

8 Haddock in the North Sea, West of Scotland, and Skagerrak

had.27.46a20 – *Melanogrammus aeglefinus* in Subarea 4, Division 6.a, and Subdivision 20

Until 2014, haddock in Subarea 4, Division 6.a, and Subdivision 20 (referred to hereafter as Northern Shelf haddock) were assessed as two separate stocks: Subarea 4 and Subdivision 20 by WGNSSK, and Division 6.a by WGCSE. The 2014 Benchmark Workshop for Northern Haddock Stocks (WKHAD; ICES, 2014) concluded that the two notional haddock stocks should be assessed as one stock.

This stock was most recently benchmarked in early 2022 at the Benchmark Workshop on North Sea and Celtic Sea Stocks (WKNSCS; ICES, 2023). The assessment model was changed to SAM (Nielsen and Berg, 2014) which also enabled the use of stochastic forecasting methods for generating catch advice. Additionally, several updates were made to the input datasets, the most significant being moving to time varying maturity-at-age estimates and developing new delta-GAM modelled survey indices for Q1 and Q3+Q4 covering the entire stock area. Updated natural mortality estimates were provided by WGSAM (ICES, 2024) in 2024. Overall, this resulted in minor changes to stock size. Reference points were updated in response to the revision of the natural mortality inputs to the assessment.

8.1 General

8.1.1 Ecosystem aspects

Ecosystem aspects are summarised in the Stock Annex.

8.1.2 Fisheries

A general description of the fishery (along with its historical development) is presented in the Stock Annex. Most of the information presented below and in the Stock Annex pertains to the Scottish fleet, which takes the largest proportion of the haddock stock. This fleet is not just confined to the Northern Shelf area, as vessels will sometimes operate in Divisions 6.b (Rockall) and 5.b (Faroes).

8.1.2.1 Changes in fleet dynamics

Specific information on changes in the Scottish fleet during 2011–2023 was not provided to WGNSSK in 2024, and it is difficult to reach a firm conclusion on the likely effect of recent fishery changes on haddock mortality.

Currently, catches of haddock are subject to national legislation regulating discards in the UK and Norway in addition to the EU landing obligation. The EU landing obligation was implemented for the majority of fleets catching Northern Shelf haddock in January 2016 and catches of this stock have been fully under the landing obligation since 2019. It is unclear what changes in fleet dynamics and fishing behaviour this has caused. In the past, vessels have only very

seldom exhausted their quota in this fishery, and previous discarding behaviour is thought to have been driven by a complicated mix of economic and other market-driven factors.

Fish from the 2019 and 2020 year-classes formed the bulk of haddock catches in 2023. The entry of the large 2019 and 2020 year-classes into the fishery led to an increase in the discarding rate for 2021 which has remained high in both 2022 and 2023. In 2023, discarding at age 3 increased substantially. Haddock at age 3 are still mostly under the Minimum Conservation Reference Size (MCRS) of 30 cm and so this suggests that the increase in discarding is driven by the large size of the 2020 year-class. The majority of the landings occurred at age 4 (2019 year-class).

8.1.2.2 Additional information provided by the fishing industry

No specific additional information on haddock was provided by the relevant fishing industries in 2024.

8.1.3 ICES advice

ICES advice for 2024

In April 2023, ICES concluded as follows:

ICES advises that when the MSY approach is applied, total catches in 2024 should be no more than 149 024 tonnes.

ICES notes the existence of a precautionary management plan, developed and adopted by one of the relevant management authorities for this stock.

8.1.4 Management

Annual management of the fishery operates through TACs for three discrete areas. The first is Subarea 4 (and EU Waters of 2.a). The 2023 and 2024 TACs for haddock in this area were 58 402 tonnes and 101 421 tonnes respectively. The second is Division 3.a (EU waters), for which the TACs for 2023 and 2024 were 3589 tonnes and 6233 tonnes respectively. The third is Division 6.a, for which the TACs in 2023 and 2024 were 6507 tonnes and 11 301 tonnes respectively.

The stock is managed according to advice based on the ICES MSY approach. The details of management plans relevant to North Sea haddock (Subarea 4 and Subdivision 20) and haddock in Division 6.a are provided in the Stock Annex. However, these management plans have not been evaluated by ICES for the wider Northern Shelf area. In 2018, EU-Norway requested an evaluation of multiple management strategies (ICES, 2019a) however, these are no longer applicable following the revisions to the assessment and reference points at the benchmark in 2022 (WKNSCS; ICES, 2023). In July 2018, the European Union agreed to a multiannual management plan (MAP) for demersal fisheries in the North Sea. However, the plan was not adopted by Norway or the UK and is therefore not used as the basis of advice for this shared stock. Details of the plan are given in EC 2018/973.

Fleets catching Northern Shelf haddock have previously been subject to several management schemes both aimed at reducing catches of cod. These were the Scottish Conservation Credits scheme which utilised Real Time Closures and the use of species-selective gears and the Fully documented Fisheries scheme which utilised on board monitoring cameras. Further details of these schemes are given in the Stock Annex.

The EU landing obligation was initially implemented from 1 January 2016 for directed haddock fisheries and was fully implemented in the North Sea and Northwestern Waters from 1 January 2019. Catches of haddock are also subject to UK and Norwegian national legislation regulating discards. A small number of exemptions exist for catches of haddock in ICES division 3.a. These

include *de minimis* exemptions for catches of haddock from creels and some bottom trawls targeting *Nephrops* or Northern prawn. A survivability exemption exists for haddock caught using pots and fyke nets.

8.2 Data available

8.2.1 Catch

Official landings data for each country participating in the fishery are presented in Table 8.2.1, together with the corresponding ICES estimates and the agreed international quota (listed as “total allowable catch” or TAC). International data on landings, discards, below minimum size (BMS) landings and logbook registered discards (LRD) from 2008 onwards are collated through the InterCatch system (see Section 1.2). The sampling coverage of haddock catch is usually quite high with the majority of the catch data being provided by Scotland.

Figure 8.2.1 and Tables 8.2.2 to 8.2.4 summarise the proportion of landings in the combined Northern Shelf area for which samples have been provided for 2023. While there are a large number of fleets for which landings have not been sampled, the overall contribution of these fleets to total landings is small. The proportion of landings that have been sampled in 2023 (88%) has risen compared to the reduced sampling coverage seen due to the impact of the COVID-19 pandemic in 2020 and 2021.

Industrial bycatch (IBC) has declined considerably from the high levels observed until the late 1970s and has rarely exceed 100 tonnes in recent years. However, estimates since 2020 have been noticeably higher (>1000 tonnes). This increase has been partly driven by the larger size of recent cohorts and may also have been due to an increase in effort in the Norway pout fishery. Additionally, since 2021 there have been changes to the Danish sampling protocols for industrial bycatch.

Subarea 4 discard estimates for 2023 are derived from data submitted by Belgium, Denmark, France, Germany, the Netherlands, England, and Scotland. As Scotland is the principal haddock fishing nation in that area, Scottish discard practices dominate the overall estimates. Subdivision 20 discard estimates are derived from data submitted by Denmark, Germany, and Sweden. Division 6.a discard estimates are provided by France, Ireland, and UK (Scotland). Where landings are provided without a corresponding discard estimate, discards are raised using a discard rate inferred using simple averaging weighted by landings weight without consideration of area, quarter, country, or gear. In 2023, discard observations are available for the fleets landing the majority of haddock landings (provided for 90% of the landings; see Figure 8.2.2), and 81% of the reported discards were sampled (see Figure 8.2.3). These sampling levels show improvement on the lower sampling coverage seen during the COVID-19 pandemic (2020-2021).

The collation of BMS landings and LRD in InterCatch was introduced in 2016 in accordance with the implementation of the EU landing obligation and national legislation regulating discards in the UK and Norway. Sampling information is solely provided by Scotland, however, the provision of BMS landings data and sampling information since 2016 has been sporadic. In 2023, Scotland were unable to provide reliable age estimates for BMS landings (see Figure 8.2.4). Logbook registered discard observations have not been submitted by any country for haddock in any year.

The full time series of landings, discards, BMS landings and industrial by-catch (IBC) is presented in Table 8.2.5 and Figure 8.2.5. The total landed yield of the international fishery has been relatively stable since 2007, however, the yield for 2023 shows a distinct increase compared to 2022. The ICES estimates (Table 8.2.5) suggest that haddock discarding (as a proportion of the total catch) decreased significantly during 2013, and the discard rate for that year was the lowest

in the time series at 7.2% by weight. This may have been due in part to fleet behaviour changes related to cod avoidance measures, but also to the weak year-classes since 2009 (implying that the bulk of the catch was large, mature fish that are less likely to be discarded). The discard rate increased year on year to 18% in 2016 before dropping again in 2017 and 2018 (see Figure 8.2.5). Since then, the discard rate has increased again, year on year, reaching 37% in 2021 then dropping to 30% in 2023. The current high discard rates are being driven by the large 2020 year-class which, in 2023, was still mostly under the MCRS and by the relatively large 2022 year-class. The recent changes in discarding are not consistent across ages (Figure 8.2.6).

It would be expected that under a landing obligation fish caught under the MCRS would be landed and recorded as BMS landings in logbooks and reported to ICES. However, low BMS values may be seen if the fish caught below MCRS are either not landed, not recorded in logbooks, not reported to ICES or a mixture of the three. BMS landings reported to ICES in 2023 are 0.5% of the total catch which is significantly lower than the discard estimate of 30% of total catch. This suggests that fish caught below MCRS are not being reported as BMS landings.

Previously, estimated discard rates could be calculated using video data from Scottish vessels carrying cameras (as part of the FDF scheme described in the Stock Annex). Neither fish ages nor weights can be measured directly using video, but a method has been developed in Scotland for estimating discard rates by measuring numbers and lengths of discarded fish and applying existing weight-length relationships to obtain a discarded weight, which can then be compared with the total landed weight (see Needle *et al.*, 2015). The lack of age information currently impedes the use of these estimates in the ICES assessment process, but work is underway in Scotland and elsewhere to address this.

8.2.2 Age compositions

Age compositions for un-sampled landings (including IBC), discards, and BMS landings are generated from the age compositions from all sampled landings, discards and BMS landings, respectively, without consideration of area, quarter, country, or gear. Total catch-at-age data are given in Table 8.2.6, while catch-at-age data for each catch component are given in Tables 8.2.7 to 8.2.10.

8.2.3 Weight-at-age

Weight-at-age for the total catch in the North Sea is given in Table 8.2.11. Weight-at-age in the total catch is a number-weighted average of weight-at-age in the human consumption landings, discards, BMS landings and industrial bycatch components. Weights-at-age in the stock are derived by applying correction factors (calculated from comparing mean weights-at-age in the catch data to survey data from NS-IBTS Q1 and UK-SCOWCGFS Q1) to the mean weights-at-age in the catch. The mean weights-at-age for the separate catch components and for the stock are given in Tables 8.2.12 to 8.2.16 and are illustrated in Figure 8.2.7 and Figure 8.2.8: this shows the declining trend in weights-at-age for older ages in total catch and landings. However, in recent years there has been a slight increase in mean weight-at-age.

The mean weights-at-age in the last data year (2023) are used in the intermediate year (2024) in the assessment. However, there is some evidence for reduced growth rates for large year-classes. Jaworski (2011) concluded that linear cohort-based growth models are the most appropriate method for characterising haddock growth. Therefore, these modelled weights are used in both the intermediate year (2024) and the advice year (2025) in the short-term forecast (Section 8.6).

8.2.4 Maturity and natural mortality

The basis for estimates of maturity and natural mortality are described in the Stock Annex. Natural mortality varies with age and year as shown in Figure 8.2.9 and Table 8.2.17. These values shown here are derived from the latest WGSAM key run conducted in 2023 (WGSAM; ICES, 2024). This represents an update to the natural mortality estimates compared to those used last year. As a result of this update, reference points were revised (see section 8.8).

Annually varying maturity ogives are estimated from Q1 survey data following WKMOG guidelines (WKMOG; ICES, 2008) and are shown in Figure 8.2.10 and Table 8.2.18. Data on maturity in quarter 1 of the assessment year (2024) are used to derive the time series of maturity at age. A GAM is then used to reduce interannual variability in the time series and focus on long term trends. It is these smoothed values that are used in the assessment except for the assessment year (2024) value which is omitted. This is because the GAM smoothing means the last data point in the time series can change a substantial amount year to year as new data are added. Therefore, the assessment year (2024) maturity estimate is set equal to that estimated for the data year (2023). This is a similar procedure to other biological parameters.

The method for producing the maturity ogives involves a re-calculation of the entire time series whenever new data are added. Therefore, a retrospective analysis was conducted to check the robustness of the historic values to the addition of new data. The Mohn's rho values for ages 1 to 3 were -0.7%, -9% and -1.6% respectively, indicating a high level of robustness (Figure 8.2.11).

A new maturity scale (shown in the table below) was introduced by WKASMSF (ICES, 2018) in 2021 which has since been used by several countries when submitting survey data – 74% of maturity samples were submitted using this new scale in 2023. The B code is subset into “Ba” and “Bb”, see table below. The “Ba” maturity code indicates first-time developers – fish which are becoming sexually mature but are unlikely to contribute to spawning that year and so are considered to be immature fish.

State	Stage	Possible sub-stages
SI. Sexually immature	A. Immature	
SM. Sexually mature	B. Developing	Ba. Developing but functionally immature (first-time developer)
		Bb. Developing and functionally mature
	C. Spawning	Ca. Actively spawning
		Cb. Spawning capable
	D. Regressing/Regenerating	Da. Regressing
		Db. Regenerating
	E. Omitted spawning	
	F. Abnormal	

8.2.5 Catch, effort and research vessel data

The available survey data are summarised in the following table: data used to generate indices for use in the final assessment are highlighted in bold.

Area	Country	Quarter	Code	Year range	Age range
Subarea 4	Scotland	Q3	ScoGFS Aberdeen Q3	1982-1997	0+
Subarea 4	Scotland	Q3	ScoGFS Q3 GOV	1998-present	0+
Subarea 4	England	Q3	EngGFS Q3 GRT	1977-1991	0+
Subarea 4	England	Q3	EngGFS Q3 GOV	1992-present	0+
Subarea 4 and Division 3.a	International	Q1	IBTS Q1	1983-present	1+
Subarea 4 and Division 3.a	International	Q3	IBTS Q3	1991-present	0+
Subarea 6.a	Scotland	Q1	ScoGFS-WIBTS Q1	1985-2010	1+
Subarea 6.a	Scotland	Q1	UK-SCOWCGFS-Q1	2011-present	1+
Subarea 6.a	Scotland	Q4	ScoGFS-WIBTS Q4	1996-2009	0+
Subarea 6.a	Scotland	Q4	UK-SCOWCGFS-Q4	2011-present	0+
Subarea 6.a	Ireland	Q4	IGFS-WIBTS-Q4	1993-2002	0+
Subarea 6.a	Ireland	Q4	New IGFS-WIBTS-Q4	2003-present	0+

The 2022 benchmark meeting (WKNSCS; ICES, 2023) developed combined North Sea-West Coast of Scotland (NS-WC) indices for Q1 and Q3+Q4 (combined quarters) for use in the assessment using the delta-GAM modelling approach. The general methodology is described in Berg et al. (2014) and full methodological details are available in the report of the last benchmark (WKNSCS; ICES, 2023). For the NS-WC Q1 survey indices the model is fit to ages 1-8+ and all are used in the assessment model. For the NS-WC Q3+Q4 survey indices the model is fit to ages 0-8+ all of which are used in the assessment model. A summary is given in the table below:

Modelled survey name	Input survey data	Quarter	Area	Years	Ages
Modelled NS-WC Q1 survey indices	ScoGFS-WIBTS-Q1; UK-SCOWCGFS-Q1; NS-IBTS-Q1	Q1	North Sea (27.4), Skagerrak (27.3.a) and West Coast of Scotland (27.6.a)	1983-2024	1-8+
Modelled NS-WC Q3+Q4 survey indices	NS-IBTS-Q3; ScoGFS-WIBTS-Q4; IGFS-WIBTS-Q4; UK-SCOWCGFS-Q4	Q3+Q4	North Sea (27.4), Skagerrak (27.3.a) and West Coast of Scotland (27.6.a)	1991-2023	0-8+

The modelled survey indices used for the calibration of the assessment are presented in Table 8.2.19. Coefficients of variation are used to weight the modelled NS-WC Q1 survey indices in the assessment model. This is to account for the increased uncertainty in the indices resulting from a reduction in sampling coverage of the NS-IBTS Q1 survey and the cancellation of the UK-SCOWCGFS Q1 survey in 2022 due to a combination of several major storms and mechanical issues with some vessels.

Survey-based abundance distributions by age and year are given in Figures 8.2.12 (North Sea IBTS Q1), 8.2.13 (North Sea IBTS Q3) which clearly show the large 2019 and 2020 year-classes in addition to a sizeable 2022 year-class. However, the survey-based abundances indicate a very small incoming year-class in 2023. Abundance trends in survey indices are shown in Figure 8.2.14. These indicate reasonably good consistency in stock signals from the two North Sea surveys and support the perception of large 2019 and 2020 year-classes.

8.3 Data analyses

The assessment has been carried out using SAM (Nielsen and Berg, 2014) as the main assessment method. The results of a SURBAR analysis are also shown for comparison with the main assessment.

8.3.1 Exploratory catch-at-age-based analyses

The catch-at-age data, in the form of log-catch curves linked by cohort (Figure 8.3.1), indicate partial recruitment to the fishery for most cohorts up to age 2 (shown by hooks towards the top of the catch curves). Gradients between consecutive values within a cohort have reduced considerably for some recent cohorts, reflecting a reduction in fishing mortality, although catch curves are considerably more variable in recent years suggesting less consistent catch data (which may reflect the lower sample size available from reduced landings, or COVID-19 impacts on sampling). Figure 8.3.2 plots the negative gradient of straight lines fitted to each cohort over the age range 2–4, which can be viewed as a rough proxy for average total mortality for ages 2–4 in the cohort. These negative gradients are also lower in most recent cohorts.

Cohort correlations in the catch-at-age matrix (plotted as log-numbers) are shown in Figure 8.3.3. These correlations show good consistency within cohorts up to the plus-group, verifying the ability of the catch-at-age data over the full time-series to track relative cohort strengths.

8.3.2 Exploratory survey-based analyses

The two survey derived indices (delta-GAM NS-WC Q1 and delta-GAM NS-WC Q3+Q4) show a high level of consistency between the indices in the plot of survey catch curves (Figure 8.3.4). Although there are indications of reduced catchability for cohorts in delta-GAM NS-WC Q1 from 2010 onwards. The plots of mean-standardised log survey indices by age and cohort (Figure 8.3.5) and the pairwise within-survey correlations (Figure 8.3.6) show that both surveys track year-class strength well through the population overall.

A SURBAR run (ICES, 2010; Needle, 2015) was carried out using the same combination of tuning indices as the SAM assessment, although excluding the plus group (8+) and age 0. The summary plot from this run is given in Figure 8.3.7, which indicates good precision in estimates for total mortality, and relative estimates for biomass and recruitment. The SURBAR residual plot in Figure 8.3.8 shows that there remains an indication of some conflict (mostly positive residuals for Q1 and negative residuals for Q3+Q4).

Mean-standardising SSB and recruitment estimates (using a common year-range for the mean) and generating SAM estimates of Z by adding F and M enables the comparison between SAM and SURBAR shown in Figure 8.3.19. SSB and recruitment estimates are very similar from the two models, although it is noticeable that the swings between high and low SURBAR SSB estimates are more pronounced than for SAM. The mean Z time-series from SURBAR are consistent for the most part with those from SAM, although there is some offset in years of higher mean Z. Overall, the SURBAR assessment concurs with and support the final SAM assessment, with some relatively minor variations.

8.3.3 Final assessment

Table 8.3.1 and Table 8.3.2 give the final SAM assessment inputs and settings, while Table 8.3.2 gives the corresponding parameter estimates from the completed run. A full description of the SAM method, inputs and settings are given in the Stock Annex, and the ICES WKNSCS (2023) report. Note that, for assessment purposes, total catch is divided into human consumption landings (referred to as “landings”) and a composite of discards, BMS landings and industrial bycatch (referred to as “discards” or “discards+bycatch+BMS”).

The stock summary is given in Figure 8.3.10. The spawning stock biomass in 2024 is seen to be at the highest value in the time series while fishing mortality is seen to be at its historical minimum. Recruitment in 2023 is seen to be very low. However, this poor recruitment estimate follows 4-year classes that have all been larger than the recent mean (see also Figure 8.3.11).

The one-observation-ahead (Figure 8.3.12) and process error (Figure 8.3.13) residuals are relatively small and, although some patterns are seen in the residuals, these are similar to those seen at the last benchmark meeting (WKNSCS; ICES, 2023). Investigation of these patterns is listed as an issue in section 8.12.

The fit to the commercial catch data, delta-GAM NS-WC Q1 indices and delta-GAM NS-WC Q3+Q4 indices are shown in figures 8.3.14-8.3.16. Overall, these indicate reasonably good fits to data, although the model tends to underestimate the largest peaks and drops in abundance in the data.

The results of the leave-one-out analysis are shown in Figure 8.3.17. These results show similar trends when either of the survey indices are removed from the analysis indicating that the signals from each survey are consistent with each other. The leave-one-out runs are all mostly within the pointwise 95% confidence intervals of the full assessment results except for some more recent years in the SSB estimate when the delta-GAM NS-WC Q1 survey is removed.

Figure 8.3.18 summarizes the results of SAM retrospective analyses for Northern Shelf haddock. There is no significant retrospective noise or bias; none of the retrospective run falls outside of the pointwise 95% confidence intervals of the full time-series assessment for any of the summaries. It may be hypothesized that the strong population signals from occasional large year-classes provide sufficient data contrast to obviate against retrospective noise.

Mohn's rho values (average relative bias of retrospective estimates) were calculated for SSB, F and recruitment estimates from SAM and were -9%, 15% and -28% respectively and lies within the limits specified by WKFORBIAS for SSB (ICES, 2020).

Fishing mortality estimates for the final SAM assessment are presented in Table 8.3.4, the stock numbers in Table 8.3.5, and the assessment summary in Table 8.3.6. A comparison with the results of last year's assessment is shown in Figure 8.3.19.

Following the revision to the natural mortality estimates from the latest SMS key run (see section 8.2.4), reference points needed to be updated using the assessment results, before conducting the short-term forecast. See section 8.8 for more details. A sensitivity assessment run was conducted

using the previous natural mortality estimates (WGSAM; ICES, 2021) to evaluate the impact of the change in natural mortality estimates on the assessment results. The changes to the assessment were small (see Figure 8.3.20) with differences in the SSB being mostly less than 3%.

8.4 Historical stock trends

The historical stock and fishery trends are presented in Figure 8.3.10.

Landings yields stabilised between 2005 and 2014, partly due to the limitation of inter-annual TAC variation to $\pm 15\%$ in the EU-Norway management plan for the North Sea. Discards have fluctuated in the same period due to the appearance and subsequent growth of the large year-classes (1999, 2005, 2009, 2014, 2019, and 2020), while industrial bycatch (IBC) is now at a very low level for haddock (see Figure 8.2.5).

Estimated fishing mortality for 2008 to 2020 fluctuates between 0.2 and 0.45 and has been decreasing since 2018. Fluctuations around the previous F(target) rate (0.3) of the management plan are an expected consequence of the lag between data collection and management action and should not be taken to indicate that the plan did not work.

The underlying mean level of recruitment has declined from the early seventies until today, and recruitment remains lower in general. Over the last two decades, recruitment has been characterised by stretches of poor recruitment (e.g., 2006–2008 and 2010–2013) with occasional modestly sized year-classes (e.g., 2005, 2009, 2014) which have sustained the fishery in recent years. However, the 2019 and 2020 year-classes are estimated to be the largest since the 1999 year-class and are very unusual for a haddock stock in that they occur consecutively. Furthermore, the last 4 year-classes (2019–2022) have all been larger than the recent mean recruitment. These recruitment events have increased the estimated SSB since 2021.

8.5 Recruitment estimates

Following the Stock Annex, recruits in the intermediate year (IY = 2024) and in the advice year ($IY + 1 = 2025$) were sampled, with replacement, from recent (2000–2023) recruitment estimates from SAM. This method ensures that information about the frequency of the occasional larger year classes is included in the forecast. The geometric mean of the resampled recruitments is 1 788 860 thousand.

The following table summarises the recruitment for the short-term forecast.

Year-class	Age	SAM forecast (millions)
2024	0 in 2024	1789
2025	0 in 2025	1789
2026	0 in 2026	1789

8.6 Short-term forecasts

Reference points were updated (see section 8.8) prior to conducting the short-term forecast following the revision to the natural mortality estimates provided by WGSAM (ICES, 2024) (see section 8.2.4).

The short-term forecast is a stochastic forecast conducted in SAM. The inputs to the short-term forecast are presented in Table 8.6.1. The forecast is conducted for a single fleet (as opposed to

two fleets: human consumption catches and industrial bycatch) and industrial bycatches are included with the projected discards. Due to limitations in the options available for setting the recruitment assumption in the first forecast year, the base year of the forecast simulation is set as the last data year (2023) to enable the resampling of recruitment to occur in all forecast years (2024–2025).

Initial stock size

The initial stock sizes are simulated from the estimated distribution at the start of last data year (including covariances).

Maturity and natural mortality

Both the natural mortality and maturity estimates used in the forecast are set equal to the mean of the final 3 data years (2021–2023).

Weights-at-age

Mean weights-at-age are forecast using the method proposed by Jaworski (2011) which was discussed by WKHAD (ICES, 2014) and modified at WKNSCS (ICES, 2023). The method is summarized in the Stock Annex and involves fitting straight lines to cohort-based weight estimates and extrapolating forward in time.

The mean weights-at-age resulting from this method for the landings are summarised in Figure 8.6.1. The weights-at-age for discards, IBC and BMS were combined using the relative contribution of each component to the total catch. These combined weights were used in the extrapolation to calculate the forecast weights and are shown in Figure 8.6.2. Where there is insufficient data (i.e. less than 3 data points) to allow for cohort-based modelling of weights-at-age a simple three-year (2021–2023) means by age are used for all forecast years. The mean weights-at-age for the total catch are derived by combining the forecast weights-at-age for the landings and discards (including IBC and BMS) using the relative contribution of each component to the total catch. Survey-derived correction factors (see Section 8.2.3 for more details) were applied to the mean weights-at-age for the catch to derive mean weight-at-age for the stock. The resulting forecast weights for the stock and all catch components are shown in Figure 8.6.3. It should be noted that the SSB value for 2024 in the forecast will be slightly different to the SSB value for 2024 from the assessment since these forecast weight-at-age are different to the mean weights-at-age used in the assessment. However, the stock numbers-at-age remain unchanged.

Fishing mortality

WKNSCS (ICES, 2023) concluded that fishing mortality estimates for the intermediate year should be a mean of the final 3 data years (2021–2023), rescaled to the final year (2023) F . When this approach results in a total catch that overshoots the TAC, a TAC constraint should be considered. A TAC constraint was not needed for the intermediate year to avoid a TAC overshoot. Therefore, $F_{\text{status quo}}$ ($F_{2023} = 0.084$) was used for the intermediate year. The combined-area human consumption TAC for 2024 is 118 955 tonnes.

The catches obtained with the fishing mortality rates discussed above are split into landings and discards (including IBC and BMS) by using the relative contribution (averaged over 2021–2023) of each component to the total catch.

Splitting catch forecasts between management units

The haddock assessment presented in this section is for the combined Northern Shelf stock, following the conclusion from ICES WKHAD (2014) that this was biologically appropriate. However, catch advice is still required for the extant management units. ICES WKHAD (2014)

proposed a survey-based method for splitting forecast catch into sub-units on the basis of a time-smoothed survey-based estimate of the proportion of the fishable stock in each area in each year.

However, the survey-based proportions were not accepted by ACOM (in June 2014) as the basis for advice, due to concerns over the comparability of survey catchability between the three management areas covered by the assessment area. As a consequence, the catch forecasts provided in Table 8.6.2 are provided for the full stock area only (Subarea 4, Division 6.a and Subdivision 20).

Forecast results

Results for the short-term forecasts are presented in Table 8.6.2. Assuming a F of 0.084 in 2024, SSB is expected to be 606 378 tonnes in 2024, before decreasing in 2025 to 535 682 tonnes (the increase in SSB is due to the size of the incoming 2022 year-class which is almost fully mature in 2025). In this case, projected landings in 2024 would be 53 277 tonnes with associated projected unwanted catch (discards + IBC + BMS) of 13 032 tonnes.

Several alternative options for 2025 have been highlighted in Table 8.6.2. These are based on various reference points including F_{MSY} , F_{pa} , F_{lim} , B_{pa} , B_{lim} , $B_{trigger}$ as well as F_{2024} , $F_{MSY\ upper}$, and $F_{MSY\ lower}$. Under the assumption of F_{MSY} , the 2025 total catch is forecast to be 112 435 tonnes, which corresponds (if recent discard+IBC+BMS rates remain unchanged) to landings yield of 93 661 tonnes and discards (including IBC and BMS) of 18 774 tonnes. This advised catch represents a 5.5% decrease on the 2024 TAC and a 25% decrease on advised catch for 2024. This exploitation is forecasted to lead in turn to an SSB in 2026 of 420 140 tonnes, a decrease of 22% on the SSB forecasted above for 2025.

Change in advice

The change in advice (-25%) is due to a change in the reference points caused by updated natural mortality estimates, a smaller recruitment estimated for 2023 than was assumed last year and the large 2019 and 2020 year-classes becoming fished out.

A comparison of the numbers at age of the current (WGNSSK 2024) and the previous (WGNSSK 2023) assessment and forecast are shown in Table 8.6.3 and Figure 8.6.4. The numbers at age in 2024 for age classes 0 and 2-5 have been revised upwards in the current assessment compared to the assumption made in the intermediate year of the forecast at WGNSSK 2023. More significantly, the size of the incoming year-class (age 0 in 2023) is smaller than the assumed recruitment in last year's forecast. The low incoming recruitment combined with the large 2019 and 2020 year-classes becoming fished out results in a drop in SSB in the advice year (2025) compared to the advice year (2024) SSB in last year's forecast.

Mean weight-at-age in the stock are different in each forecast year due to the cohort growth model used to derive the mean weights used in the forecast (Figure 8.6.5). However, a comparison with the mean weights at age used in last year's forecast shows that there is little difference except for the mean weight of the 2020 year-class (age 5 in 2025) which is estimated to be at a slightly lower mean weight in this year's forecast. The effect of the combination of changes in numbers and mean weight-at-age between the forecasts is shown in Table 8.6.4 and Figure 8.6.6. This again shows that the size of the stock is larger in this year's forecast across most ages and the small incoming 2023-year class being the most significant change.

A comparison of the selectivity used in this year's forecast compared to last year's is shown in Figure 8.6.7. However, this comparison shows very little difference between the two assumptions.

A comparison of the assumed SSB, F_{bar} , total catch and recruitment is shown in Table 8.6.5 and Figure 8.6.8. The larger stock sizes for 2023 and 2024 in this year's forecast can be seen along with the small recruitment in 2023. This year's recruitment assumption for the intermediate and

advice year is similar to that made at WGNSSK 2023 as this value comes from resampling recent recruitment values. The Fbar assumption made for 2023 in last year's forecast was not too different from the Fbar value estimated for 2023 in this year's assessment. This is also seen in the similar total catch values for 2023. The Fbar assumption made and resulting total catch for the intermediate year (2024) this year is slightly lower than the intermediate year (2023) assumption from last year. Finally, the Fbar used in the advice year this year (2025) is based on revised reference points compared to the Fbar used in the advice year (2024) in last year's forecast.

8.7 Medium-term forecasts

No specific medium-term forecasts have been carried out for this stock. Management simulations over the medium-term period were previously performed for North Sea haddock (Needle, 2008a, b) and West of Scotland haddock (Needle, 2010), while management strategy evaluations for Northern Shelf haddock were conducted in 2019 in response to a request for advice on a proposed EU-Norway management plan (ICES 2019a, b).

8.8 Biological reference points

Biological reference points were calculated at WGNSSK 2024 using EqSim following the provision of updated natural mortality estimates from the WGSAM SMS key run (ICES, 2024). The EqSim settings and assumptions remained broadly the same as those used and detailed in the WKNSSC report (ICES, 2023). The 10 most recent years were used to derive mean values for the biological parameters and for the selectivity (Figure 8.8.1). Default values were used for sigmaSSB (0.2), sigmaFbar (0.2) since the assessment sdSSB and sdFbar were both less than 0.2. Default values were also used for other settings ($cvF = 0.212$, $\phiIF = 0.423$, $cvSSB = 0$, $\phiISB = 0$).

The simulations were based on a recruitment time-series from 2000–2023, rather than the full time series. This is because the recruitment during this more recent period has been poor compared to the full time series and it would be unwise to assume that a very large recruitment is likely in the near future. There are indications of a drop in productivity, as indicated by recruits per SSB, since 2000 (Figure 8.8.2a). No autocorrelation in the recruitment time series was observed (Figure 8.8.2b). A segmented regression stock-recruitment relationship was used in the simulations (Figure 8.8.2c). To keep some consistency with the derivation of B_{lim} , which was based on the whole time series, a segmented regression stock-recruitment relationship with a fixed breakpoint at B_{lim} was used.

