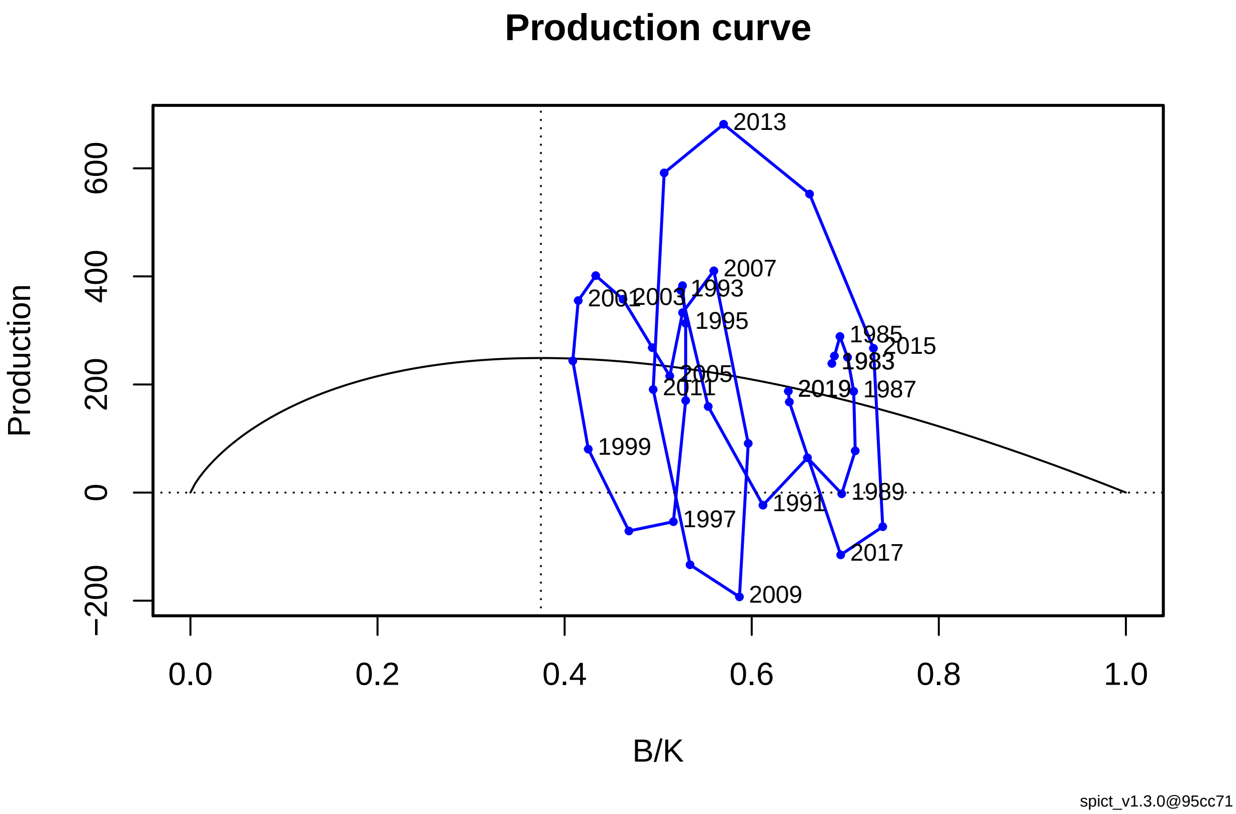

```
## Convergence: 0  MSG: relative convergence (4)
## Objective function at optimum: -29.1202582
## Euler time step (years):  1/16 or 0.0625
## Nobs C: 36,  Nobs I1: 36
##
## Priors
##  logbkfrac  ~  dnorm[log(0.5), 0.5^2]
##       logn  ~  dnorm[log(2), 2^2]
##   logalpha  ~  dnorm[log(1), 2^2]
##    logbeta  ~  dnorm[log(1), 2^2]
##
## Model parameter estimates w 95% CI
##             estimate        cilow        ciupp    log.est
##  alpha     0.3973881    0.0383206 4.120949e+00 -0.9228419
##  beta      0.1472770    0.0292248 7.421950e-01 -1.9154400
##  r         0.1130723    0.0098371 1.299708e+00 -2.1797278
##  rc        0.2180194    0.0359670 1.321556e+00 -1.5231713
##  rold      3.0340076    0.0000000 2.879859e+39  1.1098844
##  m       248.9531663  142.8379152 4.339022e+02  5.5172648
##  K      6096.0695321 1787.5411987 2.078949e+04  8.7153995
##  q         0.0007946    0.0002940 2.147300e-03 -7.1376593
##  n         1.0372683    0.0383226 2.807545e+01  0.0365906
##  sdb       0.0611045    0.0478289 7.806490e-02 -2.7951697
```

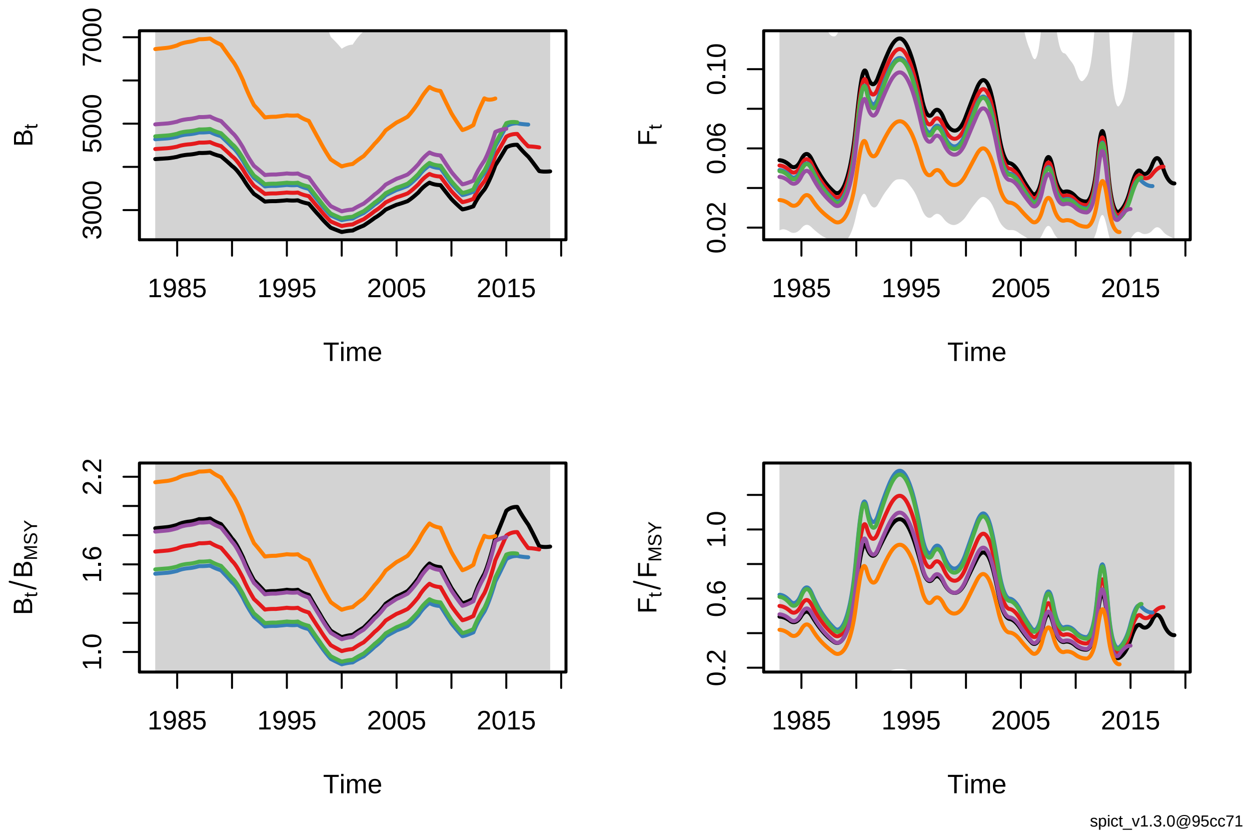
```
##  sdf       0.3278228    0.2212412 4.857496e-01 -1.1152820
##  sdi       0.0242822    0.0023297 2.530936e-01 -3.7180116
##  sdc       0.0482808    0.0128292 1.816978e-01 -3.0307219
##
## Deterministic reference points (Drp)
##            estimate       cilow        ciupp   log.est
##  Bmsyd 2283.7708650 507.7969054 10271.053857  7.733583
##  Fmsyd    0.1090097   0.0179835     0.660778 -2.216318
##  MSYd   248.9531663 142.8379152   433.902153  5.517265
## Stochastic reference points (Srp)
##           estimate       cilow        ciupp   log.est  rel.diff.Drp
##  Bmsys 2263.043382 511.1845969 1.001862e+04  7.724466 -0.0091591189
##  Fmsys    0.108975   0.0176087 6.744128e-01 -2.216637 -0.0003183793
##  MSYs   246.614486 138.4321282 4.393395e+02  5.507826 -0.0094831405
##
## States w 95% CI (inp$msytype: s)
##                     estimate        cilow        ciupp    log.est
##  B_2018.94      3894.8610394 1438.0445865 1.054901e+04  8.2674133
##  F_2018.94         0.0423122    0.0145191 1.233081e-01 -3.1626804
##  B_2018.94/Bmsy    1.7210722    0.5091702 5.817483e+00  0.5429475
##  F_2018.94/Fmsy    0.3882741    0.0692687 2.176406e+00 -0.9460438
##
## Predictions w 95% CI (inp$msytype: s)
##                   prediction        cilow        ciupp    log.est
##  B_2020.00      3918.6454118 1447.4580983 1.060879e+04  8.2735013
##  F_2020.00         0.0423123    0.0120254 1.488794e-01 -3.1626764
##  B_2020.00/Bmsy    1.7315821    0.5147494 5.824925e+00  0.5490355
##  F_2020.00/Fmsy    0.3882756    0.0612606 2.460929e+00 -0.9460399
##  Catch_2019.00   165.3135241   97.8846300 2.791915e+02  5.1078438
##  E(B_inf)       4108.9076252           NA           NA  8.3209125
```


Catch
Relative biomass
Relative fishing mortality
Catch
Time
B_t/B_{MSY}
F_t/F_{MSY}
F_t
B_t
E(B_∞)
2019


Catch
log catch data
Time
Index 1
log index 1 data
Bias p−val: 0.8593
Jan
Apr
Jul
Oct
Catch OSA residuals
Bias p−val: 0.9334
Index 1 OSA residuals
LBox p−val: 0.2036
Catch ACF
Lag
LBox p−val: 0
lag.signf: 1,3,4
Index 1 ACF
Shapiro p−val: 0.3594
Sample Quantiles
Theoretical Quantiles
Shapiro p−val: 0.7323
spict_v1.3.0@95cc71

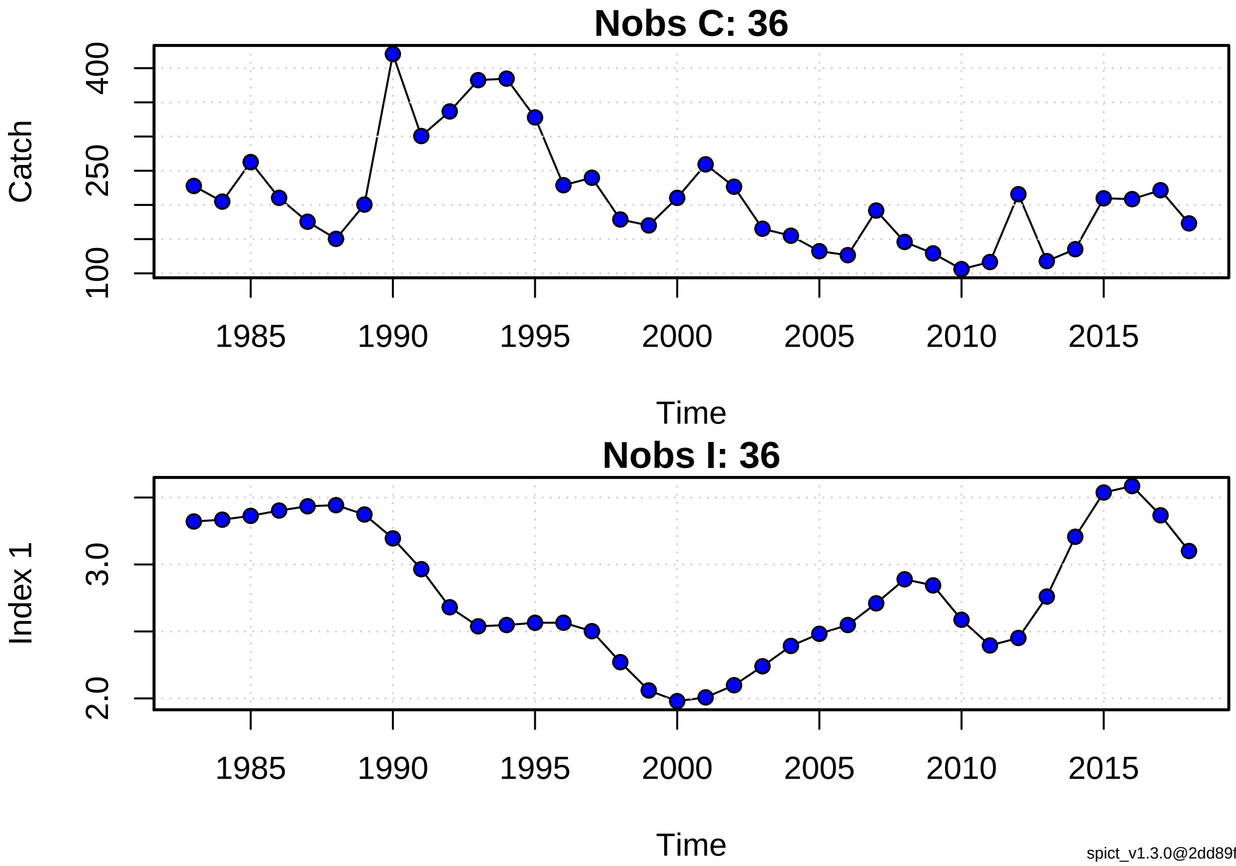

Density
bkfrac
n
alpha
beta
Prior
Post.
0.0
0.4
0.8
1.2
0.2
0.5
1.0
2.0
0.00
0.10
0.20
0.30
1e−02
1e−01
1e+00
1e+01
1e+02
0.1
0.2
0.3
0.01
0.05
0.50
5.00
0.6
0.02
0.20
2.00


Production curve
Production
B/K
600
400
200
0
−200
0.0
0.2
0.4
0.6
0.8
1.0
2013
2007
1993
2001
2003
1995
1985
2015
1983
2005
2011
2019
1987
1999
1991
1989
1997
2017
2009
spict_v1.3.0@95cc71


Bt
7000
5000
3000
1985
1995
2005
2015
Time
Ft
0.10
0.06
0.02
1985
1995
2005
2015
Time
Bt/BMSY
2.2
1.6
1.0
1985
1995
2005
2015
Time
Ft/FMSY
1.0
0.6
0.2
1985
1995
2005
2015
Time
spict_v1.3.0@95cc71

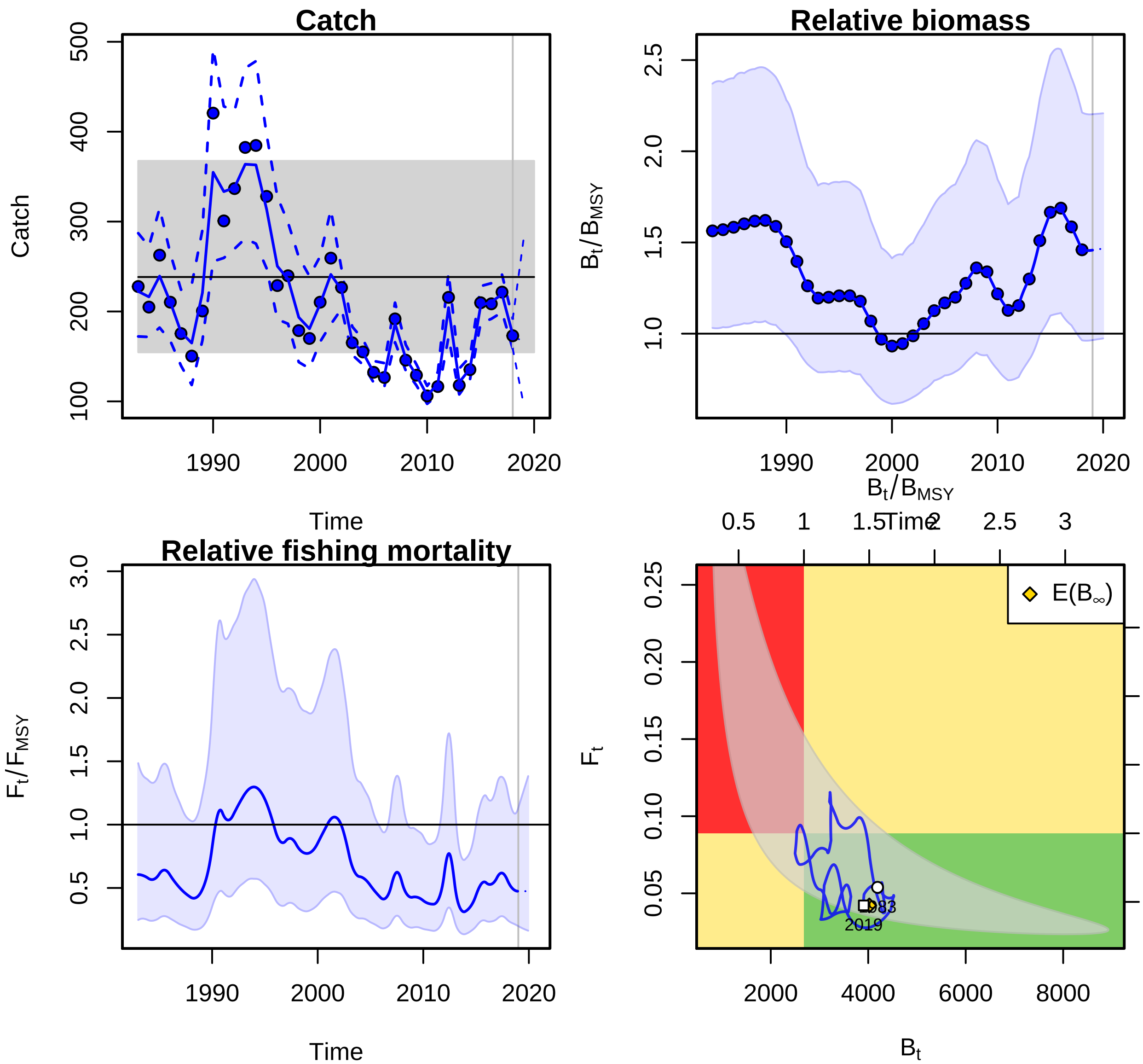
Scenario 2h

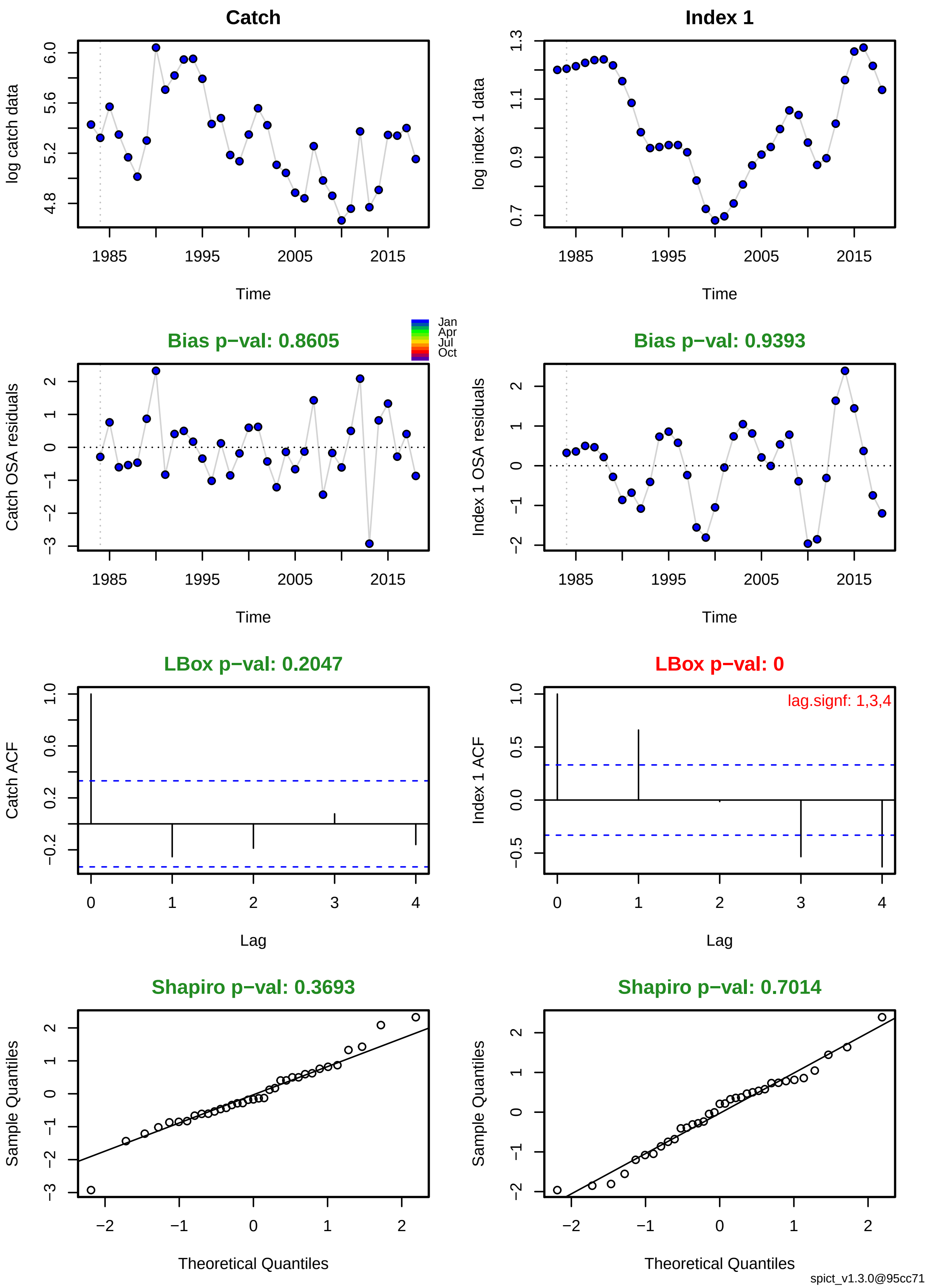
Depletion level in the beginning of the time series, default priors. Tighter prior around Shaefer.

