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6 Haddock in Division 27.6.b (Rockall)

6.1 Introduction

An analytical assessment of this stock has not been carried out since 2021 due to the unavailability of the methods to update the previously utilised survey index. As a result, biennial advice was provided for this stock in 2022 on the basis of the 'rfb' category 3 data limited rule utilising a survey index and mean catch length indicator. This resulted in a 30% reduction in advice for 2023 and 2024 (4 078 tonnes) compared to advice for 2022.

In 2024, this stock has been benchmarked (WKBGAD; ICES, 2024) and a category 1 SAM assessment agreed. The assessment and advice this year follow the methods described in the Stock Annex. No estimates of Russian catches are available for 2023, but given that in recent years, these catches have been a very low proportion of the total (See Sections 6.2 and 6.3), this is considered to have minor impact on the assessment and advice.

6.2 General

Advice

ICES advice has been provided on the basis of the MSY approach since 2014. Last year's advice was for catches of no more than 4 078 tonnes in each of the years 2023 and 2024.

Stock description and management units

The haddock stock at Rockall is considered to be an entirely separate stock from that inhabiting the continental shelf of the British Isles. Since 2004, the EU TAC for haddock in 6.b has been included with divisions 12 and 14. For details of the earlier management units see the Stock Annex (Annex 2).

Management applicable to 2022 to 2024

The TAC is set for the UK, EU and international waters of 6b, and international waters of 12 and 14 but is applicable to EU/UK vessels only and there is no agreed shared TAC for other nations fishing in the NEAFC regualatory area. For 2022 to 2024, the breakdown of the TAC by country is given below. There was no change in TAC between 2023 and 2024, although there were minor changes to the allocation between countries with a greater proportion of the TAC allocated to the UK in 2024.

TAC 2022

Species:	Haddock *Melanogrammus aeglefinus*	Zone:	United Kingdom, Union and international waters of 6b; international waters of 12 and 14 (HAD/6B1214)
Belgium	12	Analytical TAC	
Germany	12	Article 8(2) of this Regulation applies	
France	542		
Ireland	385		
Union	951		
United Kingdom	4 874		
TAC	5 825		

TAC 2023

Species:	Haddock Melanogrammus aeglefinus	Zone:	United Kingdom, Union and international waters of 6b; international waters 12 and 14 (HAD/6B1214)
Belgium	8	Analytical TAC	
Germany	8	Article 7(2) of this Regulation applies	
France	368		
Ireland	264		
Union	648		
United Kingdom	3 430		
TAC	4 078		

TAC 2024

Species:	Haddock *Melanogrammus aeglefinus*	Zone:	United Kingdom, Union and international waters of 6b; international waters 12 and 14 (HAD/6B1214)
Belgium	8	Analytical TAC	
Germany	8	Article 7(2) of this Regulation applies	
France	355		
Ireland	255		
Union	626		
United Kingdom	3 452		
TAC	4 078		

The minimum conservation reference size of haddock taken by EU and UK vessels at Rockall is 30 cm and the stock is fully under the landing obligation. There is no minimum landing size for haddock taken by non-EU/UK vessels within international waters.

In order to protect the pre-recruit stock, the International Waters component of the statistical rectangle 42D5 has been closed for fishing since 2001 and its EU component since 2002 (see the Stock Annex, Annex 2). The protected area (the whole rectangle) is referred to as the Rockall Haddock Box. In 2022, in response to a request for advice from NEAFC on the efficiency of the closure to protect juvenile haddock, ICES concluded the following:

The Rockall Haddock Box does coincide with areas of high juvenile and adult haddock densities, with high densities also observed outside the box to the northeast. For most years since the closure, haddock densities

of age classes 1+ have been higher inside than outside the box. The overall impact of the current closure area on the Rockall haddock stock continues to be difficult to assess.

In order to protect cold-water corals, three further areas (North West Rockall, Logachev Mounds and West Rockall Mounds) were closed since January 2007 (see the Stock Annex, Annex 2). A new area to protect cold-water corals (Empress of Britain Banks) was established by the NEAFC in 2007 and 2012.

Since 2009 in the NEAFC regulatory area, including international waters of Rockall, a discard ban has been in place. The fishery for haddock within EU/UK waters is under the landing obligation (EU and national legislation).

There is no agreed management plan for haddock in this area. Two management strategies (NEAFC and EU MAP) have been assessed to be precautionary. NEAFC requested ICES to evaluate the harvest control rules (HCRs) that use F_{MSY} as a target. ICES concluded that the NEAFC HCRs in the long-term management strategy for Rockall haddock were consistent with the precautionary approach (ICES, 2019) although this analysis has not been revisited since the recent benchmark.

The multiannual management plan (MAP) which has been adopted by the EU for this stock (EU, 2019) has not been agreed with UK.

Fishery in 2023

Russian fishery

No information was provided on the Russian fishery at Rockall in 2023 and no official landings have been submitted by the Russian Federation since 2021. Landings of 162 tonnes were reported to NEAFC for 2022 (~3% of total estimated catch in that year). Recent fishing activity by Russian vessels at Rockall has been very limited and there is no evidence (either data or anecdotal) to suggest that has changed in 2023.

UK fishery

The UK has the largest demersal trawl fishery operating at Rockall. This consists of a relatively small number of larger Scottish demersal trawlers targeting haddock during periods of good weather. Other important target species included anglerfish (*Lophius* spp.), ling, saithe and megrim. Total reported Scottish haddock landings in 6b have declined by over 40% since 2019 (Table 6.2.1). UK quota uptake was almost 90% in 2023. In 2021 there was a significant increase in the proportion of UK landings taken in international waters (almost 30% in 2021 compared to an average of 15% over 2018–2020), although this has subsequently reduced and was ~16 % in 2023 (Table 6.2.2).

Irish fishery

Reported landings by Irish vessels have also shown a decreasing trend in recent years and in 2023 (314 t) were less than half their 2020 value (679 t) (Table 6.2.1). Irish vessels used single otter trawls with a mesh size ranging from 100 to 120 mm together with a square-mesh panel.

6.3 Data

Landings

Nominal landings as reported to ICES are given in Table 6.2.1 and shown in Figure 6.3.1. Revisions to official catch statistics for previous years are also shown in Table 6.2.1. Some data pre-

viously submitted are now no longer or only partially available due to national data confidentiality clauses (Ireland in 2018 and 2019). As has been the case for over ten years, the majority of the reported landings come from the UK (almost 90% in 2023) with smaller amounts reported by Ireland, the Faroe Islands, Norway and Spain.

Data for the NEAFC area only (Subdivision 6b.1) are also shown in Table 6.2.1, and in Table 6.2.2 by nation. Up to 2019, these are taken from the official landings statistics. For 2020 to 2023, the estimates are a mixture of official landings, landings from InterCatch (as landings for the UK are not available split by subdivision in recent years) and landings from NEAFC (for Russia in 2022). In some years, Russian landings are reported as being from 27.6b_NK (i.e. unknown subdivision), however it is assumed that all these landings have been taken in the NEAFC area (i.e. Subdivision 27.6.b.1). The proportion of the total landings coming from international waters is just under 20% in 2023.

Anecdotal evidence suggests that misreporting of haddock from Rockall has occurred historically (particularly on fishing trips where vessels fish in both divisions 6.a and 6.b), but a quantitative estimation of the degree of misreporting is not possible.

Landings data for 2023 submitted to InterCatch are shown in Figure 6.3.2. Note that Scottish landings are submitted by subdivision. Russian Federation landings were not submitted by the national data submitter for 2023, and official landings are also not available for 2022 or 2023 (although landings for 2022 have been reported to NEAFC and are included in ICES estimates) .

Due to the lack of Russian data, total landings (both official and ICES estimates) may be underestimated in 2023. However, given the recent low level of Russian landings this underestimate is considered likely to be minor.

International age composition and mean weight-at-age in the landings were compiled according to the methods described in the Stock Annex. Landings age compositions were allocated to unsampled fleets using a weighted average of all sampled fleets. The weighting algorithm used is 'Mean weight weighted by numbers-at-age or length'. (Note that in recent years, Scottish data have been submitted to InterCatch by subdivision which often results in an 'unsampled' métier/division combination – usually Subdivision 6b.1. Scottish samples are allocated (discard rates and age compositions) to this unsampled métier as they are assumed to be the same métier operating across 6b.2 and 6b.1 with similar fishery characteristics.

BMS landings

Minor amounts of below Minimum Size (BMS) landings are reported. These are included in the official landings statistics and are also uploaded to Intercatch for the UK. For other nations, these are accounted for in total discard estimates submitted to Intercatch. The assessment/forecast includes BMS landings within total discards as these landings are typically unsampled and are allocated an age compositions from sampled discards in InterCatch.

Discards

Haddock at Rockall are reported to have lower size-at-age than haddock from other areas (Blacker, 1971; Khlivnoy, 2006; Filina, Khlivnoy and Vinnichenko, 2009). Historically, the discard rate was high; between 12 and 75% by weight according to the results of discards trips (see the Stock Annex). The methods used to reconstruct the historical time-series of discards when sampling data were insufficient or unavailable are described in the Stock Annex.

Discard rate allocation to unsampled fleets for 2023 followed the procedure outlined in the Stock Annex and consisted of:

- Manually matching annual discards to available quarterly landings by country/fleet (where necessary);

- Using a weighted average discard rate for all unsampled fleets (weighted by CATON) with the exception of the Norwegian longline fleet and the Russian fleet for which discards are both assumed to be zero. In addition, unsampled Scottish OTB_DEF>=120 in Subdivision 6b.1 are allocated samples from the Scottish OTB_DEF>=120 in Subdivision 6b.2.

Discards age compositions were allocated to unsampled fleets in a similar manner to landings age compositions.

Figure 6.3.3 shows estimated landings and discards for 2023 after raising. Scottish landings data are submitted to InterCatch by subdivision with sampling available only for Subdivision 6.b.2 and hence there are raised discards associated with this component of the landings. The final mix of numbers-at-age from sampled and un-sampled landings and sampled and raised (un-sampled) discards is given in Figure 7.3.4. The unsampled landings and unsampled raised discards are both largely associated with the Scottish landings from Subdivision 6.b.1.

After raising, the catch distribution by fleet in 2023 is as follows:

Catch	Landings		Discards*	
	Otter trawl	Other	Otter trawl	Other
4492 tonnes	98%	2%	>99%	<1%
	3666 tonnes		826 tonnes	

***Including BMS landings.**

The WG estimates of total landings, discards and BMS landings by weight are given in Table 6.3.1 and shown in Figure 6.3.5. (Values are shown as the sum of products of numbers-at-age and weights-at-age as ICES estimates ('CATON' in Intercatch) are only available for 2012 onwards). In recent years, the total discard proportion by weight (Figure 6.3.6) has shown substantial variability but is typically below 20% (~ 17% in 2023). This is substantially lower than the estimated discard proportion at the start of the time-series when the Scottish fleet was generally utilising a smaller mesh size.

Due to the distant nature of the fishery and the fact that there are relatively few vessels/trips making landings, sampling levels for both landings and discards for this stock are relatively poor. Sampling levels did not significantly worsen during the COVID-19 pandemic and the WG considers that sampling levels are adequate for the estimation of catch-at-age data.

