# WORKING GROUP ON WIDELY DISTRIBUTED STOCKS (WGWIDE)

# ICES Scientific Reports

## WORKING GROUP ON WIDELY DISTRIBUTED STOCKS (WGWIDE)

### Recommended format for purpose of citation:

## Editors

Andrew Campbell

## Authors

Thomas Brunel • Andrew Campbell • Neil Campbell • Pablo Carrera • Rui Catarino • Anatoly Chetyrkin • Gersom Costas • Laurent Dubroca • Roxanne Duncan • Sólva Eliasen • Patricia Goncalves • Åge Højnes • Sondre Hølleland • Eydna í Homrum • Jan Arge Jacobsen • Teunis Jansen • Alexander Krysov • Bernhard Kühn • Gwladys Lambert • Lisa Anne Libungan • David Miller • Richard Nash • Leif Nøttestad • Anna H. Olafsdottir • Alessandro Orio • Martin Pastoors • Are Salthaug • Sonia Sanchez • Aril Slotte • Claus Sparrevohn • Erling Kåre Stenevik • Nikolay Timoshenko • Jens Ulleweit • Sindre Vatnehol • Morten Vinther

ICES
CIEM

International Council for
the Exploration of the Sea

Conseil International pour
l'Exploration de la Mer

# Contents

# 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

Bachiller, E., Skaret, G., Nøttestad, L., Slotte, A. 2016 Feeding ecology of northeast Atlantic mackerel, Norwegian spring- spawning herring and blue whiting in the Norwegian Sea. PLoS One, 11 (2016), 10.1371/journal.pone.0149238

Berg, C.W. and Nielsen, A. 2016. Accounting for correlated observations in an age-based state-space stock assessment model. ICES Journal of Marine Science, 73: 1788-1797. doi:10.1093/icesjms/fsw046

Dolgov, A. V., Johannesen, E., Heino, M., and Olsen, E. 2010. Trophic ecology of blue whiting in the Barents Sea. ICES Journal of MarineScience, 67: 483–493

Hatun H, Payne, M.R., Beaugrand, G., Reid, P.C., Sando, A.B., Drange, H., Hansen, B., Jacobson, J.A. and Bloch., D. 2009a. Large bio-geographical shifts in the north-eastern Atlantic Ocean: From the Subpolar Gyre, via plankton, to blue whiting and pilot whales. Progress in Oceanography 80 (2009b) 149–162.

Hatun H, Payne, M.R., and Jacobson, J.A. 2009b. The North Atlantic Subpolar Gyre regulates the spawning distribution of blue whiting (Micromesistius poutassou). Canadian Journal of Fisheries and Aquatic Science 66: 759–770. doi:10.1139/F09-037441

Heino M., and Godø, O.R. 2002. Blue whiting – a key species in the mid-water ecosystems of the northeastern Atlantic. ICES C.M. 2002/L:28.

ICES. 2013a. NEAFC request to ICES to evaluate the harvest control rule element of the long-term management plan for blue whiting. Special request, Advice May 2013. *In* Report of the ICES Advisory Committee, 2013.ICES Advice 2013, Book 9, Section 9.3.3.1.

ICES. 2013b. NEAFC request on additional management plan evaluation for blue whiting. Special request, Advice October 2013.*In* Report of the ICES Advisory Committee, 2013.ICES Advice 2013, Book 9, Section 9.3.3.7.

ICES. 2016a. Report of the Inter-Benchmark Protocol for Blue Whiting (IBPBLW), 10 March–10 May 2016, By correspondence. ICES CM 2016/ACOM:36. 118 pp.

ICES. 2016b. Report of the Workshop on Blue Whiting Long Term Management Strategy Evaluation (WKBWMS), 30 August 2016ICES HQ, Copenhagen, Denmark. ICES CM 2016/ACOM:53

ICES. 2016c. Report of the Stock Identification Methods Working Group (SIMWG), By correspondence. ICES CM 2016/SSGEPI:16. 47 pp.

ICES. 2020. Report of the Working Group on Widely Distributed Stocks (WGWIDE) ICES Scientific Reports. 2:XX. XXX pp. http://doi.org/10.17895/ices.pub.XXXX.

Keating, J.P., Brophy, D., Officer, R.A., and Mullins, E. 2014.Otolith shape analysis of blue whiting suggests a complex stock structure at their spawning grounds in the Northeast Atlantic. Fish. Res. 157: 1–6. doi:10.1016/j.fishres.2014.03.009.

Mahe, K., Oudard, C., Mille, T., Keating, J.P., Gonçalves, P., Clausen, L.W., Petursdöttir, G.G., Rasmussen, H., Meland, E., Mullins, E. and Pinnegar, J.K. 2016. Identifying blue whiting (Micromesistius poutassou) stock structure in the Northeast Atlantic by otolith shape analysis. Canadian Journal of Fisheries and Aquatic Sciences, 10.1139/cjfas-2015-0332.

Miesner, A.K., Payne, M.R., 2018. Oceanographic variability shapes the spawning distribution of blue whiting (Micromesistius poutassou). Fish. Oceanogr. 623–638. doi:10.1111/fog.12382

Payne, M. R., Egan, A., Fässler, S. M. M., Hátún, H., Holst, J. C., Jacobsen, J. A., Loeng, H. (2012). The rise and fall of the NE Atlantic blue whiting (Micromesistius poutassou). Marine Biology Research, 8, 475–487. https://doi.org/10.1080/17451000.2011.639778

Pointin F. and Payne, M.R. 2014.A Resolution to the Blue Whiting (Micromesistius poutassou) Population Paradox?PLoSONE 9(9): e106237. doi:10.1371/journal.pone.0106237.

Pinnegar, J. K., Goñi, N., Trenkel, V. M., Arrizabalaga, H., Melle, W., Keating, J., and Óskarsson, G.: A new compilation of stomach content data for commercially important pelagic fish species in the northeast Atlantic, Earth Syst. Sci. Data, 7, 19–28, https://doi.org/10.5194/essd-7-19-2015, 2015.

Trenkel, V., Huse,G., MacKenzie, B., Alvarez, P., Arrizabalaga, H.,Castonguay, M., Goñi, N., Grégoire, F., Hátún, H., and Jansen, T. Comparative ecology of widely distributed pelagic fish species in the North Atlantic: implications for modelling climate and fisheries impacts. Prog. Oceanogr., 129 (2014), pp. 219-243.

Utne, K. R., Huse, G., Ottersen, G., Holst, J. C., Zabavnikov, V., Jacobsen, J. A., Oskarsson, G. J., and Nøttestad, L. 2012. Horizontal distribution and overlap of planktivorous fish stocks in the Norwegian Sea during summers 1995–2006. Marine Biology Research (1745-1019) 2012-04, Vol. 8, N. 5–6, P. 420–441.

## 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 pro-gramme, 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 pro-gramme (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 |

| Year\Age | Age 1 | Age 2 |
|---|---|---|
| 2011 | 1613 | 0 |
| 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 |

| Catch Rate | | |
| --- | --- | --- |
| Year | All | < 19 cm |
| 1996 | 9.88 | 5.81 |
| 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