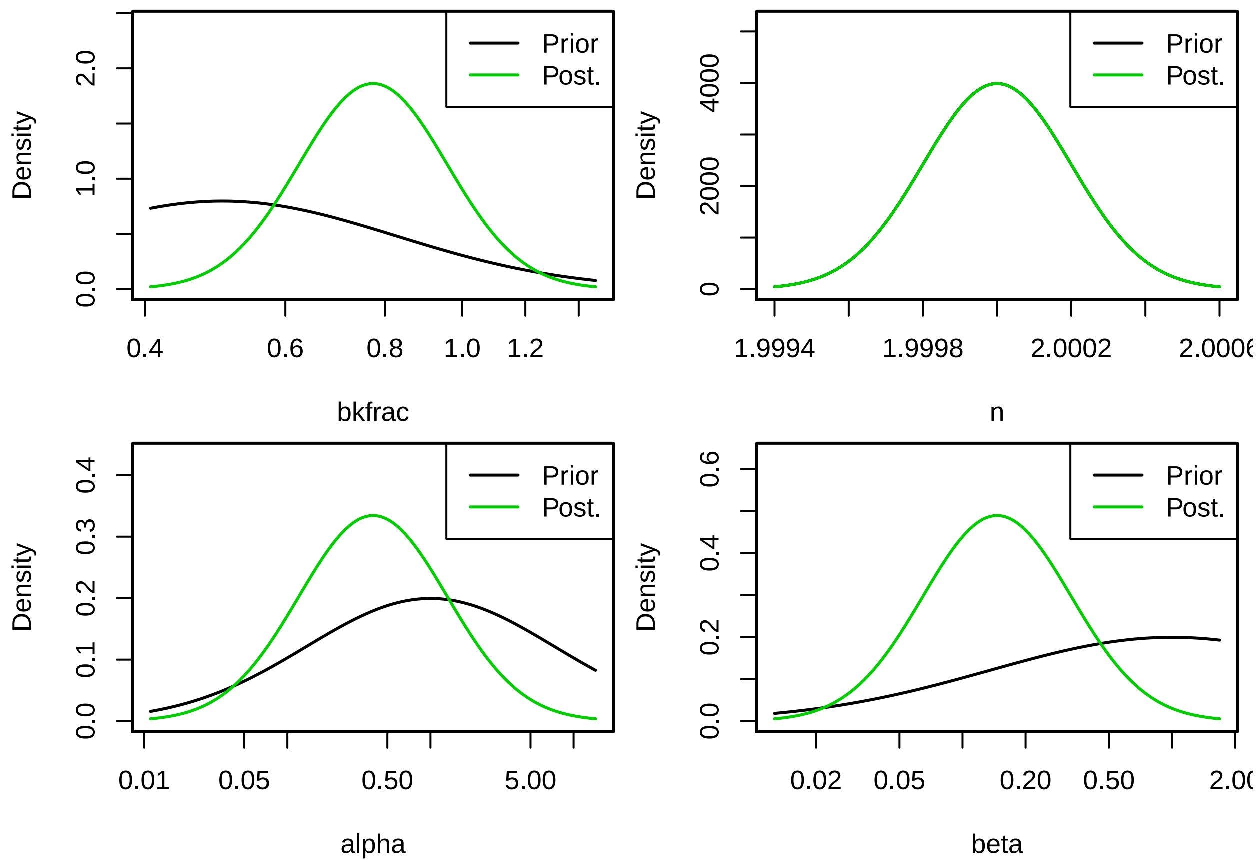


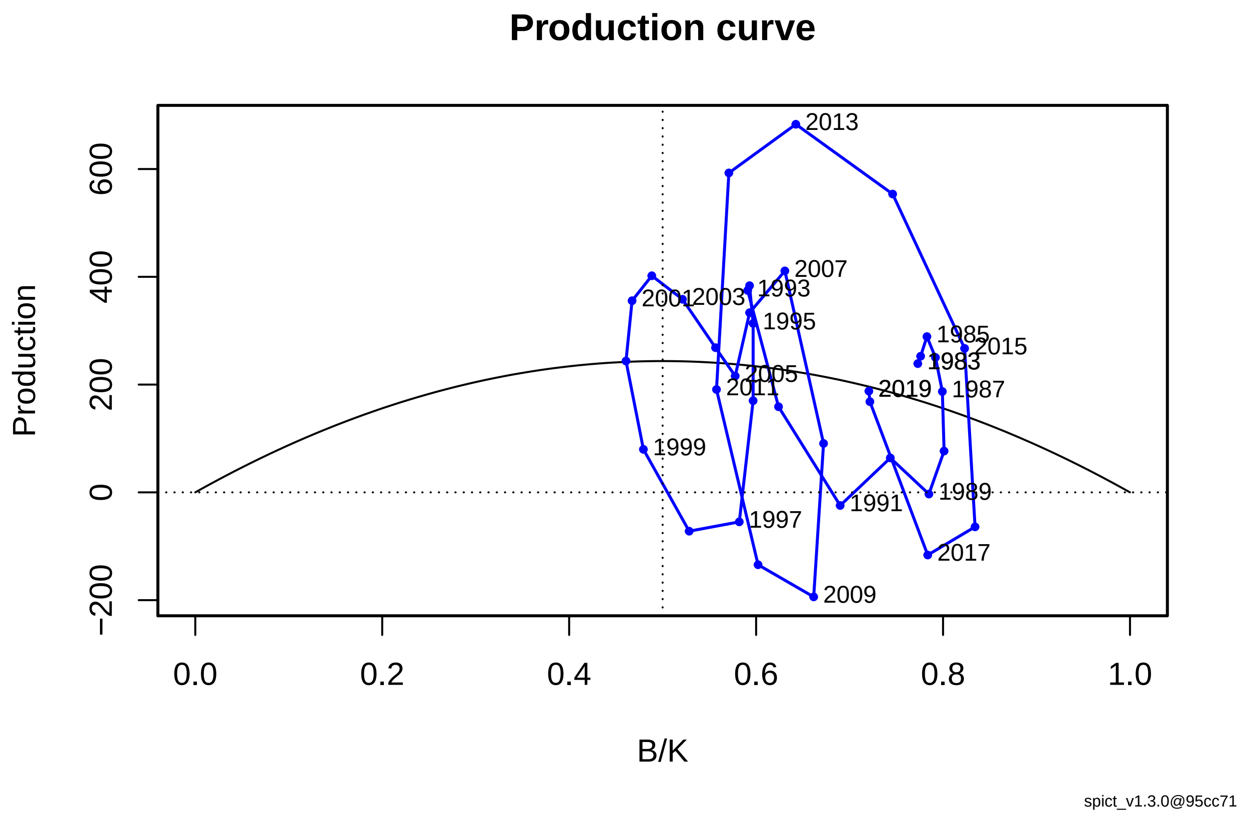

```
## Convergence: 0  MSG: relative convergence (4)
## Objective function at optimum: -38.9528922
## Euler time step (years):  1/16 or 0.0625
## Nobs C: 36,  Nobs I1: 36
##
## Priors
##  logbkfrac  ~  dnorm[log(0.5), 0.5^2]
##       logn  ~  dnorm[log(2), 0^2] (fixed)
##   logalpha  ~  dnorm[log(1), 2^2]
##    logbeta  ~  dnorm[log(1), 2^2]
##
## Model parameter estimates w 95% CI
##              estimate        cilow        ciupp    log.est
##  alpha     0.3971964    0.0383202 4.117020e+00 -0.9233244
##  beta      0.1462053    0.0295885 7.224433e-01 -1.9227436
##  r         0.1797061    0.0625221 5.165259e-01 -1.7164324
##  rc        0.1797061    0.0625221 5.165259e-01 -1.7164324
##  rold      0.1797061    0.0625221 5.165259e-01 -1.7164324
##  m       243.6422274  159.2116734 3.728466e+02  5.4957009
##  K      5423.1257916 2049.9445727 1.434687e+04  8.5984276
##  q         0.0007923    0.0002932 2.141000e-03 -7.1405111
##  n         2.0000000    1.9996080 2.000392e+00  0.6931472
##  sdb       0.0611774    0.0478567 7.820590e-02 -2.7939771
```

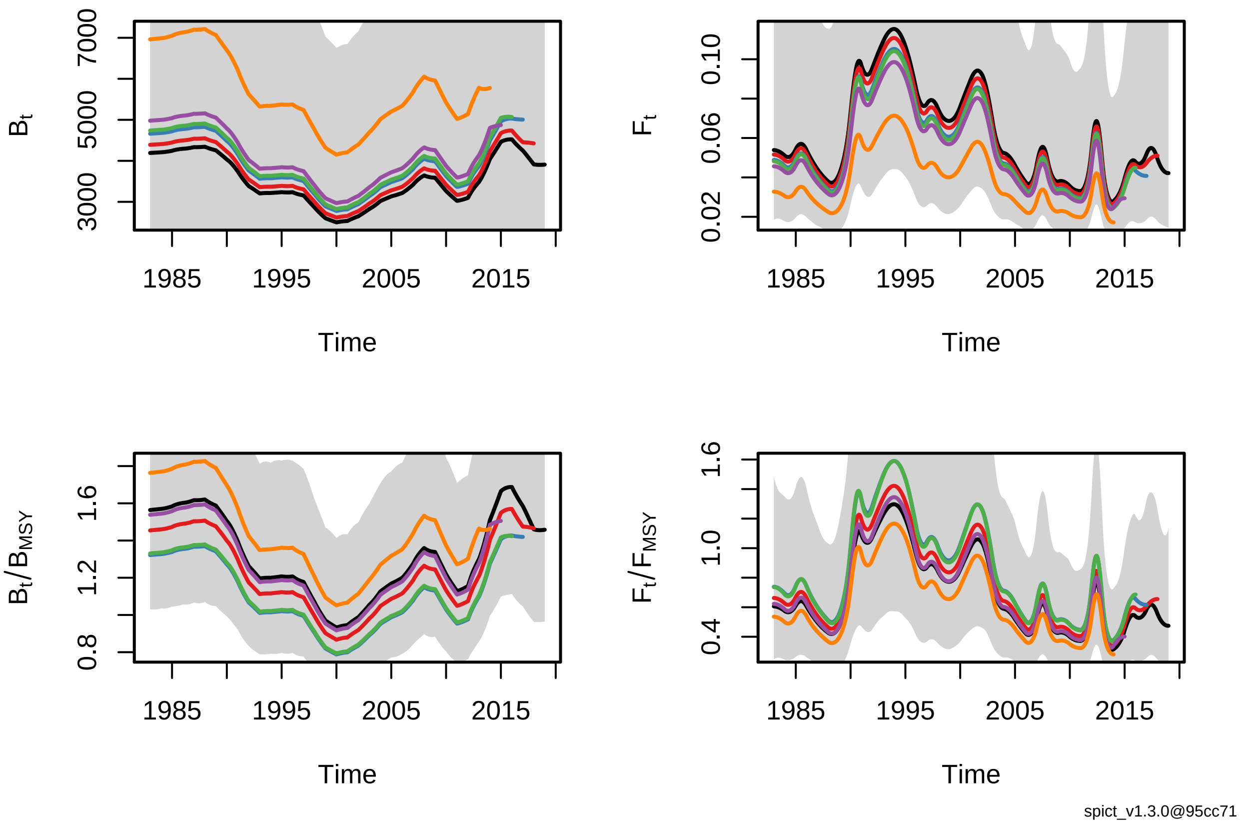
```
##  sdf       0.3282728    0.2225544 4.842097e-01 -1.1139105
##  sdi       0.0242995    0.0023323 2.531643e-01 -3.7173015
##  sdc       0.0479952    0.0129297 1.781592e-01 -3.0366540
##
## Deterministic reference points (Drp)
##            estimate        cilow        ciupp   log.est
##  Bmsyd 2711.5628934 1024.9722850 7173.4362310  7.905280
##  Fmsyd    0.0898531    0.0312611    0.2582629 -2.409580
##  MSYd   243.6422274  159.2116734  372.8466242  5.495701
## Stochastic reference points (Srp)
##            estimate        cilow        ciupp   log.est rel.diff.Drp
##  Bmsys 2680.6075558 1022.8762147 7024.9525456  7.893799  -0.01154788
##  Fmsys    0.0889195    0.0306196    0.2582228 -2.420024  -0.01049895
##  MSYs   238.3292839  154.5555299  367.5109367  5.473653  -0.02229245
##
## States w 95% CI (inp$msytype: s)
##                     estimate        cilow        ciupp    log.est
##  B_2018.94      3906.6622399 1444.8992183 1.056268e+04  8.2704386
##  F_2018.94         0.0421789    0.0144993 1.226996e-01 -3.1658351
##  B_2018.94/Bmsy    1.4573794    0.9643219 2.202537e+00  0.3766399
##  F_2018.94/Fmsy    0.4743495    0.2016879 1.115622e+00 -0.7458109
##
## Predictions w 95% CI (inp$msytype: s)
##                   prediction        cilow        ciupp    log.est
##  B_2020.00      3930.8715394 1456.9941401 1.060523e+04  8.2766164
##  F_2020.00         0.0421791    0.0120000 1.482556e-01 -3.1658311
##  B_2020.00/Bmsy    1.4664107    0.9738873 2.208018e+00  0.3828177
##  F_2020.00/Fmsy    0.4743514    0.1607261 1.399955e+00 -0.7458069
##  Catch_2019.00   165.3015242   97.8342564 2.792947e+02  5.1077712
##  E(B_inf)       4022.7607310           NA           NA  8.2997237
```


Catch
Relative biomass
Relative fishing mortality
Catch
Time
B_t/B_{MSY}
F_t/F_{MSY}
F_t
B_t
E(B∞)
1983
2019


Catch
log catch data
Time
Index 1
log index 1 data
Bias p−val: 0.8605
Jan
Apr
Jul
Oct
Catch OSA residuals
Bias p−val: 0.9393
Index 1 OSA residuals
LBox p−val: 0.2047
Catch ACF
Lag
LBox p−val: 0
lag.signf: 1,3,4
Index 1 ACF
Shapiro p−val: 0.3693
Sample Quantiles
Theoretical Quantiles
Shapiro p−val: 0.7014
spict_v1.3.0@95cc71


Prior
Post.
Density
0.0
1.0
2.0
0.4
0.6
0.8
1.0
1.2
bkfrac
Prior
Post.
Density
0
2000
4000
1.9994
1.9998
2.0002
2.0006
n
Prior
Post.
Density
0.0
0.1
0.2
0.3
0.4
0.01
0.05
0.50
5.00
alpha
Prior
Post.
Density
0.0
0.2
0.4
0.6
0.02
0.05
0.20
0.50
beta


Production curve
Production
600
400
200
0
−200
0.0
0.2
0.4
0.6
0.8
1.0
B/K
2013
2007
1993
20012003
1995
1985
2015
1983
2005
2011
2019
1987
1999
1989
1991
1997
2017
2009
spict_v1.3.0@95cc71


B_t
3000
5000
7000
1985
1995
2005
2015
Time
F_t
0.02
0.06
0.10
1985
1995
2005
2015
Time
B_t/B_MSY
0.8
1.2
1.6
1985
1995
2005
2015
Time
F_t/F_MSY
0.4
1.0
1.6
1985
1995
2005
2015
Time
spict_v1.3.0@95cc71