Age- compositions and mean weights-at-age

Raised landings, discards and bms numbers-at-age are given in Tables 6.3.2 – 6.3.4 and and total catch numbers-at-age in Table 6.3.5.

Discard proportions by age are shown in Figure 6.3.7 (landings fractions by age, required for input to the stock assessment are given in Table 6.3.6). There has been a marked change in discarding practices over time. At the start of the time series, a high proportion of older fish were discarded, but in the last ten years, discards are generally limited to age one and two fish. A short time series of the catch-at-age compositions by catch category is shown in Figure 6.3.8.

Annual mean weights-at-age in landings, discards and catch are given in Tables 6.3.7, 6.3.8 and 6.3.9 and shown in Figure 6.3.9 and 6.3.10. Mean weights-at-age in the landings (and catch) were relatively stable historically, but show a significant increase since the mid-2000s, particularly at ages 4 and above, as well as showing increased variability. While the variability may be due to low sampling levels, the reason for the trend is not known, but could potentially be due to cohort

dependent growth rates although this has not been fully explored. At older ages in particular, mean weights have begun to decline in more recent years and are levelling off in ages two to four but remain at a higher level than historical values.

Biological

Natural mortality is updated on an annual basis (i.e. between assessment WGs) although is time invariant within the assessment model. Estimates are based on mean weight-at-age (in the catch) and derived on the basis of the Lorenzen (1996) equation:

$$M_a = 3\bar{W}_a^{-0.29}$$

where M_a is the natural mortality at age a and $\bar{W}_a$ is the mean weight-at-age a. Values are then averaged over years (to account for sampling variability) and scaled such that M at the oldest age is equal to 0.2. The resulting values, applied in this year's assessment, are as follows:

Age	1	2	3	4	5	6	7	8+
Natural mortality	0.3539	0.2994	0.2759	0.2580	0.2398	0.2281	0.2120	0.2

Maturity-at-age is based on quarter 3 survey data and is time invariant as follows:

Age	1	2	3	4	5	6	7	8+
Maturity	0.24	0.84	0.99	1.0	1.0	1.0	1.0	1.0

Stock weights-at-age are based on catch weights-at-age (Figure 6.3.10). These weights-at-age are included into the SAM assessment as observations and the 'biopar' feature allows a process model to be fitted with cohort and within year correlations.

Surveys

A Scottish quarter 3 survey at Rockall began in the late 1980s. The current survey is co-ordinated by IBTS and described further in the IBTS reports, the Stock Annex and the 2024 benchmark report (ICES, 2024). The survey has undergone a number of changes in gear and design over the stock assessment period and therefore the index is split into two parts:

- 'Rockall pt1' which is a design based index running from 1991-1997 (unchanged since the 2024 benchmark, Table 6.3.10).
- 'Modelled Q3' which runs from 1999 onwards and is based on a GAM with time varying spatial component

The 'Modelled Q3' index was updated according to the approach agreed at the 2024 benchmark (ICES, 2024) and documented in the Stock Annex. The final model makes use of a Tweedie distribution with log link function, and includes a high resolution smoothly varying spatial effect over time (lat x lon x time); 'depth' and 'timeofYear' as continuous variables; and 'year' as a discrete effect. The resulting survey index is given in Table 6.3.11 (along with CVs which are also used in the assessment. The updated modelled indices show only minor historical revisions when compared to the indices derived at the benchmark (Figure 6.3.11).

6.4 Stock Assessment

This assessment is an age-based analytical assessment utilising SAM (Neilsen and Berg, 2014) as outlined in the stock annex. Exploratory analyses of the input catch and survey data are also carried out.

Exploratory data analysis

Log catch (landings + discards + bms) numbers-at-age over time (Figure 6.4.1) show some tracking of strong and weak cohorts historically. These signals become less apparent and more noisy after 2010, likely due to low sampling levels during a period when the stock was at an extremely low level (2009 to 2013). Catch curves from commercial catch-at-age data are also shown in Figure 6.4.1. Although the data are noisy (particularly latterly), there is some evidence of a flattening off of the catch curves in recent years compared to those of the cohorts spawned at the start of the time series, potentially indicating a decrease in mortality.

Figure 6.4.2 shows the mean standardised catch-at-age by proportion (in number). The figure highlights the strong cohorts and also shows that the very weak recruitments between 2007 and 2011 are consistently seen as well below average in the catch data across their life time. The data appear more noisy in recent years such that the strong cohort recruiting in 2017 does not appear as 'above average' in the catch data until age 2.

Figures 6.4.3 and 6.4.4 show the log mean standardised indices by cohort and log catch curves from the two survey series. The 'Rockall pt1' shows reasonable tracking of year class strength, particularly across ages two to five. The current 'Modelled Q3' survey index shows good internal consistency with relative cohort strength identified consistently across most age classes. In particular, the very high index value at age one in 2022 (~ four times the next highest value) is estimated to be similarly strong at age two the following year (Figure 6.4.4). The survey scatterplots also indicate good correlation between ages (including non-adjacent ages and older ages) (Figure 7.4.5).

Final assessment

The SAM configuration file for the final assessment model run is given in Table 6.4.1. The main features can be summarised as follows:

- Fishing mortality at ages 6 and above are assumed equal (coupled).
- Survey catchabilities are coupled at ages 4 and above with density dependent catchability estimated for the second modelled survey (2 parameters: uncoupled for age 1, coupled age 2 and above).
- Catch observation variance parameters are fixed across ages, but additional uncertainty is estimated for 2011 onwards (consistent with the general change in data processing and apparent increased uncertainty).
- Survey observation variance parameters differ between surveys but are coupled for all age groups within a survey (the second, modelled survey accounts for differences in uncertainty over ages/years by using the externally estimated CVs as relative weighting).
- Recruitment is modelled as a random walk
- Fishing mortality at age is modelled with AR(1) and process variance parameters are coupled across all ages. Process variance in stock numbers-at-age were assumed coupled with the exception of age 1 (the age at recruitment).

The fits of the assessment model to observations (catch and survey indices on a log scale, and weights-at-age) are shown in Figures 6.4.6 to 6.4.8. As expected the fit to the catch data appears better early in the time series and worsens from around 2011 onwards, particularly at older ages. The model appears to follow the survey data well across all ages (particularly for the 'Modelled Q3' indices), although does not quite reach the very low values observed around 2013-2016 at younger ages. The 'biopar' estimates of stock weights-at-age (based on modelling catch weights-at-age) are substantially less variable than the input data – some of the remaining variability (estimated by the model) is explained by year effects and cohort effects.

Standardised one-step ahead residuals and process residuals are shown in Figures 6.4.9 and 6.4.10 respectively. There is a tendency for negative residuals across many age classes in the 'Modelled Q3' index during the period 2018-2021, however this does not appear to have persisted since then. There is also some indication of a block of negative process errors at older ages in the numbers-at-age process. It is not clear what is causing this feature and model settings were explored extensively at the benchmark without resolution. These residual patterns were considered minor issues (largely lying within ±2) and the assessment deemed to be of acceptable quality.

Results of the retrospective analysis are shown in Figure 6.4.11 and indicate that the assessment is robust to the addition of additional years of data. All five peels lie within the confidence bounds of the final assessment, with the main revision in SSB and F related to the peel ending in 2019 when the SSB is at a local maximum (gets revised downwards in subsequent assessments) and the F in that year gets revised upwards. Unusually, recruitment is also well estimated with a Mohn's rho of just over 7%.

Mohn's rho values:

SSB	Mean F (2-5)	Recruitment (age 1)
5.25	-7.17	7.09

The impact of allowing the model to estimate greater observation uncertainty for the catch-at-age observations post-2011 is also apparent in Figure 6.4.11. Confidence intervals on both Fbar and total catch become greater and the model estimates of total catch are less consistent with the observations in this period (underestimate in 2019 and overestimate in 2023).

Final parameter estimates from the SAM assessment are given in Table 6.4.2. Estimates of survey catchability and fishery selectivity are shown in Figures 6.4.12 and 6.4.13. The 'Rockall pt1' survey appears to have higher catchability at lower ages which is in contrast to the 'Modelled Q3' index. This may be more associated with the spatial/depth coverage of the survey series rather than associated with survey gear retention – the earlier survey ('Rockall pt1') is largely confined to the shallower waters of the Rockall bank and therefore the older/larger fish may be less available to the survey if they inhabit the deeper waters of the plateau. The change in estimated fishery selectivity over time (Figure 6.4.13) was explored at the benchmark (ICES, 2024). The gradual change from increasing/flat-topped to dome-shaped coincides with the introduction of the Rockall haddock box closed area (for the protection of juvenile haddock). Analysis of survey data indicates that an increasing proportion of older ages is found within the area closed to fishing than previously and hence is not available to the fishery. The change in selectivity therefore appears to be related to change in availability of the different age classes of the stock to the fishery rather than changes associated with gear selectivity. Table 6.4.3 gives the SAM population numbers-at-age and Table 6.4.4 the estimated F at-age. A full summary output is given in Table 6.4.5.

Stock status

The stock summary plot including reference points (and intermediate year estimates) is shown in Figure 6.4.14. The stock recovered following a period of very low recruitment during 2008 to 2012. The extremely high recruitment in 2022 (almost three times the next highest value) has resulted in a very large increase in SSB such that SSB in 2023 is estimated to be well above reference points and at a historic high (and continues to be so in the intermediate year).

Fishing mortality shows substantial inter-annual variation (particularly historically), but has a general declining trend over the assessment time series. With the exception of 2020 and 2021, estimated F_{bar} has below F_{MSY} since 2011.

6.5 Short-term stock projections

6.5.1 Forecast

Forecasting in SAM takes the form of short-term stochastic projections. Samples are generated from the estimated distribution of survivors (from the assessment). These replicates are then simulated forward according to model and forecast assumptions (see below), using the usual exponential decay equations, but also incorporating the stochastic survival process (using the estimated survival standard deviation) and subject to different catch-options scenarios.

Recruitment in the forecast has been resampled from the full time series of assessment assessments given there appears to be no clear change in productivity over that time (Table 6.5.1). The 0-group survey index generally shows reasonable correlation with assessment estimates of recruitment the following year. However, it was not clear how this information could be incorporated into the SAM forecast and therefore the same recruitment assumption was used for both intermediate and forecast years. Furthermore, the impact of this assumption has extremely limited impact on the forecast results this year, with estimates dominated by the very large 2021 year class. Further consideration to this issue in future.

Ten year average values were taken for the catch mean weights and discard proportions in the forecast. This is to account for the sampling variability (Figure 6.3.7 & Figure 6.3.9) resulting from low levels of catch sampling at Rockall. Stock weights at age are forecast using the GMRF process model from the SAM assessment.

Fishing mortality in the interim year was assumed to be constrained by the TAC. Assuming status quo F (F_{2024}=F_{2023}=0.124) resulted in predicted catches in the intermediate year of almost 15,000 tonnes (TAC_{2024}=4078 tonnes). This was deemed a highly unlikely scenario given that: i) the fishery is a distant targeted haddock fishery and vessels are unlikely to go there without sufficient quota for haddock, particularly when there is a buoyant haddock stock and fishery much closer to home (Northern Shelf haddock), and ii) a relatively low UK TAC uptake was apparent at the time of the assessment WG (35%). A summary of the forecast assumptions is given in Table 7.5.1.

