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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 2016

ICES notes that F has increased from a historical low in 2011 to above F_{MSY} since 2014. Spawning-stock biomass (SSB) increased since 2010 and is above MSY $B_{trigger}$. Recent recruitments are estimated above average, but with a high uncertainty.

ICES advised that when the MSY approach is applied, catches in 2017 should be no more than 1 342 330 tonnes.

2.2 The fishery in 2016

The total catch in 2016 was 1183 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 multi-national 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. Fourteen countries reported blue whiting landings in 2016.

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 2017 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 2016 data as reported to ICES and a section including a brief description of the 2017 preliminary catch data.

2.3.1 Officially reported catch data

Official catches in 2016 were estimated to 1 183 187 tonnes based on data provided WGWIDE members. Data provided as catch by rectangle represented more than 99% of the total WG catch in 2016. Total catch by country for the period 1988 to 2016 is presented in Table 2.3.1.1 and in Figure 2.3.1.1 and 2.3.1.5.

After a minimum of 104 000 tonnes in 2011, catches peaked in 2015 (1396244 tonnes) and were 1 183 187 tonnes in 2016 (Figure 2.3.1.2.A).The spatial and temporal distribution in 2016 (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 2016 catches have largest contribution from ICES area 27.5.b, 27.5.b.2, 27.7c and 27.7.k (Figure 2.3.1.1, Figure 2.3.1.2, 2.3.1.3 and 2.3.1.6 and Table 2.3.1.3). The temporal allocation of catches has been relatively stable in recent years (Figure 2.3.1.3,) however with a small decrease of the proportion of catches from the second quarter that was also observed in 2015. 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). The proportion of catches originating from the Northern areas has been decreasing steadily over the recent period. From 2014 to 2016, the decrease was 5%.

Discards of blue whiting are small. Most of the blue whiting caught in directed fisheries are used for reduction to fish meal and fish oil. However, some discarding occurs in the fisheries for human consumption and as by-catch 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 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 2016, discards were 40% of the total catches for blue whiting in the Portuguese coast (Table 2.3.1.1.1). 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 by-catch 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 10% (in weight) in 2016 (Table 2.3.1.1.1). Spanish catches are around 3% 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 0.4% of the total catches, 4 822 tonnes. BMS landings were provided by Netherlands (185 tonnes). Discards and BMS landings were included in this year's assessment.

The total estimated catches (tonnes) inside and outside the NEAFC area by country were reported on Table 2.3.1.5. Due to some missing values it is not possible to determine the percentage of catches taken inside the NEAFC area.

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 2.3.1.2.3 and are presented and described by year, country and area (Table 2.3.1.2.1, Table 2.3.1.2.2 and Table 2.3.1.2.4). In total 1092 samples were collected from the fisheries in 2016, 120 329 fish were measured and 13 793 were aged. The percentage of catches covered by the sampling program was 89% in 2016. The most intensive sampling took place in the area 27.2.a.1 and 27.9.a. No sampling was carried out by Lithuania, Sweden and the UK (England, Wales, Northern Ireland) representing together 0.21% of the total catches. The sampled and estimated catch-at-age data is shown on Figure 2.3.1.8.

The age-length key for the sampled catches on ICES area 27.6.a is presented by quarter and country (Figure 2.3.1.9). The mean length (mm) by age reveals that age classifications present some differences between countries, an underestimation or overestimation could be observed. This could be due to age misinterpretation between countries.

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

2.3.1.2 Age compositions

The Inter Catch program was used to calculate the total international catch-at-age, and to document how it was done. The catch numbers-at-age used in the stock assessment are given in Table 2.3.3.1.

2.3.1.3 Length compositions

The length distribution of the catches was provided for some of the areas sampled, the length distribution in percentage on those areas by quarter is presented in Figure 2.3.1.7. But those catch-at-length numbers were not used on the assessment.

2.3.2 Preliminary 2017 catch data (Quarters 1 and 2)

The preliminary landings in 2017, for quarters 1 and 2, were estimated to 1 201 496 tonnes based on data provided WGWIDE members.

The spatial distribution of these 2017 preliminary landings is similar to the distribution in 2016. The majority of landings are coming from the areas 27.5.b, 27.6.a, 27.7.c and 27.7.k (Figure 2.3.2.1 and Table 2.3.2.1).

Sampling intensity for blue whiting from the preliminary landings 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 percentage of preliminary landings (quarter 1 + quarter 2) covered by the sampling program was around 42% (Figure 2.3.2.2 and Table 2.3.2.2). The preliminary catches for 2017, quarters 1 and 2, were reported by the member states. The sampling summary of the blue whiting catching areas is shown in the Table 2.3.2.2. No sampling was carried out in 27.2.a.2, 27.4.a, 27.4.b, 27.5.a, 27.6.b, 27.6.b.2, 27.57.b, 27.7.j representing together 6.3% of the total preliminary landings.

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 Benchmark approach will give an annual catch weight which might be different from the “best available estimate” however the benchmark method has no assumptions of the final catch for the year. The WGWIDE concluded to use the method suggested by the ADG based on the observation that the differences for the two methods were small for the 2016 data, and the ADG method is easier to communicate to the public.

WGWIDE estimated the expected “final” catch for 2017 from the sum of declared national quotas, corrected for expected national uptake of these quotas (Table 2.3.2.1.2).

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 more evenly distributed with main catch numbers from the younger ages.

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 2003 and onwards show a more flat curve compared to previous year classes indicating a lower F or changed exploitation pattern.

2.3.4 Weight at age

Table 2.3.4.1 and Figure 2.3.4.1 show the mean weight-at-age for the total catch during 1983—2017 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 most recent years.

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 2017 is available as a working document to this report. The survey group considers that the 2017 estimate of abundance as robust.

The survey time series (2004-2017) have been updated and the 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 2016.

The abundance estimate of blue whiting for IBWSS are presented in Table 2.3.7.1.1. In comparison to the results in 2016, there is a slight increase in the observed stock biomass (+9%) and in stock numbers (+2%).

The stock biomass within the survey area was dominated by 3, 4, 5 year old fish, contributing over 80% of total stock biomass. The age structure of the 2017 estimate is consistent with the age structure from the 2016 estimate.

Length and age distributions for the period 2013 to 2017 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 by-catch 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 19 cm (Table 2.3.7.2.2).

Icelandic bottom trawl surveys on the shelf and slope area around Iceland. Blue whiting is caught as by-catch species and 1-group is defined as greater than 15 cm and less than 22 cm in March (Table 2.3.7.2.3).

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

The International Survey in Nordic Seas and adjacent waters in July-August (IESSNS). Blue whiting are from 2016 included as a main target species in this survey and methods are changed to sample blue whiting. This was a recommendation from WGWIDE 2015 to try to have one more time series for blue whiting. The time series is presently too short for assessment purposes.

2.4 Stock assessment

2.4.1 SAM model

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, 2016a).

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

The estimated parameters from the SAM model from this year's assessment and from previous years (retrospective analysis) are shown in Table 2.4.2.1. There are only a very few abrupt changes in the estimated parameters over the time series presented. The increase in process error for age 1 in the 2017 run is probably a reflection of the low 2017 recruitment. Observation noise for age 7-8 in the IBWSS increases in the 2017 model, which can also be seen in Figure 2.4.2.1 (lower panel) where age 8 in 2017 shows a very large negative residual. The lowest observation noise and thereby the largest influence on the stock assessment is from catches, age 3-8, which also contribute most to the international catches.

The process error residuals ("Joint sample residuals") (Figure 2.4.2.2) are reasonable randomly distributed.

The correlation matrix between ages for the catches and survey indices (Figure 2.4.2.3) show a modest observation correlation for the younger ages and stronger correlation for the older ages. The same is seen for survey observation.

Figure 2.4.2.4 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 2017, 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 = 0.93, 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 2.4.2.5) 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 2 years.

Stock summary results with added 95% confidence limits (Figure 2.4.2.6 and Table 2.4.2.4) show a decrease in fishing mortality in the period 2004—2011, followed by a steep increase in F up to 2015 and a lower F in 2016-2017. Recruitment increased from low recruitments in 2006–2009 to a historically high recruitment in 2015, followed by a lower recruitment in 2016 and a very low recruitment in 2017. SSB has increased since 2010, however a small decrease is estimated in the forecasted SSB in 2018.

2.4.2 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 2.4.3.1). For the most recent years, the SAM results seem to be within the values estimated by the XSA and TISVPA.

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—2017, with catch data up to 2016 and preliminary catch data for the first semester of 2017 raised to expected annual catches, and survey data from March-April, 2004–2017. SSB 1st January in 2017 is estimated from survivors and estimated recruits (for 2018 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 2.4.2.2–2.4.2.3 and summarized in Table 2.4.2.4 and Figure 2.4.2.6. Residuals of the model fit are shown in Figures 2.4.2.1–2.4.2.2.

2.6 State of the Stock

F has increased from a historic low at 0.051 in 2011 to 0.598 in 2015 followed by a decrease in F to 0.402 in 2017. F has been above F_{MSY} (0.32) since 2014. SSB increased from 2010 (2.6 million tonnes) to 2018 (5.9 million tonnes), which is above B_{pa} (2.25 million tonnes).

The uncertainty around the recruitment in the most recent year is high. Recruitment (age 1 fish) in 2006—2009 are in the very low end of the historical recruitments, but recruitment since 2010 are estimated much higher, except for recruitment in 2017, which is 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 2016, WKBWMSE concluded to keepB_{lim} and B_{pa} unchanged but revised F_{lim}, F_{pa}, and F_{MSY} (See Table below)

The table below summaries the WKBWMSE results and the presently 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)

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 (2016 year class) and 2-group (2015 year class) indices from the survey in 2017 were below the middle 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 (2016 year class) index from the survey in 2017 was the lowest observed in the time series. The 2-group in 2017 (2015 year class) was above the middle of the historic range.

The Norwegian bottom trawl survey in the Barents Sea (BS-NoRu-Q1(Btr)) in February-March 2017, showed that 1-group blue whiting was more or less 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 2017 (2016 year class) from the Icelandic bottom trawl survey showed a decrease compared to 2016 and was in the low end in the time series.

The 1-group estimate in 2017 (2016 year class) from the Faroese Plateau spring bottom trawl survey was lower than in 2016 and around the middle of the time series.

In conclusion, the indices from available survey time series indicate that the 2015 year class is rather large, which corresponds to the SAM assessment results. The 2016 year classes estimated from surveys are in the really low end, which also is the result of the SAM assessment. It was therefore decided not to change the SAM estimate of the 2015 and 2016 year classes.

No information is available for the 2017 and 2018 year classes and the geometric mean of the full time series (1981—2016) was used for these year classes (14.8 billion at age 1 in 2018) (Table 2.8.2.1.1).

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 2.8.2.1.1 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 (2014—2016). The 2017 mean weights in the assessment are a three years average (2014—2016). 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 2016 and 2017 are assumed as estimated by the SAM model, as additional survey information was not conflicting this result. The recruitment in 2018 and 2019 are assumed at the long term average (geometric mean for the full time series, minus the last year (1981-2016).

As the assessment uses preliminary catches for 2017 an estimate of stock size exist for the 1 January 2018. The normal use of an "intermediate year"calculation is not relevant anymore. F in the "intermediate year" (2017) is as calculated by the assessment model. Catches in 2017 is the (model input) preliminary catches " (1559400 tonnes) which differs slightly from the model estimate of catch weight (1515097 tonnes). Intermediate year assumptions are summarised in Table 2.8.2.1.2

2.8.2.2 Output

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

Following the ICES MSY framework implies fishing mortality to be at $F_{MSY} = 0.32$ which will give a TAC in 2018 at 1 3878 872 tonnes (11% decrease compared to the ICES estimate of catches in 2017). SSB is predicted to decrease by 12 %.

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 2017, show consistent results.

2.10 Quality considerations

Based on the confidence interval produced by the assessment model SAM there is a moderate to high uncertainty of the absolute estimate of F and SSB and the recruiting year classes (Figure 2.4.2.6). The retrospective analysis (Figure 2.4.2.5), 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 two years (with inclusion of preliminary catch data)

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.

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 catch advices for 2017 and 2018 are considerably higher than the advice given for 2016. This is mainly a result of the large 2013 - 2014 year classes. The assessment estimates a low 2016 year class, which is confirmed by a series of surveys not used in the assessment model. This lower recruitment will negatively influence the stock size, and decrease the fishing opportunities when the 2016 year class is fully selected in the fishery in 2019.

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

Currently there is no agreement between the Coastal States EU, Norway, Iceland and the Faroe Island on the share of the blue whiting stock. Consequently, the previous management plan is no longer in force.

WGWIDE members estimate the total expected catch from the stock to be around 1.559 million tonnes in 2017 whereas the TAC advice was ≤ 1342330 tonnes.

2.13.1 Management plans and evaluations

An evaluation of a long-term management strategy (LTMS) proposed by NEAFC for blue whiting in the northeast Atlantic was conducted by ICES in 2016 (WKBWMSE; ICES, 2016b). The proposed harvest control rule (HCR; see diagram below) was found to be precautionary but a number of potential improvements in the TAC stability mechanism were identified (ICES, 2016c). These recommendations were communicated to the Coastal States in September 2016. Following this, the European Union, the Faroe Islands, Iceland and Norway agreed a new LTMS for blue whiting with amended TAC stability rules in October 2016 (Anon, 2016).

The key changes regarding the TAC stability mechanism in the new agreed LTMS compared to the one evaluated at WKBWMSE are indicated in **bold** below:

5. *Where the rules in paragraph 4 would lead to a TAC, which deviates by more than 20% below or* ***25% above*** *the TAC of the preceding year, the Parties shall fix a TAC that is respectively no more than 20% less* ***or 25% more*** *than the TAC of the preceding year.*

6. ***The TAC constraint described in paragraph 5 shall not apply if:***

   a. The spawning biomass at 1 January in the year preceding the year for which the TAC is to be set is less than Btrigger; or

   b. The rules in paragraph 4 would lead to a TAC that deviates by more than 40% from the TAC of the preceding year.

Point 5 of the LTMS addresses the issue of non-symmetrical TAC changes by increasing the upper TAC change limit. Point 6 aims to address the issue of TACs getting stuck at a low level for an extended period after recovering above B_{lim}. Point 6a allows for an unconstrained increase in the TAC for the first year that the stock is estimated to have recovered above Blim. Point 6b in interpreted to mean any TAC changes >abs(40%) are allowed (i.e. both increases and decreases greater than 40% are allowed (see Figure 2). This change loosens the TAC change limits by allowing particularly large (>40%) changes in TAC when required. This allows for a more reactive HCR that can adjust TACs appropriately should there be a large decrease or increase in the stock size.

This new agreed LTMS has been evaluated using one of the same frameworks applied at WKBWMSE (SimpSIM) to check if the amendments affect the long term precautionarity of the HCR (see Working Document XII, WGWIDE 2017: Miller, 2017). Results indicate that compared to the HCR tested at WKBWMSE, the new HCR leads to slightly higher catch on average, with TACs allowed to increase more rapidly once the stock recovers from below B_{lim}. The new HCR leads to slightly lower SSB on average in the long term, however the probability of the stock falling below B_{lim} remains less than 5%, indicating that the new proposed LTMS can be considered precautionary.