The stock-recruitment relationship indicates that haddock is a type 1 stock (Figure 8.8.2d). Using the ICES guidelines for sporadic spawners (type 1 stocks) B_{lim} was set to 141 339 tonnes (the estimated SSB for 1999, the smallest stock size to produce a good recruitment), and B_{pa} was revised to $1.645 * \sigma_{SSB} * B_{lim} = 196\,403$ tonnes (where $\sigma_{SSB} = 0.2$). An EqSim analysis run without assessment or advice error, or the advice rule gave a value of 0.39 for F_{lim} (the F that leads, on average, to B_{lim}).

An EqSim analysis run with assessment and advice error (using default values) but without the advice rule gave a value of 0.295 for the unconstrained F_{MSY} (Figure 8.8.3). The value of F_{pa} is set equal to the F that provides a 95% probability for SSB to remain above B_{lim} in the long term ($F_{p,0.05}$; run with assessment and advice error and advice rule) by the ICES guidelines. The value of $F_{p,0.05}/F_{pa}$ was calculated as 0.174. Since the value of the unconstrained F_{MSY} (0.295) was estimated to be above $F_{p,0.05}/F_{pa}$, the final value of F_{MSY} was capped at $F_{p,0.05}/F_{pa}$ (0.174) to ensure consistency between the precautionary and MSY frameworks (see Figure 8.8.4). The F_{MSY} ranges were adjusted accordingly to be consistent with the capped value of F_{MSY} ($F_{MSY\ lower} = F_{p,0.05\ lower} = 0.161$; $F_{MSY\ upper} = F_{p,0.05} = 0.174$).

Finally, the value of MSY $B_{trigger}$ was set equal to B_{pa} (196 402 tonnes) since the stock has been fished at a value above the unconstrained F_{MSY} for some of the time over the past 5 years (Figure 8.8.5).

The reference points from these analyses are given below:

Variable	WKNSCS 2022	WGNSSK 2024
B_{lim}	136 541 tonnes	141 339 tonnes
B_{pa}	189 734 tonnes	196 402 tonnes
MSY $B_{trigger}$	189 734 tonnes	196 402 tonnes
F_{lim}	0.43	0.39
$F_{p,05}/F_{pa}$	0.24	0.174
F_{MSY}	0.24	0.174
F_{MSY} lower	0.186	0.161
F_{MSY} upper	0.24	0.174

8.9 Quality of the assessment

Survey data are consistent both within and between surveys, and the catch data are internally consistent. Trends in mortality from catch data and survey indices are similar. Retrospective bias in the SAM model is low, and within the WKFORBIAS guidelines.

The COVID-19 pandemic affected catch sampling in 2020 and also, to a lesser extent, in 2021. In 2020, both observer and market sampling were not possible during Q2 but continues at a reduced level in Q3 and Q4. In 2021, Scottish observer sampling was not possible during Q1 though sampling proceeded at similar levels to the latter half of 2020 for the rest of the year. This reduced coverage is not thought to have had a significant impact on the quality of catch data for Scotland (which has the main fleets catching haddock).

In 2022, a combination of several major storms and mechanical issues with some vessels resulted in a reduction in the sampling coverage across the NS-IBTS and SCOWCGFS Q1 surveys. This increased the uncertainty on the Q1 survey indices used in the assessment. Relative weightings (CVs) for the Q1 survey indices were added as an input to the assessment model to minimise the impact of this increased uncertainty on the assessment results.

8.10 Status of the stock

Fishing mortality is now estimated to be at a historically low level in 2023 and is well below the estimate of F_{MSY} (0.174). Discard rates have increased above the historical minimum observed in 2013. The 2010–2013 year-classes were estimated to be weak, following the relatively strong 2009 year-class, but the 2014 year-class was slightly larger than the recent average and the incoming 2019 and 2020 year-classes appear to be the largest since 1999 and year-class sizes between 2019 and 2022 have all been notably above the recent mean. Spawning stock biomass has recovered from levels below B_{lim} to levels well above MSY $B_{trigger}/B_{pa}$ (196 402 tonnes) and is predicted to remain so in 2025.

8.11 Management considerations

The previous EU-Norway management plan for North Sea haddock, and the EU management plan for Division 6.a haddock, are not appropriate for the Northern Shelf stock, as they each relate to only a part of the full stock area. Discussions took place during 2019–20 between the EU and Norway to try and establish a new management strategy on the basis of the Northern Shelf stock, but no agreement has yet been reached, and further work would also need to include the UK. In the meantime, the principal basis for management of this haddock stock is the ICES MSY approach. The survey-based proposal for splitting catch advice into management subunits, which was proposed by WGNSSK in 2014, has not been agreed by ACOM, and the split of quota into management units remains based on historical landings. It is unlikely, therefore, to follow any future changes in stock distribution across the Northern Shelf.

Considering the Northern Shelf as a whole, fishing mortality declined significantly in the early 2000s and has fluctuated around a relatively low level since. The current estimate is below F_{MSY} . Spawning stock biomass is estimated to have reached a historical peak in 2002 with the growth of the large 1999 year-class, but declined again rapidly and is now driven strongly by occasional, moderately sized year-classes. The most recent of these occurred in 2005, 2009, 2014 and 2022 with two substantial year-classes occurring in 2019 and 2020.

Keeping fishing mortality close to the target MSY level would be preferable to encourage the sustainable exploitation of the recent larger year-classes. Estimated discard rates remain high as large numbers of small fish from the 2022 year-class enter the population, and this needs to be monitored and mitigated. In particular, discard rates remain high in certain small-mesh fisheries (such as the TR2 *Nephrops* fleets in Division 6.a). Further improvements to gear selectivity measures, allowing for the release of small fish, would be highly beneficial not only for the haddock stock, but also for the survival of juveniles of other species that occur in mixed fisheries along with haddock. Similar considerations also apply to spatial management approaches (such as real-time closures), and other measures intended to reduce unwanted bycatch and discarding of various species (such as the previous Scottish Conservation Credits scheme; see Stock Annex). Haddock was included in the EU Landing Obligation regulation from 2016, though the impacts on fishing and on the stock are yet unknown.

Haddock is a specific target for some fleets but is also caught as part of a mixed fishery catching cod, whiting and *Nephrops*. It is important to consider both the species-specific assessments of these species for effective management, as well as the latest developments in the mixed fisheries approach. This is not straightforward when stocks are managed via a series of single-species, single-area management plans that do not incorporate mixed-stocks considerations. However, a reduction in effort on one stock may lead to a reduction or an increase in effort on another and the implications of any change need to be considered carefully.

8.12 “Living issues” benchmark list

Below is a list of issues which were either left unresolved from the last benchmark or have arisen during subsequent WGNSSK meetings. A scoring system has been developed to aid Working Groups in prioritising stocks to be put forward for benchmark (see Annex 6 for further details). The current scoring for this stock is:

1. Assessment quality	2. Opportunity to improve	3. Management importance	4. Perceived stock status	5. Time since last benchmark	Total Score
2	2	5	1	2	2.2

8.12.1 Stock ID and other issues

Explore stock ID and structure, using otolith micro-chemistry, tagging data, and the spatial range of genetic data. Investigate ecosystem drivers for long term forecasts/MSE with consideration for climate change.

8.12.2 Data

Investigate indices of reproductive potential and methods to use them in management advice. Address spatial residual patterns in the modelled survey indices. Consider adding CVs as weighting for the Q3+Q4 survey indices as well as the Q1 indices.

8.12.3 Assessment

Investigate poor fit/residual patterns in plus group in view of increasing relative importance of this age class. Explore further model settings to address patterns within the assessment residuals.

8.12.4 Forecast

Review forecast settings in view of the settings recommended by the model developer.

8.13 References

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8.14 Tables

Table 8.2.1. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Nominal landings (000 t) during 2013–2023, as officially reported to, and estimated by, ICES, along with WG estimates of catch components, and corresponding TACs. Landings estimates for 2022 and 2023 are preliminary. Quota uptake estimates are also given, calculated as the ICES estimates of landings divided by available quota before 2018. Quota uptake from 2018 onwards is calculated as the ICES estimates of total catch divided by available quota (following the full implementation of the EU landing obligation). Reporting of BMS landings started in 2016.

Subdivision 20											
Country	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022*	2023*
DE	90	114	103	125	56	31	30	13	23	<1	180
DK	1456	1764	1059	908	852	542	457	449	1846	2740	2935
NL	5	6	4	2	20	4	4	1	11	7	4
NO	223	86	63	70	0	0	0	0	8	215	209
SE	217	219	203	110	104	140	93	56	125	270	347
UK	3	0	0	0	0	0	0	0	0	0	0
BMS landings				< 1	< 1	0	<1	74	7	13	

*Preliminary

Subarea 4											
Country	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022*	2023*
BE	78	98	47	53	30	29	29	40	148	232	345

Subarea 4											
DE	677	677	599	554	609	348	313	370	475	562	928
DK	1283	1079	1442	1244	1185	1117	1174	1680	1892	1738	3031
FO	0	0	0	0	0	0	1	2	0	0	2
FR	177	209	100	121	140	201	188	144	218	345	452
IR	0	0	0	0	0	0	0	0	0	14	1
LT	0	0	0	0	0	0	0	130	0	0	1
NL	172	99	44	146	75	102	166	218	349	751	471
NO	1662	2743	2003	1499	2164	1428	1516	3165	2215	2542	2425
SE	113	154	136	118	181	100	111	115	146	177	274
UK	33013	29851	25905	26427	25667	26091	22044	20621	17268	25455	31228
BMS landings					< 1	15	160	287	208	299	326

*Preliminary

Division 6.a											
Country	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022*	2023*
DE	0	0	0	0	0	0	0	0	0	0	1
DK	0	0	0	2	2	1	9	4	18	9	0
ES	14	19	9	33	28	28	64	26	24	14	48
FO	0	0	0	0	0	0	0	0	0	0	0
FR	51	67	41	62	68	66	57	86	92	181	165
IE	746	667	768	1034	641	758	562	448	603	878	937
NL	0	0	11	28	31	17	54	23	<1	0	0
NO	6	2	7	5	1	7	10	2	0	1	3
UK	3878	3261	3052	3101	2480	3441	2755	2080	2860	2401	2421
BMS landings					0	2	15	26	30	15	19

*Preliminary

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022*	2023*
Official landings	43864	41115	35596	35642	34334	34451	29637	29673	28322	38534	46406
ICES landings	43230	40589	35215	35111	33799	34441	30620	28942	26457	37392	44478
ICES discards	3305	5271	6241	7582	6960	5055	5335	8693	16129	18859	19812
ICES IBC	168	65	21	37	8	30	186	1077	1357	430	2036

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022*	2023*
ICES BMS	-	-	-	201	93	160	180	217	179	169	319
ICES total catch	46703	45926	41477	42930	40860	39687	36449	38928	44122	56849	66645
TAC 4	45041	38284	40711	61933	33643	41767	28950	35653	42785	44924	58402
TAC 3.a	2770	2355	2504	3926	2069	2569	1780	2193	2630	2761	3589
TAC 6.a	4211	3988	4536	6462	3697	4654	3226	3973	4767	5006	6507
Total TAC	52022	44627	47751	72321	39409	48990	33956	41819	50182	52691	68498
ICES quota uptake	83%	91%	74%	49%	86%	81%	107%	93%	88%	108%	97%

*Official landings are preliminary

Table 8.2.2. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Proportion of sampling strata for discards imported into InterCatch and proportion of discards raised from averaged discard rates for 2023.

Catch category	Raised or imported	Weight (tonnes)	Proportion
BMS landings	Imported	319	100
Discards	Imported	17127	87
Discards	Raised	2641	13
Industrial bycatch	Imported	2031	100
Landings	Imported	44388	100
Logbook registered discards	Imported	0	NA

Table 8.2.3. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Proportion of age distributions for landings, BMS landings and discards either imported or raised in InterCatch and either sampled or estimated for 2023.

Catch category	Raised or imported	Sampled or estimated	Weight (tonnes)	Proportion
Logbook registered discards	Imported	Estimated	0	NA
Landings	Imported	Sampled	38831	87
Landings	Imported	Estimated	5557	13
Industrial bycatch	Imported	Estimated	2031	100
Discards	Imported	Sampled	15961	81
Discards	Raised	Estimated	2641	13
Discards	Imported	Estimated	1167	6
BMS landings	Imported	Estimated	319	100

Table 8.2.4. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Proportion by area of distributions for landings, BMS landings and discards either imported or raised in InterCatch and either sampled or estimated for 2023.

Area	Catch category	Raised or im-ported	Sampled or esti-mated	Weight (tonnes)	Proportion
27.6.a	Logbook registered dis-cards	Imported	Estimated	0	NA
27.6.a	Landings	Imported	Sampled	3254	91
27.6.a	Landings	Imported	Estimated	316	9
27.6.a	Discards	Imported	Sampled	1022	89
27.6.a	Discards	Raised	Estimated	129	11
27.6.a	Discards	Imported	Estimated	3	0
27.6.a	BMS landings	Imported	Estimated	19	100
27.4	Logbook registered dis-cards	Imported	Estimated	0	NA
27.4	Landings	Imported	Sampled	32642	88
27.4	Landings	Imported	Estimated	4499	12
27.4	Industrial bycatch	Imported	Estimated	1978	100
27.4	Discards	Imported	Sampled	14149	82
27.4	Discards	Raised	Estimated	2103	12
27.4	Discards	Imported	Estimated	988	6
27.4	BMS landings	Imported	Estimated	300	100
27.3.a.20	Logbook registered dis-cards	Imported	Estimated	0	NA
27.3.a.20	Landings	Imported	Sampled	2935	80
27.3.a.20	Landings	Imported	Estimated	742	20
27.3.a.20	Industrial bycatch	Imported	Estimated	53	100
27.3.a.20	Discards	Raised	Estimated	790	57
27.3.a.20	Discards	Imported	Sampled	409	30
27.3.a.20	Discards	Imported	Estimated	176	13
27.3.a.20	BMS landings	Imported	Estimated	0	NA

Table 8.2.5. Haddock in Subarea 4, Division 6.a, and Subdivision 20. ICES estimates of catch components by weight (000 tonnes).

Year	Subarea 4					Subdivision 20					Division 6.a					Combined				
	Landings	Discards	BMS landings	IBC	Total	Landings	Discards	BMS landings	IBC	Total	Landings	Discards	BMS landings	IBC	Total	Landings	Discards	BMS landings	IBC	Total
1965	161.7	62.3	74.6	298.6	0.7			0.7	32.5	3.4	35.9	194.9	65.8	0.0	74.6	335.3				
1966	225.6	73.5	46.7	345.8	0.6			0.6	29.9	0.7	30.6	256.1	74.2	0.0	46.7	376.9				
1967	147.4	78.2	20.7	246.3	0.4			0.4	20.3	7.4	27.7	168.0	85.6	0.0	20.7	274.4				
1968	105.4	161.8	34.2	301.4	0.4			0.4	20.5	25.3	45.8	126.3	187.1	0.0	34.2	347.6				
1969	331.1	260.1	338.4	929.5	0.5			0.5	26.3	25.2	51.5	357.9	285.3	0.0	338.4	981.5				
1970	524.1	101.3	179.7	805.1	0.7			0.7	34.1	6.2	40.3	558.9	107.4	0.0	179.7	846.1				
1971	235.5	177.8	31.5	444.8	2			2.0	46.3	12.2	58.5	283.8	190.0	0.0	31.5	505.3				
1972	193.0	128.0	29.6	350.5	2.6			2.6	41.1	16.4	57.5	236.6	144.4	0.0	29.6	410.6				
1973	178.7	114.7	11.3	304.7	2.9			2.9	28.8	11.4	40.2	210.4	126.1	0.0	11.3	347.8				
1974	149.6	166.4	47.5	363.5	3.5			3.5	18.0	15.4	33.3	171.0	181.8	0.0	47.5	400.3				
1975	146.6	260.4	41.5	448.4	4.8			4.8	13.7	33.0	46.6	165.1	293.3	0.0	41.5	499.9				
1976	165.7	154.5	48.2	368.3	7			7.0	18.8	15.3	34.1	191.4	169.8	0.0	48.2	409.4				
1977	137.3	44.4	35.0	216.7	7.8			7.8	19.3	4.4	23.7	164.4	48.7	0.0	35.0	248.2				

Year	Subarea 4					Subdivision 20					Division 6.a					Combined				
	Landings	Discards	BMS landings	IBC	Total	Landings	Discards	BMS landings	IBC	Total	Landings	Discards	BMS landings	IBC	Total	Landings	Discards	BMS landings	IBC	Total
1978	85.8	76.8	10.9	10.9	173.5	5.9			5.9	17.2	1.1		18.3	108.9	77.9	0.0	10.9	197.7		
1979	83.1	41.7	16.2	16.2	141.0	4			4.0	14.8	6.5		21.3	101.9	48.2	0.0	16.2	166.3		
1980	98.6	94.6	22.5	22.5	215.7	6.4			6.4	12.8	4.8		17.5	117.8	99.4	0.0	22.5	239.6		
1981	129.6	60.1	17.0	17.0	206.7	6.6			6.6	18.2	7.1		25.3	154.4	67.2	0.0	17.0	238.6		
1982	165.8	40.6	19.4	19.4	225.8	7.5			7.5	29.6	7.7		37.3	203.0	48.2	0.0	19.4	270.6		
1983	159.3	66.0	12.9	12.9	238.2	6			6.0	29.4	3.4		32.8	194.8	69.4	0.0	12.9	277.1		
1984	128.2	75.3	10.1	10.1	213.6	5.4			5.4	30.0	8.1		38.1	163.6	83.4	0.0	10.1	257.0		
1985	158.6	85.2	6.0	6.0	249.8	5.6			5.6	24.4	10.7		35.1	188.5	96.0	0.0	6.0	290.5		
1986	165.6	52.2	2.6	2.6	220.4	2.7			2.7	19.6	5.2		24.7	187.8	57.4	0.0	2.6	247.8		
1987	108.0	59.1	4.4	4.4	171.6	3.8			1.4	5.2	27.0	11.1		38.1	138.8	70.2	0.0	5.8	214.8	
1988	105.1	62.1	4.0	4.0	171.2	2.9			1.5	4.4	21.1	5.0		26.1	129.1	67.1	0.0	5.5	201.8	
1989	76.2	25.7	2.4	2.4	104.2	4.1			0.4	4.5	16.7	2.5		19.2	96.9	28.2	0.0	2.8	127.9	
1990	51.5	32.6	2.6	2.6	86.6	4.1			2.0	6.1	10.1	0.8		11.0	65.7	33.4	0.0	4.6	103.7	
1991	44.7	40.2	5.4	5.4	90.2	4.1			2.6	6.7	10.6	4.8		15.3	59.3	45.0	0.0	8.0	112.3	
1992	70.2	47.9	10.9	10.9	129.1	4.4			4.6	9.0	11.3	3.5		14.9	86.0	51.5	0.0	15.5	153.0	

Year	Subarea 4					Subdivision 20					Division 6.a					Combined				
	Landings	Discards	BMS landings	IBC	Total	Landings	Discards	BMS landings	IBC	Total	Landings	Discards	BMS landings	IBC	Total	Landings	Discards	BMS landings	IBC	Total
1993	79.6	79.6	10.8	10.8	169.9	2		2.4	4.4	19.1	7.0		26.1	100.6	86.6	0.0	13.2	200.4		
1994	80.9	65.4	3.6	3.6	149.8	1.8		2.2	4.0	14.2	5.0		19.2	96.9	70.4	0.0	5.8	173.1		
1995	75.3	57.4	7.7	7.7	140.4	2.2		2.2	4.4	12.4	7.7		20.0	89.9	65.0	0.0	9.9	164.8		
1996	76.0	72.5	5.0	5.0	153.5	3.1		2.9	6.0	13.5	7.8		21.3	92.6	80.3	0.0	7.9	180.8		
1997	79.1	52.1	6.7	6.7	137.9	3.4		0.6	4.0	12.9	7.5		20.4	95.4	59.6	0.0	7.3	162.3		
1998	77.3	45.2	5.1	5.1	127.6	3.8		0.3	4.1	14.4	7.0		21.4	95.5	52.1	0.0	5.4	153.0		
1999	64.2	42.6	3.8	3.8	110.7	1.4		0.3	1.7	10.4	3.9		14.3	76.0	46.5	0.0	4.1	126.6		
2000	46.1	48.8	8.1	8.1	103.0	1.5		0.6	2.1	7.0	6.3		13.2	54.5	55.1	0.0	8.7	118.3		
2001	39.0	118.3	7.9	7.9	165.2	1.9		0.2	2.1	6.7	8.5		15.2	47.6	126.8	0.0	8.1	182.5		
2002	54.2	45.9	3.7	3.7	103.8	4.1		0.1	4.2	7.1	9.4		16.5	65.4	55.3	0.0	3.8	124.5		
2003	40.1	23.5	1.1	1.1	64.8	1.8	0.2		2.0	5.3	4.5		9.8	47.3	28.2	0.0	1.1	76.6		
2004	47.3	15.4	0.6	0.6	63.2	1.4	0.1		1.6	3.2	4.5		7.7	51.9	20.0	0.0	0.6	72.5		
2005	47.6	8.4	0.2	0.2	56.2	0.8	0.2		1.0	3.1	3.8		6.9	51.5	12.4	0.0	0.2	64.1		
2006	36.1	16.9	0.5	0.5	53.6	1.5	1.0		0.0	2.5	5.7	5.2		10.9	43.3	23.1	0.0	0.5	67.0	
2007	29.4	27.8	0.0	0.0	57.3	1.5	0.8		0.0	2.3	3.7	4.0		7.8	34.7	32.7	0.0	0.0	67.4	

Year	Subarea 4					Subdivision 20					Division 6.a					Combined				
	Landings	Discards	BMS landings	IBC	Total	Landings	Discards	BMS landings	IBC	Total	Landings	Discards	BMS landings	IBC	Total	Landings	Discards	BMS landings	IBC	Total
2008	29.0	15.5	0.0	44.5	1.3	0.4	0.0	1.8	2.8	1.6	4.4	33.2	17.5	0.0	0.0	50.7				
2009	30.1	10.0	0.0	40.1	1.5	0.4	0.0	1.9	2.8	1.8	4.6	34.4	12.2	0.0	0.0	46.6				
2010	28.0	7.3	0.0	35.3	1.4	0.6	0.0	2.0	2.9	1.6	4.5	32.3	9.5	0.0	0.0	41.8				
2011	26.8	10.1	0.0	36.8	2.1	1.3	0.0	3.4	1.8	1.3	3.1	30.7	12.7	0.0	0.0	43.4				
2012	30.5	3.8	0.0	34.4	2.6	0.8	0.0	3.4	5.1	0.5	5.6	38.2	5.1	0.0	0.0	43.4				
2013	36.9	2.1	0.0	39.0	2.2	0.2	0.2	2.5	4.8	1.0	5.8	43.8	3.3	0.0	0.2	47.3				
2014	34.7	4.3	0.1	39.1	2.3	0.2	0.0	2.4	4.1	0.8	4.9	41.1	5.3	0.0	0.1	46.5				
2015	30.0	4.7	0.0	34.7	1.4	0.2	0.0	1.6	4.0	1.4	5.4	35.4	6.3	0.0	0.0	41.7				
2016	29.7	5.9	0.2	35.8	1.2	0.1	0.0	0.0	1.3	4.3	1.6	0.0	6.0	35.3	7.6	0.2	0.0	43.1		
2017	29.3	5.2	0.1	34.6	1.1	0.1	0.0	0.0	1.2	3.5	1.6	0.0	5.1	33.9	7.0	0.1	0.0	41.0		
2018	29.3	3.6	0.1	33.1	0.8	0.1	0.0	0.0	0.9	4.4	1.4	0.0	5.8	34.5	5.1	0.2	0.0	39.8		
2019	26.6	3.4	0.2	30.3	0.6	0.1	0.0	0.0	0.7	3.6	2.1	0.0	5.7	30.8	5.6	0.2	0.2	36.7		
2020	26.0	7.9	0.2	35.1	0.4	0.2	0.0	0.1	0.8	2.7	0.6	0.0	3.3	29.1	8.7	0.2	1.1	39.2		
2021	21.0	11.3	0.2	33.7	2.0	0.6	0.0	0.1	2.7	3.7	4.3	0.0	8.0	26.7	16.3	0.2	1.4	44.5		
2022	30.9	16.4	0.2	47.8	3.4	0.9	0.0	0.0	4.3	3.5	1.8	0.0	5.2	37.7	19.0	0.2	0.4	57.3		
2023	37.2	17.3	0.3	56.8	3.7	1.4	0.0	0.1	5.2	3.5	1.2	0.0	4.7	44.5	19.8	0.3	2.0	66.6		

Table 8.2.6. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Numbers-at-age data (thousands) for total catch. Ages 0-7 and 8+ and years 1972-2023 are used in the assessment.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
1965	650218	368560	16491	721514	36301	4954	2245	626	118	97	47	0	0	0	0	0	262
1966	1672925	1007517	26186	7536	459941	11903	1109	633	222	90	23	2	0	0	0	0	337
1967	345371	856339	108401	5814	3850	202830	2843	223	231	61	34	0	0	0	0	0	326
1968	11133	1226448	477603	22671	2303	3210	60034	1052	84	22	5	0	0	0	0	0	111
1969	75301	20554	3736629	313593	9029	2678	2894	23704	392	32	7	0	0	0	0	0	431
1970	941790	272467	218881	2003201	60200	1350	1285	401	6539	81	13	19	0	0	0	0	6652
1971	337277	1881729	74866	50845	480381	10916	589	201	167	1767	176	3	5	0	0	0	2119
1972	255110	696714	671965	43309	23547	211817	4067	241	53	27	475	11	0	0	0	0	566
1973	79461	412305	587335	260080	6450	5689	72652	1406	140	34	234	49	5	0	0	0	462
1974	665110	1283252	187149	342628	60523	1956	1795	22380	345	57	63	4	7	4	0	0	480
1975	51796	2276937	673960	62175	112242	17691	1078	718	6168	339	70	11	0	8	0	0	6596
1976	171400	192030	1127520	225532	11538	32677	5864	228	84	1863	64	3	5	0	0	0	2019
1977	119506	263702	109480	426291	45756	4984	6757	1608	163	40	460	8	0	1	0	0	672
1978	281785	223294	130963	31141	144703	11791	1582	2322	740	122	33	275	16	2	0	0	1188
1979	844410	261156	220200	45487	7978	38097	3069	377	629	181	57	13	52	3	0	0	935
1980	374573	439674	374310	80225	11364	2040	11143	827	143	168	96	34	9	7	1	0	457
1981	645352	116229	430149	180553	17044	2225	497	3320	164	78	26	32	5	1	4	0	311

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
1982	275508	217834	89989	390347	49835	4275	820	551	1072	60	28	8	2	2	0	0	1172
1983	513034	148158	222772	83199	166812	20055	2365	338	255	385	93	21	4	4	0	0	763
1984	95862	483045	139887	143821	29321	56077	6238	967	127	84	185	19	5	1	1	0	423
1985	127002	161400	441785	80605	41508	7082	18393	1929	296	56	29	144	9	0	0	1	535
1986	45703	137091	144075	328016	29497	10595	1686	4421	581	156	56	47	37	16	4	1	898
1987	10249	253236	259369	56407	92705	6214	3993	1187	2596	462	56	65	35	32	17	8	3271
1988	16679	33092	424014	96795	17161	27728	2030	874	368	1076	95	21	12	13	17	1	1603
1989	19587	51743	43162	216359	21015	4189	7671	763	285	170	469	69	8	3	2	1	1007
1990	19286	82571	78881	17811	60888	4373	1104	1839	254	100	54	13	12	1	4	2	439
1991	128703	188087	101425	24822	4706	17618	1388	684	1024	171	65	11	11	1	2	2	1287
1992	277933	166550	255051	43257	7162	1486	6376	611	337	401	149	22	6	2	0	0	918
1993	136841	302610	269220	123469	11822	1986	669	2050	215	210	188	84	4	4	0	0	706
1994	89104	91674	339428	106673	35056	3381	601	366	746	132	48	36	26	5	0	0	992
1995	200150	336460	119210	182969	33802	9237	898	161	155	151	21	8	6	2	1	0	345
1996	167032	46797	505401	73987	66245	11159	4058	1080	75	72	37	9	8	3	1	0	205
1997	36954	162449	107657	251339	18037	18288	2762	937	121	16	18	5	4	4	2	0	170
1998	21919	88387	224037	60861	128348	7110	4590	850	263	60	7	8	3	2	1	1	345
1999	90634	69455	119094	110046	28510	45221	2700	2047	438	53	8	3	3	2	0	0	507

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
2000	12630	397390	110381	61263	33137	7254	9935	765	367	53	13	2	1	1	0	0	438
2001	3518	95086	633162	34548	12078	5573	2094	1611	257	89	28	3	4	0	0	0	382
2002	50927	36063	99685	372036	7812	2801	1615	729	603	283	25	8	5	0	0	0	923
2003	7082	13136	15234	48729	127241	2166	786	339	144	100	48	5	1	0	0	0	299
2004	3758	25698	24627	8958	38784	97827	1010	248	82	42	37	12	1	0	0	0	174
2005	8779	17695	24596	15085	5446	27745	61457	371	132	38	11	8	4	1	0	0	193
2006	3229	122537	30995	20657	11284	6078	16415	32978	156	56	20	7	4	1	0	0	243
2007	2046	20565	171600	16796	8187	4782	2237	6876	7254	75	8	14	3	1	0	0	7355
2008	2550	25087	35038	80164	4156	2093	1354	552	1577	2473	6	4	1	1	0	0	4061
2009	27313	11967	13754	18495	77722	1904	759	563	133	242	545	8	2	0	0	0	930
2010	2508	49728	14174	17429	11677	37295	833	379	142	78	81	162	10	0	0	3	475
2011	5024	4342	64649	12999	7402	5791	20830	450	119	70	25	12	70	0	0	0	295
2012	1377	3879	5072	66385	5431	3697	2414	8051	137	176	50	28	32	22	2	0	447
2013	1303	12258	4251	4651	68803	2216	1532	840	3919	36	7	7	2	2	2	0	3976
2014	3504	7593	20031	4690	7647	46684	1080	962	371	1694	13	6	1	1	0	2	2089
2015	3776	27610	15630	17723	1719	5013	21935	1062	434	437	785	108	0	0	0	0	1765
2016	1701	9374	61656	8846	5556	655	451	10138	253	151	9	149	9	0	0	1	573
2017	2615	12732	23207	54472	3228	1498	144	367	1442	502	6	20	3	1	0	1	1974

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
2018	3632	5556	24263	17121	35201	925	522	210	100	970	20	0	3	3	1	1	1099
2019	3554	17834	11844	25773	7208	21282	462	378	25	31	147	2	14	2	0	0	221
2020	1540	45286	27157	11930	14636	3281	7953	178	164	62	61	20	0	0	0	0	307
2021	6813	24198	72275	13536	5768	8346	767	4727	45	31	2	2	0	1	0	0	81
2022	916	3713	47267	93970	7808	2304	1189	288	681	156	0	0	0	0	0	0	838
2023	1255	7069	9189	63278	76294	4012	1257	576	124	98	24	1	6	0	0	0	253

Table 8.2.7. Haddock in Subarea 4, Division 6.a and Subdivision 20. Numbers-at-age data (thousands) for landings. Ages 0-7 and 8+ and years 1972-2023 are used in the assessment.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
1965	0	2670	3908	396363	30232	4358	2126	620	118	97	47	0	0	0	0	0	262
1966	0	13034	6899	5332	419437	11113	1082	631	222	90	23	2	0	0	0	0	337
1967	0	55548	40030	4627	3607	198991	2821	223	231	61	34	0	0	0	0	0	326
1968	0	22108	151474	17130	2160	3176	59110	1051	84	22	5	0	0	0	0	0	111
1969	0	143	759680	175763	7965	2282	2760	23452	392	32	7	0	0	0	0	0	431
1970	0	2428	52031	1211535	53570	1184	1220	398	6539	81	13	19	0	0	0	0	6652
1971	0	35945	27011	37832	448352	10551	582	201	167	1767	176	3	5	0	0	0	2119
1972	0	13354	233966	35440	22165	210167	4054	241	53	27	475	11	0	0	0	0	566
1973	0	7277	211018	209961	6085	5459	72528	1406	140	34	234	49	5	0	0	0	462
1974	0	25699	55734	236624	53054	1868	1679	22156	345	57	63	4	7	4	0	0	480

