8 Haddock in Subarea 4, Division 6.a and Subdivision 20 (North Sea, West of Scotland and Skagerrak)

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 (ICES, 2014) concluded that the two notional haddock stocks should be assessed as one stock.

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

There have been no decommissioning schemes affecting haddock fisheries since the major rounds in 2002 and 2004. A number of Scottish vessels have been taking up opportunities for oil and gas, and renewables sector support work during recent years with a view to saving quota and days at sea.

With the relatively limited cod and whiting quotas in recent years, many vessels have tended to concentrate more on the haddock fishery, with others taking the opportunity to move between the *Nephrops* and demersal fisheries (particularly during 2006 and 2007 – there may have been fewer boats changing focus in this way from 2008 to 2015). Accompanying the change in emphasis towards the haddock fishery, there has also been a tendency to target smaller fish in response to market demand. Some trawlers operating in the east of the North Sea have used 130 mm mesh and this is likely to have improved selectivity for haddock. Fish from the 2018, 2019 and 2020 year-classes formed the bulk of haddock catches in 2020. The entry of the large 2019 year-classes into the fishery has led to an increase in the discarding rate for 2020, and the similar 2020 year-class may lead to a further increase in discards from 2021 onwards. Previous changes in discarding rates may also have been due to other measures related to the Scottish Conservation Credits scheme which concluded in 2016 (CCS; see Section 8.1.4).

Specific information on changes in the Scottish fleet during 2011–2020 was not provided to WGNSSK in 2021, and it is difficult to reach a firm conclusion on the likely effect of recent fishery changes on haddock mortality. Changes in gear that were required to qualify for the Scottish CCS were likely to have reduced bycatch (and therefore discards) of haddock in the *Nephrops* fishery in particular. The inclusion of Scottish vessels in the CCS was mandatory during the period 2009–2016, and compliance was been close to 100%. Cod avoidance under the real-time closures scheme (which is a component of the CCS) could also have moved vessels away from

haddock concentrations, but the extent of this depends on how closely cod and haddock distributions are linked, and on how successful the avoidance strategies were. On the other hand, vessels catching fewer cod may have increased their exploitation of haddock in order to maintain economic viability. It is unclear what changes in fleet dynamics and fishing behaviour have been caused by the EU landings obligation which was implemented for the majority of fleets catching Northern Shelf haddock in January 2016.

Following trials during 2010–2013, 26 Scottish demersal whitefish vessels participated in the 2014 Fully Documented Fishery (FDF) scheme (although 3 vessels left the scheme during the year). Similar trials have been conducted during various periods by Denmark, England, Germany, Sweden and the Netherlands. In the Scottish North Sea FDF trials, vessels were exempt from some effort restrictions and were allocated additional cod quota: in return, they had to carry monitoring cameras and land all cod caught. It is not clear what the impact was on haddock fisheries of an enforceable discard ban for cod, and in data collation for the haddock assessment it was assumed that FDF vessels would have similar haddock discard patterns as other vessels. It should be noted that the Scottish FDF schemes implemented to date have all been restricted to the North Sea: cod discarding from CCTV vessels has remained legal in Division 6.a, and indeed has been mandatory for over-quota cod. The Scottish FDF scheme for 2015 continued without a break from the end of 2014, and included 24 vessels (although 6 left during the year). In 2016, 14 vessels participated in the scheme: the uptake of the scheme declined due to concerns about monitoring of discards under the EU Landing Obligation. The cod-specific FDF scheme terminated at the end of 2016, due to the suspension of most aspects of the EU Cod Recovery plan which removed the opportunity for countries to provide additional quota for participants. A new Scottish FDF scheme started in 2017, which was run along similar lines and which was intended to monitor discarding of saithe and monkfish: this proved to be short-lived and was terminated after one year..

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 2021.

8.1.3 ICES advice

8.1.3.1 ICES advice for 2020

Subarea 4, Division 6.a and Subdivision 20

The advice for 2020 was updated in November 2019:

ICES advises that when the MSY approach is applied, total catches in 2020 should be no more than 41 818 tonnes.

8.1.3.2 ICES advice for 2021

Subarea 4, Division 6.a and Subdivision 20

The advice for 2021 was updated in August 2020:

ICES advises that when the MSY approach is applied, total catches in 2021 should be no more than 69 280 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

Until 2014, North Sea haddock (Subarea 4 and Subdivision 20) were jointly managed by the EU and Norway under an agreed management plan, the details of which are given in the Stock Annex. However, the validity and sustainability of the management plan when applied to the wider Northern Shelf area had not been evaluated by ICES, and advice could not be provided on the basis of the plan as a consequence. A separate management plan for Division 6.a was evaluated by ICES in 2008 to be precautionary, but similarly cannot be used to provide advice for the full stock area. A management plan for Northern Shelf haddock was to have been developed during 2015, but this did not occur as the basis for management of shared EU-Norway stocks was not agreed. More recently, in 2018, EU-Norway requested an evaluation of multiple management strategies (ICES, 2019a), which are currently under consideration. In the meantime, the stock is managed according to advice based on the ICES MSY approach.

During 2008, 15 real-time closures (RTCs) were implemented under the Scottish Conservation Credits Scheme (CCS). In 2009, 144 RTCs were implemented, and the CCS was adopted by 439 Scottish and around 30 English and Welsh vessels. In 2010, there were 165 closures, and from July 2010 the area of each closure increased (from 50 square nautical miles to 225 square nautical miles). In more recent years, the following numbers of closures were implemented: 185 (2011), 173 (2012), 166 (2013), 94 (2014), and 97 (2015). 114 closures were implanted during 2016, although the scheme was suspended on 20 November and there are no plans for its reintroduction. The CCS had two central themes aimed at reducing the capture of cod through (i) avoiding areas with elevated abundances of cod through the use of Real Time Closures (RTCs) and (ii) the use of more species-selective gears. Within the scheme, efforts were also being made to reduce discards generally. Although the scheme was intended to reduce mortality on cod, it undoubtedly had an effect on the mortality of associated species such as haddock.

Studies tracking Scottish vessels during 2009–2010 concluded that vessels did indeed move from areas of higher to lower cod concentration following real-time closures during the first and third quarters, although there was no significant effect during the second and fourth quarters; see Needle and Catarino (2011). In a subsequent analysis, Needle (2012) showed that the net effect of RTCs appeared to be to attract vessels to high-abundance areas, although the movement towards RTCs may have been coincidental. However, the effect of these changes in behaviour on the haddock stock is unclear.

In early 2008, a one-net rule was introduced in Scotland as part of the CCS. This is likely to have improved the accuracy of reporting of landings to the correct mesh size range. The remaining technical conservation measures in place for the haddock fisheries in Subarea 4, Division 6.a and Subdivision 20 are summarised in the Stock Annex.

The EU landings obligation was initially implemented from 1 January 2016 for directed haddock fisheries and was fully implemented in the North Sea and North Western Waters from 1 January 2019. 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.

Annual management of the fishery operates through TACs for three discrete areas. The first is Subarea 4 (and EU Waters of 2.a). The 2020 and 2021 TACs for haddock in this area were 35 653 tonnes and 42 785 tonnes respectively. The second is Division 3.a (EU waters), for which

the TACs for 2019 and 2020 were 2193 tonnes and 2630 tonnes respectively. The third is Division 6.a, for which the TACs in 2019 and 2020 were 3973 tonnes and 4767 tonnes respectively.

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). Since 2012, international data on landings and discards have been collated through the InterCatch system (see Section 1.2). International data for below minimum size (BMS) landings and logbook registered discards (LRD) for Northern Shelf haddock have been collated through the InterCatch system from 2016. 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. 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. However, the proportion of landings that have been sampled is less than in previous years due to the impact of the covid-19 pandemic (in particular, there was no sampling at all of landings or discards during Q2 in 2020). Age compositions for the remaining landings have therefore been determined by averaging across the available sampling (as for last year), without consideration of quarter, country or gear type. Similarly, discard observations are available for the fleets landing the majority of haddock landings (see Figure 8.2.2), so discard rates for the remaining fleets have also been inferred using simple averaging weighted by landing weight.

The collation of BMS landings and LRD in InterCatch was introduced in 2016 in accordance with the implementation of the EU landing obligation. However, BMS data from Scotland were not submitted in 2017 resulting in no samples of the BMS landings by weight for that year. In 2018, BMS landings were only partially sampled in Scotland (2 out of 4 quarters) resulting in just 28% of the total BMS landings being sampled (see Figure 8.2.3). In 2019 91% of the total BMS landings were sampled: however, in 2020 (due to the impact of covid-19) only 6% of BMS landings were sampled for age. Age compositions for the overall BMS landings were determined in a similar way to the landings without consideration of quarter, country or gear. Logbook registered discard observations have not been submitted by any country for haddock since 2016.

The full time series of landings, discards, BMS landings and industrial by-catch (IBC) is presented in Table 8.2.5 and Figure 8.2.4. The total landed yield of the international fishery has been relatively stable since 2007. 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; dropping slightly in 2017 (17%) and 2018 (13%). In 2019, the discard rate has increased again to 15%, and further to 23% in 2020 (probably because of two large incoming year-classes). The recent changes in discarding are not consistent across ages (Figure 8.2.5).

It would be expected that under the EU Landing Obligation fish caught under the MCRS would be landed and recorded as BMS landings in log books rather than. The log book records of BMS landings would then be reported to ICES. However, low BMS values may be seen if the fish caught below MCRS are either not landed, not recorded in log books, not reported to ICES or a mixture of the three. BMS landings reported to ICES in 2020 are 0.56% of the total catch which is

significantly lower than the discard estimate of 23% of total catch. This suggests that fish caught below MCRS are not being reported as BMS.

Subarea 4 discard estimates are derived from data submitted by Denmark, Germany, the Netherlands, England and Scotland. As Scotland is the principal haddock fishing nation in that area, Scottish discard practices dominate the overall estimates. DCF regulations oblige only the UK (Scotland and England) and Denmark to submit discard age-composition data for Subarea 4. Subdivision 20 discard estimates are derived from data submitted by Denmark. Division 6.a discard estimates are provided by UK (Scotland) and Ireland. BMS landing estimates were provided for area Subarea 4 and Subdivision 20 by UK (Scotland). Industrial bycatch (IBC) has declined considerably from the high levels observed until the late 1970s, although the estimate for 2020 is the highest since 2003 and may be due to an increase in effort in the Norway pout fishery.

Previously, estimated discard rates could be calculated using video data from Scottish vessels carrying cameras (as part of the FDF scheme described in Section 8.1.2). 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

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. The increase in discards in 2019 and 2020 is thought to be due to the entry of the large 2018- and 2019-year classes to the fishery. 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.

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. Weight-at-age in the stock is assumed to be the same as weight-at-age in the total catch. The mean weights-at-age for the separate catch components are given in Tables 8.2.12 to 8.2.15 and are illustrated in Figure 8.2.6: 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. 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, and these are used in the short-term forecast (Section 8.6).

8.2.4 Maturity and natural mortality

Maturity is assumed to be fixed over time and knife-edged at age 3 (that is, all fish aged 0–2 are assumed to be immature, all fish aged 3 and older are assumed to be fully mature). Natural mortality varies with age and year as shown in Figure 8.2.7 and Table 8.2.16. The general basis for these estimates is described in the Stock Annex, and these values shown here are derived from the WGSAM 2014 key run (as revised in 2017). The results from the 2020 WGSAM key run have not been used this year: this implementation has been delayed until the forthcoming benchmark meeting (2021–22).

8.2.5 Catch, effort and research vessel data

The available survey data are summarised in the following table: data used 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	0-8
Subarea 4	Scotland	Q3	ScoGFS Q3 GOV	1998-present	0-8
Subarea 4	England	Q3	EngGFS Q3 GRT	1977-1991	0-9
Subarea 4	England	Q3	EngGFS Q3 GOV	1992-present	0-9
Subarea 4 and Division 3.a	**International**	**Q1**	**IBTS Q1**	**1983-present**	**1-5**
Subarea 4 and Division 3.a	**International**	**Q3**	**IBTS Q3**	**1991-present**	**0-5**
Subarea 6.a	Scotland	Q1	ScoGFS-WIBTS Q1	1985-2010	1-8
Subarea 6.a	Scotland	Q1	New ScoGFS-WIBTS Q1	2011-present	1-8
Subarea 6.a	Scotland	Q4	ScoGFS-WIBTS Q4	1996-2009	0-7
Subarea 6.a	Scotland	Q4	New ScoGFS-WIBTS Q4	2011-present	0-7
Subarea 6.a	Ireland	Q4	IGFS-WIBTS-Q4	1993-2002	0-8
Subarea 6.a	Ireland	Q4	New IGFS-WIBTS-Q4	2003-present	0-8

The 2014 benchmark meeting (ICES, 2014) concluded that only the North Sea IBTS Q1 and Q3 survey indices should be used to tune the Northern Shelf assessment. The West of Scotland surveys conducted by Scotland and Ireland cover too small a proportion of the overall stock area to be considered reliable indicators of overall Northern Shelf stock dynamics, and the separate English and Scottish North Sea indices were only used previously because of the historical timing of the working group (WGNSSK previously met in early October when the collated IBTS Q3 survey index was not yet available). ICES WKHAD (2014) recommended that the IBTS working group consider whether the North Sea IBTS Q1 and West of Scotland ScoGFS Q1 indices could be combined, but this is for future consideration.

In 2020, ICES updated the method used to produce the IBTS Q1 and Q3 survey indices by automating the age-length key fill-ins which had been done previously on a manual basis. A comparison of the stock assessment results using these new survey indices to the results of WGNSSK 2019 revealed significant differences in the estimated SSB for the last 20 years (a 20-30% reduction). As a result, the decision made was to continue to use the existing survey indices rather than adopting the new survey indices as input data. However, the survey indices will only be produced using the new method from 2020. As a result, the existing survey indices will be used as input data up until 2019 after which survey indices produced using the new method will be used until further examination of the full time series of new survey indices can take place during the next benchmark.

Survey data used for the calibration of the assessment are presented in Table 8.2.17. Survey-based abundance distributions by age and year are given in Figures 8.2.8 (North Sea IBTS Q1), 8.2.9 (North Sea IBTS Q3) and 8.2.10 (Scottish West Coast IBTS Q1 and Q4)). These demonstrate the concentration of North Sea haddock towards the north and west of the North Sea, quite widely along the continental shelf to the west of Scotland. The large incoming 2019 and 2020 year-classes can be seen in both the North Sea surveys, although they are not apparent in the West of Scotland surveys. Both North Sea surveys show a concentration of these year-classes further to the south than usually seen, particularly when very young, and this change in geographical extent possibly accounts for the lack of synchrony between the North Sea and West of

Scotland surveys for these year-classes. Abundance trends in survey indices are shown in Figure 8.2.11. 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 TSA (Fryer, 2002) as the main assessment method. The results of SURBAR and SAM analyses are also shown, to corroborate (or otherwise) 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.

An exploratory SAM assessment was conducted, using the run settings stipulated in ICES WKHAD (2014). The stock summary and residual plots from this run are given in Figure 8.3.4. The SAM assessment follows similar trends to the final TSA assessment (see also Figure 8.3.10).

8.3.2 Exploratory survey-based analyses

A SURBAR run (ICES, 2010; Needle, 2015) was carried out using the same combination of tuning indices as the TSA and SAM assessments. The summary plot from this run is given is Figure 8.3.5, which indicates good precision in estimates for total mortality, and relative estimates for biomass and recruitment. The SURBAR residual plot in Figure 8.3.6 shows that there remains an indication of some conflict (mostly positive residuals for Q1 and negative residuals for Q3). The plot of survey catch curves also shows reasonable consistency (Figure 8.3.7), although there are indications are reduced catchability for cohorts in IBTS Q1 from the 2010. The plots of mean-standardised log survey indices by age and cohort (Figure 8.3.8) and the pairwise within-survey correlations (Figure 8.3.9) show that both surveys track year-class strength well through the population overall. The results are discussed further in Section 8.3.4 below.

8.3.3 Conclusions drawn from exploratory analyses

Mean-standardising SSB and recruitment estimates (using a common year-range for the mean) and generating TSA and SAM estimates of Z by adding F and M enables the comparison between TSA, SAM and SURBAR shown in Figure 8.3.10. SSB and recruitment estimates are very similar from the three models, although it is noticeable that the SURBAR estimates for large year-classes in particular tend to be higher, and the swings between high and low SURBAR SSB estimates are more pronounced than for TSA and SAM. The mean Z time-series from SURBAR are consistent

for the most part with those from TSA and SAM, although there is some offset in years of higher mean Z. Overall, the SAM and SURBAR assessments concur with and support the final TSA assessment, with some relatively minor variations.

8.3.4 Final assessment

Table 8.3.1 gives the final TSA assessment settings, while Table 8.3.2 gives the corresponding parameter estimates from the completed run. A full description of the TSA method and the purposes of each parameter are given in the Stock Annex, and the ICES WKHAD (2014) 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"), as the selectivity characteristics of these latter components are similar.

In 2021, the WG decided not to treat the 2019 or 2020 year-classes as "large year-classes" in the TSA settings. There is good evidence that these are the largest year-classes since the 1999 year-class. However, inspection of the estimated recruitment time-series (Figure 8.3.13) shows that even these larger year-classes are much smaller than the 1974, 1979 and 1999 that are currently treated as "large" by TSA (meaning that they are given higher variance when fitting the random-walk recruitment parameter). Furthermore, the Stock Annex states that a benchmark or inter-benchmark process would be needed to assess the amount of evidence in favour of classifying any particular year class as significantly large enough to warrant a change to the TSA settings. No changes were made to the TSA settings this year on account of the 2019- and 2020-year classes and the issue will be discussed at the next benchmark.

The stock summary is given in Figure 8.3.11, with the stock-recruit plot in Figure 8.3.12 and the recruitment time-series in Figure 8.3.13. The latter plot shows that the underlying mean level of recruitment has declined from the early seventies until today, and recruitment remains lower in general. Furthermore, the size of sporadic, larger year classes has diminished since the large 1999 year-class, though the 2019- and 2020-year classes suggest this trend may have reversed. Figure 8.3.14 summarizes the observed and fitted discards (discard+bycatch+BMS) proportions by age.

TSA residuals are given in Figures 8.3.15 (landings), 8.3.16 (discard+bycatch+BMS), 8.3.17 (the IBTS Q1 survey) and 8.3.18 (the IBTS Q3 survey). Overall these indicate reasonably good fits to data, although the TSA model overpredicts landings at age 8 in recent years (this needs to be investigated at the next benchmark).

Figures 8.3.19 to 8.3.21 give the corresponding time-series of observed and fitted values for total catch (Figure 8.3.19), the IBTS Q1 survey (Figure 8.3.20) and the IBTS Q3 survey (Figure 8.3.21). The estimate of total catch at age-0 prior to 1991 is based on quite noisy discard+bycatch+BMS data where they are available, or on model inference where they are not (1973–1977), so for the earlier period model fits are not necessarily very close to observations. The other notable feature is that total catch tends to be overestimated for the larger 1999 year-class, whereas survey indices tend to be slightly underestimated for this year class: the TSA model fit is a compromise between the two.

Figure 8.3.22 summarizes the results of TSA retrospective analyses for Northern Shelf haddock. There is very little retrospective noise or bias: none of the retrospective run falls outside an approximate 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 TSA and were -6%, -2% and -23% respectively. The Mohn's rho

value for recruitment is high, but the values for SSB and mean F are small and lie well within the ±20% limits specified by WKFORBIAS (ICES, 2020).

Fishing mortality estimates for the final TSA assessment are presented in Table 8.3.3, the stock numbers in Table 8.3.4, and the assessment summary in Table 8.3.5.

8.4 Historical Stock Trends

The historical stock and fishery trends are presented in Figure 8.3.11.

Landings yields have stabilised since 2005, partly due (until 2014) to the limitation of inter-annual TAC variation to ±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 1999, 2005, 2009 and 2014 year-classes, while industrial bycatch (IBC) is now at a very low level for haddock (see also Figure 8.2.3).

Estimated fishing mortality for 2008 to 2020 fluctuates between 0.2 and 0.4 and is now just below the F_{MSY} value of 0.194 in 2020. 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 2006–2008 and 2010–2013 year-classes are estimated to have been very weak, and the fishery has been sustained in recent years by the 2005 and 2009 year-classes. The 2014 year-class is modest in size compared to the previous sporadic larger year classes and is below the long-term average for recruitment. Therefore, it is expected to make a smaller contribution to the stock compared to other recent "large" year classes over the next few years. 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. These recruitment events do not yet have any impact on estimated SSB, as that assumes a knife-edge maturity at age 3, but will impact significantly on the short-term forecast for 2022 and 2023 (see Section 8.6).

8.5 Recruitment estimates

Following the Stock Annex, recruits in the intermediate year (IY = 2021) and in the quota year (IY + 1 = 2022) are based on the TSA estimate of forecasted recruits at age 0 in the intermediate year, as this ensures consistency between assessment and forecast. This stock is subject to the reopening process later in the year, following the completion of the IBTS Q3 survey, where the TSA recruitment estimate may be updated with a recruitment estimate resulting from an RCT3 analysis (according to the standard ICES update protocol).

The following table summarises the recruitment, age 1 and age 2 assumptions for the short-term forecast.

Year class	Age in 2021	TSA estimate (millions)	TSA forecast (millions)
2019	2	1419	
2020	1	4877	
2021	0		6640
2022	Age 0 in 2022		6640
2023	Age 0 in 2023		6640

8.6 Short-term forecasts

Weights-at-age

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

The outcomes for the total catch and the landings (also referred to as wanted catch) are summarised in Figures 8.6.1 and 8.6.2 respectively. The weights-at-age for discards and BMS were combined into an unwanted catch category using the relative contribution of each component (in 2020) to the total catch. These combined weights were used in the extrapolation to calculate the forecast weights and are shown in Figure 8.6.3. There is insufficient data to allow for cohort-based modelling of weights-at-age in the industrial bycatch component, so simple three-year (2018–2020) means by age are used for all forecast years for the IBC component.

Fishing mortality

ICES WKHAD (2014) concluded that fishing mortality estimates for the intermediate year should be taken to be the same as the final year, considering that F is smoothed within the TSA model. When this approach results in landings that overshoot the TAC, a TAC constraint should be considered. A TAC constraint was needed for the intermediate year to avoid a TAC overshoot of 30 643 t (given that quota uptake for this stock very seldom exceeds 80-90%). The combined-area human consumption TAC for 2021 is 50 182 tonnes.

Given the choice of fishing-mortality rates discussed above, partial fishing mortality values were obtained for each catch component (wanted catch (human consumption landings), unwanted catch (discards and BMS landings) and bycatch) by using the relative contribution (averaged over 2018–2020) 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. This is summarised in the Stock Annex.

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

The inputs to the short-term forecast (conducted using the MFDP program) are presented in Table 8.6.1. Results for the short-term forecasts are presented in Table 8.6.2. Assuming a TAC-constrained F of 0.117 in 2021, SSB is expected to be 236 322 tonnes in 2021, before increasing in 2022 to 573 051 tonnes (the rapid increase in SSB is due to the 2019-year class and the assumption of knife-edge maturity at age 3). In this case, projected wanted catch (human consumption yield) in 2021 would be 34 514 tonnes with associated projected unwanted catch (discards + BMS) of 15 668 t. IBC would be 849 tonnes.

Several alternative options for 2022 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_{2020}, $F_{MSY\text{-}upper}$, and

$F_{MSY\text{-}lower}$. Under the assumption of F_{MSY}, the 2022 total catch is forecast to be 128 708 tonnes, which corresponds (if 2021 discard+BMS rates remain unchanged) to a wanted-catch yield of 101 908 tonnes and unwanted catch of 25 339 tonnes. This advised catch represents a 154% increase on the 2021 TAC. This exploitation is forecast to lead in turn to an SSB in 2023 of 723 334 tonnes, an increase of 26% on the value forecast above for 2021.

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

Following the estimation of revised F_{MSY} reference points at the 2014 WKMSYREF3 meeting, WGNSSK (2016) conducted further analysis using the EqSim software to check that the estimated points remained valid following the update assessment. These analyses were repeated by an IBP following modifications made to the assessment (ICES IBPHaddock, 2016). Figure 8.8.1 summarises the output from this analysis, which indicates that an appropriate value of F_{MSY} for Northern Shelf haddock is now **0.194**. This is a reduction from the value set at WKMSYREF3 (0.37): the key difference in the estimates is that the calculation is based on the recruitment time-series from 2000–2015, rather than the full 1972–2015 time series. The former period is currently more appropriate, as recruitment does appear to be declining (see Figure 8.3.11) and it would be unwise to assume that a very large recruitment is likely in the near future. However, the size of the 2019- and 2020-year classes may lead to this assumption being reassessed at the next benchmark

Using the ICES guidelines for sporadic spawners, B_{lim} was revised to **94 kt** (the estimated SSB for 1979, the smallest stock size to produce a good recruitment), and B_{pa} was revised to 1.4 x B_{lim} = **132 kt** (which was also used as the MSY $B_{trigger}$ value). An EqSim run with no advice error or rule generated $F_{lim} = F_{p50} = 0.38$, and $F_{pa} = F_{lim}/1.4 = 0.27$. A second EqSim run with advice error but no advice rule produced an estimate of $F_{MSY} = 0.24$ with the range of 0.18 to 0.30 (Figure 8.8.1, top plot). However, an EqSim run with advice error and rule showed that $F_{p05} = 0.19 < F_{MSY}$ (Figure 8.8.1, bottom plot) so both F_{MSY} and the upper limit of the F_{MSY} range were constrained resulting in an F_{MSY} estimate of 0.19 and associated range of 0.18–0.19.

The EqSim analysis was repeated by WGNSSK 2017 following the issuing of new guidelines (WKMSYREF4) that stated that the lower limit of the F_{MSY} range should be redefined when the F_{MSY} range is constrained by F_{p05}. The new guidelines define the lower limit of the F_{MSY} range as the F that delivers 95% of the yield at $F_{MSY} = F_{p05}$. The new EqSim run followed the same procedure as used in the IBP though with the new definition for the lower limit of the F_{MSY} range and resulted in a F_{MSY} range of 0.167–0.194 (see Figure 8.2.2). This rerun resulted in minor differences in the estimation of F_{MSY} (0.194 versus 0.193 from the IBP) which is thought to result from rounding.

Although there were updated natural mortality values for WGNSSK 2018, reference points have not been modified as a result There were no discernible differences in assessment parameters, and therefore it was assumed that the reference points previously derived at WGNSSK 2017 remain applicable. In WGNSSK 2021, F_{pa} was revised as the F that provides a 95% probability for SSB to be above

B_{lim} ($F_{p.05}$ with AR). Reference points will be revisited at the benchmark during 2021/22.

The reference points in full from these analyses are given below:

Variable	WKHAD (2014)	IBPHaddock (2016)	WGNSSK 2017–2020	WGNSSK 2021
B_{lim}	63 kt	94 kt	94 kt	94 kt
B_{pa}	88 kt	132 kt	132 kt	132 kt
F_{lim}	n/a	0.38	0.384	0.384
F_{pa}	n/a	0.27	0.274	0.194
F_{MSY}	0.37	0.19	0.194	0.194
$F_{MSY\ lower}$	n/a	0.18	0.167	0.167
$F_{MSYupper}$	n/a	0.19	0.194	0.194

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 TSA model is very low, and well within the WKFORBIAS guidelines.

8.10 Status of the Stock

Fishing mortality is now estimated to have remained at a relatively low level in 2020 and is now fluctuating around the historical minimum, and this is just below the estimate of F_{MSY} (0.194). 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. Spawning stock biomass is currently well above B_{pa} (132 kt) and is predicted to increase rapidly over the next few years as the 2019- and 2020-year-classes mature.

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 just 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 moderate year-classes. The most recent of these occurred in 2005, 2009 and 2014 with two substantial year classes occurring in 2019 and 2020. Other recent cohorts have been very weak. SSB is expected to increase over the next few years as the 2019 and 2020 year-classes

mature and its impact on SSB is expected to be the most significant in the available time-series (see Figure 8.11.1).

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 are now increasing as large numbers of small fish 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 Section 8.1.4). Haddock is included in the EU Landings Obligation regulation from 2016, though the impacts on fishing and on the stock are as 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
3	4	5	2	3	3.4

8.12.1 Data and stock ID

Explore combining survey indices. Derive time-varying maturity estimate. Derive estimates of mean weights at age for stock. Investigate indices of reproductive potential and methods to use them in management advice. Explore stock ID and structure, using otolith micro-chemistry, tagging data, and the spatial range of genetic data. Ensure consistency in catch data used in assessment and advice sheet (SOP issues in InterCatch data).

8.12.2 Assessment

Investigate poor fit in plus group in view of increasing relative importance of this age class. Investigate alternative models which are compatible with high performance computing (simulation runs). TSA shows some bias in prediction errors for Age 0 IBTS Q3 survey. TSA support likely unavailable after 2021/22 so need to consider alternative models. Exploratory assessment model SURBAR – develop likelihood profiling for *ad hoc* parameters, and catchability estimation

model based on catch curves. If TSA is retained, objective criteria are needed to decide if a year class is significantly large to warrant special treatment in TSA. Alternatively, some exploration of modelling techniques for sporadic recruitment is needed (mixed distributions etc.).

8.12.3 Forecast

Investigate extent of cohort effect on growth rate. Ensure consistency between catch components for weight at age cohort modelling. Investigate intermediate year recruitment assumption. Forecast value for recruitment would benefit from including information on the probability of large year classes occurring.