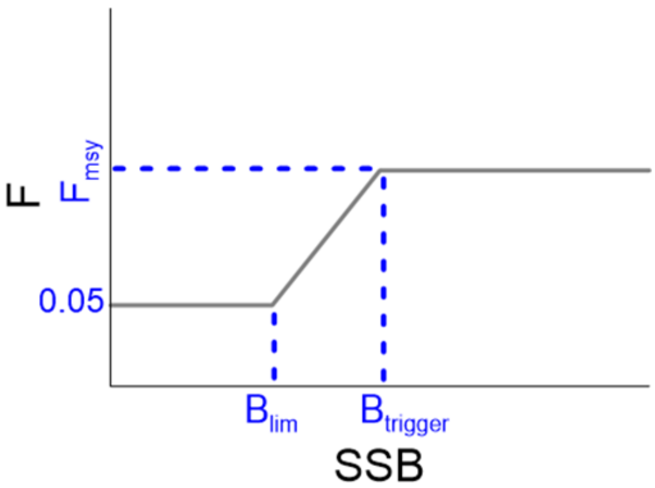

Diagram of the requested long-term management strategy to be evaluated for blue whiting. $B_{trigger} = B_{pa}$.

2.14 References

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Table 2.3.1.1.Blue whiting.ICES estimated catches (tonnes) by country for the period 1988–2016.

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

Table 2.3.1.1. (continued). Blue whiting.ICES estimated catches (tonnes) by country for the period 1988–2016.

Country	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Denmark	89 500	41 450	54 663	48 659	18 134	248	140	165	340	2 167	35 256	45 178	39 395
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
France		8 046	18 009	16 638	11 723	8 831	7839	4337	9799	8 978	10 410	9 659	10 345
Germany	15 293	22 823	36 437	34 404	25 259	5 044	9108	278	6239	11 418	24 487	24 107	20 025
Iceland	379 643	265 516	309 508	236 538	159 307	120 202	87942	5887	63056	104 918	182 879	214 870	186 914
Ireland	75 393	73 488	54 910	31 132	22 852	8 776	8324	1195	7557	13 205	21 466	24 785	27 657
Lithuania			4 635	9 812	5 338						4 717		1 129
Netherlands	95 311	147 783	102 711	79 875	78 684	35 686	33762	4595	26526	51 635	38 524	56 397	58 148
Norway	957 684	738 490	642 451	539 587	418 289	225 995	194317	20539	118832	196 246	399 520	489 439	310 412
Poland													
Portugal	3 937	5 190	5 323	3 897	4 220	2 043	1482	603	1955	2 056	2 150	2 547	2 586
Spain	15 612	17 643	15 173	13 557	14 342	20 637	12891	2416	6726	15 274	32065	29 206	31 952
Sweden ***	19 083	2 960	101	464	4	3	50	1	4	199	2	32	42
UK (England + Wales)	2 593	7 356	10 035	12 926	14 147	6 176	2475	27	1590	4 100	11	131	1 338
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
Russia	346 762	332 226	329 100	236 369	225 163	149 650	112553	45841	88303	120 674	152 256	185 763	173 655
Greenland***										2 133			
Unallocated									3 499				
TOTAL	2380161	2034309	1976176	1625255	1260615	641818	526357	103620	384021	628169	1155279	1396244	**1 183 187**

* From 1992 onlyRussia

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

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

**** From 2012

Table 2.3.1.2.Blue whiting.ICES estimated catches (tonnes) by country and area for 2016.

Area	Denmark	Faroe Islands	France	Germany	Iceland	Ireland	Lithuania	Netherlands	Norway	Portugal	Russia	Spain	Swedeen	UK (England + Wales)	UK (Northern Ireland)	UK(Scotland)	Grand Total
27.2.a		25 251			12 098	1		2 404	4 857		10 424						55 036
27.2.a.1				158			0										158
27.2.a.2	167			1 582			1 129										2 878
27.3.a		2											42				44
27.3.a.2	281																281
27.4.a	53	6 960		3 541	6 407		0	6 889	26 782		4 454		0			132	55 219
27.4.b	10								220				0				230
27.5.a		50			1 621												1 671
27.5.b		190 095			155 051			5 138	349		87 339						437 972
27.5.b.1	1 660			308												7	1 974
27.5.b.2				1 685													1 685
27.6.a	15 514	36 256	1 200	6 041		2 892	0	29 122	91 878		2 988	0		1 268		18 240	205 400
27.6.b		2 328				25			3 449		6 234						12 036
27.6.b.2	5 627											8				32	5 667
27.7.a					10 335												10 335
27.7.b	7 539			1		474		25				69				1 512	9 620
27.7.c		15 769	903			22 669		5 258	136 251		12 887						193 735
27.7.c.2	7 291			4 200								178				17 250	28 919
27.7.e														4			4
27.7.f														0			0
27.7.h			293									38		3			334
27.7.j			6			7		92						62			166
27.7.j.2				7								409					416
27.7.k	1 253	5 705	5 047			1 589		8 212	46 626		49 327	2					117 760
27.7.k.2				2 503													2 503
27.8.a			1 268									19		1			1 288
27.8.b								1 009				246					1 255
27.8.c												20 222					20 222
27.8.d			1 630														1 630
27.8.d.2												2					2
27.9.a										2 586		10 758					13 343
27.12					1 402												1 402
27.14											2						2
Grand Total	39 395	282 416	10 345	20 025	186 914	27 657	1 129	58 148	310 412	2 586	173 655	31 952	42	1 338	0	37 173	**1 183 187**

Table 2.3.1.3.Blue whiting.ICES estimated catches (tonnes) by quarter and area for 2016.

Area	1	2	3	4	2016*	Total
27.2.a	476	31725	6080	16754		55036
27.2.a.1				158		158
27.2.a.2	30			2848		2878
27.3.a	0	1	43	0		44
27.3.a.20	77	19	114	70		281
27.4.a	2382	25594	12786	14458	0	55219
27.4.b	0		9	221		230
27.5.a	596	1	502	572		1671
27.5.b	137001	251605	384	48982		437972
27.5.b.1		1967			7	1974
27.5.b.2		1685				1685
27.6.a	57665	147440	30	159	106	205400
27.6.b	12036					12036
27.6.b.2		5635			32	5667
27.7.a	3916	6419				10335
27.7.b	9138	421	20	41		9620
27.7.c	188998	4737				193735
27.7.c.2	28442	382	75	20		28919
27.7.e		2	1			4
27.7.f	0		0			0
27.7.h	0	29	10	295		334
27.7.j	19	63	71	13		166
27.7.j.2	7	180	116	113		416
27.7.k	117758			2		117760
27.7.k.2	2503					2503
27.8.a	3	7	813	465		1288
27.8.b	82	75	35	1064		1255
27.8.c	4894	6570	5192	3566		20222
27.8.d			314	1316		1630
27.8.d2	1	1				2
27.9.a	2268	4667	3402	3006		13343
27.12	1402					1402
27.14			2			2
Grand total	**569692**	**489226**	**30000**	**94124**	**145**	**1183187**

*** 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 1988–2016 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	8749.0505	**521 864**	103973.479	**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**

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

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

Table 2.3.1.1.1.Blue whiting.ICES estimates(tonnes) of catches, landings, BMS landings and discards by country for 2016.

Country	Catches	Landings	BMS landing	Discards	% discards
Denmark	39395	39134	0	260	0.66
Faroe Islands	282416	282416			0.00
France	10345	10345			0.00
Germany	20025	20025			0.00
Iceland	186914	186914			0.00
Ireland	27657	27657			0.00
Lithuania	1129	1129			0.00
Netherlands	58148	57963	185		0.00
Norway	310412	310412			0.00
Portugal	2586	1551		1035	40.03
Russia	173655	173655			0.00
Spain	31952	28708		3244	10.15
Sweden	42	42			0.00
UK (England)	1338	1331		7	0.50
UK(Scotland)	37173	36896		277	0.74
Total	**1183187**	**1178180**	**185**	**4822**	**0.41**

Table 2.3.1.2.1.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 2000-2016.

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**

Table 2.3.1.2.2.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 country for 2016.

Country	Catch (ton)	% catch covered by sampling programme	No. samples	No. Measured	No. Aged	No Aged/ 1000 tonnes	No Measured/ 1000 tonnes
Denmark	39395	65	11	348	348	9	9
Faroe Islands	282416	89	19	3089	1744	6	11
France	10345	100	439	13205	0	0	1276
Germany	20025	1	9	527	92	5	26
Iceland	186914	99	59	5113	1455	8	27
Ireland	27657	79	11	2279	1105	40	82
Lithuania	1129	0	0	0	0	0	0
Netherlands	58148	73	75	16186	1843	32	278
Norway	310412	99	155	6827	1886	6	22
Portugal	2586	100	67	4619	1039	402	1786
Russia	173655	100	35	47881	1636	9	276
Spain	31952	90	168	14855	2599	81	465
Sweden	42	0	0	0	0	0	0
UK (England and Wales)	1338	0	0	0	0	0	0
UK(Scotland)	37173	15	44	5400	46	1	145
Total	**1183187**	**89**	**1092**	**120329**	**13793**	**12**	**102**

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 2016.

	Catch (tonnes)	No. samples	No. Length Measured	No. Age Samples
Denmark				
1	16254	9	286	286
2	22780	2	62	62
3	140	0	0	0
4	221	0	0	0
Total	**39395**	**11**	**348**	**348**
Faroe Islands				
1	116051	6	976	598
2	130125	10	1591	847
3	2059	0	0	0
4	34181	3	522	299
Total	**282416**	**19**	**3089**	**1744**
France				
1	6625	295	8884	0
2	524	28	840	0
3	1126	56	1680	0
4	2070	60	1801	0
Total	**10345**	**439**	**13205**	**0**
Germany				
1	6729	0	0	0
2	9043	0	0	0
4	4253	9	527	92
Total	**20025**	**9**	**527**	**9**
Iceland				
1	48655	18	1668	441
2	114616	36	3031	893
3	1031	0	0	0
4	22612	5	414	121
Total	**186914**	**59**	**5113**	**1455**
Ireland				
1	23604	11	2279	1105
2	4017	0	0	0
4	36	0	0	0
Total	**27657**	**11**	**2279**	**1105**
Lithuania				
4	**1129**	**0**	**0**	**0**
Netherlands				
1	16646	71	15412	1746
2	28861	4	774	97
3	102	0	0	0
4	12539	0	0	0
Total	**58148**	**75**	**16186**	**1843**
Norway				
1	216197	47	2402	1338
2	76785	54	2054	399
3	12920	40	1794	120
4	4510	14	577	29
Total	**310412**	**155**	**6827**	**1886**
Portugal				
1	302	9	635	189
2	580	22	1505	408
3	845	22	1592	161
4	858	14	887	281
Total	**2586**	**67**	**4619**	**1039**
Russia				
1	87734	11	11384	522
2	76486	17	25316	915
3	3685	3	6277	99
4	5750	4	4904	100
Total	**173655**	**35**	**47881**	**1636**
Spain				
1	6946	33	2637	459
2	11044	40	3545	515
3	8004	44	3784	848
4	5958	51	4889	777
Total	**31952**	**168**	**14855**	**2599**
Sweden				
1	0	0	0	0
2	1	0	0	0
3	41	0	0	0
4	0	0	0	0
Total	**42**	0	0	0
UK (England)				
1	0	0	0	0
2	1335	0	0	0
3	2	0	0	0
4	0	0	0	0
Total	**1338**	**0**	**0**	**0**
UK(Scotland)				
1	23949	3	144	46
2	13029	4	514	0
3	45	6	97	0
4	5	4	13	0
2016*	145	27	4632	0
Total	**37173**	**44**	**5400**	**46**
Total Geral	**1183187**	**1092**	**120329**	**13793**

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

Table 2.3.1.2.4.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 2016.

Division	Preliminary catch (ton)	No. samples	No. Measured	No. Aged	No Aged/ 1000 tonnes	No Measured/ 1000 tonnes
27.2.a	55036	38	12578	424	8	229
27.2.a.1	158	9	527	92	584	3345
27.2.a.2	2878	0	0	0	0	0
27.3.a	44	0	0	0	0	0
27.3.a.2	281	0	0	0	0	0
27.4.a	55219	98	4485	556	10	81
27.4.b	230	0	0	0	0	0
27.5.a	1671	3	249	72	43	149
27.5.b	437972	72	30899	3158	7	71
27.5.b.1	1974	4	790	20	10	400
27.5.b.2	1685	0	0	0	0	0
27.6.a	205400	137	13525	2062	10	66
27.6.b	12036	2	1646	78	6	137
27.6.b.2	5667	4	2500	0	0	441
27.7.a	10335	6	489	147	14	47
27.7.b	9620	0	0	0	0	0
27.7.c	193735	91	7119	1977	10	37
27.7.c.2	28919	8	251	251	9	9
27.7.e	4	0	0	0	0	0
27.7.f	0	0	0	0	0	0
27.7.h	334	4	120	0	0	359
27.7.j	166	4	120	0	0	721
27.7.j.2	416	0	0	0	0	0
27.7.k	117760	268	22195	1293	11	188
27.7.k.2	2503	0	0	0	0	0
27.8.a	1288	42	1260	0	0	978
27.8.b	1255	0	0	0	0	0
27.8.c	20222	110	11000	1299	64	544
27.8.d	1630	66	1981	0	0	1215
27.8.d.2	2	0	0	0	0	0
27.9.a	13343	125	8474	2339	175	635
27.12	1402	1	121	25	18	86
27.14	2	0	0	0	0	0
TOTAL	1183187	1092	120329	13793	723	6280

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Table 2.3.1.2.5.Blue whiting. ICES estimated catches (tonnes) inside and outside NEAFC area for 2016 by country. NA – non available data.

Country	Catches inside NEAFC (tonnes)	Catches outside NEAFC (tonnes)
Spain	599	31353
Iceland	420	186492
FO	14730	267637
Germany	466	9318
Ireland	682	27657
Netherlands	695	57454
Norway	NA	NA
Russia	76701	96954
Scotland	0	37173
UK(England)*	1374	0
Portugal	0	2586
Lithuania	0	1129
Swedeen	0	42
Estonia	0	0
France	NA	NA
Denmark	39134	260

*** this value includes the reported landings in ICES area 27.2.a, which are missing in the data submission to InterCatch.**

Table 2.3.2.1.Blue whiting. Preliminary landings (tonnes) and discards for 2017, by quarter (Quarter 1 and 2) and area.