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
1975	0	28773	211495	41030	93617	17406	1073	718	6163	339	70	11	0	8	0	0	6591
1976	0	3045	246027	155162	11292	29594	5846	228	84	1863	64	3	5	0	0	0	2019
1977	0	8934	33058	278741	42737	4737	6516	1608	163	40	460	8	0	1	0	0	672
1978	0	13913	55636	26119	123655	11479	1496	2317	740	122	33	275	16	2	0	0	1187
1979	0	16077	120456	38247	7752	37353	3052	377	629	181	57	13	52	3	0	0	935
1980	0	11487	154765	67241	9978	1985	11057	820	143	166	96	34	9	7	1	0	456
1981	0	1959	174018	128102	16447	2219	494	3320	164	78	26	32	5	1	4	0	311
1982	0	7623	40161	282492	45732	3811	820	551	1072	60	28	8	2	2	0	0	1172
1983	0	7669	114118	57151	152477	19147	2201	338	255	385	93	21	4	4	0	0	763
1984	0	22842	80349	115405	27331	52226	6238	967	127	84	185	19	5	1	1	0	423
1985	0	3059	267559	75242	40846	6858	18360	1929	296	56	29	144	9	0	0	1	535
1986	0	12735	67173	287995	29371	10587	1685	4421	581	156	56	47	37	16	4	1	898
1987	0	11150	120584	46970	89772	6212	3993	1187	2596	462	56	65	35	32	17	8	3271
1988	0	2371	167090	83798	16114	27515	2030	874	344	1076	95	21	12	13	17	1	1579
1989	0	5446	17801	146467	19506	4130	7549	752	283	170	467	69	8	3	2	1	1003
1990	0	6279	46366	15680	54465	4117	1054	1761	250	100	54	13	12	1	4	2	435
1991	0	21627	57480	23058	4646	17468	1388	684	1024	171	65	11	11	1	2	2	1287
1992	0	3544	128147	38838	7038	1483	6354	611	337	401	149	22	6	2	0	0	918

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
1993	0	3232	92828	102781	11570	1976	669	2028	215	210	188	84	4	4	0	0	706
1994	0	1484	75783	85391	32827	3345	600	366	746	132	48	36	26	5	0	0	992
1995	0	2410	32846	114437	31198	9038	898	161	155	151	21	8	6	2	1	0	345
1996	0	1179	84349	41653	55794	11123	4058	1080	75	72	37	9	8	3	1	0	205
1997	0	2292	26774	140099	16153	17846	2762	937	121	16	18	5	4	4	2	0	170
1998	0	2167	45449	42411	106125	6959	4579	850	263	60	7	8	3	2	1	1	345
1999	0	1340	31357	60351	26260	42494	2648	2047	438	53	8	3	3	2	0	0	507
2000	0	5508	32823	34517	27247	6927	9734	765	367	53	13	2	1	1	0	0	438
2001	0	855	75731	17938	10929	5321	2094	1609	256	89	28	3	4	0	0	0	381
2002	0	816	14893	124903	6330	2710	1615	618	603	283	25	8	5	0	0	0	923
2003	0	53	2119	16076	81868	2141	777	339	144	100	48	5	1	0	0	0	299
2004	0	495	3142	4906	23978	77262	996	239	82	42	37	12	1	0	0	0	174
2005	0	788	5777	8878	4178	22915	56760	370	131	38	11	8	4	1	0	0	192
2006	0	2129	10416	11780	8602	5209	14745	30350	149	54	20	7	3	1	0	0	234
2007	0	1146	28873	11204	7361	4684	2199	6773	7183	75	8	14	3	1	0	0	7284
2008	0	327	6945	53012	3944	2063	1285	544	1576	2468	6	4	1	1	0	0	4055
2009	0	438	4589	9317	62331	1837	725	532	133	242	541	8	2	0	0	0	925
2010	0	1036	4695	12884	10496	35690	803	379	131	78	81	161	10	0	0	3	463

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
2011	0	57	15441	11014	6571	5687	20609	450	119	70	24	11	70	0	0	0	294
2012	0	209	3191	52623	4927	3685	2408	8032	137	176	50	28	32	22	2	0	447
2013	0	983	2369	4165	65909	2183	1522	825	3880	36	6	7	2	2	2	0	3935
2014	0	207	12576	3684	7471	42241	1076	948	364	1690	13	6	1	1	0	2	2077
2015	0	599	10558	16192	1631	4983	20943	1061	434	437	785	108	0	0	0	0	1764
2016	0	155	36387	8648	5532	652	443	10119	253	151	9	149	9	0	0	1	572
2017	0	148	11248	47244	3123	1482	136	366	1430	502	6	20	3	1	0	1	1962
2018	0	108	12032	15031	33277	922	521	206	100	966	20	0	3	3	1	1	1095
2019	0	187	5116	21826	6998	20451	458	375	25	31	146	2	14	2	0	0	220
2020	0	972	15876	9846	13642	2892	7555	172	158	60	59	19	0	0	0	0	296
2021	0	518	27082	10794	5138	7915	718	4456	43	29	2	1	0	1	0	0	77
2022	0	67	13562	58720	7187	2178	1151	252	667	8	0	0	0	0	0	0	675
2023	0	7	2691	21978	61922	3453	1187	549	118	91	23	1	6	0	0	0	239

Table 8.2.8. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Numbers-at-age data (thousands) for discards. Ages 0-7 and 8+ and years 1972-2023 are used in the assessment.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
2005	8779	16730	18722	6181	1258	4826	4496	1	1	0	0	0	0	0	0	0	1
2006	3229	118636	19862	8636	2634	823	1596	2520	6	1	1	0	0	0	0	0	8
2007	2045	19393	142509	5585	826	97	38	103	71	0	0	0	0	0	0	0	71
2008	2550	24760	28093	27151	212	30	69	8	2	4	0	0	0	0	0	0	6
2009	27313	11529	9165	9178	15390	67	34	31	0	0	4	0	0	0	0	0	4
2010	2508	48691	9479	4545	1181	1605	30	0	11	0	0	1	0	0	0	0	12
2011	5024	4285	49207	1985	831	104	222	0	0	0	1	1	0	0	0	0	2
2012	1377	3670	1880	13735	502	10	5	15	0	0	0	0	0	0	0	0	0
2013	1303	11271	1873	470	2638	25	5	12	24	0	1	0	0	0	0	0	25
2014	3504	7386	7435	999	164	4375	2	13	7	1	0	0	0	0	0	0	8
2015	3776	27011	5065	1522	87	27	980	0	0	0	0	0	0	0	0	0	0
2016	1700	9029	24507	188	17	2	7	8	0	0	0	0	0	0	0	0	0
2017	2580	12418	11798	7122	103	16	7	2	12	0	0	0	0	0	0	0	12
2018	3632	5440	11654	2063	1818	3	0	4	0	3	0	0	0	0	0	0	3
2019	3554	17451	6410	3595	168	705	1	0	0	0	0	0	0	0	0	0	0
2020	1540	43835	10427	1593	441	280	116	0	0	0	0	0	0	0	0	0	0
2021	6813	23588	43021	2071	366	25	11	43	0	0	0	0	0	0	0	0	0
2022	908	3613	33252	34268	534	100	25	33	7	147	0	0	0	0	0	0	153

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
2023	1235	6950	6274	39655	11356	395	16	2	0	3	0	0	0	0	0	0	3

Table 8.2.9. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Numbers-at-age data (thousands) for BMS landings. Ages 0-7 and 8+ and years 2016-2023 are used in the assessment.

Table 8.2.10. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Numbers-at-age data (thousands) for IBC. Ages 0-7 and 8+ and years 1972-2023 are used in the assessment.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
2006	0	1772	716	241	47	46	74	108	1	0	0	0	0	0	0	0	1
2007	1	27	218	6	1	0	0	0	0	0	0	0	0	0	0	0	0
2008	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	0	0	2	27	3	2	1	4	0	0	0	0	0	0	0	0	0
2013	0	4	9	16	256	8	6	3	15	0	0	0	0	0	0	0	15
2014	0	0	20	6	12	68	2	2	1	3	0	0	0	0	0	0	3
2015	0	0	6	10	1	3	12	1	0	0	0	0	0	0	0	0	1
2016	0	0	38	9	6	1	0	11	0	0	0	0	0	0	0	0	1
2017	0	0	3	12	1	0	0	0	0	0	0	0	0	0	0	0	0
2018	0	0	11	13	29	1	0	0	0	1	0	0	0	0	0	0	1
2019	0	1	31	132	42	124	3	2	0	0	1	0	0	0	0	0	1
2020	0	36	591	366	508	108	281	6	6	2	2	1	0	0	0	0	11
2021	0	27	1389	554	264	406	37	229	2	2	0	0	0	0	0	0	4
2022	0	1	156	675	83	25	13	3	8	0	0	0	0	0	0	0	8
2023	0	0	123	1006	2834	158	54	25	5	4	1	0	0	0	0	0	11

Table 8.2.11. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Mean weight-at-age data (kg) for total catch. Ages 0-7 and 8+ and years 1972-2023 are used in the assessment.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
1965	0.010	0.070	0.227	0.370	0.655	0.846	1.170	1.190	1.479	1.714	2.175	0.000	0.000	0.000	0.000	0.000	1.691
1966	0.010	0.088	0.247	0.394	0.536	0.962	1.254	1.512	1.827	1.723	2.955	2.035	0.000	0.000	0.000	0.000	1.877
1967	0.014	0.116	0.278	0.478	0.591	0.641	1.072	1.511	1.898	2.084	2.342	0.000	0.000	0.000	0.000	0.000	1.979
1968	0.010	0.129	0.254	0.516	0.743	0.827	0.829	1.483	2.071	2.622	2.065	0.000	0.000	0.000	0.000	0.000	2.179
1969	0.012	0.064	0.217	0.410	0.817	0.905	1.029	1.074	1.808	2.772	3.259	0.000	0.000	0.000	0.000	0.000	1.903
1970	0.013	0.075	0.222	0.353	0.738	0.925	1.195	1.246	1.427	2.438	3.489	3.864	0.000	0.000	0.000	0.000	1.450
1971	0.012	0.109	0.246	0.359	0.509	0.888	1.269	1.525	1.338	1.284	1.961	4.270	3.513	0.000	0.000	0.000	1.354
1972	0.025	0.117	0.242	0.383	0.503	0.585	0.987	1.380	1.967	1.979	1.618	2.861	0.000	0.000	0.000	0.000	1.692
1973	0.043	0.118	0.239	0.369	0.578	0.611	0.648	1.044	1.378	2.658	1.603	1.988	2.123	0.000	0.000	0.000	1.660
1974	0.025	0.129	0.226	0.339	0.536	0.867	0.828	0.863	1.377	1.704	1.854	4.057	1.927	0.890	0.000	0.000	1.502
1975	0.023	0.105	0.240	0.353	0.442	0.678	1.190	1.077	1.031	1.564	2.188	2.764	0.000	3.318	0.000	0.000	1.076
1976	0.014	0.129	0.225	0.394	0.505	0.578	0.916	1.829	1.656	1.247	2.296	2.425	1.679	0.000	0.000	0.000	1.300
1977	0.020	0.111	0.238	0.339	0.586	0.612	0.787	1.160	1.715	1.971	1.490	2.067	0.000	3.898	0.000	0.000	1.584
1978	0.011	0.104	0.254	0.396	0.424	0.707	0.784	0.921	1.350	1.995	1.990	1.329	2.182	4.475	0.000	0.000	1.446
1979	0.009	0.093	0.287	0.417	0.611	0.669	0.931	1.241	1.320	1.453	2.505	1.575	1.233	1.580	0.000	0.000	1.418
1980	0.012	0.081	0.276	0.464	0.693	0.985	0.908	1.264	1.511	1.501	1.676	3.104	1.050	2.134	2.921	0.000	1.664
1981	0.009	0.060	0.264	0.445	0.726	1.055	1.222	1.195	1.545	1.672	1.531	1.515	2.982	4.273	1.896	0.000	1.612

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
1982	0.010	0.074	0.286	0.423	0.759	1.109	1.415	1.578	1.466	2.136	2.122	1.877	1.886	3.179	0.000	0.000	1.522
1983	0.011	0.132	0.303	0.431	0.612	0.904	1.211	1.191	1.630	1.460	1.449	1.972	2.853	4.689	0.000	0.000	1.555
1984	0.010	0.142	0.303	0.461	0.645	0.736	1.077	1.205	1.821	2.030	1.732	1.950	2.422	2.822	4.995	0.000	1.848
1985	0.010	0.148	0.296	0.466	0.649	0.835	0.934	1.344	1.638	2.097	2.109	2.061	2.555	2.471	2.721	4.139	1.846
1986	0.023	0.123	0.261	0.406	0.600	0.848	1.195	1.098	1.524	1.356	2.178	2.366	2.498	2.993	2.778	2.894	1.653
1987	0.010	0.125	0.264	0.405	0.594	0.974	1.215	1.322	1.260	1.358	1.870	2.132	2.609	2.450	2.768	2.638	1.339
1988	0.042	0.163	0.232	0.411	0.581	0.731	1.203	1.363	1.281	0.974	1.633	2.163	2.547	3.139	3.435	2.863	1.156
1989	0.036	0.200	0.282	0.367	0.590	0.770	0.935	1.259	1.586	1.507	1.034	1.534	2.431	2.559	2.307	0.980	1.322
1990	0.040	0.187	0.313	0.422	0.506	0.795	0.995	1.179	1.495	1.898	2.519	2.259	2.188	0.562	1.852	4.731	1.768
1991	0.030	0.175	0.308	0.454	0.574	0.644	0.959	1.136	1.313	1.701	2.163	2.012	1.622	1.070	1.208	2.888	1.418
1992	0.019	0.102	0.306	0.466	0.717	0.923	0.903	1.382	1.514	1.813	2.014	2.064	2.441	1.781	0.000	0.000	1.746
1993	0.010	0.110	0.282	0.454	0.660	0.877	1.053	1.062	1.545	1.460	1.830	1.894	2.155	2.460	0.000	0.000	1.646
1994	0.018	0.121	0.247	0.435	0.599	0.846	1.240	1.274	1.289	1.573	2.060	2.070	2.834	2.403	2.523	0.000	1.439
1995	0.012	0.107	0.290	0.369	0.581	0.774	1.058	1.418	1.261	1.320	1.889	2.491	1.713	1.699	2.243	0.000	1.368
1996	0.022	0.126	0.241	0.382	0.484	0.746	0.847	0.825	1.616	1.538	1.433	1.830	2.358	2.636	3.433	0.000	1.617
1997	0.029	0.138	0.280	0.360	0.585	0.634	0.923	0.997	1.293	2.196	1.961	2.058	2.757	2.270	2.867	2.782	1.548
1998	0.027	0.153	0.255	0.396	0.444	0.665	0.777	1.041	1.109	1.251	2.373	2.334	1.656	2.433	2.085	2.509	1.210
1999	0.025	0.166	0.250	0.356	0.477	0.510	0.735	0.798	0.826	1.305	1.533	2.478	2.086	2.698	2.904	2.220	0.914

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
2000	0.052	0.121	0.256	0.355	0.480	0.605	0.656	1.033	0.973	1.529	1.911	2.323	2.365	2.310	3.595	1.843	1.084
2001	0.029	0.111	0.219	0.321	0.466	0.658	0.735	0.945	1.690	1.148	1.725	2.923	1.286	2.534	1.239	3.425	1.573
2002	0.017	0.109	0.255	0.311	0.527	0.703	0.829	0.818	1.279	1.945	1.798	1.839	2.352	2.762	0.000	0.000	1.508
2003	0.024	0.082	0.221	0.327	0.400	0.681	0.758	1.110	1.281	1.612	2.022	2.219	2.506	2.606	1.981	3.092	1.535
2004	0.039	0.139	0.238	0.378	0.395	0.440	0.686	0.926	1.184	1.602	1.753	2.605	2.170	0.000	0.000	0.000	1.506
2005	0.054	0.160	0.271	0.364	0.495	0.479	0.522	0.925	1.054	1.373	1.847	2.750	2.545	2.309	3.431	0.000	1.263
2006	0.042	0.126	0.283	0.352	0.442	0.507	0.538	0.550	1.048	1.395	2.031	2.525	1.834	3.532	5.274	2.580	1.276
2007	0.042	0.159	0.227	0.407	0.478	0.538	0.657	0.700	0.745	0.902	2.272	0.971	1.712	2.348	4.244	0.000	0.749
2008	0.034	0.141	0.252	0.359	0.570	0.642	0.758	0.836	0.878	0.834	2.058	1.248	3.538	2.685	3.792	2.923	0.854
2009	0.050	0.158	0.305	0.329	0.384	0.631	0.754	0.726	1.016	1.077	0.957	1.055	0.944	3.019	2.097	0.000	0.998
2010	0.031	0.104	0.305	0.417	0.456	0.470	0.718	0.897	1.308	1.414	1.381	1.423	2.725	2.245	2.654	2.567	1.414
2011	0.040	0.157	0.265	0.449	0.533	0.531	0.543	0.722	1.002	0.912	1.693	1.892	1.621	0.000	0.000	0.000	1.221
2012	0.034	0.160	0.442	0.407	0.568	0.687	0.680	0.642	1.146	0.848	1.426	2.158	2.121	2.095	2.368	0.000	1.246
2013	0.034	0.171	0.426	0.596	0.485	0.717	0.843	0.790	0.757	1.098	1.643	2.216	2.607	1.810	2.512	0.000	0.767
2014	0.042	0.140	0.432	0.590	0.653	0.534	0.772	0.825	0.928	0.793	1.692	2.800	1.323	2.682	0.000	1.602	0.831
2015	0.031	0.145	0.421	0.564	0.765	0.702	0.631	0.683	0.970	0.723	0.714	0.719	1.425	2.954	0.000	0.000	0.780
2016	0.048	0.161	0.363	0.638	0.765	0.874	1.022	0.737	0.798	1.083	2.622	1.122	1.286	1.978	3.312	2.835	0.998
2017	0.040	0.149	0.343	0.450	0.781	0.961	1.338	1.045	1.020	0.654	2.834	0.930	2.682	2.237	4.673	5.554	0.936

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
2018	0.043	0.139	0.355	0.503	0.533	1.021	1.030	1.147	1.421	0.890	1.235	1.883	2.383	3.356	2.198	4.662	0.961
2019	0.046	0.144	0.311	0.459	0.625	0.580	1.019	0.972	1.827	2.069	1.341	3.550	3.972	1.815	0.000	0.000	1.690
2020	0.041	0.125	0.371	0.501	0.580	0.838	0.613	1.640	2.340	2.318	3.309	1.625	1.257	0.000	0.000	0.000	2.481
2021	0.045	0.151	0.311	0.445	0.516	0.572	0.735	0.690	1.009	1.182	1.645	1.964	0.000	2.046	0.000	0.000	1.128
2022	0.046	0.125	0.289	0.373	0.565	0.646	0.769	0.814	0.830	0.368	3.233	2.353	0.000	0.000	0.000	0.000	0.745
2023	0.047	0.145	0.354	0.371	0.455	0.633	0.689	0.740	1.271	1.050	1.385	3.011	3.940	0.000	0.000	0.000	1.267

Table 8.2.12. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Mean weight-at-age data (kg) for landings. Ages 0-7 and 8+ and years 1972-2023 are used in the assessment.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
1965	0.000	0.308	0.348	0.413	0.680	0.904	1.211	1.197	1.479	1.714	2.175	0.000	0.000	0.000	0.000	0.000	1.691
1966	0.000	0.300	0.382	0.445	0.554	1.001	1.275	1.515	1.827	1.723	2.955	2.035	0.000	0.000	0.000	0.000	1.877
1967	0.000	0.260	0.399	0.530	0.610	0.646	1.077	1.511	1.898	2.084	2.342	0.000	0.000	0.000	0.000	0.000	1.979
1968	0.000	0.256	0.360	0.595	0.769	0.832	0.835	1.484	2.071	2.622	2.065	0.000	0.000	0.000	0.000	0.000	2.179
1969	0.000	0.178	0.302	0.508	0.878	0.989	1.058	1.081	1.808	2.772	3.259	0.000	0.000	0.000	0.000	0.000	1.903
1970	0.000	0.249	0.309	0.402	0.787	0.997	1.235	1.250	1.427	2.438	3.489	3.864	0.000	0.000	0.000	0.000	1.450
1971	0.000	0.256	0.332	0.393	0.525	0.905	1.280	1.525	1.338	1.284	1.961	4.270	3.513	0.000	0.000	0.000	1.354
1972	0.000	0.243	0.325	0.415	0.518	0.587	0.989	1.380	1.967	1.979	1.618	2.861	0.000	0.000	0.000	0.000	1.692
1973	0.000	0.228	0.310	0.400	0.596	0.621	0.649	1.044	1.378	2.658	1.603	1.988	2.123	0.000	0.000	0.000	1.660
1974	0.000	0.268	0.314	0.381	0.567	0.882	0.866	0.867	1.377	1.704	1.854	4.057	1.927	0.890	0.000	0.000	1.502

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
1975	0.000	0.254	0.336	0.400	0.476	0.683	1.193	1.077	1.031	1.564	2.188	2.764	0.000	3.318	0.000	0.000	1.076
1976	0.000	0.243	0.331	0.452	0.509	0.601	0.917	1.829	1.656	1.247	2.296	2.425	1.679	0.000	0.000	0.000	1.300
1977	0.000	0.272	0.344	0.381	0.595	0.625	0.800	1.160	1.715	1.971	1.490	2.067	0.000	3.898	0.000	0.000	1.584
1978	0.000	0.257	0.333	0.427	0.456	0.717	0.812	0.922	1.350	1.995	1.990	1.329	2.182	4.475	0.000	0.000	1.446
1979	0.000	0.262	0.348	0.447	0.620	0.675	0.932	1.241	1.320	1.453	2.505	1.575	1.233	1.580	0.000	0.000	1.418
1980	0.000	0.274	0.347	0.501	0.706	0.992	0.907	1.261	1.511	1.499	1.676	3.104	1.050	2.134	2.921	0.000	1.664
1981	0.000	0.334	0.364	0.503	0.734	1.056	1.222	1.195	1.545	1.672	1.531	1.515	2.982	4.273	1.896	0.000	1.612
1982	0.000	0.299	0.349	0.478	0.788	1.153	1.415	1.578	1.466	2.136	2.122	1.877	1.886	3.179	0.000	0.000	1.522
1983	0.000	0.320	0.375	0.464	0.624	0.914	1.242	1.191	1.630	1.460	1.449	1.972	2.853	4.689	0.000	0.000	1.555
1984	0.000	0.280	0.350	0.493	0.666	0.764	1.077	1.205	1.821	2.030	1.732	1.951	2.422	2.822	4.995	0.000	1.848
1985	0.000	0.279	0.348	0.478	0.651	0.844	0.935	1.344	1.638	2.097	2.109	2.061	2.555	2.471	2.721	4.139	1.846
1986	0.000	0.277	0.348	0.428	0.600	0.848	1.195	1.098	1.524	1.356	2.178	2.366	2.498	2.993	2.778	2.894	1.653
1987	0.000	0.265	0.335	0.440	0.603	0.974	1.215	1.322	1.260	1.358	1.870	2.132	2.609	2.450	2.768	2.638	1.339
1988	0.000	0.236	0.322	0.437	0.594	0.732	1.203	1.363	1.370	0.974	1.633	2.163	2.547	3.139	3.435	2.863	1.173
1989	0.000	0.319	0.356	0.413	0.602	0.769	0.934	1.256	1.579	1.507	1.025	1.534	2.431	2.559	2.307	0.980	1.316
1990	0.000	0.260	0.372	0.439	0.525	0.796	1.015	1.196	1.504	1.898	2.519	2.259	2.188	0.562	1.852	4.731	1.776
1991	0.000	0.269	0.363	0.462	0.576	0.645	0.959	1.136	1.313	1.701	2.163	2.012	1.622	1.070	1.208	2.888	1.418
1992	0.000	0.287	0.367	0.486	0.723	0.924	0.904	1.382	1.515	1.813	2.014	2.064	2.441	1.781	0.000	0.000	1.747

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
1993	0.000	0.293	0.372	0.484	0.666	0.878	1.053	1.067	1.545	1.460	1.830	1.894	2.155	2.460	0.000	0.000	1.646
1994	0.000	0.269	0.378	0.473	0.617	0.851	1.241	1.274	1.289	1.573	2.060	2.070	2.834	2.403	2.523	0.000	1.439
1995	0.000	0.316	0.400	0.424	0.600	0.782	1.058	1.418	1.261	1.320	1.889	2.491	1.713	1.699	2.243	0.000	1.368
1996	0.000	0.326	0.364	0.471	0.519	0.747	0.847	0.825	1.616	1.538	1.433	1.830	2.358	2.636	3.433	0.000	1.617
1997	0.000	0.344	0.410	0.418	0.615	0.641	0.923	0.997	1.293	2.196	1.961	2.058	2.757	2.270	2.867	2.782	1.548
1998	0.000	0.271	0.370	0.441	0.470	0.670	0.778	1.041	1.109	1.251	2.373	2.334	1.656	2.433	2.085	2.509	1.210
1999	0.000	0.297	0.349	0.422	0.490	0.523	0.746	0.798	0.826	1.305	1.533	2.478	2.086	2.698	2.904	2.220	0.914
2000	0.000	0.334	0.368	0.421	0.515	0.617	0.663	1.033	0.973	1.529	1.911	2.323	2.365	2.310	3.595	1.843	1.084
2001	0.000	0.379	0.352	0.448	0.483	0.675	0.735	0.946	1.695	1.148	1.725	2.923	1.286	2.534	1.239	3.425	1.576
2002	0.000	0.427	0.446	0.397	0.569	0.713	0.829	0.901	1.279	1.945	1.798	1.839	2.352	2.762	0.000	0.000	1.508
2003	0.000	0.283	0.377	0.464	0.441	0.684	0.759	1.110	1.281	1.612	2.022	2.219	2.506	2.606	1.981	3.092	1.535
2004	0.000	0.366	0.383	0.474	0.454	0.468	0.688	0.932	1.184	1.602	1.753	2.605	2.170	0.000	0.000	0.000	1.506
2005	0.000	0.399	0.399	0.428	0.548	0.516	0.536	0.926	1.056	1.373	1.847	2.750	2.545	2.309	3.431	0.000	1.265
2006	0.000	0.392	0.386	0.418	0.493	0.546	0.574	0.583	1.093	1.431	2.109	2.643	1.926	3.592	5.292	2.709	1.326
2007	0.000	0.379	0.385	0.466	0.497	0.542	0.662	0.705	0.748	0.902	2.272	0.971	1.712	2.348	4.244	0.000	0.752
2008	0.000	0.281	0.391	0.403	0.582	0.644	0.781	0.836	0.877	0.834	2.058	1.309	3.538	2.685	3.792	2.923	0.854
2009	0.000	0.463	0.418	0.401	0.408	0.641	0.774	0.747	1.016	1.078	0.961	1.058	0.950	3.019	2.097	0.000	1.001
2010	0.000	0.275	0.471	0.456	0.472	0.476	0.732	0.897	1.394	1.414	1.381	1.424	2.725	2.245	2.654	2.567	1.441

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
2011	0.000	0.383	0.414	0.474	0.561	0.534	0.545	0.722	1.002	0.912	1.683	1.862	1.621	0.000	0.000	0.000	1.215
2012	0.000	0.397	0.527	0.442	0.597	0.688	0.681	0.642	1.146	0.848	1.426	2.158	2.121	2.095	2.368	0.000	1.246
2013	0.000	0.437	0.566	0.622	0.491	0.719	0.843	0.794	0.757	1.098	1.557	2.216	2.607	1.810	2.512	0.000	0.766
2014	0.302	0.308	0.511	0.658	0.659	0.554	0.772	0.828	0.936	0.793	1.692	2.800	1.323	2.682	0.000	1.602	0.832
2015	0.000	0.325	0.495	0.584	0.786	0.704	0.642	0.683	0.970	0.723	0.714	0.719	1.425	2.954	0.000	0.000	0.780
2016	0.268	0.385	0.445	0.644	0.766	0.874	1.031	0.737	0.798	1.083	2.622	1.122	1.286	1.978	3.312	2.835	0.998
2017	0.000	0.254	0.457	0.472	0.789	0.967	1.362	1.047	1.024	0.654	2.836	0.930	2.682	2.333	4.673	5.554	0.939
2018	0.000	0.418	0.470	0.526	0.543	1.023	1.030	1.158	1.422	0.889	1.235	1.883	2.383	3.356	2.198	4.662	0.961
2019	0.000	0.415	0.437	0.488	0.633	0.588	1.020	0.972	1.831	2.069	1.341	3.550	3.972	1.815	0.000	0.000	1.690
2020	0.000	0.359	0.450	0.531	0.588	0.879	0.616	1.640	2.340	2.318	3.309	1.625	1.257	0.000	0.000	0.000	2.481
2021	0.000	0.441	0.378	0.468	0.527	0.572	0.739	0.692	1.009	1.182	1.645	1.964	0.000	2.046	0.000	0.000	1.128
2022	0.000	0.444	0.411	0.417	0.584	0.659	0.775	0.878	0.834	1.072	3.233	2.353	0.000	0.000	0.000	0.000	0.838
2023	0.000	0.448	0.516	0.460	0.471	0.664	0.690	0.741	1.271	1.061	1.385	3.011	3.940	0.000	0.000	0.000	1.274

Table 8.2.13. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Mean weight-at-age data (kg) for discards. Ages 0-7 and 8+ and years 1972-2023 are used in the assessment.

Table 8.2.14. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Mean weight-at-age data (kg) for BMS landings. Ages 0-7 and 8+ and years 2016-2023 are used in the assessment.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
2016	0.068	0.239	0.213	0.386	0.389	0.000	0.000	0.481	0.000	0.991	0.000	0.000	0.000	0.000	0.000	0.991	
2017	0.040	0.148	0.235	0.306	0.521	0.440	0.916	0.560	0.606	0.408	2.670	0.000	0.000	1.514	0.000	0.000	0.625
2018	0.000	0.286	0.233	0.299	0.291	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
2019	0.089	0.185	0.271	0.298	0.000	0.376	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
2020	0.000	0.220	0.267	0.259	0.365	0.792	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
2021	0.000	0.078	0.183	0.260	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
2022	0.046	0.119	0.239	0.297	0.295	0.364	0.490	0.319	0.403	0.330	0.000	0.000	0.000	0.000	0.000	0.333	
2023	0.047	0.145	0.282	0.320	0.364	0.355	0.610	0.629	0.000	0.667	0.000	0.000	0.000	0.000	0.000	0.667	

Table 8.2.15. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Mean weight-at-age data (kg) for IBC. Ages 0-7 and 8+ and years 1972-2023 are used in the assessment.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
2006	0.000	0.127	0.232	0.273	0.273	0.280	0.283	0.286	0.287	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.287
2007	0.035	0.141	0.192	0.290	0.315	0.370	0.427	0.342	0.368	0.400	0.000	0.000	0.000	0.000	0.000	0.000	0.368
2008	0.000	0.281	0.391	0.403	0.582	0.644	0.781	0.836	0.877	0.834	2.058	1.309	3.538	2.685	3.791	0.000	0.851
2009	0.000	0.463	0.418	0.401	0.408	0.641	0.774	0.747	1.016	1.078	0.961	1.058	0.950	3.020	2.100	0.000	0.995
2010	0.000	0.275	0.471	0.456	0.472	0.476	0.732	0.897	1.394	1.414	1.381	1.424	2.725	2.245	2.654	0.000	1.403
2011	0.000	0.383	0.414	0.474	0.561	0.534	0.545	0.722	1.002	0.912	1.683	1.862	1.621	0.000	0.000	0.000	1.178
2012	0.000	0.397	0.527	0.442	0.597	0.688	0.681	0.642	1.146	0.848	1.426	2.158	2.121	2.095	2.368	0.000	1.246
2013	0.000	0.437	0.566	0.622	0.491	0.719	0.843	0.793	0.757	1.098	1.557	2.216	2.607	1.810	2.512	0.000	0.766
2014	0.302	0.308	0.511	0.658	0.659	0.554	0.772	0.828	0.936	0.793	1.692	2.800	1.323	2.682	0.000	1.856	0.832
2015	0.000	0.325	0.495	0.584	0.786	0.704	0.642	0.683	0.970	0.723	0.714	0.719	1.425	2.954	0.000	0.000	0.780
2016	0.268	0.385	0.445	0.644	0.766	0.874	1.031	0.737	0.798	1.083	2.622	1.122	1.286	1.978	3.312	3.841	0.998
2017	0.000	0.254	0.457	0.472	0.789	0.967	1.362	1.047	1.024	0.654	2.836	0.930	2.682	2.333	4.673	0.000	0.936
2018	0.000	0.418	0.470	0.526	0.543	1.023	1.030	1.158	1.422	0.889	1.235	1.883	2.383	3.356	2.198	0.000	0.958
2019	0.000	0.415	0.437	0.488	0.633	0.588	1.020	0.972	1.831	2.069	1.341	3.550	3.972	1.815	0.000	0.000	1.691
2020	0.000	0.359	0.450	0.531	0.588	0.879	0.616	1.640	2.340	2.318	3.309	1.625	1.257	0.000	0.000	0.000	2.481
2021	0.000	0.441	0.378	0.468	0.527	0.572	0.739	0.692	1.009	1.182	1.645	1.964	0.000	2.046	0.000	0.000	1.128
2022	0.000	0.444	0.411	0.417	0.584	0.659	0.775	0.878	0.834	1.072	3.233	2.353	0.000	0.000	0.000	0.000	0.838
2023	0.000	0.448	0.516	0.460	0.471	0.664	0.690	0.741	1.271	1.061	1.385	3.011	3.940	0.000	0.000	0.000	1.274

Table 8.2.16. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Mean weight-at-age data (kg) for the stock. Ages 0-7 and 8+ and years 1972-2023 are used in the assessment.

Table 8.2.16. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Mean weight-at-age data (kg) for the stock. Ages 0-7 and 8+ and years 1972-2023 are used in the assessment.