8.13 References

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Table 8.2.1. Haddock in Subarea 4, Division 6.a and Subdivision 20. Nominal landings (000 t) during 2008–2020, as officially reported to, and estimated by, ICES, along with WG estimates of catch components, and corresponding TACs. Landings estimates for 2019 and 2020 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 implementation of the Landing Obligation). Reporting of BMS landings started in 2016.

Subdivision 20											
Country	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
DE	65	102	120	90	114	103	125	56	31	30	12
DK	1139	1661	1916	1456	1763	1059	908	852	542	458	448
NL	1	0	0	6	6	4	0	20	4	4	1
NO	81	125	303	223	86	63	70	65	36	27	0
PT	0	0	0	0	0	0	0	0	0	0	15
SE	126	198	210	217	219	202	129	104	140	93	56
UK	0	0	0	3	0	0	0	0	0	0	0
Subarea 4											
Country	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
BE	78	106	78	78	98	47	53	30	29	29	40
DE	634	575	548	677	677	599	554	609	347	311	331
DK	725	697	947	1283	1079	1442	1244	1185	1117	1203	1683
FO	5	0	0	0	0	0	0	0	0	1	0
FR	276	320	175	177	209	100	121	140	201	189	144
NL	41	71	191	172	99	44	146	75	89	162	175
NO	1126	1195	1006	1662	2743	2003	1499	2164	1431	1517	3171
SE	90	128	103	113	154	136	118	181	99	111	114
UK	24983	23343	27378	33013	29851	25905	26427	25667	25880	21930	20452
Division 6.a											
Country	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
DE	1	0	0	0	0	0	0	0	0	0	0
DK	0	0	0	0	0	0	2	2	1	9	4
ES	28	36	15	14	19	9	33	28	28	64	26
FO	0	0	0	0	0	0	0	<1	0	0	0
FR	89	73	32	51	67	41	62	68	66	57	86
IE	396	290	845	746	667	768	1034	641	758	562	441
NL	0	0	0	0	0	11	28	31	15	54	13
NO	9	4	0	6	2	7	5	1	7	10	2
UK	2415	1364	4123	3878	3261	3051	3101	2480	3295	2789	2081
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Official landings	32308	30288	37990	43830	40945	35520	35614	32290	34083	29610	29425
ICES landings	31940	36570	38162	43734	41143	35295	35058	32827	34404	30743	30176
ICES discards	13071	13067	5032	3305	5090	6255	7749	6936	4871	5524	9335
ICES IBC	431	24	1	54	65	21	37	19	5	186	1077
ICES BMS	-	-	-	-	-	-	201	93	155	179	314
ICES total catch	45442	49661	43195	47093	46298	41571	43045	39875	39435	36632	40558
TAC 4	35794	34057	39000	45041	38284	40711	61933	33643	41767	28950	35653
TAC 3.a	2201	2100	2095	2770	2355	2504	3926	2069	2569	1780	2193
TAC 6.a	2670	2005	6015	4211	3988	4536	6462	3697	4654	3226	3973
Total TAC	40665	38162	47110	52022	44627	47751	72321	39409	48990	33956	41819
ICES quota uptake	79%	96%	81%	84%	92%	74%	48%	83%	80%	108%	82%

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 2020.

Catch category	Raised or imported	Weight (tonnes)	Proportion
BMS landings	Imported	222	100
Discards	Imported	6217	68
Discards	Raised	2889	32
Landings	Imported	29278	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 2020.

Catch category	Raised or imported	Sampled or estimated	Weight (tonnes)	Proportion
Logbook registered discards	Imported	Estimated	0	NA
Landings	Imported	Sampled	22245	76
Landings	Imported	Estimated	7033	24
Discards	Imported	Sampled	5845	64
Discards	Raised	Estimated	2889	32
Discards	Imported	Estimated	372	4
BMS landings	Imported	Estimated	208	94
BMS landings	Imported	Sampled	14	6

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 2020.

Catch category	Raised or imported	Sampled or estimated	Area	Weight (tonnes)	Proportion
Logbook registered discards	Imported	Estimated		0	NA
Landings	Imported	Sampled	27.6.a	2389	89
Landings	Imported	Estimated	27.6.a	300	11
Discards	Imported	Sampled	27.6.a	545	75
Discards	Raised	Estimated	27.6.a	177	25
BMS landings	Imported	Sampled	27.6.a	16	99
BMS landings	Imported	Estimated	27.6.a	<1	1
Logbook registered discards	Imported	Estimated		0	NA
Landings	Imported	Sampled	27.4	19539	75
Landings	Imported	Estimated	27.4	6514	25
Discards	Imported	Sampled	27.4	5104	63
Discards	Raised	Estimated	27.4	2620	32
Discards	Imported	Estimated	27.4	369	5
BMS landings	Imported	Estimated	27.4	193	93
BMS landings	Imported	Sampled	27.4	14	7
Logbook registered discards	Imported	Estimated		0	NA
Landings	Imported	Sampled	27.3.a.20	317	59
Landings	Imported	Estimated	27.3.a.20	219	41
Discards	Raised	Estimated	27.3.a.20	196	68
Discards	Imported	Sampled	27.3.a.20	91	31
Discards	Imported	Estimated	27.3.a.20	3	1
BMS landings	Imported	Estimated	27.3.a.20	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). *Note that Subarea 4 and Subdivision 20 data are collated together in 2013, and are listed here only in the Subarea 4 section. **Note that BMS data for all areas are collated together here, and listed under the Combined column.

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	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	65.7		74.6	335.2
1966	225.6	73.5		46.7	345.8	0.6				0.6	29.9	0.7		30.6	256.1	74.2		46.7	377.0
1967	147.4	78.2		20.7	246.3	0.4				0.4	20.3	7.4		27.7	168.1	85.6		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		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		338.4	981.6
1970	524.1	101.3		179.7	805.1	0.7				0.7	34.1	6.2		40.3	558.9	107.5		179.7	846.1
1971	235.5	177.8		31.5	444.8	2				2	46.3	12.2		58.5	283.8	190.0		31.5	505.3
1972	193	128		29.6	350.5	2.6				2.6	41.1	16.4		57.5	236.7	144.4		29.6	410.7
1973	178.7	114.7		11.3	304.7	2.9				2.9	28.8	11.4		40.2	210.4	126.1		11.3	347.8
1974	149.6	166.4		47.5	363.5	3.5				3.5	18.0	15.4		33.3	171.1	181.8		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	293.4		41.5	499.9
1976	165.7	154.5		48.2	368.3	7				7	18.8	15.3		34.1	191.5	169.8		48.2	409.5
1977	137.3	44.4		35	216.7	7.8				7.8	19.3	4.4		23.7	164.4	48.8		35	248.2
1978	85.8	76.8		10.9	173.5	5.9				5.9	17.2	1.1		18.3	108.9	77.9		10.9	197.7
1979	83.1	41.7		16.2	141	4				4	14.8	6.5		21.3	101.9	48.2		16.2	166.3
1980	98.6	94.6		22.5	215.7	6.4				6.4	12.8	4.8		17.5	117.8	99.4		22.5	239.6
1981	129.6	60.1		17	206.7	6.6				6.6	18.2	7.1		25.3	154.4	67.2		17	238.6
1982	165.8	40.6		19.4	225.8	7.5				7.5	29.6	7.7		37.3	202.9	48.3		19.4	270.6
1983	159.3	66		12.9	238.2	6				6	29.4	3.4		32.8	194.7	69.4		12.9	277.0
1984	128.2	75.3		10.1	213.6	5.4				5.4	30.0	8.1		38.1	163.6	83.4		10.1	257.1
1985	158.6	85.2		6	249.8	5.6				5.6	24.4	10.7		35.1	188.6	95.9		6	290.5
1986	165.6	52.2		2.6	220.4	2.7				2.7	19.6	5.2		24.7	187.9	57.4		2.6	247.8
1987	108	59.1		4.4	171.6	2.3				2.3	27.0	11.1		38.1	137.3	70.2		4.4	211.9
1988	105.1	62.1		4	171.2	1.9				1.9	21.1	5.0		26.1	128.1	67.1		4	199.2
1989	76.2	25.7		2.4	104.2	2.3				2.3	16.7	2.5		19.2	95.2	28.2		2.4	125.8
1990	51.5	32.6		2.6	86.6	2.3				2.3	10.1	0.8		11.0	63.9	33.4		2.6	100.0
1991	44.7	40.2		5.4	90.2	3.1				3.1	10.6	4.8		15.3	58.4	45.0		5.4	108.7
1992	70.2	47.9		10.9	129.1	2.6				2.6	11.3	3.5		14.9	84.1	51.4		10.9	146.5
1993	79.6	79.6		10.8	169.9	2.6				2.6	19.1	7.0		26.1	101.3	86.6		10.8	198.7
1994	80.9	65.4		3.6	149.8	1.2				1.2	14.2	5.0		19.2	96.3	70.4		3.6	170.3
1995	75.3	57.4		7.7	140.4	2.2				2.2	12.4	7.7		20.0	89.9	65.1		7.7	162.6
1996	76	72.5		5	153.5	3.1				3.1	13.5	7.8		21.3	92.6	80.3		5	177.9
1997	79.1	52.1		6.7	137.9	3.4				3.4	12.9	7.5		20.4	95.4	59.6		6.7	161.7
1998	77.3	45.2		5.1	127.6	3.8				3.8	14.4	7.0		21.4	95.5	52.2		5.1	152.8
1999	64.2	42.6		3.8	110.7	1.4				1.4	10.4	3.9		14.3	76.0	46.5		3.8	126.3

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	Total	Landings	Discards	BMS landings	IBC	Total
2000	46.1	48.8		8.1	103	1.5				1.5	7.0	6.3		13.2	54.6	55.1		8.1	117.7
2001	39	118.3		7.9	165.2	1.9				1.9	6.7	8.5		15.2	47.6	126.8		7.9	182.3
2002	54.2	45.9		3.7	103.8	4.1				4.1	7.1	9.4		16.5	65.4	55.3		3.7	124.4
2003	40.1	23.5		1.1	64.8	1.8	0.2			2	5.3	4.5		9.8	47.2	28.2		1.1	76.5
2004	47.3	15.4		0.6	63.2	1.4	0.1			1.6	3.2	4.5		7.7	51.9	20.0		0.6	72.5
2005	47.6	8.4		0.2	56.2	0.8	0.2			1	3.1	3.8		6.9	51.5	12.4		0.2	64.1
2006	36.1	16.9		0.5	53.6	1.5	1			2.5	5.7	5.2		10.9	43.3	23.1		0.5	66.9
2007	29.4	27.8		0	57.3	1.5	0.8			2.3	3.7	4.0		7.8	34.6	32.6		0	67.3
2008	28.9	12.5		0.2	41.6	1.4	0.6			2	2.8	1.3		4.1	33.1	14.4		0.2	47.7
2009	31.3	10		0.1	41.3	1.5	0.6			2.1	2.8	1.8		4.6	35.6	12.4		0.1	48.1
2010	27.8	9.5		0.4	37.7	1.3	0.6			1.9	2.9	2.9		5.8	32.0	13.0		0.4	45.4
2011	26.3	10.2		0	36.5	9.9	1.7			11.6	1.7	1.5		3.3	37.9	13.4		0	51.4
2012	30.3	3.7		1.2	35.0	2.6	0.7			3.4	5.1	0.5		5.6	38.0	4.9		1.2	44.1
2013*	38.9	2.0		0.1	41.0						4.7	1.1		5.8	43.7	3.0		0.1	46.8
2014	34.9	4.1		0.1	39.1	2.3	0.1			2.4	4.0	0.8		4.8	41.1	5.1		0.1	46.3
2015	30.2	4.2		0.0	34.3	1.4	0.1			1.5	3.9	1.3		5.2	35.3	6.3		0.0	41.6
2016	29.8	5.5	0.2	0.0	35.5	1.2	0.0	0.0		1.2	4.2	1.5	0.0	5.8	35.2	7.1	0.2	0.0	42.6
2017	29.2	5.2	0.1	0.0	34.5	1.1	0.1	0.0		1.2	3.3	1.5	0.0	4.8	33.5	6.9	0.1	0.0	40.6
2018	29.3	3.3	0.1	0.0	32.7	0.8	0.1	0.0		0.8	4.3	1.2	0.0	5.5	34.3	4.5	0.2	0.0	39.0
2019	25.5	3.0	0.2	0.2	28.8	0.6	0.1	0.0		0.7	3.6	1.8	0.0	5.4	29.7	4.8	0.2	0.2	34.9
2020	26.4	8.4	-	1.2	36.1	0.4	0.3	-	0.2	0.9	2.8	0.8	-	3.6	30.2	9.1	0.3**	1.0	40.6

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 1972–2020 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
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	127003	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	200151	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
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

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
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	3780	15005	31864	75341	4757	2050	1516	566	1432	2570	5	8	1	1	0	0	4017
2009	10483	11042	15303	20764	78513	1860	845	567	239	276	569	6	2	0	0	0	1092
2010	2930	108139	17377	17834	11301	38134	853	416	160	83	85	148	9	0	0	3	488
2011	3003	6082	66355	17091	14138	11495	23124	677	282	95	17	5	60	0	0	0	459
2012	1319	3389	5260	66109	5388	3670	2416	7900	157	178	68	44	57	24	4	0	532
2013	1285	11998	4394	4838	68899	2269	1539	879	3896	37	7	8	2	2	2	0	3954
2014	3537	7504	19838	4818	7799	46760	1104	980	390	1706	14	6	1	1	0	2	2121
2015	3820	27637	15799	17624	1730	5166	22109	1059	433	437	782	107	0	0	0	0	1759
2016	1845	10258	61899	8780	5537	646	507	10150	262	151	9	146	8	0	0	1	57
2017	2593	12665	23033	55077	3214	1517	142	373	1482	509	5	20	5	1	0	1	2023
2018	3627	5530	24051	16957	34909	958	526	206	103	985	25	1	3	3	1	1	1122
2019	3173	18334	11863	25879	7208	21264	427	370	20	46	139	5	1	4	1	10	225
2020	2556	43607	30169	12260	14743	3303	7932	177	164	62	61	20	0	0	0	0	309

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 1972–2020 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
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

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
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
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	299	6472	50965	4461	1986	1378	563	1402	2566	5	8	1	1	0	0	3983
2009	0	486	4605	9666	61972	1775	793	521	239	276	566	6	2	0	0	0	1088
2010	0	1089	5150	12597	10176	35718	828	416	146	83	85	147	9	0	0	3	473
2011	0	224	16505	15260	13321	11383	22889	677	282	95	16	5	60	0	0	0	458
2012	0	261	3286	52091	4884	3660	2408	7885	157	178	68	44	57	24	4	0	532
2013	0	983	2493	4338	66123	2240	1526	867	3868	37	6	8	2	2	2	0	3924
2014	0	232	12630	3832	7626	42509	1100	965	382	1703	14	6	1	1	0	2	2110
2015	0	716	10568	16070	1635	5132	21108	1058	433	437	779	107	0	0	0	0	1756
2016	1	158	36148	8540	5499	641	496	10104	261	150	9	146	8	0	0	1	576
2017	0	143	10793	46544	3020	1458	130	361	1430	495	5	19	5	1	0	1	1956
2018	0	107	11991	15085	33153	954	525	202	103	980	25	1	3	3	1	1	1117
2019	0	282	5074	21822	6964	20335	421	366	19	46	137	5	1	4	1	10	222
2020	0	1013	16559	10309	14228	3002	7795	177	164	62	61	20	0	0	0	0	309

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 1972–2020 are used in the assessment.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
1965	5757	111654	4897	141863	3704	4	1	0	0	0	0	0	0	0	0	0	0
1966	13832	445648	12742	1197	24643	35	2	0	0	0	0	0	0	0	0	0	0
1967	46372	408281	62831	1032	219	1576	9	0	0	0	0	0	0	0	0	0	0
1968	67	741402	244976	3512	97	15	186	0	0	0	0	0	0	0	0	0	0
1969	4475	5234	1273332	39179	432	16	8	0	0	0	0	0	0	0	0	0	0
1970	68905	99125	78340	306391	2663	13	4	0	0	0	0	0	0	0	0	0	0
1971	14189	1275394	37883	9623	25648	66	2	0	0	0	0	0	0	0	0	0	0
1972	18446	444794	380988	6846	1236	1212	13	0	0	0	0	0	0	0	0	0	0
1973	38129	287558	363916	50108	354	33	123	0	0	0	0	0	0	0	0	0	0
1974	88456	982287	99148	59143	2869	6	4	0	0	0	0	0	0	0	0	0	0
1975	7479	1653311	377845	16385	13423	143	0	0	0	0	0	0	0	0	0	0	0
1976	6418	122012	698428	41183	200	137	0	0	0	0	0	0	0	0	0	0	0
1977	16364	107748	47070	79922	664	9	0	0	0	0	0	0	0	0	0	0	0
1978	1193	83683	63997	4214	19568	248	80	0	0	0	0	0	0	0	0	0	0
1979	4795	119245	82074	5734	142	365	0	0	0	0	0	0	0	0	0	0	0
1980	258	146751	197725	4726	96	0	0	0	0	0	0	0	0	0	0	0	0
1981	442	15023	225773	47838	157	1	0	0	0	0	0	0	0	0	0	0	0
1982	505	36063	35089	94315	2293	0	0	0	0	0	0	0	0	0	0	0	0
1983	24327	76672	94323	20914	12092	905	164	0	0	0	0	0	0	0	0	0	0
1984	3275	361946	48893	23714	1623	3317	0	0	0	0	0	0	0	0	0	0	0
1985	4924	146668	156400	3624	115	1	16	0	0	0	0	0	0	0	0	0	0
1986	13007	84333	75071	39219	23	1	0	0	0	0	0	0	0	0	0	0	0
1987	1996	159860	134988	9142	2795	2	0	0	0	0	0	0	0	0	0	0	0
1988	7399	27412	244105	10535	427	10	0	0	24	0	0	0	0	0	0	0	24
1989	10673	43756	23611	67102	1048	23	35	0	2	0	2	0	0	0	0	0	4
1990	16290	69073	30530	1772	4932	28	25	0	0	0	0	0	0	0	0	0	0
1991	11794	143967	40697	1163	17	107	0	0	0	0	0	0	0	0	0	0	0
1992	36231	82605	115933	4063	97	0	6	0	0	0	0	0	0	0	0	0	0
1993	12346	191714	163172	17474	170	1	0	3	0	0	0	0	0	0	0	0	0
1994	19197	75840	254112	20271	2069	30	0	0	0	0	0	0	0	0	0	0	0
1995	2118	231490	84163	67644	2539	199	0	0	0	0	0	0	0	0	0	0	0
1996	22563	35010	413599	28996	10344	36	0	0	0	0	0	0	0	0	0	0	0
1997	15260	114893	69948	106789	1700	425	0	0	0	0	0	0	0	0	0	0	0
1998	2936	77065	162251	15801	20732	88	11	0	0	0	0	0	0	0	0	0	0
1999	20814	57336	83205	46764	1905	2561	49	0	0	0	0	0	0	0	0	0	0
2000	8472	320463	55818	24661	5703	321	201	0	0	0	0	0	0	0	0	0	0
2001	1531	71284	521655	6483	1115	244	0	2	1	0	0	0	0	0	0	0	1
2002	1120	21358	80304	243495	978	64	0	111	0	0	0	0	0	0	0	0	0
2003	2937	7101	11014	31369	43849	13	9	0	0	0	0	0	0	0	0	0	0

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
2004	3758	24613	21221	3967	14548	19811	5	4	0	0	0	0	0	0	0	0	0
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	3768	14623	25111	24195	243	46	134	2	30	4	0	0	0	0	0	0	34
2009	10468	10521	10601	11050	16522	79	50	46	0	1	4	0	0	0	0	0	5
2010	2930	102881	11872	5201	1125	2415	25	0	14	0	0	1	0	0	0	0	15
2011	3002	5858	49830	1817	806	105	224	0	0	0	1	1	0	0	0	0	2
2012	1319	3128	1973	14017	503	11	7	15	0	0	0	0	0	0	0	0	0
2013	1285	11014	1898	494	2695	26	11	12	24	0	1	0	0	0	0	0	25
2014	3537	7272	7187	980	161	4185	2	14	7	1	0	0	0	0	0	0	8
2015	3820	26920	5225	1545	94	31	989	0	0	0	2	0	0	0	0	0	2
2016	1843	9910	24898	207	17	2	9	10	0	0	0	0	0	0	0	0	0
2017	2558	12352	11772	7098	106	17	8	2	11	0	0	0	0	0	0	0	11
2018	3627	5415	11488	1831	1623	3	0	4	0	3	0	0	0	0	0	0	3
2019	3173	17855	6448	3600	168	706	1	0	0	0	0	0	0	0	0	0	0
2020	2556	42138	13341	1823	468	300	136	0	0	0	0	0	0	0	0	0	0

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 2016–2020 are used in the assessment.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
2016	0	189	725	2	1	0	0	0	0	0	0	0	0	0	0	0	0
2017	34	166	158	95	1	0	0	0	0	0	0	0	0	0	0	0	0
2018	0	8	547	13	74	0	0	0	0	0	0	0	0	0	0	0	0
2019	0	194	285	218	0	2	0	0	0	0	0	0	0	0	0	0	0
2020	0	455	270	128	47	1	0	0	0	0	0	0	0	0	0	0	0

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 1972–2020 are used in the assessment.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
1965	644461	254237	7686	183288	2365	592	118	6	0	0	0	0	0	0	0	0	0
1966	1659093	548835	6546	1007	15861	755	25	2	0	0	0	0	0	0	0	0	0
1967	298999	392510	5539	155	24	2264	12	0	0	0	0	0	0	0	0	0	0
1968	11066	462938	81153	2029	46	19	738	1	0	0	0	0	0	0	0	0	0
1969	70826	15178	1703617	98650	632	380	126	252	0	0	0	0	0	0	0	0	0
1970	872884	170914	88509	485275	3967	153	61	2	0	0	0	0	0	0	0	0	0
1971	323088	570391	9972	3390	6381	299	6	0	0	0	0	0	0	0	0	0	0
1972	236664	238566	57010	1023	146	439	0	0	0	0	0	0	0	0	0	0	0
1973	41332	117470	12402	11	11	196	0	0	0	0	0	0	0	0	0	0	0
1974	576654	275266	32267	46862	4600	82	112	224	0	0	0	0	0	0	0	0	0
1975	44317	594854	84620	4761	5203	141	5	0	5	0	0	0	0	0	0	0	5
1976	164982	66973	183064	29188	46	2946	17	0	0	0	0	0	0	0	0	0	0
1977	103142	147019	29352	67628	2355	238	240	0	0	0	0	0	0	0	0	0	0
1978	280592	125698	11330	809	1480	64	6	5	0	0	0	0	0	0	0	0	0
1979	839615	125834	17671	1507	84	379	16	0	0	0	0	0	0	0	0	0	0
1980	374315	281436	21820	8258	1291	54	86	7	0	1	0	0	0	0	0	0	1
1981	644910	99247	30358	4613	440	6	2	0	0	0	0	0	0	0	0	0	0
1982	275003	174147	14740	13540	1810	464	0	0	0	0	0	0	0	0	0	0	0
1983	488707	63818	14331	5134	2242	3	0	0	0	0	0	0	0	0	0	0	0
1984	92587	98257	10644	4702	368	535	0	0	0	0	0	0	0	0	0	0	0
1985	122079	11672	17826	1739	547	223	17	0	0	0	0	0	0	0	0	0	0
1986	32696	40023	1831	802	103	7	0	0	0	0	0	0	0	0	0	0	0
1987	8253	82226	3797	295	138	0	0	0	0	0	0	0	0	0	0	0	0
1988	9280	3309	12819	2462	620	202	0	0	0	0	0	0	0	0	0	0	0
1989	8914	2541	1751	2789	460	37	86	10	0	0	0	0	0	0	0	0	0
1990	2996	7218	1986	359	1491	227	25	78	4	0	0	0	0	0	0	0	4
1991	116909	22493	3248	601	43	43	0	0	0	0	0	0	0	0	0	0	0
1992	241702	80402	10971	356	27	3	17	0	0	0	0	0	0	0	0	0	0
1993	124495	107664	13220	3214	82	9	0	18	0	0	0	0	0	0	0	0	0
1994	69907	14349	9534	1011	160	7	1	0	0	0	0	0	0	0	0	0	0
1995	198033	102560	2201	888	65	0	0	0	0	0	0	0	0	0	0	0	0
1996	144469	10608	7453	3338	107	0	0	0	0	0	0	0	0	0	0	0	0
1997	21694	45264	10935	4451	184	17	0	0	0	0	0	0	0	0	0	0	0
1998	18983	9155	16337	2649	1490	63	0	0	0	0	0	0	0	0	0	0	0
1999	69820	10780	4531	2932	344	166	3	0	0	0	0	0	0	0	0	0	0
2000	4158	71419	21740	2085	186	5	0	0	0	0	0	0	0	0	0	0	0
2001	1987	22946	35776	10127	35	8	0	0	0	0	0	0	0	0	0	0	0
2002	49807	13889	4489	3638	504	27	0	0	0	0	0	0	0	0	0	0	0
2003	4145	5983	2101	1285	1524	12	0	0	0	0	0	0	0	0	0	0	0

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
2004	0	590	265	84	258	753	8	4	0	0	0	0	0	0	0	0	0
2005	0	176	97	26	9	5	201	1	0	0	0	0	0	0	0	0	0
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	12	82	280	180	52	18	4	1	0	0	0	0	0	0	0	0	0
2009	15	36	97	48	19	6	2	0	0	0	0	0	0	0	0	0	0
2010	0	4169	355	36	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	0	0	19	14	11	7	12	0	0	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	0	1	3	5	82	3	2	1	5	0	0	0	0	0	0	0	5
2014	0	0	20	6	12	67	2	2	1	3	0	0	0	0	0	0	3
2015	0	6	9	1	3	12	1	0	0	0	0	0	0	0	0	0	0
2016	0	0	38	9	6	1	1	11	0	0	0	0	0	0	0	0	1
2017	0	0	6	26	2	1	0	0	1	0	0	0	0	0	0	0	1
2018	0	0	2	2	5	0	0	0	0	0	0	0	0	0	0	0	0
2019	0	2	31	132	42	123	3	2	0	0	1	0	0	0	0	0	1
2020	0	36	591	368	508	107	278	6	6	2	2	1	0	0	0	0	0

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 1972–2020 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	1.904
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	1.355
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	1.693
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
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	1.523
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

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
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	1.847
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	1.845
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	1.654
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	1.419
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
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	1.083
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	1.507
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	1.277
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	0.030	0.170	0.256	0.366	0.593	0.662	0.714	0.928	0.924	0.878	1.689	1.970	0.988	0.224	3.792	3.024	0.898
2009	0.048	0.175	0.305	0.323	0.388	0.677	0.799	0.839	1.308	1.318	1.025	1.045	1.150	3.091	2.115	0.000	1.162
2010	0.016	0.078	0.288	0.411	0.454	0.466	0.710	0.899	1.269	1.431	1.366	1.420	2.766	2.214	2.677	2.588	1.396
2011	0.017	0.140	0.260	0.399	0.434	0.466	0.534	0.661	0.864	0.558	1.484	1.787	1.593	0.000	0.000	0.000	0.930
2012	0.035	0.160	0.439	0.408	0.576	0.706	0.711	0.654	1.278	0.895	1.564	2.223	2.121	2.134	2.368	0.000	1.402
2013	0.034	0.172	0.425	0.599	0.487	0.727	0.854	0.796	0.758	1.085	1.842	2.191	2.607	1.810	2.512	0.000	0.768
2014	0.042	0.139	0.433	0.589	0.656	0.537	0.780	0.831	0.923	0.794	1.605	2.788	1.323	2.682	0.000	1.603	0.831
2015	0.031	0.145	0.417	0.561	0.752	0.698	0.631	0.685	0.970	0.725	0.715	0.719	1.448	2.954	0.000	0.000	0.781
2016	0.048	0.154	0.362	0.642	0.776	0.886	0.989	0.738	0.819	1.077	2.632	1.123	1.285	1.978	3.312	2.836	1.002
2017	0.039	0.148	0.235	0.306	0.516	0.439	0.904	0.564	0.603	0.803	2.670	0.678	0.890	1.514	0.909	0.000	0.935
2018	0.043	0.139	0.356	0.504	0.533	1.024	1.031	1.135	1.437	0.895	1.255	2.921	2.408	3.356	2.198	4.661	0.970
2019	0.044	0.150	0.310	0.463	0.629	0.579	1.013	0.983	2.271	2.652	1.337	3.551	3.491	2.628	4.051	5.041	1.944
2020	0.046	0.128	0.347	0.498	0.580	0.839	0.613	1.641	2.339	2.319	3.309	1.616	1.266	0.000	0.000	0.000	2.479

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 1972–2020 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	1.904
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	1.355
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	1.693
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
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	1.077
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	1.523
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	1.847
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	1.845
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	1.654
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	1.419
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
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	1.083
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