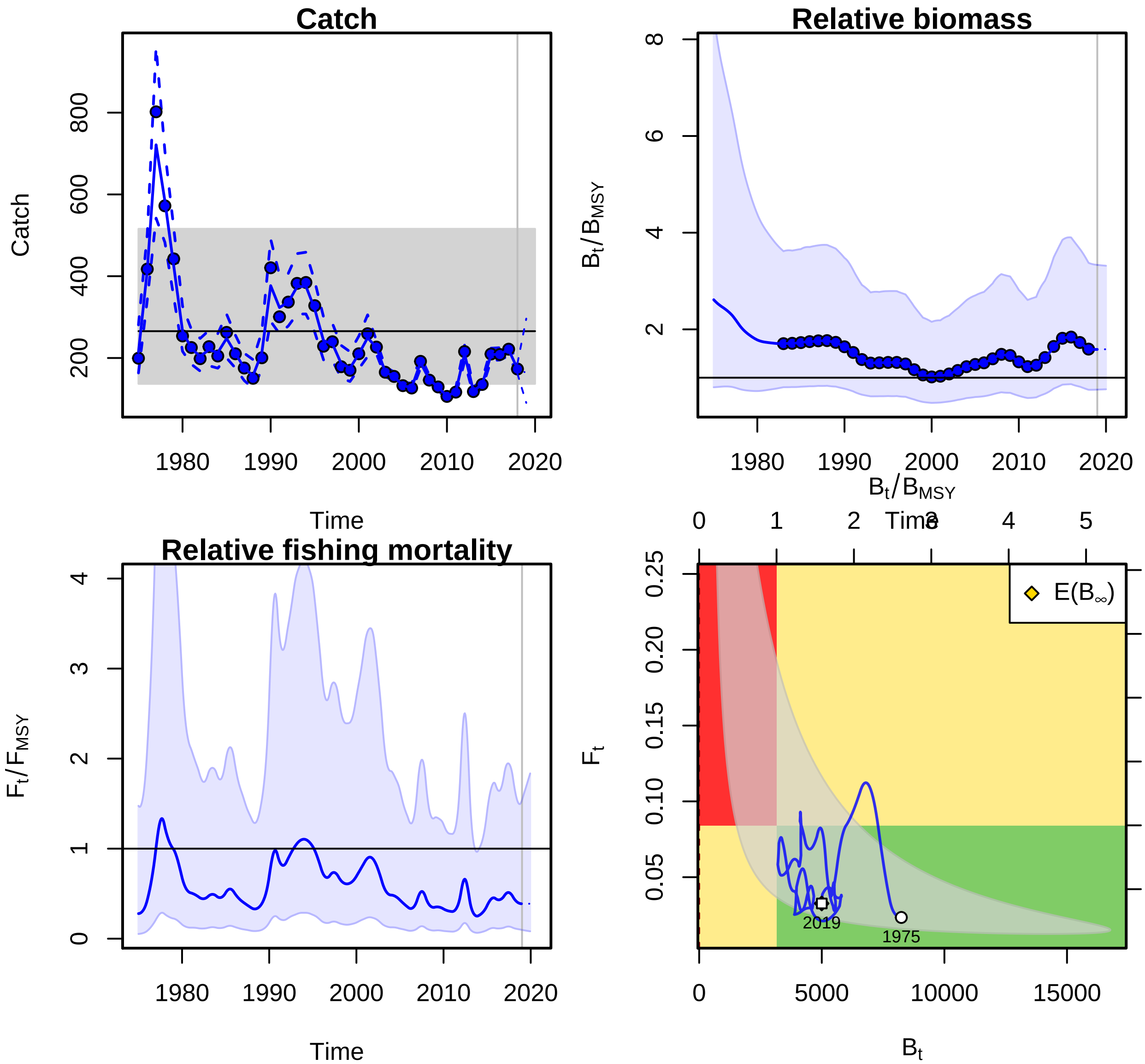
Scenario 3

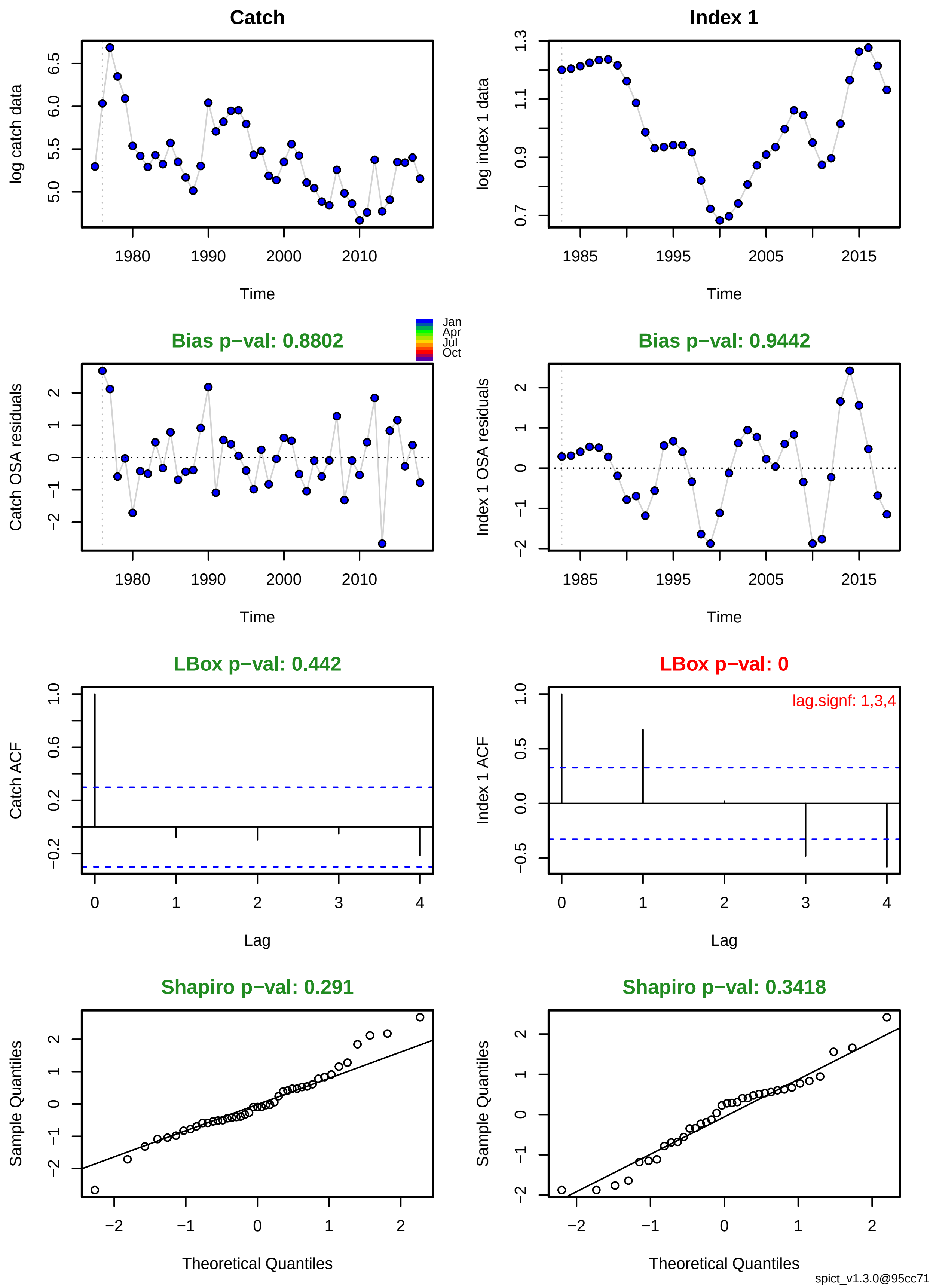
Scenario 3a

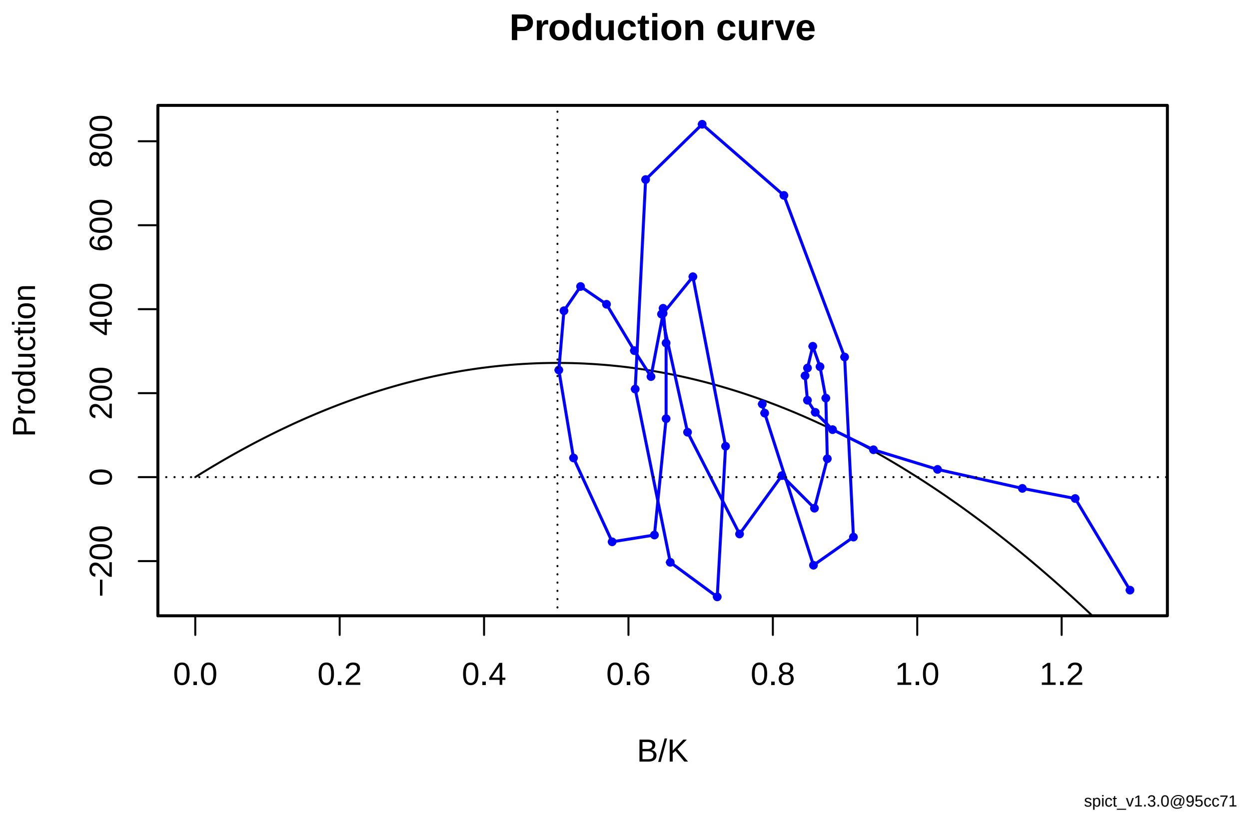
Default priors, catch series back to 1975.

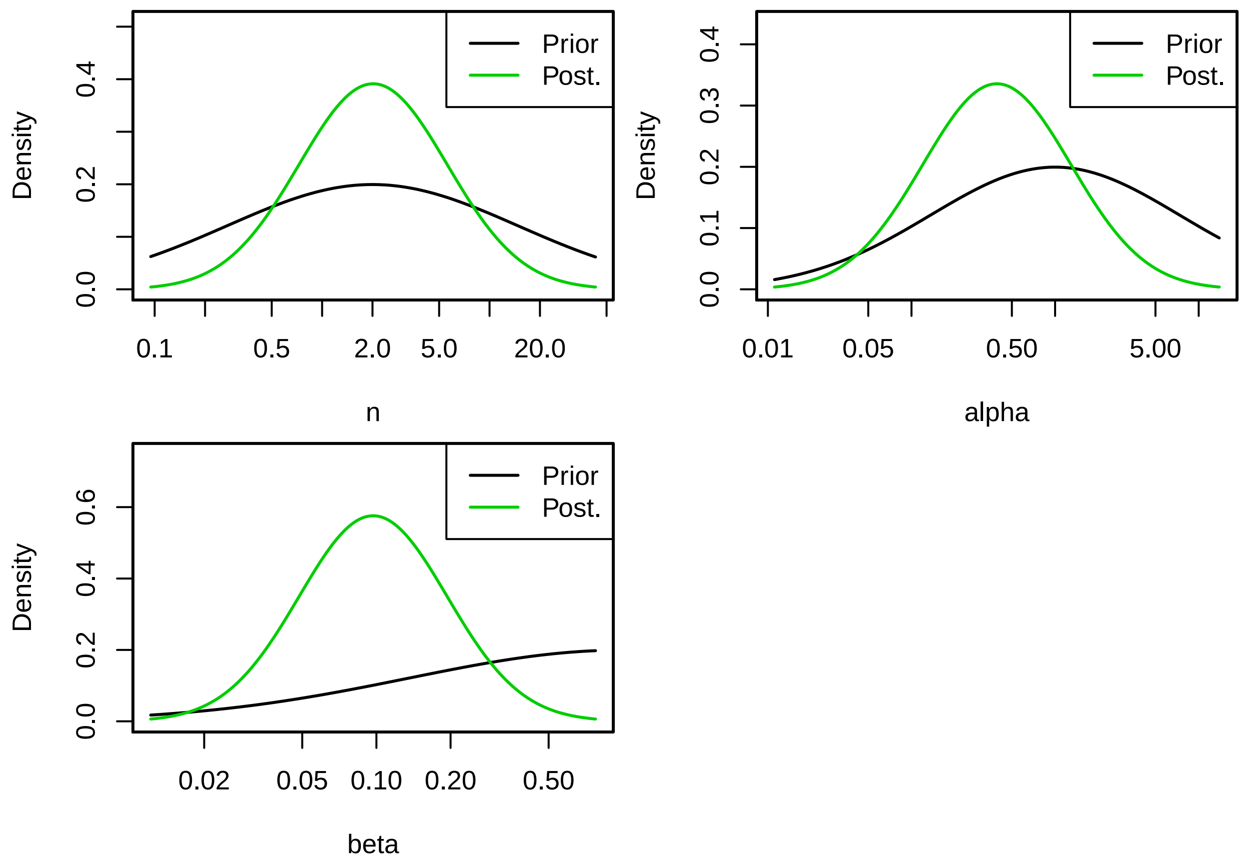
```
## Convergence: 0  MSG: relative convergence (4)
## Objective function at optimum: -21.9247563
## Euler time step (years):  1/16 or 0.0625
## Nobs C: 44,  Nobs I1: 36
##
## Priors
##      logn  ~  dnorm[log(2), 2^2]
##  logalpha  ~  dnorm[log(1), 2^2]
##   logbeta  ~  dnorm[log(1), 2^2]
##
## Model parameter estimates w 95% CI
##             estimate        cilow        ciupp    log.est
##  alpha     0.3931838    0.0382586 4.040747e+00 -0.9334781
##  beta      0.0969748    0.0249423 3.770339e-01 -2.3333042
##  r         0.1717543    0.0587834 5.018345e-01 -1.7616902
##  rc        0.1702991    0.0392276 7.393202e-01 -1.7701991
##  rold      0.1688683    0.0061909 4.606164e+00 -1.7786363
##  m       271.9886732  144.8906245 5.105771e+02  5.6057604
##  K      6367.5666720 2481.6073107 1.633857e+04  8.7589727
##  q         0.0006176    0.0001894 2.013500e-03 -7.3897359
##  n         2.0170905    0.2734809 1.487729e+01  0.7016561
##  sdb       0.0615997    0.0483383 7.849950e-02 -2.7870976
##  sdf       0.3775630    0.2843025 5.014161e-01 -0.9740177
##  sdi       0.0242200    0.0023446 2.501940e-01 -3.7205757
##  sdc       0.0366141    0.0110745 1.210518e-01 -3.3073219
##
## Deterministic reference points (Drp)
##            estimate       cilow        ciupp   log.est
##  Bmsyd 3194.2471529 825.4440500 1.236088e+04  8.069107
##  Fmsyd    0.0851495   0.0196138 3.696601e-01 -2.463346
##  MSYd   271.9886732 144.8906245 5.105771e+02  5.605760
## Stochastic reference points (Srp)
##            estimate       cilow        ciupp   log.est rel.diff.Drp
##  Bmsys 3155.3972265 828.2818630 1.202070e+04  8.056870  -0.01231221
##  Fmsys    0.0841866   0.0183613 3.859951e-01 -2.474719  -0.01143815
##  MSYs   265.6047616 136.7403491 5.159113e+02  5.582009  -0.02403538
##
## States w 95% CI (inp$msytype: s)
##                    estimate        cilow        ciupp    log.est
##  B_2018.94      5000.1402615 1538.5414180 1.625007e+04  8.5172212
##  F_2018.94         0.0326669    0.0094063 1.134477e-01 -3.4213927
##  B_2018.94/Bmsy    1.5846310    0.7532257 3.333736e+00  0.4603516
##  F_2018.94/Fmsy    0.3880298    0.0989307 1.521945e+00 -0.9466732
##
## Predictions w 95% CI (inp$msytype: s)
##                  prediction        cilow        ciupp    log.est
##  B_2020.00      5011.3193664 1551.2745489 1.618883e+04  8.5194545
##  F_2020.00         0.0326671    0.0075859 1.406735e-01 -3.4213876
##  B_2020.00/Bmsy    1.5881739    0.7608131 3.315264e+00  0.4625848
```

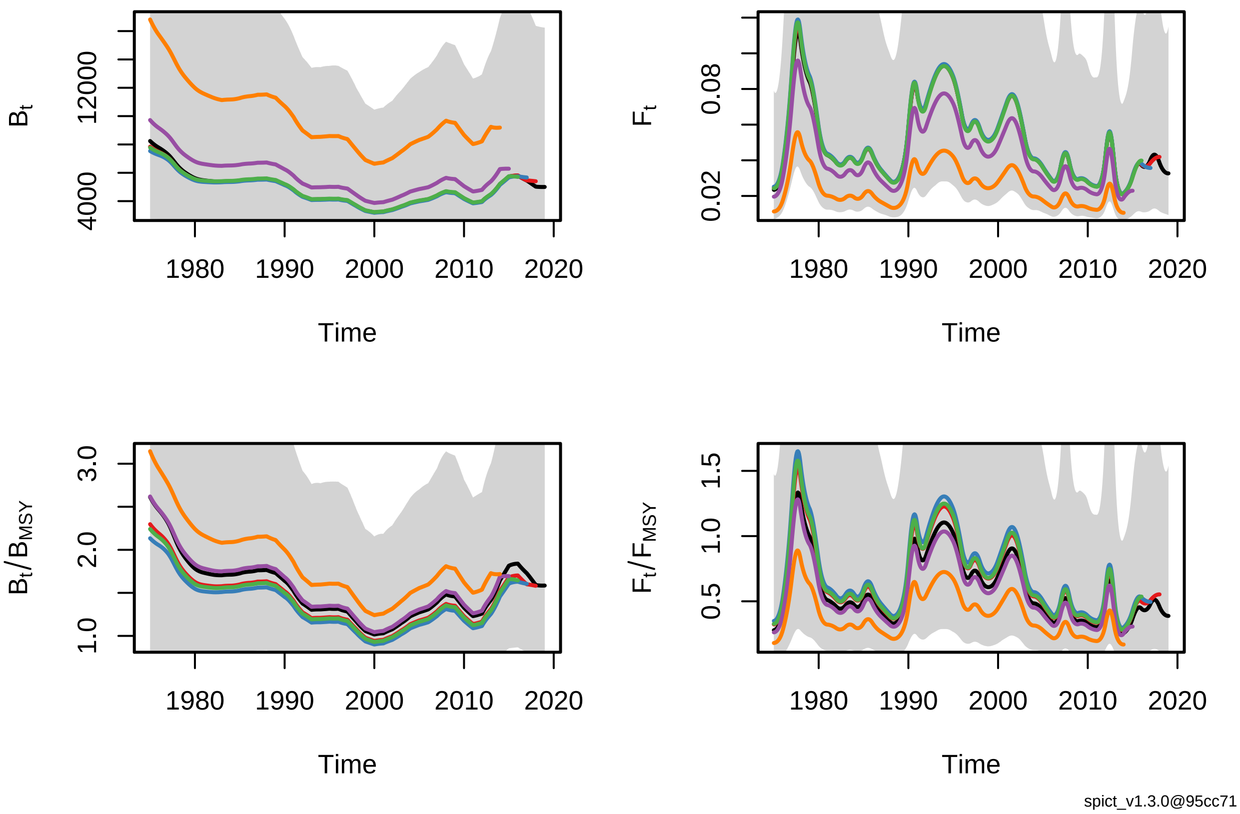
```
## F_2020.00/Fmsy     0.3880318    0.0811226 1.856064e+00 -0.9466681
## Catch_2019.00    163.5266659   90.2723693 2.962254e+02  5.0969761
## E(B_inf)        4996.4347901           NA           NA  8.5164799
```




Catch
log catch data
Time
Index 1
log index 1 data
Bias p−val: 0.8802
Jan
Apr
Jul
Oct
Catch OSA residuals
Bias p−val: 0.9442
Index 1 OSA residuals
LBox p−val: 0.442
Catch ACF
Lag
LBox p−val: 0
lag.signf: 1,3,4
Index 1 ACF
Shapiro p−val: 0.291
Sample Quantiles
Theoretical Quantiles
Shapiro p−val: 0.3418
spict_v1.3.0@95cc71


Production curve
Production
800
600
400
200
0
−200
0.0
0.2
0.4
0.6
0.8
1.0
1.2
B/K
spict_v1.3.0@95cc71


Prior
Post.
Density
0.0
0.2
0.4
0.1
0.5
2.0
5.0
20.0
n
Prior
Post.
Density
0.0
0.1
0.2
0.3
0.4
0.01
0.05
0.50
5.00
alpha
Prior
Post.
Density
0.0
0.2
0.4
0.6
0.02
0.05
0.10
0.20
0.50
beta