Table 8.2.18. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Estimates of the proportion mature-at-age. Ages 0-7 and 8+ and years 1972-2023 are used in the assessment.

Table 8.2.19. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Data available for calibration of the assessment. Only those data used in the final assessment are shown here.

Delta-GAM NS-WC Q1								
1983	2024							
1	1	0	0					
1	8							
1	325.2268	400.8767	66.8470	67.3204	11.2539	2.3100	0.2144	0.4116
1	1690.1385	226.0056	112.7614	18.6122	15.0567	2.6003	0.5053	0.1794
1	346.1691	805.0391	111.4588	33.9055	4.5774	4.0391	0.6864	0.3124
1	718.5650	193.9342	270.8359	20.7497	6.9961	1.2038	1.1117	0.2005
1	1099.3855	252.5091	54.9989	48.6850	3.3126	1.3227	0.1987	0.5818
1	174.0992	445.3988	79.0236	13.0600	8.0410	0.8365	0.2055	0.5192
1	181.6971	79.8876	173.9461	14.4524	1.9772	2.9835	0.2625	0.1349
1	259.4431	86.9376	34.1921	33.7481	2.6698	0.5346	0.8665	0.1055
1	721.3027	147.8775	30.8507	8.1743	6.7713	1.3227	0.1164	0.2806
1	1029.8400	316.0621	35.6507	3.1799	2.0460	1.2233	0.1715	0.2023
1	1670.3476	539.4769	137.7008	15.1954	0.8867	0.3374	0.7590	0.4187
1	311.2900	502.6362	107.6374	20.8821	2.5835	0.5869	0.0498	0.4751
1	2054.2223	213.0073	157.9997	24.8598	5.7203	0.8253	0.2059	0.2806
1	694.5369	690.2977	80.4069	40.7950	5.6717	1.3382	0.2234	0.0896
1	1178.6587	370.1403	253.5693	23.7009	9.9559	1.9255	0.5673	0.1009
1	445.5877	400.6811	99.3785	68.7649	7.1919	2.7571	0.9582	0.3199
1	218.1360	186.2724	105.3814	26.8938	16.3617	1.8400	0.9965	0.4785
1	5482.9544	143.2825	49.5579	19.5098	5.2969	3.3898	0.6148	0.3542
1	980.6389	1678.1820	81.3535	12.9370	4.8830	1.8824	1.0172	0.5013
1	95.6380	509.6825	614.3161	15.2849	5.1341	1.6519	1.0732	0.4910
1	92.8952	84.8640	239.7243	226.4010	3.9822	1.2713	0.8277	0.7094
1	68.5788	94.4253	41.2117	95.5495	73.5384	1.1350	0.6032	0.4239
1	72.3259	55.6549	34.7564	11.7146	25.5547	26.7712	1.3293	0.5719
1	378.0599	56.2223	26.8890	9.4273	4.0416	7.9060	10.5498	1.1533
1	93.0669	339.3386	26.7557	8.7298	3.3500	1.6388	3.9751	5.6907

Delta-GAM NS-WC Q1								
1	71.9087	79.9730	148.9322	9.4805	2.4753	1.0687	0.7646	3.2865
1	56.2513	59.0895	43.4493	46.8771	2.6685	0.9100	0.6240	1.5560
1	379.8742	53.2667	33.4776	14.7057	19.6471	1.5571	0.5499	0.9396
1	37.9439	306.5233	41.8192	12.3438	7.9512	12.3036	0.3781	0.5633
1	24.9021	44.6800	188.0372	13.8767	7.3961	3.9118	4.8859	0.4426
1	59.2607	25.0533	23.2291	56.7754	5.4366	2.9049	1.4250	2.8237
1	57.2245	36.5243	12.2305	9.8289	21.0403	1.5263	1.0305	1.7866
1	456.4435	47.8680	20.6688	3.9483	5.0236	11.1226	0.6215	1.2403
1	112.8994	256.4915	20.8819	4.9933	1.5928	1.0199	5.3560	0.3726
1	158.4422	104.8775	117.2231	7.4068	2.0356	0.4626	0.5276	2.2383
1	71.7800	109.2874	45.8949	32.3502	1.8204	0.6495	0.1187	1.0127
1	265.3868	45.2787	40.7121	8.3342	10.7281	0.5646	0.2127	0.2724
1	367.8984	140.3421	22.3057	13.3231	3.5535	5.4918	0.1418	0.1885
1	838.1557	519.5883	67.1533	7.5379	7.1791	1.5342	3.5156	0.1338
1	244.8092	1106.6067	632.7774	18.0952	6.9776	3.8376	0.6197	2.2093
1	606.3710	412.5663	680.4413	206.5071	14.9525	3.2956	1.6978	1.4295
1	104.5399	898.0063	306.7735	334.8524	110.3279	6.0806	1.0803	1.0874

Table 8.2.19. (cont.) Haddock in Subarea 4, Division 6.a, and Subdivision 20. Data available for calibration of the assessment. Only those data used in the final assessment are shown here.

Delta-GAM NS-WC Q3+Q4									
1991	2023								
1	1	0	1						
0	8								
1	2291.4065	477.5286	50.9054	4.8317	1.7168	4.8680	0.2286	0.0744	0.2436
1	4350.8046	1258.1869	199.3958	12.0786	1.5900	0.5854	1.5093	0.0655	0.1486
1	682.9434	1181.3637	246.5815	40.4350	2.4025	1.2345	0.0549	0.2356	0.0702
1	2224.8601	454.4238	287.7919	40.2768	12.5482	0.9094	0.0746	0.0134	0.1929
1	1921.5280	1834.4261	153.3161	89.2398	11.3448	4.6182	0.9729	0.0000	0.4186
1	839.6877	558.9785	406.8998	44.0491	24.5608	3.7347	0.8924	0.0937	0.0519
1	439.0355	715.9992	176.0394	151.4532	10.1844	6.3502	1.1351	0.5177	0.0686

Delta-GAM NS-WC Q3+Q4									
1	380.7995	278.3759	182.9981	46.4403	29.5694	2.8786	1.9901	0.2557	0.1993
1	6334.4293	214.5740	88.7729	46.3527	11.6626	9.0028	0.8301	0.6159	0.3141
1	1438.8909	4116.6883	57.7605	18.7790	8.4577	2.8673	2.3282	0.1906	0.1538
1	86.0839	730.6789	1300.7723	35.6074	8.4503	4.0776	1.5702	0.8684	0.1143
1	176.3171	119.0088	305.4289	527.3260	11.4659	4.0450	2.1944	0.5451	0.4317
1	102.1304	174.8316	71.8691	157.2940	130.2056	2.9494	1.4484	0.3934	0.2280
1	126.7176	108.8316	88.5301	29.5737	54.3674	68.6860	1.6211	0.5259	0.3503
1	372.5628	90.8068	50.1327	23.9148	10.6200	18.2261	13.5932	0.2779	0.1952
1	177.3627	235.5608	37.1887	12.5790	7.6268	4.3086	6.3861	6.5911	0.1894
1	148.0455	107.2775	257.8013	18.7251	8.8717	2.6077	1.4381	2.0024	2.1148
1	85.8920	62.5024	51.4920	97.8170	6.1839	3.8053	2.2469	0.7275	1.8514
1	339.1231	41.3566	38.6160	22.5821	33.1290	1.9584	1.4451	0.6916	0.5324
1	42.6143	379.7559	48.5672	29.1262	14.7200	23.2255	1.2922	0.4355	0.4394
1	37.5687	43.7697	311.9458	29.9901	13.9061	6.2763	12.0917	0.4586	0.3680
1	90.0858	29.5428	28.6322	139.7059	7.5496	4.7148	3.4128	4.2361	0.2263
1	101.4555	34.9344	20.1416	12.5930	55.0211	2.8221	2.4977	0.8684	2.1416
1	1521.4930	59.1813	27.4741	7.8926	6.1463	28.8745	1.4716	0.7765	1.2032
1	204.6876	564.0395	51.3098	13.8700	2.7864	3.5596	14.2702	0.6740	0.6225
1	322.1880	122.2924	242.5357	18.0914	4.2419	1.0118	1.6980	4.3562	0.3323
1	118.3725	185.2982	105.5967	110.9104	6.0451	1.5885	0.4025	0.7131	1.7049
1	363.4694	62.1007	66.2193	31.7950	38.1157	1.4914	0.8503	0.0570	0.3563
1	1232.4553	302.9294	30.4703	31.1937	11.7874	17.3662	0.6873	0.0549	0.1040
1	1489.1736	1348.8124	143.4262	20.3338	17.2660	5.1968	10.5654	0.1761	0.0783
1	323.7361	954.5317	671.7646	63.4614	9.7886	7.9884	2.4175	3.4833	0.1106
1	828.7275	318.0861	664.4140	393.3379	31.0402	5.3518	3.9936	0.4738	1.5602
1	81.3860	663.4354	323.2702	565.9388	223.8337	13.1892	2.1122	1.0219	0.7752

Table 8.3.1. Haddock in Subarea 4, Division 6.a, and Subdivision 20. SAM final assessment: Model inputs

Dataset	Year	Ages	Details
Catch data	Catch numbers	1972-2023	0-8+ Catch-at-age in numbers. Combination of landings, discards, BMS landings and industrial bycatch

	Dataset	Year	Ages	Details
	Catch weights	1972-2023	0-8+	Mean weights-at-age in the total catch.
	Landing weights	1972-2023	0-8+	Mean weight-at-age in the landings.
	Discard weights	1972-2023	0-8+	Mean weight-at-age in the discards.
	Discard numbers	1972-2023	0-8+	Numbers-at-age for discards. Used for plus group calculations.
	Landings fraction (numbers)	1972-2023	0-8+	Numbers-at-age for landings. Used to separate out the landings portion of the total catch for use in the forecast. This is converted to a landings fraction within the model code.
Biological data	Stock weights	1972-2023	0-8+	Mean weights-at-age. Produced from applying survey-derived correction factors to mean weights-at-age in the catch.
	Natural mortality	1974-2022	0-8+	Natural mortality estimates from the SMS key run produced by WGSAM. Smoothed.
	Maturity	1991-2023	0-8+	Proportion mature. Survey-derived maturity ogives. Smoothed. Time varying.
	Proportion of natural mortality before spawning	1972-2023	0-8+	Set to zero for all ages and years.
	Proportion of fishing mortality before spawning	1972-2023	0-8+	Set to zero for all ages and years.
Tuning data	Survey: delta-GAM NS-WC Q1	1983-2024	1-8+	Delta-GAM modelled survey indices covering the North Sea and West Coast of Scotland in quarter 1.
	Survey: delta-GAM NS-WC Q3+Q4	1991-2023	0-8+	Delta-GAM modelled survey indices covering the North Sea in quarter 3 and West Coast of Scotland in quarter 4.
	Weightings: coefficient of variations for delta-GAM NS-WC Q1	1983-2023	1-8+	Coefficient of variations for the delta-GAM modelled survey indices covering the North Sea and West Coast of Scotland in quarter 1.

Table 8.3.2. Haddock in Subarea 4, Division 6.a, and Subdivision 20. SAM final assessment: Model settings. Settings not listed use the default setting in SAM.

Configuration setting	Details
Assessment age range	0-8+
Is maximum considered a plus group	1 1 1
Coupling of the fishing mortality states	0 1 2 3 4 5 6 7 7
Correlation of fishing mortality across ages	AR(1)
Coupling of the survey catchability parameters	$\begin{bmatrix} -1 & -1 & -1 & -1 & -1 & -1 & -1 & -1 \\ -1 & 0 & 1 & 2 & 3 & 4 & 5 & 6 \\ 7 & 8 & 9 & 10 & 11 & 12 & 13 & 14 \end{bmatrix}$
Coupling of process variance parameters for F	0 0 0 0 0 0 0 0
Coupling of process variance parameters for N	0 1 1 1 1 1 1 2
Coupling of the variance parameters for observations	$\begin{bmatrix} 0 & 1 & 2 & 2 & 2 & 2 & 2 & 2 \\ -1 & 3 & 4 & 4 & 4 & 4 & 4 & 4 \\ 5 & 6 & 7 & 7 & 7 & 7 & 7 & 7 \end{bmatrix}$
Covariance structure for each fleet	Independent (ID) for all
Stock recruitment code	Random walk (0)
F range	2-4

Table 8.3.3. Haddock in Subarea 4, Division 6.a, and Subdivision 20. SAM final assessment: Parameter estimates.

	Estimate	Lower bound	Upper bound	sd(par)	log(par)
logFpar_0	0.00032	0.00028	0.00036	0.063	-8.050
logFpar_1	0.00067	0.00060	0.00074	0.056	-7.314
logFpar_2	0.00066	0.00060	0.00073	0.049	-7.323
logFpar_3	0.00045	0.00041	0.00050	0.051	-7.698
logFpar_4	0.00034	0.00030	0.00039	0.062	-7.973
logFpar_5	0.00027	0.00023	0.00032	0.084	-8.227
logFpar_6	0.00021	0.00016	0.00026	0.113	-8.492
logFpar_7	0.00032	0.00027	0.00038	0.086	-8.059
logFpar_8	0.00067	0.00059	0.00076	0.064	-7.305
logFpar_9	0.00077	0.00067	0.00089	0.069	-7.167
logFpar_10	0.00066	0.00057	0.00076	0.071	-7.320
logFpar_11	0.00052	0.00045	0.00061	0.077	-7.558
logFpar_12	0.00045	0.00037	0.00054	0.091	-7.712
logFpar_13	0.00034	0.00027	0.00042	0.114	-7.993
logFpar_14	0.00017	0.00012	0.00022	0.143	-8.709
logSdLogFsta_0	0.219	0.173	0.278	0.118	-1.518

	Estimate	Lower bound	Upper bound	sd(par)	log(par)
logSdLogN_0	1.084	0.874	1.345	0.108	0.081
logSdLogN_1	0.142	0.112	0.179	0.116	-1.952
logSdLogN_2	0.498	0.393	0.631	0.118	-0.697
logSdLogObs_0	0.997	0.801	1.240	0.109	-0.003
logSdLogObs_1	0.411	0.307	0.550	0.146	-0.889
logSdLogObs_2	0.310	0.273	0.352	0.063	-1.171
logSdLogObs_3	0.392	0.297	0.517	0.139	-0.937
logSdLogObs_4	1.832	1.590	2.110	0.071	0.605
logSdLogObs_5	0.408	0.295	0.565	0.163	-0.895
logSdLogObs_6	0.277	0.198	0.388	0.168	-1.284
logSdLogObs_7	0.325	0.288	0.368	0.061	-1.123
itrans_rho_0	6.707	4.257	10.566	0.227	1.903

Table 8.3.4. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Estimates of fishing mortality at age from the final SAM assessment. Estimates refer to the full year (January–December) except for age 0, for which the mortality rate given refers to the second half-year only (July–December).

	0	1	2	3	4	5	6	7	8+	Mean F(2-4)
1972	0.024	0.178	0.590	0.926	0.898	0.845	0.868	0.836	0.836	0.804
1973	0.024	0.174	0.570	0.886	0.862	0.819	0.850	0.825	0.825	0.773
1974	0.025	0.181	0.591	0.900	0.872	0.824	0.851	0.826	0.826	0.788
1975	0.028	0.203	0.668	1.014	0.985	0.931	0.956	0.922	0.922	0.889
1976	0.027	0.198	0.657	0.998	0.973	0.920	0.934	0.898	0.898	0.876
1977	0.027	0.194	0.651	0.986	0.974	0.911	0.916	0.879	0.879	0.870
1978	0.027	0.191	0.657	1.010	1.007	0.938	0.941	0.906	0.906	0.891
1979	0.025	0.174	0.609	0.949	0.951	0.870	0.865	0.837	0.837	0.836
1980	0.022	0.156	0.550	0.865	0.873	0.783	0.770	0.751	0.751	0.763
1981	0.018	0.129	0.453	0.711	0.721	0.638	0.621	0.612	0.612	0.628
1982	0.018	0.129	0.460	0.725	0.746	0.659	0.643	0.633	0.633	0.644
1983	0.020	0.142	0.517	0.817	0.862	0.769	0.744	0.719	0.719	0.732
1984	0.020	0.144	0.542	0.856	0.921	0.836	0.819	0.787	0.787	0.773

	0	1	2	3	4	5	6	7	8+	Mean F(2-4)
1985	0.020	0.149	0.573	0.899	0.972	0.886	0.881	0.851	0.851	0.815
1986	0.020	0.155	0.623	0.970	1.045	0.948	0.948	0.925	0.925	0.879
1987	0.020	0.161	0.667	1.029	1.101	0.999	1.018	1.002	1.002	0.933
1988	0.019	0.153	0.646	0.990	1.044	0.932	0.942	0.929	0.929	0.893
1989	0.019	0.152	0.651	0.982	1.028	0.917	0.923	0.906	0.906	0.887
1990	0.018	0.148	0.645	0.945	0.964	0.851	0.849	0.817	0.817	0.851
1991	0.020	0.165	0.730	1.068	1.071	0.947	0.939	0.882	0.882	0.957
1992	0.017	0.145	0.648	0.942	0.948	0.847	0.842	0.783	0.783	0.846
1993	0.019	0.157	0.709	1.023	1.019	0.901	0.891	0.808	0.808	0.917
1994	0.017	0.145	0.657	0.954	0.952	0.833	0.790	0.698	0.698	0.854
1995	0.014	0.119	0.537	0.778	0.780	0.673	0.596	0.499	0.499	0.699
1996	0.015	0.130	0.592	0.869	0.896	0.791	0.684	0.551	0.551	0.786
1997	0.013	0.118	0.532	0.772	0.793	0.699	0.576	0.439	0.439	0.699
1998	0.014	0.131	0.587	0.848	0.870	0.756	0.599	0.433	0.433	0.768
1999	0.016	0.148	0.669	0.982	1.008	0.883	0.682	0.477	0.477	0.886
2000	0.014	0.131	0.583	0.863	0.895	0.783	0.604	0.417	0.417	0.780
2001	0.010	0.097	0.412	0.604	0.626	0.552	0.420	0.290	0.290	0.547
2002	0.009	0.082	0.331	0.476	0.496	0.442	0.332	0.227	0.227	0.434
2003	0.006	0.058	0.226	0.318	0.332	0.300	0.221	0.149	0.149	0.292
2004	0.006	0.063	0.243	0.337	0.350	0.320	0.231	0.151	0.151	0.310
2005	0.008	0.076	0.295	0.413	0.430	0.400	0.293	0.193	0.193	0.379
2006	0.009	0.096	0.377	0.541	0.568	0.529	0.391	0.267	0.267	0.495
2007	0.009	0.090	0.355	0.520	0.553	0.519	0.386	0.277	0.277	0.476
2008	0.007	0.071	0.275	0.405	0.431	0.401	0.295	0.220	0.220	0.371
2009	0.006	0.059	0.229	0.348	0.377	0.351	0.256	0.196	0.196	0.318
2010	0.005	0.052	0.205	0.321	0.353	0.334	0.243	0.191	0.191	0.293
2011	0.004	0.047	0.189	0.306	0.343	0.331	0.243	0.198	0.198	0.279
2012	0.004	0.043	0.179	0.297	0.339	0.327	0.240	0.205	0.205	0.271
2013	0.004	0.042	0.181	0.306	0.348	0.332	0.236	0.207	0.207	0.278

	0	1	2	3	4	5	6	7	8+	Mean F(2-4)
2014	0.004	0.049	0.223	0.390	0.441	0.416	0.286	0.255	0.255	0.351
2015	0.005	0.052	0.254	0.471	0.537	0.506	0.344	0.314	0.314	0.421
2016	0.004	0.041	0.204	0.390	0.450	0.418	0.279	0.262	0.262	0.348
2017	0.003	0.035	0.179	0.352	0.411	0.383	0.254	0.239	0.239	0.314
2018	0.003	0.035	0.187	0.385	0.464	0.446	0.304	0.290	0.290	0.345
2019	0.003	0.030	0.165	0.356	0.444	0.438	0.303	0.290	0.290	0.322
2020	0.002	0.023	0.127	0.285	0.370	0.374	0.260	0.247	0.247	0.261
2021	0.001	0.014	0.081	0.188	0.254	0.263	0.183	0.172	0.172	0.174
2022	0.001	0.008	0.048	0.114	0.156	0.163	0.114	0.106	0.106	0.106
2023	0.001	0.007	0.037	0.090	0.126	0.132	0.093	0.085	0.085	0.084

Table 8.3.5. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Estimates of stock numbers-at-age (thousands) from the final SAM assessment. Estimates refer to 1 January, except for age 0 for estimates refer to 1 July. *SAM estimated survivors and projected recruitment.

	0	1	2	3	4	5	6	7	8+
1972	11625984	11835329	2080635	72667	43594	414935	7946	486	1191
1973	30143583	3367588	2366640	526371	16189	11676	133332	2588	789
1974	58438806	9312449	602582	672608	125997	4564	3812	43442	995
1975	5760455	18349127	1746613	143336	174141	34984	1550	1267	12418
1976	6665703	1648364	3592382	405736	30218	45784	10458	455	3839
1977	9285402	1935237	305570	940893	86231	8153	13537	3205	1325
1978	16158665	2724815	367168	74009	233489	21454	2528	4222	1950
1979	25273538	4729062	570165	90622	16675	62815	6093	765	1855
1980	6826886	7503384	1068708	158216	21082	4603	20567	1936	915
1981	10783073	1888988	1760216	335986	41967	5874	1669	7494	822
1982	6643471	3122845	423248	649854	105824	14685	2292	787	2994
1983	19198700	1861556	738765	148643	209039	35657	6382	950	1715
1984	5155694	5824546	466322	248462	46928	65058	11958	2408	939
1985	6804847	1478019	1469063	170708	75822	14057	22170	3993	1268
1986	10595939	2008250	364067	508665	49220	20826	4461	7333	1376
1987	1772277	3373522	508411	112442	137220	12472	5904	1398	4362

	0	1	2	3	4	5	6	7	8+
1988	1843082	525904	945928	151029	29364	35671	3767	1564	2621
1989	2789300	558536	142956	327642	37444	7502	12072	1262	1238
1990	6528720	852941	150647	49030	91021	9602	2368	4008	717
1991	10623894	2069102	236783	45353	14093	26976	3238	846	2413
1992	14350653	3081800	606599	74883	10946	3668	8664	1012	1612
1993	4818156	4052897	778322	216428	24703	3722	1084	3277	1439
1994	15604165	1392899	1003634	217306	58563	7451	1342	346	2295
1995	6655156	5017393	394759	326728	60026	18172	2943	547	1609
1996	7325806	1804789	1378511	154203	108562	20402	7151	1345	569
1997	3498311	2303491	492049	502458	49440	32819	7313	3065	597
1998	2835318	1078876	614070	182908	173692	17758	12143	3347	1570
1999	32054377	842246	300761	203840	61100	54893	6453	5324	2280
2000	7693384	10376195	245221	97899	52311	17736	16367	2564	1737
2001	1185548	2392431	2814338	94769	30632	15795	7164	6639	1771
2002	1444720	391212	695942	1162766	32379	12291	6875	4106	3453
2003	1065128	445846	118853	333143	499893	12215	5415	3606	2782
2004	1037026	345672	136549	59382	176140	255660	6186	3142	2141
2005	4064417	327098	105309	62269	29311	84734	130168	3827	2073
2006	1314060	1448182	101020	49746	28073	14921	41113	73372	3047
2007	968190	425765	528146	45564	21670	12110	7030	21725	27969
2008	779872	316596	137403	262742	19034	8970	5884	3858	17791
2009	3986314	256840	101027	71022	140900	8687	4483	3549	6382
2010	497635	1476557	91474	58215	39571	82602	4795	2742	3911
2011	347412	169781	517905	53412	32146	22506	51913	2699	2633
2012	632876	114820	57318	300159	26846	18009	12659	31561	2363
2013	730789	216158	36096	33598	171793	13061	9830	7158	17209
2014	4657046	242908	70870	18294	21390	98014	6625	5743	10092
2015	1407060	1547077	77294	34839	8304	11494	54841	3907	6385
2016	1700789	465968	454717	34162	13788	3401	4777	31598	2562

	0	1	2	3	4	5	6	7	8+
2017	816185	575889	150038	219199	14450	5831	1459	2897	11842
2018	2570283	264097	171615	68421	106215	5528	2644	781	4254
2019	9191785	869863	82546	84394	27760	53087	2332	1277	1192
2020	10592753	3255846	249645	44082	43242	12741	30379	1141	1043
2021	3837089	3760848	1157151	118043	24197	23854	6341	20345	746
2022	6712394	1293444	1412441	783411	64299	15723	13519	3779	10511
2023	1051132	2394806	502095	960220	520600	40525	10438	8746	5794
2024*	1051132	351333	881985	346332	674357	338816	25974	6777	6223

Table 8.3.6. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Stock summary table for the final SAM model. Both estimates and the 2.5th (low) and 97.5th (high) percentiles are given.

Year	Recruitment (age 0)	Recruitment low	Recruitment high	SSB esti- mate	SSB low	SSB high	Fbar (2-4)	Fbar low	Fbar high	TSB esti- mate	TSB low	TSB high
1972	11625984	7178962	18827724	415235	324811	530833	0.804	0.643	1.007	1253430	999626	1571675
1973	30143583	18811620	48301826	396068	320572	489344	0.773	0.633	0.943	1279671	1016179	1611486
1974	58438806	36396398	93830551	316917	255978	392364	0.788	0.648	0.957	1429858	1113878	1835474
1975	5760455	3600029	9217384	275804	227678	334102	0.889	0.736	1.073	1227570	938005	1606524
1976	6665703	4171459	10651333	392122	310241	495612	0.876	0.726	1.058	816468	642565	1037437
1977	9285402	5836439	14772480	318309	244755	413967	0.870	0.721	1.051	518709	424263	634179
1978	16158665	10139251	25751652	154176	124876	190351	0.891	0.739	1.075	365093	303042	439850
1979	25273538	15904860	40160791	131462	109647	157617	0.836	0.690	1.014	467587	379123	576692
1980	6826886	4341672	10734659	179467	147119	218928	0.763	0.626	0.930	563810	453042	701661
1981	10783073	6969279	16683885	281368	228170	346969	0.628	0.513	0.769	544537	442184	670582
1982	6643471	4414482	9997935	327495	265131	404527	0.644	0.530	0.781	502235	423150	596100
1983	19198700	12786013	28827602	257181	221051	299217	0.732	0.609	0.881	514614	446843	592664
1984	5155694	3430390	7748736	216269	188320	248366	0.773	0.647	0.923	614841	511463	739116
1985	6804847	4524272	10235005	257220	221261	299022	0.815	0.683	0.972	532623	454362	624365
1986	10595939	7019424	15994748	234871	197707	279021	0.879	0.739	1.046	471971	406037	548612
1987	1772277	1176953	2668726	166697	144607	192162	0.933	0.789	1.102	391245	331017	462431
1988	1843082	1226619	2769360	152254	130944	177032	0.893	0.752	1.060	300205	257240	350347

Year	Recruitment (age 0)	Recruitment low	Recruitment high	SSB esti- mate	SSB low	SSB high	Fbar (2-4)	Fbar low	Fbar high	TSB esti- mate	TSB low	TSB high
1989	2789300	1867702	4165651	136825	114440	163588	0.887	0.747	1.053	242895	209428	281710
1990	6528720	4464321	9547742	82508	71300	95479	0.851	0.715	1.014	267934	223681	320943
1991	10623894	7346316	15363772	67825	59593	77194	0.957	0.805	1.136	364868	304760	436830
1992	14350653	9870423	20864478	101327	87280	117636	0.846	0.716	0.999	406593	342951	482045
1993	4818156	3397642	6832570	163106	140324	189587	0.917	0.774	1.087	437642	374598	511296
1994	15604165	10988893	22157824	182394	157757	210878	0.854	0.719	1.016	450198	389834	519909
1995	6655156	4564226	9703967	177760	154305	204780	0.699	0.580	0.842	463390	397804	539788
1996	7325806	5151237	10418359	212751	184712	245046	0.786	0.657	0.939	482020	418619	555024
1997	3498311	2469665	4955400	235395	202904	273089	0.699	0.581	0.841	452969	396914	516941
1998	2835318	2004284	4010922	196862	172785	224294	0.768	0.640	0.923	342974	303461	387632
1999	32054377	22280915	46114940	141339	123675	161527	0.886	0.744	1.055	539821	430960	676180
2000	7693384	5408293	10943962	117824	104470	132885	0.780	0.650	0.936	780475	633238	961948
2001	1185548	830158	1693079	301950	250243	364343	0.547	0.445	0.673	575025	483646	683670
2002	1444720	1016084	2054174	381726	322936	451220	0.434	0.345	0.546	457927	392918	533693
2003	1065128	748733	1515222	280559	240202	327697	0.292	0.228	0.373	313008	271154	361323
2004	1037026	732381	1468394	196543	168906	228703	0.310	0.245	0.393	238341	208412	272567
2005	4064417	2791414	5917962	141491	120884	165610	0.379	0.304	0.473	256617	216981	303493
2006	1314060	926671	1863394	103001	87236	121614	0.495	0.403	0.608	200112	171606	233354

Year	Recruitment (age 0)	Recruitment low	Recruitment high	SSB esti- mate	SSB low	SSB high	Fbar (2-4)	Fbar low	Fbar high	TSB esti- mate	TSB low	TSB high
2007	968190	679261	1380016	115760	99456	134737	0.476	0.388	0.584	179451	156025	206393
2008	779872	541925	1122296	120295	102958	140551	0.371	0.299	0.459	155448	135449	178399
2009	3986314	2758785	5760034	92512	80192	106724	0.318	0.256	0.395	193626	161744	231792
2010	497635	346805	714063	93035	81328	106426	0.293	0.236	0.363	162687	141506	187037
2011	347412	244213	494220	132553	115017	152763	0.279	0.224	0.348	175590	152259	202495
2012	632876	442275	905618	155136	132984	180978	0.271	0.216	0.340	178165	154552	205386
2013	730789	515889	1035209	121386	104001	141677	0.278	0.223	0.348	148934	129879	170784
2014	4657046	3221292	6732728	93124	80015	108381	0.351	0.284	0.435	191645	160647	228624
2015	1407060	993066	1993642	83764	72685	96533	0.421	0.337	0.525	193041	165088	225727
2016	1700789	1197122	2416364	126267	107809	147884	0.348	0.275	0.440	222192	191965	257179
2017	816185	575068	1158398	125815	108079	146462	0.314	0.246	0.401	183700	161028	209565
2018	2570283	1810864	3648179	111305	97116	127567	0.345	0.273	0.436	182841	159819	209179
2019	9191785	6390183	13221672	89806	78359	102925	0.322	0.257	0.403	317591	255930	394108
2020	10592753	7366713	15231545	116882	102491	133293	0.261	0.207	0.328	472301	390498	571239
2021	3837089	2640961	5574959	238152	202272	280396	0.174	0.137	0.222	609651	517055	718831
2022	6712394	4567575	9864364	436853	372130	512834	0.106	0.082	0.137	741474	637019	863057
2023	1051132	609944	1811441	580727	498176	676957	0.084	0.064	0.111	793293	688239	914382
2024	1788860*			680608	573054	808349				810032	677790	968075

* Recruitment in 2024 is the geometric mean of resampled recruitment estimates from 2000 to 2023.

Table 8.6.1. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Short-term forecast inputs.

SAM forecast								
Starting year:	2023							
Number of simulations:	10000							
Initial stock size:	Simulated from the estimated distribution at the start of the final data year (including covariances)							
Recruitment	Sampled with replacement from 2000 to the final year of catch data							
Fbar age range:	2-4							
Intermediate year:	<i>F status quo</i> (2023). FintYr = 0.084							
F and M before spawning:	Taken as 0							
2024								
Age	Mat	NM	SWt	CWt	LWt	DWt	Sel	LF
0	0.000	1.107	0.019	0.046	0.000	0.046	0.001	0.000
1	0.079	1.131	0.057	0.140	0.444	0.136	0.010	0.013
2	0.595	0.500	0.205	0.320	0.435	0.266	0.059	0.318
3	0.957	0.348	0.334	0.425	0.448	0.392	0.139	0.590
4	0.998	0.301	0.381	0.452	0.456	0.423	0.192	0.874
5	1.000	0.276	0.431	0.499	0.500	0.482	0.200	0.918
6	1.000	0.259	0.595	0.697	0.706	0.529	0.140	0.950
7	1.000	0.261	0.616	0.743	0.746	0.709	0.130	0.924
8	1.000	0.235	0.580	0.924	0.919	0.974	0.130	0.901

2025								
Age	Mat	NM	SWt	CWt	LWt	DWt	Sel	LF
0	0.000	1.107	0.019	0.046	0.000	0.046	0.001	0.000
1	0.079	1.131	0.057	0.140	0.444	0.136	0.010	0.013
2	0.595	0.500	0.205	0.320	0.435	0.266	0.059	0.318
3	0.957	0.348	0.313	0.398	0.448	0.326	0.139	0.590
4	0.998	0.301	0.442	0.525	0.527	0.512	0.192	0.874
5	1.000	0.276	0.406	0.470	0.466	0.517	0.200	0.918
6	1.000	0.259	0.460	0.539	0.537	0.567	0.140	0.950
7	1.000	0.261	0.627	0.756	0.769	0.605	0.130	0.924
8	1.000	0.235	0.534	0.850	0.843	0.909	0.130	0.901
2026								
Age	Mat	NM	SWt	CWt	LWt	DWt	Sel	LF
0	0.000	1.107	0.019	0.046	0.000	0.046	0.001	0.000
1	0.079	1.131	0.057	0.140	0.444	0.136	0.010	0.013
2	0.595	0.500	0.205	0.320	0.435	0.266	0.059	0.318
3	0.957	0.348	0.313	0.398	0.448	0.326	0.139	0.590
4	0.998	0.301	0.429	0.509	0.527	0.383	0.192	0.874
5	1.000	0.276	0.546	0.632	0.632	0.633	0.200	0.918
6	1.000	0.259	0.411	0.482	0.475	0.611	0.140	0.950
7	1.000	0.261	0.482	0.581	0.575	0.653	0.130	0.924
8	1.000	0.235	0.533	0.848	0.845	0.876	0.130	0.901

Table 8.6.2. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Short-term forecast output. A number of management options are highlighted.

Basis	Total catch (2025)	Projected landings (2025)	Projected dis- cards and IBC* (2025)	F_{total} (ages 2–4) (2025)	$F_{projected landings}$ (ages 2–4) (2025)	$F_{projected discards}$ and IBC (ages 2– 4) (2025)	SSB (2026)	% SSB change**	% TAC change ***	% advice change^
ICES advice basis										
MSY approach: F_{MSY}	112435	93661	18774	0.174	0.120	0.054	420140	-22	-5.5	-25
Other scenarios										
F_{MSY} lower	104820	87350	17470	0.161	0.111	0.050	426231	-20	-11.9	-30
F_{MSY} upper	112435	93661	18774	0.174	0.120	0.054	420140	-22	-5.5	-25
$F = 0$	0	0	0	0	0	0	512700	-4.3	-100	-100
F_{pa}	112435	93661	18774	0.174	0.120	0.054	420140	-22	-5.5	-25
F_{lim}	222927	185156	37771	0.39	0.27	0.122	330341	-38	87	50
$SSB (2026)$ $= B_{lim}$	464582	381649	83203	1.24	0.85	0.39	141339	-74	291	212
$SSB (2026)$ $= B_{pa}$ $= MSY B_{trigger}$	392814	324060	68754	0.89	0.61	0.28	196402	-63	230	164
$F = F_{2024}$	57225	47765	9460	0.084	0.058	0.026	465273	-13.1	-52	-62

* Including BMS landings, assuming recent discard rate.

** SSB 2026 relative to SSB 2025.

*** Total catch in 2025 relative to TAC in 2024: Subdivision 20 (6233 t) + Subarea 4 (101421 t) + Division 6.a (11301 t) = 118955 t.

^ Total catch 2025 relative to the advice value 2024 (149024 t).

Table 8.6.3. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Ratio of numbers-at-age from stock assessment and forecast results from WGNSSK 2023 and WGNSSK 2024.

Age	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023*	2024**
0	1.05	1.07	1.11	1.14	1.18	1.23	1.29	1.33	1.42	1.48	0.73	1.24
1	1.03	1.05	1.05	1.06	1.06	1.05	1.07	1.10	1.09	1.14	1.26	0.59
2	1.10	1.08	1.10	1.08	1.10	1.08	1.07	1.07	1.10	1.13	1.38	1.25
3	1.08	1.09	1.08	1.10	1.08	1.09	1.08	1.09	1.08	1.15	1.35	1.41
4	1.07	1.07	1.07	1.07	1.08	1.07	1.06	1.07	1.06	1.04	1.18	1.33
5	1.04	1.04	1.05	1.06	1.04	1.04	1.03	1.03	1.04	1.01	0.99	1.15
6	1.03	1.02	1.04	1.03	1.03	1.03	1.02	1.03	1.02	1.00	1.00	0.98
7	1.00	1.00	1.00	1.01	1.02	1.00	0.98	0.97	1.00	0.99	0.90	0.97
8+	1.00	1.02	1.02	1.03	1.03	1.04	1.05	1.04	1.05	1.03	0.57	0.70

* 2023 was the intermediate year at WGNSSK 2023

** 2024 was the advice year at WGNSSK 2023 and is the intermediate year at WGNSSK 2024

Table 8.6.4. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Ratio of biomass-at-age from stock assessment and forecast results from WGNSSK 2023 and WGNSSK 2024.

Age	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023*	2024**
0	1.05	1.07	1.11	1.14	1.18	1.23	1.29	1.33	1.42	1.48	0.77	0.96
1	1.03	1.05	1.05	1.06	1.06	1.05	1.07	1.10	1.09	1.14	1.37	0.63
2	1.10	1.08	1.10	1.08	1.10	1.08	1.07	1.07	1.10	1.13	1.51	1.24
3	1.08	1.09	1.08	1.10	1.08	1.09	1.08	1.09	1.08	1.15	1.14	1.37
4	1.07	1.07	1.07	1.07	1.08	1.07	1.06	1.07	1.06	1.04	1.22	1.08
5	1.04	1.04	1.05	1.06	1.04	1.04	1.03	1.03	1.04	1.01	1.05	1.21
6	1.03	1.02	1.04	1.03	1.03	1.03	1.02	1.03	1.02	1.00	1.02	1.04
7	1.00	1.00	1.00	1.01	1.02	1.00	0.98	0.97	1.00	0.99	0.82	0.98
8+	1.00	1.02	1.02	1.03	1.03	1.04	1.05	1.04	1.05	1.03	0.71	0.71

* 2023 was the intermediate year at WGNSSK 2023

** 2024 was the advice year at WGNSSK 2023 and is the intermediate year at WGNSSK 2024

Table 8.6.5. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Summary of forecast assumptions from current assessment (WGNSSK 2024) and previous assessment (WGNSSK 2023).

		Year	Current assessment (2024)	Previous assessment (2023)
Assumed recruitment	2023	1 051 132		1 444 493
	2024	1 788 860		1 444 493

	Year	Current assessment (2024)	Previous assessment (2023)
Catch	2023	60 979	68 499
F	2023	0.084	0.111
Target F for TAC	2024	0.084	0.24

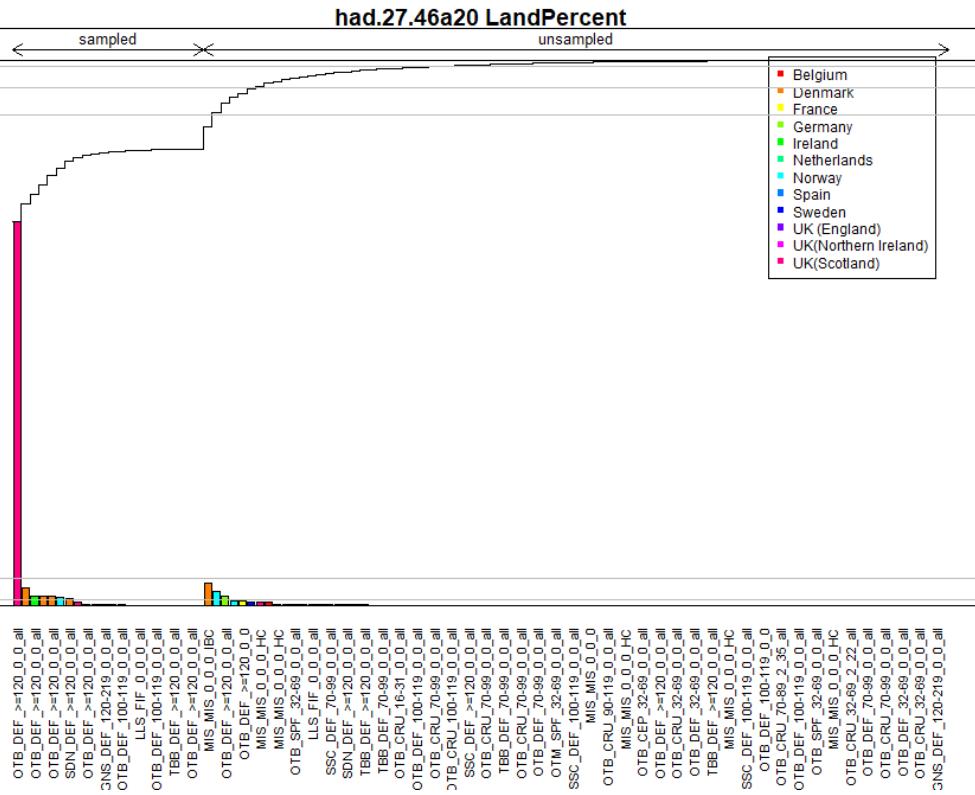


Figure 8.2.1. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Reported landings for each sampled and unsampled fleet in the full stock area, along with cumulative landings for fleets in descending order of yield.

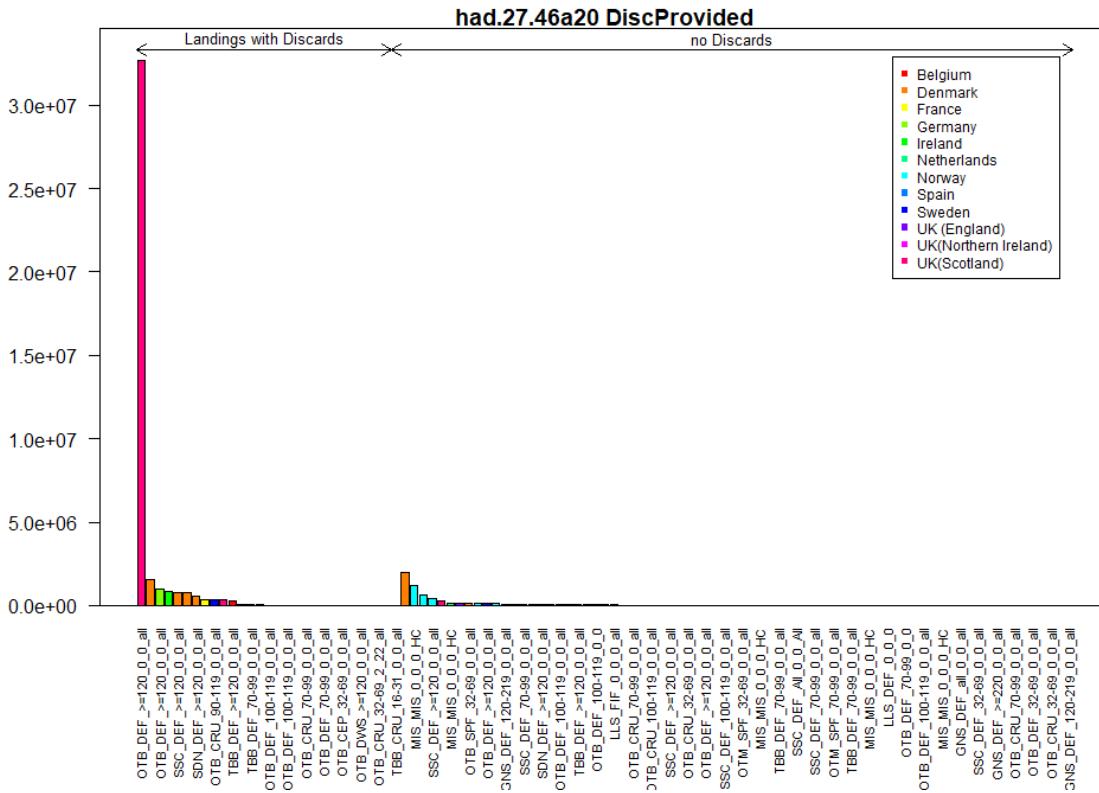


Figure 8.2.2. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Summary of landings for fleets with and without discard estimates.

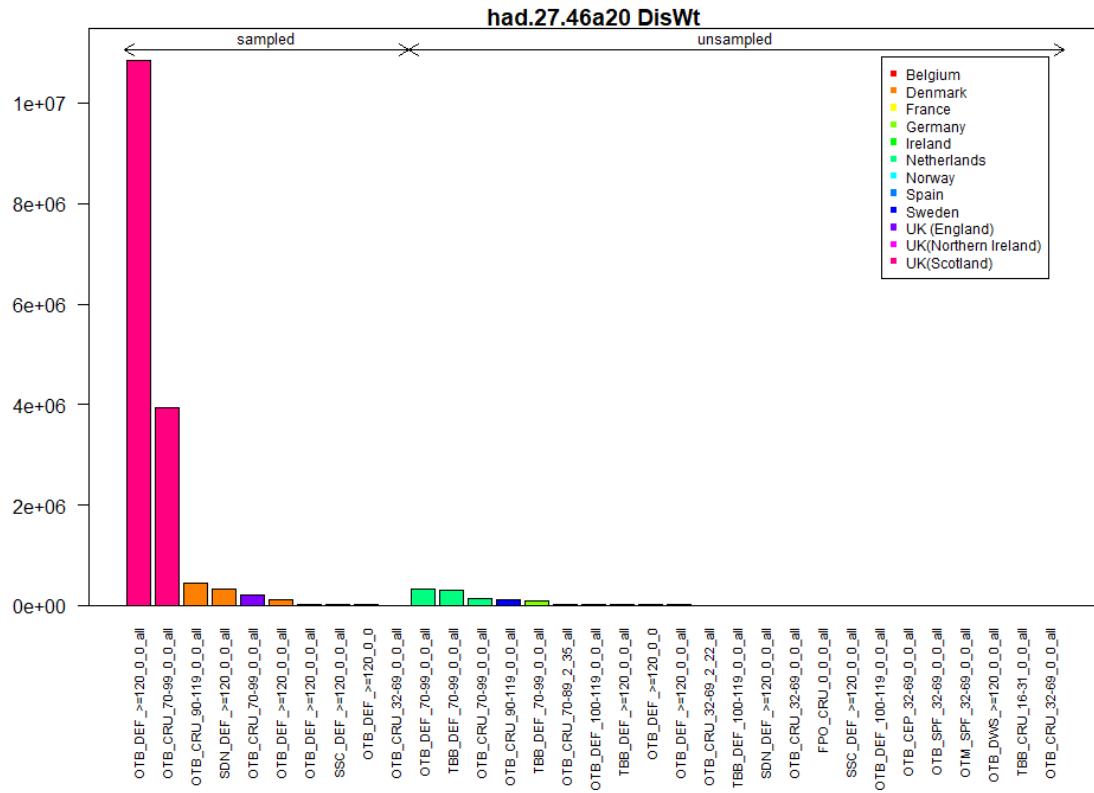


Figure 8.2.3. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Reported discards for each sampled and unsampled fleet in the full stock area, in descending order of yield.

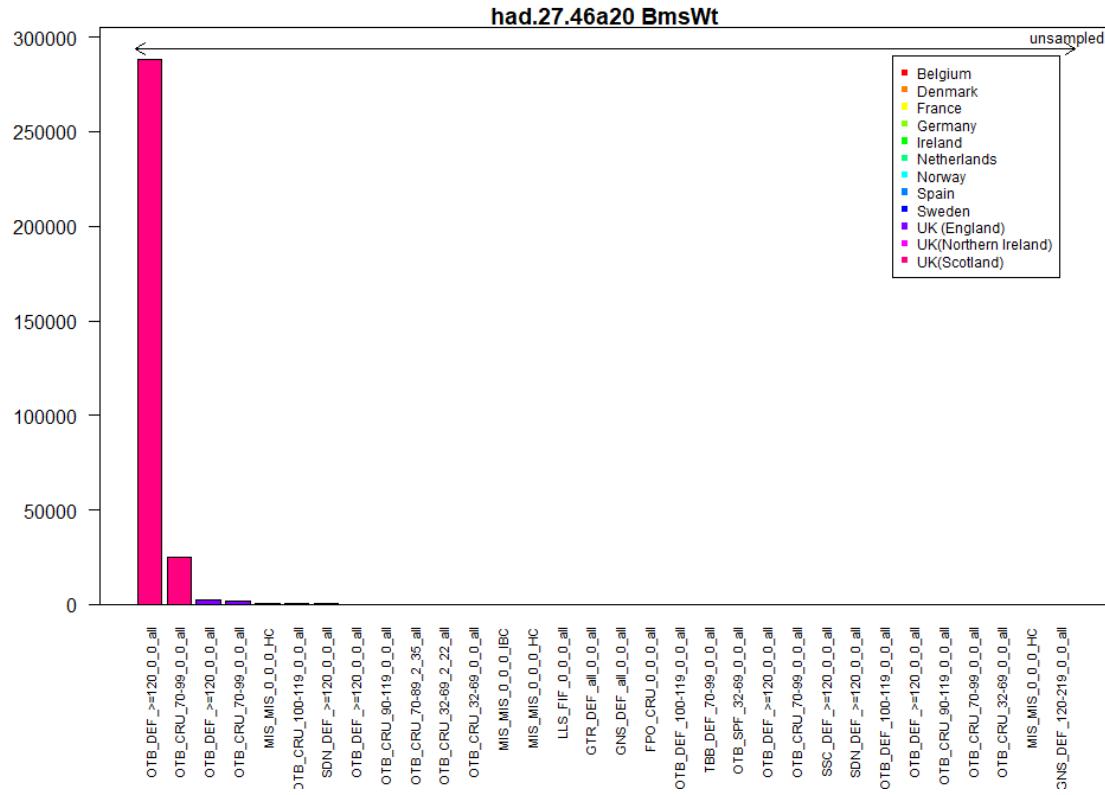


Figure 8.2.4. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Reported BMS landings for each sampled and unsampled fleet in the full stock area, in descending order of yield.

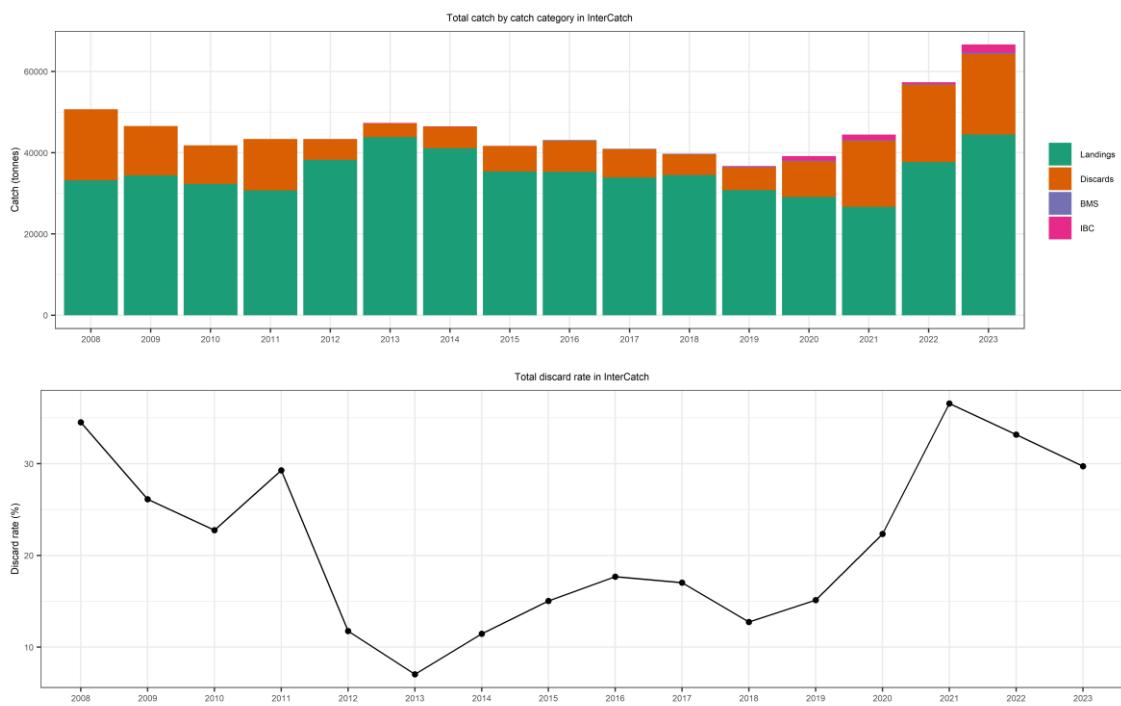


Figure 8.2.5. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Yield by catch component and discard rate.

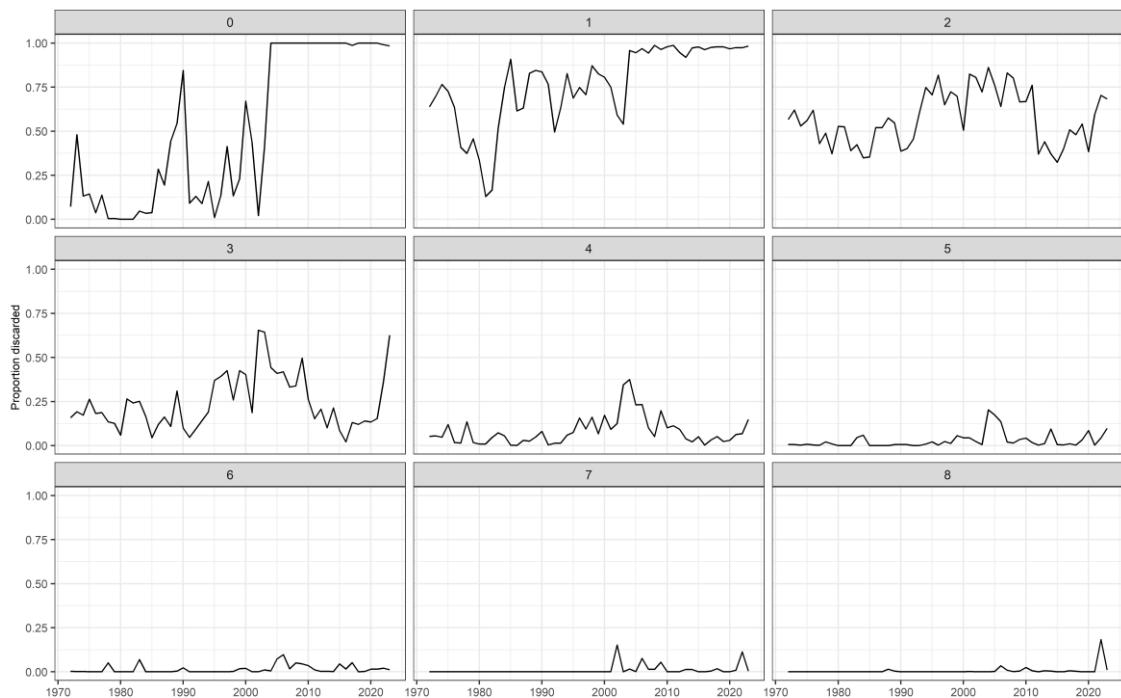


Figure 8.2.6. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Proportion of total catch discarded, by age and year.

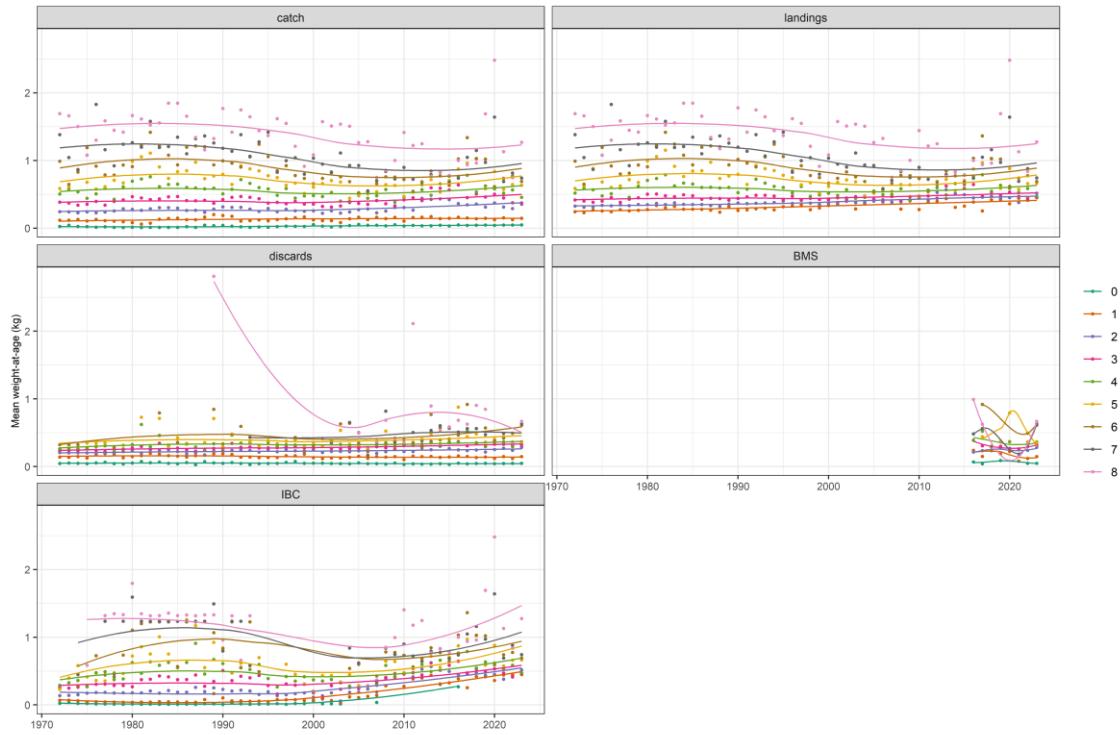


Figure 8.2.7. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Mean weights-at-age (0-8+; kg) by catch component. Points indicate the data points. The solid lines give loess smoothers through each time-series of mean weights-at-age, to show underlying trends.

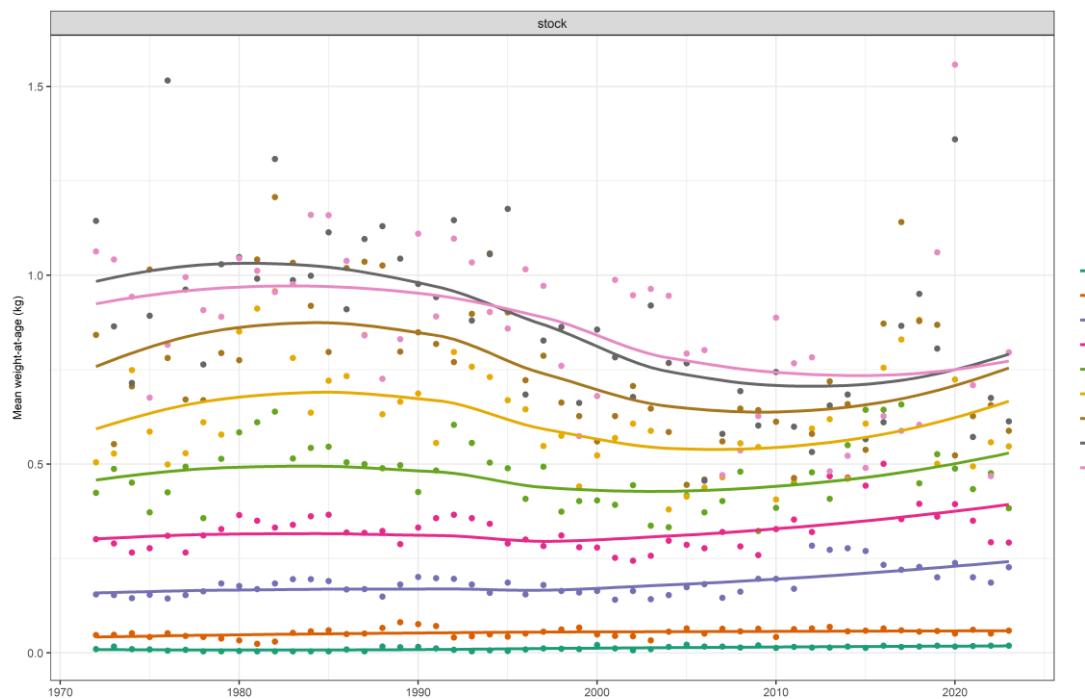


Figure 8.2.8. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Mean weights-at-age (kg) for the stock. Points indicate the data points. The solid lines give loess smoothers through each time-series of mean weights-at-age, to show underlying trends.

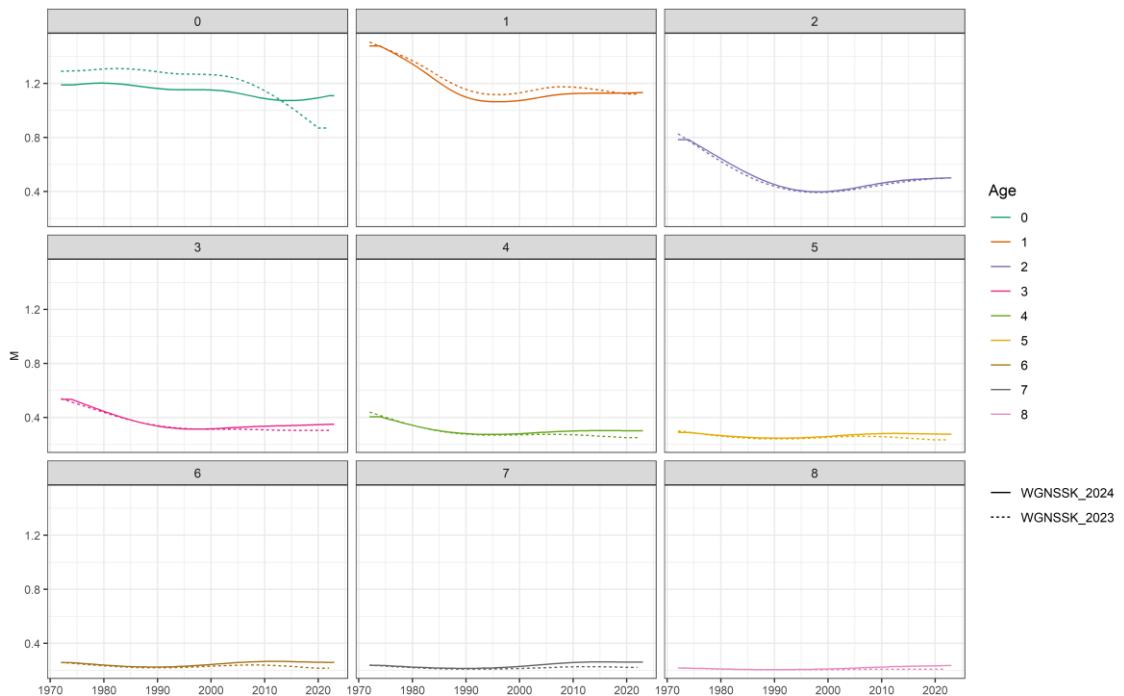


Figure 8.2.9. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Time series of estimated natural mortality at age (0-8+), from ICES WGSAM (SMS 2023; ICES, 2024) compared to the values previously provided (SMS 2020; ICES, 2021).

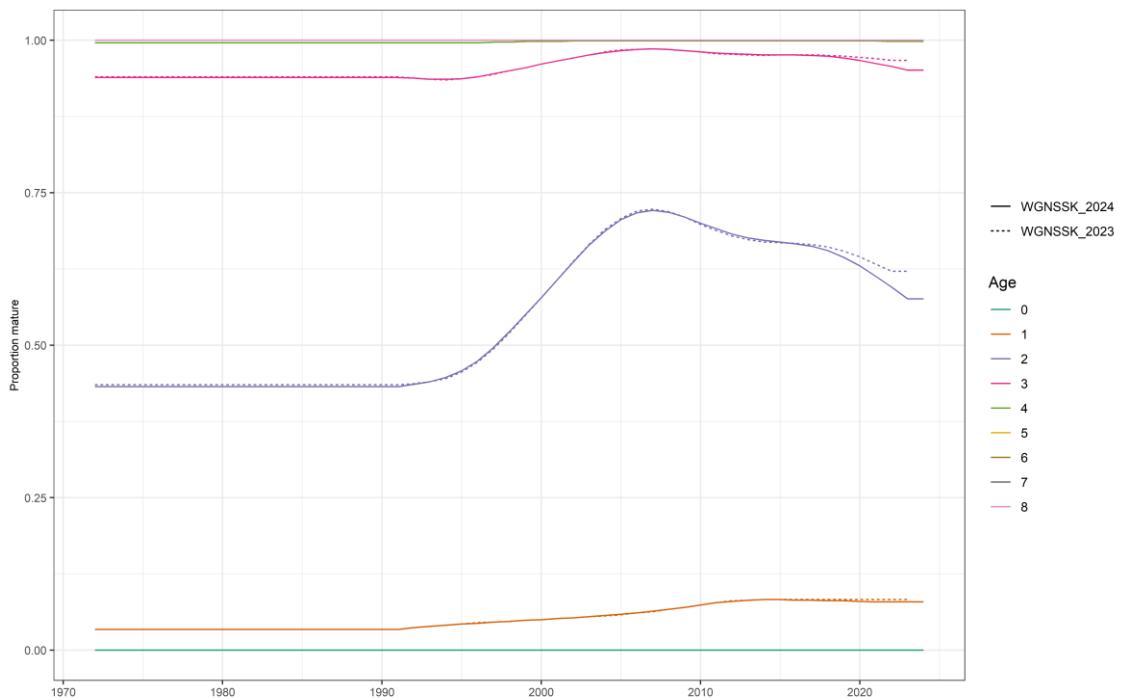


Figure 8.2.10. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Time series of estimated maturity-at-age (0-8+) used at WGNSSK 2024 compared to those used at WGNSSK 2023.