WHB catch 2019 (based on logbooks)
1507472 tonnes in total



> 10000 tonnes
1000 - 10000 tonnes
100 - 1000 tonnes
10 - 100 tonnes
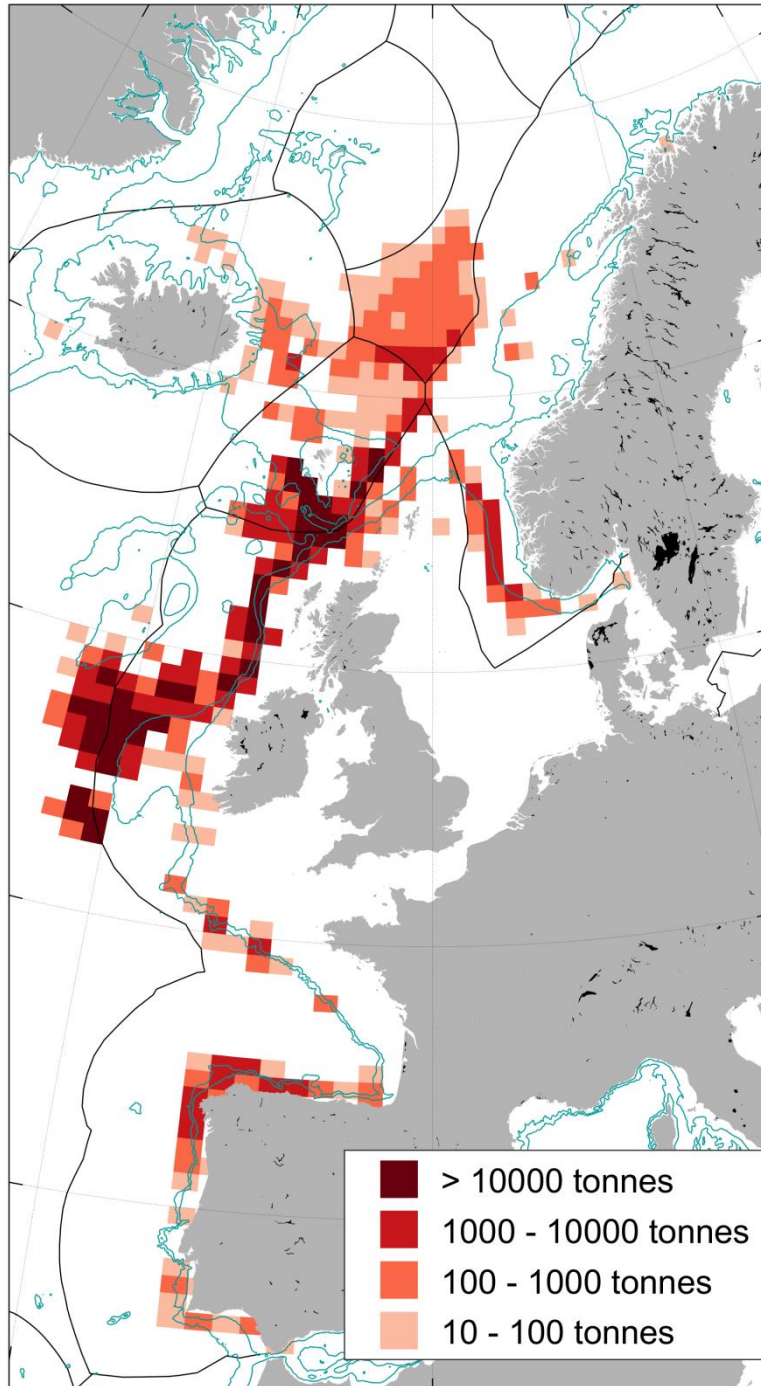
Figure 2.2.1. Blue whiting landings in 2019, based on logbook data. The catches on the map constitute 99.5 % of the ICES estimated catches. The 200 m and 1000 m depth contours are indicated in blue.
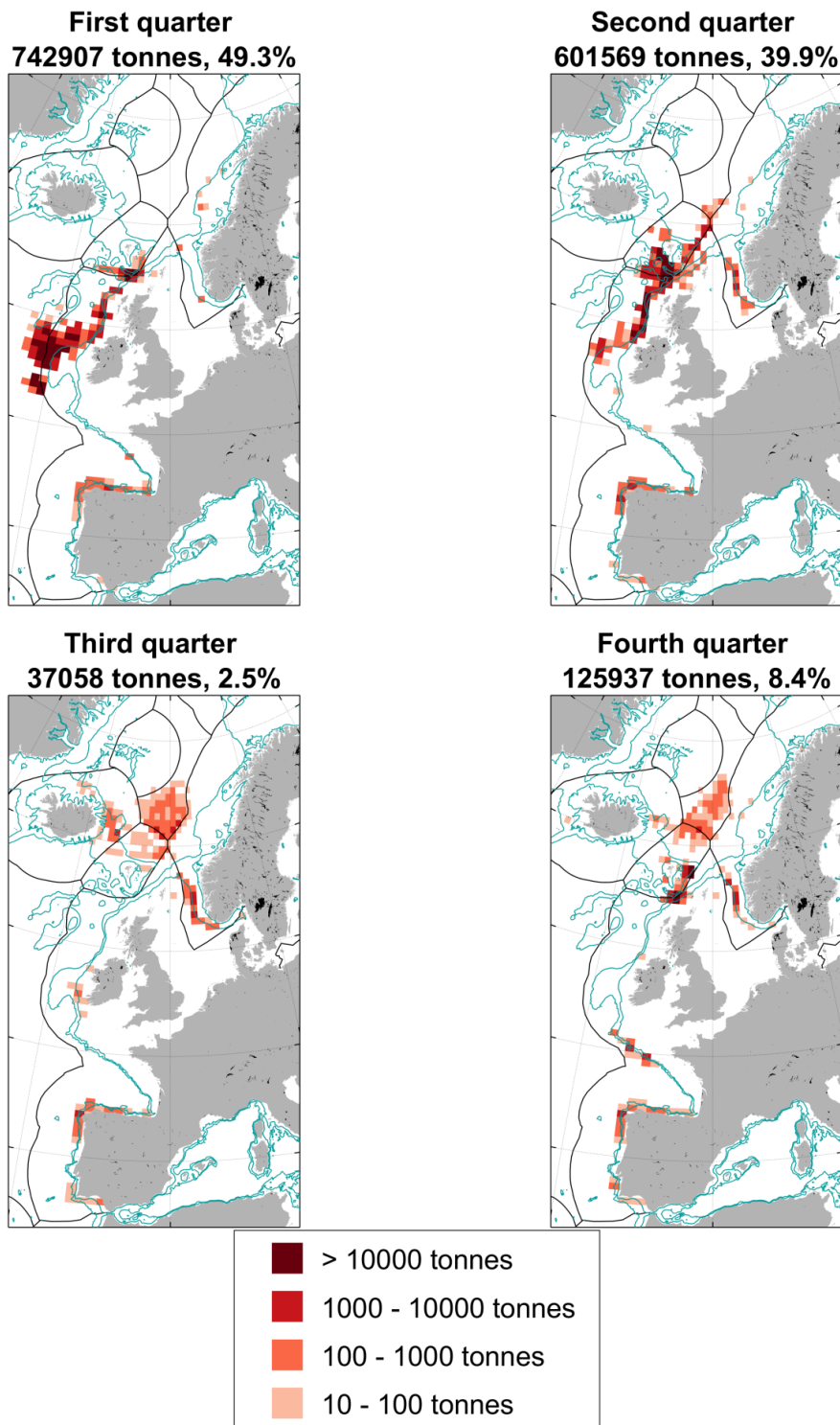
**Figure 2.2.2. Blue whiting catches per quarter 2019. The catches on the map are based on logbook data and constitute 99.5 % of the ICES estimated catches. The total catches and percentages shown on each panel are also based on logbook data, and therefore deviate slightly from the ICES estimated catches pr. quarter. The 200 m and 1000 m depth contours are indicated in blue.**
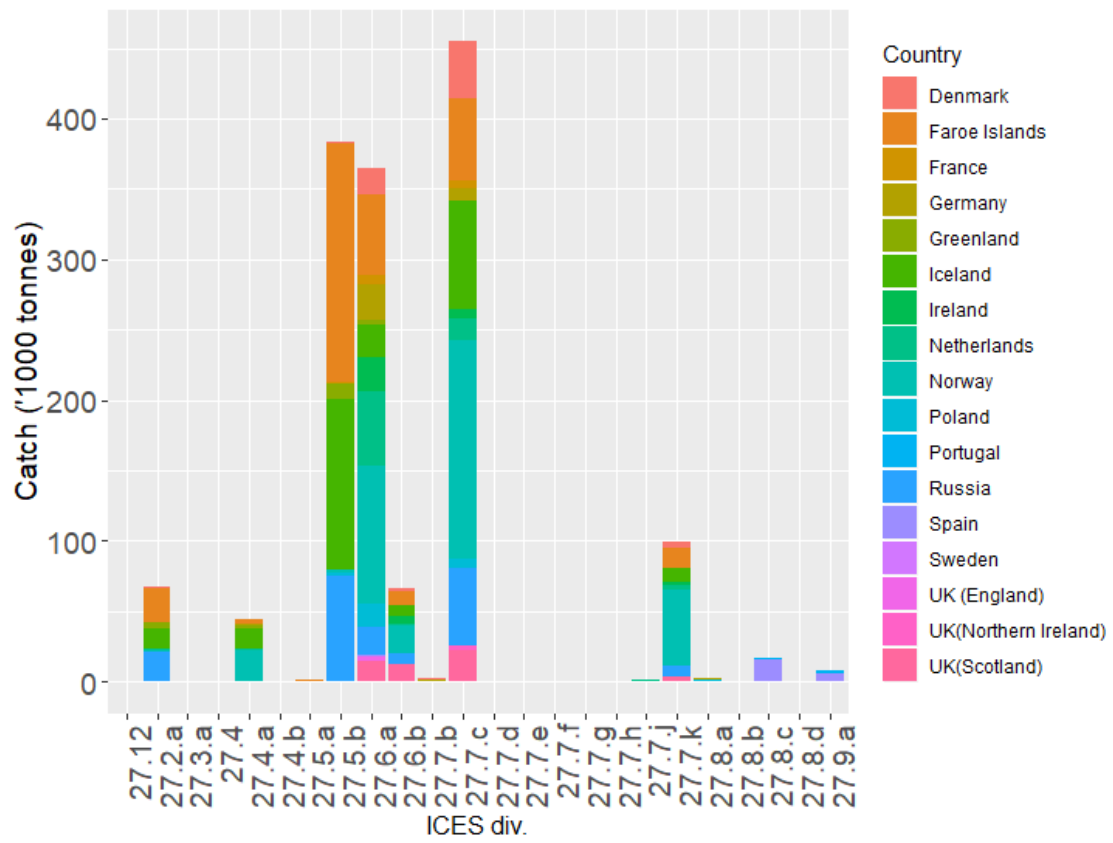
**Figure 2.3.1.1. Blue whiting. ICES estimated catches ('1000 tonnes) in 2019 by ICES division and country.**

