Contents

9 Haddock (*Melanogrammus aeglefinus*) in Division7.a (Irish Sea)

Type of assessment

Age-structured assessment model using Age Structured Assessment Program (ASAP).

ICES advice applicable to 2022

ICES advises that when the MSY approach is applied, catches in 2022 should be no more than 3038 tonnes.

ICES advice applicable to 2023

ICES advises that when the MSY approach is applied, catches in 2023 should be no more than 2648 tonnes.

9.1 General

Stock descriptions and management units

The stock and management units are both ICES Division 7.a (Irish Sea). Landing taken or reported by Irish vessels in the southern most rectangles of 7.a have been reassigned to the 7.b–k stock since 2003 because they are believed to be part of the Celtic Sea stock.

Management applicable to 2023

Management measures include TAC and effort restrictions as well as technical measures. Due to the bycatch of cod in the haddock fishery, the regulations affecting Irish Sea haddock remain linked to those implemented under the cod recovery plan. From 1st January 2019 all fleets catching haddock are subject to the landing obligation.

TAC regulations for 2022 are given below.

2022 management (Council Regulation (EU) 2020/123)

Species:	Haddock *Melanogrammus aeglefinus*	Zone:	7a (HAD/07A.)
Belgium	43	Analytical TAC Article 8(2) of this Regulation applies	
France	196		
Ireland	1171		
Union	1410		
United Kingdom	1628		
TAC	3038		

The minimum landing size for haddock in the Irish Sea is 30 cm.

Landings obligation

Since 2017 the landings obligation has been applied to the stock. According to the delegate regulation (EC, 2015) vessels where more than 25% of their landings using trawls and seines in the reference years (2013 and 2014) and area were specified gadoids (cod, haddock, whiting and saithe) were covered by the Landings Obligation. This implies that all catches of haddock in the Irish Sea by those vessels must be landed. From the 1st January 2019 all fleets catching haddock are subject to the landings obligation.

Fishery in 2021

The characteristics of the fishery are described in the stock annex.

The fishery in 2021 was prosecuted by a similar fleet and gears as in recent years, with directed fishing restricted during the cod closure under special conditions. The targeted whitefish fishery that developed during the 1990 using semi-pelagic trawls has declined considerablybut since 2014 there has been a slight increase in activity due to abundance of the haddock stock and increased fishing opportunity. However, this continues to be pursued by a small number of vessel (<15). A proportion of the TAC is taken as bycatch in the *Nephrops* fishery in a mixed fishery.

In 2020, the whitefish fishery was considerably impacted by the COVID-19 pandemic, resulting in lower fishing effort, which is represented in the landings and total catches.

In 2021, the uptake of TAC was 62%. The primary two nations exploiting the stock are the UK and Ireland. The UK used 54% of quota allocation whilst Ireland used 99%. ICES catch estimates are adjusted for reallocation of Irish landings from southern rectangles of 7.a to 7.g, as it is believed that these fish do not belong to the 7.a stock. Table 9.1 gives nominal landings of haddock from the Irish Sea (Division 7.a) as reported by each country to ICES since 1984. Newly introduced gear restriction in the Republic of Ireland waters meant that Northern Irish vessels were unable to fish in ROI waters without modifying their gear accordingly.

9.2 Data

Sampling was reduced in 2021 due to the COVID-19 pandemic. In the first quarter the TR1 fleet was asked to bring the full final haul ashore and the full haul was sampled following on-sea protocols once the vessel had returned to shore. Sampling on the *Nephrops* fleet was low during quarter 1, however resumed in quarters 2–4. The criteria for submitting samples to InterCatch was a minimum of one sample for every 4% of the landings. If that criterium was not met, sampled data were not submitted. As a result, landings only files were submitted to InterCatch for cod and haddock from Ireland.

In Northern Ireland landings and discards sampling in the first quarter was conducted by requesting the TR1 fleet to bring the full final haul ashore. This was sampled following on-sea protocols once the vessel had returned to shore. Sampling on the *Nephrops* fleet was low during quarter 1, however resumed in quarters 2–4.

Landings

Table 9.2 gives the long-term trend of nominal landings of haddock from the Irish Sea (Division 7.a) as reported to ICES since 1972, together with Working Group estimates. The 1993–2005 WG estimates includes sampled-based re-estimates of landings into the main Irish Sea ports. Sampled based evidence suggests that WG estimates are similar to reported landings since 2006. Following the benchmark (WKROUND 2013) the landings have been revised since 1993, and exclude landings from the southern rectangles in the Irish Sea as they not are believed to be part of this stock.

The methods for estimating quantities and composition of haddock landings from 7.a, used in previous years, are described in the stock annex (see Annex 2). The series of numbers-at-age in the international commercial catch is given in Table 9.3. Sampling levels were not considered adequate to derive catch age compositions in 2003.

Discards

Annual discard data were updated for Ireland and Northern Ireland. Historic discard numbers-at-age for the different sampled fleets are given in the stock annex (see Annex 2). Issues relating to the reliability and confidence in the data were addressed at the benchmark assessment for this stock (WKROUND 2013; WKIrish3 2017).

Methods for estimating quantities and composition of discards from UK (NI) and Irish *Nephrops* trawlers are described in the stock annex. Sampling levels have increased in recent years. The large estimates of discarding for *Nephrops* fleets observed by previous WG are still evident. A historic time-series of discard numbers-at-age was constructed at the benchmark. Discard rates are very variable between fleets.

Biological data

The derivation of biological parameters and variables is described in the stock annex (see Annex 2). Natural mortality-at-age was calculated using the methods proposed by Lorenzen (1996) at WKIrish2 (2016). The proportions mature-at-age was also recalculated at the benchmark, and based on the mean proportion observed during the NIGFS-WIBTS-Q1 survey with a smoother fitted that is updated annually.

There is evidence of trends in mean length-at-age over time (Figure 9.1), which needs to be reflected in the stock weights-at-age. Since 2001 the WG calculated stock weights by fitting a von

Bertalanffy growth curve to survey estimates of mean length-at-age in March, described in the Stock Annex. The procedure was updated this year using NIGFS-WIBTS-Q1 (2021) and quarter one commercial landings data for 2021. The time-series of length–weight parameters indicate a reduction in expected weight-at-length since 1996, although this strength of this decline has reduced in recent years (see stock annex for historical data):

	Length–weight parameters		Expected weight-at-length	
Year	A	B	30 cm	40 cm
2006	0.00506	3.165	239	595
2007	0.00469	3.194	244	612
2008	0.00523	3.159	242	601
2009	0.00431	3.224	249	629
2010	0.00413	3.238	250	635
2011	0.00457	3.207	250	629
2012	0.00499	3.174	243	606
2013	0.00451	3.208	247	622
2014	0.00591	3.121	241	591
2015	0.00423	3.232	251	637
2016	0.00420	3.233	250	634
2017	0.004144	3.235	249	631
2018	0.006453	3.108	251	614
2019	0.004911	3.196	258	647
2020	0.005161	3.165	245	608
2021	0.00591	3.1184	239	586

The following parameter estimates were obtained:

Mean LI_{yc} = 45.4 cm; K = 0.428; t_0 = -0.092

Year-class effects giving estimates of asymptotic length relative to the mean were as follows:

Year class	Effect	Year class	Effect
1990	0.949	2004	0.983
1991	0.979	2005	0.989
1992	0.954	2006	0.953
1993	1.045	2007	0.986
1994	1.092	2008	0.961
1995	1.018	2009	1.002
1996	1.049	2010	1.058
1997	0.968	2011	1.074
1998	1.024	2012	1.106
1999	1.004	2013	1.014
2000	0.995	2014	1.019
2001	0.971	2015	0.943
2002	0.971	2016	0.920
2003	0.998	2017	1.001
		2018	0.999
		2019	0.999
		2020	
		2021	

The year-class effects show a smooth decline from the mid-1990s coinciding with the rapid growth of the stock and may represent density-dependent growth effects, although other environmental factors may contribute. There is evidence in a reversal of this trend in recent years. The resultant stock weights-at-age are given in Table 9.3. The weight-at-age in the stock shows a decreasing trend over time which appears to have reversed in recent years.

Surveys

The survey data considered in the assessment for this stock are given in Table 9.5. All survey series data for haddock available to the Working Group are described in the stock annex (see Annex 2). The following age-structured abundance indices were used in the assessment:

- UK (NI) groundfish survey (NIGFS) in March (age classes 1 to 4, years 1992–2021). Acronym NIGFS-WIBTS-Q1.
- UK (NI) groundfish survey (NIGFS) in October (age classes 0 to 3; years 1991 to 2021). Acronym NIGFS-WIBTS-Q4.

- UK (NI) Methot-Isaacs-Kidd (NI-MIK) net survey in June (age 0; years 1994–2021, excluding 2020).
- UK Fishery Science Partnership (UKFspW) western Irish Sea roundfish survey (age classes 2 to 5, years 2004–2021, the survey was not conducted in 2014).

The relative log standardised indices for cohorts are plotted against time in Figure 9.2. While ages 2 to 4 appear to show strong signal in the UKFspW, the ability to detect the year class in age 5 haddock is less clear. The strong 2013 year class could be tracked in all indices, indicating that the different surveys are capturing the prominent year-class signals in this stock (Figure 9.2). Correlation between survey indices by age is positive for all surveys and show high consistency within each survey (Figure 9.3). The indices from the UKFspW survey in the western Irish Sea also show similar year-class signals to the other survey-series, but are noisy with strong year effects (Figure 9.2).