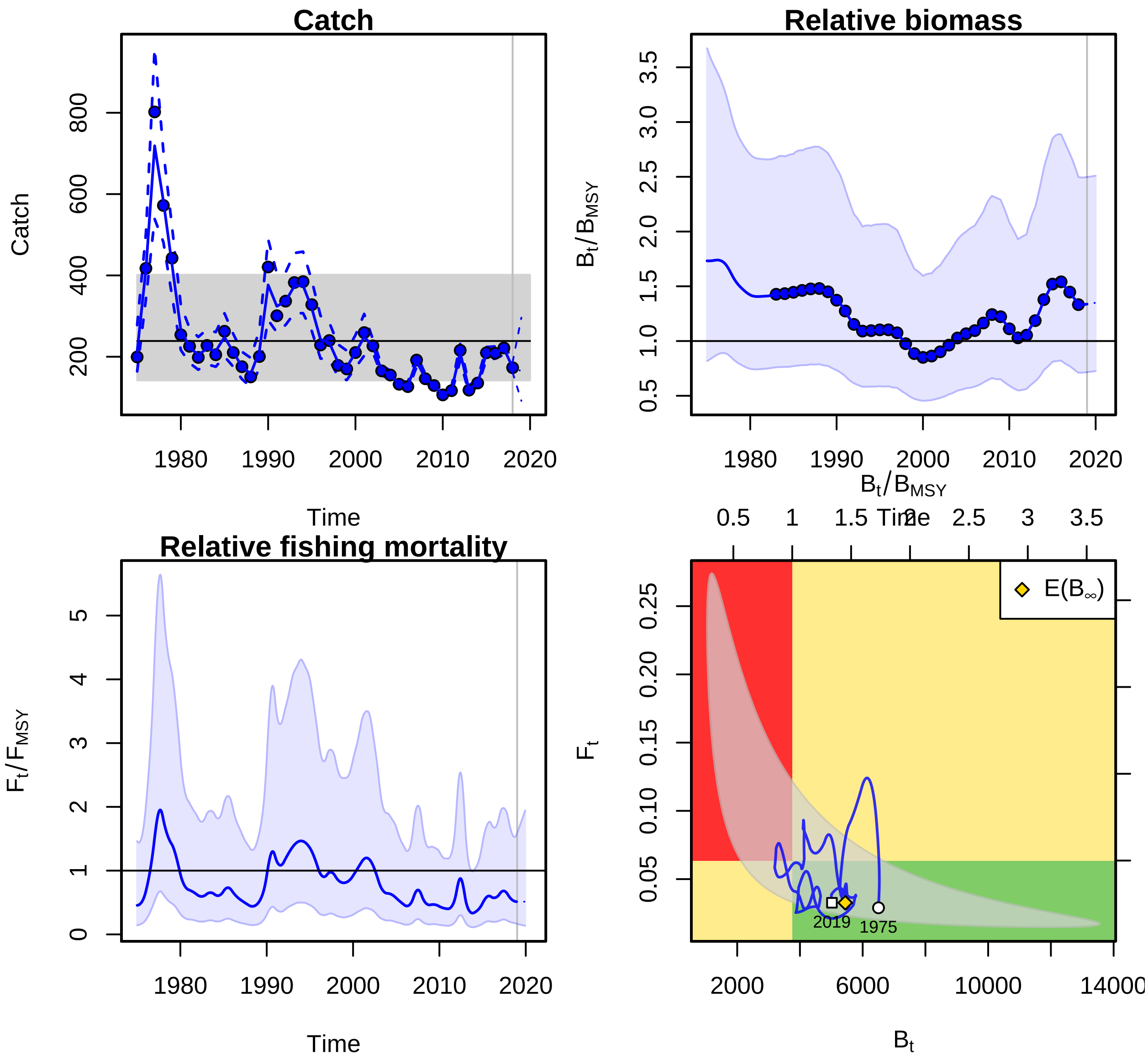


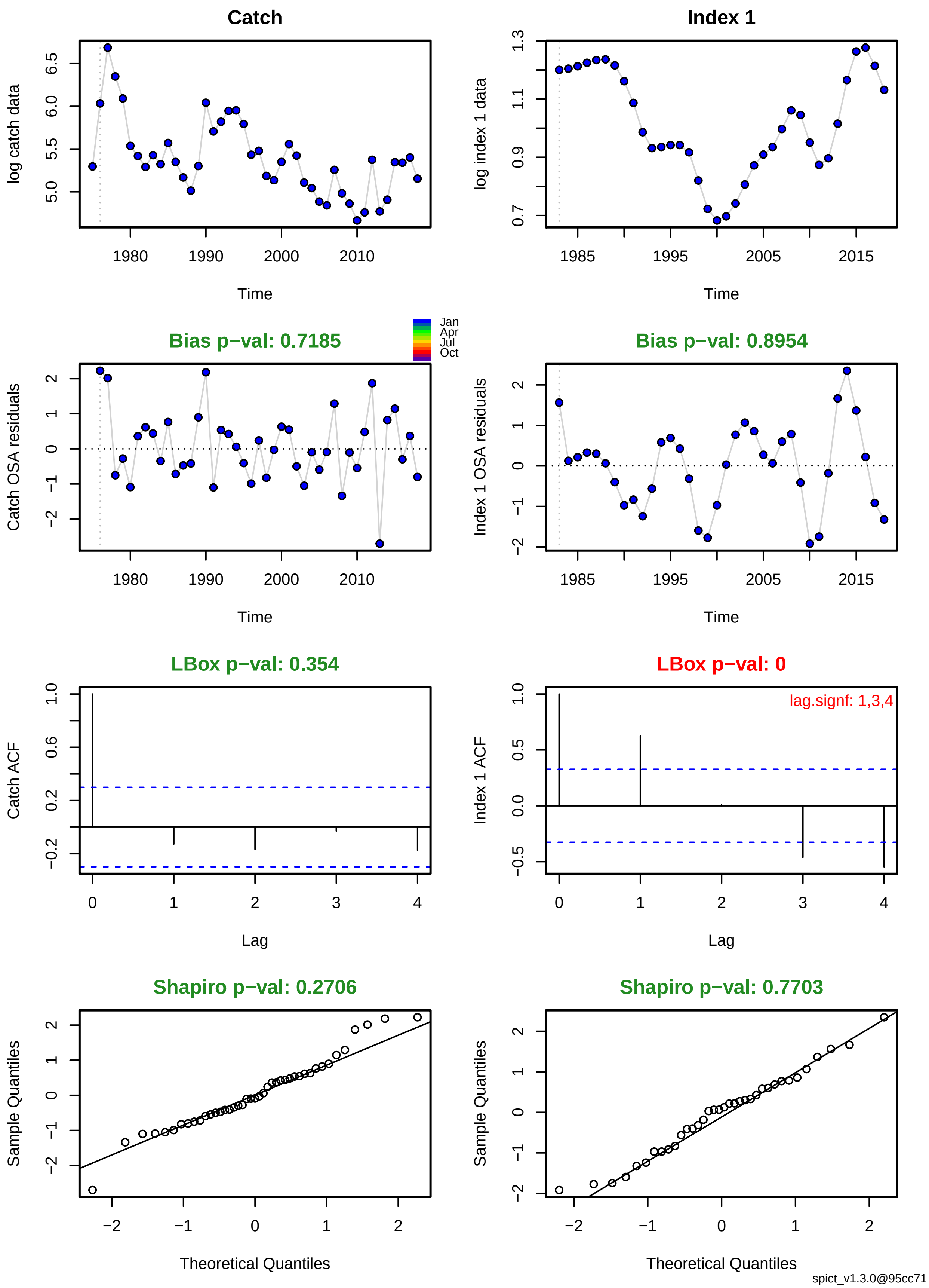
Scenario 3b

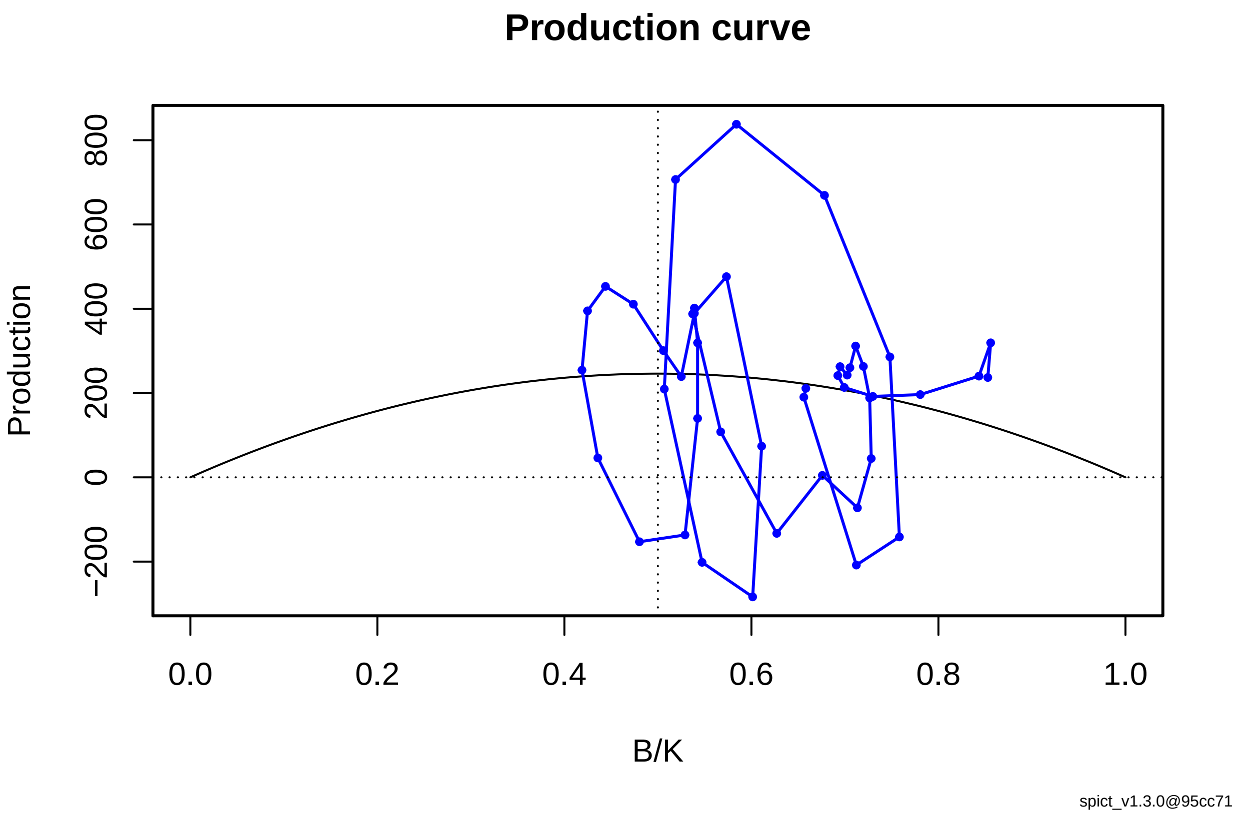
Shaefer, catch series back to 1975. Prior on initial depletion (around 0.5).

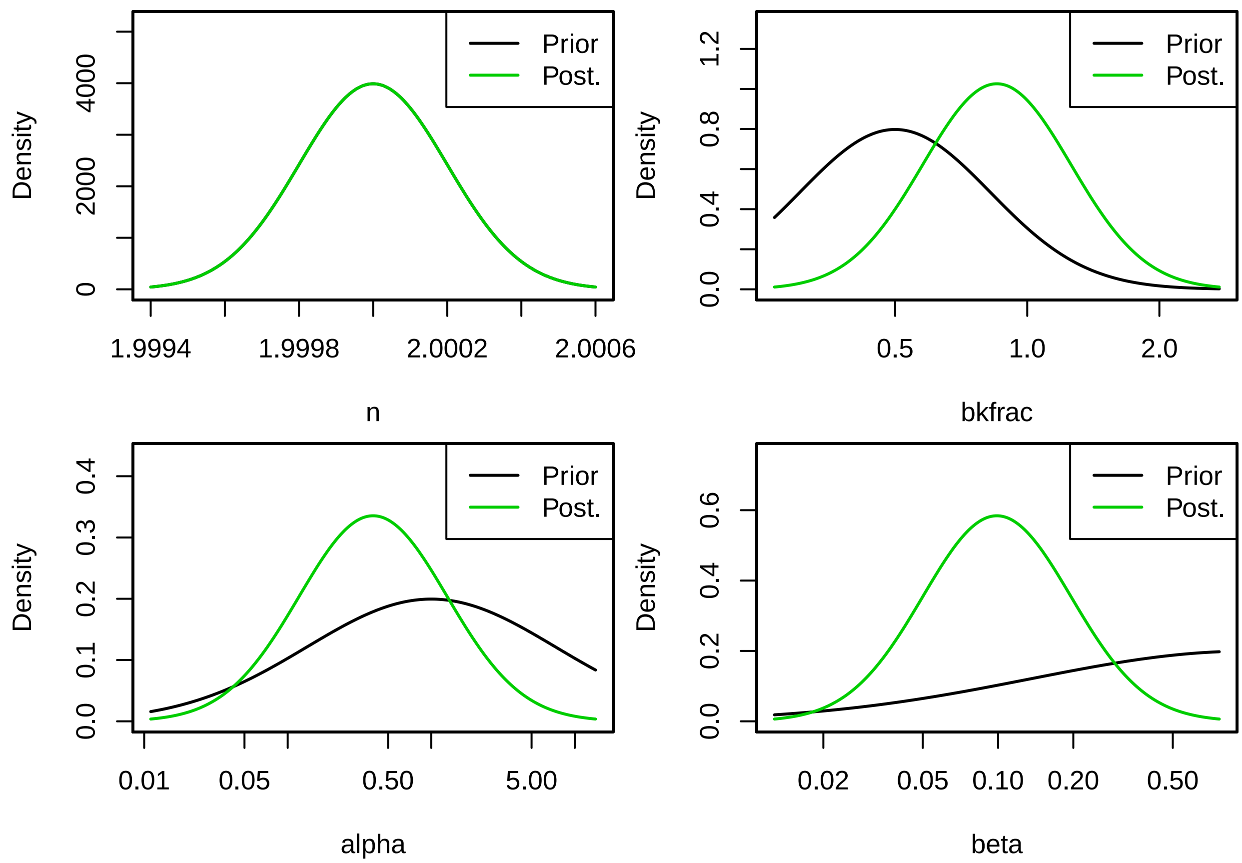
```
## Convergence: 0  MSG: relative convergence (4)
## Objective function at optimum: -33.5430674
## Euler time step (years):  1/16 or 0.0625
## Nobs C: 44,  Nobs I1: 36
##
## Priors
##       logn  ~  dnorm[log(2), 0^2] (fixed)
##  logbkfrac  ~  dnorm[log(0.5), 0.5^2]
##   logalpha  ~  dnorm[log(1), 2^2]
##    logbeta  ~  dnorm[log(1), 2^2]
##
## Model parameter estimates w 95% CI
##             estimate        cilow        ciupp    log.est
##  alpha     0.3936321    0.0382625 4.049563e+00 -0.9323387
##  beta      0.0989070    0.0259383 3.771482e-01 -2.3135752
##  r         0.1290410    0.0407122 4.090070e-01 -2.0476247
##  rc        0.1290410    0.0407122 4.090070e-01 -2.0476247
##  rold      0.1290411    0.0407122 4.090070e-01 -2.0476247
##  m       246.0459116  148.2770848 4.082802e+02  5.5055182
##  K      7626.9036134 2686.8709593 2.164959e+04  8.9394372
##  q         0.0006199    0.0002109 1.822000e-03 -7.3860228
##  n         2.0000000    1.9996080 2.000392e+00  0.6931472
```

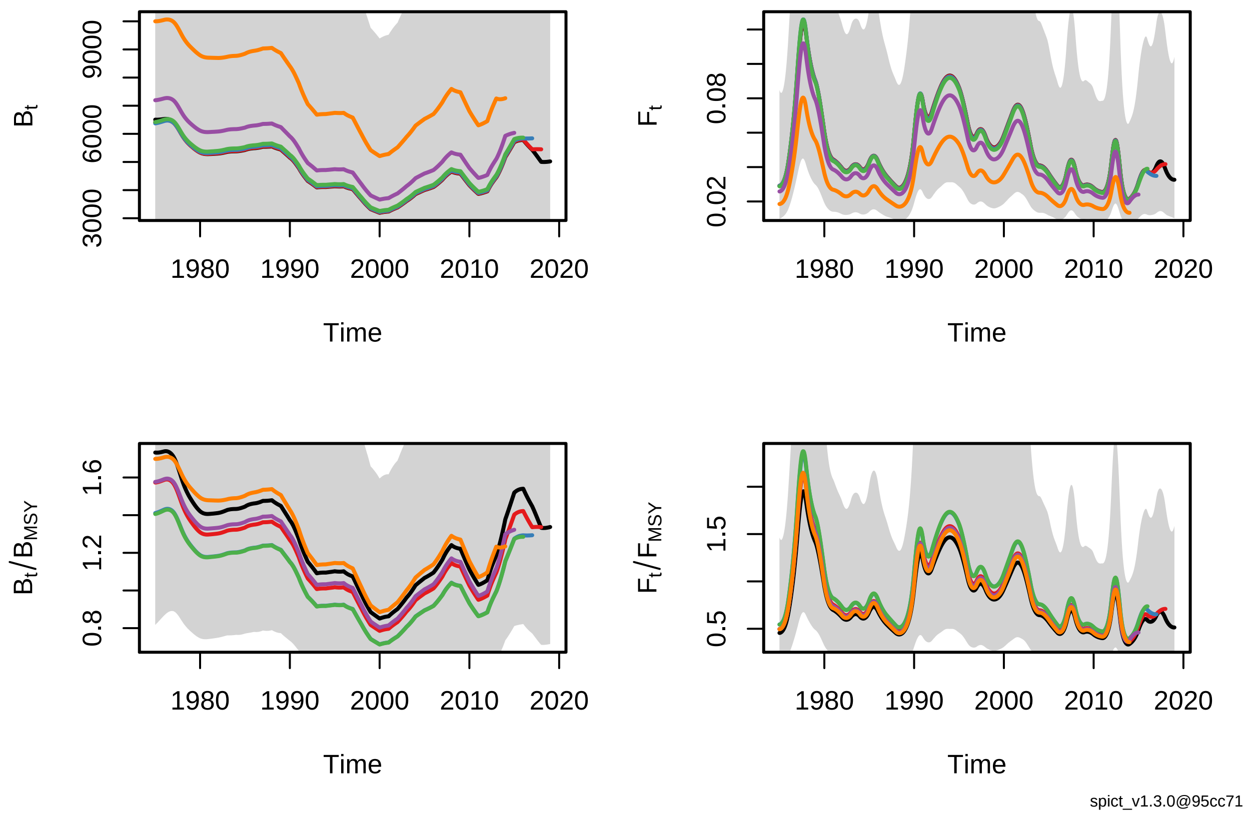
```
##  sdb       0.0612046    0.0481434 7.780940e-02 -2.7935323
##  sdf       0.3723759    0.2809315 4.935858e-01 -0.9878515
##  sdi       0.0240921    0.0023305 2.490587e-01 -3.7258710
##  sdc       0.0368306    0.0113661 1.193450e-01 -3.3014267
##
## Deterministic reference points (Drp)
##            estimate        cilow        ciupp   log.est
##  Bmsyd 3813.4518009 1343.4354760 1.082480e+04  8.246290
##  Fmsyd    0.0645205    0.0203561 2.045035e-01 -2.740772
##  MSYd   246.0459116  148.2770848 4.082802e+02  5.505518
## Stochastic reference points (Srp)
##            estimate        cilow        ciupp   log.est rel.diff.Drp
##  Bmsys 3754.3484778 1342.2120393 10501.420103  8.230670  -0.01574263
##  Fmsys    0.0635851    0.0197384     0.204832 -2.755377  -0.01471138
##  MSYs   238.6651978  141.8597584   401.530901  5.475062  -0.03092497
##
## States w 95% CI (inp$msytype: s)
##                    estimate        cilow        ciupp    log.est
##  B_2018.94      5017.0526924 1712.0904928 1.470180e+04  8.5205979
##  F_2018.94         0.0326545    0.0103877 1.026525e-01 -3.4217715
##  B_2018.94/Bmsy    1.3363311    0.7153642 2.496324e+00  0.2899279
##  F_2018.94/Fmsy    0.5135567    0.1687114 1.563264e+00 -0.6663948
##
## Predictions w 95% CI (inp$msytype: s)
##                  prediction        cilow        ciupp    log.est
##  B_2020.00      5066.4945787 1738.4195483 1.476592e+04  8.5304045
##  F_2020.00         0.0326547    0.0082950 1.285513e-01 -3.4217664
##  B_2020.00/Bmsy    1.3495003    0.7258812 2.508883e+00  0.2997344
##  F_2020.00/Fmsy    0.5135593    0.1339968 1.968279e+00 -0.6663898
##  Catch_2019.00   164.6487166   91.5767773 2.960270e+02  5.1038142
##  E(B_inf)       5443.8067856           NA           NA  8.6022339
```

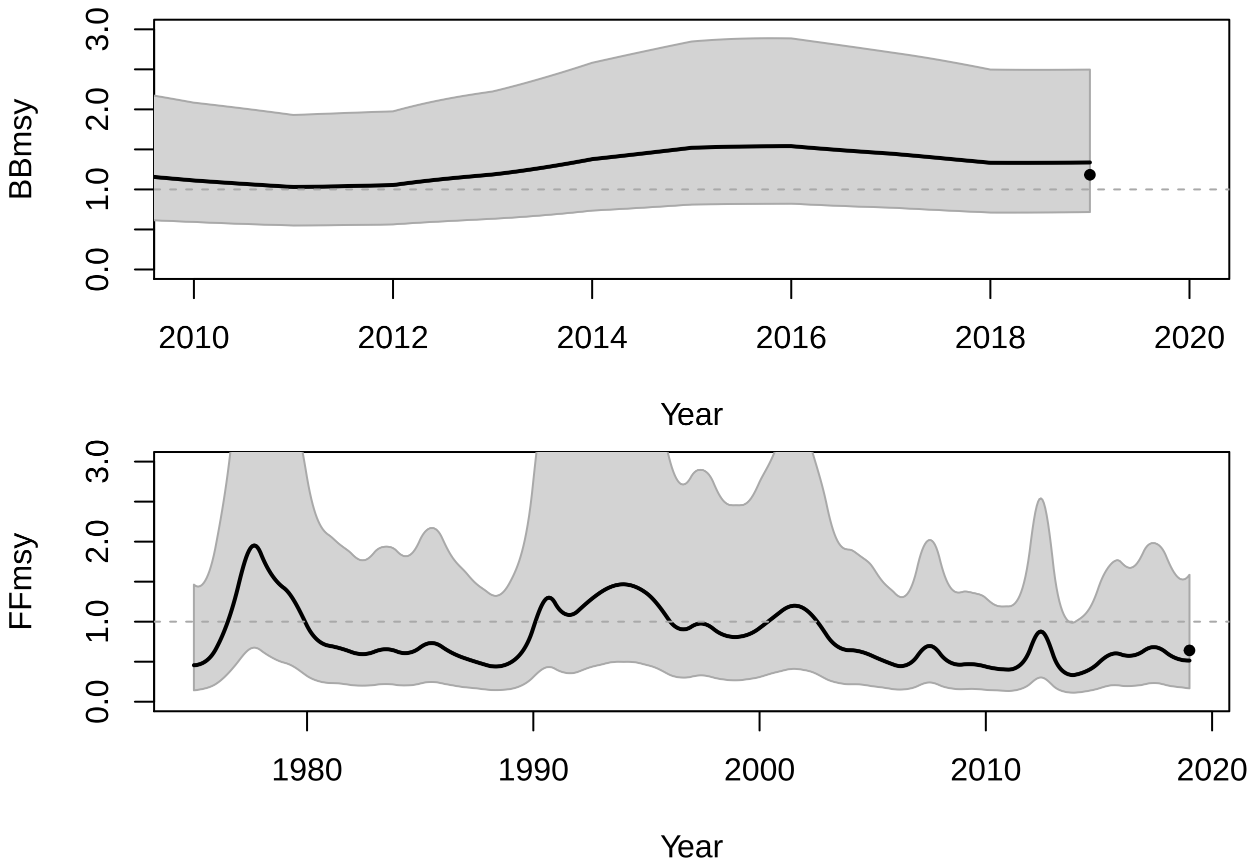

Catch
Catch
Time
Relative biomass
B_t/B_MSY
Time
Relative fishing mortality
F_t/F_MSY
Time
B_t/B_MSY
F_t
B_t
E(B_∞)
2019
1975