**A**
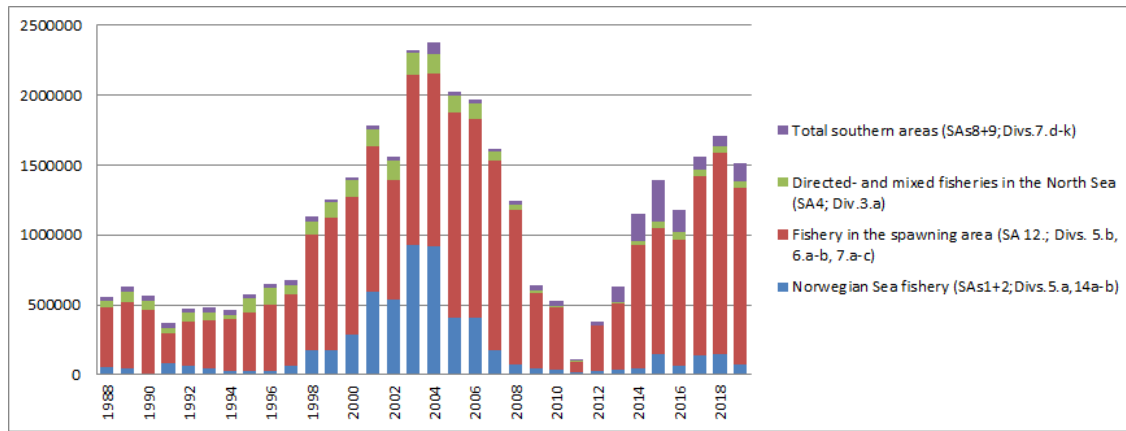


**B**
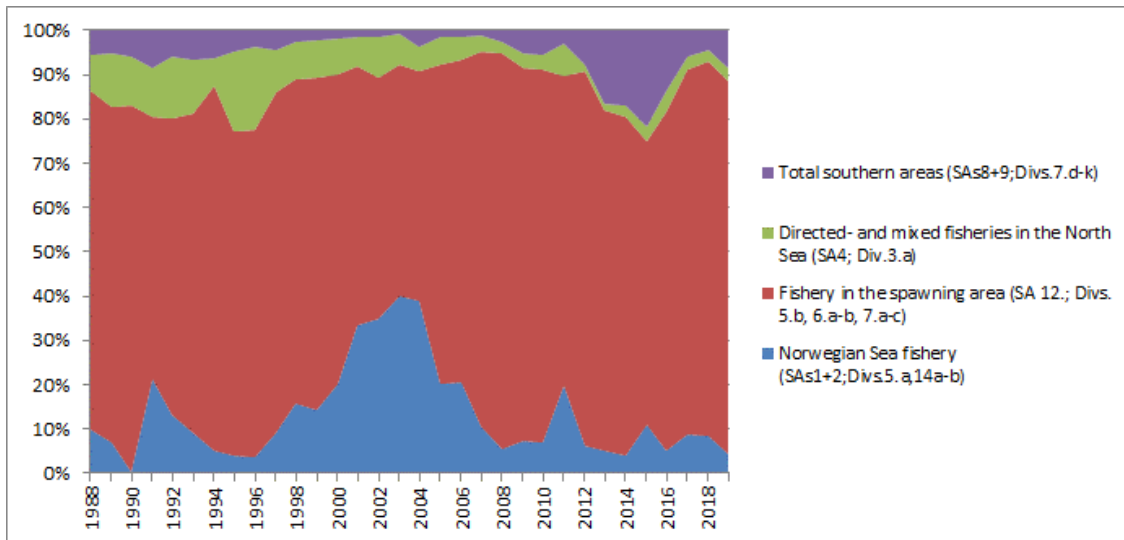


Figure 2.3.1.2. Blue whiting.(A) ICES estimated catches (tonnes) of blue whiting by fishery subareas from 1988-2019 and (B) the percentage contribution to the overall catch by fishery subarea over the same period.
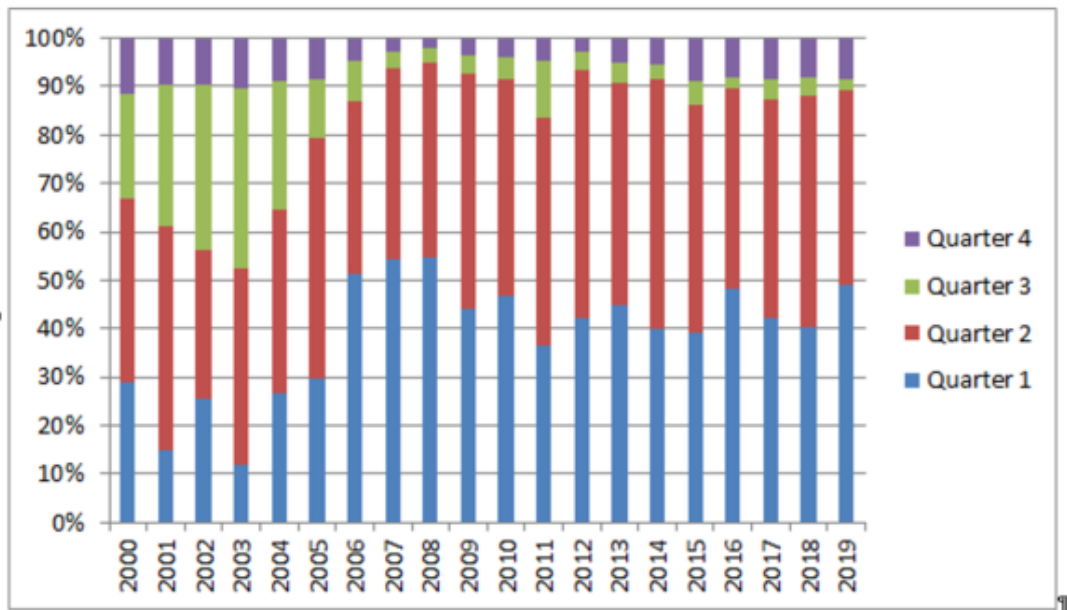
**Figure 2.3.1.3. Blue whiting. Distribution of 2019 ICES estimated catches (in percentage) by ICES division area.**
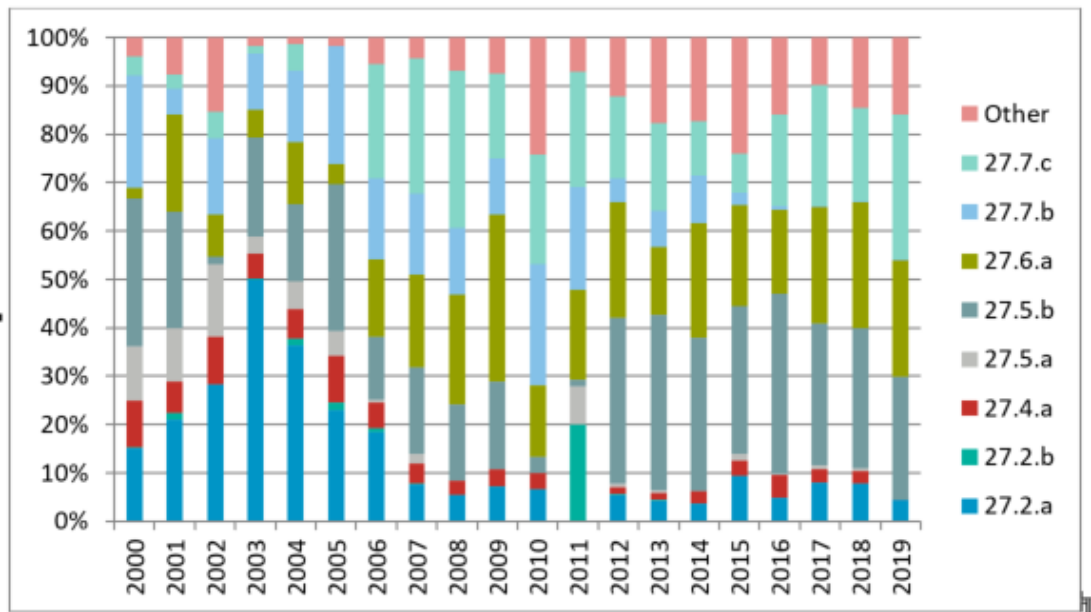


**Figure 2.3.1.4. Blue whiting. Distribution of 2019 ICES estimated catches (in percentage) by quarter.**
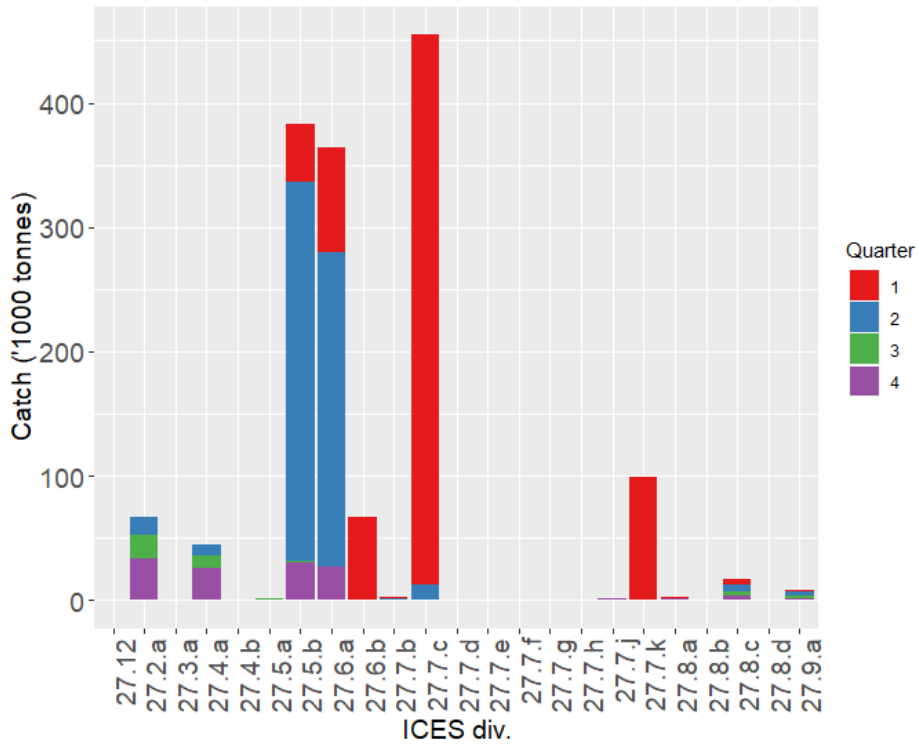
Figure 2.3.1.6. Blue whiting. Distribution of 2019 ICES estimated catches ('1000 tonnes) by ICES division and by quarter.
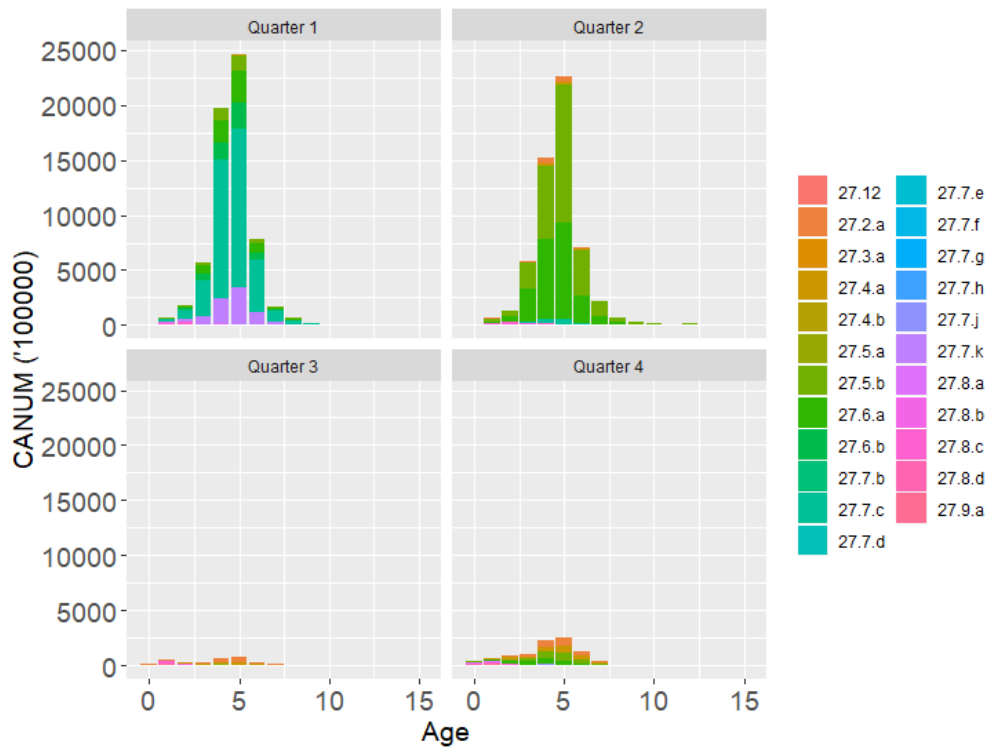


Figure 2.3.1.7. Blue whiting. Catch-at-age numbers (CANUM) distribution by quarter and ICES division for 2019.
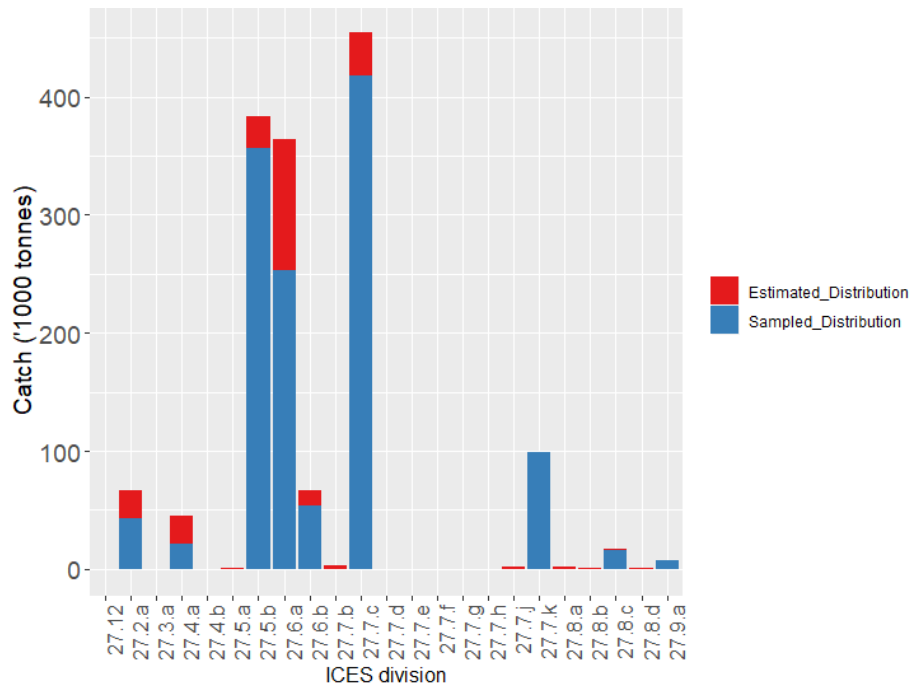
**Figure 2.3.1.1.1. Blue whiting. 2019 ICES catches ('1000 tonnes) based on sampled or estimated distribution by ICES division.**
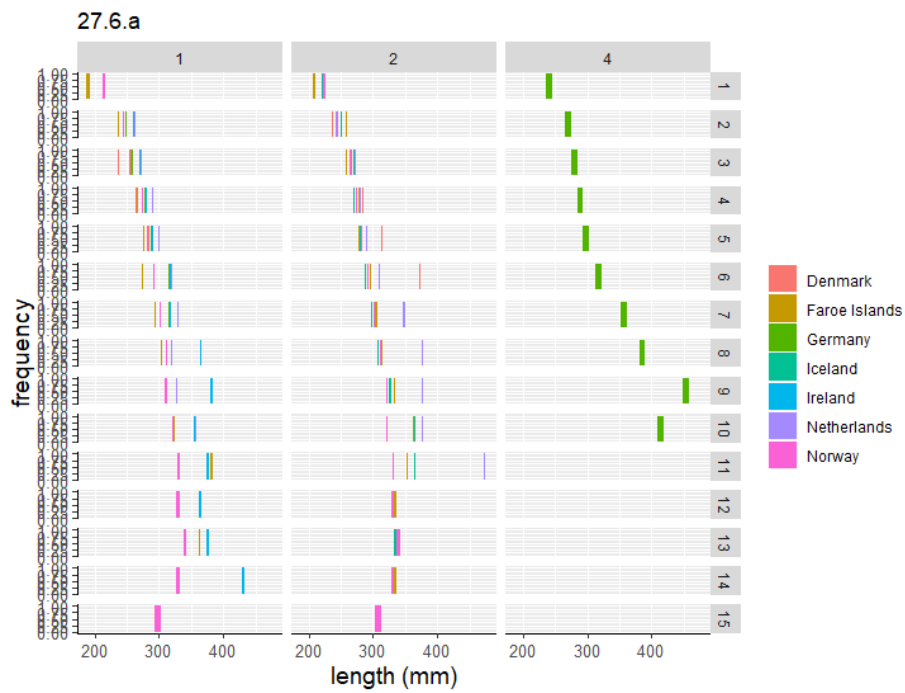