9.3 Assessment

The assessment presented is the single fleet ASAP model.

The following model settings were applied in 2022.

ASAP was used for the assessment and model settings:

Option	Setting
Use likelihood constant	Yes
Mean F (F_{bar}) age range	2–4
Fleet selectivity block 1	Asymptotic
Fleet selectivity block 2	Age coefficients (age 0–5) (0.2;0.5;0.8;1;0.7;0.5)
Fleet selectivity block 3	Age coefficients (age 0–5) (0.3;0.6;0.7;0.7;0.4;0.2)
Fleet selectivity block 4	Age coefficients (age 0–5) (0.1;0.6;0.8;0.9;1.0;1.0)
Discards	Included in catch (not specified separately from landings)
Index units	4 (numbers)
Index month	NIGFS-Q1 (3); NIGFS-Q4 (10); NIMIK (7); UKFSPW(3)
Index selectivity linked to fleet	-1 (not linked)
Index age range	NIGFS-Q1 (1–4); NIGFS-Q4 (0–3); NIMIK (0); UKFSPW(2–5)
Index Selectivity (NIGFS-Q1)	Double logistic
Index Selectivity (NIGFS-Q4)	Asymptotic
Index Selectivity (NIMIK)	
Index Selectivity (UK-FSPW)	Asymptotic
Index CV & ESS (NIGFS-Q1)	Observed strata CV (lower limit 0.1); ESS = 50
Index CV & ESS (NIGFS-Q4)	Observed strata CV (lower limit 0.1); ESS = 50
Index CV & ESS (NIMIK)	Observed station CV (lower limit 0.1); ESS = 50; not used for 2020
Index CV & ESS (UK-FSPW)	CV = 0.7; ESS = 10
Phase for F-Mult in 1st year	1
Phase for F-Mult deviations	2
Phase for recruitment deviations	3
Phase for N in 1st Year	1
Phase for catchability in 1st Year	3
Phase for catchability deviations	-5 (Assume constant catchability in indices)
Phase for unexploited stock size	1
Phase for steepness	-5 (Do not fit stock–recruitment curve)
Catch total CV	1993–2000 (0.175); 2003–2006 (0.2); 2007– 2019 (0.15); 2020 (0.175); 2021 (0.15)

Option	Setting
Catch effective sample size	1993–2000 (50); 2003–2006 (1); 2007–2019 (50); 2020 (1); 2021 (50)
Lambda for recruit deviations	0 (freely estimated)
Lambda for total catch	1
Lambda for total discards	NA (discards included in catch)
Lambda for F-Mult in 1st year	0 (freely estimated)
Lambda for F-Mult deviations	0 (freely estimated)
Lambda for index	1 for both indices in the model
Lambda for index catchability	0 for all indices (freely estimated)
Lambda for catchability devs	NA (phase is negative)
Lambda N in 1st year deviations	0 (freely estimated)
Lambda devs initial steepness	0 (freely estimated)
Lambda devs unexpl stock size	0 (freely estimated)

Final update assessment

The final assessment was run with the same settings as established by WKIrish 2017 and described in the stock annex, with the addition of a new selectivity pattern 2013–2021, as applied in 2018 and with the lower starting value for selection of age 0 haddock in the final selectivity block. Hence the changes as described in the stock annex were followed. Discards were combined with the landings as catch in the model.

Figure 9.5 shows the predicted and observed catch. The catch information from 2007 to present is regarded as the most confident, during 2003–2006 it is regarded that catch and sampling information is of relatively lower quality due to lack of sampling opportunity. Before 2003, the catch series is regarded as of intermediate confidence. The model has close fit to the current observed catch 2011–present. Before this time, there is consistent over estimation of the catch 2000–2011 following a period of consistent underestimation of catch 1993–2001. Figure 9.6 shows the residuals of the catch proportions-at-age. For all ages there appears to good fit with no consistent pattern, however, there are some large deviations from observed and predicted for age 5 fish since 2015. Figure 9.7 shows that the catch is dominated by fish <4 years, therefore the large residuals for fish of age 5 are likely to result from low sampling and small contribution of 5+ fish to the stock. The fishing pressure (F)-at-age is shown in Table 9.6.

The residuals of the indices are shown in Figure 9.7. A good fit to the NI-MIK index is seen across the series, although some single year events are observed with a strong deviation in the last two years of the index. For the UKFSPW survey a poor fit in years 2017 and 2018 is evident. This suggests an inability of the model to track the large survey index values, this should be investigated further to explore the method of index calculation. There is strong tracking of both NIGFS-WIBTS-Q1 and NIGFS-WIBTS-Q4 index patterns in general, however, a general trend to under estimate the NIGFS-WIBTS-Q1 index by the model early 2000s to 2013, followed by a period of over-estimation (during years of high abundance, and with the decline in SSB the model is once again underestimating Q1 survey index.

Figure 9.9 shows the residuals of the survey proportions-at-age. For all indices there is close fit between the observed and model predicted fit for fish up to four years old. The largest deviations occur in five year old fish in the UKFSPW survey, which over-reported five year old fish prior to 2014.

Figure 9.10 shows the retrospective analysis. The predicted catch shows no obvious retrospective pattern, neither does the recruitment estimate or fishing pressure. The results of the assessment are given in Table 9.8.

Comparison with previous assessments

Figure 9.11 shows the comparison of the current assessment with previous ASAP and model. There is close agreement with the stock trends of the current assessment and the previous assessment. Mohn's Rho values were calculated for five retrospective runs 2021: 2016 for F_{bar} (0.08), SSB (-0.04) and recruitment (-.51).

State of the stock

Following a period of sustained decline, since 2008, SSB increased during 2010–2013. A short-term decline was observed in 2014, but was reversed, and since 2014 the SSB has increased markedly. The stock is characterized by highly variable recruitment. The model indicates above average recruitment for the 2009–2011 year class after below average recruitment for the 2007 and 2008 year classes. Recruitment in 2013 is amongst the highest observed in the time-series and has been followed by strong recruitment in 2014 and 2015. Since 2018 SSB has declined from the highest observed level and continued the decline in 2021.

With the very low recruitment in 2020, the SSB is further projected to decline in 2022 and 2023.

9.4 Short-term projections

Short-term projections were performed using FLR libraries. Recruitment for 2022–2024 was estimated at (GM 1993–2019; 364 084 thousands). The F used in the forecast for 2022 was derived as F_{sq}= $F_{average}$ (2018–2021), excluding the 2020 F as this is deemed to be non-representative for the fishery and due to low effort of the TR1 fleet during the COVID-19 pandemic.

Catches were split into landings and discards using the proportions of the catch that were discarded over the full the last three years. Input data for the short-term forecast are given in Table 9.7. The management options output is given in Table 9.9.

Estimates of the relative contribution of recent year classes to the 2023 landings and 2024 SSB are shown in Figure 9.12. The contribution to landings in 2023 consists mainly of the 2018 cohort (72%), with the SSB in 2024 largely be dependent on the 2019 cohort, comprising 67% of the SSB and the 2021 cohort contributing 17%. This is an issue as the SSB will largely consist of the plus group.

9.5 Biological reference points

MSY evaluations

In response to an EU special request to provide plausible and updated F_{MSY} ranges for Irish Sea haddock the management reference points for the stock were re-estimated (Table 9.10 ICES, 2018). The B_{lim} was set as the lowest SBB at which above recruitment in the upper quartile has

been observed (2994 t). The S–R plot for Irish Sea haddock shows no obvious S–R relationship mainly because the recruitment is highly variable. B_{lim} was estimated as 4160 t. MSY $B_{trigger}$ is set to 4281 t as the stock has been fished at or below F_{MSY} for more than five years. F_{MSY} median point estimates is 0.28. The upper bound of the F_{MSY} range giving at least 95% of the maximum yield was estimated to 0.35 and the lower bound at 0.20. F_{lim} is estimated to be 0.50 as F with 50% probability of SSB <B_{lim}; F_{pa} as 0.41= $F_{p.05}$ the F that leads to SSB>B_{lim} with 95% probability; F_{lim} x exp(-1.645 x σ); σ = 0.20.

Yield and biomass-per-recruit

Not available for this stock, previous explorations are detailed in the stock annex.

9.6 Management plans

There is no specific management plan for haddock in the Irish Sea. The regulations affecting Irish Sea haddock remain linked to those implemented under the cod management plan due to potential for bycatch of cod in a fishery targeting haddock (Council Regulation (EC) 1342/2008).

9.7 Uncertainties and bias in assessment and forecast

Landings

Sampling levels of the landed catch for recent years are considered to be sufficient to support current assessment. However, within the assessment there is relocation of reported landings in rectangles 33E2 and 33E3 which are not considered part of the stock. Historic misreporting estimates are considered in the assessment and accounted for, current misreporting is not considered to be a factor within the fishery.

Discards

Sampling levels of discarding at sea remains high. For Northern Irish vessels targeting haddock 27.0% of trips are observed and 2.7% of the main *Nephrops* targeted fishery trips observed, however due to the COVID-19 pandemic the sampling level of the *Nephrops* targeting fishery has been impacted in 2021.

