17 Greenland Halibut in Subareas 5, 6, 12, and 14

Greenland halibut in ICES Subareas 5, 6, 12 and 14 are assessed as one stock unit although precise stock associations are not known.

17.1 Catches, Fisheries, Fleet and Stock Perception

17.1.1 Catches

Total annual catches in Divisions 5.a, 5.b, and Subareas 6, 12 and 14 are presented for the years 1981–2019 in Tables 17.2.1–17.2.6 and since 1961 in Figure 17.2.1. Catches decreased in 2019 by 14% to 23 428 t. Landings in Iceland waters (usually allocated to Division 5a) have historically predominated the total landings in areas 5+14, but since the mid-1990s also fisheries in Subarea 14 and Division 5.b have developed. Total landings have since 1997 been between 20 and 31 kt.

17.1.2 Fisheries and fleets

In 2019 quotas in Greenland EEZ and Iceland EEZ were utilized as in the preceding fishing years. In the Faroe EEZ the fishery is regulated by a fixed numbers of licenses and technical measures like by-catch regulations for the trawlers and depth and gear restrictions for the gillnetters. Catches in 5b decreased in 2019 from 2 917 t to 1986 t.

Most of the fishery for Greenland halibut in Divisions 5.a, 5.b and 14.b is still a directed trawl fishery, but a gillnet fishery has gained importance in Iceland where the proportions of both gillnets and longlines have increased especially in the northern area, where the catches in gillnets are now more than 50% of the catches in 5a. Only minor catches in 5a and 14b are taken as by-catches in a redfish fishery (see section 22 on Greenland slope redfish). No or insignificant discarding has been observed in this fishery.

Spatial distribution of the 2019 fishery and historic effort and catch in the trawl fishery in Subareas 5, 6, 12 and 14 is provided in Figures 17.2.2–5. Fishery in the entire area did in the past occur in a more or less continuous belt on the continental slope from the slope of the Faroe plateau to southeast of Iceland extending north and west of Iceland and further south to southeast Greenland. Fishing depth ranges from 350–500 m southeast, east and north of Iceland to deeper than 1000 m at East Greenland (Figure 17.2.6). In recent years and in 2019 the distribution of the fishery covered all areas but bottom trawling has moved towards a more discontinuous distribution (Figure 17.2.2). Catches in gillnets has increased substantially in 5.a, north of Iceland and in 2019 the majority of the landings were from gillnets (Figure 17.2.7).

In 2001–2008 a directed and a by-catch fishery by Spain, France, Lithuania, UK and Norway developed in the Hatton Bank area of Division 6.b, however, most of these fisheries ceased after 2008. Presently UK, France and Spain have a small fishery in the area. All catches in Subareas 6 and 12 are assumed to derive from the Hatton Bank area (Tables 17.2.5–17.2.6).

17.1.3 By-catch and discard

The Greenland halibut trawl fishery is mostly a clean fishery with little by-catches. Eventual by-catches are mainly redfish and cod. Southeast of Iceland the cod fishery and a minor Greenland halibut fishery are coinciding spatially. In East Greenland where fishery is located on the steep

slope, fishing grounds for cod and redfish are close to the Greenland halibut fishing grounds, but nevertheless the catches from single hauls are clean.

The mandatory use of sorting grids in the shrimp fishery in Iceland since the late 1980s and in Greenland since 2002 was observed to have reduced by-catches considerably. Based on few samplings in 2006–2007, scientific staff observed by-catches of Greenland halibut to be less than 1% compared to about 50% by weight observed before the implementation of sorting grids (Sünksen, 2007). No information has since been available but the fishery in Division 14b generally report discard rates less than 1% by weight in logbooks.

17.2 Trends in Effort and CPUE

17.2.1 Division 5.a

Indices of CPUE for the Icelandic trawl fleet directed at Greenland halibut for the period 1985–2019 is provided in Table 17.3.1 and Figures 17.3.1–2. The overall CPUE index for the Icelandic fishery is compiled as the average of the standardised indices from four areas.

