5 Faroe haddock

This section was updated in November 2021.

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 were at lowest in 2017 where the nominal catch was 2800 t. Since 2017 the nominal catch increased and was at its highest in 2019, 9334 t. In 2020 the nominal catch was 7300 t. Most of the landings are taken from the Faroe Plateau; the 2020 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 410 t (tables 5.1 and 5.2).

Faroese vessels have taken the bulk of the catch since the late 1970s (Figure 5.1). Most of the catch is caught by longliners and in recent years, and in 2020 the share of longliners was 62% and share of trawlers was 12%. Small open boats and jiggers, which mainly fish near shore, caught 26% of the total catch of 2020 (Figure 5.2).

5.2.2 Catch-at-age

Landings-at-age for 2020 are provided for the Faroese fishery in Table 5.4. Faroese landings from the main fleet categories were sampled and the sampling intensity in the terminal year is shown 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-at-age in numbers is 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 in recent years, but decreased for age 2–6 in 2020. 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.

The 2021 assessment was done in October at an online NWWG-meeting. Comparison between the 2021 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, yet the catchability reduced for both fleets in 2021.

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). The new research vessel, Jákup Sverri, conducted the august survey in 2021. 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. This inconsistency reduced in 2021, nevertheless, the reasons behind this conflicting signal are yet 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 $\sigma = 0.185$. This year (2021), the value of F_{pa} was set equal to the $F_{p0.5}$ of 0.19, which is the fishing mortality that leads to probability of 5% of SSB going below B_{lim}.

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 0.19. 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 F_{MSY} = 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, albeit increasing steeply the last two years, and is above both F_{MSY} and F_{pa} in 2020. (Table 5.13, Figure 5.14). The spawning stock biomass was beneath MSY $B_{trigger}$ from 2008–2017 but has increased slowly since 2018. (Table 5.13, Figure 5.16). The poor state of the stock since 2008 has been due to poor recruitment combined with high F but with above average year classes in 2016 and 2017, the state of the stock has improved and the spawning stock biomass is above all reference points in 2020 (Table 5.13, Figure 5.17).

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 2021 were originally expected to be 20 thousand tonnes with status quo fishing mortality. However, the landings in 2021 were estimated to be only 6 634 tonnes, based on the January-September landings 2021 and comparing with 2015-2020. Therefore, (deviating from the stock annex) a catch constraint was set on the landings in 2021 of 6 634 tonnes and forecasts based on this assumption (Table 5.14). The spawning stock biomass is expected to be 68 000 tonnes in 2022, 70 000 tonnes in 2023 and eventually 71 000 tonnes in 2024, if the F_{MSY} is applied. This is markedly lower than expected in the last years' forecast.

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 0.67, but due to the very flat topped curve this value is poorly defined. $F_{0.1}$ was estimated at 0.1 and $F_{0.35SPR}$ at 0.3 (Figure 5.13).

5.8 Uncertainties in assessment and forecast

Since there is no incentive to discard fish or misreport catches under the effort management system, the catch figures are considered adequate, as well as the catch-at-age.

Retrospective analyses indicate periods with tendencies to overestimate recruitment and underestimate fishing mortality (Figures 5.14–5.16). Mohn´s Rho was 37% for SSB, 80% for recruitment and -33% for F(ages 3–7). The massive downscaling of the recruitment is commented on later in this report (5.9).

A preliminary catch-at-age for 2021 was calculated, based on the data already available (catch figures January-September scaled up to the whole year, 6634 tonnes, based on the landings in 2015-2020; age and length samples from the catch January-September). The catch-at-age figures for 2021 were (age 2 to 10+ in thousands): 54, 2515, 2481, 588, 238, 100, 62, 24, and 3. The fishing mortality in 2021 was much more reasonable (0.216 vs. 0.798) and the recruitment was even more downscaled leading to a more pessimistic forecast of future biomass.

5.9 Comparison with previous assessment and forecast

The assessment settings were according to the Stock Annex. The assessment this year showed substantial downscaling of the recruitment, a lower total stock biomass and spawning stock biomass and higher fishing mortality compared with last year's assessment (Figure 5.19). One possible reason for this downscaling of the stock is a variable natural mortally (m) on younger ages of haddock in some years. WD30 (NWWG2021) demonstrates that the downscaling of year classes from age 1 to age 3 is most severe, when the condition factor of adult haddock is low, which is often the case in years when primary production index is low. Thus, the younger year classes experience higher natural mortality in these years, due to either food shortage or/and higher predation. Further investigations should be done to investigate these findings and optimise the assessments settings to avoid these inconsistencies and downscaling between assessment years.

5.10 Management plans and evaluations

A management plan based on the fishing day system was implemented in 2021. The management plan comprises the fishery for cod, haddock and saithe on the Faroe Plateau. Longliners and small trawlers are regulated by the status of the cod and haddock stocks whereas the large single trawlers and pair trawlers are regulated by the status of the saithe stock. The change in the allocated fishing days can be either -5%, 0% or +5% from one year to the next. Due to the management plan the fishery for cod, haddock and saithe on the Faroe Plateau was certified as sustainable by MSC in September 2021. The management plan is not yet evaluated by ICES.

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 75% of the haddock landings derive from long line fisheries. 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

Fishing effort per fishing day may have increased gradually since the effort management system was introduced in 1996, although little direct quantitative information exists. There also seems to have been substantial increases in fishing power when new vessels are replacing old vessels.

The fishing pattern in recent years has changed in comparison to previous years. The large longliners seem to have exploited the deep areas (> 200 m) to a larger extent (ling and tusk) because the catches in shallower waters of cod and haddock have been so poor – which was also observed in the beginning of the 1990s. They also have fished in other areas, e.g. in Greenland and on the Flemish Cap. This could reduce the fishing mortality on cod and haddock, but the small longliners and jiggers still exploit the shallow areas.

5.14 Changes in the environment

The primary production was low for a number of years, albeit high in 2008 to 2010 and in 2017, but it is not believed that this has any relationship with a change in the environment. Since 2002, the temperature has been about 1 °C higher than in the 1990s.

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	2020
Faroe Islands	13620	13457	20776	21615	18995	18172	15600	11689	6728	4895	4932	3350	2490	2877	2756	2919	3090	2575	5192	8679	6688
France	6	8	2	4	+		12	4	3	2	1	2	1	+	+	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	49
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	183
Total (tonnes)	14186	13876	21203	22084	19489	19455	15778	11798	6832	4976	4979	3352	2493	2877	3105	3352	3339	2649	5334	9003	6921
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	7329

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	2020
Faroe Islands	1565	1948	3698	4804	3594	2444	1374.84	810	556	192	178	194	141	47	71	48	111	196	192	330	407
France	+									1							5				
Greenland											12										
Norway	48	66	28	54	17	45	1	8	+	3	1				2	1	+	5	1	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	408

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	400	120	400
Longliners	< 100 GRT	2	205	60	205
Longliners	> 100 GRT	8	1682	475	1682
Jiggers		0	0	0	0
Gillnetters		0	0	0	0
Single trawlers	< 400 HP	0	0	0	0
Single trawlers	400-1000 HP	0	0	0	0
Single trawlers	> 1000 HP	0	0	0	0
Pair trawlers	< 1000 HP	0	0	0	0
Pair trawlers	> 1000 HP	19	3766	1139	6053
Total		30	6053	1794	6053

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

27.5.b - Faroese fleet			
	Longliners, open boats, jiggers	Longliners	Trawlers
Age	< 100 GRT	> 100 GRT	
0	0	0	0
1	0	0	0
2	272	164	10,876
3	1,519,175	778,357	356,645
4	1,401,856	521,254	308,936
5	430,433	262,405	66,064
6	162,764	117,069	27,522
7	77,298	96,273	4,673
8	46,688	67,034	2,253
9	23,676	23,090	1,018
10	0	2,559	0
11	0	0	0
12	0	0	0
13	0	0	0
14	0	0	0
15	0	0	0
Total no.	3,662,162	1,868,205	777,988
Catch, t.	3354	2291	734

Numbers in 1000'

Catch, gutted weight in tonnes

Table 5.4. Faroe haddock. Catch in numbers at age 1957–2020.

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	1461	3061	210	682	2685	2846	79	1	71
2001	0	19	4380	3128	2423	173	451	1151	1375	17	18
2002	0	0	1515	14039	2879	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	312	2396	2664	1135	560	139	91	38	4
2020	0	0	11	2659	2236	760	308	179	116	48	3

Table 5.5 Faroe Haddock. Mean weight at age (kg) in the catches, 1957–2020.

Year \ age	1	2	3	4	5	6	7	8	9	10
1957	0.25	0.47	0.73	1.13	1.55	1.97	2.41	2.76	3.07	3.55
1958	0.25	0.47	0.73	1.13	1.55	1.97	2.41	2.76	3.07	3.55
1959	0.25	0.47	0.73	1.13	1.55	1.97	2.41	2.76	3.07	3.55
1960	0.25	0.47	0.73	1.13	1.55	1.97	2.41	2.76	3.07	3.55
1961	0.25	0.47	0.73	1.13	1.55	1.97	2.41	2.76	3.07	3.55
1962	0.25	0.47	0.73	1.13	1.55	1.97	2.41	2.76	3.07	3.55
1963	0.25	0.47	0.73	1.13	1.55	1.97	2.41	2.76	3.07	3.55
1964	0.25	0.47	0.73	1.13	1.55	1.97	2.41	2.76	3.07	3.55
1965	0.25	0.47	0.73	1.13	1.55	1.97	2.41	2.76	3.07	3.55
1966	0.25	0.47	0.73	1.13	1.55	1.97	2.41	2.76	3.07	3.55
1967	0.25	0.47	0.73	1.13	1.55	1.97	2.41	2.76	3.07	3.55
1968	0.25	0.47	0.73	1.13	1.55	1.97	2.41	2.76	3.07	3.55