Selectivity

A breakpoint in selectivity is applied in 2000, associated with management measures to reduce fishing mortality on cod. The model included three selectivity blocks in fishery-dependent data, reflecting bycatch and targeted fishery until the year 2000 (asymptotic). After 2007, a fleet selectivity pattern without targeted fishing of older fish (dome-shaped) is applied. During 2000–2007 a transition between a fully selected stock to a regime without targeted fishing of older fish is fitted. The use of current specified selectivity blocks may require review at annual at regular intervals. In the current assessment a new selectivity pattern for the fishery was added from 2013 onwards with full selection of fish older than three years. With advice and management for haddock or other species, it is possible that the character of the fishery may change. A retrospective analysis demonstrated a consistent historic downward revision of the perceived SSB trend, however, there is consistent estimation of F. The initial two years of the retrospective plot show significant deviations. This was considered due to the model having a selectivity block, beginning

in 2007, with reduced selection for older fish and the introduction of the UKFspW, with an asymptotic selectivity pattern, starting in 2007. The short period to estimate the selectivity parameters for both the fishery and survey index are considered to contribute to the instability of the model during this time.

Surveys

The survey indices used in the model have spatial coverage of the assessment area. The combination of a recruitment index (NI-MIK), juvenile fish survey indices (NIGFS-WIBTS-Q1 & NIGFS-WIBTS-Q4) and the UKFspW survey aimed at older fish using commercial fishing gear means that the full age range of the stock is covered by survey information.

9.8 Recommendations for next benchmark assessment

This stock was benchmarked through the WKIrish process in 2016–2017. New estimation of the MikNet survey and re-estimation of ages might need an inter-benchmark.

9.9 References

EC. 2015. Commission Delegated Regulation (EU) 2015/2438 of 12 October 2015 establishing a discard plan for certain demersal fisheries in north-western waters.

Table 9.1. Landings (t) of HADDOCK in Division 7.a, 1984–present, as officially reported to ICES. (Working Group figures are given in Table 9.2).

Country	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Belgium	3	4	5	10	12	4	4	1	8	18
France	38	31	39	50	47	n/a	n/a	n/a	73	41
Ireland	199	341	275	797	363	215	80	254	251	252
Netherlands	-	-	-	-	-	-	-	-	-	-
UK(E&W)[1]	29	28	22	41	74	252	177	204	244	260
UK (Isle of Man)	2	5	4	3	3	3	5	14	13	19
UK (N. Ireland)	38	215	358	230	196	…	…	…	…	…
UK (Scotland)	78	104	23	156	52	86	316	143	114	140
Total	387	728	726	1,287	747	560	582	616	703	730

Country	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Belgium	22	32	34	55	104	53	22	68	44	20
France	22	58	105	74	86	n/a	49	184	72	146
Ireland	246	320	798	1,005	1,699	759	1,238	652	401	229
Netherlands	-	-	1	14	10	5	2	-	-	-
UK(E&W)[1]	301	294	463	717	1,023	1,479	1,061	1,238	551	248
UK (Isle of Man)	24	27	38	9	13	7	19	1	-	-
UK (N. Ireland)	…	…	…	…	…	…	…	…	…	…
UK (Scotland)	66	110	14	51	80	67	56	86	47	31
Total	681	841	1,453	1,925	3,015	2,370	2,447	2,229	1,115	674

Country	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Belgium	15	22	23	30	15	7	9	16	13	6.2
France	20	36	20	11	6	3	2	8	3	.7
Ireland	296	139	184	477	319	388	333	434	561	492
Netherlands	-	-		-	-	-	-	-	-	-
UK (England & Wales)[1]	421	344	419	559	521	446	593	355	236	154
UK (Isle of Man)	-	-	-	-	1	1	-	-	<1	<.1
UK (N. Ireland)	…	…	…	…	…	…	…	…	…	…
UK (Scotland)	9	6	9	1	17	1	2			-
United Kingdom									236	154
Total	761	547	655	1078	879	846	939	813	813	654

Country	2014	2015	2016	2017	2018	2019	2020*	2021*
Belgium	7	7	5	5	4	9	4	3
France	0	7	1	5	0	0	0	0
Ireland	541	507	632	114	949	1347	754	1162
Netherlands	-	-		-	-	-	-	-
UK (England & Wales)[1]	-	-		-	-	-	-	-
UK (Isle of Man)	<1	<1		-	-	-	-	-
UK (N. Ireland)	...	-		-	-	-	-	-
UK (Scotland)	-	-		-	-	-	-	-
United Kingdom	426	634	825	1240	1580	1197	539	884
Total	974	1154	1463	2363	2532	2553	1296	2048

* **Preliminary.**

[1] **1989–2015 Northern Ireland included with England and Wales.**

n/a = not available.

Table 9.2. Haddock in 7.a. Total international landings of haddock from the Irish Sea, 1972–present as officially reported to ICES. Working Group figures, assuming 1972–1992 official landings to be correct, are also given. The 1993–2005 WG estimates include sampled-based estimates of landings at a number of Irish Sea ports. Sample-based evidence confirms more accurate catch reporting since 2006. Landings in tonnes live weight. Since 1993 the landings have been corrected to exclude catches from the southernmost rectangles, which are not considered part of this stock.

Year	Official landings	WG landings	ICES discards**	ICES catch	% Discard	Landings taken or reported in rectangles 33E2 and 33E3
1972	2204	2204				
1973	2169	2169				
1974	683	683				
1975	276	276				
1976	345	345				
1977	188	188				
1978	131	131				
1979	146	146				
1980	418	418				
1981	445	445				
1982	303	303				
1983	299	299				
1984	387	387				
1985	728	728				
1986	726	726				
1987	1287	1287				
1988	747	747				
1989	560	560				
1990	582	582				
1991	616	616				
1992	703	656				
1993	730	813				
1994	681	1042				
1995	841	1736	780	2516	31%	16
1996	1453	2981	709	3690	19%	33
1997	1925	3547	895	4442	20%	36

Year	Official landings	WG landings	ICES discards**	ICES catch	% Discard	Landings taken or reported in rectangles 33E2 and 33E3
1998	3015	4874	1015	5889	17%	28
1999	2370	4095	634	4729	13%	34
2000	2447	1357	802	2159	37%	11
2001	2229	2246	269	2515	11%	74
2002	1115	1817	387	2204	18%	82
2003	674	659	-	-	-	64
2004	761	1217	392	1609	24%	53
2005	547	666	551	1217	45%	35
2006	655	633	306	939	33%	26
2007	1078	886	722	1608	45%	222
2008	879	786	643	1429	45%	194
2009	846	581	579	1160	50%	285
2010	939	679	508	1187	43%	267
2011	813	446	307	753	41%	374
2012	n/a	343	599	942	64%	473
2013	654	254	283	537	53%	410
2014	953	518	488	1006	49%	444
2015	1154	833	652	1451	44%	322
2016	1463	1008	298	1306	23%	455
2017	2363	1662	333	1995	17%	715
2018	2532	1993	568	2561	22%	532
2019	2537	1778	672	2450	27%	759
2020	1296	7423	234	976	24%	554
2021	2048	1219	674	1891	36%	827

Table 9.3. Haddock in 7.a: stock weights-at-age.

	Age					
	0	1	2	3	4	5
1993	0.02	0.095	0.42	1.043	1.759	2.563
1994	0.02	0.083	0.338	0.968	1.999	3.028
1995	0.02	0.085	0.347	0.785	1.708	3.219
1996	0.02	0.083	0.359	0.788	1.319	2.718
1997	0.022	0.07	0.357	0.863	1.435	2.391
1998	0.018	0.06	0.253	0.743	1.384	2.165
1999	0.016	0.057	0.226	0.561	1.294	2.262
2000	0.017	0.048	0.23	0.51	0.966	2.123
2001	0.018	0.051	0.201	0.548	0.93	1.822
2002	0.017	0.056	0.215	0.472	0.983	1.637
2003	0.017	0.05	0.229	0.485	0.798	1.52
2004	0.017	0.041	0.199	0.509	0.816	1.306
2005	0.018	0.031	0.165	0.459	0.902	1.347
2006	0.014	0.033	0.128	0.378	0.803	1.435
2007	0.019	0.034	0.136	0.299	0.68	1.402
2008	0.014	0.037	0.139	0.31	0.515	1.167
2009	0.025	0.042	0.153	0.326	0.563	0.98
2010	0.017	0.04	0.176	0.357	0.58	0.945
2011	0.018	0.052	0.167	0.407	0.624	0.937
2012	0.012	0.057	0.209	0.375	0.688	0.96
2013	0.023	0.059	0.233	0.491	0.673	1.115
2014	0.022	0.038	0.238	0.512	0.812	1.04
2015	0.017	0.046	0.153	0.577	0.97	1.371
2016	0.021	0.047	0.192	0.354	1.015	1.533
2017	0.022	0.054	0.137	0.347	0.809	1.476
2018	0.023	0.068	0.196	0.472	0.601	0.987
2019	0.024	0.066	0.121	0.480	0.636	1.04
2020*	0.023	0.063	0.151	0.433	0.682	1.168
2021	0.034	0.064	0.117	0.372	0.552	0.967

***Average weights 2017–2019.**

Table 9.4. Haddock in 7.a: Catch numbers-at-age.