Catch rates of Icelandic bottom trawlers decreased for all fishing grounds during 1990–1996 (Figure 17.3.1), but have since peaked in 2001 and have in recent years been variable with an overall decrease in 2018. The overall tendency is the same for four areas in 5a (Figure 17.3.2) although higher variability is observed in areas north, east and southeast of Iceland.

17.2.2 Division 5.b

Information from logbooks from the Faroese otterboard trawl fleet (>1000 hp) was available for the years 1995-2019 (Table 17.3.1, Figure 17.3.3.). The bulk of the fishery has historically been on the south-east slope of the Faroe Plateau. CPUE has decreased drastically since 2009 coinciding with a significant increase in effort. Catch rates in 2019 are record low at about 50 kg per hour compared to 300 to 400 kg in Divisions 5a and 14b.

17.2.3 Division 14.b

CPUE and effort from logbooks in area 14 are provided in Table 17.3.1 and Figure 17.3.4–5. Following a period with relatively low CPUEs in 1999–2004, catch rates have been variable but increasing and reached in 2016 a record high. Since 2016 CPUE slightly decreased but is maintained at high rates.

CPUE series from Divisions 5a, 5b and 14b show different trends over the time indicating that the populations/areas most likely have different dynamics.

17.2.4 Divisions 6.b and 12.b

Since 2001 a fishery developed in Divisions 6.b and 12.b in the Hatton Bank area by Spain, UK and France. The recent catches are stable but small. Limited fleet information is available from this area (ICES WGDEEP).

17.3 Catch composition

Length compositions of catches from the commercial trawl fishery in Division 5a are rather stable from year to year. In Figure 17.3.1 length distributions are shown since 1996 from Icelandic trawlers. Norwegian length measurements are available for Subarea 14 and France has provided length measurements from Div. 6a.

17.4 Survey information

Three surveys are conducted in the distribution area of the Greenland halibut stock; in East Greenland (14b), in Iceland waters (5a) and in Faroese waters (5b). The total surveyed area in 2019 in Divisions 5.a is provided in Figure 17.4.1. These two surveys in 5.a and 14.b are combined to one index and used as input for the assessment model. Since the Greenland survey in 14b has not been conducted since 2016, the index used for 2016 and onwards are 2016 values. The distribution of the historic catch rates from the two surveys are provided in Figure 17.4.2.

17.4.1 Division 5.a

Since 2006 the total biomass of Greenland halibut has increased significantly in Icelandic waters until 2017 (Figure 17.4.3). In 2018 and 2019 the total biomass has decreased significantly mainly due to lower abundance of smaller fish (less than 40 cm) (Figures 17.4.3 and 17.4.4). Given the continued low abundance of smaller fish, the decrease in total biomass is expected to continue for the next years.

Catch composition data is available from the survey in Icelandic waters are illustrated in Figures 17.4.4 (size) and 17.4.5 (age).

17.4.2 Division 5.b

The catch rates from the available time series of the Faroese survey have declined from a record high level in 2012–13 to about average for the time series in 2019. (Figure 17.4.6). Decreasing catch rates are also seen for the eastern part of Iceland waters adjacent to division 5b indicating a declining stock in this eastern part of its distribution area.

17.4.3 Division 14.b

The Greenland survey have not been conducted since 2016 due to out phasing of old research vessel and lack of ability to get vessel replacement for these years. It is expected that a new research vessel will be in operation in 2021. The text table below provides information for surveys in 5a and 14b on the intended coverage and numbers of stations in 2019.

Survey /Division	No. hauls in 2019 (planned hauls)	Depth range (m)	Coverage (km2)
5.a	203	32 - ~1500	~130 000
14.b	0 (100)	400-1500	29 000

From 1995 to 2016 the total biomass index in 14.b did shown a decreasing trend. The stock annex provides more extensive descriptions of the surveys.

17.5 Stock Assessment

17.5.1 Stock production model

The assessment uses a stochastic version of the logistic production model and Bayesian inference according to the Stock Annex in which a more detailed formulation of the model and its performance is found.