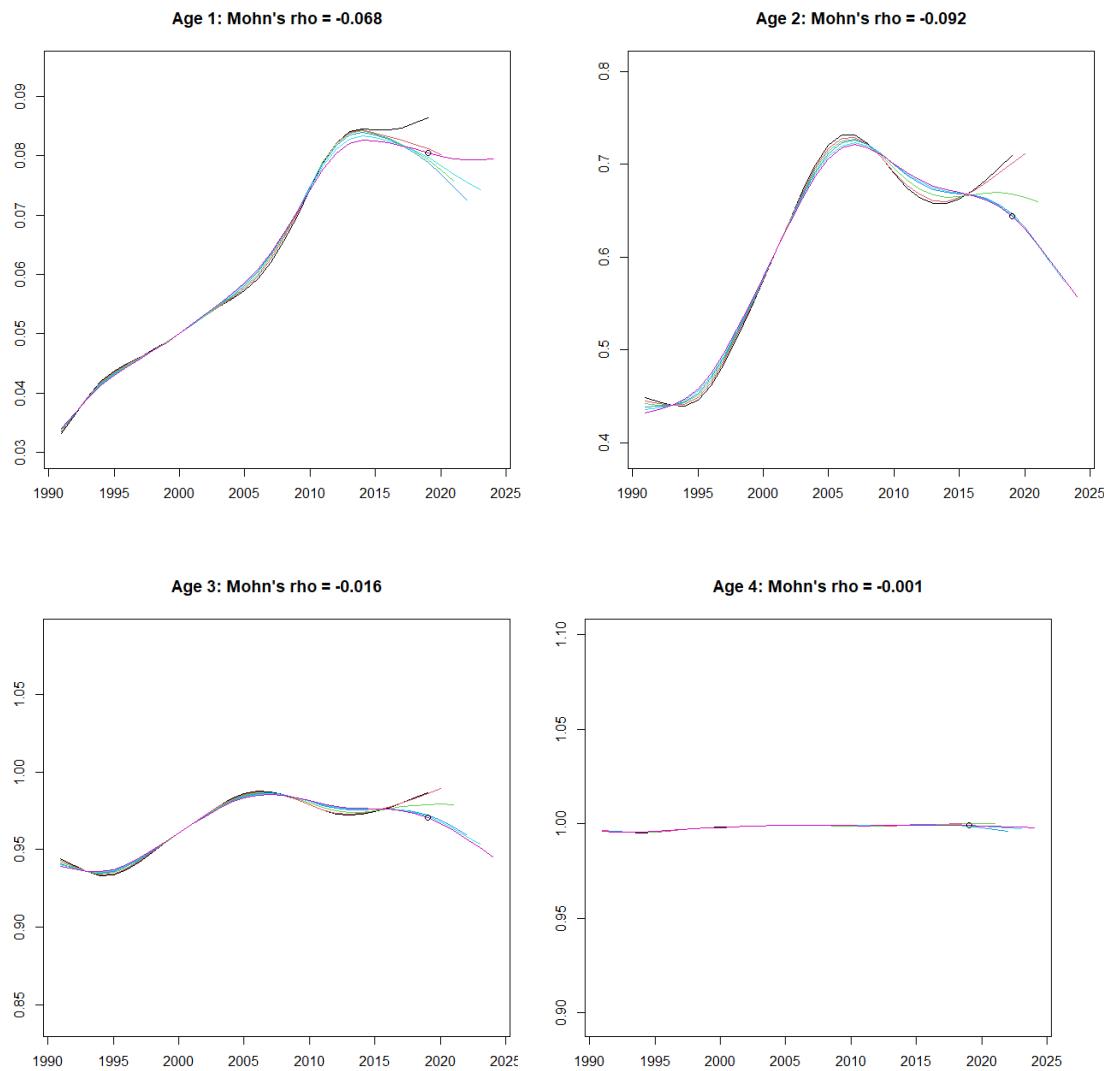


Figure 8.2.11. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Retrospective analysis of maturity time series for ages 1-4.

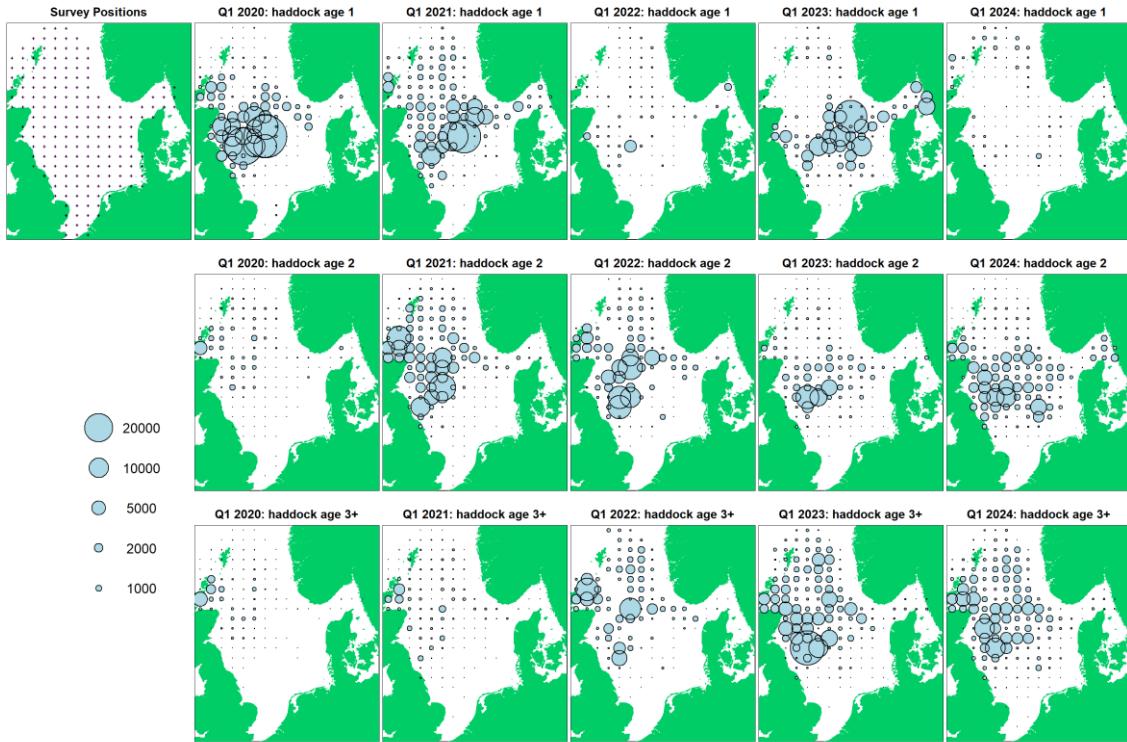


Figure 8.2.12. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Survey distributions by age for the international IBTS Q1 survey (North Sea).

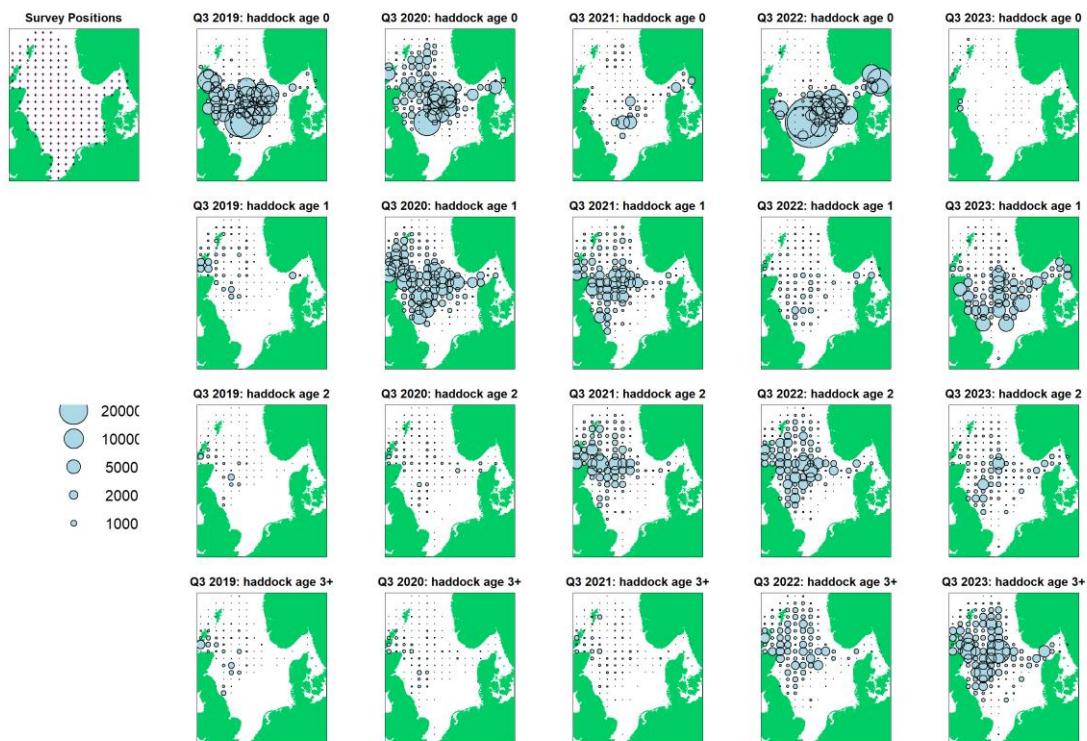


Figure 8.2.13. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Survey distributions by age for the international IBTS Q3 survey (North Sea).

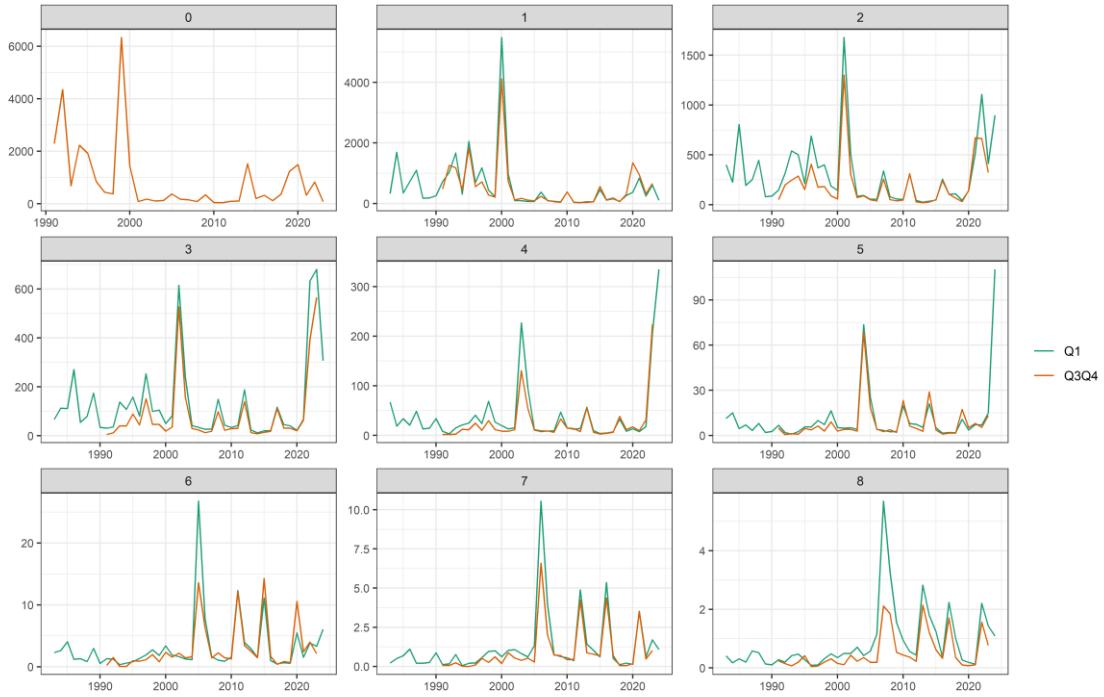


Figure 8.2.14. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Delta-GAM survey indices for NS-WC Q1 and NS-WC Q3+Q4.

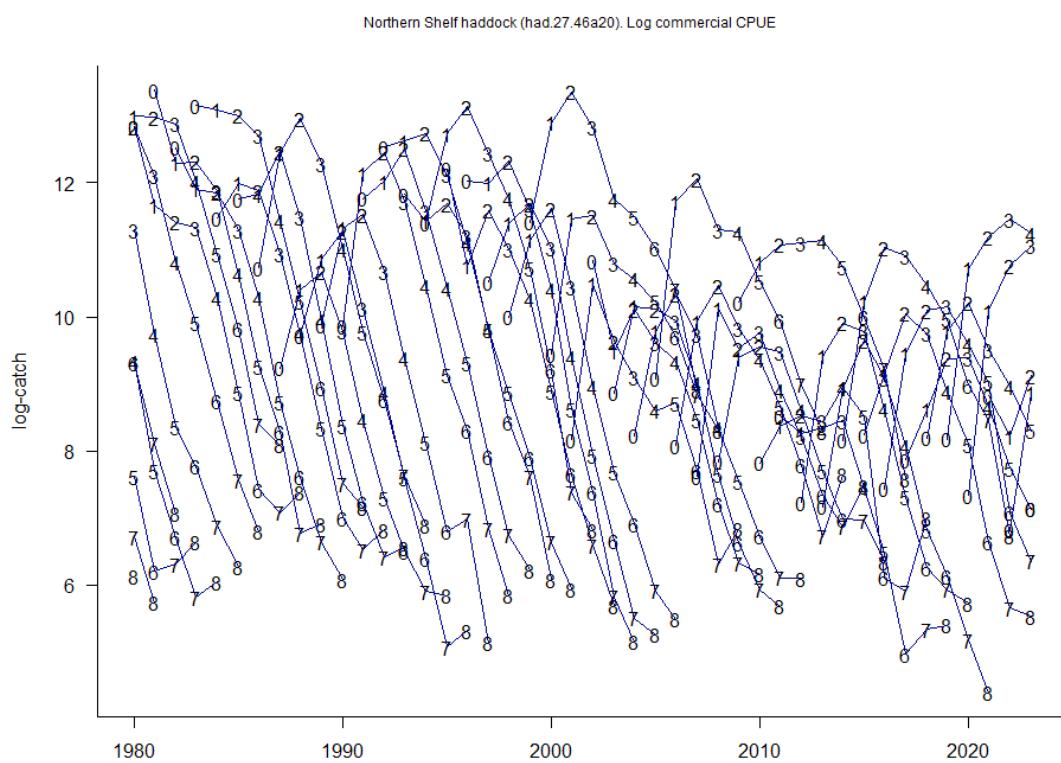


Figure 8.3.1. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Log catch curves by cohort for total catches.

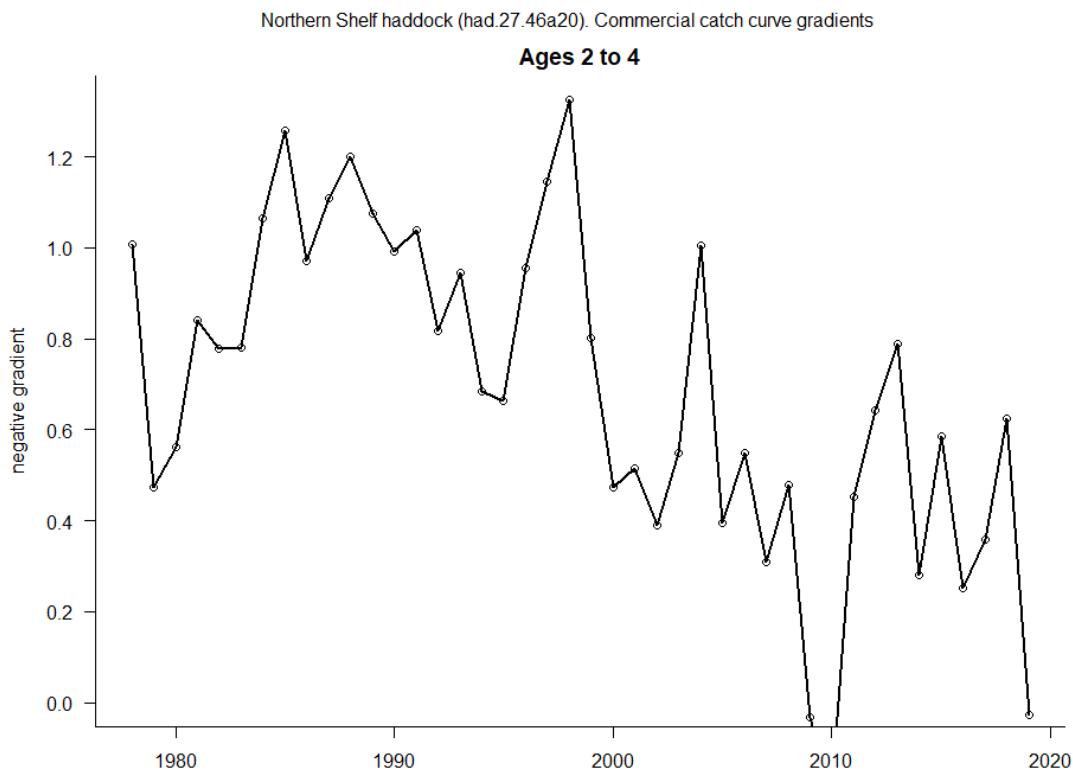


Figure 8.3.2. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Negative gradients of log catches per cohort, averaged over ages 2–4. The x-axis represents the spawning year of each cohort.

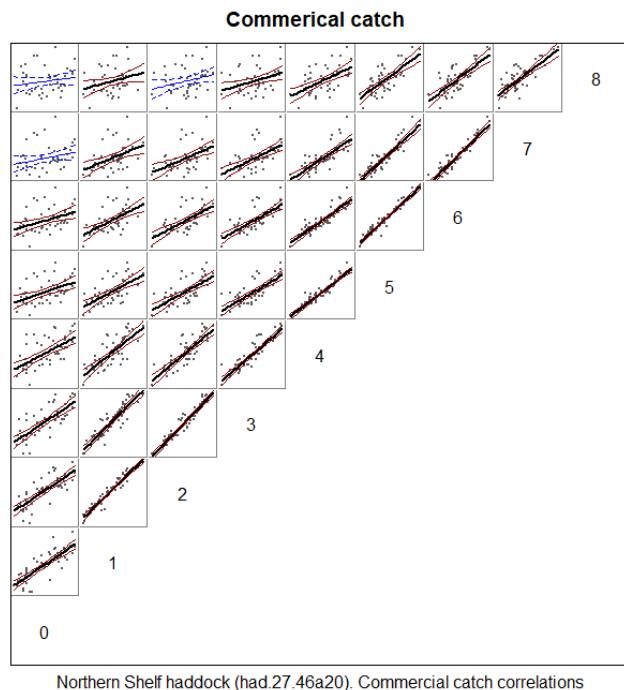


Figure 8.3.3. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Correlations in the catch-at-age matrix (including the plus-group for ages 8), comparing estimates at different ages for the same year-classes (cohorts). In each plot, the straight line is a normal linear model fit: a thick line (and black points) represents a significant ($p < 0.05$) regression, while a thin line (and blue points) is not significant. Approximate 95% confidence intervals for each fit are also shown.

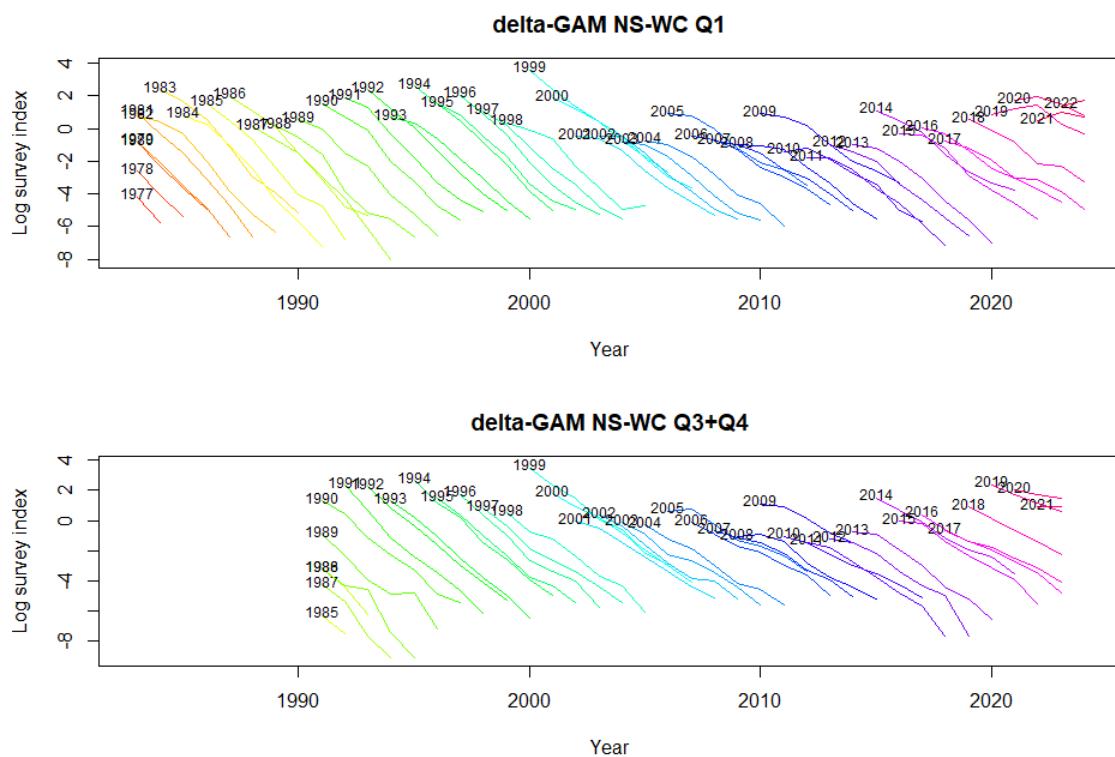


Figure 8.3.4. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Log abundance indices by cohort (survey “catch curves”) for each of the survey indices.

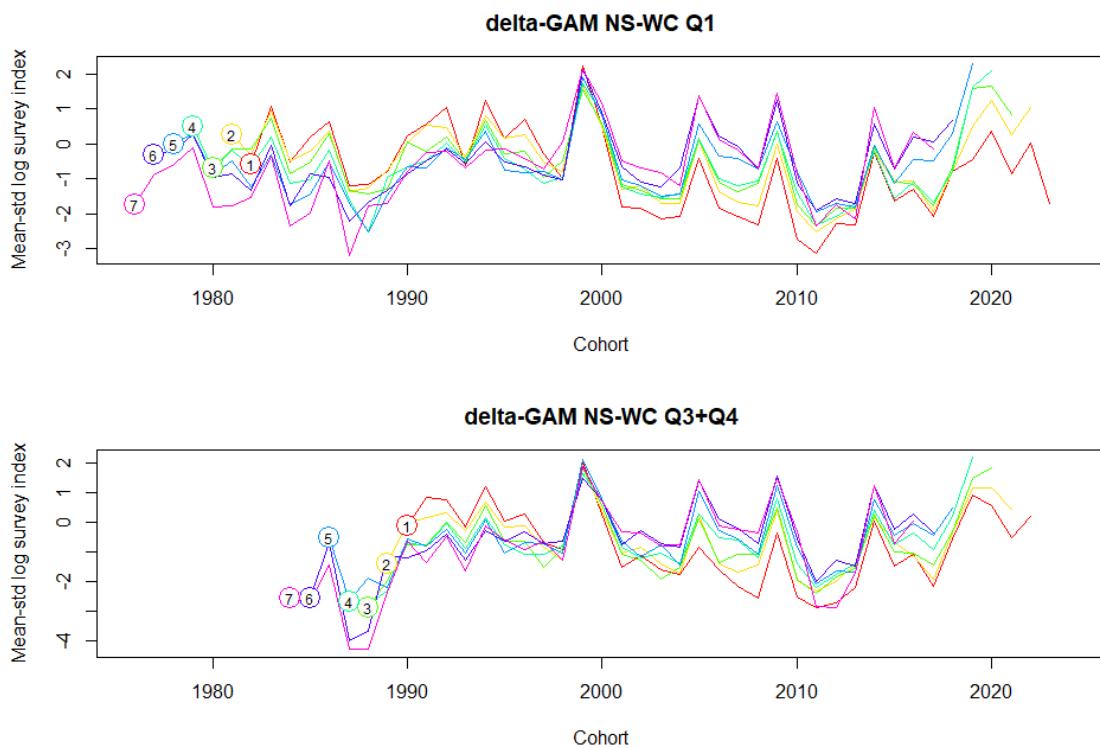


Figure 8.3.5. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Mean-standardised log abundance indices by age and cohort for each of the survey indices. The age represented by each line is indicated by a circled number at the start of the line.



Figure 8.3.6. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Within-survey correlations for the delta-GAM NS-WC Q1 (upper) and Q3+Q4 (lower) survey series, comparing index values at different ages for the same year-classes (cohorts). In each plot, the straight line is a normal linear model fit: a thick line (with black points) represents a significant ($p < 0.05$) regression, while a thin line (with blue points) is not significant. Approximate 95% confidence intervals for each fit are also shown.

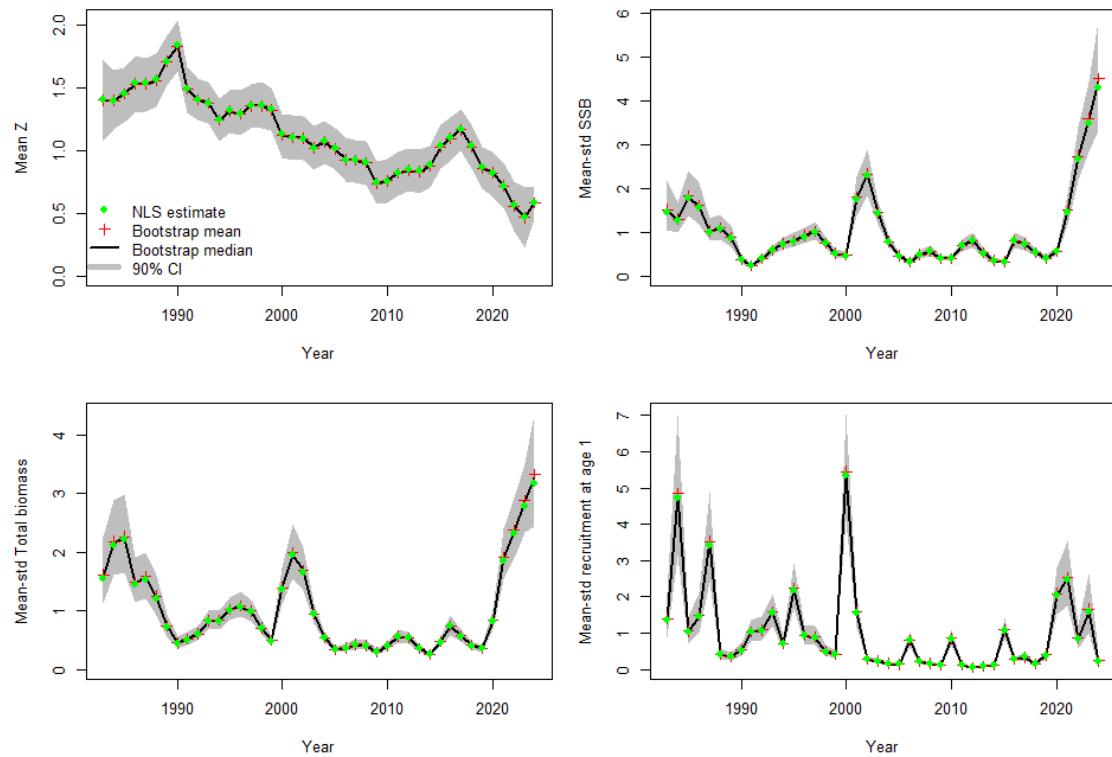


Figure 8.3.7. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Summary plots from an exploratory SURBAR assessment, using both available survey-derived indices (delta-GAM NS-WC Q1 and delta-GAM NS-WC Q3+Q4). Mean mortality Z (ages 2 to 4), relative spawning stock biomass (SSB), relative total biomass (TSB), and relative recruitment. Shaded grey areas correspond to the 90% CI. Green points give the model estimates, while red crosses and black lines give (respectively) the mean and median values from the uncertainty estimation bootstrap.

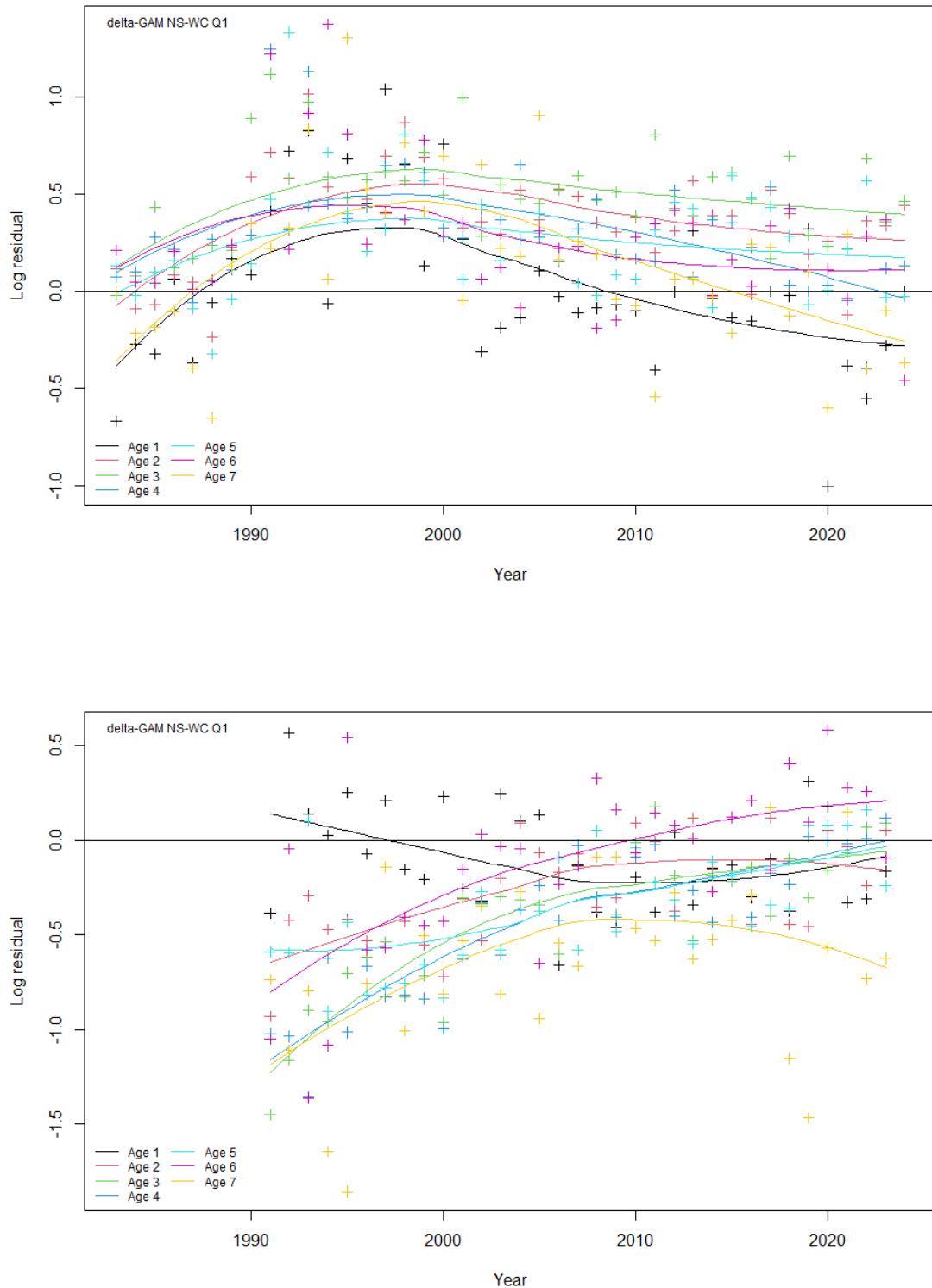


Figure 8.3.8. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Log residuals by age from an exploratory SURBAR assessment, using both available survey-derived indices (delta-GAM NS-WC Q1 and delta-GAM NS-WC Q3+Q4).