Catch
log catch data
Time
Index 1
log index 1 data
Time
Bias p−val: 0.7185
Jan
Apr
Jul
Oct
Catch OSA residuals
Time
Bias p−val: 0.8954
Index 1 OSA residuals
Time
LBox p−val: 0.354
Catch ACF
Lag
LBox p−val: 0
lag.signf: 1,3,4
Index 1 ACF
Lag
Shapiro p−val: 0.2706
Sample Quantiles
Theoretical Quantiles
Shapiro p−val: 0.7703
Sample Quantiles
Theoretical Quantiles
spict_v1.3.0@95cc71


Production curve
Production
800
600
400
200
0
−200
0.0
0.2
0.4
0.6
0.8
1.0
B/K
spict_v1.3.0@95cc71


Prior
Post.
Density
0
2000
4000
1.9994
1.9998
2.0002
2.0006
n
Prior
Post.
Density
0.0
0.4
0.8
1.2
0.5
1.0
2.0
bkfrac
Prior
Post.
Density
0.0
0.1
0.2
0.3
0.4
0.01
0.05
0.50
5.00
alpha
Prior
Post.
Density
0.0
0.2
0.4
0.6
0.02
0.05
0.10
0.20
0.50
beta


Bt
3000
6000
9000
1980
1990
2000
2010
2020
Time
Ft
0.02
0.08
Bt/BMSY
0.8
1.2
1.6
Ft/FMSY
0.5
1.5
spict_v1.3.0@95cc71

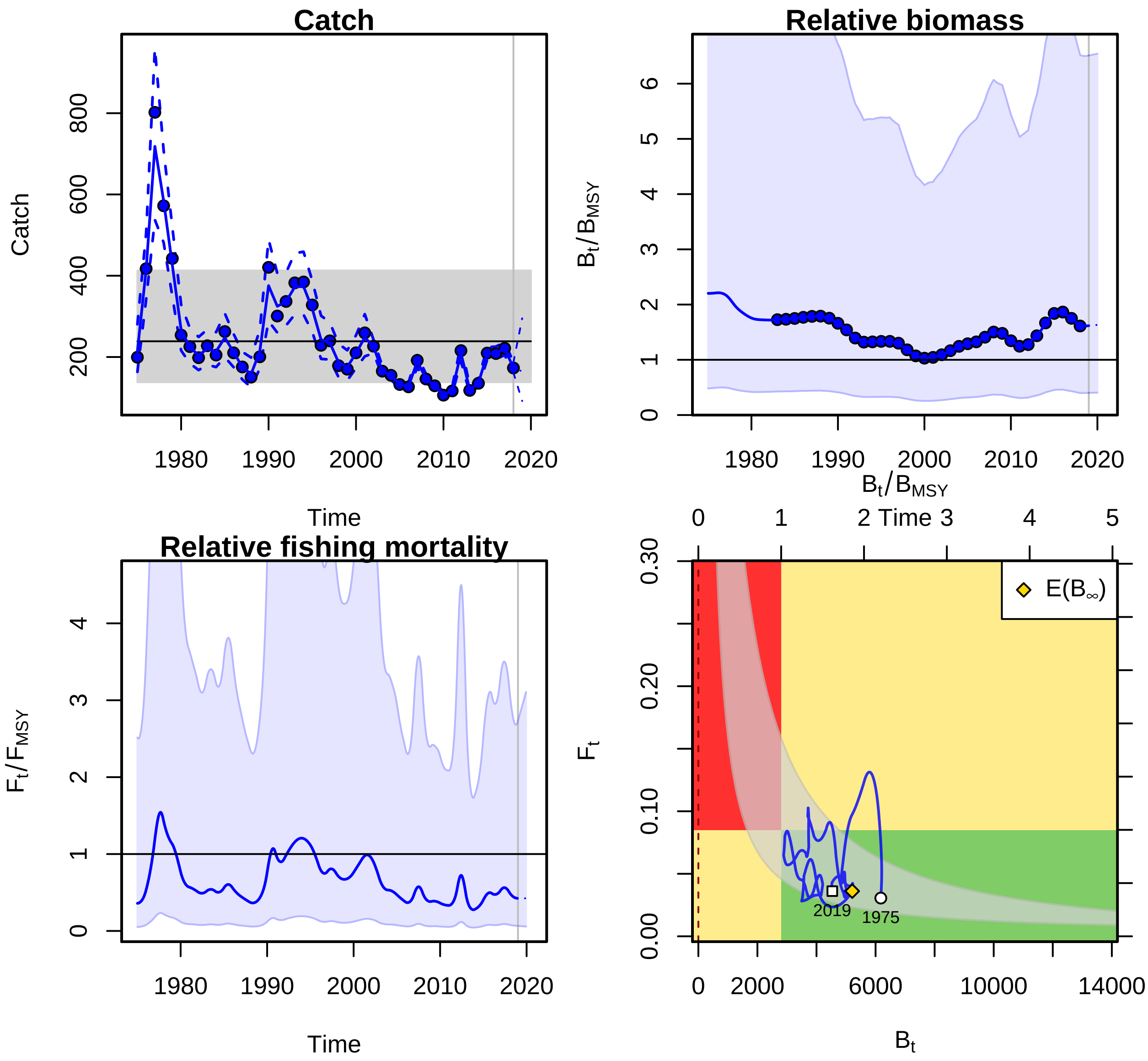

BBmsy
0.0
1.0
2.0
3.0
2010
2012
2014
2016
2018
2020
Year
FFmsy
0.0
1.0
2.0
3.0
1980
1990
2000
2010
2020
Year

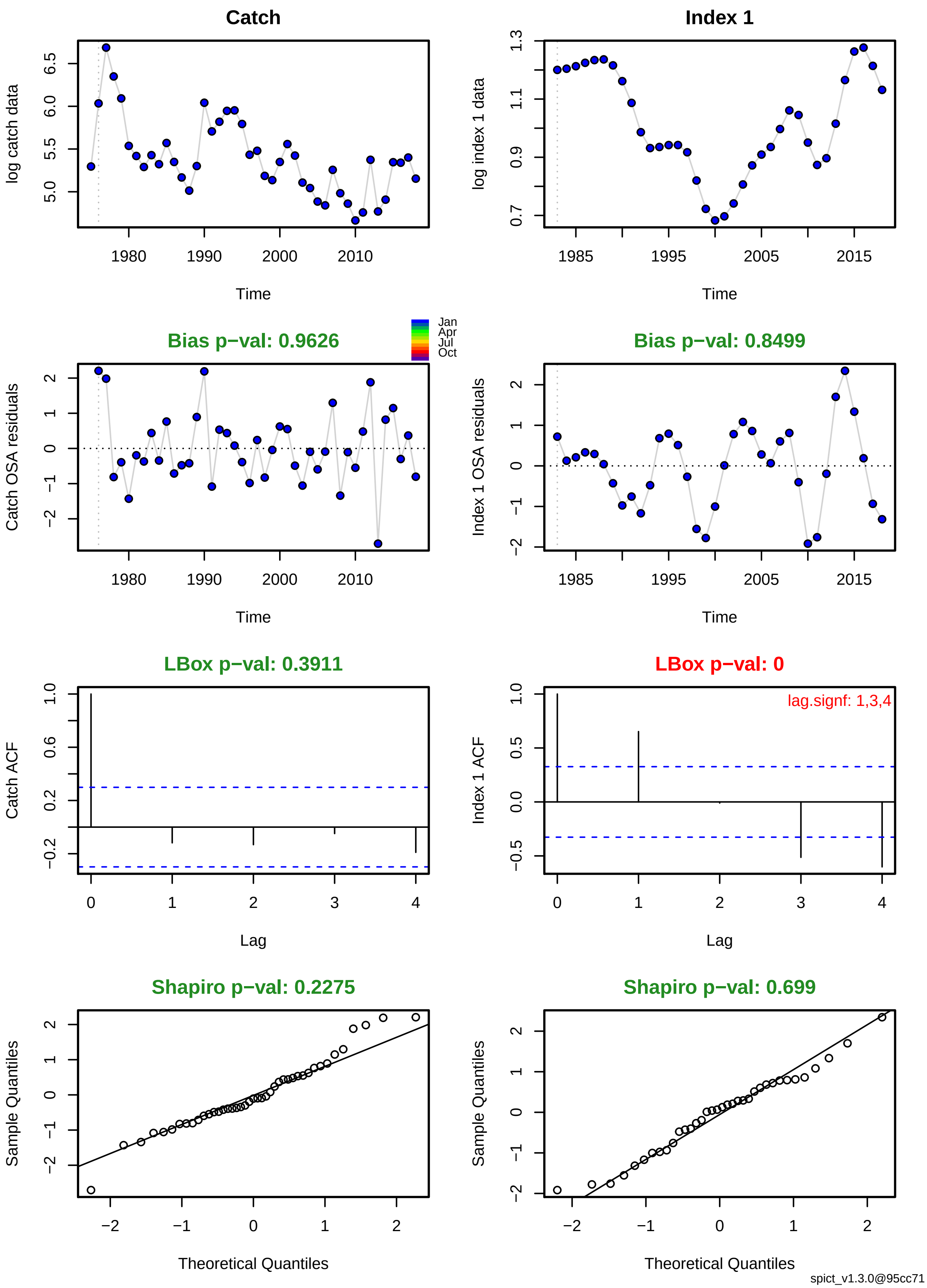
Scenario 3c

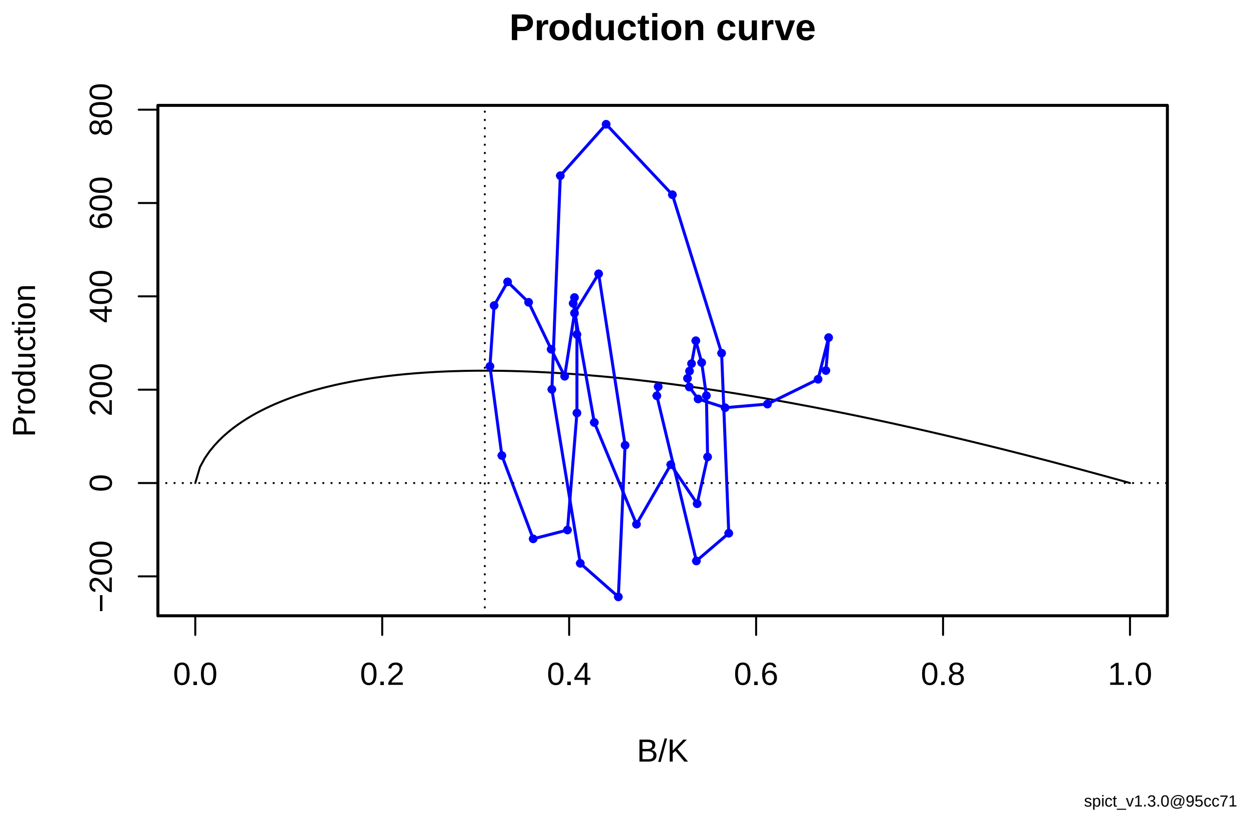
Default priors, prior on intitial depletion, catch series back to 1975.

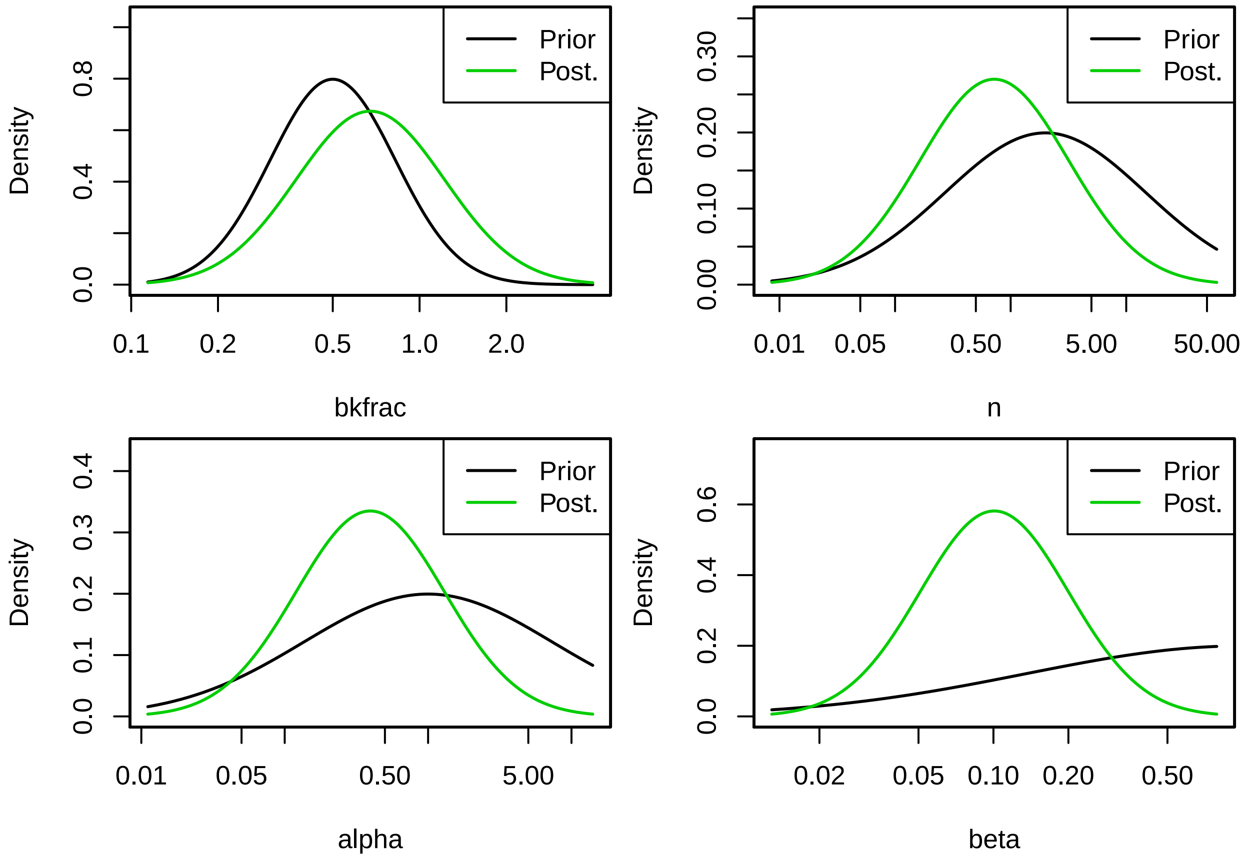
```
## Convergence: 0  MSG: relative convergence (4)
## Objective function at optimum: -23.858384
## Euler time step (years):  1/16 or 0.0625
## Nobs C: 44,  Nobs I1: 36
##
## Priors
##  logbkfrac  ~  dnorm[log(0.5), 0.5^2]
##       logn  ~  dnorm[log(2), 2^2]
##   logalpha  ~  dnorm[log(1), 2^2]
##    logbeta  ~  dnorm[log(1), 2^2]
##
## Model parameter estimates w 95% CI
##             estimate        cilow        ciupp    log.est
##  alpha     0.3951701    0.0382841 4.078964e+00 -0.9284390
##  beta      0.1007769    0.0262713 3.865808e-01 -2.2948458
##  r         0.0612402    0.0065700 5.708308e-01 -2.7929514
##  rc        0.1697187    0.0231540 1.244035e+00 -1.7736127
##  rold      0.2200249    0.0000210 2.310581e+03 -1.5140146
##  m       240.7197088  141.2162232 4.103351e+02  5.4836332
##  K      9157.6049715 2396.2750627 3.499670e+04  9.1223400
##  q         0.0006859    0.0002425 1.940000e-03 -7.2848441
##  n         0.7216669    0.0398741 1.306120e+01 -0.3261915
##  sdb       0.0611758    0.0481291 7.775910e-02 -2.7940041
##  sdf       0.3708642    0.2789466 4.930702e-01 -0.9919193
##  sdi       0.0241748    0.0023308 2.507426e-01 -3.7224431
##  sdc       0.0373746    0.0115217 1.212371e-01 -3.2867652
##
## Deterministic reference points (Drp)
##            estimate      cilow        ciupp   log.est
##  Bmsyd 2836.6899138 503.896461 1.596917e+04  7.950393
##  Fmsyd    0.0848594   0.011577 6.220176e-01 -2.466760
##  MSYd   240.7197088 141.216223 4.103351e+02  5.483633
## Stochastic reference points (Srp)
##            estimate       cilow        ciupp   log.est rel.diff.Drp
##  Bmsys 2804.4309138 509.1736001 15446.269699  7.938956 -0.011502869
##  Fmsys    0.0851193   0.0115114     0.629399 -2.463702  0.003053756
##  MSYs   238.7194928 137.9964596   412.959842  5.475289 -0.008378939
##
## States w 95% CI (inp$msytype: s)
##                     estimate        cilow        ciupp    log.est
##  B_2018.94      4532.6141284 1602.2766526 1.282212e+04  8.4190541
##  F_2018.94         0.0361480    0.0118986 1.098176e-01 -3.3201350
##  B_2018.94/Bmsy    1.6162331    0.4014477 6.506973e+00  0.4800982
##  F_2018.94/Fmsy    0.4246741    0.0666017 2.707861e+00 -0.8564332
##
## Predictions w 95% CI (inp$msytype: s)
##                   prediction        cilow        ciupp    log.est
##  B_2020.00      4577.1724776 1621.7824307 1.291820e+04  8.4288367
##  F_2020.00         0.0361481    0.0094633 1.380796e-01 -3.3201304
##  B_2020.00/Bmsy    1.6321217    0.4072229 6.541432e+00  0.4898808
##  F_2020.00/Fmsy    0.4246761    0.0575673 3.132851e+00 -0.8564286
```