17.5.1.1 Input data

The model synthesizes information from input priors and two independent series of Greenland halibut biomass indices and one series of catches by the fishery (Table 17.5.1). The two series of biomass indices are a revised annually for use in assessment: a standardised series of annual commercial-vessel catch rates in 5a in 1985–2019, $CPUE_t$, and a combined trawl-survey biomass index (5a and 14b) for 1996–2019, $Isur_t$,. In 2017, 2018 and 2019 the survey index is based on the Icelandic survey and the 2016 values from the Greenland survey due to lack Greenland survey data (see section 17.4.3).

Total reported catch or WGs best estimates in ICES Subareas 5, 6, 12 and 14 1961–2019 was used as yield data (Table 17.5.1, Figure. 17.2.1). Since the fishery has no major discarding problems or misreporting, the reported catches were entered into the model as error-free. The assumed catches for 2019 was 25 000 t based on agreed TACs for 5a and 14b and a continued catch level for 5b.

17.5.1.2 Model performance

The model parameters were estimated (posterior) based on the prior assumptions (Table 17.5.2–3 and Figure 17.5.1). The data could not be expected to carry much information on the parameter P_{1960} – the initial stock size 25 years prior to when the series of stock biomass series start – and the posterior resembled the prior (Figure 17.5.1). The prior for K was updated but similar to previous estimates. However, the posterior still had a wide distribution with an inter-quartile range of 713–1069 kt (Table 17.5.3).

The posterior for MSY was positively skewed with upper and lower quartiles at 26 kt and 40 kt (Table 17.5.3). As mentioned above, MSY was relatively insensitive to changes in prior distributions.

The model was able to produce a reasonable simulation of the observed data (Figure 17.5.2). The probabilities of getting more extreme observations than the realised ones given in the data series on stock size were in the range of 0.03 to 0.94 i.e. the observations did not lie in the extreme tails of their posterior distributions (Table 17.5.4). Exceptions are observed for the survey in 1997 (p = 0.94) and in 2019 (p = 0.03). The 2019 observations have, however, high residuals for both indices (-12% and 9%) both outside the quartiles of the model estimate (Figure. 17.5.2).

The retrospective runs suggest high consistency for both biomass and fishing mortality within +- 20% (range 0.03 to 0.043, Figure 17.5.3).

17.5.1.3 Assessment results

The time series of estimated median biomass-ratios starts in 1960 as a virgin stock at K (2xBmsy, Figure. 17.5.4–5). The fishery on the stock starts in 1961. Under continuously increasing fishing mortality the stock declined sharply in the mid–1990s to levels below the optimum, B_{MSY}. Some rebuilding towards B_{MSY} was then seen in the late 1990s. Since then the stock started to increase from its lowest level in 2004–5 of approx. 48% of B_{MSY} and has in recent years been around 70% of B_{MSY} with a slight increase in 2019. The median fishing mortality ratio (F/F_{MSY}) has exceeded F_{MSY} since the 1990s, but has in recent years decreased and are now close to F_{MSY} (Figures 17.5.4-

5 and Table 17.5.5-6). Relative fishing mortality can only be estimated with large uncertainty and the posteriors therefore also include values below F_{MSY}. However, the probability that F exceed F_{MSY} is high for most of the years.

17.5.2 Short-term forecast and management options

Assuming catches of 25 000 t in 2020, a fishery a F_{MSY} (F / F_{MSY} =1) in 2021 will lead to catches of 23 530 t (Table 17.5.7). Fishing at this level in 2021 will result in a 2% increase in biomass in 2022 and constitute an increase in advice of 10%.

Biomass scenarios at various catch options are provided in Figures 17.5.6–7. Catches below 30 kt is estimated to lead to an increase in biomass, while catches of 30 kt will remain biomass at current level over the next decade (Figure 17.5.7). Only catches of less or equal to 20 kt will lead the biomass to reach BMSY within the next decade (Figure 17.5.6).

The risk trajectory associated with ten-year projections of stock development assuming a maintained annual catch in the entire period ranging from 0 to 30 kt were investigated (Figure 17.5.6.–7). The calculated risk is a result of the projected development of the stock and the increase in uncertainty as projections are carried forward. It must be noted that a catch scenario of a maintained constant catch over a decade without considering arrival of new biological information and advice is unrealistic.

