WORKING GROUP ON WIDELY DISTRIBUTED STOCKS (WGWIDE)

VOLUME 07 | ISSUE 96

ICES SCIENTIFIC REPORTS

RAPPORTS SCIENTIFIQUES DU CIEM

ICES INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA
CIEM CONSEIL INTERNATIONAL POUR L'EXPLORATION DE LA MER

International Council for the Exploration of the Sea
Conseil International pour l’Exploration de la Mer

H.C. Andersens Boulevard 44-46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

ISSN number: 2618-1371

ICES Scientific Reports

Volume 07 | Issue 96

WORKING GROUP ON WIDELY DISTRIBUTED STOCKS (WGWIDE)

Recommended format for purpose of citation:

ICES. 2025. Working Group on Widely Distributed Stocks (WGWIDE).
ICES Scientific Reports. 07:96. 921 pp. https://doi.org/10.17895/ices.pub.30233824

Editors

Erling Kåre Stenevik

Authors

Paula Alvarez • Jan Arge Jacobsen • Esther Beukhof • Sigurvin Bjarnason • Thomas Brunel
Andrew Campbell • Gersom Costas • Rosario Dominguez • Afra Egan • Sólvá Káradóttir Eliasen
Edward Farrell • Patrícia Gonçalves • Anna H. Ólafsdóttir • Åge Høines • Eydna Homrum
Teunis Jansen • Andrzej Jaworski • Jose Luis Cebrian • Steven Mackinson • David Miller • Richard Nash
Leif Nøttestad • Alessandro Orio • Rosana Ourens • Campbell Pert • Are Salthaug • Aril Slotte
Claus Sparrevohn • Erling Kåre Stenevik • Jens Ulleweit • Sindre Vatnehol • Joseph Watson

ICES
CIEM
International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

Contents

i Executive summary

WGWIDE reports on the status and considerations for management of the 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.

2025 advice was drafted for seven of the stocks (excluding striped red mullet). Benchmark is proposed for 2027 for blue whiting while and Boarfish and both horse mackerel stocks were benchmarked in 2024. Mackerel and herring was benchmarked in 2025, and new assessment has been approved for both stocks.

Northeast Atlantic Mackerel. This migratory stock is widely distributed throughout the Northeast Atlantic with significant fisheries in several ICES subareas. The assessment conducted in 2025 was based on the data and configuration agreed during the 2025 benchmark and incorporates updates to the commercial catch, tagging index, swept area index, and egg survey index. Advice is given based on stock reference points which were updated during the 2025 benchmark. SSB has been declining since 2014 and is below B_{lim} in 2025. Fishing mortality has been increasing since 2019 and above F_{MSY} since 2022.

Blue Whiting. This pelagic gadoid is widely distributed in the eastern part of the North Atlantic. The current assessment configuration (inter-benchmark in 2016) uses preliminary catch and sampling data along with the acoustic survey data from the current year. The 2025 update assessment indicates that SSB has been increasing until 2024 following strong recent recruitment and is well above MSY $B_{trigger}$, even though a decline in SSB is estimated since 2024. Fishing mortality has been above F_{MSY} since 2014.

Norwegian Spring Spawning Herring. This stock is migratory, spawning along the Norwegian coast and feeding throughout much of the Norwegian Sea. The assessment conducted in 2025 was based on the data and configuration agreed during the 2025 benchmark. SSB has been declining since 2007, except for an increase in 2021-2022 which was due to the strong 2016 year-class entering the SSB. Fishing mortality has been below F_{MSY} since 2019 (except for 2020). Recruitment in 2016-2020 is estimated to be below average and SSB is below MSY $B_{trigger}$ in 2025 and decreasing further in 2026. However, recruitment in 2021 and 2022 is estimated to be above average, and SSB is forecast to be above MSY $B_{trigger}$ in 2027 if the management strategy is followed in 2026.

Western Horse Mackerel. The western stock of horse mackerel is distributed throughout ICES subareas 4,6,7,8 and 9. Following a benchmark in 2017, the stock is assessed using the Stock Synthesis integrated assessment model and improvements to the assessment were done in the 2024 benchmark. Stock reference points were revised in 2024 and new reference points were estimated. Following a period of declining SSB, there has been a modest upward trend since 2015, albeit from a low level. The 2025 assessment indicates that SSB is above MSY $B_{trigger}$ in 2025 and 2026. The assessment has been displaying significant retrospective bias, but changes made to the assessment in the 2024 benchmark have improved the diagnostic analyses compared to the previous model.

North Sea Horse Mackerel. In the 2024 benchmark, a SAM assessment was set up for the North Sea horse mackerel. The new assessment includes catch data, a commercial CPUE index and a combined SSB index from two ground fish surveys. The change resulted in the stock being moved from a category 3 to a category 1 stock and a new advice for 2025 replaced the advice issued in 2023. New reference points were estimated in the 2024 benchmark, but some of the reference point (F_{MSY}, F_{pa}) could not be reliably estimated. The SSB is estimated to be below B_{lim} in 2025 and forecast to be below B_{lim} in 2026 and to remain below B_{lim} in 2027 even with zero catch in 2026. Based on the MSY approach the advice for 2026 is therefore for zero catch.

Northeast Atlantic Boarfish. Boarfish is a small, pelagic, planktivorous, shoaling species, found over much of the Northeast Atlantic shelf but primarily in ICES subareas 4,6,7 and 8. The directed fishery occurs primarily in the Celtic Sea and developed during the early 2000s, initially unregulated before the introduction of a TAC in 2011. In the 2024 benchmark a length based analytical assessment in Stock Synthesis 3 was set up including catch data, a combined acoustic survey biomass index, a combined ground fish survey biomass index, and new reference points were estimated. Based on the new assessment, the stock was moved from category 3 to category 1 and a new advice for 2025 replaced the advice issued in 2023. The current assessment indicates that, following a decline from 2012 to 2019, SSB has been increasing sharply in recent years following high recruitment in 2017 to 2019, but declining since 2024. SSB is estimated to be well above MSY $B_{trigger}$ in 2025 and forecast to remain above MSY $B_{trigger}$ in 2026 and 2027.

Northeast-Atlantic Red Gurnard. This stock was first considered by WGWIDE in 2016 with advice issued biennially. The assessment was benchmarked in 2021 and a survey-based relative biomass indicator was developed. The 2025 update assessment continues to show the indicator fluctuating without trend since 2010. However, large uncertainties remain with regard to landings data due to poor resolution at the species level and reported discarding levels vary widely.

Striped Red Mullet in Bay of Biscay, Southern Celtic Seas, Atlantic Iberian Waters. No assessment is available for this stock and information on abundance and exploitation level is limited with advice given triennially on the basis of the precautionary approach. However, there are a number of research projects underway which will inform the planned benchmark and potential upgrade of the assessment category.

ii Expert group information

Expert group name	Working Group on Widely Distributed Stocks (WGWIDE)
Expert group cycle	Annual
Year cycle started	2024
Reporting year in cycle	1/1
Chair	Erling Kåre Stenevik, Norway
Meeting venue and dates	27 August – 2 September 2025, Copenhagen, Denmark

1 Introduction

1.1 Terms of References (ToRs)

2024/AT/FRSG24 The **Working Group on Widely Distributed Stocks** (WGWIDE), chaired by Erling Kåre Stenevik, Norway, met on 27 August to 2 September 2025 in ICES HQ in Copenhagen to:

a) Address generic ToRs for Regional and Species Working Groups.

The assessments will be carried out based on the stock annex. The assessments must be available for audit on the first day of the meeting.

Material and data relevant to the meeting must be available to the group no later than 14 days prior to the starting date.

WGWIDE will report by 10 September 2025 for the attention of ACOM.

Only experts appointed by national Delegates or appointed in consultation with the national Delegates of the expert's country can attend this Expert Group.

1.1.1 The WG work 2025 in relation to the ToRs

The WG considered updates for all eight stocks within its remit. Based upon these assessments and associated short term forecasts, the group produced draft advice sheets for Northeast Atlantic mackerel, Blue Whiting, Norwegian spring spawning herring, Western horse mackerel, North Sea horse mackerel, Boarfish and Red gurnard. All draft advice sheets were agreed in plenary. Advice sheets, report sections and assessments were audited with 2-3 working group members assigned to each stock.

1.2 Participants at the meeting

WGWIDE 2025 was attended by 35 delegates (including online participants) from the Netherlands, Ireland, Spain, Norway, Germany, Portugal, Iceland, UK (England and Scotland), Faroe Islands, France, Denmark and Sweden. The full list of participants, all of whom are authors of this report is given in Annex 1.

All the participants were made aware of ICES Code of Conduct, which all abided by and none had Conflicts of Interest that prevented them from acting with scientific independence, integrity, and impartiality.

1.3 Overview of stocks within the WG

Eight stocks are assessed by WGWIDE. In 2025, the group drafted 2026 advice sheets for seven of the stocks. A summary of the WGWIDE stocks, current data category and assessment method and advice frequency is given in the table below:

Stock	ICES code	Data Category	Assessment method	Assessment Frequency	Last Assessment
Boarfish	boc.27.6-8	1	Stock Synthesis	1	2024
Red gurnard	gur.27.3-8	3.2	Survey trends based	2	2023
Norwegian spring-sp. Herring	her.27.1-24a514a	1	SAM	1	2024
Western horse mackerel	hom.27.2a3a4a5b6a7a-ce-k8	1	Stock Synthesis	1	2024
North Sea horse mackerel	hom.27.4bc7d	1	SAM	1	2024
NE-Atlantic mackerel	mac.27.nea	1	SAM	1	2024
Striped red mullet	mur.27.67a-ce-k89a	5	No assessment	3	2023
Blue whiting	whb.27.1-91214	1	SAM	1	2024

1.4 Quality and Adequacy of fishery and sampling data

1.4.1 Sampling Data from Commercial Fishery

Each year, the working group reviews available sampling data and the level of sampling on the commercial fisheries. Details are given in the relevant stock-specific sections of this report.

Generally, the amount and quality of available data to the WG has been unchanged in the most recent years. However, in 2022 no Russian data submissions were available (for 2021). Russian catch data for 2022, 2023 and 2024 for NEA Mackerel, Blue Whiting and Norwegian Spring-Spawning Herring were available and used in the assessments of the three stocks.

The WG identified issues associated with the formatting and availability of data from commercial catch sampling programmes such as the requirement for length frequency and age-length key data for the assessment of Western horse mackerel and the availability of data arising from the sampling of catches of North Sea horse mackerel from foreign flagged vessels. The issues have been included on the individual stock issue lists and the ICES data call has been updated such that future data submissions should provide data in the appropriate format.

The Pelagic Freezer-trawler Association (PFA) initiated a self-sampling programme in 2015, aimed at expanding and standardizing ongoing fish monitoring programmes by the vessel quality managers on board of the vessels. An overview of the self-sampling in widely distributed pelagic fisheries from 2018 onwards is presented in the text table below.

Year	Number Vessels	Number Trips	Number Days	Number Hauls	Catch (t)	Catch per Day (t)	Number Length Measurements
2019	16	97	1,233	2,668	225,059	183	126,772
2020	17	115	1,441	3,066	309,552	215	168,949

Year	Number Vessels	Number Trips	Number Days	Number Hauls	Catch (t)	Catch per Day (t)	Number Length Measurements
2021	19	119	1,401	2,881	282,898	202	140,339
2022	18	112	1,244	2,708	236,681	190	95,949
2023	18	119	1,257	2,941	280,453	223	164,868
2024	17	128	1308	3,097	306,256	234	195,638
2025*	14	64	856	2,088	207,891	243	177,967
(all)		754	8,740	19,449	1,848,791		1,070,482

***incomplete**

In the 2025 self-sampling report, a standardized CPUE calculation has been included for most of the stocks. The standardized CPUE is based on a GLM model with a negative binomial distribution. The response variable is catch by week and vessel, with an offset of the log effort (number of fishing days per week) and explanatory variables year, GT category, month, division and depth category. An assumed technical efficiency increase of 2.5% per year has been included in the fitting of the model (Rousseau et al 2019)

The trends in the 2025 Mackerel assessment are quite different from the standardized CPUE for the PFA vessels which shows a stabilisation of the stock while the stock assessment points to a sharp decline. The trends for Western horse mackerel CPUE and North Sea horse mackerel are included in the assessment and are in line with stock trends estimated by the stock assessment models. The CPUE for blue whiting showed a rather stable stock in the past 7 years while the stock assessment clearly shows a peak at around 2018, a decline followed by a peak again in 2022-2024. PFA will interact with the skippers to find an explanation for this difference in CPUE and stock trends as it is clear that the fishery was good this year. For 2025, preliminary CPUE results of the PFA fleet show a decline of approximately 10%, contrasting sharply with the 30% decline from the assessment.

1.4.2 Catch Data

The WG has on a number of occasions discussed the accuracy of the catch statistics and the possibility of large scale under reporting or species and area misreporting. The working group considers that the best estimates of catch it can produce are likely to be underestimates.

In the case of red gurnard catch data, the available information is of poor quality. Prior to 1977, red gurnard catches were not reported. Since this time, landings of gurnards have often been reported as mixed gurnards, or using the incorrect species code. With the exception of Portugal, there is no detail provided to the WG on the methodology used to estimate the proportion of red gurnards in mixed landings.

1.4.3 Discards

In 2015, the European Union introduced a landing obligation for fisheries directed on small pelagic fish including mackerel, horse mackerel, blue whiting and herring. The obligation was expanded over the following years in a stepwise fashion such that discarding of small pelagic species could still legally occur in other fisheries. From 2019 onwards the landing obligation is generally effective. A general discard ban is already in place for Norwegian, Faroese and Icelandic fisheries.

Historically, discarding in pelagic fisheries is more sporadic than in demersal fisheries. This is because the nature of pelagic fishing is to pursue schooling fish, creating hauls with low diversity of species and sizes. Consequently, discard rates typically show extreme fluctuation (100% or zero discards). High discard rates occurred especially during ´slippage´ events, when the entire catch is released. The main reasons for ´slipping´ are daily or total quota limitations, illegal size and mixture with unmarketable bycatch. Quantifying such discards at a population level is extremely difficult as they vary considerably between years, seasons, species targeted and geographical region.

Discard estimates of pelagic species from pelagic and demersal fisheries have been published by several authors. Discard percentages of pelagic species from demersal fisheries were estimated between 3% to 7% (Borges *et al.*, 2005) of the total catch in weight, while from pelagic fisheries were estimated between 1% to 17% (Pierce *et al.* 2002; Hofstede and Dickey-Collas 2006, Dickey-Collas and van Helmond 2007, Ulleweit and Panten 2007, Borges *et al.* 2008, van Helmond and van Overzee 2009, 2010, van Overzee and van Helmond 2011, Ulleweit *et al.* 2016, van Overzee *et al.* 2013, 2020). Slipping estimates have been published for the Dutch freezer trawler fleet only, with values at around 10% by number (Borges *et al.* 2008) and around 2% in weight (van Helmond *et al.* 2009, 2010 and 2011) over the period 2003—2010. In Iberian waters the discard composition of pelagic species, mainly blue whiting, in demersal fisheries were estimated between 20% and 30% of the total catch in weight (Fernandes *et al*. 2015). Nevertheless, the majority of these estimates were associated with very large variances and composition estimates of ´slippages´ are liable to strong biases and are therefore open to criticism.

Because of the potential importance of significant discarding levels on pelagic species assessments, the Working Group again recommends that observers should be placed on board vessels in those areas in which discarding occurs, and existing observer programmes should be continued. Furthermore, agreement should be made on sampling methods and raising procedures to allow comparisons and merging of dataset for assessment purposes. The newest update on discards for the different stocks assessed by the WG is provided in the sections for each of the stocks.

1.4.4 Age-reading

Reliable age data are an important prerequisite in the stock assessment process. The accuracy and precision of these data, for the various species, is kept under constant review by the Working Group. The most recent updates on this aspect for the different stocks are addressed below.

1.4.4.1 Mackerel

An age calibration exercise was carried out in 2024/2025. A total of 268 otolith images from the main areas of mackerel distribution were included in the exchange which were representative of the temporal and spatial coverage of otoliths read for stock assessment purposes. The exercise was completed by 15 readers from 9 countries. There were 9 advanced readers whose ages are used in the data submissions and 6 basic readers. This is a reduction from the 2021 exchange which had 37 readers from 12 countries. It should be noted that some of the countries that catch large quantities of mackerel and undertake extensive sampling did not participate in this exchange.

Results from advanced readers show an overall agreement of 73%, an improvement from 69% when less experienced readers were included and up from 67.8% in the previous exchange in

2021. Agreement is highest at age 0 (96%) and remains strong for ages 1-6 (71-82%), while it is lowest for ages above 10 (37-49%). The coefficient of variation (CV) is highest for ages 1-4 (up to 38%) and stabilizes for ages 6-12 (6-17%), with some increased variability at older ages. The percentage agreement varies by reader, however overall, there is no strong systemic bias, but inconsistencies are notable at specific ages and amongst certain readers.

For basic readers, the overall agreement is lower compared to advanced readers, as expected, indicating greater variability in age readings. Basic readers tend to have higher disagreement, particularly at older ages where precision is more challenging. The coefficient of variation (CV) is also generally higher, reflecting inconsistencies in age estimation. Some readers exhibit noticeable biases, either underestimating or overestimating ages, which impacts overall reliability. These readers are new to age reading and are still in training.

While a improvement is observed, when compared with the previous exchange results in 2021, there is still room for improvement across all readers. Specific issues for individual readers to work on, are highlighted in the report. The exchange findings highlight priorities for future work, i.e. the creation of a Training Reference Collection, active engagement with technological developments around machine learning, through WGBIOP workshops and WGSMART. Additional training and calibration to improve consistency and accuracy in age estimations is also recommended.

1.4.4.2 Horse mackerel

The most recent workshop on the age reading of *Trachurus trachurus (*also *T. mediterraneus* and *T. picturatus)* was carried out in November 2018 and involved 15 age readers from 9 countries. This was followed by an otolith exchange which was conducted in 2021 for the three horse mackerel species T. Trachurus, T. mediterraneus, and T. picturatus and 28, 14 and 18 readers participated, respectively.

For T. trachurus both whole (N=249) and sliced (N=134) otoliths were read from 10 different areas (5 in the Mediterranean and 5 in the Atlantic). For whole otoliths and all readers, the weighted average percentage agreement (PA) based on modal ages for all readers is 46%, with a weighted average CV of 44% and an APE of 32%. For sliced otoliths and all readers, the weighted average percentage agreement based on modal ages for all readers is 44 %, with a weighted average CV of 22 % and an APE of 15 %. The readers had some difficulties in recognizing first ring and the edge nature, and with overlapped rings in old specimens. CV PA APE decrease for sliced oto-liths; however, high differences in the modal age is observed between same sample/different preparation.

A new full ototlith exchange is scheduled for October 2025.

1.4.4.3 Norwegian Spring-spawning Herring

For some years, there have been issues with age reading of herring. These issues were raised around 2010, and since then two scale/otolith exchanges and a workshop have been held; and a final workshop was planned after the second exchange. There were, however, concerns with the second scale/otolith exchange and the final workshop was postponed. It was therefore recommended to organise a new scale/otolith exchange and a follow up workshop.

There are several topics to cover in the recommended work.

Firstly, age-error matrices are needed as input to the stock-assessment, to evaluate sensitivity to ageing errors, and such age-error matrices are an output of age-reading inter-calibrations.

Secondly, stock mixing is an issue. There are several herring stocks surrounding the distribution area of Norwegian spring spawning (NSS) herring, *e.g.* North Sea herring, Icelandic summer spawning herring, local autumn-spawning herring in the Norwegian fjords, and Faroese autumn spawning herring. Mixing with these other stocks in the fringe areas of the NSS herring distribution area leads to confounding effects on the survey indices of NSS herring in the ecosystem surveys and potentially also in the catch data. Methods to separate the NSS herring stock from the other herring stocks are needed – both with regards to obtain more accurate age-readings as well as to reduce confounding effects on the survey indices.

Finally, the experience from earlier exchanges is that age of older fish is more prone to be underestimated when aged is read from otoliths as compared to being read from scales. Some of the institutes mainly sample and read scales, whereas other institutes use the otoliths.

In 2021, WGWIDE recommended to organise a scale/otolith exchange and workshop. This workshop, WKRANSSH was held in Bergen 17-21 April 2023 (ICES 2023a). Overall results for both exchanges and the combination were high and at acceptable levels. However, as described above, disagreement between scales and otoliths occurred especially for older individuals (age 8 and above), and disagreement between scales and otoliths occurred especially for older individuals. The next step is to investigate how these discrepancies impacts the stock assessment, based on the general age error matrix from the workshop.

1.4.4.4 Blue Whiting

In 2025, the most recent age reading workshop (WKARBLUE4) was held, following an exchange in SmartDots. Unlike previous workshops, on this one the readers only have read the otoliths from ICES Divisions that they usually read for the stock assessment. Thus, two exchanges were performed one including samples from the southern ICES Divisions (9.a and 8.c) and other one from the northern ICES Division (2.a, 5.a, 5.b, 6.a, 6.b, 7.c and 7.k). The overall results showed a high percentage of agreement (PA) between the age readers, with a PA of 90% in exchange exercise from the southern areas and of 67% for the northern areas.

The comparison between the results from 2025 WKARBLUE4 with the ones obtained from the previous workshops (WKARBLUE, WKARBLUE2 and WKARBLUE3) (ICES, 2013, ICES, 2017b, ICES, 2023c) revealed an increase in precision amongst readers from workshop to workshop.

During the 2025 workshop, as in the last two previous workshops, an effort was put to improve the age reading guidelines to increase the agreement between age readers and to use the same standards when handling the reoccurring problems on age identification, e.g, the otoliths from some areas proved to be more difficult to read, the position of the first annual growth ring, false rings and the interpretation of the edge. Considering the reoccurring problems on blue whiting age classifications, in order to overcome those and also increase the accuracy on ageing, age validations studies were further recommended and must be conducted. Furthermore, age reading exchanges and workshops are recommended to be held every 3 years, to monitor and mitigate the differences on age classifications between the readers from the different countries providing age data to blue whiting stock assessment.

1.4.4.5 Boarfish

Sampling of the commercial catch of boarfish has been included within the EU data collection framework since 2017. An age length key was produced in 2012 following increased sampling of a developing fishery. The age reading was conducted by DTU Aqua on samples from the three main fishery participants: Ireland, Denmark and UK (Scotland). No ageing has been carried out since 2012 although otoliths continue to be collected from the Irish fishery during routine catch sampling.

In November 2022, an ageing exercise was initiated via SmartDots with the aim to age samples less than 10 cm (all samples less than 10cm used in the ALK were estimations), to compile otolith images for future training purposes and to potentially shed light on the possibility of adjusting the plus group designation. A total of 158 boarfish otoliths of varying difficulty were aged by three readers from Denmark and Ireland. The otoliths were sourced from both legs of the 2022 WESPAS survey (14th June to 24th July). The fish length distribution of the samples ranged from 55 – 170mm with one third of the samples in the 55-95 mm length range. To image and read the otoliths, the protocol outlined in the boarfish age reading manual, created by DTU Aqua, was followed.

Results from the ageing exercise found that boarfish within the length range of 5.5 cm - 9.5 cm were between the ages of 1 and 3 years old. Concerning the plus group designation, the exercise wasn’t able to advise or provide useful information to support or oppose changes to the plus group. The full results from the exercise were compiled in a report and published on the SmartDots webpage (ID 509).

1.4.4.6 Striped red mullet

In 2011, an otolith exchange was carried out, the second such exercise for the striped red mullet. For details see section 10.5.

1.4.4.7 Red gurnard

Age data are available for red gurnard from the EVHOE and IGFS groundfish surveys. Improvements in the understanding of the age structure of this stock would be improved by reading otoliths from other surveys in the assessment area (*e.g.* NS-IBTS, SCO-WCS, CGFS) which also contribute information on stock status in term of their CPUE series.

1.4.5 Horse mackerel genetic stock identification

A number of studies have attempted to investigate the genetic stock structure of horse mackerel in order to refine the stock delineation (see review in Farrell et al., 2024a). Most recently the application of Whole Genome Sequencing (WGS) approaches, developed on her-ring (see Han et al., 2020) and described by Andersson et al. (2024), have proved the most successful. Fuentes-Pardo et al. (2020; 2023) identified, for the first time, the existence of three locally adapted biological units of horse mackerel in the northeast Atlantic. Most of the popu-lation structure patterns were driven by a few highly differentiated putatively adaptive loci which indicated significant population structure between horse mackerel from the three bio-logical units underlying the three stocks. The results indicated that gene flow occurred be-tween neighbouring geographic areas, which explained why putatively neutral genetic mark-ers did not reveal any population structure. It is increasingly apparent that neutral genetic markers are generally ineffective for stock identification in marine fish species such as horse mackerel (see Andersson et al., 2024).

The primary output of Fuentes-Pardo et al. (2020; 2023) was the development of a panel of genetic markers that were capable of differentiating between the three biological units under-lying the three horse mackerel stocks. These markers were recently included on a multispecies Axiom® SNP genotyping array to enable high throughput genotyping of large numbers of samples (see Andersson et al., 2024).

The results of the large scale largescale genotyping of samples collected from 2015-2023 (145 samples, 3,075 individuals) across the three stock areas with the genotyping array were presented as a working document to the ICES Benchmark workshop on horse mackerel and boarfish stocks (WKBHMB) (ICES, 2024c; Farrell et al., 2024a). Samples comprised both baseline spawning samples and potentially mixed samples (Figure 1.4.5.1.).

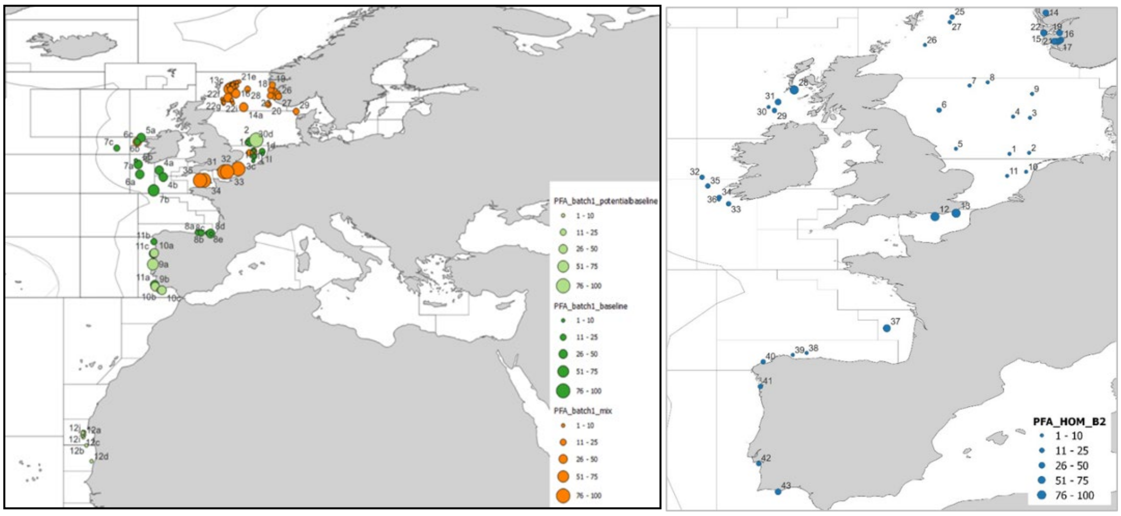


Figure 1.4.5.1. (left) Overview of sampling locations and samples genetically analysed in the original analysis in Farrell et al. (2024a). Dark green represents spawning baseline samples, Light green represents potential baseline samples and orange represents mixed samples for assignment. (right) Additional samples collected and analysed prior to the WKBHMB DEWK Farrell et al. (2024a).

Exploratory analyses of the population structure of baseline spawning samples agreed with the results in Fuentes-Pardo et al. (2020; 2023) and indicated clear genetic differentiation between three genetically differentiated biological units (Figure 1.4.5.2.). The baseline samples from the pre-WKBHMB North Sea and western stock areas clustered within their stock units, whereas the baseline samples from the southern stock areas were divided between two clusters. All of the baseline samples from the northern part of division 9.a (north of Lisbon) and one sample from south of Lisbon clustered with the baseline samples from the western stock area and were genetically indistinguishable from the western biological unit. The remaining baseline samples from south of Lisbon and the south coast of Portugal clustered together in a discrete group and were considered to represent the southern biological unit.

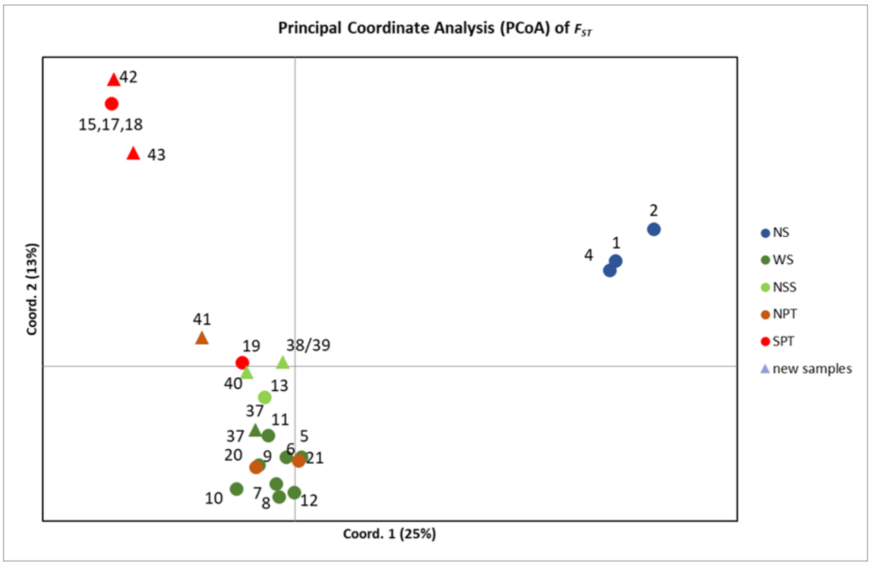


Figure 1.4.5.2. Principal Coordinate Analysis (PCoA) of F_{ST} of baseline samples in Farrell et al. (2024a). The samples are colour coded as per the baseline samples according to sampling location. NS = North Sea, WS = Western, NSS = Northern Spanish Shelf, NPT = Northern Portugal, SPT = Southern Portugal.

A support vector machine learning (*svm*) based assignment model was developed in the *R* package *assignPOP* (Chen et al., 2018) to distinguish individuals from the western and North Sea biological units and to assign individuals of unknown origin, from potentially mixed samples caught in these stock areas, to either biological unit. Monte-Carlo and *K*-fold cross-validation of the baseline dataset indicated a high level of self-assignment accuracy (> 90%). Widescale application of the model to mixed samples from the Western and North Sea stock areas revealed a clear spatial pattern of the distribution of individuals assigned to either the Western or North Sea biological units (Figure 1.4.5.3). The North Sea individuals were primarily restricted to the southern part of 4.b, 4.c and 7.d. There was little evidence of North Sea individuals in divisions 3.a or 4.a, where samples comprised primarily individuals from the Western biological unit. The patterns of assignment in the channel (divisions 7.d and 7.e) also indicated a significant issue with the current delineation of the North Sea stock. The samples from 7.d contained a significant proportion of samples from the Western biological unit and there was also potential temporal variation in the relative mixing proportions. There was also evidence of individuals from the North Sea biological unit in 7.e.

Due to the small number of baseline samples from the Southern biological unit it was not possible to develop an assignment model to distinguish the Southern and Western biological units. However it was possible to conclude that there was mixing of the Western and Southern units along the Portuguese coast but the majority of the Southern individuals were caught south of Lisbon.

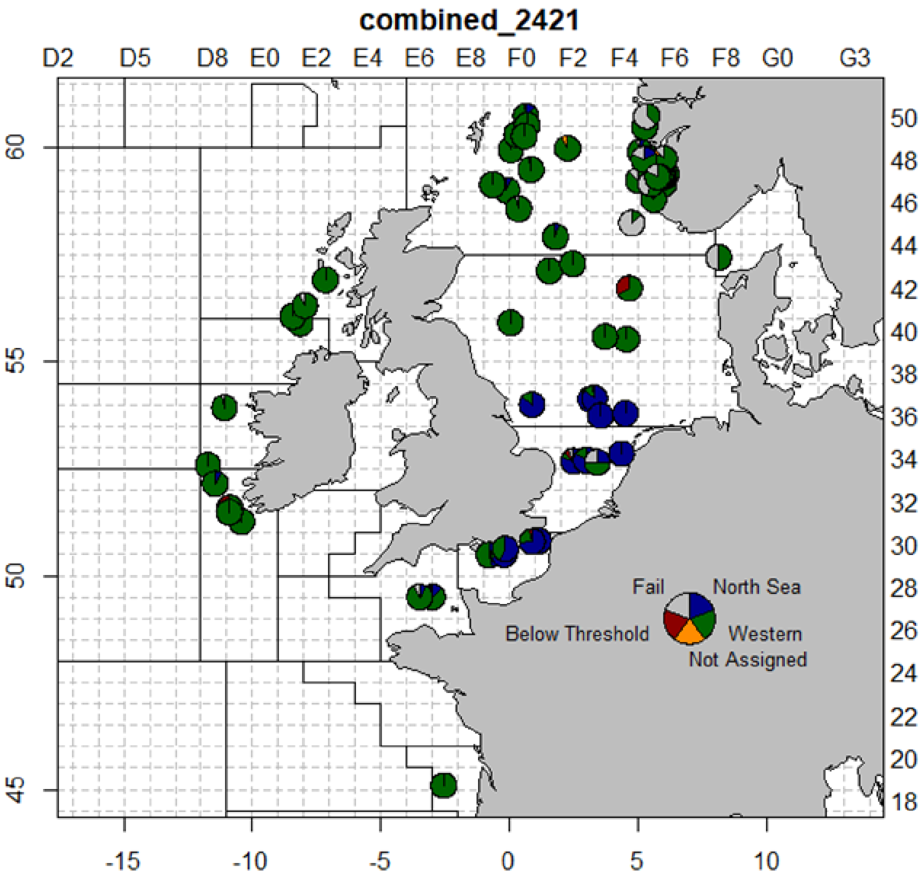


Figure 1.4.5.3. The output of the combined assignments, with the *western-Northsea* panel, of the mixed samples from all quarters.

The Western biological unit has the widest distribution and based on the samples analysed ranged from division 4.a in the north, to division 3.a in the east and south into division 9.a. Based on the samples analysed spawning occurs to the west and southwest of Ireland, in the Bay of Biscay along the Northern Spanish Shelf and in Portuguese waters. The Western unit also occurs in divisions 7.e and 7.d in significant numbers and may also be present in divisions 4.b at certain times of the year.

The horse mackerel that spawn in the southern North Sea are a locally adapted biological unit, which based on the samples analysed, has a limited distribution and occurs primarily in divisions 4.b and 4.c and also in 7.d where it mixes with the Western biological unit. It was also recorded as the minority component in samples from division 7.e and in small numbers in samples from division 4.a.

The Southern biological unit was the least well sampled in Farrell et al. (2024a). Only a small number of spawning individuals were collected in the Southern part of division 9.a. These individuals were genetically characteristic of the Southern unit, which is more closely related to the north African population than to the Western biological unit.

In summary, widescale application of the genetic stock identification approach indicated that the current delineation of the three horse mackerel stocks is not appropriate for the purposes of data collection and collation for stock assessment. Further development of the genetic assignment models is required in order to establish a robust basis for realignment of the stock assessment areas and/or for splitting catch and survey data by biological unit.

Based on the review of the history of the stock identification of horse mackerel and the new genetic information presented in Farrell et al. (2024a), WKBHMB considered two actions as part of the current benchmark:

1. the reallocation of the catches in divisions 3.a and 4.a in quarters 1 and 2 from the North Sea stock to the Western stock;
2. the undertaking of sensitivity analysis of the North Sea assessment to the genetic assignment results from divisions 7.d and 7.e.

In order to progress these actions the WKBHMB requested the Stock Identification Methods Working Group (SIMWG) to review a brief summary working document with the genetic stock Identification results of the Western and North Sea analyses be prepared (Farrell, 2024b).

SIMWG endorsed the two actions and action 1 was conducted as part of WKBHMB. There was insufficient to undertate the sensitivity analyses and it was planned to do this in advance of WGWIDE 2024 and to present it as part of the North Sea horse mackerel assessment. This action remains to be completed and to date the mixing issue has not been accounted for in the North Sea assessment catch or survey data. As such the assessment likely overestimates to the biomass of horse mackerel from the North Sea biological unit. Further genetic sampling has been conducted by CEFAS and the PFA and it is expected that the results will be presented in WGWIDE 2026.

1.4.6 Current methods of compiling fisheries assessment data

Information on official, area misreported, unallocated, discarded and sampled catches have again this year been recorded by the national laboratories on the WG-data exchange sheet (MS

Excel; for definitions see text table below) and sent to the stock co-ordinators and uploaded through InterCatch. Co-ordinators collate data using the either the sallocl (Patterson, 1998) application which produces a standard output file (sam.out) or InterCatch.

There are at present no specified criteria on the selection of samples for allocation to unsampled catches. The following general process is implemented by the species co-ordinators. A search is made for appropriate samples by gear (fleet), area, and quarter. If an exact match is not available the search will extend to adjacent areas, should the fishery extend to this area in the same quarter. Should multiple samples be available, more than one sample may be allocated to the unsampled catch. A straight mean or weighted mean (by number of samples, aged or measured fish) of the observations may be used. If there are no samples available the search will move to the closest non-adjacent area by gear (fleet) and quarter, but not in all cases.

It is not possible to formulate a generic method for the allocation of samples to unsampled catches for all stocks considered by WGWIDE. However full documentation of any allocations made are stored each year in the data archives (see below). It should be noted that when samples are allocated the quality of the samples may not be examined (i.e. numbers aged) and that allocations may be made notwithstanding this. The Working Group again encourages national data submitters to provide an indication of what data could be used as representative of their unsampled catches.

Following the introduction of the landings obligations for EU fisheries new catch categories had to be introduced from 2015 onwards. The catch categories used by the WGWIDE are detailed below:

Official Catch	**Catches as reported by the official statistics to ICES**
Unallocated Catch	Adjustments (positive or negative) to the official catches made for any special knowledge about the fishery, such as under- or over-reporting for which there is firm external evidence.
Area misreported Catch	To be used only to adjust official catches which have been reported from the wrong area (can be negative). For any country the sum of all the area misreported catches should be zero.
BMS landing	Landings of fish below minimum landing size according to landing obligation
Logbook registered discards	Discards which are registered in the logbooks according to landing obligation
Discarded Catch	Catch which is discarded
WG Catch	The sum of the 6 categories above
Sampled Catch	The catch corresponding to the age distribution

1.4.7 Quality of the Input data

Primary responsibility for the accuracy of national biological data lies with the national laboratories that submit such data. Each stock co-ordinator is responsible for combining, collating, and interpolating the national data where necessary to produce the input data for the assessments. A number of validation checks are already incorporated in the data submission spreadsheet currently in use, and these are checked by the co-ordinators who in the first instance report anomalies to the laboratory which provided the data.

Overall, data quality has improved and sampling deficiencies have been reduced compared to earlier years, partly due to the implementation of the EU sampling regulation for commercial catch data. However, some nations still have no (or inadequate) aged samples. Occasionally, no data are submitted such that only catch data from EuroStat is available, which are not aggregated quarterly but are yearly catch data per area.

The Working Group documents sampling coverage of the catches in two ways. National sampling effort is tabulated against official catches of the corresponding country (see stock specific sections). Furthermore, tables showing total catch in relation to numbers of aged and measured fish by area give a picture of the quality of the overall sampling programme in relation to where the fisheries are taking place. These tables are contained in the species sections of this report.

The national data on the amount and the structure of catches and effort are archived in the ICES InterCatch database. The data are provided directly by the individual countries and are highly aggregated for the use of stock assessments.

There exist gaps in some data series, in particular for historical periods. The WG has requested members to provide any national data reported to previous working groups (official catches, working group catches, catch-at-age and biological sampling data) not currently available to the WG. Furthermore, the WG recommends that national institutes increase national efforts to collate historic data.

A number of stock data problems relevant to data collections have been brought forward to the contact person in preceding years. Those that still apply are listed in table below for the information of ICES-Working Groups and RCMs as specified.

Stock	Data Problem	How to be addressed in	By whom
Northeast Atlantic Mackerel	Submission of data	Data submissions must include all the data outlined in the data call and be submitted by the deadline. Data should include biological data from catch sampling ad survey programmes. Should the data submitter be unavailable after the data has been submitted (e.g. vacation) an alternative contact should be available who can be contacted in the event of any queries.	National laboratories
Northeast Atlantic Mackerel	Discard and slippage information	Discard and slippage information is incomplete. All fleets, including demersal fleets should be monitored and sampled for discards and slipping. Data should be supplied to the coordinator by the submission deadline, accompanied by documentation describing the sampling protocol.	National laboratories, RCG NA, RCG NS&EA
Northeast Atlantic Mackerel	Sampling deficiencies– general	All countries involved should provide sampling information. Increased cooperation between countries would help reduce redundancy and increase coverage.	National laboratories, RCG NA, RCG NS&EA
Northeast Atlantic Mackerel	Sampling of foreign vessels	Any information available from the sampling of foreign vessels should be forwarded to the appropriate person in the national laboratory in order that they may use this information when compiling the data submission.	National laboratories; RCG NA, RCG NS&EA
Horse Mackerel – Western Stock	Missing sampling data for some parts of the distribution area (e.g. 27.2a)	Fishing nations to Sample age and length Distributions from commercial fleets	National Institutes
Horse Mackerel – North Sea Stock	Incomplete report of discards by non-pelagic fleet.	Reporting of discards by national institutes.	National Institutes

Stock	Data Problem	How to be addressed in	By whom
Horse Mackerel – North Sea Stock	Lack of maturity ogive both by age or length	Collection of information about maturity stage during regular biological sampling (otoliths) in commercial and survey fleets	National institutes
Horse Mackerel – North Sea Stock	Lack of length distributions in the discarded component	Sampling of length distribution of discarded individuals	National institutes
Norwegian Spring-spawning Herring	Low sampling effort on some nations	Sampling effort should be increased by nations with little or no samples.	National laboratories; RCG NS&EA
Red gurnard	Species level catch reporting and sampling	Red gurnard catches should be reported to species level and with the appropriate codification. Where reported as mixed gurnards, this should be accompanied by documented procedures for estimating the proportion of red gurnard.	National laboratories
Red gurnard	Discard and slippage information	Discard rates for this species can be very high (up to 100% of catch at a trip level). Alternative data sources and methods for estimation (e.g. CCTV systems) should be investigated.	National laboratories
Red gurnard	Stock area	Red gurnard is found all along the Iberian continental shelf. There are no records of catches of red gurnards in SA5, and this area could be removed from the data call.	
Northeast Atlantic Blue whiting	Submission of data	Data submissions must include all the data outlined in the data call and be submitted by the deadline. Should the data submitter be unavailable after the data has been submitted (e.g. vacation) an alternative contact should be available who can be contacted in the event of any queries.	National laboratories

1.4.8 Quality control of data and assessments, auditing

As a quality control of the data and the assessment, WG participants were appointed as auditors for each stock. The primary aim of the auditing process is to check that the assessment and forecast has been conducted as detailed in the relevant stock annex. Auditors conducted checks of the assessment input data, assessment code (time permitting), draft WG report and draft advice sheet. Auditors completed an audit report upon completion (annex 4). Issues identified in the audit reports were followed up by the appropriate stock coordinator/assessor with updates made where appropriate.

1.5 Comment on update and benchmark assessments

Updates were presented to the WG for the stocks in the group.

Boarfish, Western and North Sea horse mackerel were assessed on basis of a benchmark that took place in 2024 (ICES, 2024c). NEA mackerel and Norwegian spring spawning herring were assessed based on a benchmark that took place in 2025 (ICES, 2025b). The Blue whiting SAM assessment was introduced following a benchmark in 2012. Since this time, an inter-benchmark in 2016 incorporated the use of preliminary in-year catch data with the stock weights in the assessment year estimated from catch sampling incorporated in 2019 (previously the average of the most recent three years was used). The acoustic survey time series was updated in 2020 following recalculation by the StoX platform with minor updates to the historic index. The red gurnard assessment conducted at WGWIDE 2025 followed a benchmark in February 2021 (WKWEST) during which an index of abundance based on a number of bottom trawl surveys was developed.

The remaining stock addressed by the WG (striped red mullet) has not been benchmarked recently but was still assessed by the WG.

1.6 Planning future benchmarks

Full benchmarks are scheduled for Blue whiting in 2027.

The current status of the WGWIDE stocks with respect to benchmarking is summarised below:

Stock	Benchmark History	WGWIDE 2023 Proposal
Boarfish	Full benchmark 2024	
Red gurnard	Full benchmark 2021	
Norwegian Spring Spawning herring	Full benchmark 2025 Full benchmark 2016	
Western horse mackerel	Full benchmark 2024 Reference point interbenchmark 2019 Full benchmark 2017	
North Sea horse mackerel	Full benchmark 2024 Full benchmark 2017	
Northeast Atlantic mackerel	Full benchmark 2025 Interbenchmark 2019 Full benchmark 2017 Full benchmark 2014	
Striped red mullet	No benchmark	
Blue whiting	Inter-benchmark 2016 Full benchmark 2012	

1.7 Scientific advice and management of widely distributed and migratory pelagic fish

1.7.1 General overview of management system

The North East Atlantic Fisheries Commission (NEAFC) is the Regional Fisheries Management Organisation (RFMO) for the North East Atlantic. NEAFC is an end user of ICES advice and provides a forum for its contracting parties (Coastal States and fishing parties) to manage the exploitation of straddling stocks that occur in several EEZs and international waters such as WGWIDE stocks North East Atlantic Mackerel, Blue Whiting and Norwegian Spring Spawning herring (also known as Atlanto-Scandian herring). There are 6 contracting parties to NEAFC: Denmark (in respect of the Faroe Islands and Greenland), European Union, Iceland, Norway, Russian Federation and the UK. The management of Western horse mackerel is not considered by NEAFC with sharing subject of separate agreements between EU, Norway and the UK.

1.7.2 Management plans

Catch advice in recent years for two stocks considered by WGWIDE has been given on the basis of an agreed long term management strategy:

- A long-term management strategy for Norwegian spring spawning herring was agreed by the European Union, the Faroe Islands, Iceland, Norway and Russian Federation in 2018 following an evaluation by ICES (WKNSSHMSE, ICES, 2018a) which found it to be precautionary. The plan is based on a target fishing mortality of 0.14 when the stock is above B_{pa}. Should SSB fall below B_{pa}, the target fishing mortality is linearly reduced to 0.05 at and below B_{lim}. The plan incorporates TAC change limits of -20% and +25% which are suspended when below B_{pa} and 10% interannual transfer which is suspended when below B_{lim}. The plan was scheduled for review no later than 2023 but this has not yet been conducted. The assessment has been recently benchmarked and a number of updates were implemented. A limited analysis suggests that the current management plan likely remains precautionary although a full re-evaluation is recommended in light of the updates to the assessment. Although the management plan is agreed by the parties involved in the fishery and ICES advice is based on application of the management strategy, there has been no agreement on the relative catch share since 2013 with the total unilaterally declared quotas exceeding the management plan based catch advice since this time.
- A long term management strategy for Blue Whiting was agreed by the European Union, the Faroe Islands, Iceland and Norway in 2016 following an evaluation by ICES (WKBWMS, ICES, 2016) in 2016 which found it to be precautionary. The plan is based on a target fishing mortality equivalent to F_{MSY} (0.32) when the stock is above B_{pa}. Should SSB fall below B_{pa}, the target fishing mortality is linearly reduced to 0.05 at and below B_{lim}. The plan incorporates TAC change limits of +/-20% which are suspended when below B_{pa} and 10% interannual transfer. The Coastal States subsequently agreed a long-term management plan for the blue whiting stock with a TAC change limit of -20%/+25% and a new clause (6.b.) stating that the TAC change limit is not applied when the catch advice deviates more than 40% from the TAC of the preceding year (clause 6.b., see Annex 1 in Anon, 2021). This clause was then evaluated by ICES and found precautionary in 2017 (Working Document in ICES, 2017a). No agreement on quota shares has been reached since 2015 and catches have exceeded advice since this time. Since the management plan target fishing mortality is equivalent to F_{MSY}, the MSY approach results in the same advice as the LTMS.

There is no currently agreed management strategy for either Northeast Atlantic Mackerel or Western horse mackerel. Strategies have been proposed and evaluated but agreement has not yet been reached on their implementation such that catch advice has been given on the basis of the MSY approach.

1.7.3 Comparison of advice, TAC and catches

This section presents an overview of the time-series (2010 to present) of ICES catch advice, TAC (either agreed between all fishing parties or a sum of unilaterally declared quotas) and ICES estimates of total catch for Norwegian spring spawning herring, Western horse mackerel, Northeast Atlantic mackerel and blue whiting. The overviews are based on the history of advice, management and catch as reported in the ICES single stock advice documents. The information is summarised in Tables 1.7.3.1-4 and figure 1.7.3.1. Figures 1.7.3.2-5 compare the TAC and advice, catch and advice and catch and TAC and catch and the sum of unilateral quotas respectively, each expressed as a percentage difference *e.g.* (TAC-advice)/advice.

For Norwegian spring-spawning herring some deviations between TAC and advice occurred between 2010-2013, but from 2014 on the sum of unilateral quotas has been in excess of the scientific catch advice which was based on the agreed management plan. Catches have likewise been in excess of the scientific advice and close to the sum of unilateral quotas.

Western horse mackerel: some deviations between TAC and advice have been occurring during the time-series presented, but there does not appear to be a clear trend. No management plan is applicable for western horse mackerel. Catches have generally been at or below the agreed TAC.

Northeast Atlantic mackerel has not had agreed TACs during the period presented. The sum of unilateral quota has always been higher than the scientific advice. Catches have on average been 40% above the scientific advice since 2010. Since catches have been approximately 10% below the sum of declared unilateral quotas.

Blue whiting: up to 2013, the agreed management plan has been followed. From 2014 onwards, the sum of unilateral quota has been in excess of the scientific advice and the agreed management plan. Catches have likewise been in excess of the scientific advice and close to the sum of unilateral quota.

In summary, although long term management plans exist for Norwegian spring-spawning herring and Blue whiting (and previously Northeast Atlantic mackerel), they have not been effective in limiting the TACs to the pre-agreed values. While the Coastal States may have agreed on the overall TACs for these stocks, there has been, and remains no agreement on the distribution of quota between Coastal States. As a consequence, the sum of unilateral quota and the catches have been in excess of both the scientific advice and the rules of the management plans.

Table 1.7.3.1. Overview of scientific advice, agreed TAC, sum of unilateral quotas and catch for Norwegian Spring Spawning Herring.

Year	Advice Basis	Advice (t)	TAC (t)	Unilateral Quota (t)	Catch (t)
2010	Do not exceed the harvest control rule	1,483,000	1,483,000		1,457,000
2011	See scenarios	1,170,000	988,000		993,000
2012	Follow the management plan	833,000	833,000		826,000
2013	Follow the management plan	619,000	619,000	692,000	685,000
2014	Follow the management plan	418,000	418,487	436,000	461,000
2015	Follow the management plan	283,000		328,000	329,000
2016	Follow the management plan	317,000		377,000	383,174

2017	Follow the management plan	646,075		805,142	721,566
2018	Follow the management plan	384,197		546,448	592,899
2019	Follow the management plan, Fmgt = 0.14 and Bmgt = 3.184 Mt)	588,562	588,562	773,750	777,165
2020	Follow the management plan, Fmgt = 0.14 and Bmgt = 3.184 Mt)	525,594	525,594	693,915	720,937
2021	Follow the management plan, Fmgt = 0.14 and Bmgt = 3.184 Mt)	651,033	651,033	881,097	851,813
2022	Follow the management plan, Fmgt = 0.14 and Bmgt = 3.184 Mt)	598,588	598,588	827,963	813,834
2023	Follow the management plan, Fmgt = 0.14 and Bmgt = 3.184 Mt)	511,171	511,171	692,942	680,552
2024	Follow management strategy	390,010	390,010	446,928	460,226
2025	Follow management strategy	401,794	401,794	435,010	
2026	Follow management strategy	533,914			

Table 1.7.3.2. Overview of scientific advice, agreed TAC, sum of unilateral quotas and catch for Western Horse Mackerel.

Year	Advice Basis	Advice (t)	TAC (t)	Unilateral Quota (t)	Catch (t)
2010	Follow proposed management plan	180,000	185,000		203,112
2011	See scenarios	229,000	184,000		193,698
2012	MSY framework	211,000	183,000		169,858
2013	MSY framework	126,000	183,000		165,258
2014	MSY approach	110,546	135,000		136,360
2015	MSY approach	99,304	99,300		98,419
2016	MSY approach	126,000	126,000		98,811
2017	MSY approach	69,186	95,500		82,961
2018	MSY approach	117,070	115,470		101,682
2019	MSY approach	145,237	136,376		124,947
2020	MSY approach	83,954	81,796		76,422
2021	MSY approach	81,376	81,375		81,557
2022	MSY approach	71,138	71,138		70,114
2023	MSY approach	0	15,277		12,845
2024	MSY approach	0	15,347		12,402

Year	Advice Basis	Advice (t)	TAC (t)	Unilateral Quota (t)	Catch (t)
2025	MSY approach	75,545	75,545		
2026	MSY approach	74,214			

Table 1.7.3.3. Overview of scientific advice, agreed TAC, sum of unilateral quotas and catch for Northeast Atlantic Mackerel.

Year	Advice Basis	Advice (t)	TAC (t)	Unilateral Quota (t)	Catch (t)
2010	harvest control rule	572,000	691,305		877,420
2011	See scenarios	672,000	929,943		949,529
2012	Follow the management plan	639,000	938,410		899,576
2013	Follow the management plan	542,000	857,319		937,003
2014	Follow the management plan	1,011,000		1,400,981	1,401,766
2015	Follow the management plan	906,000	1,054,000	1,208,719	1,215,760
2016	MSY approach	773,840	895,900	1,047,432	1,100,286
2017	MSY approach	857,000	1,020,996	1,191,970	1,161,226
2018	MSY approach	550,948	816,797	999,929	1,023,779
2019	MSY approach	770,358	653,438	864,000	838,441
2020	MSY approach	922,064	922,064	1,090,879	1,031,828
2021	MSY approach	852,284	852,284	1,199,103	1,082,656
2022	MSY approach	794,920	794,920	1,188,227	1,046,702
2023	MSY approach	782,066	782,066	1,188,265	1,056,526
2024	MSY approach	739,386	739,386	990,582	897,701
2025	MSY approach	576,958	576,958	760,714	
2026	MSY approach	175,298			

Table 1.7.3.4. Overview of scientific advice, agreed TAC, sum of unilateral quotas and catch for Blue Whiting.

Year	Advice Basis	Advice (t)	TAC (t)	Unilateral Quota (t)	Catch (t)
2010	Follow the agreed management plan	540,000	548,000		540,000
2011	See scenarios	40,000	40,100		105,000

Year	Advice Basis	Advice (t)	TAC (t)	Unilateral Quota (t)	Catch (t)
2012	Follow the agreed management plan	391,000	391,000		384,000
2013	Follow the agreed management plan	643,000	643,000		626,000
2014	Follow the agreed management plan	948,950	1,200,000		1,155,000
2015	Follow the agreed management plan	839,886	1,260,000		1,396,244
2016	MSY approach	776,000	776,000	1,147,000	1,183,187
2017	MSY approach	1,342,330	1,342,330	1,675,400	1,558,061
2018	Long-term management strategy	1,387,872	1,387,872	1,727,964	1,711,477
2019	Long-term management strategy	1,143,629	1,143,629	1,483,208	1,515,527
2020	Long-term management strategy	1,161,615	1,161,615	1,478,358	1,495,248
2021	Long-term management strategy	929,292	929,292	1,157,604	1,143,450
2022	Long-term management strategy	752,736	752,736	752,736	1,038,736
2023	Long-term management strategy	1,359,629	1,359,629	1,359,629	1,733,7,169
2024	Long-term management strategy	1,529,754	1,529,754	1,529,754	1,797,260
2025	Long-term management strategy	1,447,054	1,447,054	1,447,054	
2026	Long-term management strategy	851,344			

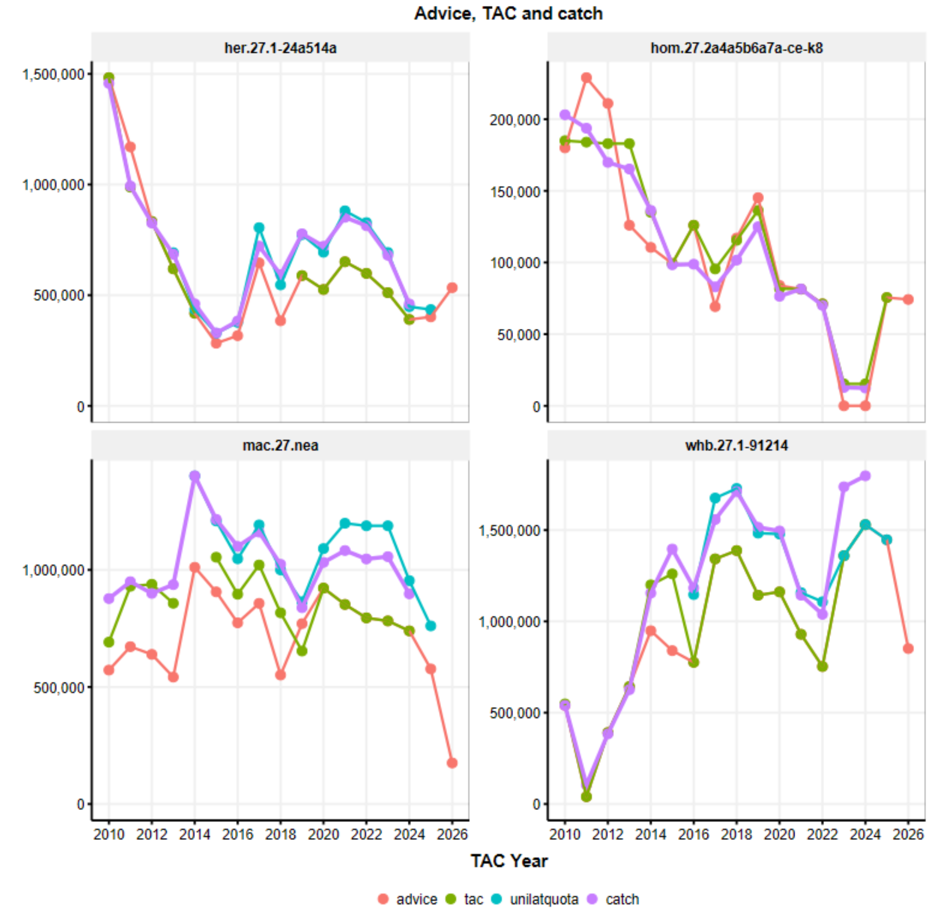


Figure 1.7.3.1: Overview of scientific advice, agreed TAC (or sum of unilateral quota) and catch

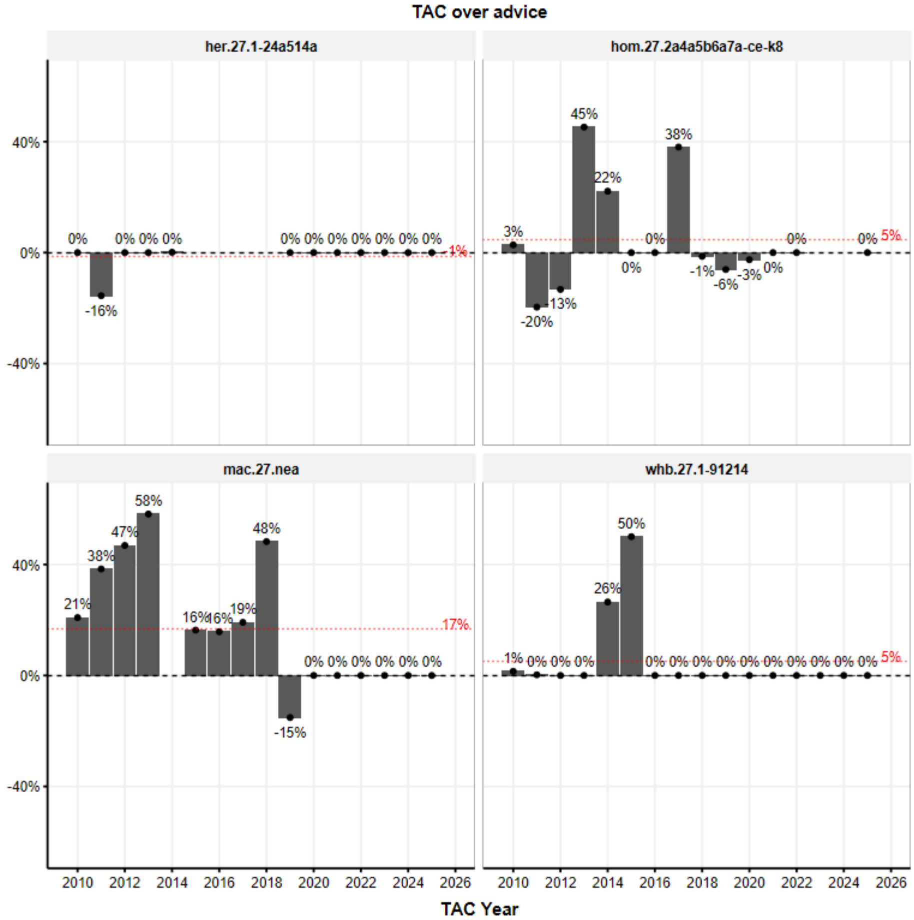


Figure 1.7.3.2: Relative deviations of TAC over advice. Red line indicates average relative deviation over the time series shown.

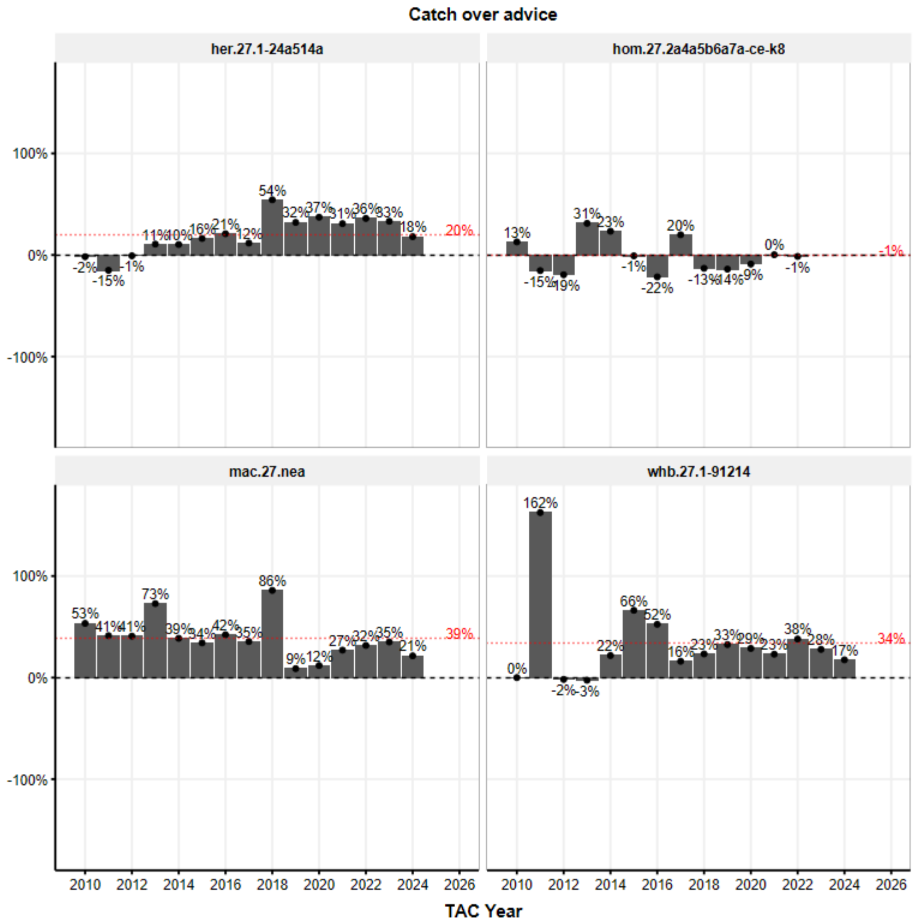


Figure 1.7.3.3: Overview of catch over advice

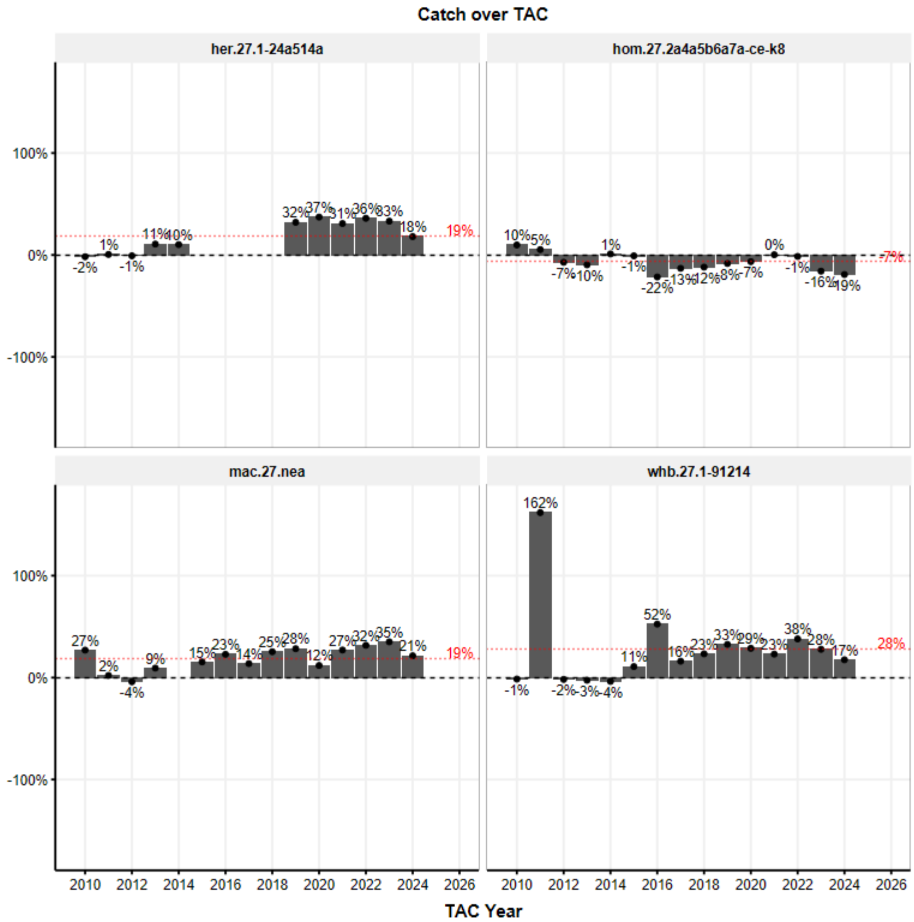


Figure 1.7.3.4: Overview of catch over TAC

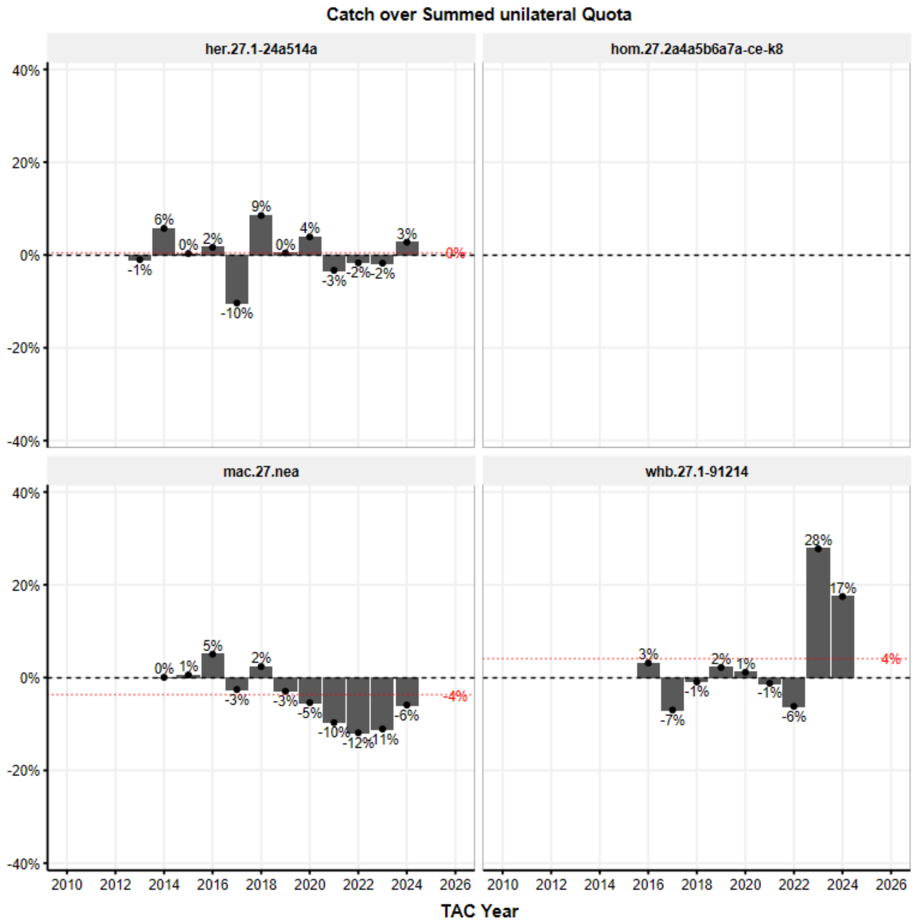


Figure 1.7.3.5: Overview of catch over sum of unilateral quotas.

1.8 General stock trends for widely distributed and migratory pelagic fish

WGWIDE 2025 has carried out update stock assessments for the four stocks that constitute the bulk of the biomass of pelagic species in the Northeast Atlantic:

- Northeast Atlantic mackerel
- Norwegian spring spawning herring
- Blue whiting
- Western horse mackerel

Each of these stocks has a full analytical (category 1) stock assessment. The time series of the combined catch of these four stocks since 1998 is shown in figure 1.8.1. The highest combined catch (approx. 4 million tonnes) for these four species combined was taken in 2004 and 2005. Over the most recent period (2019-2024) the total catch has been composed of ~45% blue whiting, ~30% mackerel, ~23% herring and ~2% horse mackerel (by weight).

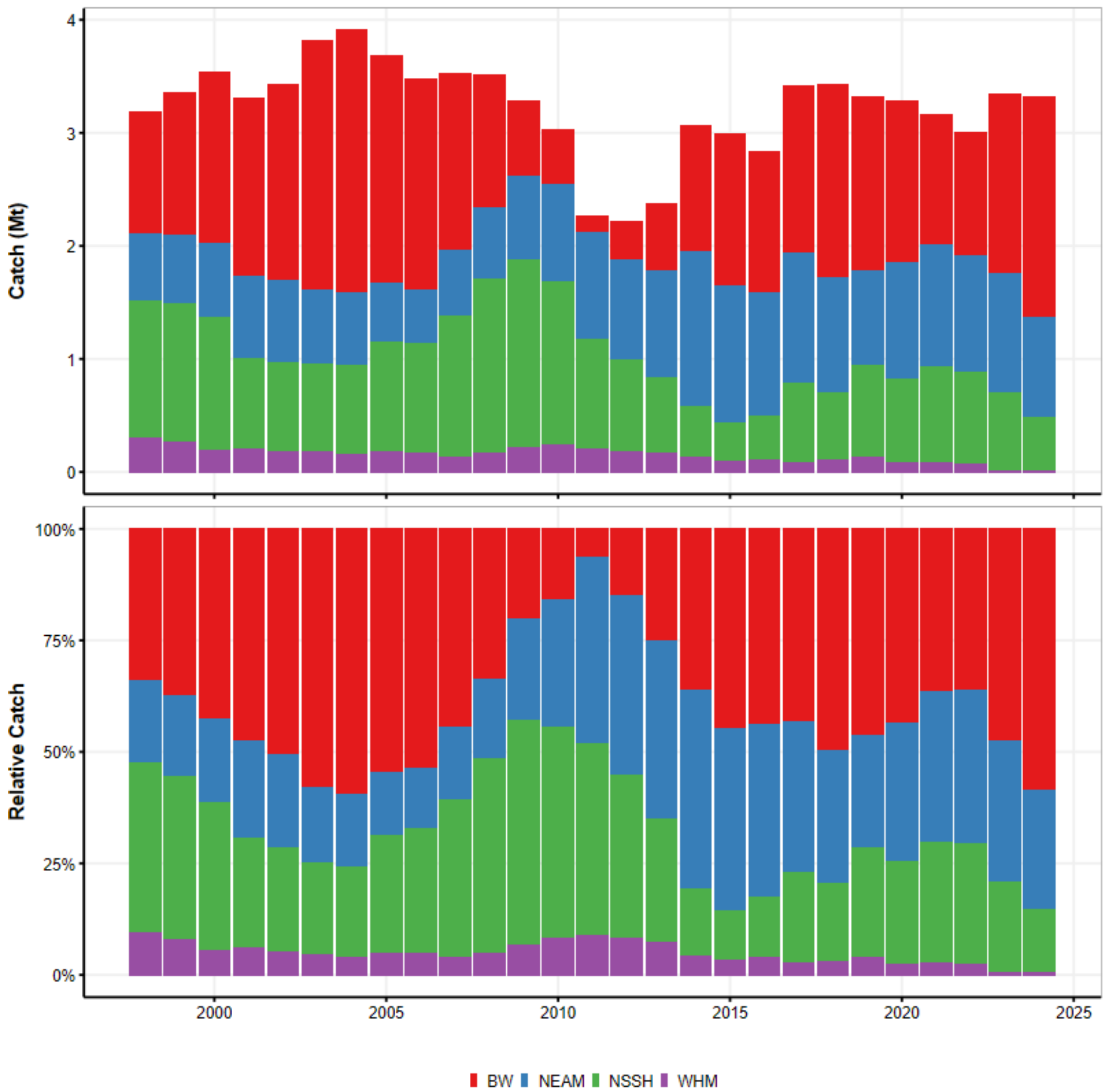


Figure 1.8.1: Catch of blue whiting, mackerel, western horse mackerel and Norwegian spring spawning herring.

An overview of the key variables for each of the stocks (SSB, fishing mortality and recruitment), is shown in Figure 1.8.2. The stock size of mackerel has been declining steadily from a historic high in 2015 and is currently below B_{lim} . Herring And Western Horse Mackerel are both close to MSY $B_{trigger}$ whereas Blue Whiting is well above both B_{lim} and MSY $B_{trigger}$ although it has been declining in the most recent years following a 2 year period of strong recruitment.

Fishing mortality for herring has been around F_{MSY} in the most recent period. Fishing mortality for blue whiting has been consistently above F_{MSY} for much of the time series with a substantial increase in recent years. Following zero catch advice for 2023 and 2024, catches and fishing pressure for Western Horse Mackerel fell significantly. In contrast, fishing mortality on mackerel has increased significantly in recent years and is now well above F_{MSY} with catches in excess of advice.

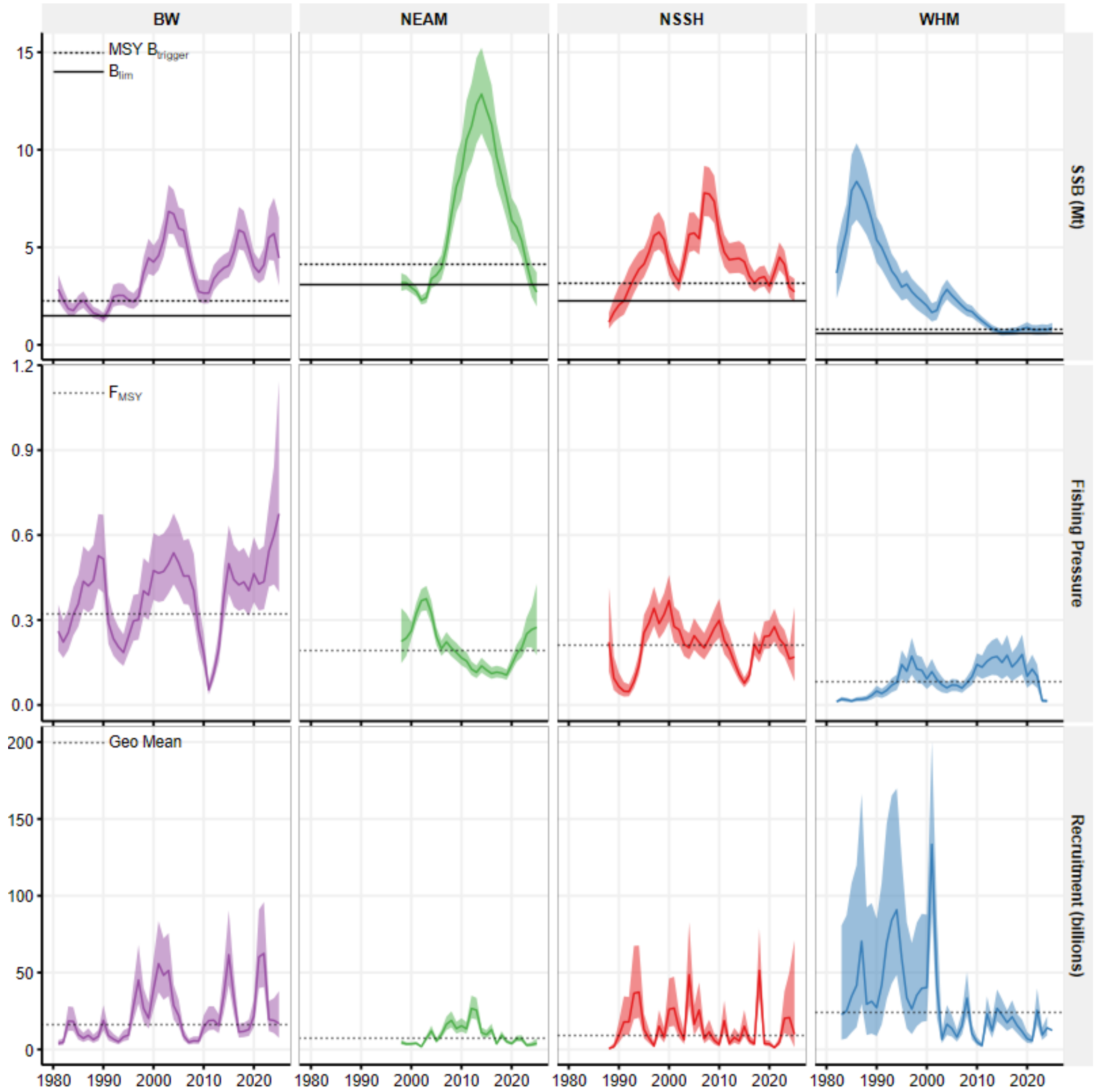


Figure 1.8.2: SSB (top), fishing mortality (middle) and recruitment (bottom) estimates from the (left to right) 2025 update assessments of Blue Whiting, NEA Mackerel, Norwegian spring spawning herring and Western Horse Mackerel.

An overview of stock weight-at-age for mackerel, blue whiting and herring are shown in figures 1.8.3-5.

For mackerel, a consistent decline in weight at age for most ages started around 2005 and persisted for approximately 10 years. Following this period an increase was seen although not back to previous highs. The most recent period is associated with declining weights for most ages, particularly the youngest.

Weight-at-age of blue whiting shows substantial fluctuations over time. For most ages, a decline in weight at age has been observed from 2010 although this appears to have ceased and, for some ages reversed in the most recent years.

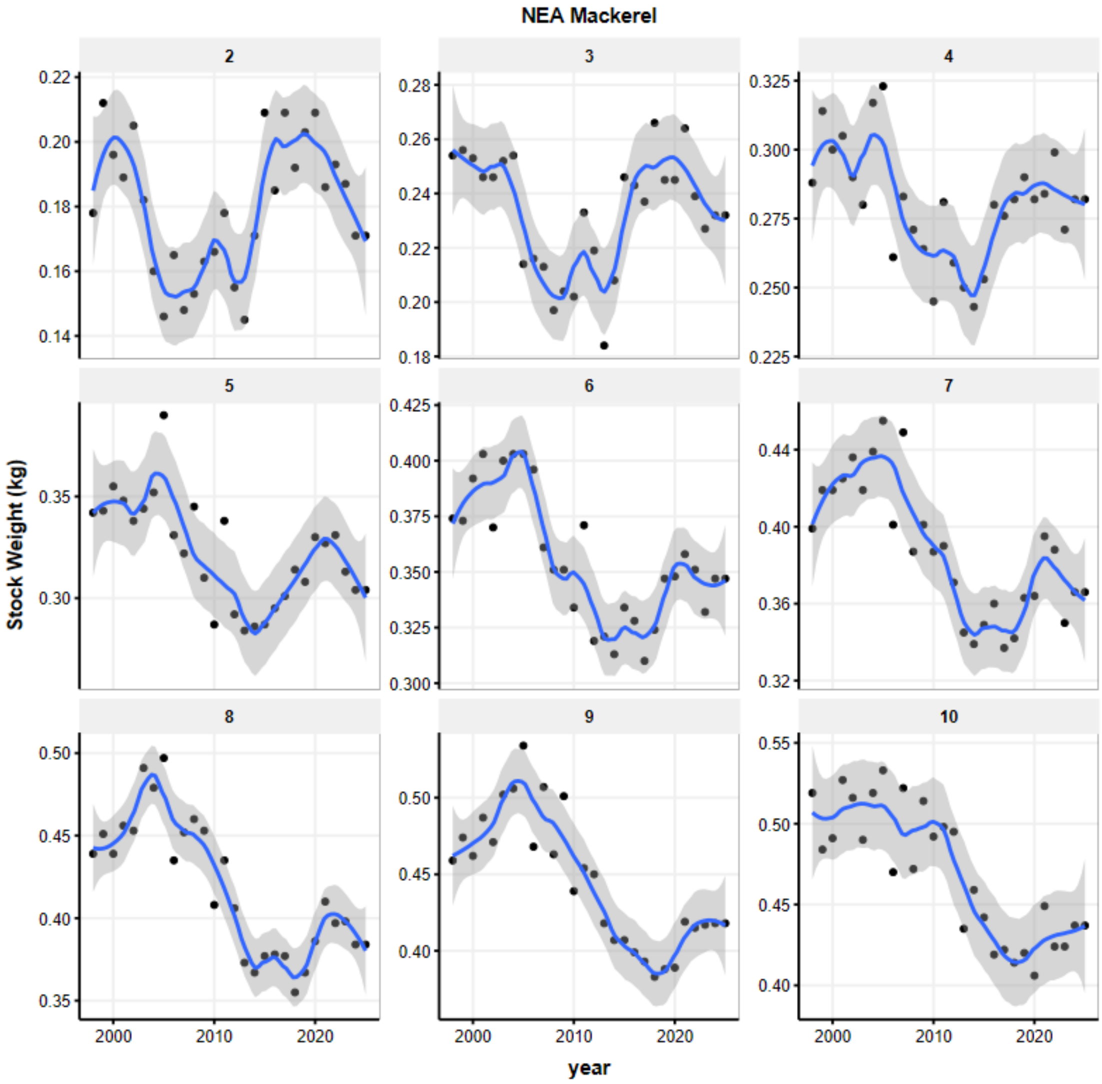


Figure 1.8.3: Stock weight-at-age of NEA mackerel.

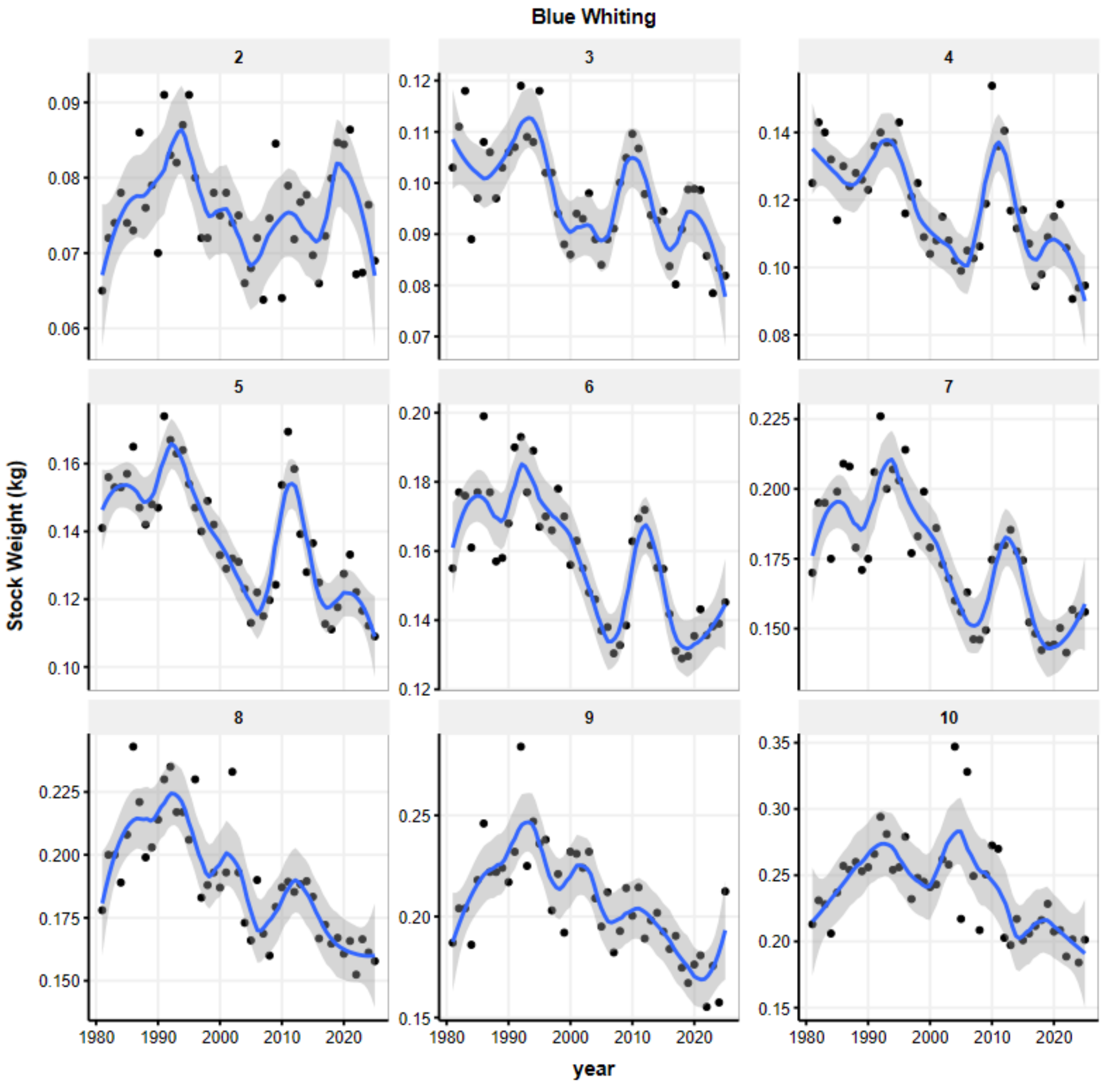


Figure 1.8.4: Stock weight at age of blue whiting.

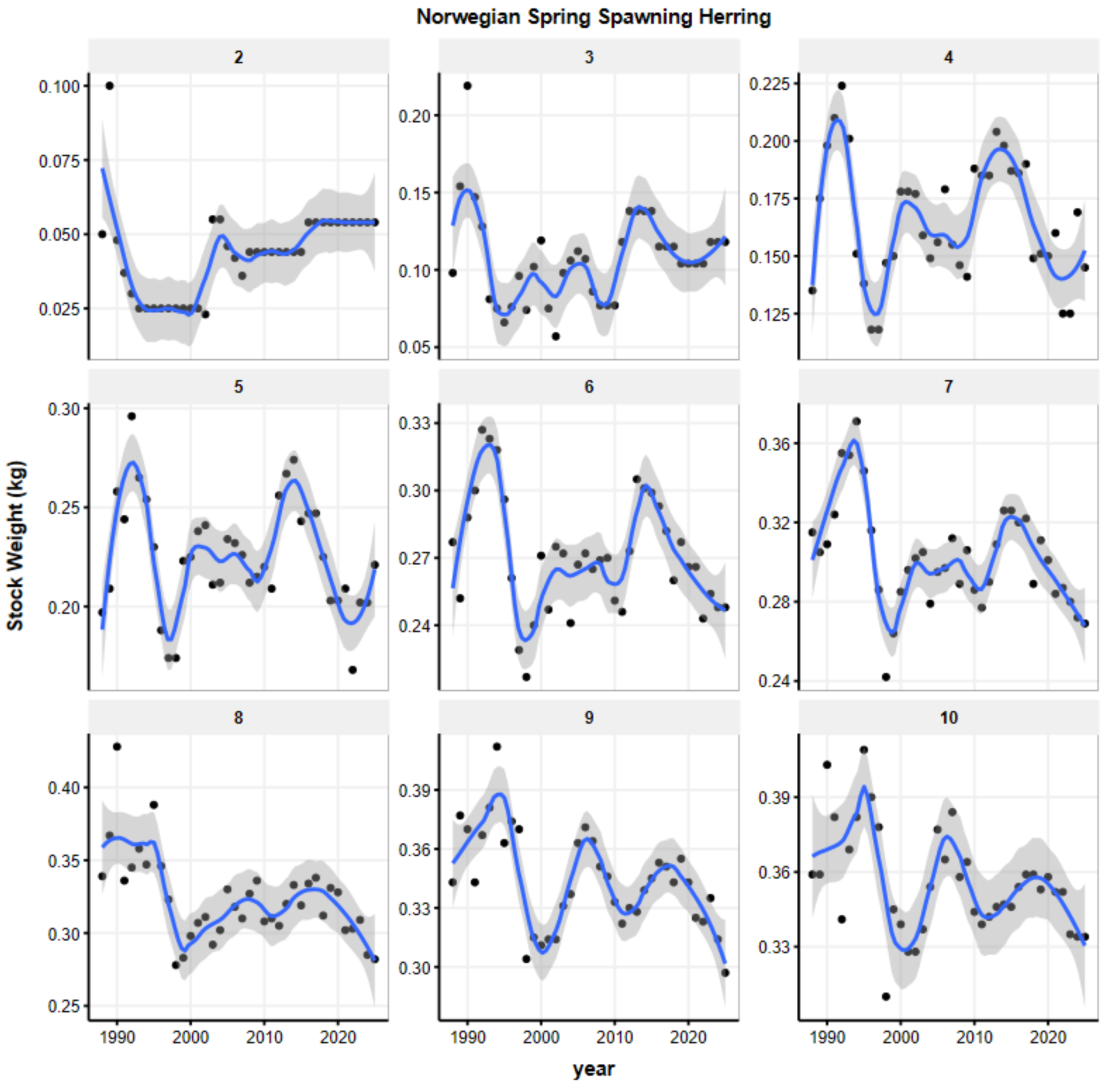


Figure 1.8.5: Stock weight at age of Norwegian Spring Spawning Herring

WGWIDE (and its precursors WGMHSA and WGNPBW) has been publishing catch per statistical rectangle plots in their annual reports for several years. Catch by rectangle information has been compiled by WG members and, although catch by rectangle data do not represent the official catches and cannot be used for management purposes, the total annual catch data by rectangle is usually within 10 % from the official catches. In the individual stock report sections, the catch by rectangle is been presented by quarter for the most recent year. For this overview, WGWIDE has collated all available data for herring, blue whiting, mackerel and horse mackerel. For horse mackerel and mackerel, a long time series is available, starting in 2001 (horse mackerel) and 1998 (mackerel). The time series for herring and blue whiting are shorter (from 2011) although additional information is contained in earlier WG reports.

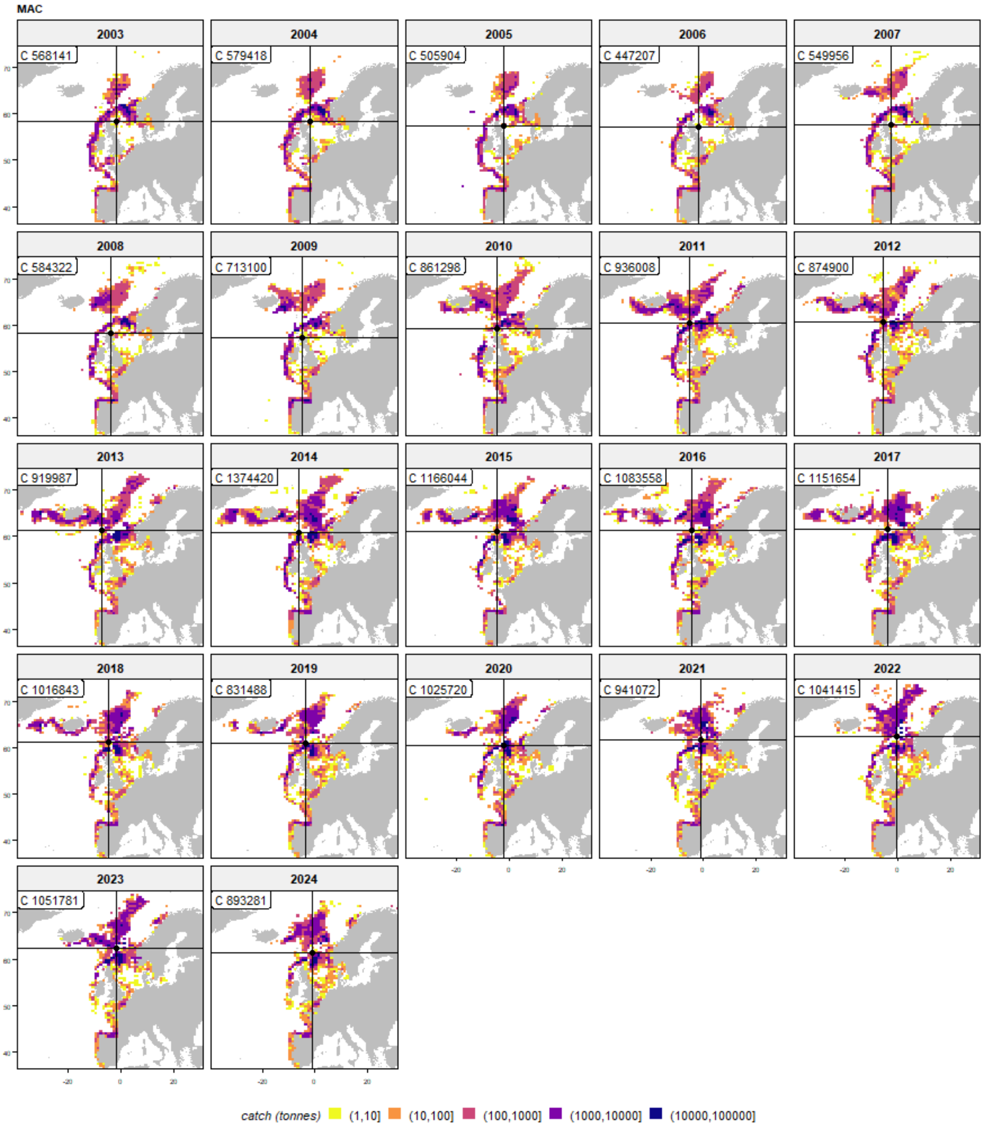


Figure 1.8.6: Catch of mackerel (tonnes) by year and rectangle. Catch by rectangle data do not represent the official catches and cannot be used for management purposes

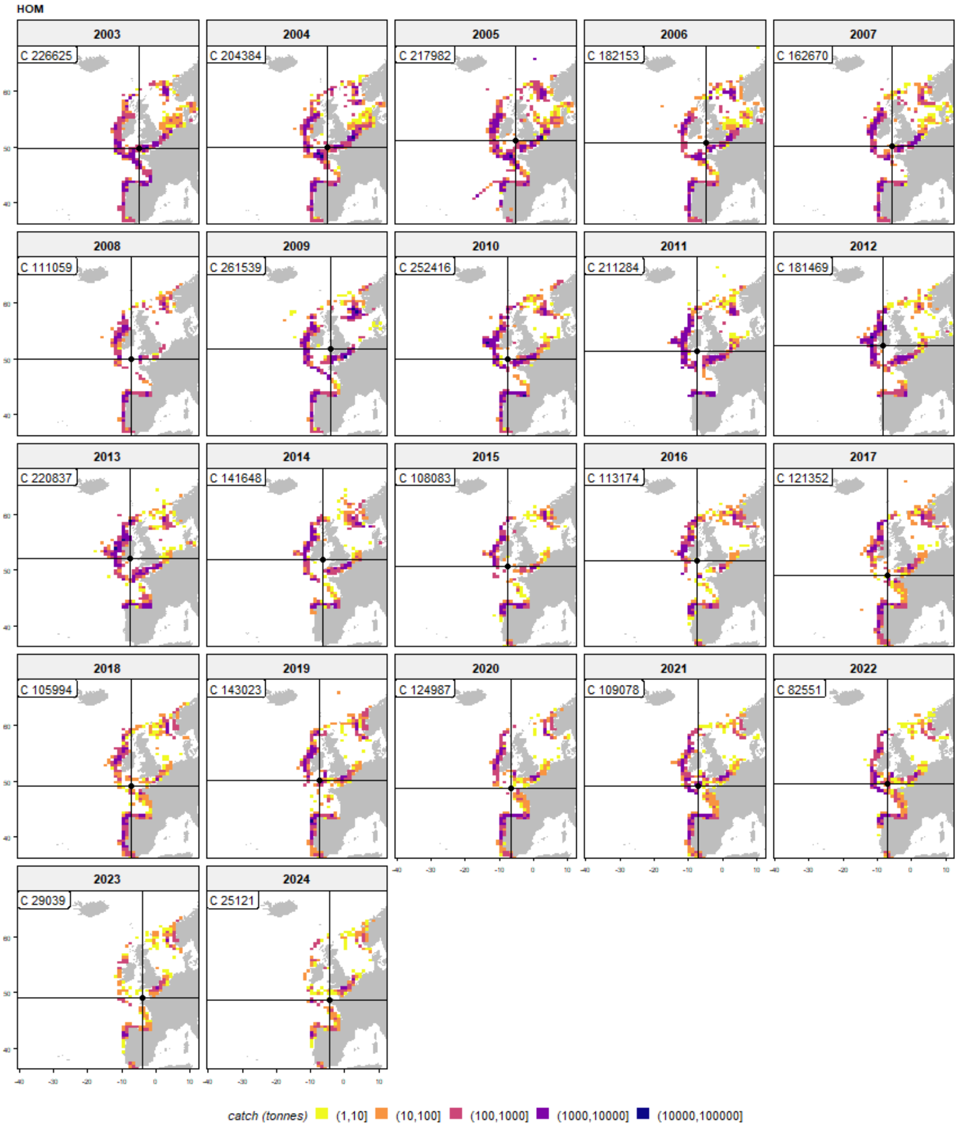


Figure 1.8.7: Catch of horse mackerel (all stocks, tonnes) by year and rectangle. Catch by rectangle data do not represent the official catches and cannot be used for management purposes.

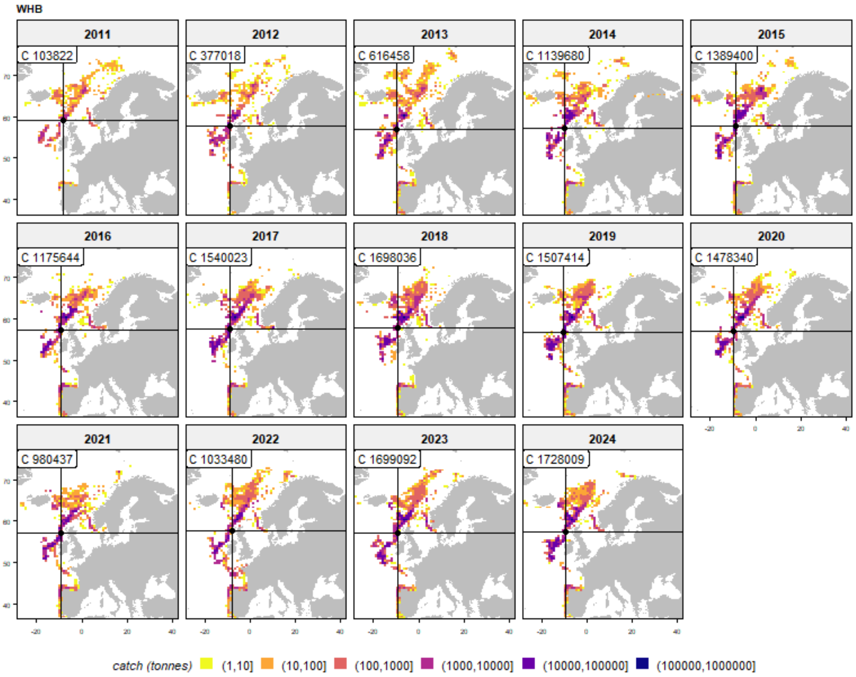


Figure 1.8.8: Catch of blue whiting (tonnes) by year and rectangle. Catch by rectangle data do not represent the official catches and cannot be used for management purposes.

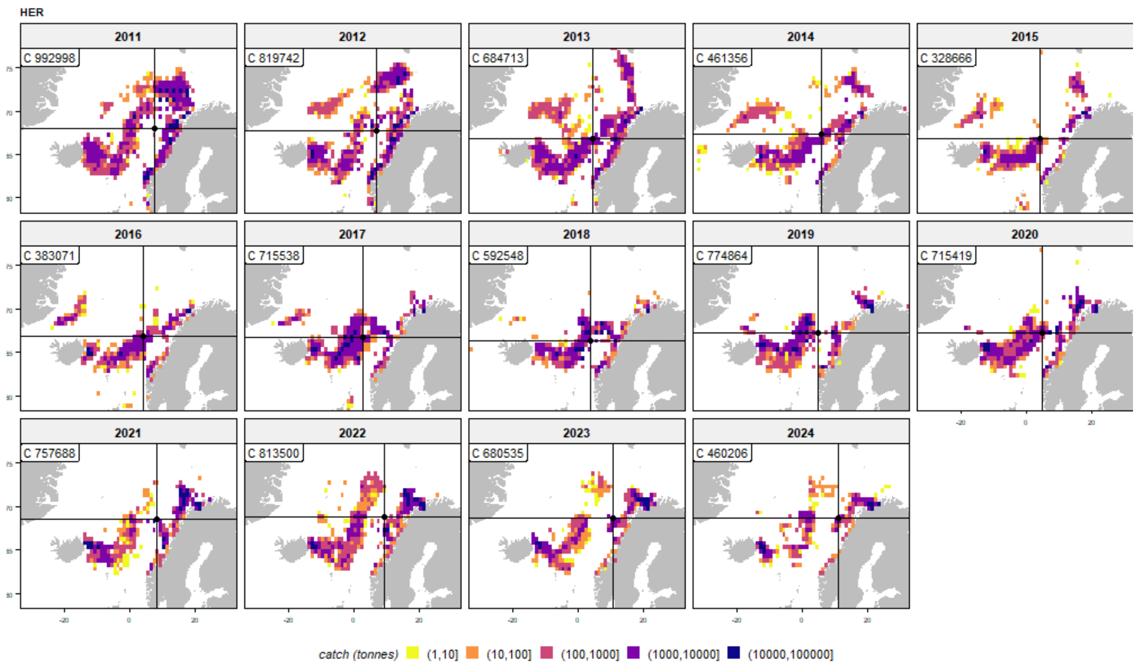


Figure 1.8.9: Catch of Norwegian spring-spawning (Atlanto-scandian) herring (tonnes) by year and rectangle. Catch by rectangle data do not represent the official catches and cannot be used for management purposes.

1.9 Ecosystem considerations for widely distributed and migratory pelagic fish species

A number of studies demonstrate that environmental conditions (physical, chemical and biological) can significantly influence stock productivity by changing the level of recruitment, growth rates, survival rates, or inducing variations in their geographical distribution (*e.g.* Skjoldal *et al.*, 2004, Sherman and Skjoldal 2002). It has been acknowledged that future development in stock assessment methods should take ecosystem considerations into account to reduce assessment uncertainty. Therefore, WGWIDE encourages further work to be carried out on ecosystem considerations linked to widely distributed fish stocks including NEA mackerel, Norwegian spring-spawning herring, blue whiting, and horse mackerel. A close collaboration with the Working Group on Integrated Assessment of Norwegian Sea (WGINOR; ICES 2018b; 2025), and other relevant Integrated Assessment groups within ICES could help in operationalizing the ecosystem approach for widely distributed pelagic stocks assessed by WGWIDE.

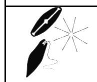
Below are highlights and graphical summary of trends and current status of ocean climate, phytoplankton production, zooplankton biomass, seabirds, marine mammals, pelagic fish biomass and their spatial distribution in the Norwegian Sea ecoregion. For detailed description of the ecoregion status and possible reasons for changes see WGINOR annual report (ICES, 2025).

Highlights

- In recent years, temperature and salinity in the Atlantic inflow have increased. The subpolar gyre index is in a weak state indicating that the Atlantic inflow will remain warm and saline. The relative heat content shows a warm state over the last 20 years in part explained by reduced local ocean-to-air heat loss. The positive trend in relative freshwater content has stopped. The volume of Arctic Water is still high but warmer and less dense.
- During the period 1996 to 2023, primary production has varied slightly from year-to-year and without noticeable trend. During the last two decades, the timing of the peak of production has gradually shifted to a later date by 10 days per decade.
- Zooplankton biomass in spring, measured since 1995, declined in the mid-2000s. Since then, there have been interannual variations but no clear trend. The biomass has been low in some sub-areas in the last few years. Zooplankton biomass in summer, measured since 2010, has increased in some sub-areas in recent years.
- A decline in spawning biomass started around 2009 for Norwegian spring-spawning herring and around 2015 for mackerel. In 2024, these declines continued with herring biomass estimated below MSY-$B_{trigger}$[1]. Blue whiting biomass continued to increase in 2024, driven by historically high recruitment of the 2020 and 2021 year classes, but is predicted to decline in 2025.
- The long-term decrease in breeding numbers for Atlantic puffin continues at the Norwegian coast where the parallel trend for black-legged kittiwake has apparently levelled off after 2015. Common guillemot numbers are still low but have increased markedly over the last decade.
- Abundance indicators suggest declining population levels for hooded and grey seals, and low levels for harbour seals. During 2006-2018, harbour porpoise bycatch levels in the Norwegian Sea have been deemed unsustainable. These have likely been reduced in

recent years due to the use of acoustic alarms on gill nets. Since about 2008, the distribution of Baleen whales has gradually shifted away from the Norwegian Sea into adjacent areas. The overall estimated abundance of minke whales in the Northeast Atlantic region showed a 50% nominal increase in the 2014-2019 survey cycle, though the change was not statistically significant.

Graphical summary

	Topic	Overall trend	Situation in 2022/2023	Certainty	Possible implications
	Ocean climate	Generally, warm and saline conditions prevailed from the early 2000s until 2016. Since 2012, temperature of the Atlantic inflow has been close to the long-term mean while salinity has been below the long-term mean since 2016. The extent of Arctic Water has increased from 2017.	The temperature of the Atlantic inflow is close to the long-term mean while salinity is below the long-term mean. The extent of Arctic Water continues to increase but the recent decline in relative heat content has ceased. The North Atlantic SPG is currently weakening which may lead to a warmer and more saline Atlantic Inflow in coming years.	Highly certain: dedicated monitoring with good spatial coverage exists.	The recent increase of Arctic Water may lead to in-creased new pro-duction due to rela-tive high winter nutrient concentra-tion and import of Arctic zooplankton.
	Primary production	There is no trend in the level of spring and summer primary production in the Norwegian Sea deep basins since 1996. The timing of peak production has gradually shifted to a later date over the last two decades.	The primary production for 2023 is low but within the range of previously observed values. The timing of the peak production in 2023 is 20 days later than in 2003.	Certain: Phytoplankton estimates are based on satellite data covering the productive season with high geographic resolution. The production model is not calibrated for high latitudes and absolute estimates of primary production are uncertain. The absence of long-term trend is confirmed by production estimates in the field.	Change in timing can lead to seasonal match/mismatch with reproduction & feeding of zooplankton.

	Topic	Overall trend	Situation in 2022/2023	Certainty	Possible implications
	Zooplankton biomass	The spring biomass of mesozooplankton was at a higher level from 1995 to mid-2000s and has been at a lower level in the following years. Summer biomass shows an increasing trend or no trend from 2010 until 2024	Biomass in 2024 was at similar level as the previous year for all sub-areas and both seasons, but decreased in the Iceland Sea, after being relatively high in 2023.	Moderately certain: plankton is patchily distributed, which leads to uncertain estimates. The timing of seasonal development relative to time of sampling can affect the level of biomass measured	Reduced zooplankton biomass may have caused reduced food resources for planktivorous feeders, including pelagic fish. in the recent decade.
	Zooplankton spatial distribution	The spring distribution of zooplankton has changed from higher biomasses in Arctic water in the west to become evenly distributed in the Norwegian Sea.	In 2024, the zooplankton was relatively evenly distributed in spring and summer, but with patches of higher concentrations.	Moderately certain: The spatial distribution reflects and is affected by the timing of the survey and the timing of the zooplankton seasonal development.	Changes in the spatial distribution of plankton can affect the spatial distribution of planktivorous fish.
	Pelagic fish biomass	Spawning stock biomass of Norwegian spring-spawning herring and mackerel continued to decline while blue whiting increased slightly to a record high value.	Herring spawning stock biomass decreased by 17% and mackerel by 12% whereas blue whiting increased by 7% compared to previous year. Estimated recruitment of blue whiting is at a historical high for two year-classes. Fishing remains above scientific advice for all stocks.	Highly certain for herring and blue whiting, moderately certain for mackerel due to repeated revisions of stock perception from assessment: estimates are based on quantitative stock assessments.	Changes in pelagic fish biomass have direct implications for fisheries opportunities.

	Topic	Overall trend	Situation in 2022/2023	Certainty	Possible implications
	Pelagic fish spatial distribution	From the mid-2000s to the mid-2010s, mackerel distribution expanded westward into Icelandic and Greenlandic waters each summer. However, this westward expansion began to decline in 2015. Since 2020, the feeding migration of mackerel has been mostly limited to the Norwegian Sea.	No mackerel in Greenlandic waters. Presence in Icelandic waters was limited to waters southeast of Iceland.	Highly certain: based on ecosystem surveys in the Nordic Seas in spring (May) and summer (July).	Changes in pelagic fish spatial distribution have direct implications for fisheries opportunities.
	Seabirds	Substantial long-term declines for most species, including common guillemot, Atlantic puffin, and black-legged kittiwake.	No clear signs of improvements, except common guillemot abundance increases in colonies which provide shelter from eagle predation.	Highly certain: Trends are derived from dedicated monitoring.	Many bird colonies are at risk of extinction, and some have already disappeared.
	Marine mammals	Decline or sustained low levels of pup production in several seal species. Long term shift in summer distribution of baleen whales from the Norwegian Sea to the adjacent areas. Levels of harbour porpoise bycatch are of concern but have like been reduced in recent years.	No new data on abundance and distribution.	Highly certain: Trends in pup production are based on dedicated surveys. Moderately certain: Data are scarce on bycatch and productivity-connectivity for harbour porpoises.	Changes in marine mammals affect food-web structure and long-term viability of marine mammal populations.

1.10 Future Research and Development Priorities

As part of the planning towards future benchmark assessments, the working group maintains, for each stock, a list of research and development priorities on topics including proposed research projects, improved sampling and data collection and development of stock assessment techniques. In addition to these individual stock issues, increased consideration should be given to integrated ecosystem assessments for the stocks within WGWIDE. Several WGWIDE members are also participants in the work of the Working Group on Integrated Assessment for Norwegian Sea (WGINOR). Improving linkages with other regional Integrated Ecosystem Assessment groups within ICES would be beneficial and should be considered in future.

1.10.1 NEA Mackerel

In 2019, the ICES Workshop on a Research Roadmap for Mackerel (WKRRMAC, (ICES, 2019b)) met to discuss the research needs for the provision of advice for the management of NEA Mackerel. The workshop involved a diverse range of stakeholders including industry representatives, managers and scientists and identified a number of priorities (see report of WGWIDE 2019 (ICES, 2019c) for details).

WGWIDE 2022 recommended the establishment of WKEVALMAC (A Workshop on the Evaluation of NEA Mackerel stock components and regional management measures) to review available information from appropriate methods to infer the stock structure of NEA Mackerel. This workshop took place in 2023 (ICES 2024b) See section 8.11 for a summary of the conclusions of this workshop.

1.10.2 Blue Whiting

Numerous scientific studies have suggested that blue whiting in the North Atlantic consists of multiple stock units. The ICES Stock Identification Methods Working Group (SIMWG) reviewed this evidence in 2014 (ICES, 2014) and concluded that the perception of blue whiting in the NE Atlantic as a single-stock unit is not supported by the best available science. SIMWG further recommended that blue whiting be considered as two units. There is currently no information available that can be used as the basis for generating advice on the status of the individual stocks. A project is going on with more data being collected (NEA) to allow clarify the stock definition for this species.

In 2025, a comprehensive review of blue whiting studies was published (Lee et al., 2025), which synthesizes existing evidence on population structure, revealing a complex metapopulation composed of both resident and migratory subpopulations. This review supports the presence of partial migration, with both contingents contributing to the spatial complexity of the species' population dynamics. Data from genetics, otolith analysis, parasitology, and life-history traits point to the existence of relatively distinct northern and southern subpopulations, as well as mixing zones and resident groups. The study underscores the importance of adaptive, spatially explicit management strategies that account for temporal variability, promote stakeholder engagement, and encourage regional cooperation. Despite these insights, the authors highlight persistent knowledge gaps in fine-scale population structuring, life-history stage characterization, and connectivity mechanisms. Addressing these gaps will require integrative approaches combining genomics, otolith chemistry, and biophysical modelling. Although current stock boundaries encompass the species' overall distribution, incorporating internal biological structure into assessment and management frameworks will improve their precision and support sustainable exploitation.

1.10.3 NSS Herring

Request and incorporate within the assessment information on the uncertainty in catches from all countries submitting catch data (currently only available from Norway).

The maturity ogive for NSSH is calculated with 1 decimal precision. This is a low resolution and the maturity ogive should be calculate with a 2 decimal precision as common for other stocks.

1.10.4 Western Horse Mackerel

Considering the potential of mixing between Western and North Sea horse mackerel occurring in division 7d and 7e, improved insight into the origin of catches from that area will be a major benefit for improvement of the quality of future scientific advice and thus management of the North Sea and Western horse mackerel stocks. A project addressing stock structure and boundaries of horse mackerel was initiated by the Northern Pelagic Working Group in collaboration with University College Dublin and Wageningen Marine Research. In 2018, the results of the genetic analysis have been published (Farrell *et al* 2018) which concluded that the spawners of North Sea and Western horse mackerel can be genetically identified as two distinct stocks. However, at that stage it was not yet possible to separate the two stocks when they occur in mixed samples. Subsequently, a full genome sequencing on horse mackerel has been carried out (Fuentes-Pardo et al 2020), which confirmed the earlier results on separating western, North Sea and southern horse mackerel (see also text below on North Sea horse mackerel). In addition, this study concluded that it would also be possible to distinguish horse mackerel from different spawning populations in mixed samples.

The 2020 study also concluded that further analysis on the mixing between the Western stock and the Southern stock in area 8c should be carried out: the fishery in the area targets mainly juveniles, would be therefore be very important to understand the impact of this fishery on each of the two stocks.

The most recent results indicate that a further large-scale analysis of samples, with a greater temporal and spatial coverage, with the newly identified molecular markers was required to test and reassess the current stock delineations.

During the benchmark of Western horse mackerel in 2024 the potential mixing between Western and North Sea horse mackerel in divisions 7d and 7e and in between Western and Southern horse mackerel in 8c and 9a were identified as potential source of uncertainty for the assessment. However, further sensitivity studies are necessary to carry out before the mixing can be included in future assessments. These studies should be carried out before the next benchmark.

1.10.5 North Sea horse mackerel

Studies on stock identity and the degree of connection and migrations between the North Sea and the Western Stock are considered particularly relevant. On behalf of the Pelagic Advisory Council and the EAPO Northern Pelagic Working Group, a research project on genetic composition of horse mackerel stocks was initiated. Genetic samples have been taken over the whole distribution area of horse mackerel during the years 2015- 2017. The full genome of horse mackerel was sequenced and results indicated that the western horse mackerel stock is clearly genetically different from the North Sea stock (Farrell and Carlsson, 2019; Fuentes-Pardo *et al.*, 2020). Markers were identified that are be able to reveal the stock identity of individual horse mackerel

caught in potential mixing areas. Horse mackerel samples from division 7d and 7e have been collected by the PFA on board of commercial vessels in the Autumn of 2020, while horse mackerel from division 4a have been collected during the NS-IBTS in Q3. Initial results of this comprehensive genetic research project on stock identification of horse mackerel suggest that the boundaries of the stocks might require revision. This relates to the Northern boundary in 4a to the Southern border in 7d. Additionally, the Institute of Marine Research in Norway sampled horse mackerel in coastal waters within 4a during all quarters in 2019. Preliminary results presented at WGWIDE 2021 showed that the genetic profile of individuals caught in all quarters matched well with the genetic profile of the Western HOM stock, with just one or two individuals matching better with North Sea HOM profile (Florian Berg, pers. comm.). Ongoing and new studies are being undertaken to investigate these issues. Potential changes in the perception of the stock distributions could impact the reliability of the assessments for the three current stocks of horse mackerel in the Northeast Atlantic (see also section 1.4.8.3 for details).
During the benchmark of Western horse mackerel in 2024 the potential mixing between Western and North Sea horse mackerel in divisions 7d and 7e were identified as potential source of uncertainty for the assessment. However, further sensitivity studies are necessary to carry out before the mixing can be included in future assessments. These studies should be carried out before the next benchmark.

1.10.6 Boarfish

The assessment for boarfish was benchmarked in 2024 with the new assessment making use of additional data including length composition information available from the sampling of commercial and survey catches. Currently, information on growth is derived from a limited ageing exercise carried out during the initial development of the fishery around 2010. Ageing has not been routinely carried out as it is difficult and expertise is limited. Efforts should continue to improve age reading capabilities to update information on growth.

The updated assessment also makes greater use of information from acoustic surveys (incorporating the Pélagiques GAScogne (PELGAS) survey along with WESPAS). Further improvements could be made by considering additional surveys (*e.g.* MSHAS in subareas 4 and 6 where the incidence of boarfish appears to be increasing) and developing a unfied approach to the estimation of biomass from multiple surveys.

1.10.7 Striped red mullet

In the WGWIDE framework, the assessment of striped red mullet stock is currently absent. The limited and scarce availability of data within the ICES database, coupled with uncertainties regarding data quality, has precluded the establishment of any analytical assessment. The foremost development priorities encompass the enhancement of fishery-dependent information and the creation of biomass indices derived from EVHOE and SP-NSGFS. These indices will be meticulously tailored to the unique characteristics of the stock, which include its coastal distribution and potential variations in dynamics between the Bay of Biscay and the Celtic Sea. Ongoing research initiatives (MATO and ACOST, as detailed in the stock-related section of this report) are anticipated to furnish updated data and published findings pertaining to the sexual maturity of this species, along with reference fleet CPUE, by 2024. Armed with these inputs, an analytical assessment framework could be subjected to intersessional testing and subsequently presented to WGWIDE. This endeavor aims to bolster the potential for a benchmark request in the near future, pertaining to the assessment of this stock.

1.11 References

Andersson L, Bekkevold D, Berg F, Farrell ED, Felkel S, Ferreira M, Fuentes-Pardo AP, Goodall J, Pettersson M. 2024. How Fish Population Genomics Can Promote Sustainable Fisheries: a Road Map. Annual Review in Animal Biosciences, 12: 1–20.

Anon 2021. Agreed record of conclusions of fisheries consultations between the European Union, the Faroe Islands, Iceland, Norway and UK on the management of blue whiting in the north-east Atlantic in 2022. https://www.regjeringen.no/contentassets/2ea04e97a8fd45c2b1758e2602e79c46/blue-whiting-agreed-record-october-2021.pdf

Borges, L., Rogan, E. and Officer, R. 2005. Discarding by the demersal fishery in the watersaround Ireland. Fisheries Research, 76: 1–13.

Borges, L., van Keeken, O. A., van Helmond, A. T. M., Couperus, B., and Dickey-Collas, M. 2008. What do pelagic freezer-trawlers discard? ICES Journal of Marine Science, 65: 605– 611.

Chen, K., Marshall, E.A., Sovic, M.G., Fries, A.C., Gibbs, H.L., Ludsin, S.A. 2018. assignPOP: An r pack-age for population assignment using genetic, non-genetic, or integrated data in a machine-learning framework. Methods in Ecology and Evolution, 9: 439-446. (doi.org/10.1111/2041-210X.12897)

Dickey-Collas, M., van Helmond, E., 2007. Discards by Dutch flagged freezer trawlers. Working Document to the Working Group Mackerel, Horse Mackerel, Sardine and Anchovy (ICES CM 2007/ACFM: 31).

Farrell, E.D, Fuentes-Pardo, A.P., Murray, D.S. & Andersson, L. 2024a. WD01: A working document on the genetic stock identification and assignment of western and North Sea horse mackerel, Trachurus trachurus. ICES Benchmark workshop on horse mackerel and boarfish stocks (WKBHMB). 89pp.

Farrell, E.D. 2024b. WD02: A summary working document on the genetic stock identification and as-signment of Western and North Sea horse mackerel, Trachurus trachurus. ICES Benchmark workshop on horse mackerel and boarfish stocks (WKBHMB). 16pp.

Fernandes, A. C., Pérez, N., Prista, N., Santos, J., Azevedo, M. 2015. Discard composition from Iberian trawl fleets. Marine Policy, 53: 33-44.

Fuentes-Pardo, A.P., Farrell, E.D., Pettersson, M.E., Sprehn, C.G. and Andersson, L. 2023. The genomic basis and environmental correlates of local adaptation in the Atlantic horse mackerel (*Trachurus trachurus*). Evolutionary Applications, 16: 1201-1219. https://doi.org/10.1111/eva.13559

Fuentes-Pardo, A.P., Pettersson, M., Sprehn, C.G., Andersson, L. & Farrell, E.D. 2020. Population structure of the Atlantic horse mackerel (*Trachurus trachurus*) revealed by whole-genome sequencing. A report prepared for the members of the Northern Pelagic Working Group and the Pelagic Advisory Council. 38 pp.

Genner, M., & Collins, R. (2022). The genome sequence of the Atlantic horse mackerel, *Trachurus trachurus* (Linnaeus 1758). Wellcome Open Research, 7, 118. https://doi.org/10.12688/wellcomeopenres.17813.1

Han, F., Jamsandekar, M., Pettersson, M.E., Su, L., Fuentes-Pardo, A., Davis, B., Bekkevold, D., Berg, F., Cassini, M., Dahle, G., Farrell, E.D., Folkvord, A. and Andersson, L. 2020. Ecological adaptation in Atlantic herring is associated with large shifts in allele frequencies at hundreds of loci. eLife, 2020;9:e61076 (doi:10.7554/eLife.61076)

Hofstede, R. and Dickey-Collas, M. 2006. An investigation of seasonal and annual catches and discards of the Dutch pelagic freezer-trawlers in Mauritania, Northwest Africa. Fisheries Research, 77: 184–191.

ICES. 2013. Report of the Workshop on the Age Reading of Blue Whiting, 10-14 June 2013, Bergen, Norway. ICES CM 2013/ACOM:53. 52 pp.

ICES. 2014. First Interim Report of the Stock Identification Methods Working Group (SIMWG), by correspondence. ICES CM 2014/SSGSUE:02. 31 pp.

ICES. 2015. Report of the Workshop on Maturity Staging of Mackerel and Horse Mackerel (WKMSMAC2), 28 September–2 October 2015, Lisbon, Portugal. ICES CM 2015/SSGIEOM:17. 93 pp.

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

ICES. 2017a. Report of the Benchmark Workshop on Widely Distributed Stocks (WKWIDE), 30 January–3 February 2017, Copenhagen, Denmark. ICES CM 2017/ACOM:36. 196 pp.

ICES. 2017b. Report of the workshop on Age estimation of Blue Whiting (Micromesistius poutassou) WKARBLUE2, 6-9 June 2017, Lisbon, Portugal. ICES CM 2017/ SSGIEOM:22. 60pp

ICES. 2018a. Report of the Workshop on a long-term management strategy for Norwegian Spring-spawning herring (WKNSSHMSE), 26–27 August 2018, Torshavn, Faroe Islands. ICES CM 2018/ACOM:53. 113 pp. https://doi.org/10.17895/ices.pub.5583. Annex 9 is available separately at the ICES website.

ICES. 2018b. Interim Report of the Working Group on InteICEgrated Ecosystem Assessments for the Norwegian Sea (WGINOR). ICES WGINOR REPORT 2017 27 November - 1 December 2017. Tórshavn, Faroe Islands. ICES CM 2018/SSGIEA:10. 38 pp.

ICES. 2019a. Interbenchmark Workshop on the assessment of northeast Atlantic Mackerel (IBPNEAMac). ICES Scientific Reports. 1:5. 71 pp. http://doi.org/10.17895/ices.pub.4985

ICES. 2019b. Workshop on a Research Roadmap for Mackerel (WKRRMAC). ICES Scientific Reports. 1:48. 23 pp. http://doi.org/10.17895/ices.pub.5541

ICES. 2019c. Working Group on Widely Distributed Stocks (WGWIDE). ICES Scientific Reports. 1:36. 948 pp. http://doi.org/10.17895/ices.pub.5574

ICES. 2023a. Workshop on Age reading of Norwegian Spring Spawning Herring (Clupea harengus) (WKARNSSH) ICES Scientific Reports. X:X. 58pp.

ICES. 2023b. Workshop on age reading of Blue whiting (WKARBLUE3; outputs from 2021 meeting). ICES Scientific Reports. 5:54. 97 pp. https://doi.org/10.17895/ices.pub.22785875

ICES. 2023c. Workshop on age reading of Blue whiting (WKARBLUE3; outputs from 2021 meeting). ICES Scientific Reports. 5:54. 97 pp. https://doi.org/10.17895/ices.pub.22785875

ICES. 2024. Working Group on the Integrated Assessments of the Norwegian Sea (WGINOR; outputs from 2023 meeting). ICES Scientific Reports. 6:33. 71 pp. https://doi.org/10.17895/ices.pub.25526548

ICES. 2024b. Workshop on the evaluation of NEA mackerel stock components (WKEVALMAC, outputs from 2023 meeting). ICES Scientific Reports. 6:25. 48 pp. https://doi.org/10.17895/ices.pub.24216843

ICES. 2024c. Benchmark workshop on horse mackerel and boarfish (WKBHMB). ICES Scientific Reports. 6:8. https://doi.org/10.17895/ices.pub.25002482.

ICES. 2025. Working Group on Integrated Assessments of the Norwegian Sea (WGINOR; outputs from 2024 meeting). ICES Scientific Reports. 07:82. 91 pp. https://doi.org/10.17895/ices.pub.29503769

ICES. 2025b. Benchmark workshop on Mackerel and Norwegian spring-spawning herring (WKBMACNSSH). ICES Scientific Reports. 7:64. 509pp. https://doi.org/10.17895/ices.pub.29279615

Lee, B., Ólafsdóttir, A. H., Post, S., Jacobsen, J. A., Høines, Å., Gonçalves, P., Randhawa, H. S., 2025. Unravelling the stock structure of blue whiting in the Northeast Atlantic: navigating contradictions towards resolution. Rev. Fish Biol. Fisheries. https://doi.org/10.1007/s11160-025-09976-1

Patterson, K.R. 1998: A programme for calculating total international catch-at-age and weight at-age. WD to Herring Assessment Working Group 1998.

Pierce, G. J., J. Dyson, E. Kelly, J. D. Eggleton, P. Whomersley, I. A. G. Young, M. B. Santos, J. J. Wang and N. J. Spencer (2002). Results of a short study on by-catches and discards in pelagic fisheries in Scotland (UK). Aquatic Living Resources 15(6): 327-334.

Rousseau, Y., R.A.Watson, J.L.Blanchard and E.A.Fulton (2019). “Evolution of global marine fishing fleets and the response of fished resources.” Proceedings of the National Academy of Sciences 116(25): 12238-12243.

Skjoldal, H. R., Dalpadado, P., and Dommasnes, A., 2004. Food webs and trophic interactions.InTheNorwegian Sea Ecosystem, 1st edn, pp. 263 – 288. Eds. H. R. Skjoldal R. Sætre, A. Fernö, O.A. Misund and I. Røttingen. Tapir Academic Press, Trondheim, Norway. 559 pp.

Sherman, K., and Skjoldal, H.R., 2002. Large Marine Ecosystems of the North Atlantic. Changing states and sustainability. Sherman, K., and Skjoldal H.R. (Eds.)). Elsevier Science B.V. The Netherlands.

Ulleweit, J. and Panten, K., 2007. Observing the German Pelagic Freezer Trawler Fleet 2002 to 2006 – Catch and Discards of Mackerel and Horse Mackerel. Working Document to the Working Group Mackerel, Horse Mackerel, Sardine and Anchovy (ICES CM 2007/ACFM: 31).

Ulleweit, J., Overzee, H. M. J., van Helmond, A. T. M., van Panten, K. (2016): Discard sampling of the Dutch and German pelagic freezer fishery operating in European waters in 2013-2014 – Joint report of the Dutch and German national sampling programmes. Stichting DLO Centre for Fisheries Research (CVO), 62 pages, CVO Report 15.014

van Helmond, A.T.M. and H.J.M. van Overzee 2009. Discard sampling of the Dutch pelagic freezer fishery in 2003-2007. CVO report 09.001

van Helmond, A.T.M. and H.J.M. van Overzee 2010. Discard sampling of the Dutch pelagic freezer fishery in 2008 and 2009. CVO report 10.008

van Overzee, H. M. J., & van Helmond, A. T. M. (2011). Discard sampling of the Dutch pelagic freezer fishery in 2010. (CVO report; No. 11.010). Centrum voor Visserijonderzoek. https://edepot.wur.nl/189414

van Overzee, H. M. J., ; Helmond, A. T. M. van; Ulleweit, J.; Panten, K. (2013): Discard sampling of the Dutch and German pelagic freezer fishery operating in European waters in 2011 and 2012. Stichting DLO Centre for Fisheries Research (CVO), 68 pages, CVO Report 13.013

van Overzee H.M.J., Ulleweit J, Helmond ATM van, Bangma T (2020) Catch sampling of the pelagic freezer trawler fishery operating in European waters in 2017-2018 - joint report of the Dutch and German national sampling programmes. Ijmuiden: Stichting Wageningen Research, Centre for Fisheries Research (CVO), 53 p, CVO Rep 20.004

Vartia, S., Collins, P.C., Cross, T.F., FitzGerald, R.D., Gauthier, D.T., McGinnity, P., Mirimin, L. & Carlsson J. 2014. Multiplexing with three-primer PCR for rapid and economical microsatellite validation. Hereditas, 151: 43–54.

Vartia, S., Villanueva, J.L.., Finarelli, J., Farrell, E.D., Hughes, G., Carlsson, J.E.L., Collins, P.C., Gauthier, D.T., McGinnity, P., Cross, T.F., FitzGerald, R.D., Mirimin, L., Cotter, P. & Carlsson, J. 2016. A novel method of microsatellite genotyping-by-sequencing using individual combinatorial barcoding. Royal Society Open Science, 3 DOI: 10.1098/rsos.150565.