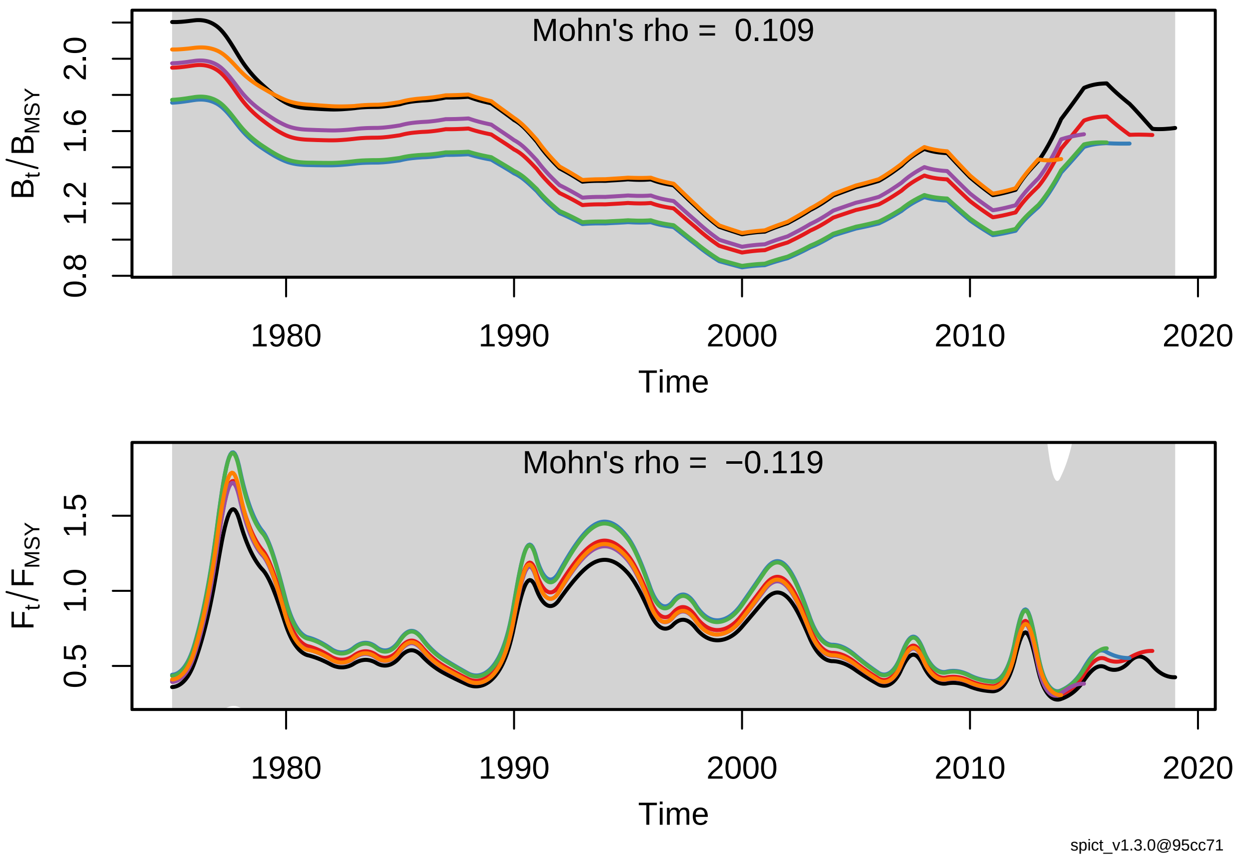
```
## Catch_2019.00    164.6602880   91.8578447 2.951627e+02  5.1038845
## E(B_inf)        5209.8473661          NA           NA  8.5583058
```

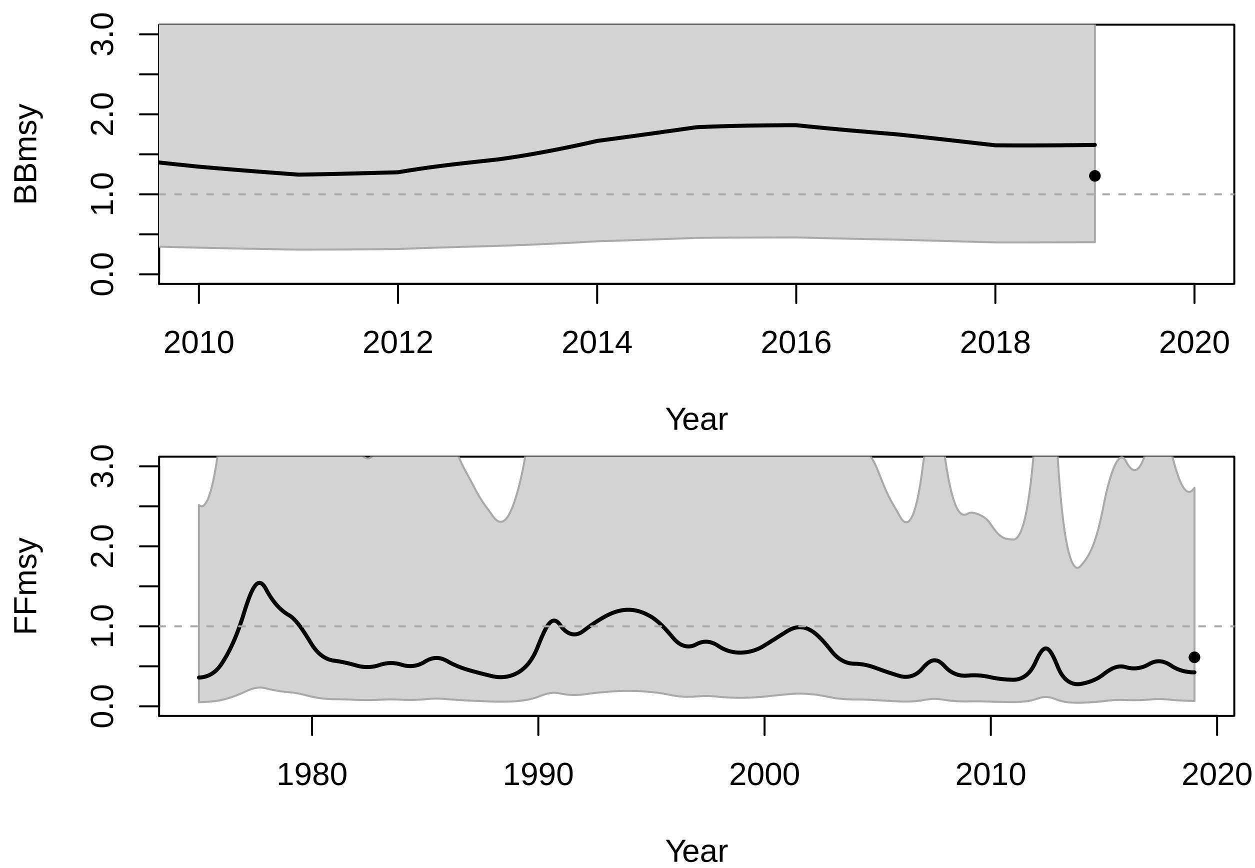



Catch
log catch data
Time
Index 1
log index 1 data
Bias p−val: 0.9626
Jan
Apr
Jul
Oct
Catch OSA residuals
Bias p−val: 0.8499
Index 1 OSA residuals
LBox p−val: 0.3911
Catch ACF
Lag
LBox p−val: 0
lag.signf: 1,3,4
Index 1 ACF
Shapiro p−val: 0.2275
Sample Quantiles
Theoretical Quantiles
Shapiro p−val: 0.699
spict_v1.3.0@95cc71


Production curve
Production
800
600
400
200
0
−200
0.0
0.2
0.4
0.6
0.8
1.0
B/K
spict_v1.3.0@95cc71


Prior
Post.
Density
0.0
0.4
0.8
0.1
0.2
0.5
1.0
2.0
bkfrac
Prior
Post.
Density
0.00
0.10
0.20
0.30
0.01
0.05
0.50
5.00
50.00
n
Prior
Post.
Density
0.0
0.1
0.2
0.3
0.4
0.01
0.05
0.50
5.00
alpha
Prior
Post.
Density
0.0
0.2
0.4
0.6
0.02
0.05
0.10
0.20
0.50
beta

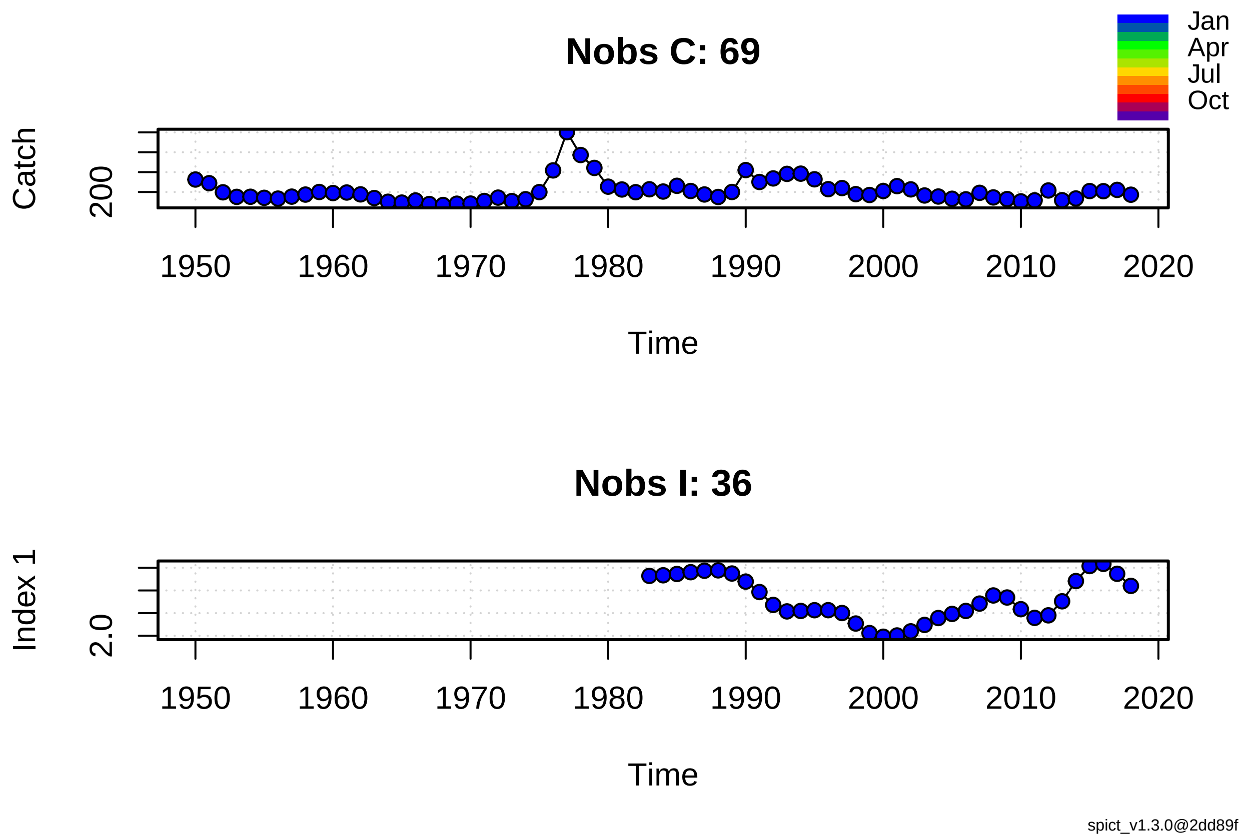

Mohn's rho = 0.109
B_t/B_{MSY}
0.8
1.2
1.6
2.0
1980
1990
2000
2010
2020
Time
Mohn's rho = −0.119
F_t/F_{MSY}
0.5
1.0
1.5
1980
1990
2000
2010
2020
Time
spict_v1.3.0@95cc71


BBmsy
0.0
1.0
2.0
3.0
2010
2012
2014
2016
2018
2020
Year
FFmsy
0.0
1.0
2.0
3.0
1980
1990
2000
2010
2020
Year

Scenario 4

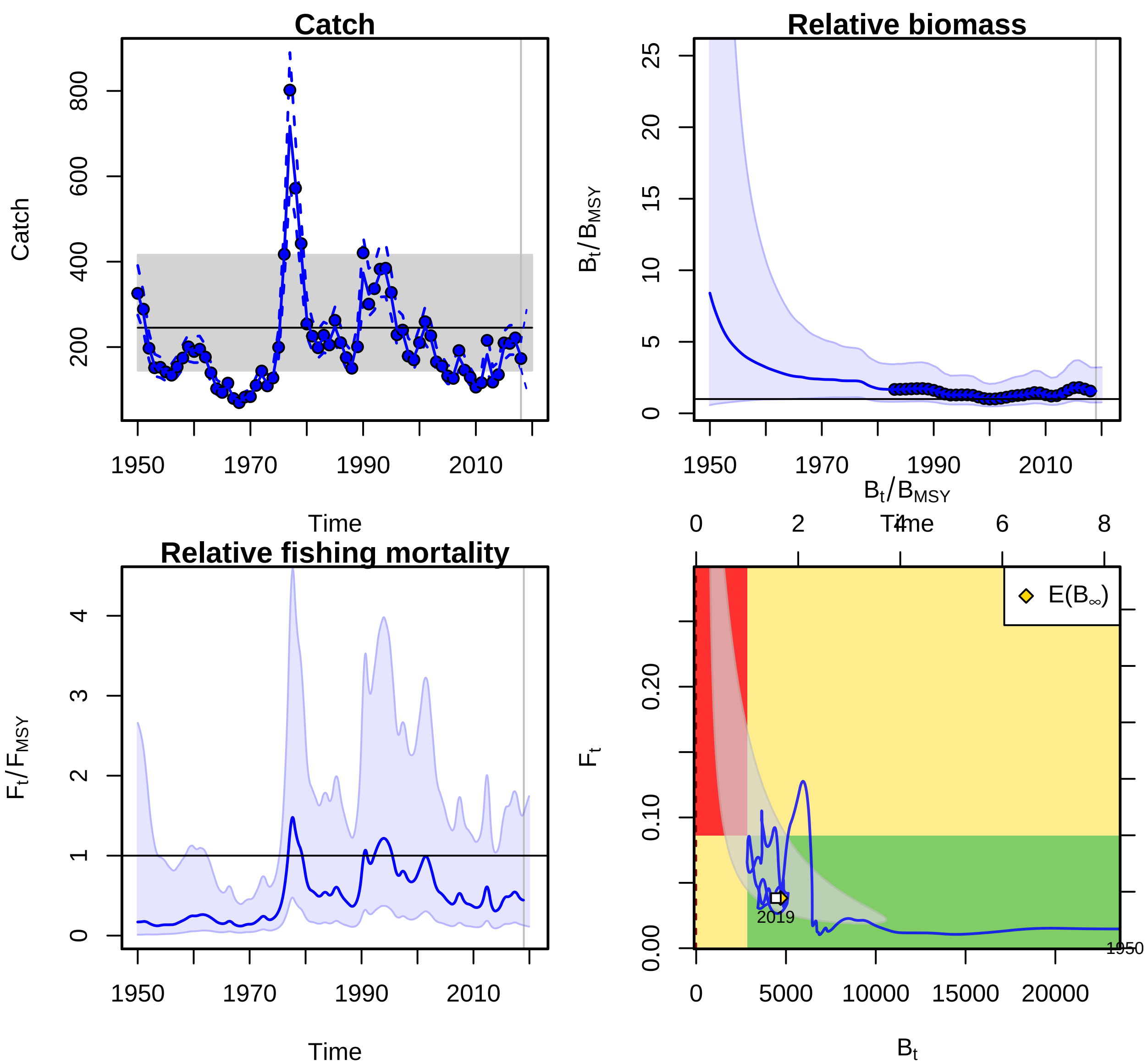
Scenario 4a

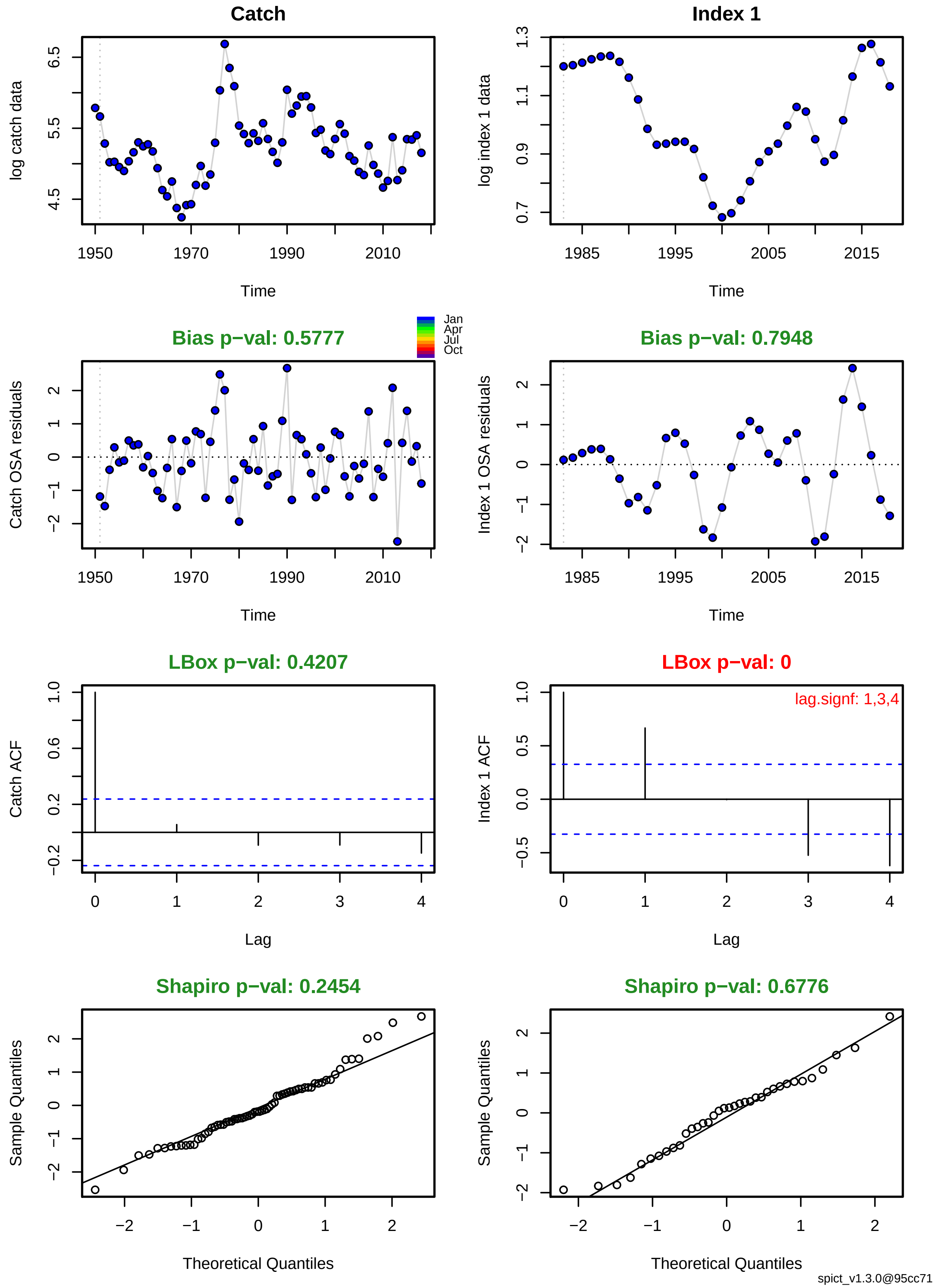
Complete catch time series 1950–2018.