Scenarios of fixed levels of fishing mortality ratios within the range of 0.3 to 1.7 were conducted and are shown in Figure 17.5.8. Present biomass is above the MSY $B_{trigger}$ (50% of B_{MSY}) and a fishery at F_{MSY} is advised according the ICES MSY advice rule. Fishing at F_{MSY} will result in slowly increasing yield the next decade.

17.5.3 Reference points

Reference points are unchanged from last benchmark in 2013 (WKBUT, ICES 2013)

17.6 Management considerations

Available biological information and information on distribution of the fisheries suggest that Greenland halibut in East Greenland, Iceland and Faroe Islands belong to the same entity and do mix. Recent information of tagging experiments in the Barents Sea suggests high mixing between the Barents Sea and Iceland. This connectivity is not accommodated for in the present assessment.

A bilateral agreement between Iceland and Greenland since 2014 have limited the overall catches in recent years and assured that fishing pressure is around F_{MSY}. An attempts to include Faroe Islands

17.7 Data consideration and Assessment quality

The Icelandic CPUE series has for many years been used as a biomass indicator in the assessment of the stock. The CPUE of the Greenlandic trawlers and the biomass indices from the Faroese waters have not been used in the assessment, mainly because the stock production model is not able to accommodate contrasting indices (Icelandic CPUE and Greenlandic/Icelandic autumn surveys). A common analysis of all CPUE data from the stock area should possibly be utilized for a combined standardised CPUE index for the assessment. Likewise the Faroese survey should be merged into a combined survey index. This lack of optimal usage of available information

need to be solved at the next benchmark. Further work should also investigate effects of the changes in effort in 5a as the proportion of landings from and distribution of effort of bottom trawls has been substantially reduced.

17.8 Research needs and recommendations

Stock structure and connectivity between the main fishing areas remains unquantified. Basic biological information on spawning and nursery grounds for the juveniles also remains poorly known. Trends of biomass indices over the entire assessment area are not similar and may suggest different dynamics between areas. Further, tagging experiments in the Barents Sea suggest a high connectivity with Iceland waters. Therefore a compilation of present knowledge of stock identification for Greenland halibut in the East Greenland, Iceland, Faroese and Norwegian waters are being reviewed. Workshops in 2019 and 2020 with trans-Atlantic participation from major fishery research institutes is presently analysing historic tag-recapture data with the objective to outline stock structure with focus on evaluating present stock entities in the entire North Atlantic. Further, a Nordic project on Greenland halibut structure run by Greenland Institute of Natural Resources has been initiated in 2020 using several methods, eg. genetics, tagging, otolith microstructure and drift modelling. This project is running until 2022.

A number of issues on the quality of the input biomass indices to the present assessment model are questioned. The Icelandic CPUE series that is based on the principal trawler fleet is assumed to have undergone marked changes with respect to management regulations and spatial distribution. The possibility to estimate these effects by standardization of catch rates should be explored. Similar analyses should be conducted on the remaining CPUE series, in order to evaluate them as indicative of biomass development.

The present assessment model, a stock production model in Bayesian framework, is criticized for its behaviour in relation to the biomass indices. The models use of process error and sensitivity to various priors should be further scrutinized.

At the benchmark in 2013 (WKBUT, ICES 2013) an alternative assessment model, Gadget, was presented. Presently input to the Gadget model is not complete and the approach need further exploration and especially age data from the entire stock distribution area is required.

Ageing of Greenland halibut ceased for many of the marine institutes in Greenland, Iceland, Faroe Island and Norway around 2000 due to reading difficulties and lack of inter-calibration. A new method has been agreed upon and cooperation between institutes has been initiated on age calibration. With respect to the Greenland halibut stock in 5,6,12 and 14 Iceland has now progressed so far that the 5 previous years otolith samplings has been read and the Greenland institute is also in progress. With an ALK some years back and assumptions on constant growth initial exercises with age-based assessment models should be conducted.

17.9 References

ICES. 2013. Report of the Benchmark Workshop on Greenland Halibut Stocks (WKBUT), 26–29 November 2013, Copenhagen, Denmark. ICES CM 2013/ ACOM:44. 367 pp.

