2 Blue whiting (*Micromesistius poutassou*) in subareas 27.1–9, 12, and 14 (Northeast Atlantic)

Blue whiting (*Micromesistius poutassou*) is a small pelagic gadoid that is widely distributed in the eastern part of the North Atlantic. The highest concentrations are found along the edge of the continental shelf in areas west of the British Isles and on the Rockall Bank plateau, where it occurs in large schools at depths ranging between 300 and 600 meters, and is also present in almost all other management areas between the Barents Sea and the Strait of Gibraltar and west to the Irminger Sea. Blue whiting reaches maturity at 2–7 years of age. Adults undertake long annual migrations from the feeding grounds to the spawning grounds. Most of the spawning takes place between March and April, along the shelf edge and banks west of the British Isles. Juveniles are abundant in many areas, with the main nursery area believed to be the Norwegian Sea. See the Stock Annex for further details on stock biology.

2.1 ICES advice in 2019

ICES notes that fishing mortality (F) has decreased since 2015 but is estimated to be above F_{MSY} in 2019. Spawning-stock biomass (SSB) has decreased since 2018 but it is estimated to remain well above MSY $B_{trigger}$. Recruitment (R) in 2017 to 2019 is estimated to be low, following a period of high recruitment. ICES advised that when the long-term management strategy agreed by the European Union, the Faroe Islands, Iceland, and Norway is applied, catches in 2020 should be no more than 1 161 615 tonnes.

2.2 The fishery in 2019

The total catch in 2019 was 1.52 million tonnes. The main fisheries on blue whiting were targeting spawning and post-spawning fish (Figures 2.2.1 and 2.2.2). Most of the catches (89%) were taken in the first two quarters of the year and the largest part of this was taken along the slopes of the Western European shelf, in the Rockall Trough and in the deep trenches around the Faroes. Smaller quantities were taken in the Norwegian Trench and along the coast of Spain and Portugal.

The fishery in the latter half of the year was mainly east of the Faroes and in the central Norwegian Sea, with smaller amounts in the Norwegian Trench, along the slopes of the Western European shelf and along the coast of Portugal and Spain.

The multinational fleet targeting blue whiting in 2019 consisted of several types of vessels from 17 countries. The bulk of the catch is caught with large pelagic trawlers, some with capacity to process or freeze on board. The remainder is caught by RSW vessels.

2.3 Input to the assessment

At the Inter-Benchmark Protocol on Blue Whiting, IBPBLW (ICES, 2016a), it was decided to use preliminary within year, quarter 1 and quarter 2, catch-at-age data in the assessment to get additional information to the within year IBWSS result. In most recent years around 90% of the annual catches of the age 3+ fish are taken in the first half year, which makes it reasonable to estimate the total annual catch-at-age from reported first semester (Q1 & Q2) data. The catch data

sections in this report give first a comprehensive description of the 2019 data as reported to ICES and then a section including a brief description of the 2020 preliminary catch data.

2.3.1 Officially reported catch data

Official catches in 2019 were estimated as 1 515 527 tonnes based on data provided by WGWIDE members (Table 2.3.1.1). Data provided as catch by rectangle represented more than 99% of the total WG catch in 2019.

In 2019, the majority of catches were caught at the spawning grounds with largest contribution from ICES area 27.7.c, 27.5.b, 27.6.a, and 27.7.k respectively (Figure 2.3.1.1; Table 2.3.1.2, 2.3.1.3), and caught respectively in quarter 1 and quarter 2 (Figure 2.3.1.6). In the first two quarters, catches are taken over a broad area, with the highest catches respectively in 27.7.c, 27.5.b, and 27.6.a, while later in the year catches are mainly taken further north in area 27.2.a and in the North Sea (27.4.a) (Figure 2.3.1.6 and 2.3.1.7 and Table 2.3.1.3).The spatial and temporal distribution of catches in 2019 are similar to previous years (Figures 2.3.1.2, 2.3.1.3, 2.3.1.4; Table 2.3.1.4). Majority of blue whiting were caught by four nations, Norway, Faroe Islands, Iceland, and Russia, respectively (Figure 2.3.1.5).

Discards of blue whiting are small. Most of the blue whiting caught in directed fisheries are used for reduction to fish meal and fish oil. However, some discarding occurs in the fisheries for human consumption and as bycatch in fisheries directed towards other species.

Reports on discarding from fisheries which catch blue whiting were available from the Netherlands for the years 2002—2007 and 2012—2014. A study carried out to examine discarding in the Dutch fleet found that blue whiting made a minor contribution to the total pelagic discards when compared with the main species mackerel, horse mackerel and herring.

The blue whiting discards data provided by Portuguese vessels operating with bottom otter trawl within the Portuguese portions of ICES Division 27.9.a are available since 2004. The discards data are from two fisheries: the crustacean fishery and the demersal fishery. The blue whiting estimates of discards in the crustacean fishery for the period of 2004–2011 ranged between 23% and 40% (in weight). For the same period the frequency of occurrence in the demersal fishery was around zero for the most of the years, in the years where it was significant (2004, 2006, 2010) ranged between 43% and 38% (in weight). In 2019, discards were 24% of the total catches for blue whiting along the Portuguese coast (Table 2.3.1.5). The total catch from Portugal is less than a half percentage of the total international catches.

Information on discards was available for Spanish fleets since 2006. Blue whiting is a bycatch in several bottom-trawl mixed fisheries. The estimates of discards in these mixed fisheries in 2006 ranged between 23% and 99% (in weight) as most of the catch is discarded and only the catch of the last day may be retained for marketing fresh. The catch rates of blue whiting in these fisheries are however low. In the directed fishery for blue whiting for human consumption with pair trawls, discards were estimated to be 5% (in weight) in 2019 (Table 2.3.1.5). Spanish catches are around 2% of the international catches.

In general, discards are assumed to be small in the blue whiting directed fishery. Discard data are provided by Denmark, France, Ireland, Portugal, Spain, Sweden, UK (England and Wales) and UK (Scotland), to the working group. The discards constituted 0.17% of the total catches, 2570 tonnes. BMS landings were reported by UK (England and Wales), although no minimum conservation reference size is defined on blue whiting, those landings are related to fish that have not been sold at market but was landed, for example damaged fish, and it correspond to 34 tonnes in 2019.

The total estimated catches (tonnes) inside and outside the NEAFC regulatory area by country were reported on Table 2.3.1.6. The catches inside the NEAFC RA represent 22% of the total catches of blue whiting in 2019.

2.3.1.1 Sampling intensity

In 2019, 84% of catches were covered by the sampling program. In 2019, 1537 length samples, 1253 age samples, were collected from the fisheries , and 136604 fish were measured and 17869 were aged. Sampling intensity for blue whiting with detailed information on catch, proportion of catch covered by sampling program, the number of samples, number of fish measured, and number of fish aged per year from 2000 to 2019 is given in Table 2.3.1.1.1. Sampling intensity per country, quarter and ICES division for 2019 is listed in Tables 2.3.1.1.2, 2.3.1.1.3 and 2.3.1.1.4. The most intensive sampling, considering the age samples and the number of aged fish, took place in areas 27.2.a, 27.5.b, 27.6.b, 27.7.b, 27.7.c, 27.7.k, 27.8.c and 27.9.a. No sampling was carried out by Greenland, Poland, Sweden and the UK (England, Wales, Northern Ireland) which combined represent 4% of the total catches. The sampled and estimated catch-at-age data are shown on Figure 2.3.1.1.1.

Sampling intensity for age and weight of blue whiting are made in proportion to landings according to CR 1639/2001 and apply to EU member states. The Fisheries Regulation 1639/2001, requires EU Member States to take a minimum of one sample for every 1000 tonnes landed in their country. Various national sampling programs are in force.

2.3.1.2 Age compositions

As an example of an age-length key from sampled catches in 2019, data from ICES area 27.6.a is presented by quarter and country (Figure 2.3.1.2.1). The mean length (mm) by ages reveals that age classifications do present some differences between countries. The difference in mean length-at-age increases in older ages, higher than age 6.

The ICES InterCatch program was used to calculate the total international catch-at-age, and to document how it was done.

2.3.2 Preliminary 2020 catch data (Quarters 1 and 2)

The preliminary catches for 2020 as reported by the WGWIDE members are presented in Table 2.3.2.1.

The spatial distribution of these 2020 preliminary catches is similar to the distribution in 2019 with majority of catches taken in division 27.7.c, 27.6.a, 27.5.b, and 27.7.k , respectively (Figure 2.3.2.1 and Table 2.3.2.2).

Sampling intensity for blue whiting from the preliminary catches by area with detailed information on the number of samples, number of fish measured, and number of fish aged is presented in Table 2.3.2.2.

WGWIDE estimated the expected total catch for 2020 from the sum of declared national quotas, corrected for expected national uptake and transfer of these quotas (Table 2.3.2.3).

For the period 2016 to 2019, preliminary and final catch estimates are similar with maximum deviation in 2019 when the final catch was 4.7 % higher than the preliminary catch (Table 2.3.2.4). Age composition is also similar between preliminary and final catch data, with a few exceptions between 2016 and 2018, however some deviations were observed for the ages 1 and 2 in 2019 (Figure 2.3.2.2).

The estimation of catch at age and mean weight at age followed the method described in the (2019 updated) Stock Annex.

2.3.3 Catch-at-age

Catch-at-age numbers from 1981 to 2020 are presented in Table 2.3.3.1 and catch proportions at age shown in Figure 2.3.3.1. Strong year classes that dominated the catches can be clearly seen in the early 1980s, 1990 and the late 1990s. In 2020, the age compositions are dominated by the ages 4-6

Catch curves for the international catch-at-age dataset (Figure 2.3.3.2), indicate a consistent decline in catch number by cohort in years with rather high landings (and probably similar high effort). The catch curves for year classes 2010-2011 show a consistent decline in the stock numbers with an estimated total mortality (Z=F+M) around 0.6-0.7 for the ages fully recruited to the fisheries. With an estimated historical F around 0.4-0.5, this indicates that the used natural mortality (0.2) is a reasonable choice for the fully selected year classes.

2.3.4 Weight at age

Table 2.3.4.1 and Figure 2.3.4.1 show the mean weight-at-age for the total catch during 1981-2020 used in the stock assessment. Mean weight at ages 3-9 has generally decreased in the most recent 10 years, even though some increase can be observed for the most recent years for ages 4-6.

The weight-at-age for the stock is assumed the same as the weight-at-age for the catch.

2.3.5 Maturity and natural mortality

Blue whiting natural mortality and proportion of maturation-at-age are shown in Table 2.3.5.1. See the Stock Annex for further details.

2.3.6 Information from the fishing industry

No new information available.

2.3.7 Fisheries independent data

Data from the International Blue Whiting spawning stock survey are used by the stock assessment model (last updated in 2019), while recruitment indices from several other surveys are used to qualitatively adjust the most recent recruitment estimate by the assessment model and to guide the recruitments used in the forecast.

2.3.7.1 International Blue Whiting spawning stock survey

The Stock annex gives an overview of the surveys available for the blue whiting. The International Blue Whiting Spawning Stock Survey (IBWSS) is the only survey used as input to the assessment model. The survey was not carried out in 2020 due to the COVID-19 situation.

The full time series of IBWSS was recalculated in summer 2020, using the same software (StoX) and method as previously applied. The recalculated values are presented in Table 2.3.7.1.1. and Figure 2.3.7.1.1.a. Differences between the old values and the recalculated values are displayed in Table 2.3.7.1.2. The indices are identical for 7 years. The indices deviate with maximum of 1 (probably a rounding issue) for 3 years and with a deviation > 1 occurs in 6 years with the largest deviation in relative terms for 2017 with deviations up to 4%. WGWIDE decided to use the recalculated values as these can be reproduced, are practically identical and as assessment results are the same for old and recalculated index.

The survey time-series (2004-2019, not updated in 2020) show variable internal consistency (Figure 2.3.7.1.1B) for the main age groups.

The distribution of acoustic backscattering densities for blue whiting for the period 2016-2019 is shown in Figure 2.3.7.1.2. The abundance estimate of blue whiting for IBWSS are presented in Table 2.3.7.1.1.

Length and age distributions for the period 2015 to 2019 are given in Figure 2.3.7.1.3.

Survey indices, (ages 1-8 years 2004-2019) as applied in the stock assessment are shown in Table 2.3.7.1.1.

2.3.7.2 Other surveys

The Stock Annex provides information and time-series from surveys covering parts of the stock area. A brief survey description and survey results are provided below.

The International ecosystem survey in the Nordic Seas (IESNS) in May which is aimed at observing the pelagic ecosystem with particular focus on Norwegian spring-spawning herring and blue whiting (mainly immature fish) in the Norwegian Sea (Table 2.3.7.2.1).

Norwegian bottom-trawl survey in the Barents Sea (BS-NoRu-Q1(Btr)) in February-March where blue whiting are regularly caught as a bycatch species. This survey gives the first reliable indication of year class strength of blue whiting. The 1-group in this survey is defined as less than 19 cm (Table 2.3.7.2.2).

Icelandic bottom-trawl surveys on the shelf and slope area around Iceland. Blue whiting is caught as bycatch species and 1-group is defined as less than 22 cm in March (Table 2.3.7.2.3).

Faroese bottom-trawl survey on the Faroe plateau in spring where blue whiting is caught as bycatch species. The 1-group in this survey is defined as less than 23 cm in March (Table 2.3.7.2.4).

The International Survey in Nordic Seas and adjacent waters in July-August (IESSNS). Blue whiting are from 2016 included as a main target species in this survey and methods are changed to sample blue whiting. This was a recommendation from WGWIDE 2015 to try to have one more time-series for blue whiting. Data for the survey are not used yet, due to the short time series.

2.4 Stock assessment

The IBWSS survey is the only survey used by the SAM assessment, but this survey was cancelled in 2020 due to the COVID-19 pandemic.

Apart from the missing 2020 IBWSS data, the presented assessment in this report follows the recommendations from the Inter-Benchmark Protocol of Blue (ICES, 2016a) to use the SAM model.

2.4.1 Analysis of the effects of missing survey data for the terminal year.

The use of preliminary catch at age data was introduced in 2016, to have additional data for evaluation of potential bias in the survey results from the same year. Without a survey in the terminal year (the case this year) the benefit of using preliminary catch data will depend on the quality of the preliminary catch data. There is a high consistency between the preliminary and final catches (Figure 2.3.2.2). However, for a better understanding of the importance of preliminary catch data in a situation like this year, with no survey data for the terminal year, scenarios

were investigated with 2017 and 2018 as final survey year, and with use of both preliminary and "final" data for the terminal year.

As an example of that analysis, the results for a scenario with 2018 as the last IBWSS year, and 1) no preliminary data for 2019, 2) preliminary data for 2019 and 3) final catch data for 2019 are shown in Figure 2.4.1.1. If run 3) with the use of final catch data for 2019 is seen as the most "correct" assessment results (as it contains the longest time series with final data), it is seen that the use of preliminary catch data gives an assessment result for SSB and F closer to the "correct" assessment than the assessment with no preliminary catch data. Based on the log likelihood from the models, the use of final data gave a slightly better fit than the use of preliminary data (as expected). The best fit was however obtained for the run without catch data for the year after the last survey year, probably due to the fewer observations in that run. There was no clear conclusion on the "best" use of data from the parameter estimates from the three configurations.

The scenarios also showed that the inclusion of preliminary catch data did not change the historical estimates of SS, SSB and recruitment much.

The analysis was only conducted for two analyses using 2017 and 2018 as the last year with survey data. Both sets of runs showed a small improvement in assessment result using the preliminary catches. In addition, with use of preliminary catch data, the benchmark recommended method for calculating F in the "intermediate year" (use assessment F from the terminal year, i.e. from preliminary catches) could also be applied. Based on these reasons, the assessment this year used also preliminary data for 2020.

2.4.2 2020 stock assessment

For a model as SAM, Berg and Nielsen (2016) pointed out that the so-called "One Step Ahead" (OSA) residuals should be used for diagnostic purposes. The OSA residuals (Figure 2.4.2.1) show a quite random distribution of residuals. There might be an indication of "years effect" (too low index) for the IBWSS 2015 observations which has also be seen in previous assessment.

The estimated parameters from the SAM model from this year's assessment and from previous years (retrospective analysis) are shown in Table 2.4.2.1. There are only a very few abrupt changes in the estimated parameters over the time-series presented. Observation noises for the IBWSS increase in 2019 and 2020 (with no new observations) are practically the same, indicating a similar model weighting of data for the two years. The lowest observation noise has in all years been from catches ages 3-8.

The process error residuals ("Joint sample residuals") (Figure 2.4.2.2) are reasonable randomly distributed. Process noise SAM is implemented as a "process mortality, Z"; these deviations in mortalities are shown in Figure 2.4.2.3. The deviations in mortality (plus or minus mortality) seems fairly randomly distributed without very pronounced clusters.

The correlation matrix between ages for the catches and survey indices (Figure 2.4.2.4) show a modest observation correlation for the younger ages and a stronger correlation for the older ages. This difference is more distinct for catches, probably because it includes older ages (1-10+) than the survey data (ages 1-8).

Figure 2.4.2.5 presents exploitation pattern for the whole time-series. There are no abrupt changes in the exploitation pattern from 2010 to 2020, even though the landings in 2011 were just 19% of the landings in 2010, which might have given a different fishing practice. The plateau in selection at age 6 and older seen for the last 15 years seems more realistic than the more linear selection estimated for previous years. The estimated rather stable exploitation pattern might be influenced by the use of correlated random walks for F at age with a high estimated correlation coefficient (rho = 0.94, Table 2.4.2.1).

The retrospective analysis (Figure 2.4.2.6) shows a quite stable assessment for the last 5 years, previous years within 95% CI for the current assessment. Mohn's rho by year and as the average value over the last five years are presented in (Table 2.4.2.2). Even though the annual values might be high (reflecting large changes from one year to the next) the average Mohn's rho is rather low indicating no serious bias.

Stock summary results with added 95% confidence limits (Figure 2.4.2.7 and Table 2.4.2.5) show a decrease in fishing mortality in the period 2004—2011, followed by a steep increase in F up to 2015 after which F has fluctuated around 0.4. Recruitment increased from low recruitments in 2006–2009 to a historically high recruitment in 2015. This is followed by a lower recruitment in 2016 and a much lower recruitments in 2017-2020. SSB has increased in the period 2010-2018, followed by a large reduction.

2.4.3 Alternative model runs

The assessment models TISVPA and XSA were run for a better screening of potential errors in input and for comparison with the SAM results. All three models gave a similar result with respect F and SSB dynamics (Figure 2.4.3.1), even though the absolute values differ between models.

SAM and TISVPA show a low recruitment in the most recent years, while XSA estimates recruitment higher. Without survey data from 2020, XSA cannot estimate recruits in the terminal year and recruitment was estimated in an alternative way, which might explain the higher XSA estimate of recruitment in the last two years.

2.5 Final assessment

Following the recommendations from Inter-Benchmark Protocol on Blue Whiting (ICES, 2016a) the SAM model is used for the final assessment. The model settings can be found in the Stock annex. Alternative model runs give similar results.

Input data are catch numbers-at-age (Table 2.3.3.1), mean weight-at-age in the stock and in the catch (Table 2.3.4.1) and natural mortality and proportion mature in Table 2.3.5.1. Applied survey data are presented in Table 2.3.7.1.1.

The model was run for the period 1981—2020, with catch data up to 2019 and preliminary catch data for the first semester (Q1 and Q2) of 2020 raised to expected annual catches, and survey data from March-April, 2004–2019 (no new survey in 2020). SSB 1st January in 2020 is estimated from survivors and estimated recruits (for 2021 estimated outside the model, see short-term forecast section). 11% of age group 1 is assumed mature, thus recruitment influences the size of SSB. The key results are presented in Tables 2.4.2.3–2.4.2.4 and summarized in Table 2.4.2.5 and Figure 2.4.2.7. Residuals of the model fit are shown in Figures 2.4.2.1 and 2.4.2.2.

2.6 State of the Stock

F has increased from a historic low at 0.051 in 2011 to around 0.4 since 2014. F has been above F_{MSY} (0.32) since 2014. SSB increased from 2010 (2.73 million tonnes) to 2017 (6.27 million tonnes), followed by a decline to 2021 (3.25 million tonnes). SSB has been above B_{pa} (2.25 million tonnes) since 1997.

Recruitment (age 1 fish) was high in 2014-2016 followed by recruitments in the low end of the historical recruitments. The lower recruitment in combination with a high F in recent years have resulted in a decline in SSB.

2.7 Biological reference points

In spring of 2016, the Inter-Benchmark Protocol on Blue Whiting (IBPBLW) (ICES, 2016a) delegated the task of re-evaluating biological reference points of the stock to the ICES Workshop on Blue Whiting Long Term Management Strategy Evaluation (WKBWMSE) (ICES 2016b). During the WGWIDE meeting 2017, WKBWMSE concluded to keep B_{lim} and B_{pa} unchanged but revised F_{lim}, F_{pa}, and F_{MSY}. The table below summarises the currently used reference points.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	2.25 million t	B_{pa}	ICES (2013a, 2013b, 2016b)
	F_{MSY}	0.32	Stochastic simulations with segmented regression stock–recruitment relationship	ICES (2016b)
Precautionary approach	B_{lim}	1.50 million t	Approximately B_{loss}	ICES (2013a, 2013b, 2016b)
	B_{pa}	2.25 million t	B_{lim} exp(1.645 × σ), with σ = 0.246	ICES (2013a, 2013b, 2016b)
	F_{lim}	0.88	Equilibrium scenarios with stochastic recruitment: F value corresponding to 50% probability of (SSB< B_{lim})	ICES (2016b)
	F_{pa}	0.53	Based on F_{lim} and assessment uncertainties. F_{lim} exp(−1.645 × σ), with σ = 0.299	ICES (2016b)

2.8 Short-term forecast

2.8.1 Recruitment estimates

The benchmark WKPELA in February 2012 concluded that the available survey indices should be used in a qualitative way to estimate recruitment, rather than using them in a strict quantitative model framework. The WGWIDE has followed this recommendation and investigated several survey time-series indices with the potential to give quantitative or semi-quantitative information of blue whiting recruitment. The investigated survey series were standardized by dividing with their mean and are shown in Figure 2.8.1.1.

The International Ecosystem Survey in the Nordic Seas (IESNS) only partially covers the known distribution of recruitment from this stock. The 1–group (2019 year class) and the 2–group (2018 year class) indices from the survey in 2020 were approximately at the median and below the median of the historical range, respectively.

The International Blue Whiting Spawning Stock Survey (IBWSS) was not updated in 2020.

The Norwegian bottom-trawl survey in the Barents Sea (BS-NoRu-Q1(Btr)) in February-March 2020, showed that 1-group blue whiting was above the median in the time series(Table 2.3.7.2.2). However, the index in 2020 is low compared to the strong year classes observed earlier. This index should be used as a presence/absence index, in the way that when blue whiting is present in the Barents Sea, this is usually a sign of a strong year class, as all known strong year classes have been strong also in the Barents Sea.

The 1-group estimate in 2020 (2019 year class) from the Icelandic bottom-trawl survey showed an increase compared to 2019 and was above the median in the time-series.

The 1-group estimate in 2020 (2019 year class) from the Faroese Plateau spring bottom-trawl survey was the lowest observed in the time-series.