**Figure 2.3.1.2.1. Blue whiting. Mean length (mm) by age (0-15 year), by quarter (1,2,4), by country for ICES division area 27.6.a. These data only comprises the 2019 ICES catch-at-age sampled estimates for ICES division 27.6.a.**
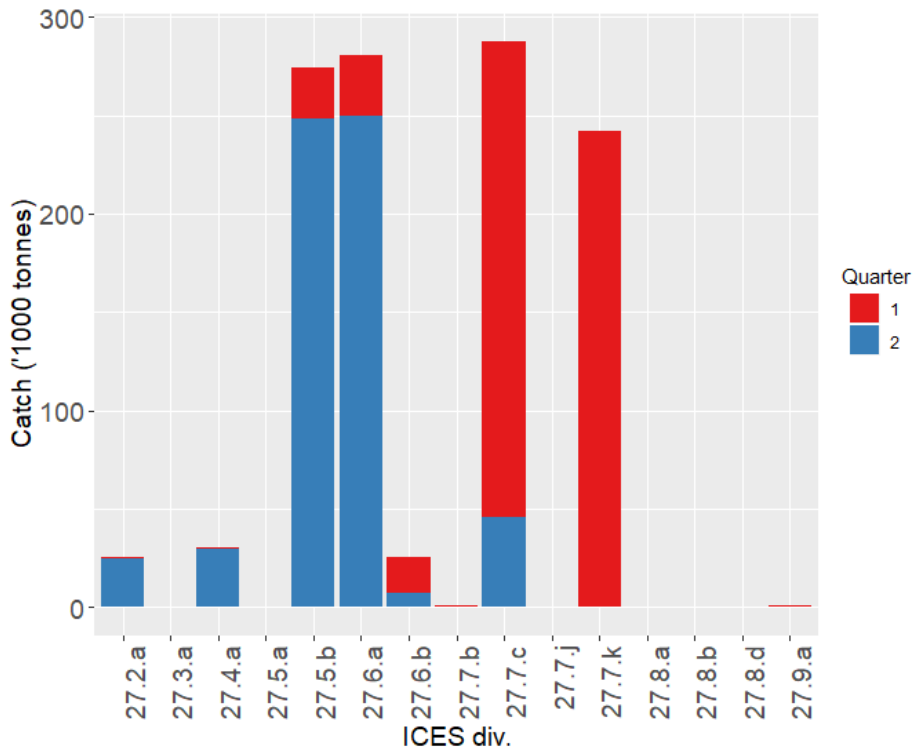
**Figure 2.3.2.1. Blue whiting. Distribution of 2020 ICES preliminary estimated catches (tonnes) (1st semester) by ICES division and quarter.**
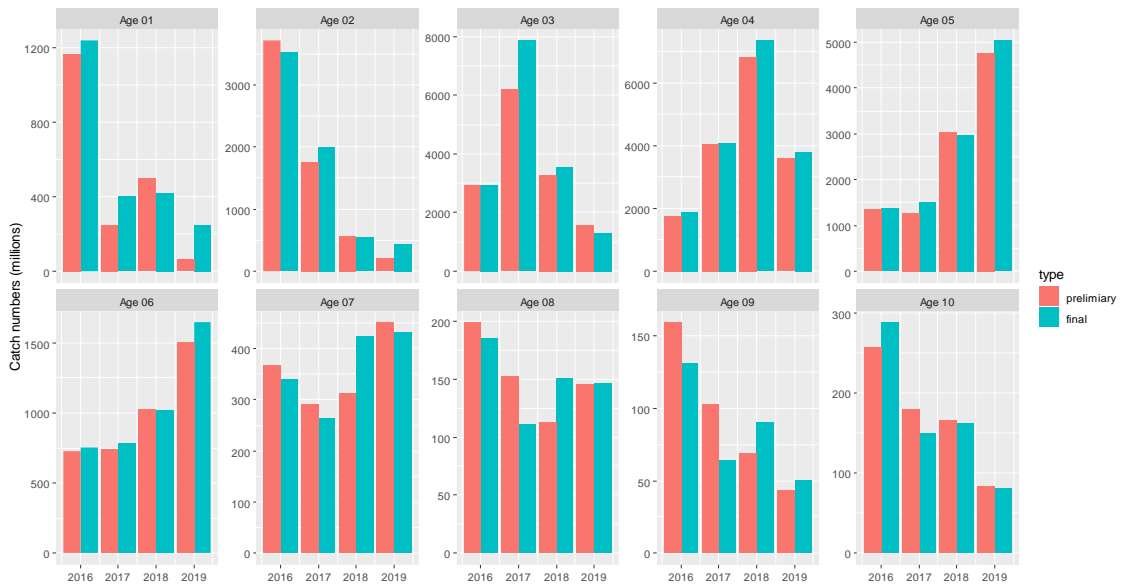


**Figure 2.3.2.2 Preliminary and final estimates of catch at age number by age and year.**
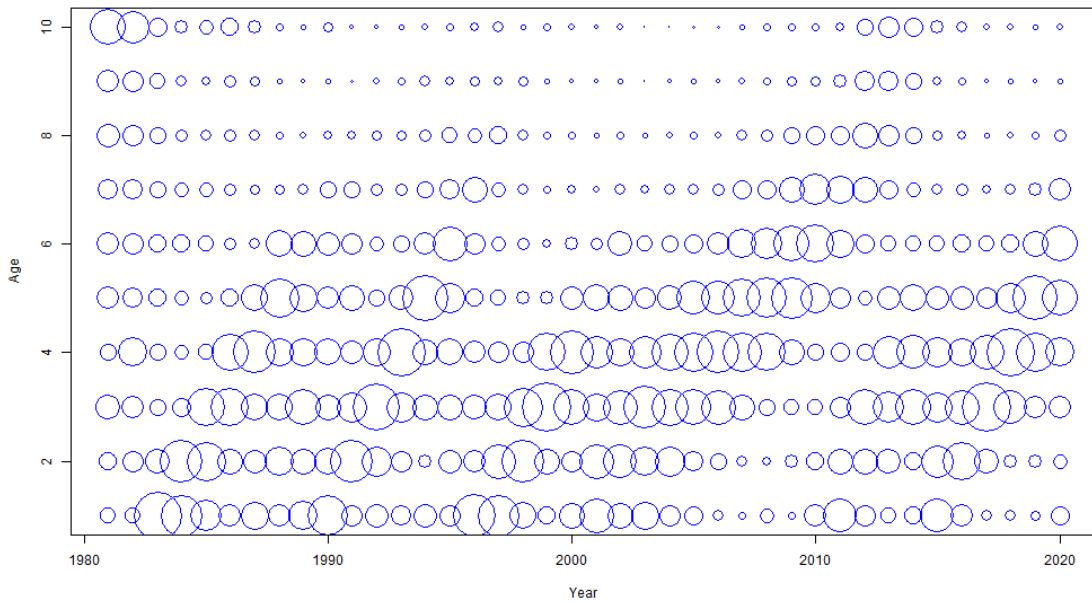
**Figure 2.3.3.1. Blue whiting. Catch proportion at age, 1981-2020. Preliminary values for 2020 have been used.**
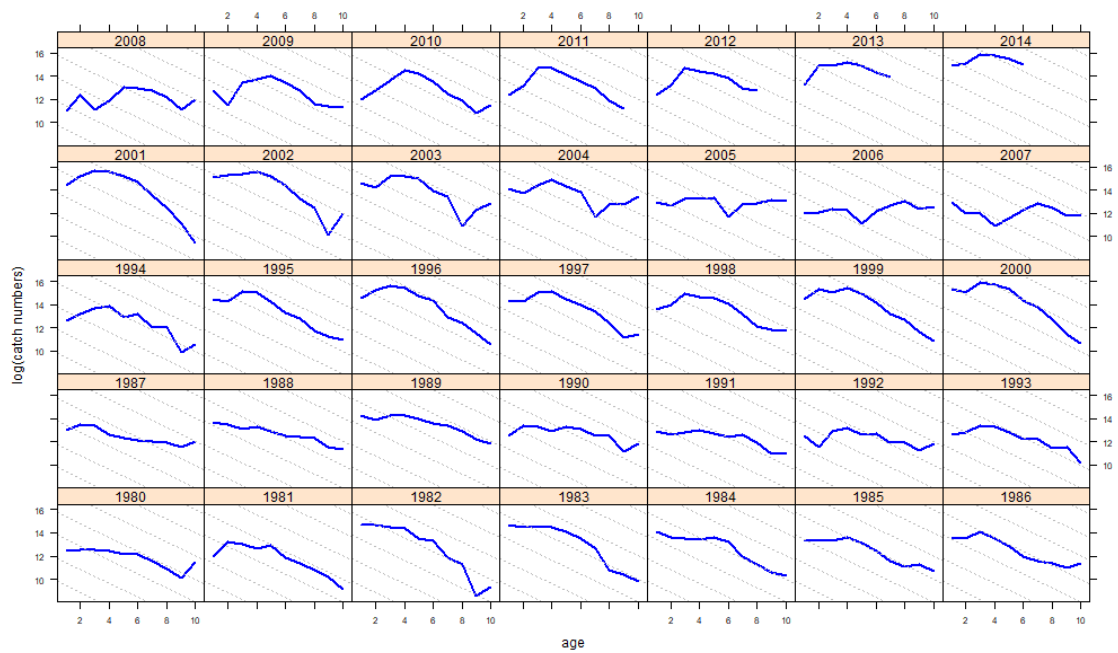


**Figure 2.3.3.2. Blue whiting. Age disaggregated catch (numbers) plotted on log scale. The labels for each panel indicate year classes. The grey dotted lines correspond to *Z*=0.6. Preliminary catch-at-age data for 2020 have been used.**
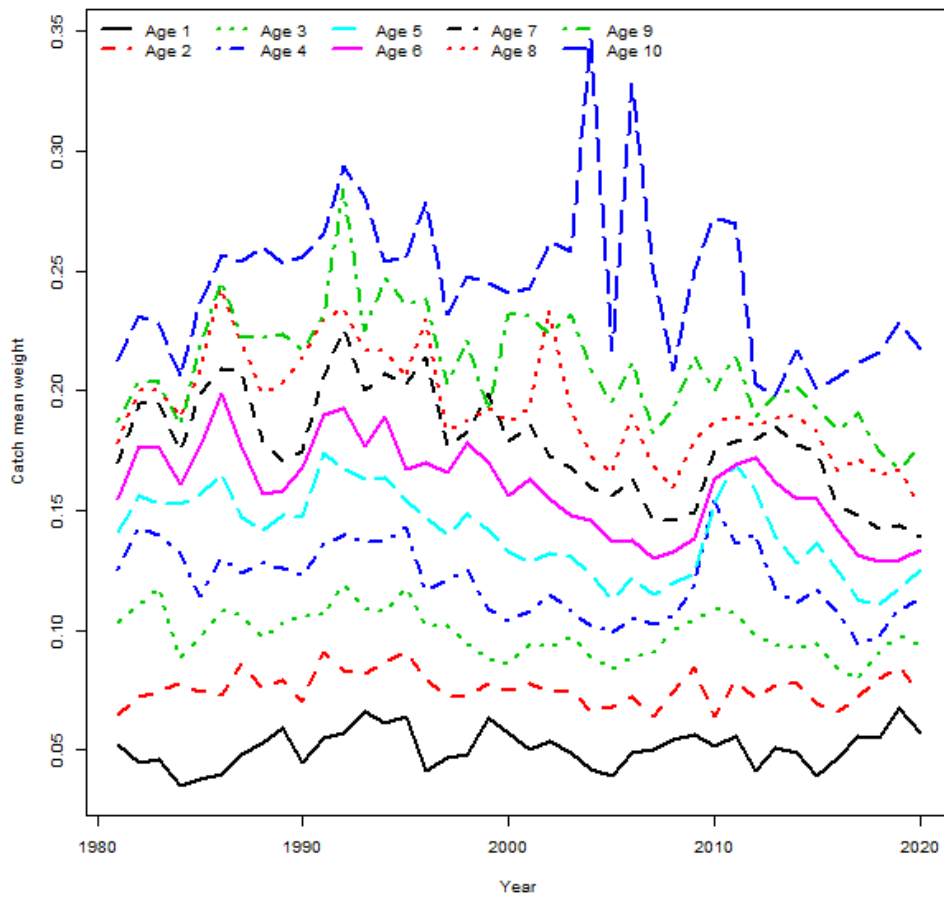
**Figure 2.3.4.1. Blue whiting. Mean catch (and stock) weight (kg) at age by year. Preliminary values for 2020 have been used**