	Discards			Landings			
Division	**Quarter 1**	**Quarter 2**	**Total**	**Quarter 1**	**Quarter 2**	**Total**	**Total**
27.2.a				342	52223	52565	52565
27.2.a.2				1		1	1
27.3.a		1	1		0	0	1
27.3.d				0		0	0
27.4.a	1	2	2	103	8757	8860	8863
27.4.b	1	1	2	0		0	2
27.4.c	0		0				0
27.5.a				4383	7260	11643	11643
27.5.b				57499	287709	345208	345208
27.6.a				63594	238740	302334	302334
27.6.b				47558		47558	47558
27.6.b.2				2025		2025	2025
27.7.b				2928	3332	6260	6260
27.7.c				299304	1219	300523	300523
27.7.c.1				1898		1898	1898
27.7.c.2				65163		65163	65163
27.7.j				3		3	3
27.7.k				51689		51689	51689
27.7.k.1				3632		3632	3632
27.7.k.2				1437		1437	1437
27.9.a				356	335	691	691
Total	2	4	5	601915	599576	1201491	1201496

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 2017 preliminary data (quarters 1 and 2).

	Catch (tonnes)	N. of samples	N. of fish measured	N. of fish aged
27.2.a	52565	5	595	198
27.2.a.2	2	0	0	0
27.4.a	8863	0	0	0
27.4.b	2	0	0	0
27.5.a	11643	0	0	0
27.5.b	345208	54	19150	2391
27.6.a	302334	16	1866	757
27.6.b	47558	0	0	0
27.6.b.2	2025	0	0	0
27.7.b	6260	0	0	0
27.7.c	300523	13	7185	1109
27.7.c.1	1898	16	498	498
27.7.c.2	65163	21	1657	748
27.7.j	3	0	0	0
27.7.k	51689	12	6201	602
27.7.k.1	3632	4	101	101
27.7.k.2	1437	4	101	101
27.9.a	691	17	1072	494
Total Geral	**1201496**	**162**	**38426**	**6999**

Table 2.3.2.1.1.Blue whiting.Proportion of the annual catch taken in the first half-year of 2004-2016, average proportion and scaling factor used for raisin the preliminary first half year of 2017 catch data.

Values	2014	2015	2016	Average	Raising factor
Age 1	64.3	76.6	76.4	72.4	1.380
Age 2	71.8	83.7	85.9	80.5	1.242
Age 3	92.7	87.4	92.2	90.7	1.102
Age 4	94.4	89.5	92.3	92.0	1.086
Age 5	93.8	91.7	97.0	94.2	1.062
Age 6	94.3	88.9	97.1	93.4	1.070
Age 7	94.9	88.9	96.2	93.3	1.071
Age 8	97.1	90.8	98.1	95.4	1.049
Age 9	97.3	95.2	96.3	96.2	1.039
Age 10	95.2	90.3	95.0	93.5	1.069

Table 2.3.2.1.2 Blue whiting. ICES estimates of catches (tonnes) in 2017, based on declared quotas and expected uptake raised with the age distribution from the preliminary 2017 catch data.

Country	Reportedpreliminary Q1-Q2 catch 2017	National quota	Deviation from quota	Catch 2016
Denmark	60,802	58,818		
Faroe Islands	292,396	476,901		
Germany	11,380	22,869		
Iceland	170,759	250,008		
Ireland	18,571	45,547		
Netherlands	59,571	71,721		
Norway	368,970	410,000		
Portugal	691	14,976	-12,000	2,586
Russia	167,796	101,518		
UK(Scotland)	47,125	76,319		
UK (England)				1,338
Sweden	0	14,550	-14,000	42
France	0	40,933	-30,000	10,345
Spain	0	91,240	-60,000	31,944
Total	1,198,061	1,675,400	-116,000	
EU	198,140	436,973		
Estimate ofcatches in 2017		**1,559,400**		

Table 2.3.3.1.Bluewhiting. Catch at age numbers (thousands) by year. Discards included since 2014. Values for 2017 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
2015	2944849	2852384	2427329	2465286	1518235	707533	329882	258743	239164	450046
2016	1239331	3518677	2933271	1874011	1367844	756824	339851	185368	131039	288635
2017	248683	1750260	6212831	4042584	1275662	739967	290859	152145	102211	180112

Table 2.3.4.1.Blue whiting.Individual mean weight (kg) at age in the catch.Preliminary values for 2017 (average of 2014-2016) 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
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	0.045	0.071	0.090	0.112	0.130	0.151	0.168	0.180	0.193	0.208

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 age composition (millions) from the IBWSS for 2004—2017.

	AGE										
Year	1	2	3	4	5	6	7	8	9	10	11	Total
2004	1 097	5 538	13 062	15 134	5 119	1 086	994	593	164			42 787
2005	2 129	1 413	5 601	7 780	8 500	2 925	632	280	129	15	8	29 412
2006	2 512	2 222	10 858	11 677	4 713	2 717	923	352	198	31	0	36 203
2007	468	706	5 241	11 244	8 437	3 155	1 110	456	123	54	4	30 998
2008	337	523	1 451	6 642	6 722	3 869	1 715	1 028	269	182	102	22 840
2009	275	329	360	1 292	3 739	3 457	1 636	587	250	88	74	12 087
2010*												
2011	312	1 361	1 135	930	1 043	1 712	2 170	2 422	1 298	239	11	12 633
2012	1 141	1 818	6 464	1 022	596	1 420	2 231	1 785	1 256	926	96	18 755
2013	586	1 346	6 183	7 197	2 933	1 280	1 306	1 396	927	1 358	312	24 824
2014	4 183	1 491	5 239	8 420	10 202	2 754	772	577	899	773	812	36 122
2015	3 255	4 565	1 888	3 630	1 792	465	173	108	206	132	115	16 329
2016	2 745	7 893	10 164	6 274	4 687	1 539	413	133	235	138	119	34 339
2017	2 75	2 180	15 939	10 196	3 621	1 711	900	75	66	72	79	35 113

*** The quality of the survey was regarded as not satisfactory.**

Total stock biomass (kt)

YEAR	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
TSB (1000t)	3505	2513	3512	3274	2639	1599		1826	2355	3107	3337	1403	2873	3108

Table 2.3.7.1.2.Blue Whiting.Survey indices (IBWSS) 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

Table 2.3.7.2.1.Blue Whiting.Estimated abundance of 1 and 2 year oldblue whiting from the International Norwegian Sea ecosystem survey, 2003–2017.

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	1219	2014

***Using the old TS-value. To compare the results all valueswere 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

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

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

Table 2.4.2.1.Blue whiting. Parameter estimates, from final assessment (2017) and retrospective analysis (2014-2016).

Parameter Year	2014	2015	2016	2017
Random walk variance				
-F Age 1-10	0.40	0.41	0.39	0.38
Process error				
-log(N) Age 1	0.58	0.58	0.58	0.63
--- Age 2-10	0.15	0.17	0.17	0.18
Observation variance				
-Catch Age 1	0.41	0.46	0.45	0.44
--- Age 2	0.30	0.29	0.29	0.28
--- Age 3-8	0.21	0.20	0.20	0.20
--- Age 9-10	0.41	0.40	0.40	0.40
-IBWSS Age 1	0.91	0.77	0.75	0.75
--- Age 2	0.33	0.33	0.31	0.32
--- Age 3	0.42	0.46	0.46	0.44
--- Age 4-6	0.35	0.45	0.45	0.41
--- Age 7-8	0.29	0.37	0.41	0.51
Survey catchability				
-IBWSS Age 1	0.06	0.07	0.07	0.07
--- Age 2	0.10	0.12	0.12	0.12
--- Age 3	0.33	0.38	0.36	0.37
--- Age 4	0.60	0.70	0.66	0.67
--- Age 5-8	0.86	0.92	0.86	0.86
Rho				
--	0.91	0.92	0.92	0.93

Table 2.4.2.2.Blue whiting.Estimated fishing mortalities. Catch data for 2017 are preliminary.

Year Age	1	2	3	4	5	6	7	8	9	10
1981	0.080	0.122	0.171	0.208	0.239	0.313	0.342	0.444	0.495	0.495
1982	0.069	0.105	0.148	0.180	0.203	0.265	0.288	0.369	0.408	0.408
1983	0.082	0.123	0.172	0.209	0.235	0.309	0.333	0.416	0.448	0.448
1984	0.100	0.149	0.215	0.264	0.302	0.394	0.414	0.503	0.527	0.527
1985	0.105	0.156	0.233	0.295	0.346	0.448	0.462	0.555	0.572	0.572
1986	0.116	0.173	0.270	0.360	0.436	0.557	0.574	0.691	0.705	0.705
1987	0.101	0.151	0.246	0.337	0.418	0.544	0.562	0.674	0.675	0.675
1988	0.098	0.147	0.250	0.347	0.443	0.587	0.593	0.694	0.672	0.672
1989	0.113	0.171	0.302	0.417	0.531	0.701	0.722	0.848	0.802	0.802
1990	0.104	0.156	0.287	0.401	0.509	0.672	0.723	0.859	0.818	0.818
1991	0.058	0.087	0.164	0.230	0.287	0.367	0.397	0.465	0.447	0.447
1992	0.049	0.073	0.140	0.194	0.232	0.286	0.313	0.372	0.364	0.364
1993	0.043	0.063	0.126	0.176	0.205	0.245	0.269	0.320	0.315	0.315
1994	0.036	0.054	0.113	0.159	0.184	0.216	0.241	0.292	0.287	0.287
1995	0.047	0.070	0.151	0.215	0.241	0.280	0.313	0.384	0.369	0.369
1996	0.056	0.085	0.188	0.272	0.293	0.342	0.381	0.476	0.452	0.452
1997	0.055	0.085	0.191	0.282	0.296	0.342	0.378	0.477	0.454	0.454
1998	0.071	0.111	0.256	0.388	0.404	0.465	0.505	0.633	0.594	0.594
1999	0.064	0.102	0.241	0.375	0.393	0.450	0.474	0.593	0.557	0.557
2000	0.073	0.117	0.282	0.453	0.496	0.571	0.580	0.703	0.663	0.663
2001	0.070	0.112	0.268	0.437	0.495	0.570	0.566	0.677	0.643	0.643
2002	0.064	0.103	0.249	0.417	0.499	0.590	0.587	0.697	0.665	0.665
2003	0.067	0.107	0.261	0.442	0.543	0.631	0.618	0.699	0.663	0.663
2004	0.069	0.109	0.269	0.465	0.594	0.692	0.682	0.745	0.707	0.707
2005	0.060	0.095	0.238	0.423	0.562	0.655	0.657	0.702	0.671	0.671
2006	0.052	0.082	0.208	0.375	0.516	0.605	0.611	0.643	0.615	0.615
2007	0.048	0.077	0.194	0.356	0.510	0.614	0.639	0.674	0.650	0.650
2008	0.042	0.068	0.169	0.309	0.450	0.542	0.580	0.614	0.604	0.604
2009	0.027	0.045	0.110	0.196	0.288	0.345	0.380	0.402	0.400	0.400
2010	0.020	0.034	0.080	0.138	0.202	0.240	0.268	0.278	0.280	0.280
2011	0.006	0.010	0.024	0.039	0.056	0.065	0.074	0.078	0.081	0.081
2012	0.013	0.022	0.053	0.086	0.122	0.141	0.164	0.180	0.188	0.188
2013	0.021	0.038	0.093	0.153	0.216	0.246	0.290	0.328	0.344	0.344
2014	0.039	0.071	0.181	0.299	0.414	0.468	0.554	0.647	0.679	0.679
2015	0.050	0.093	0.237	0.392	0.538	0.611	0.713	0.854	0.899	0.899
2016	0.043	0.080	0.200	0.337	0.462	0.533	0.623	0.768	0.817	0.817
2017	0.040	0.075	0.188	0.318	0.432	0.497	0.577	0.733	0.788	0.788

Table 2.4.2.3.Blue whiting.Estimated stock numbers at age (thousands).Preliminary catch data for 2017 have been used.

Year Age	1	2	3	4	5	6	7	8	9	10
1981	3873800	3466311	4894817	2129670	2645713	2172786	1662074	1737561	1200702	2916733
1982	4631025	2896953	2527249	3312381	1615958	1533483	1316421	1020874	885453	1912276
1983	17917609	3709294	1878856	1841818	1955171	1231277	1021101	860339	625268	1276653
1984	17867374	14147005	2425726	1241943	1282282	1401411	820401	556247	484731	941288
1985	9478922	13371209	9577976	1455907	758119	912258	751708	462786	270058	728672
1986	7216911	6373992	9389330	5460774	930433	457782	475574	379854	231840	498621
1987	9088875	5065052	4131102	6724890	2540495	396754	253773	238323	157276	293834
1988	6417562	6841312	3558711	2909730	3658719	1233465	197924	125577	99704	173318
1989	8591218	4644958	4972977	2446743	2118032	1667319	351192	101577	59668	116979
1990	18959441	6070830	3125785	2751429	1482582	1175710	557015	120534	33089	83070
1991	9048738	15639427	4336337	1830443	1490137	859655	551547	188638	32968	44376
1992	6718375	7399589	12509726	3325526	1284787	801229	484704	286089	100630	39179
1993	4960963	5143787	5287228	9683073	2265559	985559	517709	283286	156444	74363
1994	7946169	3449578	4043828	3456201	6857254	1450743	761077	326921	202244	118183
1995	9246816	5804771	3118547	2590625	2858137	3783710	1035547	537681	217440	185422
1996	27616800	7066060	4042902	2380026	1586677	1876192	2240506	637886	303556	245310
1997	44328895	21042652	5412167	2553242	1435427	1086523	1069237	1213067	288970	326097
1998	26694986	37064899	16077590	3462094	1395738	936082	780801	600359	615720	293227
1999	20415668	20514533	26973634	10191700	1726013	784927	525973	407814	237280	424675
2000	39326162	15396429	16444608	15598632	4313941	1103640	472908	323596	156027	312451
2001	56189765	31486496	12090635	10643495	7420796	1711036	495406	227138	159505	180818
2002	49008984	45179812	20574539	8287613	5477740	3392891	701888	255950	101795	153592
2003	52753701	39024050	34827076	13574114	5037911	2976021	1227422	350864	91172	106747
2004	28329330	41865556	29761031	20864858	7272917	2459895	1324533	513183	153947	81951
2005	22004054	21406567	28623458	17969051	10699398	3240034	1108884	519735	196124	99618
2006	8910800	15481081	21708082	19139867	9400522	4452898	1358477	484905	219581	121435
2007	4895088	6001045	13160562	15675243	10228998	4639249	1821278	606003	226646	161349
2008	5664722	3507763	4435561	10953782	9067778	4858075	1837695	748877	232990	190793
2009	5670783	3921222	2478844	3755239	6894715	4668118	2154090	830184	314012	180381
2010	15066348	4912719	2391592	1902440	3351904	4279330	2755993	1162665	399365	253351
2011	18528179	13002025	3324654	1679803	1632097	2590857	2637897	1327428	769373	371455
2012	18460860	14775562	12027506	2332671	1210463	1614525	2278830	2017705	1032649	850074
2013	15528181	15268858	11286153	7244636	2185866	1087069	1342170	1544949	1276481	1286866
2014	36212714	12270735	13380650	7827721	4317818	1332158	894647	920977	928127	1370700
2015	59245602	31607805	10535531	8407615	4229068	1750446	714428	468995	413402	902411
2016	30197756	51796684	21096772	7361560	4327867	1853424	707184	316420	176071	442787
2017	8857470	24196794	39535668	15386660	4170233	2167919	789326	284194	131186	233689
2018		6966458	18375407	26823095	9169291	2217024	1079437	363020	111848	135839

Table 2.4.2.4.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 2017 are included.