Year \ age	1	2	3	4	5	6	7	8	9	10
1969	0.25	0.47	0.73	1.13	1.55	1.97	2.41	2.76	3.07	3.55
1970	0.25	0.47	0.73	1.13	1.55	1.97	2.41	2.76	3.07	3.55
1971	0.25	0.47	0.73	1.13	1.55	1.97	2.41	2.76	3.07	3.55
1972	0.25	0.47	0.73	1.13	1.55	1.97	2.41	2.76	3.07	3.55
1973	0.25	0.47	0.73	1.13	1.55	1.97	2.41	2.76	3.07	3.55
1974	0.25	0.47	0.73	1.13	1.55	1.97	2.41	2.76	3.07	3.55
1975	0.25	0.47	0.73	1.13	1.55	1.97	2.41	2.76	3.07	3.55
1976	0.25	0.47	0.73	1.13	1.55	1.97	2.41	2.76	3.07	3.55
1977	0	0.311	0.633	1.044	1.426	1.825	2.241	2.205	2.57	2.591
1978	0	0.357	0.79	1.035	1.398	1.87	2.35	2.597	3.014	2.92
1979	0.3	0.357	0.672	0.894	1.156	1.59	2.07	2.525	2.696	3.519
1980	0	0.643	0.713	0.941	1.157	1.493	1.739	2.095	2.465	3.31
1981	0	0.452	0.725	0.957	1.237	1.651	2.053	2.406	2.725	3.25
1982	0	0.7	0.896	1.15	1.444	1.498	1.829	1.887	1.961	2.856
1983	0	0.47	0.74	1.01	1.32	1.66	2.05	2.26	2.54	3.04
1984	0.359	0.681	1.011	1.255	1.812	2.061	2.059	2.137	2.368	2.686
1985	0	0.528	0.859	1.391	1.777	2.326	2.44	2.401	2.532	2.686
1986	0	0.608	0.887	1.175	1.631	1.984	2.519	2.583	2.57	2.922
1987	0	0.605	0.831	1.126	1.462	1.941	2.173	2.347	3.118	2.933
1988	0	0.501	0.781	0.974	1.363	1.68	1.975	2.344	2.248	3.295
1989	0	0.58	0.779	0.923	1.207	1.564	1.746	2.086	2.424	2.514
1990	0	0.438	0.699	0.939	1.204	1.384	1.564	1.818	2.168	2.335
1991	0	0.547	0.693	0.884	1.086	1.276	1.477	1.574	1.93	2.153
1992	0	0.525	0.724	0.817	1.038	1.249	1.43	1.564	1.633	2.126
1993	0.36	0.755	0.982	1.027	1.192	1.378	1.643	1.796	1.971	2.24
1994	0	0.754	1.103	1.254	1.465	1.593	1.804	2.049	2.225	2.423
1995	0	0.666	1.054	1.489	1.779	1.94	2.182	2.357	2.49	2.678
1996	0.36	0.534	0.858	1.459	1.993	2.33	2.351	2.469	2.777	2.582
1997	0	0.519	0.771	1.066	1.799	2.27	2.34	2.475	2.501	2.676
1998	0	0.622	0.846	1.016	1.283	2.08	2.556	2.572	2.452	2.753
1999	0.278	0.504	0.624	0.974	1.22	1.49	2.456	2.658	2.598	2.953
2000	0.28	0.661	0.936	1.166	1.483	1.616	1.893	2.821	3.749	3.196
2001	0.28	0.608	0.94	1.374	1.779	1.971	2.119	2.373	2.75	3.966
2002	0	0.584	0.857	1.405	1.799	1.974	2.301	2.37	2.626	3.13
2003	0	0.571	0.715	1.008	1.537	1.911	2.091	2.301	2.406	2.535
2004	0.367	0.574	0.77	0.887	1.159	1.638	1.87	2.438	2.357	2.417
2005	0	0.538	0.649	0.797	1.02	1.245	1.843	2.061	2.263	2.579
2006	0	0.475	0.601	0.768	0.911	1.126	1.374	2.158	2.211	2.569
2007	0	0.628	0.669	0.859	0.969	1.06	1.245	1.475	2.266	2.256
2008	0.491	0.636	0.754	0.86	0.991	1.082	1.151	1.379	1.727	2.435

Year \ age	1	2	3	4	5	6	7	8	9	10
2009	0	0.482	0.734	0.985	1.13	1.264	1.357	1.545	1.792	2.154
2010	0	0.692	0.87	1.149	1.308	1.386	1.429	1.568	1.74	1.841
2011	0	0.553	0.815	1.086	1.303	1.387	1.469	1.538	1.702	1.862
2012	0	0.619	0.786	1.069	1.405	1.616	1.656	1.675	1.727	1.905
2013	0	0.576	0.83	1.149	1.465	1.71	1.827	1.886	1.856	2.085
2014	0	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	1.64	1.729	2.424	2.003	2.218	2.302
2016	0.396	0.645	0.934	1.22	1.571	1.908	2.066	2.187	2.276	2.789
2017	0.343	0.79	0.904	1.169	1.595	2.137	2.291	2.666	2.697	3.791
2018	0	0.642	1	1.584	1.944	2.281	2.544	2.597	2.818	3.288
2019	0	0.626	0.775	1.133	1.807	2.096	2.677	2.461	2.872	2.505
2020	0	0.574	0.673	1.028	1.731	2.129	2.874	3.069	3.013	2.596

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

Year/Age	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 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

Year/Age	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10
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
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	19585	2381	208	323	170	308	414
1995	53979	21906	748	235	164	54	158
1996	5982	35320	20186	716	102	77	59
1997	273	7908	15994	26431	689	156	40
1998	3534	1360	3410	9793	13430	372	16
1999	4555	6953	113	1499	4402	3362	54
2000	29968	8695	5247	222	455	1686	2036
2001	27317	37139	3549	1126	28	112	448
2002	21041	17601	26398	2089	718	42	107
2003	9110	22710	13017	13606	855	241	20
2004	1699	15554	10921	7158	12092	560	90
2005	5860	5455	7921	6402	4678	5304	269
2006	733	6207	1514	4485	3327	3450	1756
2007	1258	1403	3056	816	2900	3079	2363
2008	691	2145	783	1711	612	1706	1534
2009	4157	2082	1073	407	941	376	970
2010	6529	5192	652	419	198	287	277
2011	103	6360	1894	463	268	221	257
2012	439	368	4957	908	228	143	293
2013	3513	1254	264	3987	674	132	116
2014	3643	4175	830	918	2286	295	101
2015	1598	3363	4090	1079	2087	1373	204
2016	14093	4497	2471	1382	279	461	115
2017	60511	15358	2763	2352	714	170	340
2018	85580	24603	3849	1010	734	267	66
2019	14548	38587	21130	7091	1382	768	218
2020	2521	47592	24449	16663	2197	869	301
2021	4319	7993	8306	17356	988	161	65

Summer Survey									
Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8
1996	375	47,759	42,901	64,257	1,278	214	299	248	425
1997	27	7,738	14,052	25,104	49,758	977	183	87	176
1998	1,485	20,209	2,763	2,502	14,017	19,433	321	99	82
1999	1,441	24,141	9,549	6,383	1,620	8,473	10,331	235	6
2000	5,148	169,563	19,483	7,956	390	1,300	4,696	6,007	105
2001	1,913	96,784	98,147	13,072	4,632	181	647	2,714	3,429
2002	2,047	95,407	53,532	62,498	6,158	1,974	170	412	1,336
2003	261	45,045	38,177	21,476	37,994	4,370	667	110	466
2004	670	7,951	33,766	10,718	15,151	17,822	1,003	207	27
2005	6	14,510	7,191	12,563	16,713	12,085	12,958	592	43
2006	76	2,504	8,700	1,790	8,009	8,237	6,980	3,494	129
2007	24	3,986	6,587	1,744	1,565	4,322	5,364	2,731	630
2008	684	4,798	1,877	1,135	2,505	1,001	3,183	3,287	1,513
2009	4,063	10,597	1,337	411	1,303	1,273	948	2,300	1,304
2010	21	24,891	3,636	1,457	1,072	576	828	776	1,329
2011	32	670	12,059	2,108	530	486	294	319	424
2012	2,733	2,454	357	5,617	1,176	223	149	161	105
2013	157	9,447	212	1,330	5,021	1,129	224	114	176
2014	247	13,910	3,989	891	1,034	2,944	428	94	84
2015	131	7,676	9,320	4,086	873	1,449	1,094	129	74
2016	3,861	36,511	3,303	3,101	1,989	284	567	378	46
2017	4,182	144,745	16,698	1,813	2,529	1,115	293	302	134
2018	4,675	135,364	54,716	12,800	4,557	3,435	1,106	528	598
2019	540	38,266	6,902	13,595	9,889	2,665	1,322	510	356
2020	44	13,005	3,652	11,020	12,442	1,024	463	126	36
2021	196	34,543	4,883	5,470	21,531	2,699	343	87	26

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	-4.701	0.171	0.009	0.006	0.013
logFpar_1	-5.439	0.159	0.004	0.003	0.006
logFpar_2	-5.548	0.114	0.004	0.003	0.005
logFpar_3	-5.346	0.11	0.005	0.004	0.006
logFpar_4	-5.403	0.108	0.005	0.004	0.006
logFpar_5	-5.335	0.105	0.005	0.004	0.006
logFpar_6	-5.19	0.091	0.006	0.005	0.007
logFpar_7	-5.502	0.213	0.004	0.003	0.006
logFpar_8	-4.956	0.144	0.007	0.005	0.009
logFpar_9	-5.488	0.134	0.004	0.003	0.005
logFpar_10	-5.458	0.128	0.004	0.003	0.006
logFpar_11	-5.639	0.123	0.004	0.003	0.005
logFpar_12	-5.687	0.113	0.003	0.003	0.004
logSdLogFsta_0	-0.957	0.111	0.384	0.308	0.48
logSdLogN_0	-0.066	0.11	0.936	0.751	1.168
logSdLogN_1	-1.27	0.09	0.281	0.235	0.336
logSdLogObs_0	-1.065	0.082	0.345	0.293	0.407
logSdLogObs_1	-0.415	0.124	0.66	0.516	0.846
logSdLogObs_2	-0.892	0.082	0.41	0.348	0.483
logSdLogObs_3	-0.032	0.163	0.969	0.699	1.343
logSdLogObs_4	-0.518	0.081	0.596	0.507	0.7
transfIRARdist_0	0.656	0.295	1.928	1.068	3.48
transfIRARdist_1	-0.211	0.228	0.809	0.513	1.278
itrans_rho_0	1.204	0.121	3.334	2.62	4.244

Model	log(L)	#par	AIC
Current	-1010.37	24	2068.73
base	-1010.37	24	2068.73

Year	sd(log(R))	sd(log(SSB))	sd(log(Fbar))
2020	0.371	0.152	0.198
2021	0.518	0.202	0.313