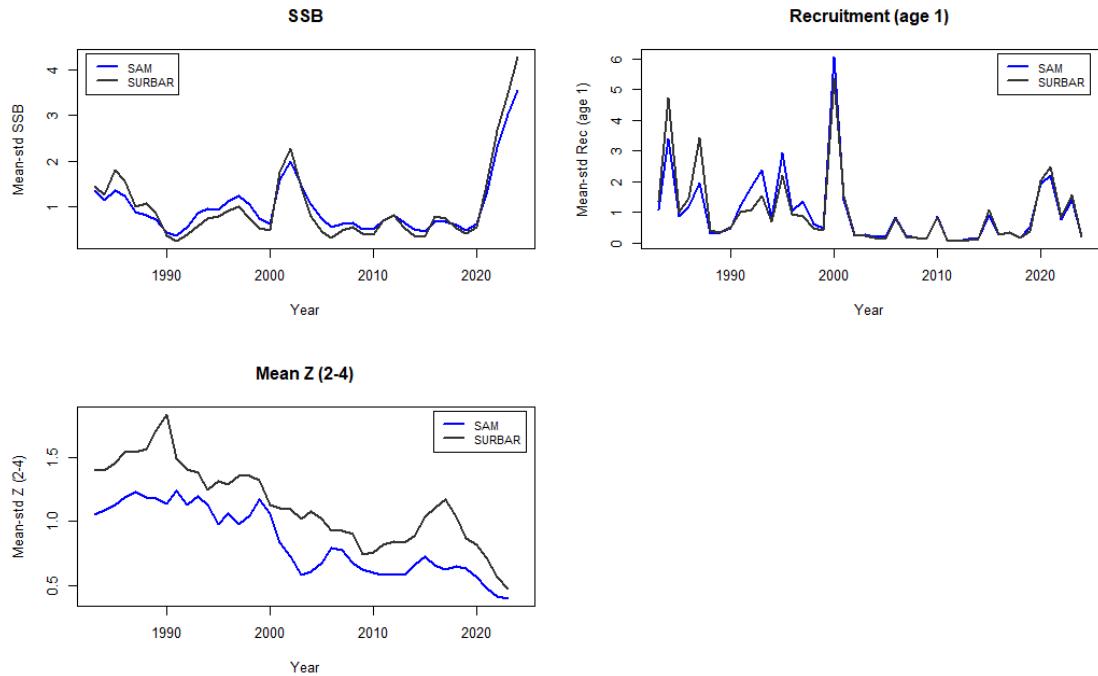


Figure 8.3.9. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Comparisons of stock summary estimates from SAM (blue) and SURBAR (black) models. To facilitate comparison, SSB and recruitment values have been mean-standardised using the year range for which estimates are available from all three models, and a composite Z estimate has been made for SAM by adding natural and fishing mortality estimates.

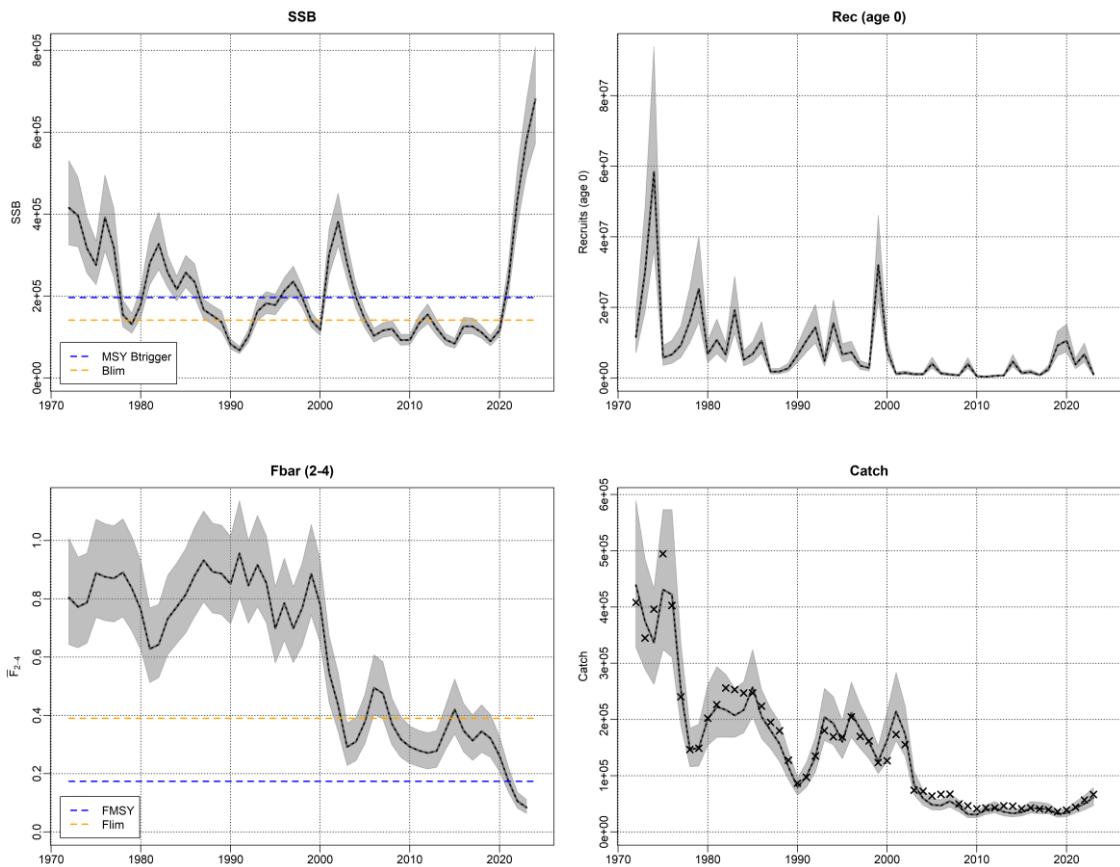


Figure 8.3.10. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Stock summary from final SAM assessment. Black lines give the assessment estimates for spawning stock biomass (SSB; tonnes), fishing mortality (F_{bar} , ages 2-4), recruit-
ment (age 0; thousands) and total catch (tonnes). Grey shading indicates the pointwise 95% confidence intervals, and
black crosses give observed values for total catch. Horizontal dashed lines indicate various reference points in relation to
SSB (B_{lim} in orange, MSY B_{trigger} in blue) or fishing mortality (F_{lim} in orange, F_{MSY} in blue) as calculated at WGNSSK 2024 (see
section 8.8).

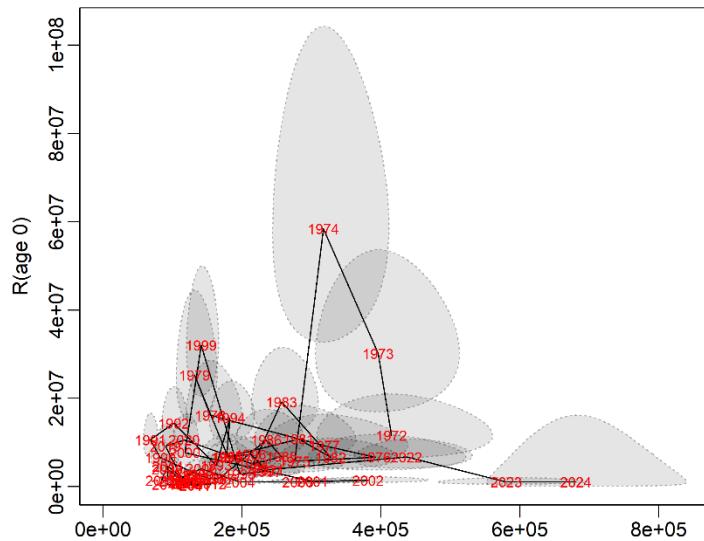


Figure 8.3.11. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Stock-recruitment estimates from the final SAM assessment. Points are labelled by year-class.

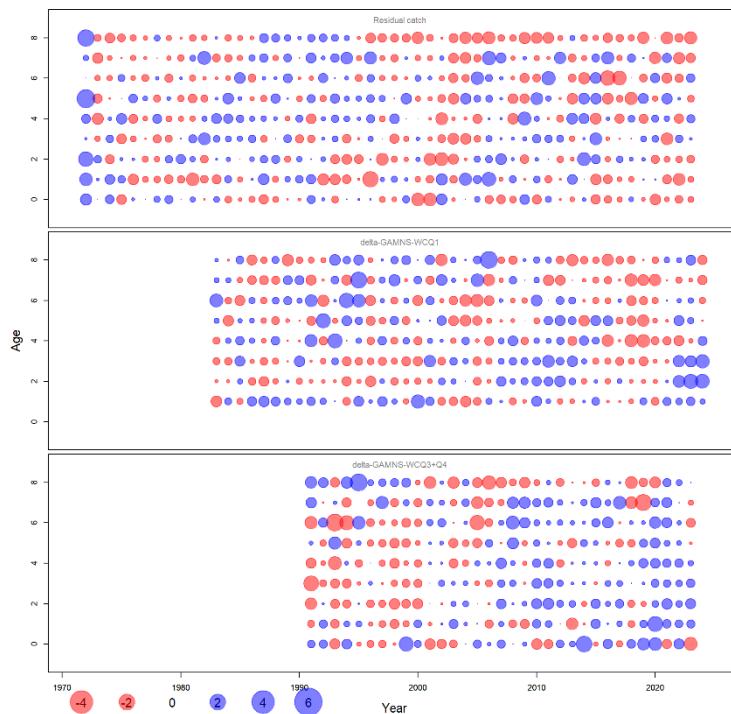


Figure 8.3.12. Haddock in Subarea 4, Division 6.a, and Subdivision 20. One-observation-ahead residuals for commercial catch, delta-GAM NS-WC Q1 and delta-GAM NS-CS Q3+Q4 from the final SAM assessment.

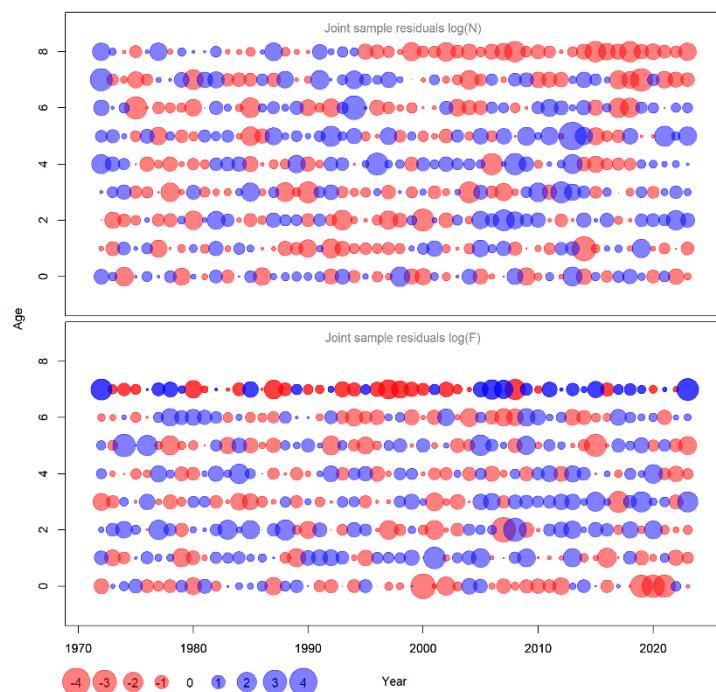


Figure 8.3.13. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Residuals for the N-process (survival) and F-process (fishing mortality) from the final SAM assessment.

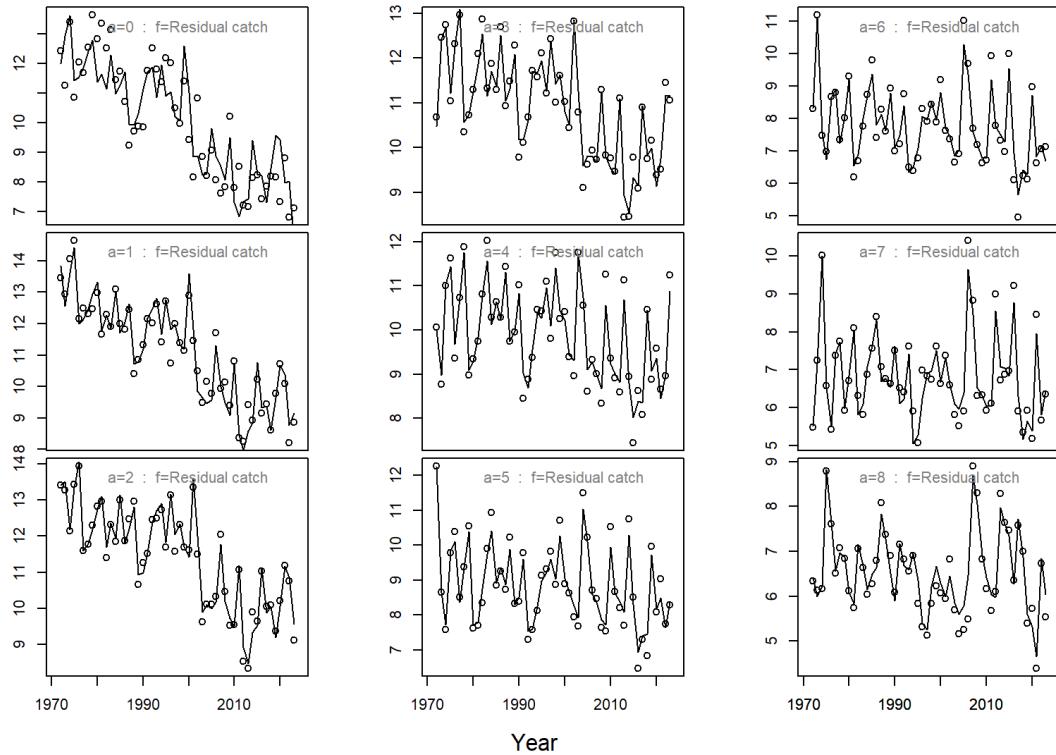


Figure 8.3.14. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Time-series of observed (points) and fitted (lines) values for total catch, by age.

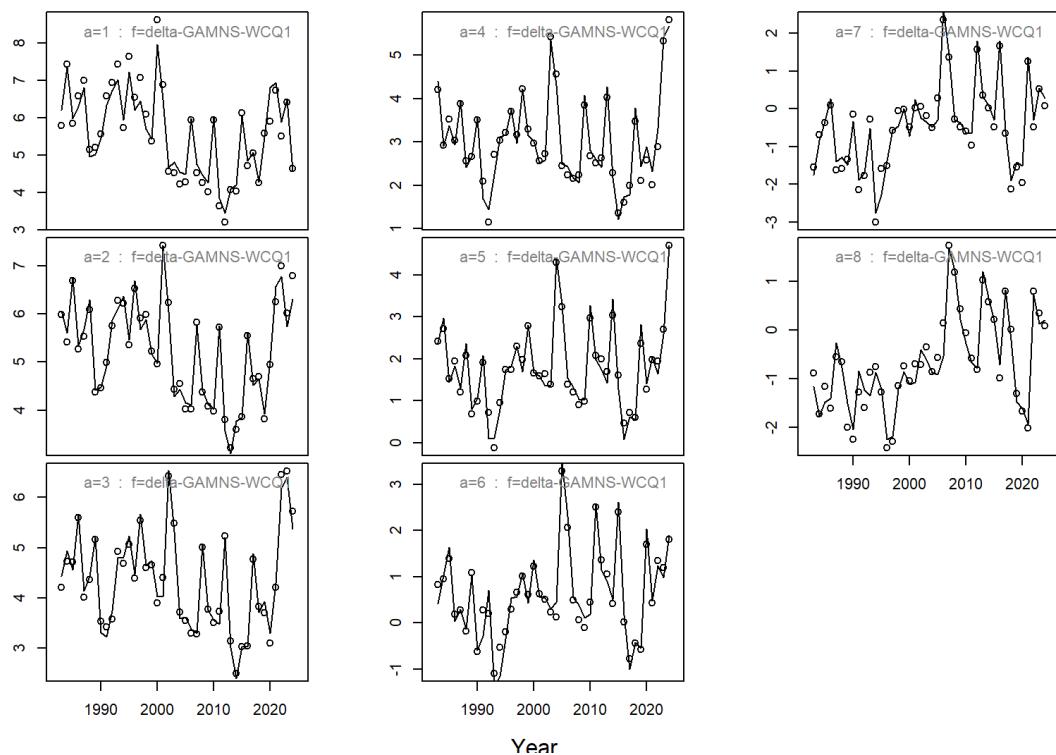


Figure 8.3.15. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Time-series of observed (points) and fitted (lines) values for the delta-GAM NS-WC Q1 survey index, by age.

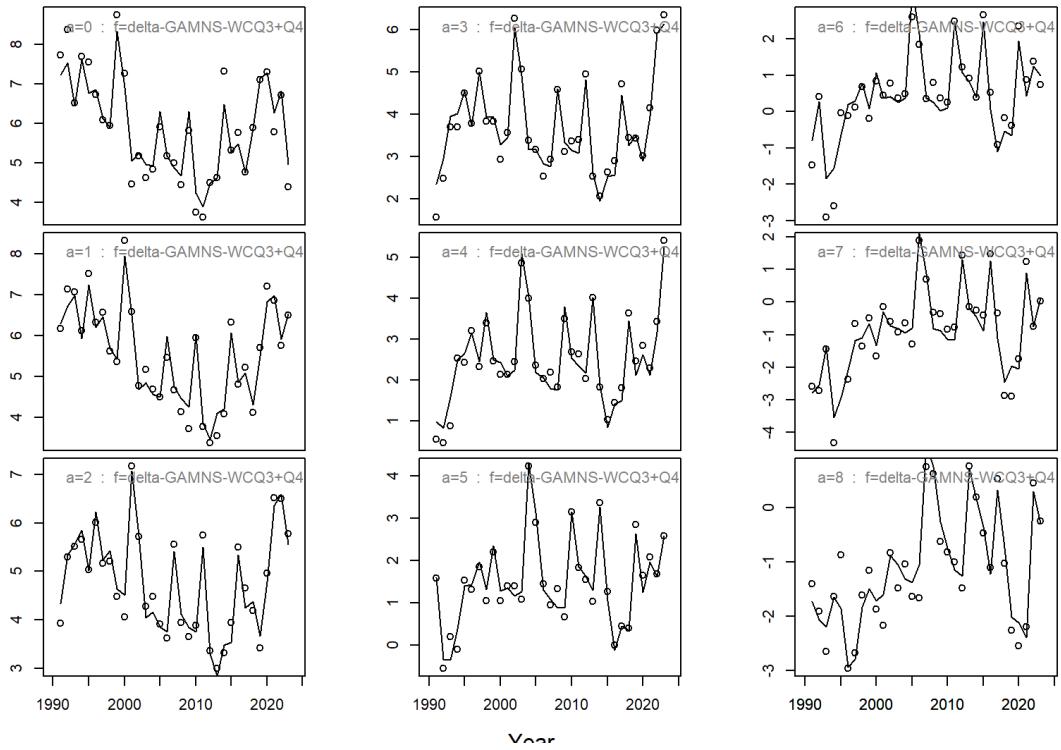


Figure 8.3.16. Haddock in Subarea 4, Division 6.a, and Subdivision 20 Time-series of observed (points) and fitted (lines) values for the delta-GAM NS-WC Q3+Q4 survey index, by age.

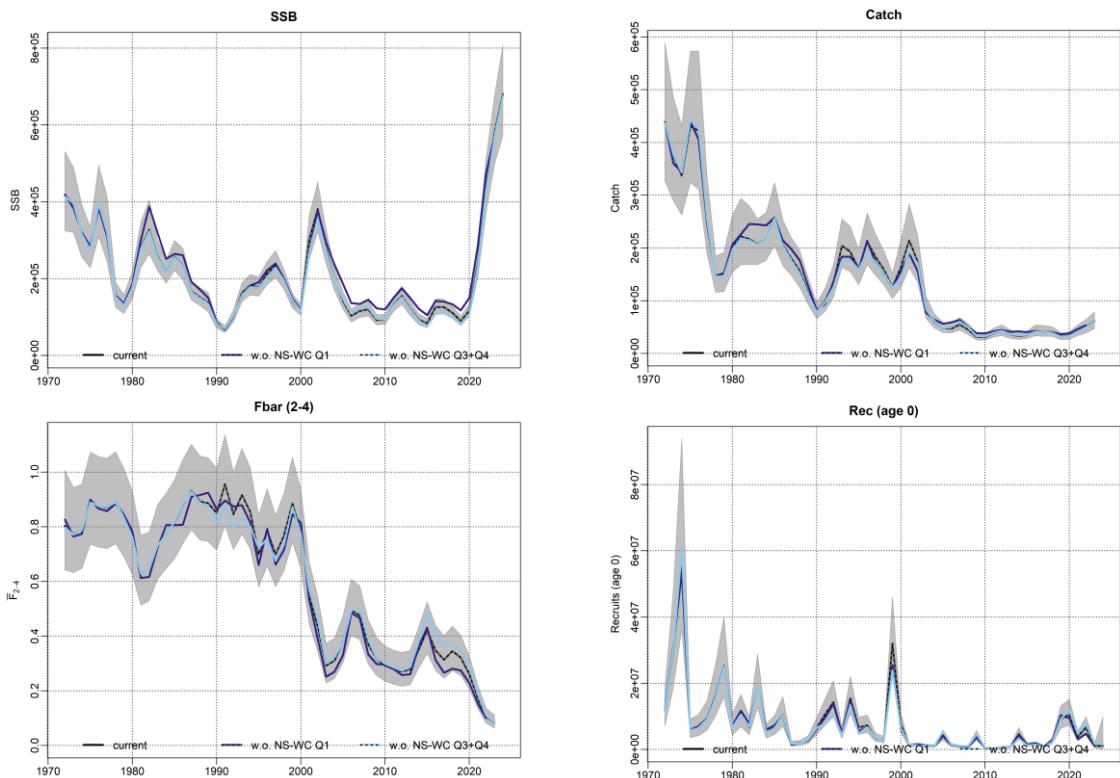


Figure 8.3.17. Haddock in Subarea 4, Division 6.a, and Subdivision 20 Leave one out analysis results for spawning stock biomass (SSB; tonnes), fishing mortality (Fbar, ages 2-4), recruitment (age 0; thousands) and total catch (tonnes) from the final SAM assessment.

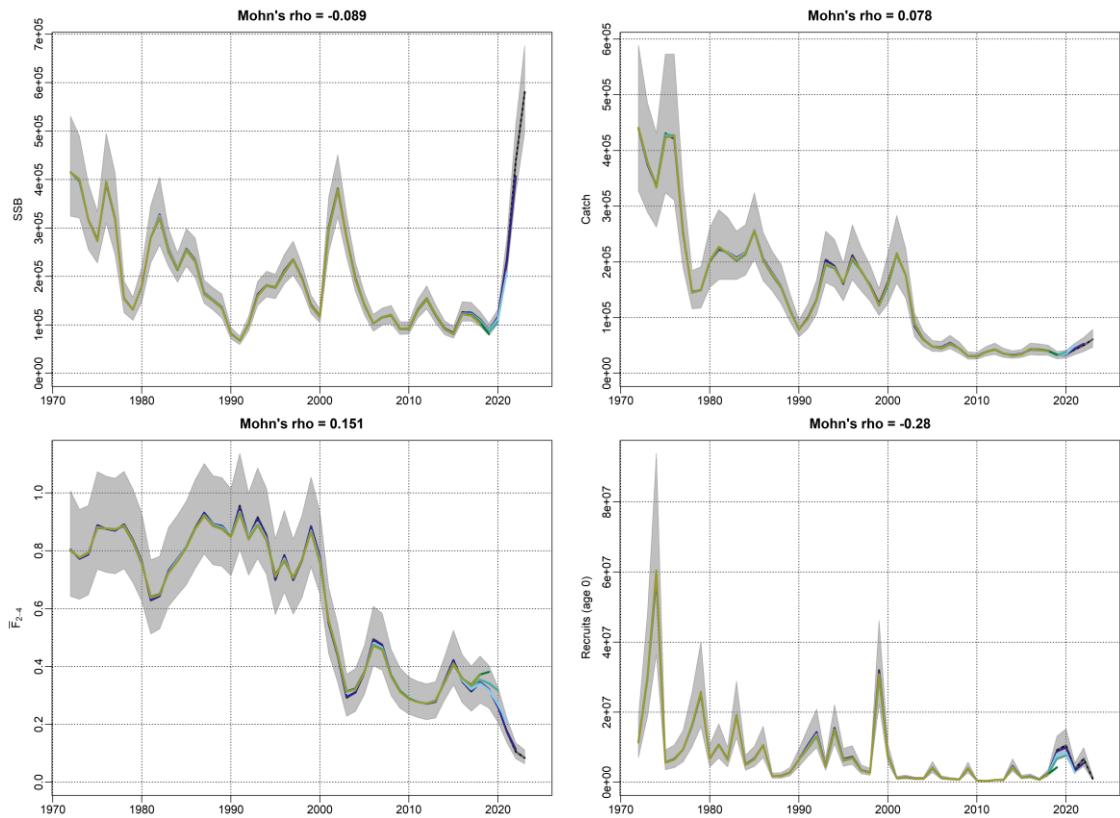


Figure 8.3.18. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Retrospective plots for the SAM assessment. The final-year run is shown in black with the pointwise 95% confidence interval indicated by the grey shading, while retrospective peels are shown with coloured lines. Mohn's rho estimates are given in the top right of each plot.

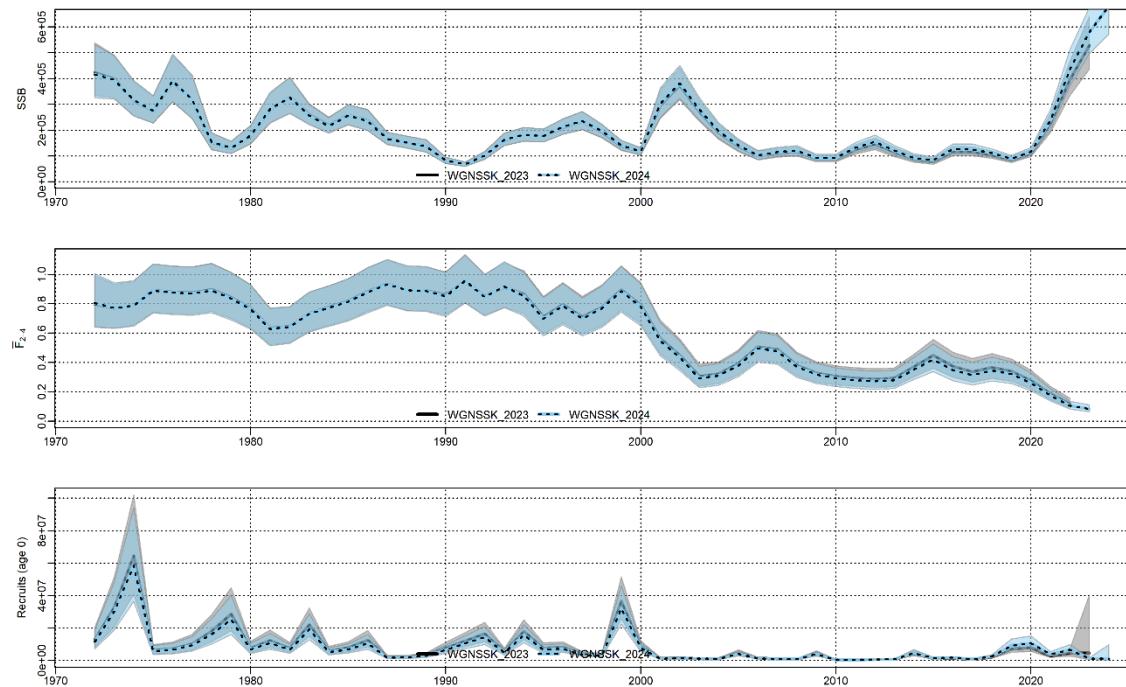


Figure 8.3.19. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Comparison of assessment results from previous stock assessment (WGNSSK 2023) and current stock assessment (WGNSSK 2024).

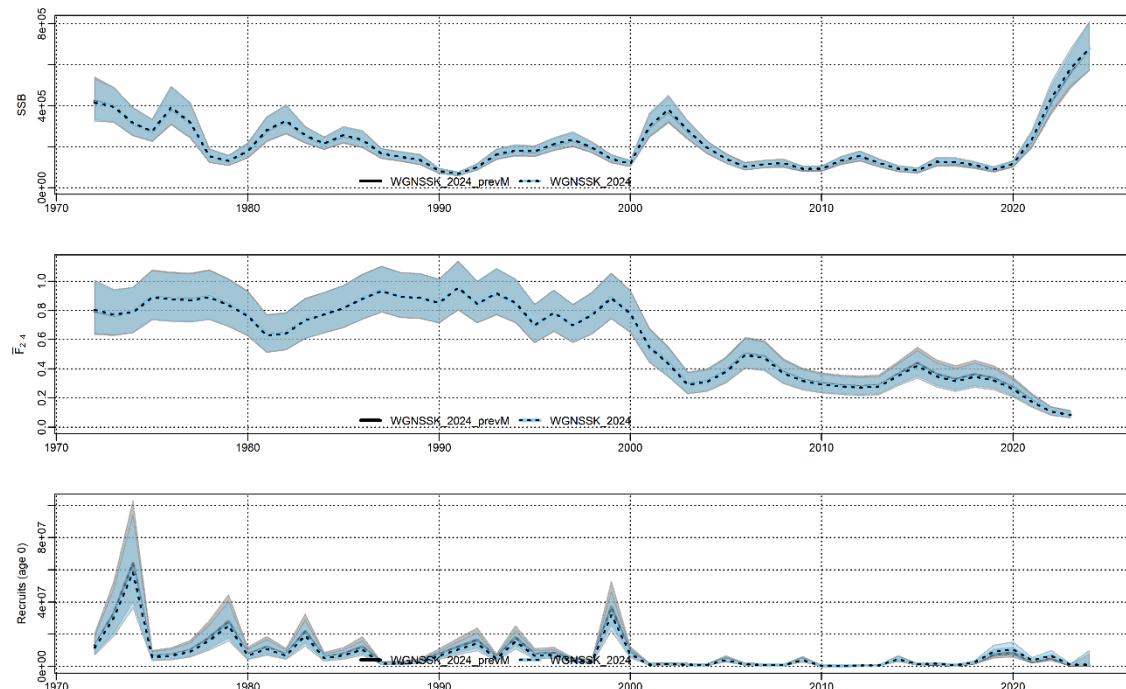


Figure 8.3.20. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Comparison of the assessment results using the previous estimates of natural mortality (WGNSSK_2024_prevM) and the standard stock assessment (WGNSSK_2024) which uses the updated natural mortality estimates.

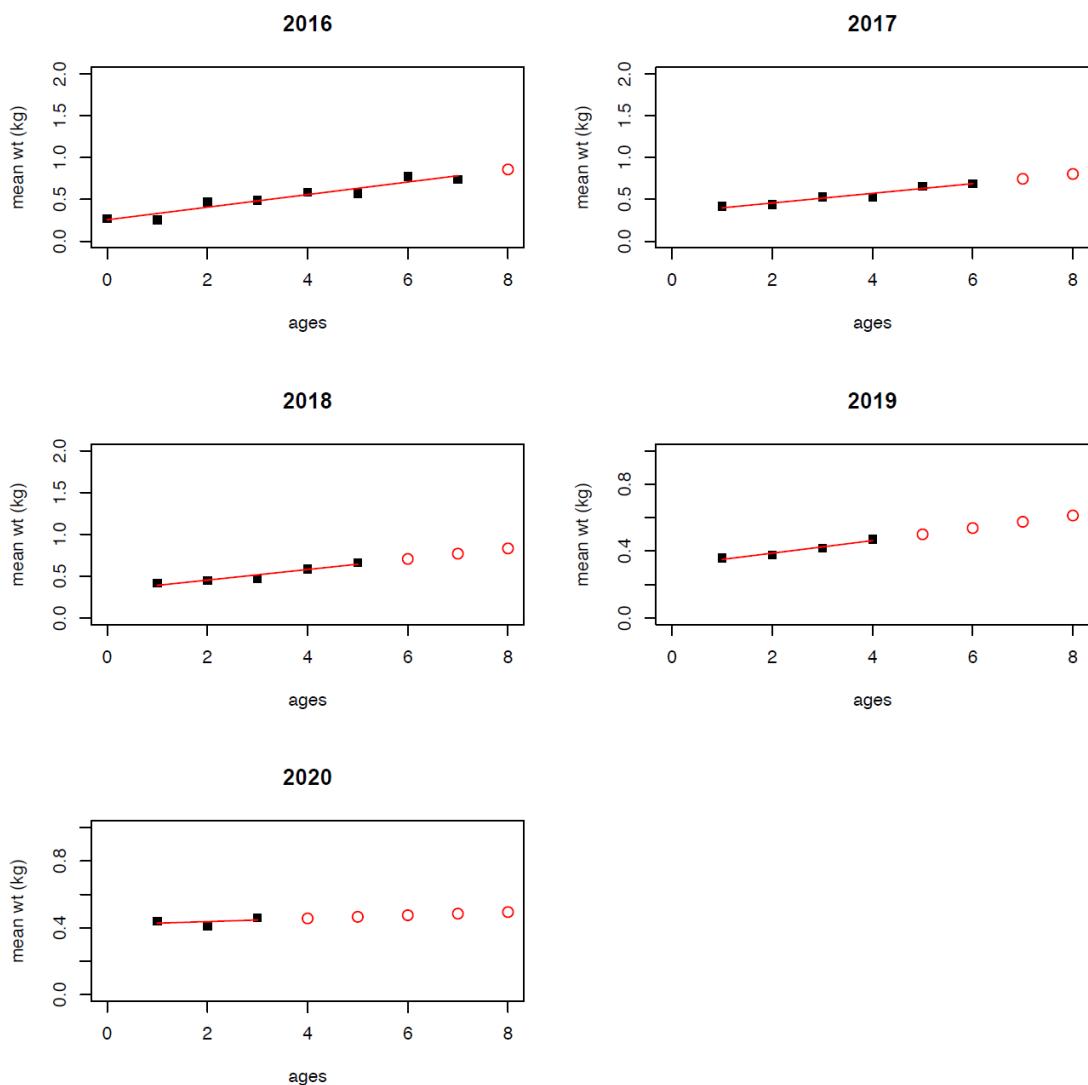


Figure 8.6.1. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Results of growth modelling for landings mean weights-at-age using cohort-based linear models (Jaworski, 2011). Cohorts 2016–2020 are shown here. Black points are available observations, red solid lines show linear fits to these points, and red points indicate projected weights for older ages.