Under the forecast assumption of an intermediate year TAC constraint, landings in 2024 are predicted to be 3937 tonnes and discards 141 tonnes. SSB at the start of 2025 is estimated as 117972 tonnes and remains well above MSY Btrigger. Projected discards in the intermediate year and forecast represent only a very low proportion of total catch (<5%) compared to recent data. This is due to the application of age-based discard proportions which indicate very low discard rates at ages 3 and above. In 2024 and 2025 the majority of the catch is age 3 or 4 (2022 recruitment) and therefore total discards are projected to be low.

The forecast under different catch scenarios for 2025 is shown in Table 6.5.2. Almost all scenarios result in a reduction in SSB in 2026 as the very strong year class passes through the stock (with weaker cohorts following). However, all reasonable scenarios (i.e. F<1.0) results in zero probably of SSB falling below Blim in 2026. The forecast stock trajectory under the proposed advice (MSY approach) for 2025 is shown in Figure 6.5.1 and results in a 14.6% decline in SSB in 2026 (compared to 2025). Both the predicted catch in 2025 and SSB in 2026 are dominated by the year class which recruited in 2022 (Figure 6.5.2). This year class contributes 82% to the catch in 2025 and over 50% to the SSB in 2026.

The catch advice for 2025 is 31 565 tonnes under the MSY approach. The change in advice is 674% (compared to advice given in 2022 for 2023 and 2024) and is due to the increase in stock size following the very high recruitment in 2022 and the change in assessment method/advice basis following the benchmark.

6.5.2 Reference points

Both MSY and precautionary reference points were re-estimated at WKBGAD (ICES, 2024) and are given below.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	12 877	5th percentile of equilibrium SSB when fishing at F_{MSY}; in tonnes	ICES (2024a)
	F_{MSY}	0.28	Stochastic simulations (EqSim) with segmented regression stock recruitment relationship.	ICES (2024a)
Precautionary approach	B_{lim}	8 542	Lowest SSB which results in high recruitment (> 75th percentile) (SSB in 2001); in tonnes	ICES (2024a)
	B_{pa}	11 870	$B_{pa} = B_{lim} \times e^{1.645\sigma}$ where σ=0.2; in tonnes	ICES (2024a)
	F_{lim}	1.10	F giving 50% probability of SSB < B_{lim} in stochastic simulation (EqSim) using segmented regression recruitment with breakpoint = B_{lim}	ICES (2024a)
	F_{pa}	0.42	F_{P05}; the F that leads to SSB ≥ B_{lim} with 95% probability	ICES (2024a)
EU Management plan	MAP MSY $B_{trigger}$	12 877	5th percentile of equilibrium SSB when fishing at F_{MSY}; in tonnes	EU(2019) & ICES(2024a)
	MAP B_{lim}	8 542	Lowest SSB which results in high recruitment (> 75th percentile) (SSB in 2001); in tonnes	EU(2019) & ICES(2024a)
	MAP F_{MSY}	0.28	F_{MSY}	EU(2019) & ICES(2024a)
	MAP range $F_{MSY\ lower}$	0.184	Consistent with ranges resulting in no more than 5% reduction in long-term yield compared with MSY	EU(2019) & ICES(2024a)
	MAP range $F_{MSY\ upper}$	0.41	Consistent with ranges resulting in no more than 5% reduction in long-term yield compared with MSY	EU(2019) & ICES(2024a)

6.6 Management plans

Haddock at Rockall are included in the EU multiannual management plan (MAP) (EU, 2019). However this is not agreed with the UK or other parties involved in the fishery for this stock and therefore the advice is provided according to the ICES MSY approach.

On a number of occasions previously, ICES has evaluated the harvest control rule components of NEAFC management plan proposals. Further details can be found in ICES (2013) and ICES (2019).

6.7 Quality of the assessment

Figure 6.7.1 shows a comparison between this year's and previous years' assessments. Given the recent benchmark and revisions to reference points, only the assessment results from this year's WG should be compared to the reference points indicated. The results from the latest assessment are relatively consistent with previous analytical assessments (carried out in 2020 and 2021). Differences in estimated recruitment and SSB are likely to be largely due to changes in natural mortality and maturity made at WKBGAD (ICES, 2024). The estimated Fbar from the most recent assessment is much less noisy than that from previous assessments. This is considered likely due to the change in assessment method from XSA, which assumes catch-at-age data to be exact, to SAM, which allows for uncertainty in the catch-at-age observations. Variability in catch-at-age data (due to poor sampling levels) is therefore less likely to be interpreted as a change in fishing mortality by SAM. The retrospective analysis also shows that the new SAM assessment is robust to the addition of extra years of data.

Sampling

While the main fleets in the fishery (UK-Scotland & Ireland) are sampled for both landings and discards, the number of sampling trips is low – typically less than 10 landings sampled per year and less than five discard samples. This is due to the low number of vessels conducting few, but longer, fishing trips to this area. This results in uncertainty in stock assessment input data (catch numbers- and weights-at-age, and discard proportions) and subsequent estimates of fishing mortality. A new industry co-sampling scheme has begun in UK and it is envisaged that this will improve the quality of the catch data in future years.

Surveys

There have been a number of changes to survey design over time. Taking a statistical modelling approach to deriving survey indices can account for some of these changes, and the resulting 'Modelled Q3' indices show high precision and good internal consistency.

6.8 Recommendation for next benchmark

Haddock in Division 6.b. was benchmarked in 2024 (WKBGAD, ICES, 2024). The remaining issues are given below:

Type	Problem/Aim	Work Required	Data Required
Biological parameters	Natural mortality. Currently scaled time invariant Lorenzen. Much lower than other haddock stocks (and most other demersal stocks in general). Given the highly variable stock size and potential for density dependent effects in growth, it seems likely M may also vary over time, and assuming it to be constant may account for some of the residual patterns in the final model.	Explore alternative approaches for deriving natural mortality values – utilising alternative scaling of the Lorenzen estimates, other life-history based approaches or re-evaluating values from N Sea SMS model. Variable M (from Lorenzen) could also be modelled in SAM ('biopar').	Life history parameters.
Assessment method	A number of minor patterns are still apparent in the one-step ahead and process residuals. Further exploration of model configuration settings may improve this.	SAM model configuration exploration	Assessment input data
Input data - discards	The processing of historical catch data (pre-2011) was not revisited at the 2024 benchmark. While most of the historical raw data are unavailable, it may be possible to rework data from around 2005 to place this on a more transparent footing.	Data processing in Intercatch (or using RDBES)	Catch sampling data
Assessment method	Further exploration of the appropriateness of the Fbar age range. The proportion of the catch within the range varies quite considerably over time due to the highly variable recruitment.	Explore the utility of an increased age range or weighted average F over all ages.	Assessment results.
Forecast assumptions	Intermediate year recruitment currently resampled from full time series. Consider how best to make use of information from 0-group survey index not currently included in the assessment.	Consider whether a bespoke SAM forecast function can be utilised to allow separate recruitment assumptions between intermediate & forecast years. Issue could also potentially be addressed by including 0-group index as a forward shifted recruitment (at age 1) index in the assessment (although initial exploration at WKBGAD resulted in substantial retro patterns).	Assessment output

6.9 Management considerations

In 2022 advice for this stock was given following ICES MSY approach for data-limited stocks using the empirical rfb rule (Fischer *et al.*, 2021). Following the benchmark, the basis for advice is the MSY approach based on a Category 1 stock assessment.

The year class recruiting in 2022 makes up the majority of the catch in the interim year and forecast (82% in 2025). It is not known how future discarding practices will be affected by this very large year class and therefore there is uncertainty in the projected discards and landings split.

Due to the very high recruitment in 2022 and low fishing mortality, the stock size is at an historic high. This could potentially result in slower individual growth due to density dependent effects which is not accounted for in the calculation of advised catch. A reduction in growth rate of the strong cohort could result in lower advised catch and a higher proportion of discards.

The TAC for haddock in Division 6.b only applies to catches from EU and UK fleets. Part of Division 6.b is in international waters (NEAFC regulatory area) where non-EU/UK vessels are

not subject to TAC. This allows for unregulated catches in the Rockall area although in recent years the catches from non-EU/UK fleets have been very low.

6.10 References

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6.11 Tables and Figures

Table 6.2.1. Haddock in Division 6.b. Nominal landings (tonnes) as officially reported to ICES.

Year	Faroe Islands	France	Iceland	Ireland	Norway	Portugal	Russian Federation	Spain	UK (E,W, & NI)	UK (Scot.)	UK (total)	Total^^	Landings from NEAFC area**	ICES landings#
1996	-	-	-	747	24	-	-	1	293	5753		6818		7075
1997	-	-	<0.5	895	24	-	-	22	165	4114		5220		5166
1998	-	-	-	704	40	4	-	21	561	3768		5098		4984
1999	-	-	167	1021	61	-	458	25	288	3970		5990		5358
2000	-	5	-	824	152	-	2154	47	36	2470		5688		5445^
2001	-	2	-	357	70	-	630	51	-	1205		2315		2020^
2002	-	-	-	206	49	-	1630	7	<0.5	1145		3037		3116^
2003	-	-	-	169	60	-	4237	19	56	1607		6148		5967^
2004	-	-	-	19	32	-	5844	-	-	411		6306		6437
2005	-	-	-	105	33	-	4708	-	-	332		5178		5238
2006	2	<0.5	-	41	123	-	2154	5	1	439		2765		2756
2007	2	-	-	338	84	-	1282	+	8	1635		3349		3348
2008	16	-	-	721	36	-	1669	1	-	1779		4222		4221

Year	Faroe Islands	France	Iceland	Ireland	Norway	Portugal	Russian Federation	Spain	UK (E,W, & NI)	UK (Scot.)	UK (total)	Total^^	Landings from NEAFC area**	ICES landings#
2009	10	1	-	352	71	-	55	+	-	2951		3440		3242
2010	42	-	-	169	65	-	198	+	-	2931		3405		3404
2011	2	<0.5	-	123	40	-	-	-	-	1732		1897	376	1861
2012	53	-	-	31	48	-	1	-	-	577		710	33	702
2013	-	-	-	105	121	-	4	-	-	596		826	147	824
2014	24	2	-	94	55	-	388	-	-	1152		1713	423	1690
2015	1	-	-	190	66	-	136	-			2052	2445	241	2442
2016	<0.5	-	-	362	63	-	-	-			2160	2585	565	2504
2017	<0.5	-	-	500	26	-	153	-			3907	4586	715	4431
2018	-	-	-	431##	16	-	-	-			3418	3865##	782##	3850
2019	-	8	-	4##	13	-	245	1			6536	6807##	809	7782
2020	-	-	-	679	14	-	133	<0.5			4575	5401	745	5510
2021	<0.5	<0.5	-	510	-	-	20	-			3558	4089	1183	4094
2022*	25	-	-	403	-	-	-				3565	3993	1200	4251
2023*	13	-	-	314	71	-	-	1			3494	3894	652	3666

*** Preliminary official landings.**

****Official landings except 2020 - 2023 which include ICES estimates.**

^ Includes the total Russian catch.

^^ Including below minimum size (BMS) landings where available

 # Historical values updated in 2024.

##Incomplete: part of the data being unavailable under data confidentiality clauses. n/a = Not available.

Table 6.2.2. Haddock in Division 6.b. Landings from the NEAFC area (Subdivision 27.6b.1). (Mixture of official landings and ICES estimates – see Section 7.3 for explanation).