A
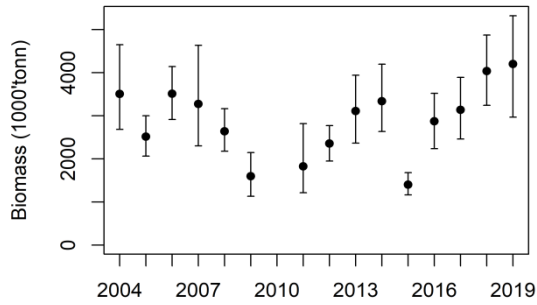
B
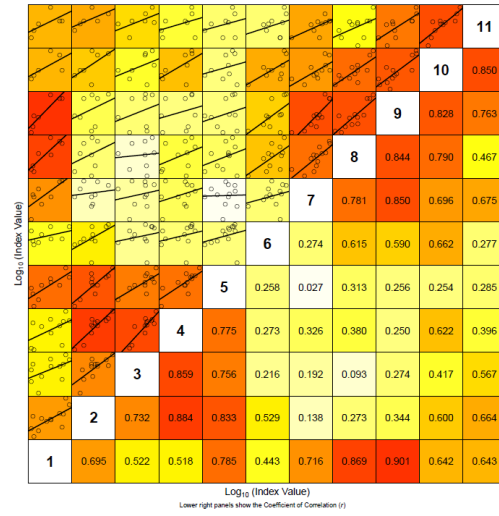


**Figure 2.3.7.1.1. Blue whiting – Not updated in 2020. (A) Estimate of total biomass from the International blue whiting spawning stock survey. The black dots and error bands are StoX estimates with 90 % confidence intervals. (B) Internal consistency within the International blue whiting spawning stock 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.**
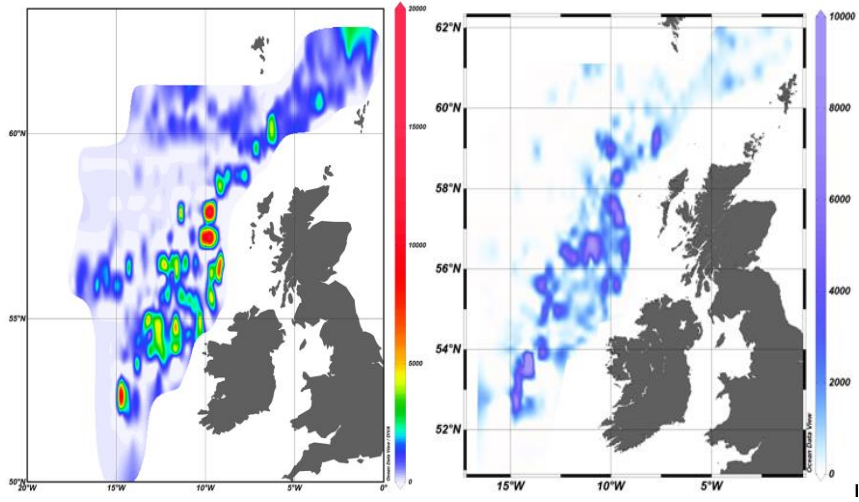
**2016**