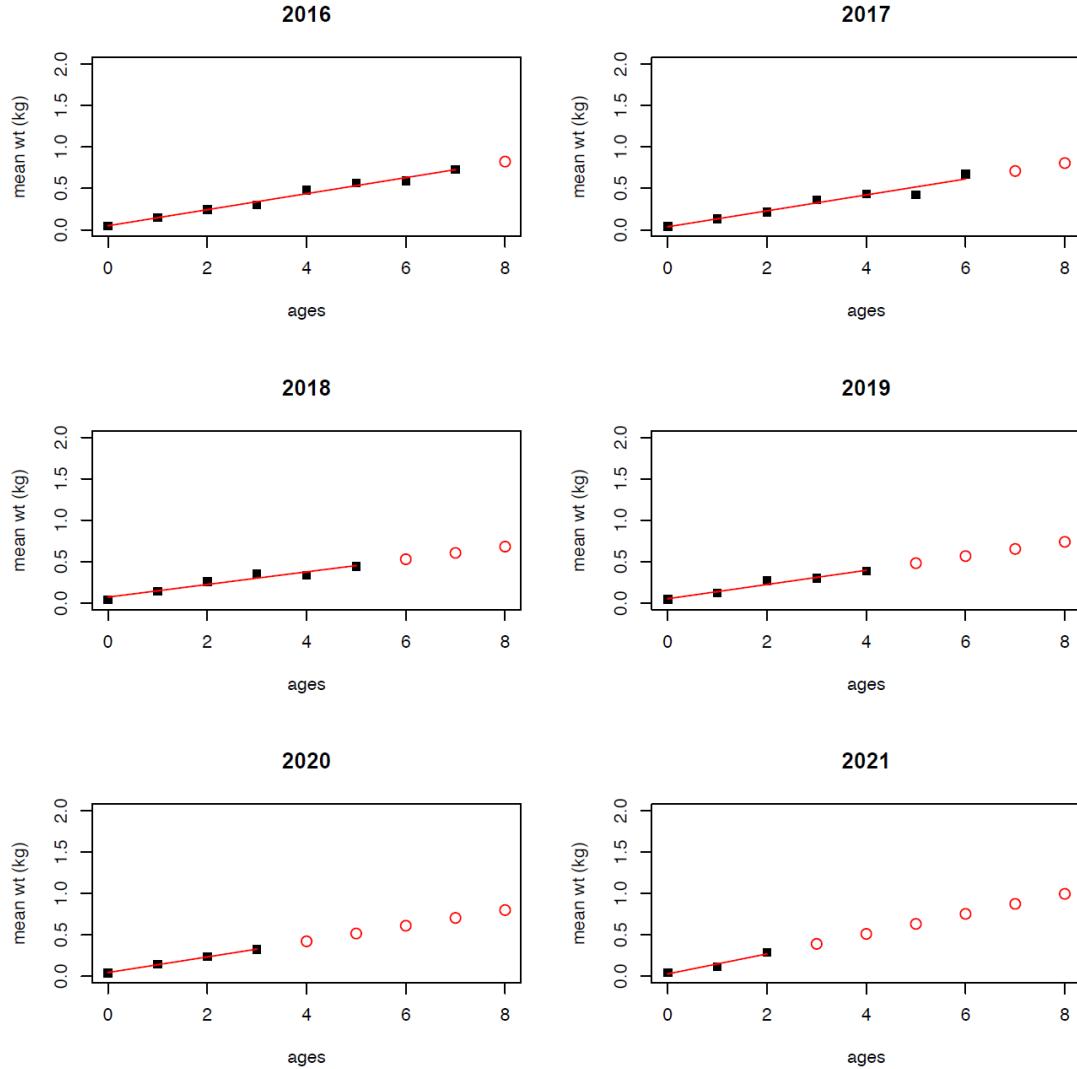


Figure 8.6.2. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Results of growth modelling for discards+IBC+BMS mean weights-at-age using cohort-based linear models (Jaworski, 2011). Cohorts 2016–2021 are shown here. Black points are available observations, red solid lines show linear fits to these points, and red points indicate projected weights for older ages.

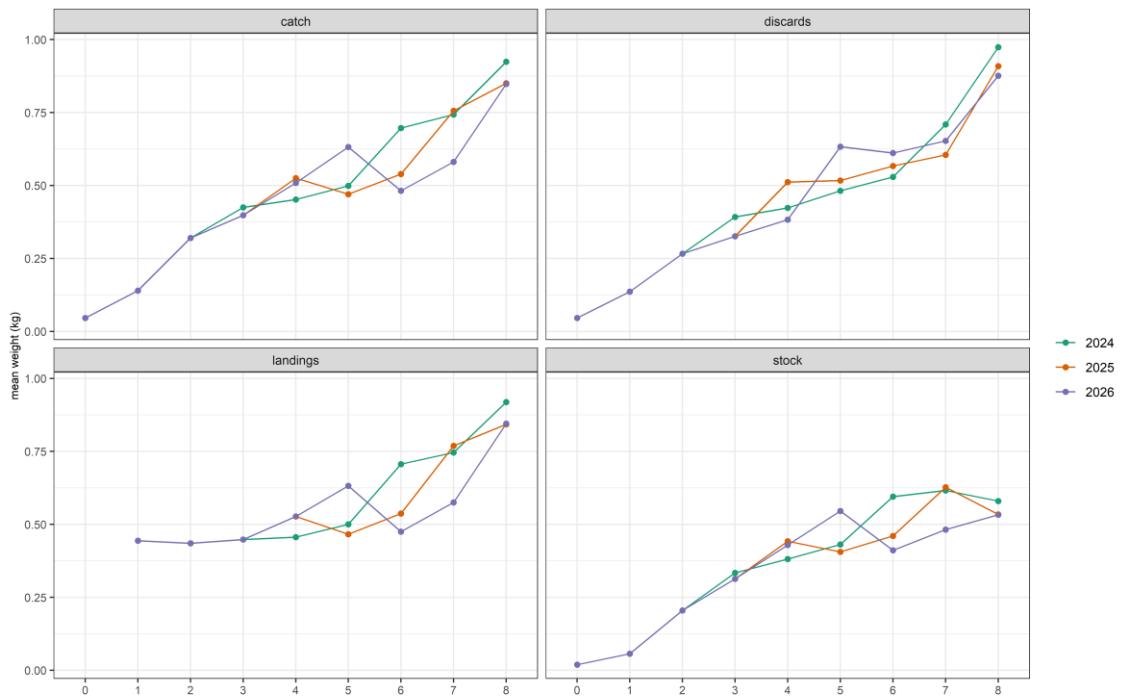


Figure 8.6.3. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Mean weights-at-age used in the forecast for total catch, landings, discards (including IBC and BMS) and the stock.

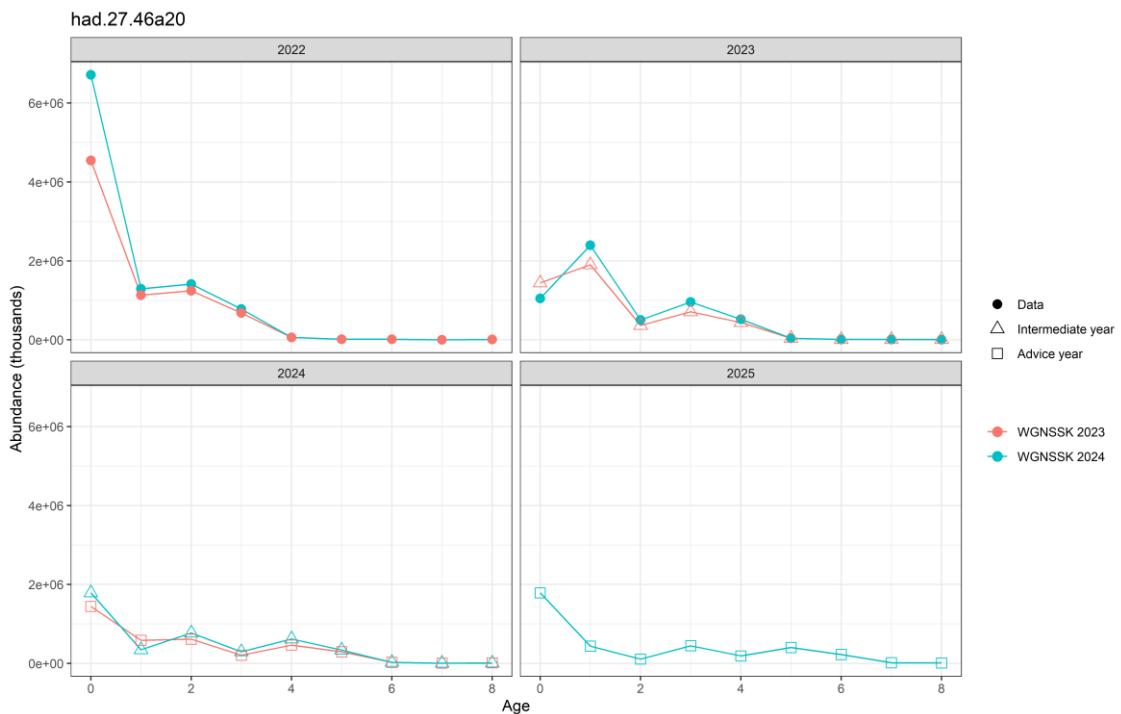


Figure 8.6.4. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Comparison of numbers at age from previous stock assessment and forecast results (WGNSSK 2023) and current stock assessment and forecast results (WGNSSK 2024).

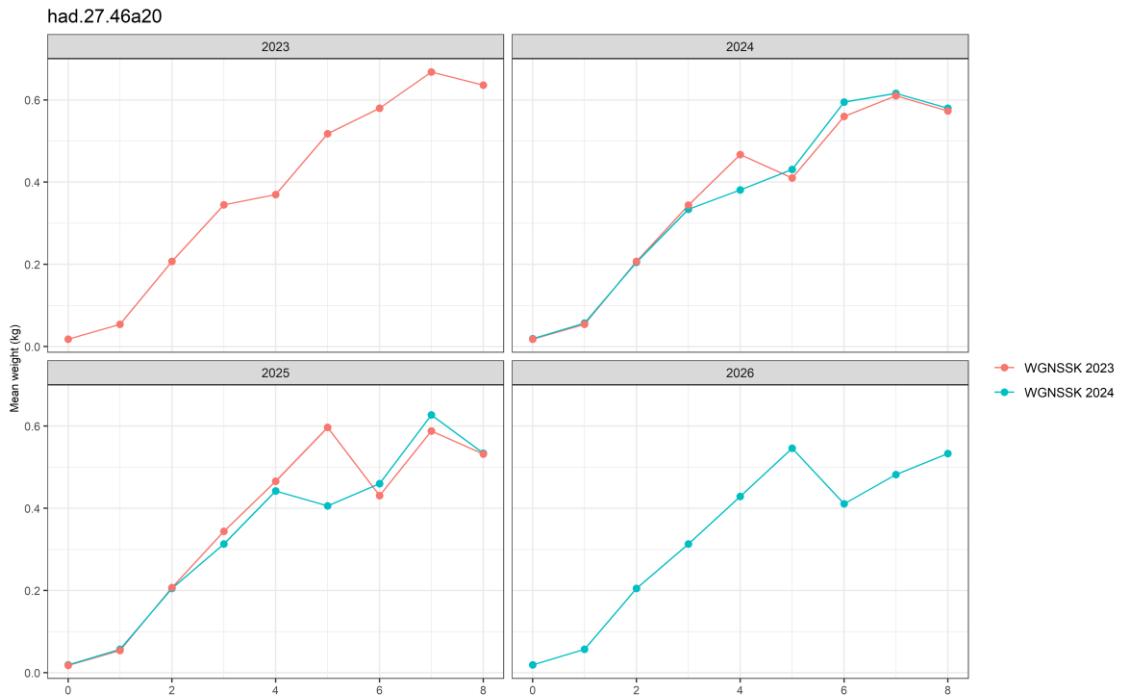


Figure 8.6.5. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Comparison of mean weights-at-age in the stock used in the previous forecast (WGNSSK 2023) and current forecast (WGNSSK 2024).

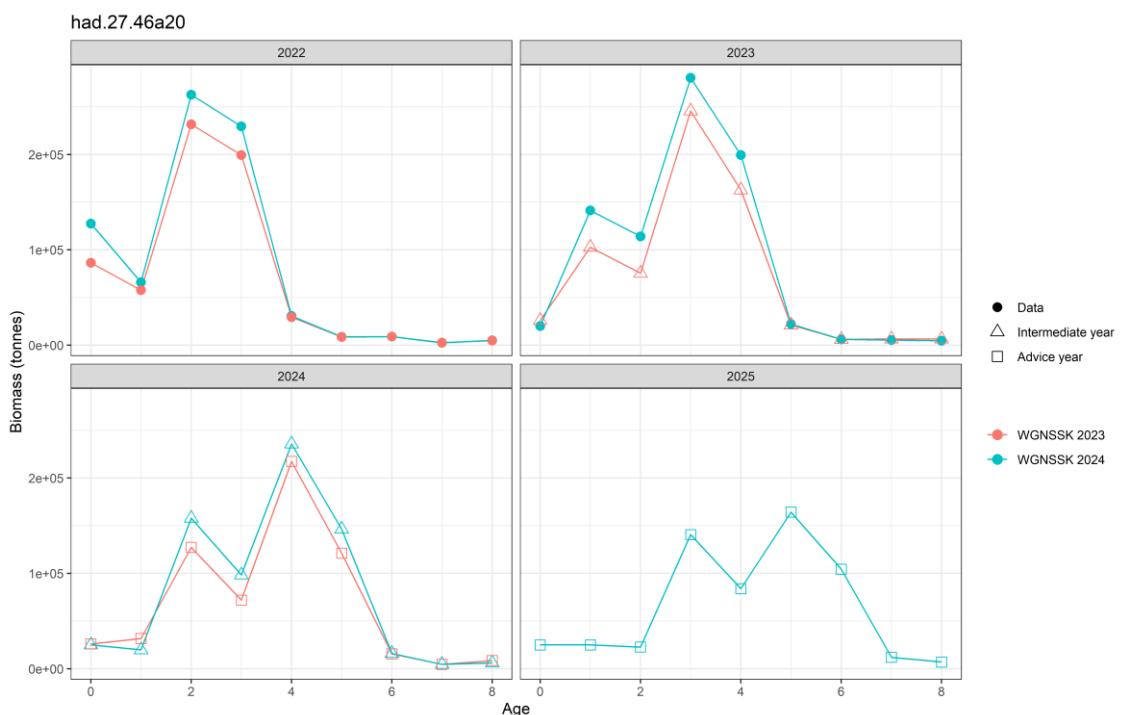


Figure 8.6.6. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Comparison of biomass at age from previous stock assessment and forecast results (WGNSSK 2023) and current stock assessment and forecast results (WGNSSK 2024).

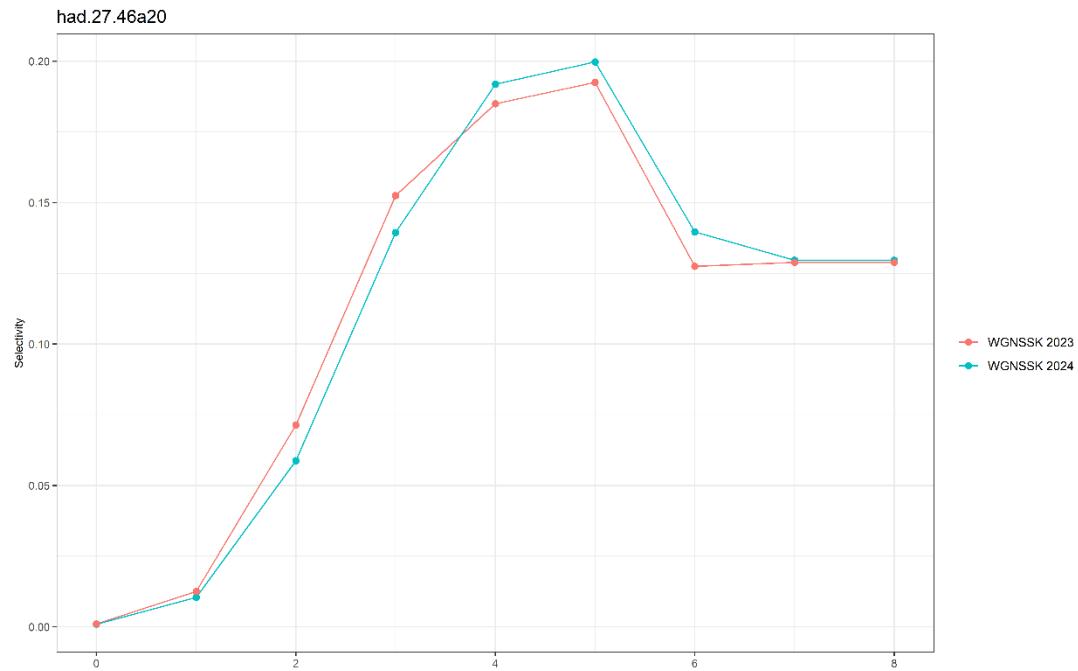


Figure 8.6.7. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Comparison of selectivity used in the previous forecast (WGNSSK 2023) and current forecast (WGNSSK 2024).

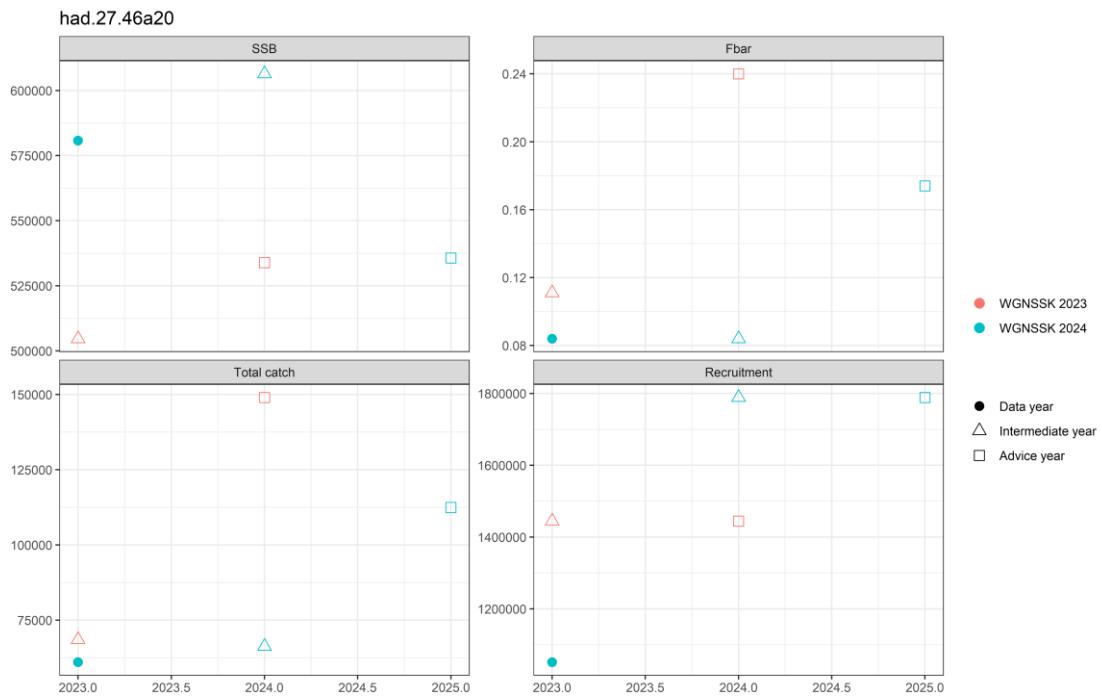


Figure 8.6.8. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Comparison of SSB, Fbar, total catch and recruitment assumptions used in the previous forecast (WGNSSK 2023) and current forecast (WGNSSK 2024).

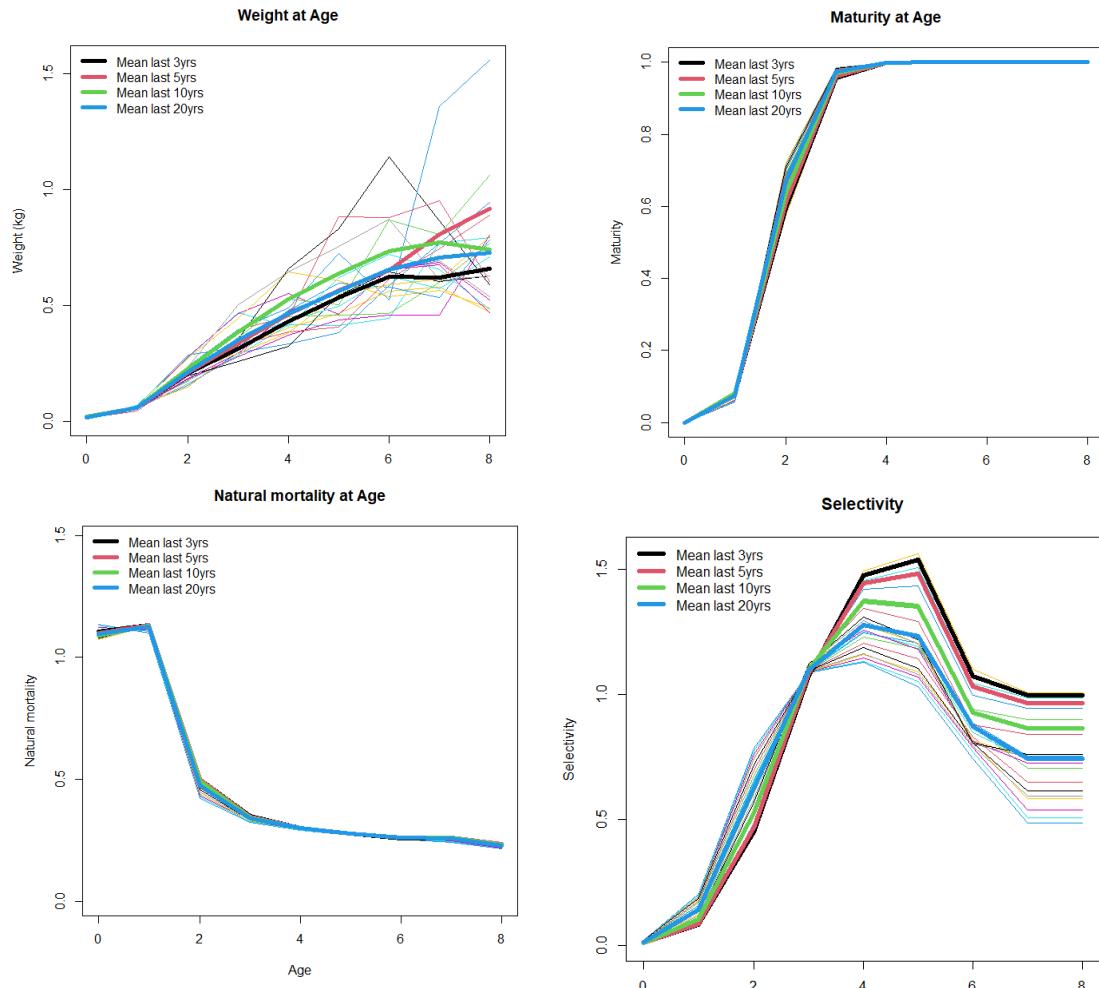


Figure 8.8.1. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Mean values of stock weights-at-age, maturity-at-age, natural mortality-at-age, and selectivity over the most recent 3, 5, 10 and 20 years.

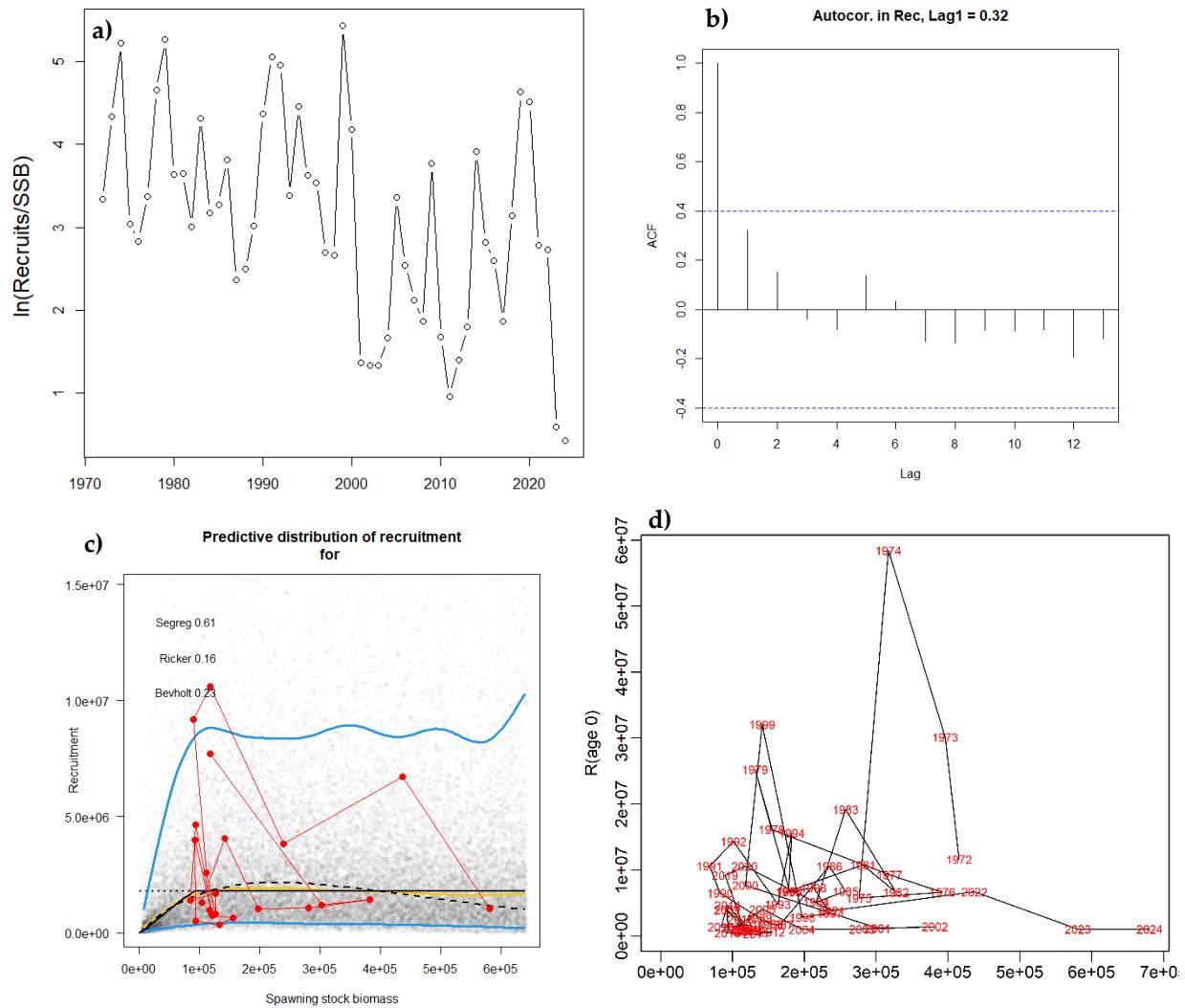


Figure 8.8.2. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Recruitment, stock-recruitment relationships and stock type: a) Recruits per SSB (log scale), b) estimation of autocorrelation in the recruitment time series, c) fitting different stock-recruitment relationships, d) stock-recruitment relationship for determining stock type.

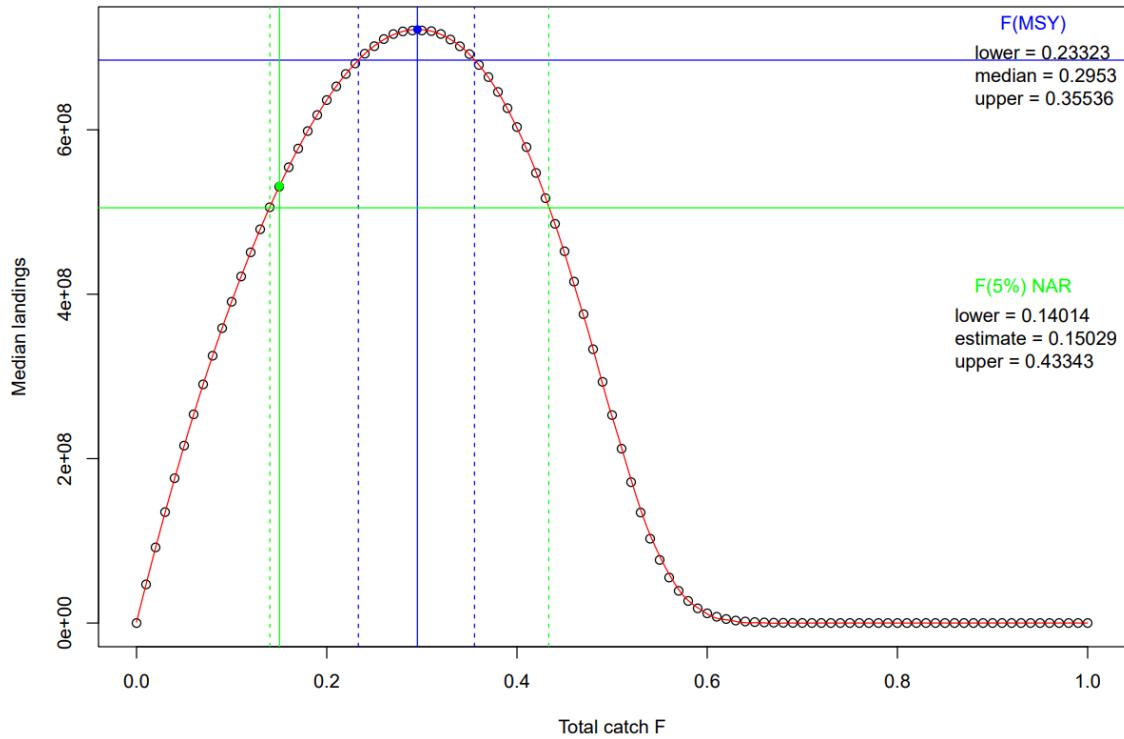


Figure 8.8.3. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Results of EqSim estimation of F_{MSY} and of $F_{p,05}$ with the assessment/advice error but no rule.

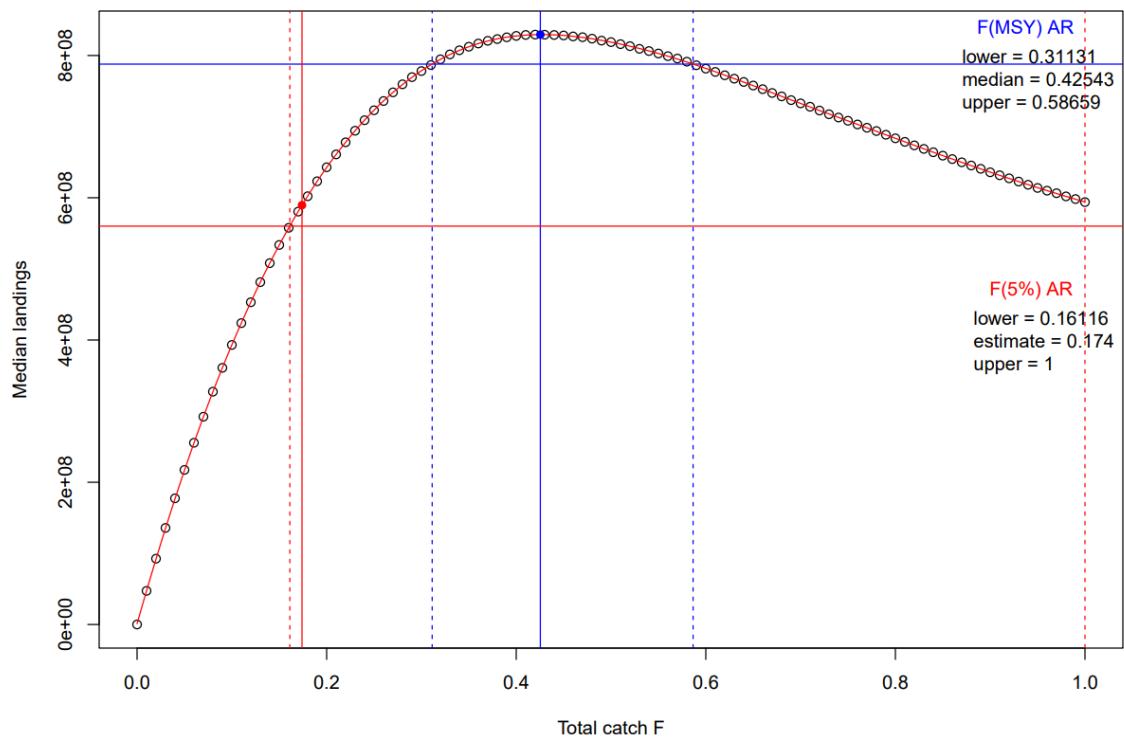


Figure 8.8.4. Haddock in Subarea 4, Division 6.a, and Subdivision 20. Results of EqSim estimation of F_{MSY} and of $F_{p,05}$ with both the assessment/advice error and rule.

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