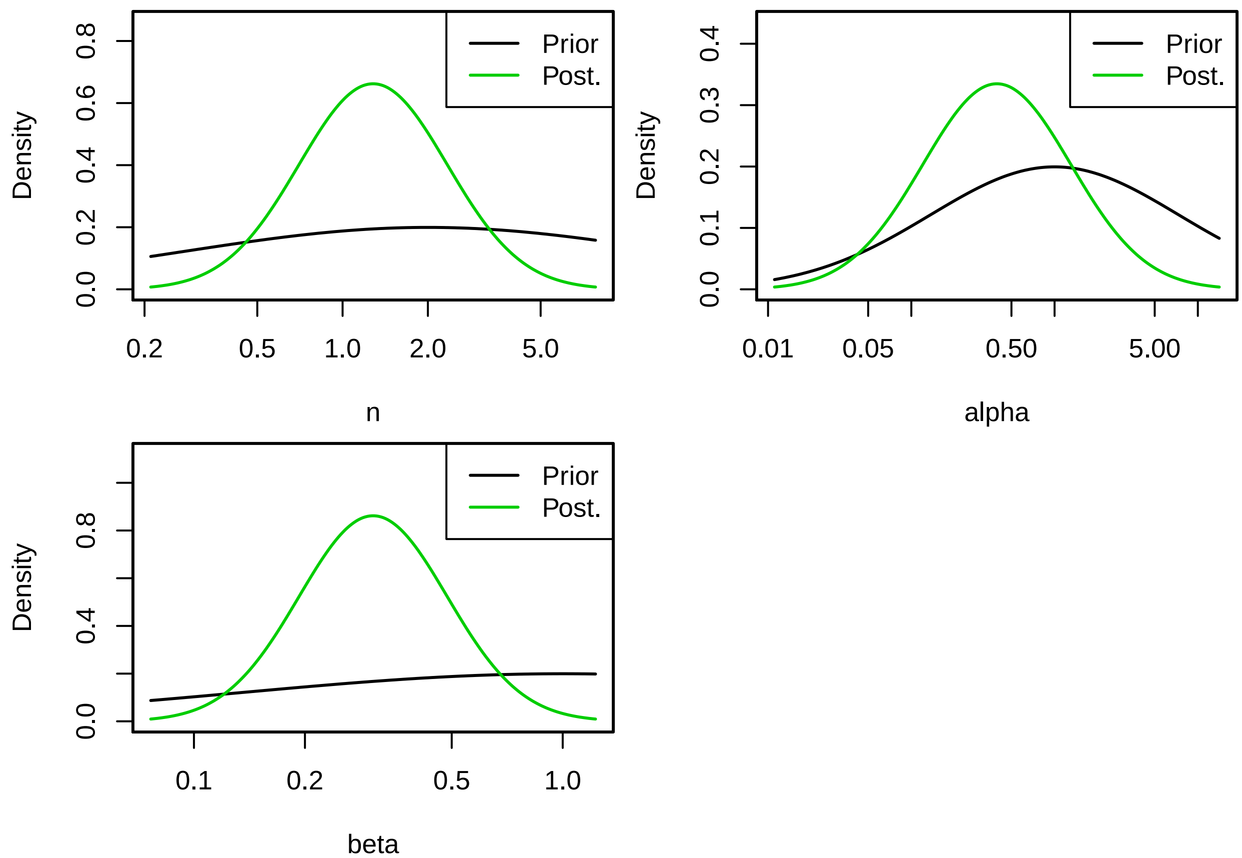


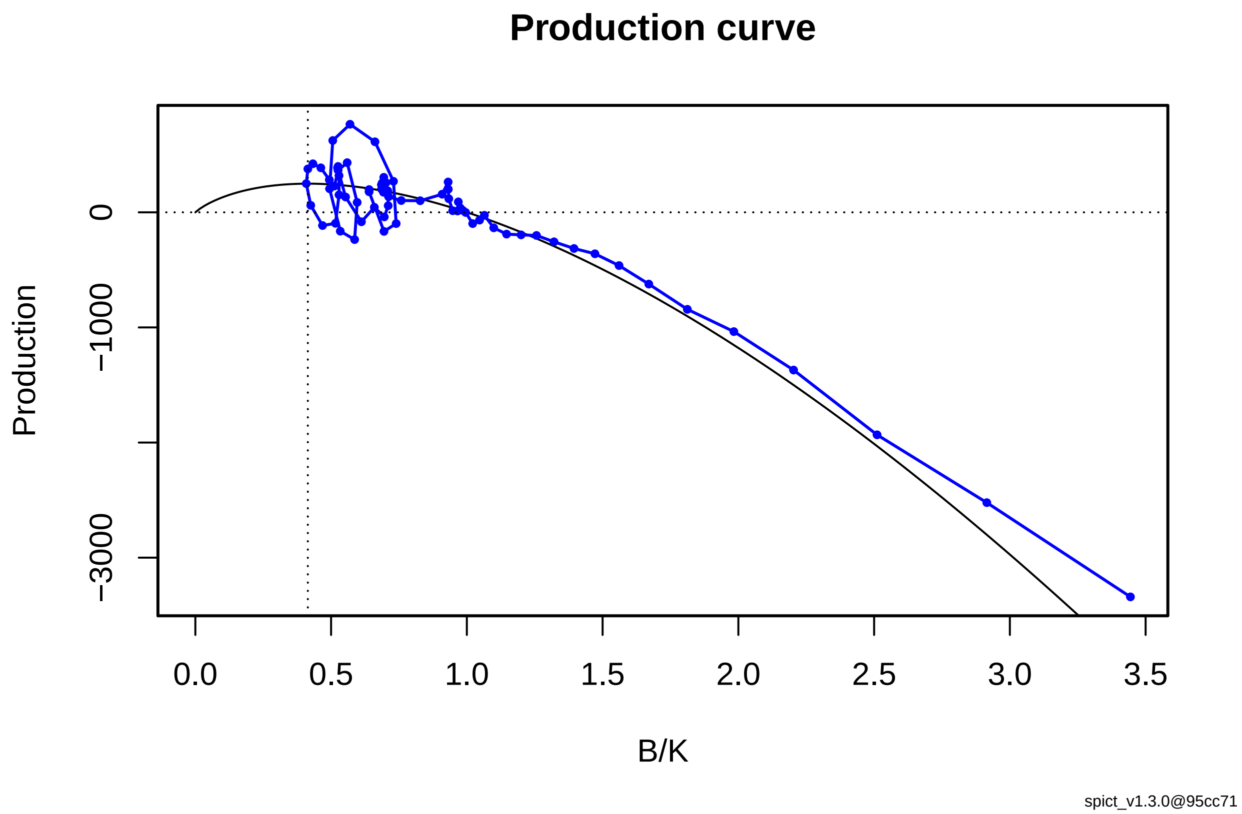

```
## Convergence: 0  MSG: relative convergence (4)
## Objective function at optimum: -26.6689107
## Euler time step (years):  1/16 or 0.0625
## Nobs C: 69,  Nobs I1: 36
##
## Priors
##      logn  ~  dnorm[log(2), 2^2]
##  logalpha  ~  dnorm[log(1), 2^2]
##   logbeta  ~  dnorm[log(1), 2^2]
##
## Model parameter estimates w 95% CI
##             estimate        cilow        ciupp    log.est
##  alpha     0.3956132    0.0382857 4.087940e+00 -0.9273182
##  beta      0.3061154    0.1235598 7.583913e-01 -1.1837930
##  r         0.1109947    0.0574180 2.145639e-01 -2.1982726
##  rc        0.1732128    0.0519926 5.770575e-01 -1.7532341
##  rold      0.3941585    0.0020650 7.523427e+01 -0.9310022
##  m       248.8280756  148.8743456 4.158904e+02  5.5167622
##  K      6934.1495822 3287.2933150 1.462675e+04  8.8442137
##  q         0.0006989    0.0002477 1.971800e-03 -7.2660511
##  n         1.2815992    0.3935251 4.173804e+00  0.2481087
```

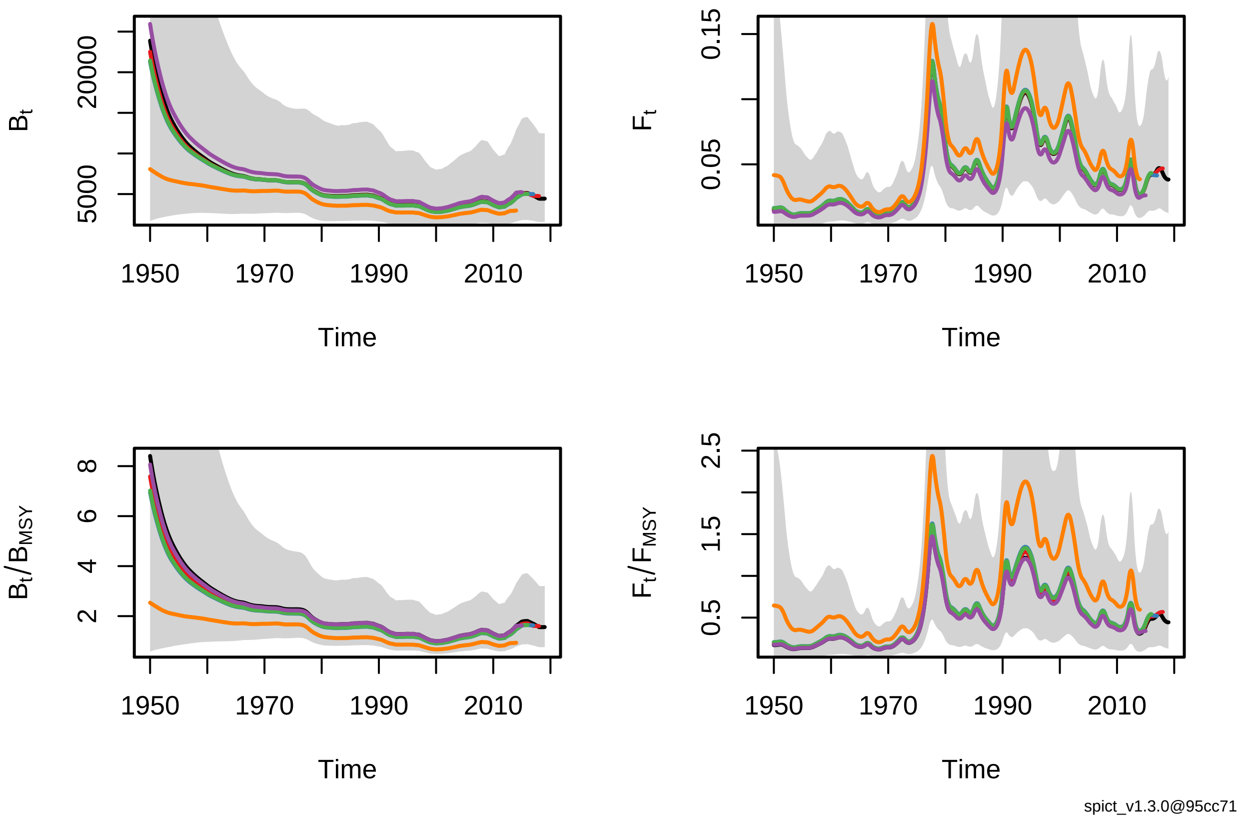
```
## sdb       0.0603534    0.0475699 7.657210e-02 -2.8075385
## sdf       0.3042524    0.2321440 3.987590e-01 -1.1898978
## sdi       0.0238766    0.0023000 2.478673e-01 -3.7348567
## sdc       0.0931363    0.0453476 1.912864e-01 -2.3736908
##
## Deterministic reference points (Drp)
##            estimate       cilow        ciupp   log.est
## Bmsyd 2873.0902558 991.0308750 8329.3546407  7.963144
## Fmsyd    0.0866064   0.0259963    0.2885287 -2.446381
## MSYd   248.8280756 148.8743456  415.8904003  5.516762
## Stochastic reference points (Srp)
##            estimate       cilow        ciupp   log.est rel.diff.Drp
## Bmsys 2841.1109925 991.2960956 8142.7857000  7.951950 -0.011255901
## Fmsys    0.0863505   0.0254856    0.2925734 -2.449340 -0.002963792
## MSYs   245.3232192 144.6372103  416.0995760  5.502577 -0.014286688
##
## States w 95% CI (inp$msytype: s)
##                     estimate        cilow        ciupp    log.est
## B_2018.94      4436.8969236 1576.9373693 1.248373e+04  8.3977105
## F_2018.94         0.0383285    0.0126270 1.163437e-01 -3.2615604
## B_2018.94/Bmsy    1.5616767    0.7616007 3.202248e+00  0.4457601
## F_2018.94/Fmsy    0.4438716    0.1294914 1.521507e+00 -0.8122199
##
## Predictions w 95% CI (inp$msytype: s)
##                   prediction        cilow        ciupp    log.est
## B_2020.00      4465.8206038 1594.8353429 1.250509e+04  8.4042083
## F_2020.00         0.0383287    0.0107732 1.363654e-01 -3.2615560
## B_2020.00/Bmsy    1.5718571    0.7684899 3.215052e+00  0.4522578
## F_2020.00/Fmsy    0.4438736    0.1120316 1.758644e+00 -0.8122155
## Catch_2019.00   170.6240305  101.3595307 2.872207e+02  5.1394625
## E(B_inf)       4703.8994706           NA           NA  8.4561471
```


Catch
Catch
Time
Relative biomass
B_t/B_{MSY}
Time
Relative fishing mortality
F_t/F_{MSY}
Time
B_t/B_{MSY}
F_t
B_t
$E(B_\infty)$
2019
1950


Catch
log catch data
Time
Index 1
log index 1 data
Bias p−val: 0.5777
Jan
Apr
Jul
Oct
Catch OSA residuals
Bias p−val: 0.7948
Index 1 OSA residuals
LBox p−val: 0.4207
Catch ACF
Lag
LBox p−val: 0
lag.signf: 1,3,4
Index 1 ACF
Shapiro p−val: 0.2454
Sample Quantiles
Theoretical Quantiles
Shapiro p−val: 0.6776
spict_v1.3.0@95cc71

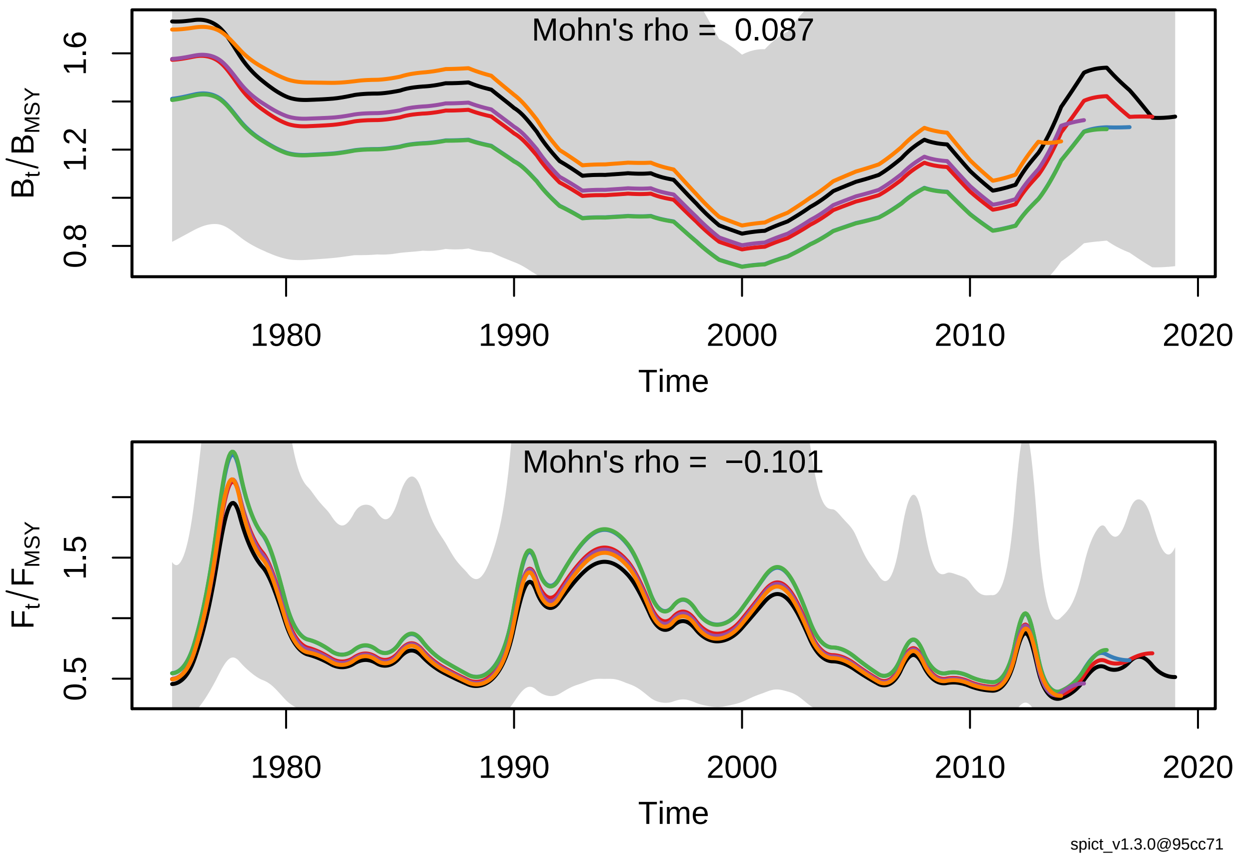

Prior
Post.
Density
0.0
0.2
0.4
0.6
0.8
0.2
0.5
1.0
2.0
5.0
n
Prior
Post.
Density
0.0
0.1
0.2
0.3
0.4
0.01
0.05
0.50
5.00
alpha
Prior
Post.
Density
0.0
0.4
0.8
0.1
0.2
0.5
1.0
beta


Production curve
Production
0
−1000
−3000
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
B/K
spict_v1.3.0@95cc71

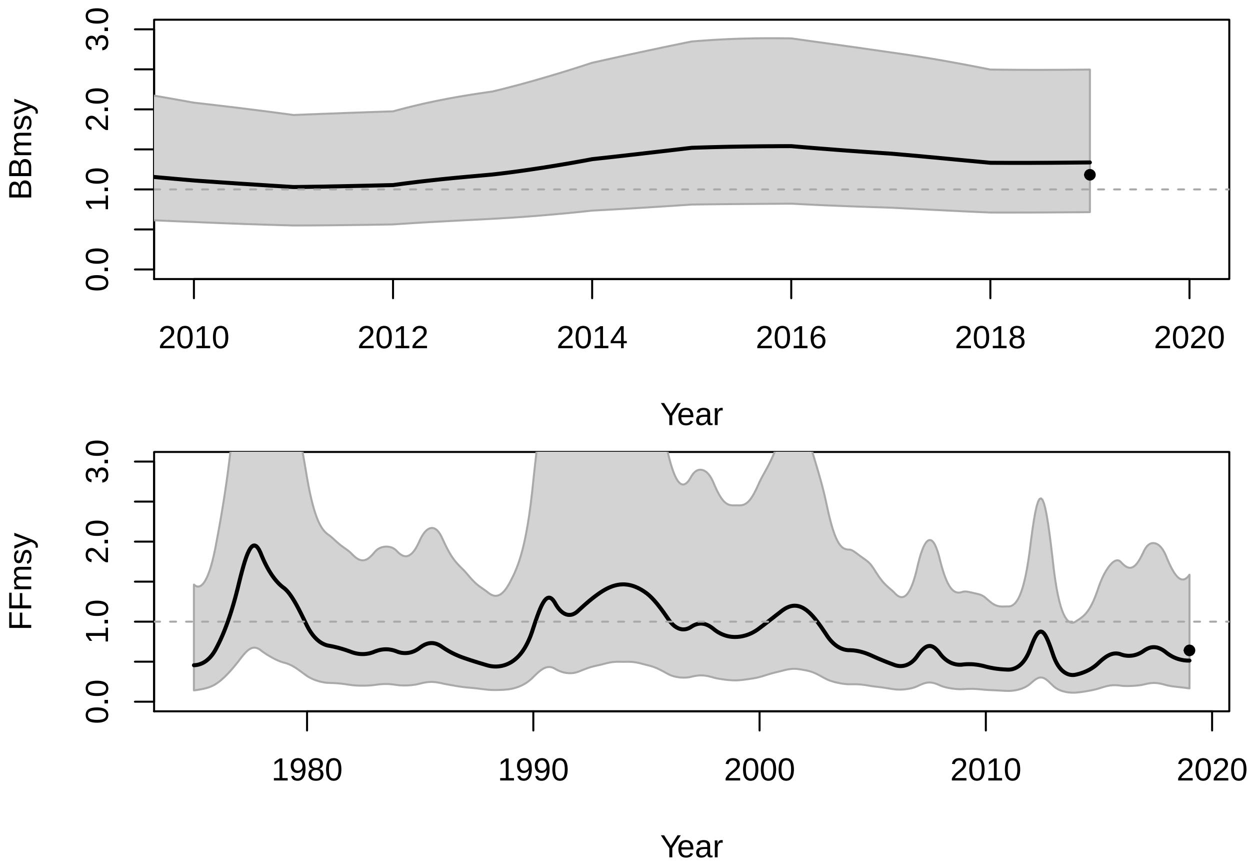

B_t
20000
5000
1950
1970
1990
2010
Time
F_t
0.15
0.05
B_t/B_MSY
8
6
4
2
F_t/F_MSY
2.5
1.5
0.5
spict_v1.3.0@95cc71

Proposed assessment

We propose scenario 3b, which uses the catch time series that include the high catches by the Netherlands (1975–2018) and the complete biomass index time series (1983–2018). The shape paramter n is equal to 2, corresponding to a Shaefer model and there is a prior on initial depletion. The retrospective bias is quite low; Mohn's ρ for B/B_{MSY} is -0.1005613 and for $F/FMSY$ is 0.0873851.



The stock status shown below indicates that the stock is above in a good state (above $BMSY$ and below $FMSY$).