**2017**
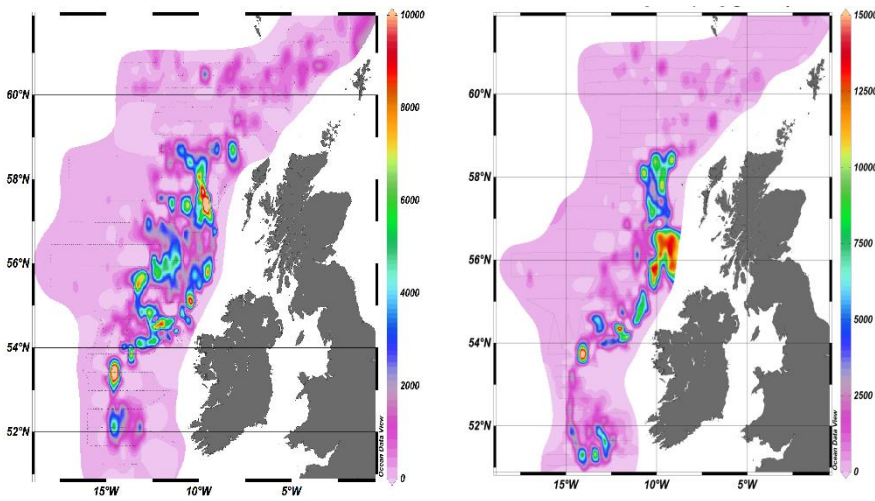
**2018**

**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.**
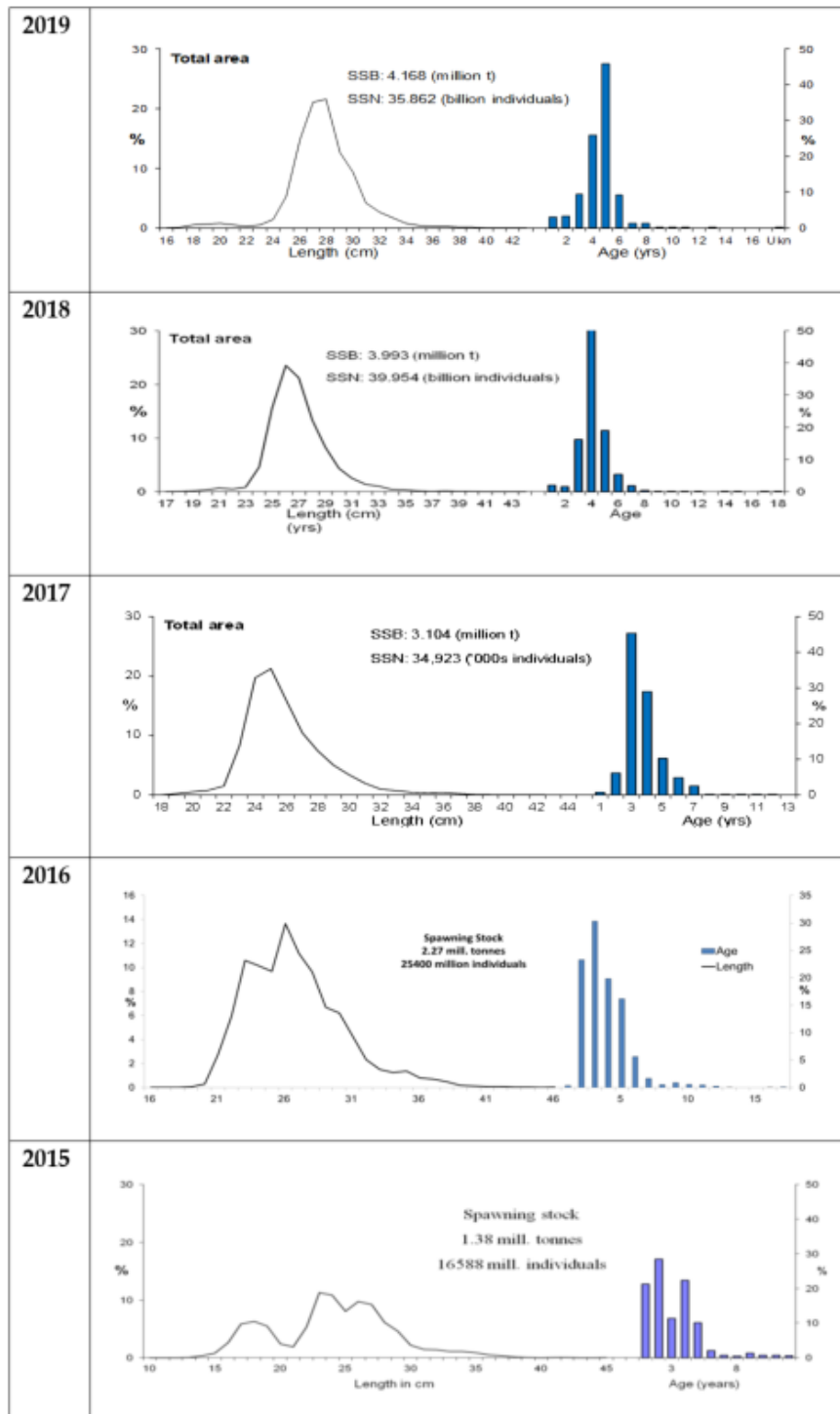


**Figure 2.3.7.1.3. Blue whiting – Not updated in 2020. Length (line) and age (bars) distribution of the blue whiting stock in the area to the west of the British Isles, spring 2015 (lower panel) to 2019 (upper panel).Spawning-stock biomass and numbers are given.**
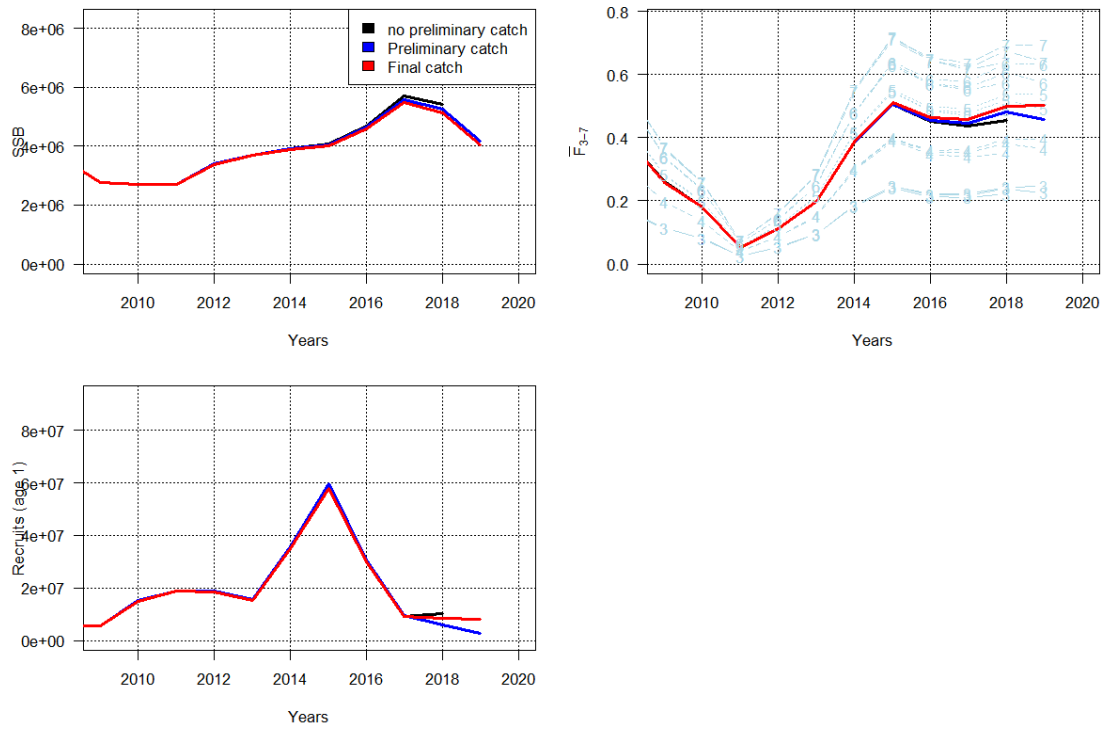
**Figure 2.4.1.1. Blue whiting. Scenario results with 2018 as the last survey year, and 1) no preliminary catch at age data for 2019, 2) preliminary catch at data for 2019 and 3) final catch at age data for 2019.**
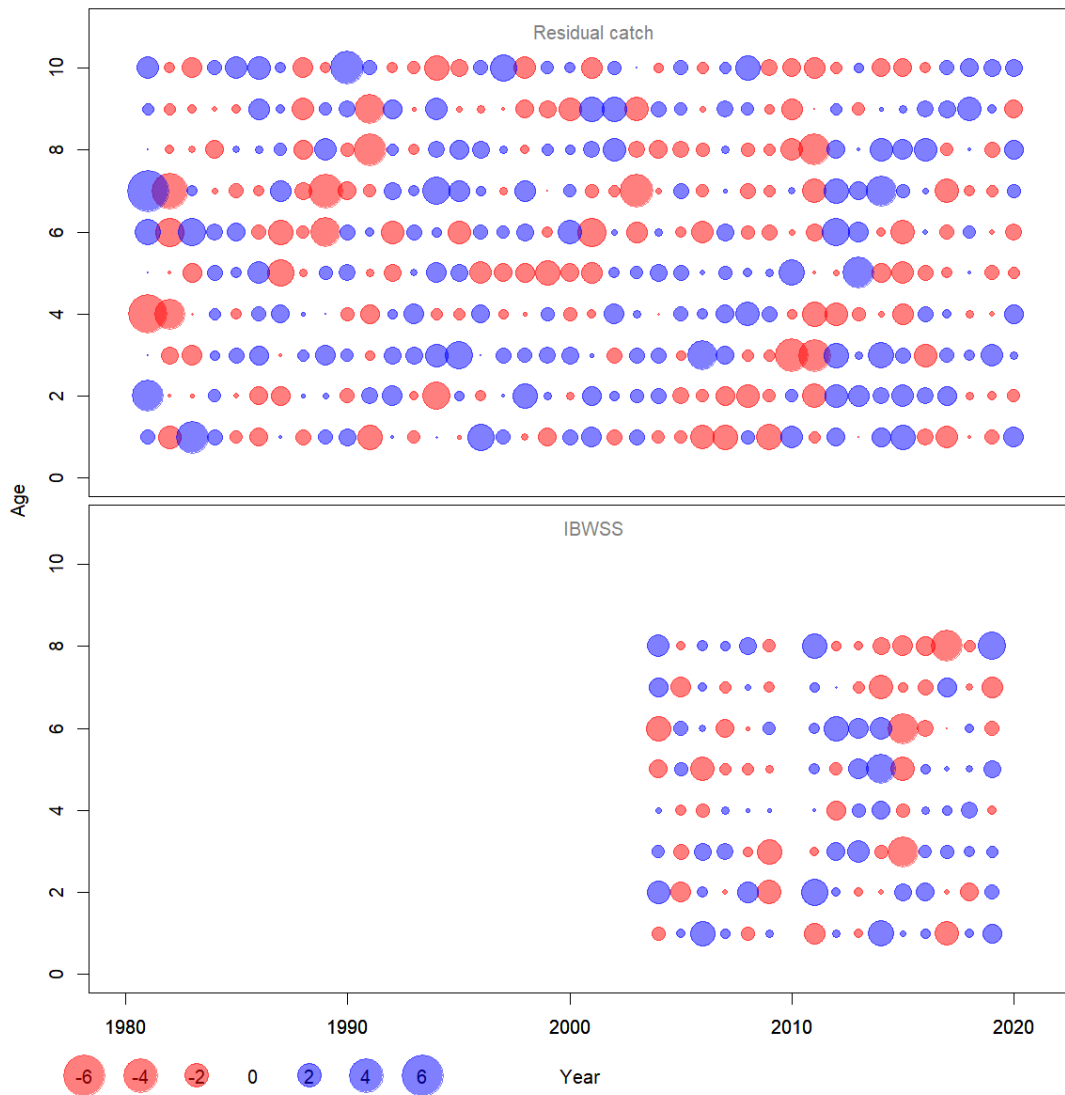
**Figure 2.4.2.1. Blue Whiting. OSA (One Step Ahead) residuals (see Berg and Nielsen, 2016) from catch-at-age and the IBWSS survey 2004-2019 (no survey in 2020). Red (lighter) bubbles show that the observed value is less than the expected value. Preliminary catch data for 2020 have been used.**
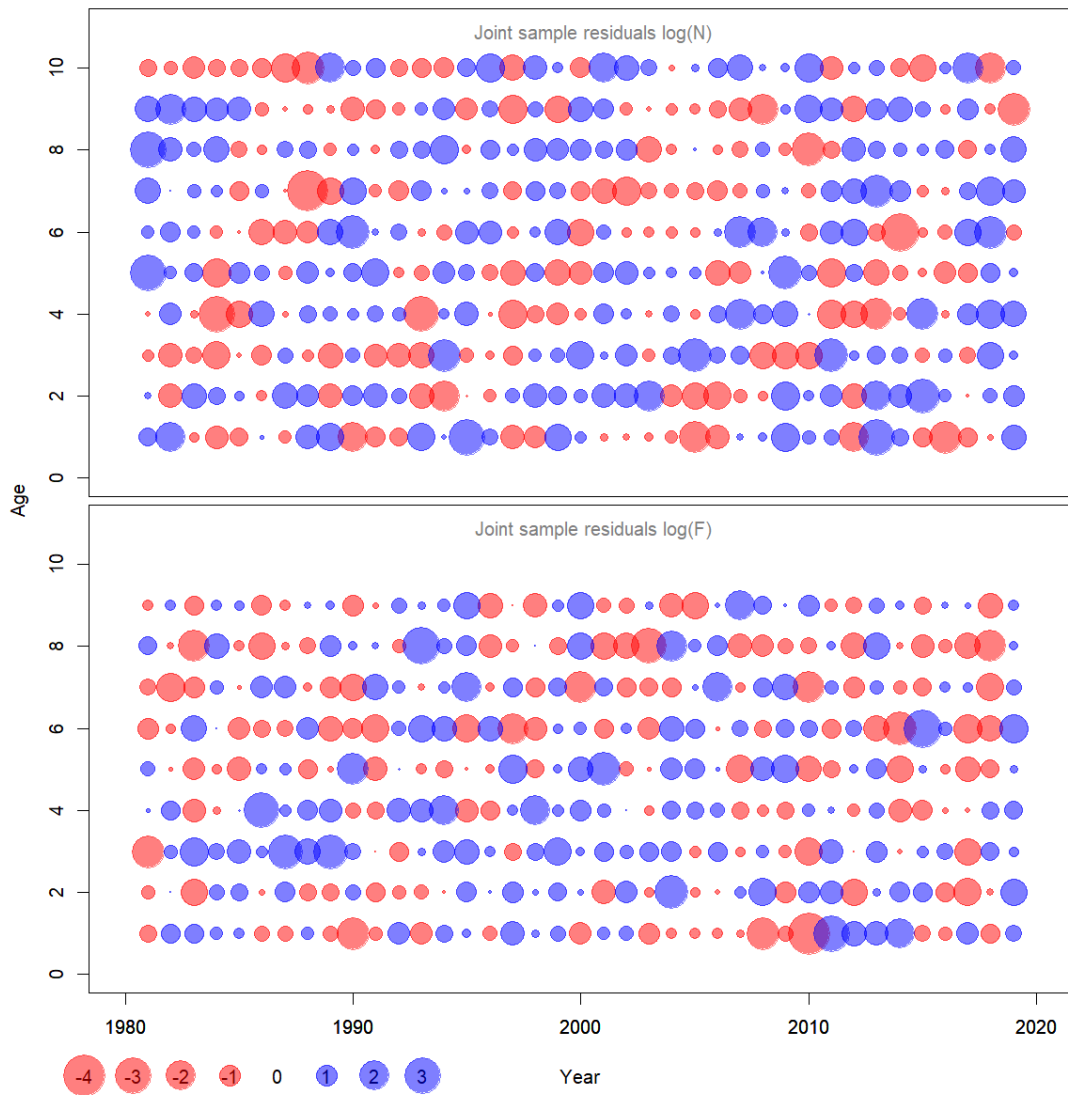
**Figure 2.4.2.2 Blue whiting. Joint sample residuals (Process errors) for stock number and F at age. Red (lighter) bubbles show that the observed value is less than the expected value. Preliminary catch data for 2020 have been used.**
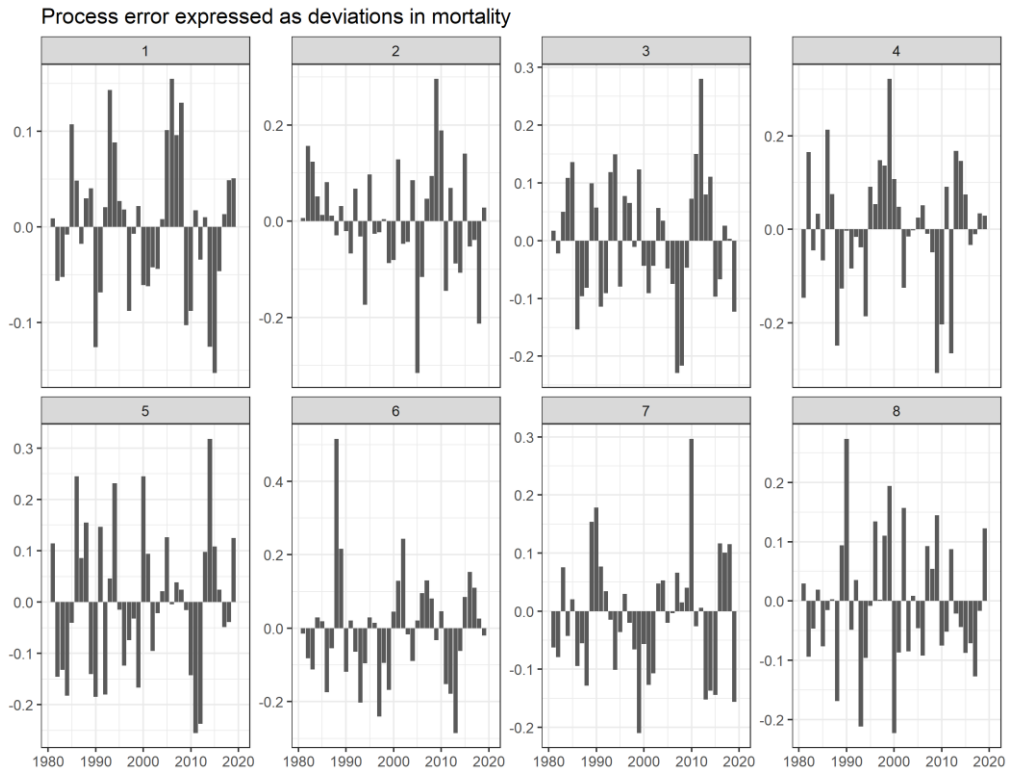
**Figure 2.4.2.3. Blue whiting. Process errors expressed as deviation in instantaneous mortality at age by age and year.**