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
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	1.507
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	0.753
2008	0.000	0.357	0.408	0.414	0.607	0.668	0.754	0.931	0.935	0.879	1.703	1.970	0.988	0.224	3.792	3.024	0.902
2009	0.000	0.443	0.434	0.410	0.416	0.691	0.830	0.882	1.309	1.321	1.029	1.045	1.150	3.091	2.115	0.000	1.165
2010	0.000	0.278	0.473	0.457	0.471	0.476	0.721	0.899	1.364	1.431	1.366	1.420	2.766	2.214	2.677	2.588	1.429
2011	0.016	0.266	0.358	0.411	0.442	0.468	0.535	0.661	0.864	0.559	1.456	1.698	1.593	0.000	0.000	0.000	0.925
2012	0.000	0.358	0.525	0.445	0.606	0.707	0.712	0.654	1.279	0.895	1.564	2.223	2.121	2.134	2.368	0.000	1.402
2013	0.000	0.437	0.564	0.625	0.492	0.729	0.850	0.800	0.757	1.085	1.795	2.191	2.607	1.810	2.512	0.000	0.767
2014	0.000	0.311	0.510	0.654	0.662	0.557	0.781	0.834	0.932	0.794	1.605	2.788	1.323	2.682	0.000	1.603	0.832
2015	0.000	0.321	0.494	0.582	0.773	0.700	0.642	0.685	0.970	0.725	0.714	0.719	1.448	2.954	0.000	0.000	0.781
2016	0.356	0.383	0.445	0.649	0.777	0.886	0.998	0.738	0.819	1.077	2.632	1.123	1.285	1.978	3.312	2.835	1.002
2017	0.000	0.249	0.448	0.469	0.783	0.963	1.295	1.034	1.022	0.647	2.744	0.910	2.824	2.333	4.673	5.558	0.937
2018	0.000	0.418	0.470	0.524	0.542	1.025	1.031	1.145	1.437	0.895	1.255	2.921	2.408	3.356	2.198	4.664	0.970
2019	0.000	0.776	0.436	0.492	0.637	0.587	1.013	0.983	2.271	2.652	1.337	3.551	3.491	2.628	4.051	5.040	1.944
2020	0.000	0.359	0.450	0.533	0.588	0.882	0.617	1.641	2.339	2.319	3.309	1.616	1.266	0.000	0.000	0.000	2.479

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 1972–2020 are used in the assessment.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
1965	0.062	0.131	0.203	0.335	0.607	0.321	0.321	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1966	0.053	0.141	0.208	0.245	0.309	0.321	0.321	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1967	0.043	0.170	0.210	0.273	0.306	0.321	0.321	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1968	0.054	0.181	0.212	0.257	0.317	0.321	0.321	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1969	0.049	0.129	0.216	0.238	0.300	0.321	0.321	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1970	0.057	0.131	0.210	0.239	0.263	0.321	0.321	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1971	0.052	0.135	0.202	0.244	0.264	0.321	0.321	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1972	0.045	0.140	0.207	0.239	0.261	0.321	0.321	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1973	0.051	0.135	0.201	0.237	0.263	0.321	0.321	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1974	0.046	0.146	0.201	0.234	0.259	0.321	0.321	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1975	0.041	0.126	0.201	0.257	0.275	0.348	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1976	0.053	0.172	0.198	0.239	0.291	0.337	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1977	0.062	0.191	0.198	0.220	0.306	0.347	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1978	0.042	0.175	0.199	0.222	0.225	0.265	0.284	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1979	0.037	0.128	0.221	0.245	0.259	0.314	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1980	0.051	0.147	0.232	0.276	0.325	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1981	0.074	0.160	0.199	0.296	0.621	0.727	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1982	0.055	0.194	0.247	0.265	0.289	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1983	0.066	0.184	0.237	0.343	0.458	0.711	0.792	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
1984	0.047	0.160	0.245	0.315	0.309	0.290	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1985	0.040	0.154	0.221	0.271	0.356	0.423	0.353	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1986	0.057	0.140	0.185	0.246	0.337	0.329	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1987	0.026	0.160	0.201	0.227	0.286	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1988	0.072	0.167	0.172	0.239	0.256	0.352	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1989	0.054	0.188	0.229	0.266	0.336	0.708	0.844	0.000	2.572	0.000	3.048	0.000	0.000	0.000	0.000	0.000	0.000
1990	0.047	0.189	0.229	0.248	0.264	0.290	0.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1991	0.059	0.179	0.238	0.341	0.464	0.480	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1992	0.043	0.136	0.246	0.282	0.345	0.000	0.592	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1993	0.028	0.139	0.237	0.287	0.355	0.369	0.000	0.430	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1994	0.042	0.130	0.212	0.273	0.310	0.304	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1995	0.044	0.132	0.250	0.276	0.356	0.384	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1996	0.047	0.133	0.218	0.279	0.297	0.335	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1997	0.060	0.159	0.250	0.286	0.322	0.374	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1998	0.075	0.159	0.232	0.293	0.317	0.391	0.428	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1999	0.047	0.182	0.217	0.273	0.308	0.304	0.227	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2000	0.049	0.129	0.245	0.278	0.316	0.355	0.292	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2001	0.049	0.115	0.206	0.300	0.301	0.300	0.000	0.411	0.416	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2002	0.044	0.125	0.223	0.267	0.334	0.382	0.000	0.358	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2003	0.042	0.124	0.223	0.261	0.327	0.536	0.630	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2004	0.039	0.135	0.218	0.263	0.299	0.330	0.639	0.650	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2005	0.054	0.150	0.232	0.273	0.318	0.301	0.342	0.499	0.493	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2006	0.042	0.121	0.231	0.265	0.279	0.274	0.217	0.164	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	0.042	0.146	0.195	0.291	0.314	0.358	0.375	0.356	0.368	0.400	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2008	0.030	0.166	0.217	0.262	0.365	0.456	0.317	0.454	0.427	0.596	0.321	0.000	0.000	0.000	0.000	0.000	0.000
2009	0.048	0.162	0.250	0.248	0.282	0.394	0.315	0.357	0.366	0.409	0.452	0.000	0.000	0.000	0.000	0.000	0.000
2010	0.016	0.076	0.209	0.303	0.307	0.315	0.350	0.523	0.284	0.000	0.000	1.445	0.000	0.000	0.000	0.000	0.000
2011	0.017	0.135	0.227	0.297	0.310	0.352	0.351	0.000	0.000	0.000	2.027	2.215	0.000	0.000	0.000	0.000	0.000
2012	0.035	0.143	0.295	0.271	0.286	0.406	0.353	0.392	0.633	0.488	0.316	0.000	0.000	0.000	0.000	0.000	0.000
2013	0.034	0.148	0.243	0.362	0.345	0.498	1.355	0.533	0.842	0.000	2.113	0.000	0.000	0.000	0.000	0.000	0.000
2014	0.042	0.133	0.298	0.336	0.394	0.340	0.572	0.617	0.475	0.885	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2015	0.031	0.141	0.261	0.347	0.377	0.411	0.407	0.634	0.634	0.000	1.082	0.000	0.000	0.000	0.000	0.000	0.000
2016	0.048	0.149	0.245	0.357	0.361	0.876	0.457	0.508	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2017	0.039	0.148	0.235	0.306	0.516	0.439	0.904	0.564	0.603	0.803	2.670	0.678	0.890	1.514	0.909	0.000	0.000
2018	0.043	0.133	0.243	0.342	0.352	0.478	0.000	0.561	0.000	0.905	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2019	0.044	0.139	0.211	0.293	0.301	0.358	0.567	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2020	0.046	0.122	0.220	0.317	0.371	0.404	0.377	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

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 2016–2020 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	0.000	0.000	0.481	0.000	0.991	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2017	0.039	0.148	0.235	0.306	0.516	0.439	0.904	0.564	0.603	0.000	2.67	0.000	0.000	1.514	0.000	0.000	0.000
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	0.000
2019	0.089	0.185	0.271	0.298	0.408	0.382	0.000	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	0.000

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 1972–2020 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	0.040	0.180	0.302	0.400	0.420	0.440	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1966	0.010	0.040	0.180	0.302	0.400	0.420	0.440	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1967	0.010	0.040	0.180	0.302	0.400	0.420	0.440	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1968	0.010	0.040	0.180	0.302	0.400	0.420	0.440	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1969	0.010	0.040	0.180	0.302	0.400	0.420	0.440	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1970	0.010	0.040	0.180	0.302	0.400	0.420	0.440	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1971	0.010	0.040	0.180	0.302	0.400	0.420	0.440	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1972	0.023	0.067	0.136	0.255	0.288	0.231	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1973	0.035	0.068	0.141	0.246	0.327	0.396	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1974	0.022	0.058	0.150	0.260	0.359	0.579	0.277	0.447	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1975	0.020	0.039	0.173	0.275	0.267	0.413	0.585	0.000	0.585	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.585
1976	0.012	0.046	0.181	0.304	0.473	0.360	0.725	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1977	0.013	0.042	0.184	0.307	0.490	0.352	0.442	1.234	1.315	1.319	0.000	0.000	0.000	0.000	0.000	0.000	1.317
1978	0.011	0.040	0.174	0.286	0.372	0.473	0.411	0.456	1.315	0.000	1.400	0.000	0.000	0.000	0.000	0.000	1.345
1979	0.009	0.039	0.177	0.285	0.384	0.461	0.735	1.234	1.315	0.000	1.400	0.000	0.000	0.000	0.000	0.000	1.333
1980	0.012	0.039	0.176	0.268	0.623	0.722	1.102	1.591	0.000	1.796	0.000	0.000	0.000	0.000	0.000	0.000	1.796
1981	0.009	0.040	0.176	0.371	0.467	0.858	1.200	1.234	1.315	1.319	1.400	0.000	0.000	0.000	0.000	0.000	1.346
1982	0.010	0.040	0.206	0.379	0.636	0.751	1.225	1.233	1.315	1.319	0.000	0.000	0.000	0.000	0.000	0.000	1.316
1983	0.008	0.047	0.173	0.428	0.584	1.006	1.225	1.234	1.315	1.319	0.000	0.000	0.000	0.000	0.000	0.000	1.318
1984	0.009	0.045	0.211	0.414	0.626	0.751	1.225	1.234	1.315	1.319	1.400	1.400	0.000	0.000	0.000	0.000	1.356
1985	0.009	0.043	0.186	0.371	0.550	0.563	0.565	1.234	1.315	1.319	1.400	0.000	0.000	0.000	0.000	0.000	1.319
1986	0.010	0.040	0.186	0.375	0.626	1.259	1.225	1.234	1.315	1.319	1.400	0.000	0.000	0.000	0.000	0.000	1.328
1987	0.006	0.038	0.258	0.442	0.908	1.171	1.225	1.234	1.315	1.319	0.000	0.000	0.000	0.000	0.000	0.000	1.316
1988	0.018	0.077	0.196	0.274	0.455	0.549	1.225	1.234	1.315	1.319	1.400	0.000	0.000	0.000	0.000	0.000	1.330
1989	0.015	0.165	0.251	0.347	0.670	0.923	1.065	1.492	1.315	0.000	1.400	0.000	0.000	0.000	0.000	0.000	1.329
1990	0.005	0.104	0.229	0.506	0.609	0.842	0.829	0.796	0.956	1.319	0.000	0.000	0.000	0.000	0.000	0.000	0.956
1991	0.027	0.058	0.206	0.357	0.472	0.477	1.225	1.234	1.315	1.319	0.000	0.000	0.000	0.000	0.000	0.000	1.316
1992	0.015	0.059	0.217	0.422	0.552	0.615	0.548	1.234	0.621	0.820	0.000	0.000	0.000	0.000	0.000	0.000	0.659
1993	0.008	0.053	0.206	0.399	0.521	0.578	1.225	0.582	1.315	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.315
1994	0.011	0.055	0.155	0.435	0.595	0.698	0.490	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1995	0.012	0.045	0.193	0.285	0.387	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1996	0.018	0.077	0.136	0.162	0.264	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1997	0.007	0.076	0.149	0.309	0.419	0.601	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1998	0.020	0.075	0.166	0.291	0.351	0.453	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1999	0.018	0.064	0.177	0.304	0.416	0.309	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2000	0.058	0.070	0.113	0.176	0.370	0.203	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2001	0.014	0.086	0.133	0.110	0.353	0.431	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2002	0.016	0.064	0.178	0.283	0.374	0.431	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2003	0.012	0.031	0.056	0.231	0.326	0.339	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	8+
2004	0.000	0.116	0.183	0.255	0.276	0.446	0.539	0.840	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2005	0.000	0.107	0.187	0.239	0.268	0.287	0.598	0.619	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
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	0.042	0.146	0.291	0.388	0.454	0.526	0.414	0.406	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009	0.047	0.180	0.252	0.247	0.279	0.410	0.417	0.413	0.400	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.400
2010	0.000	0.080	0.244	0.310	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2011	0.016	0.316	0.324	0.350	0.367	0.443	0.460	0.493	0.589	0.385	0.000	1.331	1.624	0.000	0.000	0.000	0.421
2012	0.451	0.762	1.045	1.498	1.854	2.098	2.188	2.317	2.541	2.173	2.324	2.121	2.452	2.368	0.000	0.000	2.233
2013	0.000	0.437	0.564	0.626	0.492	0.729	0.850	0.800	0.757	1.085	1.795	2.191	2.607	1.810	2.512	0.000	0.767
2014	0.000	0.311	0.510	0.654	0.662	0.557	0.781	0.834	0.932	0.794	1.605	2.788	1.323	2.682	0.000	1.830	0.832
2015	0.000	0.321	0.494	0.582	0.773	0.700	0.642	0.685	0.970	0.725	0.714	0.719	1.448	2.954	0.000	0.000	0.781
2016	0.356	0.383	0.445	0.49	0.777	0.886	0.998	0.738	0.819	1.077	2.632	1.123	1.285	1.978	3.312	3.766	1.003
2017	0.000	0.249	0.448	0.469	0.783	0.963	1.295	1.034	1.022	0.647	2.744	0.910	2.824	2.333	4.673	5.558	0.936
2018	0.000	0.417	0.470	0.524	0.542	1.025	1.031	1.145	1.437	0.895	1.255	2.921	2.408	3.356	2.198	0.000	0.967
2019	0.000	0.776	0.436	0.492	0.637	0.587	1.013	0.983	2.271	2.652	1.337	3.551	3.491	2.628	4.051	5.098	1.945
2020	0.000	0.359	0.450	0.533	0.588	0.882	0.617	1.641	2.339	2.319	3.309	1.616	1.266	0.000	0.000	0.000	2.479

Table 8.2.16. Haddock in Subarea 4, Division 6.a and Subdivision 20. Estimates of natural mortality from the most recent key run of SMS (ICES WGSAM, 2017). Ages 0–7 and 8+ and years 1972–2020 are used in the assessment.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1965	1.466	1.508	0.843	0.529	0.466	0.321	0.268	0.243	0.219	0.206	0.200	0.233	0.233	0.233	0.233	0.233
1966	1.466	1.508	0.843	0.529	0.466	0.321	0.268	0.243	0.219	0.206	0.200	0.233	0.233	0.233	0.233	0.233
1967	1.466	1.508	0.843	0.529	0.466	0.321	0.268	0.243	0.219	0.206	0.200	0.233	0.233	0.233	0.233	0.233
1968	1.466	1.508	0.843	0.529	0.466	0.321	0.268	0.243	0.219	0.206	0.200	0.233	0.233	0.233	0.233	0.233
1969	1.466	1.508	0.843	0.529	0.466	0.321	0.268	0.243	0.219	0.206	0.200	0.233	0.233	0.233	0.233	0.233
1970	1.466	1.508	0.843	0.529	0.466	0.321	0.268	0.243	0.219	0.206	0.200	0.233	0.233	0.233	0.233	0.233
1971	1.466	1.508	0.843	0.529	0.466	0.321	0.268	0.243	0.219	0.206	0.200	0.233	0.233	0.233	0.233	0.233
1972	1.466	1.508	0.843	0.529	0.466	0.321	0.268	0.243	0.219	0.206	0.200	0.233	0.233	0.233	0.233	0.233
1973	1.466	1.508	0.843	0.529	0.466	0.321	0.268	0.243	0.219	0.206	0.200	0.233	0.233	0.233	0.233	0.233
1974	1.271	1.493	0.773	0.520	0.416	0.284	0.251	0.235	0.218	0.206	0.200	0.233	0.233	0.233	0.233	0.233
1975	1.316	1.514	0.748	0.505	0.401	0.280	0.248	0.232	0.216	0.206	0.200	0.233	0.233	0.233	0.233	0.233
1976	1.357	1.536	0.722	0.490	0.385	0.275	0.245	0.228	0.214	0.205	0.201	0.233	0.233	0.233	0.233	0.233
1977	1.394	1.555	0.696	0.476	0.369	0.270	0.242	0.225	0.212	0.205	0.201	0.233	0.233	0.233	0.233	0.233
1978	1.424	1.569	0.669	0.461	0.354	0.264	0.238	0.222	0.210	0.205	0.201	0.232	0.232	0.232	0.232	0.232
1979	1.449	1.574	0.642	0.446	0.339	0.259	0.235	0.219	0.208	0.205	0.201	0.231	0.231	0.231	0.231	0.231
1980	1.467	1.569	0.615	0.432	0.325	0.254	0.231	0.217	0.207	0.204	0.201	0.230	0.230	0.230	0.230	0.230
1981	1.478	1.550	0.588	0.417	0.313	0.249	0.227	0.215	0.206	0.204	0.202	0.228	0.228	0.228	0.228	0.228
1982	1.484	1.515	0.561	0.404	0.303	0.246	0.224	0.213	0.205	0.204	0.202	0.226	0.226	0.226	0.226	0.226

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1983	1.485	1.464	0.534	0.390	0.295	0.243	0.221	0.212	0.204	0.204	0.202	0.224	0.224	0.224	0.224	0.224
1984	1.483	1.402	0.510	0.377	0.289	0.241	0.219	0.210	0.204	0.204	0.202	0.222	0.222	0.222	0.222	0.222
1985	1.479	1.337	0.487	0.365	0.284	0.239	0.218	0.209	0.204	0.204	0.202	0.219	0.219	0.219	0.219	0.219
1986	1.470	1.275	0.467	0.355	0.280	0.238	0.216	0.209	0.204	0.204	0.203	0.217	0.217	0.217	0.217	0.217
1987	1.455	1.222	0.451	0.345	0.277	0.237	0.215	0.208	0.203	0.204	0.203	0.215	0.215	0.215	0.215	0.215
1988	1.433	1.179	0.437	0.337	0.274	0.236	0.214	0.207	0.203	0.204	0.203	0.213	0.213	0.213	0.213	0.213
1989	1.404	1.146	0.426	0.329	0.272	0.235	0.214	0.207	0.203	0.204	0.203	0.211	0.211	0.211	0.211	0.211
1990	1.370	1.125	0.417	0.322	0.270	0.234	0.214	0.207	0.203	0.203	0.203	0.210	0.210	0.210	0.210	0.210
1991	1.334	1.113	0.409	0.316	0.268	0.234	0.213	0.207	0.203	0.203	0.202	0.208	0.208	0.208	0.208	0.208
1992	1.302	1.110	0.402	0.311	0.267	0.234	0.213	0.207	0.203	0.202	0.202	0.207	0.207	0.207	0.207	0.207
1993	1.278	1.112	0.397	0.308	0.266	0.235	0.213	0.207	0.203	0.202	0.201	0.207	0.207	0.207	0.207	0.207
1994	1.263	1.117	0.392	0.306	0.266	0.236	0.214	0.207	0.203	0.201	0.201	0.206	0.206	0.206	0.206	0.206
1995	1.257	1.125	0.388	0.305	0.267	0.238	0.215	0.208	0.203	0.201	0.201	0.205	0.205	0.205	0.205	0.205
1996	1.257	1.132	0.385	0.306	0.268	0.242	0.217	0.208	0.204	0.201	0.200	0.204	0.204	0.204	0.204	0.204
1997	1.263	1.138	0.382	0.309	0.270	0.246	0.220	0.209	0.204	0.200	0.200	0.204	0.204	0.204	0.204	0.204
1998	1.272	1.144	0.381	0.313	0.273	0.250	0.224	0.209	0.204	0.200	0.200	0.203	0.203	0.203	0.203	0.203
1999	1.284	1.153	0.381	0.318	0.276	0.255	0.228	0.210	0.204	0.200	0.200	0.203	0.203	0.203	0.203	0.203
2000	1.296	1.166	0.384	0.323	0.280	0.261	0.232	0.211	0.204	0.200	0.200	0.203	0.203	0.203	0.203	0.203
2001	1.306	1.185	0.390	0.330	0.284	0.266	0.237	0.212	0.204	0.200	0.199	0.203	0.203	0.203	0.203	0.203
2002	1.308	1.208	0.398	0.336	0.289	0.272	0.242	0.214	0.204	0.201	0.199	0.204	0.204	0.204	0.204	0.204
2003	1.300	1.232	0.407	0.340	0.293	0.277	0.248	0.216	0.205	0.201	0.199	0.205	0.205	0.205	0.205	0.205
2004	1.280	1.252	0.417	0.343	0.297	0.281	0.253	0.219	0.205	0.203	0.199	0.206	0.206	0.206	0.206	0.206
2005	1.251	1.263	0.427	0.344	0.299	0.283	0.257	0.222	0.206	0.204	0.199	0.208	0.208	0.208	0.208	0.208
2006	1.216	1.266	0.437	0.342	0.300	0.284	0.259	0.225	0.207	0.207	0.199	0.209	0.209	0.209	0.209	0.209
2007	1.181	1.261	0.448	0.338	0.299	0.283	0.261	0.228	0.208	0.209	0.200	0.212	0.212	0.212	0.212	0.212
2008	1.147	1.250	0.458	0.333	0.297	0.282	0.261	0.231	0.209	0.212	0.201	0.214	0.214	0.214	0.214	0.214
2009	1.118	1.238	0.470	0.327	0.295	0.280	0.261	0.235	0.210	0.216	0.202	0.216	0.216	0.216	0.216	0.216
2010	1.094	1.227	0.482	0.320	0.292	0.278	0.260	0.239	0.211	0.220	0.203	0.219	0.219	0.219	0.219	0.219
2011	1.074	1.221	0.496	0.314	0.288	0.276	0.258	0.243	0.213	0.223	0.205	0.219	0.219	0.219	0.219	0.219
2012	1.054	1.221	0.510	0.307	0.284	0.273	0.255	0.248	0.215	0.226	0.208	0.219	0.219	0.219	0.219	0.219
2013	1.035	1.225	0.526	0.302	0.279	0.269	0.252	0.252	0.217	0.229	0.211	0.219	0.219	0.219	0.219	0.219
2014	1.017	1.234	0.542	0.297	0.274	0.265	0.248	0.257	0.220	0.231	0.214	0.219	0.219	0.219	0.219	0.219
2015	0.999	1.245	0.560	0.292	0.268	0.260	0.244	0.262	0.223	0.233	0.217	0.219	0.219	0.219	0.219	0.219
2016	0.981	1.258	0.577	0.288	0.263	0.255	0.240	0.267	0.226	0.235	0.221	0.219	0.219	0.219	0.219	0.219
2017	0.981	1.258	0.577	0.288	0.263	0.255	0.240	0.267	0.226	0.235	0.221	0.219	0.219	0.219	0.219	0.219
2018	0.981	1.258	0.577	0.288	0.263	0.255	0.240	0.267	0.226	0.235	0.221	0.219	0.219	0.219	0.219	0.219
2019	0.981	1.258	0.577	0.288	0.263	0.255	0.240	0.267	0.226	0.235	0.221	0.219	0.219	0.219	0.219	0.219
2020	0.981	1.258	0.577	0.288	0.263	0.255	0.240	0.267	0.226	0.235	0.221	0.219	0.219	0.219	0.219	0.219

Table 8.2.17. 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.

North Sea IBTS Q1					
1983	2021				
1	1	0.00	0.25		
1	5				
100	302.278	403.079	89.463	116.447	13.182
100	1072.285	221.275	127.770	20.410	20.900
100	230.968	833.257	107.598	32.317	3.575
100	573.023	266.912	303.546	17.888	6.490
100	912.559	328.062	45.201	58.262	4.345
100	101.691	677.641	97.149	12.684	13.965
100	219.060	97.372	273.008	16.604	2.114
100	217.448	139.114	32.997	50.367	3.163
100	680.231	134.076	25.032	4.260	8.476
100	1141.396	331.044	17.035	3.026	0.664
100	1242.121	519.521	152.384	8.848	1.076
100	227.919	491.051	97.656	23.308	1.566
100	1355.485	201.069	176.165	24.354	5.286
100	267.411	813.268	65.869	46.691	7.734
100	848.966	354.766	466.823	24.987	15.238
100	357.597	420.926	103.531	112.632	8.758
100	211.139	222.907	127.063	48.217	36.649
100	3734.200	107.125	48.605	24.504	15.594
100	893.460	2220.593	76.321	14.493	6.385
100	57.309	473.459	1309.380	9.180	6.886
100	89.981	39.261	241.523	532.045	5.355
100	71.745	79.256	36.962	176.352	324.910
100	70.189	51.885	38.458	14.057	54.576
100	1158.194	46.081	28.477	9.896	4.837
100	109.440	963.393	35.962	14.956	3.019
100	61.357	107.390	241.221	14.886	1.592
100	75.068	141.444	102.986	135.595	2.528
100	674.962	71.132	68.015	51.480	90.942
100	46.068	781.507	101.666	35.942	47.870
100	14.103	66.523	391.036	21.248	15.153
100	58.249	24.585	32.557	93.814	6.488
100	24.067	104.034	18.351	49.981	126.068
100	390.813	32.707	29.979	3.889	9.107
100	111.384	413.503	17.101	12.026	1.952
100	218.515	138.465	222.582	8.644	3.070
100	47.048	155.733	54.928	67.800	1.016
100	153.070	126.234	150.811	22.464	77.331
100	2355.810	162.481	61.292	55.104	8.536
100	1510.405	1442.539	104.955	23.759	28.491

Table 8.2.17. (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.

North Sea IBTS Q3						
1991	2020					
1	1	0.50	0.75			
0	5					
100	718.479	233.55	22.921	2.842	0.507	1.561
100	2741.14	595.235	189.015	10.529	1.583	0.396
100	577.382	605.99	140.146	37.604	2.36	0.372
100	1781.191	195.331	262.643	32.423	8.383	0.381
100	520.855	1019.607	106.642	97.383	8.06	3.131
100	627.502	247.469	428.471	30.426	20.215	2.649
100	195.255	347.567	123.793	149.048	6.672	5.282
100	276.401	257.14	164.853	53.69	42.66	3.093
100	6904.539	176.457	94.108	47.947	13.268	9.904
100	1092.754	2504.185	44.3	19.502	10.287	4.264
100	34.743	360.422	1099.293	30.29	6.371	3.648
100	137.709	45.969	237.732	573.754	9.826	2.485
100	163.931	69.348	31.171	199.259	368.665	2.942
100	183.977	69.539	40.556	23.119	82.685	154.82
100	1412.973	67.605	45.54	16.254	9.845	37.095
100	191.608	547.284	27.543	11.709	3.612	3.352
100	111.475	149.743	385.791	10.354	5.35	1.126
100	126.428	86.627	89.934	174.968	5.206	2.253
100	909.334	77.703	79.994	38.131	73.972	1.643
100	30.294	557.39	59.017	34.214	25.186	53.33
100	30.64	77.035	344.508	27.159	12.209	9.196
100	68.068	31.515	40.248	132.237	7.344	4.397
100	86.267	58.356	25.177	18.293	82.781	2.515
100	747.545	48.207	58.51	5.216	9.093	51.625
100	104.274	463.428	22.807	15.993	1.662	2.307
100	352.014	94.977	220.721	8.166	3.731	0.41
100	146.171	167.605	72.398	130.786	2.896	1.29
100	123.141	74.11	94.752	22.692	32.776	0.724
100	1940.393	164.608	53.427	63.534	12.388	18.324
100	1345.814	1468.487	93.95	26.789	25.321	5.049

Table 8.3.1. Haddock in Subarea 4, Division 6.a and Subdivision 20. TSA final assessment: Model settings. ω is a multiplier on the permitted variance of the estimated value: a higher setting for ω indicates greater down weighting of that value in the overall assessment.

Landings	**Ages**	**0–8+**
	Years	1972–2020
Discards	Ages	0–8+
	Years	1972, 1978–2020
Industrial bycatch	Ages	0–8+
	Years	1972, 1978–2020
BMS landings	Ages	0–8+
	Years	2016–2020
Survey: NS IBTS Q1	Ages	1–5
	Years	1983–2021
Survey: NS IBTS Q3	Ages	0–5
	Years	1991–2020
Maturity		Knife-edge at age 3 (interim measure)
Natural mortality		Age- and time-varying from North Sea SMS key runs
Catch weights		Catch abundance-weighted average of North Sea and West of Scotland catch weights
Stock weights		Set equal to catch weights (interim measure)
Large year-classes ($\lambda = 5$)		1974, 1979, 1999
Age-dependent F variability		$H(a) = (2,2,1,1,1,1,1,1,1,1)$
F plateau		a_m =7
Measurement-error multiplier for landings		$B_{landings}(a) = (*, 3.7, 1.3, 1, 1.1, 1.4, 1.6, 2.7, 2.8)$
Measurement-error multiplier for discards+bycatch+bms		$B_{discards}(a) = (2.0, 1.7, 1, 1.5, 1.8, 2.4, *, *, *)$
Downweighted landings outliers		1996, age 7 (ω = 3)
Downweighted discards+bycatch+bms outliers		1982, age 5; 2002, age 0; 2012, age 2 (ω = 3 for all)
Downweighted survey outliers		NS IBST Q1: 2011, age 5; 2014, age 4 (ω = 3 for all)

Table 8.3.2. Haddock in Subarea 4, Division 6.a and Subdivision 20. TSA final assessment: Parameter estimates.