	Age					
	0	1	2	3	4	5
1993	790	1568	2066	19	1	1
1994	16857	821	258	922	3	2
1995	950	8079	1587	107	220	5
1996	15171	1380	5510	728	16	30
1997	347	8828	1528	2388	201	16
1998	4209	4642	10532	252	488	42
1999	4944	3200	3436	4773	25	57
2000	287	11118	1771	466	457	418
2001	7883	425	3246	1074	30	89
2002	2105	8229	789	2063	142	18
2003	2000	2000	400	800	50	25
2004	10797	2056	421	827	46	78
2005	6048	4342	1416	285	193	34
2006	5334	2971	656	524	63	51
2007	2282	3537	3371	671	60	47
2008	2158	4569	2052	837	242	36
2009	4327	2490	2021	629	121	36
2010	3933	4058	834	464	309	59
2011	5669	2324	942	239	97	52
2012	6235	2799	774	201	27	28
2013	4525	1162	558	156	41	17
2014	1392	3854	1265	189	17	10
2015	518	1915	3087	324	63	5
2016	512	1845	907	1079	109	108
2017	231	783	2234	829	1096	78
2018	56	1039	5325	2845	426	526
2019	415	5276	4528	604	1132	467
2020	0	3269	559	282	598	367
2021	716	782	3064	2256	364	133

Table 9.5. Haddock in 7.a: Available tuning data and maturity ogive

```
IRISH SEA haddock, 2013 WG,ANON,COMBSEX,TUNING DATA(effort, nos-at-age)
101
NIGFS-WIBTS-Q1
1993 2021
1 1 0.21 0.25
0 5
```

1	**0**	**139**	**569**	**31**	**0**	**0**
1	0	644	58	183	0	0
1	0	24823	437	0.1	43	0
1	0	1065	3743	67	3	1.1
1	0	25118	474	1457	44	2.1
1	0	3913	8694	70	105	1.1
1	0	6058	680	2072	16	11.1
1	0	14028	1853	64	147	5
1	0	3277	6990	770	40	20.1
1	0	28755	842	1059	78	1.1
1	0	6966	14162	341	356	26.1
1	0	19945	2379	2206	45	35.1
1	0	24488	6454	406	234	15
1	0	13444	12721	2194	91	33.1
1	0	20918	11325	3661	240	27
1	0	7480	12009	2559	495	48.1
1	0	9345	3888	2877	163	42
1	0	17058	1765	524	239	27
1	0	17278	5543	299	67	50
1	0	13509	5266	1095	38	13
1	0	8245	5202	751	119	20
1	0	33807	2260	773	108	22
1	0	15495	22420	1297	407	44
1	0	14418	9109	5594	205	38
1	0	4321	18887	5524	323	33
1	0	7897	4683	7086	1709	1369
1	0	38570	6789	814	832	183
1	0	16709	28889	2571	260	257
1	0	2478.3	17390.6	6690.7	550.6	41

```
NIGFS-WIBTS-Q4
1991 2021
1 1 0.83  0.88
0 4
```

1	**36.127**	**0.716**	**3.965**	**0**	**0**
1	2.042	151.766	1.171	0.959	0
1	15.289	101.536	0.753	0	0.045
1	1067.99	13.327	13.2	0.092	0.001
1	160.434	398.722	1.81	0.886	0.04
1	365.679	10.521	39.889	0.08	0.034
1	685.913	28.002	0.527	1.633	0.001
1	59.867	93.66	5.533	0.125	0.104
1	584.902	19.354	28.408	0.947	0
1	146.491	105.115	1.18	3.372	0
1	552.309	59.354	30.746	0.295	0.27
1	666.652	167.224	7.422	4.911	0.001
1	476.2	122.094	12.378	0.264	0.052
1	387.556	111.692	35.717	2.228	0.441
1	94.667	102.086	37.1	11.654	0.375
1	88.61	46.338	23.832	1.991	0.33
1	451.303	45.695	6.139	4.891	0.23
1	219.533	82.392	5.858	1.752	0.973
1	207.925	42.145	7.808	1.044	0.093
1	165.294	79.593	12.05	1.275	0
1	1004.22	8.279	1.531	0.179	0
1	339.218	311.607	68.768	3.016	0.423
1	455.385	81.189	108.663	2.309	0.362
1	99.046	154.865	52.207	4.273	0.281
1	191.946	42.885	90.324	15.934	6.202
1	690.663	167.338	12.891	16.507	2.003
1	21.174	179.518	169.383	8.19	0.58
1	133.3	1209	50	13.2	0.66

```
NIMIK
1994 2021
1 1 0.38 0.47
0 0
```

1	**47000**
1	1700
1	47800
1	14500
1	2500
1	15400
1	1700
1	17100
1	1200
1	4250
1	25970
1	8250
1	40240
1	3820
1	6638
1	18540
1	4532
1	6606
1	9818
1	28325
1	12892
1	48463
1	1800
1	26900
1	30954
1	23942
1	NA
1	16800

FSP Haddock: Tuning data
101
UKFspW
2005 2021
1 1 0.15 0.25
0 5

1	0	0	1.774	1.506	4.981	0.291
1	0	0.308	7.749	7.336	0.546	1.115
1	0	0.208	42.727	37.286	6.289	0.697
1	0	0	4.657	12.836	7.213	0.794
1	0	0	0.662	3.99	1.443	0.541
1	0	0.627	1.422	3.78	2.753	0.866
1	0	0.048	0.598	1.976	1.121	0.81
1	0	0.27	4.135	4.772	0.79	0.226
1	0	0.035	3.684	7.674	1.742	0.176
1	NA	NA	NA	NA	NA	NA
1	0	0.437	31.2	19.349	5.051	0.554
1	0	0	0	59.769	12.592	6.205
1	0	0	19.748	85.536	246.488	10.838
1	0	0	0	36.397	62.861	55.448
1	0	0.339	4.357	25.291	40.261	22.519
1	0	0	0	26.759	16.887	16.539
1	0	0	0	43.95	18.27	14.03

Maturity ogive at-age.

Year	0	1	2	3	4	5+
1993	0	0	0.762	0.99	1	1
1994	0	0	0.762	0.99	1	1
1995	0	0	0.784	0.99	1	1
1996	0	0	0.78	0.99	1	1
1997	0	0	0.777	0.99	1	1
1998	0	0	0.775	0.99	1	1
1999	0	0	0.773	0.99	1	1
2000	0	0	0.771	0.99	1	1
2001	0	0	0.769	0.99	1	1
2002	0	0	0.767	0.99	1	1
2003	0	0	0.763	0.99	1	1
2004	0	0	0.762	0.99	1	1
2005	0	0	0.771	0.99	1	1
2006	0	0	0.784	0.99	1	1
2007	0	0	0.797	0.99	1	1
2008	0	0.01	0.809	0.99	1	1
2009	0	0.01	0.817	0.99	1	1
2010	0	0.01	0.825	0.99	1	1
2011	0	0.01	0.833	0.99	1	1
2012	0	0.01	0.841	0.99	1	1
2013	0	0.02	0.847	0.99	1	1
2014	0	0.02	0.846	0.99	1	1
2015	0	0.02	0.848	1	1	1
2016	0	0.03	0.85	1	1	1
2017	0	0.03	0.851	1	1	1
2018	0	0.03	0.853	1	1	1
2019	0	0.03	0.853	1	1	1
2020	0	0.03	0.854	1	1	1
2021	0	0.06	0.855	1	1	1

Table 9.6. Haddock in 7.a: F-at-age.

	Age					
	0	1	2	3	4	5
1993	0.032533	0.3892	0.861503	0.91716	0.920132	0.920281
1994	0.04169	0.498745	1.103981	1.175304	1.179113	1.179304
1995	0.038902	0.465392	1.030154	1.096706	1.100261	1.100439
1996	0.02542	0.304103	0.673138	0.716625	0.718948	0.719065
1997	0.028486	0.340777	0.754316	0.803049	0.805651	0.805782
1998	0.032306	0.386486	0.855495	0.910764	0.913716	0.913864
1999	0.045476	0.544036	1.204235	1.282034	1.28619	1.286398
2000	0.03025	0.361882	0.801032	0.852782	0.855546	0.855685
2001	0.123163	0.404643	0.73249	0.786004	0.551934	0.393002
2002	0.154348	0.507099	0.917957	0.985021	0.691685	0.492511
2003	0.126182	0.414562	0.750445	0.805271	0.565464	0.402636
2004	0.122492	0.402438	0.728499	0.781721	0.548927	0.390861
2005	0.100897	0.331491	0.600069	0.643908	0.452154	0.321954
2006	0.057887	0.190183	0.344271	0.369423	0.25941	0.184711
2007	0.096329	0.316482	0.572899	0.614753	0.431682	0.307377
2008	0.144765	0.505022	0.575852	0.547062	0.299876	0.145633
2009	0.112144	0.391222	0.446092	0.423789	0.232303	0.112817
2010	0.163635	0.570852	0.650915	0.618372	0.338965	0.164617
2011	0.088326	0.308132	0.351348	0.333782	0.182965	0.088856
2012	0.093186	0.325087	0.370681	0.352148	0.193032	0.093745
2013	0.007748	0.06819	0.120837	0.120837	0.120837	0.120837
2014	0.01022	0.089946	0.159389	0.159388	0.159389	0.159389
2015	0.009024	0.079421	0.140738	0.140738	0.140738	0.140738
2016	0.006105	0.053732	0.095216	0.095216	0.095216	0.095216
2017	0.007814	0.068769	0.121862	0.121862	0.121862	0.121862
2018	0.009921	0.087311	0.15472	0.15472	0.15472	0.15472
2019	0.010692	0.094097	0.166745	0.166745	0.166745	0.166745
2020	0.004897	0.043096	0.076369	0.076369	0.076369	0.076369
2021	0.010063	0.088559	0.156931	0.156931	0.156931	0.156931

Table 9.7. Forecast input data.