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	0.122	0.344	0.494	0.392	0.484	0.744	0.752	0.853	0.853
1958	0.005	0.172	0.444	0.605	0.495	0.638	1.020	1.076	1.284	1.284
1959	0.007	0.190	0.448	0.576	0.474	0.630	1.034	1.133	1.405	1.405
1960	0.010	0.230	0.530	0.668	0.543	0.716	1.187	1.300	1.589	1.589
1961	0.010	0.217	0.477	0.580	0.466	0.607	0.999	1.131	1.317	1.317
1962	0.010	0.237	0.534	0.650	0.516	0.661	1.089	1.341	1.559	1.559
1963	0.008	0.217	0.528	0.689	0.564	0.707	1.183	1.647	2.010	2.010
1964	0.004	0.110	0.313	0.469	0.422	0.550	0.883	1.366	1.618	1.618
1965	0.003	0.092	0.280	0.449	0.431	0.625	1.112	1.721	1.801	1.801
1966	0.003	0.088	0.278	0.443	0.417	0.588	1.004	1.341	1.509	1.509
1967	0.002	0.071	0.233	0.364	0.342	0.492	0.851	1.074	1.311	1.311
1968	0.002	0.088	0.280	0.412	0.368	0.508	0.853	0.987	1.231	1.231
1969	0.003	0.096	0.324	0.482	0.432	0.588	0.975	1.031	1.282	1.282
1970	0.003	0.082	0.303	0.445	0.409	0.518	0.800	0.704	0.762	0.762
1971	0.002	0.072	0.305	0.451	0.441	0.523	0.797	0.737	0.891	0.891
1972	0.002	0.072	0.329	0.441	0.418	0.427	0.610	0.576	0.755	0.755
1973	0.004	0.111	0.420	0.479	0.394	0.342	0.380	0.329	0.359	0.359
1974	0.003	0.077	0.293	0.364	0.306	0.283	0.309	0.316	0.386	0.386
1975	0.002	0.057	0.226	0.295	0.261	0.245	0.258	0.309	0.424	0.424
1976	0.001	0.042	0.202	0.312	0.324	0.343	0.361	0.448	0.586	0.586
1977	0.001	0.018	0.125	0.268	0.388	0.506	0.593	0.811	1.129	1.129
1978	0.000	0.008	0.072	0.183	0.295	0.408	0.546	0.815	1.149	1.149
1979	0.000	0.006	0.061	0.151	0.221	0.269	0.334	0.491	0.679	0.679
1980	0.000	0.014	0.119	0.258	0.315	0.320	0.339	0.446	0.576	0.576
1981	0.001	0.019	0.140	0.273	0.299	0.271	0.243	0.276	0.341	0.341
1982	0.001	0.033	0.238	0.428	0.452	0.397	0.335	0.389	0.474	0.474
1983	0.001	0.030	0.198	0.363	0.388	0.378	0.328	0.418	0.503	0.503
1984	0.001	0.029	0.171	0.317	0.334	0.352	0.289	0.404	0.492	0.492
1985	0.001	0.028	0.164	0.311	0.356	0.406	0.332	0.483	0.594	0.594
1986	0.000	0.022	0.126	0.252	0.318	0.395	0.369	0.588	0.720	0.720
1987	0.001	0.025	0.134	0.259	0.339	0.451	0.481	0.705	0.798	0.798
1988	0.000	0.021	0.112	0.214	0.281	0.363	0.397	0.536	0.637	0.637
1989	0.000	0.017	0.106	0.211	0.300	0.414	0.511	0.676	0.818	0.818
1990	0.000	0.022	0.143	0.264	0.337	0.452	0.567	0.713	0.923	0.923
1991	0.000	0.029	0.171	0.292	0.324	0.389	0.438	0.464	0.540	0.540

Year \ Age	1	2	3	4	5	6	7	8	9	10
1992	0.000	0.026	0.146	0.256	0.283	0.321	0.351	0.360	0.423	0.423
1993	0.001	0.037	0.192	0.307	0.298	0.297	0.298	0.288	0.321	0.321
1994	0.000	0.018	0.122	0.240	0.265	0.290	0.308	0.308	0.336	0.336
1995	0.000	0.017	0.125	0.269	0.314	0.340	0.363	0.356	0.366	0.366
1996	0.000	0.013	0.119	0.288	0.377	0.442	0.495	0.478	0.452	0.452
1997	0.000	0.015	0.132	0.284	0.404	0.526	0.655	0.652	0.588	0.588
1998	0.000	0.025	0.222	0.388	0.516	0.731	1.028	1.151	0.913	0.913
1999	0.000	0.030	0.277	0.428	0.514	0.681	0.948	1.339	0.963	0.963
2000	0.001	0.040	0.299	0.425	0.456	0.515	0.573	0.725	0.576	0.576
2001	0.000	0.033	0.241	0.383	0.427	0.454	0.440	0.491	0.438	0.438
2002	0.000	0.025	0.194	0.350	0.444	0.511	0.502	0.552	0.561	0.561
2003	0.000	0.014	0.125	0.280	0.458	0.675	0.771	0.834	0.906	0.906
2004	0.000	0.015	0.122	0.263	0.446	0.721	0.984	1.140	1.318	1.318
2005	0.000	0.019	0.135	0.264	0.420	0.655	0.946	1.146	1.417	1.417
2006	0.001	0.025	0.162	0.280	0.401	0.604	0.902	1.103	1.582	1.582
2007	0.001	0.030	0.187	0.295	0.376	0.521	0.765	0.974	1.268	1.268
2008	0.001	0.030	0.186	0.287	0.328	0.435	0.646	0.885	1.279	1.279
2009	0.001	0.025	0.185	0.288	0.310	0.378	0.507	0.631	0.901	0.901
2010	0.001	0.036	0.275	0.414	0.423	0.490	0.615	0.720	1.044	1.044
2011	0.000	0.025	0.221	0.367	0.403	0.478	0.633	0.736	1.103	1.103
2012	0.000	0.019	0.165	0.282	0.337	0.408	0.529	0.626	0.962	0.962
2013	0.000	0.032	0.243	0.337	0.383	0.449	0.578	0.699	1.115	1.115
2014	0.000	0.036	0.269	0.365	0.408	0.431	0.499	0.563	0.965	0.965
2015	0.000	0.037	0.274	0.371	0.415	0.443	0.479	0.549	1.046	1.046
2016	0.000	0.029	0.235	0.348	0.417	0.461	0.482	0.591	1.215	1.215
2017	0.000	0.011	0.117	0.214	0.286	0.335	0.386	0.555	1.320	1.320
2018	0.000	0.011	0.140	0.266	0.358	0.396	0.435	0.663	1.936	1.936
2019	0.000	0.008	0.136	0.334	0.537	0.615	0.663	0.949	2.759	2.759
2020	0.000	0.003	0.078	0.230	0.481	0.661	0.877	1.371	3.701	3.701
2021	0.000	0.004	0.109	0.344	0.798	1.164	1.572	2.299	5.700	5.700

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	27174	36643	25426	20827	5416	2606	1226	470	202	118
1958	32279	30697	25236	14228	9549	2980	1334	480	182	127
1959	58842	29225	23239	12848	6300	4397	1275	390	134	68
1960	77199	39354	24213	13354	6228	3300	1794	379	104	39
1961	78120	54399	23945	12857	5727	3040	1350	415	89	22
1962	77730	51062	35473	12356	6534	3018	1364	399	108	27
1963	40281	60653	26885	16395	5481	3587	1266	369	84	25
1964	18343	28808	33018	11484	6536	2585	1716	303	60	11
1965	17748	16865	20935	17234	5227	3103	1147	806	63	11
1966	32740	15250	14016	13567	8411	2725	1275	300	98	11
1967	47072	25019	12615	9268	7085	4140	1212	360	68	19
1968	28708	48283	19003	8972	5598	4222	1930	418	102	19
1969	32460	26350	33328	11956	5274	3437	2141	670	130	29
1970	20126	25984	20776	19531	5791	3196	1628	682	201	29
1971	24173	13964	20097	13479	9964	3198	1601	515	279	120
1972	27389	19334	10391	13209	7264	5079	1493	580	186	140
1973	119111	24399	19965	4760	7724	3595	3244	594	310	83
1974	109345	80346	15449	11950	2272	4155	1961	2007	316	330
1975	70056	91827	49120	9372	6724	1463	2424	1119	1258	440
1976	27258	68033	53626	28161	5824	4266	1111	1833	698	927
1977	10248	20029	44146	29454	14925	3911	2410	765	1020	931
1978	993	9474	16774	29167	17271	6788	1673	1090	309	488
1979	5908	561	13902	13556	18690	9794	3277	641	363	186
1980	6140	6115	653	14414	10016	11589	6204	1814	271	212
1981	18045	4576	4227	744	10598	6094	7177	3753	839	184
1982	21351	16027	3416	2752	628	7302	3807	4490	2958	612
1983	45886	16553	12536	1624	1444	349	4562	2253	2636	2018
1984	40814	40646	12533	8534	759	791	220	2644	1186	2561
1985	20070	34534	31961	9037	4659	443	424	171	1354	2061
1986	13519	15963	26042	21420	5673	2486	207	261	108	1546
1987	24628	10115	15138	18937	12918	3356	1279	131	109	670
1988	9587	23158	6303	12872	12866	7782	1736	540	48	296
1989	7179	7397	16194	4428	9538	8241	4606	1005	264	154
1990	3239	6150	8178	10222	3120	5632	4618	2115	391	159
1991	2752	2504	5735	6745	5953	2013	3000	2158	854	132
1992	3971	2148	1669	3926	4394	3690	1158	1492	1153	484
1993	26187	2834	1893	1200	2533	2654	2237	661	856	843
1994	25691	11235	1709	1420	760	1641	1740	1486	441	1108
1995	42977	40640	5098	1089	898	503	1092	1104	937	991

Year Age	1	2	3	4	5	6	7	8	9	10
1996	10231	35336	55237	3079	577	487	379	719	685	1204
1997	3972	7913	30068	50047	1821	332	225	243	437	1159
1998	14285	3263	6033	21668	32527	962	127	123	128	838
1999	26062	12826	2437	3712	13891	16823	408	26	33	351
2000	119639	23686	13036	872	2142	7236	7951	148	4	138
2001	54635	107580	17697	7510	441	1236	3701	4339	58	63
2002	35862	45176	90173	10034	3691	310	742	2234	2624	72
2003	23410	24292	33629	56537	5824	1676	204	550	1272	1467
2004	7234	21324	21465	23927	35033	2607	607	98	214	1019
2005	9297	5617	17157	18713	18535	17434	1051	187	32	273
2006	2940	8756	3703	12477	13085	11828	6266	321	58	69
2007	2985	2641	5804	2562	8431	8439	5592	1732	117	18
2008	3774	2542	1880	3928	1828	5060	4291	2170	480	40
2009	7819	2262	1785	1473	2350	1479	3088	1814	648	105
2010	11040	6740	1888	1325	914	1306	1141	1611	770	257
2011	1014	10254	4136	1028	696	551	601	647	609	295
2012	2315	884	9050	2099	535	339	337	232	279	231
2013	7910	1983	1561	6075	1080	296	192	163	106	172
2014	9492	6661	1745	1753	3386	450	157	92	45	77
2015	7983	8021	5646	1145	1680	1248	177	81	40	36
2016	26193	6719	5950	2993	673	1060	432	67	38	21
2017	34349	17512	4562	4076	1590	427	508	168	27	15
2018	48855	34608	13581	3751	2645	897	310	254	52	10
2019	17577	35240	24196	8455	2546	1341	423	209	71	6
2020	7967	11927	29432	14991	2788	1003	426	155	60	4
2021	12325	6998	10192	29467	6926	1184	372	140	32	1