	Estimate	Lower bound	Upper bound	Estimated	On bound
F age 0	0.0421	0.005	0.1	TRUE	FALSE
F age 1	0.0894	0.05	0.3	TRUE	FALSE
F age 2	0.8719	0.6	1.5	TRUE	FALSE
F age 7	1.3378	1	1.4	TRUE	FALSE
sd F	0.183	0.01	0.2	TRUE	FALSE
sd U	0.0749	0.01	0.15	TRUE	FALSE
sd V	0.1274	0.01	0.2	TRUE	FALSE
sd Y	0.1764	0.01	0.25	TRUE	FALSE
cv landings	0.1503	0.05	0.3	TRUE	FALSE
cv discards	0.284	0.1	0.4	TRUE	FALSE
log mean recruitment at start	6.9433	5	9	TRUE	FALSE
sd of random walk	0.0375	0	0.25	TRUE	FALSE
recruitment cv	0.5627	0.3	0.6	TRUE	FALSE
discards sd transitory	0	0	0.35	TRUE	TRUE
discards sd persistent	0.3261	0.125	0.5	TRUE	FALSE
NSQ1 selection age 1	0.2982	0.1	0.3	TRUE	FALSE
NSQ1 selection age 2	0.7129	0.4	0.8	TRUE	FALSE
NSQ1 selection age 3	0.7429	0.6	0.9	TRUE	FALSE
NSQ1 selection age 4	0.5309	0.4	0.8	TRUE	FALSE
NSQ1 selection age 5	0.4522	0.4	0.8	TRUE	FALSE
NSQ1 sigma	0.3363	0.1	0.4	TRUE	FALSE
NSQ1 eta	0.1105	0.1	0.8	TRUE	FALSE
NSQ1 omega	0.0979	0	0.3	TRUE	FALSE
NSQ1 beta	0	0	0.1	FALSE	TRUE
NSQ3 selection age 0	0.2516	0.1	0.4	TRUE	FALSE
NSQ3 selection age 1	0.3879	0.2	0.6	TRUE	FALSE
NSQ3 selection age 2	0.5793	0.2	0.8	TRUE	FALSE
NSQ3 selection age 3	0.4894	0.2	0.8	TRUE	FALSE
NSQ3 selection age 4	0.3691	0.2	0.8	TRUE	FALSE
NSQ3 selection age 5	0.3145	0.2	0.8	TRUE	FALSE
NSQ3 sigma	0.2458	0.1	0.4	TRUE	FALSE
NSQ3 eta	0.0992	0	0.3	TRUE	FALSE
NSQ3 omega	0.0662	0	0.3	TRUE	FALSE
NSQ3 beta	0	0	0.1	FALSE	TRUE

Table 8.3.3. Haddock in Subarea 4, Division 6.a and Subdivision 20. Estimates of fishing mortality at age from the final TSA 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). The 2021 estimates (*) are TSA forecasts.

	0	1	2	3	4	5	6	7	8	Mean F(2–4)
1972	0.040	0.085	0.599	1.028	0.968	0.919	1.015	1.050	0.977	0.865
1973	0.034	0.091	0.577	0.902	0.861	0.899	0.998	1.033	1.113	0.780
1974	0.032	0.087	0.619	0.724	0.873	0.772	0.907	0.978	0.983	0.739
1975	0.036	0.091	0.693	0.899	0.991	0.949	1.115	1.091	1.078	0.861
1976	0.034	0.092	0.541	0.980	0.862	1.073	0.976	0.998	1.004	0.794
1977	0.033	0.104	0.622	0.733	1.107	0.995	0.990	0.948	0.981	0.821
1978	0.026	0.127	0.670	0.962	1.107	1.109	1.088	1.090	1.134	0.913
1979	0.032	0.103	0.715	1.063	1.013	1.031	1.044	1.052	1.059	0.930
1980	0.037	0.084	0.499	1.066	1.140	0.803	0.920	0.973	0.974	0.902
1981	0.032	0.075	0.316	0.786	0.923	0.754	0.430	0.732	0.695	0.675
1982	0.022	0.075	0.382	0.566	0.679	0.574	0.591	0.707	0.614	0.542
1983	0.021	0.087	0.457	0.845	0.868	0.924	0.761	0.749	0.768	0.723
1984	0.024	0.120	0.505	0.942	1.105	0.819	0.839	0.806	0.806	0.851
1985	0.024	0.124	0.451	0.912	1.030	0.879	0.830	0.772	0.777	0.798
1986	0.018	0.127	0.672	0.924	1.120	0.825	0.665	0.670	0.722	0.905
1987	0.025	0.098	0.764	1.008	0.949	0.877	0.885	0.815	0.784	0.907
1988	0.024	0.122	0.596	1.168	1.112	0.948	0.854	0.776	0.820	0.959
1989	0.022	0.125	0.657	0.942	1.128	0.880	0.853	0.782	0.788	0.909
1990	0.017	0.121	0.755	0.982	1.002	0.872	0.725	0.681	0.701	0.913
1991	0.019	0.168	0.714	1.021	0.939	0.787	0.775	0.738	0.697	0.891
1992	0.021	0.125	0.643	0.973	0.991	0.651	0.857	0.690	0.716	0.869
1993	0.024	0.170	0.818	0.992	1.012	0.966	0.822	0.815	0.833	0.941
1994	0.016	0.128	0.736	1.020	0.976	1.025	0.965	0.900	0.817	0.911
1995	0.021	0.100	0.586	0.905	0.932	0.809	0.905	0.694	0.690	0.808
1996	0.019	0.097	0.515	0.855	1.000	0.958	0.946	0.680	0.673	0.790
1997	0.014	0.119	0.479	0.619	0.729	0.883	0.767	0.583	0.566	0.609
1998	0.014	0.152	0.623	0.663	0.858	0.793	0.768	0.581	0.565	0.715
1999	0.012	0.127	0.672	0.898	0.820	1.056	0.827	0.628	0.595	0.797
2000	0.011	0.098	0.734	0.938	0.938	0.773	0.810	0.556	0.532	0.870
2001	0.010	0.080	0.398	0.663	0.676	0.623	0.548	0.387	0.371	0.579
2002	0.006	0.110	0.258	0.333	0.452	0.424	0.377	0.251	0.249	0.348
2003	0.005	0.045	0.200	0.200	0.244	0.298	0.247	0.158	0.154	0.215
2004	0.004	0.050	0.203	0.226	0.228	0.280	0.213	0.133	0.130	0.219
2005	0.003	0.060	0.287	0.345	0.261	0.307	0.284	0.148	0.143	0.298
2006	0.005	0.052	0.420	0.518	0.549	0.510	0.359	0.235	0.191	0.496
2007	0.005	0.055	0.232	0.500	0.505	0.473	0.359	0.198	0.192	0.412
2008	0.003	0.037	0.177	0.220	0.324	0.296	0.245	0.130	0.128	0.240
2009	0.002	0.032	0.126	0.186	0.257	0.233	0.171	0.104	0.094	0.190

	0	1	2	3	4	5	6	7	8	Mean F(2–4)
2010	0.003	0.034	0.166	0.238	0.221	0.257	0.167	0.101	0.093	0.208
2011	0.003	0.040	0.129	0.408	0.393	0.362	0.257	0.135	0.112	0.310
2012	0.002	0.036	0.135	0.176	0.251	0.223	0.151	0.093	0.080	0.187
2013	0.002	0.042	0.179	0.175	0.256	0.213	0.141	0.082	0.083	0.203
2014	0.002	0.037	0.325	0.340	0.342	0.361	0.164	0.110	0.102	0.336
2015	0.003	0.037	0.439	0.544	0.364	0.468	0.285	0.151	0.131	0.449
2016	0.002	0.034	0.182	0.439	0.359	0.292	0.161	0.121	0.097	0.327
2017	0.002	0.025	0.179	0.239	0.301	0.233	0.120	0.080	0.077	0.240
2018	0.002	0.023	0.124	0.269	0.236	0.199	0.110	0.076	0.065	0.210
2019	0.001	0.024	0.113	0.204	0.207	0.206	0.104	0.061	0.054	0.175
2020	0.001	0.017	0.155	0.214	0.202	0.167	0.116	0.056	0.051	0.190
2021*	0.001	0.022	0.138	0.221	0.214	0.189	0.111	0.059	0.059	0.191

Table 8.3.4. Haddock in Subarea 4, Division 6.a and Subdivision 20. Estimates of stock numbers at age (thousands) from the final TSA assessment. Estimates refer to 1 January, except for age 0 for estimates refer to 1 July. *TSA estimated survivors.

	0	1	2	3	4	5	6	7	8+
1972	8738660	13105860	2083200	78790	44810	394550	7110	430	1170
1973	32331910	1942820	2682540	484150	17120	11150	117940	2050	460
1974	50765470	7182920	393940	650670	118250	4800	3440	34600	720
1975	3121860	13848620	1467570	106350	187410	33450	1670	1100	10660
1976	5393140	947620	2836760	347620	27500	48520	10240	460	3400
1977	11907540	1531010	213590	818220	83890	8390	13490	3270	1250
1978	24519910	2930620	284270	64850	257570	21090	2660	4550	1560
1979	48276390	5737140	538710	77790	16240	63430	5360	760	1770
1980	8994400	11113830	1069930	141620	18090	4630	18870	1670	790
1981	15261810	2009880	2130450	341760	33670	4640	1610	6210	810
1982	9232000	3414350	399370	785680	99350	10460	1740	640	2540
1983	29543510	2064610	693900	162430	298000	37680	4690	790	1390
1984	5949750	6530860	438310	261000	48530	93400	12020	1810	830
1985	9642390	1464680	1415310	159400	71470	12440	30260	4250	910
1986	17814510	2214240	340000	545920	45380	19790	4140	10690	1920
1987	210740	3830570	544550	110330	149900	11520	6750	1620	4760
1988	1115120	338360	1023020	161940	29320	43420	3850	2320	2360
1989	1853400	532410	103140	364160	36030	7540	13380	1350	1750
1990	8410270	728210	148020	35210	104280	9140	2550	4760	1210
1991	9933570	2194320	209020	41990	9600	30250	3150	1030	2530
1992	16817750	2563120	605740	68020	11280	2710	9690	1160	1360
1993	4286520	4476960	740440	213460	17880	3180	1080	3360	1040
1994	16989810	1167370	1228650	218320	58610	5000	980	390	1660
1995	4782850	4730370	336860	394640	58570	16930	1440	310	770

	0	1	2	3	4	5	6	7	8+
1996	6840430	1335210	1389900	127710	118510	17750	6000	490	460
1997	4193100	1911890	391550	564930	40230	33650	5420	1930	410
1998	3077120	1162200	543000	166100	223780	14900	10910	2070	1100
1999	46584030	874850	317680	196950	62840	72700	5270	4060	1490
2000	9156130	12750000	243710	108840	56780	20950	19460	1860	2500
2001	920370	2478580	3601710	80210	30320	16470	7420	6870	2130
2002	1164420	344290	700580	1643470	29260	11570	6760	3420	5090
2003	1326730	392060	92320	364220	843470	13840	5780	3670	5480
2004	1192400	421150	109370	50400	212350	492850	7760	3530	6420
2005	13297300	418340	114460	58860	28530	125530	279450	4850	7100
2006	2738270	3794870	111550	56100	29580	16320	69500	160880	8350
2007	1799180	817690	1015950	47450	23850	12740	7420	37530	106390
2008	1221120	580230	219390	515140	20620	10730	6000	4020	95720
2009	9633460	459700	159800	116290	295470	11110	6040	3640	71180
2010	804220	3142750	129170	88250	69770	170160	6670	3940	55320
2011	65560	317540	890860	67660	50590	41850	99930	4360	43680
2012	1082830	117750	90060	477060	32490	25600	22170	59920	34640
2013	457360	425580	33560	47260	294070	18950	15610	14820	68550
2014	6285130	258080	119860	16260	29350	172190	11710	10560	61450
2015	1557360	2268410	72490	50100	8310	15860	92400	7770	51950
2016	2910960	597660	629660	26760	21240	4370	7670	54640	41680
2017	1257280	1088980	164330	294880	12910	11320	2540	5150	67360
2018	2402110	500190	301840	77280	174300	7340	6970	1780	53470
2019	13559850	905450	138860	149240	44330	105800	4670	4920	41260
2020	13682500	5079920	251040	69640	91360	27750	66760	3310	34740
2021	6640480	4887130	1418980	120860	42260	57510	18210	46800	28730

Table 8.3.5. Haddock in Subarea 4, Division 6.a and Subdivision 20. Stock summary table. Both estimates (EST) and standard errors (SE) are given. *TSA model fits or projections. **Discards refers to discard+bycatch+BMS

Year	Catch	Catch.est	Catch.se	Landings	Landings.est	Landings.se	Discards**	Discards.est **	Discards.se **	Meanf.est	Meanf.se	Ssb.est	Ssb.se	Tsb.est	Tsb.se	Recruit.est	Recruit.se
1972	408043	384498	42458	234140	229325	25245	173903	155174	30018	0.865	0.066	293120	29753	2549107	253372	8738656	1908495
1973	344581	369688	50040	207383	214678	20637	137198	155010	38931	0.780	0.073	274699	18971	2535351	214931	32331910	3608970
1974	397158	245670	28723	167655	157691	13964	229503	87978	22334	0.739	0.076	321906	23111	2606670	253561	50765467	7929697
1975	494390	294164	39644	160380	164182	13875	334009	129982	34334	0.861	0.086	157703	11430	2035828	245356	3121856	1468059
1976	401969	329184	48444	184244	209270	23551	217725	119915	35755	0.794	0.084	193539	15380	1029557	114038	5393141	1481165
1977	240259	197587	21380	156534	161078	17911	83726	36509	8781	0.820	0.091	348050	29166	806978	63931	11907538	1742686
1978	146700	140557	13614	102940	104295	10289	43760	36262	7321	0.913	0.093	158339	14004	805046	52703	24519908	1895940
1979	149260	143572	15935	97884	87589	9422	51376	55983	10326	0.931	0.095	93237	11365	1215888	69281	48276386	4708282
1980	202640	186599	19075	111375	105618	10395	91265	80981	14043	0.902	0.088	103372	11034	1406827	86738	8994401	1014186
1981	226585	215411	20297	147920	146684	14483	78665	68727	11212	0.675	0.068	192108	12776	1012495	53463	15261807	1593909
1982	256302	202972	15493	195572	162386	13234	60730	40585	6643	0.542	0.047	426693	20168	885895	36640	9232003	816112
1983	253185	227631	16730	188735	180450	13067	64451	47181	7550	0.723	0.055	295226	15263	1102986	44489	29543509	2113889
1984	247238	226394	22974	158181	150042	11231	89057	76352	17312	0.851	0.062	237031	14989	1356718	71918	5949746	1564530
1985	247430	222399	17985	183055	162977	13553	64375	59423	9605	0.798	0.058	166700	8413	898827	38255	9642389	1269050
1986	223854	205856	14940	185119	163249	12333	38735	42607	6929	0.905	0.062	285507	16086	1056334	54849	17814510	1861474
1987	195046	177455	14621	135000	124688	9383	60046	52767	9265	0.907	0.064	161662	8575	786353	40148	210743	1409162
1988	179911	167410	13851	126181	121675	10759	53729	45735	7257	0.959	0.069	125842	8432	465170	82104	1115116	1783240
1989	127679	118366	9919	92801	93480	8575	34878	24886	4431	0.909	0.069	177242	11178	379530	58547	1853396	1505492
1990	86743	79145	7584	61584	57752	5186	25159	21394	4223	0.913	0.069	85160	5764	604079	66111	8410272	1562071
1991	97205	92005	13057	55211	45239	4546	41993	46767	10731	0.891	0.069	51828	3934	798219	41082	9933569	781733
1992	134993	124983	12213	81572	70611	7157	53421	54372	8533	0.869	0.054	55015	2696	821348	37053	16817751	1303128
1993	180206	214971	22530	98697	111627	10883	81509	103344	17467	0.941	0.059	117925	7490	862062	44726	4286522	384027
1994	169472	231712	22917	95175	131126	13819	74297	100586	15223	0.911	0.061	138404	9797	888949	38972	16989806	1146679
1995	168893	172410	17313	89858	102709	10771	79035	69701	11668	0.807	0.059	195770	14138	857004	40275	4782853	381901
1996	204687	197568	18624	92632	98545	8955	112055	99023	14331	0.790	0.057	125611	7211	779302	33275	6840430	571373
1997	170051	162429	14878	95448	94500	8892	74603	67929	10335	0.609	0.049	255801	14980	750875	34172	4193095	481512
1998	161971	159179	13794	95513	92680	7741	66457	66499	9538	0.715	0.056	186995	9773	586359	25161	3077120	332864
1999	123421	127416	11016	75974	73850	6155	47446	53566	7533	0.797	0.063	145643	8832	1534890	89615	46584026	3404932
2000	126870	166779	30965	54476	56149	5161	72395	110630	28492	0.870	0.067	95954	6549	2177213	122934	9156133	619922
2001	173526	271281	38687	47549	99069	14674	125978	172212	30888	0.579	0.052	66008	4698	1156597	67646	920372	838475
2002	155145	179150	21372	65399	96393	11913	89745	82757	15123	0.348	0.036	550753	37165	786724	41549	1164424	503802
2003	74415	94942	11130	47266	73570	9262	27149	21372	4159	0.215	0.024	482786	28945	567180	31382	1326733	432518
2004	72511	75084	9348	51925	64059	8474	20586	11024	1960	0.219	0.024	338047	23230	469119	28796	1192405	386153

Year	Catch	Catch.est	Catch.se	Landings	Landings.est	Landings.se	Discards**	Discards.est **	Discards.se **	Meanf.est	Meanf.se	Ssb.est	Ssb.se	Tsb.est	Tsb.se	Recruit.est	Recruit.se
2005	64116	65952	7907	51542	56273	7224	12573	9679	1549	0.298	0.031	254992	20481	1070998	47191	13297296	743284
2006	66955	66467	8315	43333	45866	5552	23622	20601	4617	0.496	0.043	177633	16643	802363	36841	2738267	365118
2007	67430	76365	8374	34680	46120	5372	32751	30245	4857	0.412	0.038	148434	16671	584632	33847	1799180	560169
2008	47733	56200	5985	33037	41606	4556	14697	14593	2565	0.240	0.026	301827	19888	493264	26442	1221123	477595
2009	47943	44713	4618	35569	36754	3946	12374	7959	1258	0.190	0.020	250312	18980	841903	33278	9633460	510176
2010	45412	44490	4818	31937	35578	3784	13474	8912	1802	0.208	0.023	232743	18370	527946	27581	804222	869226
2011	49658	57304	5587	36572	40937	3825	13086	16367	2884	0.310	0.032	165311	11919	442504	22554	65563	755557
2012	43196	46349	4780	38164	40935	4224	5032	5414	1122	0.187	0.021	334919	18368	431195	25179	1082830	459212
2013	47066	43888	4717	43712	40511	4384	3354	3377	700	0.204	0.021	263066	13914	366078	21929	457363	456063
2014	46317	51172	5215	41165	46209	4811	5152	4963	882	0.335	0.032	190277	11749	542023	20454	6285135	355184
2015	41594	48583	5054	35306	39137	3804	6287	9446	2308	0.449	0.040	149626	10533	557052	25183	1557364	354040
2016	43053	49622	5413	35060	39078	4414	7994	10543	1915	0.327	0.032	127240	10549	586943	22229	2910963	206836
2017	39898	43200	4394	32843	36604	3820	7055	6595	1195	0.240	0.025	224216	12777	491051	21152	1257282	217269
2018	39435	40605	3903	34404	35300	3464	5031	5305	886	0.210	0.023	200462	11512	480902	22268	2402113	305498
2019	36453	35865	3582	30743	31218	3103	5710	4647	894	0.175	0.021	247936	15239	1018075	50343	13559848	1000008
2020	40608	41795	4698	30176	31703	3125	10412	10092	2447	0.190	0.024	243433	16328	1610171	84726	13682503	1385521
2021*		85669	23889		61947	17688		23722	8279	0.191	0.056	256765	16910	1708322	186726	6640480	3799667

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

MFDP version 1a							
Run: 04	Uses Fmult = 0.605754 (see text)						
Time and date: 16:29 27/04/2020							
Fbar age range (Total): 2-4							
Fbar age range Fleet 1: 2-4							
Fbar age range Fleet 2: 2-4							
2021							
Age		N		M	Mat	PF	PM	SWt
	0	6640480		0.981	0	0	0	0.044
	1	4887130		1.258	0	0	0	0.139
	2	1418980		0.577	0	0	0	0.337
	3	120860		0.288	1	0	0	0.483
	4	42260		0.263	1	0	0	0.633
	5	57510		0.255	1	0	0	0.732
	6	18210		0.24	1	0	0	0.979
	7	46800		0.267	1	0	0	0.782
	8	28730		0.376	1	0	0	1.903
Catch								
Age		Sel		CWt	DSel	DCWt		
	0	0		0	0.001	0.044		
	1	0		0.518	0.022	0.132		
	2	0.067		0.452	0.07	0.226		
	3	0.188		0.516	0.03	0.313		
	4	0.204		0.577	0.008	0.401		
	5	0.179		0.709	0.008	0.458		
	6	0.109		0.931	0.001	0.486		
	7	0.058		0.695	0	0.48		
	8	0.058		1.862	0	0.776		
IBC								
Age		Sel		CWt				
	0	0		0				
	1	0		0.5175				
	2	0.001		0.4517				
	3	0.0025		0.5162				
	4	0.0028		0.589				
	5	0.0024		0.8314				
	6	0.0015		0.8871				
	7	0.0008		1.2563				
	8	0.0008		2.0155				

Table 8.6.1 (cont). Haddock in Subarea 4, Division 6.a and Subdivision 20. Short-term forecast input.

2022						
Age	N	M	Mat	PF	PM	SWt
0	6640480	0.981	0	0	0	0.044
1	.	1.258	0	0	0	0.139
2	.	0.577	0	0	0	0.337
3	.	0.288	1	0	0	0.488
4	.	0.263	1	0	0	0.635
5	.	0.255	1	0	0	0.787
6	.	0.24	1	0	0	0.87
7	.	0.267	1	0	0	1.14
8	.	0.376	1	0	0	1.735
Catch						
Age	Sel	CWt	DSel	DCWt		
0	0	0	0.001	0.044		
1	0	0.518	0.022	0.132		
2	0.067	0.452	0.07	0.226		
3	0.188	0.516	0.03	0.316		
4	0.204	0.589	0.008	0.402		
5	0.179	0.634	0.008	0.491		
6	0.109	0.813	0.001	0.537		
7	0.058	1.05	0	0.555		
8	0.058	1.668	0	0.88		
IBC						
Age	Sel	CWt				
0	0	0				
1	0	0.5175				
2	0.001	0.4517				
3	0.0025	0.5162				
4	0.0028	0.589				
5	0.0024	0.8314				
6	0.0015	0.8871				
7	0.0008	1.2563				
8	0.0008	2.0155				

Table 8.6.1 (cont). Haddock in Subarea 4, Division 6.a and Subdivision 20. Short-term forecast input.

2023						
Age	N	M	Mat	PF	PM	SWt
0	6640480	0.981	0	0	0	0.044
1	.	1.258	0	0	0	0.139
2	.	0.577	0	0	0	0.337
3	.	0.288	1	0	0	0.488
4	.	0.263	1	0	0	0.581
5	.	0.255	1	0	0	0.787
6	.	0.24	1	0	0	0.942
7	.	0.267	1	0	0	1.008
8	.	0.376	1	0	0	1.218
Catch						
Age	Sel	CWt	DSel	DCWt		
0	0	0	0.001	0.044		
1	0	0.518	0.022	0.132		
2	0.067	0.452	0.07	0.226		
3	0.188	0.516	0.03	0.316		
4	0.204	0.589	0.008	0.34		
5	0.179	0.831	0.008	0.491		
6	0.109	0.692	0.001	0.581		
7	0.058	0.917	0	0.616		
8	0.058	1.069	0	0.59		
IBC						
Age	Sel	CWt				
0	0	0				
1	0	0.5175				
2	0.001	0.4517				
3	0.0025	0.5162				
4	0.0028	0.589				
5	0.0024	0.8314				
6	0.0015	0.8871				
7	0.0008	1.2563				
8	0.0008	2.0155				
Input units are thousands and kg - output in tonnes						

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 (2022)	Projected landings* (2022)	Projected discards** (2022)	IBC*** (2022)	HC catch (2022)	F_{total} (ages 2-4) (2022)	$F_{projected\ landings}$ (ages 2-4) (2022)	$F_{projected\ discards}$ (ages 2-4) (2022)	F_{IBC} (ages 2-4) (2022)	SSB (2022)	% SSB change^	% TAC change^^	% Advice change^^^
ICES advice basis													
MSY approach: F_{MSY}	128708	101908	25339	1460	127248	0.194	0.155	0.037	0.0021	723334	26%	154%	86%
Other scenarios													
F = $F_{MSY\ lower}$	111702	88316	21909	1477	110225	0.167	0.133	0.031	0.0021	740295	29%	120%	61%
F = $F_{MSY\ upper}$#	128708	101908	25339	1460	127248	0.194	0.155	0.037	0.0021	723334	26%	154%	86%
F = 0 (no HC fishery)	1586	0	0	1586	0	0	0	0	0.0021	850838	48%	-100%	-98%
F(p05) with AR	128708	101908	25339	1460	127248	0.194	0.155	0.037	0.0021	723334	26%	154%	86%
F(p05) without AR	109812	86806	21527	1479	108333	0.164	0.131	0.031	0.0021	742179	30%	116%	59%
F_{lim}	248379	197557	49482	1340	247039	0.384	0.309	0.073	0.0021	603983	5.4%	392%	259%
SSB (2022) = B_{lim}	759578	606204	152547	826	758751	1.194	0.964	0.227	0.0021	94000	-84%	1412%	996%
SSB (2022) = B_{pa} = MSY $B_{trigger}$	721485	575754	144866	864	720620	1.133	0.916	0.215	0.0021	132000	-77%	1336%	941%
F_{2021}	79958	62944	15504	1509	78448	0.117	0.093	0.022	0.0021	771954	35%	56%	15%
Rollover TAC	51719	40368	9814	1537	50182	0.072	0.057	0.013	0.0021	800133	40%	0%	-25%

*** Marketable landings.**

**** Including BMS landings, assuming recent discard rate.**

***** IBC = Industrial bycatch, HC = Human Consumption. F(IBC) is assumed to be constant in all scenarios at status quo value**

^ SSB 2023 relative to SSB 2022.

^^ Human consumption fishery (HCF) catch in 2022 relative to TAC in 2021: Subdivision 20 (2630 t) + Subarea 4 (42 785 t) + Division 6.a (4767 t) = 50 182 t.

^^^ Total catch 2022 relative to the advice value 2021 (69 280 t).

 # For this stock, $F_{MSY\ upper}$ = F_{MSY}.

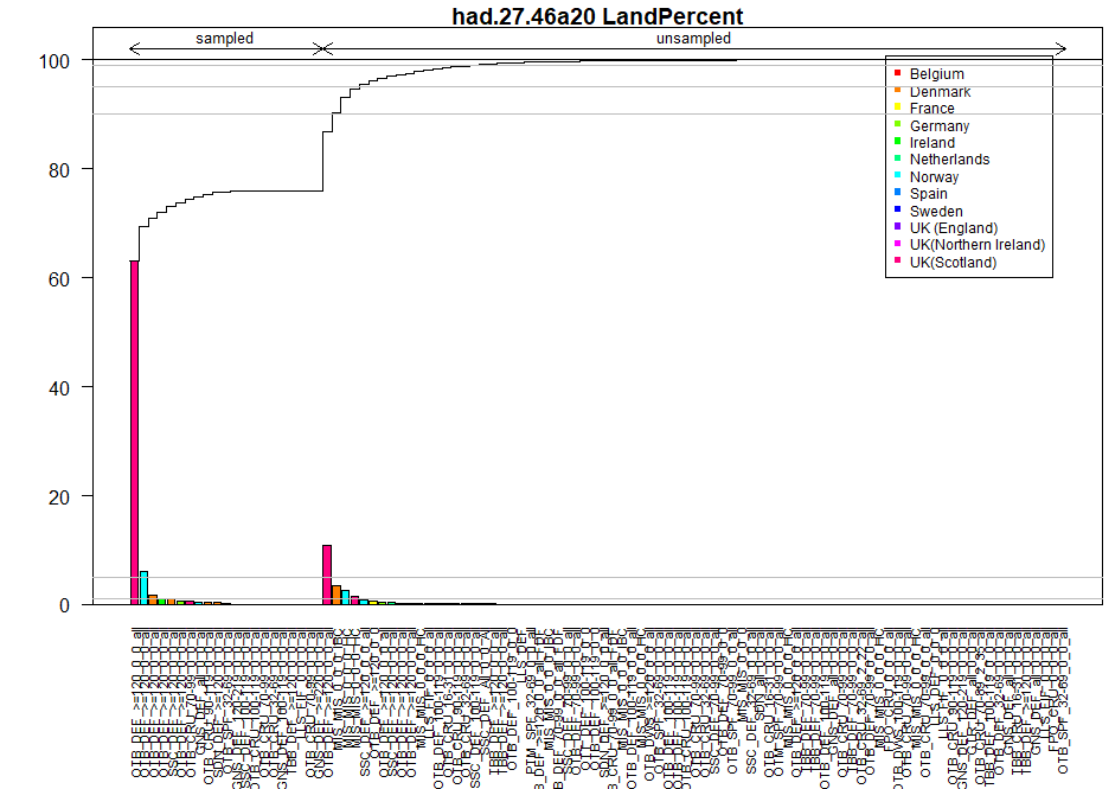


Figure 8.2.1. Haddock in Subarea 4, Division 6.a and Subdivision 20. Reported landings for each sampled and unsampled fleet in the full stock area, along with cumulative landings for fleets in descending order of yield.

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

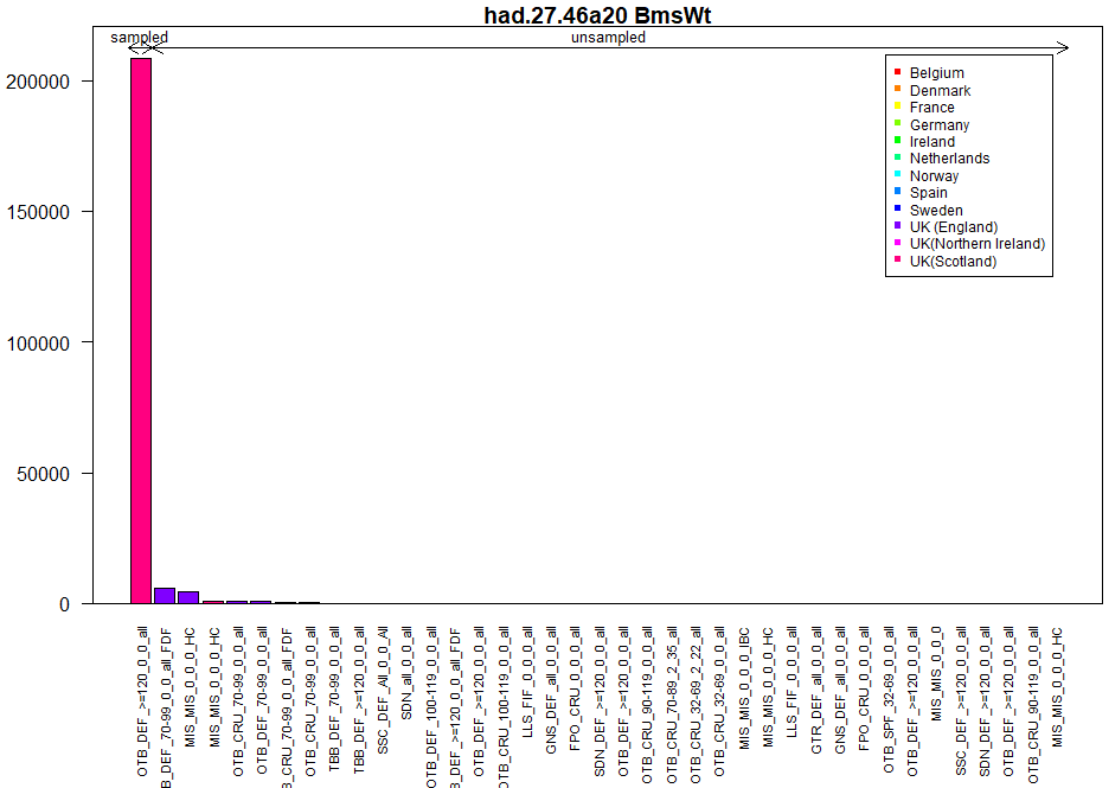


Figure 8.2.3. Haddock in Subarea 4, Division 6.a and Subdivision 20. Reported BMS landings for each sampled and unsampled fleet in the full stock area, in descending order of yield.

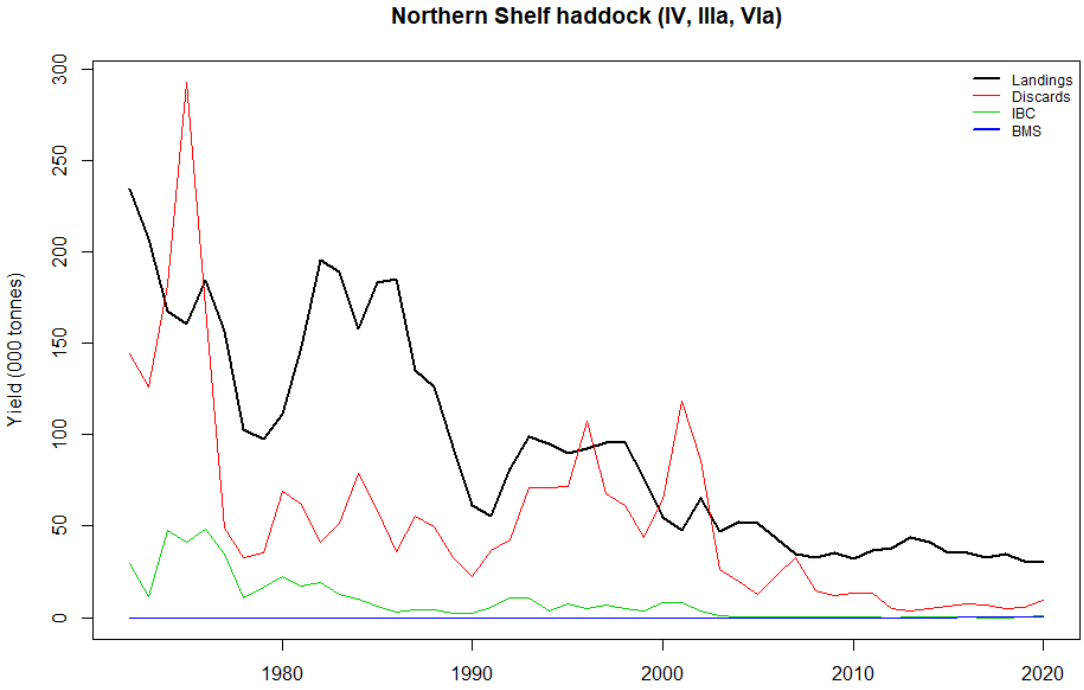


Figure 8.2.4. Haddock in Subarea 4, Division 6.a and Subdivision 20. Yield by catch component.

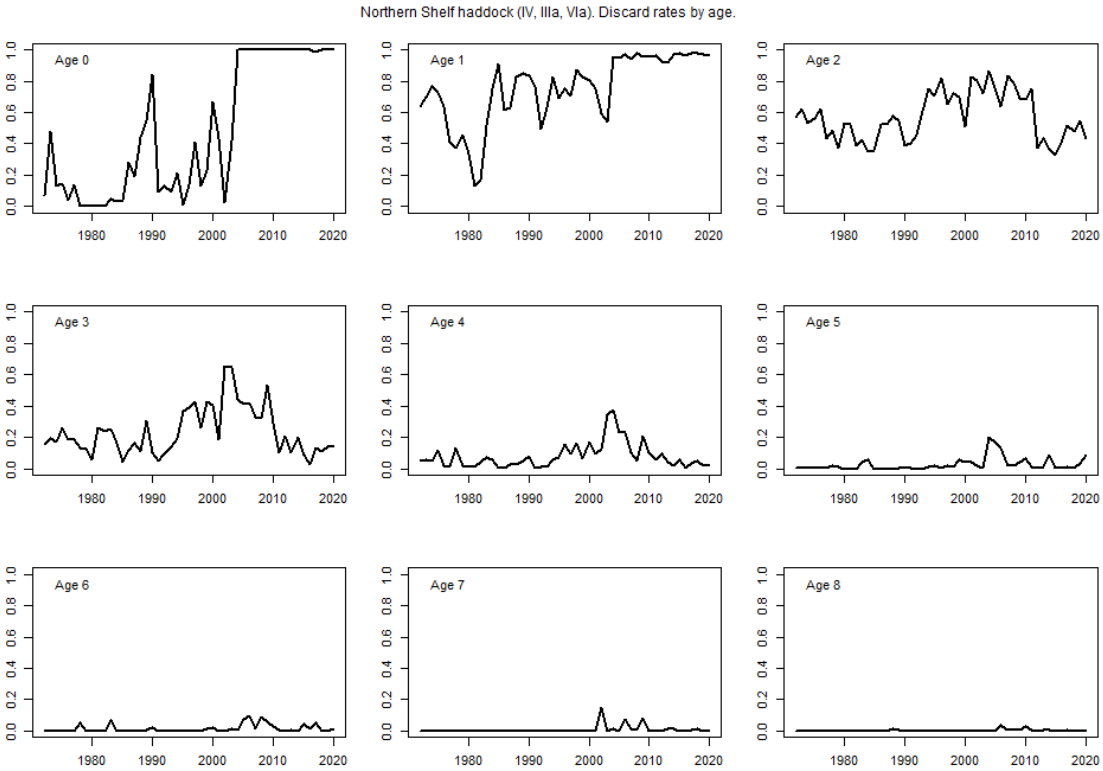


Figure 8.2.5. Haddock in Subarea 4, Division 6.a and Subdivision 20. Proportion of total catch discarded, by age and year.

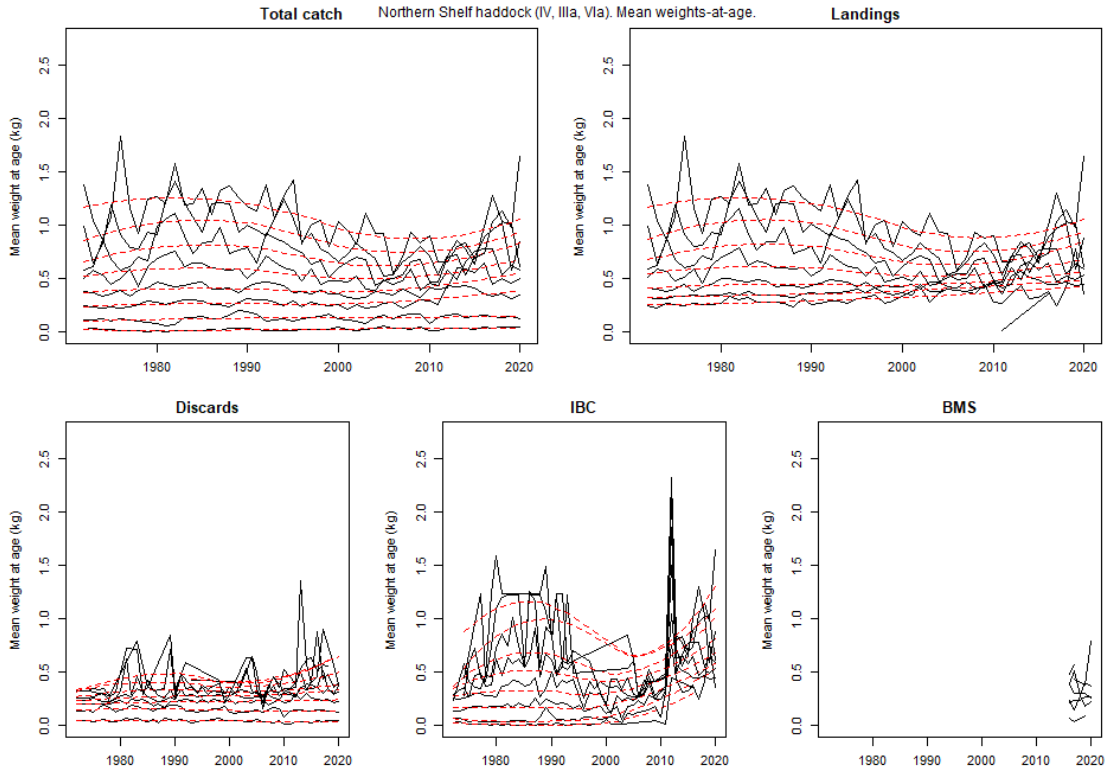


Figure 8.2.6. Haddock in Subarea 4, Division 6.a and Subdivision 20. Mean weights-at-age (kg) by catch component. Total catch mean weights are also used as stock mean weights. Red dotted lines give loess smoothers through each time-series of mean weights-at-age, to show underlying trends.

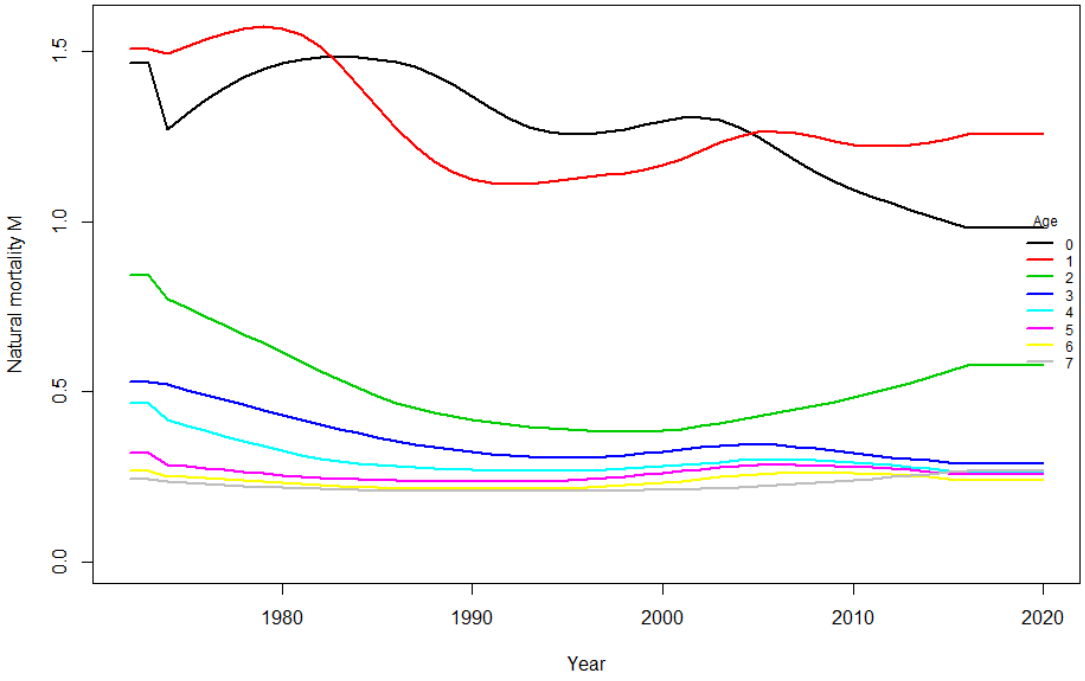


Figure 8.2.7. Haddock in Subarea 4, Division 6.a and Subdivision 20. Time series of estimated natural mortality at age, from ICES WGSAM (2014).

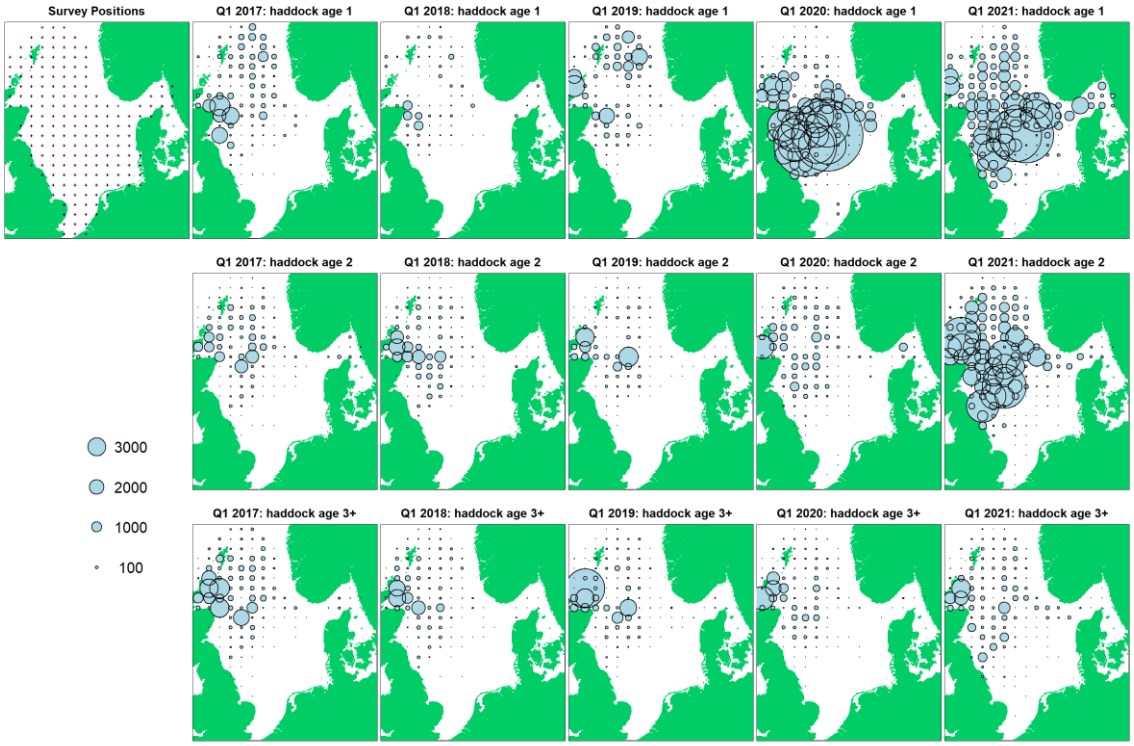


Figure 8.2.8. Haddock in Subarea 4, Division 6.a and Subdivision 20. Survey distributions by age for the international IBTS Q1 survey (North Sea).

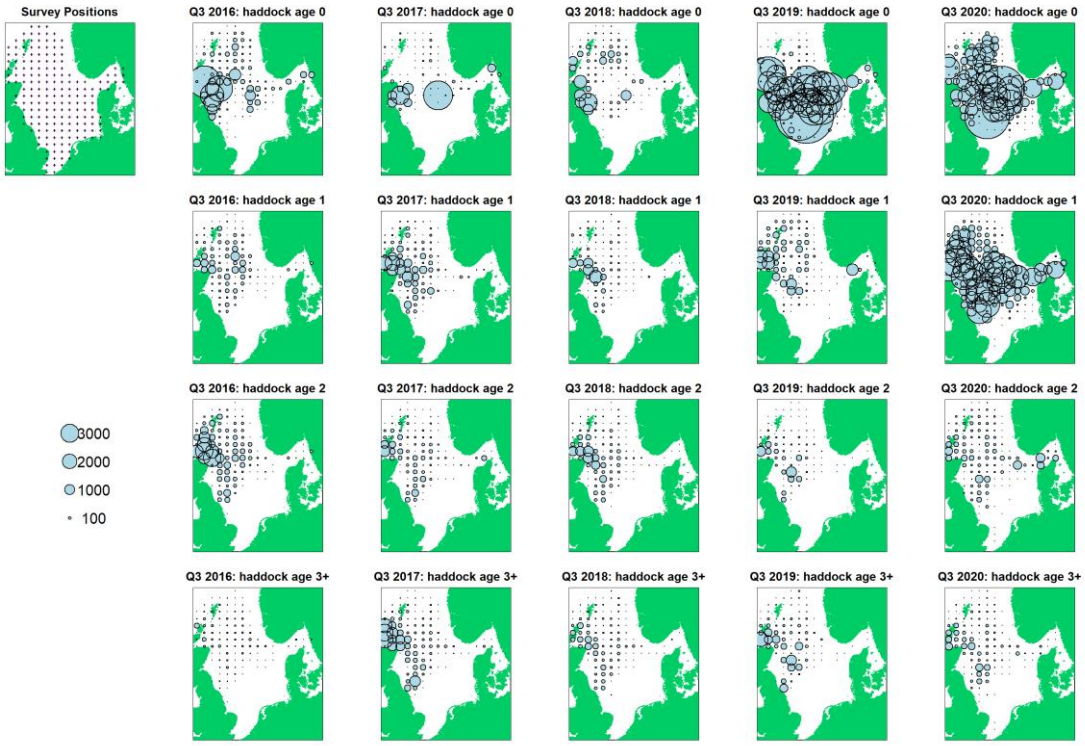


Figure 8.2.9. Haddock in Subarea 4, Division 6.a and Subdivision 20. Survey distributions by age for the international IBTS Q3 survey (North Sea).

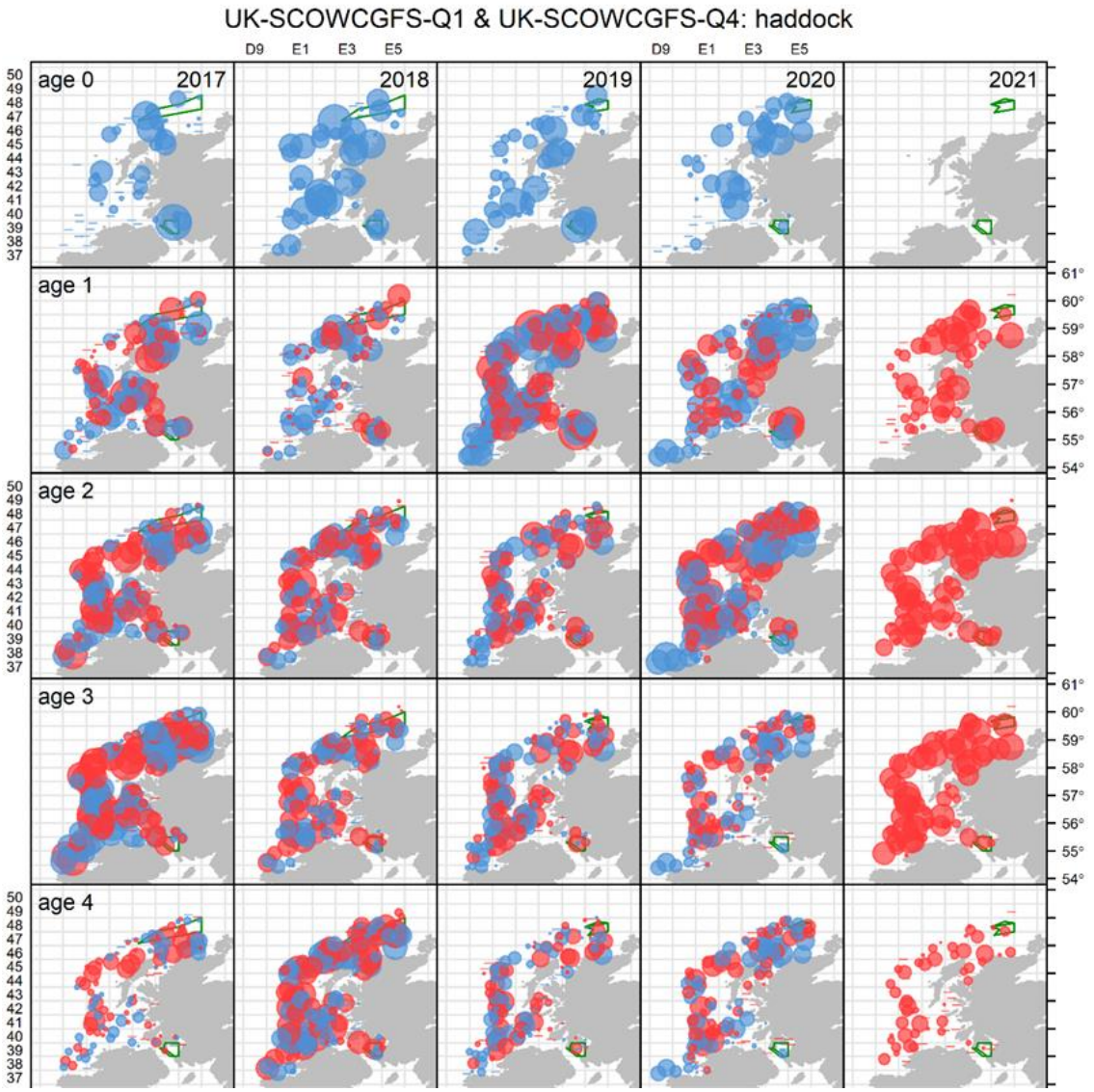


Figure 8.2.10. Haddock in Subarea 4, Division 6.a and Subdivision 20. Survey distributions by age and quarter for the Scottish West Coast Q1 and Q4 survey (West of Scotland).

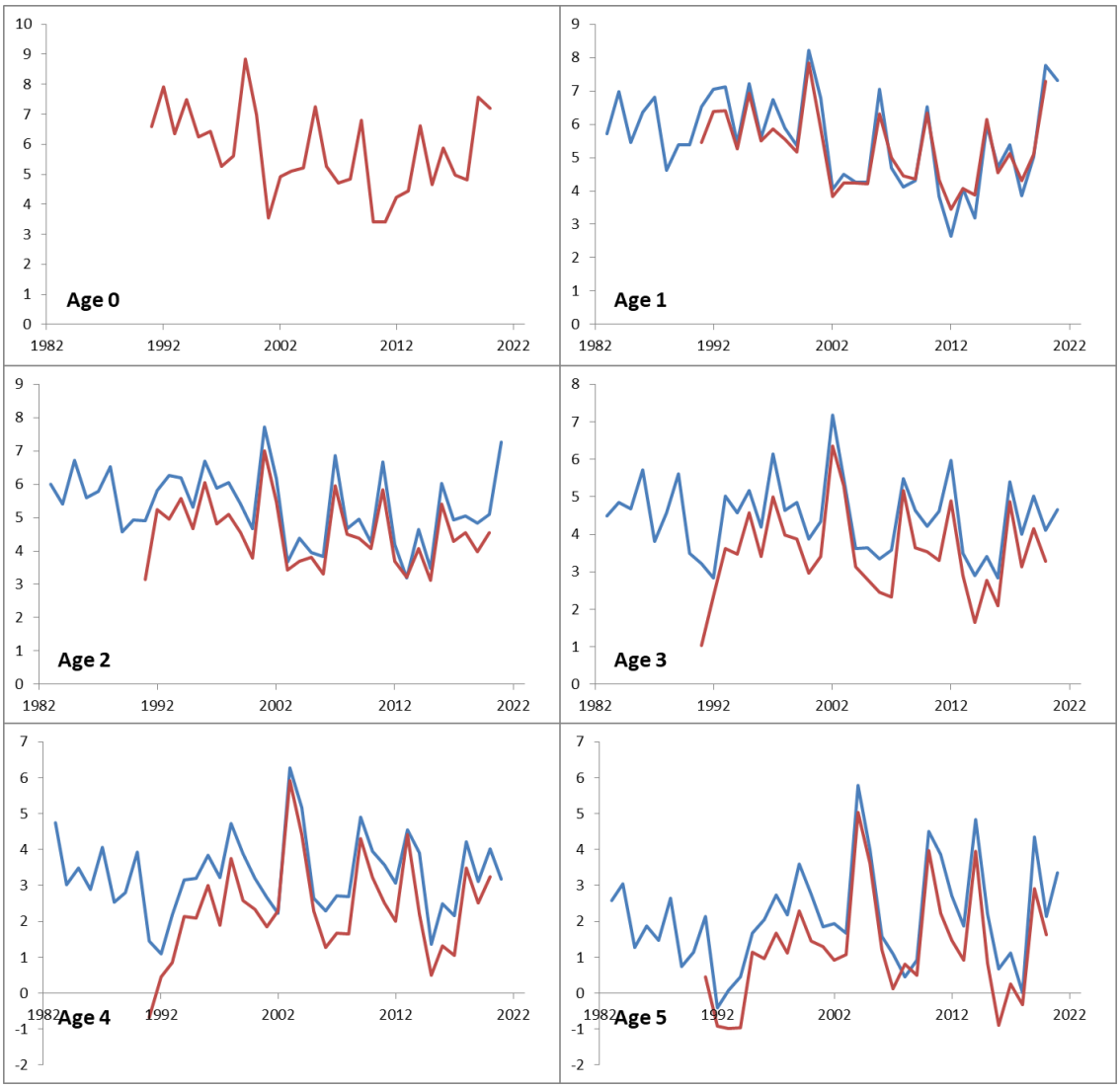


Figure 8.2.11. Haddock in Subarea 4, Division 6.a and Subdivision 20. Survey log CPUE (catch per unit effort) at age.

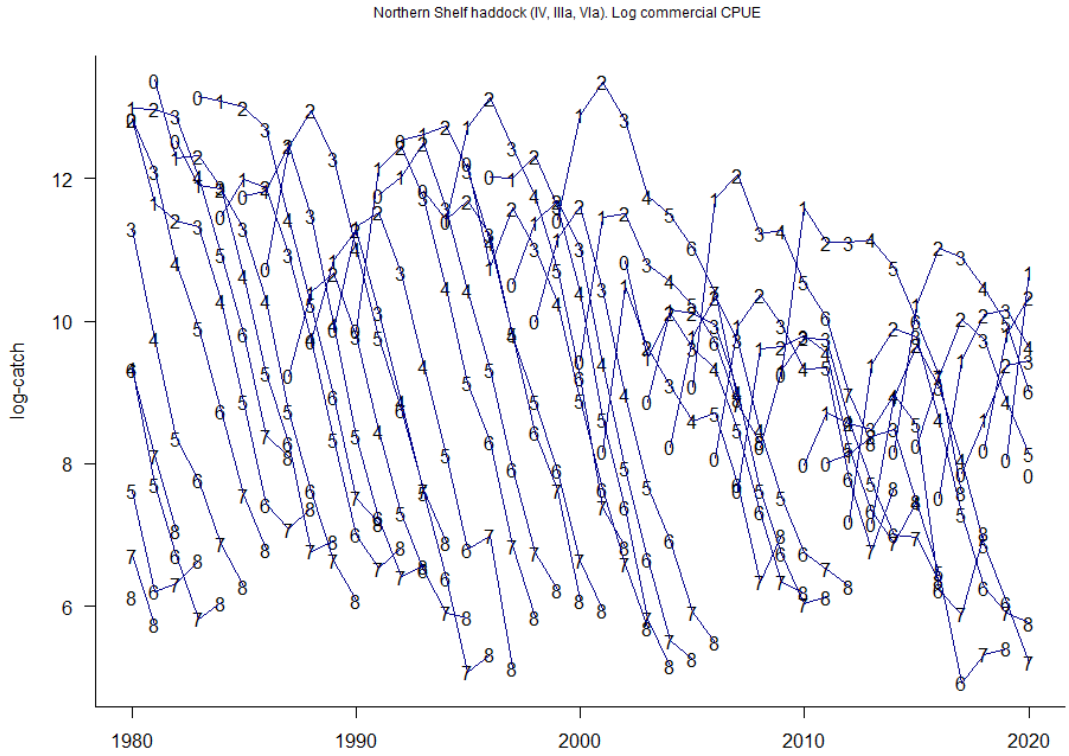


Figure 8.3.1. Haddock in Subarea 4, Division 6.a and Subdivision 20. Log catch curves by cohort for total catches.

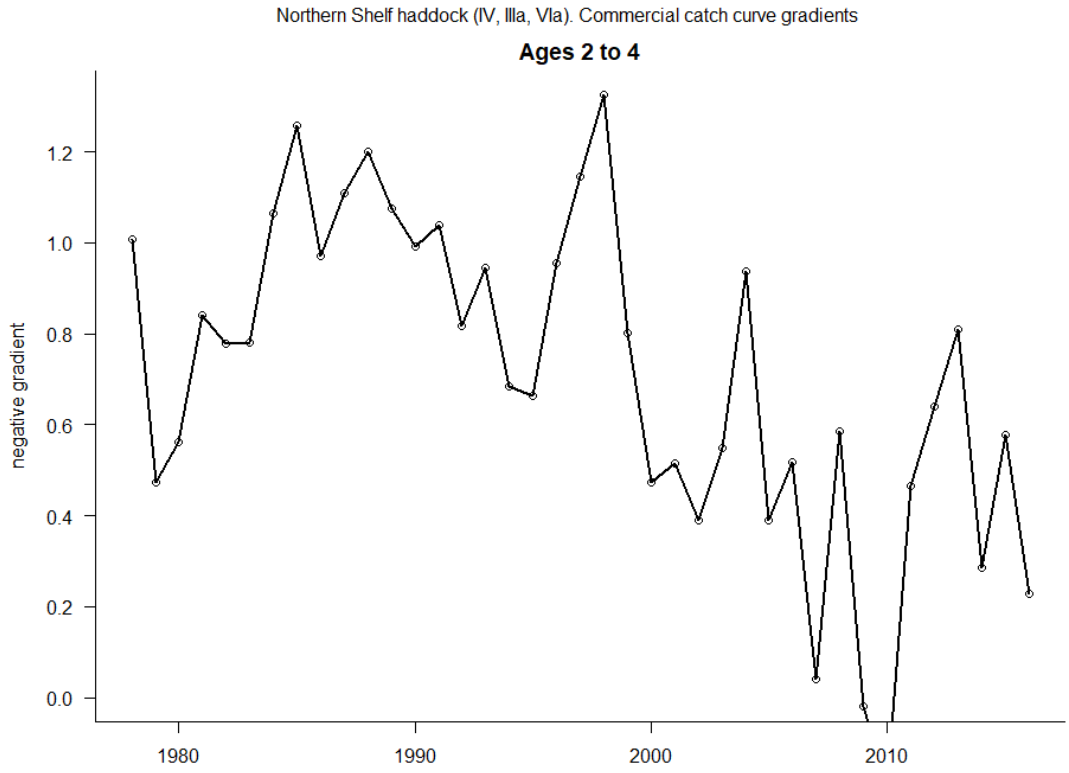


Figure 8.3.2. Haddock in Subarea 4, Division 6.a and Subdivision 20. Negative gradients of log catches per cohort, averaged over ages 2–4. The x-axis represents the spawning year of each cohort.

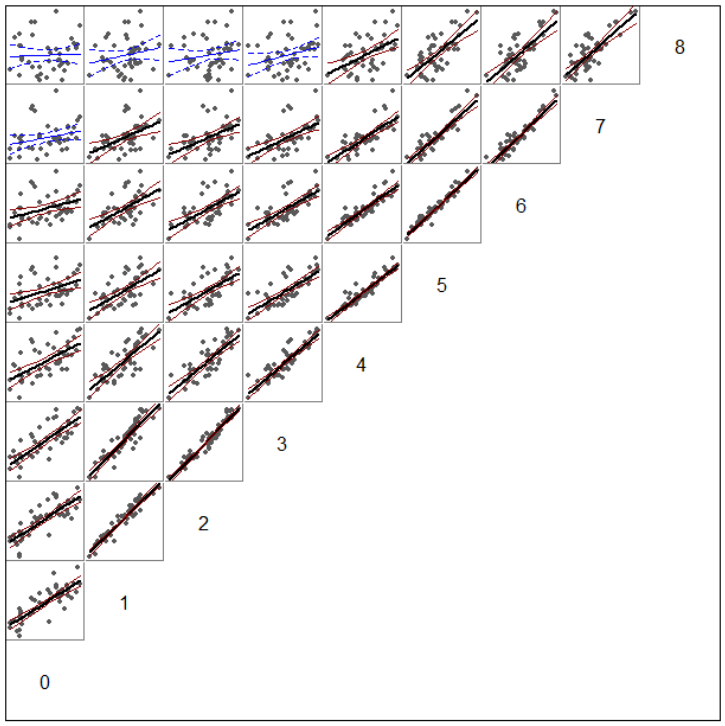


Figure 8.3.3. Haddock in Subarea 4, Division 6.a and Subdivision 20. Correlations in the catch-at-age matrix (including the plus-group for ages 8), comparing estimates at different ages for the same year-classes (cohorts). In each plot, the straight line is a normal linear model fit: a thick line (and 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.

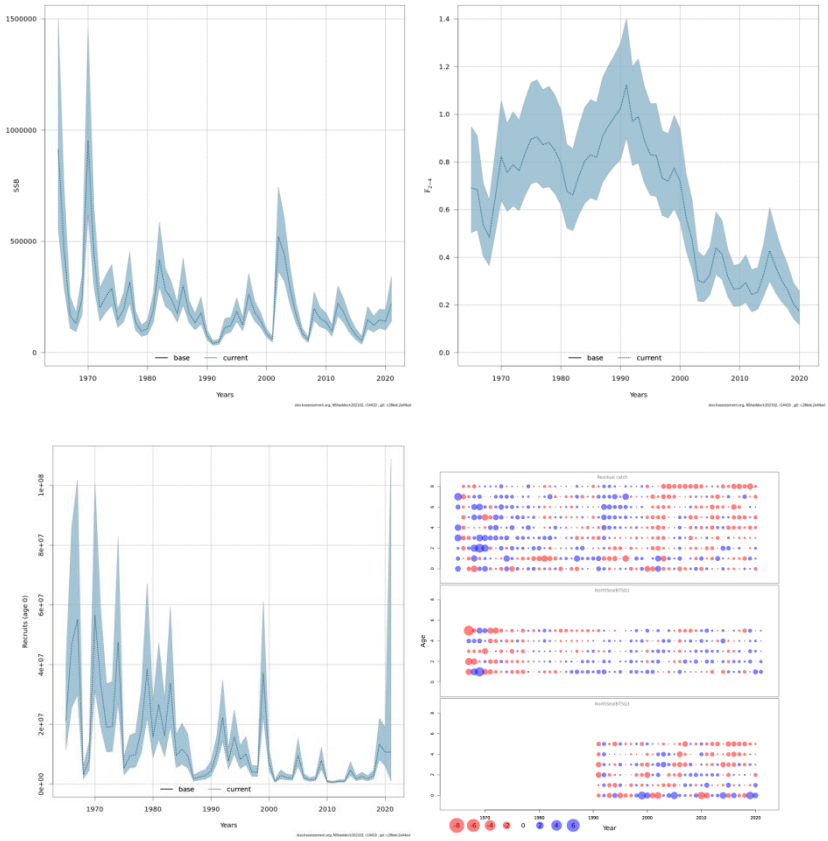


Figure 8.3.4. Haddock in Subarea 4, Division 6.a and Subdivision 20. Summary plots from an exploratory SAM assessment. Time-series of estimated mean F (2–4) (top left), SSB F(2–4) (top right) and recruitment (bottom left) are shown with approximate pointwise 95% confidence intervals. Model residuals (bottom right) are depicted with a clear blue circle for a positive residual, and a solid red circle for a negative residual.

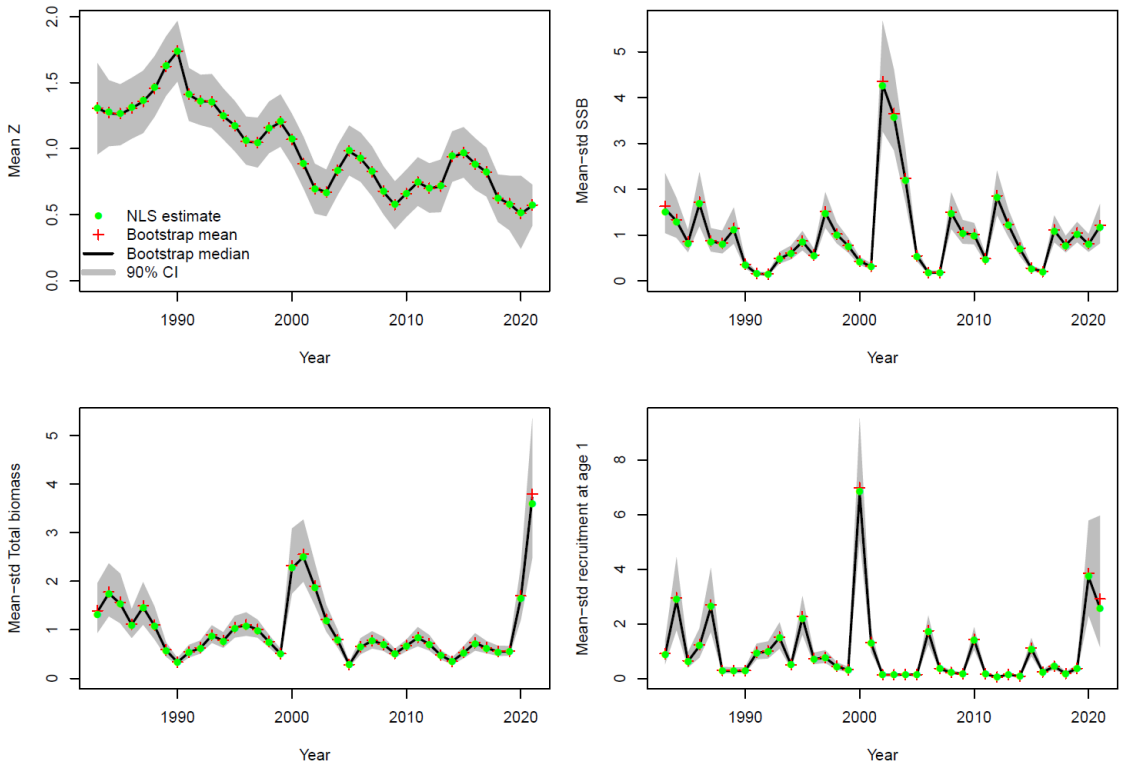


Figure 8.3.5. Haddock in Subarea 4, Division 6.a and Subdivision 20. Summary plots from an exploratory SURBAR assessment, using both available surveys (IBTS Q1 and Q3). Mean mortality Z (ages 2 to 4), relative spawning stock biomass (SSB), relative total biomass (TSB), and relative recruitment. Shaded 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.

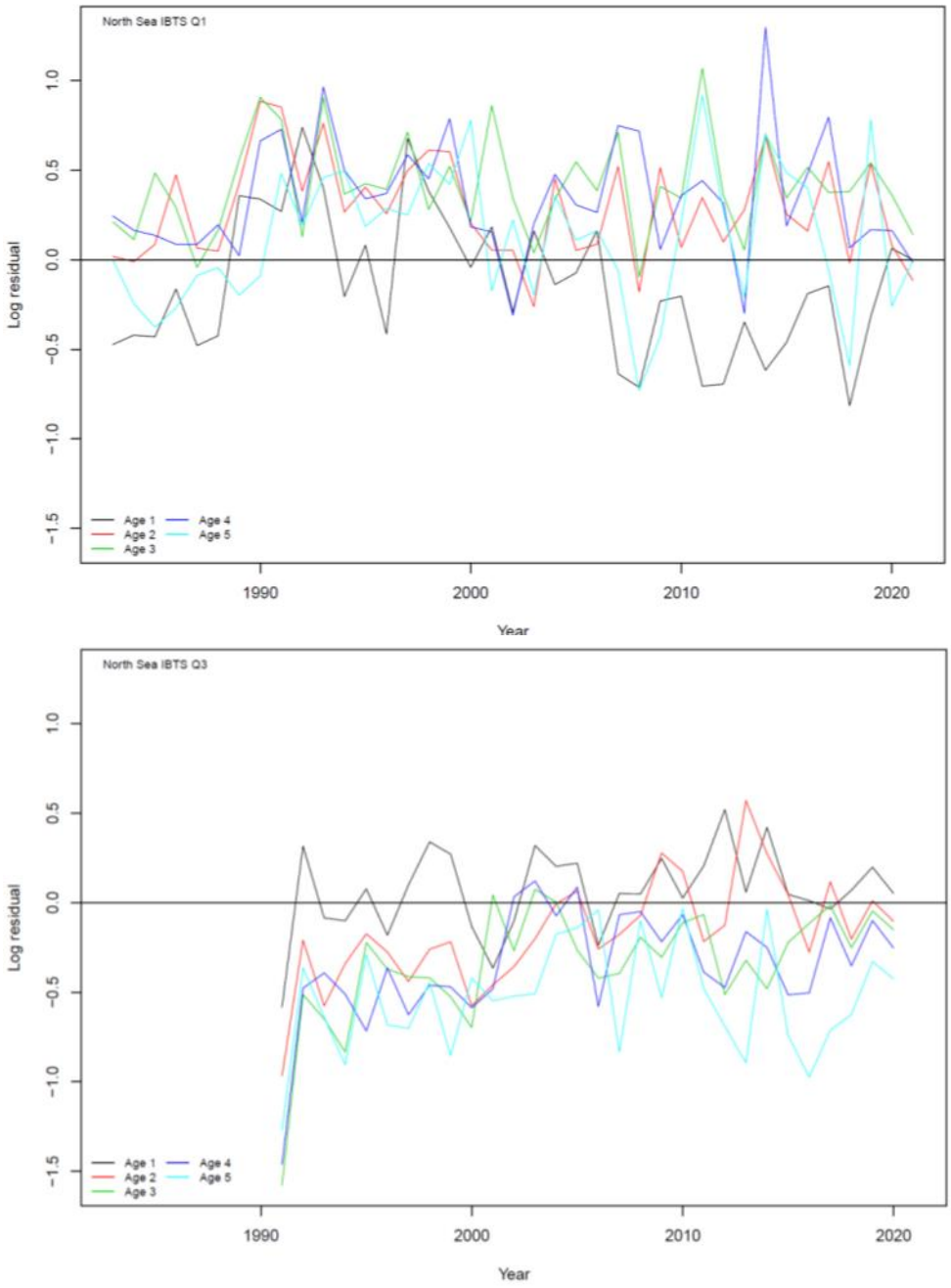


Figure 8.3.6. Haddock in Subarea 4, Division 6.a and Subdivision 20. Log residuals by age from an exploratory SURBAR assessment, using both available surveys (IBTS Q1 and Q3).

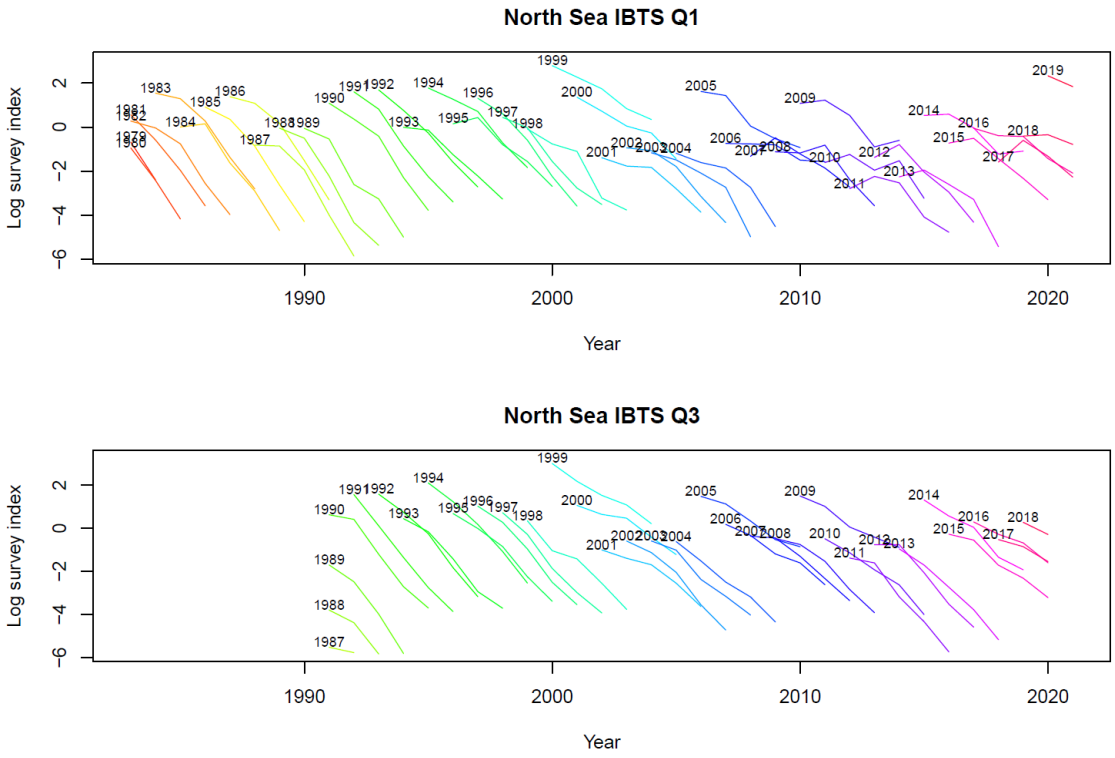


Figure 8.3.7. Haddock in Subarea 4, Division 6.a and Subdivision 20. Log abundance indices by cohort (survey "catch curves") for each of the survey indices.

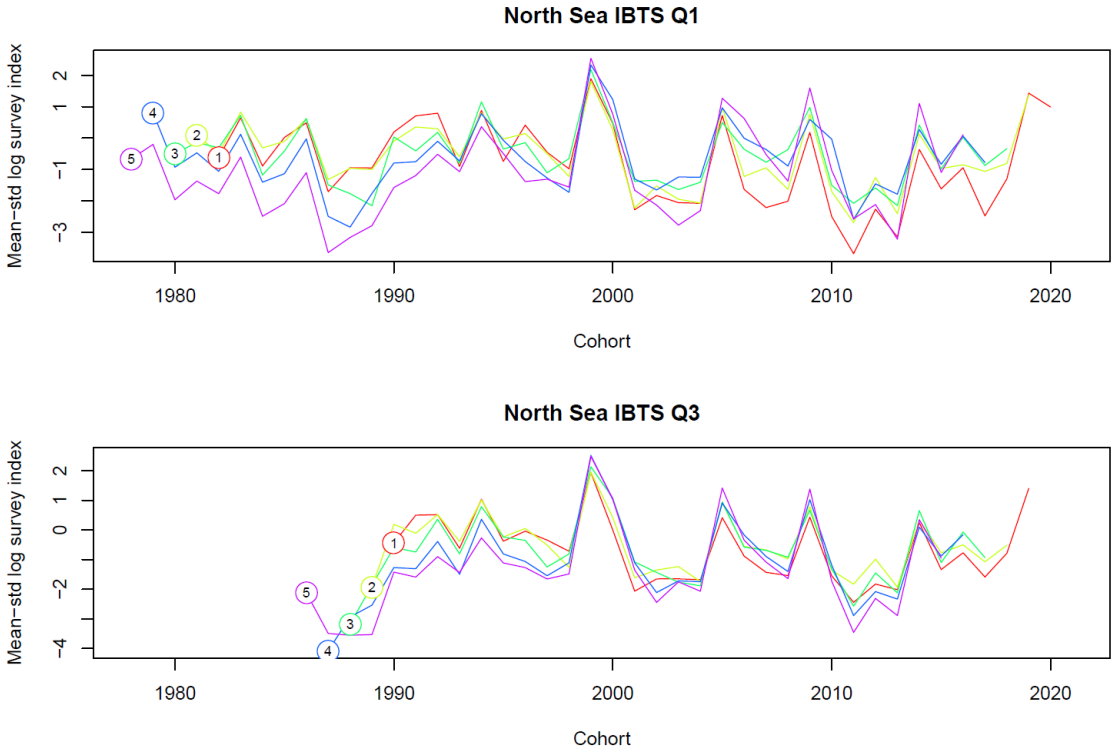


Figure 8.3.8. Haddock in Subarea 4, Division 6.a and Subdivision 20. Mean-standardised log abundance indices by age and cohort for each of the survey indices. The age represented by each line is indicated by a circled number at the start of the line.

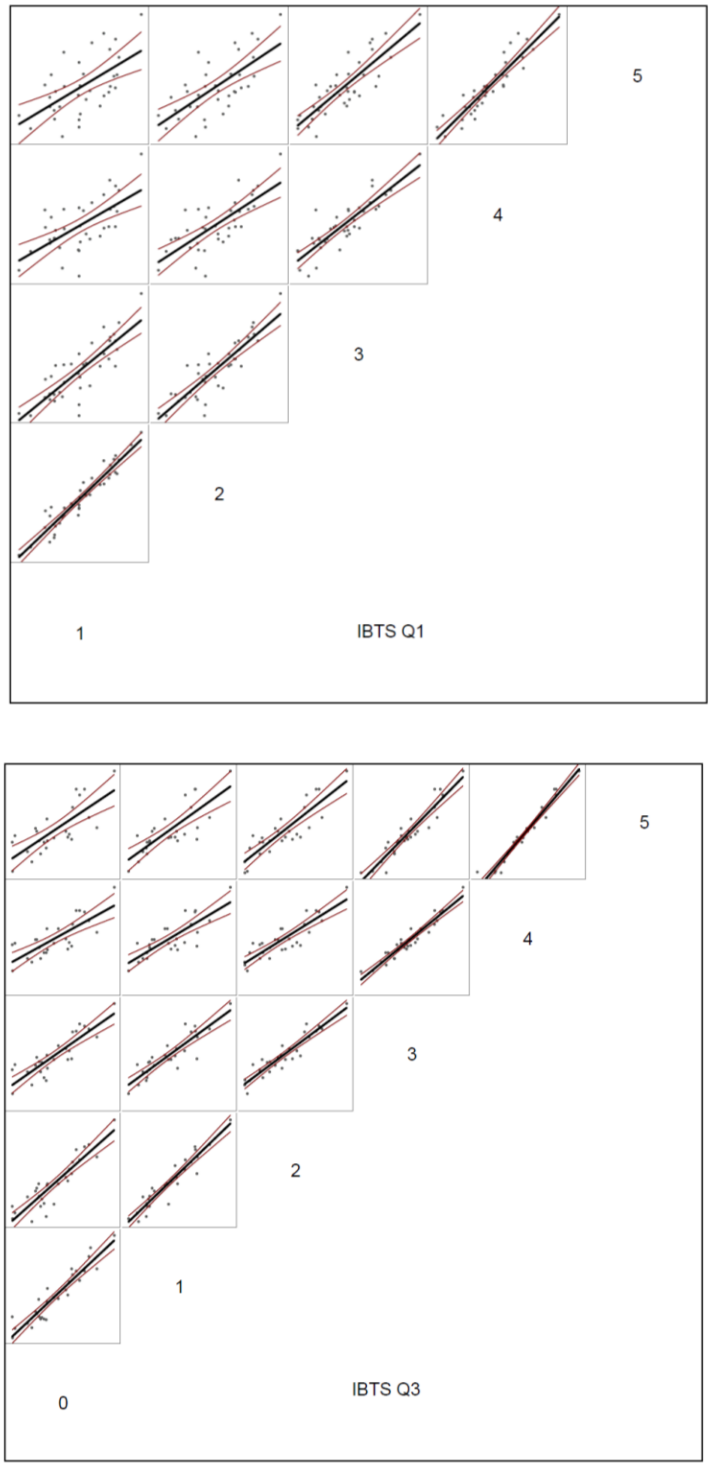


Figure 8.3.9. Haddock in Subarea 4, Division 6.a and Subdivision 20. Within-survey correlations for the IBTS Q1 (upper) and Q3 (lower) survey series, comparing index values at different ages for the same year-classes (cohorts). In each plot, the straight line is a normal linear model fit: a thick line (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.

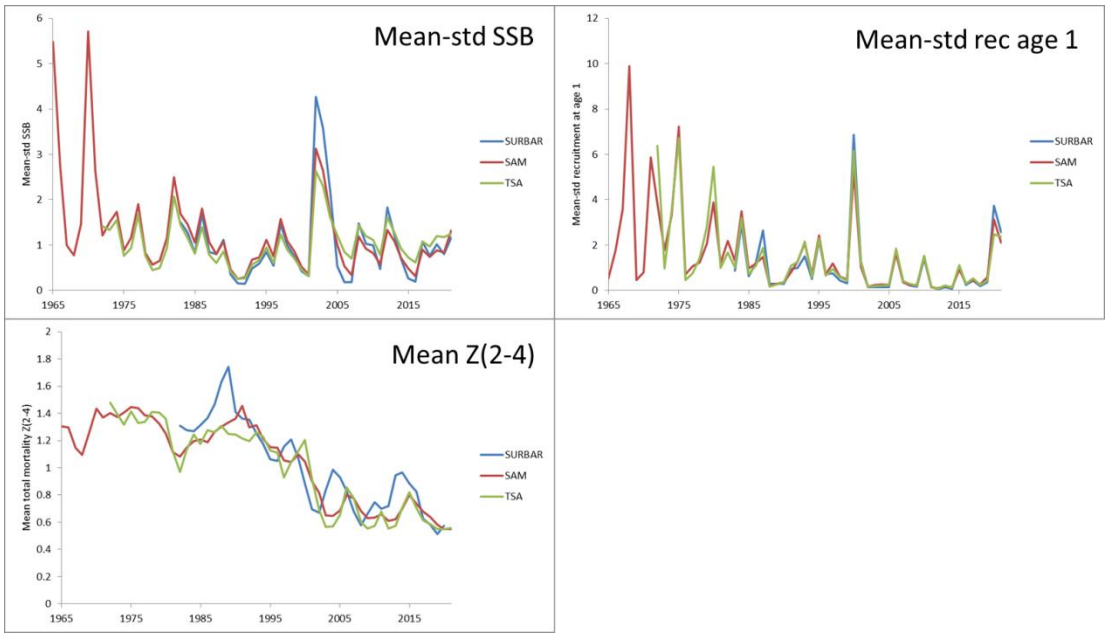


Figure 8.3.10. Haddock in Subarea 4, Division 6.a and Subdivision 20. Comparisons of stock summary estimates from TSA (green), SAM (red) and SURBAR (blue) models. To facilitate comparison, SSB and recruitment values have been mean-standardised using the year range for which estimates are available from all three models, and a composite Z estimate has been made for TSA and SAM by adding natural and fishing mortality estimates.

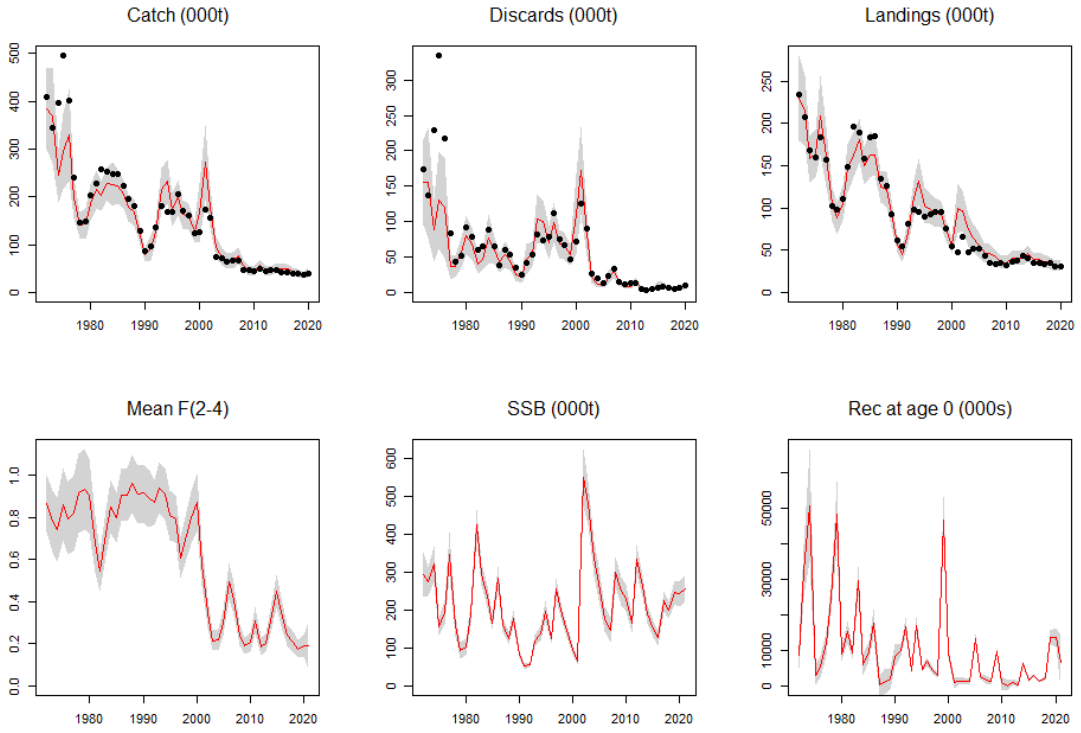


Figure 8.3.11. Haddock in Subarea 4, Division 6.a and Subdivision 20. Stock summary from final TSA. Red lines (or points) give best estimates, grey bands (or lines) give approximate pointwise 95% confidence intervals, and black points give observed values for catch, discards (discards+IBC+BMS), and landings.

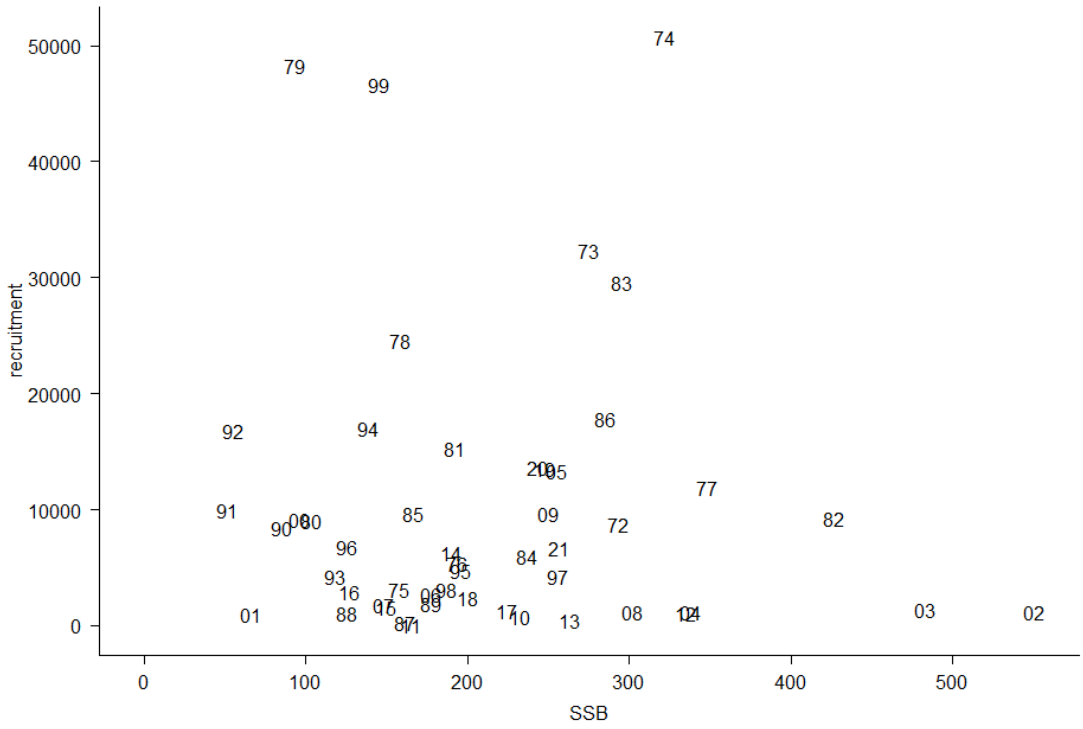


Figure 8.3.12. Haddock in Subarea 4, Division 6.a and Subdivision 20. Stock-recruitment estimates from the final TSA assessment. Points are labelled by year-class

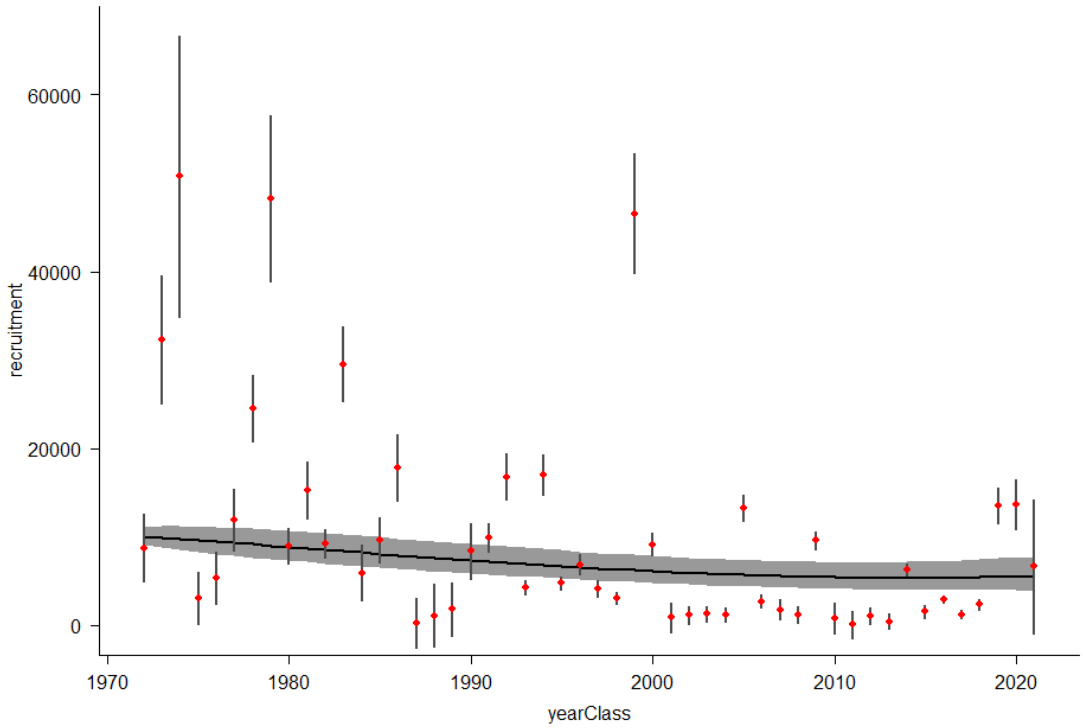


Figure 8.3.13. Haddock in Subarea 4, Division 6.a and Subdivision 20. Estimated recruitment time-series from the final TSA assessment. Red points give estimated values with grey bars indicating approximate pointwise 95% confidence intervals. The black line (also with 95% CI) shows the underlying random-walk recruitment model estimated by TSA.

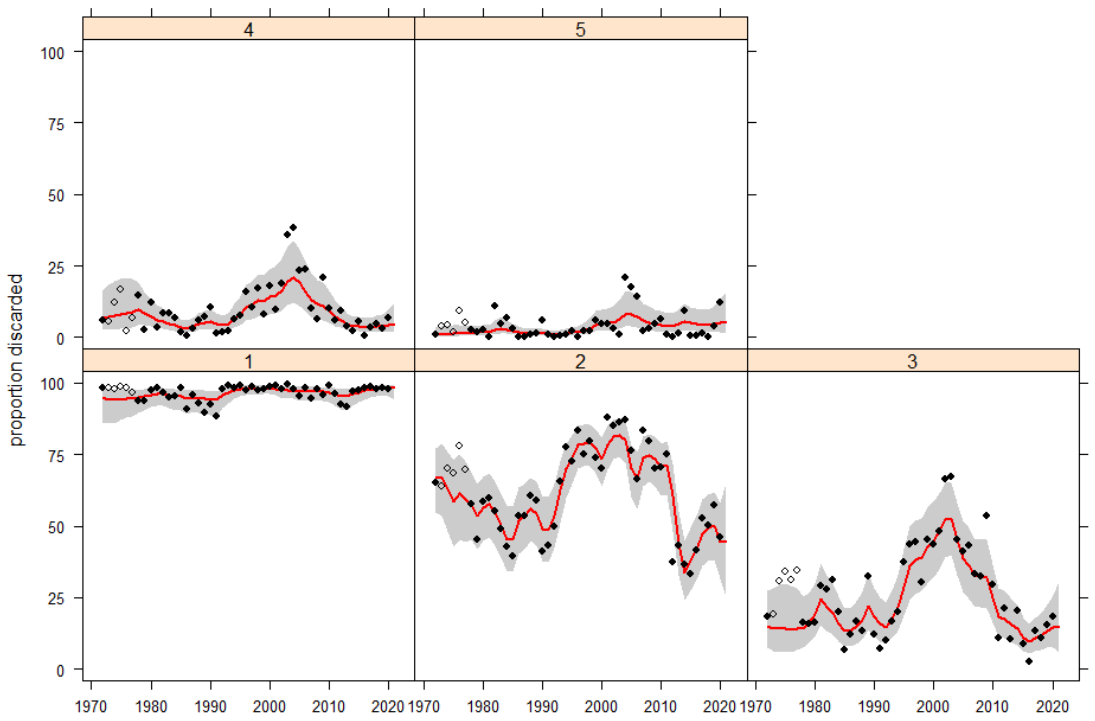


Figure 8.3.14. Haddock in Subarea 4, Division 6.a and Subdivision 20. Observed (points) and fitted (red lines with 95% CI indicated by grey bands) for the proportion discarded by age. Here "discards" is shorthand for combined discards + industrial bycatch + BMS. The open points for the years 1973–1977 indicate that these values are treated as missing in the TSA estimation. All haddock of age 0 are assumed to be either discarded or caught as industrial bycatch or BMS.

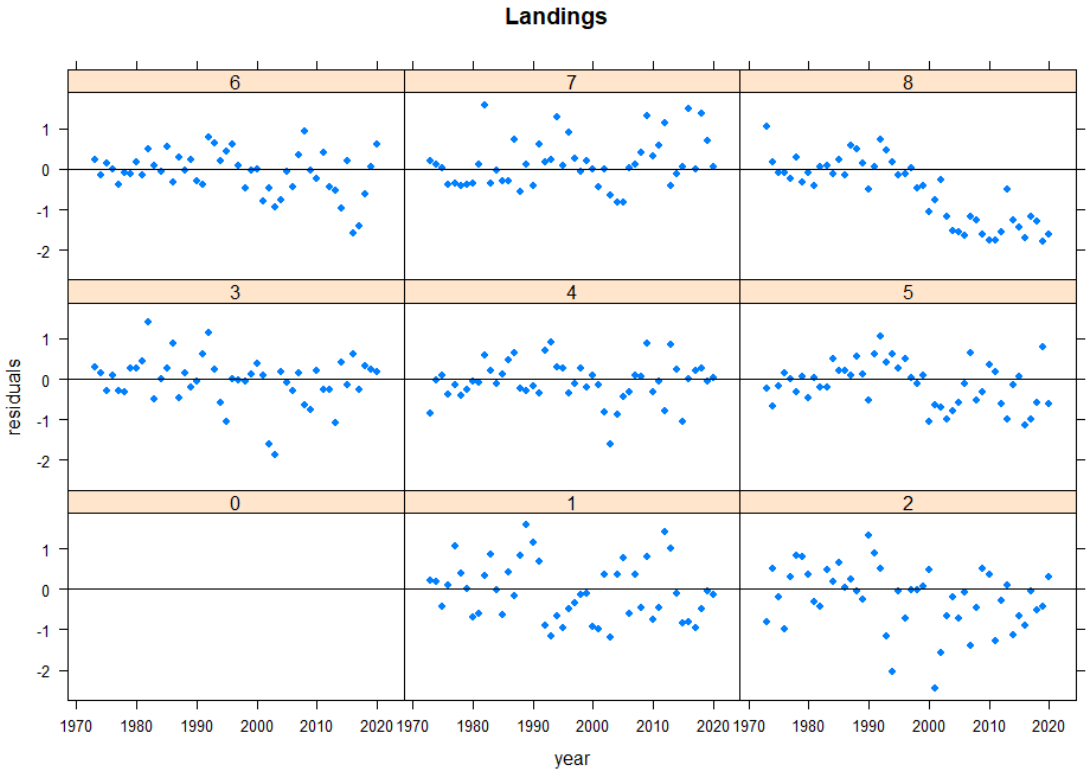


Figure 8.3.15. Haddock in Subarea 4, Division 6.a and Subdivision 20. TSA landings residuals by age.

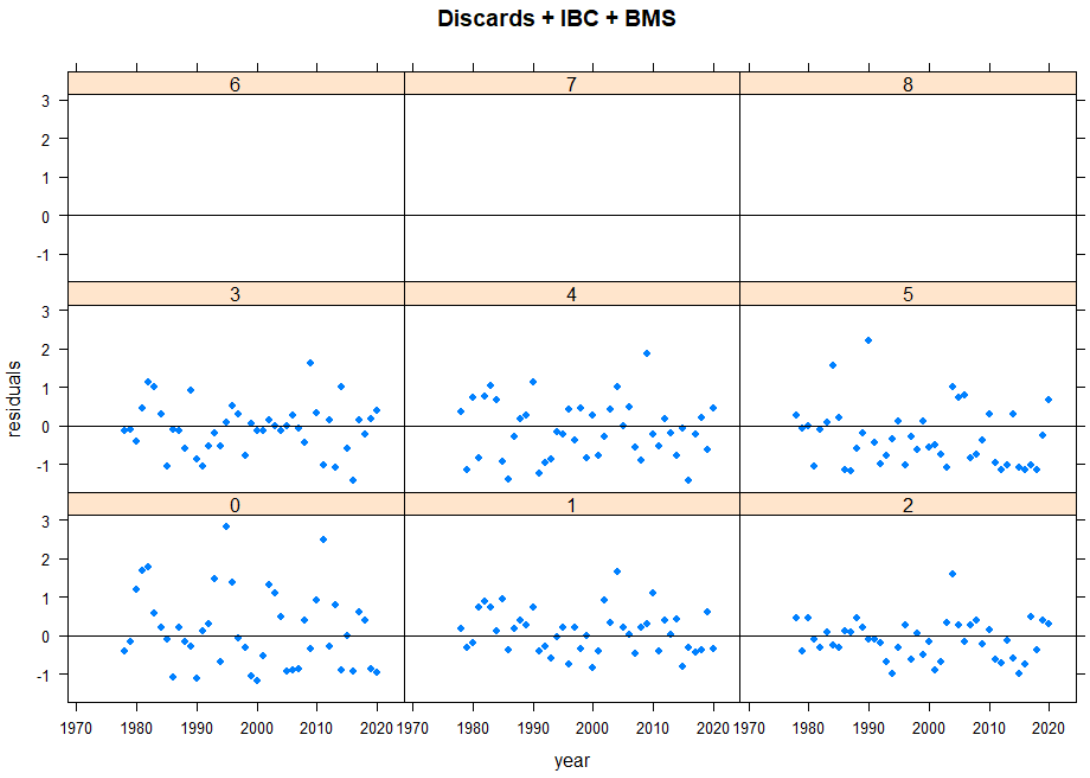


Figure 8.3.16. Haddock in Subarea 4, Division 6.a and Subdivision 20. TSA discards + IBC + BMS residuals by age.

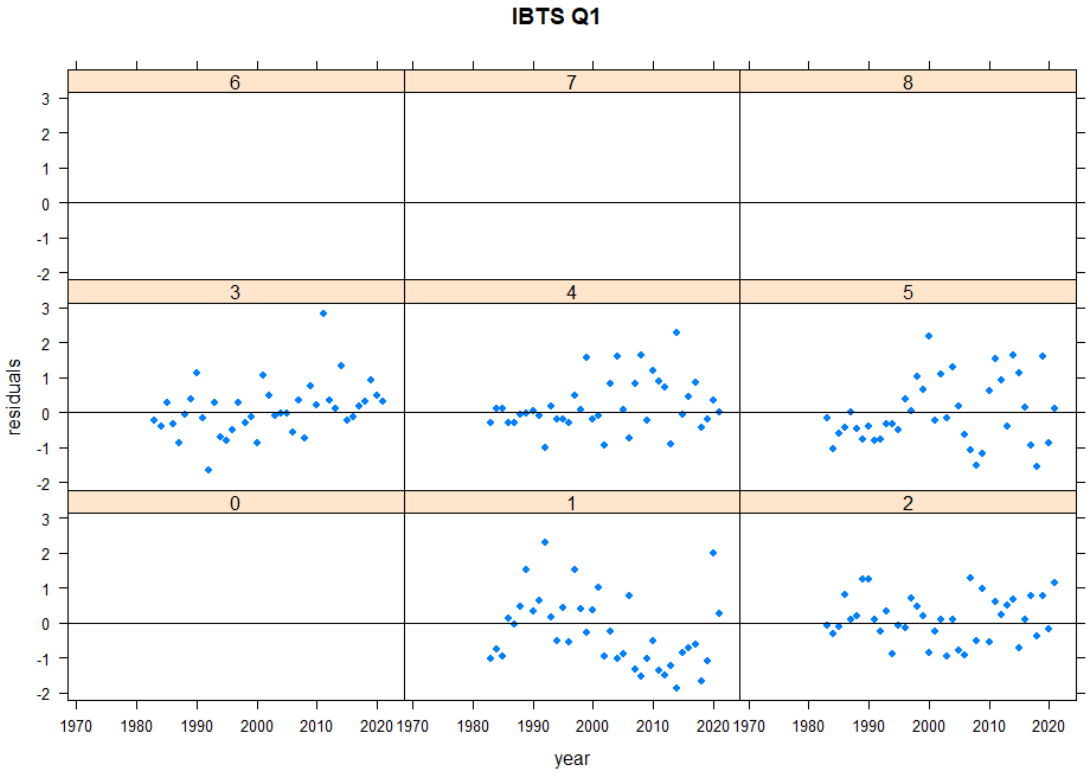


Figure 8.3.17. Haddock in Subarea 4, Division 6.a and Subdivision 20. TSA residuals by age for the IBTS Q1 survey index.

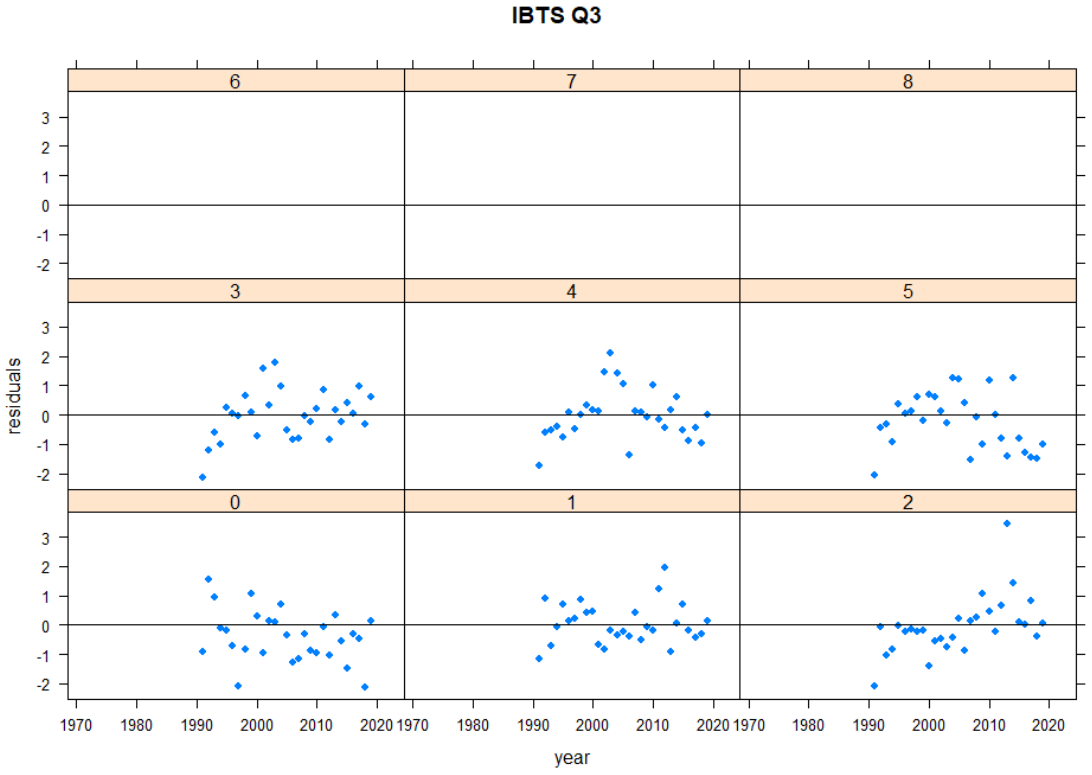


Figure 8.3.18. Haddock in Subarea 4, Division 6.a and Subdivision 20. TSA residuals by age for the IBTS Q3 survey index.

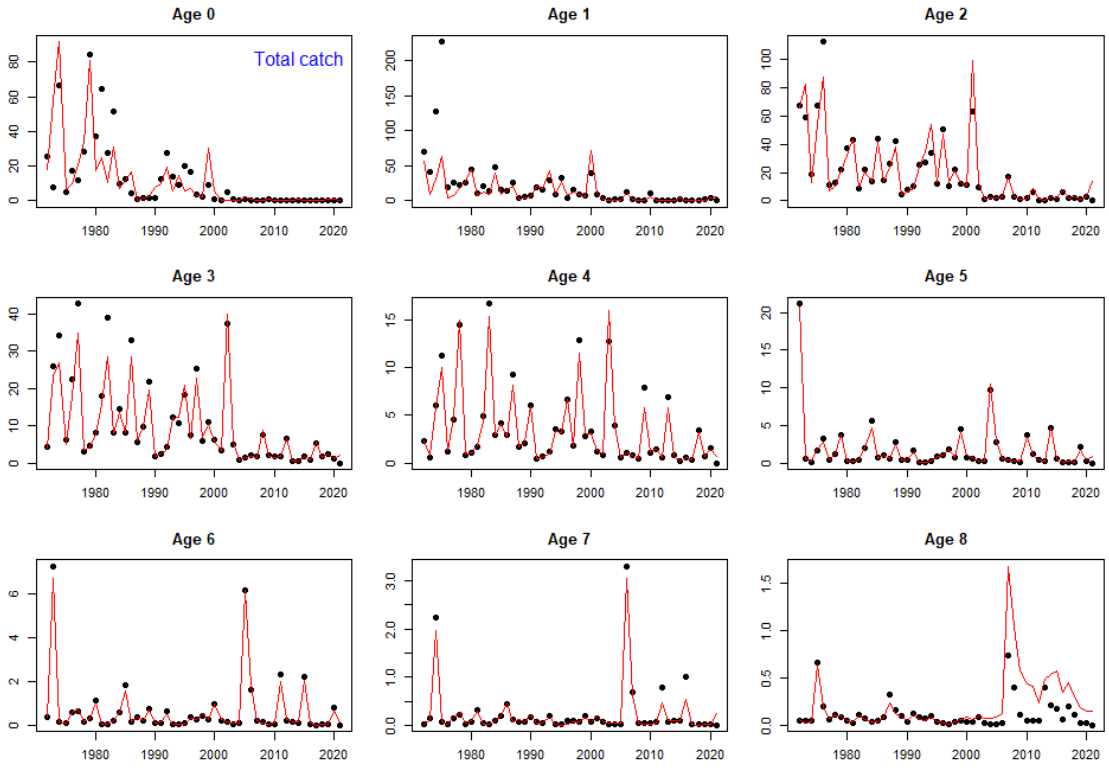


Figure 8.3.19. Haddock in Subarea 4, Division 6.a and Subdivision 20. Time-series of observed (points) and fitted (lines) values for total catch, by age.

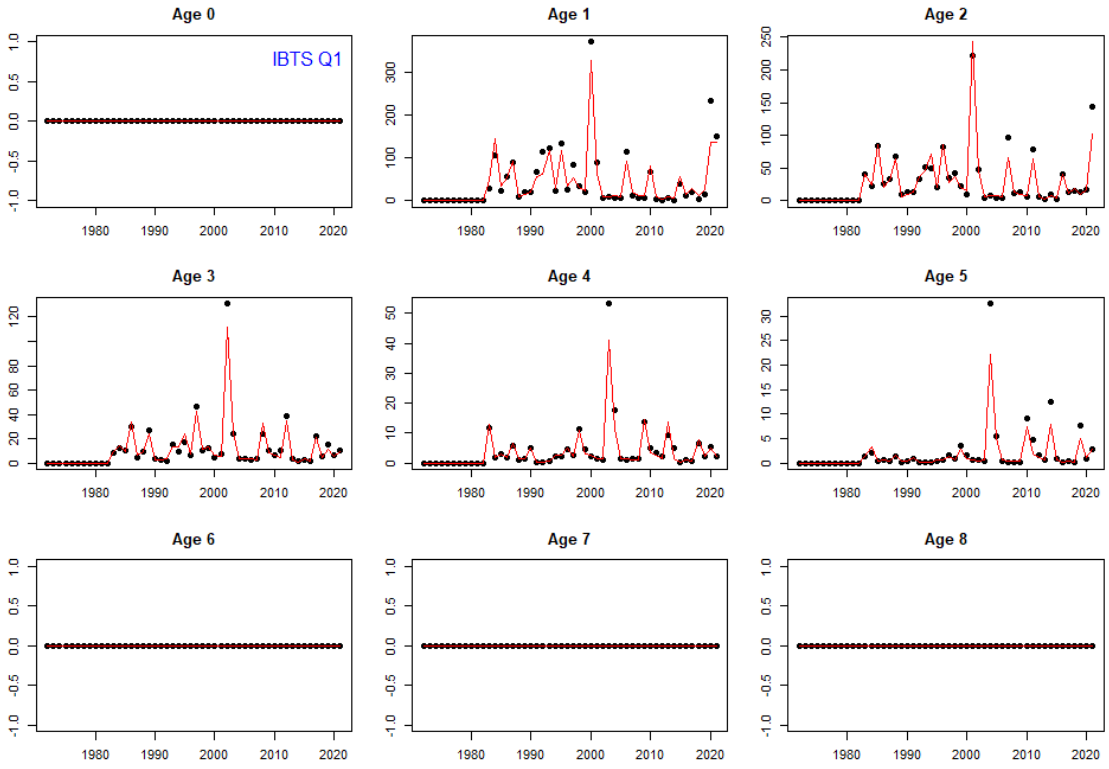


Figure 8.3.20. Haddock in Subarea 4, Division 6.a and Subdivision 20. Time-series of observed (points) and fitted (lines) values for the IBTS Q1 survey index, by age.

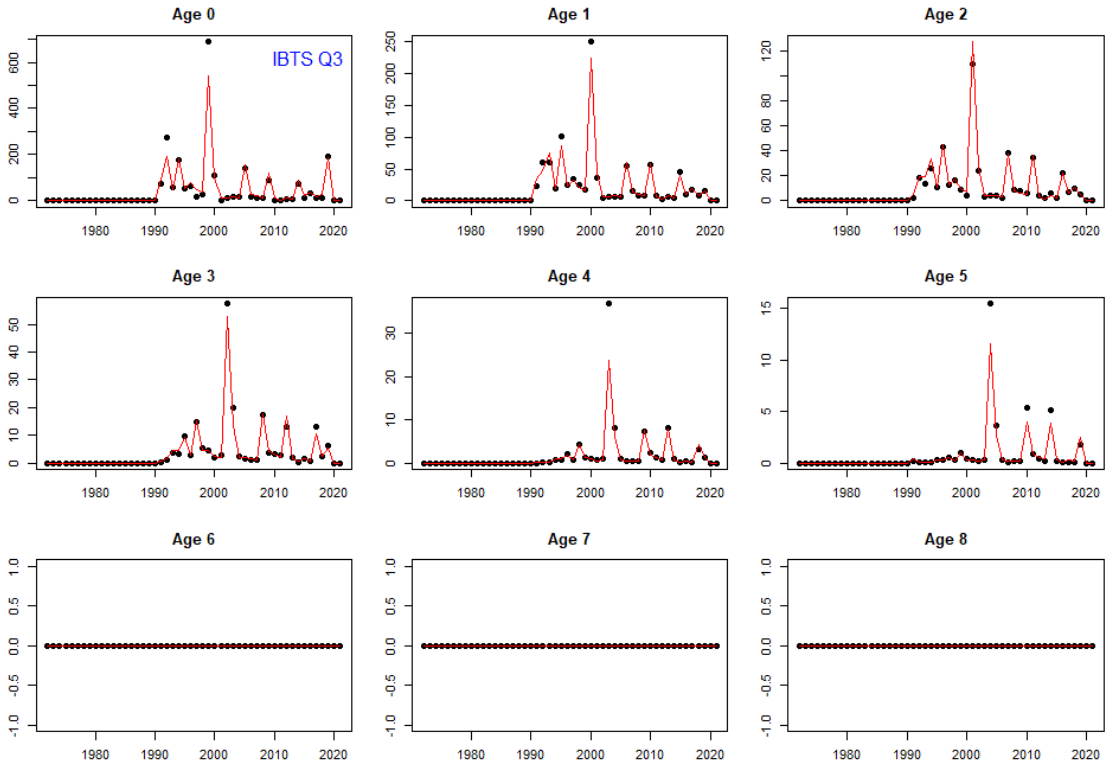
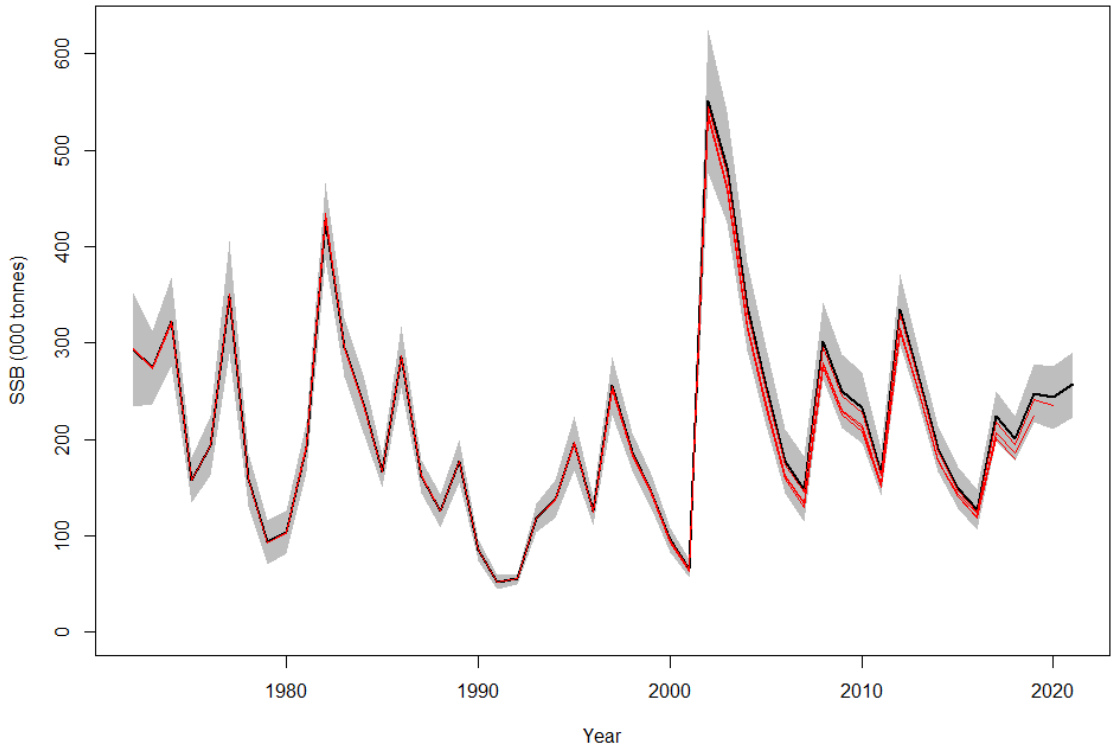
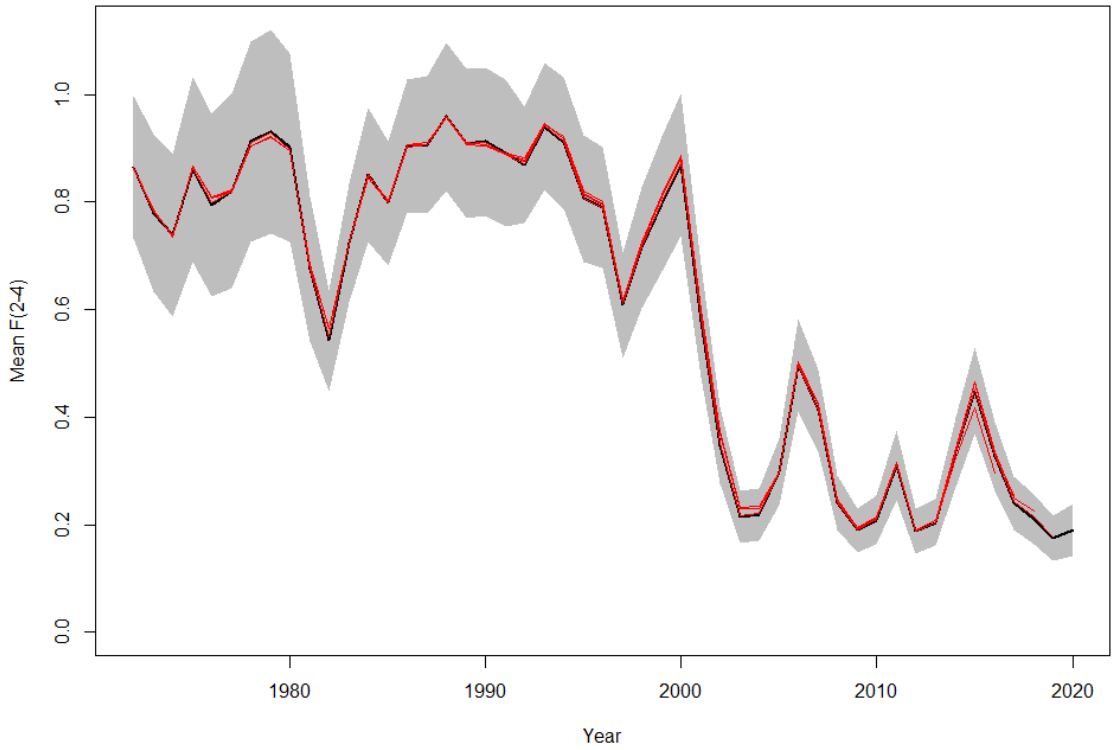


Figure 8.3.21. Haddock in Subarea 4, Division 6.a and Subdivision 20 Time-series of observed (points) and fitted (lines) values for the IBTS Q3 survey index, by age.


SSB (000 tonnes)
0
100
200
300
400
500
600
1980
1990
2000
2010
2020
Year


Mean F(2-4)
0.0
0.2
0.4
0.6
0.8
1.0
1980
1990
2000
2010
2020
Year

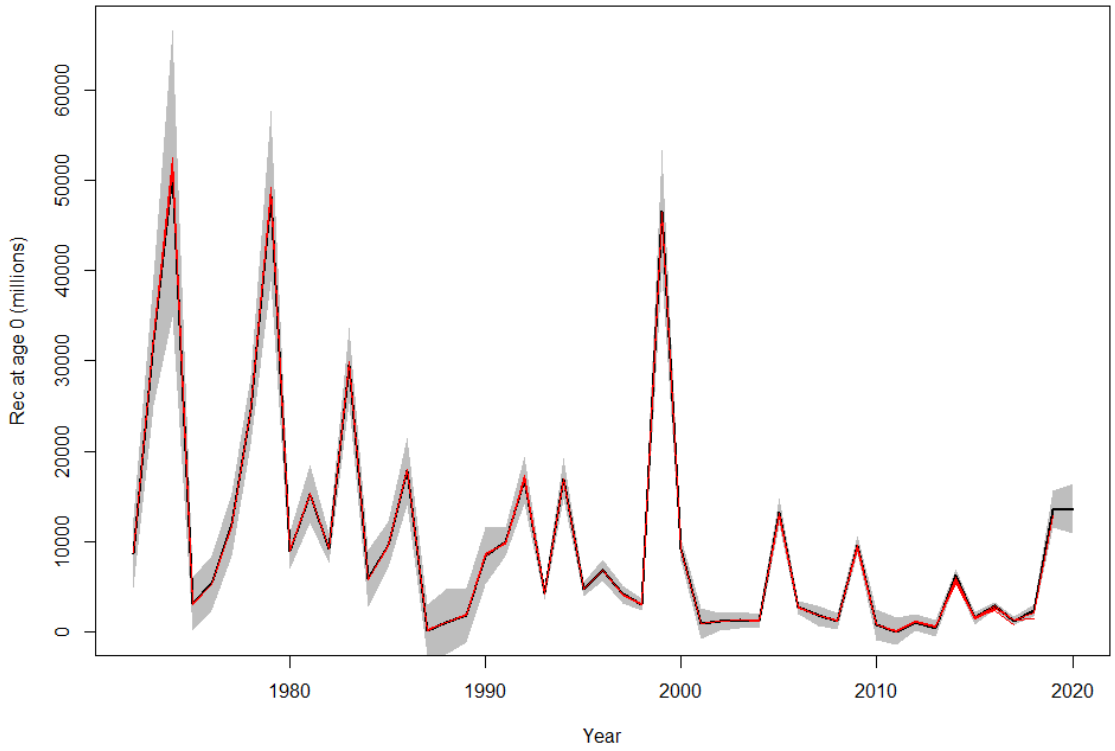


Figure 8.3.22. Haddock in Subarea 4, Division 6.a and Subdivision 20. Retrospective plots for the TSA assessment. The final-year run is shown in red with the approximate pointwise 95% confidence interval in grey, while retrospective peels are shown with black lines. Mohn's rho estimates are -6% (SSB), -2% (mean F), and -23% (recruitment).

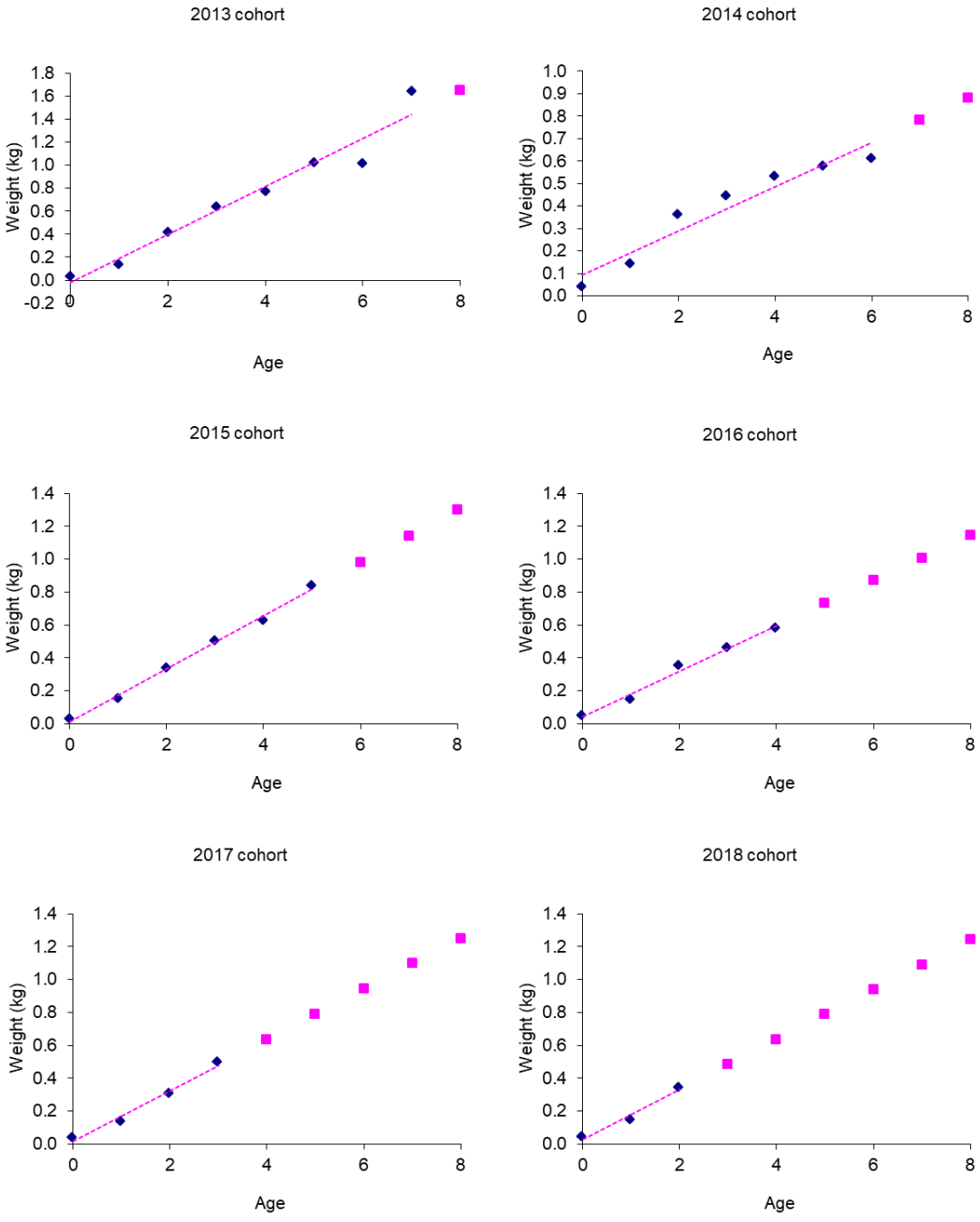


Figure 8.6.1. Haddock in Subarea 4, Division 6.a and Subdivision 20. Results of growth modelling for total catch weights (also used as stock weights) using cohort-based linear models (Jaworski, 2011). Cohorts 2013–2018 are shown here. Blue points are available observations, pink dotted lines show linear fits to these points, and pink points indicate projected weights for older ages.

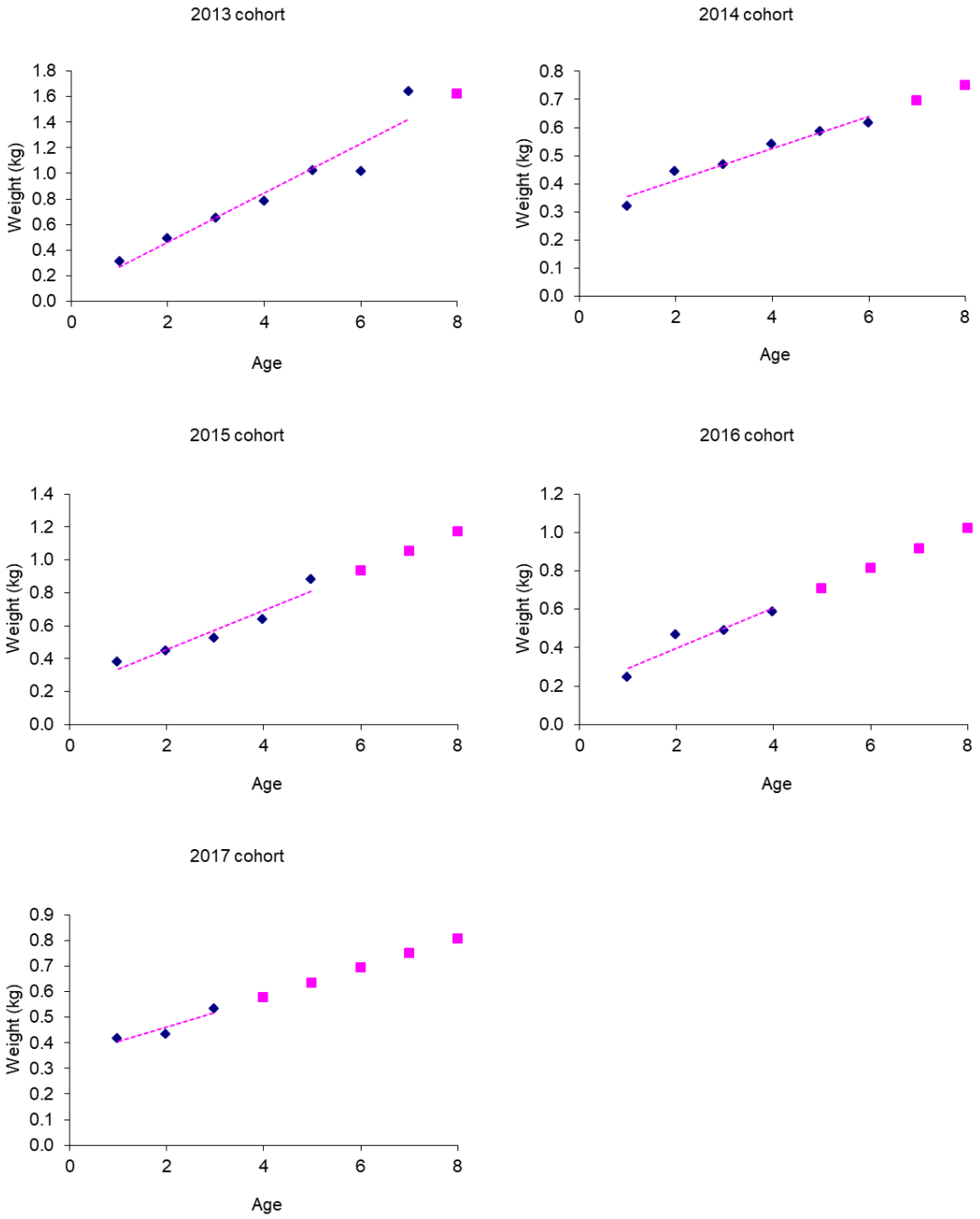


Figure 8.6.2. Haddock in Subarea 4, Division 6.a and Subdivision 20. Results of growth modelling for wanted catch (landings) weights using cohort-based linear models (Jaworski, 2011). Cohorts 2013–2017 are shown here. Blue points are available observations, pink dotted lines show linear fits to these points, and pink points indicate projected weights for older ages.

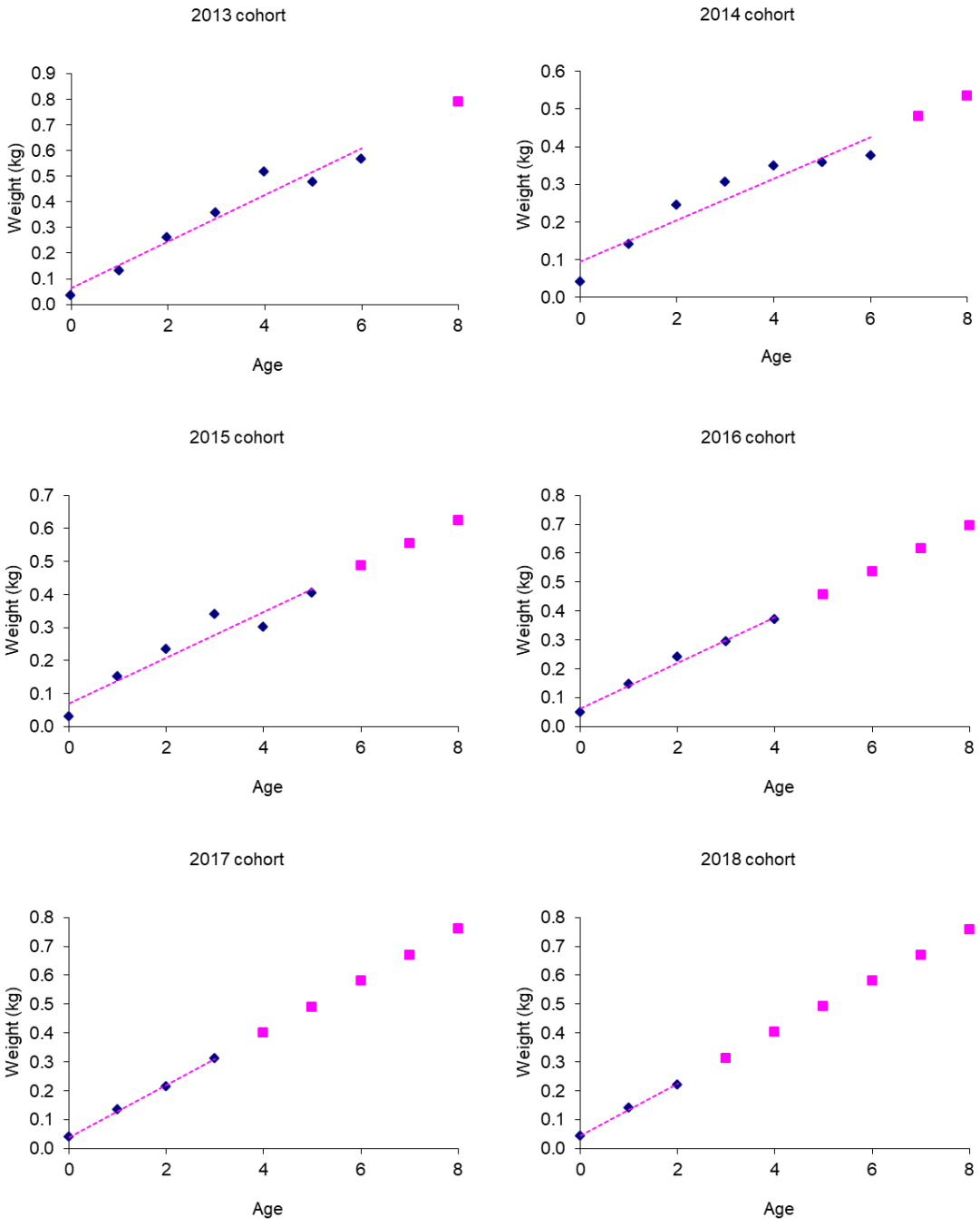


Figure 8.6.3. Haddock in Subarea 4, Division 6.a and Subdivision 20. Results of growth modelling for unwanted catch (discards + BMS) weights using cohort-based linear models (Jaworski, 2011). Cohorts 2013–2018 are shown here. Blue points are available observations, pink dotted lines show linear fits to these points, and pink points indicate projected weights for older ages.

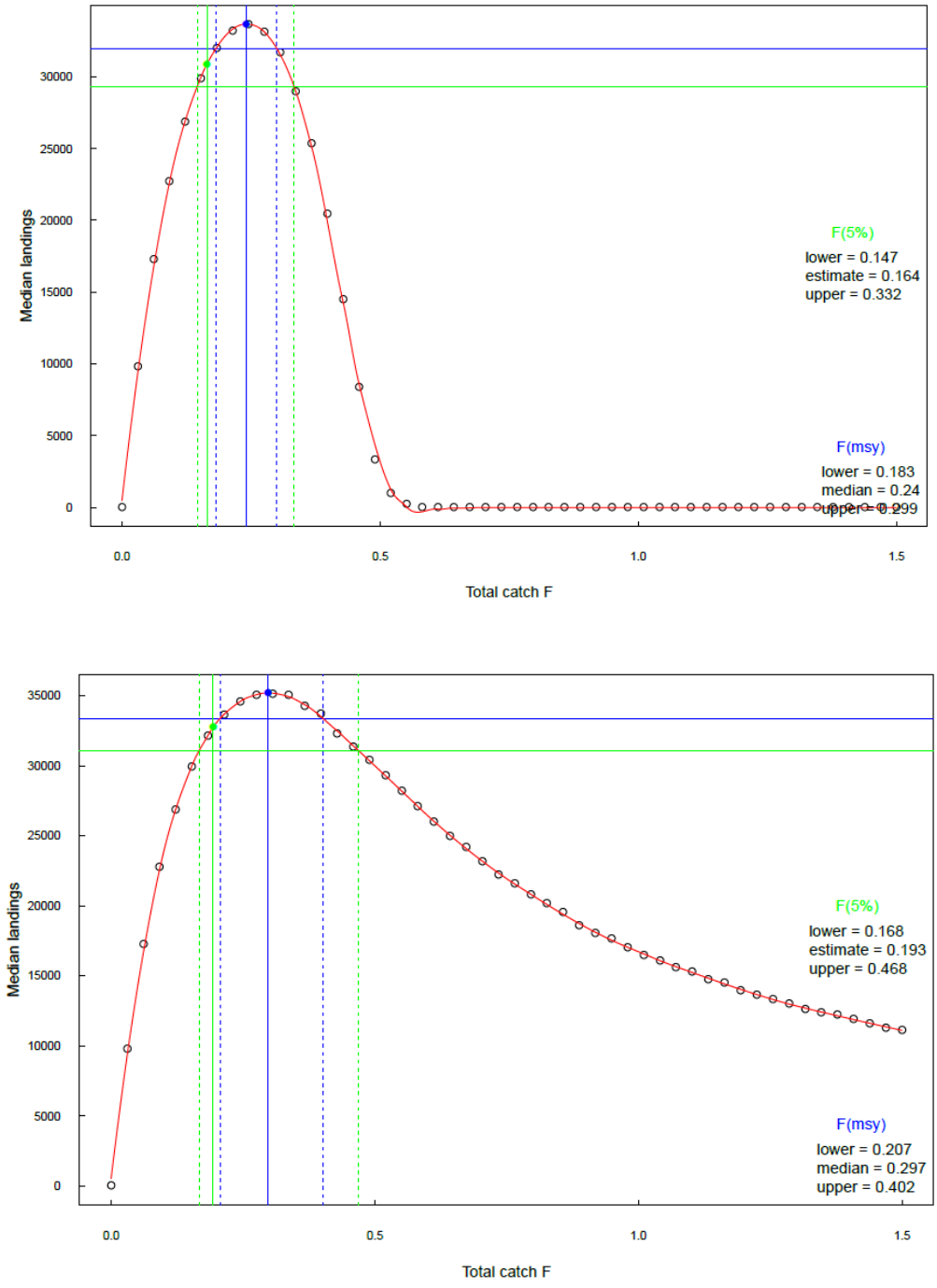


Figure 8.8.1. Haddock in Subarea 4, Division 6.a and Subdivision 20. Results of EqSim estimation from IBPhaddock 2016 of $F_{(MSY)}$ with the advice error but no rule (top) and of F_{p05} with both advice error and rule (bottom).

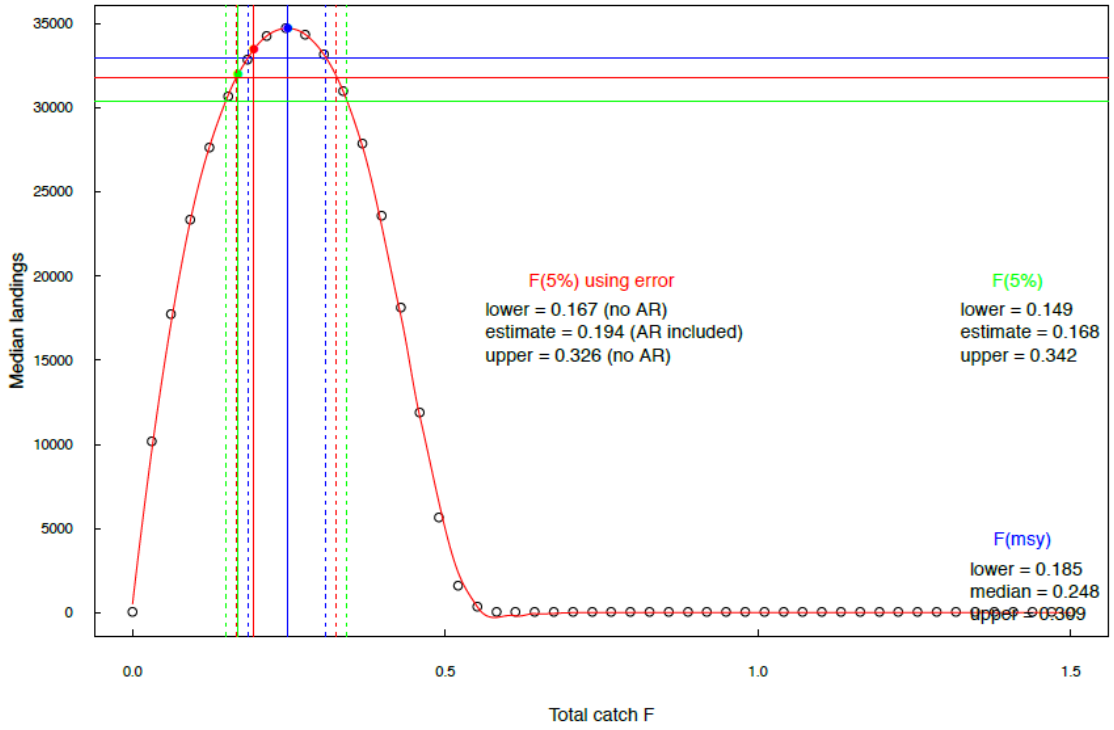


Figure 8.8.2. Haddock in Subarea 4, Division 6.a and Subdivision 20. Results of EqSim estimation run for ADGNS 2017 following updated guidance (WKMSYREF4).

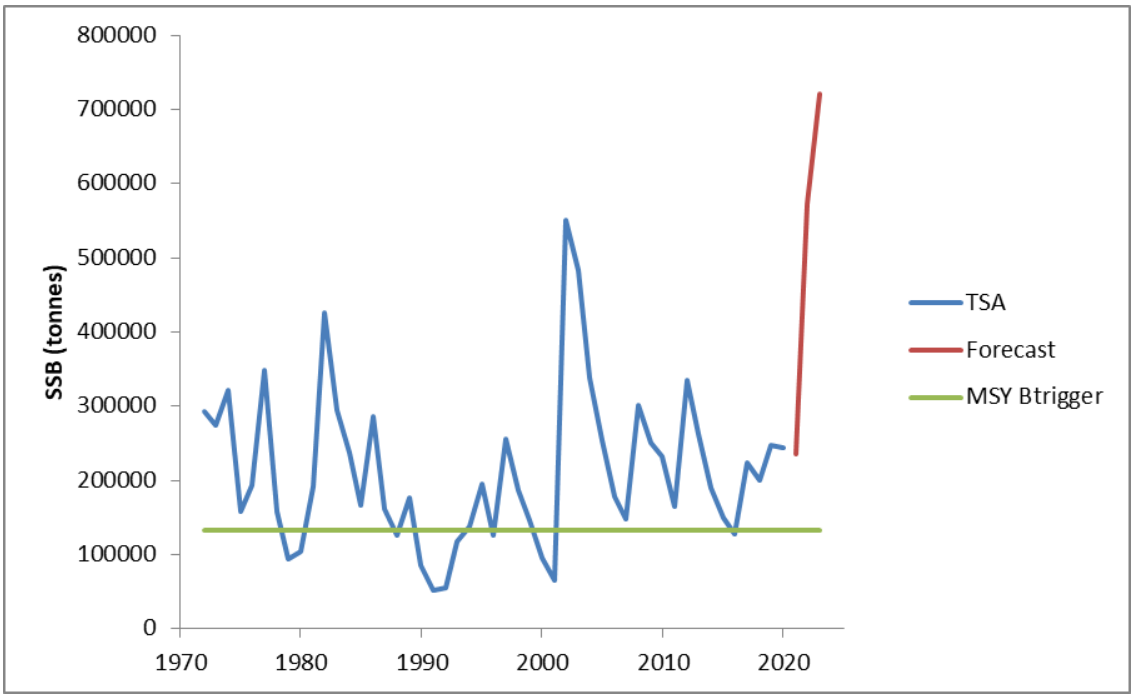


Figure 8.11.1. Haddock in Subarea 4, Division 6.a and Subdivision 20. Spawning stock biomass estimates from the TSA assessment (blue) along with short-term forecast under the ICES MSY approach (red) and the current MSY $B_{trigger}$ value (green).