Variable	Value	Source	Notes
F ages 2–4 (2021)	0.159	ICES (2022a)	Fsq = $F_{average(2018-2021)}$ excluding 2020
SSB (2023)	11817	ICES (2022a)	Short-term forecast
R age 0 (2022 and 2023) (thousand)	364084	ICES (2022a)	Geometric mean (1993–2019)
Catch (2022)	1846	ICES (2022a)	Short-term forecast, fishing at F_{sq}
Wanted catch * (2022)	1545	ICES (2022a)	Average discard rate (2019–2021)
Unwanted catch *(2022)	301	ICES (2022a)	Average discard rate (2019–2021)

*** "Wanted catch" is used to describe fish that would be landed in the absence of the EU landing obligation.**

Table 9.8. Haddock in Division 7.a. Assessment summary. All weights are in tonnes, recruitment (age 0) in thousands. Low and high refer to 95% confidence intervals.

Year	Recruitment age 0			SSB			Land-ings	Dis-cards*	F ages 2–4		
	Low	Value	High	Low	Value	High			Low	Value	High
1993	116600	152730	188861	1640	2288	2937	813	365	0.40	0.68	0.96
1994	421898	520923	619948	1408	2161	2913	1042	468	0.40	0.72	1.03
1995	39534	63565	87597	1492	2312	3131	1736	780	0.52	0.94	1.37
1996	1087922	1340978	1594034	3603	4773	5944	2981	709	0.48	0.75	1.02
1997	149800	210066	270332	2638	3952	5265	3547	895	0.57	0.94	1.31
1998	260460	342308	424155	6375	8051	9727	4874	1015	0.68	0.98	1.27
1999	539265	669483	799702	4062	5504	6946	4095	634	0.97	1.46	1.95
2000	64449	98739	133030	1769	2646	3522	1357	802	0.60	1.04	1.48
2001	553816	698136	842457	2689	3746	4803	2246	269	0.48	0.73	0.98
2002	91899	132937	173975	1840	2790	3741	1817	387	0.59	0.95	1.31
2003	309707	419741	529776	2224	3233	4243	1517	390	0.46	0.77	1.09
2004	500341	642619	784897	1418	2371	3324	1217	392	0.43	0.76	1.09
2005	384571	490288	596004	1389	2229	3070	666	551	0.35	0.63	0.90
2006	450802	558138	665473	1968	2885	3803	633	306	0.198	0.35	0.51
2007	169235	219870	270505	2828	3859	4889	886	722	0.39	0.59	0.80
2008	115259	154177	193095	2834	3931	5027	786	643	0.34	0.52	0.71
2009	256751	328391	400031	2211	3343	4475	581	579	0.25	0.40	0.55
2010	186107	242003	297898	1804	2862	3920	679	508	0.37	0.61	0.84
2011	229755	297411	365066	1538	2539	3540	446	307	0.189	0.32	0.45
2012	210728	286718	362707	1776	2823	3869	343	599	0.197	0.34	0.47
2013	1092158	1375162	1658166	2315	3638	4960	254	282	0.076	0.133	0.191
2014	475004	626559	778114	3470	5107	6744	518	488	0.103	0.172	0.24
2015	706489	927283	1148077	8046	10842	13637	833	652	0.092	0.150	0.21
2016	207449	293473	379497	10782	14457	18131	1008	298	0.062	0.101	0.139
2017	273576	383175	492774	13817	18505	23192	1662	333	0.079	0.129	0.178
2018	632164	872205	1112247	13986	18988	23990	1993	568	0.097	0.163	0.23
2019	389547	570827	752108	11121	15753	20385	1778	672	0.101	0.175	0.25
2020	25337	61526	97716	10081	14579	19078	742	177	0.042	0.079	0.116
2021	176790	321561	466333	10297	14944	19590	1219	672	0.088	0.161	0.23
2022		370456**			14274						

*** Discards estimates available since 2007, prior to 2007 discards estimates are based on limited sampling.**

****Geometric mean recruitment 1993–2019.**

Table 9.9. Haddock in Division 7.a. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2023)	Wanted catch* (2023)	Un-wanted catch* (2023)	F_{total} (2023)	F_{wanted} (2023)	$F_{un-wanted}$ (2023)	SSB (2024)	%SSB change **	%Ad-vice change ^
ICES advice Basis									
EU MAP ***: F_{MSY}	2648	2107	541	0.28	0.171	0.109	9321	-21	-12.8
F = MAP $F_{MSY\ lower}$	1956	1560	396	0.2	0.122	0.078	10044	-15	-35.6
F = MAP $F_{MSY\ upper}$	3216	2554	661	0.35	0.21	0.137	8732	-26	5.9
Other scenarios									
F = 0	0	0	0	0	0	0	12115	2.5	-100
F = F_{pa}	3676	2915	761	0.41	0.25	0.16	8258	-30	21
F = F_{lim}	4323	3421	903	0.5	0.3	0.195	7597	-36	42.3
F = F2022	1587	1267	320	0.15947	0.097	0.062	10432	-11.7	-47.8
SSB2023 = B_{lim}	9125	7029	2095	1.52547	0.93	0.6	2994	-75	200
SSB2023 = B_{pa}	7834	6092	1742	1.15805	0.71	0.45	4160	-65	158
SSB2023=MSY $B_{trigger}$	7704	5997	1708	1.12632	0.69	0.44	4281	-64	154
SSB2023=SSB2022	280	224	56	0.02653	0.0162	0.0104	11817	0	-90.8

*** "Wanted" and "unwanted" catch are used to describe fish that would be landed and discarded in the absence of the EU landing obligation, based on discard rate estimates for 2019–2021.**

**** SSB 2024 relative to SSB 2023.**

***** EU multiannual plan (MAP) for the Western Waters (EU, 2019).**

^ Advice value for 2023 relative to the F_{MSY} advice value for 2022 (3038 tonnes).

Table 9.10. Haddock in 7.a Management reference points.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	4281 tonnes	5th percentile of BMSY; Irish Sea haddock has been fished at, or below F_{MSY} for >five years.	ICES (2018a)
	F_{MSY}	0.28	Median point estimates of EqSim with segmented regression stock–recruitment relationship	ICES (2018a)
	$F_{MSYLower}$	0.20	F at 95% of MSY below F_{MSY}	ICES (2018a)
	$F_{MSYUpper}$	0.35	F at 95% of MSY above F_{MSY}	ICES (2018a)
Precautionary approach	B_{lim}	2994 tonnes	Lowest observed SSB with >75th percentile recruitment	ICES (2018a)
	B_{pa}	4160 tonnes	B_{lim} combined with the assessment error; $B_{lim} \times \exp(1.645 \times \sigma)$; $\sigma = 0.20$	ICES (2018a)
	F_{lim}	0.50	F with 50% probability of SSB $<B_{lim}$	ICES (2018a)
	F_{pa}	0.41	$F_{p0.05}$; the F that leads to SSB$>B_{lim}$ with 95% probability	ICES (2018a)
Management plan	SSB_{MGT}	Not applicable		
	F_{MGT}	Not applicable		