In conclusion, the indices from available survey time-series indicate that the 2018 year class is in the low end and it corresponds to the SAM assessment results. The 2019 year classes estimated from surveys are also in the low end, which also is the result of the SAM assessment where it is in the lower end. It was therefore decided not to change the SAM estimate of the 2018 and 2019 year classes.

No information is available for the 2020 and 2021 year classes and the geometric mean of the full time-series (1981—2019) was used for these year classes (14.75 billion at age 1 in 2021) (Table 2.8.1.1).

2.8.2 Short-term forecast

As decided at WGWIDE 2014, a deterministic version of the SAM forecast was applied. Details about specific implementation can be found in the Stock Annex.

2.8.2.1 Input

Table 2.8.2.1.1 lists the input data for the short-term predictions. Mean weight at age in the stock and mean weight in the catch are the same, and are calculated as three year averages (2018—2020) in accordance with the 2019 updated Stock Annex. Selection (exploitation pattern) is based on F in the most recent year. The proportion mature for this stock is assumed constant over the years and values are copied from the assessment input.

Recruitment (age 1) in 2019 and 2020 are assumed as estimated by the SAM model, as additional survey information was not conflicting this result. Recruitment in 2021 and 2022 are assumed at the long-term average (geometric mean for the full time-series, minus the last year (1981-2019).

As the assessment uses preliminary catches for 2020 an estimate of stock size exist for the 1st of January 2021. The normal use of an "intermediate year" calculation is not relevant in this case. F in the "intermediate year" (2020) is as calculated by the assessment model. Catches in 2020 is the (model input) preliminary catches (1478358 tonnes). Intermediate year assumptions are summarised in Table 2.8.2.1.2.

2.8.2.2 Output

A range of predicted catch and SSB options from the deterministic short-term forecast used for advice are presented in Table 2.8.2.2.1.

Following the ICES MSY framework or the target F from the LTMS implies fishing mortality to be at F_{MSY} = 0.32 which will give a TAC in 2021 at 841717 tonnes. This corresponds to a 27.5 % reduction compared to the ICES advice last year, and 43.1% reduction compared to the preliminary estimate of catches in 2020.

The LTMS specifies a TAC constraint at +25 / -20 %. With at maximum decrease at 20% in catches in relation to the ICES advice last year (LTMS advice), catches in 2021 is calculated to be at 929292 tonnes. SSB in 2022 is predicted to decrease 6.2 % to 3046216 tonnes, if the advised catches are taken.

2.9 Comparison with previous assessment and forecast

Comparison of the final assessment results from the last 5 years is presented in Figure 2.9.1. The last two assessments are very similar for the historical results for SSB and F, but differs more for recruitment, probably an effect of the missing 2020 survey results. For the five years period, result from the 2018 assessment differs most.

2.10 Quality considerations

Based on the confidence interval produced by the assessment model SAM there is a moderate to high uncertainty of the absolute estimate of F and SSB and the recruiting year classes (Figure 2.4.2.7). The retrospective analysis (Figure 2.4.2.6), the comparison of SSB and F estimated by three different assessment programs TISVPA, XSA and SAM (Figure 2.4.3.1) and the comparison of the 2016-2020 assessments (Figure 2.9.1) suggest a consistent assessment.

There are several sources of uncertainty: age reading, stock identity, and survey indices. As there is only one survey (IBWSS) that covers the spawning stock, the quality of the survey influences the assessment result considerably. The Inter-Benchmark Protocol on Blue Whiting (IBPBLW 2016) introduced a configuration of the SAM model that includes the use of estimated correlation for catch and survey observations. This handles the "year effects" in the survey observation in a better way than assuming an uncorrelated variance structure as usually applied in assessment models. However, a biased survey indices will still give a biased stock estimate with the new SAM configuration. The estimated correlation for catch at age observations might correspond to the age reading discrepancy estimated from inter-calibration exercise .

Utilization of preliminary catch data provides the assessment with information for the most recent year in addition to the survey information. This should give a less biased assessment, as potential biased survey data in the final year are supplemented by additional catch data.

The effect of the missing survey data for 2020 have provided slightly more uncertain assessment results for SSB and F compared to last year, and a more uncertain estimate of recruitment in 2020. The missing data seems not to have influenced the historical estimate of SSB, F and recruitment much. This year's assessment results for the historical part the time series are very close to the result estimated last year. However, additional data years, including survey data, are necessary to fully realise the effect of the missing 2020 survey data.

2.11 Management considerations

The assessment estimates low 2016-2019 year classes, which is confirmed by a series of surveys not used in the assessment model. This low recruitment will result in a decrease in stock size, and a reduction in fishing opportunities.

2.12 Ecosystem considerations

Blue whiting is one of the most abundant pelagic and mesopelagic fish stocks in the Northeast Atlantic, SSB estimated from 1.4 - 6.9 million ton during the period from 1981 to 2020 (ICES, 2020). The stock is widely distributed and highly migratory. It´s distribution range is approximately from latitude 30 °N to 80 °N and from the coast of Europe to Greenland, into Barents Sea and the Mediterranean Sea (Trenkel *et al*., 2014). Spawning is in the spring and mostly occurs on the shelf and banks west of Ireland and Scotland and major summer feeding area is in the Norwegian Sea. Blue whiting is most frequently observed at 100-600 m depth (Heino and Godo,

2002). Their most important prey is respectively euphausiids, amphipods and copepods (Pinnegar *et al*., 2015, Bachiller *et al*., 2016) and they are prey for piscivorous fish (Dolgov *et al*., 2010) and cetaceans (Hátún *et al*., 2009a). Large stock size suggests blue whiting is an important species in the pelagic and mesopelagic ecosystem of the NE Atlantic and it´s best documented ecosystem interactions are listed below:

(a) Stock productivity - recruitment: blue whiting population dynamic is driven by large annual variability in recruitment (at age 1 in the assessment model) which is not linked to spawning stock size (ICES, 2020). Changes in recruitment have been correlated to changes in the North Atlantic subpolar gyre between strong and weak states (Hátún *et al*., 2009a,b). Two hypotheses have been suggested to explain a mechanical relationship between low gyre index and high recruitment (Payne *et al*., 2012). One suggests changes in marine climate where weak gyre results in increased flow of warm subtropical waters and increased abundance of important prey for juvenile blue whiting on their nursing grounds west of Ireland and Scotland. The other suggests increasing predation of mackerel on blue whiting larvae during years of weak index, but neither has been proven right (Payne *et al*., 2012). Future benchmarks should explore options to include the subpolar gyre index in the assessment model forecast for recruitment.

(b) Changes in distribution: blue whiting spawning distribution varies between years. It has been linked to the North Atlantic subpolar gyre as a strong gyre, cold and fresh water masses on the Rockall Plateau, shrinks the spawning area compared to a weak gyre, increasing saline and warm waters at Rockall, which expands the spawning area northward and westward into Rockall Plateau (Hátún *et al.,* 2009a,b; Miesner and Payne, 2018). Salinity appears specifically to impact spawning location of blue whiting (Miesner and Payne, 2018). Future benchmarks should explore options to include information on spawning ground salinity in the assessment model forecast for recruitment.

(c) It is disputed if there are one or two blue whiting populations in the Northeast Atlantic (Keating *et al*., 2014; Pointin and Payne, 2014; ICES, 2016c; Mahé *et al*., 2016). Currently blue whiting is considered a single population for management purpose. Future benchmarks should explore the impact of single population assessment versus an assessment for two populations.

(d) Trophic interactions in the Norwegian Sea: it appears to be limited prey competition between blue whiting and the two other abundant pelagic species, Norwegian spring-spawning herring and Atlantic mackerel, as studies show limited dietary overlap between blue whiting and the two other species (Bachiller *et al*., 2016; Pinnegar *et al*., 2014). Limited prey competitions between blue whiting and mackerel can be explained by limited geographical overlap, mackerel mostly feed in the surface layer and blue whiting deeper in the water column (Utne *et al*., 2012). Whereas distribution of blue whiting and herring overlap (Utne *et al*., 2012) they appear to feed on different species (Bachiller *et al.,* 2016; Pinnegar et al., 2014). Given the current knowledge, future benchmarks do not need to prey competition between blue whiting and herring/mackerel, future benchmarks do not need to consider adding mackerel and NSS herring stock size to the blue whiting stock assessment model.

An extensive overview of ecosystem considerations relevant for blue whiting can be found in the stock annex.

2.13 Regulations and their effects

There is an agreed long-term management strategy agreed by the European Union, the Faroe Islands, Iceland and Norway. However there is no agreement between the Coastal States, i.e. EU, Norway, Iceland and the Faroe Island on the share of the blue whiting TAC. An overview of the scientific advice, the TACs (or sum of unilateral quota) and the catches is shown in Figure 2.13.1.

While from 2010 until 2013, TACs were set in line with the scientific advice, from 2014 onwards the sum of unilateral quota and catches have been 20-50% in access of the scientific advice.

WGWIDE members estimate the total expected catch to be 1,478,358 tonnes in 2020, whereas ICES advised that when the long-term management strategy agreed by the European Union, the Faroe Islands, Iceland, and Norway is applied, catches in 2020 should be no more than 1,161,615 tonnes.

2.13.1 Management plans and evaluations

A response to NEAFC request to ICES to evaluate a long-term management strategy for the fisheries on the blue whiting ICES WKBWMSE was established in the fall of 2015. The ICES Advice September 2016, "NEAFC request to ICES to evaluate a long-term management strategy for the fisheries on the blue whiting (*Micromesistius poutassou*) stock" concluded that:

- That the harvest control rule (HCR) proposed for the Long-Term Management Strategy (LTMS) for blue whiting, as described in the request, is precautionary given the ICES estimates of Blim (1.5 million t), Bpa (2.25 million t), and F_{MSY} (0.32).
- The HCR was found to be precautionary both with and without the 20% TAC change limits above Bpa. However, the 20% TAC change limits can lead to the TAC being lowered significantly if the stock is estimated to be below Bpa, while also limiting how quickly the TAC can increase once the stock is estimated to have recovered above Bpa.
- The evaluation found that including a 10% interannual quota flexibility ('banking and borrowing') in the LTMS had an insignificant effect on the performance of the HCR.

2.14 Recommendations

The WGWIDE expert group analysed the mean length at age by area and by quarter of the data submitted from the different institutes/member states and differences have been identified in the data from the northern and southern areas. Due to the impact that biased age classifications could have on the blue whiting stock assessment, an inter-calibration exercise and a workshop is needed to review the age criteria used on this species. An age reading inter-calibration exercise is currently going on, which involves the readers providing data for stock assessment, and with samples covering this species distribution, the main quarters and the length composition of catches. A workshop on age reading is also planned for June 2021, in which the results and the age classifications from the exchange will be reviewed and discussed. The age-error matrix resulting from the inter-calibration exercise and the workshop, will be used to correct the catch-at-age and survey data used for assessment. The impact of these uncertainties on age reading on the stock assessment results will be further investigated.

2.15 Deviations from stock annex caused by missing information from Covid-19 disruption.

The one and only survey used for the SAM assessment, The International Blue Whiting Spawning Stock Survey (IBWSS) was not conducted in 2020. The method used this year follows the method outlined in the Stock Annex, but setting the survey observations for 2020 to "missing". The data situation and approach are described in more details below, using the ICES template.

1. Stock: Blue whiting (*Micromesistius poutassou*) in subareas 27.1–9, 12, and 14 (Northeast Atlantic)

2. Missing or deteriorated survey data:
   The assessment uses preliminary catch at age data and survey data for the assessment year (2020). The International Blue Whiting Spawning Stock Survey (IBWSS) is the only survey used in the quantitative assessment and this survey was cancelled in 2020 due to the COVID-19 pandemic. Other surveys used for a qualitative estimate of recruitment were conducted in 2020.

3. Missing or deteriorated catch data: No

4. Missing or deteriorated commercial *LPUE*/*CPUE* data: No

5. Missing or deteriorated biological data: No

6. Brief description of methods explored to remedy the challenge:
   The use of preliminary catch at age data was introduced in 2016, to have additional data for evaluation of potential bias in the survey results from the same year. Without a survey in the terminal year (the case this year) the benefit of using preliminary catch data will depend on the quality of the preliminary catch data. There is a high consistency between the preliminary and final catches (Figure 2.3.2.2). However, for a better understanding of the importance of preliminary catch data in a situation like this year, with no survey data for the terminal year, scenarios were investigated with 2017 and 2018 as final survey year, and with use of both preliminary and "final" data for the terminal year.

   As an example of that analysis, the results for a scenario with 2018 as the last IBWSS year, and 1) no preliminary data for 2019, 2) preliminary data for 2019 and 3) final catch data for 2019 are shown in Figure 2.4.1.1. If run 3) with the use of final catch data for 2019 is seen as the most "correct" assessment results (as it contains the longest time series with final data), it is seen that the use of preliminary catch data gives an assessment result for SSB and F closer to the "correct" assessment than the assessment with no preliminary catch data. Based on the log likelihood from the models, the use of final data gave a slightly better fit than the use of preliminary data (as expected). The best fit was however obtained for the run without catch data for the year after the last survey year, probably due to the fewer observations in that run. There was no clear conclusion on the "best" use of data from the parameter estimates from the three configurations.

   The scenarios also showed that the inclusion of preliminary catch data did not change the historical estimates of F, SSB and recruitment much.

   The analysis was only conducted for two cases using 2017 and 2018 as the last year with survey data. Both sets of runs showed a small improvement in assessment result using the preliminary catches. In addition, with use of preliminary catch data, the benchmark recommended method for calculating F in the "intermediate year" (use assessment F from the terminal year, i.e. from preliminary catches) could also be applied. Based on these reasons, the assessment this year used also preliminary data for 2020.

7. Suggested solution to the challenge, including reason for this selecting this solution: See above.
8. Was there an evaluation of the loss of certainty caused by the solution that was carried out?
   The effect of the missing survey data for 2020 have provided slightly more uncertain assessment results for SSB and F compared to last year, and a more uncertain estimate of recruitment in 2020. The missing data seems not to have influenced the historical estimate of SSB,

F and recruitment much. This year's assessment results for the historical part the time series are very close to the result estimated last year. However, additional data years, including survey data, are necessary to fully realise the effect of the missing 2020 survey data.

2.16 References

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2.17 Tables

Table 2.3.1.1. Blue whiting. ICES estimated catches (tonnes) by country for the period 1988–2019.

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	2003
Denmark	18 941	26 630	27 052	15 538	34 356	41 053	20 456	12 439	52 101	26 270	61 523	82 935
Estonia					6 156	1 033	4 342	7 754	10 982	5 678	6 320	
Faroes	79 831	75 083	48 686	10 563	13 436	16 506	24 342	26 009	24 671	28 546	71 218	329 895
France		2 191				1 195		720	6 442	12 446	7 984	14 149
Germany	5 546	5 417	1 699	349	1 332	100	2	6 313	6 876	4 724	17 969	22 803
Iceland		4 977						369	302	10 464	68 681	501 493
Ireland	4 646	2 014			781		3	222	1 709	25 785	45 635	22 580
Japan					918	1 742	2 574					
Latvia					10 742	10 626	2 582					
Lithuania						2 046						
Netherlands	800	2 078	7 750	17 369	11 036	18 482	21 076	26 775	17 669	24 469	27 957	48 303
Norway	233 314	301 342	310 938	137 610	181 622	211 489	229 643	339 837	394 950	347 311	560 568	834 540
Poland	10											
Portugal	5 979	3 557	2 864	2 813	4 928	1 236	1 350	2 285	3 561	2 439	1 900	2 651
Spain	24 847	30 108	29 490	29 180	23 794	31 020	28 118	25 379	21 538	27 683	27 490	13 825
Sweden **	1 229	3 062	1 503	1 000	2 058	2 867	3 675	13 000	4 000	4 568	9 299	65 532
UK (England + Wales)***												
UK (Northern Ireland)												
UK (Scotland)	5 183	8 056	6 019	3 876	6 867	2 284	4 470	10 583	14 326	33 398	92 383	27 382
USSR / Russia *	177 521	162 932	125 609	151 226	177 000	139 000	116 781	107 220	86 855	118 656	130 042	355 319
Greenland**												
Unallocated												
TOTAL	557 847	627 447	561 610	369 524	475 026	480 679	459 414	578 905	645 982	672 437	1 128 969	2 321 406

*** From 1992 only Russia.**

**** Estimates from Sweden and Greenland: are not included in the Catch at Age Number.**

***** From 2012.**

Table 2.3.1.1. (continued). Blue whiting. ICES estimated catches (tonnes) by country for the period 1988–2019.

Country	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Denmark	89500	41450	54663	48659	18134	248	140	165	340	2167	35256	45178	39395	60868	87348	68716
Estonia	*															0
Faroes	322322	266799	321013	317859	225003	58354	49979	16405	43290	85768	224700	282502	282416	356501	349838	336569
France		8046	18009	16638	11723	8831	7839	4337	9799	8978	10410	9659	10345	13369	16784	16095
Germany	15293	22823	36437	34404	25259	5044	9108	278	6239	11418	24487	24107	20025	45555	47708	38244
Iceland	379643	265516	309508	236538	159307	120202	87942	5887	63056	104918	182879	214870	186914	228934	292944	268356
Ireland	75393	73488	54910	31132	22852	8776	8324	1195	7557	13205	21466	24785	27657	43238	49903	38836
Lithuania			4635	9812	5338						4717		1129	5300		
Netherlands	95311	147783	102711	79875	78684	35686	33762	4595	26526	51635	38524	56397	58148	81156	121864	75020
Norway	957684	738490	642451	539587	418289	225995	194317	20539	118832	196246	399520	489439	310412	399363	438426	351429
Poland														15889	12152	27185
Portugal	3937	5190	5323	3897	4220	2043	1482	603	1955	2056	2150	2547	2586	2046	2497	3481
Spain	15612	17643	15173	13557	14342	20637	12891	2416	6726	15274	32065	29206	31952	28920	24718	22782
Sweden	19083	2960	101	464	4	3	50	1	4	199	2	32	42	90	16**	54
UK (England + Wales)	2593	7356	10035	12926	14147	6176	2475	27	1590	4100	11	131	1374+	3447	1864	4062
UK (Northern Ireland)										1232	2205	1119			4508	2899
UK (Scotland)	57028	104539	72106	43540	38150	173	5496	1331	6305	8166	24630	30508	37173	64724	66682	54040
Russia	346762	332226	329100	236369	225163	149650	112553	45841	88303	120674	152256	185763	173655	188449	170892	188006
Greenland										2133				20212	23333	19753
Unallocated									3499							
TOTAL	2380161	2034309	1976176	1625255	1260615	641818	526357	103620	384021	628169	1155279	1396244	1183224	1558061	1711477	1515527

*** Reported to the EU but not to the ICES WGNPBW. (Landings of 19,467 tonnes).**

**** only landings (2018).**

+ data updated in 2018.

Table 2.3.1.2. Blue whiting. ICES estimated catches (tonnes) by country and ICES division for 2019.

ICES Division	Denmark	Faroe Islands	France	Germany	Greenland	Iceland	Ireland	Netherlands	Norway	Poland	Portugal	Russia	Spain	Sweden	UK (England + Wales)	UK (Northern Ireland)	UK (Scotland)	Total
27.2.a	271	24250		579	4009	14694	9	604	1293	96		21349						**67154**
27.3.a	77													54				**131**
27.4																	129	**129**
27.4.a	70	3764	59	1173	2130	14116	3	1012	21347			894						**44569**
27.4.b	4								25						0		0	**28**
27.5.a		1039				400												**1439**
27.5.b	1066	169397	1397	195	10215	121714			2452	1217		75507			174			**383334**
27.6.a	18413	56688	7141	25671	3399	22587	23990	53076	97762	16444		20342	619		3848	12	14360	**364351**
27.6.b	2618	9394	396	177		7515	5824	369	20047	213		7562	46				12550	**66711**
27.7.b	1730		214	408			15	529					2		6			**2905**
27.7.c	40184	58171	5545	9220		77127	6541	15616	154805	6711		54557	257		1	2887	22908	**454531**
27.7.d															0			**0**
27.7.e			2												0			**2**
27.7.f								0							0			**0**
27.7.g			0				0						2		0			**2**
27.7.h			0				21	17					4					**42**
27.7.j			894	89			11	330		474			75		31			**1905**
27.7.k	4284	13866	0			10203	2414	3076	53698			7744	1				4093	**99378**
27.8.a			132	733			8			1568			1					**2443**
27.8.b			3					392					136					**531**
27.8.c			0								1204		16130					**17334**
27.8.d			311							462			1					**774**
27.9.a											2277		5507					**7784**
27.12												51						**51**
Total	**68716**	**336569**	**16095**	**38244**	**19753**	**268356**	**38836**	**75020**	**351429**	**27185**	**3481**	**188006**	**22782**	**54**	**4062**	**2899**	**54040**	**1515527**

Table 2.3.1.3. Blue whiting. ICES estimated catches (tonnes) by quarter and ICES division for 2019.

ICES Division	Quarter 1	Quarter 2	Quarter 3	Quarter 4	2019*	Total
27.2.a	448	14048	19160	33499		**67154**
27.3.a	2	23	29	76		**131**
27.4					129	**129**
27.4.a	233	8550	10229	25556		**44569**
27.4.b	0	15	12	0		**28**
27.5.a	12	7	1373	48		**1439**
27.5.b	46485	305785	107	30957		**383334**
27.6.a	84374	253281	7	26686	4	**364351**
27.6.b	65618	1014	2		77	**66711**
27.7.b	818	2037	46	4		**2905**
27.7.c	441654	12843	33			**454531**
27.7.d	0					**0**
27.7.e	0	0	2	0		**2**
27.7.f	0			0		**0**
27.7.g	2	0	0	0		**2**
27.7.h	2	17	23			**42**
27.7.j	36	61	385	1422		**1905**
27.7.k	99267		111			**99378**
27.8.a	741	1	0	1700		**2443**
27.8.b	30	74	10	417		**531**
27.8.c	4856	5145	4035	3299		**17334**
27.8.d	1	0	0	773		**774**
27.9.a	996	2469	2262	2058		**7784**
27.12	51					**51**
Total	**745625**	**605370**	**37826**	**126497**	**209**	**1515527**

***Discards data from UK(Scotland) were provided by year, due to sampling intensity.**

Table 2.3.1.4. Blue whiting. ICES estimated catches (tonnes) from the main fisheries 1988–2019 by area.

Year	Norwegian Sea fishery (SAs1+2;Divs .5.a,14a-b)	Fishery in the spawning area (SA 12.; Divs. 5.b, 6.a-b, 7.a-c)	Directed- and mixed fisheries in the North Sea (SA4; Div.3.a)	Total northern areas	Total southern areas (SAs8+9;Divs.7.d-k)	Grand total
1988	55829	426037	45143	**527009**	30838	**557847**
1989	42615	475179	75958	**593752**	33695	**627447**
1990	2106	463495	63192	**528793**	32817	**561610**
1991	78703	218946	39872	**337521**	32003	**369524**
1992	62312	318018	65974	**446367**	28722	**475026**
1993	43240	347101	58082	**448423**	32256	**480679**
1994	22674	378704	28563	**429941**	29473	**459414**
1995	23733	423504	104004	**551241**	27664	**578905**
1996	23447	478077	119359	**620883**	25099	**645982**
1997	62570	514654	65091	**642315**	30122	**672437**
1998	177494	827194	94881	**1099569**	29400	**1128969**
1999	179639	943578	106609	**1229826**	26402	**1256228**
2000	284666	989131	114477	**1388274**	24654	**1412928**
2001	591583	1045100	118523	**1755206**	24964	**1780170**
2002	541467	846602	145652	**1533721**	23071	**1556792**
2003	931508	1211621	158180	**2301309**	20097	**2321406**
2004	921349	1232534	138593	**2292476**	85093	**2377569**
2005	405577	1465735	128033	**1999345**	27608	**2026953**
2006	404362	1428208	105239	**1937809**	28331	**1966140**
2007	172709	1360882	61105	**1594695**	17634	**1612330**
2008	68352	1111292	36061	**1215704**	30761	**1246465**
2009	46629	533996	22387	**603012**	32627	**635639**
2010	36214	441521	17545	**495280**	28552	**523832**
2011	20599	72279	7524	**100401**	3191	**103592**
2012	24391	324545	5678	**354614**	29402	**384016***
2013	31759	481356	8749	**521864**	103973	**625837****
2014	45580	885483	28596	**959659**	195620	**1155279**
2015	150828	895684	44661	**1091173**	305071	**1396244**
2016	59744	905087	55774	**1020604**	162583	**1183187*****
2017	136565	1284105	45474	**1466144**	91917	**1558061**
2018	143204	1445957	43484	**1632646**	78831	**1711477**
2019	**68593**	**1271883**	**44856**	**1385333**	**130194**	**1515527**

*** Official catches by area from Sweden are not included (2012).**

**** Official catches by area from Sweden and Greenland are not included (2013).**

***** Grand total includes only 1336 tonnes from UK(England+Wales)**
(2016 total catch from UK(England+Wales) = 1374 ton).

Table 2.3.1.5. Blue whiting. ICES estimates (tonnes) of catches, landings and discards by country for 2019.

Country	Catches	BMS landings	Landings	Discards	% discards
Denmark	68716	0	68634	82	0.12
Faroe Islands	336569		336569	0	0.00
France	16095		16095	0	0.00
Germany	38244		38244	0	0.00
Greenland	19753		19753	0	0.00
Iceland	268356		268356	0	0.00
Ireland	38836		38569	267	0.69
Netherlands	75020		75020	0	0.00
Norway	351429		351429	0	0.00
Poland	27185		27184	0	0.00
Portugal	3481		2659	822	23.62
Russia	188006		188006	0	0.00
Spain	22782		21603	1179	5.17
Sweden	54	0	43	11	19.65
UK (England+Wales)	4062	34	4027	0	0.01
UK(Northern Ireland)	2899		2899	0	0.00
UK(Scotland)	54040		53831	209	0.39
Total	**1515527**	**34**	**1512922**	**2570**	**0.17**

Table 2.3.1.6. Blue whiting. ICES estimated catches (tonnes) inside and outside NEAFC regulatory area for 2019 by country.

	Catches inside NEAFC RA	Catches outside NEAFC RA	Total catches
Denmark	655	68061	68716
Faroe Islands	70321	266248	336569
France	74	16022	16095
Germany	550	37694	38244
Greenland	19555	198	19753
Iceland	97022	171333	268356
Ireland	9	38827	38836
Netherlands*	557	74464	75020
Norway*	59690	291739	351429
Poland	1313	25872	27185
Portugal	0	3481	3481
Russia	90316	97690	188006
Spain	0	22782	22782
Sweden	0	54	54
UK (England + Wales)	0	4062	4062
UK(Northern Ireland)	0	2899	2899
UK(Scotland)	0	54040	54040
Total in 2019	**340062**	1175465	**1515527**

*** the values of catches inside/outside NEAFC RA are based on the ICES Preliminary Catch Statistics.**

Table 2.3.1.1.1. Blue whiting. ICES estimated catches (tonnes), the percentage of catch covered by the sampling programme, No. of age samples, No. of fish measured and No. of fish aged for 2000-2019.

Year	Catch (tonnes)	% catch covered by sampling programme	No. Age samples	No. Measured	No. Aged
2000	1412928	*	1136	125162	13685
2001	1780170	*	985	173553	17995
2002	1556792	*	1037	116895	19202
2003	2321406	*	1596	188770	26207
2004	2377569	*	1774	181235	27835
2005	2026953	*	1833	217937	32184
2006	1966140	*	1715	190533	27014
2007	1610090	87	1399	167652	23495
2008	1246465	90	927	113749	21844
2009	635639	88	705	79500	18142
2010	524751	87	584	82851	16323
2011	103591	85	697	84651	12614
2012	373937	80	1143	173206	15745
2013	625837	96	915	111079	14633
2014	1155279	89	912	111316	39738
2015	1396244	94	1570	102367	29821
2016	1183187	89	1092	120329	13793
2017	1558061	91	1779	147297	15828
2018	1711477	87	1565	131779	16426
2019	**1515527**	**84**	**1253**	**136604**	**17869**

Table 2.3.1.1.2. Blue whiting. ICES estimated catches (tonnes), the percentage of catch covered by the sampling programme (catch-at-age numbers), No. of length samples, No. of age samples, No. of fish measured, No. of fish aged, No. of fish aged by 1000 tonnes and No. of fish measured by 1000 tonnes by country for 2019.

Country	Catch (ton)	% catch covered by sampling programme	No. Length samples	No. Age samples	No. Measured	No. Aged	No Aged/ 1000 tonnes	No Measured/ 1000 tonnes
Denmark	68716	92	34	34	2359	1911	28	34
Faroe Islands	336569	91	17	17	1656	1636	5	5
France	16095	0	55	0	3659	0	0	227
Germany	38244	19	64	64	10792	730	19	282
Greenland	19753	0	0	0	0	0	0	0
Iceland	268356	100	98	98	7910	2341	9	29
Ireland	38836	61	90	15	8506	1504	39	219
Netherlands	75020	76	75	75	16080	1836	24	214
Norway	351429	93	32	32	838	838	2	2
Poland	27185	0	0	0	0	0	0	0
Portugal	3481	65	44	44	2611	986	283	750
Russia	188006	82	164	164	48980	3137	17	261
Spain	22782	96	853	699	30788	2463	108	1351
Sweden	54	0	0	0	0	0	0	0
UK (England + Wales)	4061.56	0	0	0	0	0	0	0
UK(Northern Ireland)	2899	0	0	0	0	0	0	0
UK(Scotland)	54040	73	11	11	2425	487	9	45
Total	**1515527**	**84**	**1537**	**1253**	**136604**	**17869**	**12**	**90**

Table 2.3.1.1.3. Blue whiting. ICES estimated catches (tonnes), No. of Age samples, No. of fish measured and No. of fish aged by country and quarter for 2019.

	Catch (tonnes)	No. Age samples	No. Length Measured	No. Age Samples
Denmark				
1	46543	21	1201	1201
2	21771	13	1158	710
3	46	0	0	0
4	355	0	0	0
Total	**68716**	**34**	**2359**	**1911**
Faroe Islands				
1	144389	9	890	888
2	162359	6	608	598
3	4165	0	0	0
4	25656	2	158	150
Total	**336569**	**17**	**1656**	**1636**
France				
1	4766	0	2460	0
2	8466	0	0	0
3	10	0	0	0
4	2854	0	1199	0
Total	**16095**	**0**	**3659**	**0**
Germany				
1	14854	3	141	137
2	20992	4	975	153
3	554	0	0	0
4	1844	57	9676	440
Total	**38244**	**64**	**10792**	**730**
Greenland				
1	1646	0	0	0
2	10590	0	0	0
3	65	0	0	0
4	7452	0	0	0
Total	**19753**	**0**	**0**	**0**
Iceland				
1	94857	37	3030	848
2	130017	48	3740	1168
3	5030	4	369	100
4	38452	9	771	225
Total	**268356**	**98**	**7910**	**2341**
Ireland				
1	23840	15	6101	1504
2	14794	0	0	0
3	140	0	2405	0
4	63	0	0	0
Total	**38836**	**15**	**8506**	**1504**
Netherlands				
1	12028	35	6872	866
2	52940	40	9208	970
3	250	0	0	0
4	9803	0	0	0
Total	**75020**	**75**	**16080**	**1836**

Table 2.3.1.1.3. (continued) Blue whiting. ICES estimated catches (tonnes), No. of Age samples, No. of fish measured and No. of fish aged by country and quarter for 2019.

	Catch (tonnes)	No. Age samples	No. Length Measured	No. Age Samples
Norway				
1	258073	24	617	617
2	77277	8	221	221
3	10201	0	0	0
4	5878	0	0	0
Total	**351429**	**32**	**838**	**838**
Poland				
1	11304	0	0	0
4	15881	0	0	0
Total	**27185**	**0**	**0**	**0**
Portugal				
1	1051	13	320	131
2	659	11	652	254
3	875	7	663	329
4	896	13	976	272
Total	**3481**	**44**	**2611**	**986**
Russia				
1	78279	103	30682	2615
2	86774	12	3550	140
3	10950	36	10833	353
4	12003	13	3915	29
Total	**188006**	**164**	**48980**	**3137**
Spain				
1	5103	197	9787	409
2	7692	294	8773	843
3	5486	93	5703	784
4	4501	115	6525	427
Total	**22782**	**699**	**30788**	**2463**
Sweden				
1	1	0	0	0
2	1	0	0	0
3	24	0	0	0
4	28	0	0	0
Total	**54**	**0**	**0**	**0**
UK (England + Wales)				
1	1	0	0	0
2	3199	0	0	0
3	31	0	0	0
4	830	0	0	0
Total	**4062**	**0**	**0**	**0**
UK (Northern Ireland)				
1	2899	0	0	0
Total	**2899**	**0**	**0**	**0**
UK (Scotland)				
1	45992	11	2425	487
2	7838	0	0	0
2019*	209	0	0	0
Total	**54040**	**11**	**2425**	**487**
Total Geral	**1515527**	**1253**	**136604**	**17869**

*** Discards data from UK (Scotland) were provided by year, due to sampling intensity.**

Table 2.3.1.1.4. Blue whiting. ICES estimated catches (tonnes), the percentage of catch covered by the sampling programme, No. of length samples, No. of age samples, No. of fish measured, No. of fish aged, No. of fish aged by 1000 tonnes and No. of fish measured by 1000 tonnes by ICES division for 2019.

ICES Division	Catch (ton)	No. Length samples	No. Age samples	No. Measured	No. Aged	No Aged/ 1000 tonnes	No Measured/ 1000 tonnes
27.2.a	67154	95	95	16705	770	11	249
27.3.a	131	0	0	0	0	0	0
27.4	129	0	0	0	0	0	0
27.4.a	44569	6	6	1103	208	5	25
27.4.b	28	0	0	0	0	0	0
27.5.a	1439	1	1	100	25	17	69
27.5.b	383334	76	76	11402	2125	6	30
27.6.a	364351	127	112	21574	3859	11	59
27.6.b	66711	36	36	7934	1500	22	119
27.7.b	2905	6	2	677	48	17	233
27.7.c	454531	191	153	33140	4391	10	73
27.7.d	0	0	0	0	0	0	0
27.7.e	2	0	0	0	0	0	0
27.7.f	0	0	0	0	0	0	0
27.7.g	2	15	0	0	0	0	0
27.7.h	42	6	0	1134	0	0	27098
27.7.j	1905	173	0	1731	0	0	909
27.7.k	99378	58	29	8443	1494	15	85
27.8.a	2443	0	0	0	0	0	0
27.8.b	531	132	132	1257	0	0	2368
27.8.c	17334	327	327	19870	1233	71	1146
27.8.d	774	4	0	299	0	0	386
27.9.a	7784	284	284	11235	2216	285	1443
27.12	51	0	0	0	0	0	0
TOTAL	**1515527**	**1537**	**1253**	**136604**	**17869**	**12**	**90**

Table 2.3.2.1. Blue whiting. ICES estimated preliminary catches (tonnes) in 2020 by quarter and ICES division. Data submitted to InterCatch.

ICES Division	Quarter 1	Quarter 2	Quarter 3	Total
27.2.a	526	24963		**25489**
27.3.a			**18**	**18**
27.4.a	511	29663		**30173**
27.5.a	3			**3**
27.5.b	26210	247998		**274208**
27.6.a	30748	249794		**280542**
27.6.b	18535	7138		**25673**
27.7.b	279	505		**784**
27.7.c	241076	46198		**287274**
27.7.j	0	22		**22**
27.7.k	241713			**241713**
27.8.a	0			**0**
27.8.b		20		**20**
27.8.d	365	68		**434**
27.9.a	366	336		**702**
Total	**560332**	**606706**	**18**	**1167057**

Table 2.3.2.2. Blue whiting. ICES estimated preliminary catches (tonnes), the percentage of catch covered by the sampling programme, No. of samples, No. of fish measured, No. of fish aged, No. of fish aged by 1000 tonnes and No. of fish measured by 1000 tonnes by ICES division for 2020 preliminary data (quarters 1 and 2). Data submitted to InterCatch.

ICES Division	Catch (ton)	No. samples	No. Measured	No. Aged
27.2.a	25489	2	300	300
27.3.a*	18	0	0	0
27.4.a	30173	2	225	275
27.5.a	3	0	0	0
27.5.b	274208	57	14982	940
27.6.a	280542	17	2563	1415
27.6.b	25673	21	4143	297
27.7.b	784	0	0	0
27.7.c	287274	45	3314	1970
27.7.j	22	0	0	0
27.7.k	241713	83	12616	2199
27.8.a	0	0	0	0
27.8.b	20	0	0	0
27.8.d	434	0	0	0
27.9.a	702	5	388	175
Total	**1167057**	**232**	**38531**	**7571**

***from Quarter 3 landings.**

Table 2.3.2.3. Blue whiting. ICES estimates of catches (tonnes) in 2020, based on (initial) declared quotas and expected uptake estimated by WGWIDE.

Country	Prelim Q1-Q2 catch	Expected remaining catch or total year catch	Total catch
Denmark	58,604	0	58,604
Faroe Islands	273,153	51,543	324,696
Germany	38,497	6,500	44,997
Greenland	0	19,773	19,773
France	5,069	0	5,069
Iceland	185,477	61,423	246,900
Ireland	39,169	0	39,169
The Netherlands	57,304	16,000	73,304
Norway	329,584	30,000	359,584
Poland	35,508	0	35,508
Portugal	702	2,000	2,702
Russia	149,059	46,113	195,172
United Kingdom	51,371	0	51,371
Spain	11,972	9,467	21,439
Sweden	0	70	70
Total	1,235,469	242,889	1,478,358
EU	298,196	34,037	332,233
Non-EU	937,273	208,852	1,146,125
	Best estimate of catches in 2020		**1,478,358**

Table 2.3.2.4. Blue whiting. Comparison of preliminary and final catches (tonnes).

Year	Preliminary	Final	Deviation %*
2016	1147000	1183224	3.1
2017	1559437	1558061	-0.1
2018	1712874	1711477	-0.1
2019	1444301	1515527	4.7

*** (final-preliminary)/final*100**

Table 2.3.3.1. Blue whiting. Catch-at-age numbers (thousands) by year. Discards included since 2014. Values for 2020 are preliminary.

Year Age	1	2	3	4	5	6	7	8	9	10+
1981	258000	348000	681000	334000	548000	559000	466000	634000	578000	1460000
1982	148000	274000	326000	548000	264000	276000	266000	272000	284000	673000
1983	2283000	567000	270000	286000	299000	304000	287000	286000	225000	334000
1984	2291000	2331000	455000	260000	285000	445000	262000	193000	154000	255000
1985	1305000	2044000	1933000	303000	188000	321000	257000	174000	93000	259000
1986	650000	816000	1862000	1717000	393000	187000	201000	198000	174000	398000
1987	838000	578000	728000	1897000	726000	137000	105000	123000	103000	195000
1988	425000	721000	614000	683000	1303000	618000	84000	53000	33000	50000
1989	865000	718000	1340000	791000	837000	708000	139000	50000	25000	38000
1990	1611000	703000	672000	753000	520000	577000	299000	78000	27000	95000
1991	266686	1024468	513959	301627	363204	258038	159153	49431	5060	9570
1992	407730	653838	1641714	569094	217386	154044	109580	79663	31987	11706
1993	263184	305180	621085	1571236	411367	191241	107005	64769	38118	17476
1994	306951	107935	367962	389264	1221919	281120	174256	90429	79014	30614
1995	296100	353949	421560	465358	615994	800201	253818	159797	59670	41811
1996	1893453	534221	632361	537280	323324	497458	663133	232420	98415	82521
1997	2131494	1519327	904074	577676	295671	251642	282056	406910	104320	169235
1998	1656926	4181175	3541231	1044897	383658	322777	303058	264105	212452	85513
1999	788200	1549100	5820800	3460600	412800	207200	151200	153100	68800	140500
2000	1814851	1192657	3465739	5014862	1550063	513663	213057	151429	58277	139791
2001	4363690	4486315	2962163	3806520	2592933	585666	170020	97032	76624	66410

Year Age	1	2	3	4	5	6	7	8	9	10+
2002	1821053	3232244	3291844	2242722	1824047	1647122	344403	168848	102576	142743
2003	3742841	4073497	8378955	4824590	2035096	1117179	400022	121280	19701	27493
2004	2156261	4426323	6723748	6697923	3044943	1276412	649885	249097	75415	36805
2005	1427277	1518938	5083550	5871414	4450171	1419089	518304	249443	100374	55226
2006	412961	939865	4206005	6150696	3833536	1718775	506198	181181	67573	36688
2007	167027	306898	1795021	4210891	3867367	2353478	935541	320529	130202	88573
2008	408790	179211	545429	2917190	3262956	1919264	736051	315671	113086	126637
2009	61125	156156	231958	594624	1596095	1156999	592090	251529	88615	48908
2010	349637	222975	160101	208279	646380	992214	702569	256604	70487	43693
2011	162997	101810	63954	53863	69717	116396	120359	55470	25943	12542
2012	239667	351845	663155	141854	106883	203419	363779	356785	212492	157947
2013	228175	508122	848597	896966	462714	224066	321310	397536	344285	383601
2014	588717	584084	2312953	2019373	1272862	416523	386396	462339	526141	662747
2015	2944849	2852384	2427329	2465286	1518235	707533	329882	258743	239164	450046
2016	1239331	3518677	2933271	1874011	1367844	756824	339851	185368	131039	288635
2017	401947	1999011	7864694	4063916	1509651	777185	263007	110351	63945	149369
2018	418781	541041	3572357	7340084	2983975	1022883	424206	150753	90387	163289
2019	249923	433573	1288871	3778379	5037323	1645999	431925	145916	50622	81357
2020	870600	518121	1164363	2011963	3136797	3128045	1137272	338127	72711	93956

Table 2.3.4.1. Blue whiting. Individual mean weight (kg) at age in the catch. Preliminary values for 2020.

Year Age	1	2	3	4	5	6	7	8	9	10+
1981	0.052	0.065	0.103	0.125	0.141	0.155	0.170	0.178	0.187	0.213
1982	0.045	0.072	0.111	0.143	0.156	0.177	0.195	0.200	0.204	0.231
1983	0.046	0.074	0.118	0.140	0.153	0.176	0.195	0.200	0.204	0.228
1984	0.035	0.078	0.089	0.132	0.153	0.161	0.175	0.189	0.186	0.206
1985	0.038	0.074	0.097	0.114	0.157	0.177	0.199	0.208	0.218	0.237
1986	0.040	0.073	0.108	0.130	0.165	0.199	0.209	0.243	0.246	0.257
1987	0.048	0.086	0.106	0.124	0.147	0.177	0.208	0.221	0.222	0.254
1988	0.053	0.076	0.097	0.128	0.142	0.157	0.179	0.199	0.222	0.260

Year Age	1	2	3	4	5	6	7	8	9	10+
1989	0.059	0.079	0.103	0.126	0.148	0.158	0.171	0.203	0.224	0.253
1990	0.045	0.070	0.106	0.123	0.147	0.168	0.175	0.214	0.217	0.256
1991	0.055	0.091	0.107	0.136	0.174	0.190	0.206	0.230	0.232	0.266
1992	0.057	0.083	0.119	0.140	0.167	0.193	0.226	0.235	0.284	0.294
1993	0.066	0.082	0.109	0.137	0.163	0.177	0.200	0.217	0.225	0.281
1994	0.061	0.087	0.108	0.137	0.164	0.189	0.207	0.217	0.247	0.254
1995	0.064	0.091	0.118	0.143	0.154	0.167	0.203	0.206	0.236	0.256
1996	0.041	0.080	0.102	0.116	0.147	0.170	0.214	0.230	0.238	0.279
1997	0.047	0.072	0.102	0.121	0.140	0.166	0.177	0.183	0.203	0.232
1998	0.048	0.072	0.094	0.125	0.149	0.178	0.183	0.188	0.221	0.248
1999	0.063	0.078	0.088	0.109	0.142	0.170	0.199	0.193	0.192	0.245
2000	0.057	0.075	0.086	0.104	0.133	0.156	0.179	0.187	0.232	0.241
2001	0.050	0.078	0.094	0.108	0.129	0.163	0.186	0.193	0.231	0.243
2002	0.054	0.074	0.093	0.115	0.132	0.155	0.173	0.233	0.224	0.262
2003	0.049	0.075	0.098	0.108	0.131	0.148	0.168	0.193	0.232	0.258
2004	0.042	0.066	0.089	0.102	0.123	0.146	0.160	0.173	0.209	0.347
2005	0.039	0.068	0.084	0.099	0.113	0.137	0.156	0.166	0.195	0.217
2006	0.049	0.072	0.089	0.105	0.122	0.138	0.163	0.190	0.212	0.328
2007	0.050	0.064	0.091	0.103	0.115	0.130	0.146	0.169	0.182	0.249
2008	0.055	0.075	0.100	0.106	0.120	0.133	0.146	0.160	0.193	0.209
2009	0.056	0.085	0.105	0.119	0.124	0.138	0.149	0.179	0.214	0.251
2010	0.052	0.064	0.110	0.154	0.154	0.163	0.175	0.187	0.200	0.272
2011	0.055	0.079	0.107	0.136	0.169	0.169	0.179	0.189	0.214	0.270
2012	0.041	0.072	0.098	0.140	0.158	0.172	0.180	0.185	0.189	0.203
2013	0.051	0.077	0.094	0.117	0.139	0.162	0.185	0.188	0.198	0.197
2014	0.049	0.078	0.093	0.112	0.128	0.155	0.178	0.190	0.202	0.217
2015	0.039	0.070	0.094	0.117	0.137	0.155	0.174	0.183	0.193	0.201
2016	0.047	0.066	0.084	0.107	0.125	0.142	0.152	0.167	0.184	0.206
2017	0.056	0.072	0.080	0.094	0.113	0.131	0.148	0.172	0.190	0.212

Year Age	1	2	3	4	5	6	7	8	9	10+
2018	0.055	0.080	0.091	0.098	0.111	0.129	0.142	0.165	0.175	0.216
2019	0.068	0.085	0.099	0.109	0.118	0.130	0.144	0.167	0.167	0.228
2020	0.057	0.073	0.093	0.113	0.125	0.134	0.139	0.152	0.177	0.218

Table 2.3.5.1. Blue whiting. Natural mortality and proportion mature.

AGE	0	1	2	3	4	5	6	7–10+
Proportion mature	0.00	0.11	0.40	0.82	0.86	0.91	0.94	1.00
Natural mortality	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20

Table 2.3.7.1.1. Blue whiting. Time-series of StoX abundance estimates of blue whiting (millions) by age in the IBWSS. Total biomass in last column (1000 t). Shaded values (ages 1-8; years 2004-2019) are used as input to the assessment

	Age										
Year	1	2	3	4	5	6	7	8	9	10+	TSB
2004	1097	5538	13062	15134	5119	1086	994	593	164	0	3505
2005	2129	1413	5601	7780	8500	2925	632	280	129	23	2513
2006	2512	2224	10881	11695	4717	2719	923	352	198	39	3517
2007	468	706	5241	11244	8437	3155	1110	456	123	65	3274
2008	337	524	1455	6661	6747	3882	1719	1029	269	296	2647
2009	275	329	360	1292	3739	3458	1636	587	250	194	1599
2010*											
2011	312	1361	1135	930	1043	1713	2171	2423	1298	272	1827
2012	1140	1816	6454	1021	595	1415	2220	1777	1249	1085	2347
2013	582	1337	6175	7211	2938	1282	1308	1398	929	1807	3110
2014	4183	1491	5239	8420	10202	2754	772	577	899	2251	3761
2015	3255	4570	1891	3641	1797	466	174	108	206	365	1405
2016	2745	7893	10164	6274	4687	1539	413	133	235	361	2873
2017	262	2248	15682	10176	3762	1793	921	76	84	173	3135
2018	836	628	6615	21490	7692	2187	755	188	72	138	4035
2019	1129	1169	3468	9590	16979	3434	484	513	99	43	4198

*Survey discarded.

Table 2.3.7.1.2. Blue whiting. Difference between the old StoX abundance estimates of blue whiting (millions) and the re-calculated StoX abundance estimates.

Year/Age	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8
2004	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0
2006	0	-2	-23	-18	-4	-2	0	0
2007	0	0	0	0	0	0	0	0
2008	0	-1	-4	-19	-25	-13	-4	-1
2009	0	0	0	0	0	-1	0	0
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	-1	-1	-1
2012	1	2	10	1	1	5	11	8
2013	4	9	8	-14	-5	-2	-2	-2
2014	0	0	0	0	0	0	0	0
2015	0	-5	-3	-11	-5	-1	-1	0
2016	0	0	0	0	0	0	0	0
2017	13	-68	257	20	-141	-82	-21	-1
2018	0	0	0	0	0	0	0	0
2019	0	0	0	0	0	0	0	0

Table 2.3.7.2.1. Blue whiting. Estimated abundance of 1 and 2 year old blue whiting from the International Norwegian Sea ecosystem survey, 2003–2020.

Year\Age	Age 1	Age 2
2003*	16127	9317
2004*	17792	11020
2005*	19933	7908
2006*	2512	5504
2007*	592	213
2008	25	17
2009	7	8
2010	0	280
2011	1613	0

Year\Age	Age 1	Age 2
2012	9476	3265
2013	454	6544
2014	3893	2048
2015	8563	2796
2016	4223	8089
2017	1236	2087
2018	441	1491
2019	3157	215
2020	2 822	481

***Using the old TS-value. To compare the results all values were divided by approximately 3.1.**

Table 2.3.7.2.2. Blue whiting. 1-group indices of blue whiting from the Norwegian winter survey (late January-early March) in the Barents Sea. (Blue whiting < 19 cm in total body length which most likely belong to 1-group.)

Catch Rate		
Year	**All**	**< 19 cm**
1981	0.13	0
1982	0.17	0.01
1983	4.46	0.46
1984	6.97	2.47
1985	32.51	0.77
1986	17.51	0.89
1987	8.32	0.02
1988	6.38	0.97
1989	1.65	0.18
1990	17.81	16.37
1991	48.87	2.11
1992	30.05	0.06
1993	5.80	0.01
1994	3.02	0
1995	1.65	0.10
1996	9.88	5.81

Catch Rate		
Year	**All**	**< 19 cm**
1997	187.24	175.26
1998	7.14	0.21
1999	5.98	0.71
2000	129.23	120.90
2001	329.04	233.76
2002	102.63	9.69
2003	75.25	15.15
2004	124.01	36.74
2005	206.18	90.23
2006	269.2	3.52
2007	80.38	0.16
2008	17.97	0.04
2009	4.50	0.01
2010	3.30	0.08
2011	1.48	0.01
2012	127.71	125.93
2013	39.54	2.33
2014	31.48	24.97
2015	148.4	128.34
2016	86.99	11.31
2017	167.16	0.71
2018	9.19	0.03
2019	22.56	11.79
2020	20.96	16.20

Table 2.3.7.2.3. Blue whiting. 1-group indices of blue whiting from the Icelandic bottom-trawl surveys, 1-group (< 22 cm in March).

Catch Rate	
Year	**< 22 cm**
1996	6.5
1997	3.4
1998	1.1
1999	6.3
2000	9
2001	5.2
2002	14.2
2003	15.4
2004	8.9
2005	8.3
2006	30.4
2007	3.9
2008	0.1
2009	1.6
2010	0.2
2011	10.8
2012	29.9
2013	11.7
2014	66.3
2015	43.8
2016	6.3
2017	1.8
2018	0.4
2019	0.1
2020	9.8

Table 2.3.7.2.4. Blue whiting. 1-group indices of blue whiting from Faroese bottom-trawl surveys, 1-group (< 23 cm in March).

Catch Rate	
Year	< 23 cm
1994	1382
1995	1105
1996	4442
1997	1764
1998	360
1999	1330
2000	782
2001	3357
2002	3885
2003	929
2004	15163
2005	23750
2006	13364
2007	11509
2008	840
2009	3754
2010	824
2011	11406
2012	5345
2013	8855
2014	51313
2015	14444
2016	22485
2017	5286
2018	1948
2019	285
2020	140

Table 2.4.2.1. Blue whiting. Parameter estimates, from final assessment (2020) and retrospective analysis (2016-2019).

Parameter Year	2016	2017	2018	2019	2020
Random walk variance					
-F Age 1-10	0.39	0.38	0.38	0.37	0.37
Process error					
-log(N) Age 1	0.58	0.62	0.62	0.61	0.61
--- Age 2-10	0.17	0.18	0.18	0.18	0.18
Observation variance					
-Catch Age 1	0.45	0.44	0.44	0.43	0.43
--- Age 2	0.29	0.28	0.28	0.28	0.27
--- Age 3-8	0.20	0.20	0.19	0.19	0.19
--- Age 9-10	0.40	0.40	0.40	0.39	0.38
-IBWSS Age 1	0.75	0.78	0.74	0.75	0.75
--- Age 2	0.31	0.32	0.31	0.33	0.34
--- Age 3	0.46	0.44	0.42	0.41	0.41
--- Age 4-6	0.45	0.40	0.39	0.37	0.37
--- Age 7-8	0.41	0.48	0.50	0.54	0.55
Survey catchability					
-IBWSS Age 1	0.07	0.06	0.07	0.07	0.06
--- Age 2	0.12	0.12	0.12	0.11	0.11
--- Age 3	0.36	0.38	0.37	0.37	0.36
--- Age 4	0.66	0.70	0.69	0.68	0.67
--- Age 5-8	0.86	0.89	0.87	0.87	0.86
Rho					
--	0.92	0.93	0.93	0.93	0.94

Table 2.4.2.2. Blue whiting. Mohn's rho by year and average over the last five years (n=5).

Year	R(age 1)	SSB	Fbar(3-7)
2015	-0.336	-0.149	0.289
2016	0.233	0.033	-0.057
2017	-0.075	-0.117	0.212
2018	-0.121	-0.118	0.163
2019	0.000	-0.020	0.042
rho.mean	-0.060	-0.074	0.130

Table 2.4.2.3. Blue whiting. Estimated fishing mortalities. Catch data for 2020 are preliminary.

Year Age	1	2	3	4	5	6	7	8	9	10+
1981	0.078	0.118	0.172	0.212	0.245	0.318	0.346	0.443	0.484	0.484
1982	0.067	0.102	0.148	0.183	0.208	0.270	0.293	0.371	0.403	0.403
1983	0.078	0.118	0.171	0.211	0.241	0.315	0.338	0.420	0.446	0.446
1984	0.096	0.143	0.212	0.266	0.306	0.398	0.419	0.510	0.531	0.531
1985	0.101	0.150	0.230	0.295	0.346	0.448	0.466	0.562	0.576	0.576
1986	0.113	0.168	0.268	0.358	0.431	0.552	0.573	0.692	0.704	0.704
1987	0.100	0.150	0.247	0.337	0.414	0.536	0.559	0.673	0.674	0.674
1988	0.098	0.148	0.253	0.349	0.438	0.574	0.588	0.694	0.677	0.677
1989	0.114	0.171	0.304	0.420	0.526	0.686	0.712	0.842	0.806	0.806
1990	0.105	0.159	0.292	0.408	0.511	0.664	0.712	0.849	0.816	0.816
1991	0.059	0.089	0.167	0.235	0.290	0.367	0.395	0.465	0.450	0.450
1992	0.049	0.073	0.140	0.196	0.234	0.286	0.311	0.370	0.363	0.363
1993	0.042	0.063	0.125	0.176	0.206	0.246	0.268	0.319	0.314	0.314
1994	0.036	0.054	0.112	0.159	0.185	0.219	0.241	0.291	0.285	0.285
1995	0.046	0.070	0.149	0.215	0.243	0.284	0.313	0.383	0.368	0.368
1996	0.056	0.085	0.185	0.271	0.297	0.348	0.383	0.473	0.451	0.451
1997	0.054	0.084	0.187	0.279	0.300	0.349	0.381	0.474	0.452	0.452
1998	0.070	0.110	0.251	0.381	0.408	0.474	0.510	0.630	0.593	0.593
1999	0.064	0.101	0.236	0.368	0.396	0.457	0.482	0.592	0.557	0.557
2000	0.074	0.117	0.278	0.445	0.497	0.575	0.589	0.705	0.665	0.665

Year Age	1	2	3	4	5	6	7	8	9	10+
2001	0.070	0.111	0.265	0.429	0.493	0.572	0.574	0.679	0.644	0.644
2002	0.065	0.103	0.250	0.416	0.500	0.592	0.595	0.699	0.664	0.664
2003	0.067	0.107	0.261	0.439	0.542	0.633	0.628	0.709	0.668	0.668
2004	0.069	0.109	0.269	0.460	0.588	0.688	0.686	0.752	0.708	0.708
2005	0.060	0.094	0.238	0.418	0.552	0.646	0.653	0.701	0.663	0.663
2006	0.051	0.082	0.208	0.371	0.504	0.592	0.603	0.637	0.602	0.602
2007	0.048	0.077	0.196	0.355	0.499	0.597	0.623	0.656	0.623	0.623
2008	0.042	0.067	0.170	0.306	0.437	0.522	0.556	0.584	0.561	0.561
2009	0.027	0.044	0.111	0.195	0.281	0.334	0.363	0.379	0.366	0.366
2010	0.019	0.032	0.080	0.137	0.196	0.232	0.254	0.261	0.252	0.252
2011	0.006	0.010	0.024	0.040	0.056	0.065	0.072	0.074	0.073	0.073
2012	0.012	0.020	0.052	0.085	0.119	0.138	0.156	0.164	0.162	0.162
2013	0.020	0.035	0.090	0.149	0.209	0.239	0.273	0.290	0.287	0.287
2014	0.037	0.066	0.176	0.292	0.403	0.459	0.524	0.562	0.553	0.553
2015	0.049	0.086	0.232	0.385	0.525	0.602	0.675	0.724	0.707	0.707
2016	0.042	0.074	0.198	0.333	0.453	0.525	0.585	0.627	0.610	0.610
2017	0.040	0.070	0.189	0.317	0.425	0.489	0.535	0.570	0.555	0.555
2018	0.039	0.069	0.188	0.316	0.421	0.483	0.529	0.563	0.548	0.548
2019	0.036	0.063	0.173	0.293	0.386	0.440	0.481	0.512	0.497	0.497
2020	0.045	0.078	0.215	0.365	0.479	0.545	0.599	0.640	0.618	0.618

Table 2.4.2.4. Blue whiting. Estimated stock numbers-at-age (thousands). Preliminary catch data for 2020 have been used.

Year Age	1	2	3	4	5	6	7	8	9	10+
1981	3957322	3489739	4854972	2065979	2614542	2139251	1643260	1743521	1225865	2975946
1982	4693398	2970934	2521470	3288892	1583580	1495334	1292773	1013457	890323	1941761
1983	18181946	3802399	1878891	1820333	1900567	1217877	1014672	855134	629325	1255912
1984	18057318	14506280	2445488	1233494	1261705	1396380	814834	549303	481906	923880
1985	9628473	13540999	9778114	1451846	749201	912758	745912	457685	264904	721686
1986	7242024	6401799	9413565	5551032	946025	451780	468785	375549	230722	498164
1987	9098048	5046259	4084300	6875450	2567269	394106	253680	237951	156379	293043
1988	6425056	6861058	3518414	2876446	3727398	1275068	199370	125554	99164	170230
1989	8511756	4628225	4992481	2426867	2131107	1686808	351034	103098	60814	115198
1990	18623678	5974494	3095519	2729757	1481267	1186503	560262	120893	33108	85596
1991	9002675	15566858	4258772	1787099	1490726	875378	563265	188301	32202	45478
1992	6723250	7441617	12474420	3306435	1258816	788954	486282	287705	101643	39141
1993	4998200	5137324	5294784	9722312	2261671	976954	517123	281785	157072	74264
1994	8148170	3399914	4077789	3396923	6939360	1438649	766045	328605	207238	115840
1995	9362066	5890028	3138122	2569503	2857808	3743702	1041845	545548	221316	184826
1996	28034940	7123125	4080490	2396115	1548699	1862607	2239666	646440	307312	249541
1997	44725598	21321139	5504031	2569826	1417099	1065693	1060692	1213227	288353	337022

Year Age	1	2	3	4	5	6	7	8	9	10+
1998	26724248	37873149	16434306	3499188	1373239	926111	783070	605224	617371	292586
1999	20359418	20546053	27680822	10579753	1707285	771721	519136	411176	236370	427894
2000	39255183	15303295	16598018	15821130	4342781	1111494	472900	323815	153448	313917
2001	55761819	31726262	12089094	10750048	7456817	1694176	489109	227465	163697	178113
2002	48895382	45307964	20438307	8318248	5458100	3394178	688059	256080	103005	154666
2003	52993568	39136408	35061195	13611508	5092905	2979654	1204953	345798	89080	107092
2004	28800650	42387475	30065499	20885180	7293341	2476605	1317926	502039	151737	80498
2005	22282661	21838601	28601857	18173003	10818542	3245612	1114934	515230	192201	98879
2006	9064943	15531344	22303629	19373722	9552994	4494242	1364758	485012	219098	120453
2007	4960888	6038015	13158471	15990860	10397135	4744134	1851627	613760	230388	164103
2008	5944464	3516588	4369307	11132684	9268106	4972044	1876451	761492	237644	202566
2009	5794358	4099827	2451029	3747407	7050758	4785985	2227533	868557	329440	191942
2010	15473168	5119277	2388694	1881875	3432417	4429064	2899397	1218840	421069	271434
2011	19647386	13564563	3362966	1679379	1646744	2664011	2747473	1368043	829001	399538
2012	19399347	15718811	12712845	2314738	1206670	1645367	2380410	2148962	1096107	914883
2013	16169499	16243351	11772431	7468821	2270594	1112147	1402439	1657863	1367804	1404005
2014	37230666	12842914	14022794	8127627	4452286	1367506	953262	1017784	1037089	1515358
2015	63695809	33279395	10954651	8616338	4291560	1772309	752903	530008	496325	1081099

Year Age	1	2	3	4	5	6	7	8	9	10+
2016	34888644	57860038	21711361	7837557	4453808	1864582	730271	362627	229704	615299
2017	11735400	28692060	46393085	15585864	4756946	2262907	775206	296291	170341	398032
2018	11679974	9113899	22773093	30644893	9392707	2672828	1017678	336146	155752	292155
2019	10145773	8756999	8619260	15408297	17672969	5250964	1314734	437472	159319	231967
2020	17925568	7615374	6543115	6708796	9143821	8679178	2824765	777733	189829	210776
2021		14036236	5764845	4320417	3812664	4636311	4121523	1270686	335703	176806

Table 2.4.2.5. Blue whiting. Estimated recruitment (R) in thousands, spawning-stock biomass (SSB) in tonnes, average fishing mortality for ages 3 to 7 (Fbar 3-7) and total-stock biomass (TBS) in tonnes. Preliminary catch data for 2020 are included.

Year	R(age 1)	Low	High	SSB	Low	High	Fbar(3-7)	Low	High	TSB	Low	High
1981	3957322	2540278	6164834	2845488	2232351	3627027	0.259	0.188	0.356	3343972	2673066	4183266
1982	4693398	2978221	7396359	2301321	1826705	2899252	0.220	0.163	0.298	2771973	2239181	3431536
1983	18181946	11793619	28030678	1855241	1505755	2285843	0.255	0.191	0.340	2883054	2342066	3549003
1984	18057318	11824046	27576577	1753978	1447345	2125575	0.320	0.244	0.421	3088192	2486524	3835446
1985	9628473	6333315	14638069	2092477	1722997	2541189	0.357	0.274	0.464	3233510	2633915	3969599
1986	7242024	4795267	10937224	2273644	1876035	2755523	0.436	0.337	0.565	3115330	2576333	3767092
1987	9098048	6010796	13770967	1933331	1597602	2339612	0.419	0.322	0.544	2817823	2333505	3402661
1988	6425056	4242157	9731218	1639304	1366293	1966867	0.440	0.339	0.571	2427862	2019034	2919474
1989	8511756	5599097	12939585	1547399	1293881	1850590	0.530	0.410	0.684	2393477	1981004	2891832
1990	18623678	12067196	28742500	1355825	1123181	1636656	0.517	0.394	0.680	2490258	1986610	3121590
1991	9002675	5764336	14060276	1775078	1421100	2217227	0.291	0.214	0.395	3215083	2511180	4116296
1992	6723250	4360685	10365822	2456884	1940172	3111208	0.233	0.172	0.318	3528611	2789388	4463737
1993	4998200	3203687	7797893	2542322	2016565	3205155	0.204	0.151	0.277	3422585	2733756	4284979
1994	8148170	5271609	12594387	2536056	2033675	3162541	0.183	0.135	0.250	3419060	2767399	4224173
1995	9362066	6120492	14320463	2311551	1896673	2817180	0.241	0.181	0.321	3361626	2759155	4095649
1996	28034940	18370286	42784193	2210252	1831448	2667406	0.297	0.225	0.392	3728476	3026212	4593707
1997	44725598	29370182	68109184	2466370	2039600	2982438	0.299	0.227	0.394	5431372	4259792	6925174

Year	R(age 1)	Low	High	SSB	Low	High	Fbar(3-7)	Low	High	TSB	Low	High
1998	26724248	17662958	40434076	3682009	3002195	4515758	0.405	0.311	0.527	6827399	5443897	8562501
1999	20359418	13389190	30958253	4448140	3612411	5477216	0.388	0.298	0.506	7180850	5822775	8855676
2000	39255183	25751761	59839380	4235816	3510177	5111462	0.477	0.369	0.615	7465559	6072934	9177537
2001	55761819	36892189	84282894	4577749	3809022	5501620	0.467	0.361	0.603	9014170	7254280	11201010
2002	48895382	32317499	73977208	5405309	4490236	6506867	0.471	0.363	0.610	10339364	8349834	12802943
2003	52993568	35480553	79150916	6880604	5696134	8311376	0.501	0.392	0.640	11863582	9699850	14509974
2004	28800650	19202255	43196876	6791916	5684725	8114751	0.538	0.424	0.684	10429351	8678702	12533136
2005	22282661	14889744	33346241	6055782	5073301	7228528	0.501	0.391	0.642	8541270	7137338	10221358
2006	9064943	5992001	13713814	5917460	4935259	7095137	0.455	0.353	0.588	7767939	6480256	9311494
2007	4960888	3266725	7533665	4703578	3909457	5659008	0.454	0.348	0.593	5747215	4786524	6900724
2008	5944464	3862982	9147506	3630450	2973117	4433114	0.398	0.296	0.535	4460271	3668178	5423404
2009	5794358	3642868	9216523	2795836	2229162	3506565	0.257	0.186	0.355	3521752	2827534	4386416
2010	15473168	9994421	23955257	2733239	2136290	3496996	0.180	0.127	0.254	3819177	3013063	4840958
2011	19647386	12798884	30160426	2753922	2166841	3500066	0.051	0.035	0.075	4514423	3553617	5735008
2012	19399347	12844864	29298453	3498827	2825110	4333209	0.110	0.082	0.148	5196215	4189355	6445060
2013	16169499	10733154	24359353	3821120	3147113	4639476	0.192	0.145	0.254	5661435	4639119	6909037
2014	37230666	24445788	56701895	4063545	3384144	4879342	0.371	0.283	0.486	6710317	5473437	8226706
2015	63695809	41772298	97125518	4251496	3521915	5132213	0.484	0.373	0.627	8267418	6572122	10400022

Year	R(age 1)	Low	High	SSB	Low	High	Fbar(3-7)	Low	High	TSB	Low	High
2016	34888644	22485578	54133253	5014269	4038626	6225606	0.419	0.318	0.552	9269532	7258837	11837187
2017	11735400	7189336	19156097	6266824	4913563	7992792	0.391	0.290	0.528	9034929	7018865	11630077
2018	11679974	6724704	20286662	6206072	4706773	8182958	0.387	0.271	0.553	8124813	6110876	10802476
2019	10145773	4949635	20796831	5387150	3790692	7655961	0.355	0.224	0.562	7057799	4888659	10189405
2020	17925568	6568567	48918733	4214250	2585528	6868966	0.441	0.236	0.824	5846514	3455778	9891181
2021				3248023*						4859014*		

***assuming long term GM(1981-2019) recruitment (14751018) in 2021 and weight at age as used for 2020 (preliminary catch data)**

Table 2.4.6. Blue whiting. Model estimate of total catch weight (in tonnes) and Sum of Product of catch number and mean weight at age for ages 1-10+ (Observed catch). Preliminary catch data for 2020 are included.

Year	Estimate	Low	High	Observed
1981	787308	563337	1100326	922980
1982	543109	412244	715517	550643
1983	512368	395589	663619	553344
1984	563653	434824	730652	615569
1985	639188	501565	814573	678214
1986	760632	597287	968648	847145
1987	637579	500965	811448	654718
1988	569521	448173	723725	552264
1989	619780	491071	782222	630316
1990	552813	435187	702233	558128
1991	406830	316193	523448	364008
1992	438679	345491	557004	474592
1993	440589	345323	562136	475198
1994	424106	330543	544153	457696
1995	508525	402970	641730	505176
1996	598340	474249	754901	621104
1997	639214	502628	812916	639681
1998	1080286	844264	1382291	1131955
1999	1245122	968306	1601075	1261033
2000	1502155	1177051	1917053	1412449
2001	1560956	1222689	1992809	1771805
2002	1707715	1338263	2179163	1556955
2003	2204215	1735617	2799328	2365319
2004	2321682	1835652	2936400	2400795
2005	2000723	1583907	2527227	2018344
2006	1856156	1469251	2344946	1956239
2007	1558008	1231223	1971527	1612269
2008	1168430	916486	1489634	1251851

Year	Estimate	Low	High	Observed
2009	655131	512725	837089	634978
2010	479696	369590	622604	539539
2011	135746	100184	183931	103771
2012	327167	258846	413522	375692
2013	591402	467158	748689	613863
2014	1110886	871693	1415713	1147650
2015	1354241	1072365	1710209	1390656
2016	1246768	984179	1579419	1180786
2017	1480424	1167180	1877736	1555069
2018	1688827	1325517	2151716	1709856
2019	1524159	1195250	1943578	1512026
2020	1489070	1164489	1904122	1478358

Table 2.8.2.1.1. Blue whiting. Input to short-term projection (median values for exploitation pattern and stock numbers).

Age	Mean weight in the stock and catch (kg) in 2020	Mean weight in the stock and catch (kg) in 2021+	Proportion mature	Natural mortality	Exploitation pattern	Stock numbers (2021) (thousands)
Age 1	0.057	0.060	0.11	0.20	0.101	14751018
Age 2	0.073	0.079	0.40	0.20	0.178	14036236
Age 3	0.093	0.094	0.82	0.20	0.488	5764845
Age 4	0.113	0.107	0.86	0.20	0.829	4320417
Age 5	0.125	0.118	0.91	0.20	1.088	3812664
Age 6	0.134	0.131	0.94	0.20	1.236	4636311
Age 7	0.139	0.142	1.00	0.20	1.359	4121523
Age 8	0.152	0.161	1.00	0.20	1.453	1270686
Age 9	0.177	0.173	1.00	0.20	1.403	335703
Age 10	0.218	0.221	1.00	0.20	1.403	176806

Table 2.8.2.1.2. Blue whiting. Deterministic forecast, intermediate year assumptions and recruitments.

Variable	Value	Notes
$F_{ages\ 3–7}$ (2020)	0.441	From the assessment (preliminary 2020 catches)
SSB (2021)	3248023	From forecast; in tonnes
Rage 1 (2020)	17925568	From the assessment; in thousands
Rage 1 (2021-2022)	14751018	GM (1981–2019); in thousands
Total catch (2020)	1478358	Preliminary 2020 catches as estimated by ICES, based on declared quotas and expected uptake; in tonnes.

Table 2.8.2.2.1. Blue whiting. Deterministic forecast (weights in tonnes).

Basis	Catch (2021)	F (2021)	SSB (2022)	% SSB change*	% Catch change**	% Advice change***
Long-term management strategy						
Catch (2021) = Advice (2020) -20 %	929292	0.360	3046216	-6.2	-37.1	-20.0
MSY approach: FMSY	841717	0.320	3127644	-3.7	-43.1	-27.5
F = 0	0	0.000	3921194	20.7	-100.0	-100.0
Fpa	1265493	0.530	2735932	-15.8	-14.4	8.9
Flim	1810385	0.880	2243305	-30.9	22.5	55.9
SSB (2022) = Blim	2677773	1.814	1500000	-53.8	81.1	130.5
SSB (2022 = Bpa	1802838	0.874	2250000	-30.7	21.9	55.2
SSB (2022) = MSY Btrigger	1802838	0.874	2250000	-30.7	21.9	55.2
F = F (2020)	1095465	0.441	2892329	-11.0	-25.9	-5.7
SSB (2022) = SSB (2021)	712737	0.264	3248040	0.0	-51.8	-38.6
Catch (2021) = Catch (2020)	1478380	0.654	2541771	-21.7	0.0	27.3
Catch (2021) = Catch (2020) -20 %	1182686	0.485	2811956	-13.4	-20.0	1.8
Catch (2021) = Catch (2020) +25%	1847948	0.909	2209901	-32.0	25.0	59.1
Catch (2021) = Advice (2020) -20 %	929292	0.360	3046216	-6.2	-37.1	-20.0

*) SSB 2022 relative to SSB 2021.

**) Catch 2021 relative to expected catch in 2020 (1478358 tonnes).

***) Catch 2020 relative to advice for 2020 (1161615 tonnes).

2.18 Figures

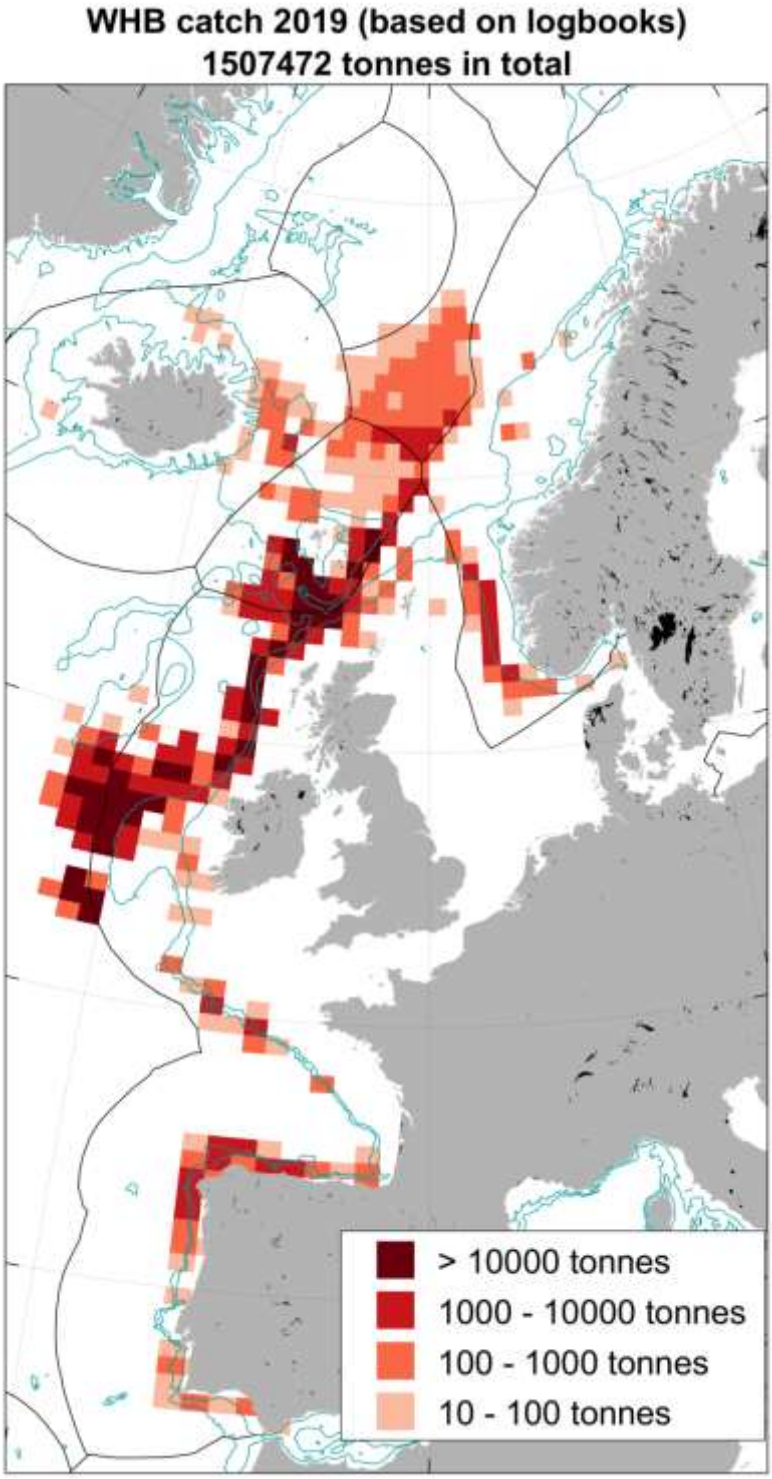


Figure 2.2.1. Blue whiting landings in 2019, based on logbook data. The catches on the map constitute 99.5 % of the ICES estimated catches. The 200 m and 1000 m depth contours are indicated in blue.

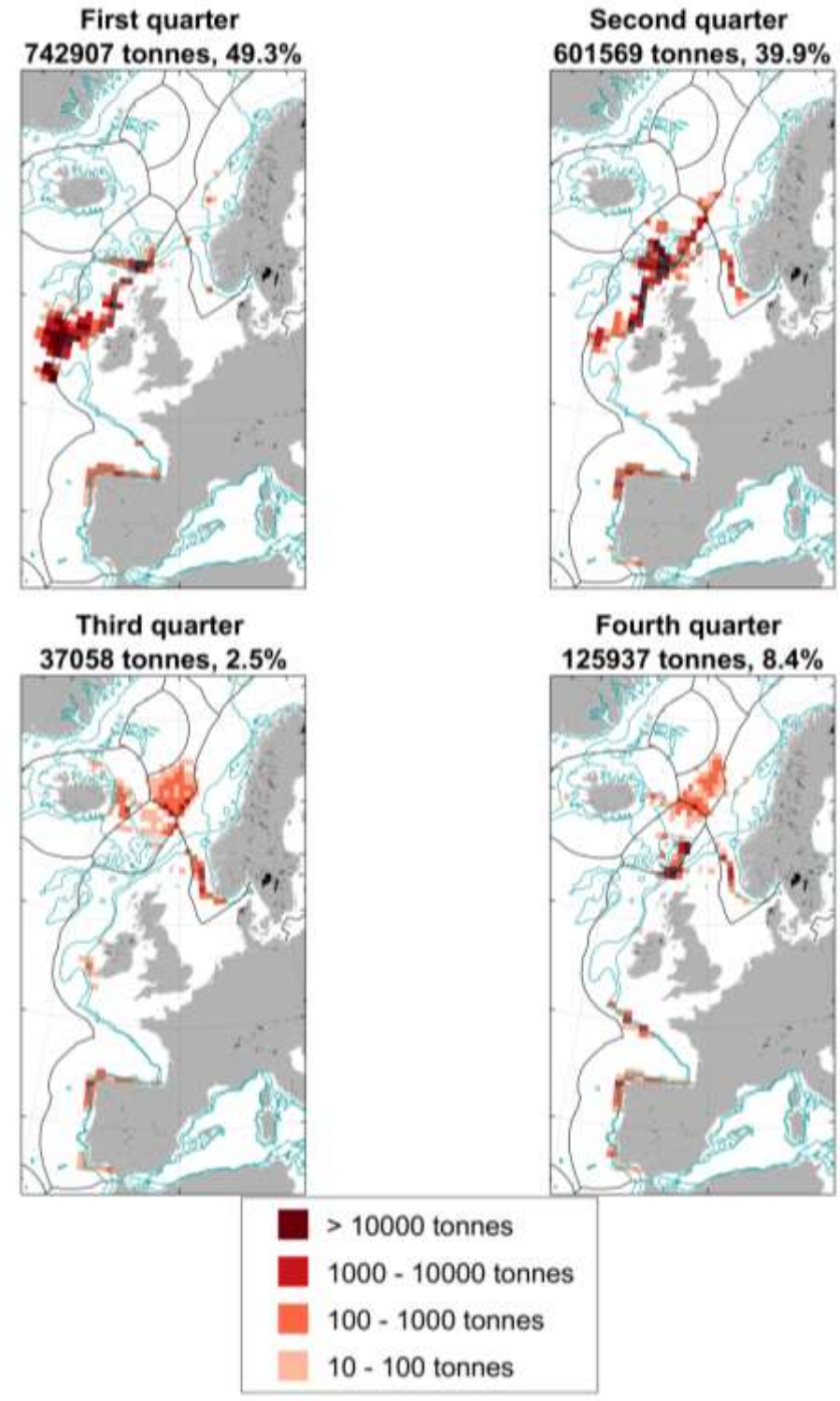


Figure 2.2.2. Blue whiting catches per quarter 2019. The catches on the map are based on logbook data and constitute 99.5 % of the ICES estimated catches. The total catches and percentages shown on each panel are also based on logbook data, and therefore deviate slightly from the ICES estimated catches pr. quarter. The 200 m and 1000 m depth contours are indicated in blue.

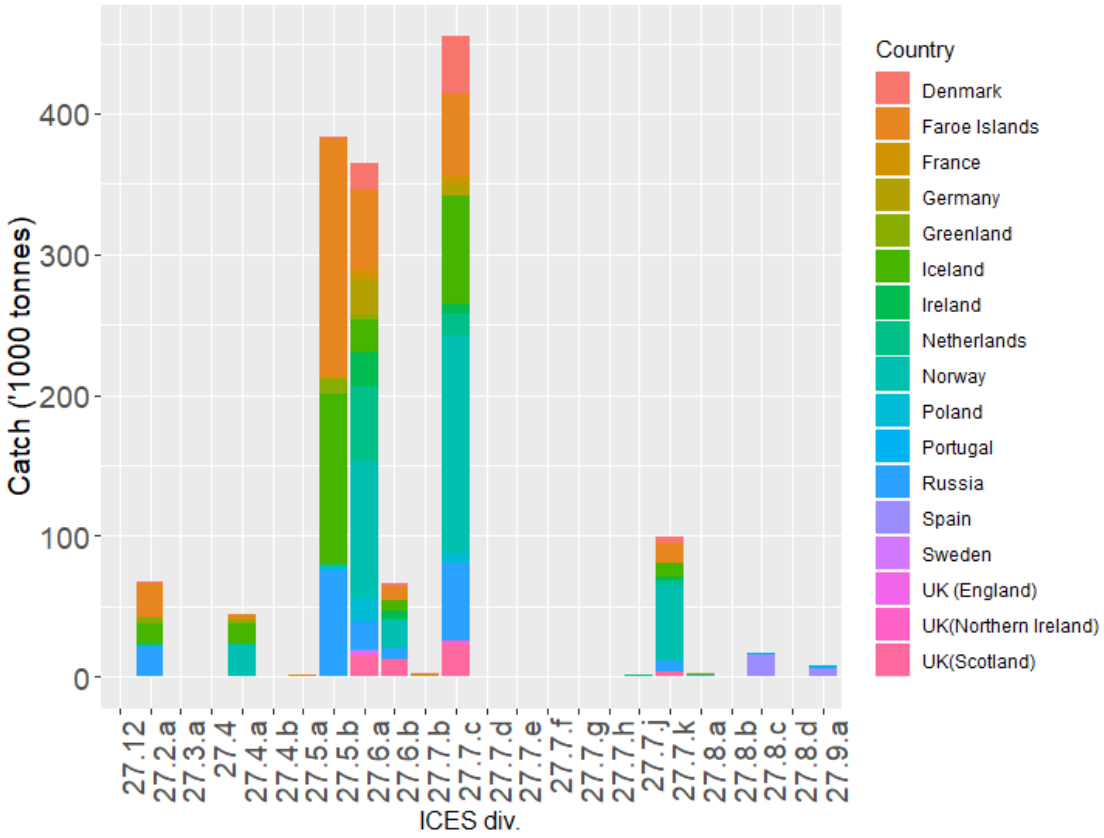
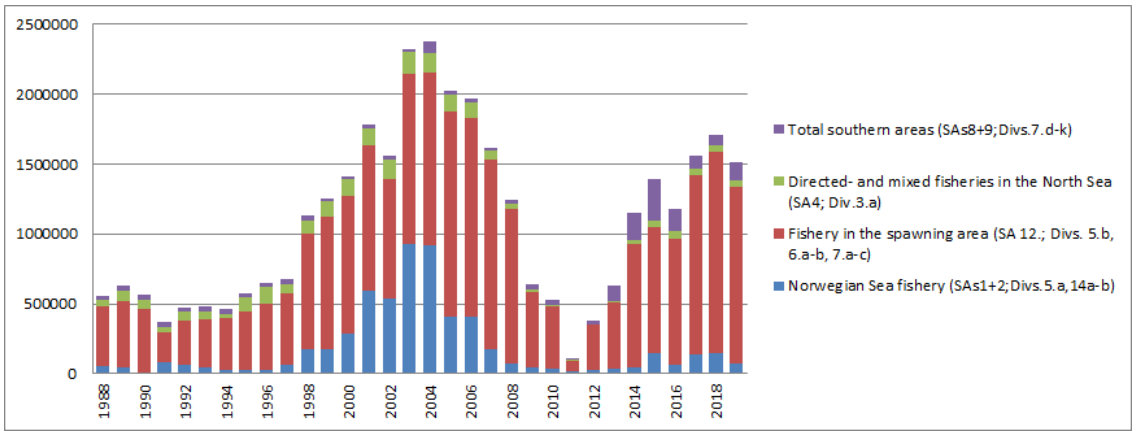


Figure 2.3.1.1. Blue whiting. ICES estimated catches ('1000 tonnes) in 2019 by ICES division and country.

A



B

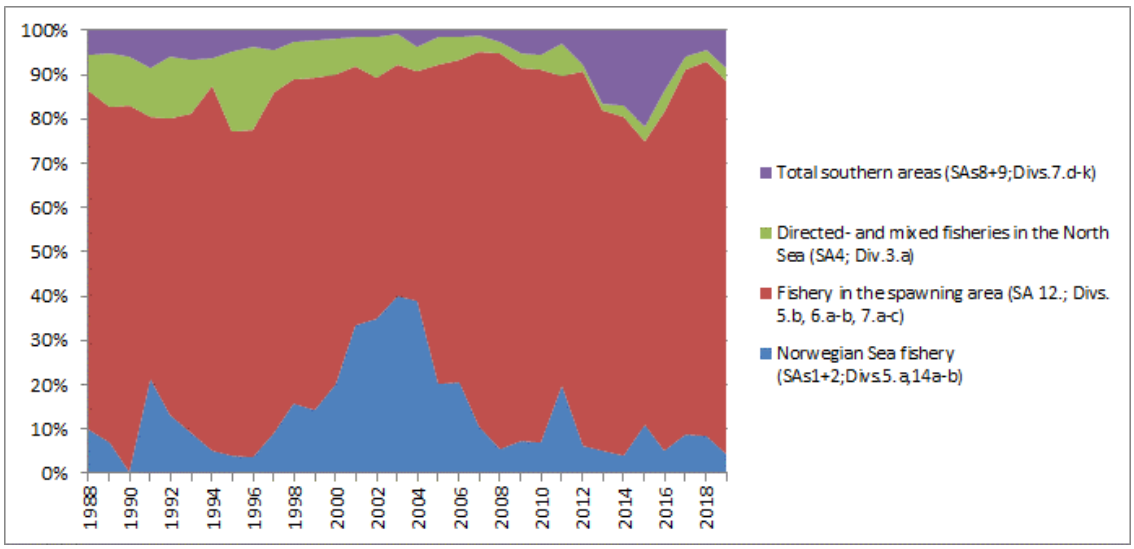


Figure 2.3.1.2. Blue whiting.(A) ICES estimated catches (tonnes) of blue whiting by fishery subareas from 1988-2019 and (B) the percentage contribution to the overall catch by fishery subarea over the same period.

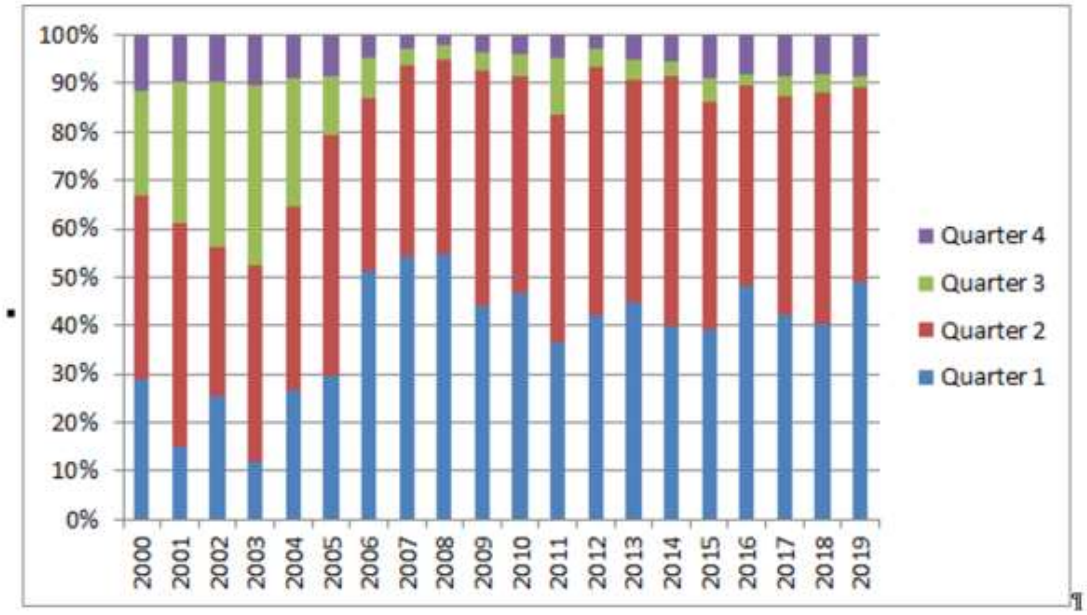


Figure 2.3.1.3. Blue whiting. Distribution of 2019 ICES estimated catches (in percentage) by ICES division area.

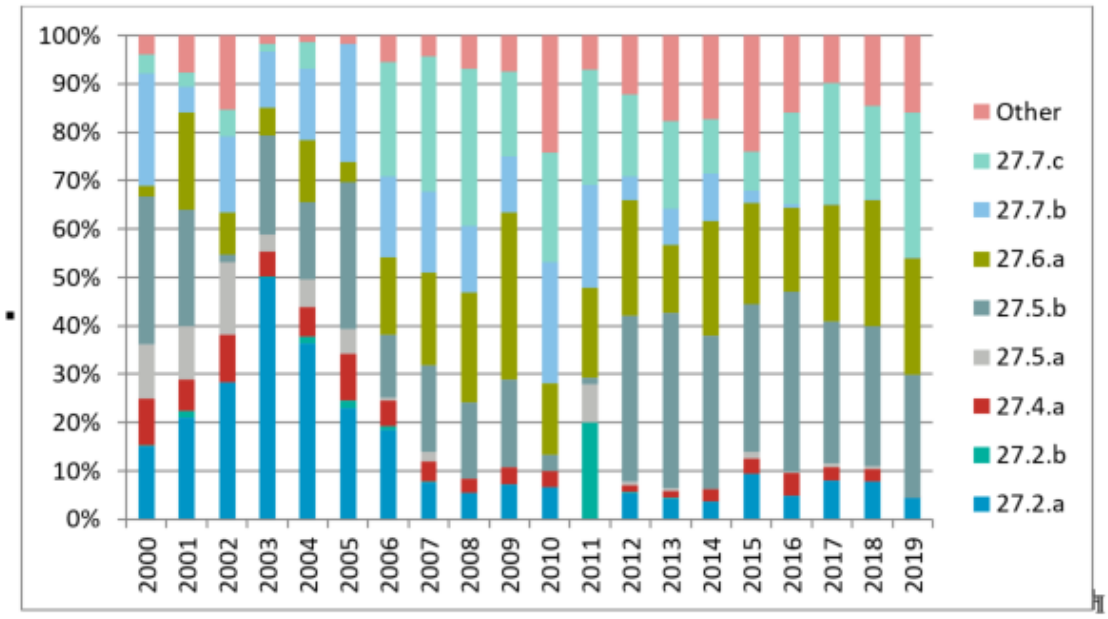


Figure 2.3.1.4. Blue whiting. Distribution of 2019 ICES estimated catches (in percentage) by quarter.

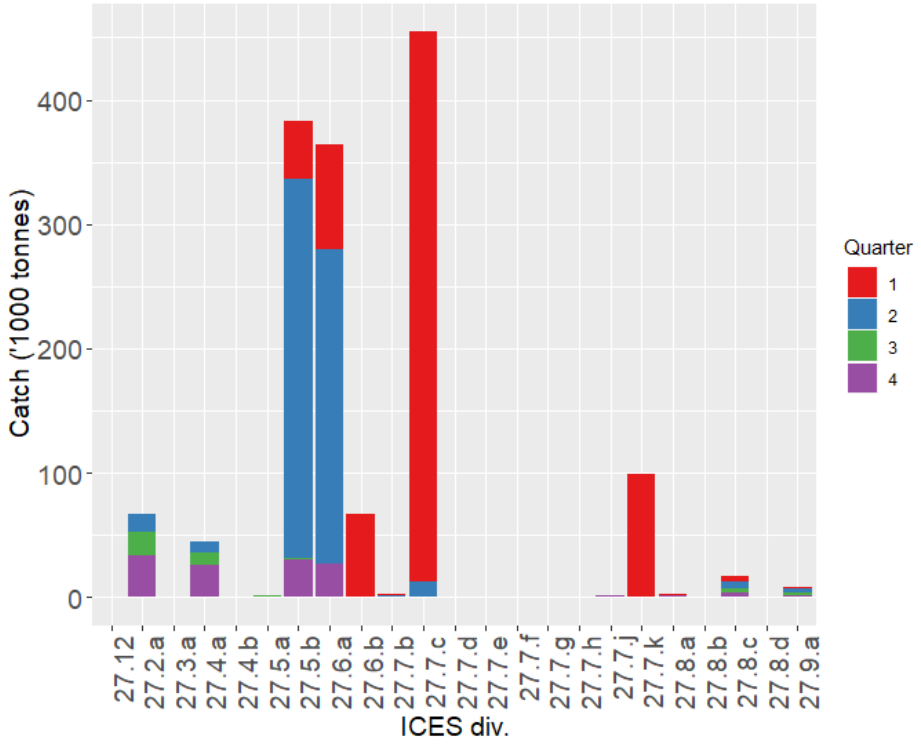


Figure 2.3.1.6. Blue whiting. Distribution of 2019 ICES estimated catches ('1000 tonnes) by ICES division and by quarter.

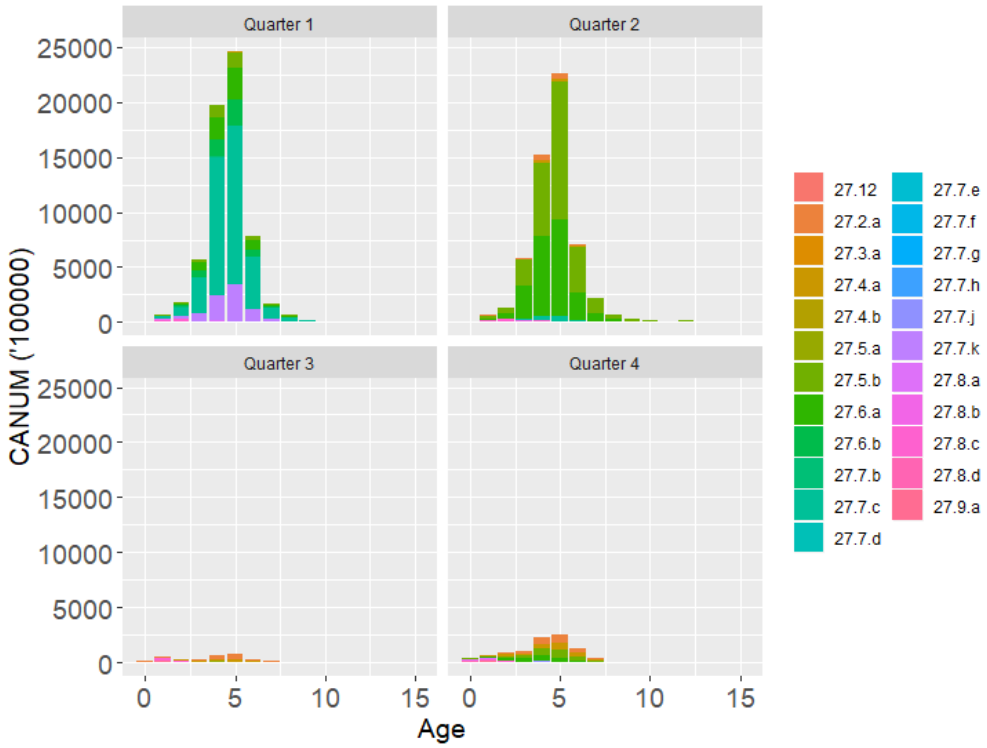


Figure 2.3.1.7. Blue whiting. Catch-at-age numbers (CANUM) distribution by quarter and ICES division for 2019.

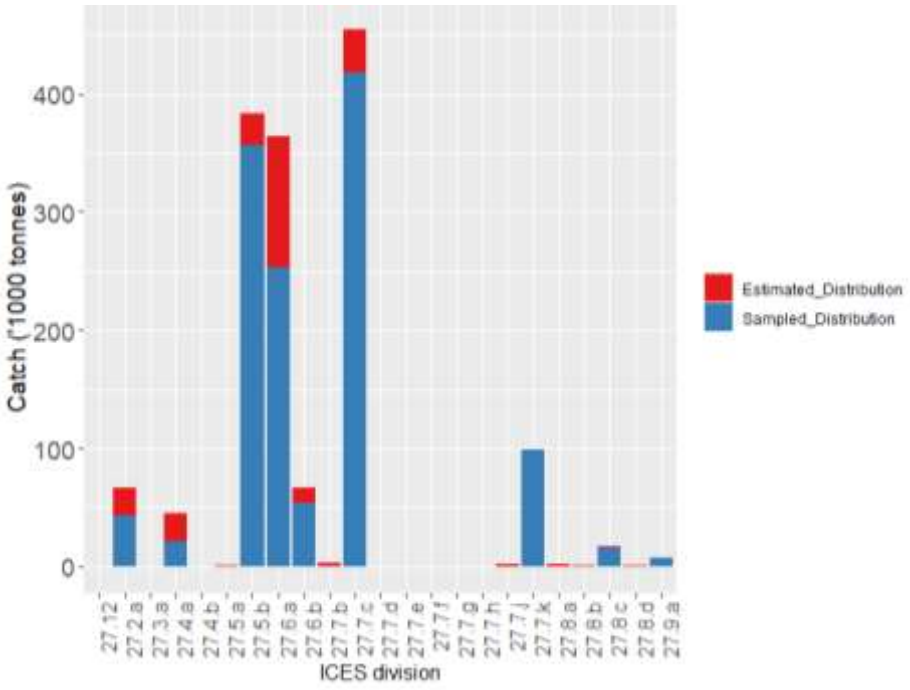


Figure 2.3.1.1.1. Blue whiting. 2019 ICES catches ('1000 tonnes) based on sampled or estimated distribution by ICES division.

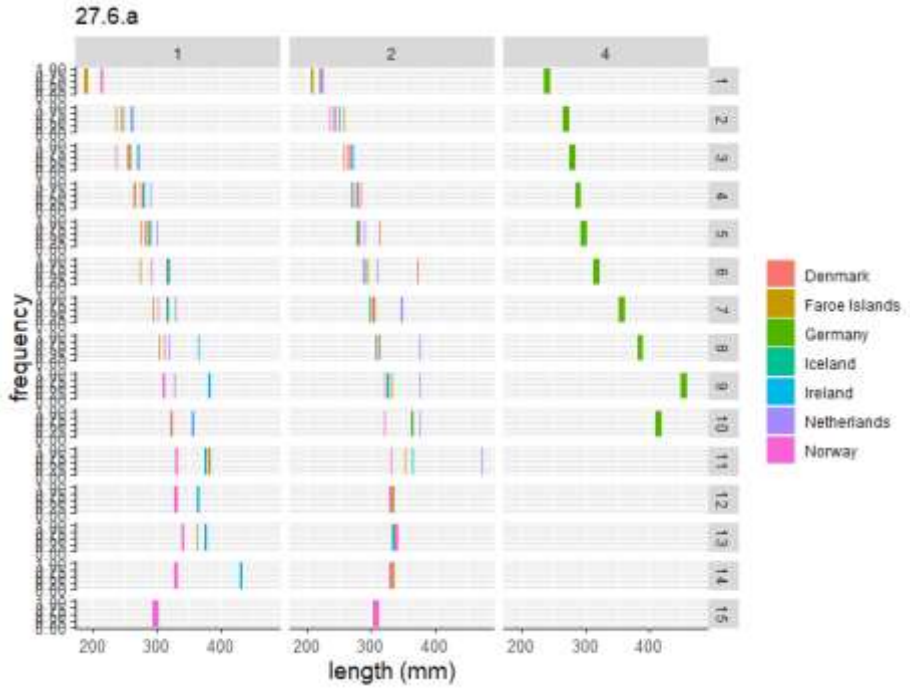


Figure 2.3.1.2.1. Blue whiting. Mean length (mm) by age (0-15 year), by quarter (1,2,4), by country for ICES division area 27.6.a. These data only comprises the 2019 ICES catch-at-age sampled estimates for ICES division 27.6.a.

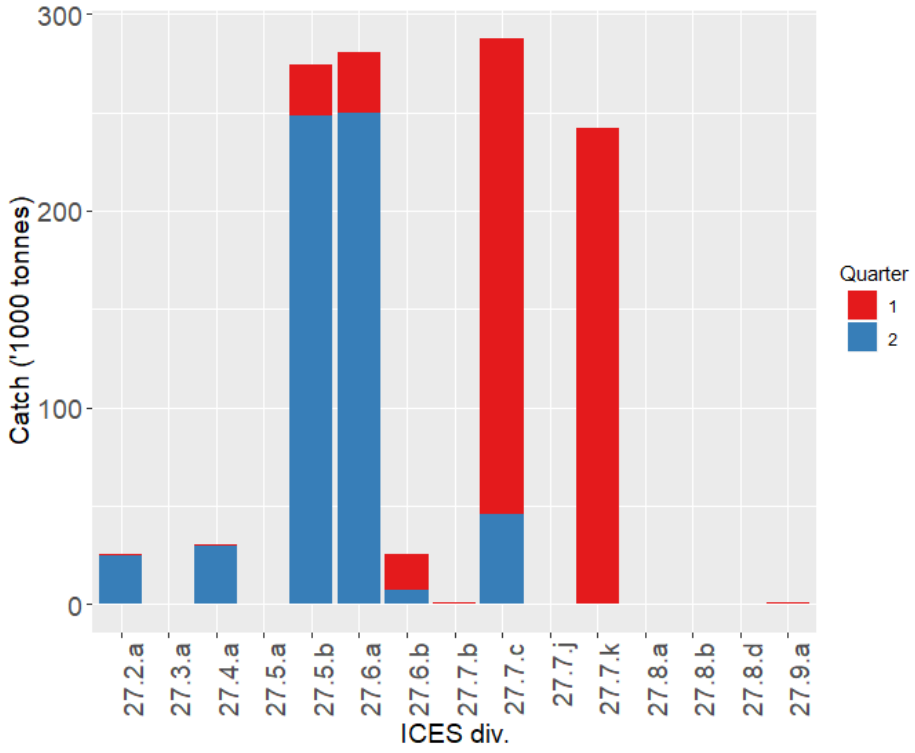


Figure 2.3.2.1. Blue whiting. Distribution of 2020 ICES preliminary estimated catches (tonnes) (1st semester) by ICES division and quarter.

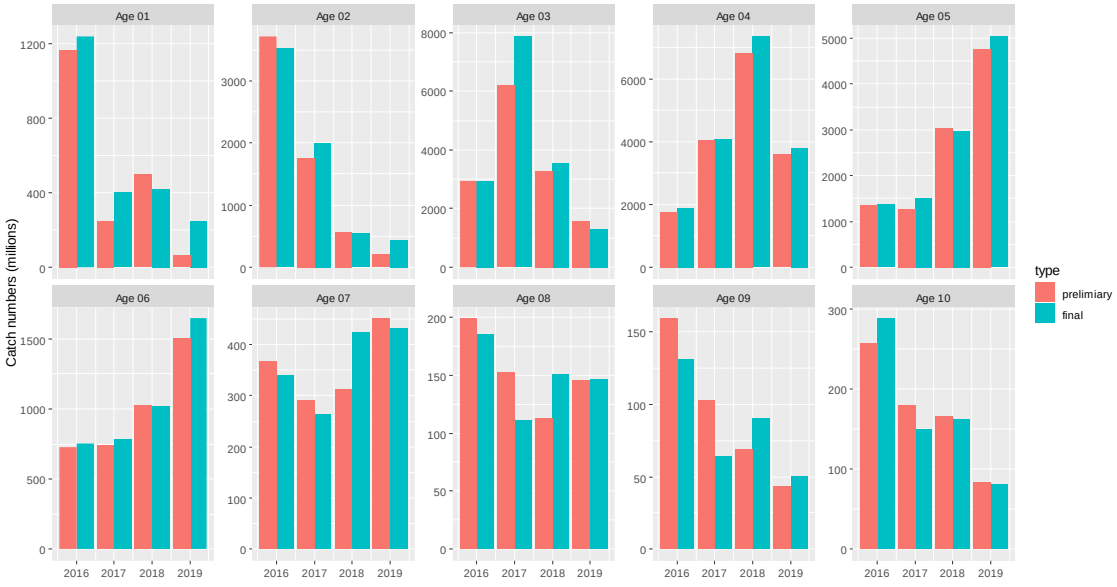


Figure 2.3.2.2 Preliminary and final estimates of catch at age number by age and year.

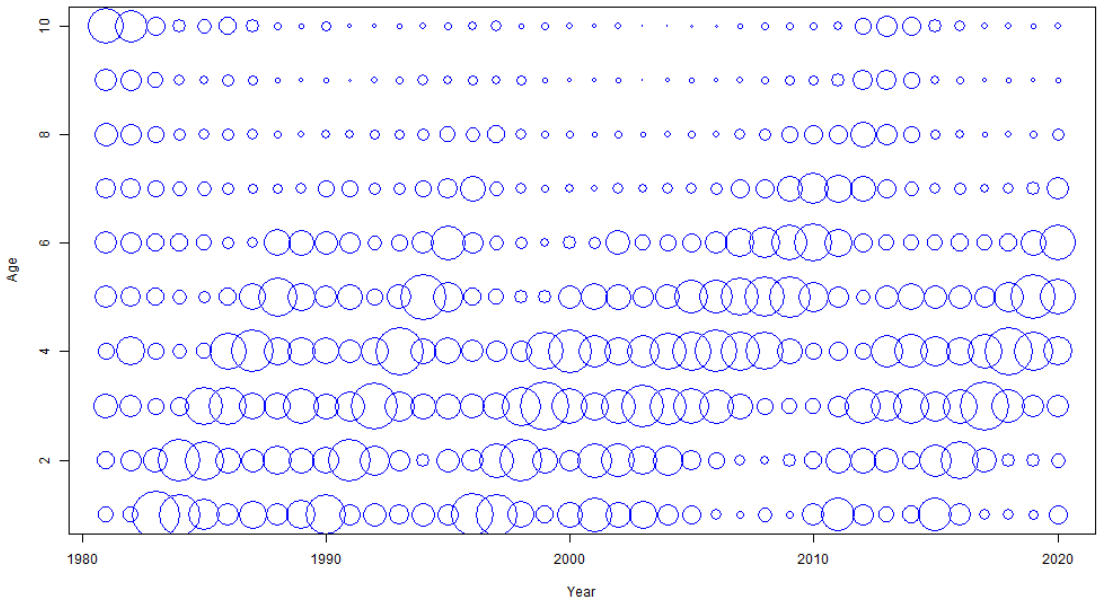


Figure 2.3.3.1. Blue whiting. Catch proportion at age, 1981-2020. Preliminary values for 2020 have been used.

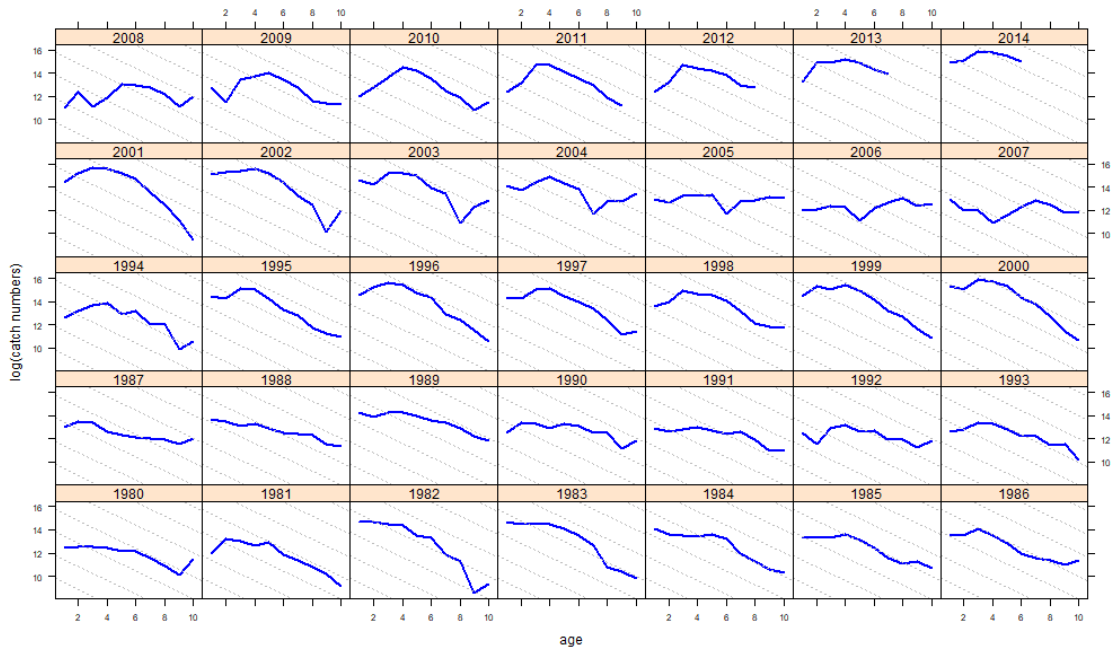


Figure 2.3.3.2. Blue whiting. Age disaggregated catch (numbers) plotted on log scale. The labels for each panel indicate year classes. The grey dotted lines correspond to *Z*=0.6. Preliminary catch-at-age data for 2020 have been used.

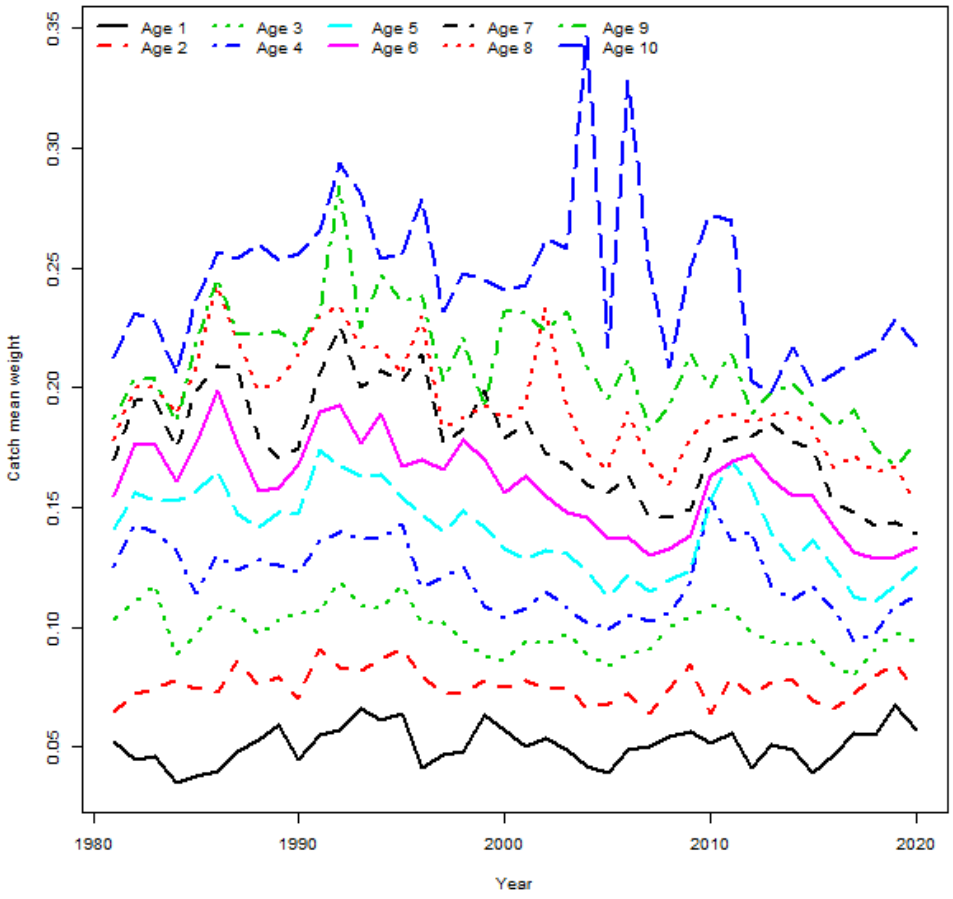


Figure 2.3.4.1. Blue whiting. Mean catch (and stock) weight (kg) at age by year. Preliminary values for 2020 have been used

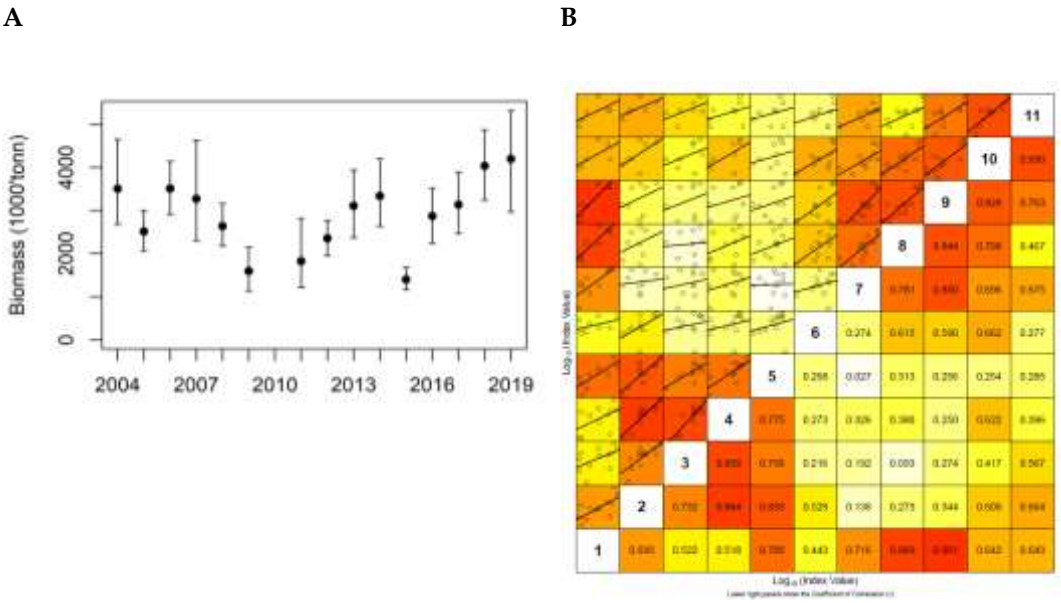
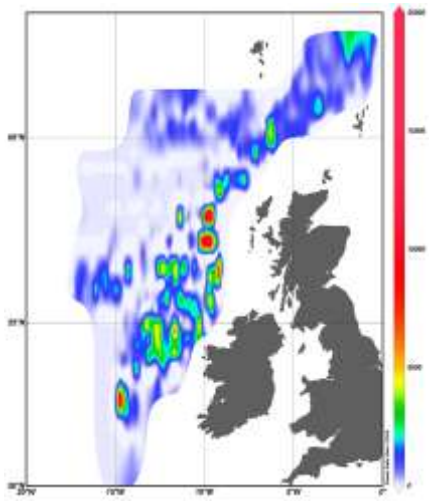
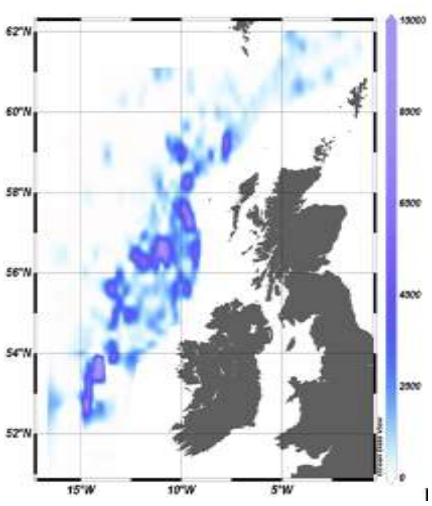


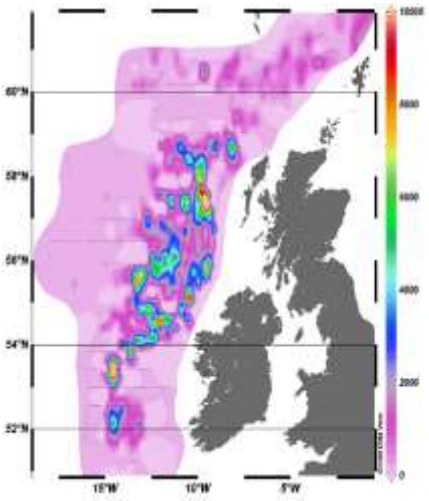
Figure 2.3.7.1.1. Blue whiting – Not updated in 2020. (A) Estimate of total biomass from the International blue whiting spawning stock survey. The black dots and error bands are StoX estimates with 90 % confidence intervals. (B) Internal consistency within the International blue whiting spawning stock survey. The upper left part of the plots shows the relationship between log index-at-age within a cohort. Linear regression line shows the best fit to the log-transformed indices. The lower-right part of the plots shows the correlation coefficient (r) for the two ages plotted in that panel. The background colour of each panel is determined by the r value, where red equates to r=1 and white to r<0.



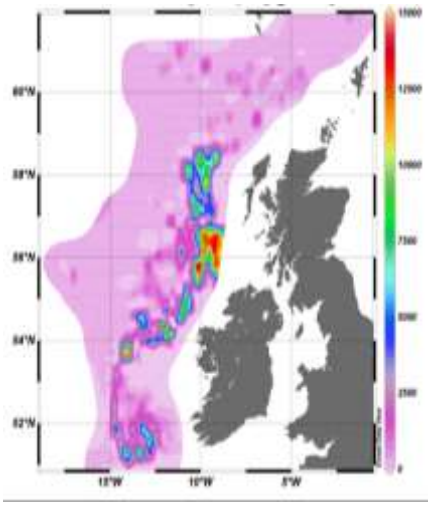
2016



2017



2018



2019

Figure 2.3.7.1.2. Map of blue whiting acoustic density (sA, m2/nm2) found during the spawning survey in spring 2016—2019. – Not updated in 2020.

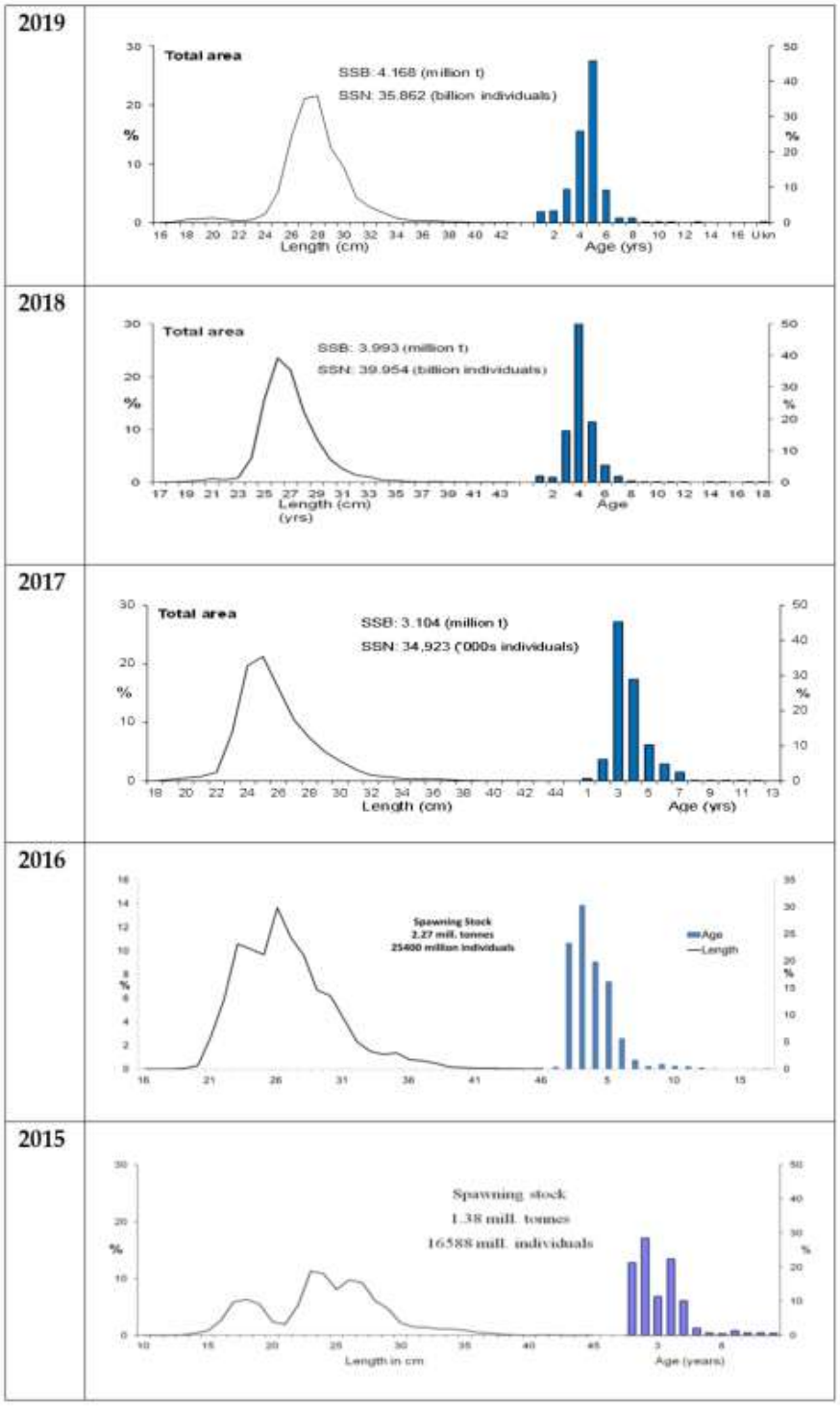


Figure 2.3.7.1.3. Blue whiting – Not updated in 2020. Length (line) and age (bars) distribution of the blue whiting stock in the area to the west of the British Isles, spring 2015 (lower panel) to 2019 (upper panel).Spawning-stock biomass and numbers are given.

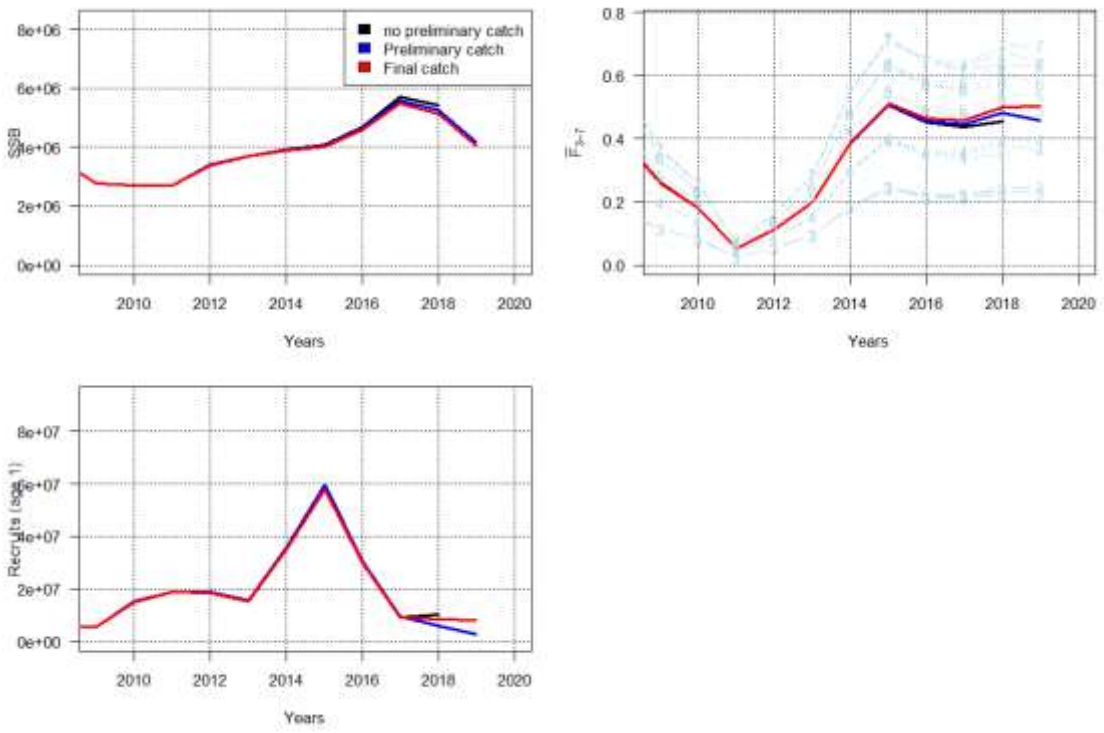


Figure 2.4.1.1. Blue whiting. Scenario results with 2018 as the last survey year, and 1) no preliminary catch at age data for 2019, 2) preliminary catch at data for 2019 and 3) final catch at age data for 2019.

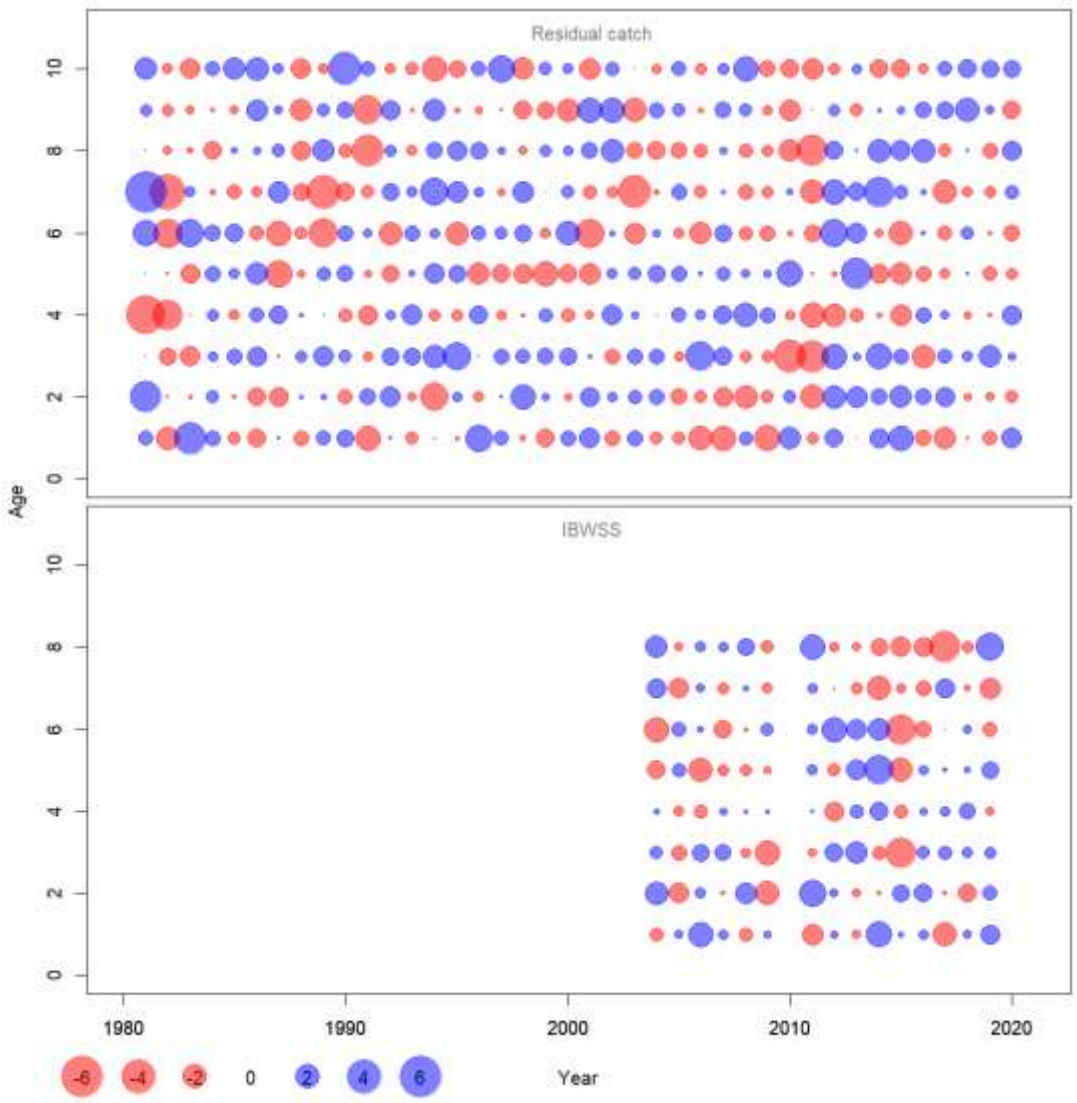


Figure 2.4.2.1. Blue Whiting. OSA (One Step Ahead) residuals (see Berg and Nielsen, 2016) from catch-at-age and the IBWSS survey 2004-2019 (no survey in 2020). Red (lighter) bubbles show that the observed value is less than the expected value. Preliminary catch data for 2020 have been used.

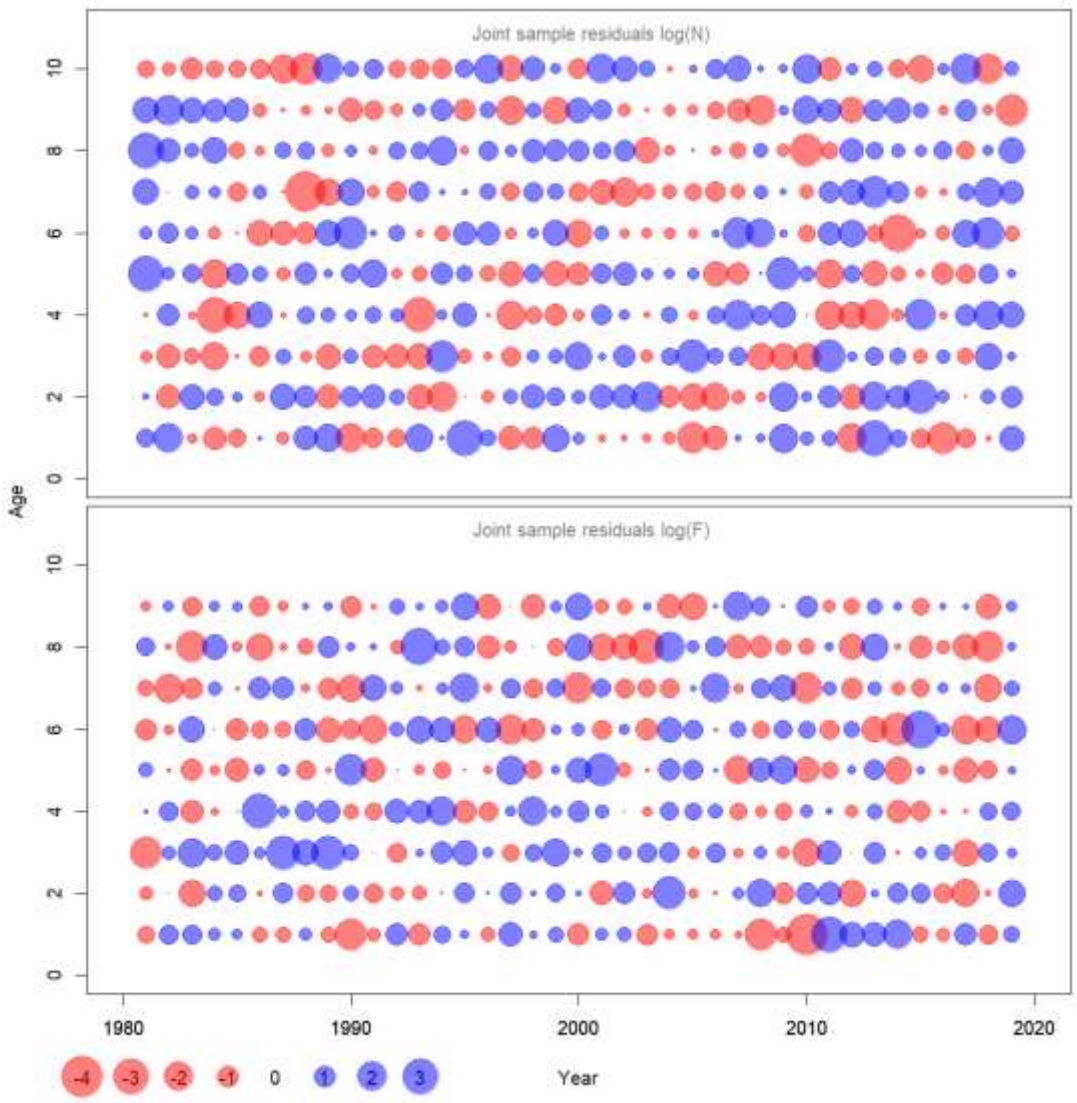


Figure 2.4.2.2 Blue whiting. Joint sample residuals (Process errors) for stock number and F at age. Red (lighter) bubbles show that the observed value is less than the expected value. Preliminary catch data for 2020 have been used.

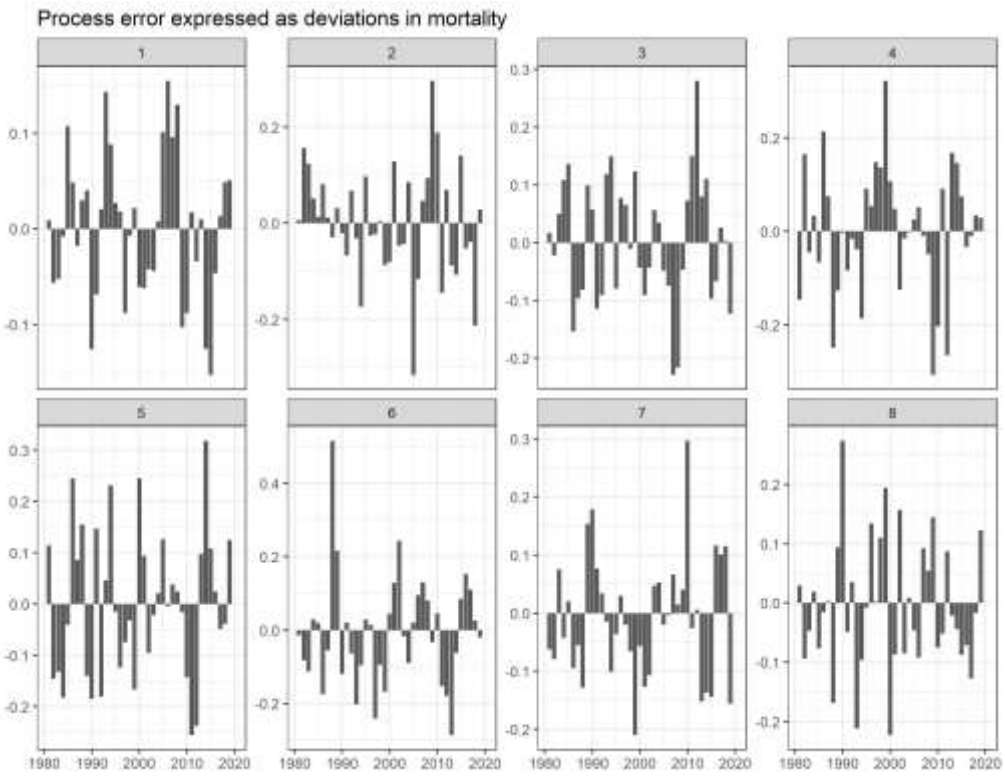


Figure 2.4.2.3. Blue whiting. Process errors expressed as deviation in instantaneous mortality at age by age and year.

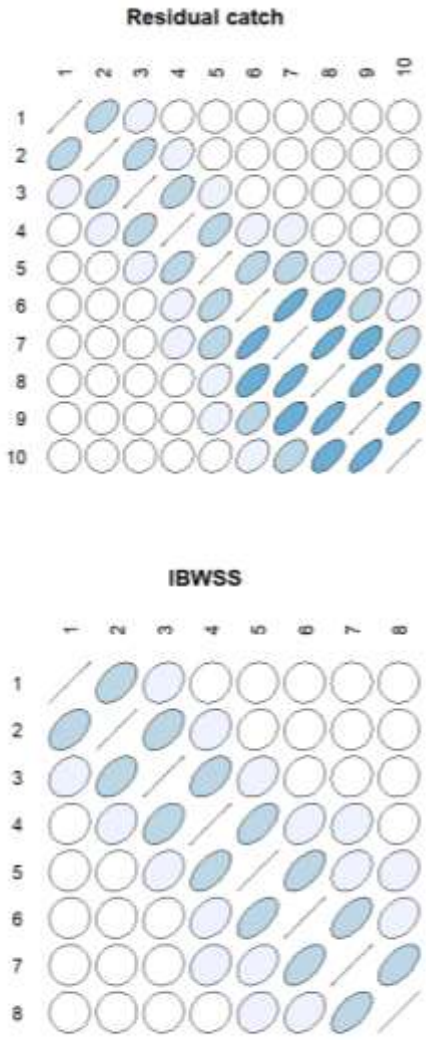


Figure 2.4.2.4. Blue whiting. The correlation matrix between ages for the catches and survey indices. Each ellipse represents the level curve of a bivariate normal distribution with the corresponding correlation. Hence, the sign of a correlation corresponds to the sign of the slope of the major ellipse axis. Increasingly darker shading is used for increasingly larger absolute correlations, while uncorrelated pairs of ages are depicted as circles with no shading.

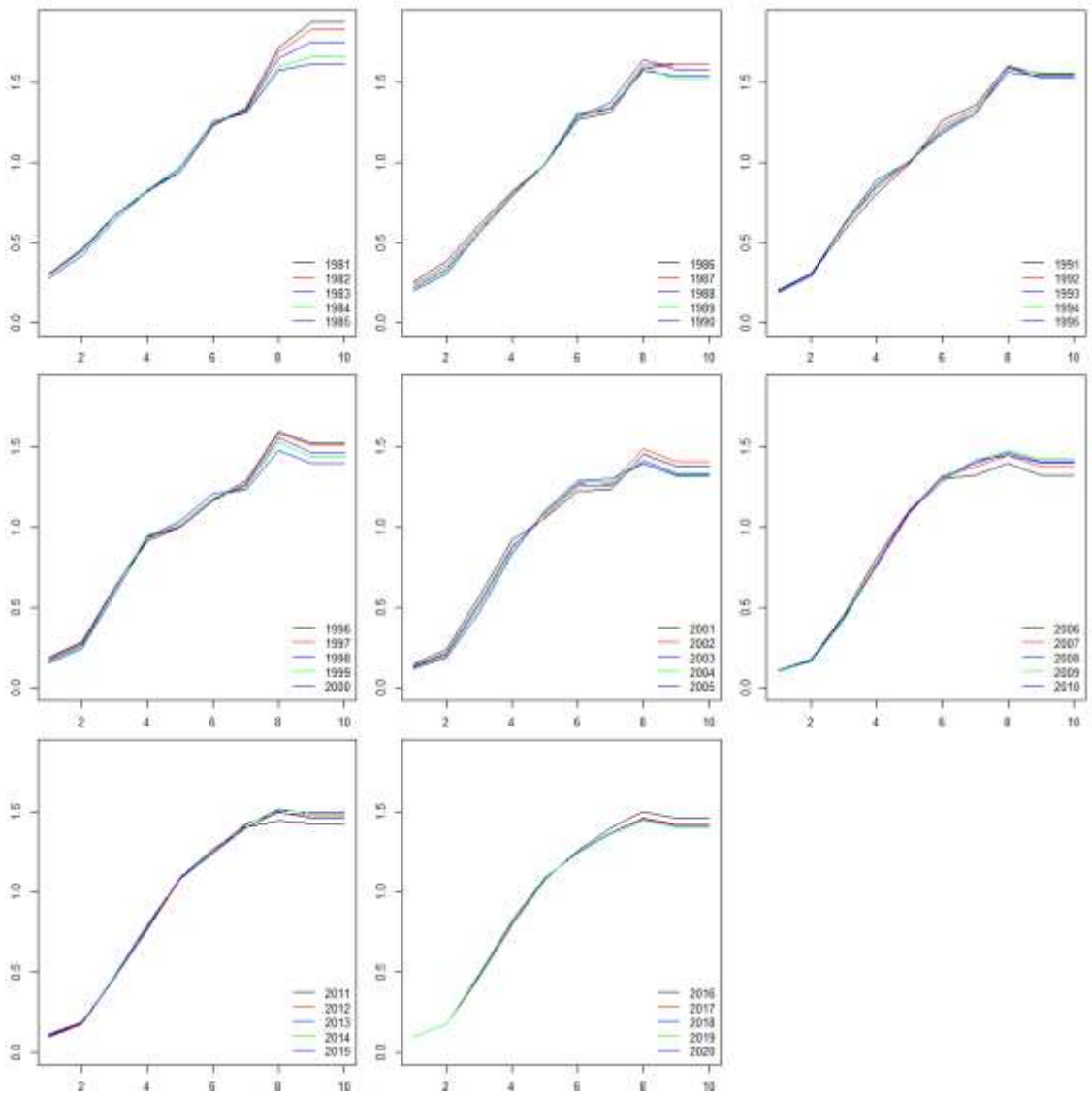


Figure 2.4.2.5. Blue whiting. Exploitation pattern by 5-years' time blocks. Values for 2020 are preliminary.

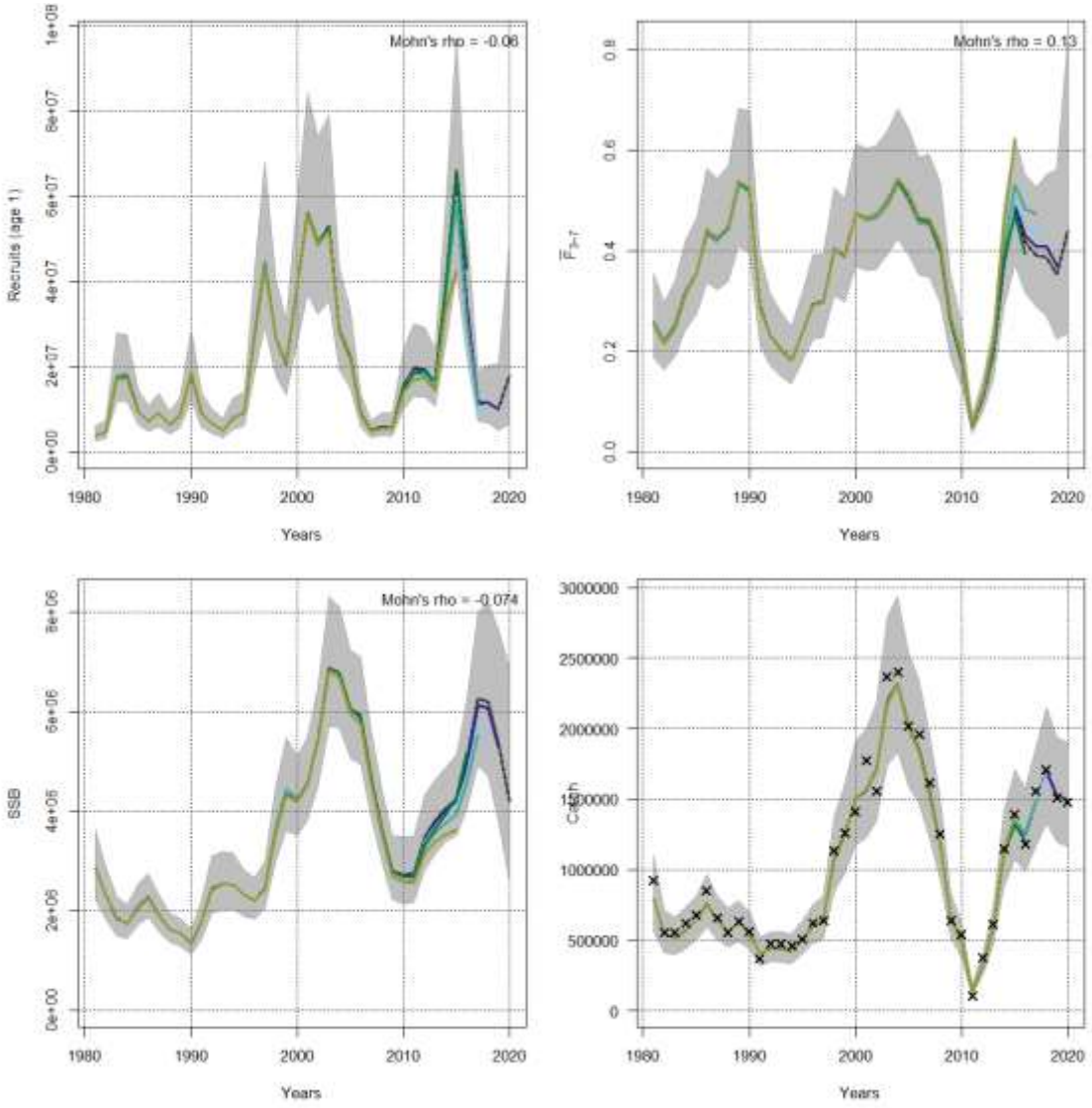


Figure 2.4.2.6. Blue whiting. Retrospective analysis of recruitment (age 1), SSB (tonnes), F and total catch using the SAM model. The 95% confidence interval is shown for the most recent assessment.

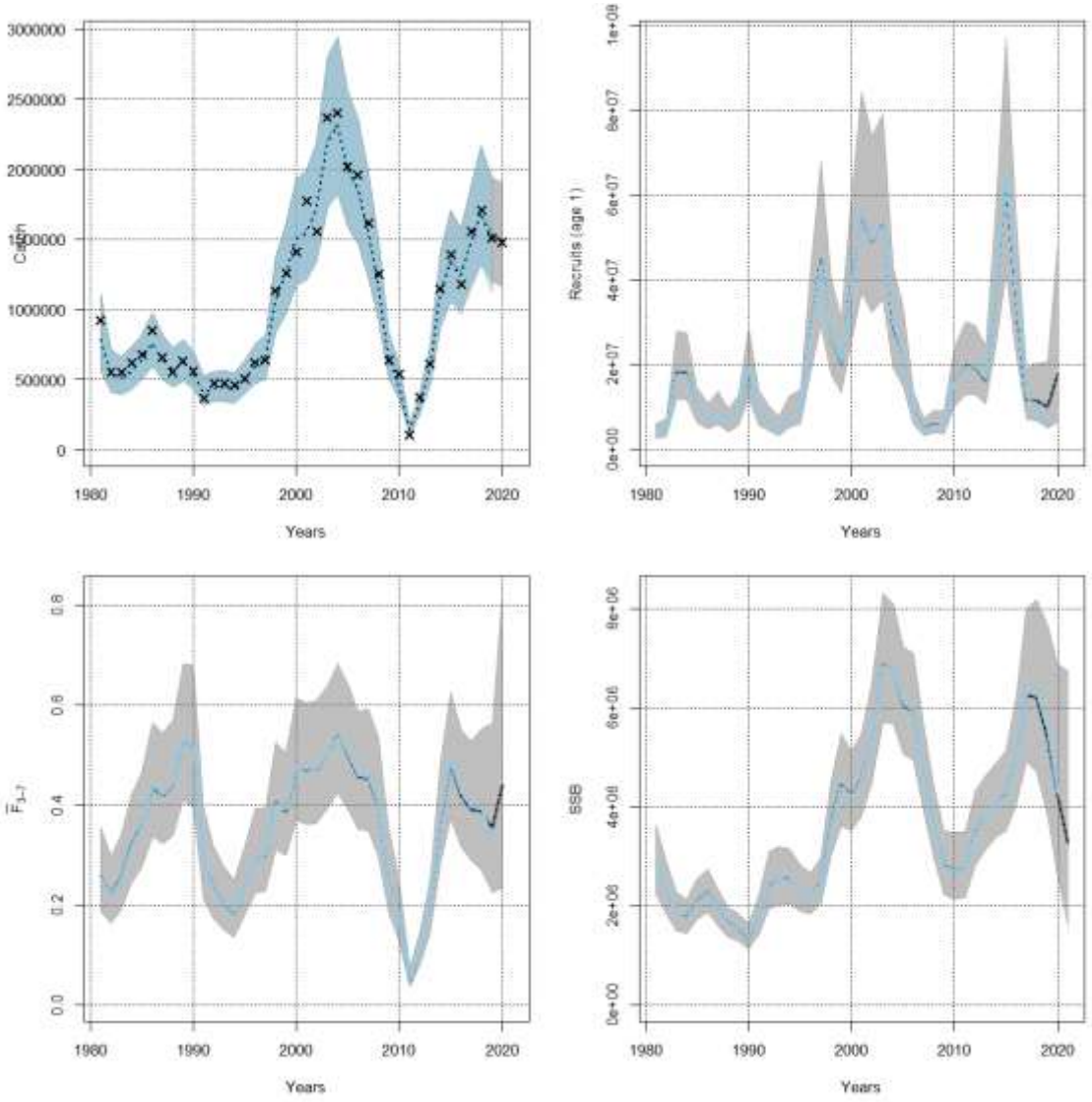


Figure 2.4.2.7. Blue whiting. SAM final run: Stock summary, total catches (tonnes), recruitment (age 1), F and SSB (tonnes). The graphs show the median value and the 95% confidence interval. The catch plot does also include the observed catches (x). The assessment results from 2020 assessment are shown by the black line, the assessment results from 2019 by the blue line. Catches for 2020 are preliminary.

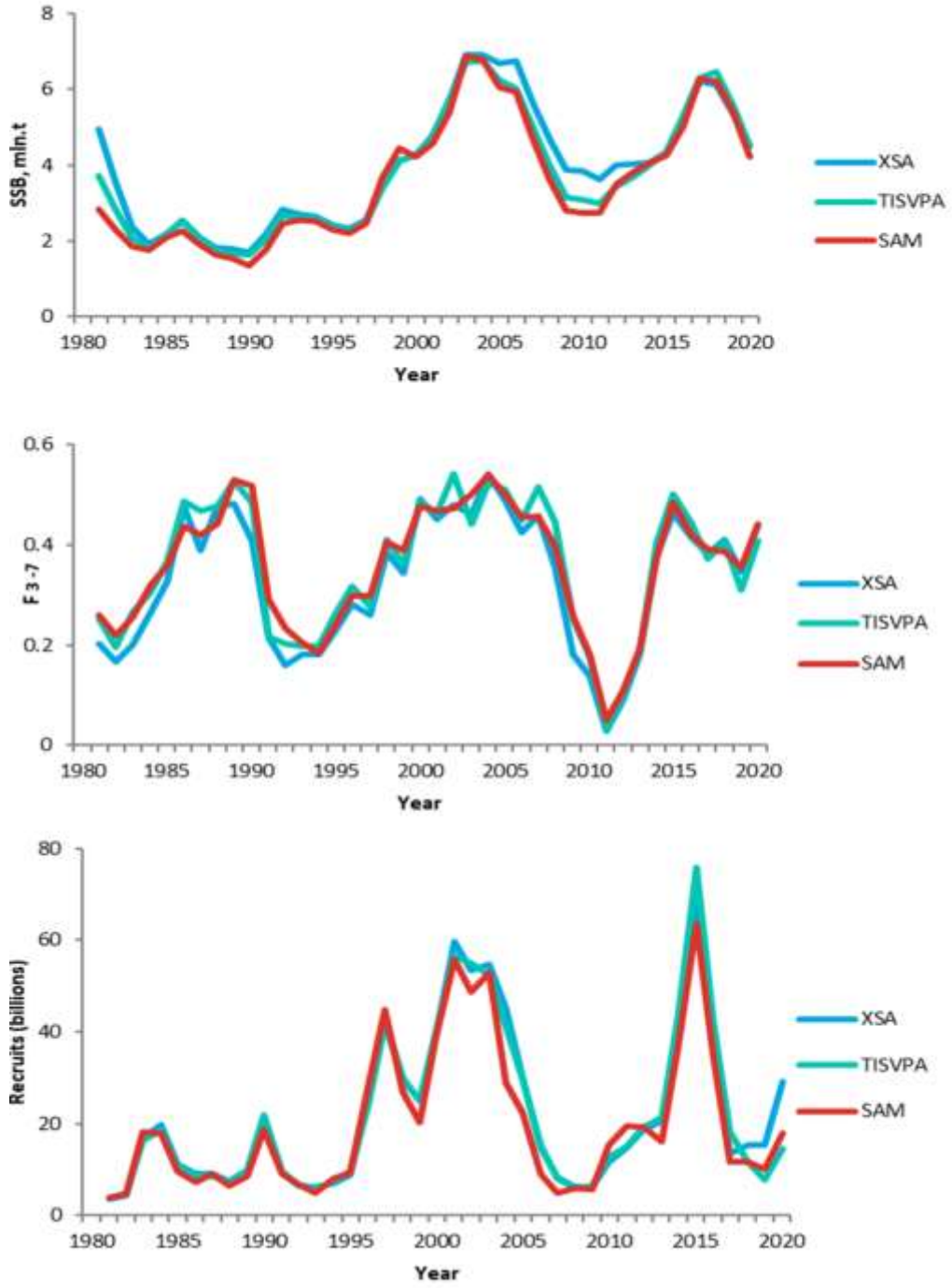


Figure 2.4.3.1. Blue whiting. Comparison of SSB, F and recruitment estimated by the assessment programs XSA, TISVPA and SAM. Catch values for 2020 are preliminary.

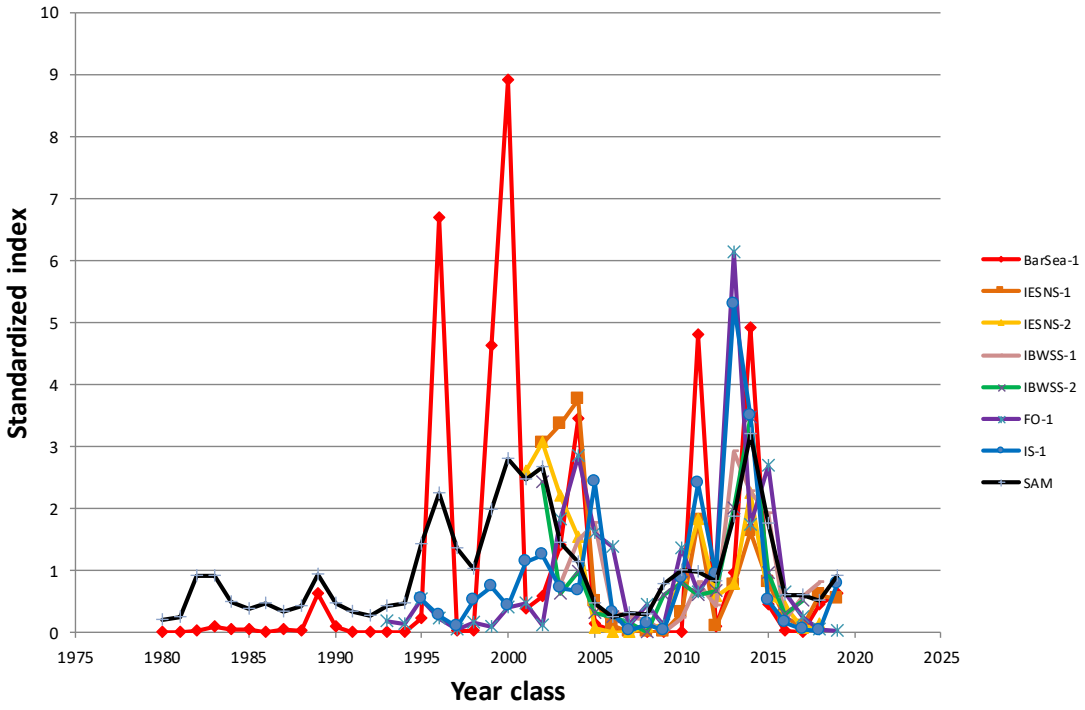


Figure 2.8.1.1. Blue whiting young fish indices from five different surveys and recruitment index from the assessment, standardized by dividing each series by their mean. BarSea - Norwegian bottom-trawl survey in the Barents Sea, IESNS: International Ecosystem Survey in the Nordic Seas in May (1 and 2 is the age groups), IBWSS (Not updated in 2020): International Blue Whiting Spawning Stock survey (1 and 2 is the age groups), FO: the Faroese bottom-trawl surveys in spring, IS: the Icelandic bottom-trawl survey in spring, SAM: recruits from the assessment.

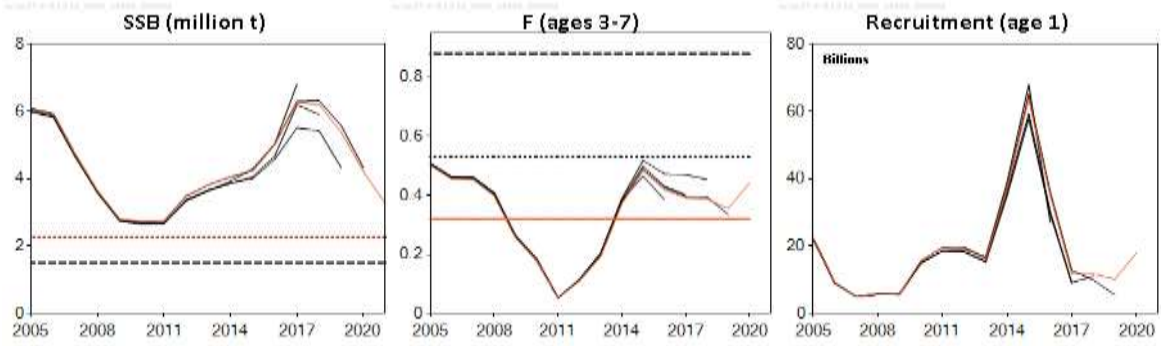


Figure 2.9.1. Blue whiting. Comparison of the 2016 - 2020 assessments.

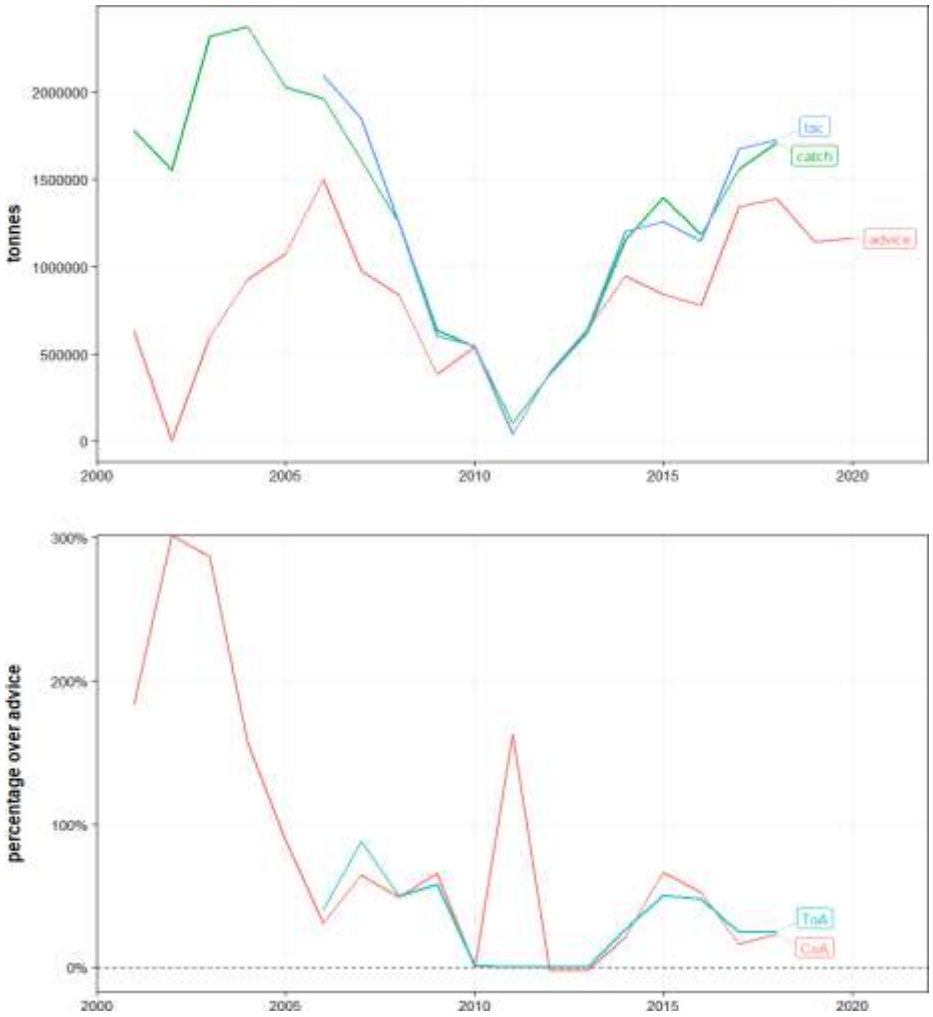


Figure 2.13.1. Blue whiting. Top: comparison of (max) scientific advice, TAC (or sum of unilateral quota) and Total Catch. Bottom: percentage deviation from ICES advice, CoA is Catch over Advice, ToA is TAC over Advice.