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

Year	Recruitment			SSB			Total	F		
	Age 1	97.5%	2.5%		97.5%	2.5%	Catch	Ages 3–7	97.5%	2.5%
	thousands			tonnes			tonnes			
1957	27174	51861	14239	50178	66116	38083	20995	0.49	0.67	0.36
1958	32279	58859	17702	50561	64505	39631	23871	0.64	0.84	0.49
1959	58842	105643	32774	45408	57354	35950	20239	0.63	0.82	0.49
1960	77199	138673	42977	45306	56831	36118	25727	0.73	0.94	0.56
1961	78120	141371	43168	42764	53823	33977	20831	0.63	0.82	0.48
1962	77730	140898	42882	47465	59683	37748	27151	0.69	0.89	0.53
1963	40281	73342	22124	47968	60870	37801	27571	0.73	0.95	0.57
1964	18343	33635	10003	44608	57225	34773	19490	0.53	0.70	0.40
1965	17748	32617	9658	44968	58133	34784	18479	0.58	0.76	0.44
1966	32740	60070	17844	41937	54381	32341	18766	0.55	0.72	0.41
1967	47072	86435	25635	37987	48742	29606	13381	0.46	0.61	0.34
1968	28708	52589	15671	40423	50866	32124	17852	0.48	0.64	0.37
1969	32460	59356	17751	47170	59549	37365	23272	0.56	0.74	0.43
1970	20126	36894	10979	49895	64545	38570	21361	0.50	0.66	0.37
1971	24173	44273	13199	49604	63918	38496	19393	0.50	0.68	0.37
1972	27389	50319	14908	45299	58757	34923	16485	0.45	0.61	0.32
1973	119111	225416	62939	42339	54620	32818	18035	0.40	0.56	0.29
1974	109345	207403	57648	44081	56553	34359	14773	0.31	0.44	0.22
1975	70056	133991	36628	57097	73782	44185	20715	0.26	0.36	0.183
1976	27258	52820	14066	80267	105735	60933	26211	0.31	0.43	0.22
1977	10248	22794	4607	82309	109632	61796	25555	0.38	0.53	0.27
1978	993	2244	439	79992	108957	58728	19200	0.30	0.44	0.21
1979	5908	11644	2997	62737	85442	46066	12424	0.21	0.30	0.141
1980	6140	12926	2917	57653	77130	43094	15016	0.27	0.39	0.189
1981	18045	38013	8566	52061	70010	38714	12233	0.25	0.35	0.174
1982	21351	45045	10120	40441	52698	31035	11937	0.37	0.51	0.27
1983	45886	97280	21644	37594	49125	28770	12894	0.33	0.47	0.24
1984	40814	80036	20813	41135	53112	31859	12378	0.29	0.41	0.21
1985	20070	42661	9442	49355	65278	37316	15143	0.31	0.44	0.22
1986	13519	28834	6339	54218	73052	40239	14477	0.29	0.41	0.21
1987	24628	52883	11469	54152	72552	40419	14882	0.33	0.47	0.24
1988	9587	20522	4478	48956	65190	36765	12178	0.27	0.38	0.196
1989	7179	15232	3383	41868	54632	32087	14325	0.31	0.43	0.22
1990	3239	6846	1532	34805	44958	26945	11726	0.35	0.50	0.25
1991	2752	5798	1307	26865	35003	20619	8429	0.32	0.46	0.23
1992	3971	8410	1875	19977	26385	15125	5476	0.27	0.39	0.190
1993	26187	51687	13268	17197	22762	12992	4026	0.28	0.39	0.198

Year	Recruitment			SSB			Total	F		
	Age 1	97.5%	2.5%		97.5%	2.5%	Catch	Ages 3–7	97.5%	2.5%
	thousands			tonnes			tonnes			
1994	25691	47904	13778	16252	21143	12492	4252	0.25	0.34	0.176
1995	42977	82815	22303	17282	21818	13688	4948	0.28	0.39	0.21
1996	10231	17567	5959	36959	47959	28481	9642	0.34	0.46	0.26
1997	3972	7227	2183	68838	91008	52069	17924	0.40	0.53	0.30
1998	14285	25487	8006	67586	87351	52294	22210	0.58	0.75	0.44
1999	26062	43826	15498	47742	61022	37352	18482	0.57	0.74	0.44
2000	119639	202066	70835	36352	45257	29199	15799	0.45	0.60	0.34
2001	54635	92494	32272	46237	55831	38292	15891	0.39	0.51	0.29
2002	35862	64729	19869	75018	94655	59455	24929	0.40	0.53	0.30
2003	23410	42046	13034	87604	113294	67740	26942	0.46	0.61	0.35
2004	7234	12352	4236	74544	94933	58533	23100	0.51	0.67	0.39
2005	9297	16593	5209	60910	75558	49102	21944	0.48	0.63	0.37
2006	2940	5253	1645	44543	54570	36358	17154	0.47	0.62	0.36
2007	2985	5325	1673	30993	37708	25474	12631	0.43	0.56	0.33
2008	3774	6537	2179	20277	24411	16842	7393	0.38	0.50	0.29
2009	7819	13921	4392	15064	18051	12571	5197	0.33	0.44	0.25
2010	11040	19852	6140	11646	13766	9852	5203	0.44	0.58	0.34
2011	1014	1886	545	9223	10985	7743	3546	0.42	0.56	0.32
2012	2315	4180	1281	11081	14033	8749	2634	0.34	0.46	0.26
2013	7910	14130	4428	11484	14719	8960	2924	0.40	0.53	0.30
2014	9492	16904	5330	9998	12500	7997	3252	0.40	0.53	0.30
2015	7983	14334	4446	12554	15523	10154	3421	0.40	0.53	0.29
2016	26193	45264	15157	13468	16756	10825	3470	0.39	0.52	0.29
2017	34349	61021	19335	15325	19104	12293	2863	0.27	0.36	0.197
2018	48855	90614	26341	27339	34857	21443	5549	0.32	0.44	0.23
2019	17577	33410	9247	37451	48262	29062	9334	0.46	0.63	0.33
2020	7967	16746	3790	40342	54674	29767	7329	0.47	0.69	0.31
2021	12325	34727	4374	53186	79601	35537				

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

Forecast table 1. TAC 6634 in 2021, 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
2021	0.216	0.120	0.400	12623	4377	36843	54123	37104	79690	6634	3077	14781	59876	41097	86488
2022	0.165	0.062	0.399	9297	1014	119639	68037	41574	112196	8639	3258	24047	77218	47680	124312
2023	0.165	0.050	0.559	7983	1014	119639	70117	40044	127000	11374	3885	30807	82134	45827	153367
2024	0.165	0.042	0.653	9297	1014	119639	71326	34026	148638	12186	3763	33759	82168	39897	168915

Forecast table 2. TAC 6634 in 2021, 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
2021	0.216	0.120	0.400	12623	4377	36843	54123	37104	79690	6634	3077	14781	59876	41097	86488
2022	0.000	0.000	0.000	9297	1014	119639	68037	41574	112196	0	0	0	77218	47680	124312
2023	0.000	0.000	0.000	7983	1014	119639	82225	47678	146496	0	0	0	93490	52902	170089
2024	0.000	0.000	0.000	9297	1014	119639	96151	52257	183792	0	0	1	108508	57918	205522

Forecast table 3. SQ all years.

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
2021	0.811	0.451	1.503	12623	4377	36843	54123	37104	79690	19738	10037	38899	59876	41097	86488
2022	0.826	0.312	2.000	9297	1014	119639	51160	29708	87275	21851	9899	49160	60511	35965	100072
2023	0.814	0.246	2.760	7983	1014	119639	38164	16959	78015	15698	6989	33702	49157	22136	112635
2024	0.850	0.217	3.361	9297	1014	119639	32891	11129	96235	11630	4224	28443	44566	16460	124033

Forecast table 6. TAC 6634 in 2021, then Fpa=0.19.

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
2021	0.216	0.120	0.400	12623	4377	36843	54123	37104	79690	6634	3077	14781	59876	41097	86488
2022	0.190	0.072	0.460	9297	1014	119639	68037	41574	112196	9761	3709	26893	77218	47680	124312
2023	0.190	0.057	0.644	7983	1014	119639	68674	39054	124965	12518	4349	32828	80512	44608	152127
2024	0.190	0.049	0.751	9297	1014	119639	68739	32183	145952	12776	4156	34004	79860	37726	165767

Forecast table 7. TAC 6634 in 2021, then Flim=0.54.

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
2021	0.216	0.120	0.400	12623	4377	36843	54123	37104	79690	6634	3077	14781	59876	41097	86488
2022	0.540	0.204	1.307	9297	1014	119639	68037	41574	112196	22946	9520	55772	77218	47680	124312
2023	0.540	0.163	1.831	7983	1014	119639	53762	26335	102834	19188	8306	42325	64947	32940	131970
2024	0.540	0.138	2.135	9297	1014	119639	44591	16447	115641	14053	5376	33213	56476	21833	136273

Forecast table 4. TAC 6634 in 2021, then Fsq=0.216.

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
2021	0.216	0.120	0.400	12623	4377	36843	54123	37104	79690	6634	3077	14781	59876	41097	86488
2022	0.216	0.082	0.523	9297	1014	119639	68037	41574	112196	10928	4166	29801	77218	47680	124312
2023	0.216	0.065	0.732	7983	1014	119639	67143	37895	122768	13603	4826	35092	79125	43856	151383
2024	0.216	0.055	0.854	9297	1014	119639	65873	30131	142996	13358	4486	34686	77276	36227	162589

Forecast table 5. TAC 6634 in 2021, then F2020=0.465.

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
2021	0.216	0.120	0.400	12623	4377	36843	54123	37104	79690	6634	3077	14781	59876	41097	86488
2022	0.465	0.176	1.126	9297	1014	119639	68037	41574	112196	20575	8344	51158	77218	47680	124312
2023	0.465	0.140	1.577	7983	1014	119639	56513	28686	107326	18568	7902	42075	67518	35476	133916
2024	0.265	0.068	1.048	9297	1014	119639	48118	18347	119755	9646	3488	23744	60060	24243	140379

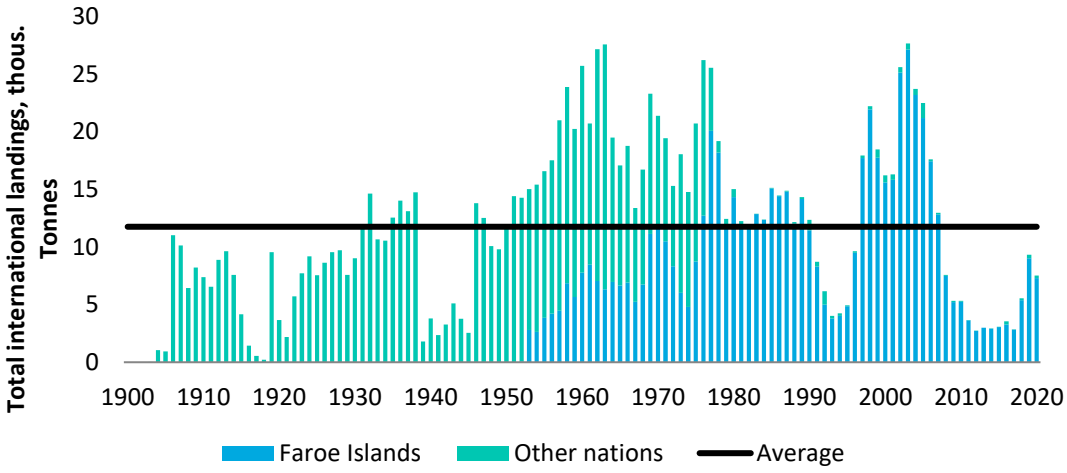

Figure 5.1. Haddock in ICES Division 5.b. Landings by all nations 1904–2020.

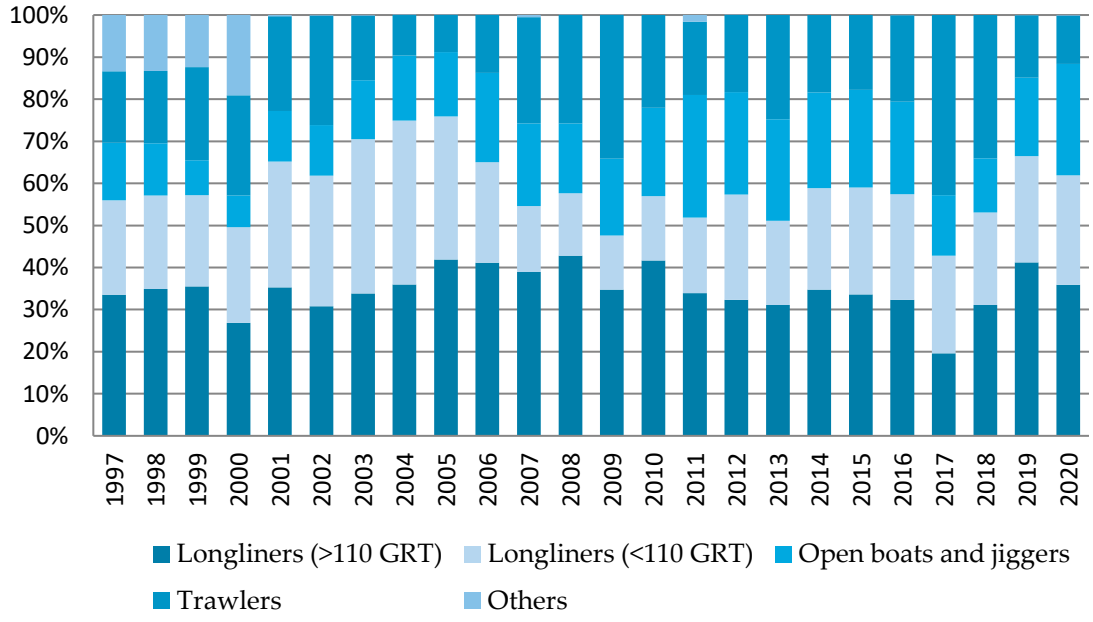

Figure 5.2. Faroe haddock. Catch distribution (%) between main fleets of the total Faroese landings 1997–2020.

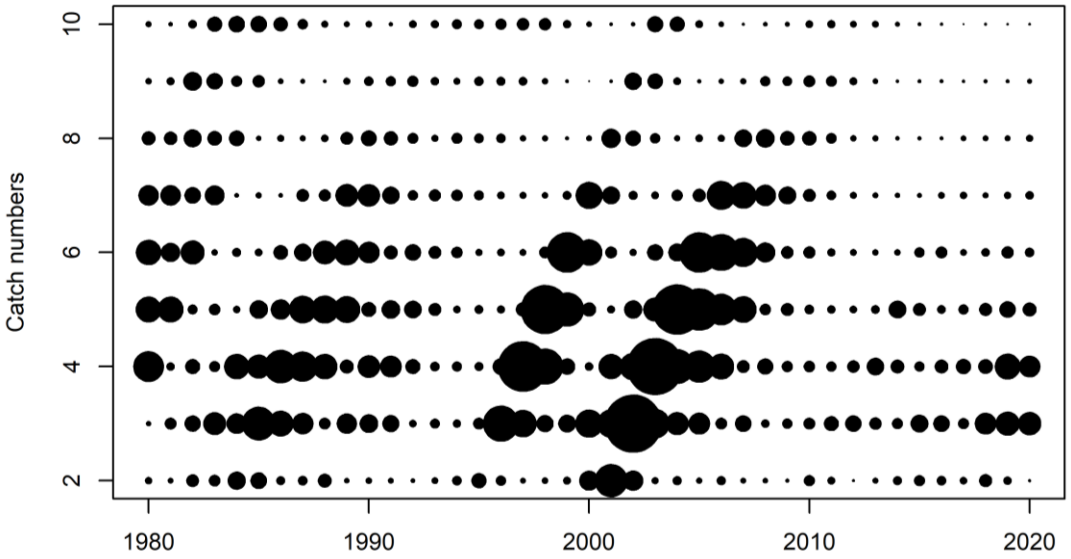

Figure 5.3. Faroe Haddock. Cath-at-age numbers in the commercial catches (ages 2–10) (1980–2020).

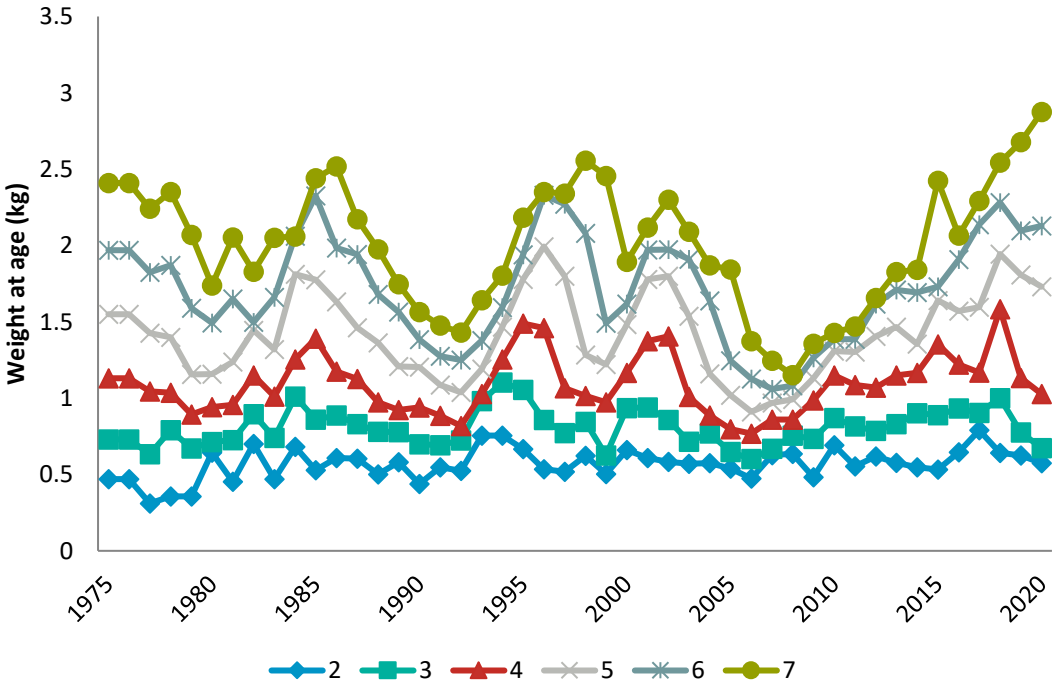

Figure 5.4. Faroe haddock. Mean weight (kg) at age (2–7).

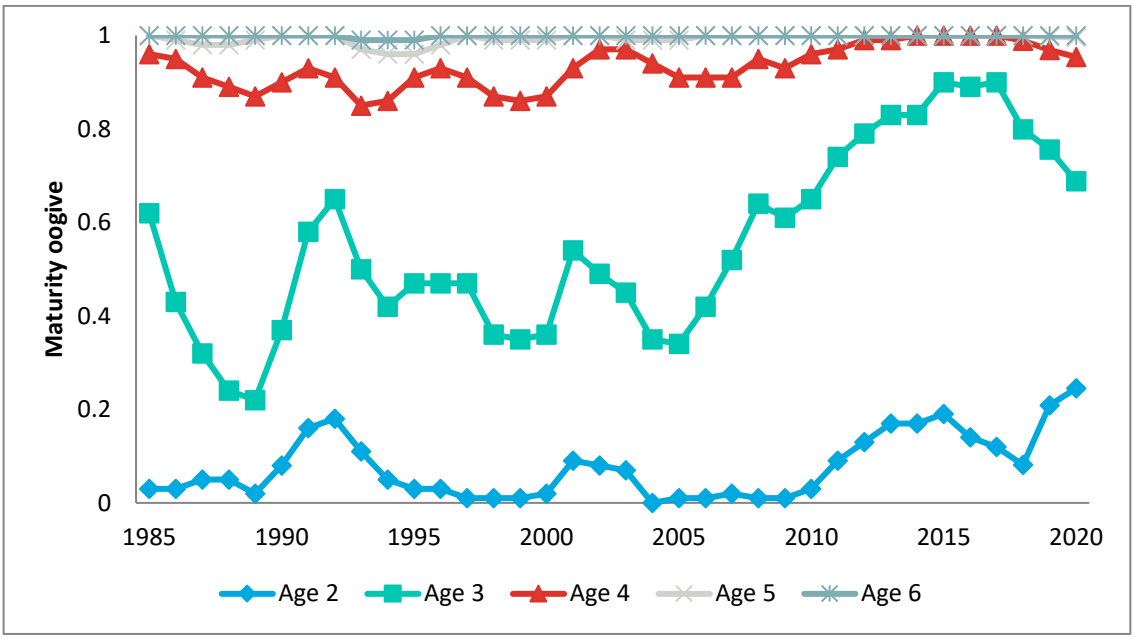

Figure 5.5. Faroe haddock. Maturity at age since 1985. Running 3-years average of spring survey observations for ages 2–6.

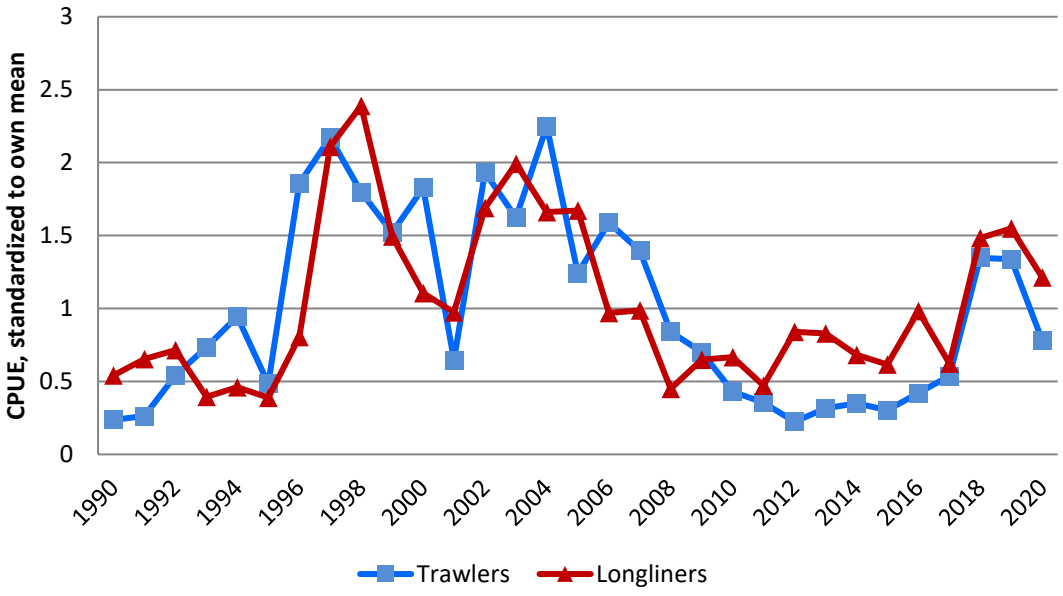

Figure 5.6. Commercial CPUEs of Faroe haddock for trawlers and longliners.

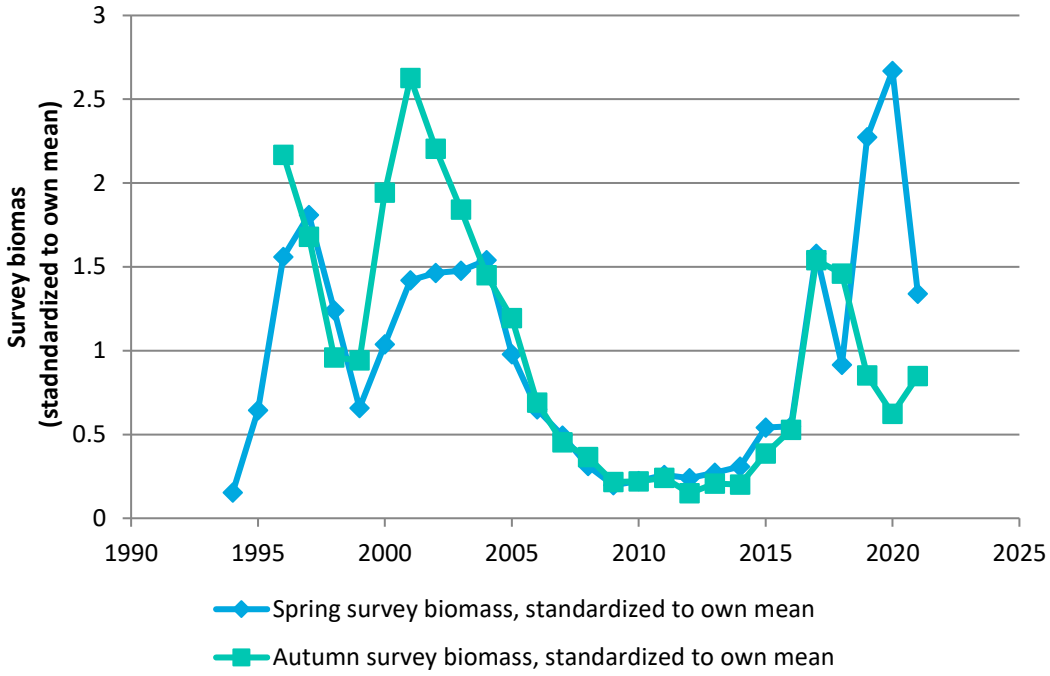

Figure 5.7. Tuning series biomass for spring surveys (1994–2021) and summer surveys (1996–2021). Surveys biomass is standardised to series mean biomass.

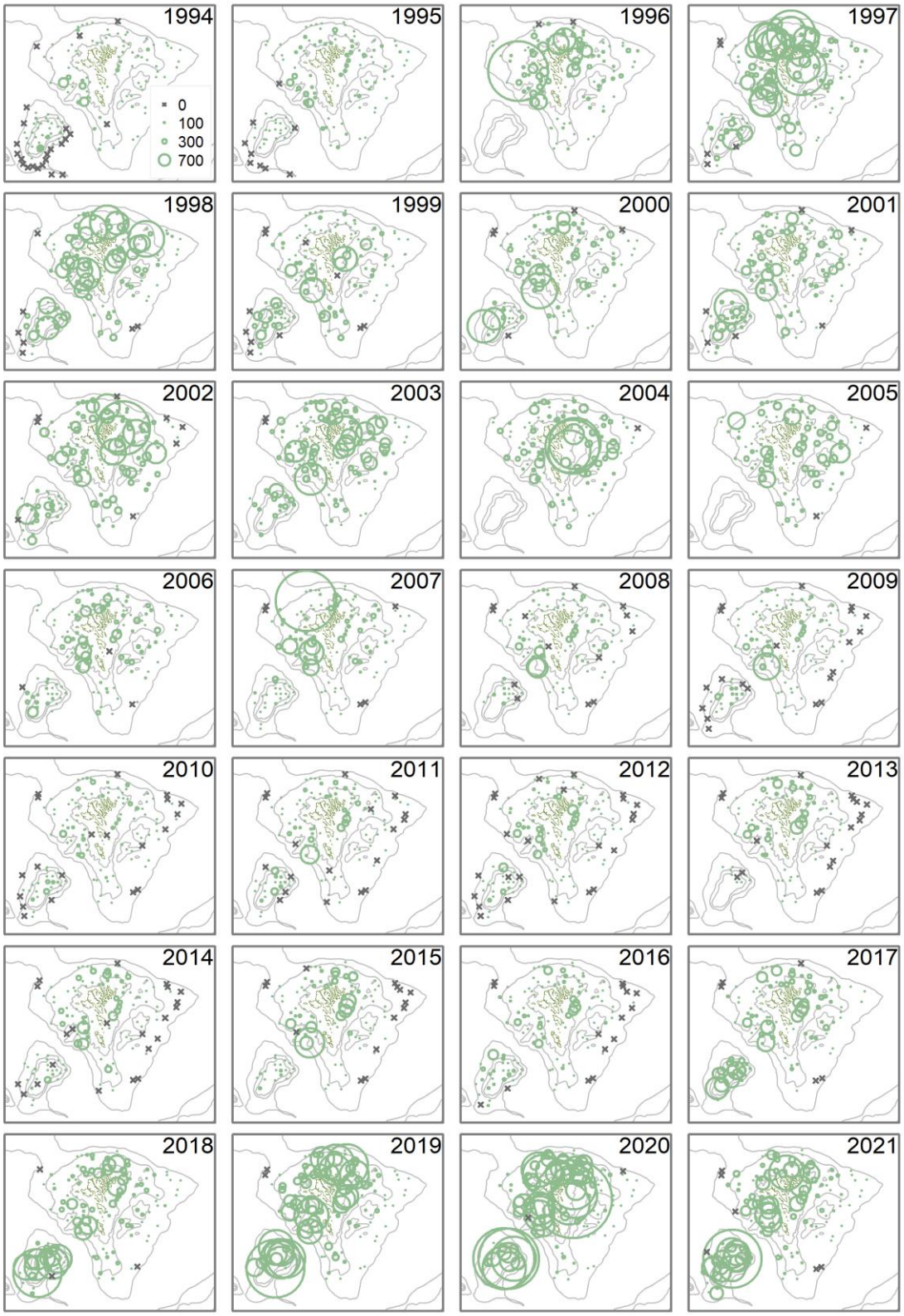

Figure 5.8a. Distribution of Faroe haddock catches in the spring survey.

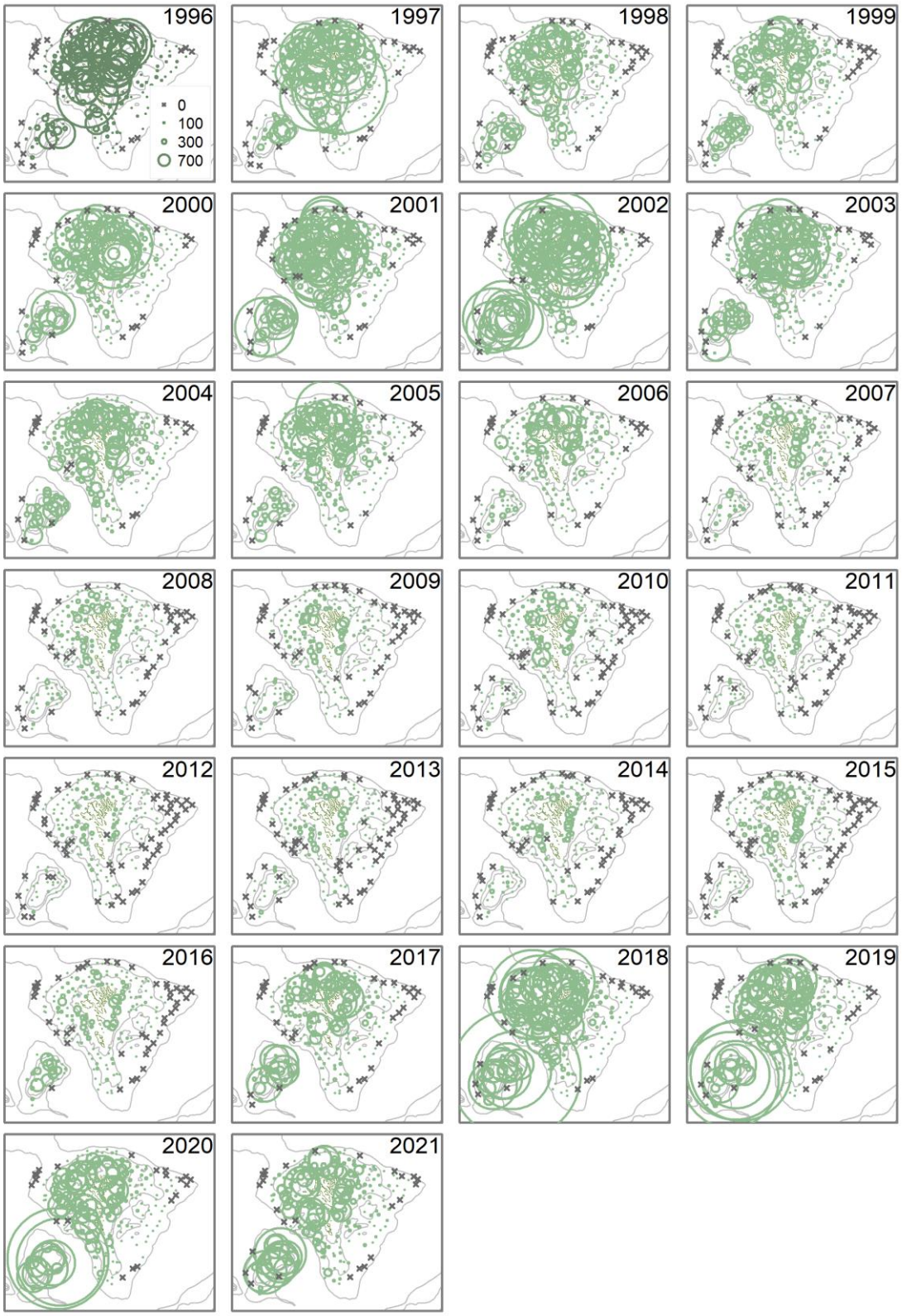

Figure 5.8b. Distribution of Faroe haddock catches in the summer survey.

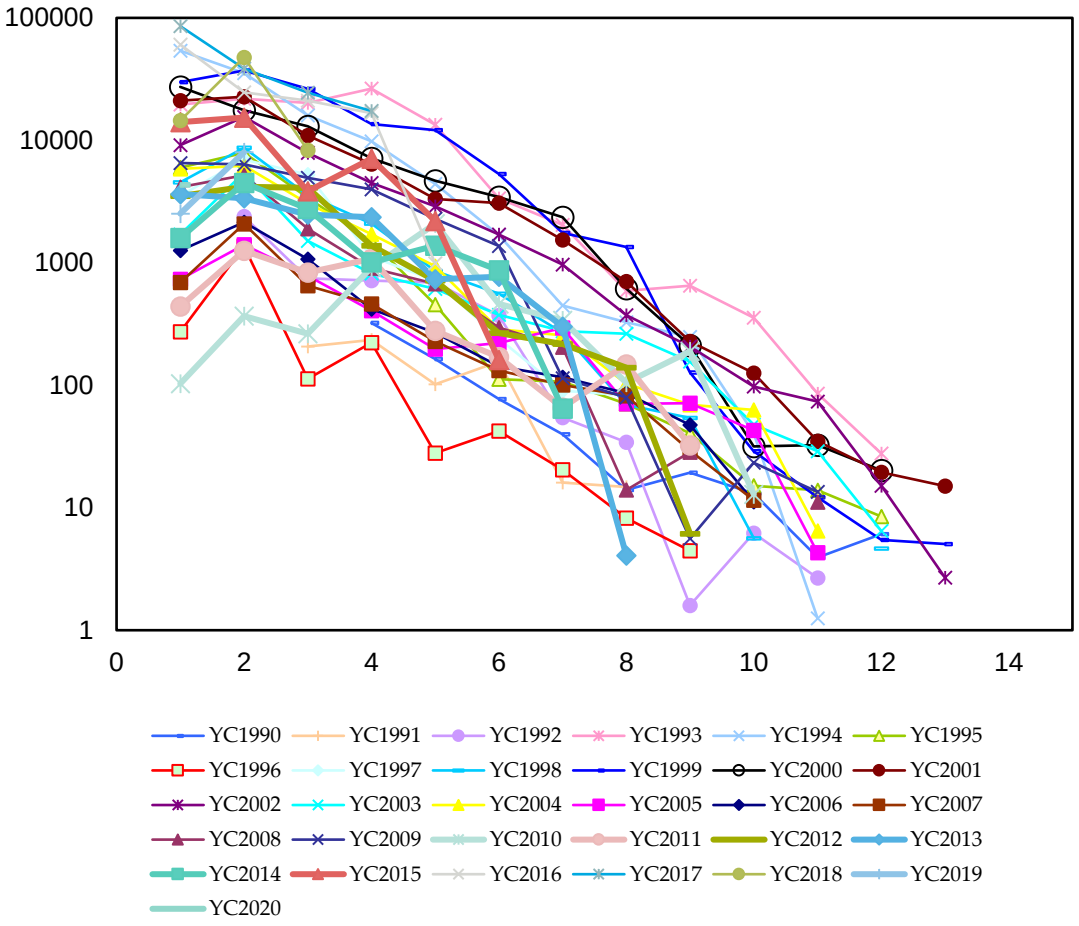

Figure 5.9. Faroe haddock. LN (catch at age in numbers) in the spring survey 1994–2020.

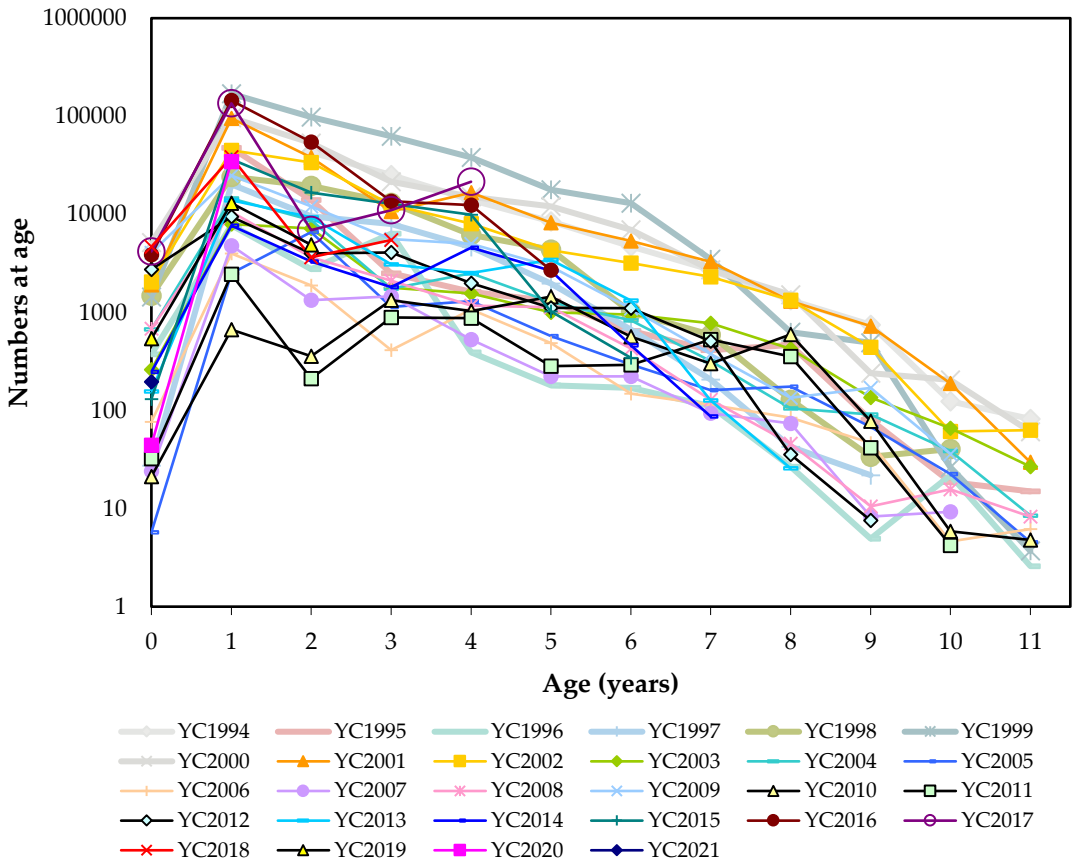

Figure 5.10. Faroe haddock. LN (catch at age in numbers) in the summer survey 1996–2021.

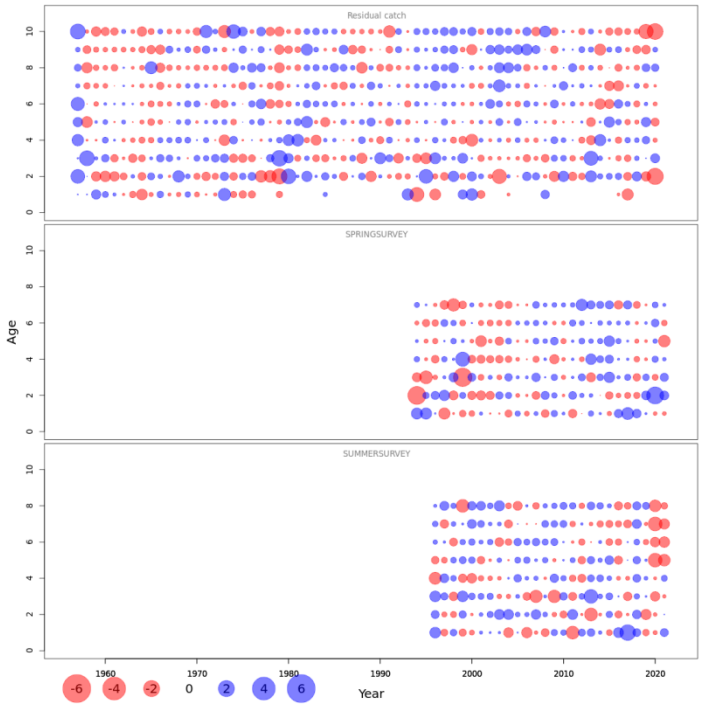

Figure 5.11. Faroe haddock (Division 5.b). Observation residuals for the catch, spring survey and the summer survey as estimated by the SAM model.

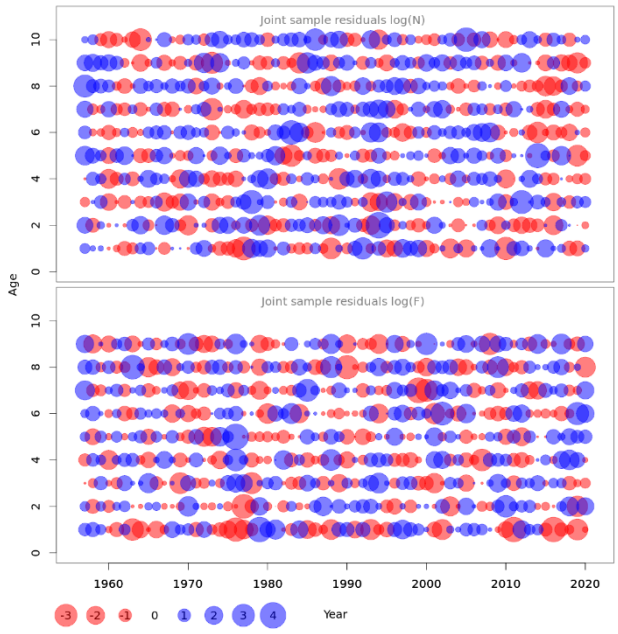

Figure 5.12. Faroe haddock (Division 5.b). Joint sample residuals for the population numbers and fishing mortality as estimated by the SAM model.

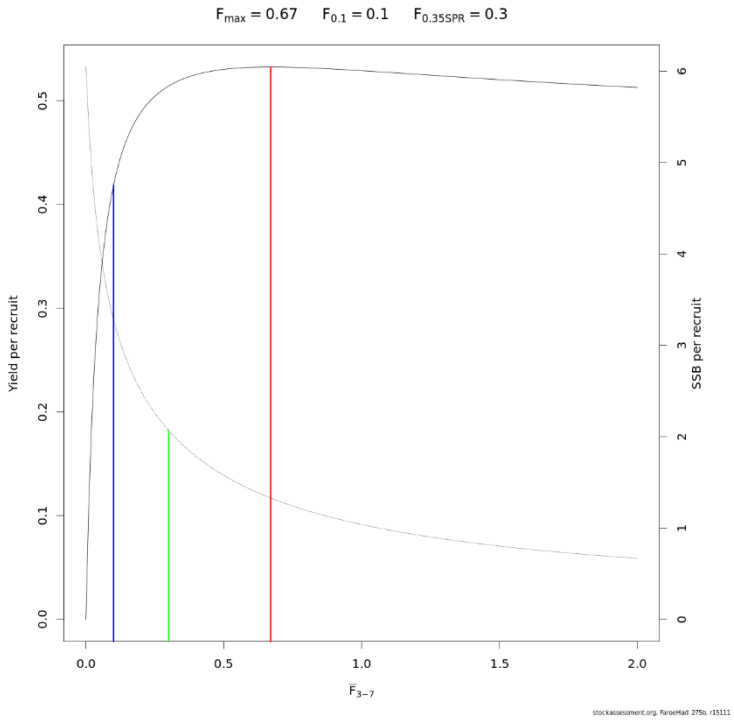

Figure 5.13. Faroe haddock (Division 5.b). Yield per recruit and spawning stock biomass (SSB) per recruit versus fishing mortality.

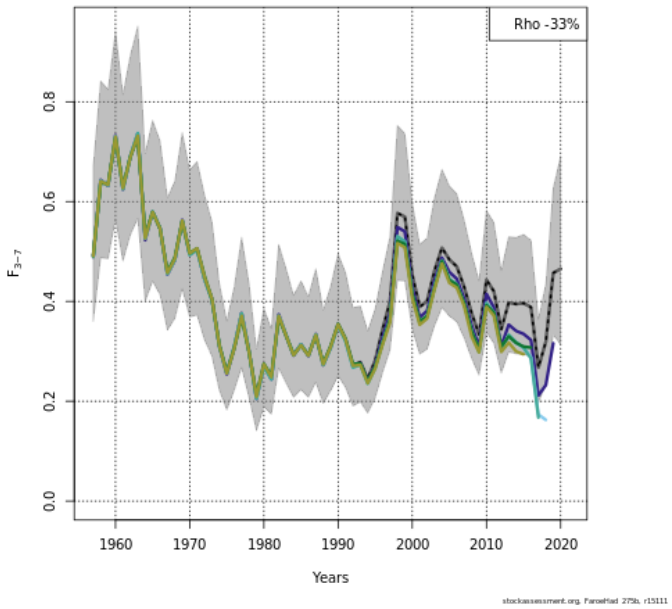

Figure 5.14. Faroe haddock (Division 5.b). Results from the SAM retrospective analysis of fishing mortality (ages 3–7).

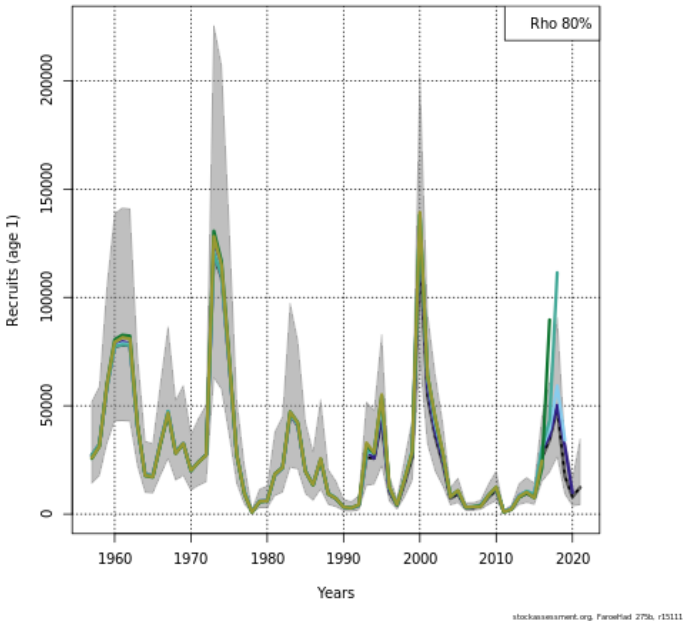

Figure 5.15. Faroe haddock (Division 5.b). Results from the SAM retrospective analysis. Recruitment at age 1.

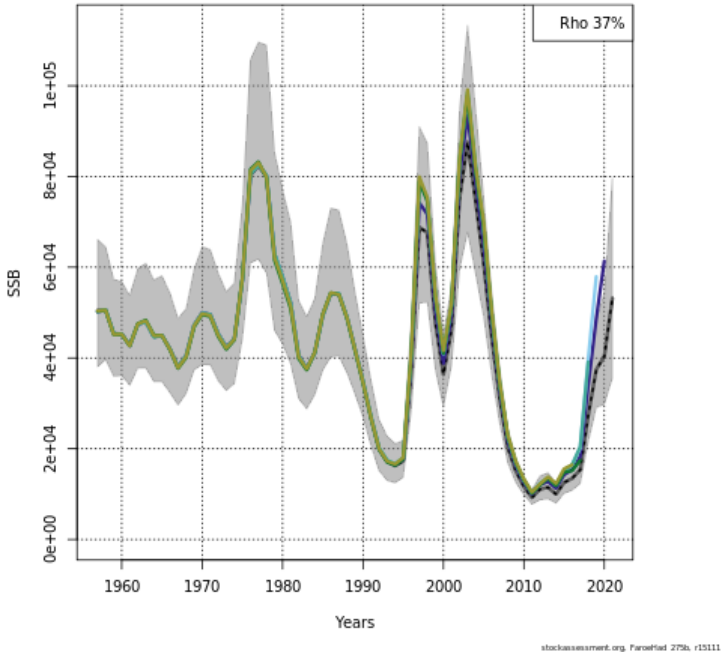

Figure 5.16. Faroe haddock (Division 5.b). Results from the SAM retrospective analysis (continued). Spawning stock biomass.

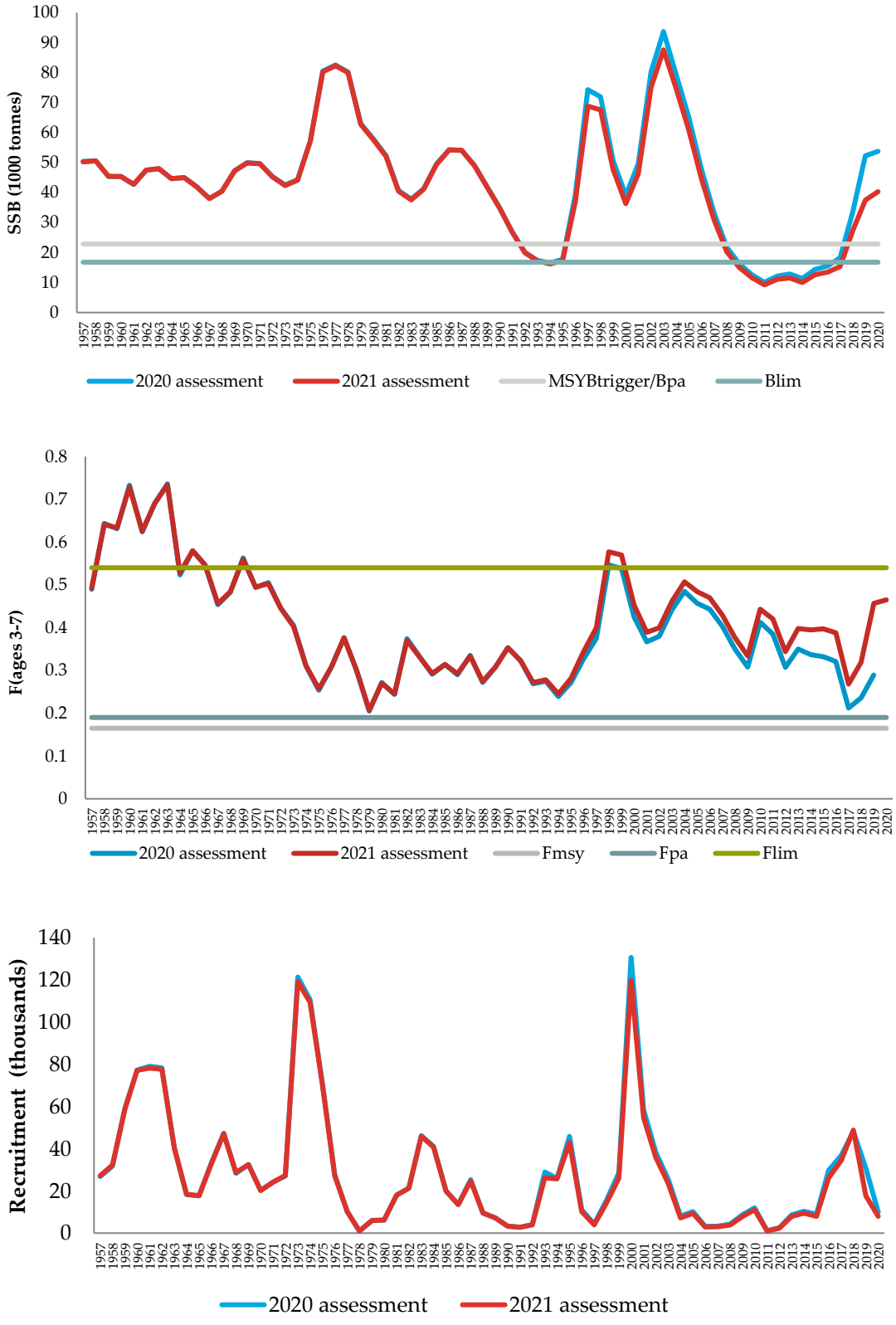

Figure 5.19. Faroe haddock (Division 5.b). Comparison between the November 2020 assessment (blue line) with the assessment (red) in the terminal year.