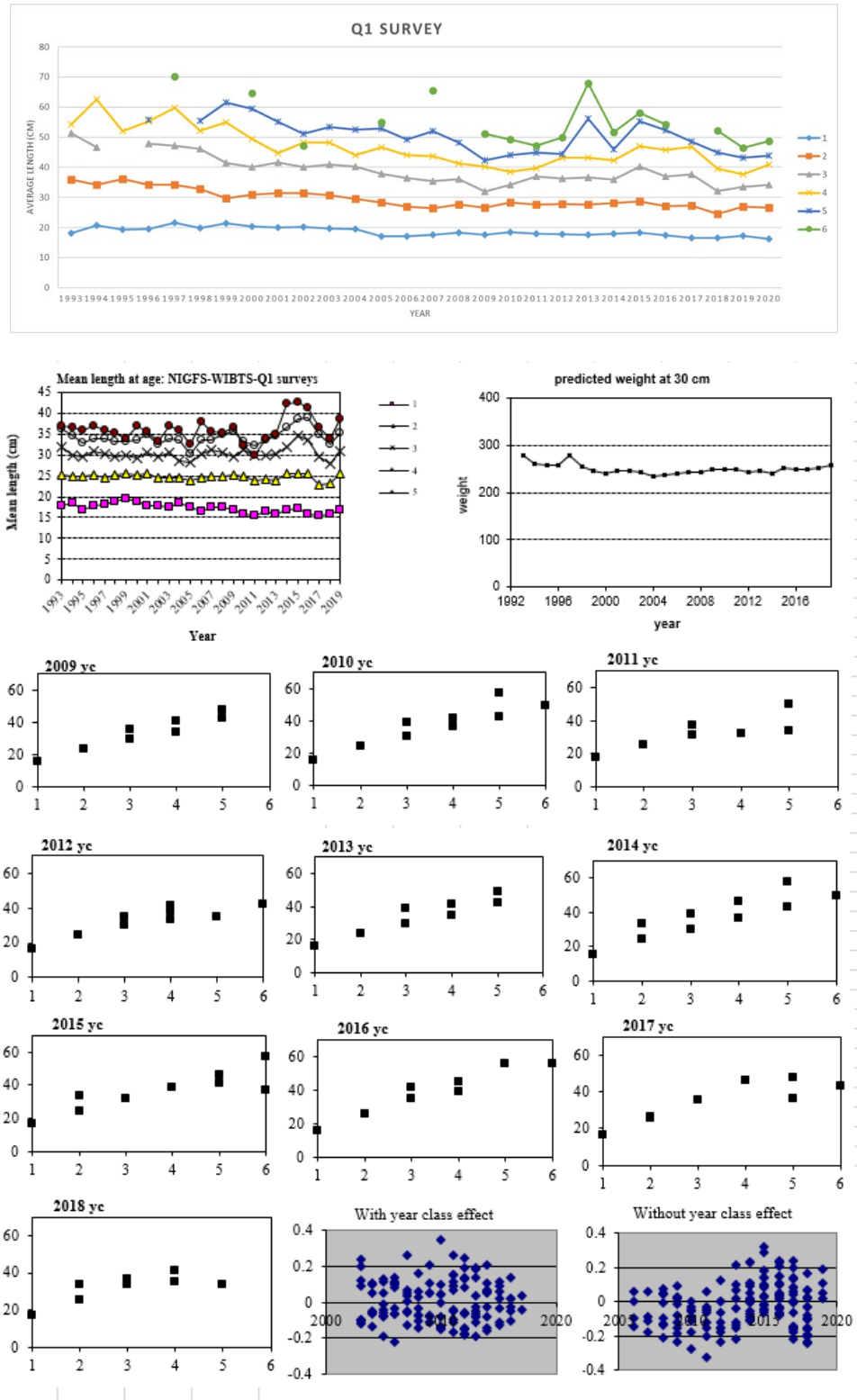


Figure 9.1. Haddock in 7.a: Growth of haddock in the Irish Sea. Top two panels: mean length-at-age in UK(NI) groundfish surveys in March (NIGFS-WIBTS-Q1), by year and age, and expected mean weight-at-length based on length–weight parameters from each survey. Lower panels: mean length-at-age from March surveys, and from Quarter 1 commercial landings at-age 3 and over, by year class. Lines are von Bertalanffy model fits with year-class effect included. Model residuals are shown for the fit without year-class effects, and for the fit with year-class effects.

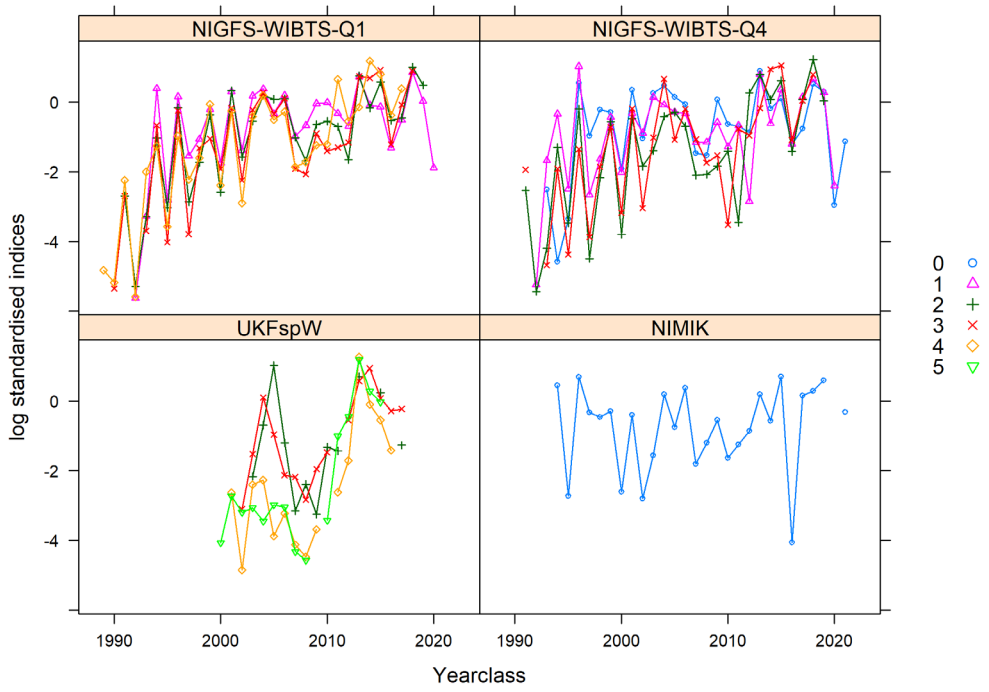
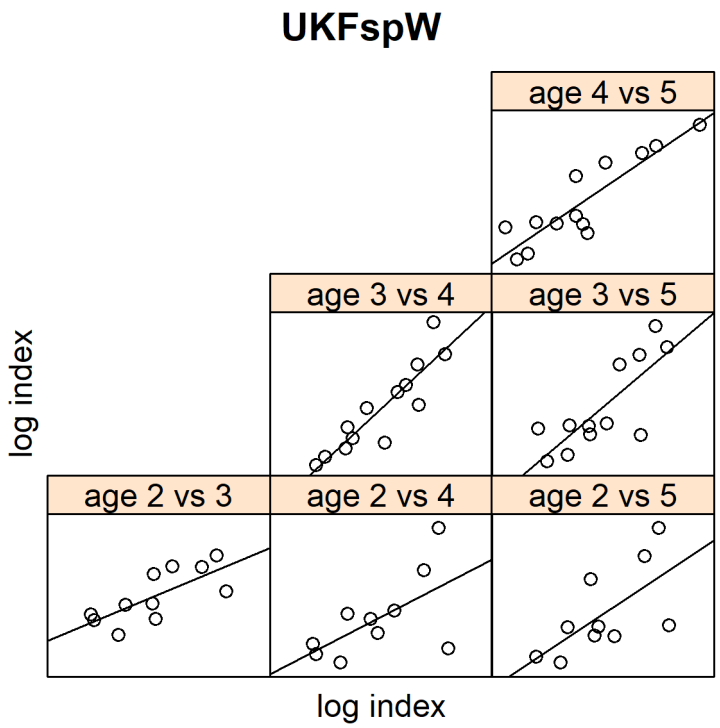


Figure 9.2. Haddock in 7.a: Trends in log-standardised survey indices.



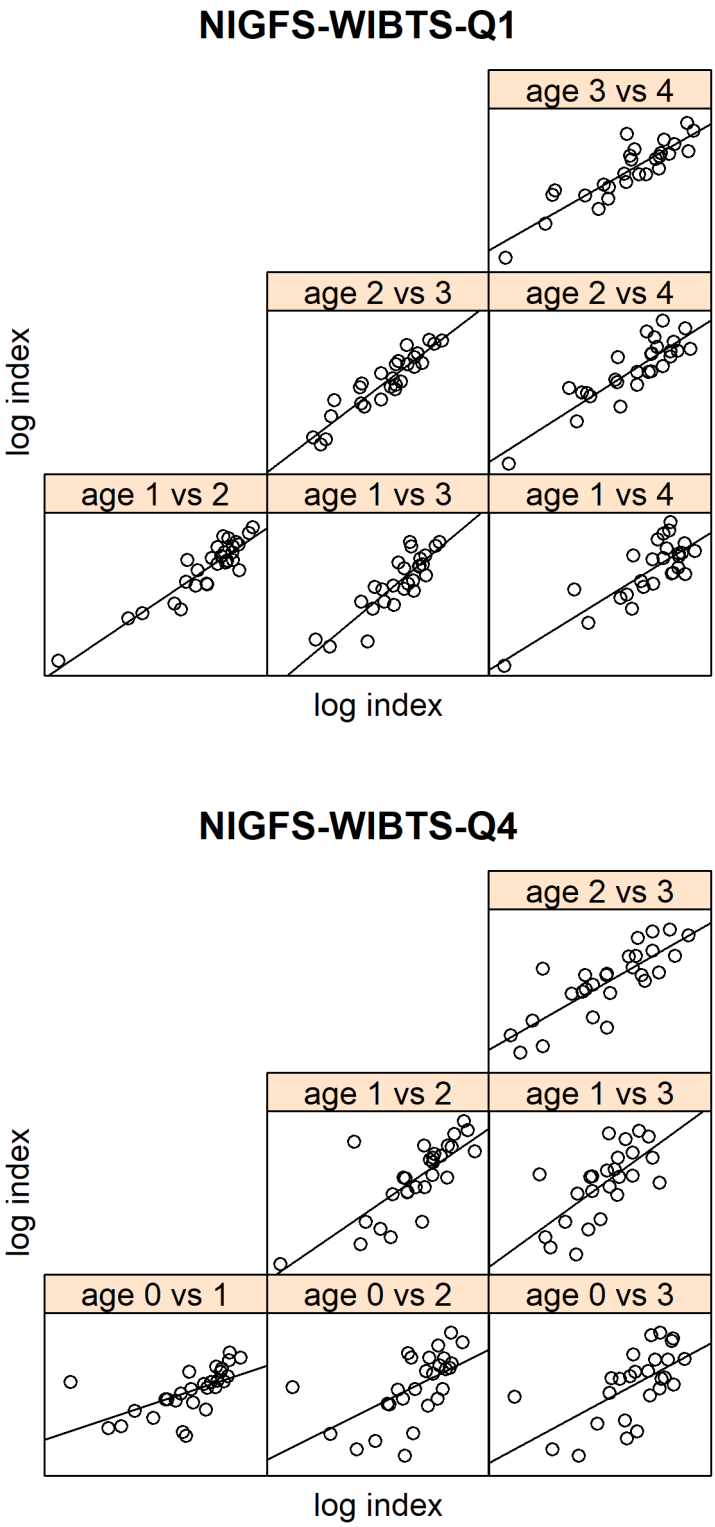


Figure 9.3. Haddock in 7.a: Scatterplot matrix of log indices of cohorts at different ages.