ICES. 2017. Report of the Workshop on age reading of Greenland halibut 2 (WKARGH2), 22-26 August 2016, Reykjavik, Iceland. ICES CM 2016/SSGIEOM:16. 40 pp.

Sünksen,K. 2007. Bycatch in the fishery for Greenland halibut. WD 17, NWWG 2007.

17.10 Tables

Table 17.2.1 GREENLAND HALIBUT. Nominal landings (tonnes) by countries, in Sub-areas 5,6,12 and 14 as officially reported to ICES and estimated by WG

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Denmark	-	-	-	-	-	-	6	+	-	-
Faroe Islands	767	1,532	1,146	2,502	1,052	853	1,096	1,378	2,319	1,803
France	8	27	236	489	845	52	19	25	-	-
Germany	3,007	2,581	1,142	936	863	858	565	637	493	336
Greenland	+	1	5	15	81	177	154	37	11	40
Iceland	15,457	28,300	28,360	30,080	29,231	31,044	44,780	49,040	58,330	36,557
Norway	-	-	2	2	3	+	2	1	3	50
Russia	-	-	-	-	-	-	-	-	-	-
UK (Engl. and Wales)	-	-	-	-	-	-	-	-	-	27
UK (Scotland)	-	-	-	-	-	-	-	-	-	-
United Kingdom	-	-	-	-	-	-	-	-	-	
Total	19,239	32,441	30,891	34,024	32,075	32,984	46,622	51,118	61,156	38,813
Working Group estimate	-	-	-	-	-	-	-	-	61,396	39,326

Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Denmark	-	-	-	-	-	1	-			0
Faroe Islands	1,566	2,128	4,405	6,241	3,763	6,148	4,971	3,817	3,884	-
France	-	3	2	-	-	29	11	8	-	2
Germany	303	382	415	648	811	3,368	3,342	3,056	3,082	3,265
Greenland	66	437	288	867	533	1,162	1,129	747	200	1,740
Iceland	34,883	31,955	33,987	27,778	27,383	22,055	18,569	10,728	11,180	14,537
Norway	34	221	846	1,173 [1]	1,810	2,164	1,939	1,367	1,187	1,750
Russia	-	5	-	-	10	424	37	52	138	183
Spain								89		779
UK (Engl. and Wales)	38	109	811	513	1,436	386	218	190	261	370
UK (Scotland)	-	19	26	84	232	25	26	43	69	121
United Kingdom									-	166
Total	36,890	35,259	40,780	37,305	36,006	35,762	30,242	20,360	20,226	22,913
Working Group estimate	37,950	35,423	40,817	36,958	36,300	35,825	30,309	20,382	20,371	26,644

Country	2001	2002	2003 [1]	2004 [1]	2005 [1]	2006 [1]	2007 [1]	2008 [1]	2009 [1]	2010 [1]
Denmark	-	-	-	-	-	-	-	-	-	-
Estonia	-	8	-	-	5	3	-	-	-	-
Faroe Islands	121	334	458	338	1,150	855	1,142	-	270	1,408
France	32	290	177	157	-	62	17	114	-	-
Germany	2,800	2,050	2,948	5,169	5,150	4,299	4,930	4,846	427	5,287
Greenland	1,553	1,887	1,459	-	-	-	155	-	2,819	-
Iceland	16,590	19,224	20,366	15,478	13,023	11,798	9,567	11,671	-	13,293
Ireland	56	-	-	-	-	-	-	-	-	-
Lithuania	-	-	2	1	-	2	3	566		-
Norway	2,243	1,998	1,074	1,233	1,124	1,097	78	639	124	233
Poland	2	16	93	207	-	-	-	1,354	988	960
Portugal	6	130	-	-	-	1,094	-	-	-	-
Russia	187	44	-	262	-	552	501	799	762	1,070
Spain	1,698	1,395	3,075	4,721	506	33	-	-	-	-
UK (Engl. and Wales)	227	71	40	49	10	1	-	-	-	-
UK (Scotland)	130	181	367	367	391	1	-	-	-	-
United Kingdom	252	255	841	1,304	220	93	17	422	581	577
Total	25,897	27,609	30,900	29,286	21,579	19,890	16,410	20,411	5,974	22,901
Working Group estimate	20,703	19,714	20,680	27,102	24,978	21,466	21,402	15,379	28,197	25,995

