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Torshavn, Faroe Islands

ICES International Council for the Exploration of the Sea

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Executive Summary

The Working Group on Widely Distributed Stocks (WGWIDE) met in Tórshavn, Faroe Islands, during 28 August3 September 2018. The meeting, chaired by Guðmundur J. Óskarsson, was attended by 31 delegates and 5 by correspondence from 14 countries. The WG reports on the status and considerations for management of Northeast-Atlantic mackerel, blue whiting, Western and North Sea horse mackerel, Northeast-Atlantic boarfish, Norwegian spring-spawning herring, striped red mullet (Subareas 6, 8 and Divisions 7.a-c, e-k and 9.a), and red gurnard (Subareas 3, 4, 5, 6, 7, and 8) stocks. Additionally, a special request from the European Commission on interarea flexibility of horse mackerel fishery was addressed.

Northeast-Atlantic (NEA) Mackerel. This species is widely distributed throughout the ICES area and currently supports one of the most valuable European fisheries. Mackerel is fished by a variety of fleets from many countries (ranging from open boats using handlines on the Iberian coasts to large freezer trawlers and Refrigerated Sea Water (RSW) vessels in the Northern Area). The stock was benchmark in 2017 and the 2018 assessment was an update assessment, incorporating a new year for the catch information, for the IESSNS survey and for the RFID tagging recapture data (no new egg survey and recruitment index not available). The 2018 assessment revises the stock downward, and indicates that the SSB has been declining continuously since 2011, while the fishing mortality has been increasing. SSB in 2018 is estimated to be below MSY $B_{trigger}$ and F larger that F_{pa}, which represents a deterioration of stock status compared to last year.

Blue Whiting. This pelagic gadoid is widely distributed in the eastern part of the North Atlantic. The assessment this year followed the Stock Annex based the conclusions from the Inter-Benchmark Protocol of Blue Whiting (IBPBLW 2016). Most of the annual catches are taken in the first half-year, which makes it possible to use preliminary catches for 2018 in the assessment. This is done to reduce the effect of potential biases from the single survey used for this assessment. The SSB of the stock is large but declining since 2017. F has been reduced in recent years, but is still above F_{MSY}. Recruitments in 2017 and 2018 are estimated to be low, following a period of high recruitments.

Western Horse Mackerel. This species is widely distributed throughout the Northeast Atlantic: it spawns in the Bay of Biscay, and in UK and Irish waters; after spawning, parts of the stock migrate northwards into the Norwegian Sea and the North Sea. The stock is assessed using the Stock Synthesis integrated assessment model. The 2018 assessment is an update of the benchmark assessment with the inclusion of the 2017 data. According to the assessment results, the 20152017 recruitment estimates are the highest observed since 2008 (and higher than the geometric mean estimated over the years 19832017). Fishing mortality since 2012 has been decreasing, dropping to low values in 20152017 due to lower catches and a reduced proportion of fraction of the adult population in the exploited stock; it is currently below F_{MSY}. SSB in 2017 is estimated as the lowest in the time-series, below the precautionary reference point but above the limit reference point. The updated assessment shows the same trend as the previous ones, but rescales the absolute level of SSB and F over the most recent decade and, although this years' revision is smaller, this indicates that there is still considerable uncertainty

associated with it. An inter-benchmark workshop has been scheduled for 2019: the workshop will aim at the revision of the biomass reference points and at investigate the causes of the instability in the assessment.

North Sea Horse Mackerel. After being benchmarked in January 2017, the CGFS and NS-IBTS survey indices were modelled with a zero inflated model to produce a combined index. The observed trend in the last years suggest that the stock is still at low levels in comparison with values in the early time-series. In 2017, the survey index shows a steep decline in comparison with year 2016. Despite this abrupt change in the survey abundance index, the catch advice for 2019 (decided in 2017) was not modified. The result of Length Based Methods to estimate proxy MSY reference points for the North Sea Horse Mackerel indicate that in 2016 and 2017 fishing mortality was slightly above F_{MSY}.

Northeast Atlantic Boarfish. This is a small, pelagic, planktivorous, shoaling species, found at depths of 0 to 600 m. The species is widely distributed from Norway to Senegal. The directed fishery for boarfish in the NEA is a relatively new one with large catches during the early 2000s when the fishery was unregulated. Catches have reduced significantly since 2012 to the current level. Annual catch advice is provided using the data limited category 3 approach based on output from an exploratory Bayesian surplus production assessment model. The assessment model utilises catch data, an acoustic survey estimate of stock size and indices from a number of bottom-trawl surveys. The current assessment indicates that since a historic high in 2012 biomass has declined sharply to a stable and low level since 2014.

Norwegian Spring Spawning Herring. This is one of the largest herring stocks in the world. It is highly migratory and distributed throughout large parts of the NE Atlantic. This stock was benchmarked in 2016 (WKPELA). The assessment model introduced in the benchmark (XSAM), incorporates uncertainty in the input data, and has been used to provide advice after the benchmark. The SSB on 1 January 2018 is estimated by XSAM to be above B_{pa} (3.184 million t). The stock is declining and the SSB time-series from the 2018 assessment is in line with the SSB time-series from the 2017 assessment. Fishing mortality in 2017 is estimated to be above the management plan F that was used to give advice for 2017. A new management plan is being developed for the 2019 advisory year

Striped Red Mullet in North Sea, Bay of Biscay, Southern Celtic Seas, Atlantic Iberian Waters. 2016 was the first year this stock was considered by WGWIDE. This is a category 5 stock without information on abundance or exploitation, and the evaluation is based on commercial landings. The advice for this stock was given last year for 2018, 2019 and 2020.

Northeast-Atlantic Red Gurnard. 2016 was the first year this stock was been considered by WGWIDE. This is a category 6 stock for which there is no indication of where fishing mortality is relative to proxies and no stock indicators, and the evaluation is based on commercial landings. The advice for this stock was given last year for 2018 and 2019.

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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 but 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 2017

ICES notes that fishing mortality has increased from a historical low in 2011 to above F_{MSY} since 2014. Spawning-stock biomass increased since 2010 and is above MSY $B_{trigger}$. Recruitment in 2017 is estimated to be low, following a period of high recruitments.

ICES advised that when the MSY approach is applied, catches in 2018 should be no more than 1 387 872 tonnes.

2.2 The fishery in 2017

The total catch in 2017 was 1558 kt. 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 (90%) were taken in the first two quarters of the year and the largest part of this west of the British Isles and south and east of the Faroes. Smaller quantities were taken along the coast of Spain and Portugal. The fishery in the latter half of the year was concentrated in the central Norwegian Sea. The multinational fleet currently targeting blue whiting consists of several types of vessels. 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 2016) it was decided to use preliminary catch-at-age data from 2016 in the assessment to get additional information to the within year IBWSS result. In most recent years more than 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 data. The catch data sections in this report give first a comprehensive description of the 2017 data as reported to ICES and then a section including a brief description of the 2018 preliminary catch data.

2.3.1 Officially reported catch data

Official catches in 2017 were estimated to 1558061 tonnes based on data provided by WGWIDE members. Data provided as catch by rectangle represented more than 99% of the total WG catch in 2017. Total catch by country for the period 1988 to 2017 is presented in Table 2.3.1.1 and in Figure 2.3.1.1.

After a minimum of 104 000 tonnes in 2011, catches peaked in 2017 (1 558 061 tonnes tonnes) (Figure 2.3.1.2.A).The spatial and temporal distribution in 2017 (Figure 2.2.1, 2.2.2 and Table 2.3.1.2), is quite similar to the distribution in previous years. The majority of catches is coming from the spawning area. The 2017 catches have largest contribution from ICES area 27.5.b, 27.6.a and 27.7.c (Figures 2.3.1.1 to 2.3.1.8). The temporal allocation of catches has been relatively stable in recent years (Figure 2.3.1.4). In the first two quarters, catches are taken over a broad area, with the highest catches in 27.5.b, 27.6.a, 27.7.c and 27.7.k, while later in the year catches is 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 proportion of catches originating from the Northern areas has been decreasing from 2014 to 2016, in 2017 an increase of 8% was observed.

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 produced by Portuguese vessels operating with bottom otter trawl within the Portuguese reaches of ICES Division 27.9.a is 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 were it was significant (2004, 2006, 2010) was ranging between 43% and 38% (in weight). In 2017, discards were 21% of the total catches for blue whiting in 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 last day catch 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 2015 (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 the Denmark, Portugal, Spain, UK (England and Wales) and UK(Scotland), to the working group. The discards constituted 0.13% of the total catches, 2 030 tonnes.

The total estimated catches (tonnes) inside and outside the NEAFC regulatory area by country were reported on Table 2.3.1.6. Lithuania and Sweden have not provided data concerning NEAFC area, but their catches are negligible.

2.3.1.1 Sampling intensity

Sampling intensity for blue whiting with detailed information on the number of samples, number of fish measured, and number of fish aged by country and quarter is given in Table 2.3.1.1.1 and are presented and described by year, country and area (Tables 2.3.1.1.2 Table 2.3.1.4). In total 1779 samples were collected from the fisheries in 2017, 147297 fish were measured and 15828 were aged. The percentage of catches covered by the sampling program was 91% in 2017. The most intensive sampling took place in the area 27.4.a, 27.5.b, 27.7.c, 27.8.b, 27.8.c and 27.9.a. No sampling was carried out by Greenland, Lithuania, Poland, Sweden and the UK (England, Wales, Northern Ireland) representing together 3% 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 Length compositions

The length distribution in numbers of around 67% of catches was provided for some of the areas sampled (Figure 2.3.1.2.1), fish from length between 20 and 30 cm dominated the catches composition.

2.3.1.3 Age compositions

The age-length key for the sampled catches on ICES area 27.6.a (as an example) is presented by quarter and country (Figure 2.3.1.3.1). The mean length (mm) by ages reveals that age classifications do not present significant differences between countries.

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

2.3.2 Preliminary 2018 catch data (Quarters 1 and 2)

The preliminary catches in 2018, for quarters 1 and 2, were estimated to 1351802 tonnes (Table 2.3.2.1) based on data provided WGWIDE members.

The spatial distribution of these 2018 preliminary catches is similar to the distribution in 2017. The majority of catches are coming from the areas 27.5.b, 27.6.a, 27.6.b, 27.7.c and 27.7.k (Figure 2.3.2.1 and Table 2.3.2.2).

Sampling intensity for blue whiting from the preliminary catches by area and quarter 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. The preliminary catches for 2018, quarters 1 and 2, and the expected whole 2018 catches were reported by the WGWIDE members (Table 2.3.2.3).

A comparison of the preliminary and the final catch for 2016 and 2017 (Table 2.3.2.4) shows a good agreement (i.e. max 2.9 % deviation).

2.3.2.1 Raising procedure

The 2016 Benchmark concluded that the first semester(=first half year=quarter 1 and quarter 2) catch-at-ages for the preliminary year are raised to annual total catch-at-age from a 3 years average of the observed proportion of annual catches, taken in the first semester. Average proportion landed in the first semester and raising factor by age are presented in Table 2.3.2.1.1.

The WGWIDE Advice Drafting Group in 2016 proposed to further raise the preliminary first semester catches to "best available estimate" on the final catch weight. This approach is easier to communicate to the public as the raised catch is the same at the expected. The approach suggested by the ADG has been used since the 2016.

WGWIDE estimated the expected total catch for 2018 from the sum of declared national quotas, corrected for expected national uptake and transfer of these quotas (Table 2.3.2.3).

2.3.3 Catch-at-age

Catch-at-age numbers are presented in Table 2.3.3.1. Catch proportions at age are plotted 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 recent years, the age compositions are dominated by the younger ages (ages 35).

Catch curves for the international catch-at-age dataset (Figure 2.3.3.2) indicate a consistent decline in catch number by cohort and thereby reasonably good quality catch-at-age data. Catch curves for year class 2004-2008 show a more flat curve compared to previous year classes indicating a lower F or changed exploitation pattern, probably related to the low year-class strengths for some of the year classes. Year classes 2008-2010 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.

2.3.4 Weight at age

Table 2.3.4.1 and Figure 2.3.4.1show the mean weight-at-age for the total catch during 1983—2018 used in the stock assessment. Mean weight at age for ages 3—9 reached a minimum around 2007, followed by an increase until 2010—2012, and a decrease in the recent years. Mean weight for the preliminary 2018 catches are calculated as the mean weight of catches in the period 2015-2017.

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, 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 however the only survey used as input to the assessment model. The cruise report from IBWSS in spring 2018 is available as a working document to this report. The survey group considers that the 2018 estimate of abundance as robust.

The updated survey time-series (2004-2018) show an high internal consistency for the main age groups are given in Figure 2.3.7.1.1. B.

The distribution of acoustic backscattering densities for blue whiting for the last 4 years is shown in Figure 2.3.7.1.2. The bulk of the mature stock was located from the north Porcupine to the Hebrides core area in a corridor close to the shelf edge. This is comparable to what was observed in 2017.

The abundance estimate of blue whiting for IBWSS are presented in Table 2.3.7.1.1. In comparison to the results in 2017, there is an increase in the observed stock biomass (+29%) and in stock numbers (+15%).

The stock biomass within the survey area was dominated by 3, 4, 5 year old fish, contributing over 86% of total-stock biomass. The age structure of the 2018 estimate is consistent with the age structure from the 2017 estimate.

Length and age distributions for the period 2014 to 2018 are given in Figure 2.3.7.1.3.

Survey indices as applied in the stock assessment are shown in Table 2.3.7.1.2. (identical to the numbers, ages 1-8, 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. 1 group is defined in this survey as less than 19cm (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 greater than 15 cm and less than 22cm 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. 1 group is defined in this survey as less than 23cm 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. The time-series is currently too short for assessment purposes.

This year, IEO joined the IBWSS, covering the adjacent area of the core spawning ground in Porcupine Seabight from 14th to 20th March, thus before the coverage of the core area. Blue whiting occurred in a pelagic layer located as usually at around 500 m depth, from the slope to open sea. In the southern part (from 49ºN up to 51º30'N) the outer limit was reached while northwards, there was a continuity towards Porcupine Bank (Figure 2.3.7.2.1). A total of 100 kt were assessed, corresponding to 1.1 billion fish. Length distribution shown 3 modes, located 19, 25 and 29 cm, with mean length esti-

mated at 25.2 cm (Figure 2.3.7.2.2). This length distribution had not significant differences with that estimated in the Spanish area (see Carrera et al. WD004 for further details). Data from the IEO survey were not included in the IBWSSS survey index.

2.4 Stock assessment

The presented assessment in this report follows the recommendations from the Inter-Benchmark Protocol of Blue Whiting (IBPBLW) convened by correspondence from 10 March to 10 May 2016 (ICES, 2016) to use the SAM model.

The configuration of the SAM model (see the Stock Annex for details) includes the same settings as agreed during IBPBLW 2016, but due to a new version of SAM, the actual values have changed in 2017. The new SAM version begins with 0 for parameters, while the old version begins with 1. The Stock Annex has been updated accordingly.

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 2.4.1) show a quite random distribution of residuals. There might be an indication of "years effect" (too low index) for the IBWSS 2015 observations.

The estimated parameters from the SAM model from this year's assessment and from previous years (retrospective analysis) are shown in Table 2.4.1. There are only a very few abrupt changes in the estimated parameters over the time-series presented. The increase in process error for age 1 in the 2017 run is probably a reflection of the low 2017 recruitment. Process errors for N ages 2-10 increase slightly for the period2015-2018. Observation noises for the IBWSS decrease from 2017 to 2018, except for the for ages 7-8.The lowest observation noise and thereby the largest influence on the stock assessment is from catches, age 3-8, and these ages also contribute most to the international catches.

The process error residuals ("Joint sample residuals") (Figure 2.4.2) are reasonable randomly distributed.

The correlation matrix between ages for the catches and survey indices (Figure 2.4.3) show a modest observation correlation for the younger ages and stronger correlation for the older ages. The same is seen for survey observations.

Figure 2.4.4 presents estimated F at age and exploitation pattern for the whole time-series. There are no abrupt changes in the exploitation pattern from 2010 to 2018, even though the landings in 2011 were just 19% of the landings in 2010, which might have given a different fishing practice. The estimated rather stable exploitation pattern might be due to the use of correlated random walks for F at age with a high estimated correlation coefficient (rho = 0.94, Table 2.4.2.1). However, the rather large changes in exploitation pattern for age 8 and 9+ in the most recent years might be due to aging problems.

The retrospective analysis (Figure 2.4.5) shows an unstable assessment with substantial downward revision of SSB in the 2015 assessment(due to the 2015 low survey indices) followed by an increase in 2016. The use of "preliminary" catches (here in the retrospective analysis it is actually the final catches that are used for the period before 2017) gives a more stable assessment in the most recent 3 years. The Mohn's rho by year and as the average value over the last five years are presented in (Table 2.4.2). 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 bias.

Stock summary results with added 95% confidence limits (Figure 2.4.6 and Table 2.4.5) show a decrease in fishing mortality in the period 2004—2011, followed by a steep increase in F up to 2015 and a small decrease in F in 2016-2018. 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 recruitment in 2017-2018. SSB has increased since 2010, followed by a small reduction in 2018.

2.4.1 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 to F, SSB and recruitment (Figure 2.4.1.1).

2.5 Final assessment

Following the recommendations from Inter-Benchmark Protocol on Blue Whiting (IBPBLW 2016) 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 2.3.7.1.2

The model was run for the period 1981—2018, with catch data up to 2017 and preliminary catch data for the first semester of 2018 raised to expected annual catches, and survey data from March-April, 2004–2018. SSB 1st January in 2019 is estimated from survivors and estimated recruits (for 2019 estimator 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 2.4.2–2.4.3 and summarized in Table 2.4.5 and Figure 2.4.6. Residuals of the model fit are shown in Figures 2.4.1–2.4.2.

2.6 State of the Stock

F has increased from a historic low at 0.052 in 2011 to 0.518 in 2015 followed by a decrease in F to 0.454 in 2018. F has been above F_{MSY}(0.32) since 2014. SSB increased from 2010 (2.68 million tonnes) to 2017 (5.50 million tonnes), followed by a decline to 2019 (4.33 million tonnes). SSB has been above B_{pa} (2.25 million tonnes) since 1997.

Recruitment (age 1 fish) in 2006—2009 are in the very low end of the historical recruitments, but recruitment 2010-2016 are estimated much higher. The uncertainty around the recruitment in the most recent year is high, but recruitments in 2017 and 2018 are estimated low.

2.7 Biological reference points

In spring of 2016, the Inter-Benchmark Protocol on Blue Whiting (IBPBLW 2016) 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). During the WGWIDE meeting 2017, WKBWMSE concluded to keep B_{lim} and B_{pa} unchanged but revised F_{lim}, F_{pa}, and F_{MSY} (See Table below)

The table below summaries 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)

References

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. 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

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. Both the 1–group (2017 year class) and 2–group (2016 year class) indices from the survey in 2018 were below the median of the historical range.

The International Blue Whiting Spawning Stock Survey (IBWSS) is not designed to give a representative estimate of immature blue whiting. However, the 1-group indices appear to be fairly consistent with corresponding indices from older ages. The 1-group (2017 year class) index from the survey in 2018 was the below the middle of the historic range. The 2-group in 2018 (2016 year class) was in the low end in the time-series.

The Norwegian bottom-trawl survey in the Barents Sea (BS-NoRu-Q1(Btr)) in February-March 2018, showed that 1-group blue whiting was absent (Table 2.3.7.2.2). 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 2018 (2017 year class) from the Icelandic bottom-trawl survey showed a decrease compared to 2017 and was in the low end in the time-series.

The 1-group estimate in 2018 (2017 year class) from the Faroese Plateau spring bottom-trawl survey was lower than in 2016 and were below the median of the historical range.

In conclusion, the indices from available survey time-series indicate that the 2016 year class is in the low end and it corresponds to the SAM assessment results. The 2017 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 2016 and 2017 year classes.

No information is available for the 2018 and 2019 year classes and the geometric mean of the full time-series (1981—2017) was used for these year classes (14.6 billion at age 1 in 2018) (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.

2.8.2.1 Input

Table 2.8.2.1 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 (2015—2017). The 2018 mean weights in the assessment are a three years average (2015—2017). 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 2017 and 2018 are assumed as estimated by the SAM model, as additional survey information was not conflicting this result. The recruitment in 2019 and 2020 are assumed at the long-term average (geometric mean for the full time-series, minus the last year (1981-2017).

As the assessment uses preliminary catches for 2018 an estimate of stock size exist for the 1 January 2019. The normal use of an “intermediate year “calculation is not relevant anymore. F in the “intermediate year” (2018) is as calculated by the assessment model. Catches in 2018 is the (model input) preliminary catches (1712874 tonnes). Intermediate year assumptions are summarised in Table 2.8.2.1.1

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 implies fishing mortality to be at F_{MSY} = 0.32 which will give a TAC in 2018 at 1143629 tonnes (33.2 % decrease compared to the ICES estimate of catches in 2018 and 17.2 % decrease compared to the ICES advice for 2018). SSB is predicted to decrease by 13.2 %.

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 three assessments, with the inclusion of the preliminary catches in 2016, show a tendency for overestimating SSB and underestimating F.

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 2.4.6). The retrospective analysis (Figure 2.4.5), 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 2010-2017 assessments (Figure 2.9.1) suggest a consistent assessment for the last three years (with inclusion of preliminary catch data). The preliminary 2016 and 2017 catches in weight correspond well with the final catch statistics (Table 2.3.2.4).

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, biased survey indices will still give a biased stock estimate with the new SAM configuration.

During the WGWIDE 2017 (ICES 2017), a comparison between the mean length-at-age, by quarter and ICES division was been made. This comparison reveals a considerable lower mean length-at-age from the Faroese catch-at-age data. The 2017 catch-at-age from Faroese Islands, provided for this year assessment, were based on the age reading guidelines from the last workshop on blue whiting ageing (WKARBLUE2) and no significant deviations of the mean length-at-age have been found (Figure 2.3.1.10.). The Faroese catch-at-age data from the previous years are under revision and the assessment will be updated, when the data become available.

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.

2.11 Management considerations

The expected catches for 2018 (1.712 million tonnes) are considerably higher than the ICES advice for 2018 (1.388 million tonnes) based on the long-term management strategy agreed by the European Union, the Faroe Islands, Iceland and Norway. This higher catch in combination with the small recruitment in 2017 and 2018 lead to the reduction in the ICES TAC advice for 2019. Without a strong recruitment in 2019 the decline in stock size and TAC will probably continue.

2.12 Ecosystem considerations

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 EU, Norway, Iceland and the Faroe Island on the share of the blue whiting TAC.

WGWIDE members estimate the total expected catch from the stock to be around 1.712 million tonnes in 2018 (close to the sum of declared quotas) whereas the TAC advice, according to the long-term management strategy was≤ 1.388 million 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 FMSY (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.

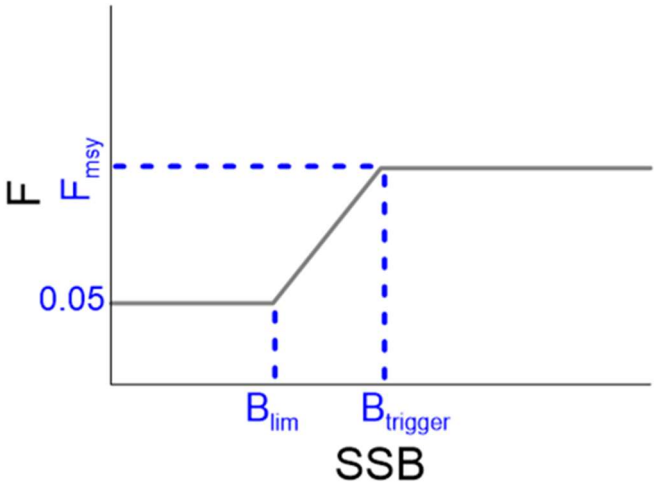

Diagram of the requested long-term management strategy to be evaluated for blue whiting. $B_{trigger} = B_{pa}$.

2.14 References

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, doi: 10.1093/icesjms/fsw046.

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Nielsen, A., and Berg, C.W. 2014.Estimation of time-varying selectivity in stock assessments using state-space models. Fisheries Research, 158: 96-101

2.15 Tables

Table 2.3.1.1.Blue whiting. ICES estimated catches (tonnes) by country for the period 1988–2017.

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.**

Table 2.3.1.1.(continued). Blue whiting. ICES estimated catches (tonnes) by country for the period 1988–2017.

Country	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Denmark	89 500	41 450	54 663	48 659	18 134	248	140	165	340	2 167	35 256	45 178	39 395	60 868
Estonia	**													
Faroes	322 322	266 799	321 013	317 859	225 003	58 354	49979	16405	43290	85 768	224 700	282 502	282 416	356 501
France		8 046	18 009	16 638	11 723	8 831	7839	4337	9799	8 978	10 410	9 659	10 345	13 369
Germany	15 293	22 823	36 437	34 404	25 259	5 044	9108	278	6239	11 418	24 487	24 107	20 025	45 555
Iceland	379 643	265 516	309 508	236 538	159 307	120 202	87942	5887	63056	104 918	182 879	214 870	186 914	228 934
Ireland	75 393	73 488	54 910	31 132	22 852	8 776	8324	1195	7557	13 205	21 466	24 785	27 657	43 238
Lithuania			4 635	9 812	5 338						4 717		1 129	5 300
Netherlands	95 311	147 783	102 711	79 875	78 684	35 686	33762	4595	26526	51 635	38 524	56 397	58 148	81 156
Norway	957 684	738 490	642 451	539 587	418 289	225 995	194317	20539	118832	196 246	399 520	489 439	310 412	399 363
Poland														15 889
Portugal	3 937	5 190	5 323	3 897	4 220	2 043	1482	603	1955	2 056	2 150	2 547	2 586	2 046
Spain	15 612	17 643	15 173	13 557	14 342	20 637	12891	2416	6726	15 274	32065	29 206	31 952	28 920
Sweden	19 083	2 960	101	464	4	3	50	1	4	199	2	32	42	90
UK (England + Wales) +	2 593	7 356	10 035	12 926	14 147	6 176	2475	27	1590	4 100	11	131	1 374	3 447
UK (Northern Ireland)										1 232	2 205	1 119		
UK (Scotland)	57 028	104 539	72 106	43 540	38 150	173	5496	1331	6305	8 166	24 630	30 508	37 173	64 724
Russia	346 762	332 226	329 100	236 369	225 163	149 650	112553	45841	88303	120 674	152 256	185 763	173 655	188 449
Greenland										2 133				20 212
Unallocated									3 499					
TOTAL	2380161	2034309	1976176	1625255	1260615	641818	526357	103620	384021	628169	1155279	1396244	1 183 224	**1 558 061**

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

+ data from 2017 updated in the 2018.

Table 2.3.1.2.Blue whiting. ICES estimated catches (tonnes) by country and area for 2017.

	Denmark	Faroe Islands	France	Germany	Greenland	Iceland	Ireland	Lithuania	Netherlands	Norway	Poland	Portugal	Russia	Spain	Sweden	UK (England)	UK(Scotland)	Grand Total
27.14.a					27													**27**
27.14.b					0													**0**
27.2.a	1	47 377		5 857	2 931	36 305	9		1 942	8 066			21 736		3	108		**124 335**
27.3.a	41	5								185					87			**317**
27.3.d	0																	**0**
27.4.a	26	3 708	46	1 938	2 942	9 595			1 805	24 113	170		795		0			**45 138**
27.4.b	2									17					0		0	**18**
27.4.c	0															0		**0**
27.5.a		250				11 953												**12 203**
27.5.b		217 002	453	5 133	12 612	125 237			7 555	2 143			86 285					**456 419**
27.6.a	18 255	31 136	5 641	21 242	1 700	35 023	18 787		35 274	139 826	13 405		12 778	1		3 332	37 383	**373 783**
27.6.b	479	5 900	231			10 821	1 208		338	32 790			7 573	4			1 323	**60 668**
27.7.b	2 597			16			1 450		272					25		2		**4 362**
27.7.c	35 493	36 797	5 784	10 245			21 750	3 099	33 888	183 677	1 604		30 467	52			26 018	**388 873**
27.7.d			0															**0**
27.7.e			36													2		**38**
27.7.f																0		**0**
27.7.g			11													0		**11**
27.7.h			8	10										4		2		**23**
27.7.j			206	19			35		81					210				**550**
27.7.k	3 974	14 327	830	1 095				2 201		8 548	711		28 815	2				**60 502**
27.8.a			71											2				**73**
27.8.b			26											218				**245**
27.8.c			0											21 449				**21 449**
27.8.d			26											1				**27**
27.9.a												2 046		6 951				**8 997**
Total	**60 868**	**356 501**	**13 369**	**45 555**	**20 212**	**228 934**	**43 238**	**5 300**	**81 156**	**399 363**	**15 889**	**2 046**	**188 449**	**28 920**	**90**	**3 447**	**64 724**	**1 558 061**

Table 2.3.1.3.Blue whiting. ICES estimated catches (tonnes) by quarter and area for 2017.

Area	Quarter 1	Quarter 2	Quarter 3	Quarter 4	2017	Total
27.2.a	354	61145	43238	19598		**124335**
27.3.a	0	1	313	3		**317**
27.3.d	0					**0**
27.4.a	105	14313	15789	14932		**45138**
27.4.b	1	16	2	0		**18**
27.4.c	0	0	0	0		**0**
27.5.a		7553		4650		**12203**
27.5.b	57472	314429	1436	83082		**456419**
27.6.a	86698	286366	0	707	12	**373783**
27.6.b	59304	1339	2	2	22	**60668**
27.7.b	2941	1403	7	11		**4362**
27.7.c	384291	4540	17	26		**388873**
27.7.d	0					**0**
27.7.e	1	5	30	2		**38**
27.7.f		0				**0**
27.7.g		11	0			**11**
27.7.h	1	19	2	2		**23**
27.7.j	15	186	44	305		**550**
27.7.k	60500	1	1			**60502**
27.8.a	1	68	3	2		**73**
27.8.b	62	76	35	72		**245**
27.8.c	6074	5171	5362	4843		**21449**
27.8.d	0	1		26		**27**
27.9.a	1536	2945	2508	2007		**8997**
27.14.a		0	27			**27**
27.14.b			0			**0**
Grand total	**659354**	**699587**	**68817**	**130269**	**34**	**1558061**

*** 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 1988–2017 by area.

Area	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	55 829	426 037	45 143	**527 009**	30 838	**557 847**
1989	42 615	475 179	75 958	**593 752**	33 695	**627 447**
1990	2 106	463 495	63 192	**528 793**	32 817	**561 610**
1991	78 703	218 946	39 872	**337 521**	32 003	**369 524**
1992	62 312	318 018	65 974	**446 367**	28 722	**475 026**
1993	43 240	347 101	58 082	**448 423**	32 256	**480 679**
1994	22 674	378 704	28 563	**429 941**	29 473	**459 414**
1995	23 733	423 504	104 004	**551 241**	27 664	**578 905**
1996	23 447	478 077	119 359	**620 883**	25 099	**645 982**
1997	62 570	514 654	65 091	**642 315**	30 122	**672 437**
1998	177 494	827 194	94 881	**1 099 569**	29 400	**1 128 969**
1999	179 639	943 578	106 609	**1 229 826**	26 402	**1 256 228**
2000	284 666	989 131	114 477	**1 388 274**	24 654	**1 412 928**
2001	591 583	1 045 100	118 523	**1 755 206**	24 964	**1 780 170**
2002	541 467	846 602	145 652	**1 533 721**	23 071	**1 556 792**
2003	931 508	1 211 621	158 180	**2 301 309**	20 097	**2 321 406**
2004	921 349	1 232 534	138 593	**2 292 476**	85 093	**2 377 569**
2005	405 577	1 465 735	128 033	**1 999 345**	27 608	**2 026 953**
2006	404 362	1 428 208	105 239	**1 937 809**	28 331	**1 966 140**
2007	172 709	1 360 882	61 105	**1 594 695**	17 634	**1 612 330**
2008	68 352	1 111 292	36 061	**1 215 704**	30 761	**1 246 465**
2009	46 629	533 996	22 387	**603 012**	32 627	**635 639**
2010	36 214	441 521	17 545	**495 280**	28 552	**523 832**
2011	20 599	72 279	7 524	**100 401**	3 191	**103 592**
2012	24 391	324 545	5678.346	**354 614**	29401.78	**384016***
2013	31 759	481 356	8749.051	**521 864**	103973.5	**625837****
2014	45 580	885 483	28 596	**959 659**	195 620	**1 155 279**
2015	150 828	895 684	44 661	**1 091 173**	305 071	**1 396 244**
2016	59 744	905 087	55 774	**1 020 604**	162 583	**1 183 187**
2017	**136 565**	**1 284 105**	**45 474**	**1 466 144**	**91 917**	**1 558 061**

*** Data from UK(England + Wales) not included (2004-2007).**

**** Data from UK(England + Wales) and Sweden not included (2008-2011).**

Table 2.3.1.5. Blue whiting. ICES estimates(tonnes) of catches, landings and discards by country for 2017.

Country	Catches	Landings	Discards	% discards
Denmark	60868	60864	4	0.01
Faroe Islands	356501	356501		0.00
France	13369	13221	148	1.11
Germany	45555	45555		0.00
Greenland	20212	20212		0.00
Iceland	228934	228934		0.00
Ireland	43238	43238	0	0.00
Lithuania	5300	5300		0.00
Netherlands	81156	81156		0.00
Norway	399363	399363		0.00
Poland	15889	15889		0.00
Portugal	2046	1625	421	20.58
Russia	188449	188449		0.00
Spain	28920	27500	1419	4.91
Sweden	90	90		0.00
UK (England)	3447	3442	4	0.12
UK(Scotland)	64724	64690	34	0.05
Total	**1558061**	**1556030**	**2030**	**0.13**

Table 2.3.1.6. Blue whiting. ICES estimated catches (tonnes) inside and outside NEAFC area for 2017 by country.

	Catches inside NEAFC area	Catches outside NEAFC area	Total catches
Denmark	3935	56933	60868
Faroe Islands	45731	310770	356501
France	230*	13139	13369
Germany	41471	4084	45555
Greenland	1	20211	20212
Iceland	8127	220807	228934
Ireland	9	43229	43238
Lithuania**	0	5300	5300
Netherlands	1073	80082	81156
Norway	77714	321649	399363
Poland	0	15889	15889
Portugal	0	2046	2046
Russia	84620	103829	188449
Spain	0	28920	28920
Sweden**	0	90	90
UK (England)	108	3339	3447
UK(Scotland)	0	64724	64724
Total in 2017	**263019**	**1295042**	**1558061**

*** landings only.**
**** those values are assumed, since data of catches inside/outside NEAFC was not available.**

Table 2.3.1.1.1. Blue whiting. ICES estimated catches (tonnes), the percentage of catch covered by the sampling programme, No. of samples, No. of fish measured and No. of fish aged for 2000-2017.

Year	Catch (tonnes)	% catch covered by sampling programme	No. 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
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**

Table 2.3.1.1.2. Blue whiting. ICES estimated catches (tonnes), the percentage of catch covered by the sampling programme (catch-at-age numbers), No. of 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 2017.

Country	Catch (ton)	% catch covered by sampling programme	No. samples	No. Measured	No. Aged	No Aged/ 1000 tonnes	No Measured/ 1000 tonnes
Denmark	60868	88	43	1402	1402	23	23
Faroe Islands	356501	89	32	3159	1710	5	9
France	13369	0	118	7004	0	0	524
Germany	45555	58	59	23277	563	12	511
Greenland	20212	0	0	0	0	0	0
Iceland	228934	100	84	7545	2112	9	33
Ireland	43238	94	14	2997	1426	33	69
Lithuania	5300	0	0	0	0	0	0
Netherlands	81156	83	74	16866	1850	23	208
Norway	399363	100	287	11868	1120	3	30
Poland	15889	0	0	0	0	0	0
Portugal	2046	100	69	3725	1045	511	1821
Russia	188449	100	41	36931	1702	9	196
Spain	28920	99	951	31012	2526	87	1072
Sweden	90	0	0	0	0	0	0
UK (England)	3447	0	0	0	0	0	0
UK(Scotland)	64724	87	7	1511	372	6	23
Total	**1558061**	**91**	**1779**	**147297**	**15828**	**10**	**95**

Table 2.3.1.2.3.Blue whiting. ICES estimated catches (tonnes), No. of samples, No. of fish measured and No. of fish aged by country and quarter for 2017.

	Catch (tonnes)	No. samples	No. Length Measured	No. Age Samples
Denmark				
1	42554	39	1243	1243
2	18246	4	159	159
3	58	0	0	0
4	9	0	0	0
Total	60868	43	1402	1402
Faroe Islands				
1	118066	16	1504	810
2	174329	13	1365	700
3	14778	2	190	100
4	49328	1	100	100
Total	356501	32	3159	1710
France				
1	4317	52	4078	0
2	8084	57	2488	0
3	37	0	0	0
4	931	9	438	0
Total	13369	118	7004	0
Germany				
1	11380	0	0	0
2	27524	59	23277	563
3	3677	0	0	0
4	2973	0	0	0
Total	45555	59	23277	563
Greenland				
2	15260	0	0	0
3	29	0	0	0
4	4924	0	0	0
Total	20212	0	0	0
Iceland				
1	10821	5	451	120
2	169503	65	5986	1642
3	5279	2	147	50
4	43331	12	961	300
Total	228934	84	7545	2112
Ireland				
1	33829	13	2817	1323
2	9400	1	180	103
4	9	0	0	0
Total	43238	14	2997	1426
Lithuania				
1	5300	0	0	0
Total	5300	0	0	0
Netherlands				
1	33162	66	14854	1650
2	37306	8	2012	200
3	1286	0	0	0
4	9401	0	0	0
Total	81156	74	16866	1850
Norway				
1	274147	32	1368	647
2	98041	71	2653	362
3	21716	152	6768	90
4	5459	32	1079	21
Total	399363	287	11868	1120
Poland				
1	2315	0	0	0
2	13575	0	0	0
Total	15889	0	0	0
Portugal				
1	456	15	779	159
2	462	18	741	136
3	541	20	1393	412
4	587	16	812	338
Total	2046	69	3725	1045
Russia				
1	83298	13	11113	597
2	84503	17	14997	822
3	13800	5	5503	120
4	6848	6	5318	163
Total	188449	41	36931	1702
Spain				
1	7231	257	8702	602
2	7803	270	9456	446
3	7425	194	5900	703
4	6460	230	6954	775
Total	28920	951	31012	2526
Sweden				
1	0	0	0	0
2	0	0	0	0
3	86	0	0	0
4	3	0	0	0
Total	90	0	0	0
UK (England)				
1	3	0	0	0
2	3334	0	0	0
3	104	0	0	0
4	6	0	0	0
Total	3447	0	0	0
UK(Scotland)				
1	32474	5	1159	250
2	32216	2	352	122
3	0	0	0	0
4	0	0	0	0
2017	34	0	0	0
Total	64724	7	1511	372
Grand Total	**1558061**	**1779**	**147297**	**15828**

*** 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 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 2017.

Division	Catch (ton)	No. samples	No. Measured	No. Aged	No Aged/ 1000 tonnes	No Measured/ 1000 tonnes
27.2.a	124335	68	20694	961	8	166
27.3.a	317	26	442	0	0	1392
27.3.d	0	0	0	0	0	0
27.4.a	45138	219	14615	364	8	324
27.4.b	18	0	0	0	0	0
27.4.c	0	0	0	0	0	0
27.5.a	12203	8	575	198	16	47
27.5.b	456419	105	30633	3207	7	67
27.6.a	373783	98	12055	2073	6	32
27.6.b	60668	9	689	240	4	11
27.7.b	4362	0	0	0	0	0
27.7.c	388873	163	25530	4350	11	66
27.7.d	0	0	0	0	0	0
27.7.e	38	0	0	0	0	0
27.7.f	0	0	0	0	0	0
27.7.g	11	18	136	0	0	12293
27.7.h	23	6	59	0	0	2514
27.7.j	550	0	0	0	0	0
27.7.k	60502	29	6982	864	14	115
27.8.a	73	0	0	0	0	0
27.8.b	245	182	4319	0	0	17652
27.8.c	21449	439	19712	1335	62	919
27.8.d	27	0	0	0	0	0
27.9.a	8997	409	10856	2236	249	1207
27.14.a	27	0	0	0	0	0
27.14.b	0	0	0	0	0	0
TOTAL	**1558061**	**1779**	**147297**	**15828**	**385**	**36807**

Table 2.3.2.1 .Blue whiting. ICES estimated preliminary catches (tonnes) in 2018 by quarter and area.

	Landings		
ICES div.	**Quarter 1**	**Quarter 2**	**Total**
27.2.a	346	21902	**22248**
27.2.a.1		1023	**1023**
27.2.a.2	20	4421	**4441**
27.4.a	14	13105	**13119**
27.4.b		7	**7**
27.5.a		2403	**2403**
27.5.b	74661	376864	**451525**
27.5.b.1		1222	**1222**
27.6.a	31506	310952	**342457**
27.6.b	140727	300	**141027**
27.6.b.2	22083	788	**22870**
27.7.b	4017	756	**4773**
27.7.c	181026	6416	**187442**
27.7.c.2	91345	4781	**96127**
27.7.j.2	1	21	**22**
27.7.k	39508		**39508**
27.9.a	177	364	**541**
Total	**585430**	**745323**	**1330754**

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 2018 preliminary data (quarters 1 and 2).

ICES div.	Catch (ton)	No. samples	No. Measured	No. Aged
27.2.a	22248	3	261	74
27.2.a.1	1023	0	0	0
27.2.a.2	4441	0	0	0
27.4.a	13119	0	0	0
27.4.b	7	0	0	0
27.5.a	2403	0	0	0
27.5.b	451525	56	16213	2215
27.5.b.1	1222	2	34	34
27.6.a	342457	22	4157	1210
27.6.b	141027	14	2582	452
27.6.b.2	22870	5	502	301
27.7.b	4773	0	0	0
27.7.c	187442	33	7108	1338
27.7.c.2	96127	19	1960	755
27.7.j.2	22	0	0	0
27.7.k	39508	26	5496	360
27.9.a	541	11	749	251
Total	**1330754**	**191**	**39062**	**6990**

Table 2.3.2.3. Blue whiting. ICES estimates of catches (tonnes) in 2018, based on (initial) declared quotas and expected uptake estimated by WGWIDE.

COUNTRY	PRELIM Q1–Q2 CATCH	NATIONAL QUOTA	DEVIATION FROM QUOTA
Denmark	87289	61,277	26,012
Faroe Islands	307,353	493,081	-99,500
Germany	39,281	23,825	15,456
Greenland	14,839	16,000	0
Iceland	224,009	275971	0
Ireland	47,620	47,451	0
Lithuania	0	5,300	0
Netherlands	0	74,720	40,013
Norway	420,161	421,100	10,000
Portugal	541	4,826	-2,413
Russia	145,206	207,345	-47,345
UK(Scotland)	65,503	79,513	-9,513
UK (England)	0	0	0
Sweden	0	15,158	-15,000
France	0	42,644	-25,000
Spain	0	51,949	0
Total	1,351,802	1,819,860	-106,990
EU	240,234	401,363	
	Best guess on catches in 2018		**1,712,870**

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

YEAR	PRELIMINARY	FINAL	DEVIATION %*
2016	1147000	1180786	2.9
2017	1559437	1555069	-0.3
2018	1712874		

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

Table 2.3.2.1.1 .Blue whiting. Proportion of the annual catch taken in the first half-year of 2015-2017, average proportion and scaling factor used for raising the preliminary first half year of 2018 catch data.

Values	2015	2016	2017	Average	Raising factor
Age 1	76.6	76.4	73.3	75.4	1.326
Age 2	83.7	85.9	82.5	84.0	1.190
Age 3	87.4	92.2	87.9	89.2	1.122
Age 4	89.5	92.3	91.0	90.9	1.100
Age 5	91.7	97.0	93.8	94.2	1.062
Age 6	88.9	97.1	94.5	93.5	1.069
Age 7	88.9	96.2	98.1	94.4	1.059
Age 8	90.8	98.1	97.2	95.4	1.048
Age 9	95.2	96.3	98.6	96.7	1.034
Age 10	90.3	95.0	97.2	94.2	1.062

Table 2.3.3.1.Bluewhiting. Catch-at-age numbers (thousands) by year. Discards included since 2014. Values for 2018 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
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

Year Age	1	2	3	4	5	6	7	8	9	10+
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	497019	575187	3292297	6825720	3034801	1026145	312013	112844	69289	166324

Table 2.3.4.1. Blue whiting. Individual mean weight (kg) at age in the catch. Preliminary values for 2018 (average of 2015-2017) are included.

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
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

Year Age	1	2	3	4	5	6	7	8	9	10+
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
2018	0.047	0.069	0.086	0.106	0.125	0.143	0.158	0.174	0.189	0.206

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.Bluewhiting.Time-series of StoX abundance estimates of blue whiting (millions) by age in the IBWSS. Total biomass in last column (1000 t).

	Age										
Year	1	2	3	4	5	6	7	8	9	10+	TSB
2004	1 097	5 538	13 062	15 134	5 119	1 086	994	593	164		3 505
2005	2 129	1 413	5 601	7 780	8 500	2 925	632	280	129	23	2 513
2006	2 512	2 222	10 858	11 677	4 713	2 717	923	352	198	31	3 512
2007	468	706	5 241	11 244	8 437	3 155	1 110	456	123	58	3 274
2008	337	523	1 451	6 642	6 722	3 869	1 715	1 028	269	284	2 639
2009	275	329	360	1 292	3 739	3 457	1 636	587	250	162	1 599
2010*											
2011	312	1 361	1 135	930	1 043	1 712	2 170	2 422	1 298	250	1 826
2012	1 141	1 818	6 464	1 022	596	1 420	2 231	1 785	1 256	1 022	2 355
2013	586	1 346	6 183	7 197	2 933	1 280	1 306	1 396	927	1 670	3 107
2014	4 183	1 491	5 239	8 420	10 202	2 754	772	577	899	1 585	3 337
2015	3 255	4 565	1 888	3 630	1 792	465	173	108	206	247	1 403
2016	2 745	7 893	10 164	6 274	4 687	1 539	413	133	235	256	2 873
2017	275	2 180	15 939	10 196	3 621	1 711	900	75	66	144	3 135
2018	836	628	6 615	21 490	7 692	2 187	755	188	72	144	4 035

***Survey discarded.**

Table 2.3.7.1.2.Blue Whiting. Survey indices (IBWSS) as used in the assessment.

Year/ Age	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8
2004	1097	5538	13062	15134	5119	1086	994	593
2005	2129	1413	5601	7780	8500	2925	632	280
2006	2512	2222	10858	11677	4713	2717	923	352
2007	468	706	5241	11244	8437	3155	1110	456
2008	337	523	1451	6642	6722	3869	1715	1028
2009	275	329	360	1292	3739	3457	1636	587
2010	-1	-1	-1	-1	-1	-1	-1	-1
2011	312	1361	1135	930	1043	1712	2170	2422
2012	1141	1818	6464	1022	596	1420	2231	1785
2013	586	1346	6183	7197	2933	1280	1306	1396
2014	4183	1491	5239	8420	10202	2754	772	577
2015	3255	4565	1888	3630	1792	465	173	108
2016	2745	7893	10164	6274	4687	1539	413	133
2017	275	20180	15939	10196	3621	1711	900	75
2018	836	628	6615	21490	7692	2187	755	188

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, 2003–2018.

Year\Age	Age 1	Age 2
2003*	16127	9317
2004*	17792	11020
2005*	19933	7908
2006*	2512	5504
2007*	592	213
2008	25	17
2009	7	8
2010	0	280
2011	1613	0
2012	9476	3265
2013	454	6544
2014	3893	2048
2015	8563	2796
2016	4223	8089
2017	1236	2087
2018	441	1491

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

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

	Catch Rate	
Year	All	< 19 cm
1981	0.13	0
1982	0.17	0.01
1983	4.46	0.46
1984	6.97	2.47
1985	32.51	0.77
1986	17.51	0.89
1987	8.32	0.02
1988	6.38	0.97
1989	1.65	0.18
1990	17.81	16.37
1991	48.87	2.11
1992	30.05	0.06
1993	5.80	0.01
1994	3.02	0
1995	1.65	0.10
1996	9.88	5.81
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	9.52	0.007

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

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

Table 2.4.1.Blue whiting. Parameter estimates, from final assessment (2018) and retrospective analysis (2015-2017).

Parameter Year	2014	2015	2016	2017	2018
Random walk variance					
-F Age 1-10	0.40	0.41	0.39	0.38	0.38
Process error					
-log(N) Age 1	0.58	0.58	0.58	0.62	0.62
--- Age 2-10	0.15	0.17	0.17	0.18	0.19
Observation variance					
-Catch Age 1	0.41	0.46	0.45	0.44	0.44
--- Age 2	0.30	0.29	0.29	0.29	0.28
--- Age 3-8	0.21	0.20	0.20	0.20	0.19
--- Age 9-10	0.41	0.40	0.40	0.40	0.40
-IBWSS Age 1	0.91	0.77	0.75	0.77	0.73
--- Age 2	0.33	0.33	0.31	0.32	0.31
--- Age 3	0.42	0.46	0.46	0.44	0.42
--- Age 4-6	0.35	0.45	0.45	0.40	0.39
--- Age 7-8	0.29	0.37	0.41	0.48	0.51
Survey_catchability					
-IBWSS Age 1	0.06	0.07	0.07	0.07	0.07
--- Age 2	0.10	0.12	0.12	0.12	0.12
--- Age 3	0.33	0.38	0.36	0.38	0.38
--- Age 4	0.60	0.70	0.66	0.70	0.70
--- Age 5-8	0.86	0.92	0.86	0.89	0.88
Rho					
--	0.91	0.92	0.92	0.93	0.94

Table 2.4.2.Blue whiting. Mohn's rho by year and average over the last five years (n=5).

Year	R(age 1)	SSB	Fbar(3–7)
2013	-0.218	0.206	-0.140
2014	-0.350	0.353	-0.298
2015	-0.266	-0.094	0.203
2016	0.472	0.134	-0.167
2017	0.177	-0.009	0.026
Rho-mean	-0.037	0.118	-0.075

Table 2.4.3.Blue whiting. Estimated fishing mortalities. Catch data for 2018 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	0.442	0.482	0.482
1982	0.067	0.102	0.148	0.183	0.208	0.270	0.293	0.371	0.401	0.401
1983	0.078	0.118	0.171	0.211	0.240	0.314	0.338	0.419	0.445	0.445
1984	0.096	0.143	0.212	0.265	0.305	0.397	0.418	0.509	0.528	0.528
1985	0.101	0.151	0.230	0.295	0.347	0.448	0.466	0.561	0.575	0.575
1986	0.113	0.169	0.269	0.358	0.432	0.553	0.573	0.692	0.703	0.703
1987	0.101	0.150	0.248	0.338	0.416	0.538	0.560	0.674	0.674	0.674
1988	0.098	0.148	0.253	0.349	0.438	0.574	0.588	0.693	0.677	0.677
1989	0.113	0.171	0.303	0.419	0.525	0.684	0.711	0.840	0.804	0.804
1990	0.105	0.159	0.292	0.407	0.510	0.663	0.711	0.846	0.813	0.813
1991	0.059	0.089	0.167	0.234	0.288	0.366	0.393	0.463	0.448	0.448
1992	0.049	0.073	0.140	0.195	0.233	0.286	0.311	0.369	0.362	0.362
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	0.113	0.160	0.186	0.219	0.241	0.292	0.285	0.285
1995	0.046	0.070	0.149	0.214	0.243	0.284	0.313	0.381	0.367	0.367
1996	0.056	0.085	0.185	0.270	0.297	0.347	0.382	0.471	0.450	0.450
1997	0.055	0.084	0.188	0.279	0.300	0.349	0.382	0.473	0.452	0.452
1998	0.070	0.110	0.250	0.380	0.407	0.472	0.508	0.627	0.590	0.590
1999	0.064	0.101	0.237	0.368	0.396	0.457	0.481	0.590	0.556	0.556
2000	0.074	0.118	0.279	0.444	0.496	0.575	0.587	0.703	0.664	0.664
2001	0.070	0.112	0.265	0.428	0.493	0.571	0.573	0.677	0.642	0.642
2002	0.066	0.105	0.251	0.417	0.502	0.593	0.595	0.698	0.664	0.664
2003	0.068	0.108	0.262	0.438	0.541	0.632	0.625	0.704	0.666	0.666

Year Age	1	2	3	4	5	6	7	8	9	10
2004	0.070	0.111	0.271	0.461	0.590	0.689	0.686	0.750	0.709	0.709
2005	0.061	0.097	0.241	0.420	0.557	0.651	0.656	0.704	0.668	0.668
2006	0.053	0.084	0.210	0.372	0.507	0.596	0.605	0.638	0.605	0.605
2007	0.050	0.080	0.198	0.356	0.502	0.602	0.625	0.657	0.626	0.626
2008	0.043	0.070	0.172	0.307	0.441	0.529	0.560	0.588	0.567	0.567
2009	0.028	0.046	0.113	0.196	0.285	0.340	0.368	0.384	0.373	0.373
2010	0.020	0.034	0.081	0.137	0.199	0.236	0.258	0.264	0.258	0.258
2011	0.006	0.010	0.024	0.040	0.057	0.067	0.073	0.076	0.075	0.075
2012	0.013	0.022	0.053	0.086	0.123	0.144	0.162	0.170	0.170	0.170
2013	0.022	0.038	0.094	0.152	0.217	0.252	0.285	0.305	0.304	0.304
2014	0.041	0.073	0.184	0.298	0.422	0.491	0.553	0.599	0.595	0.595
2015	0.055	0.097	0.245	0.396	0.561	0.659	0.729	0.792	0.784	0.784
2016	0.049	0.088	0.220	0.357	0.508	0.609	0.670	0.731	0.723	0.723
2017	0.050	0.089	0.222	0.358	0.506	0.608	0.655	0.716	0.712	0.712
2018	0.049	0.088	0.217	0.346	0.491	0.589	0.629	0.690	0.694	0.694

Table 2.4.4. Blue whiting. Estimated stock numbers-at-age (thousands). Preliminary catch data for 2018 have been used.

Year Age	1	2	3	4	5	6	7	8	9	10
1981	3943692	3488784	4859060	2076248	2618264	2146444	1649518	1744321	1220346	2953625
1982	4664381	2960440	2521907	3288160	1587728	1502456	1297429	1015300	891437	1940099
1983	18115304	3773493	1878552	1823709	1908926	1219432	1012103	853821	626640	1273072
1984	18014177	14418718	2439230	1234269	1263492	1392379	813203	549695	481380	934332
1985	9611988	13503947	9735673	1453143	750716	910275	745441	457726	265989	724254
1986	7249682	6409196	9412823	5530414	943091	453109	470431	376132	229802	496885
1987	9122396	5061002	4097616	6843814	2562277	396719	253566	237646	156249	292857
1988	6427638	6873810	3531484	2884514	3707908	1260555	198998	125516	99236	171477
1989	8537748	4633873	4991355	2430816	2129918	1682807	352575	102615	60199	115895
1990	18736561	6005399	3106085	2737879	1482622	1189410	563082	121621	33337	84487
1991	8988548	15608671	4282592	1798497	1492165	870272	561713	190059	32994	45240
1992	6713109	7409881	12477451	3311350	1265977	794944	487709	288632	102008	39508
1993	4998700	5132861	5288210	9706302	2261567	978157	518320	283539	157823	74937
1994	8135997	3417183	4076316	3410694	6919250	1441441	764562	328596	205616	117856
1995	9335808	5886126	3141338	2577034	2857853	3751871	1039398	543237	219866	185984
1996	27984503	7110350	4084034	2399449	1558932	1867109	2242241	644926	306700	248522
1997	44654015	21276484	5494343	2574210	1424080	1071777	1064883	1218157	290420	333352
1998	26698034	37684012	16390067	3500268	1380547	928845	780824	604511	618616	294523
1999	20324984	20540726	27575781	10528634	1715494	776468	521586	410706	238132	428401
2000	39079520	15297659	16594148	15830032	4347296	1108867	472166	324122	155373	314533
2001	55497740	31482540	12072473	10747410	7479057	1704442	491788	227543	161849	180036
2002	48380225	45012302	20420467	8317975	5471791	3413372	695587	256524	102664	154653
2003	52143422	38633073	34816368	13565168	5063018	2969554	1214175	348189	90256	107123
2004	27840934	41597583	29708160	20801295	7277885	2454603	1318032	508010	152905	81304
2005	21854787	20958087	28217872	17943922	10759639	3244168	1107069	515249	193741	99173
2006	8915416	15214984	21736797	19133061	9422615	4457765	1359644	483782	218294	120636
2007	4873765	5916804	12980388	15742899	10276454	4686246	1836896	611595	228534	162864
2008	5730029	3456510	4319952	10977175	9140533	4906009	1864245	762892	237690	198625
2009	5577076	3930396	2416993	3700656	6945693	4727082	2206941	858654	327481	190213
2010	14802057	4904170	2336334	1860322	3357171	4327255	2843716	1206054	417629	268918
2011	18517015	12923098	3271120	1650914	1613891	2585190	2684504	1362763	816029	394679
2012	18200627	14807332	12169939	2276802	1178572	1603821	2319215	2089712	1076181	899308
2013	15173469	15156414	11246027	7226372	2191295	1069671	1355113	1601432	1329327	1363701
2014	34951221	12049711	13315826	7775563	4282644	1315215	905664	962744	984953	1461751

Year Age	1	2	3	4	5	6	7	8	9	10
2015	57777072	30998427	10369579	8225393	4084705	1678424	708618	491099	454668	1011553
2016	29276819	51763155	20193887	7359970	4105291	1695049	657303	320562	199265	543064
2017	9104584	23379038	41023710	14373309	4332574	1911764	656796	240411	135352	321343
2018	11037772	6697833	18011646	26425229	8372176	2411845	738959	236217	102601	209397
2019		8604992	5024187	11875347	15302312	4195934	1096200	322551	97019	127623

Table 2.4.5. Blue whiting. Estimated recruitment in thousands, spawning-stock biomass (SSB) in tonnes, average fishing mortality for ages 3 to 7 (F3-7) and total-stock biomass (TBS) in tonnes. Preliminary catch data for 2018 are included.

Year	R(age 1)	Low	High	SSB	Low	High	Fbar (3–7)	Low	High	TSB	Low	High
1981	3943692	2520198	6171224	2843780	2221416	3640508	0.258	0.186	0.359	3341965	2661374	4196604
1982	4664381	2946828	7383007	2303718	1821256	2913988	0.220	0.162	0.301	2772882	2232015	3444814
1983	18115304	11695267	28059578	1858444	1502264	2299072	0.255	0.190	0.342	2882436	2334841	3558459
1984	18014177	11740672	27639865	1752199	1441049	2130531	0.320	0.241	0.423	3080871	2473661	3837132
1985	9611988	6291195	14685653	2088626	1714249	2544764	0.357	0.273	0.468	3226731	2620479	3973239
1986	7249682	4776823	11002687	2271261	1867669	2762068	0.437	0.335	0.569	3113127	2566429	3776281
1987	9122396	5997119	13876349	1931350	1590580	2345128	0.420	0.321	0.549	2817310	2325903	3412539
1988	6427638	4223067	9783063	1637240	1359781	1971313	0.440	0.337	0.575	2426489	2011389	2927256
1989	8537748	5588110	13044327	1547528	1289249	1857550	0.528	0.406	0.687	2395234	1976026	2903376
1990	18736561	12078959	29063658	1360082	1122934	1647312	0.517	0.390	0.684	2500723	1988528	3144845
1991	8988548	5728713	14103339	1779458	1420075	2229791	0.290	0.211	0.397	3221695	2508294	4138000
1992	6713109	4333876	10398504	2459581	1936174	3124481	0.233	0.170	0.320	3529552	2782205	4477648
1993	4998700	3187939	7837980	2540869	2009014	3213523	0.204	0.149	0.279	3420516	2724355	4294568
1994	8135997	5237893	12637610	2535365	2026669	3171744	0.184	0.134	0.252	3418580	2759310	4235365
1995	9335808	6074990	14346906	2312732	1891556	2827686	0.240	0.179	0.322	3361400	2751602	4106337
1996	27984503	18249895	42911611	2212106	1827081	2678269	0.296	0.223	0.394	3728177	3018014	4605447
1997	44654015	29188410	68314138	2467411	2034689	2992161	0.299	0.226	0.397	5427534	4244969	6939538
1998	26698034	17560241	40590846	3674788	2986783	4521274	0.403	0.308	0.528	6810285	5413990	8566692
1999	20324984	13302894	31053766	4438043	3591370	5484320	0.388	0.295	0.509	7166282	5792673	8865611
2000	39079520	25520182	59843181	4235751	3497561	5129742	0.476	0.367	0.619	7456428	6049105	9191166
2001	55497740	36531341	84311145	4571904	3792756	5511112	0.466	0.358	0.606	8985204	7212545	11193538
2002	48380225	31821100	73556421	5397878	4469870	6518552	0.472	0.362	0.615	10294085	8290040	12782590
2003	52143422	34804230	78120861	6834267	5636111	8287133	0.500	0.388	0.643	11752059	9580906	14415221
2004	27840934	18409030	42105293	6730016	5610974	8072237	0.539	0.422	0.690	10293010	8540046	12405795
2005	21854787	14554141	32817581	5976941	4982409	7169991	0.505	0.392	0.650	8402061	6986988	10103727
2006	8915416	5871058	13538385	5824060	4830917	7021375	0.458	0.353	0.594	7639999	6342177	9203399
2007	4873765	3198282	7426981	4641908	3837586	5614809	0.456	0.348	0.599	5668818	4697569	6840878
2008	5730029	3706275	8858823	3584601	2920250	4400090	0.402	0.298	0.543	4396217	3597370	5372459
2009	5577076	3482285	8932002	2755802	2185478	3474958	0.260	0.187	0.362	3459138	2762543	4331386
2010	14802057	9497910	23068329	2676765	2079551	3445491	0.182	0.128	0.260	3720075	2917079	4744115
2011	18517015	11981809	28616700	2681413	2093175	3434960	0.052	0.035	0.078	4352159	3402862	5566282
2012	18200627	11951951	27716214	3379349	2706766	4219058	0.113	0.083	0.154	4982053	3987711	6224336
2013	15173469	9976381	23077923	3665883	2991885	4491716	0.200	0.150	0.267	5396783	4383191	6644762
2014	34951221	22594064	54066761	3870679	3185710	4702926	0.389	0.295	0.514	6361361	5125400	7895367
2015	57777072	36854356	90577896	4001425	3254742	4919409	0.518	0.395	0.680	7695209	5986917	9890940
2016	29276819	17996990	47626416	4575498	3546395	5903228	0.473	0.345	0.649	8320101	6256088	11065074
2017	9104584	5101379	16249224	5508728	4013548	7560914	0.470	0.315	0.702	7815325	5645224	10819641

Year	R(age 1)	Low	High	SSB	Low	High	Fbar (3–7)	Low	High	TSB	Low	High
2018	11037772	4815497	25300070	5422226	3586596	8197337	0.454	0.262	0.787	6952013	4582975	10545659
2019				4326857*								

*assuming long tem GM(1981-2017) recruitment (14580847)

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 2018 are included.

Year	Estimate	Low	High	Observed catch
1981	784934	556689	1106761	922980
1982	543231	409101	721340	550643
1983	512673	392727	669252	553344
1984	562099	430053	734690	615569
1985	638465	497039	820132	678214
1986	760762	592701	976476	847145
1987	638856	497827	819838	654718
1988	568654	443878	728504	552264
1989	618626	486149	787205	630316
1990	553978	432532	709524	558128
1991	406313	313193	527120	364008
1992	438851	342851	561731	474592
1993	439997	342045	565999	475198
1994	424834	328214	549897	457696
1995	507850	399237	646013	505176
1996	597801	470210	760014	621104
1997	641181	500273	821778	639681
1998	1077597	835390	1390027	1131955
1999	1243881	958805	1613717	1261033
2000	1503366	1167941	1935124	1412449
2001	1562271	1214242	2010053	1771805
2002	1716431	1333431	2209440	1556955
2003	2194967	1713850	2811144	2365319
2004	2314871	1814965	2952469	2400795
2005	1996040	1567578	2541613	2018344
2006	1841398	1444963	2346596	1956239
2007	1545598	1210851	1972889	1612269
2008	1162864	904241	1495455	1251851

Year	Estimate	Low	High	Observed catch
2009	654781	508179	843676	634978
2010	477149	364441	624713	539539
2011	136638	99573	187499	103771
2012	329201	258410	419384	375692
2013	592951	464578	756796	613863
2014	1108159	861440	1425539	1147650
2015	1355520	1064908	1725440	1390656
2016	1267922	991376	1621611	1180786
2017	1510357	1180296	1932717	1555069
2018	1688894	1292561	2206752	1712874

Table 2.8.1.1.Blue whiting. Input to short-term projection (median values for exploitation pattern and stock numbers).

Age	Mean weight in the stock (kg)	Mean weight in the catch (kg)	Proportion mature	Natural mortality	Exploi-tation pattern	Stock number(2019) (thousands)
Age 1	0.047	0.047	0.11	0.20	0.108	14580847
Age 2	0.069	0.069	0.40	0.20	0.193	8604992
Age 3	0.086	0.086	0.82	0.20	0.477	5024187
Age 4	0.106	0.106	0.86	0.20	0.762	11875347
Age 5	0.125	0.125	0.91	0.20	1.080	15302312
Age 6	0.143	0.143	0.94	0.20	1.296	4195934
Age 7	0.158	0.158	1.00	0.20	1.385	1096200
Age 8	0.174	0.174	1.00	0.20	1.519	322551
Age 9	0.189	0.189	1.00	0.20	1.528	97019
Age 10	0.206	0.206	1.00	0.20	1.528	127623

Table 2.8.2.1.1. Blue whiting. Deterministic forecast, intermediate year assumptions and recruitments.

VALUES	VALUE	NOTES
F ages 3-7 (2018)	0.454	From the assessment (preliminary 2018 catches)
SSB (2019)	4326857	From forecast
R age 1 (2018)	11037772	From assessment
R age 1 (2019)	14580847	GM (1981–2017)
R age 1 (2020)	14580847	GM (1981–2017)
Total catch (2018)	1712874	Preliminary 2018 catches as estimated by the WG, based on declaredquotas and expecteduptake.

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

Basis	Catch (2019)	F(2019)	SSB (2020)	% SSB change*	% Catch change**	% Advice change***
MSY approach: FMSY	1143629	0.320	3752236	-13.3	-33.2	-17.6
F = 0	4	0.000	4850444	12.1	-100.0	-100.0
Fpa	1725357	0.530	3201021	-26.0	0.7	24.3
Flim	2476742	0.880	2499796	-42.2	44.6	78.5
SSB (2020) = Blim	3587714	1.735	1500171	-65.3	109.5	158.5
SSB (2020 = Bpa	2747920	1.039	2250714	-48.0	60.4	98.0
SSB (2020) = MSY Btrigger	2747920	1.039	2250714	-48.0	60.4	98.0
F = F (2018)	1528542	0.454	3386825	-21.7	-10.8	10.1
SSB (2020) = SSB (2019)	544778	0.140	4325259	-0.0	-68.2	-60.7
Catch (2019) = Catch (2018)	1712790	0.525	3212862	-25.7	-0.0	23.4
Catch (2019) = Catch (2018) -20 %	1370342	0.397	3536701	-18.3	-20.0	-1.3
Catch (2019) = Advice (2018) -20 %	1109872	0.309	3784400	-12.5	-35.2	-20.0
F = 0.05	202887	0.050	4654469	7.6	-88.2	-85.4
F = 0.1	396102	0.100	4468252	3.3	-76.9	-71.5
F = 0.15	580153	0.150	4291275	-0.8	-66.1	-58.2
F = 0.16	615906	0.160	4256945	-1.6	-64.0	-55.6
F = 0.17	651316	0.170	4222960	-2.4	-62.0	-53.1
F = 0.18	686385	0.180	4189318	-3.2	-59.9	-50.5
F = 0.19	721119	0.190	4156014	-3.9	-57.9	-48.0
F = 0.2	755520	0.200	4123044	-4.7	-55.9	-45.6
F = 0.21	789591	0.210	4090406	-5.5	-53.9	-43.1
F = 0.22	823337	0.220	4058095	-6.2	-51.9	-40.7
F = 0.23	856761	0.230	4026108	-7.0	-50.0	-38.3
F = 0.24	889866	0.240	3994442	-7.7	-48.0	-35.9
F = 0.25	922655	0.250	3963093	-8.4	-46.1	-33.5
F = 0.26	955133	0.260	3932057	-9.1	-44.2	-31.2
F = 0.27	987302	0.270	3901331	-9.8	-42.4	-28.9
F = 0.28	1019165	0.280	3870912	-10.5	-40.5	-26.6
F = 0.29	1050726	0.290	3840796	-11.2	-38.7	-24.3
F = 0.3	1081989	0.300	3810980	-11.9	-36.8	-22.0
F = 0.31	1112955	0.310	3781462	-12.6	-35.0	-19.8
F = 0.32	1143629	0.320	3752236	-13.3	-33.2	-17.6
F = 0.33	1174013	0.330	3723302	-13.9	-31.5	-15.4
F = 0.34	1204111	0.340	3694655	-14.6	-29.7	-13.2
F = 0.35	1233925	0.350	3666292	-15.3	-28.0	-11.1

Year	Estimate	Low	High		Observed catch		
F = 0.45		1517116	0.450	3397635	-21.5	-11.4	9.3
F = 0.5		1649075	0.500	3272945	-24.4	-3.7	18.8

Weights in tonnes.

***) SSB 2020 relative to SSB 2019.**

****) Catch 2019 relative to expected catch in 2018 (1712874 tonnes).**

*****) Catch 2019 relative to advice for 2018 (1387872 tonnes).**

2.16 Figures

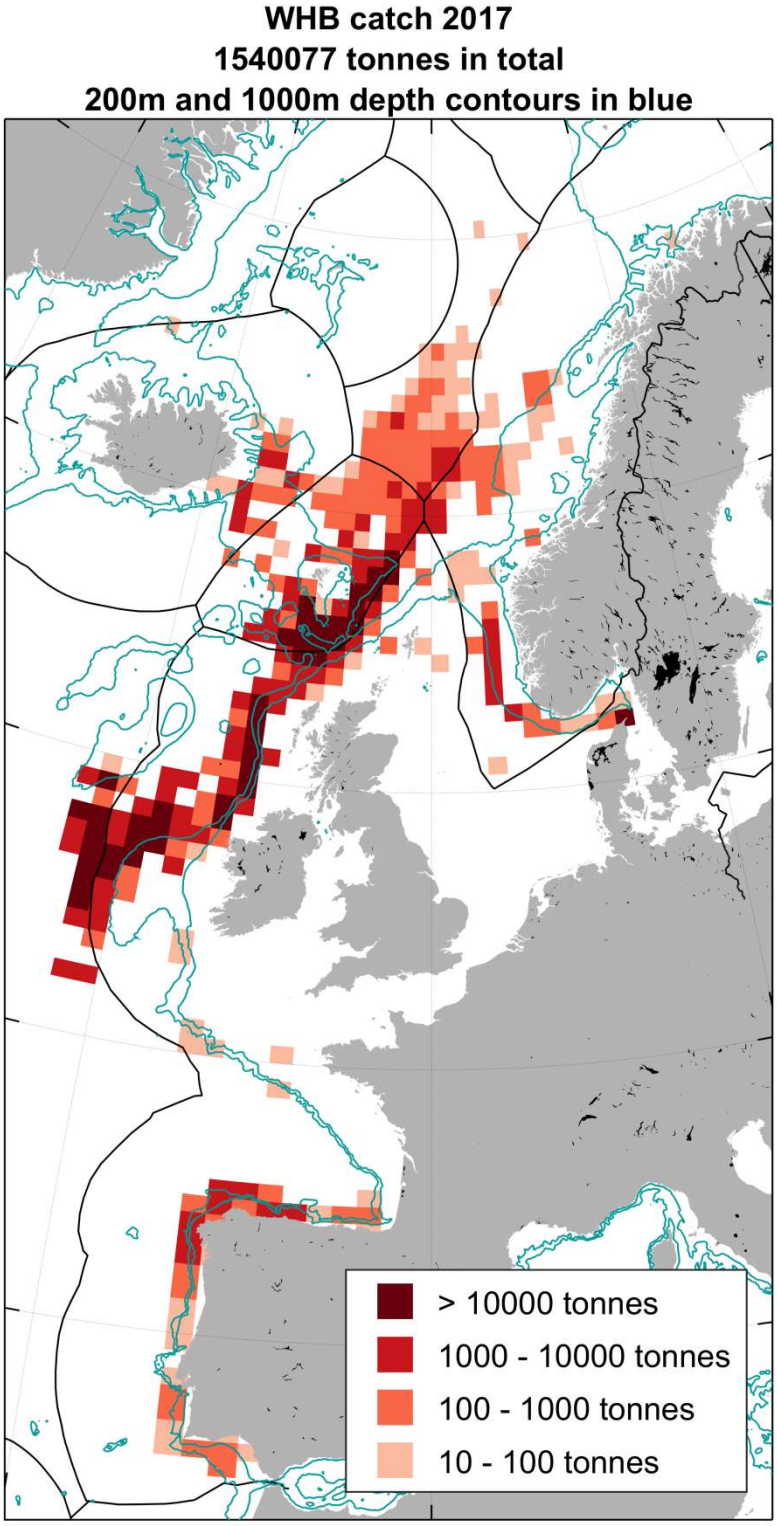


Figure 2.2.1. Blue whiting landings (ICES estimates) in 2017 by ICES rectangle. The 200 m and 1000 m depth contours are indicated in blue. The catches on the map constitute 98.8 % of the total landings.

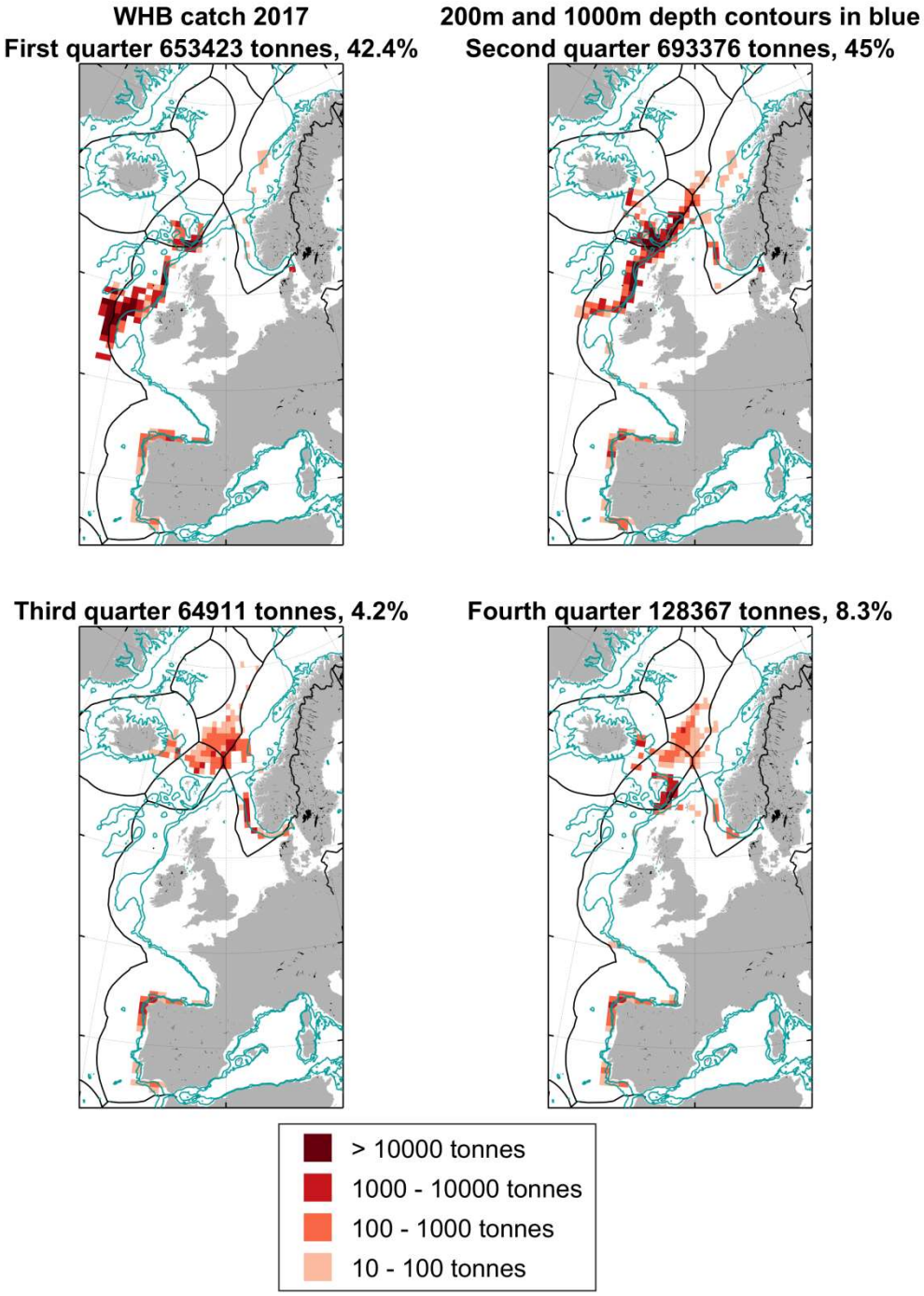


Figure 2.2.2. Blue whiting total catches pr quarter (ICES estimates) 2017 by ICES rectangle. The 200 m and 1000 m depth contours are indicated in blue. The catches on the map constitute 98.8 % of the total landings.

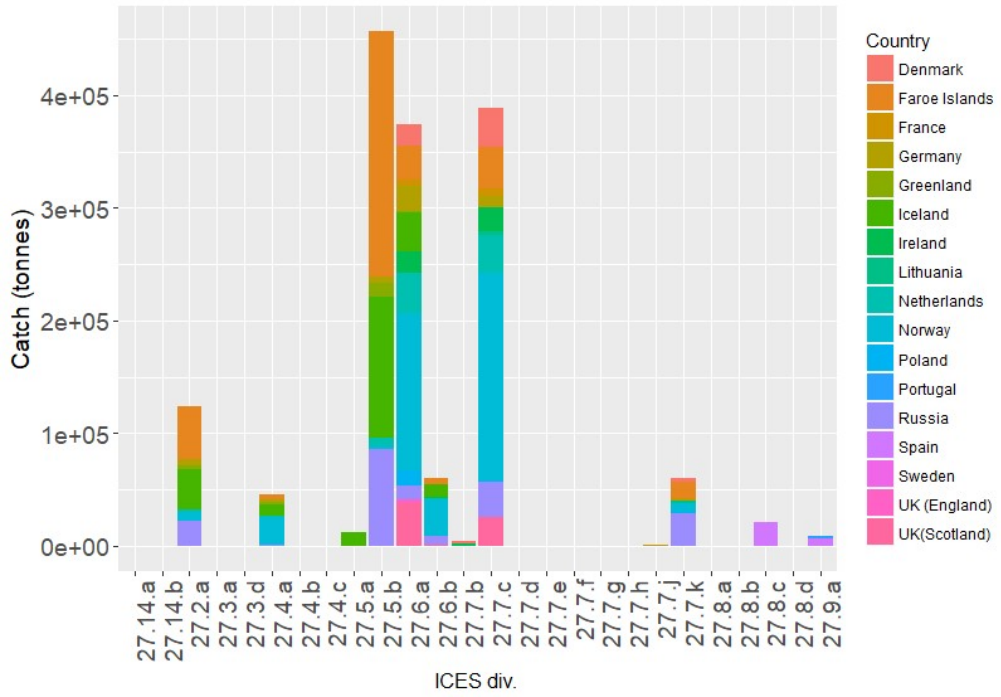
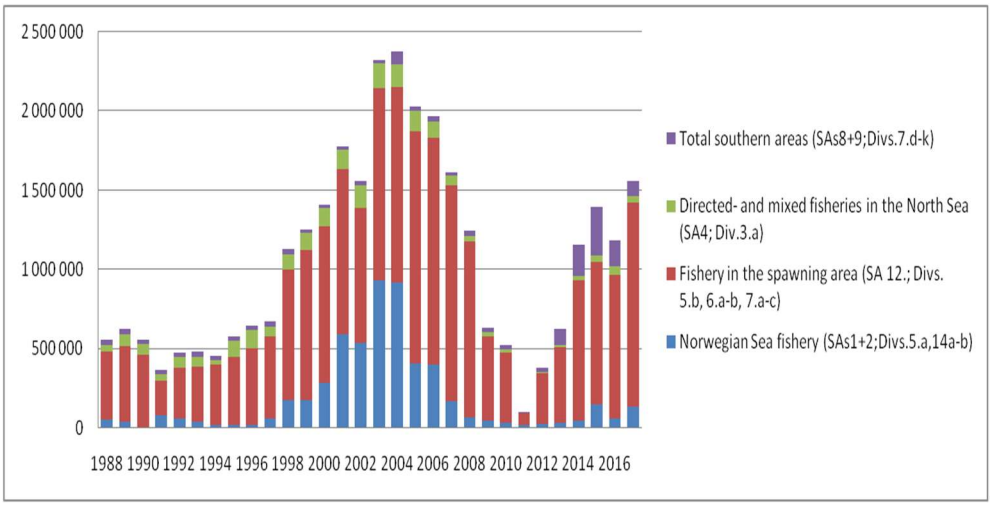


Figure 2.3.1.1. Blue whiting. ICES estimated catches (tonnes) in 2017 by ICES division area and country.

A



B

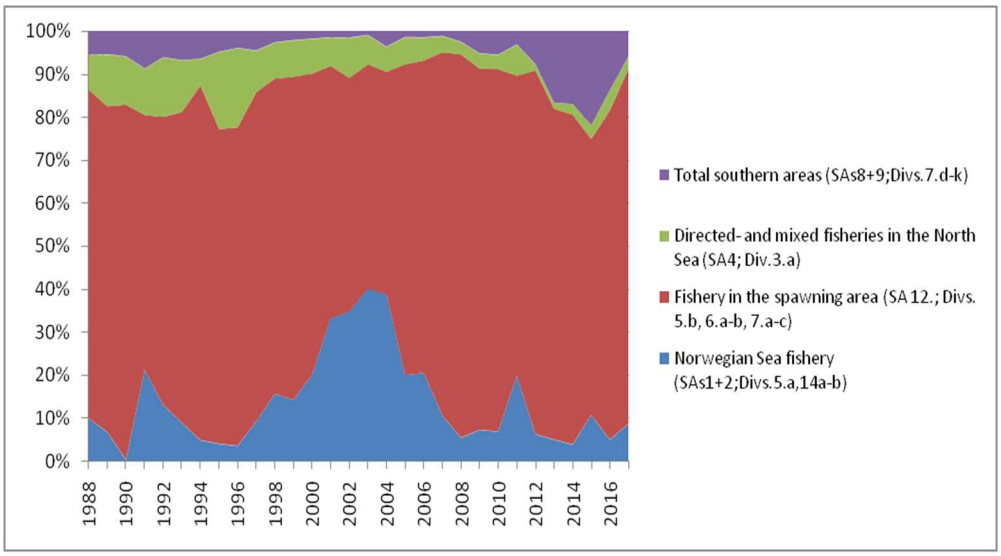


Figure 2.3.1.2. Blue whiting. (A) ICES estimated catches (tonnes) of blue whiting by fishery subareas from 1988-2017 and (B) the percentage contribution to the overall catch by fishery subarea over the same period.

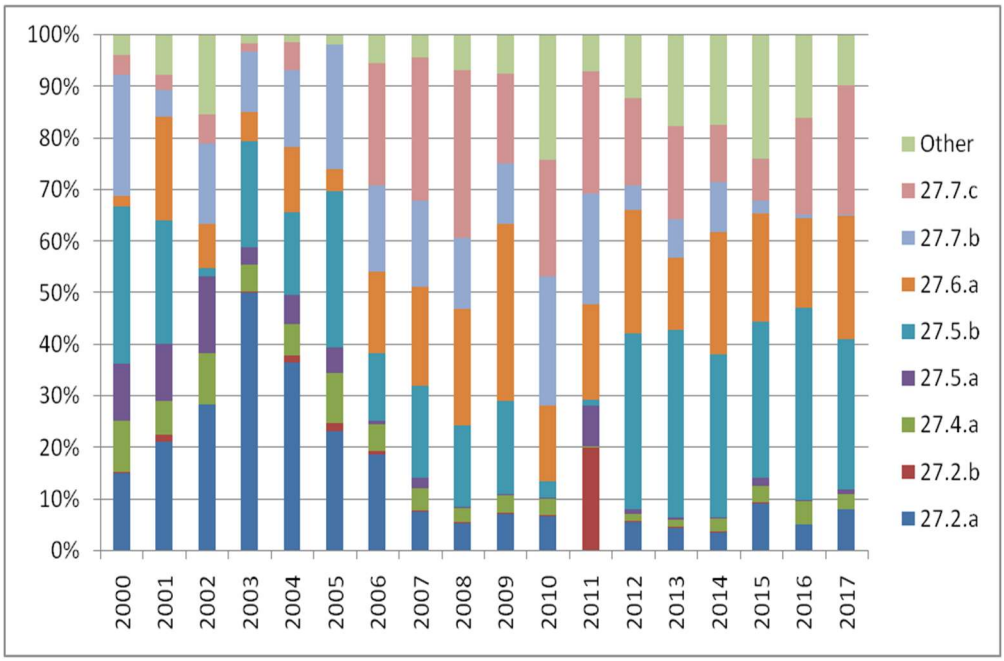


Figure 2.3.1.3. Blue whiting. Distribution of 2017 ICES estimated catches (in percentage) by ICES division area.

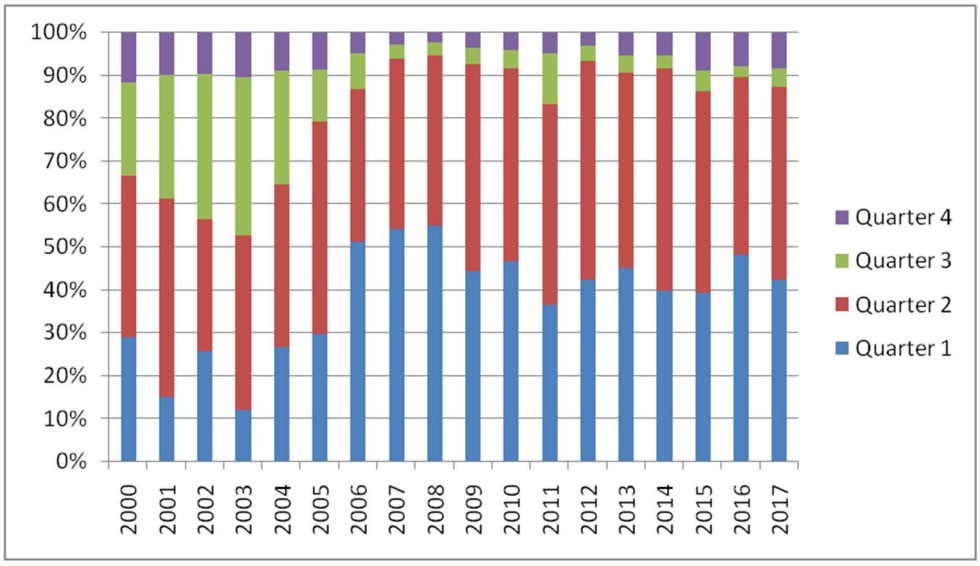


Figure 2.3.1.4. Blue whiting. Distribution of 2017 ICES estimated catches (in percentage) by quarter.

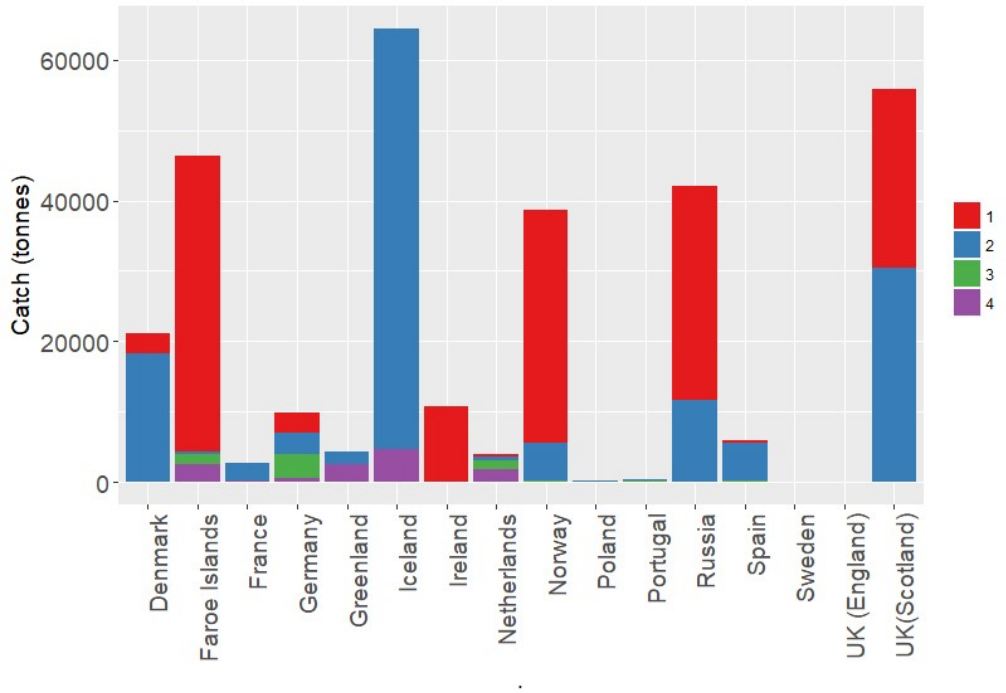


Figure 2.3.1.5. Blue whiting. Distribution of 2017 ICES estimated catches (tonnes) by country and by quarter.

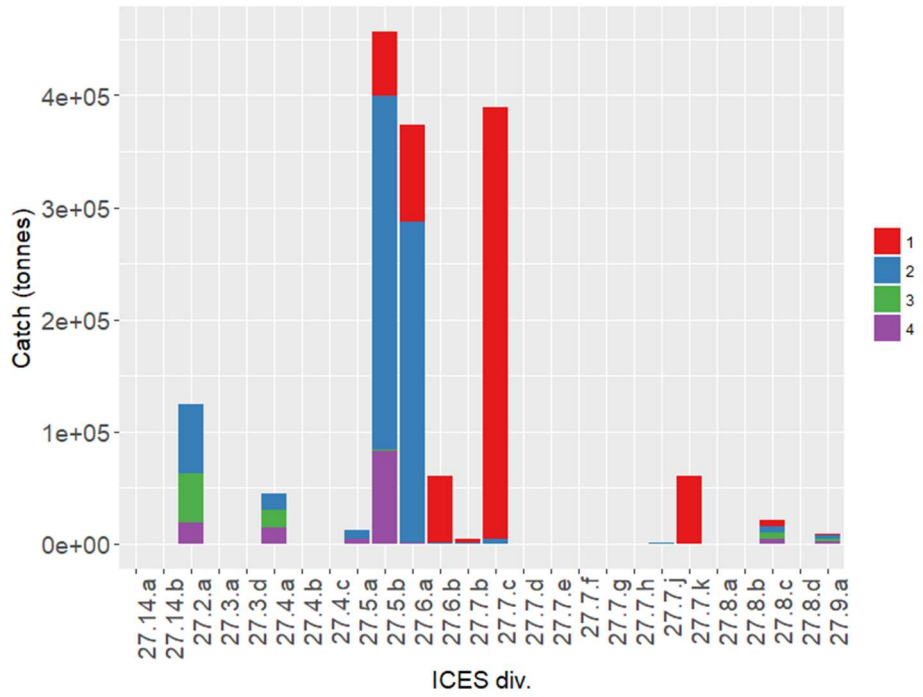


Figure 2.3.1.6. Blue whiting. Distribution of 2017 ICES estimated catches (tonnes) by ICES division area and by quarter.

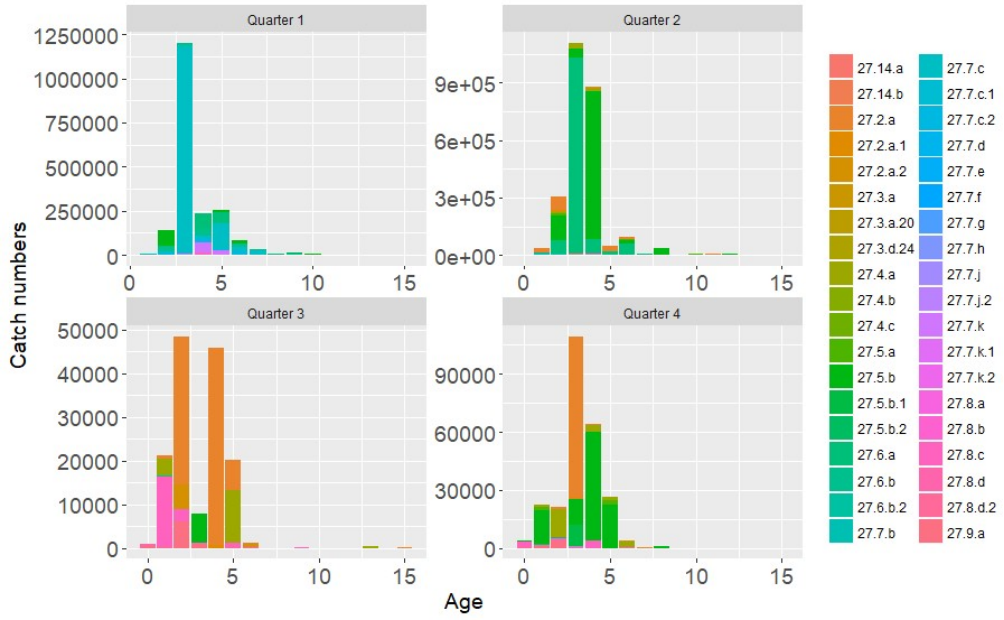


Figure 2.3.1.7. Blue whiting. Catch-at-age numbers (CANUM) distribution by quarter and ICES division area for 2017.

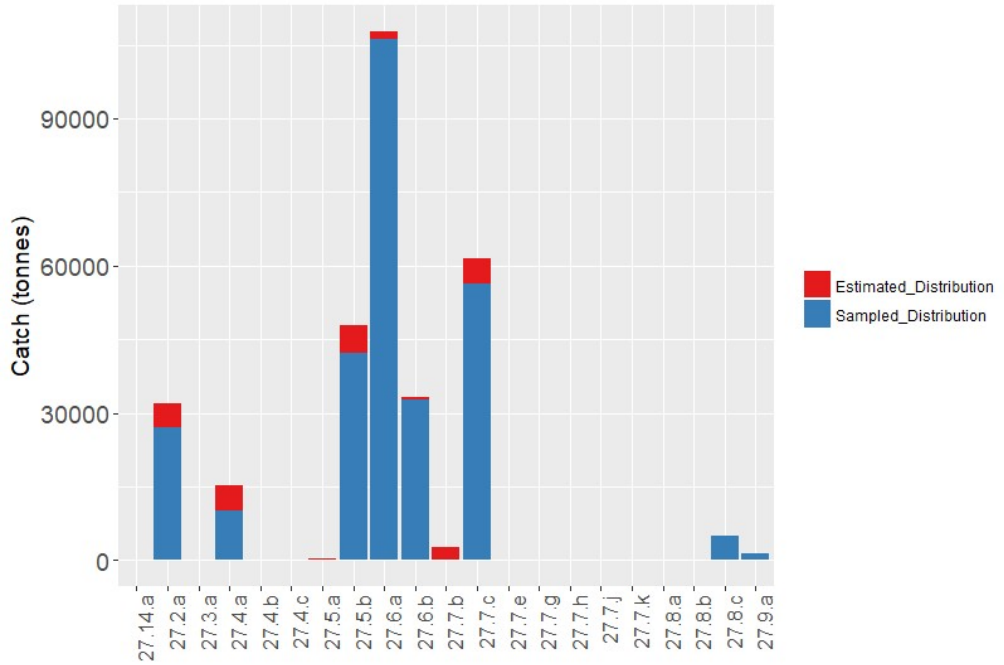
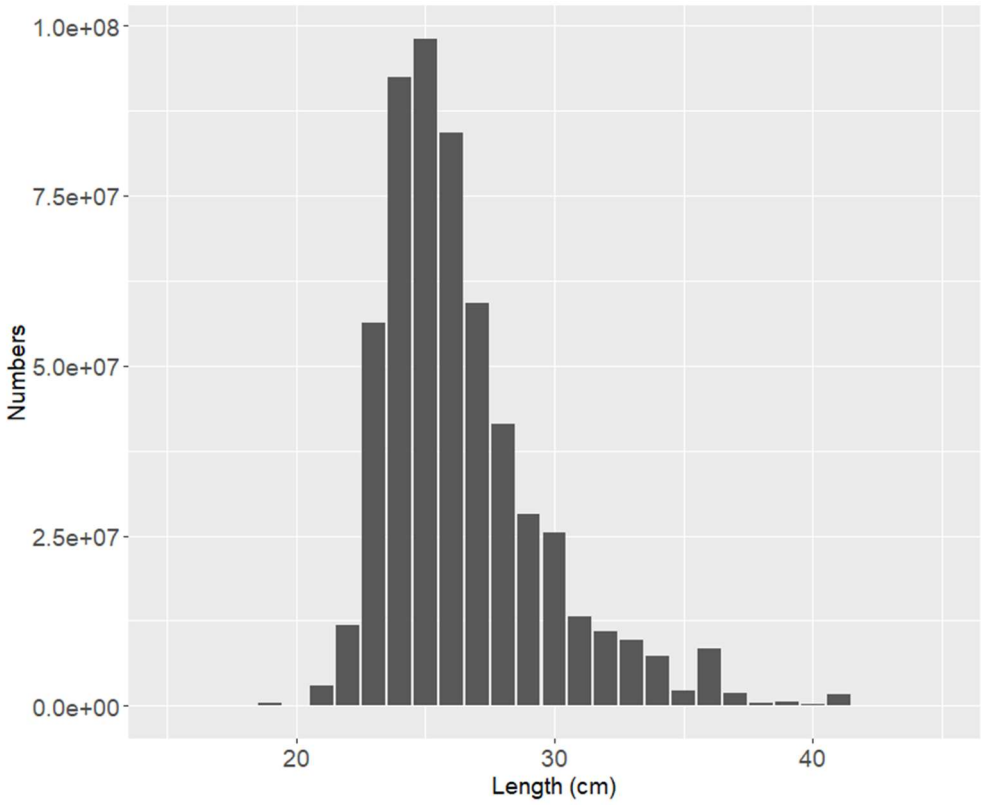


Figure 2.3.1.8. Blue whiting. 2017 ICES catches (tonnes) sampled and estimated by ICES division area.



2.3.1.2.1 .Blue whiting. Length (cm) for 2017 ICES estimated catches (tonnes).This length distribution represents only 67% of the 2017 ICES estimated total catches (tonnes).

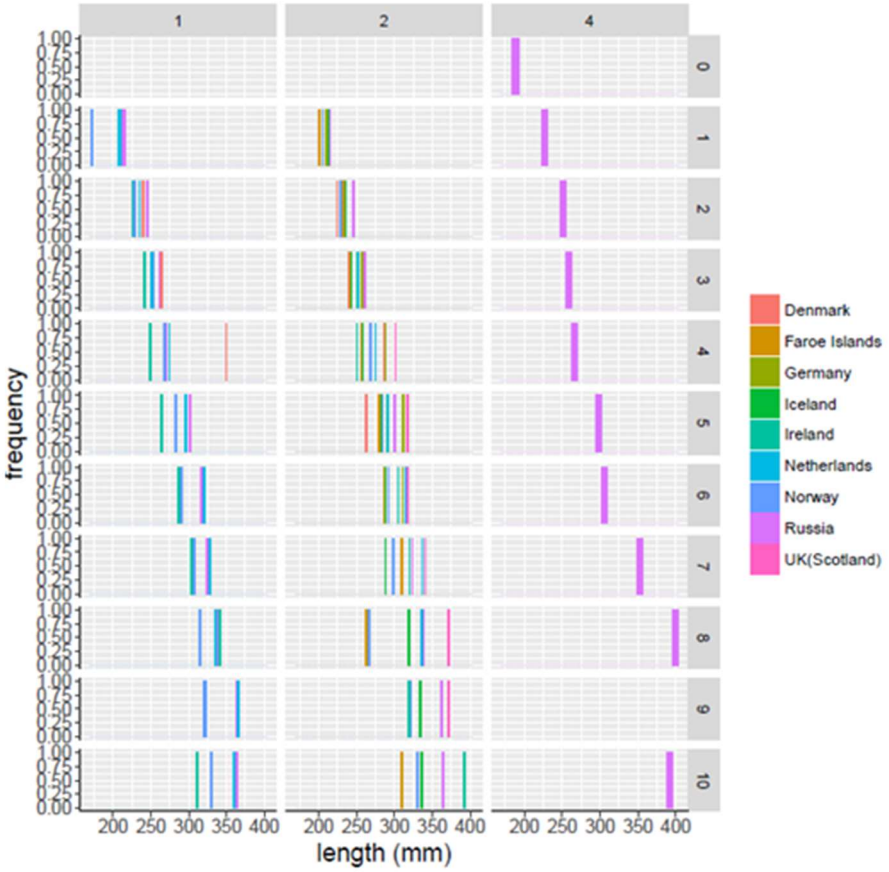


Figure 2.3.1.3.1. Blue whiting. Mean length (mm) by age (0-10 year), by quarter (1,2,4), by country for ICES division area 27.6.a. These data only comprises the 2017 ICES catch-at-age sampled estimates for ICES division area 27.6.a.

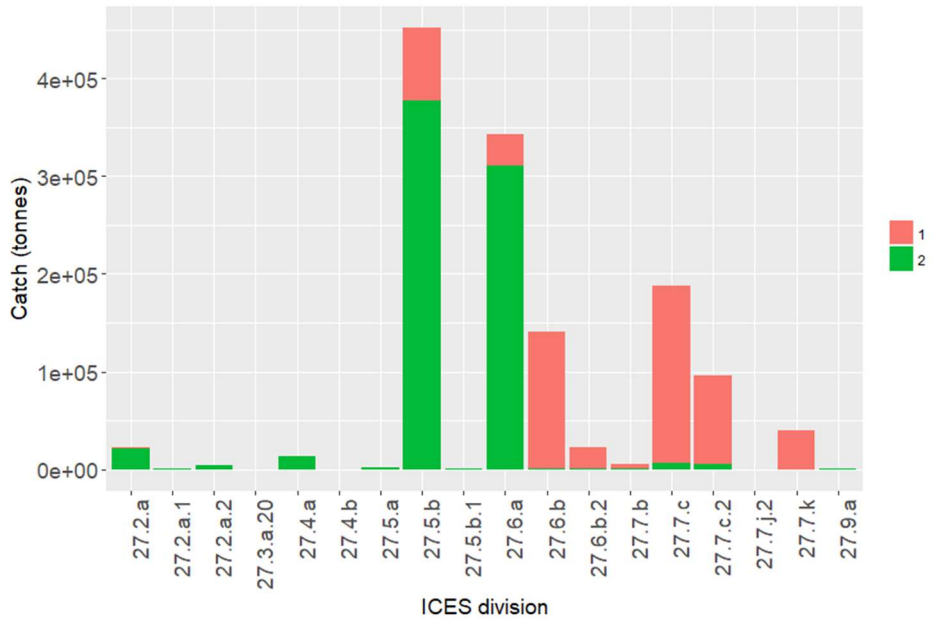


Figure 2.3.2.1. Blue whiting. Distribution of 2018 preliminary catches (tonnes) by ICES division area and quarter.

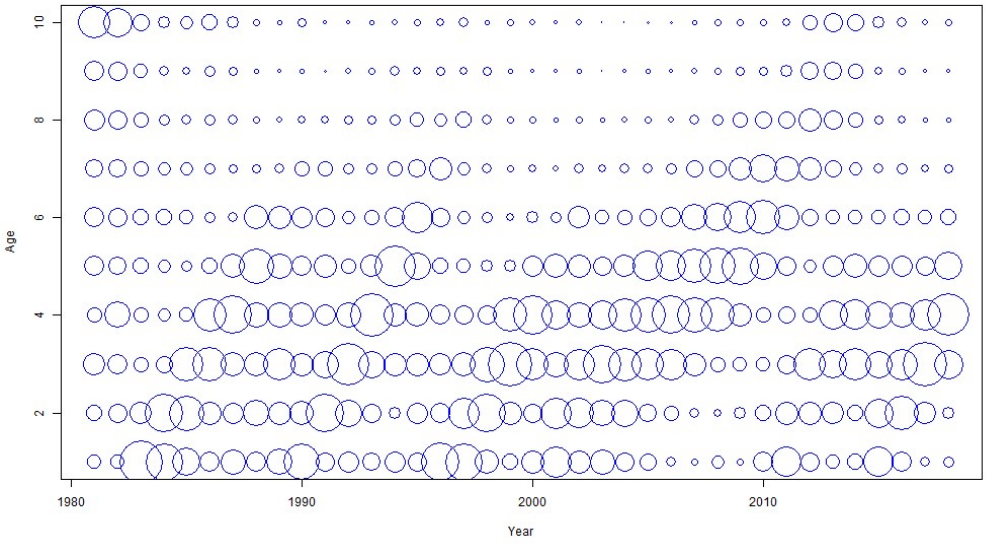


Figure 2.3.3.1. Blue whiting. Catch proportion at age, 1981-2018. Preliminary values for 2018 have been used.

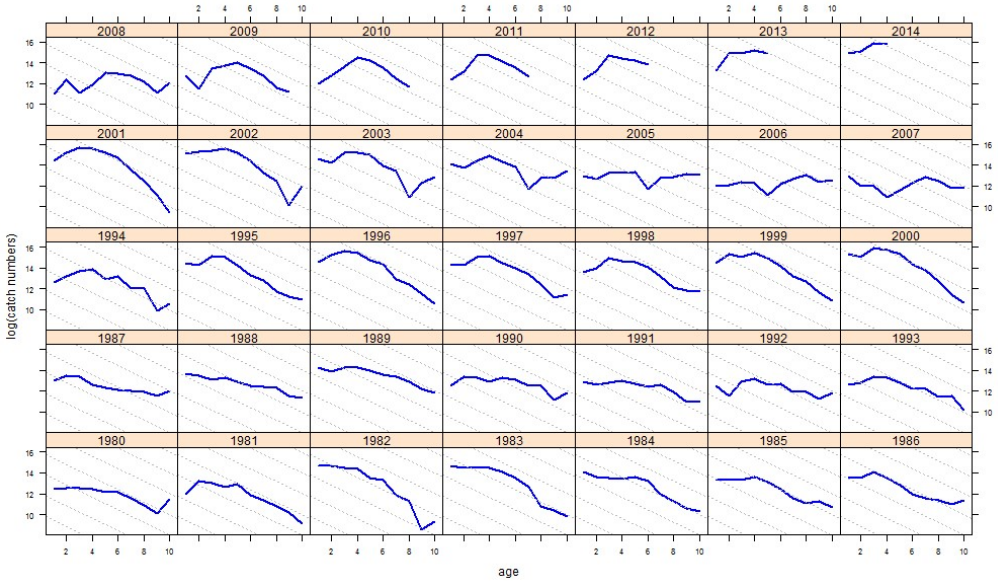


Figure 2.3.3.2. Blue whiting. Age disaggregated catch (numbers) plotted on log scale. The labels for each panel indicate year classes. The grey dotted lines correspond to *Z*=0.6. Preliminary catch-at-age for 2018 have been used.

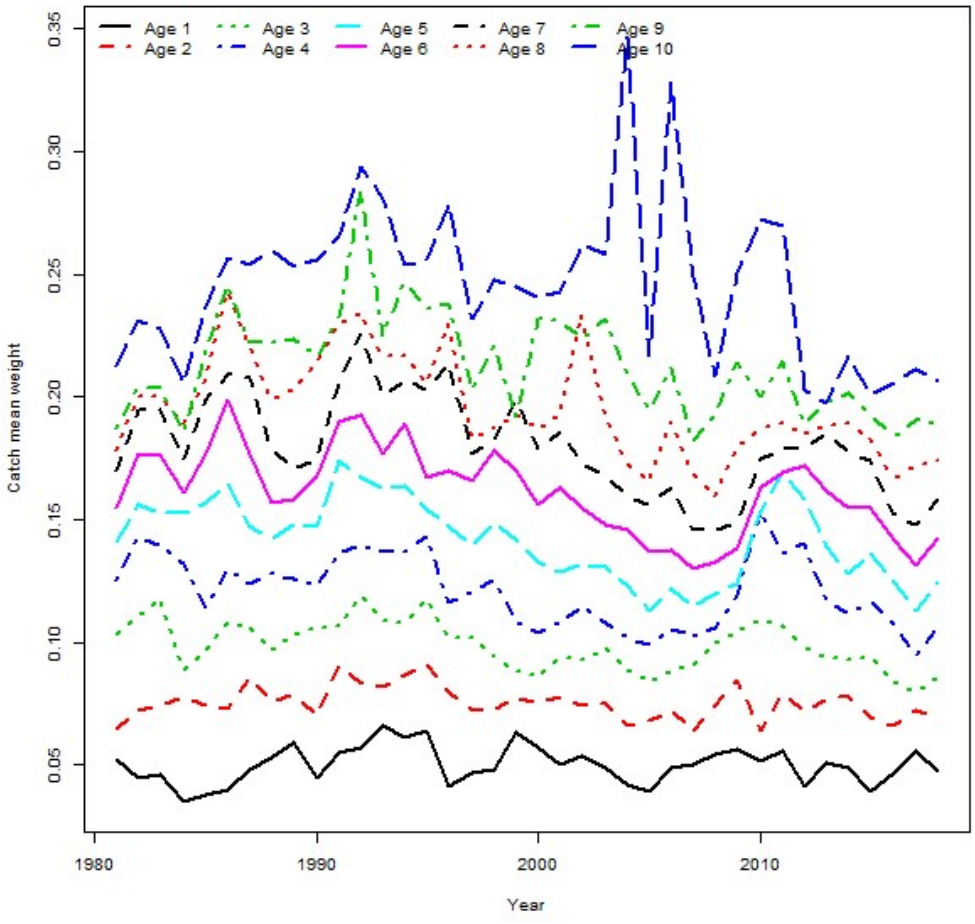


Figure 2.3.4.1. Blue whiting. Mean catch (and stock) weight (kg) at age by year. Preliminary values for 2018 (average of 2015-2017) have been used.

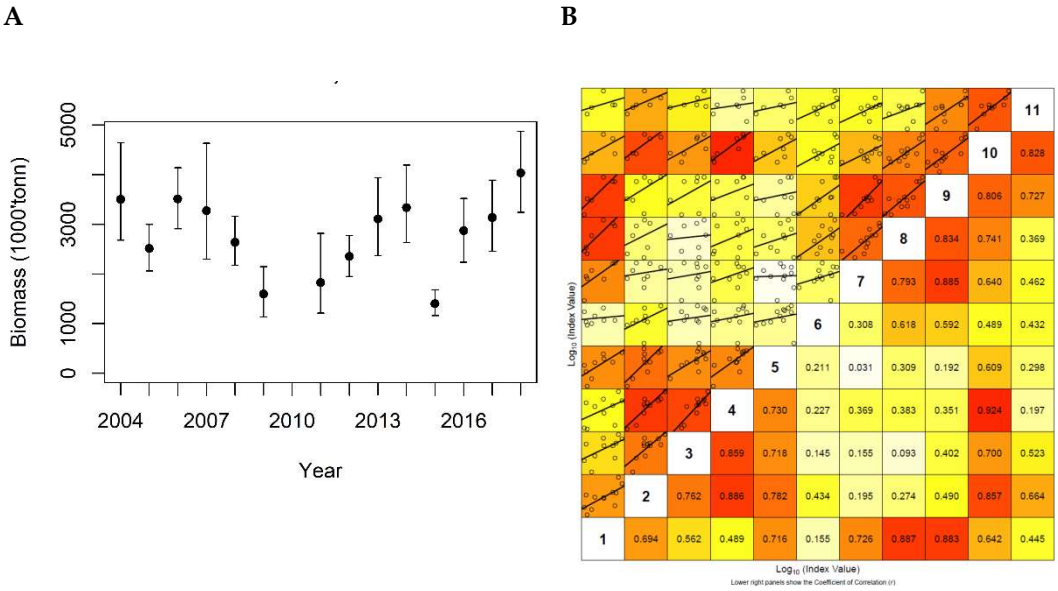


Figure 2.3.7.1.1. Blue whiting. (A) Estimate of total biomass from the International blue whiting spawning stock survey. The black dots and error bands are StoX estimates with 95 % confidence intervals. (B) Internal consistency within the International blue whiting spawning stock survey. The upper left 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.

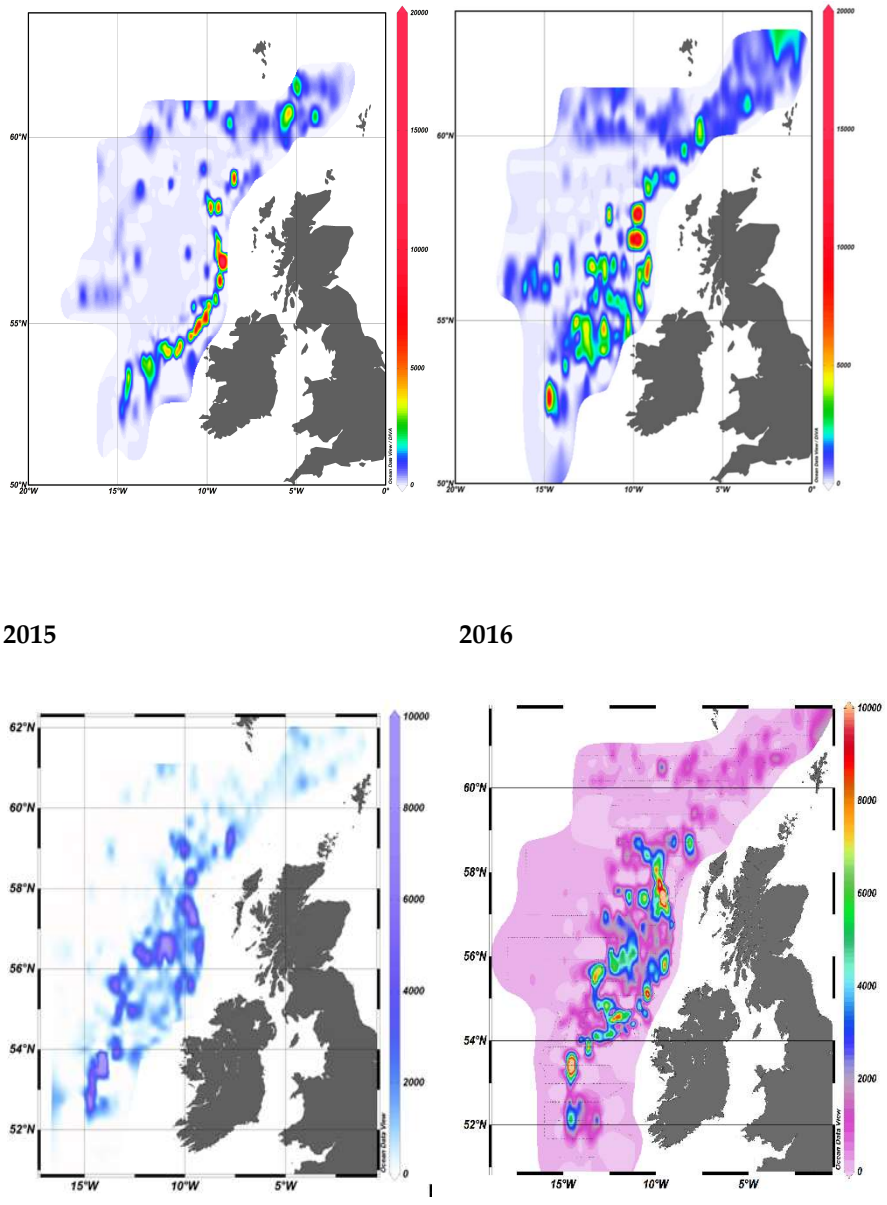


Figure 2.3.7.1.2. Map of blue whiting acoustic density (sA, m2/nm2) found during the spawning survey in spring 2015—2018.

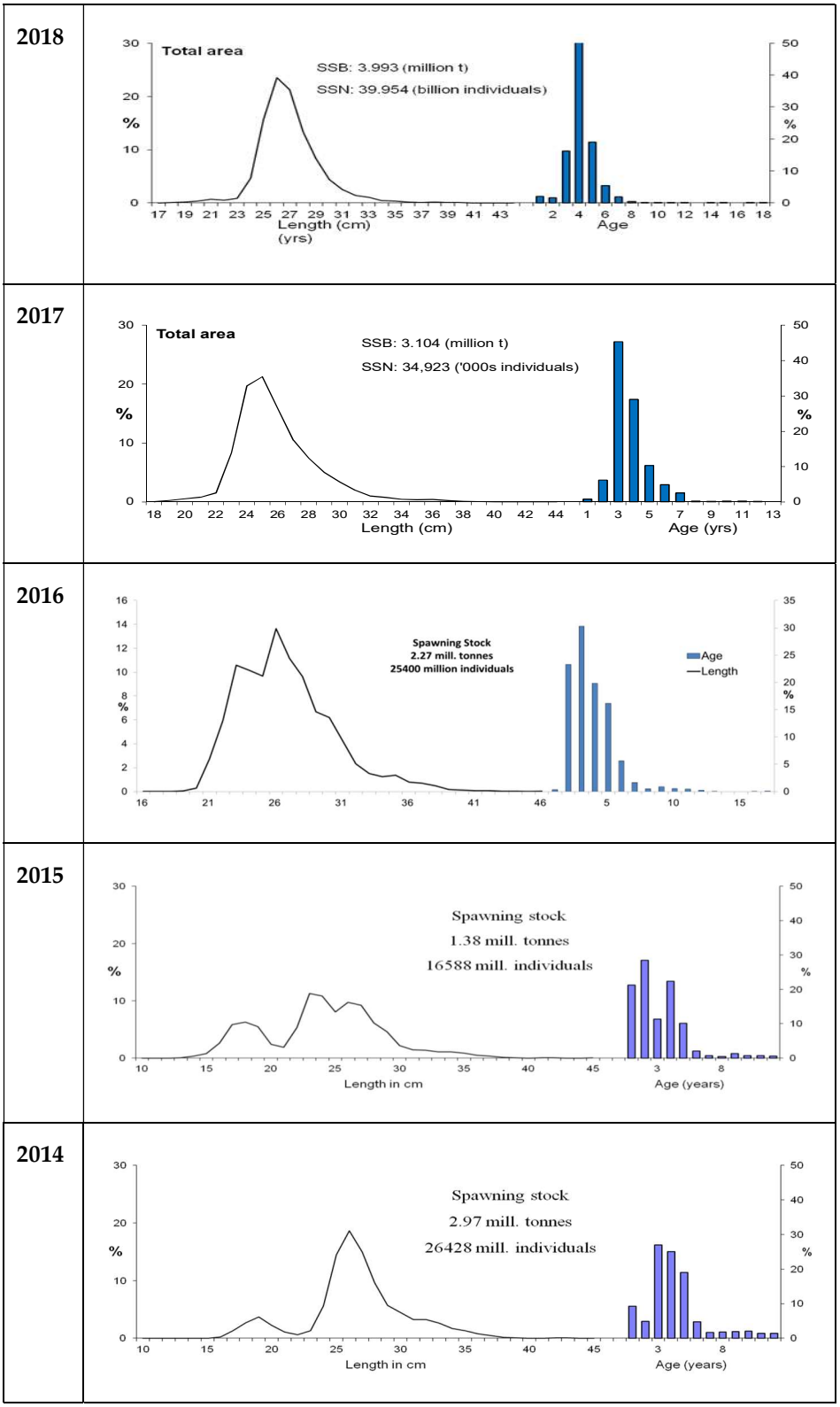


Figure 2.3.7.1.3. Blue whiting. Length (line) and age (bars) distribution of the blue whiting stock in the area to the west of the British Isles, spring 2014 (lower panel) to 2018 (upper panel). Spawning-stock biomass and numbers are given.

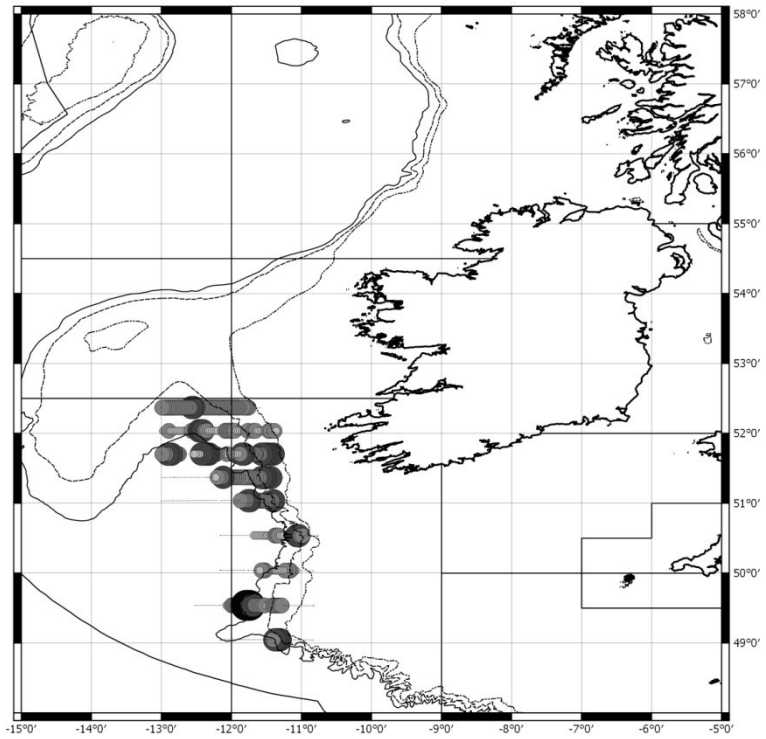


Figure 2.3.7.2..1 Blue whiting spatial distribution according to NASC values allocated to this species during PELACUS-IBWSS 0318.

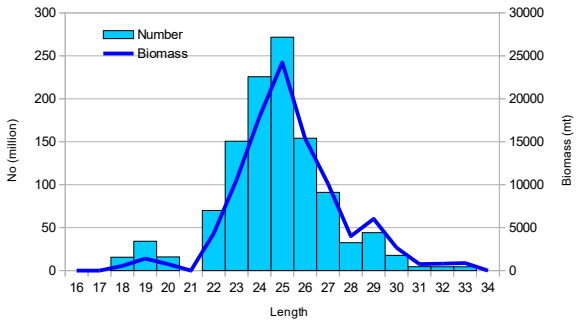


Figure 2.3.7.2.2. Blue whiting length distribution as estimated during PELACUS-IBWSS 0318.

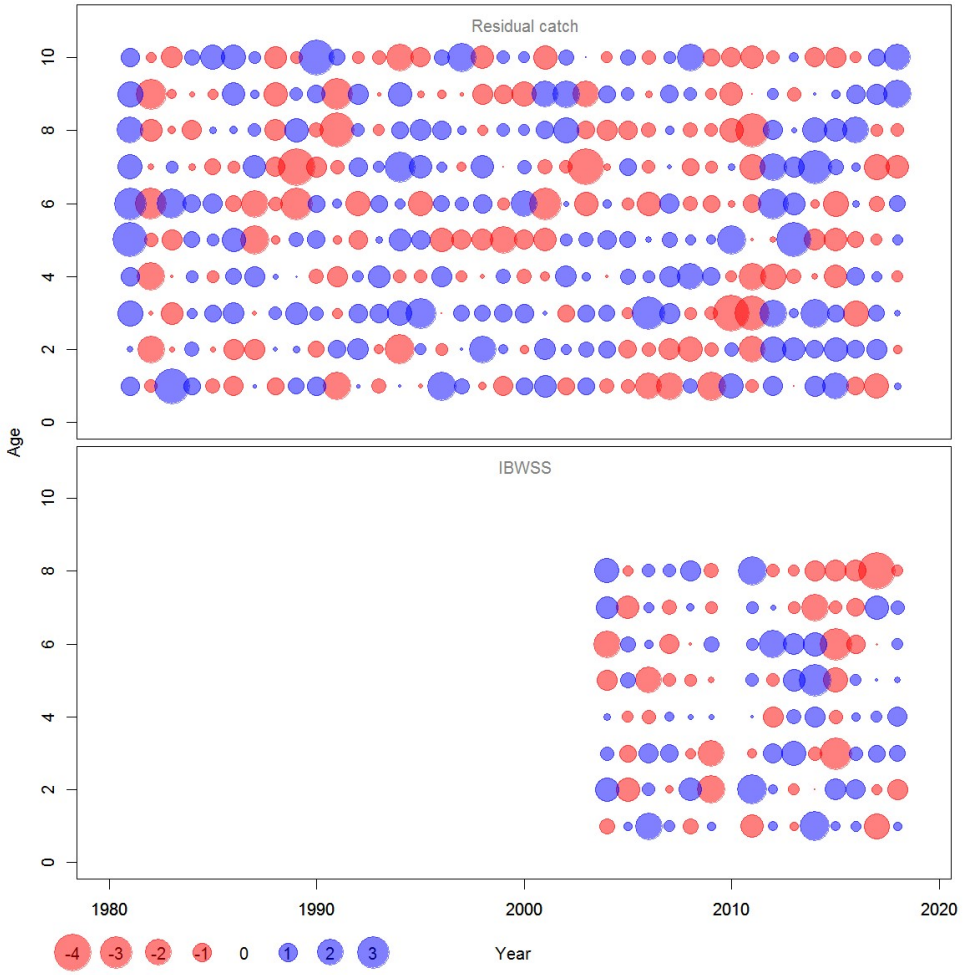


Figure 2.4.1. Blue Whiting. OSA (One Step Ahead) residuals (see Berg and Nielsen, 2016) from catch-at-age and the IBWSS survey. Red (lighter) bubbles show that the observed value is less than the expected value. Preliminary catch data for 2018 have been used.

Figure 2.4.2. 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 2018 have been used.

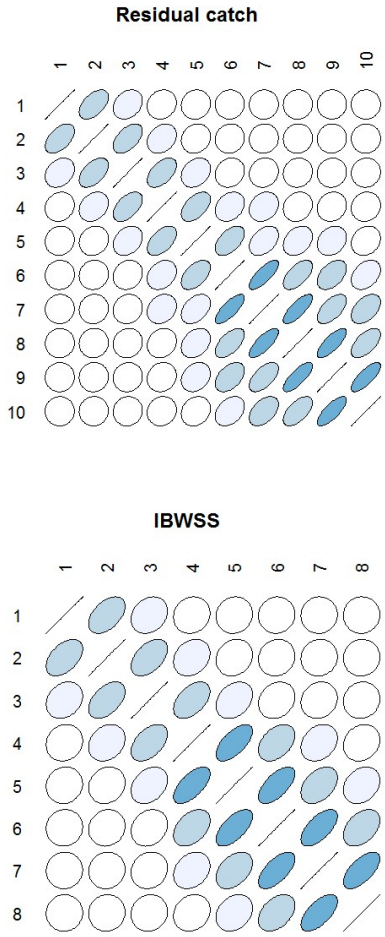


Figure 2.4.3. Blue whiting. The correlation matrix between ages for the catches and survey indices. Each ellipse represents the level curve of a bivariate normal distribution with the corresponding correlation. Hence, the sign of a correlation corresponds to the sign of the slope of the major ellipse axis. Increasingly darker shading is used for increasingly larger absolute correlations, while uncorrelated pairs of ages are depicted as circles with no shading.

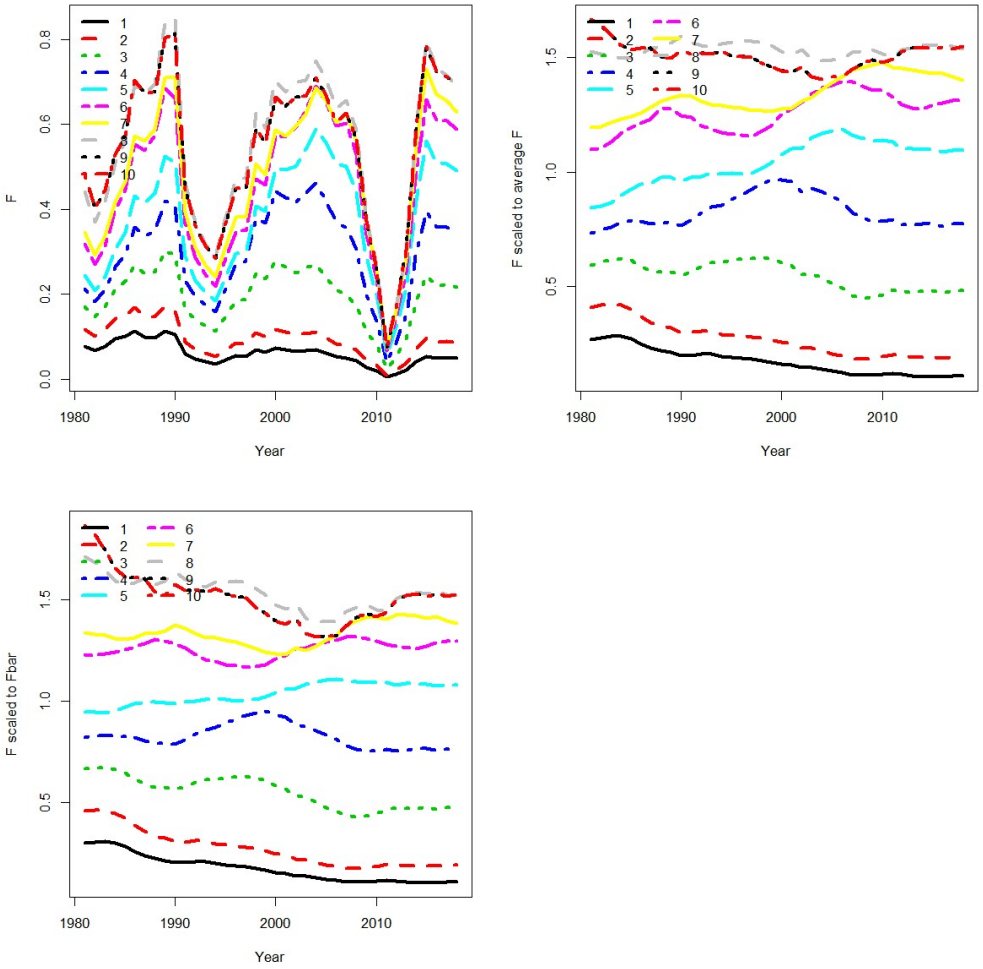


Figure 2.4.4. Blue whiting. F at age and exploitation pattern (F scaled to mean F all ages, and F scaled to mean F ages 3-7). Values for 2018 are preliminary.

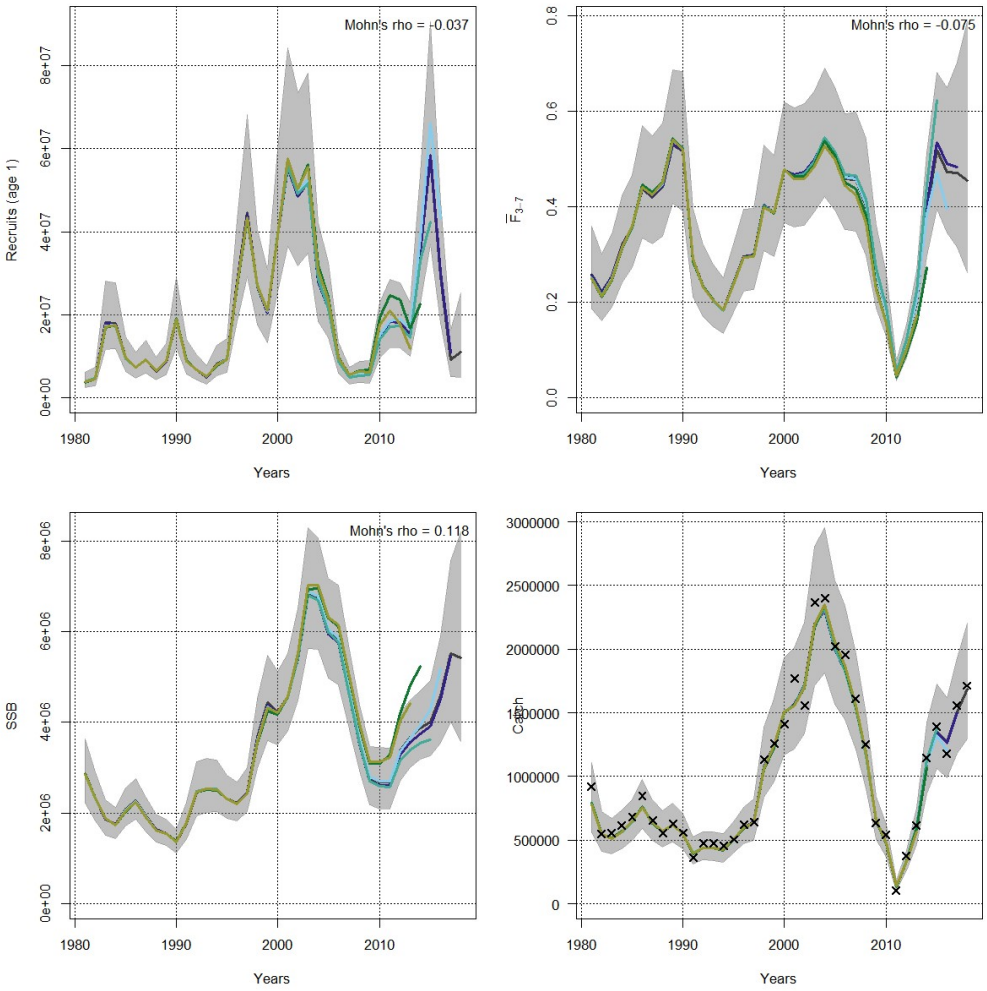


Figure 2.4.5. Blue whiting. Retrospective analysis of recruitment (age 1), SSB (tonnes), F and total catch using the SAM model. The 95% confidence interval is shown for the most recent assessment.

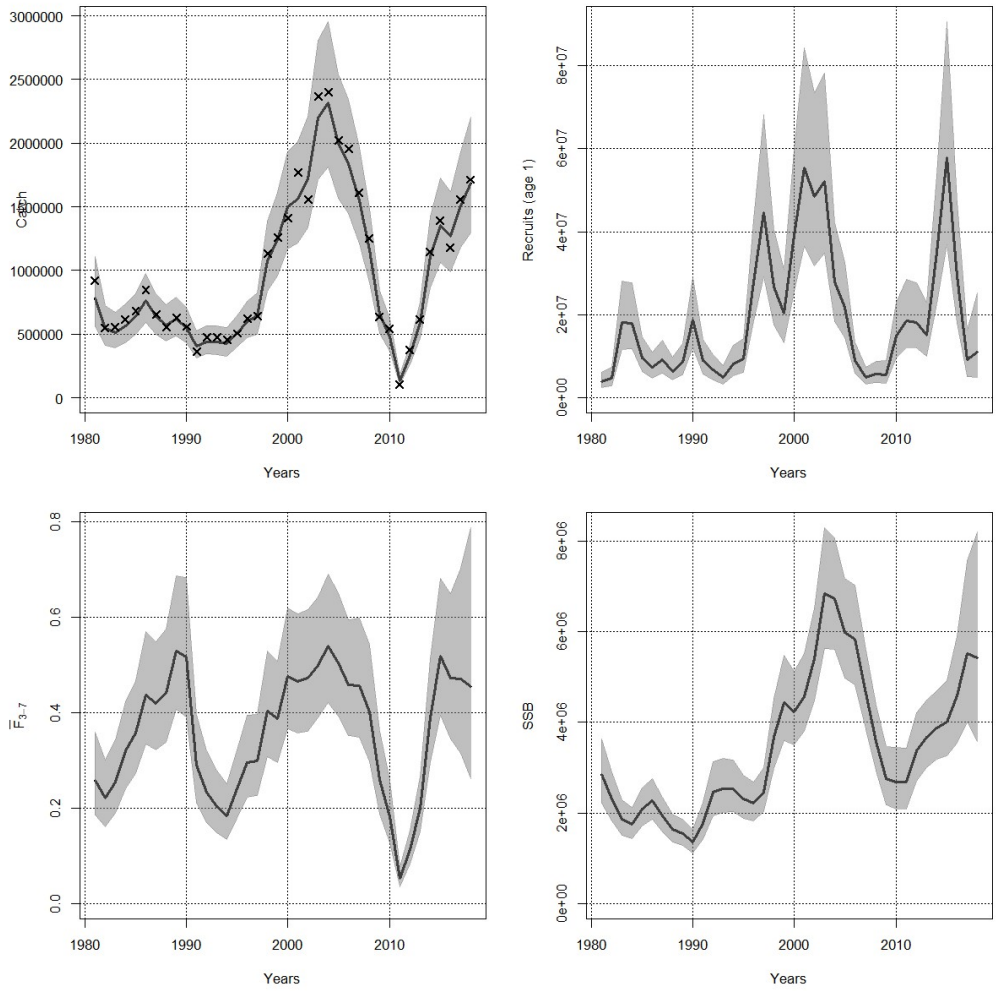


Figure 2.4.6.Blue whiting. SAM final run: Stock summary, total catches (tonnes), recruitment (age 1), F and SSB (tonnes). The graphs show the median value and the 95% confidence interval. The catch plot does also include the observed catches (x). Catches for 2018 are preliminary.

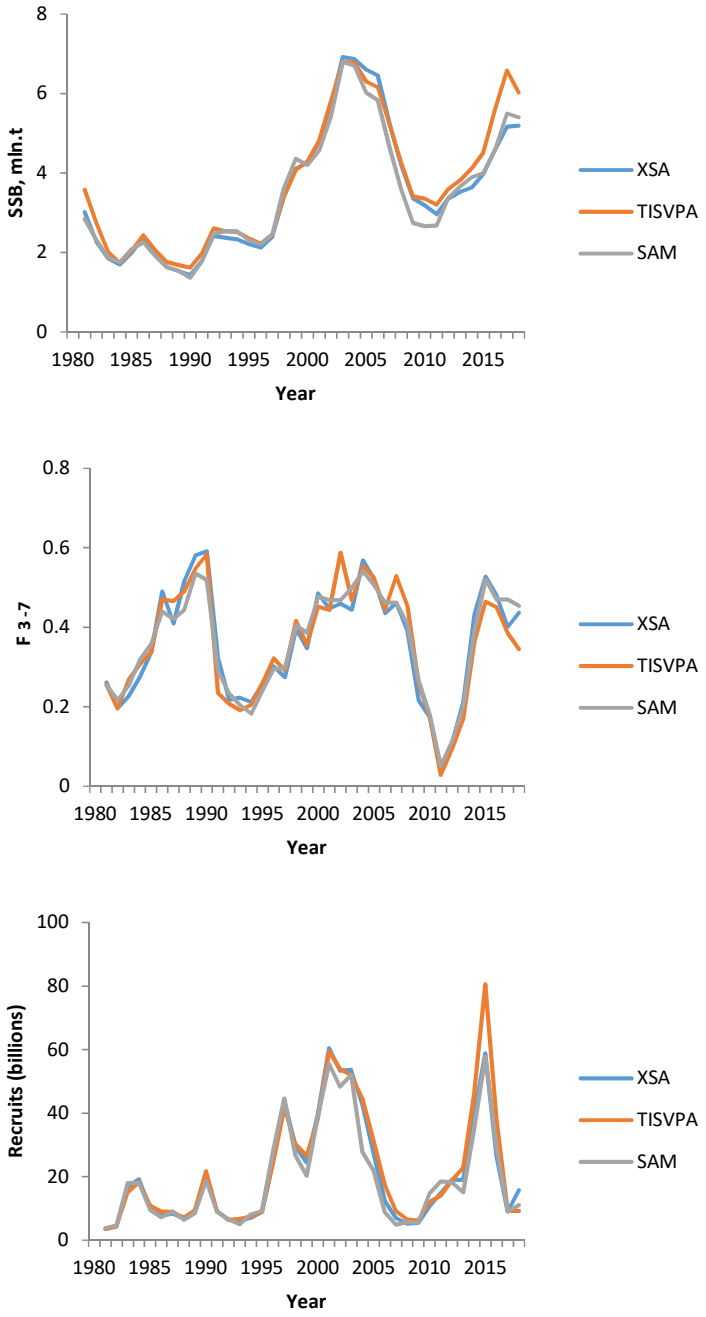


Figure 2.4.1.1. Blue whiting. Comparison of SSB, F and recruitment estimated by the assessment programs XSA, TISVPA and SAM. Catch values for 2018 are preliminary.

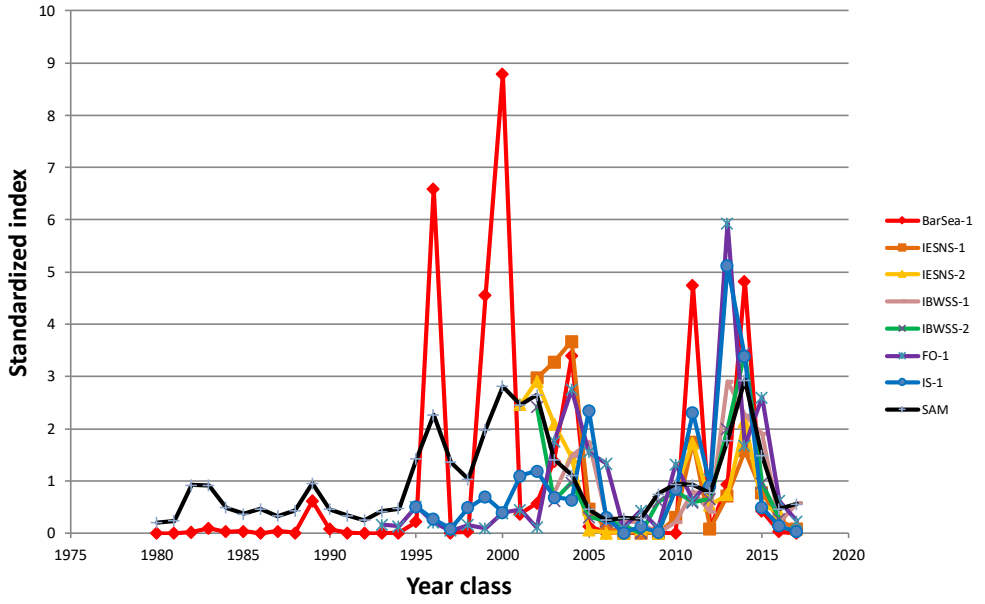


Figure 2.8.1.1. Blue whiting young fish indices from five different surveys and recruitment index from the assessment, standardized by dividing each series by their mean. BarSea - Norwegian bottom-trawl survey in the Barents Sea, IESNS: International Ecosystem Survey in the Nordic Seas in May (1 and 2 is the age groups), IBWSS: 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.

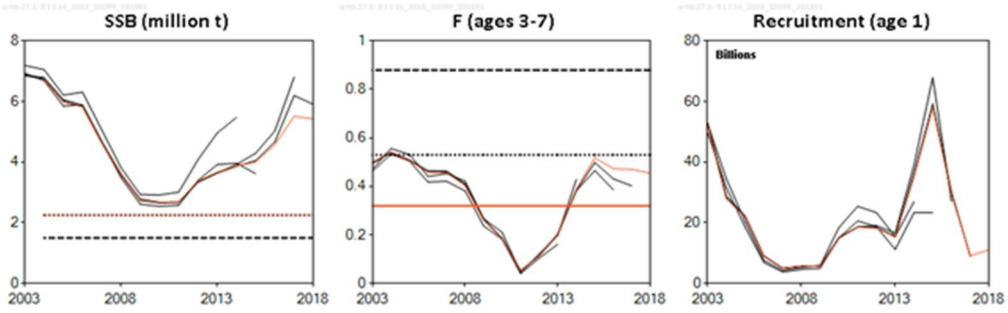


Figure 2.9.1. Blue whiting. Comparison of the 2010 - 2018 assessments.