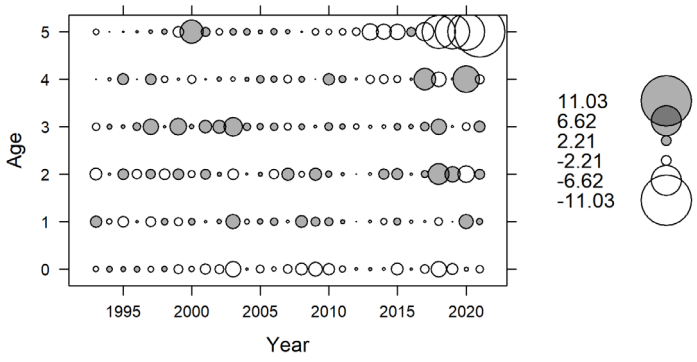


Figure 9.4. Standardised residuals from fitted and observed catch age proportions.

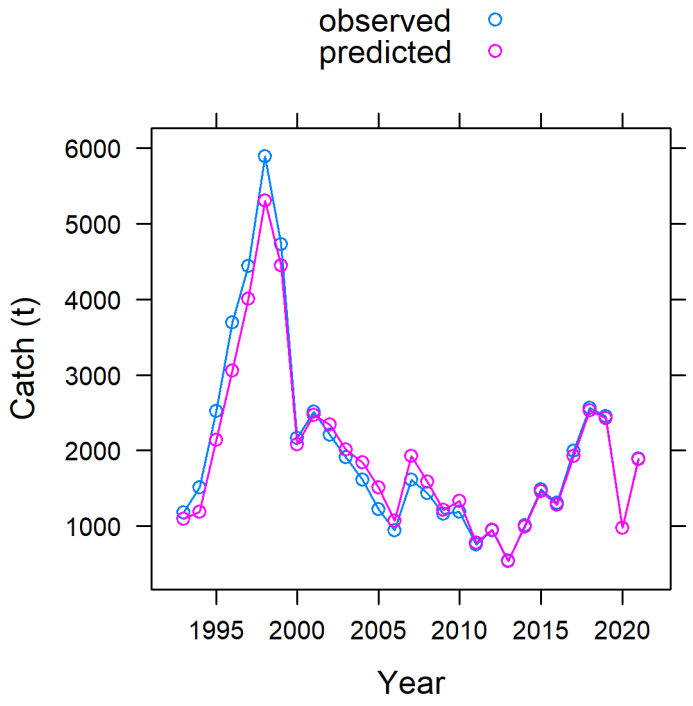


Figure 9.5. Fitted and observed catch from update assessment.

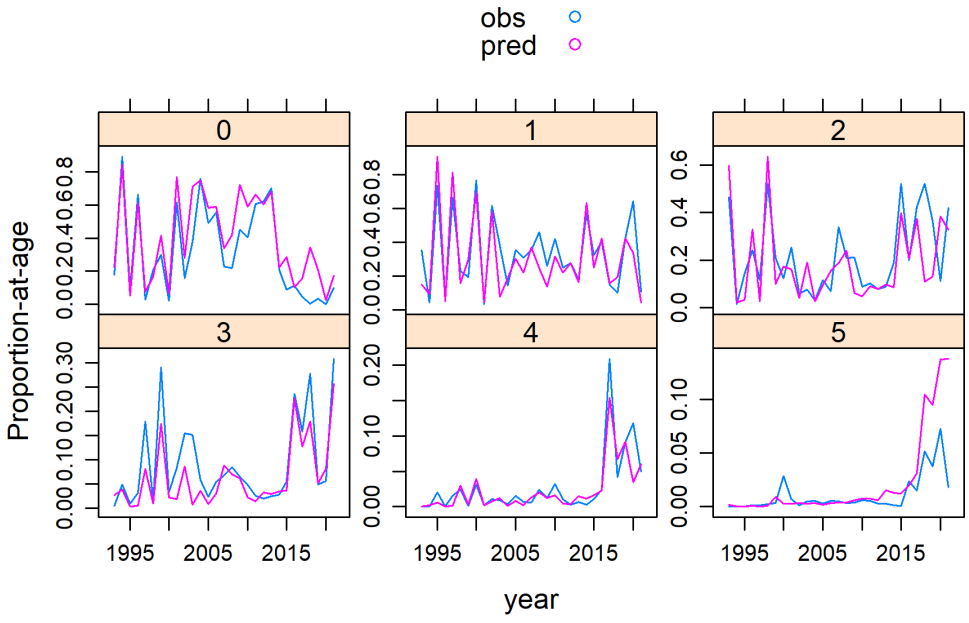


Figure 9.6. Fitted and observed catch age proportions from update assessment.

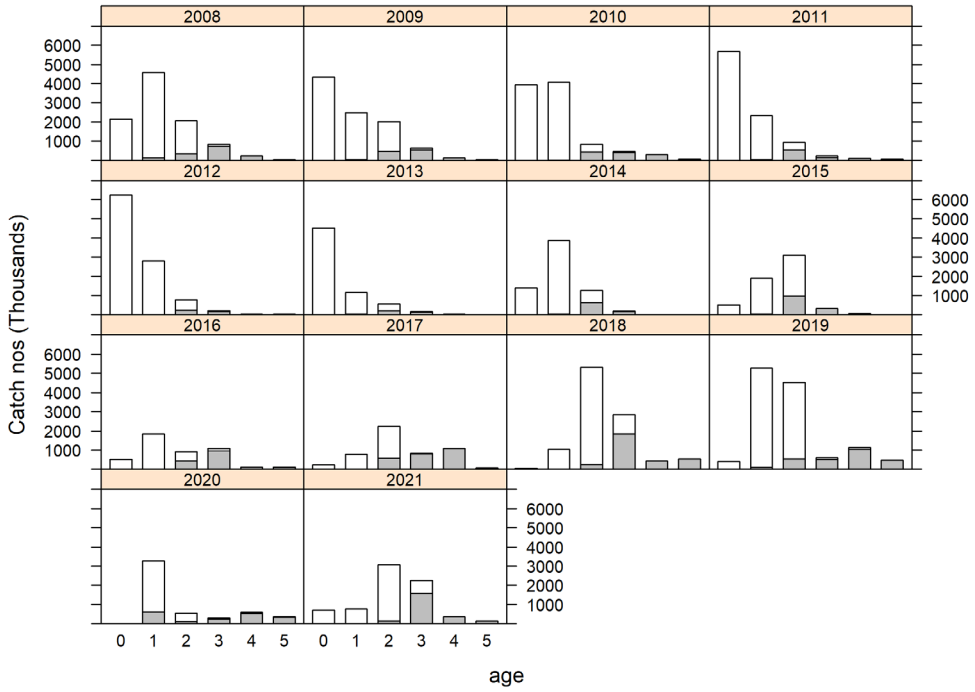


Figure 9.7. Observed catch numbers 2008–present.

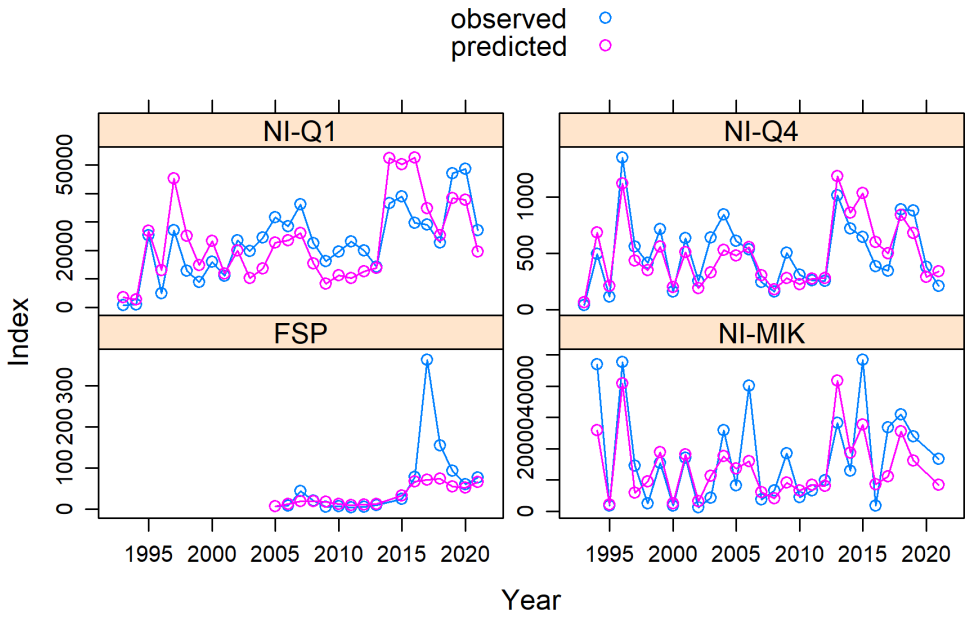


Figure 9.8. Fitted and observed index series from update assessment.