Year	R(age 1)	Low	High	SSB	Low	High	Fbar (3-7)	Low	High	TSB
1981	3873800	2495554	6013224	2848318	2235745	3628731	0.255	0.184	0.352	3344584
1982	4631025	2951145	7267142	2311530	1834417	2912735	0.217	0.159	0.295	2777933
1983	17917609	11656742	27541203	1869746	1516293	2305591	0.252	0.188	0.337	2883917
1984	17867374	11745142	27180858	1751579	1447113	2120102	0.318	0.241	0.419	3063233
1985	9478922	6256431	14361216	2077490	1712420	2520389	0.357	0.274	0.465	3202617
1986	7216911	4787202	10879800	2262124	1867219	2740548	0.439	0.339	0.571	3099424
1987	9088875	6013290	13737512	1919302	1587329	2320704	0.422	0.324	0.549	2802325
1988	6417562	4243007	9706583	1631183	1360766	1955338	0.444	0.341	0.579	2418518
1989	8591218	5654501	13053146	1544207	1291849	1845862	0.535	0.412	0.693	2394880
1990	18959441	12291756	29244024	1362283	1129603	1642892	0.519	0.394	0.683	2515069
1991	9048738	5802496	14111111	1784519	1431007	2225362	0.289	0.212	0.394	3232873
1992	6718375	4365750	10338787	2466363	1950265	3119035	0.233	0.171	0.318	3537413
1993	4960963	3186466	7723651	2539304	2017097	3196705	0.204	0.150	0.278	3416944
1994	7946169	5148604	12263829	2528268	2029832	3149099	0.182	0.134	0.249	3402300
1995	9246816	6055195	14120704	2311005	1898087	2813751	0.240	0.180	0.320	3350273
1996	27616800	18124111	42081382	2205180	1828780	2659052	0.295	0.223	0.391	3705096
1997	44328895	29146948	67418753	2451549	2032100	2957578	0.298	0.225	0.393	5386397
1998	26694986	17667644	40334879	3630276	2964731	4445229	0.403	0.309	0.526	6733223
1999	20415668	13441086	31009360	4364768	3549467	5367340	0.387	0.296	0.505	7082407
2000	39326162	25833821	59865207	4203899	3488100	5066590	0.476	0.368	0.617	7435402
2001	56189765	37199998	84873383	4561996	3802744	5472840	0.467	0.360	0.606	9004401
2002	49008984	32423957	74077342	5413532	4501459	6510405	0.468	0.360	0.609	10349365
2003	52753701	35386458	78644576	6851741	5670292	8279354	0.499	0.389	0.640	11813827
2004	28329330	18765212	42768020	6751329	5642121	8078601	0.541	0.424	0.689	10344937
2005	22004054	14695522	32947342	6014719	5024413	7200212	0.507	0.395	0.651	8469151
2006	8910800	5885027	13492269	5827692	4844377	7010600	0.463	0.358	0.599	7654281
2007	4895088	3214645	7453977	4636984	3840613	5598488	0.463	0.354	0.604	5669196
2008	5664722	3674829	8732128	3570518	2914533	4374147	0.410	0.305	0.551	4381825
2009	5670783	3545477	9070085	2735187	2173000	3442819	0.264	0.190	0.366	3443776
2010	15066348	9670054	23473998	2649614	2060906	3406490	0.186	0.131	0.263	3706850
2011	18528179	11987727	28637073	2664433	2077927	3416484	0.052	0.035	0.077	4341382
2012	18460860	12082995	28205206	3342454	2666549	4189684	0.113	0.083	0.154	4952554
2013	15528181	10048893	23995120	3639536	2949336	4491255	0.200	0.149	0.268	5392753
2014	36212714	22598584	58028446	3859746	3123890	4768937	0.383	0.286	0.513	6418186
2015	59245602	35485840	98913860	4051466	3144285	5220383	0.498	0.364	0.683	7830339
2016	30197756	16840634	54149058	4671649	3314432	6584629	0.431	0.285	0.652	8473453
2017	8857470	3602229	21779510	6197320	3973084	9666741	0.402	0.228	0.709	8537065
2018				5906696*						

***assuming long tem GM(1981-2016) recruitment (14823908)**

Table 2.4.2.5.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 2017 are included.

Year	Estimate	Low	High	Observed catches
1981	787234	558104	1110432	922980
1982	543748	410143	720877	550643
1983	515890	396489	671249	553344
1984	567898	436617	738651	615569
1985	642293	501996	821801	678214
1986	763286	596919	976021	847145
1987	635194	496925	811936	654718
1988	567318	444605	723902	552264
1989	619728	488884	785590	630316
1990	551889	432678	703945	558128
1991	403303	312502	520487	364008
1992	440011	344857	561420	474592
1993	440311	343399	564573	475198
1994	420894	326525	542536	457696
1995	506663	399571	642459	505176
1996	596374	470627	755720	621104
1997	639204	500788	815878	639681
1998	1076352	837391	1383503	1131955
1999	1235355	956549	1595424	1261033
2000	1501055	1170301	1925287	1412449
2001	1567230	1222266	2009554	1771805
2002	1704414	1329748	2184644	1556955
2003	2196554	1721006	2803505	2365319
2004	2322018	1826409	2952114	2400795
2005	2002210	1577455	2541339	2018344
2006	1848999	1454973	2349733	1956239
2007	1548399	1216762	1970426	1612269
2008	1170999	913593	1500930	1251851
2009	656601	510850	843936	634978
2010	480896	368696	627241	539539
2011	135607	99250	185282	103771
2012	331675	260698	421976	375692
2013	602930	473089	768407	613863
2014	1110835	867054	1423157	1147650
2015	1342765	1058090	1704032	1390656
2016	1205225	947126	1533659	1180786
2017	1515097	1166030	1968661	1559437

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

Age	Mean weight in the stock (kg)	Mean weight in the catch (kg)	Proportion mature	Natural mortality	Exploitation pattern	Stocknumber(2018) (thousands)
Age 1	0.045	0.045	0.11	0.20	0.100	14823908
Age 2	0.071	0.071	0.40	0.20	0.187	6966458
Age 3	0.090	0.090	0.82	0.20	0.467	18375407
Age 4	0.112	0.112	0.86	0.20	0.790	26823095
Age 5	0.130	0.130	0.91	0.20	1.073	9169291
Age 6	0.151	0.151	0.94	0.20	1.236	2217024
Age 7	0.168	0.168	1.00	0.20	1.434	1079437
Age 8	0.180	0.180	1.00	0.20	1.821	363020
Age 9	0.193	0.193	1.00	0.20	1.959	111848
Age 10	0.208	0.208	1.00	0.20	1.959	135839

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

Values	Value	Notes
F ages 3-7 (2017)	0.402	From assessment (preliminary 2017 catches)
SSB (2018)	5906696	From forecast
R age 1 (2017)	8857470	From assessment
R age 1 (2018)	14823908	GM (1981–2016)
R age 1 (2019)	14823908	GM (1981–2016)
Total catch (2017)	1559400	Preliminary 2017 catchesestimated by ICES, based on declared quotas and expected uptake

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

Values	Catch (2018)	F(2018)	SSB(2019)	% SSB change*	% Catch change**
F=FMSY	1387872	0.320	5181388	-12	-11
F=0	0	0.000	6509015	10	-100
F=0.05	242634	0.050	6275795	6	-84
F=0.1	475020	0.100	6052835	2	-70
F=0.15	697658	0.150	5839627	-1	-55
F=0.16	741058	0.160	5798113	-2	-52
F=0.17	784090	0.170	5756966	-3	-50
F=0.18	826759	0.180	5716182	-3	-47
F=0.19	869068	0.190	5675758	-4	-44
F=0.2	911020	0.200	5635690	-5	-42
F=0.21	952619	0.210	5595974	-5	-39
F=0.22	993869	0.220	5556608	-6	-36
F=0.23	1034772	0.230	5517587	-7	-34
F=0.24	1075333	0.240	5478908	-7	-31
F=0.25	1115554	0.250	5440567	-8	-28
F=0.26	1155439	0.260	5402562	-9	-26
F=0.27	1194992	0.270	5364889	-9	-23
F=0.28	1234214	0.280	5327544	-10	-21
F=0.29	1273111	0.290	5290525	-10	-18
F=0.3	1311683	0.300	5253828	-11	-16
F=0.31	1349936	0.310	5217450	-12	-13
F=0.32	1387872	0.320	5181388	-12	-11
F=0.33	1425494	0.330	5145639	-13	-9
F=0.34	1462805	0.340	5110199	-13	-6
F=0.35	1499808	0.350	5075065	-14	-4
F=0.36	1536506	0.360	5040236	-15	-1
F=0.37	1572902	0.370	5005706	-15	1
F=0.38	1608999	0.380	4971475	-16	3
F=0.39	1644799	0.390	4937538	-16	5
F=0.4	1680306	0.400	4903893	-17	8
F=0.45	1853538	0.450	4739945	-20	19
F=0.5	2019842	0.500	4582878	-22	30
F=Fpa	2116435	0.530	4491803	-24	36
F=Flim	3088351	0.880	3582582	-39	98
F=Fsq	1688386	0.402	4896239	-17	8
SSB(2019)=Bpa	4546226	1.681	2253487	-62	192
SSB(2019)=Blim	5410452	2.514	1500131	-75	247
SSB(2019)=SSB(2018)	631861	0.135	5902594	-0	-59
Catch(2019)=catch(2018)	1554741	0.365	5022934	-15	-0

Weights in tonnes.

***) SSB 2019 relative to SSB 2018.**

****) Catch 2018 relative to expected catch in 2017 (1559400 tonnes).**

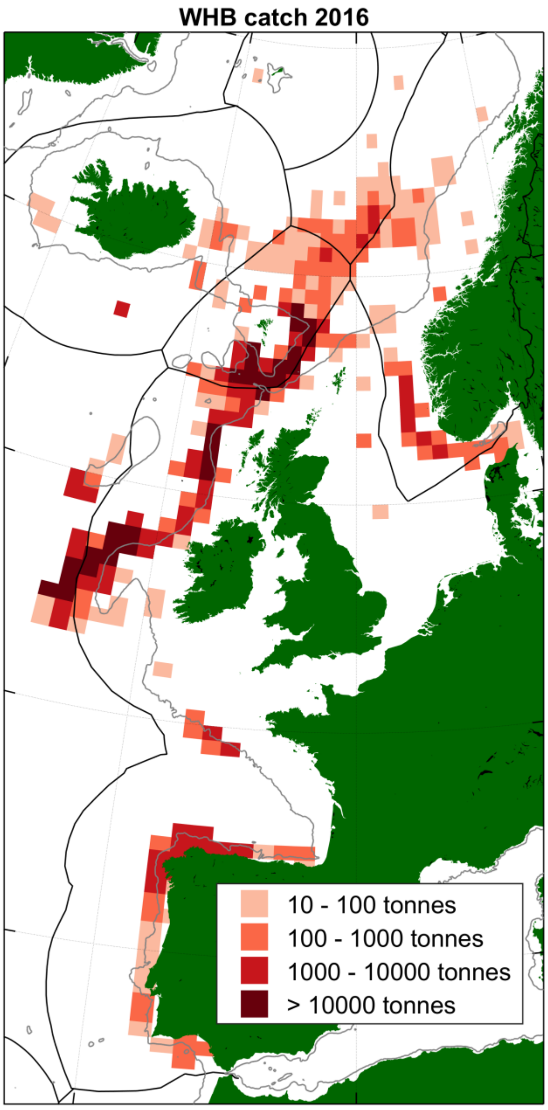


Figure 2.2.1. Blue whiting landings (ICES estimates) in 2016 by ICES rectangle. The 500-m depth contour is indicated in grey. The catches on the map constitute 99 % of the total landings.

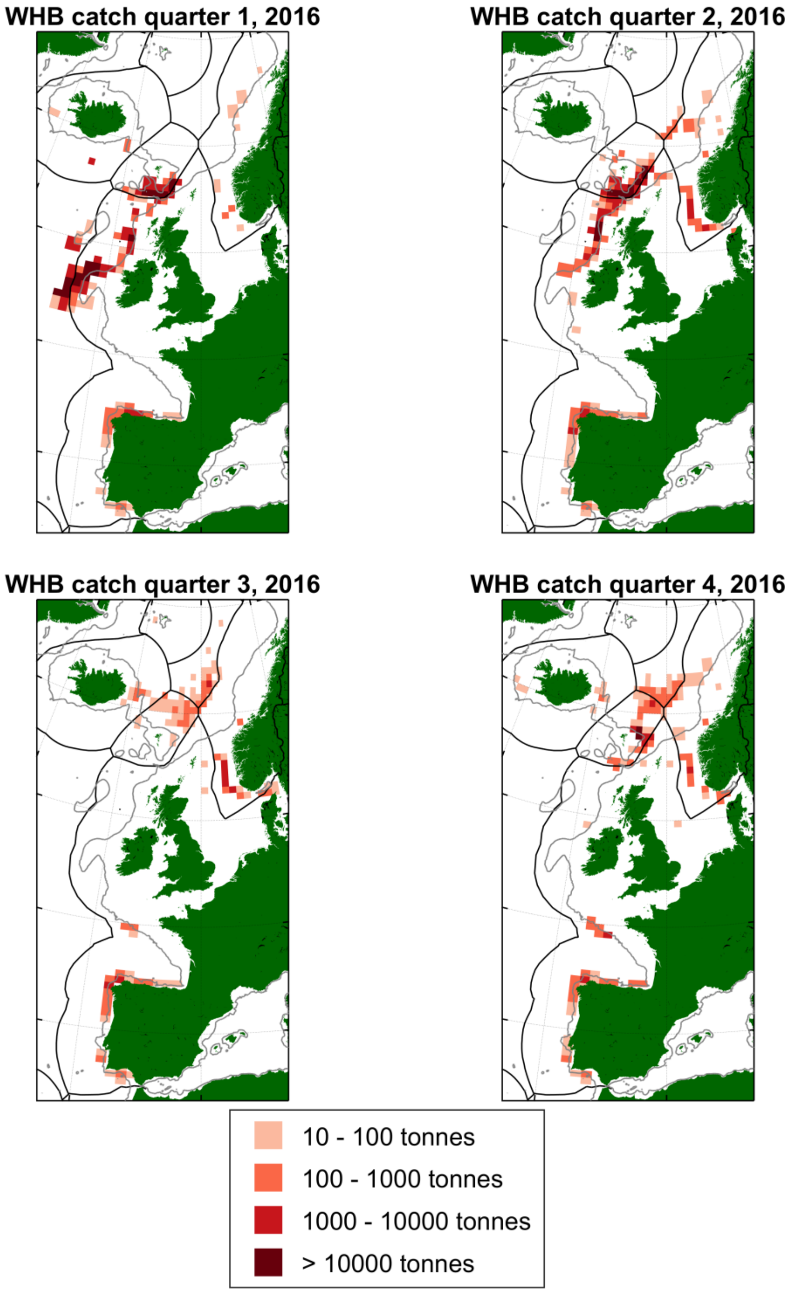


Figure 2.2.2. Blue whiting total catches (ICES estimates) in 2016 by quarter and ICES rectangle. The 500-m depth contour is indicated in grey. The catches on the maps constitute 99 % of the total catches.

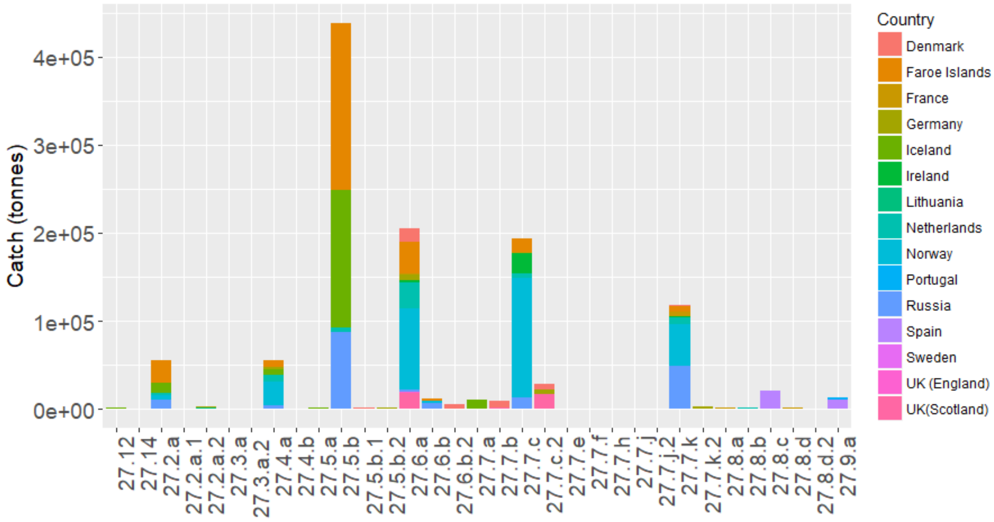
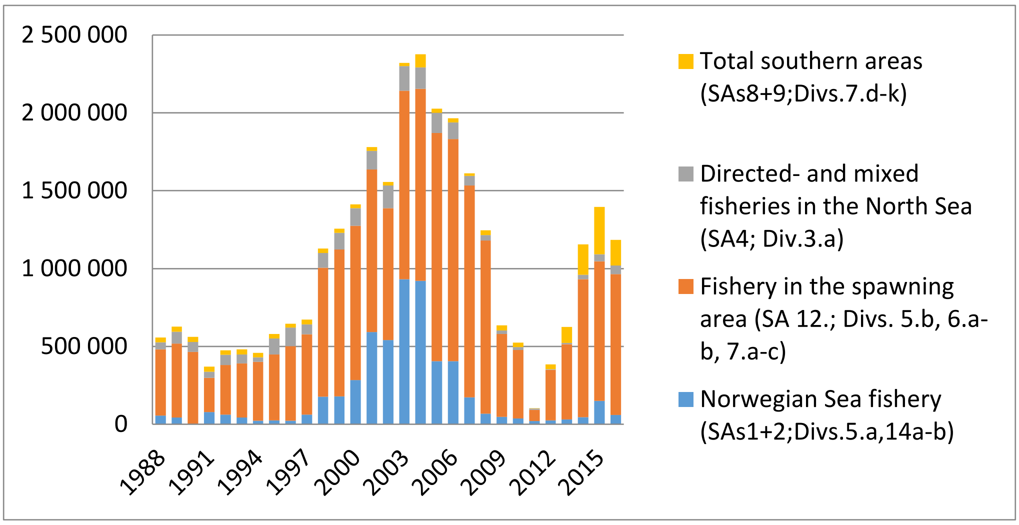


Figure 2.3.1.1. Blue whiting. ICES estimated catches (tonnes) in 2016 by area and country.

A



B

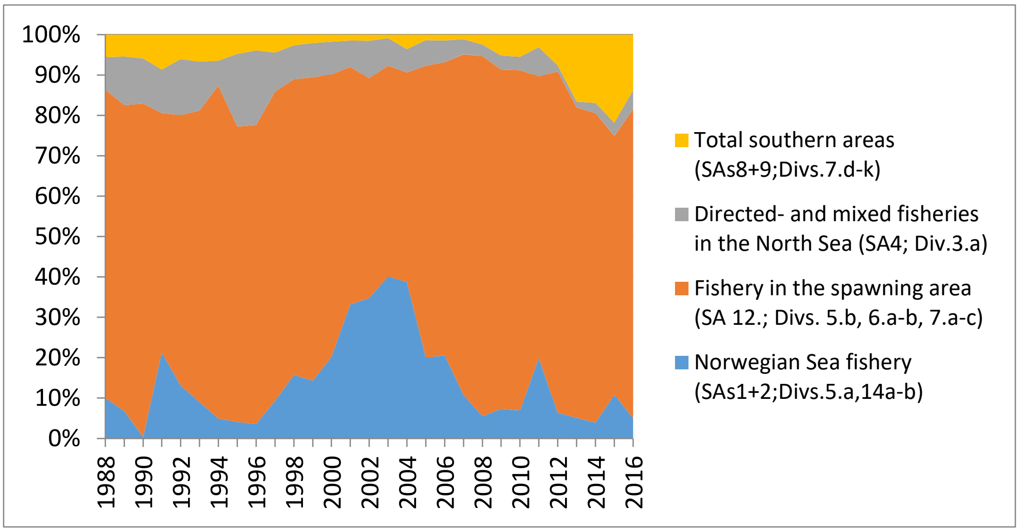


Figure 2.3.1.2. Blue whiting. (A) ICES estimated catches (tonnes) of blue whiting by fishery sub-areas from 1988-2016 and (B) the percentage contribution to the overall catch by fishery sub-area over the same period.

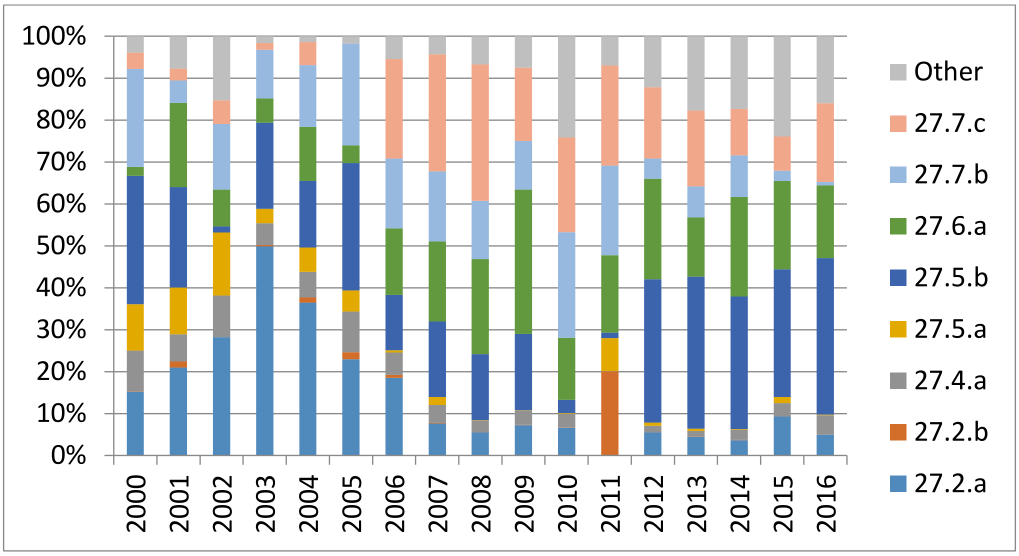


Figure 2.3.1.3. Blue whiting. Distribution of 2016 ICES estimated catches (in percentage) by ICES area.

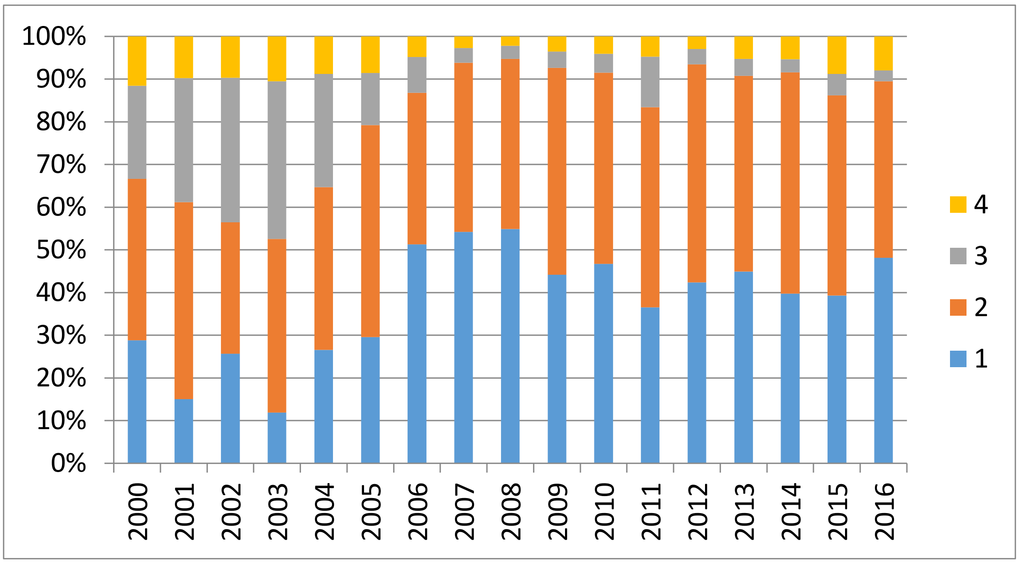


Figure 2.3.1.4. Blue whiting. Distribution of 2016 ICES estimated catches (in percentage) by quarter.

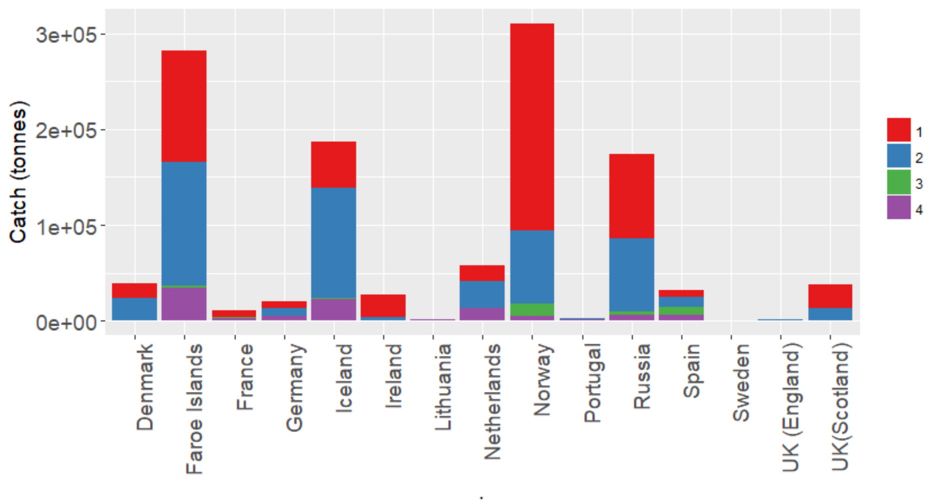


Figure 2.3.1.5. Blue whiting. Distribution of 2016 ICES estimated catches (tonnes) by country and by quarter.

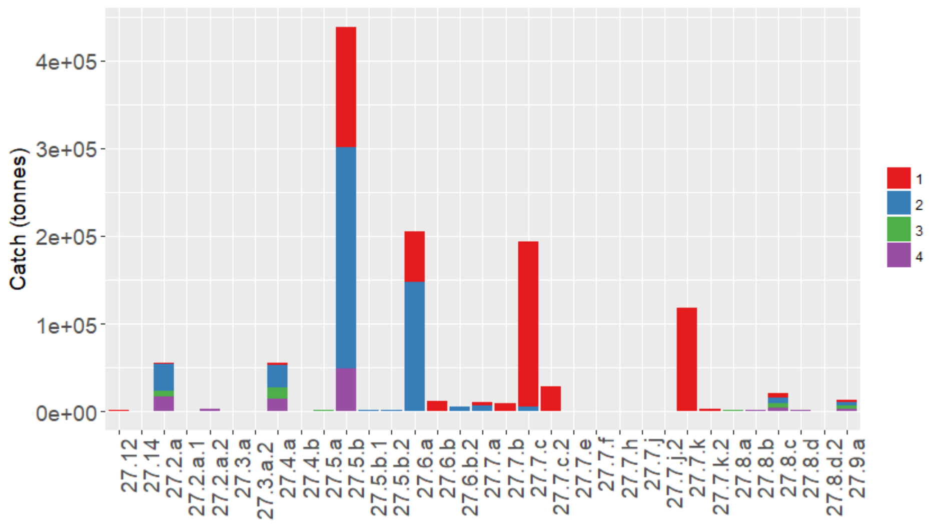


Figure 2.3.1.6. Blue whiting. Distribution of 2016 ICES estimated catches (tonnes) by area and by quarter.

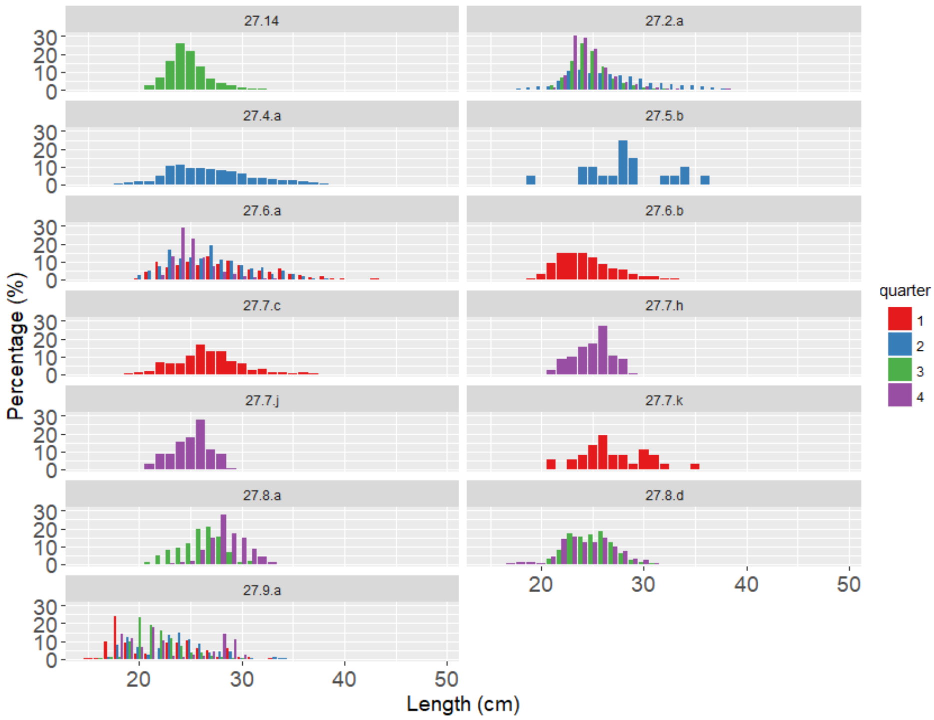


Figure 2.3.1.7. Blue whiting. Length (cm) distribution in percentage by ICES division and quarter for 2016. This length distribution represents only part of the 2016 ICES estimated total catches (tonnes).

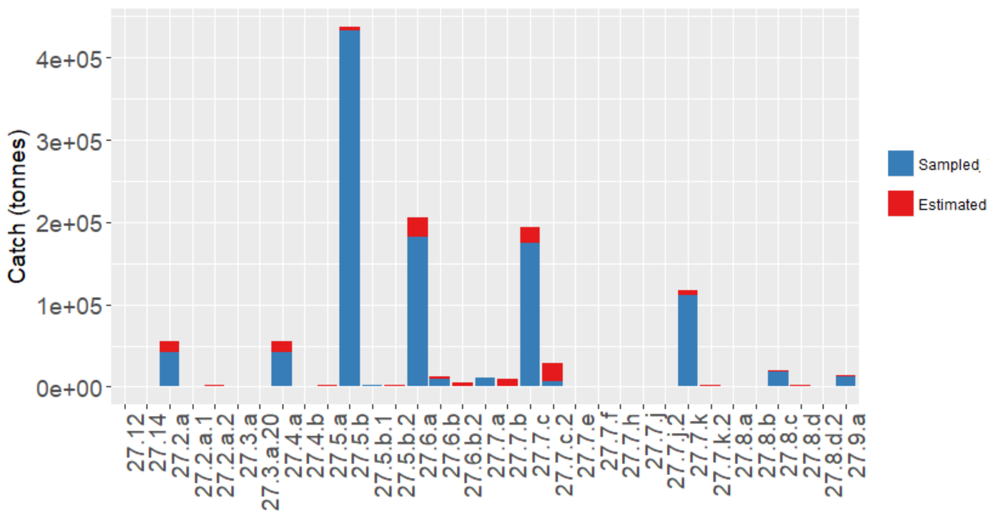


Figure 2.3.1.8. Blue whiting. 2016 ICES catches (tonnes) sampled and estimated by area.

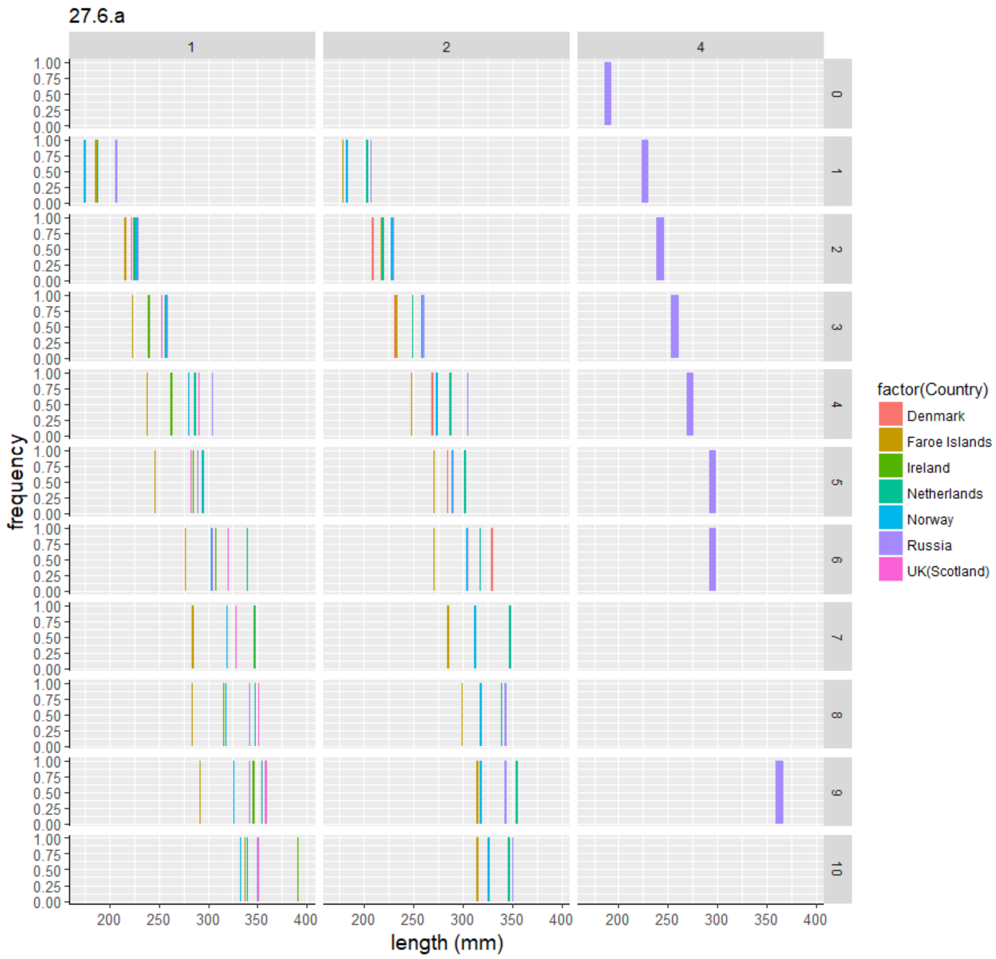


Figure 2.3.1.9. Blue whiting. Mean length (mm) by age (0-10 year), by quarter (1,2,4), by country for ICES area 27.6.a. This data only comprises the 2016 ICES catch-at-age sampled estimates for ICES area 27.6.a.

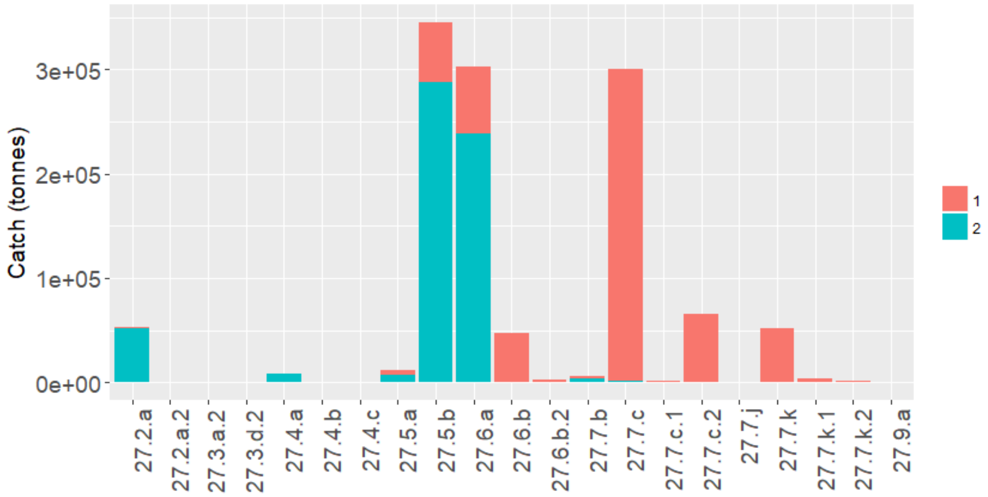


Figure 2.3.2.1. Blue whiting. Distribution of 2017 preliminary landings (tonnes) by area and quarter.

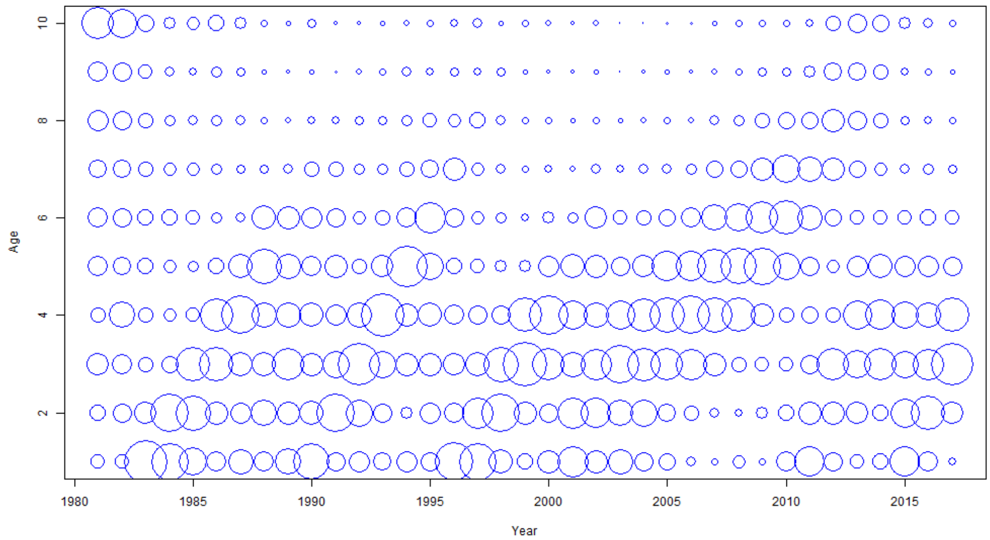


Figure 2.3.3.1. Blue whiting. Catch proportion at age, 1981-2017. Preliminary values for 2017 have been used.

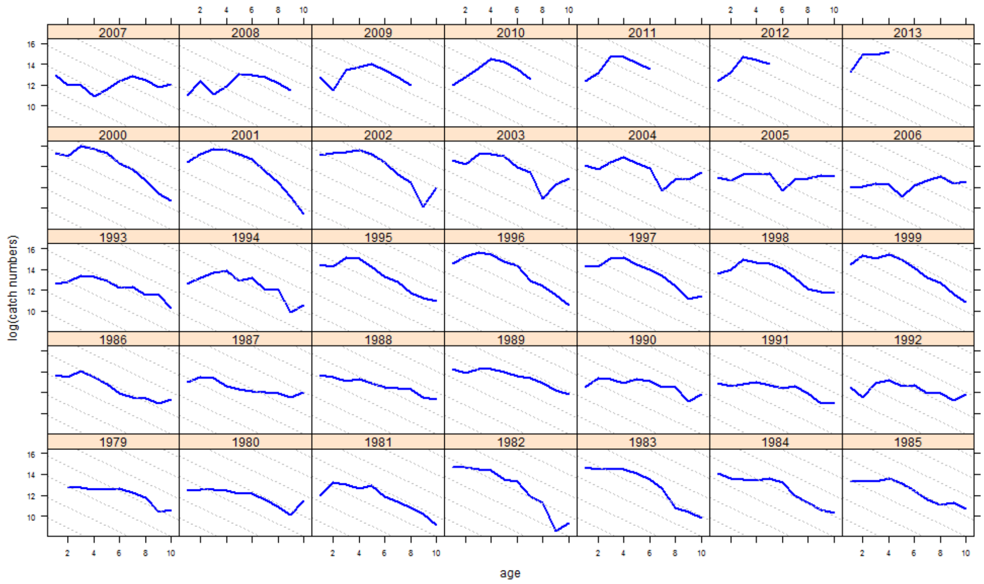


Figure 2.3.3.2. Blue whiting. Age disaggregated catch (numbers) plotted on log scale. The labels behind each panel indicate year classes. The grey dotted lines correspond to *Z*=0.6. Preliminary catch at age for 2017 have been used.

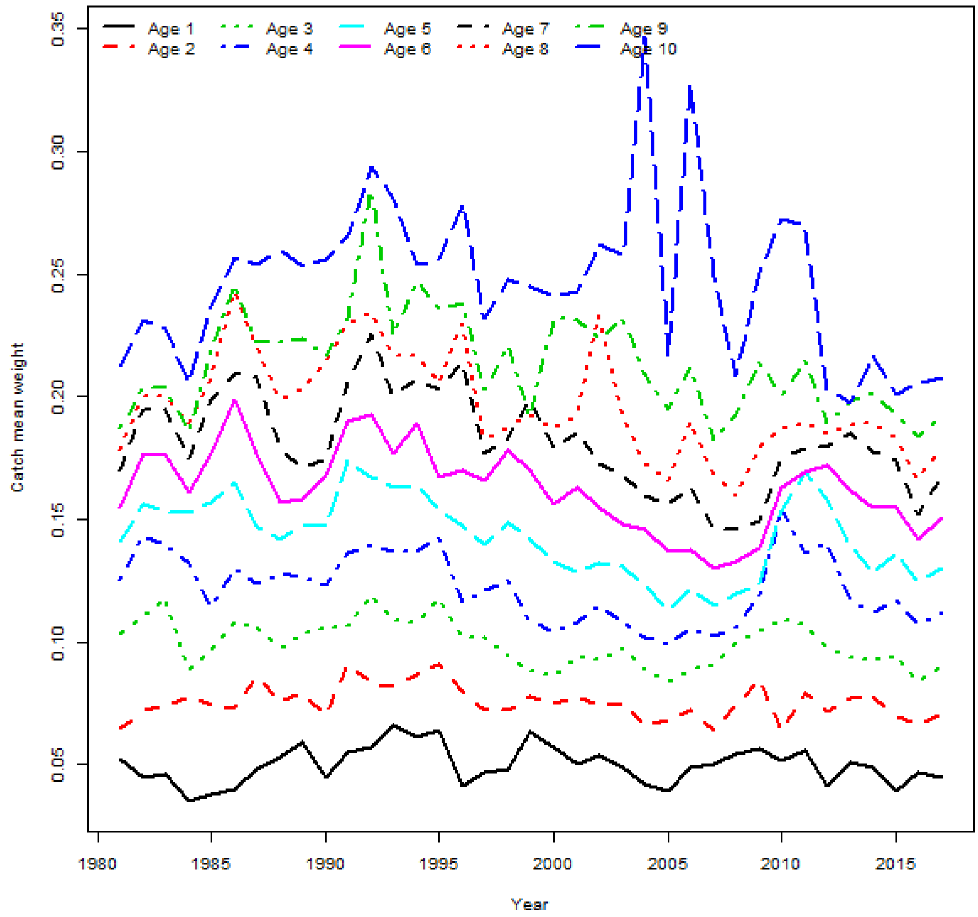
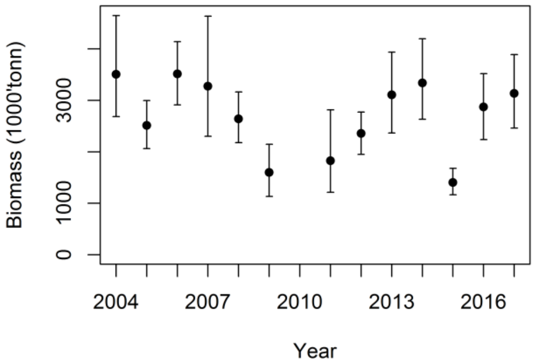


Figure 2.3.4.1. Blue whiting. Mean catch (and stock) weight (kg) at age by year. Preliminary values for 2017 (average of 2014-2016) have been used.

A



B

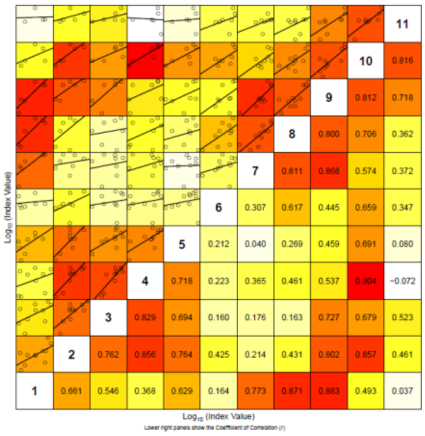
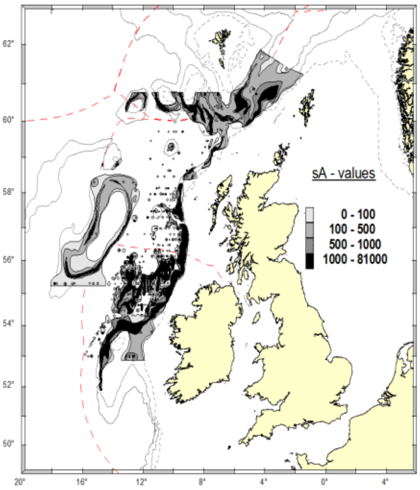
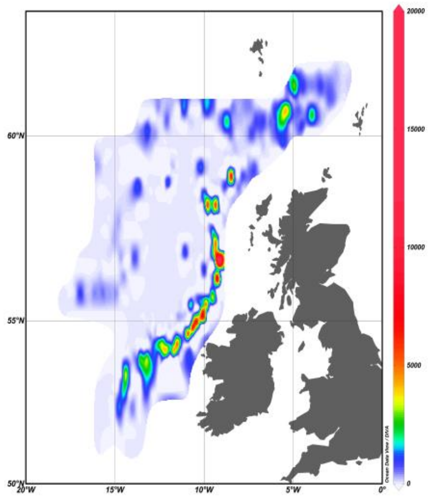


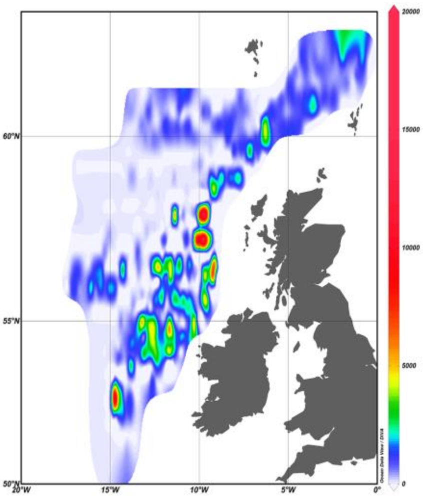
Figure 2.3.7.1.1. Blue whiting. (A) Estimate of total biomass from the International blue whiting spawning stock survey. The black dots and error bands are StoX estimates with 95 % confidence intervals. (B) Internal consistency within the International blue whiting spawning stock survey. The upper left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



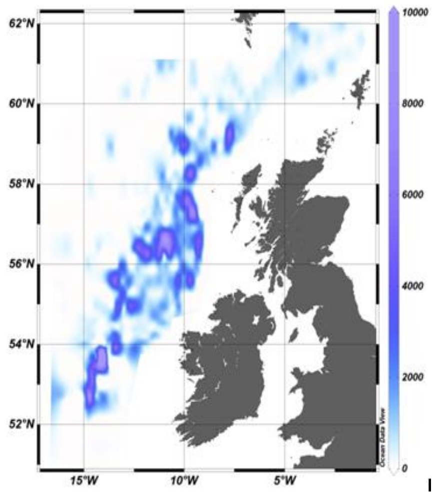
2014



2015



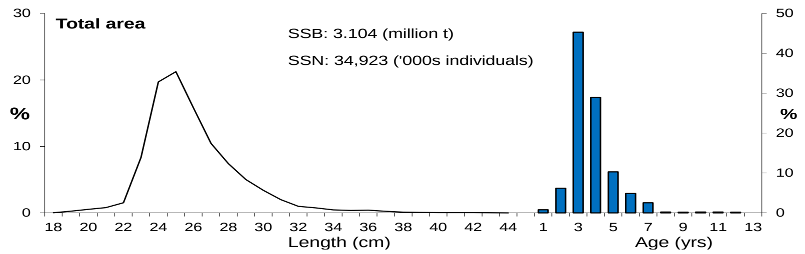
2016



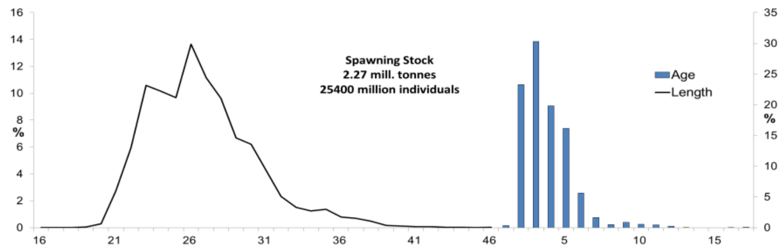
2017

Figure 2.3.7.1.2. Map of blue whiting acoustic density (sA, m2/nm2) found during the spawning survey in spring 2014—2017.

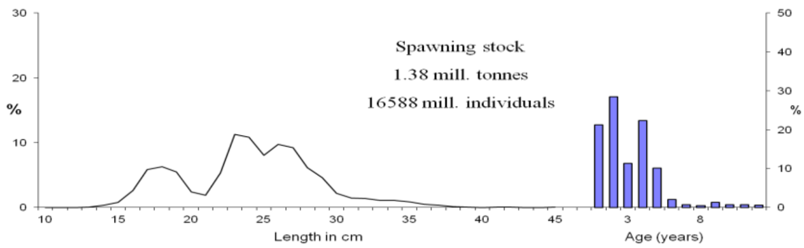
2017



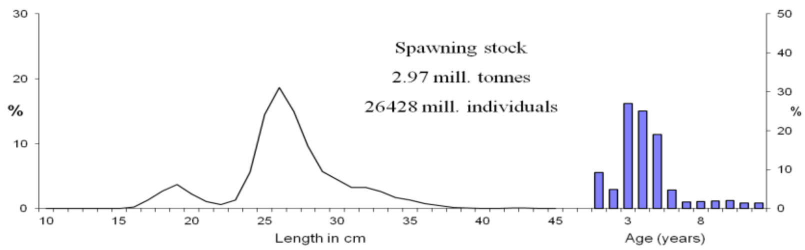
2016



2015



2014



2013

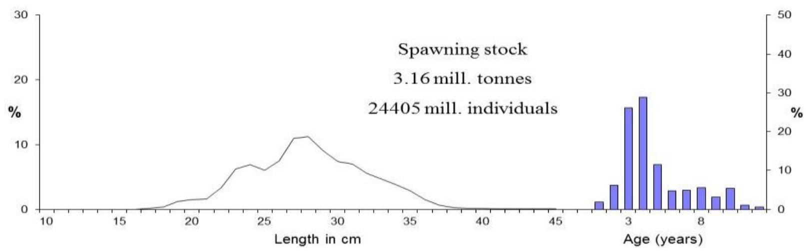


Figure 2.3.7.1.3. Blue whiting. Length (line) and age (bars) distribution of the blue whiting stock in the area to the west of the British Isles, spring 2013 (lower panel) to 2017 (upper panel). Spawning stock biomass and numbers are given.

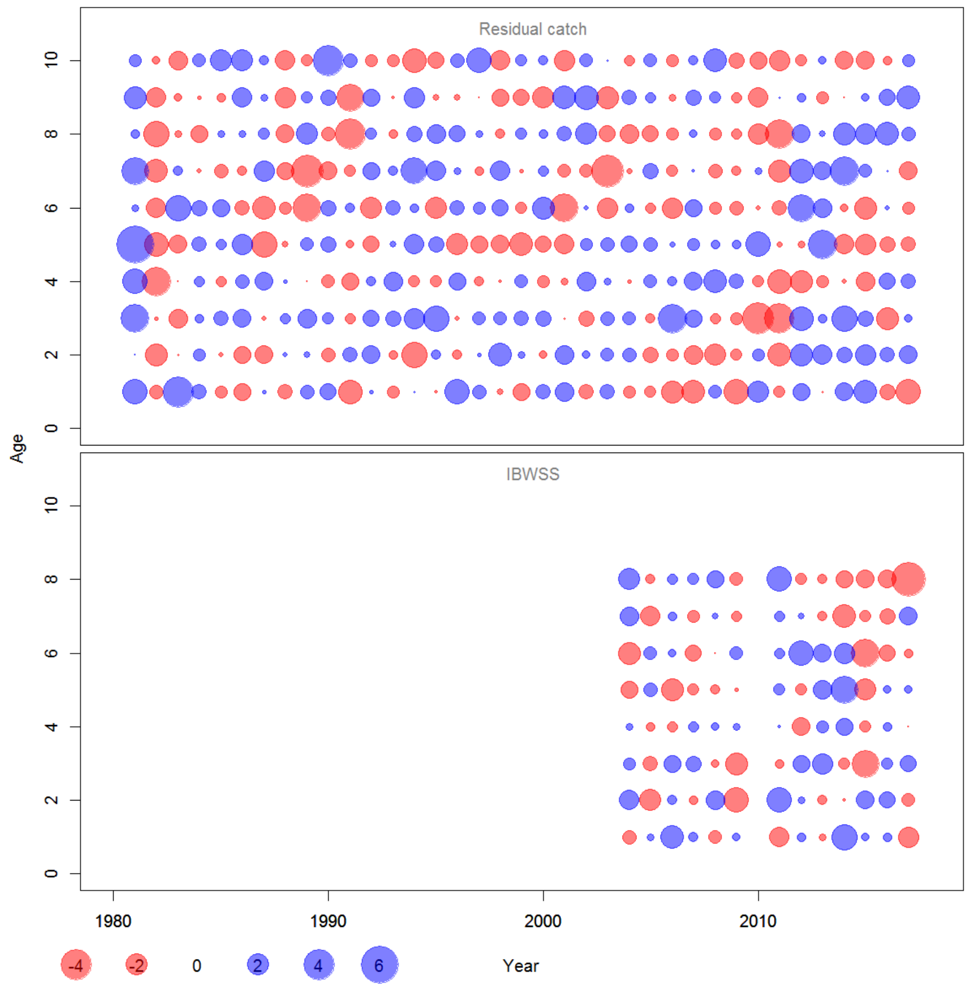
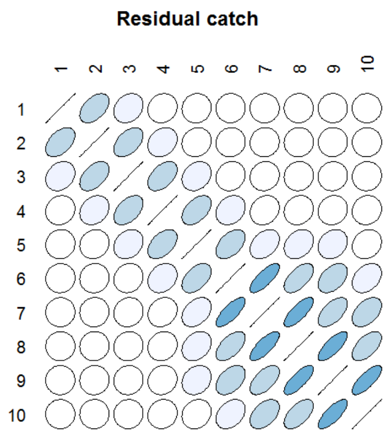


Figure 2.4.2.1. Blue Whiting. OSA (One Step Ahead) residuals (see Berg and Nielsen, 2016) from catch at age and the IBWSS survey. Red (lighter) bubbles show that the observed value is less than the expected value. Preliminary catch data for 2017 have been used.

Figure 2.4.2.2. Blue whiting. Joint sample residuals (Process errors) for stock number and F at age. Red (lighter) bubbles show that the observed value is less than the expected value. Preliminary catch data for 2017 have been used.



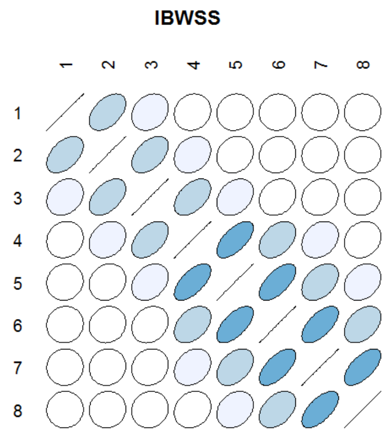


Figure 2.4.2.3. Blue whiting. The correlation matrix between ages for the catches and survey indices. Each ellipse represents the level curve of a bivariate normal distribution with the corresponding correlation. Hence, the sign of a correlation corresponds to the sign of the slope of the major ellipse axis. Increasingly darker shading is used for increasingly larger absolute correlations, while uncorrelated pairs of ages are depicted as circles with no shading.

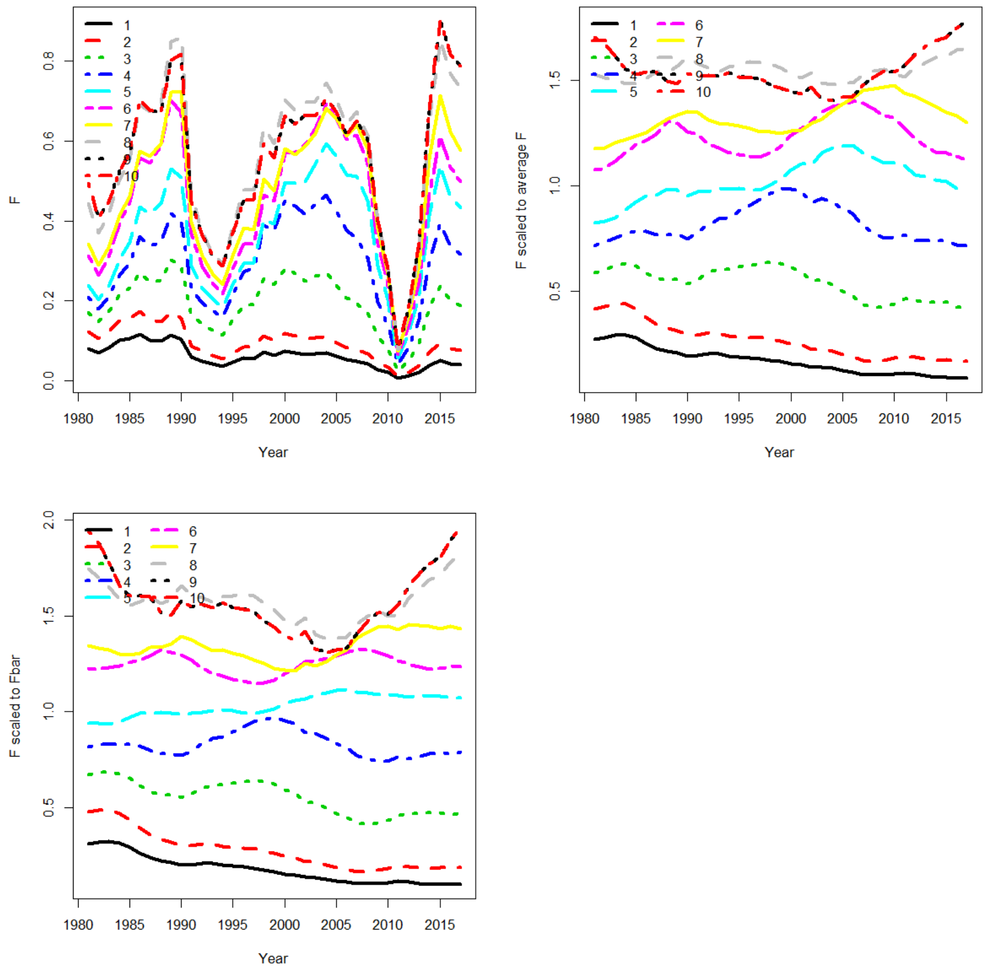


Figure 2.4.2.4. Blue whiting. F at age and exploitation pattern (F scaled to mean F all ages, and F scaled to mean F ages 3-7). Values for 2017 are preliminary.

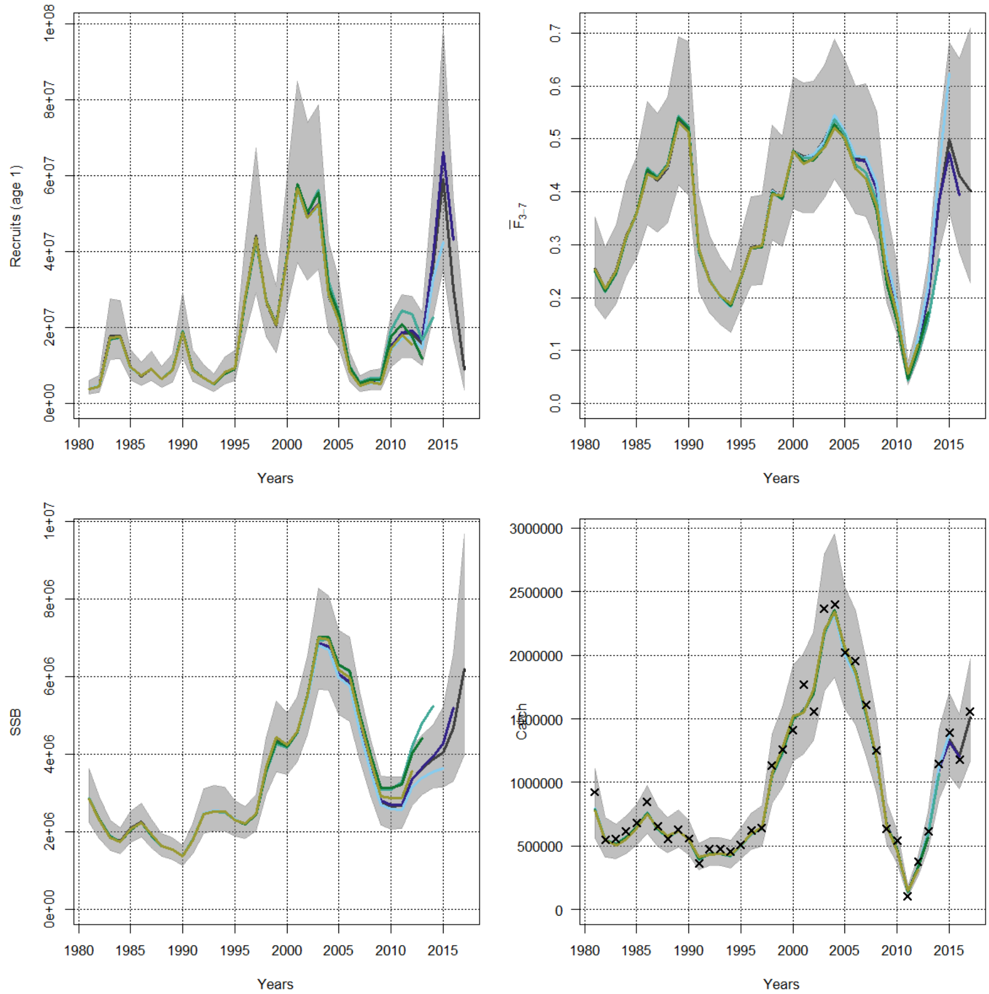


Figure 2.4.2.5. Blue whiting. Retrospective analysis of recruitment (age 1), SSB (tonnes), F and total catch using the SAM model. The 95% confidence interval is shown for the most recent assessment.

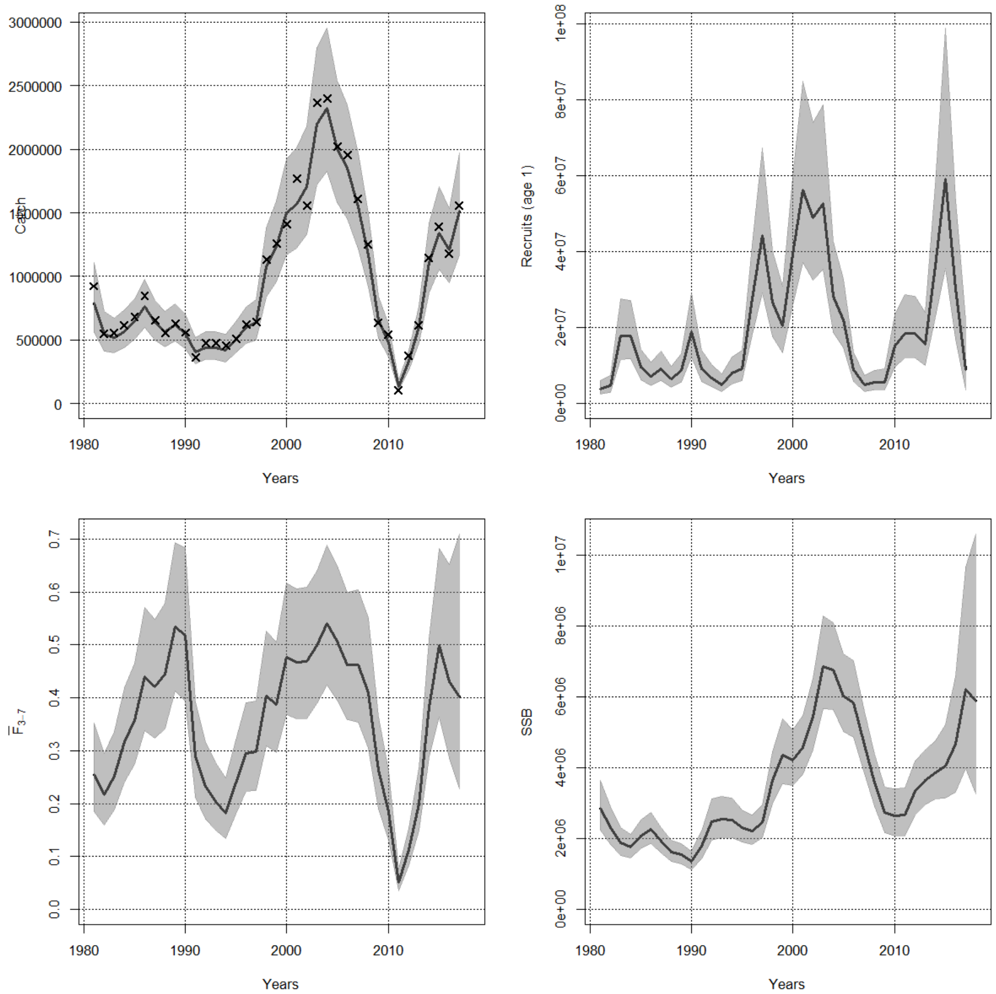


Figure 2.4.2.6.Blue whiting. SAM final run: Stock summary, total catches (tonnes), recruitment (age 1), F and SSB (tonnes). The graphs show the median value and the 95% confidence interval. The catch plot does also include the observed catches Catches for 2017 are preliminary.

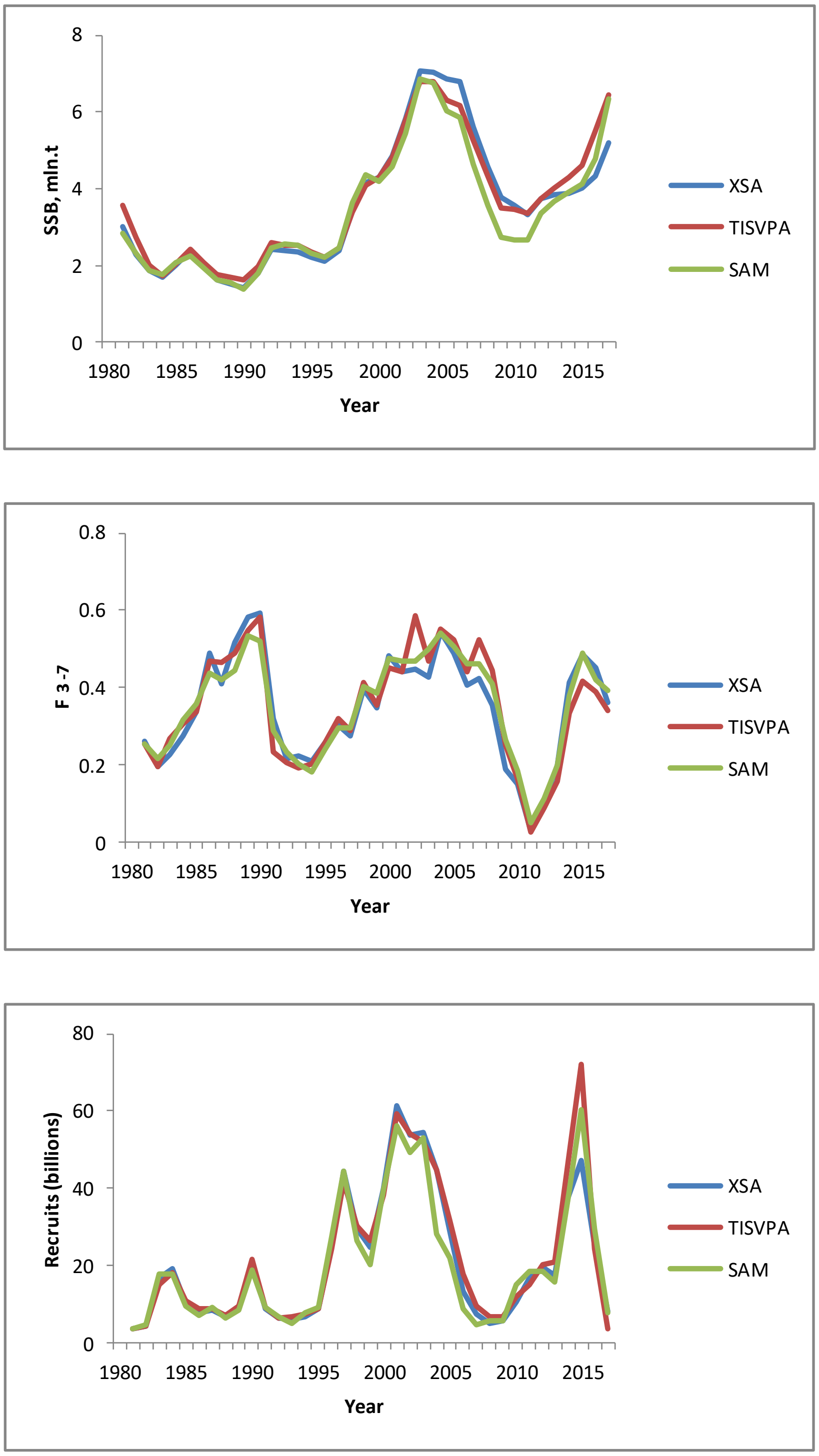


Figure 2.4.3.1. Blue whiting. Comparison of SSB and F estimated by the assessment programs TISVPA, XSA and SAM. Catch values for 2017 are preliminary. The comparison was made for preliminary data which in practical terms do not deviate from the final data used in the assessment.

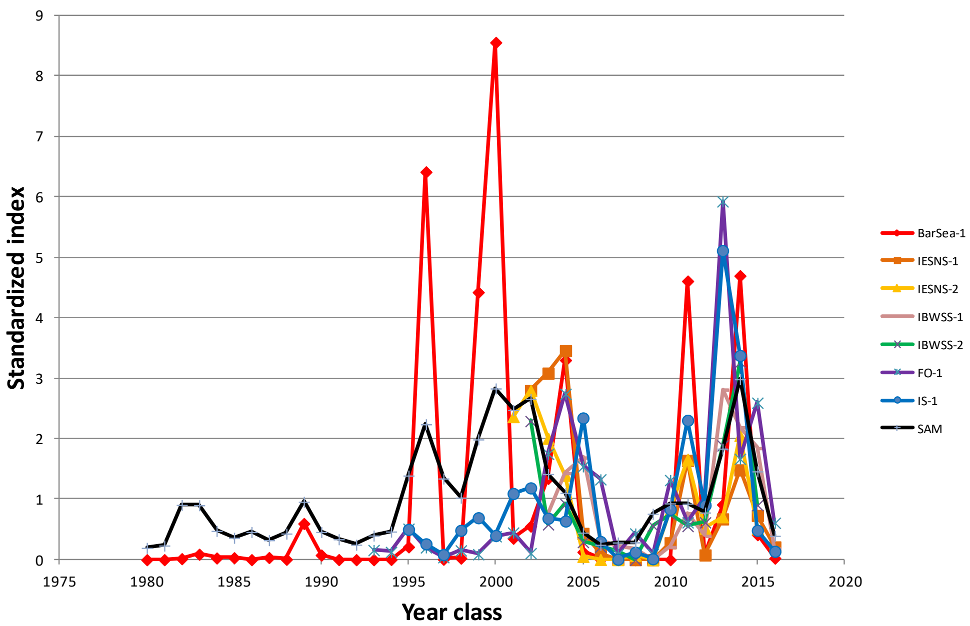


Figure 2.8.1.1. Blue whiting young fish indices from five different surveys and recruitment index from the assessment, standardized by dividing each series by their mean. BarSea - Norwegian bottom trawl survey in the Barents Sea, IESNS: International Ecosystem Survey in the Nordic Seas in May (1 and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

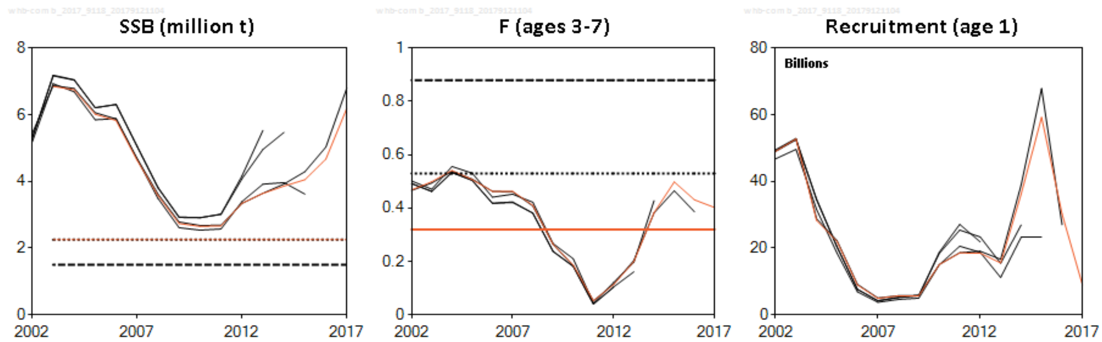


Figure 2.9.1. Blue whiting. Comparison of the 2010 - 2017 assessments.