**Residual catch**



**IBWSS**
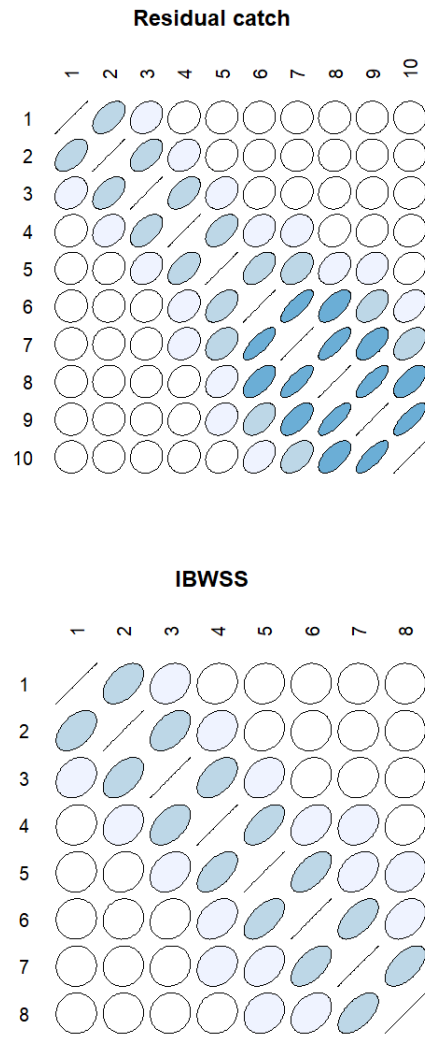


Figure 2.4.2.4. Blue whiting. The correlation matrix between ages for the catches and survey indices. Each ellipse represents the level curve of a bivariate normal distribution with the corresponding correlation. Hence, the sign of a correlation corresponds to the sign of the slope of the major ellipse axis. Increasingly darker shading is used for increasingly larger absolute correlations, while uncorrelated pairs of ages are depicted as circles with no shading.
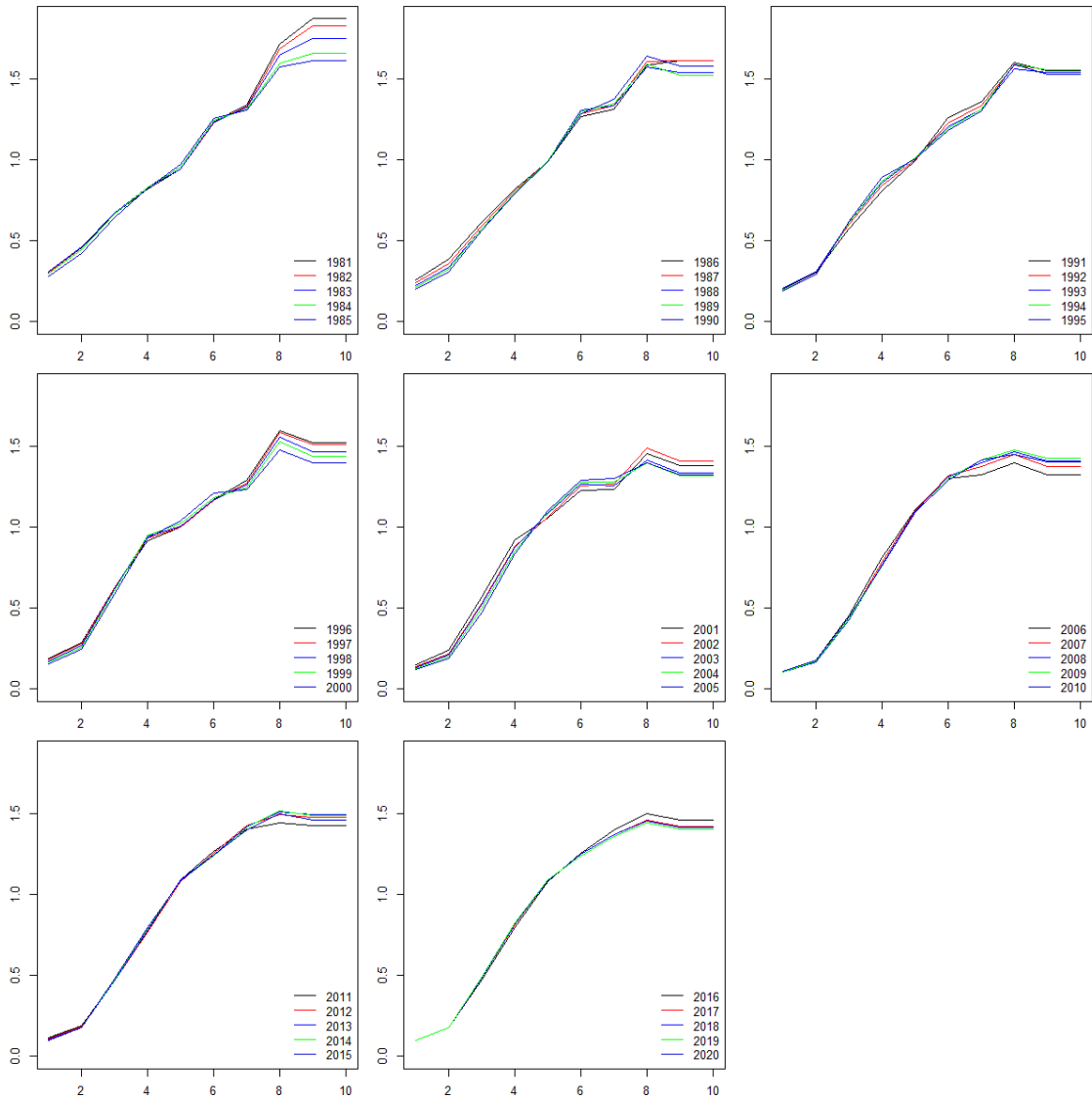
Figure 2.4.2.5. Blue whiting.  Exploitation pattern by 5-years' time blocks. Values for 2020 are preliminary.
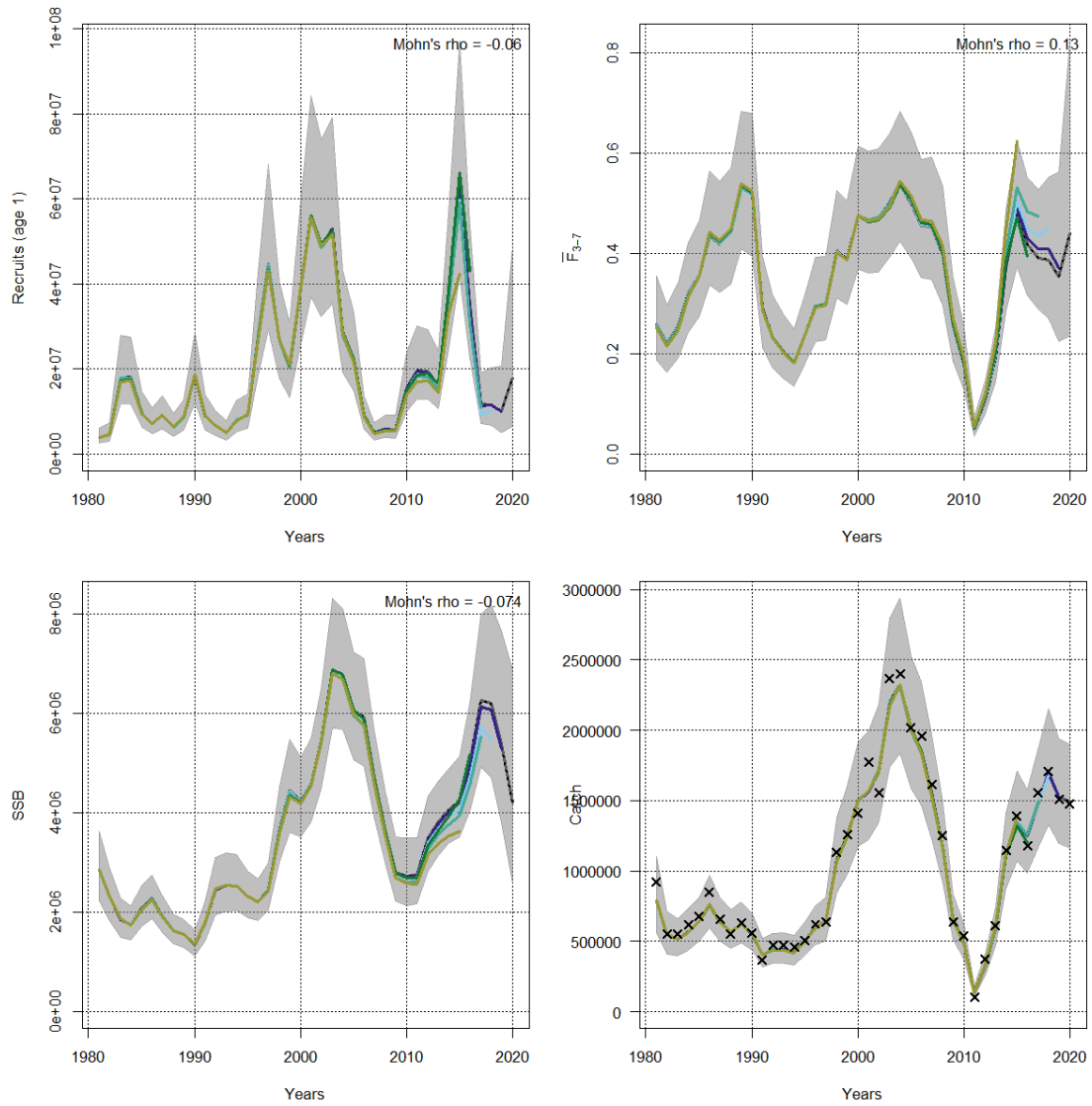
**Figure 2.4.2.6. Blue whiting. Retrospective analysis of recruitment (age 1), SSB (tonnes), F and total catch using the SAM model. The 95% confidence interval is shown for the most recent assessment.**
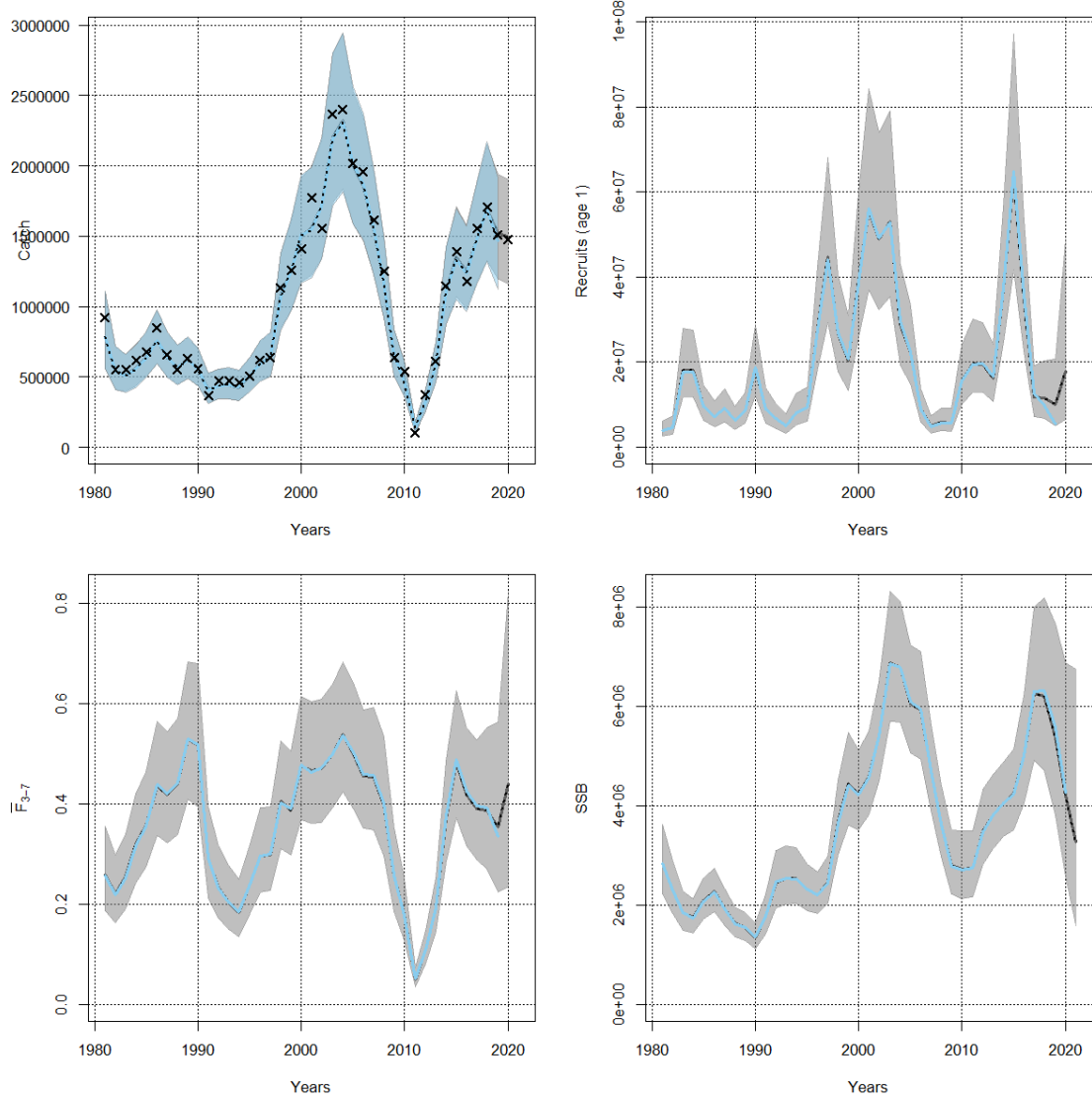
**Figure 2.4.2.7. Blue whiting. SAM final run: Stock summary, total catches (tonnes), recruitment (age 1), F and SSB (tonnes). The graphs show the median value and the 95% confidence interval. The catch plot does also include the observed catches (x). The assessment results from 2020 assessment are shown by the black line, the assessment results from 2019 by the blue line. Catches for 2020 are preliminary.**
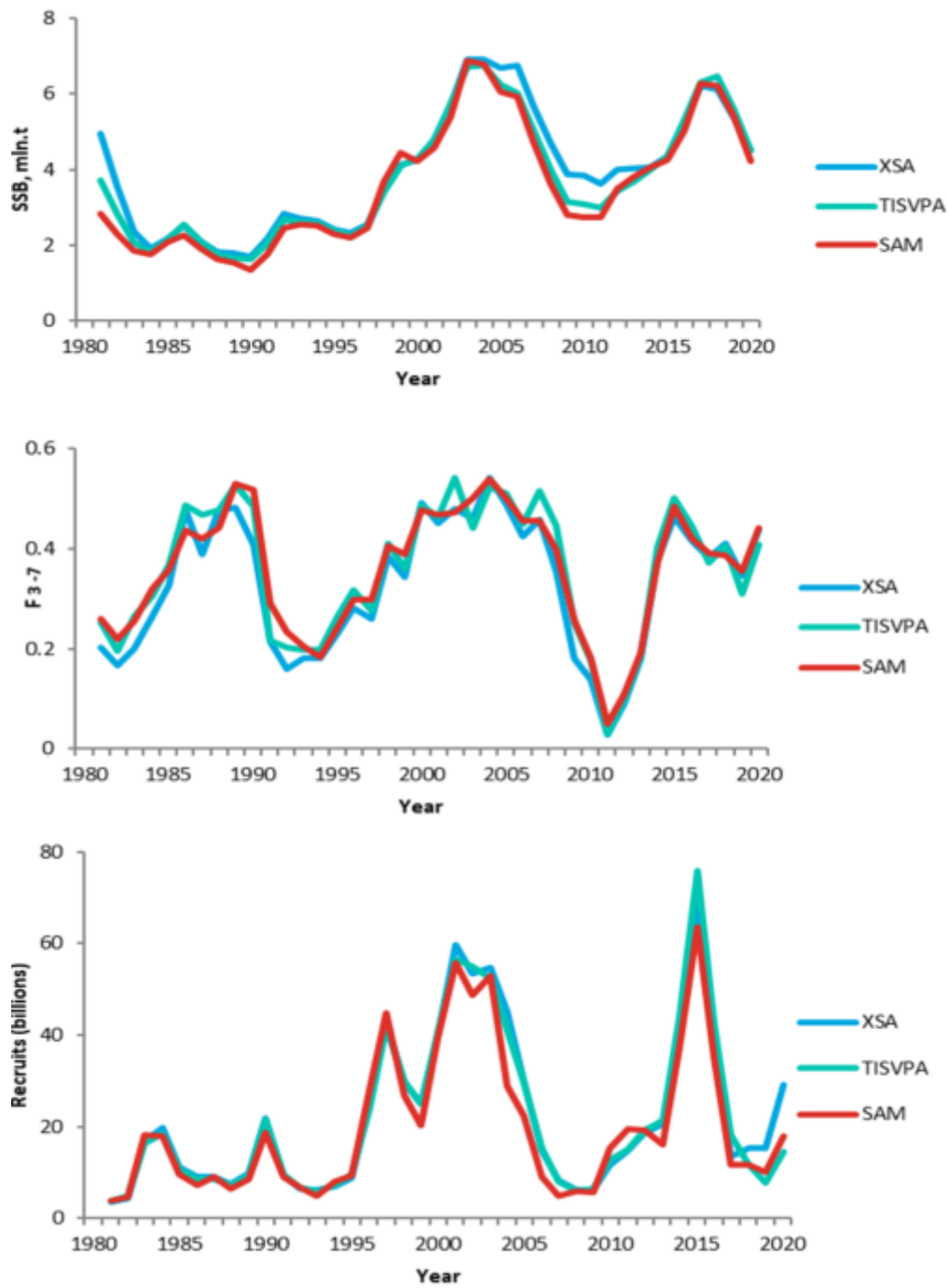
**Figure 2.4.3.1. Blue whiting. Comparison of SSB, F and recruitment estimated by the assessment programs XSA, TISVPA and SAM. Catch values for 2020 are preliminary.**
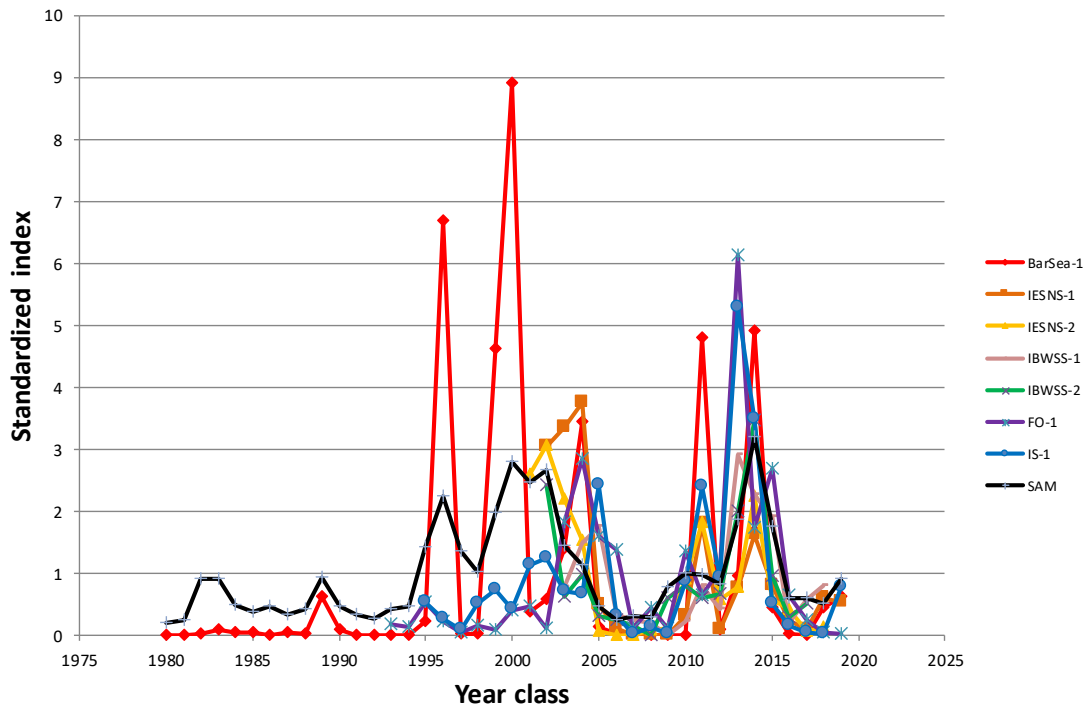
**Figure 2.8.1.1. Blue whiting young fish indices from five different surveys and recruitment index from the assessment, standardized by dividing each series by their mean. BarSea - Norwegian bottom-trawl survey in the Barents Sea, IESNS: International Ecosystem Survey in the Nordic Seas in May (1 and 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.**
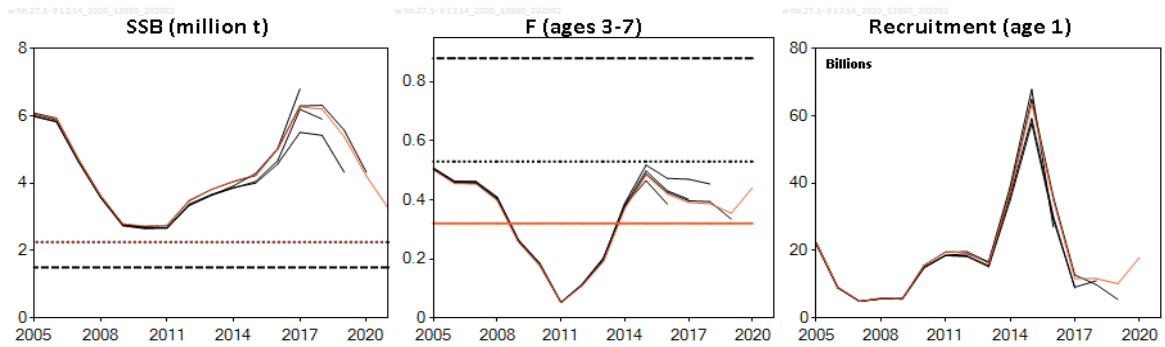