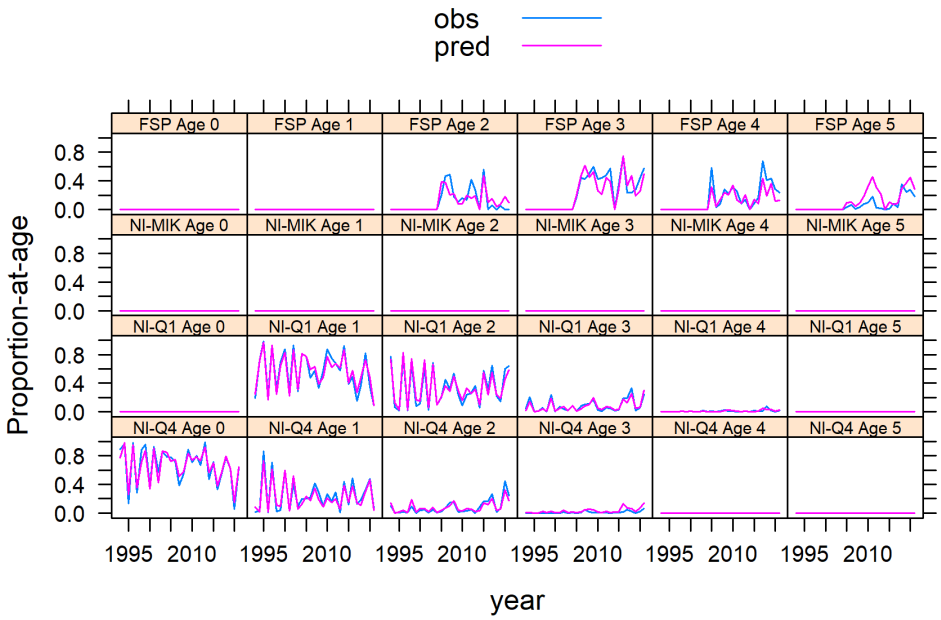
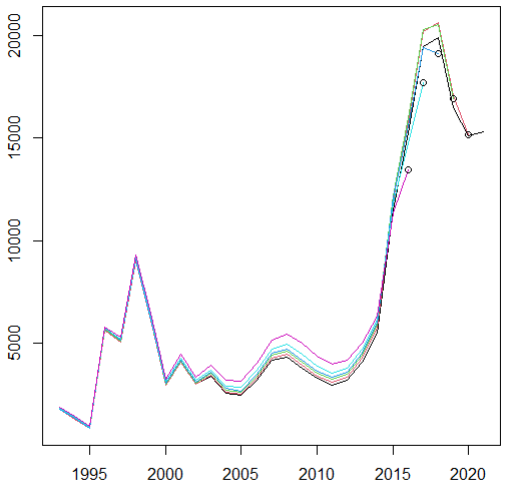
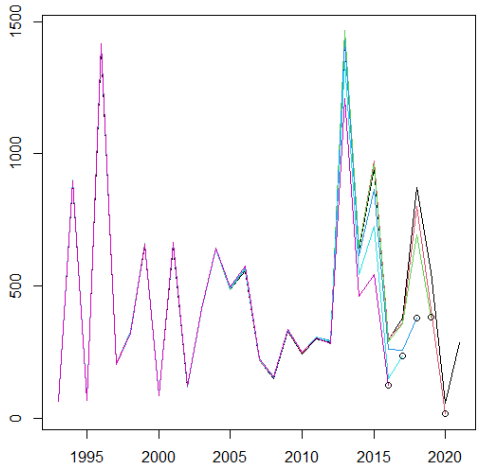


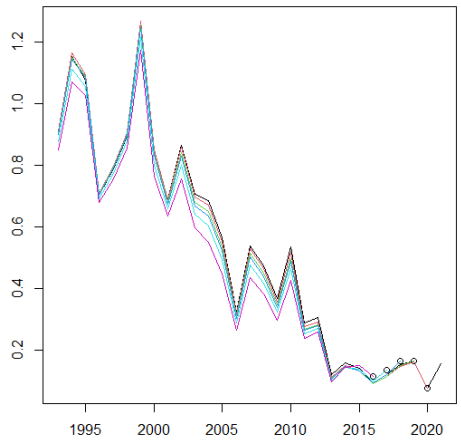
Figure 9.9. Fitted and observed index age proportions from update assessment.



SSB -0.044



Recruitment -0506



F_{bar} 0.082

Figure 9.10. Retrospective plot the final update model.

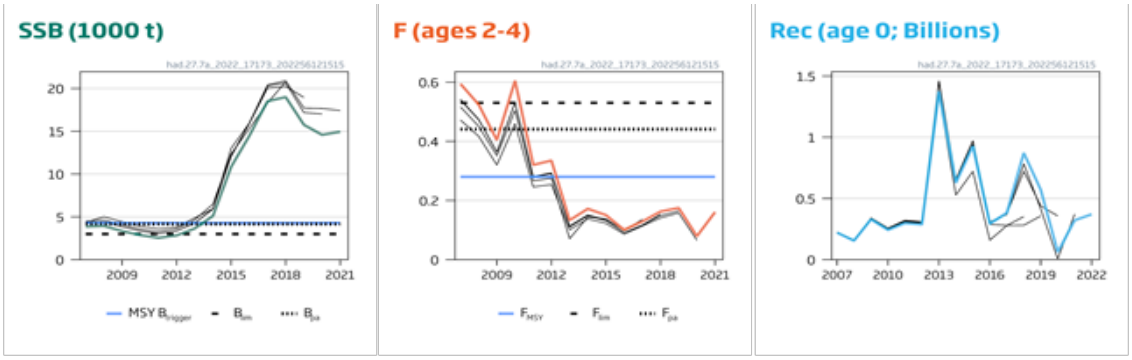


Figure 9.11. Haddock in Division7.a. Historical assessment results.

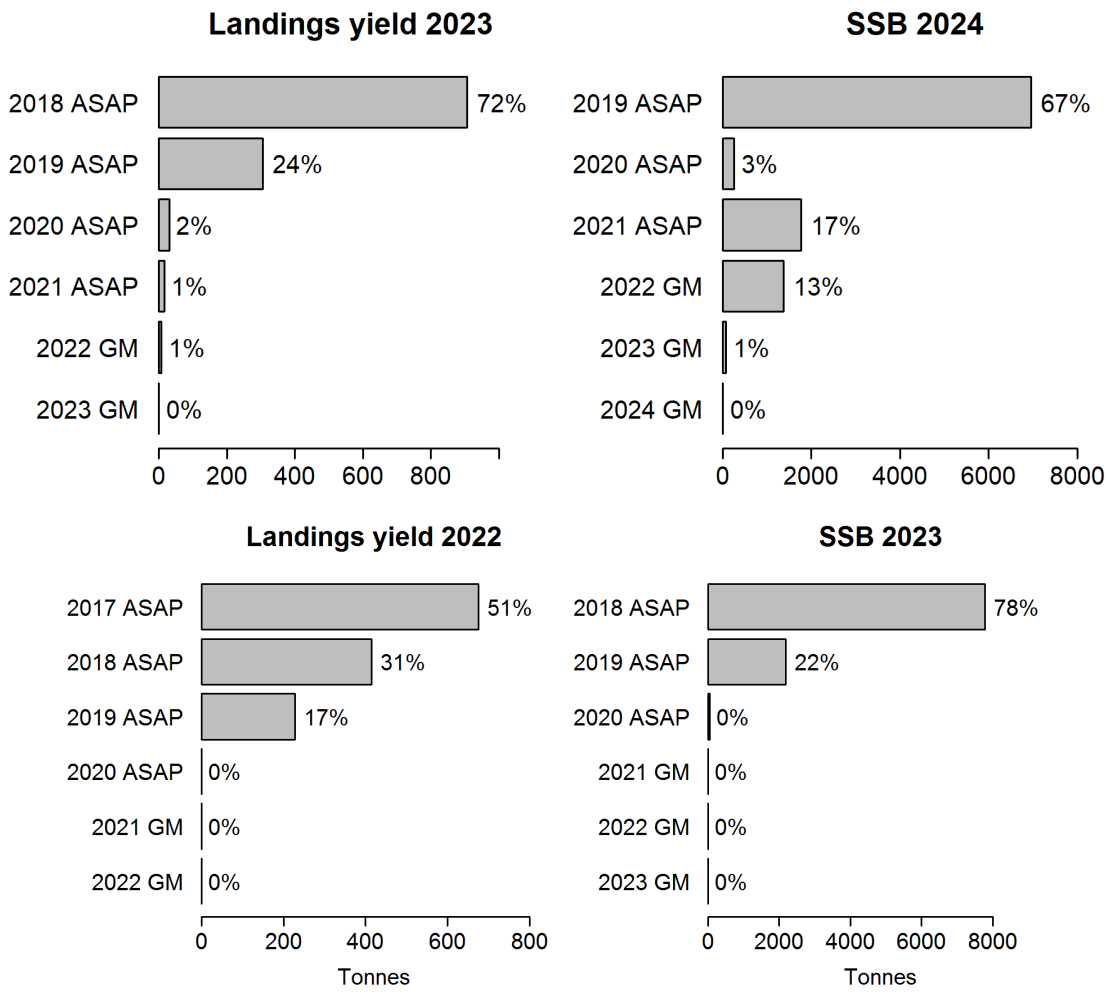


Figure 9.12. Haddock in 7a. Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes.