5 Faroe haddock

This section was updated in November 2020.

5.1 Stock description and management units

Haddock in Faroese Waters, i.e. ICES subdivisions 5.b.1 and 5.b.2 and in the southern part of ICES Division 2.a, close to the border of Subdivision 5.b.1, are generally believed to belong to the same stock and are treated as one management unit named Faroe haddock. Haddock is distributed all over the Faroe Plateau and the Faroe Bank from shallow water down to more than 450 m. A more detailed description of haddock in Faroese waters is given in the stock annex. The spatial distribution of the haddock in the summer survey and in the spring survey is shown in Figure 5.8.

5.2 Scientific data

5.2.1 Trends in landings and fisheries

Nominal landings of Faroe haddock gradually decreased since its peak in 2003 with 27 000 t and amounted in 2017 to only about 2800 t but is now increasing again with 9334 t in 2019. Most of the landings are taken from the Faroe Plateau; the 2019 landings from the Faroe Bank (Subdivision 5.b.2), where the area shallower than 200 m depths has been closed to the bulk of fisheries since the fiscal year 2008–2009, amounted to about 330 t (tables 5.1 and 5.2).

Faroese vessels have taken almost the entire catch since the late 1970s (Figure 5.1). The longliners have taken most of the catches in recent years followed by the trawlers. This was also the case in 2017, where the share by longliners was 67% and the trawler's share was 15%. Small open boats and jiggers, which mainly fish near shore, caught 19% of the total catch of 2019 (Figure 5.2).

5.2.2 Catch-at-age

Catch-at-age data was provided for fish taken by the Faroese fleets from 5.b. The sampling intensity in the terminal year is shown in Table 5.3. All longliners were grouped into two fleets (above and below 100 GRT, Gross Register Tons), and all trawlers were also grouped to one fleet, and the samples were treated by using 2 seasons (Jan–Jun, Jul–Dec.). The results are given in Table 5.3. The most recent data were revised according to the final catch figures and the results are shown in Table 5.4. Catch curves are shown in Figure 5.3.

5.2.3 Weight-at-age

Mean weight-at-age data are provided for the Faroese fishery (Table 5.5). Figure 5.4 shows the mean weights-at-age in the landings for age groups 2–8 since 1977. During this period, weights have shown cyclical changes. They were at a minimum in 2007–2009, but have increased again since then. The mean weights at age in the stock are assumed equal to those in the landings.

5.2.4 Maturity-at-age

Maturity-at-age data is available from the Faroese Spring Groundfish Surveys from 1982 and onwards. The survey is carried out in February–March. This means the maturity-at-age is determined just prior to the spawning of haddock in Faroese waters happening in April and the determination of the different maturity stages is relatively easy.

In order to reduce year-to-year variation, the routine by the WG has been to use a 3-year running average in the assessment. For the years prior to 1982, average maturity-at-age from the surveys 1982–1995 was adopted (Table 5.6 and Figure 5.5).

5.3 Information from the fishing industry

There exists a considerable amount of data on fish size in the fishing industry. No such information was used directly in the current assessment but catch per unit effort for some selected fleets (logbook data) is used as additional information on the status of the stock (see Section 5.3.1.1).

5.3.1 Methods

The benchmark in February 2017 decided to change the traditional assessment tool from XSA to SAM although it was recognized that the results of the assessment were mainly data-driven. The SAM model has some beneficial characteristics as compared to XSA, e.g. it provides uncertainty estimates for the catch in numbers, surveys and the output from the assessment (biomasses and fishing mortalities). See the stock annex for more information.

In the NWWG meeting in 2018, it was proposed to change the settings for the model (Table 5.9). Default settings used the same sdLogN for all ages (1–7/8 years) in the two tuning series, but different for each survey. Comparisons of the results from the two different settings were presented in the first version of the NWWG report 2018 (June 2018). The Advice Drafting Group 2018 (May 2018) adopted the revised model settings for future assessments and advice.

From mid-1990s to 2017/2018 the fishing year was from September 1st to August 31th and the ICES advice to Faroese authorities provided in June. The assessment was based on catch data up to the year before the interim year and the last tuning data point was from spring in the interim year. This was the situation when the benchmark assessment was performed in February 2017. However, the fishing year was changed to be equal to the calendar year and this change was first applied to the calendar year 2018. Faroese authorities needed the ICES advice in November and this implied that the tuning data point in August in the interim year could be added as input in the assessment. These settings were applied for the first time in the stock assessment performed in November 2019, i.e. using catch data up to 2018 and tuning data (both surveys) up to 2019.

No preliminary assessment was conducted in April 2020 as the working group meeting was cancelled due to the COVID-19 outbreak; the 2020 assessment was done in November at a webex NWWG-meeting. Comparison between the 2019 assessment and the latest assessments is shown in Figure 5.9.

5.3.1.1 Tuning and estimates of fishing mortality

Commercial CPUE series

The age-aggregated CPUE series for longliners and pair trawlers are presented in Figure 5.6. In general, the two series show the same trends although in some periods the two series are conflicting; this has been explained by variations in catchability of the longlines due to changes in

productivity of the Faroe Shelf ecosystem. Both series, however, show that the total stock biomass has been low, but is now increasing. The longliner CPUE does not decrease as much as the trawler CPUE which in addition to the explanation given above may be attributed to the fact that in the management of the demersal Faroese stocks, large areas have been closed to trawling with the effect that when the haddock stock is small, the distribution of it is mainly outside the "trawl areas".

Fisheries independent CPUE series

Two annual groundfish surveys are available, one carried out in February–March since 1982 (100 stations per year down to 500 m depth), and the other in August-September since 1996 (200 stations per year down to 500 m depth). Survey catch at age data is presented in Table 5.7. The main trends from the surveys are the same but the summer survey indicates a more depleted stock in recent years than the summer survey; both surveys indicate a slow increase in recent years. Age disaggregated data are available for the whole summer series, but due to problems with the database (see earlier reports), age disaggregated data for the spring survey are only available since 1994. The calculation of indices at age is based on age-length keys with a Gaussian smoother applied. This is a useful method but some artefacts may be introduced since the smoothing can assign wrong ages to some lengths, especially for the youngest and oldest specimen. As in recent years, the length distributions have been used more directly for calculation of indices at age (ages 0–2), since these ages have length distributions almost without overlap. LN (numbers at age) for the surveys is presented in Figures 5.9–5.10. The distribution of haddock catches for spring and summer survey is shown in Figure 5.8.

These surveys have shown similar signal through the time series, however, since 2019, the signal has been conflicting, showing highly above average in the spring survey and the opposite, beneath average, in the summer survey. This is presented in Figure 5.7. This conflicting signal is furthermore exposed in the residual plot, see Figure 5.11, where SAM delimits the signal from the summer survey, especially for the older ages. The reasons for this difference between surveys is unclear and urge for further investigations.

5.4 Reference points

Since the assessment model was replaced at the benchmark in February 2017, it was necessary to recalculate reference points at the NWWG meeting in 2017 (this was not finally conducted during the benchmark).

The B_{lim} was changed from 22 thousand tonnes to 16 780 tonnes, the lowest spawning biomass from which the stock had made a recovery. The biomass was lower later in the time series, but the stock had not recovered by the time of the determination of this reference point.

The $B_{pa} = B_{trigger}$ = 22 843 tonnes (changed from 35 000 tonnes). The uncertainty in the SAM assessment in the final year of SSB was found to be $\sigma = 0.188$ and the B_{pa} was found by using the formula $B_{pa} = B_{lim} \times \exp(\sigma \times 1.645)$. The $B_{trigger}$ was, according to ICES guidelines, set equal to B_{pa} since the stock had not been fished at F_{MSY} for five or more years.

$F_{lim} = 0.54$ (changed from 0.4). F_{lim} was derived from B_{lim}. A stock was simulated with a segmented regression on the spawning stock – recruitment function having the point of inflection at B_{lim}. F_{lim} was set to the F that, in equilibrium, gave a 50% probability that SSB > B_{lim}. This simulation was based on a fixed F, i.e., without inclusion of a $B_{trigger}$ and without inclusion of assessment/advice errors.

$F_{pa} = 0.40$ (changed from 0.25). F_{pa} was derived from F_{lim} in the reverse of the way B_{pa} was derived from B_{lim}, i.e., $F_{pa} = F_{lim} \times \exp(-\sigma \times 1.645)$, where $\sigma = 0.185$.

The calculations were conducted using EQSIM following ICES guidelines. Decisions made involved the spawning stock – recruitment relationship, the weights at age, the selection pattern and the level of advice error. The period since 1978 was used as basis for the spawning stock – recruitment relationship where the S-R function was based on the segmented regression (weight 0.7), Ricker (weight 0.24), and Beverton and Holt (weight 0.06). The autocorrelation between SSB-R data points was approximately 0.52. The weights at age were based on the last 20 years. The selection pattern was based on the last 5 years. The advice error was estimated from advice sheets back to 1999: cvF = 0.48, phiF = 0.37, cvSSB = 0.40, phiSSB = 0.43. In total, 2000 iterations were performed that projected the stock 200 years into the future, of which, the last 50 years were kept to calculate 'equilibrium' values.

The result of the analyses was that F_{MSY} = 0.165 (changed from 0.25). The fishing mortality that is associated with a risk of 5% to fall below B_{lim}, $F_{p0.5}$, was estimated to be 0.09. The value was in the first simulations 0.13 assuming autocorrelation in the recruitment. At a web-ex meeting in June 2017 it was assumed there was no autocorrelation in the recruitment that led to Fmsy = 0.165.

5.5 State of the stock - historical and compared to what is now.

At the benchmark in February 2017 the traditional XSA was replaced by a SAM assessment model. The SAM model settings and the model parameters are shown in Table 5.8. AR covariance structure has been applied for both surveys, eliminating year effects. The observation residuals look quite random (Figure 5.11) as well as the process residuals (Figure 5.12).

The results from the SAM-run show that fishing mortality (F3–7) has decreased in recent years (Table 5.13, Figure 5.14). The spawning stock biomass has been low since 2009 but is now increasing (Table 5.13 Figure 5.16). The poor state of the stock since 2009 has been due to poor recruitment combined with high F but with the successful recruitment recently, the state of the stock has now improved (Table 5.13 Figure 5.17). The spawning stock biomass is now above B_{lim} and the fishing mortality around F_{MSY} (Table 5.13).

5.6 Short term forecast

Input data

The SAM model provides predictions that carry the signals from the assessment into the short term forecast. The forecast procedure starts from the assessment year's estimate of the state (log(N) and log(F) at age. One thousand replicates of the last state are simulated from its estimated joint distribution. Each of these replicates are then simulated forward according to the assumptions and parameter estimates found by the assessment model. In the forward simulations, a 5 year average (years up to and including the assessment year) is used for catch mean weight, stock mean weight, proportion mature, and natural mortality. Recruitment is re-sampled from the period 2001 to terminal year. In each forward simulation step the fishing mortality is scaled so that the median of the distribution is matching the requirement in the scenario (e.g. hitting a specific mean F value or a specific catch).

Results

The landings in 2020 were originally expected to be 12 thousand tonnes with status quo fishing mortality. However, the observed landings hidherto (January-September) in 2020 suggest that the landings at the end of 2020 will be close to 7 thousand tonnes, based on landings in January-September 2019 and January-December 2019. Therefore, in technical terms, a "TAC constraint" was set on the landings in 2020 of 7146 tonnes and forecasts based on this assumption (Table

5.14). The spawning stock biomass is expected to be 90 392 tonnes in 2021, 94 854 tonnes in 2022 and eventually 96 132 tonnes in 2023, if the Fmsy is applied.

5.7 Yield per recruit

The yield-per-recruit calculations were performed in the SAM model based on the last 20 years. The F_{max} was estimated at 0.72, but due to the very flat topped curve this value is poorly defined. $F_{0.1}$ was estimated at 0.15 and $F_{0.35SPR}$ at 0.29 (Figure 5.13).

5.8 Uncertainties in assessment and forecast

Retrospective analyses indicate periods with tendencies to overestimate recruitment and underestimate fishing mortality (Figures 5.14–5.16). Mohn´s Rho was 14% for SSB, 49% for recruitment and -18% for F(ages 3–7).

5.9 Comparison with previous assessment and forecast

The assessment settings were according to the Stock Annex. The assessment this year showed downscaling of the recruitment and based on, TAC constraint in 2020, similar fishing mortality compared with last year's assessment, however, spawning stock biomass is essentially unvaried (Figure 5.19).

5.10 Management plans and evaluations

An effort management system has been in use from 1996 to 2020. There is still ongoing work on a new management system. The catch quota needs to be converted into fishing days. Management of fisheries on haddock also needs to take into account measures for cod, as cod and haddock are caught in mixed fishery. Further development of management measures that includes the mixed-fishery issue would be useful.

The spawning-stock biomass (SSB) decreased significantly from 2003 and is estimated to have been below B_{lim} in the period between 2009–2017, but has been improving the past three years. The fishing mortality (F) has decreased in recent years but is still above F_{MSY}. Recruitment (age 1) from 2004 onwards has been well below the long-term average. However, the 2016 and 2017 year classes are estimated to be above average.

5.11 Ecosystem considerations

Since on average about 75% of the catches are taken by longliners and the remaining by trawls, effects of the haddock fishery on the bottom is moderate (Figure 5.2).

5.12 Regulations and their effects

As explained in the overview (Section 2), the fishery for haddock in 5.b is regulated through a maximum number of allocated fishing days, gear specifications, closed areas during spawning times, closed areas for longlining close to land and large areas closed to trawling. As a consequence, around 80% of the haddock landings derive from long line fisheries. Since the minimum mesh size in the trawls (codend) is 145 mm, the trawl catches consist of fewer small fish than the

long line fisheries. Other nations fishing in Faroese waters are regulated by TAC's obtained during bilateral negotiations; their total landings are minimal, however, and in 2011–2013 no agreement could be made between the Faroe Islands and EU and Norway, respectively, due to the dispute on mackerel quota sharing. Afterwards, however, the parties managed to get an agreement in place again. Since there is no incentive to discard fish or misreport catches under the effort management system, the catch figures are considered adequate.

5.13 Changes in fishing technology and fishing patterns

See Section 2.

5.14 Changes in the environment

See Section 2.

Table 5.1. Faroe Plateau (Sub-division 5b1) HADDOCK. Nominal catches (tonnes) by countries 2000-2020 and Working group estimates in 5b.

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Faroe Islands	13620	13457	20776	21615	18995	18172	15600	11689	6728	4895	4932	3350	2490	2877	2756	2919	3090	2575	5192	8679
France	6	8	2	4	+		12	4	3	2	1	2	1	+	+	1	+	1	+	+
Germany	1	2	6	1	6		1													
Greenland							1	9		6										
Iceland			4										2							
Ireland																+				
Norway	355	257	227	265	229	212	57	61	31	8	6				+	5	11	1	21	41
Russia					16				10	0										
Spain					49															
UK (Engl. And Wales)	19	4	11	14	8	1	1													
UK (Scotland)	185	148	177	185	186	1,070	106	35	60	65	40									
United Kingdom														+	350	428	237	72	121	283
Total (tonnes)	14186	13876	21203	22084	19489	19455	15778	11798	6832	4976	4979	3352	2493	2877	3105	3352	3339	2649	5334	9003
Used in the assessment in 5b	**15799**	**15891**	**24929**	**26941.97**	**23100**	**21944**	**17154**	**12631**	**7393**	**5197**	**5203**	**3546**	**2634**	**2924**	**3252**	**3421**	**3470**	**2863**	**5549**	**9334**

Table 5.2 Faroe Bank (Sub-division 5b2) HADDOCK. Nominal catches (tonnes) by countries, 2000–2020.

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Faroe Islands	1565	1948	3698	4804	3594	2444	1374.84	810	556	192	178	194	141	47	71	48	111	196	192	330
France	+									1							5			
Greenland											12									
Norway	48	66	28	54	17	45	1	8	+	3	1				2	1	+	5	1	1
UK (Scotland)								15	5	26	33									
United Kingdom															74	21	15	14	22	
Total (tonnes)	1613	2014	3726	4858	3611	2489	1376	833	561	222	224	194	141	47	147	69	131	214	215	332

Table 5.3. Faroe Plateau (Subdivision 5.b) haddock. Catch at age and sampling intensity of terminal year.

Fleet	Size	Samples	Lengths	Otoliths	Weights
Open boats		2	429	120	429
Longliners	< 100 GRT	4	888	239	888
Longliners	> 100 GRT	24	5224	1419	5224
Jiggers		0	0	0	0
Gillnetters		0	0	0	0
Single trawlers	< 400 HP	0	0	0	0
Single trawlers	400-1000 HP	3	654	119	654
Single trawlers	> 1000 HP	0	0	0	0
Pair trawlers	< 1000 HP	0	0	0	0
Pair trawlers	> 1000 HP	23	4613	1255	4405
Total		56	11808	3152	11600

Table 5.4. Faroe haddock. Catch in numbers at age per fleet in terminal years.

27.5.b - Faroese fleet				
Age	Longliners < 100 GRT	Longliners > 100 GRT	Trawlers	Others
0	0	0	0	0
1	0	0	0	0
2	0	155	46	0
3	820	1,036	398	0
4	987	1,189	458	0
5	318	505	160	0
6	187	246	75	0
7	58	60	24	0
8	34	35	15	0
9	3	14	9	0
10	0	1	2	0
11	0	0	0	0
12	0	0	0	0
13	0	0	0	0
14	0	0	0	0
15	0	0	0	0
Total no.	2,407	3,242	1,186	0
Catch, t.	4002	3392	827	0

Numbers in 1000'

Catch, gutted weight in tonnes

Others include netters, jiggers, other small categories and catches not otherwise accounted for

Table 5.4. Faroe haddock. Catch in numbers at age 1957–2019.

Year \ age	0	1	2	3	4	5	6	7	8	9	10
1957	0	45	4133	7130	8442	1615	894	585	227	94	58
1958	0	116	6255	8021	5679	3378	1299	817	294	125	105
1959	0	525	3971	7663	4544	2056	1844	721	236	98	47
1960	0	854	6061	10659	6655	2482	1559	1169	243	85	28
1961	0	941	7932	7330	5134	1937	1305	838	236	59	13
1962	0	784	9631	13977	5233	2361	1407	868	270	72	22
1963	0	356	13552	8907	7403	2242	1539	860	257	75	23
1964	0	46	2284	7457	3899	2360	1120	728	198	49	7
1965	0	39	1368	4286	5133	1443	1209	673	1345	43	8
1966	0	90	1081	3304	4804	2710	1112	740	180	54	9
1967	0	70	1425	2405	2599	1785	1426	631	197	52	13
1968	0	49	5881	4097	2812	1524	1526	923	230	68	12
1969	0	95	2384	7539	4567	1565	1485	1224	378	114	20
1970	0	57	1728	4855	6581	1624	1383	1099	326	68	10
1971	0	55	717	4393	4727	3267	1292	864	222	147	102
1972	0	43	750	3744	4179	2706	1171	696	180	113	95
1973	0	665	3311	8416	1240	2795	919	1054	150	68	11
1974	0	253	5633	2899	3970	451	976	466	535	68	147
1975	0	94	7337	7952	2097	1371	247	352	237	419	187
1976	0	40	4396	7858	6798	1251	1189	298	720	258	318
1977	0	0	255	4039	5168	4918	2128	946	443	731	855
1978	0	0	32	1022	4248	4054	1841	717	635	243	312
1979	0	1	1	1162	1755	3343	1851	772	212	155	74
1980	0	0	143	58	3724	2583	2496	1568	660	99	86
1981	0	0	74	455	202	2586	1354	1559	608	177	36
1982	0	0	539	934	784	298	2182	973	1166	1283	214
1983	0	0	441	1969	383	422	93	1444	740	947	795
1984	0	25	1195	1561	2462	147	234	42	861	388	968
1985	0	0	985	4553	2196	1242	169	91	61	503	973
1986	0	0	230	2549	4452	1522	738	39	130	71	712
1987	0	0	283	1718	3565	2972	1114	529	83	48	334
1988	0	0	655	444	2463	3036	2140	475	151	18	128
1989	0	0	63	1518	658	2787	2554	1976	541	133	81
1990	0	0	105	1275	1921	768	1737	1909	885	270	108
1991	0	0	77	1044	1774	1248	651	1101	698	317	32
1992	0	0	40	154	776	1120	959	335	373	401	162
1993	0	43	113	298	274	554	538	474	131	201	185
1994	0	1	277	191	307	153	423	427	383	125	301
1995	0	0	804	452	235	226	132	295	290	262	295

Year \ age	0	1	2	3	4	5	6	7	8	9	10
1996	0	1	326	5234	1019	179	163	161	270	234	394
1997	0	0	77	2913	10517	710	116	123	93	220	516
1998	0	0	106	1055	5269	9856	446	99	87	95	502
1999	0	9	174	1142	942	4677	6619	226	26	20	192
2000	0	73	1459	3057	210	681	2681	2842	79	1	71
2001	0	19	4380	3128	2423	173	451	1151	1375	17	18
2002	0	0	1515	14036	2878	1200	133	239	843	1095	33
2003	0	0	132	3419	13486	2213	944	162	332	854	920
2004	0	3	243	2007	4802	10425	1163	409	89	166	811
2005	0	0	91	1793	4132	7245	6573	581	158	30	165
2006	0	0	247	446	2566	3949	5423	3278	136	63	70
2007	0	0	76	982	547	2732	3309	2758	1117	89	9
2008	0	6	66	204	919	424	1472	1707	1255	320	39
2009	0	0	27	329	402	555	514	1133	739	285	48
2010	0	0	389	445	426	279	484	553	718	444	159
2011	0	0	170	774	325	198	186	280	354	368	187
2012	0	0	8	960	513	156	114	123	94	171	114
2013	0	0	82	506	1108	217	94	77	87	70	118
2014	0	0	236	392	637	1133	101	61	32	15	48
2015	0	0	387	1153	320	564	324	49	27	23	20
2016	0	8	280	982	638	220	454	116	22	24	12
2017	0	1	156	391	812	321	113	143	70	14	10
2018	0	0	583	1809	768	583	213	85	78	28	9
2019	0	0	198	2212	2584	964	498	140	82	25	3

Table 5.5 Faroe Haddock. Mean weight at age (kg) in the catches, 1957–2019.

Year \ age	1	2	3	4	5	6	7	8	9	10
1957	0.250	0.470	0.730	1.130	1.550	1.970	2.410	2.760	3.070	3.550
1958	0.250	0.470	0.730	1.130	1.550	1.970	2.410	2.760	3.070	3.550
1959	0.250	0.470	0.730	1.130	1.550	1.970	2.410	2.760	3.070	3.550
1960	0.250	0.470	0.730	1.130	1.550	1.970	2.410	2.760	3.070	3.550
1961	0.250	0.470	0.730	1.130	1.550	1.970	2.410	2.760	3.070	3.550
1962	0.250	0.470	0.730	1.130	1.550	1.970	2.410	2.760	3.070	3.550
1963	0.250	0.470	0.730	1.130	1.550	1.970	2.410	2.760	3.070	3.550
1964	0.250	0.470	0.730	1.130	1.550	1.970	2.410	2.760	3.070	3.550
1965	0.250	0.470	0.730	1.130	1.550	1.970	2.410	2.760	3.070	3.550
1966	0.250	0.470	0.730	1.130	1.550	1.970	2.410	2.760	3.070	3.550
1967	0.250	0.470	0.730	1.130	1.550	1.970	2.410	2.760	3.070	3.550
1968	0.250	0.470	0.730	1.130	1.550	1.970	2.410	2.760	3.070	3.550
1969	0.250	0.470	0.730	1.130	1.550	1.970	2.410	2.760	3.070	3.550
1970	0.250	0.470	0.730	1.130	1.550	1.970	2.410	2.760	3.070	3.550
1971	0.250	0.470	0.730	1.130	1.550	1.970	2.410	2.760	3.070	3.550
1972	0.250	0.470	0.730	1.130	1.550	1.970	2.410	2.760	3.070	3.550
1973	0.250	0.470	0.730	1.130	1.550	1.970	2.410	2.760	3.070	3.550
1974	0.250	0.470	0.730	1.130	1.550	1.970	2.410	2.760	3.070	3.550
1975	0.250	0.470	0.730	1.130	1.550	1.970	2.410	2.760	3.070	3.550
1976	0.250	0.470	0.730	1.130	1.550	1.970	2.410	2.760	3.070	3.550
1977	0.000	0.311	0.633	1.044	1.426	1.825	2.241	2.205	2.570	2.591
1978	0.000	0.357	0.790	1.035	1.398	1.870	2.350	2.597	3.014	2.920
1979	0.300	0.357	0.672	0.894	1.156	1.590	2.070	2.525	2.696	3.519
1980	0.000	0.643	0.713	0.941	1.157	1.493	1.739	2.095	2.465	3.310
1981	0.000	0.452	0.725	0.957	1.237	1.651	2.053	2.406	2.725	3.250
1982	0.000	0.700	0.896	1.150	1.444	1.498	1.829	1.887	1.961	2.856
1983	0.000	0.470	0.740	1.010	1.320	1.660	2.050	2.260	2.540	3.040
1984	0.359	0.681	1.011	1.255	1.812	2.061	2.059	2.137	2.368	2.686
1985	0.000	0.528	0.859	1.391	1.777	2.326	2.440	2.401	2.532	2.686
1986	0.000	0.608	0.887	1.175	1.631	1.984	2.519	2.583	2.570	2.922
1987	0.000	0.605	0.831	1.126	1.462	1.941	2.173	2.347	3.118	2.933
1988	0.000	0.501	0.781	0.974	1.363	1.680	1.975	2.344	2.248	3.295
1989	0.000	0.580	0.779	0.923	1.207	1.564	1.746	2.086	2.424	2.514
1990	0.000	0.438	0.699	0.939	1.204	1.384	1.564	1.818	2.168	2.335
1991	0.000	0.547	0.693	0.884	1.086	1.276	1.477	1.574	1.930	2.153
1992	0.000	0.525	0.724	0.817	1.038	1.249	1.430	1.564	1.633	2.126
1993	0.360	0.755	0.982	1.027	1.192	1.378	1.643	1.796	1.971	2.240
1994	0.000	0.754	1.103	1.254	1.465	1.593	1.804	2.049	2.225	2.423
1995	0.000	0.666	1.054	1.489	1.779	1.940	2.182	2.357	2.490	2.678

Year \ age	1	2	3	4	5	6	7	8	9	10
1996	0.360	0.534	0.858	1.459	1.993	2.330	2.351	2.469	2.777	2.582
1997	0.000	0.519	0.771	1.066	1.799	2.270	2.340	2.475	2.501	2.676
1998	0.000	0.622	0.846	1.016	1.283	2.080	2.556	2.572	2.452	2.753
1999	0.278	0.504	0.624	0.974	1.220	1.490	2.456	2.658	2.598	2.953
2000	0.280	0.661	0.936	1.166	1.483	1.616	1.893	2.821	3.749	3.196
2001	0.280	0.608	0.940	1.374	1.779	1.971	2.119	2.373	2.750	3.966
2002	0.000	0.584	0.857	1.405	1.799	1.974	2.301	2.370	2.626	3.130
2003	0.000	0.571	0.715	1.008	1.537	1.911	2.091	2.301	2.406	2.535
2004	0.367	0.574	0.770	0.887	1.159	1.638	1.870	2.438	2.357	2.417
2005	0.000	0.538	0.649	0.797	1.020	1.245	1.843	2.061	2.263	2.579
2006	0.000	0.475	0.601	0.768	0.911	1.126	1.374	2.158	2.211	2.569
2007	0.000	0.628	0.669	0.859	0.969	1.060	1.245	1.475	2.266	2.256
2008	0.491	0.636	0.754	0.860	0.991	1.082	1.151	1.379	1.727	2.435
2009	0.000	0.482	0.734	0.985	1.130	1.264	1.357	1.545	1.792	2.154
2010	0.000	0.692	0.870	1.149	1.308	1.386	1.429	1.568	1.740	1.841
2011	0.000	0.553	0.815	1.086	1.303	1.387	1.469	1.538	1.702	1.862
2012	0.000	0.619	0.786	1.069	1.405	1.616	1.656	1.675	1.727	1.905
2013	0.000	0.576	0.830	1.149	1.465	1.710	1.827	1.886	1.856	2.085
2014	0.000	0.547	0.902	1.165	1.354	1.693	1.841	1.872	1.856	1.823
2015	0.424	0.533	0.889	1.353	1.640	1.729	2.424	2.003	2.218	2.302
2016	0.396	0.645	0.934	1.220	1.571	1.908	2.066	2.187	2.276	2.789
2017	0.343	0.790	0.904	1.169	1.595	2.137	2.291	2.666	2.697	3.791
2018	0.000	0.642	1.000	1.584	1.944	2.281	2.544	2.597	2.818	3.288
2019	0.000	0.694	0.824	1.240	1.999	2.351	3.011	2.890	3.151	2.803

Table 5.6 Faroe haddock. Proportion mature at age 1957–2020.

Year/Age	0	1	2	3	4	5	6	7	8	9	10
1957	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1958	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1959	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1960	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1961	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1962	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1963	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1964	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1965	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1966	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1967	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1968	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1969	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1970	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1971	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1972	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1973	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1974	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1975	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1976	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1977	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1978	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1979	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1980	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1981	0	0	0.06	0.48	0.91	1	1	1	1	1	1
1982	0	0	0.08	0.62	0.89	1	1	1	1	1	1
1983	0	0	0.08	0.62	0.89	1	1	1	1	1	1
1984	0	0	0.08	0.76	0.98	1	1	1	1	1	1
1985	0	0	0.03	0.62	0.96	1	1	1	1	1	1
1986	0	0	0.03	0.43	0.95	0.99	1	1	1	1	1
1987	0	0	0.05	0.32	0.91	0.98	1	1	1	1	1
1988	0	0	0.05	0.24	0.89	0.98	1	1	1	1	1
1989	0	0	0.02	0.22	0.87	0.99	1	1	1	1	1
1990	0	0	0.08	0.37	0.9	1	1	1	1	1	1
1991	0	0	0.16	0.58	0.93	1	1	1	1	1	1
1992	0	0	0.18	0.65	0.91	1	1	1	1	1	1
1993	0	0	0.11	0.5	0.85	0.97	0.99	1	1	1	1
1994	0	0	0.05	0.42	0.86	0.96	0.99	1	1	1	1
1995	0	0	0.03	0.47	0.91	0.96	0.99	1	1	1	1

Year/Age	0	1	2	3	4	5	6	7	8	9	10
1996	0	0	0.03	0.47	0.93	0.98	1	1	1	1	1
1997	0	0	0.01	0.47	0.91	1	1	1	1	1	1
1998	0	0	0.01	0.36	0.87	0.99	1	1	1	1	1
1999	0	0	0.01	0.35	0.86	0.99	1	1	1	1	1
2000	0	0	0.02	0.36	0.87	0.99	1	1	1	1	1
2001	0	0	0.09	0.54	0.93	1	1	1	1	1	1
2002	0	0	0.08	0.49	0.97	1	1	1	1	1	1
2003	0	0	0.07	0.45	0.97	0.99	1	1	1	1	1
2004	0	0	0	0.35	0.94	0.99	1	1	1	1	1
2005	0	0	0.01	0.34	0.91	0.99	1	1	1	1	1
2006	0	0	0.01	0.42	0.91	1	1	1	1	1	1
2007	0	0	0.02	0.52	0.91	1	1	1	1	1	1
2008	0	0	0.01	0.64	0.95	1	1	1	1	1	1
2009	0	0	0.01	0.61	0.93	1	1	1	1	1	1
2010	0	0	0.03	0.65	0.96	1	1	1	1	1	1
2011	0	0	0.09	0.74	0.97	1	1	1	1	1	1
2012	0	0	0.13	0.79	0.99	1	1	1	1	1	1
2013	0	0	0.17	0.83	0.99	1	1	1	1	1	1
2014	0	0	0.17	0.83	1	1	1	1	1	1	1
2015	0	0	0.19	0.9	1	1	1	1	1	1	1
2016	0	0	0.14	0.89	1	1	1	1	1	1	1
2017	0	0	0.12	0.9	1	1	1	1	1	1	1
2018	0	0	0.08	0.80	0.99	1	1	1	1	1	1
2019	0	0	0.21	0.76	0.97	1	1	1	1	1	1
2020	0	0	0.24	0.69	0.95	1	1	1	1	1	1

Table 5.7. Faroe haddock. Spring survey tuning series (number of individuals per 100 stations) and summer survey tuning series (numbers of individuals per 200 stations) used as tuning series in the assessment model.

Spring survey							
Year	**Age 1**	**Age 2**	**Age 3**	**Age 4**	**Age 5**	**Age 6**	**Age 7**
1994	19584.95	2380.56	207.72	322.62	169.51	308.20	414.41
1995	53978.57	21905.74	747.98	234.72	164.36	54.35	158.08
1996	5981.52	35319.54	20186.24	716.49	102.12	77.29	58.57
1997	272.73	7907.90	15993.99	26430.77	689.35	156.07	39.94
1998	3533.88	1359.68	3410.17	9792.94	13430.09	372.01	16.06
1999	4555.20	6952.91	112.76	1499.15	4402.16	3361.94	54.43
2000	29967.78	8695.48	5247.12	222.17	455.29	1686.01	2035.75
2001	27317.40	37138.52	3548.95	1126.13	27.90	111.92	448.01
2002	21041.18	17601.09	26398.34	2088.51	717.88	42.22	107.10
2003	9109.99	22709.63	13017.25	13605.55	855.42	240.61	20.44
2004	1699.15	15554.18	10921.06	7157.62	12092.03	560.05	90.15
2005	5859.86	5455.46	7921.11	6402.22	4678.30	5303.56	269.20
2006	732.72	6206.61	1514.38	4485.32	3326.55	3450.18	1756.37
2007	1257.94	1403.39	3055.62	815.95	2900.21	3078.51	2363.20
2008	691.37	2144.92	782.76	1711.25	611.54	1705.82	1534.32
2009	4157.33	2081.85	1073.28	406.99	940.92	375.79	969.90
2010	6528.81	5191.86	651.55	419.10	197.85	287.49	276.91
2011	103.23	6360.19	1893.70	462.76	268.11	221.49	256.59
2012	439.29	367.60	4957.25	908.04	227.77	142.50	293.35
2013	3513.08	1254.01	263.93	3987.46	674.00	132.21	116.00
2014	3643.42	4175.07	830.45	918.25	2285.83	295.32	100.93
2015	1597.84	3363.12	4089.89	1078.58	2086.55	1373.34	204.49
2016	14092.83	4497.12	2471.24	1381.97	278.55	460.98	114.54
2017	60511.01	15358.50	2763.07	2351.99	713.93	169.90	339.60
2018	85580.40	24602.97	3849.20	1009.64	734.25	267.01	65.81
2019	14547.66	38586.53	21129.77	7090.88	1381.72	768.48	217.57
2020	2521.22	47592.45	24449.45	16663.34	2197.35	868.83	300.86

Summer survey									
Year	**Age 0**	**Age 1**	**Age 2**	**Age 3**	**Age 4**	**Age 5**	**Age 6**	**Age 7**	**Age 8**
1996	375.07	47,759.22	42,901.43	64,256.98	1,277.88	213.98	299.07	248.07	425.46
1997	27.46	7,737.70	14,052.02	25,104.26	49,757.64	976.89	183.48	86.61	175.79
1998	1,484.77	20,209.15	2,762.85	2,501.85	14,016.63	19,433.07	320.61	99.18	81.98
1999	1,441.11	24,140.84	9,549.22	6,383.13	1,619.95	8,472.84	10,331.00	235.36	5.64
2000	5,147.88	169,563.21	19,482.99	7,956.12	390.22	1,299.72	4,695.60	6,007.12	105.17
2001	1,913.36	96,784.20	98,147.35	13,071.95	4,631.77	181.06	647.30	2,714.02	3,428.66
2002	2,046.73	95,406.61	53,532.20	62,497.82	6,157.50	1,973.65	169.62	412.18	1,336.13
2003	260.63	45,045.10	38,176.64	21,475.96	37,993.50	4,369.62	666.63	110.39	466.25
2004	670.23	7,951.41	33,766.22	10,717.98	15,150.84	17,821.70	1,002.83	206.61	26.69
2005	5.73	14,509.66	7,191.19	12,562.85	16,713.24	12,085.49	12,958.34	591.96	42.55
2006	76.42	2,504.28	8,700.40	1,790.00	8,008.98	8,237.30	6,979.66	3,494.06	129.22
2007	24.04	3,986.34	6,586.86	1,744.47	1,565.30	4,322.01	5,364.04	2,731.04	630.36
2008	684.02	4,798.42	1,877.20	1,134.60	2,505.22	1,000.51	3,183.09	3,286.96	1,513.27
2009	4,062.57	10,597.00	1,336.75	411.30	1,302.54	1,273.39	948.13	2,299.72	1,303.78
2010	21.26	24,890.62	3,636.25	1,457.01	1,071.91	575.75	827.88	775.56	1,329.29
2011	32.24	669.93	12,058.69	2,107.80	530.30	485.52	293.68	319.40	423.83
2012	2,733.46	2,453.60	356.96	5,617.18	1,176.14	223.48	148.97	161.11	105.46
2013	156.94	9,446.92	211.63	1,330.08	5,020.65	1,128.75	223.54	113.89	175.68
2014	247.47	13,909.70	3,989.20	890.52	1,033.76	2,943.59	427.92	94.19	84.31
2015	130.67	7,676.15	9,319.60	4,085.51	872.80	1,449.06	1,094.43	128.99	73.67
2016	3,861.49	36,510.61	3,302.94	3,101.37	1,988.92	284.21	567.38	378.31	45.85
2017	4,182.10	144,744.70	16,698.23	1,813.40	2,528.86	1,114.64	293.04	301.62	134.34
2018	4,675.03	135,364.13	54,715.62	12,800.05	4,557.00	3,435.03	1,106.35	528.31	597.60
2019	539.66	38,265.57	6,901.51	13,595.25	9,888.80	2,665.25	1,322.19	510.20	356.30
2020	44.26	13,004.82	3,651.55	11,020.39	12,441.80	1,024.32	463.45	126.45	35.69

Table 5.8 Faroe haddock. Configuration in the SAM-run and the model parameters.

```
$minAge
[1] 1

$maxAge
[1] 10

$maxAgePlusGroup
[1] 1

$keyLogFsta
     [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10]
[1,]    0    1    2    3    4    5    6    7    8     8
[2,]   -1   -1   -1   -1   -1   -1   -1   -1   -1    -1
[3,]   -1   -1   -1   -1   -1   -1   -1   -1   -1    -1

$corFlag
[1] 2

$keyLogFpar
     [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10]
[1,]   -1   -1   -1   -1   -1   -1   -1   -1   -1    -1
[2,]    0    1    2    3    4    5    6    6   -1    -1
[3,]    7    8    9   10   11   12   12   -1   -1    -1

$keyQpow
     [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10]
[1,]   -1   -1   -1   -1   -1   -1   -1   -1   -1    -1
[2,]   -1   -1   -1   -1   -1   -1   -1   -1   -1    -1
[3,]   -1   -1   -1   -1   -1   -1   -1   -1   -1    -1

$keyVarF
     [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10]
[1,]    0    0    0    0    0    0    0    0    0     0
[2,]   -1   -1   -1   -1   -1   -1   -1   -1   -1    -1
[3,]   -1   -1   -1   -1   -1   -1   -1   -1   -1    -1

$keyVarLogN
 [1] 0 1 1 1 1 1 1 1 1 1

$keyVarObs
     [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10]
[1,]    0    0    0    0    0    0    0    0    0     0
[2,]    1    1    1    1    1    1    1    1   -1    -1
[3,]    2    2    2    2    2    2    2   -1   -1    -1

$obsCorStruct
[1] ID AR AR
Levels: ID AR US

$keyCorObs
     1-2 2-3 3-4 4-5 5-6 6-7 7-8 8-9 9-10
[1,]  NA  NA  NA  NA  NA  NA  NA  NA   NA
[2,]   0   0   0   0   0   0   0  -1   -1
[3,]   1   1   1   1   1   1   1  -1   -1

$stockRecruitmentModelCode
[1] 0

$noScaledYears
[1] 0

$keyScaledYears
numeric(0)
```

$keyParScaledYA
<0 x 0 matrix>

$fbarRange
[1] 3 7

$keyBiomassTreat
[1] -1 -1 -1

$obsLikelihoodFlag
[1] LN LN LN
Levels: LN ALN

$fixVarToWeight
[1] 0

Table 5.9 Faroe haddock 2018. Changes in the SAM settings to incorporate the different variance on age 1–2 in summer survey and age 1 in spring survey.

Default settings:
$keyVarObs

	[,1]	[,2]	[,3]	[,4]	[,5]	[,6]	[,7]	[,8]	[,9]	[,10]
[1,]	0	0	0	0	0	0	0	0	0	0
[2,]	1	1	1	1	1	1	1	1	-1	-1
[3,]	2	2	2	2	2	2	2	-1	-1	-1

Revised settings:
$keyVarObs

	[,1]	[,2]	[,3]	[,4]	[,5]	[,6]	[,7]	[,8]	[,9]	[,10]
[1,]	0	0	0	0	0	0	0	0	0	0
[2,]	1	1	2	2	2	2	2	2	-1	-1
[3,]	3	4	4	4	4	4	4	-1	-1	-1

Table 5.10 Faroe haddock. Model parameters, model fitting and selected sd from SAM run.

Parameter name	par	sd(par)	exp(par)	Low	High
logFpar_0	-4.834	0.181	0.008	0.006	0.011
logFpar_1	-5.543	0.169	0.004	0.003	0.005
logFpar_2	-5.631	0.116	0.004	0.003	0.005
logFpar_3	-5.478	0.112	0.004	0.003	0.005
logFpar_4	-5.526	0.111	0.004	0.003	0.005
logFpar_5	-5.478	0.112	0.004	0.003	0.005
logFpar_6	-5.374	0.111	0.005	0.004	0.006
logFpar_7	-5.604	0.221	0.004	0.002	0.006
logFpar_8	-5.080	0.142	0.006	0.005	0.008
logFpar_9	-5.597	0.131	0.004	0.003	0.005
logFpar_10	-5.590	0.126	0.004	0.003	0.005
logFpar_11	-5.731	0.122	0.003	0.003	0.004
logFpar_12	-5.800	0.114	0.003	0.002	0.004
logSdLogFsta_0	-0.921	0.100	0.398	0.326	0.486
logSdLogN_0	-0.056	0.112	0.945	0.756	1.181
logSdLogN_1	-1.257	0.089	0.284	0.238	0.340
logSdLogObs_0	-1.119	0.087	0.327	0.275	0.389
logSdLogObs_1	-0.378	0.124	0.685	0.535	0.878
logSdLogObs_2	-0.951	0.080	0.386	0.329	0.454
logSdLogObs_3	-0.019	0.166	0.981	0.704	1.368
logSdLogObs_4	-0.597	0.083	0.551	0.466	0.650
transfIRARdist_0	0.699	0.299	2.013	1.106	3.662
transfIRARdist_1	-0.129	0.244	0.879	0.539	1.432
itrans_rho_0	1.235	0.122	3.440	2.694	4.391

Model	log(L)	#par	AIC
Current	-964.81	24	1977.62
base	-964.81	24	1977.62

Year	sd(log(R))	sd(log(SSB))	sd(log(Fbar))
2019	0.379	0.148	0.181
2020	0.561	0.198	0.745

Table 5.11. Faroe haddock (Division 5.b.). Fishing mortality at age from the SAM model.

Year Age	1	2	3	4	5	6	7	8	9	10
1957	0.003	0.121	0.343	0.492	0.390	0.482	0.740	0.745	0.843	0.843
1958	0.005	0.174	0.447	0.608	0.497	0.641	1.025	1.078	1.290	1.290
1959	0.007	0.190	0.448	0.574	0.472	0.629	1.033	1.129	1.406	1.406
1960	0.010	0.232	0.534	0.672	0.545	0.719	1.194	1.303	1.599	1.599
1961	0.010	0.216	0.475	0.578	0.465	0.606	0.996	1.123	1.307	1.307
1962	0.010	0.237	0.534	0.649	0.516	0.661	1.087	1.337	1.554	1.554
1963	0.008	0.219	0.529	0.691	0.566	0.709	1.184	1.656	2.025	2.025
1964	0.004	0.109	0.309	0.466	0.420	0.546	0.872	1.364	1.613	1.613
1965	0.003	0.091	0.278	0.447	0.431	0.626	1.116	1.748	1.808	1.808
1966	0.003	0.088	0.278	0.444	0.418	0.589	1.003	1.342	1.503	1.503
1967	0.002	0.071	0.231	0.362	0.340	0.490	0.847	1.070	1.309	1.309
1968	0.002	0.088	0.280	0.412	0.366	0.506	0.851	0.982	1.230	1.230
1969	0.003	0.097	0.325	0.484	0.432	0.589	0.983	1.036	1.296	1.296
1970	0.003	0.082	0.302	0.444	0.407	0.517	0.801	0.696	0.749	0.749
1971	0.002	0.072	0.304	0.450	0.441	0.524	0.804	0.737	0.893	0.893
1972	0.002	0.072	0.328	0.440	0.418	0.426	0.613	0.576	0.762	0.762
1973	0.004	0.114	0.428	0.482	0.397	0.341	0.378	0.323	0.349	0.349
1974	0.003	0.078	0.293	0.363	0.305	0.281	0.306	0.313	0.380	0.380
1975	0.002	0.057	0.224	0.292	0.258	0.241	0.253	0.304	0.418	0.418
1976	0.001	0.043	0.202	0.311	0.323	0.342	0.357	0.445	0.578	0.578
1977	0.001	0.017	0.123	0.266	0.390	0.511	0.597	0.821	1.145	1.145
1978	0.000	0.007	0.070	0.180	0.293	0.408	0.547	0.823	1.165	1.165
1979	0.000	0.006	0.060	0.149	0.219	0.266	0.330	0.487	0.674	0.674
1980	0.000	0.015	0.121	0.261	0.318	0.320	0.339	0.446	0.575	0.575
1981	0.001	0.018	0.140	0.273	0.298	0.268	0.240	0.270	0.332	0.332
1982	0.001	0.033	0.243	0.434	0.459	0.400	0.335	0.388	0.473	0.473
1983	0.001	0.030	0.199	0.364	0.389	0.379	0.327	0.418	0.502	0.502
1984	0.001	0.029	0.171	0.316	0.332	0.352	0.286	0.402	0.489	0.489
1985	0.001	0.028	0.164	0.311	0.357	0.408	0.330	0.483	0.594	0.594
1986	0.000	0.021	0.125	0.250	0.316	0.395	0.366	0.592	0.723	0.723
1987	0.000	0.025	0.134	0.259	0.340	0.455	0.484	0.716	0.808	0.808
1988	0.000	0.021	0.111	0.213	0.280	0.361	0.394	0.533	0.635	0.635
1989	0.000	0.016	0.104	0.209	0.299	0.414	0.514	0.681	0.830	0.830
1990	0.000	0.022	0.143	0.263	0.336	0.453	0.572	0.722	0.953	0.953
1991	0.000	0.029	0.172	0.291	0.323	0.388	0.439	0.462	0.544	0.544
1992	0.000	0.026	0.143	0.252	0.280	0.318	0.349	0.357	0.426	0.426
1993	0.001	0.037	0.191	0.304	0.294	0.292	0.293	0.282	0.318	0.318
1994	0.000	0.017	0.117	0.233	0.259	0.282	0.301	0.302	0.334	0.334
1995	0.000	0.016	0.119	0.258	0.304	0.327	0.351	0.345	0.361	0.361

Year Age	1	2	3	4	5	6	7	8	9	10
1996	0.000	0.012	0.111	0.272	0.360	0.420	0.473	0.457	0.442	0.442
1997	0.000	0.013	0.121	0.262	0.380	0.493	0.620	0.619	0.570	0.570
1998	0.000	0.024	0.208	0.362	0.489	0.693	0.983	1.110	0.892	0.892
1999	0.000	0.028	0.261	0.397	0.486	0.643	0.902	1.292	0.928	0.928
2000	0.001	0.038	0.283	0.396	0.431	0.483	0.532	0.676	0.534	0.534
2001	0.000	0.031	0.227	0.359	0.408	0.429	0.409	0.454	0.401	0.401
2002	0.000	0.024	0.182	0.329	0.425	0.488	0.474	0.521	0.529	0.529
2003	0.000	0.013	0.115	0.260	0.437	0.650	0.746	0.812	0.888	0.888
2004	0.000	0.014	0.113	0.244	0.424	0.690	0.955	1.128	1.322	1.322
2005	0.000	0.017	0.124	0.244	0.396	0.618	0.904	1.124	1.412	1.412
2006	0.001	0.023	0.151	0.260	0.378	0.569	0.857	1.078	1.588	1.588
2007	0.001	0.028	0.175	0.275	0.355	0.489	0.721	0.945	1.246	1.246
2008	0.001	0.028	0.172	0.266	0.305	0.404	0.602	0.850	1.238	1.238
2009	0.001	0.022	0.169	0.266	0.287	0.350	0.467	0.594	0.838	0.838
2010	0.001	0.034	0.256	0.386	0.393	0.456	0.575	0.686	0.969	0.969
2011	0.000	0.023	0.200	0.335	0.367	0.438	0.584	0.697	0.994	0.994
2012	0.000	0.017	0.146	0.252	0.300	0.363	0.476	0.576	0.809	0.809
2013	0.000	0.030	0.219	0.302	0.335	0.388	0.506	0.616	0.841	0.841
2014	0.000	0.035	0.239	0.325	0.351	0.357	0.413	0.452	0.586	0.586
2015	0.000	0.036	0.238	0.326	0.354	0.360	0.380	0.406	0.507	0.507
2016	0.000	0.029	0.197	0.301	0.354	0.375	0.376	0.395	0.437	0.437
2017	0.000	0.011	0.092	0.177	0.234	0.268	0.292	0.319	0.307	0.307
2018	0.000	0.012	0.106	0.209	0.273	0.294	0.299	0.285	0.226	0.226
2019	0.000	0.010	0.098	0.237	0.352	0.383	0.373	0.282	0.149	0.149
2020	0.000	0.017	0.191	0.521	0.918	1.055	1.102	0.795	0.358	0.358

Table 5.12 Faroe haddock (Division 5.b). Stock number at age from the SAM model.

Year Age	1	2	3	4	5	6	7	8	9	10
1957	26820	36850	25505	21011	5421	2609	1227	470	201	118
1958	31703	30905	25205	14218	9578	2981	1339	481	183	129
1959	59229	28861	23334	12773	6284	4395	1270	389	134	68
1960	77343	39008	24200	13439	6229	3303	1793	378	104	39
1961	79034	54085	23729	12825	5741	3043	1353	412	89	22
1962	78269	51112	35472	12316	6521	3031	1368	400	108	27
1963	40403	61218	26725	16419	5488	3577	1270	369	85	25
1964	18221	28748	33057	11429	6563	2594	1718	302	60	11
1965	17660	16894	20922	17214	5195	3097	1146	836	63	11
1966	33079	15189	14082	13616	8412	2719	1271	299	97	11
1967	47321	25104	12629	9311	7091	4128	1210	358	68	19
1968	28342	49118	19035	8990	5628	4231	1919	419	102	19
1969	32483	26250	33393	11997	5278	3471	2148	666	131	29
1970	20273	25902	20776	19534	5789	3219	1651	682	199	29
1971	24127	13969	20030	13557	9931	3215	1607	516	280	123
1972	27140	19106	10471	13228	7336	5027	1501	576	186	142
1973	121306	24401	20131	4700	7791	3609	3262	595	313	81
1974	110652	80846	15309	12060	2240	4170	1966	2029	314	343
1975	70384	93556	49065	9345	6772	1453	2416	1120	1273	455
1976	27558	69416	53594	28185	5831	4296	1114	1854	701	938
1977	10193	20165	44464	29248	14963	3979	2417	774	1032	955
1978	957	9443	16973	29353	17230	6757	1686	1095	312	488
1979	6091	535	14262	13705	18775	9757	3270	639	362	184
1980	6189	6319	638	14697	10090	11580	6188	1821	270	211
1981	18038	4604	4258	747	10711	6127	7215	3742	838	182
1982	21259	16022	3441	2742	636	7361	3819	4488	3003	615
1983	46165	16455	12536	1608	1439	349	4617	2259	2639	2047
1984	41009	40956	12442	8584	749	791	220	2662	1185	2589
1985	19889	34692	32107	9019	4667	442	422	172	1352	2086
1986	13608	15774	26038	21467	5687	2488	204	262	110	1548
1987	25284	10173	15117	18894	12873	3358	1280	132	108	670
1988	9518	23910	6249	12984	12897	7782	1734	532	48	294
1989	7185	7313	16483	4402	9666	8257	4625	1012	261	154
1990	3259	6158	8263	10249	3117	5659	4625	2103	391	157
1991	2767	2520	5802	6843	5935	2026	3018	2153	847	127
1992	4091	2153	1664	3962	4464	3706	1168	1493	1156	480
1993	28915	2906	1916	1203	2563	2687	2253	666	859	839
1994	25899	11948	1750	1463	769	1678	1780	1509	447	1115
1995	45828	43198	5275	1128	927	515	1127	1129	952	1004

Year Age	1	2	3	4	5	6	7	8	9	10
1996	11088	38198	59609	3252	599	511	401	761	704	1222
1997	4345	8588	32312	54327	1930	353	238	261	465	1184
1998	15483	3541	6419	23152	34580	1017	136	133	139	862
1999	28580	13732	2630	3948	14788	17893	436	27	36	363
2000	130661	25657	13899	915	2266	7753	8585	161	4	147
2001	58546	116284	18836	8018	460	1309	3977	4705	64	68
2002	38312	48694	96503	10691	3899	328	789	2400	2805	79
2003	25407	25792	35976	60639	6172	1768	218	597	1357	1553
2004	8036	23033	22906	25590	37179	2737	639	105	228	1060
2005	10170	6150	18461	20253	19813	18592	1114	197	34	277
2006	3201	9523	3945	13427	13990	12704	6697	338	62	70
2007	3282	2825	6184	2736	9021	9103	6036	1845	124	18
2008	4222	2770	1994	4239	1948	5444	4652	2349	502	43
2009	8709	2457	1907	1595	2532	1600	3366	1967	685	111
2010	11986	7545	2042	1438	980	1412	1246	1756	822	278
2011	1117	11075	4513	1122	757	600	657	714	653	326
2012	2594	953	9858	2318	587	374	378	256	310	263
2013	8665	2230	1707	6758	1205	332	218	190	123	210
2014	10385	7283	1923	1971	3858	518	185	111	57	109
2015	9007	8713	6239	1291	1945	1470	215	103	56	61
2016	29690	7549	6574	3375	768	1281	540	91	60	46
2017	36812	19776	5243	4755	1845	518	680	248	50	47
2018	48034	38581	16527	4586	3183	1077	410	430	115	49
2019	30788	31677	30413	11795	3433	1753	519	331	234	56
2020	9946	27296	27217	25859	5272	2021	762	191	204	205

Table 5.13 Faroe haddock (Division 5.b). Summary table from the SAM model (catch is also provided).

Year	Recruitment	High	Low	SSB	High	Low	Catch	F	High	Low
	Age 1 thousands			tonnes			tonnes	Ages 3–7		
1957	26820	51017	14099	50418	66163	38420	20995	0.49	0.67	0.36
1958	31703	57612	17446	50614	64275	39857	23871	0.64	0.84	0.49
1959	59229	105893	33129	45313	56972	36039	20239	0.63	0.82	0.49
1960	77343	138341	43241	45384	56662	36351	25727	0.73	0.94	0.57
1961	79034	142556	43817	42668	53477	34044	20831	0.62	0.81	0.48
1962	78269	141355	43338	47440	59375	37905	27151	0.69	0.89	0.53
1963	40403	73345	22256	47955	60573	37965	27571	0.74	0.95	0.57
1964	18221	33315	9966	44624	57081	34886	19490	0.52	0.69	0.40
1965	17660	32356	9639	44963	57909	34911	18479	0.58	0.76	0.44
1966	33079	60506	18084	41982	54265	32479	18766	0.55	0.72	0.42
1967	47321	86617	25853	38015	48649	29705	13381	0.45	0.60	0.34
1968	28342	51776	15514	40519	50840	32293	17852	0.48	0.64	0.37
1969	32483	59217	17819	47315	59551	37593	23272	0.56	0.74	0.43
1970	20273	37055	11092	49985	64466	38757	21361	0.49	0.66	0.37
1971	24127	44056	13213	49672	63849	38643	19393	0.51	0.68	0.37
1972	27140	49693	14822	45366	58757	35027	16485	0.45	0.61	0.32
1973	121306	229078	64236	42510	54809	32971	18035	0.41	0.56	0.29
1974	110652	209584	58420	44251	56769	34494	14773	0.31	0.43	0.22
1975	70384	134511	36829	57234	73924	44312	20715	0.25	0.36	0.181
1976	27558	53426	14215	80503	105922	61184	26211	0.31	0.43	0.22
1977	10193	22733	4570	82523	109790	62028	25555	0.38	0.53	0.27
1978	957	2170	422	80178	109241	58847	19200	0.30	0.43	0.21
1979	6091	11981	3096	62983	85784	46243	12424	0.21	0.30	0.140
1980	6189	13058	2934	57950	77448	43361	15016	0.27	0.39	0.190
1981	18038	38076	8545	52313	70325	38914	12233	0.24	0.34	0.173
1982	21259	44959	10052	40659	52890	31256	11937	0.37	0.52	0.27
1983	46165	98130	21718	37790	49320	28955	12894	0.33	0.47	0.24
1984	41009	80526	20884	41236	53171	31981	12378	0.29	0.41	0.21
1985	19889	42397	9330	49483	65354	37467	15143	0.31	0.44	0.22
1986	13608	29112	6361	54297	73062	40352	14477	0.29	0.41	0.21
1987	25284	54471	11736	54040	72263	40412	14882	0.34	0.47	0.24
1988	9518	20448	4430	49075	65248	36911	12178	0.27	0.38	0.195
1989	7185	15294	3376	42115	54830	32349	14325	0.31	0.43	0.22
1990	3259	6908	1538	34870	44978	27034	11726	0.35	0.50	0.25
1991	2767	5846	1310	26963	35138	20690	8429	0.32	0.46	0.23
1992	4091	8697	1924	20106	26584	15206	5476	0.27	0.38	0.188
1993	28915	57344	14580	17332	22960	13083	4026	0.28	0.39	0.196

Year	Recruitment	High	Low	SSB	High	Low	Catch	F	High	Low
	Age 1 thousands			tonnes			tonnes	Ages 3–7		
1994	25899	48501	13830	16566	21528	12748	4252	0.24	0.33	0.172
1995	45828	88783	23655	17756	22376	14090	4948	0.27	0.37	0.199
1996	11088	19129	6428	39355	51068	30328	9642	0.33	0.44	0.25
1997	4345	7998	2361	74261	98088	56222	17924	0.38	0.50	0.28
1998	15483	27871	8601	71880	92562	55820	22210	0.55	0.72	0.42
1999	28580	48262	16924	50779	64682	39865	18482	0.54	0.70	0.41
2000	130661	221664	77020	38998	48587	31300	15799	0.43	0.56	0.32
2001	58546	99582	34421	49607	60037	40988	15891	0.37	0.49	0.28
2002	38312	69746	21045	80146	101095	63539	24929	0.38	0.50	0.29
2003	25407	46022	14027	93699	120944	72591	26942	0.44	0.58	0.34
2004	8036	13810	4676	79205	100560	62385	23100	0.49	0.64	0.37
2005	10170	18324	5644	65202	80769	52635	21944	0.46	0.60	0.35
2006	3201	5778	1773	47723	58420	38985	17154	0.44	0.58	0.34
2007	3282	5912	1822	33274	40505	27335	12631	0.40	0.53	0.31
2008	4222	7395	2410	21829	26345	18087	7393	0.35	0.46	0.26
2009	8709	15685	4835	16285	19608	13526	5197	0.31	0.41	0.23
2010	11986	21789	6594	12614	14995	10610	5203	0.41	0.55	0.31
2011	1117	2095	596	10054	12085	8364	3546	0.39	0.52	0.29
2012	2594	4732	1422	12173	15515	9551	2634	0.31	0.42	0.23
2013	8665	15681	4788	12839	16544	9964	2924	0.35	0.48	0.26
2014	10385	18728	5758	11364	14395	8972	3252	0.34	0.46	0.25
2015	9007	16371	4956	14346	17971	11453	3421	0.33	0.46	0.24
2016	29690	51903	16983	15493	19529	12291	3470	0.32	0.45	0.23
2017	36812	67126	20187	18282	23186	14416	2863	0.21	0.30	0.151
2018	48034	91863	25116	33685	43695	25968	5549	0.24	0.33	0.168
2019	30788	65741	14418	52245	70306	38824	9334	0.29	0.41	0.20
2020	9946	30514	3242	53760	79871	36185				

Table 5.14 Faroe haddock (Division 5.b). Prediction tables with different F scenarios.

Forecast table 1. TAC 7146 in 2020, then Fmsy=0.165.

Year	fbar:median	fbar:low	fbar:high	rec:median	rec:low	rec:high	ssb:median	ssb:low	ssb:high	catch:median	catch:low	catch:high	tsb:median	tsb:low	tsb:high
2020	0.162	0.035	0.722	10207	3244	32531	55080	38012	80118	7147	1540	28747	80006	54256	116467
2021	0.165	0.033	0.952	10277	1117	130661	90392	56238	145627	11440	2415	41822	107247	65062	169470
2022	0.165	0.024	1.146	10170	1117	130661	94854	46483	174184	14448	2661	45406	112890	58464	209191
2023	0.165	0.021	1.254	10170	1117	130661	96132	34438	204423	14297	2364	43339	114934	47750	238498

Forecast table 4. TAC then Fpa.

Year	fbar:median	fbar:low	fbar:high	rec:median	rec:low	rec:high	ssb:median	ssb:low	ssb:high	catch:median	catch:low	catch:high	tsb:median	tsb:low	tsb:high
2020	0.162	0.035	0.722	10207	3244	32531	55080	38012	80118	7147	1540	28747	80006	54256	116467
2021	0.400	0.081	2.307	10277	1117	130661	90392	56238	145627	24277	5760	69898	107247	65062	169470
2022	0.400	0.058	2.778	10170	1117	130661	79692	31127	158850	22960	5801	54825	96734	43757	188956
2023	0.400	0.050	3.040	10170	1117	130661	70770	17289	179203	18191	4581	47188	89782	27589	208263

Forecast table 5. TAC then Flim.

Year	fbar:median	fbar:low	fbar:high	rec:median	rec:low	rec:high	ssb:median	ssb:low	ssb:high	catch:median	catch:low	catch:high	tsb:median	tsb:low	tsb:high
2020	0.162	0.035	0.722	10207	3244	32531	55080	38012	80118	7147	1540	28747	80006	54256	116467
2021	0.540	0.109	3.115	10277	1117	130661	90392	56238	145627	30378	7703	81069	107247	65062	169470
2022	0.540	0.078	3.751	10170	1117	130661	72440	25540	150578	24958	7308	57448	90034	37630	181658
2023	0.540	0.068	4.104	10170	1117	130661	60561	13232	168291	18217	5286	46954	79735	22686	198716

Forecast table 2. TAC then zero.

Year	fbar:median	fbar:low	fbar:high	rec:median	rec:low	rec:high	ssb:median	ssb:low	ssb:high	catch:median	catch:low	catch:high	tsb:median	tsb:low	tsb:high
2020	0.162	0.035	0.722	10207	3244	32531	55080	38012	80118	7147	1540	28747	80006	54256	116467
2021	0.000	0.000	0.000	10277	1117	130661	90392	56238	145627	0	0	0	107247	65062	169470
2022	0.000	0.000	0.000	10170	1117	130661	110764	63906	192264	0	0	1	129588	74293	221244
2023	0.000	0.000	0.000	10170	1117	130661	129839	68619	250850	0	0	1	150427	77646	278349

Forecast table 6. TAC 7146 in 2020, then SQ.

Year	fbar:median	fbar:low	fbar:high	rec:median	rec:low	rec:high	ssb:median	ssb:low	ssb:high	catch:median	catch:low	catch:high	tsb:median	tsb:low	tsb:high
2020	0.162	0.041	0.628	10249	3406	29861	55476	37246	82945	7146	1929	24615	80554	51661	122011
2021	0.167	0.035	0.745	10385	1117	130661	90135	54717	154917	11585	2403	39854	106481	63465	175623
2022	0.167	0.034	0.934	10170	1117	130661	95787	48399	169188	14074	3192	45100	112266	61754	205381
2023	0.169	0.027	1.110	10385	1117	130661	96334	37961	195569	14294	2949	46609	115566	48316	238157

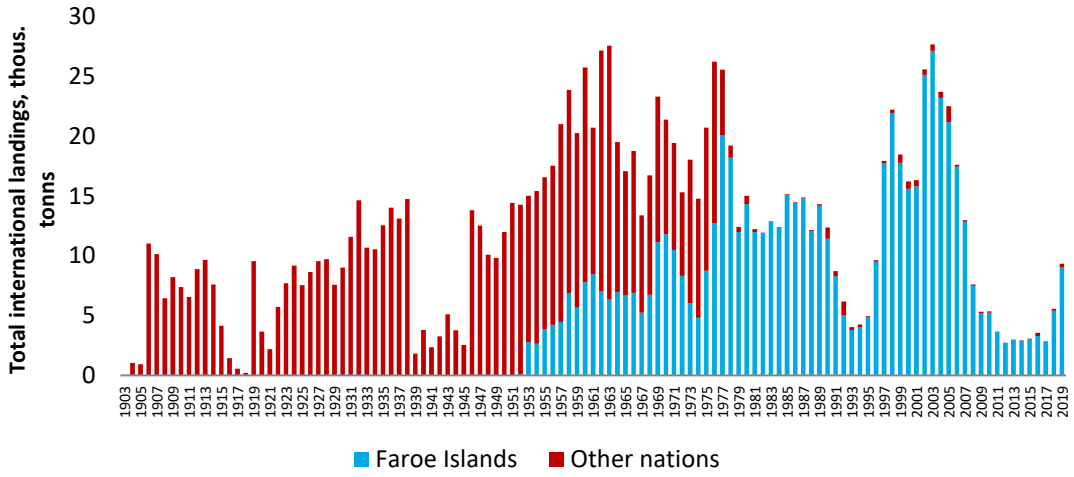

Figure 5.1. Haddock in ICES Division 5.b. Landings by all nations 1904–2019.

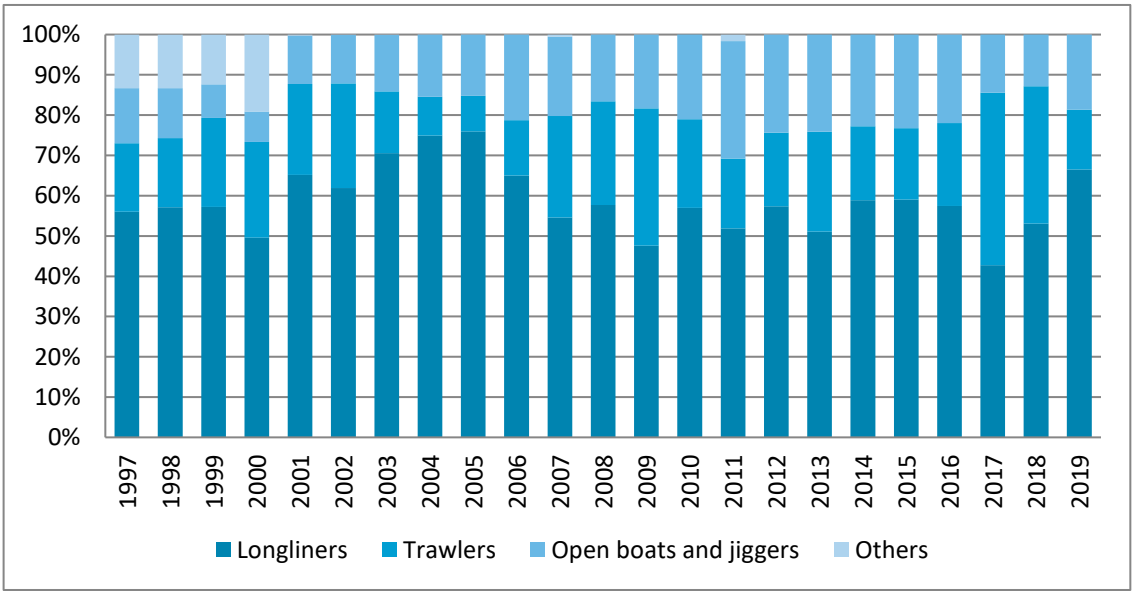

Figure 5.2. Faroe haddock. Distribution (%) between trawlers and longliners to the total Faroese landings 1997–2019.

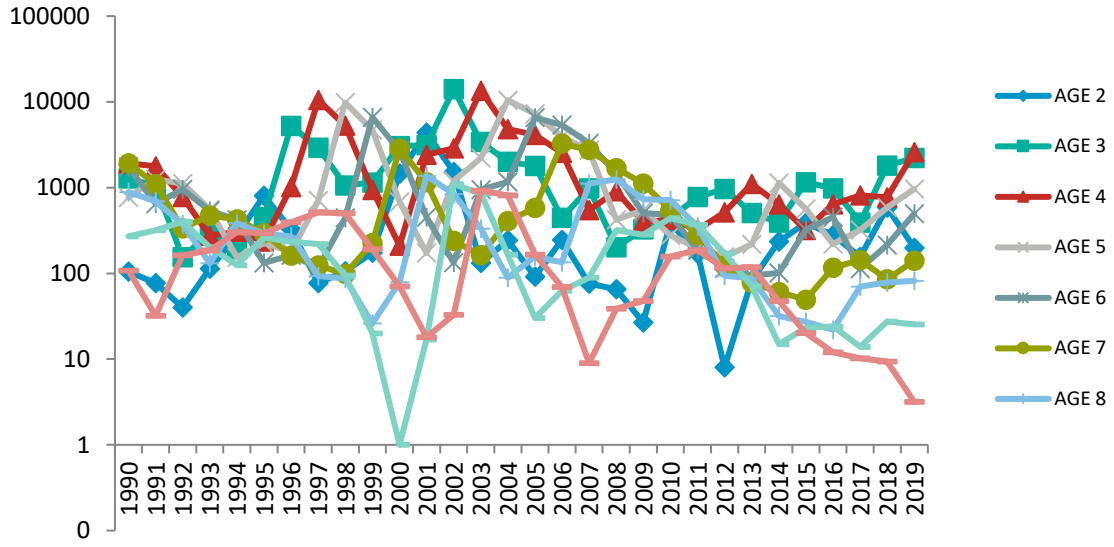

Figure 5.3. Faroe Haddock. Catch in numbers at age shown in catch curves.

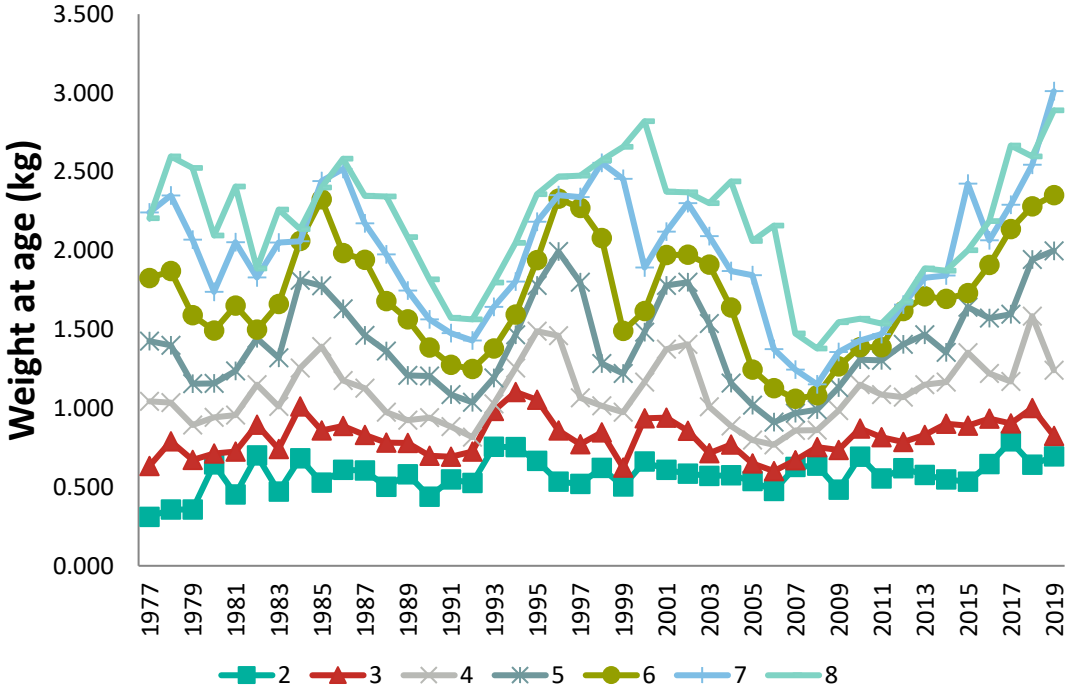

Figure 5.4. Faroe haddock. Mean weight (kg) at age (2–8).

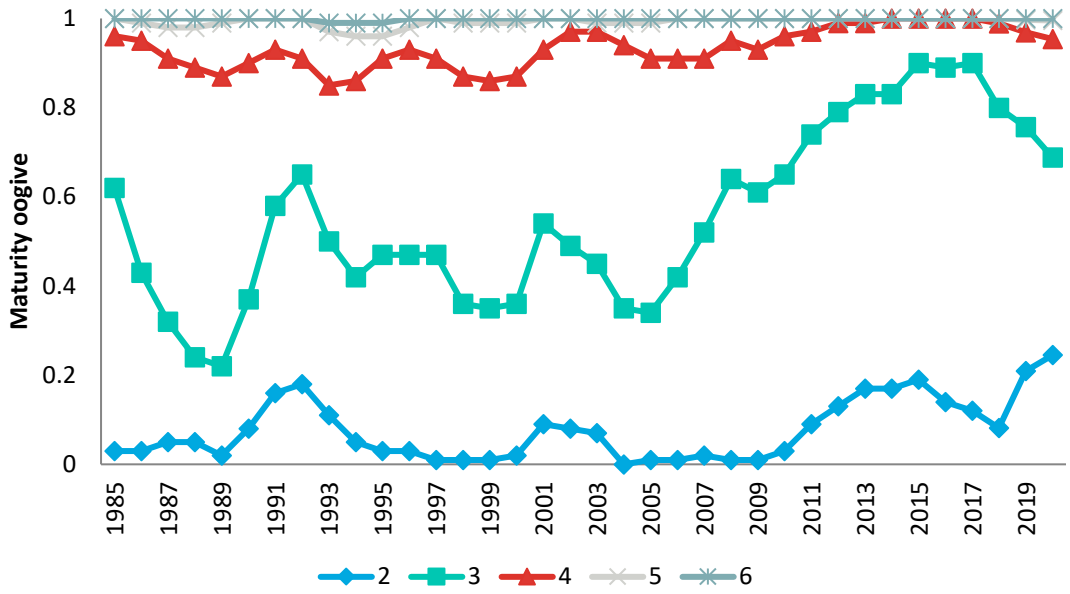

Figure 5.5. Faroe haddock. Maturity at age since 1985. Running 3-years average of spring survey observations for ages 2–6.

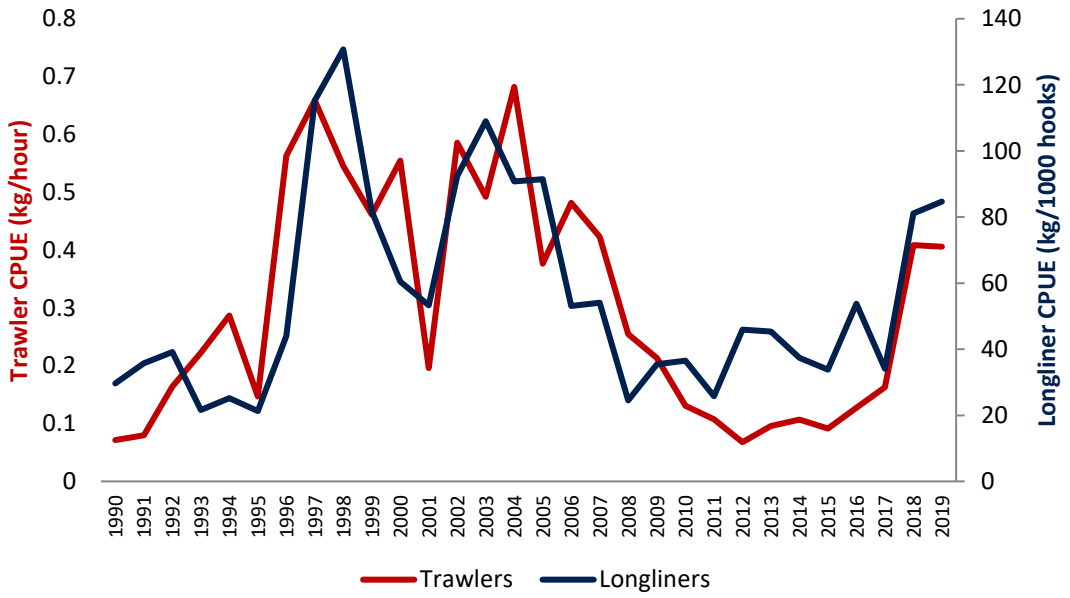

Figure 5.6. Commercial CPUEs for trawlers and longliners.

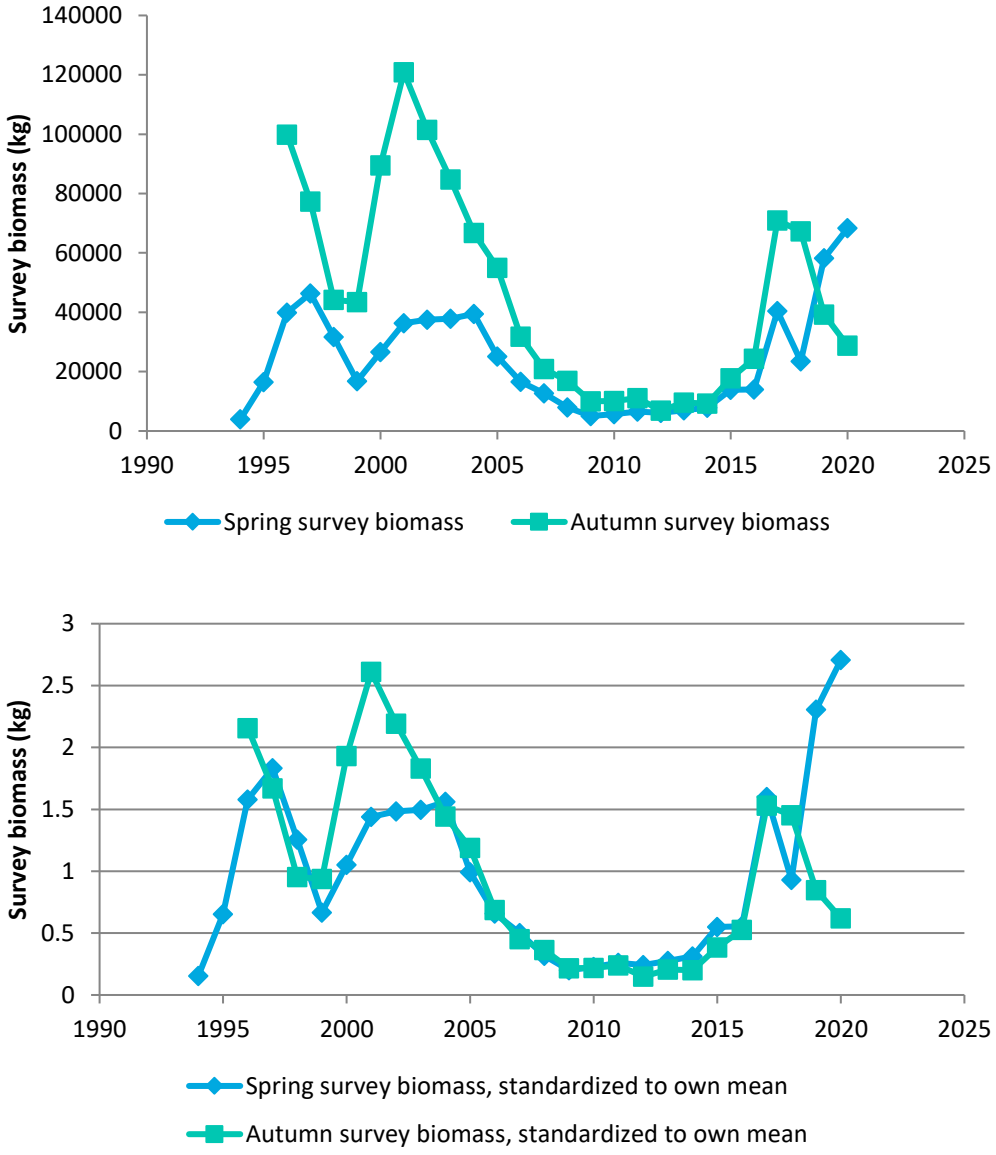

Figure 5.7. Tuning series biomass for spring surveys (1994-2020) and summer surveys (1996–2020). The total biomass (kg) for each series is shown on the first figure and on the second figure the biomass is standardised to series mean biomass.

Figure 5.8a. Distribution of Faroe haddock catches in the spring survey.

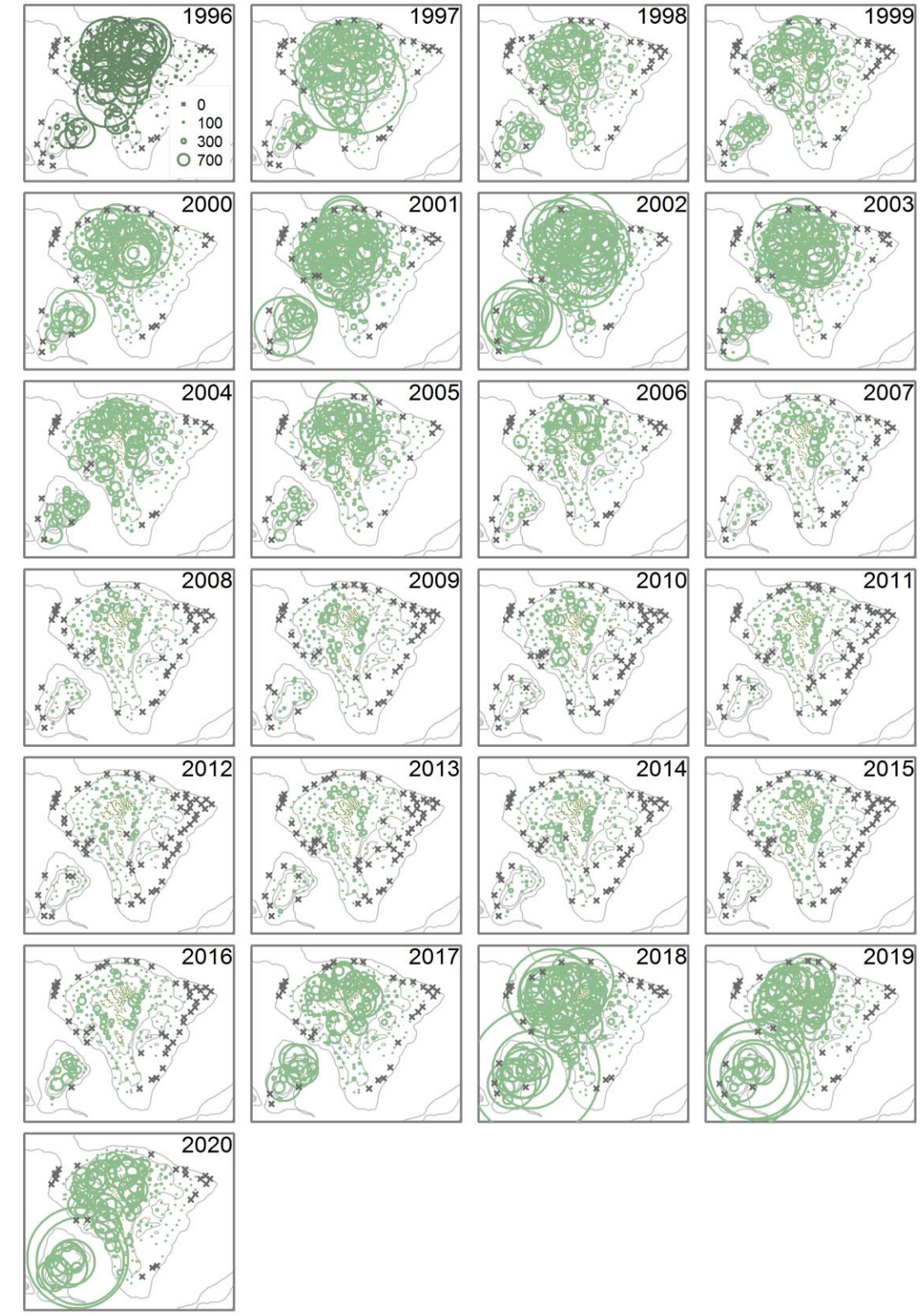

Figure 5.8b. Distribution of Faroe haddock catches in the summer survey.

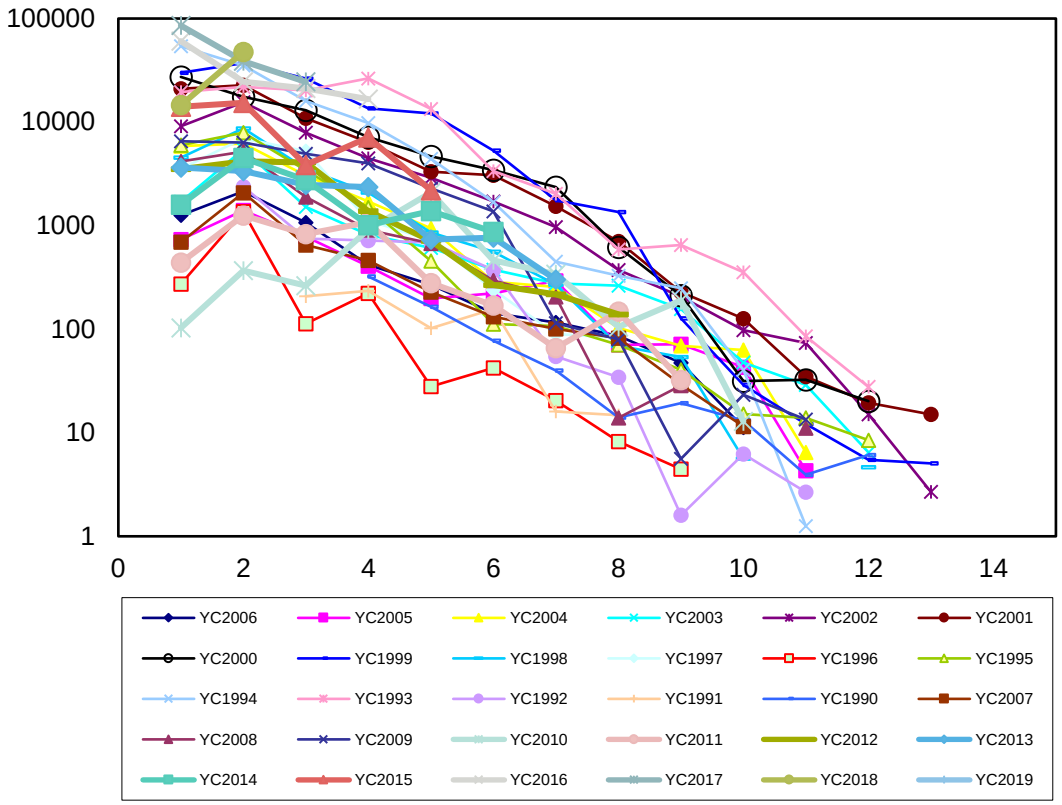

Figure 5.9. Faroe haddock. LN (catch at age in numbers) in the spring survey 1994–2020.

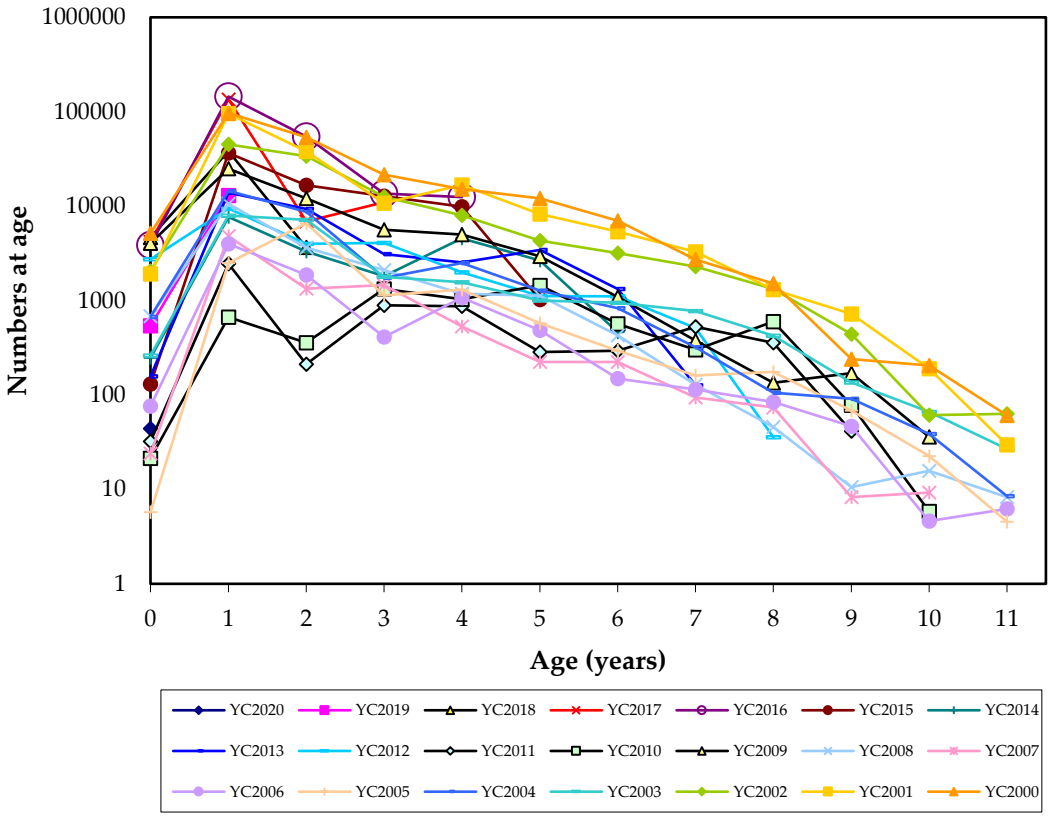

Figure 5.10. Faroe haddock. LN (catch at age in numbers) in the summer survey 2000–2020.

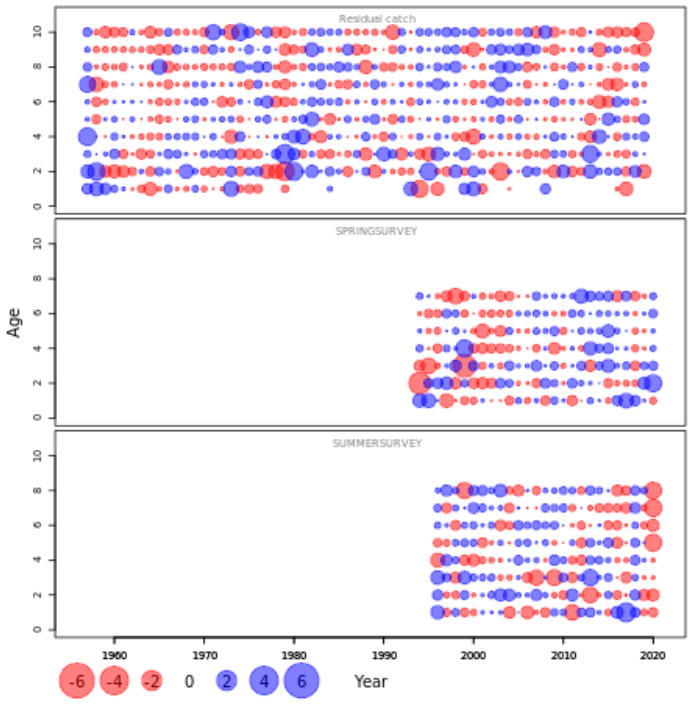

Figure 5.11. Faroe haddock (Division 5.b). Observation residuals for the catch, spring survey and the summer survey as estimated by the SAM model.