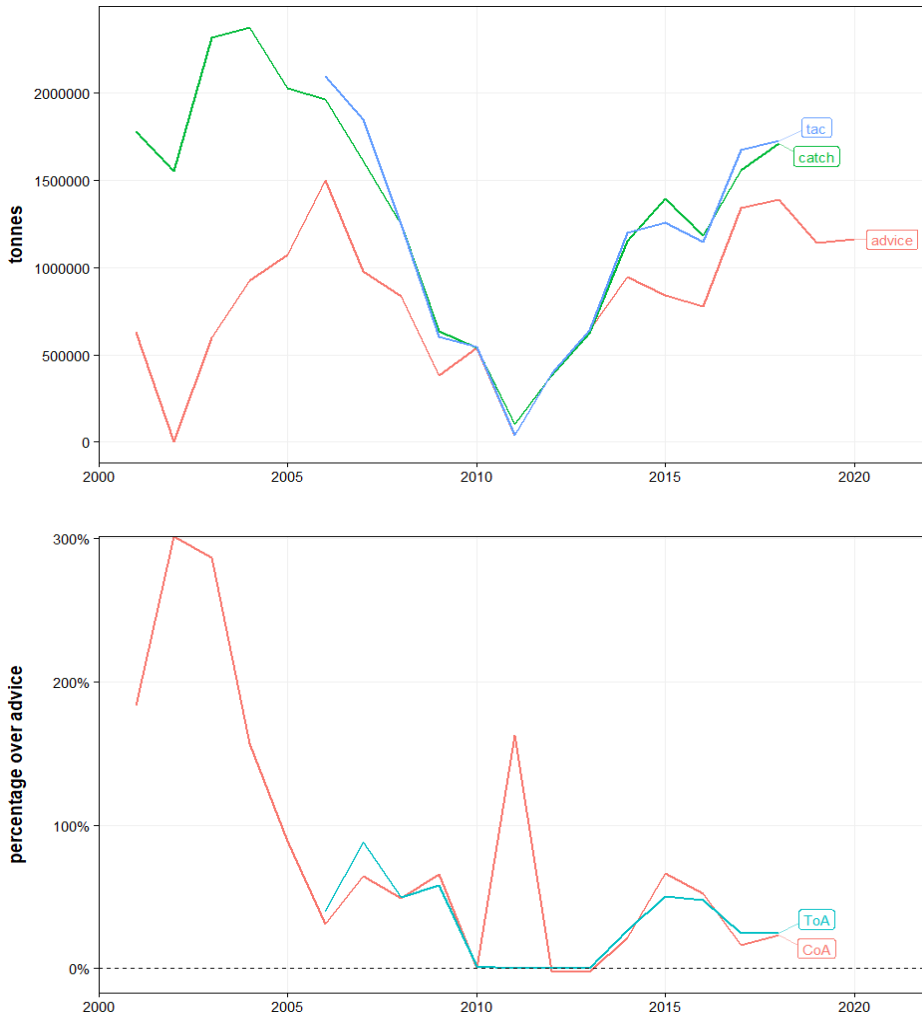**Figure 2.9.1. Blue whiting. Comparison of the 2016 - 2020 assessments.**

**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.**