Quality of the assessment

There are some issues that affect the quality of the assessment. The most important issue is that turbot in 3a is most probably not a closed stock, but rather the Skagerrak part belongs to the North Sea stock and the Kattegat to the Baltic Sea stock.

Furtermore, there is an issue with the the biomass index residuals, which show high autocorellation. This is somewhat expected because the individual observation of the standardised biomass index are not independent. SPiCT at the moment is not able to account for correlation structures on the observations. Therefore, further development of the assessment model is needed to take into account such standardised biomass indices.

References

Pedersen, Martin W., and Casper W. Berg. 2017. "A stochastic surplus production model in continuous time." *Fish and Fisheries* 18 (2): 226–43. https://doi.org/10.1111/faf.12174.

Calculation of reference points for North Sea sole (sol.27.4) based on the updated AAP stock assessment

Iago MOSQUEIRA (WMR)*

06 May 2010

Abstract

The estimation of reference points for the North Sea stock of common sole (*Sole solea*), as carried out in 2020 as part of the benchmark process for ICES sol.27.4 stock, is documented here.

1 Introduction

A benchmark process for the North Sea sole stock (ICES sol.27.4) has taken place in which a new stock assessment has been fitted and reviewed. This model makes use of new data, most notably a new index of abundance based on BTS surveys conducted by three countries (NL, BE and DE). The model applied to this stock, the *AAP* statistical catch-at-ge with estimates of discards (Aarts and Poos 2009) has also been modified to provide greater flexibility at explaining the patterns in landings for certain ages.

Following the benchmark guidelines, a new set of reference points needs to be calculated for this stock. This calculation, carried out following the procedures set in ICES (2017), is documented here.

The code developed for this analysis is available as part of the TAF repository[1] set up for the WGNSSK 2020 stock assessment of the stock. Annex A contains the source code of the reference points calculation for inspection but it can only be executed as part of the repository.

2 Inputs

This analysis is based on the results of the stock assessment model run conducted during the meeting of WKFlatNSCS that took place in ICES, Copenhagen, between 17 and 21 February 2020. The model is an update of the Aarts and Poos (2009) method, run with the following inputs and settings:

- Landings-at-age data, years 1957-2018, ages 1-10+.
- Discards-at-age data, years 1957-2018, ages 1-10+.
- Indices of abundance
  - BTS (GAM), years 1985:2018, ages 1-10+
  - SNS, years 1970-2018, ages 1-6
- Fbar: ages 2-6.
- Age from which F is constant, `qplat.Fmatrix`: 9
- Dimensions of the F matrix tensor spline, `Fage.knots`: 8, 'Ftime.knots': 28
- Age from which surrvey q is constant (`qplat.surveys`): 8
- Number of knots of the selectivity spline, `Sage.knots`: 6

The correlation plot of estimated values for recruitment, in thousands, and Spawning Stock Biomass (SSB), in tonnes is presented in Figure 1. The assessment model estimates recruitments as independent yearly parameters, so no stock-recruit relationship is assumed or estimated.

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[1] https://github.com/ices-taf/2020_sol.27.4_assessment

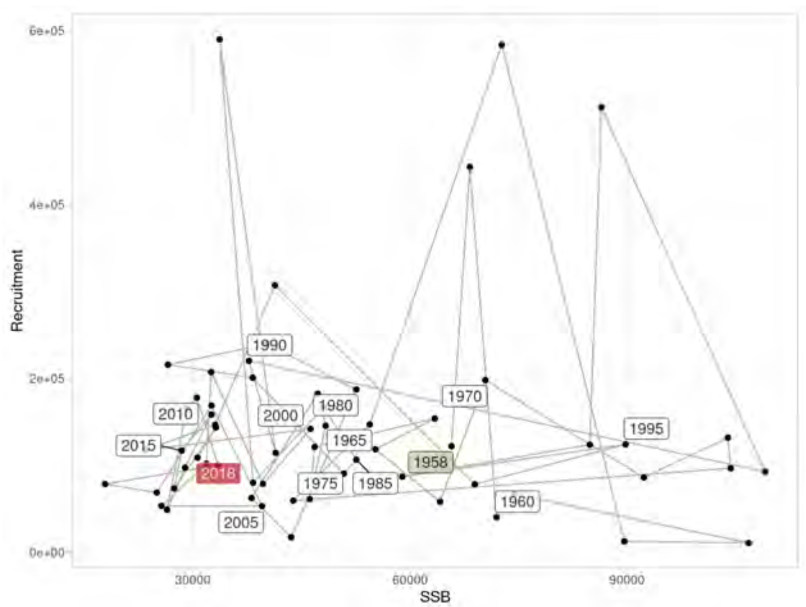

Figure 1: Estimates of number of age 1 recruits (in thousands) against the SSB (in tonnes) in the previous year obtained from the sol.27.4 stock assesment model run used for the reference points analysis. Labels refer to the recruitment year.

3 Methods

The analysis was conducted applying the methodology presented in ICES (2017) for a category 1 stock, and using version 0.1.19 of the `msy` package. Simulation runs have been conducted for 2000 iterations (`nsmap = 2000`). Selectivity patterns, maturity, weights-at-age and natural mortality were sampled from the last five years (2014-2018).

4 Results

An initial stock-recruit model fit, conducted to explore the support for two alternative stock-recruitment relationships (SRR), Ricker and segmented regression, appeared to suggest the observed relationships could provide some support, 20%, for a Ricker model (Figure 2). There appears to be little evidence for North Sea sole able to support the existence of overcompensation in recruitment, for example through cannibalism. Some of the lower recruitment values estimated in the past appear to inmediately follow large recruitment events. This could suggest competition for resources between two adjacent year classes could play a part in the observed dynamics. This would still not be modelled correctly by the Ricker model, which would predict lower recruitment and higher biomass levels, even when those levels do not arise through a strong year class entering the population.

The decision was taken to conduct all analyses using only the segmented regression SRR. The stock was clasified by the group as following under *Type 2*[2] according to the relevant ICES guidelines (ICES 2017), so the biomass limit reference point (B_{lim}) will be set to the inflection point of the segmented regression curve, in this case 30828 t.

Following this, the Precautionary Approach (PA) level of biomass, considered to ensure that the probability of the spawning stock biomass falls below B_{lim} is less than 5%, is set as a product of this reference point times the PA factor, ϕ, defined in this case as the default value of $exp(1.645 \cdot 0.20)$. This calculation produces a B_{pa} value of 42838 t.

The first forward simulation was conducted assuming no error in the assessment estimates for the advice year, 2019, or autocorrelation in those errors (`Fcv = 0, Fphi = 0`). This allowed the calculation of the fishing mortality that would lead the SSB to the level set by B_{lim}, $F_{lim} = 0.4196$. Subsequently, the value of the corresponding PA level of fishing mortality was computed as $F_{pa} = F_{lim}/\phi = 0.3019$.

[2]Stocks with a wide dynamic range of SSB, and evidence that recruitment is or has been impaired.

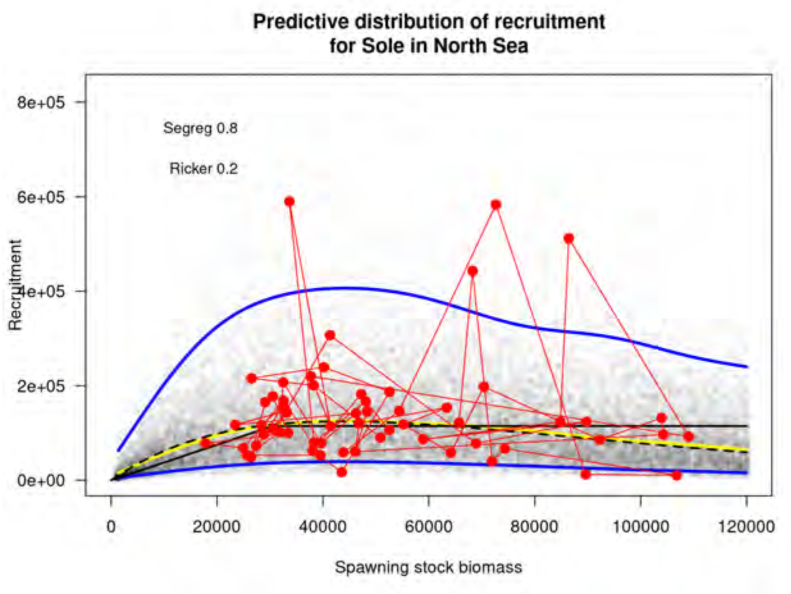

Figure 2: Fit of the two initial stock-recruitment relationships to the sol.27.4 SSB and recruits time series.

A new model fit was carried out in which the last three years of data were removed. From a forward simulation based on those results, this time conducted with standard values for assessment error and autocorrelation (`Fcv = 0.212, Fphi = 0.423`), an initial estimate of F_{MSY} and F_{05} were obtained. A subsequent simulation run provided an initial value for $\mathrm{MSY}B_{trigger}$. This value was then applied in a new simulation run to calculate a new candidate value for F_{05} (Figure 3). A comparison of this value with the candidate F_{MSY} led to adopting as value for F_{MSY} the initial candidate calculation, $F_{\mathrm{MSY}} = 0.2072$.

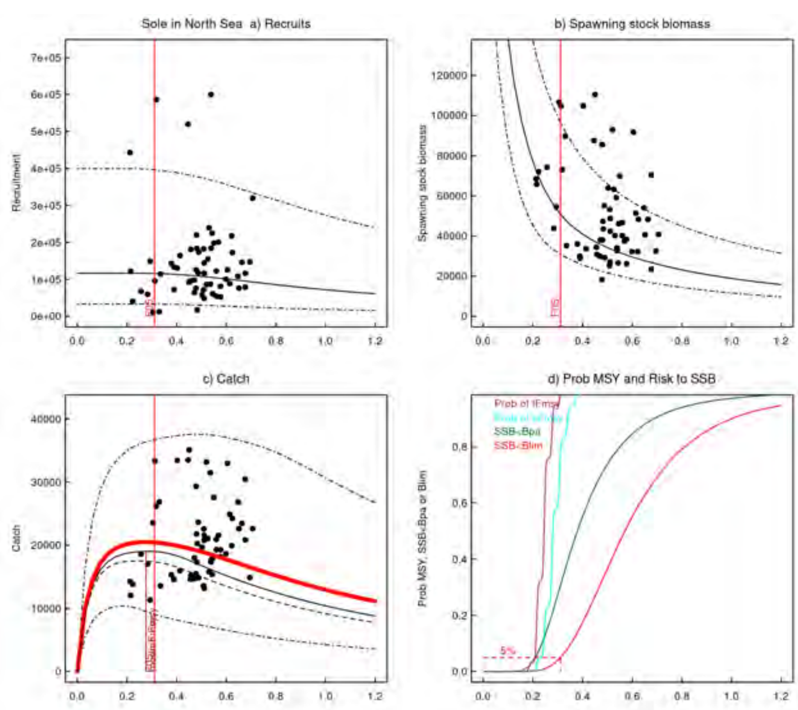

Figure 3: Summary plot of the final eqsim simulation.

The times series of fishing mortality for the stock (Figure 4) shows the last five yearly estimates to be above F_{MSY}. The value of the MSY$B_{trigger}$ reference point was therefore set to equal B_{pa}, at a level of 42 838 t.

Figure 4: Time series of estimated mean fishing mortality for ages 2-6 compared with relevant candidate reference points.

4.1 Proposed reference points

The complete table of proposed reference points, obtained from the analysis presented above, can be found in the following table

Reference point	Value	Technical basis
MSY Btrigger	42 838 t	B_{pa}
FMSY	0.2072	EQsim analysis based on the recruitment period 1958-2015
Blim	30 828 t	Break-point of hockey stick stock-recruit relationship, based on the recruitment period 1958-2018
Bpa	42 838 t	$B_{lim} \cdot \exp(1.645 \cdot 0.2)$
Flim	0.4196	EQsim analysis, based on the recruitment period 1958-2018
Fpa	0.3019	$F_{lim} / \exp(1.645 \cdot 0.2)$
F05	0.311	EQsim analysis
MAP MSY Btrigger	42 838 t	MSY
MAP range Flower	0.1231-0.2072	Consistent with ranges provided by ICES (2017a), resulting in no more than 5% reduction in long-term yield compared with MSY

Reference point	Value	Technical basis
MAP range Fupper	0.2072-0.3408	Consistent with ranges provided by ICES (2017a), resulting in no more than 5% reduction in long-term yield compared with MSY

4.2 Sensitivity runs

A sensitivity run was conducted in which a forward simulation run was conducted using a moving window for the selectivity-at-age matrix, from the last ten years (2009-2018) to one ending ten years before (2000-2009). Biological information was still taken from the same time period.

This analysis returned a range of estimates for F_{MSY} between 0.200 and 0.288.

5 Discussion

The reference point calculation does appear to be robust. Reference points are not too distant from those estimated in the previous benchmark in 2015, despite the changes in the estimated recent trajectory of the stock obtained from the new AAP model run that uses the combined BTS index of abundance.

Questions remain on the precise form of the stock recruit relationship, although the use of the segmented regression appears coherent for the purpose of calculating reference points for short-term advice. Large recruitments of North Sea sole, as observed again in the 2018 year class, not used in this analysis, appear to be generally followed by recruitment events at lower-than-average levels. These patterns could have an effect on the suitability of reference point estimates across those two time periods, with or without the influence of a large year class in the spawning biomass.

6 References

Aarts, G., and J. J. Poos. 2009. "Comprehensive Discard Reconstruction and Abundance Estimation Using Flexible Selectivity Functions." *ICES Journal of Marine Science* 66 (4): 763–71. https://doi.org/10.1093/icesjms/fsp033.

ICES. 2017. "ICES Fisheries Management Reference Points for Category 1 and 2 Stocks," no. ICES Advice Technical Guidelines 12.4.3.1: 19. https://doi.org/10.17895/ices.pub.3036.

7 Appendix A: Reference points calculation in R

```
# model_refpts.R - Estimate reference points (benchmark)
# 2020_sol.27.4_assessment/model_refpts.R

# Iago MOSQUEIRA (WMR) <iago.mosqueira@wur.nl>
#
# Distributed under the terms of the EUPL-1.2

library(msy)

# SETTINGS

Fs <- seq(0, 1.5, length=51)
nsamp <- 2000

# SELECT run up to 2018
runrp <- retro[['2018']]

# USE 5 y for selex and biology
bio.years <- c(-4, -0) + dims(runrp)$maxyear
sel.years <- c(-4, -0) + dims(runrp)$maxyear

# REMOVE no years
remove.years <- NULL

# FIT all models

srfit0 <- eqsr_fit(runrp, nsamp = nsamp, models = c("Segreg", "Ricker"))

# NOTE Segreg CHOSEN

# FIT segreg to obtain BLIM & BPA (Type 2)

srfit1 <- eqsr_fit(runrp, nsamp = nsamp,
  models = "Segreg")

Blim <- srfit1[["sr.det"]][,"b"]

# PA from sd(ssb)[,2019], NOTE too low
pa <- c(exp(1.645 * sqrt(var(ssb(fit)[,'2019'])) / mean(ssb(fit)[,'2019'])))

# PA from cv=0.2, exp(1.645 * 0.2)
pa <- exp(1.645 * 0.2)

Bpa <- Blim * pa

# SIMULATE all models w/10 y, Fcv=Fphi=0, Btrigger=0

srsim1 <- eqsim_run(srfit1,
  bio.years = bio.years, sel.years = sel.years,
  Fcv = 0, Fphi = 0,
  Btrigger=0, Blim = Blim, Bpa = Bpa,
  Fscan = Fs,
  verbose = FALSE)

# EXTRACT Flim and Fpa
Flim <- srsim1$Refs2["catF", "F50"]
```

```r
Fpa <- Flim / pa

# FIT all models, REMOVE last remove.years
srfit2 <- eqsr_fit(runrp, nsamp = nsamp,
  models = "Segreg",
  remove.years=remove.years)

# SIMULATE, Fcv=0.212, Fphi=0.423 (WKMSYREF4)
srsim2 <- eqsim_run(srfit2,
  bio.years = bio.years, sel.years = sel.years,
  bio.const = FALSE, sel.const = FALSE,
  Fcv=0.212, Fphi=0.423,
  Btrigger=0, Blim = Blim, Bpa = Bpa,
  Fscan = Fs,
  verbose = FALSE)

cFmsy <- srsim2$Refs2["lanF", "medianMSY"]
F05 <- srsim2$Refs2["catF", "F05"]

# SIMULATE for Btrigger
srsim3 <- eqsim_run(srfit2,
  bio.years = bio.years, sel.years = sel.years,
  bio.const = FALSE, sel.const = FALSE,
  Fcv = 0, Fphi = 0,
  Btrigger=0, Blim = Blim, Bpa = Bpa,
  Fscan = Fs,
  verbose = FALSE)

# Btrigger < Bpa -> Bpa
x <- srsim3$rbp[srsim3$rbp$variable=="Spawning stock biomass", ]
cBtrigger <- x[which(abs(x$Ftarget - cFmsy) == min(abs(x$Ftarget - cFmsy))), "p05"]

# SIMULATE
srsim4 <- eqsim_run(srfit2,
  bio.years = bio.years, sel.years = sel.years,
  bio.const = FALSE, sel.const = FALSE,
  Fcv=0.212, Fphi=0.423,
  Btrigger=cBtrigger, Blim = Blim, Bpa = Bpa,
  Fscan = seq(0, 1.2, len = 40),
  verbose = FALSE)

F05 <- srsim4$Refs2["catF", "F05"]

# If F05 < Fmsy, then Fmsy = F05
if(cFmsy > F05) {
  Fmsy <- F05
} else {
  Fmsy <- cFmsy
}

# IF Btrigger < Bpa, then Btrigger = Bpa, then redo srsim4
# OR IF Fbar 5yr != Fmsy

if(cBtrigger < Bpa | all(tail(fbar(runrp), 5) > Fmsy)) {

  Btrigger <- Bpa

  srsim4 <- eqsim_run(srfit2,
```

```r
    bio.years = bio.years, sel.years = sel.years,
    bio.const = FALSE, sel.const = FALSE,
    Fcv=0.212, Fphi=0.423,
    Btrigger=Btrigger, Blim = Blim, Bpa = Bpa,
    Fscan = seq(0, 1.2, len = 40),
    verbose = FALSE)

  cFmsy <- srsim4$Refs2["lanF", "medianMSY"]
  F05 <- srsim4$Refs2["catF", "F05"]

  # If F05 < Fmsy, then Fmsy = F05
  if(cFmsy > F05) {
    Fmsy <- F05
  }
}

# FMSY (low - upp) w/o Btrigger
lFmsy <- srsim3$Refs2["lanF", "Medlower"]
uFmsy <- srsim3$Refs2["lanF", "Medupper"]

# REFPTS
refpts <- FLPar(Btrigger=Btrigger, Fmsy=Fmsy, Blim=Blim, Bpa=Bpa,
  Flim=Flim, Fpa=Fpa, lFmsy=lFmsy, uFmsy=uFmsy,
  units=c("t", "f", rep("t", 2), rep("f", 4), rep("t", 2)))

# SENSITIVITY

# sel.years
years <- setNames(lapply(seq(2009, by=-1, length=10), seq, by=9, length=2),
  seq(2018, by=-1, length=10))

# RUN w/srsim2 conditions
sens_sel.years <- parallel::mclapply(years, eqsim_run, fit=srfit2,
  bio.years = bio.years, bio.const = FALSE, sel.const = FALSE,
  Fcv=0.212, Fphi=0.423, Btrigger=0, Blim = Blim, Bpa = Bpa,
  Fscan = Fs, verbose = FALSE, mc.cores=3)

sensel_fmsy <- cbind(do.call(rbind, lapply(sens_sel.years, function(x) {
  data.frame(Fmsy05=x$Refs2['lanF', 'Medlower'],
    Fmsy95=x$Refs2['lanF', 'Medupper'],
    FmsyMed=x$Refs2['lanF', 'medianMSY'])
  })), year=names(years))

# bio.years
sens_bio.years <- parallel::mclapply(years, eqsim_run, fit=srfit2,
  sel.years = sel.years, bio.const = FALSE, sel.const = FALSE,
  Fcv=0.212, Fphi=0.423, Btrigger=0, Blim = Blim, Bpa = Bpa,
  Fscan = Fs, verbose = FALSE, mc.cores=3)

senbiol_fmsy <- cbind(do.call(rbind, lapply(sens_bio.years, function(x) {
  data.frame(Fmsy05=x$Refs2['lanF', 'Medlower'],
    Fmsy95=x$Refs2['lanF', 'Medupper'],
    FmsyMed=x$Refs2['lanF', 'medianMSY'])
  })), year=names(years))

sens <- list(sel.years=senSel_fmsy, bio.years=senbiol_fmsy)
```