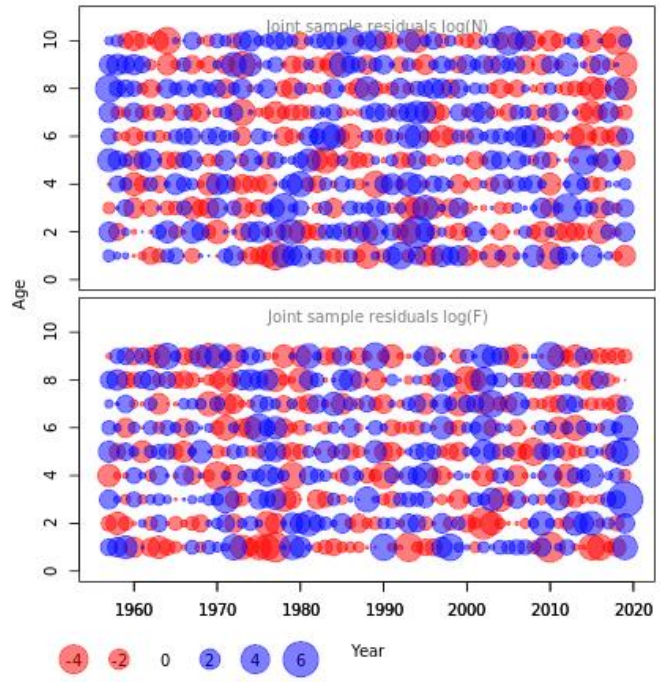

Figure 5.12. Faroe haddock (Division 5.b). Joint sample residuals for the population numbers and fishing mortality as estimated by the SAM model.

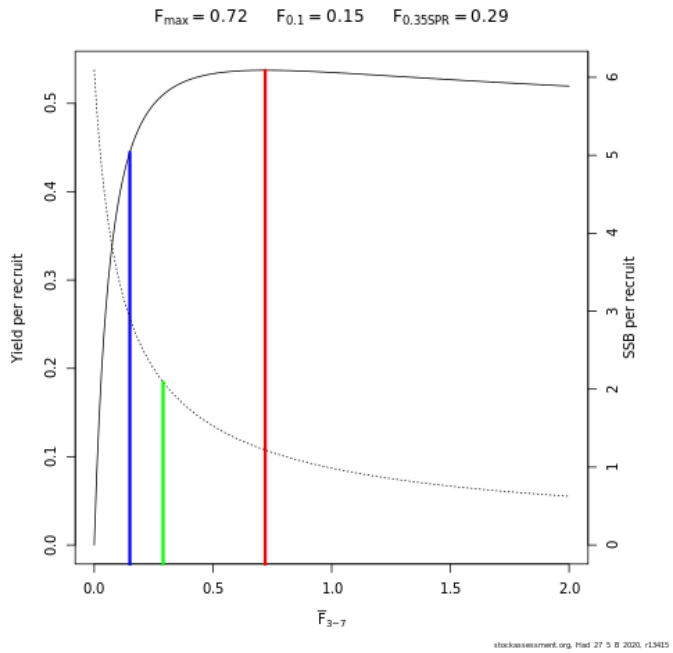

Figure 5.13. Faroe haddock (Division 5.b). Yield per recruit and spawning stock biomass (SSB) per recruit versus fishing mortality.

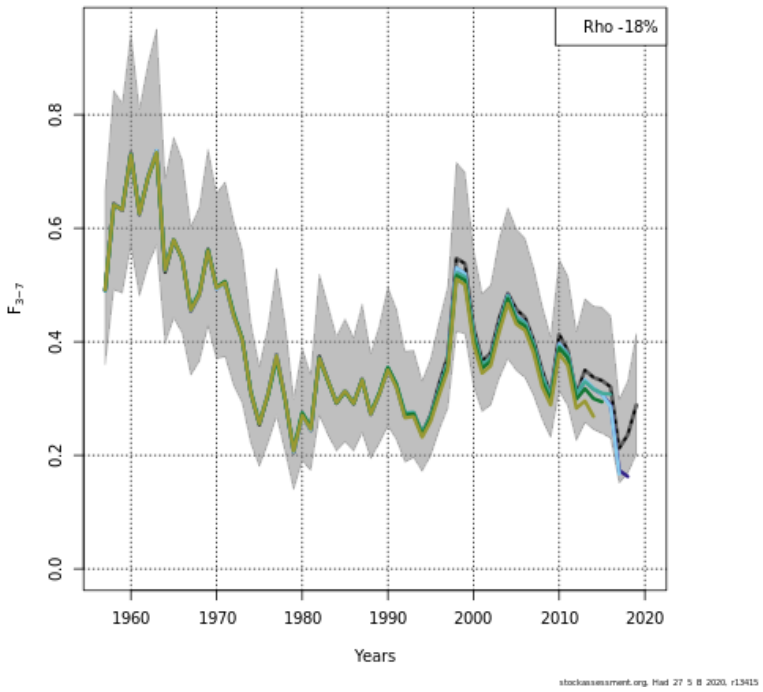

Figure 5.14. Faroe haddock (Division 5.b). Results from the SAM retrospective analysis of fishing mortality (ages 3–7).

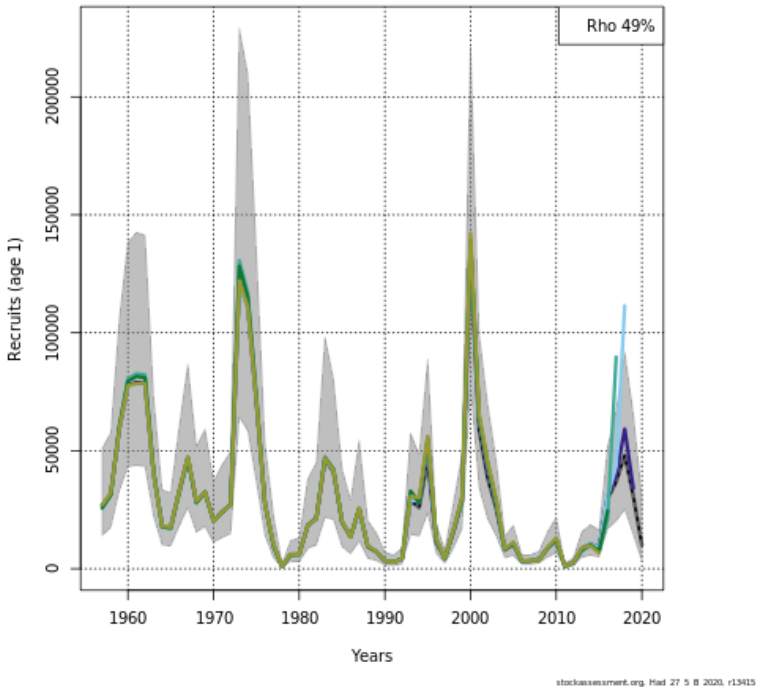

Figure 5.15. Faroe haddock (Division 5.b). Results from the SAM retrospective analysis. Recruitment at age 1.

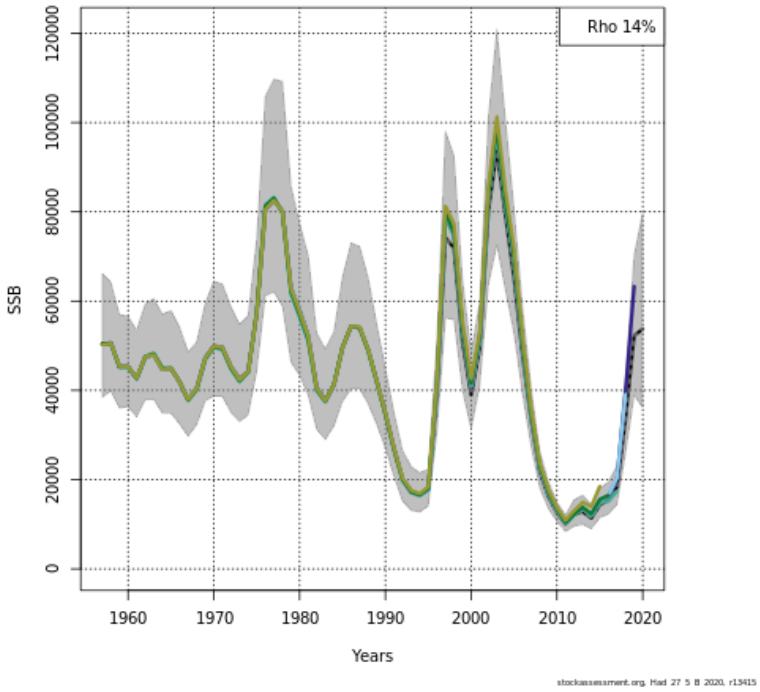

Figure 5.16. Faroe haddock (Division 5.b). Results from the SAM retrospective analysis (continued). Spawning stock biomass.

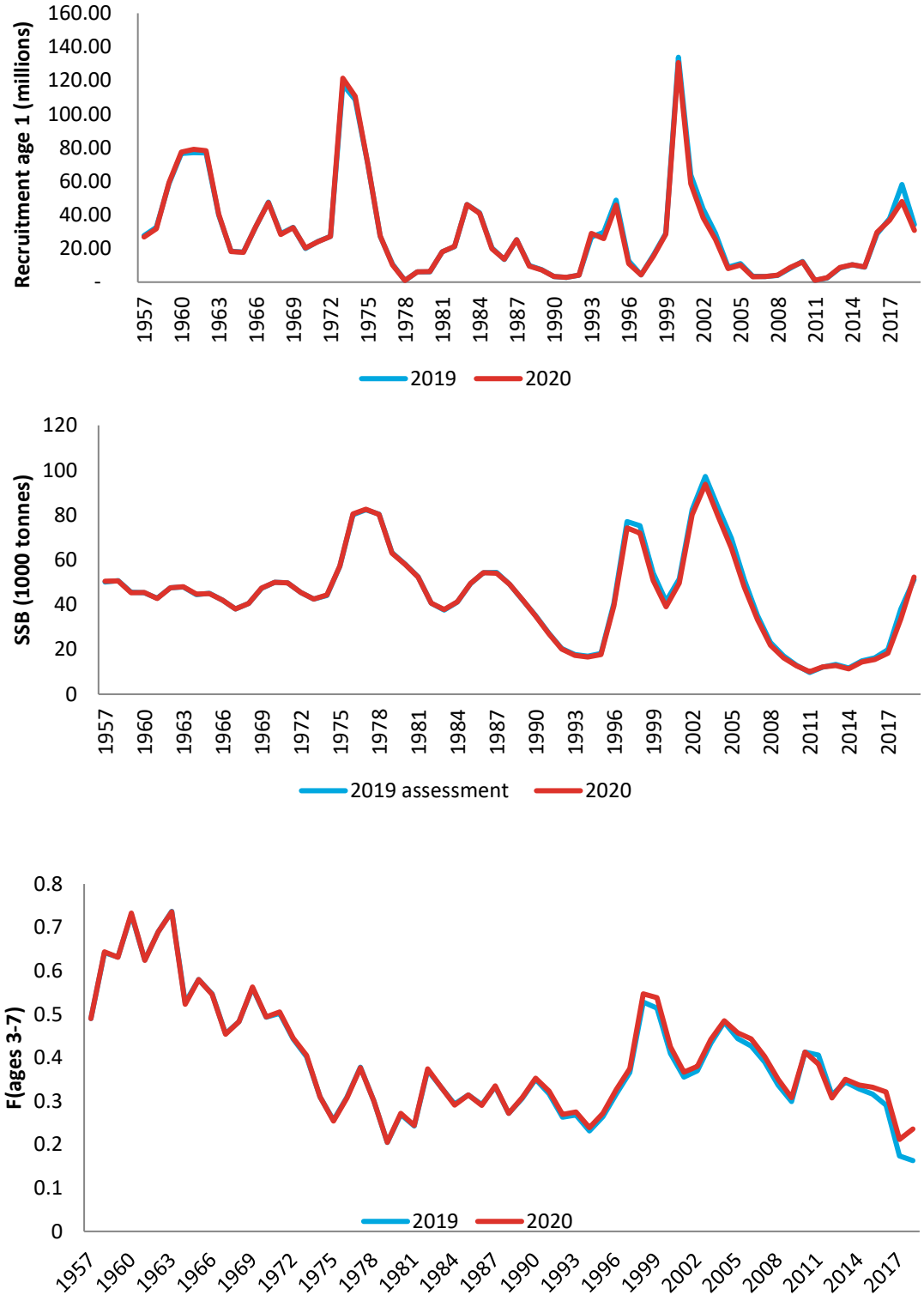

Figure 5.19. Faroe haddock (Division 5.b). Comparison between the November 2019 assessment (dark blue line) with the assessment (light green) in the terminal year.