Year	Faroe Islands	France	Ireland	Norway	Russian Federation	Spain	UK (total)	Total
2012		0	2.2	4.96	1	0	24.6	32.8
2013		0	4.5	31.4	4	0	107.2	147.1
2014		0	5.85	28.9	388	0	0	422.7
2015		0	6.4	38.6	136	0	59.9	240.9
2016		0	5.2	47.9	-	0	511.8	564.9
2017		0	19.9	7.3	153	0	535.1	715.3
2018		0	**	9.9	-	0	772.6	782.5**
2019		1.4	3.8	7.3	245	0.51	550.4	808.5
2020		0	15.3	11.6	133	0	584.6	744.6
2021	0.2	0.012	140.9		20	0	1021.6	1182.7
2022*	24.709	0	63.2235		162		949.62	1199.6
2023*	12.412		31.7944	59.54		0.0397	547.769	651.6

***Preliminary**

****Incomplete: part of the data being unavailable under data confidentiality clauses.**

Table 6.3.1. Haddock in Division 6.b. ICES estimates of landings, discards and bms calculated as sum of products of numbers and weights (in tonnes).

Year	Landings	Discards	BMS
1991	5655	13228	
1992	5320	11873	
1993	4784	9856	
1994	5733	11027	
1995	5587	9170	
1996	7075	9356	
1997	5166	5893	
1998	4984	10863	
1999	5358	11065	
2000	5445	6611	
2001	2020	1536	
2002	3116	4153	
2003	5967	5521	
2004	6437	883	
2005	5238	505	
2006	2756	386	
2007	3348	2242	
2008	4221	2104	
2009	3242	1556	
2010	3404	907	
2011	1861	152	
2012	702	25	
2013	824	1065	
2014	1690	270	
2015	2442	554	
2016	2504	401	0.4
2017	4431	379	-
2018	3850	788	-

Year	Landings	Discards	BMS
2019	7782	303	4.0
2020	5510	130	1.9
2021	4094	1117	0.7
2022	4251	1095	1.0
2023	3666	764	62.4

Table 6.3.2. Haddock in Division 6.b. International landings numbers (*10³) at-age.

Year	1	2	3	4	5	6	7	8
1991	87	6807	3011	1344	558	32	347	117
1992	86	3642	5623	964	580	364	51	109
1993	28	1919	4740	1157	489	144	178	113
1994	30	1160	5299	3665	1039	66	57	84
1995	1	146	5205	4791	1319	279	14	29
1996	2	5149	1861	4149	2347	473	74	11
1997	0	319	2102	2155	3658	1540	183	9
1998	4	392	1815	1340	1898	2284	897	404
1999	245	2600	2994	1972	1228	1600	1757	534
2000	33	3446	5081	3006	1296	1176	1250	713
2001	402	994	1116	555	991	462	319	230
2002	657	2983	3998	2111	809	217	170	223
2003	920	8103	11010	1848	1189	879	387	206
2004	197	1765	9502	9119	1364	286	262	210
2005	887	2835	6866	7913	725	98	134	48
2006	2344	768	1290	2356	2269	428	94	56
2007	31	1220	2709	1074	1550	1634	531	188
2008	17	749	6191	1164	479	761	684	164
2009	5	11	244	5243	460	261	255	231
2010	0	71	196	352	4078	274	161	133
2011	2	23	71	177	181	2405	100	122
2012	0	0	156	59	0	41	447	31
2013	162	14	2	46	6	46	29	524
2014	198	1528	415	44	121	34	69	528
2015	4	664	3164	104	7	60	10	101
2016	127	612	2137	842	3	2	7	3
2017	7	1336	1783	2179	1207	58	26	33
2018	0	3418	502	2233	598	222	3	10
2019	10	1514	10556	59	484	90	59	1
2020	21	1936	1190	3391	364	518	62	118
2021	132	544	2863	556	1788	53	243	94
2022	60	5806	551	575	203	677	19	58
2023	0	373	2331	606	552	216	97	268

Table 6.3.3. Haddock in 6.b. International discards numbers (*10³) at-age.

Year	1	2	3	4	5	6	7	8
1991	21099	27040	12178	3998	1146	313	51	7
1992	15998	21069	12961	4397	1181	312	40	6
1993	11151	17456	10755	3781	1128	317	60	9
1994	8140	19464	12570	4545	1409	410	79	12
1995	2748	9685	16379	4965	1145	508	34	3
1996	12094	13662	9051	5463	952	278	6	1
1997	9957	10216	3286	1944	1344	218	13	2
1998	14220	19415	8357	3423	1842	483	82	9
1999	17037	19348	9209	3526	2191	1084	413	72
2000	8189	9136	5616	1912	755	322	90	13
2001	7268	1019	583	266	50	15	18	3
2002	12706	8136	539	334	89	43	15	36
2003	5655	15503	3558	217	97	48	7	1
2004	735	2346	781	93	22	10	2	0
2005	174	888	554	210	28	11	9	2
2006	536	707	336	58	22	8	1	0
2007	1458	8609	921	440	678	193	0	0
2008	458	1458	5246	128	28	203	70	12
2009	218	696	993	2803	35	2	15	2
2010	152	463	868	1736	19	2	1	1
2011	2	36	4	6	0	174	27	0
2012	5	6	10	7	2	0	18	0
2013	4733	84	99	40	33	38	0	12
2014	164	1190	0	0	0	0	0	0
2015	71	2153	173	0	0	0	0	0
2016	245	439	502	146	0	0	0	0
2017	1187	334	20	12	0	0	0	0
2018	88	2955	3	40	0	0	0	0
2019	275	471	308	8	76	0	0	0
2020	237	263	0	0	0	0	0	0
2021	2797	1556	339	72	74	0	0	0
2022	1913	2403	150	0	0	0	0	0
2023	4	2462	302	0	0	0	0	0

Table 6.3.4. Haddock in Division 6.b. International bms numbers (*10³) at-age.

Year	1	2	3	4	5	6	7	8
2016	1	0	0	0	0	0	0	0
2017	0	0	0	0	0	0	0	0
2018	0	0	0	0	0	0	0	0
2019	2	10	3	0	0	0	0	0
2020	4	3	0	0	0	0	0	0
2021	2	1	0	0	0	0	0	0
2022	2	2	0	0	0	0	0	0
2023	0	201	25	0	0	0	0	0

Table 6.3.5. Haddock in Division 6.b. International catch (landings, discards and bms) numbers- at-age(*10³).

Year	1	2	3	4	5	6	7	8
1991	21186	33847	15189	5341	1704	346	398	124
1992	16084	24711	18584	5361	1761	676	91	115
1993	11178	19375	15494	4938	1617	461	237	122
1994	8170	20623	17868	8209	2449	476	136	97
1995	2749	9831	21585	9756	2464	787	47	32
1996	12096	18811	10911	9612	3299	751	80	12
1997	9957	10535	5388	4098	5002	1758	196	11
1998	14224	19807	10173	4763	3740	2767	979	413
1999	17282	21949	12203	5499	3419	2684	2170	605
2000	8222	12581	10698	4917	2050	1498	1340	726
2001	7669	2013	1699	821	1041	477	338	233
2002	13363	11119	4537	2445	898	260	185	259
2003	6576	23606	14568	2065	1286	927	395	207
2004	932	4112	10282	9212	1386	296	264	210
2005	1061	3723	7420	8124	753	109	143	50
2006	2880	1475	1626	2414	2291	436	95	56
2007	1489	9829	3630	1514	2227	1827	531	189
2008	476	2207	11437	1291	507	964	755	175
2009	223	707	1237	8046	495	263	270	233
2010	152	534	1064	2087	4096	276	162	134
2011	4	59	75	183	181	2579	127	122
2012	5	6	166	67	3	41	465	31
2013	4896	98	101	86	39	84	29	536
2014	362	2718	415	44	121	34	69	528
2015	75	2817	3338	104	7	60	10	101
2016	374	1051	2639	988	3	2	7	3
2017	1194	1670	1802	2191	1207	58	26	33
2018	88	6373	504	2273	598	222	3	10
2019	288	1995	10866	67	560	90	59	1
2020	262	2203	1190	3392	364	518	62	118
2021	2931	2101	3202	628	1862	53	243	94
2022	1975	8211	702	575	203	677	19	58
2023	5	3036	2659	606	552	216	97	268

Table 6.3.6. Haddock in Division 6.b. Landing fraction by age (accounts for total discards including bms).

Year	1	2	3	4	5	6	7	8
1991	0.004	0.201	0.198	0.252	0.327	0.094	0.873	0.941
1992	0.005	0.147	0.303	0.180	0.329	0.538	0.558	0.949
1993	0.002	0.099	0.306	0.234	0.302	0.313	0.748	0.925
1994	0.004	0.056	0.297	0.446	0.424	0.139	0.420	0.873
1995	0.000	0.015	0.241	0.491	0.535	0.354	0.289	0.916
1996	0.000	0.274	0.171	0.432	0.711	0.630	0.923	0.919
1997	0.000	0.030	0.390	0.526	0.731	0.876	0.934	0.811
1998	0.000	0.020	0.178	0.281	0.507	0.825	0.917	0.978
1999	0.014	0.118	0.245	0.359	0.359	0.596	0.810	0.882
2000	0.004	0.274	0.475	0.611	0.632	0.785	0.933	0.981
2001	0.052	0.494	0.657	0.676	0.952	0.969	0.946	0.987
2002	0.049	0.268	0.881	0.863	0.901	0.834	0.918	0.860
2003	0.140	0.343	0.756	0.895	0.925	0.949	0.982	0.995
2004	0.211	0.429	0.924	0.990	0.984	0.966	0.994	0.999
2005	0.836	0.761	0.925	0.974	0.963	0.901	0.935	0.969
2006	0.814	0.521	0.793	0.976	0.990	0.982	0.992	0.998
2007	0.021	0.124	0.746	0.709	0.696	0.894	0.999	1.000
2008	0.036	0.339	0.541	0.901	0.945	0.790	0.907	0.933
2009	0.021	0.016	0.197	0.652	0.928	0.994	0.944	0.989
2010	0.000	0.132	0.184	0.169	0.995	0.993	0.994	0.991
2011	0.576	0.393	0.946	0.966	0.998	0.933	0.789	1.000
2012	0.000	0.000	0.942	0.893	0.064	0.999	0.962	0.999
2013	0.033	0.141	0.016	0.533	0.158	0.550	1.000	0.978
2014	0.548	0.562	1.000	1.000	1.000	1.000	1.000	1.000
2015	0.055	0.236	0.948	1.000	1.000	1.000	1.000	1.000
2016	0.341	0.582	0.810	0.852	0.978	1.000	1.000	1.000
2017	0.006	0.800	0.989	0.995	1.000	1.000	1.000	1.000
2018	0.000	0.536	0.994	0.983	0.999	0.998	1.000	1.000
2019	0.034	0.759	0.971	0.881	0.864	1.000	1.000	1.000
2020	0.080	0.879	1.000	1.000	1.000	1.000	1.000	1.000
2021	0.045	0.259	0.894	0.886	0.960	1.000	1.000	1.000
2022	0.030	0.707	0.785	1.000	1.000	1.000	1.000	1.000
2023	0.000	0.123	0.877	1.000	1.000	1.000	1.000	1.000

Table 6.3.7. Haddock in Division 6.b. International landings mean weights-at-age (kg).

Year	1	2	3	4	5	6	7	8
1991	0.3018	0.4018	0.4439	0.5921	0.7242	0.9630	0.7667	0.5169
1992	0.1364	0.3659	0.4548	0.6582	0.6125	0.7591	0.8127	1.0197
1993	0.3046	0.4021	0.5033	0.7011	0.8305	0.8203	0.8673	1.1368
1994	0.3140	0.3562	0.4522	0.5579	0.6381	1.2244	0.7641	0.9749
1995	0.3767	0.3107	0.4141	0.4789	0.6397	0.6994	1.6996	1.0187
1996	0.3269	0.4364	0.5008	0.4874	0.6272	0.7087	0.7651	0.9060
1997	0.3000	0.3152	0.4008	0.4437	0.5637	0.6614	0.9582	1.2885
1998	0.2561	0.3440	0.4939	0.5166	0.5416	0.5906	0.6753	0.6842
1999	0.0853	0.1768	0.3263	0.4169	0.4954	0.5954	0.6505	0.7015
2000	0.1110	0.2057	0.2421	0.3278	0.4129	0.4835	0.6672	0.8137
2001	0.0936	0.2814	0.3436	0.4967	0.4273	0.5222	0.5553	0.8769
2002	0.1069	0.1956	0.2270	0.3230	0.5209	0.6271	0.7421	0.8504
2003	0.0997	0.1639	0.2461	0.3502	0.3874	0.4229	0.5373	0.7338
2004	0.1418	0.1724	0.2411	0.2932	0.4457	0.6173	0.6802	0.8470
2005	0.1033	0.1841	0.2297	0.3100	0.4613	0.6137	1.0637	1.1813
2006	0.0841	0.1669	0.2225	0.3267	0.4405	0.5981	0.6551	1.0139
2007	0.0959	0.2380	0.2755	0.3216	0.4489	0.5213	0.5616	0.6247
2008	0.1247	0.1972	0.3017	0.4438	0.5833	0.7518	0.9682	1.0522
2009	0.3001	0.3461	0.4198	0.4162	0.6919	0.5118	0.9714	1.0962
2010	0.0518	0.4195	0.5172	0.4566	0.5911	0.9798	1.3463	1.6256
2011	0.2138	0.3285	0.6127	0.4545	0.6943	0.5944	0.6965	0.8486
2012	-	-	0.5550	0.7470	0.8401	1.2405	1.0418	1.7401
2013	0.5069	0.5315	0.6835	0.8879	1.4497	0.8494	1.5170	1.1459
2014	0.1463	0.3517	0.2671	0.4863	1.0387	1.1288	1.2670	1.4003
2015	0.1103	0.3485	0.6158	0.3534	1.1753	0.9483	0.8406	1.4957
2016	0.4090	0.5737	0.6643	0.7667	1.5763	1.8078	2.3443	3.3346
2017	0.1730	0.4600	0.5871	0.6923	0.9442	0.7804	0.9126	1.5459
2018	-	0.3322	0.5641	0.7048	0.9354	1.2347	2.2115	1.8386
2019	0.1895	0.4893	0.5894	0.8246	1.1161	1.4395	1.6628	3.1576
2020	0.2977	0.5311	0.5763	0.8075	0.7486	1.0290	1.5356	1.2720
2021	0.2839	0.3936	0.5116	0.8374	0.8183	1.1379	0.9390	1.6937
2022	0.1738	0.4287	0.7441	0.7928	0.9602	0.9094	0.7988	1.0349
2023	-	0.6131	0.7069	0.9582	0.9595	0.9648	1.6386	1.1609

Table 6.3.8. Haddock in Division 6.b. International discards (and bms) mean weights-at-age (kg).

Year	1	2	3	4	5	6	7	8
1991	0.1418	0.1995	0.2533	0.3059	0.3452	0.3577	0.4931	0.3884
1992	0.1331	0.2169	0.2582	0.2976	0.3301	0.3425	0.4924	0.5411
1993	0.1365	0.2196	0.2601	0.3074	0.3463	0.3593	0.4989	0.5391
1994	0.1528	0.2260	0.2631	0.3080	0.3449	0.3562	0.5027	0.5415
1995	0.1183	0.2204	0.2761	0.3254	0.3406	0.3285	0.4326	0.5048
1996	0.1365	0.2180	0.2756	0.3260	0.3696	0.3476	0.5106	0.5420
1997	0.1364	0.2380	0.2718	0.3123	0.3715	0.4419	0.5070	0.5424
1998	0.1414	0.2482	0.2673	0.2907	0.3266	0.3360	0.4469	0.4866
1999	0.1388	0.2122	0.2548	0.2879	0.3133	0.3178	0.4125	0.4399
2000	0.1891	0.2670	0.2889	0.3110	0.3297	0.3337	0.4796	0.5140
2001	0.1353	0.2467	0.2937	0.3438	0.4122	0.4404	0.5098	0.5313
2002	0.1366	0.2545	0.3082	0.3352	0.3983	0.3377	0.5052	0.3302
2003	0.1614	0.2228	0.2871	0.3421	0.3369	0.4402	0.4807	0.5281
2004	0.1479	0.2177	0.2820	0.3426	0.3239	0.3711	0.4537	0.4112
2005	0.1706	0.2403	0.2981	0.3565	0.3872	0.4728	0.5054	0.5424
2006	0.1319	0.2326	0.3335	0.4201	0.4951	0.4351	0.4259	0.4060
2007	0.1148	0.1791	0.2328	0.2265	0.2425	0.2801	0.4044	0.5145
2008	0.2019	0.2636	0.2785	0.3701	0.3506	0.3581	0.4330	0.5225
2009	0.2465	0.2874	0.3186	0.3434	0.3604	0.6620	0.5018	0.5416
2010	0.1410	0.2205	0.2920	0.3008	0.3225	0.5336	0.4595	0.0725
2011	0.1777	0.2479	0.3002	0.3024	0.7949	0.7274	0.4813	-
2012	0.2630	0.2945	0.4883	0.3193	0.3395	0.7333	0.7966	1.0788
2013	0.2013	0.3370	0.2284	0.3968	0.2473	0.6795	0.0000	0.9802
2014	0.0798	0.2156	-	-	-	-	-	-
2015	0.1040	0.2269	0.3343	-	-	-	-	-
2016	0.2404	0.2757	0.3249	0.3930	0.4090	-	-	-
2017	0.2193	0.3081	0.4820	0.5203	0.7260	-	-	-
2018	0.0879	0.2580	0.3611	0.4222	0.4790	0.5360	-	-
2019	0.1795	0.2586	0.2970	0.3741	0.4862	-	-	-
2020	0.2419	0.2741	-	0.5120	-	-	-	-
2021	0.1817	0.2835	0.3357	0.3438	0.3942	-	-	-
2022	0.1758	0.2929	0.3640	-	-	-	-	-
2023	0.1030	0.2721	0.3090	-	-	-	-	-

Table 6.3.9. Haddock in Division 6.b. International catch (landings and discards) mean weights-at-age (kg).

Year	1	2	3	4	5	6	7	8
1991	0.1425	0.2402	0.2911	0.3779	0.4692	0.4144	0.7319	0.5182
1992	0.1331	0.2388	0.3177	0.3624	0.4231	0.5667	0.6713	0.9954
1993	0.1369	0.2377	0.3345	0.3997	0.4927	0.5035	0.7744	1.0921
1994	0.1534	0.2333	0.3192	0.4196	0.4694	0.4773	0.6124	0.9197
1995	0.1184	0.2218	0.3094	0.4008	0.5007	0.4598	0.7991	0.9756
1996	0.1365	0.2778	0.3140	0.3956	0.5528	0.5751	0.7455	0.8766
1997	0.1364	0.2403	0.3221	0.3814	0.5121	0.6341	0.9285	1.1477
1998	0.1414	0.2501	0.3078	0.3543	0.4357	0.5462	0.6562	0.6798
1999	0.1380	0.2080	0.2723	0.3342	0.3787	0.4833	0.6052	0.6706
2000	0.1888	0.2502	0.2667	0.3212	0.3822	0.4513	0.6547	0.8081
2001	0.1331	0.2638	0.3265	0.4472	0.4266	0.5197	0.5529	0.8723
2002	0.1351	0.2387	0.2366	0.3247	0.5087	0.5792	0.7225	0.7778
2003	0.1527	0.2026	0.2561	0.3493	0.3836	0.4238	0.5363	0.7327
2004	0.1466	0.1982	0.2442	0.2937	0.4438	0.6090	0.6788	0.8465
2005	0.1144	0.1975	0.2348	0.3112	0.4585	0.5997	1.0271	1.1613
2006	0.0930	0.1984	0.2455	0.3289	0.4410	0.5952	0.6533	1.0125
2007	0.1144	0.1864	0.2646	0.2939	0.3861	0.4958	0.5615	0.6246
2008	0.1991	0.2411	0.2911	0.4365	0.5705	0.6689	0.9182	1.0169
2009	0.2477	0.2883	0.3386	0.3908	0.6682	0.5127	0.9453	1.0903
2010	0.1410	0.2468	0.3334	0.3271	0.5899	0.9766	1.3409	1.6121
2011	0.1985	0.2796	0.5958	0.4493	0.6945	0.6033	0.6512	0.8486
2012	0.2630	0.2945	0.5511	0.7011	0.3717	1.2400	1.0325	1.7392
2013	0.2114	0.3645	0.2357	0.6588	0.4373	0.7729	1.5170	1.1423
2014	0.1162	0.2921	0.2671	0.4863	1.0387	1.1288	1.2670	1.4003
2015	0.1043	0.2556	0.6012	0.3534	1.1753	0.9483	0.8406	1.4957
2016	0.2978	0.4491	0.5997	0.7114	1.5504	1.8078	2.3443	3.3346
2017	0.2190	0.4297	0.5859	0.6914	0.9441	0.7804	0.9126	1.5459
2018	0.0879	0.2978	0.5629	0.6999	0.9351	1.2334	2.2115	1.8386
2019	0.1797	0.4335	0.5810	0.7708	1.0302	1.4395	1.6628	3.1576
2020	0.2455	0.5000	0.5763	0.8075	0.7486	1.0290	1.5356	1.2720
2021	0.1863	0.3120	0.4930	0.7810	0.8015	1.1379	0.9390	1.6937
2022	0.1757	0.3889	0.6625	0.7928	0.9602	0.9094	0.7988	1.0349
2023	0.1030	0.3140	0.6580	0.9582	0.9595	0.9648	1.6386	1.1609

Table 6.3.10. Haddock in Division 6.b. Scottish Q3 Rockall haddock survey: 'Rockall pt1' 1991-1997 (ages 1 to 8+ used in the assessment).

	0	1	2	3	4	5	6	7	8+
1991	14458	16398	4431	683	315	228	37	64	3
1992	20336	44912	14631	3150	647	127	200	4	32
1993	15220	37959	15689	3716	1104	183	38	73	21
1994	23474	13287	11399	4314	969	203	30	12	4
1995	16923	16971	6648	5993	1935	483	200	16	-1
1996	33578	19420	5903	1940	1317	325	69	6	1
1997	28897	10693	2384	538	292	281	71	9	1

Table 6.3.11. Haddock in Division 6.b. Scottish Q3 Rockall haddock survey: 'Modelled Q3' index - mean and CV (1999 onwards, ages 1-8+ used in the assessment).

Mean

	0	1	2	3	4	5	6	7	8+
1999	34877.86	85187.17	39974.23	7858.54	3281.63	2780.39	984.82	862.33	268.34
2000	NA	NA	NA	NA	NA	NA	NA	NA	NA
2001	239688.63	60357.57	3953.78	3041.45	1402.15	389.02	119.01	103.26	93.06
2002	52256.33	171465.72	30293.22	2266.02	1272.86	936.91	200.06	144.05	208.82
2003	13557.62	78471.92	157756.21	17357.22	2254.44	1380.50	1175.69	295.99	105.86
2004	NA	NA	NA	NA	NA	NA	NA	NA	NA
2005	147815.41	33599.26	11729.55	19120.91	29422.88	2898.87	433.86	138.62	85.47
2006	30165.33	170904.08	19479.98	2395.12	12391.23	17019.02	3587.73	118.91	96.56
2007	5764.54	20279.83	57537.76	6899.39	1570.46	3572.91	3745.58	286.98	33.87
2008	964.74	4960.90	7396.23	49316.03	2279.44	546.90	2703.36	3596.01	401.42
2009	944.67	821.78	2375.83	4996.06	25930.36	659.59	161.24	1386.11	208.89
2010	NA	NA	NA	NA	NA	NA	NA	NA	NA
2011	76.32	149.78	1801.51	231.77	401.25	1327.26	6635.27	19.03	113.55
2012	117260.76	29.75	75.64	548.46	88.10	480.91	359.98	4120.28	143.61
2013	49576.73	132145.74	42.28	110.15	86.28	104.30	142.52	227.81	2008.47
2014	36145.32	69968.32	85726.54	55.37	49.03	144.30	72.00	178.48	1020.40
2015	46846.36	30102.37	110689.67	33614.22	36.94	228.32	80.23	33.82	607.91
2016	218062.18	15919.00	22318.29	19978.64	15188.27	47.53	10.32	53.77	287.79
2017	241406.11	315286.76	11172.89	8541.24	14213.82	8604.04	77.46	18.68	135.12
2018	198832.56	35270.97	43752.86	2513.47	1947.47	5141.07	3967.09	0.80	150.22
2019	37695.55	50424.83	11593.99	47985.35	648.16	1180.46	3706.13	948.76	83.44
2020	289881.66	17333.92	12372.73	6531.85	8997.27	478.43	663.18	375.12	392.06
2021	689967.22	113923.00	4944.64	7424.79	2606.78	6991.77	537.41	44.92	793.83
2022	9873.39	1205426.86	26228.72	3261.52	2349.03	1617.13	5875.94	73.15	328.82
2023	40464.87	8664.80	698961.67	23393.63	2012.03	2278.34	1591.47	2742.67	532.47

CV

	0	1	2	3	4	5	6	7	8+
1999	0.3395	0.1104	0.2183	0.3801	0.4874	0.4532	0.3356	0.4112	0.2275
2000	NA	NA	NA	NA	NA	NA	NA	NA	NA
2001	0.2936	0.0947	0.1631	0.2914	0.3007	0.3094	0.2581	0.4986	0.1976
2002	0.2564	0.1145	0.1737	0.2955	0.3046	0.3004	0.2906	0.4931	0.2177
2003	0.2913	0.1138	0.1893	0.2361	0.2802	0.2786	0.2401	0.4470	0.2385
2004	NA	NA	NA	NA	NA	NA	NA	NA	NA
2005	0.3453	0.1395	0.2127	0.2135	0.2423	0.2963	0.2631	0.4795	0.2266
2006	1.0483	0.1386	0.2017	0.2070	0.2175	0.2054	0.1936	0.3894	0.2514
2007	3.9784	0.1997	0.1710	0.1723	0.2112	0.1766	0.1819	0.3032	0.2956
2008	1.4386	0.2471	0.2209	0.1948	0.2167	0.2375	0.2164	0.3848	0.2796
2009	0.3988	0.2449	0.2565	0.2012	0.1948	0.2387	0.2286	0.4217	0.2490
2010	NA	NA	NA	NA	NA	NA	NA	NA	NA
2011	0.7027	0.2841	0.2477	0.1930	0.3300	0.2134	0.1022	0.4328	0.1886
2012	0.2661	0.3922	0.2683	0.1783	0.2113	0.1547	0.1588	0.0997	0.1692
2013	0.2536	0.0976	0.2969	0.2790	0.2770	0.2444	0.2264	0.2171	0.1201
2014	0.2864	0.0877	0.1607	0.2137	0.2941	0.2268	0.1808	0.3111	0.1066
2015	0.3279	0.1082	0.1748	0.0843	0.3380	0.2464	0.1928	0.3790	0.1210
2016	0.3023	0.1040	0.1378	0.0926	0.1434	0.2410	0.2695	0.2632	0.1375
2017	0.3710	0.0729	0.1210	0.1181	0.0905	0.1029	0.2004	0.3353	0.1805
2018	0.2700	0.0925	0.2520	0.1383	0.3646	0.2535	0.1055	0.7201	0.1737
2019	0.2185	0.0946	0.1931	0.0951	0.2709	0.2019	0.0938	0.2638	0.1881
2020	0.1825	0.1134	0.1494	0.1159	0.1885	0.1741	0.1372	0.1975	0.1344
2021	0.1873	0.0761	0.1358	0.1076	0.1544	0.1209	0.1351	0.2403	0.1150
2022	0.2907	0.0568	0.1655	0.1187	0.2464	0.1920	0.0950	0.3000	0.1391
2023	0.3383	0.1259	0.0739	0.1052	0.1327	0.1124	0.1162	0.0908	0.1302

Table 6.4.1. Haddock in Division 6.b. SAM assessment configuration file.

```
# Configuration saved: Fri May 24 12:27:26 2024
#
# Where a matrix is specified rows corresponds to fleets and columns to ages.
# Same number indicates same parameter used
# Numbers (integers) starts from zero and must be consecutive
# Negative numbers indicate that the parameter is not included in the model
#
$minAge
# The minimium age class in the assessment
 1
$maxAge
# The maximum age class in the assessment
 8
$maxAgePlusGroup
# Is last age group considered a plus group for each fleet (1 yes, or 0 no).
 1 1 1
$keyLogFsta
# Coupling of the fishing mortality states processes for each age (normally only
# the first row (= fleet) is used).
# Sequential numbers indicate that the fishing mortality is estimated individually
# for those ages; if the same number is used for two or more ages, F is bound for
# those ages (assumed to be the same). Binding fully selected ages will result in a
# flat selection pattern for those ages.
   0   1   2   3   4   5   5   5
  -1  -1  -1  -1  -1  -1  -1  -1
  -1  -1  -1  -1  -1  -1  -1  -1

$corFlag
# Correlation of fishing mortality across ages (0 independent, 1 compound symmetry,
# 2 AR(1), 3 separable AR(1).
# 0: independent means there is no correlation between F across age
# 1: compound symmetry means that all ages are equally correlated;
# 2: AR(1) first order autoregressive - similar ages are more highly correlated than
# ages that are further apart, so similar ages have similar F patterns over time.
# if the estimated correlation is high, then the F pattern over time for each age
# varies in a similar way. E.g if almost one, then they are parallel (like a
# separable model) and if almost zero then they are independent.
# 3: Separable AR - Included for historic reasons . . .  more later
 2

$keyLogFpar
# Coupling of the survey catchability parameters (nomally first row is
# not used, as that is covered by fishing mortality).
```

```
  -1  -1  -1  -1  -1  -1  -1  -1
   0   1   2   3   3   3   3   3
   4   5   6   7   7   7   7   7

$keyQpow
# Density dependent catchability power parameters (if any).
  -1  -1  -1  -1  -1  -1  -1  -1
  -1  -1  -1  -1  -1  -1  -1  -1
   0   1   1   1   1   1   1   1

$keyVarF
# Coupling of process variance parameters for log(F)-process (Fishing mortality
# normally applies to the first (fishing) fleet; therefore only first row is used)
   0   0   0   0   0   0   0   0
  -1  -1  -1  -1  -1  -1  -1  -1
  -1  -1  -1  -1  -1  -1  -1  -1

$keyVarLogN
# Coupling of the recruitment and survival process variance parameters for the
# log(N)-process at the different ages. It is advisable to have at least the first
age
# class (recruitment) separate, because recruitment is a different process than
# survival.
 0 1 1 1 1 1 1 1

$keyVarLogP
#

$keyVarObs
# Coupling of the variance parameters for the observations.
# First row refers to the coupling of the variance parameters for the catch data
# observations by age
# Second and further rows refers to coupling of the variance parameters for the
# index data observations by age
   0   0   0   0   0   0   0   0
   1   1   1   1   1   1   1   1
   2   2   2   2   2   2   2   2

$obsCorStruct
# Covariance structure for each fleet ("ID" independent, "AR" AR(1), or "US" for
unstructured). | Possible values are: "ID" "AR" "US"
 "ID" "ID" "ID"

$keyCorObs
# Coupling of correlation parameters can only be specified if the AR(1) structure
is chosen above.
```

```
# NA's indicate where correlation parameters can be specified (-1 where they cannot).
#1-2 2-3 3-4 4-5 5-6 6-7 7-8
  NA  NA  NA  NA  NA  NA  NA
  NA  NA  NA  NA  NA  NA  NA
  NA  NA  NA  NA  NA  NA  NA

$stockRecruitmentModelCode
# Stock recruitment code (0 for plain random walk, 1 for Ricker, 2 for Beverton-Holt, 3 piece-wise constant, 61 for segmented regression/hockey stick, 62 for AR(1), 63 for bent hyperbola / smooth hockey stick, 64 for power function with degree < 1, 65 for power function with degree > 1, 66 for Shepher, 67 for Deriso, 68 for Saila-Lorda, 69 for sigmoidal Beverton-Holt, 90 for CMP spline, 91 for more flexible spline, and 92 for most flexible spline).
 0

$noScaledYears
# Number of years where catch scaling is applied.
 0

$keyScaledYears
# A vector of the years where catch scaling is applied.

$keyParScaledYA
# A matrix specifying the couplings of scale parameters (nrow = no scaled years, ncols = no ages).

$fbarRange
# lowest and higest age included in Fbar
 2 5

$keyBiomassTreat
# To be defined only if a biomass survey is used (0 SSB index, 1 catch index, 2 FSB index, 3 total catch, 4 total landings, 5 TSB index,  6 TSN index, and 10 Fbar idx).
 -1 -1 -1

$obsLikelihoodFlag
# Option for observational likelihood | Possible values are: "LN" "ALN"
 "LN" "LN" "LN"

$fixVarToWeight
# If weight attribute is supplied for observations this option sets the treatment (0 relative weight, 1 fix variance to weight). Can be specified fleetwise.
 0 0 0

$fracMixF
# The fraction of t(3) distribution used in logF increment distribution
 0
```

```
$fracMixN

# The fraction of t(3) distribution used in logN increment distribution (for each age group)

 0 0 0 0 0 0 0 0


$fracMixObs

# A vector with same length as number of fleets, where each element is the fraction of t(3) distribution used in the distribution of that fleet

 0 0 0


$constRecBreaks

# For stock-recruitment code 3: Vector of break years between which recruitment is at constant level. The break year is included in the left interval. For spline stock-recruitment: Vector of log-ssb knots. (This option is only used in combination with stock-recruitment code 3, 90-92, and 290)


$predVarObsLink

# Coupling of parameters used in a prediction-variance link for observations.

  -1  -1  -1  -1  -1  -1  -1  -1

  -1  -1  -1  -1  -1  -1  -1  -1

  -1  -1  -1  -1  -1  -1  -1  -1


$stockWeightModel

# Integer code describing the treatment of stock weights in the model (0 use as known, 1 use as observations to inform stock weight process (GMRF with cohort and within year correlations)), 2 to add extra correlation to plusgroup

 1


$keyStockWeightMean

# Coupling of stock-weight process mean parameters (not used if stockWeightModel==0)

 0 1 2 3 4 5 6 7


$keyStockWeightObsVar

# Coupling of stock-weight observation variance parameters (not used if stockWeight-Model==0)

 0 0 0 0 0 0 0 0


$catchWeightModel

# Integer code describing the treatment of catch weights in the model (0 use as known, 1 use as observations to inform catch weight process (GMRF with cohort and within year correlations)), 2 to add extra correlation to plusgroup

 0

$matureModel

# Integer code describing the treatment of proportion mature in the model (0 use as known, 1 use as observations to inform proportion mature process (GMRF with cohort and within year correlations on logit(proportion mature))), 2 to add extra correla-tion to plusgroup

 0

$mortalityModel
```

```
# Integer code describing the treatment of natural mortality in the model (0 use as
known, 1 use as observations to inform natural mortality process (GMRF with cohort
and within year correlations)), 2 to add extra correlation to plusgroup

 0


$keyXtraSd

# An integer matrix with 4 columns (fleet year age coupling), which allows additional
uncertainty to be estimated for the specified observations

   1 2011   1   0

   1 2012   1   0

   1 2013   1   0

   1 2014   1   0

   1 2015   1   0

   1 2016   1   0

   1 2017   1   0

   1 2018   1   0

   1 2019   1   0

   1 2020   1   0

   1 2021   1   0

   1 2022   1   0

   1 2023   1   0

   1 2011   2   0

   1 2012   2   0

   1 2013   2   0

   1 2014   2   0

   1 2015   2   0

   1 2016   2   0

   1 2017   2   0

   1 2018   2   0

   1 2019   2   0

   1 2020   2   0

….

….
```

Table 6.4.2. Haddock in Division 6.b. Parameter estimates from final SAM assessment.

	par	sd(par)	exp(par)	Low	High
logFpar_0	-1.2460	0.3024	0.2876	0.1571	0.5266
logFpar_1	-1.7503	0.2930	0.1737	0.0967	0.3121
logFpar_2	-2.1725	0.2885	0.1139	0.0640	0.2028
logFpar_3	-2.0891	0.1553	0.1238	0.0907	0.1689
logFpar_4	-4.5613	1.2810	0.0104	0.0008	0.1354
logFpar_5	-3.0829	0.6892	0.0458	0.0115	0.1819
logFpar_6	-3.0163	0.6472	0.0490	0.0134	0.1787
logFpar_7	-2.7736	0.6116	0.0624	0.0184	0.2122
logQpow_0	0.4155	0.0820	1.5151	1.2858	1.7851
logQpow_1	0.3059	0.0508	1.3579	1.2267	1.5031
logSdLogFsta_0	-0.7719	0.1756	0.4621	0.3253	0.6565
logSdLogN_0	0.2947	0.1427	1.3428	1.0094	1.7861
logSdLogN_1	-1.0677	0.1351	0.3438	0.2624	0.4504
logSdLogObs_0	-1.3914	0.1800	0.2487	0.1735	0.3565
logSdLogObs_1	-0.3856	0.1227	0.6800	0.5320	0.8692
logSdLogObs_2	0.7684	0.1066	2.1564	1.7424	2.6686
itrans_rho_0	1.6921	0.2612	5.4307	3.2212	9.1558
logPhiSW_0	5.4723	1.4489	238.0002	13.1232	4316.3362
logPhiSW_1	5.4597	1.3960	235.0366	14.4075	3834.2656
logSdProcLogSW_0	1.3026	0.6658	3.6790	0.9714	13.9336
meanLogSW_0	-1.8846	0.2115	0.1519	0.0995	0.2319
meanLogSW_1	-1.3005	0.2089	0.2724	0.1794	0.4137
meanLogSW_2	-0.9888	0.2074	0.3720	0.2457	0.5632
meanLogSW_3	-0.7332	0.2068	0.4804	0.3177	0.7265
meanLogSW_4	-0.4538	0.2072	0.6352	0.4197	0.9614
meanLogSW_5	-0.2599	0.2086	0.7711	0.5081	1.1703
meanLogSW_6	0.0089	0.2109	1.0089	0.6617	1.5384
meanLogSW_7	0.2361	0.2142	1.2663	0.8251	1.9436
logSdLogSW_0	-1.6779	0.0921	0.1868	0.1553	0.2245
logXtraSd_0	1.4146	0.1952	4.1149	2.7850	6.0798

Table 6.4.3. Haddock in Division 6.b. Estimates of numbers-at-age (in 1000s) from final SAM assessment.

Year	1	2	3	4	5	6	7	8+
1991	144212.43	87770.45	27858.74	9309.99	3499.13	595.05	722.92	179.53
1992	153176.05	87933.31	39091.50	9637.51	2874.91	1295.31	162.39	257.46
1993	137498.17	90313.63	41779.34	12089.11	2847.72	798.86	427.26	186.67
1994	82230.21	90748.41	48752.43	16416.52	4208.98	683.83	200.88	139.96
1995	47811.24	48498.06	57912.30	21687.25	5046.21	1097.22	91.01	51.08
1996	86604.34	46729.32	28185.69	24850.18	7791.52	1504.09	146.19	23.41
1997	84308.11	43250.82	18942.71	12425.52	11703.85	3551.28	528.38	30.51
1998	83680.10	54460.41	24264.66	11683.13	8305.58	6155.73	1860.69	546.54
1999	61523.61	47904.60	23307.41	10117.48	6179.83	4335.24	3012.74	1015.75
2000	25853.47	24954.88	16134.45	7864.49	3367.89	2348.23	1630.54	1079.33
2001	47493.25	9221.30	6569.40	3153.05	2092.63	901.96	669.44	516.31
2002	94119.85	37594.91	8455.51	4701.37	2309.20	851.04	428.61	609.95
2003	50706.67	80942.48	29005.95	4576.51	2501.11	1733.70	662.35	455.25
2004	16950.90	26804.57	36563.90	14791.93	2272.46	852.76	580.85	441.53
2005	24136.76	15425.93	21694.60	22916.27	3960.28	669.26	471.81	269.63
2006	74402.08	15160.41	6732.64	10763.41	11452.17	2612.47	426.09	319.68
2007	20165.60	51228.33	10050.25	3618.79	5959.58	5431.38	1284.12	404.37
2008	7644.93	11540.95	38973.93	3841.56	1494.45	2893.97	2202.80	638.17
2009	3430.08	4487.05	6252.93	23270.91	1603.29	749.39	1000.57	794.00
2010	2719.82	2124.24	2826.53	4231.79	12480.66	743.35	422.20	503.63
2011	622.66	2029.60	815.95	1202.58	1657.41	7067.41	282.87	393.11
2012	522.53	403.47	1180.84	399.61	735.87	808.90	4382.95	392.13
2013	63739.63	369.78	369.10	570.92	297.54	489.04	523.26	2759.82
2014	43780.75	48233.92	306.38	254.83	386.66	217.42	365.89	1714.02
2015	23981.75	42384.55	27563.72	213.48	201.01	257.41	135.22	1067.92
2016	16502.61	18241.16	20022.05	13248.98	161.53	96.70	170.58	586.00
2017	108467.69	11178.51	10472.43	12703.75	7863.44	157.42	81.79	418.91
2018	25988.48	54268.57	4499.70	4477.63	6013.28	4082.59	75.96	330.57
2019	32028.69	14915.63	35713.73	1832.97	2056.56	3627.89	1703.54	227.57

Year	1	2	3	4	5	6	7	8+
2020	16241.85	16406.67	9417.01	14299.13	1151.96	1120.57	1256.97	941.02
2021	57693.35	8295.60	10307.76	4426.33	7722.93	849.69	399.66	1314.09
2022	274022.11	30173.01	5136.43	4508.90	2506.09	5621.38	401.31	819.76
2023	10393.93	243499.78	20838.72	2982.17	2958.95	2114.66	3329.40	986.63

Table 6.4.4. Haddock in Division 6.b. Estimates of fishing mortality-at-age from final SAM assessment.

Year	1	2	3	4	5	6	7	8+
1991	0.1805	0.5230	0.8824	0.9788	0.9721	1.0370	1.0370	1.0370
1992	0.1361	0.3960	0.6987	0.8259	0.8812	0.9096	0.9096	0.9096
1993	0.1065	0.3084	0.5587	0.7216	0.8929	1.0506	1.0506	1.0506
1994	0.1171	0.3371	0.6058	0.8246	1.0993	1.4786	1.4786	1.4786
1995	0.1002	0.2908	0.4967	0.6460	0.8532	1.1909	1.1909	1.1909
1996	0.1621	0.4209	0.5852	0.6400	0.7590	0.9828	0.9828	0.9828
1997	0.1460	0.3416	0.4412	0.4559	0.5194	0.6233	0.6233	0.6233
1998	0.2238	0.4963	0.6224	0.6078	0.6635	0.7908	0.7908	0.7908
1999	0.3486	0.7326	0.9180	0.8756	0.9154	1.0504	1.0504	1.0504
2000	0.4201	0.8739	1.1435	1.0995	1.1550	1.2891	1.2891	1.2891
2001	0.1768	0.3585	0.4940	0.5211	0.5968	0.6809	0.6809	0.6809
2002	0.1703	0.3857	0.5873	0.6146	0.5851	0.5850	0.5850	0.5850
2003	0.1487	0.3835	0.6576	0.7704	0.7420	0.7290	0.7290	0.7290
2004	0.0856	0.2571	0.5074	0.6995	0.6545	0.6182	0.6182	0.6182
2005	0.0644	0.2055	0.3756	0.4343	0.3327	0.3008	0.3008	0.3008
2006	0.0473	0.1471	0.2765	0.3253	0.2580	0.2484	0.2484	0.2484
2007	0.0850	0.2728	0.5097	0.6440	0.5353	0.5561	0.5561	0.5561
2008	0.0729	0.2377	0.4128	0.5295	0.4342	0.4565	0.4565	0.4565
2009	0.0641	0.2173	0.3692	0.4881	0.3903	0.4262	0.4262	0.4262
2010	0.0706	0.2807	0.5091	0.6423	0.4568	0.4940	0.4940	0.4940
2011	0.0295	0.1268	0.2472	0.3079	0.2126	0.2436	0.2436	0.2436
2012	0.0168	0.0766	0.1518	0.1765	0.1108	0.1250	0.1250	0.1250
2013	0.0231	0.1171	0.2392	0.2667	0.1584	0.1676	0.1676	0.1676
2014	0.0205	0.1169	0.2537	0.2785	0.1609	0.1630	0.1630	0.1630
2015	0.0142	0.0872	0.1904	0.2029	0.1102	0.1053	0.1053	0.1053
2016	0.0117	0.0756	0.1609	0.1620	0.0823	0.0715	0.0715	0.0715
2017	0.0169	0.1230	0.2720	0.2795	0.1431	0.1172	0.1172	0.1172
2018	0.0148	0.1158	0.2586	0.2647	0.1326	0.1004	0.1004	0.1004
2019	0.0136	0.1102	0.2433	0.2461	0.1254	0.0914	0.0914	0.0914

Year	1	2	3	4	5	6	7	8+
2020	0.0196	0.1698	0.3873	0.4137	0.2217	0.1673	0.1673	0.1673
2021	0.0185	0.1667	0.3841	0.4146	0.2281	0.1758	0.1758	0.1758
2022	0.0105	0.0976	0.2325	0.2606	0.1481	0.1175	0.1175	0.1175
2023	0.0061	0.0589	0.1504	0.1801	0.1081	0.0887	0.0887	0.0887

Table 6.4.5. Haddock in Division 6.b. Summary of the stock assessment. Weights in tonnes. Recruitment in 1000s. Catch is model estimates.

Year	Recruitment (age 1)			SSB			Fbar (2-5)			Estimated catch		
	Low	Value	High	Low	Value	High	Low	Value	High	Low	Value	High
1991	85777	144212	242457	26753	36269	49169	0.643	0.839	1.094	14067	18040	23134
1992	91126	153176	257477	30098	40562	54662	0.532	0.7	0.923	13277	16734	21092
1993	81138	137498	233006	31573	42699	57746	0.469	0.62	0.82	12240	15395	19362
1994	48465	82230	139521	33696	45168	60544	0.552	0.717	0.931	14140	17799	22405
1995	27855	47811	82065	30495	40689	54291	0.433	0.572	0.755	11402	14424	18246
1996	52690	86604	142348	27616	35649	46018	0.451	0.601	0.801	12698	15651	19291
1997	51272	84308	138630	23037	29955	38952	0.318	0.44	0.607	8862	10757	13058
1998	51598	83680	135710	26545	33561	42431	0.455	0.598	0.785	12710	15468	18825
1999	45286	61524	83583	23451	28708	35143	0.679	0.86	1.09	13066	15861	19252
2000	16342	25853	40901	14358	17724	21881	0.832	1.068	1.371	9556	11589	14053
2001	34884	47493	64660	7032	8772	10943	0.367	0.493	0.661	3059	3697	4468
2002	66548	94120	133114	12754	16333	20916	0.417	0.543	0.708	5261	6586	8246
2003	36264	50707	70901	21038	27973	37194	0.488	0.638	0.835	8279	10532	13397
2004	9938	16951	28912	16155	21677	29088	0.376	0.53	0.746	5775	7293	9208
2005	16477	24137	35357	14086	19127	25973	0.24	0.337	0.473	3940	5020	6396
2006	50827	74402	108913	12888	17078	22630	0.18	0.252	0.352	2692	3304	4056
2007	13204	20166	30798	15766	20415	26437	0.362	0.49	0.665	4748	5806	7100
2008	4773	7645	12245	15279	20634	27867	0.291	0.404	0.56	5048	6401	8117
2009	2060	3430	5711	11519	15807	21691	0.261	0.366	0.514	3794	4971	6512
2010	1472	2720	5026	8540	12322	17778	0.323	0.472	0.691	3237	4220	5501
2011	297	623	1304	5763	8357	12119	0.121	0.224	0.414	773	1409	2569
2012	243	523	1124	4796	7053	10371	0.064	0.129	0.261	414	814	1601
2013	44229	63740	91857	5956	8238	11394	0.107	0.195	0.358	562	988	1738
2014	31201	43781	61433	12485	18277	26757	0.111	0.203	0.369	1024	1954	3729
2015	16504	23982	34848	19730	27742	39007	0.078	0.148	0.28	1769	3546	7105
2016	11315	16503	24070	20148	27368	37176	0.06	0.12	0.242	1777	3552	7098
2017	75647	108468	155529	23875	31698	42086	0.103	0.204	0.407	2632	4969	9379

Year	Recruitment (age 1)			SSB			Fbar (2-5)			Estimated catch		
	Low	Value	High	Low	Value	High	Low	Value	High	Low	Value	High
2018	18271	25988	36967	24363	33855	47045	0.091	0.193	0.411	1959	3834	7504
2019	22481	32029	45632	26734	36234	49109	0.087	0.181	0.376	2743	5772	12142
2020	10897	16242	24208	20274	27442	37143	0.152	0.298	0.586	3443	6940	13990
2021	41453	57693	80297	18216	24080	31832	0.159	0.298	0.558	2586	4632	8297
2022	176743	274022	424844	27239	36332	48460	0.097	0.185	0.352	2075	3636	6371
2023	6446	10394	16761	62889	91843	134125	0.06	0.124	0.26	3228	6805	14349
2024	523	47493*	274022	58349	107879	214925	NA	NA	NA	NA	NA	NA

* Median resampled (1991–2023), as estimated by stochastic projection.

Table 6.5.1. Haddock in Division 6.b. Values in the forecast and interim year.

Variable	Value	Notes
$F_{ages\ 2–5}$ (2024)	0.035	Based on a catch constraint for 2024. Average selection pattern (2021– 2023).
SSB (2025)	117972	Short-term forecast; in tonnes
$R_{age\ 1}$ (2024, 2025, 2026)	47493	Median recruitment, resampled from the years 1991–2023; in thousands
Total catch (2024)	4078	TAC for 2024; in tonnes
Projected landings (2024)	3937	Short-term forecast, assuming average 2014–2023 landing pattern; in tonnes
Projected discards (2024)	141	Short-term forecast, assuming average 2014–2023 discard pattern; in tonnes

Table 6.5.2. Haddock in Division 6.b. Forecast catch scenarios. All weights are in tonnes.

Basis	Total catch (2025)	Projected landings (2025)	Projected discards (2025)	F_{total} (2025)	$F_{projected\ landings}$ (2025)	$F_{projected\ discards}$ (2025)	SSB (2026)	% SSB change *	% advice change^	Probability of SSB (2026) < Blim (%)
ICES advice basis										
MSY approach: $F = F_{MSY}$	31565	30215	1350	0.28	0.25	0.027	100709	-14.6	674	0
Other scenarios										
EU MAP: F_{MSY}	31565	30215	1350	0.28	0.25	0.027	100709	-14.6	674	0
EU MAP $F_{MSY\ lower}$	22041	21183	858	0.184	0.166	0.0180	111338	-5.6	440	0
EU MAP $F_{MSY\ upper}$	42625	40916	1709	0.41	0.37	0.040	88877	-25	945	0
F = 0	0	0	0	0	0	0	135134	14.5	-100	0
F_{pa}	43399	41662	1737	0.42	0.38	0.041	88080	-25	964	0
F_{lim}	79588	75944	3644	1.1	0.99	0.107	48969	-58	1852	0.44
$F = F_{2024}$	4607	4436	171	0.035	0.031	0.0040	130432	10.5	12.9	0
$SSB_{2026} = B_{lim}$	126876	117999	8877	7.1	6.4	0.69	8542	-93	3011	50
$SSB_{2026} = B_{pa}$	121639	114019	7620	4.7	4.3	0.46	11870	-90	2882	34
SSB_{2026} = MSY $B_{trigger}$	120065	112627	7438	4.3	3.9	0.42	12877	-89	2844	30
$SSB_{2026} = SSB_{2025}$	16257	15633	624	0.131	0.118	0.0130	117972	0	299	0

Figure 6.3.1. Haddock in Division 6.b. Official landings by country.

Figure 6.3.2. Haddock in Division 6.b. ICES estimated landings as submitted to Intercatch for 2023. There are two Scottish OTB_DEF>=120 due to landings being submitted by subdivision.

Figure 6.3.3. Haddock in Division 6.b. ICES estimated landings and discards (for 2023) after raising in InterCatch (grey=imported landings; black=imported discards; red=raised discards).

Figure 6.3.4. Haddock in Division 6.b. Catch numbers-at-age by sampled and unsampled landings and sampled and raised (unsampled) discards for 2023, after allocations within InterCatch.

Figure 6.3.5. Haddock in Division 6.b. ICES estimates of total landings and discards.

Figure 6.3.6. Haddock in Division 6.b. Discard proportion by weight.

Figure 6.3.7. Haddock in Division 6.b. Discard proportion by age.

Figure 6.3.8. Haddock in Division 6.b. Catch-at-age in numbers by year. Red: bms, green: discards, blue: landings.

Figure 6.3.9. Haddock in Division 6.b. Mean weight-at-age in discards and landings.

Figure 6.3.10. Haddock in Division 6.b. Mean weight-at-age in catch.

Figure 6.3.11. Haddock in Division 6.b. Comparision of modelled Q3 survey indices between WGCSE 2024 (including data to 2023) and WKBGAD (data <to 2022).

Figure 6.4.1. Haddock in Division 6.b. Log catch numbers-at-age (upper) and catch curves (lower) from commercial catch at age data.

Figure 6.4.2. Haddock in Division 6.b. Mean standardised catch-at-age proportions by number (dark shaded values are above average).

Figure 6.4.3, Haddock in Division 6.b. Rockall pt 1 survey: log mean standardised indices at age by cohort (left) and catch curves (right).

Figure 6.4.4. Haddock in Division 6.b Modelled Q3 survey index: log mean standardised indices by cohort (left) and catch curves (righ).

Figure 6.4.5. Haddock in Division 6.b. Modelled Q3 survey index: scatterplots.

Figure 6.4.6. Haddock in Division 6.b. Comparison of model estimated catch numbers-at-age (log-scale) and input data.

Figure 6.4.7. Haddock in Division 6.b. Comparison of model estimated survey numbers-at-age (log scale) and input data: Rockall pt 1 (left panel of 8 plots) & Modelled Q3 (right panel of 8 plots).

Figure 6.4.8. Haddock in Division 6.b. Comparison of model estimated stock weights-at-age and input data.

Figure 6.4.9. Haddock in Division 6.b. One-step ahead residuals from final SAM assessment.

Figure 6.4.10. Haddock in Division 6.b. Process residuals from final SAM assessment.

Figure 6.4.11. Haddock in Division 6.b. Final assessment retrospective plots.

Figure 6.4.12. Haddock in Division 6.b. Final assessment estimates of survey catchabilities.

Figure 6.4.13. Haddock in Division 6.b Final assessment estimates of fishery selectivity.

Figure 6.4.14. Haddock in Division 6.b. Summary of the stock assessment. The assumed recruitment value for 2024 is shaded in a lighter colour.

Figure 6.5.1. Haddock in Division 6.b. Forecast at F=F_{MSY} assuming intermediate year TAC constraint and recruitment resampled from the full time series.

Figure 6.5.2. Haddock in Division 6.b. Contribution to forecast of total catch (2025) and SSB (2026) by recruitment year. Yellow indicates assumed value, blue is an assessment model estimate.

Figure 6.7.1. Haddock in Division 6.b. Historical assessment results (final-year recruitment assumption and SSB estimate included). This stock was benchmarked in 2024 at which point the reference points were revised, and therefore only the last assessment results should be compared to the reference points indicated. Assessments conducted in 2022 and 2023 do not provide estimates of SSB, F and recruitment and therefore are not included.