Country	2011 [1]	2012 [1]	2013 [1]	2014	2015 [1]	2016 [1]	2017 [1]	2018 [1]	2019 [1]
Estonia	-	-	-	429	-	-	-	-	-
Faroe Islands	1,705	2,811	2,788	3,393	3,214	4,656	3,999	2,949	1,973
France	150	67	133	-	117	88	51	71	78
Germany	5,782	4,620	3,814	3,701	3,808	4,420	2,994	4,463	4,483
Greenland	3,415	5,239	3,251	1,897	3,642	1,511	2,692	2,970	2,999
Iceland	13,192	13,749	14,859	9,861	12,400	12,652	11,926	15,214	12,390
Ireland	-	-	-	-	-	-	-	-	-
Lithuania	-	99	-	-	-	-	-	-	-
Norway	171	856	614	764	1,126	1,007	1,002	937	995
Poland	-	786	-	-	-	-	-	-	-
Portugal	-	-	-	-	-	-	-	-	-
Russia	1,095	1,168	1,369	587	600	600	599	400	398
Spain	-	-	-		110	2,105	114	125	82
United Kingdom	323	12	95		127	348	90	13	29
Total	25,693	29,407	26,923	20,743	25,145	27,388	23,466	27,142	23,428
Working Group estimate	26,347			21,069	25,677	25,397			

1) Provisional data

Table 17.2.2 GREENLAND HALIBUT. Nominal landings (tonnes) by countries, in Division 5a, as officially reported to ICES and estimated by WG.

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989
Faroe Islands	325	669	33	46			15	379	719
Germany									
Greenland									
Iceland	15,455	28,300	28,359	30,078	29,195	31,027	44,644	49,000	58,330
Norway			+	+	2				
Total	15,780	28,969	28,392	30,124	29,197	31,027	44,659	49,379	59,049
Working Group estimate									59,272 [2]

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998
Faroe Islands	739	273	23	166	910	13	14	26	6
Germany					1	2	4		9
Greenland					1				
Iceland	36,557	34,883	31,955	33,968	27,696	27,376	22,055	16,766	10,580
Norway									
Total	37,296	35,156	31,978	34,134	28,608	27,391	22,073	16,792	10,595
Working Group estimate	37,308 [2]	35,413 [2]							

Country	1999	2000	2001	2002	2003 [1]	2004 [1]	2005 [1]	2006 [1]	2,007 [1]
Faroe Islands	9		15	7	34	29	77	16	26
Germany	13	22	50	31	23	10	6	1	228
Greenland									155
Iceland	11,087	14,507	2,310 [4]	2,277 [4]	20,360	15,478	13,023	11,798	9,567
Norway							100		77
UK (E/W/I)	26	73	50	21	16	8	8	1	
UK Scotland	3	5	12	16	5	2	27	1	
UK									1
Total	11,138	14,607	2,437	2,352	20,438	15,527	13,241	11,817	10,054
Working Group estimate		14,607	16,752	19,714	20,415	15,477	13,172	11,817	10,054

Country	2008 [1]	2009 [1]	2010 [1]	2011 [1]	2012 [1]	2013 [1]	2014 [1]	2015 [1]	2016 [1]
Faroe Islands	26	93	37	123	585	103	30	18	15
Germany	4	423	797	576	269	386	587	265	
Greenland	224	1285	64	157		92		1	
Iceland	11,671	15,765	13,293	13,192	6,459	14,859	9,859	12,309	12,652
Norway	15		39						
Russia	4								
Poland	3	270							
UK	179								
Total	12,126	17,837	14,230	14,048	7,313	15,440	10,476	12,593	12,667
Working Group estimate	11,859	15,782	14,230	14,048	14,603 [3]	15,440	10,476	12,593	12,667

Country	2017 [1]	2018 [1]	2019 [1]
Faroe Islands	17	31	
Germany	246	552	259
Greenland	3		1
Iceland	11,926	15,214	12,390
Norway			
Russia			
Poland			
UK	15		
Total	12,207	15,797	12,649
Working Group estimate			

1) Provisional data

2) Includes 223 t catch by Norway.

3) Includes 7290 t taken in SA14 in Iceland EEZ

Table 17.2.3 GREENLAND HALIBUT. Nominal landings (tonnes) by countries, in Division 5b as officially reported to ICES and estimated by WG.

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989
Denmark	-	-	-	-	-	-	6	+	-
Faroe Islands	442	863	1,112	2,456	1,052	775	907	901	1,513
France	8	27	236	489	845	52	19	25	...
Germany	114	142	86	118	227	113	109	42	73
Greenland	-	-	-	-	-	-	-	-	-
Norway	2	+	2	2	2	+	2	1	3
UK (Engl. and Wales)	-	-	-	-	-	-	-	-	-
UK (Scotland)	-	-	-	-	-	-	-	-	-
United Kingdom	-	-	-	-	-	-	-	-	-
Total	566	1,032	1,436	3,065	2,126	940	1,043	969	1,589
Working Group estimate	-	-	-	-	-	-	-	-	1,606 [2]

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998
Denmark	-	-	-	-	-	-	-	-	
Faroe Islands	1,064	1,293	2,105	4,058	5,163	3,603	6,004	4,750	3,660
France	...	...	3 [1]	2	1	28	29	11	8 [1]
Germany	43	24	71	24	8	1	21	41	
Greenland	-	-	-	-	-	-	-	-	
Norway	42	16	25	335	53	142	281	42 [1]	114 [1]
UK (Engl. and Wales)	-	-	1	15	-	31	122		
UK (Scotland)	-	-	1	-	-	27	12	26	43
United Kingdom	-	-	-	-	-				
Total	1,149	1,333	2,206	4,434	5,225	3,832	6,469	4,870	3,825
Working Group estimate	1,282 [2]	1,662 [2]	2,269 [2]	-	-		-	-	-

Country	1999	2000 [1]	2001 [1]	2002 [1]	2003 [1]	2004 [1]	2005 [1]	2006 [1]	2007 [1]
Denmark									
Faroe Islands	3873		106	13	58	35	887	817	1,116
France		1	32	4	8	17		40	9
Germany	22								
Norway	87	1	2	1	1		1		1
UK (Engl. and Wales)	9	35	77	50	24	41	2		
UK (Scotland)	66	116	118	141	174	87	204		
United Kingdom								19	1
Total	4057	153	335	209	265	180	1,094	876	1,127
Working Group estimate	0 [2]	5079	3,951	0	265	1,771	892	873	1,060

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016
Denmark									
Faroe Islands			1,037	1,476	2,149	2,560	2,953	3,139	4,633
France	36		35	1	13	20		28	16
Germany									
Iceland								45	
Ireland									
Norway	1	1	5				3	10	8
United Kingdom	32	117	336	11		2	2	9	
Total	69	118	1,413	1,489	2,162	2,582	2,958	3,231	4,658
Working Group estimate	1,759	1,739	1,413	1,489	2,162	2,582	2,958	3,231	4,658

Country	2017 [1]	2018 [1]	2019 [1]
Denmark			
Faroe Islands	3,548	2,903	1,973
France	7	8	7
Germany			
Iceland			
Ireland			
Norway	6	5	1
United Kingdom	15	1	5
Total	3,576	2,917	1,986
Working Group estimate			

1) Provisional data
2) WG estimate includes additional catches as described in Working Group reports for each year and in the report from 2001.

Table 17.2.4 GREENLAND HALIBUT. Nominal landings (tonnes) by countries, in Sub-area 14 as officially reported to ICES and estimated by WG.

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989
Faroe Islands	-	-	-	-	-	78	74	98	87
Germany	2,893	2,439	1,054	818	636	745	456	595	420
Greenland	+	1	5	15	81	177	154	37	11
Iceland	-	-	1	2	36	17	136	40	+
Norway	-	-	-	+	-	-	-	-	-
Russia	-	-	-	-	-	-	-	-	+
UK (Engl. and Wales)	-	-	-	-	-	-	-	-	-
UK (Scotland)	-	-	-	-	-	-	-	-	-
United Kingdom	-	-	-	-	-	-	-	-	-
Total	2,893	2,440	1,060	835	753	1,017	820	770	518
Working Group estimate	-	-	-	-	-	-	-	-	-

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998
Denmark	-	-	-	-	-	-	1	+	+
Faroe Islands	-	-	-	181	168	147	130	148	151
Germany	293	279	311	391	639	808	3,343	3,301	3,399
Greenland	40	66	437	288	866	533	1,162	1,129	747 [1,7]
Iceland	-	-	-	19	82	7	-	1,803	148
Norway	8	18	196	511	1,120	1,668	1,881	1,897 [1]	1,253 [1]
Russia	-	-	5	-	-	10	424	37	52
UK (Engl. and Wales)	27	38	108	796	513	1405	264	218	190
UK (Scotland)	-	-	18	26	84	205	13		
United Kingdom	-	-	-	-	-	-	-		
Total	368	401	1,075	2,212	3,472	4,783	7,218	8,533	5,940
Working Group estimate	736 [2]	875 [3]	1,176 [4]	2,249 [5]	3,125 [6]	5,077 [7]	7,283	8,558	

Country	1999	2000	2001 [1]	2002 [1]	2003 [1]	2004 [1]	2005 [1]	2006 [1]	2007 [1]
Denmark									
Faroe Islands	2			274	366	274	186	22	
Germany	3,047	3,243	2,750	2,019	2,925	5,159	5,144	4,298	4,702
Greenland	200 [1,4]	1,740	1,553	1,887	1,459				
Iceland	93	30	14,280	16,947	6				
Ireland			7						
Norway	1,100	1,161	1,424	1,660	846	1,114	1,023	1,094	
Poland						205			
Portugal			6	130				1,094	
Russia	138	183	186	44		261		505	500
Spain		8	10		2,131	3,406	2		
UK (Engl. and Wales)	226	262	100						
UK (Scotland)				24	188	278	160		
United Kingdom				178	799	1,294			
Total	4,806	6,627	20,316	22,889	8,720	11,991	6,515	7,013	5,202
Working Group estimate	0	6958	0 [6]	0 [6]	0	9,854	10,185	8,589	10,261

Country	2008 [1]	2009 [1]	2010 [1]	2011 [1]	2012 [1]	2013 [1]	2014 [1]	2015 [1]	2016 [1]
Estonia							429		
Faroe Islands		270	333		77	125	409	57	7
Germany	4,842	4	4,490	5,206	4,351	3,428	3,114	3,543	4,420
Greenland		2,819		3,258	5,239	3,159	1,897	3,641	1,511
Iceland					7,290		3	46	
Ireland									
Norway	637	29	226	164	853	613	761	1,115	996
Poland	1,354	718	960		786				
Portugal									
Russia	763		1,070	1,095	1,168	1,369	587	600	600
Spain									
United Kingdom	131	452	229	309	1	1			0
Total	7,727	4,292	7,308	10,032	19,765	8,694	7,200	9,002	7,534
Working Group estimate	9,005	9,805	10,402	10,761	12,475		7,526	9,534	7,534

Country	2017 [1]	2018 [1]	2019 [1]
Estonia			
Faroe Islands	434	15	0
Germany	2,747	3,911	4,225
Greenland	2,689	2,970	2,999
Iceland			
Ireland			
Norway	995	931	993
Poland			
Portugal			
Russia	599	400	398
Spain			
United Kingdom	1	1	0
Total	7,466	8,228	8,615
Working Group estimate	0	0	0

1) Provisional data

2)WG estimate includes additional catches as described in working Group reports for each year and in the report from 2001.

3) Includes 125 t by Faroe Islands and 206 t by Greenland.

4) Excluding 4732 t reported as area unknown.

5) Includes 1523 t by Norway, 102 t by Faroe Islands, 3343 t by Germany, 1910 t by Greenland, 180 t by Russia, as reported to Greenland authorities.

6) Does not include most of the Icelandic catch as those are included in WG estimate of Va.

7) Excluding 138 t reported as area unknown.

Table 17.2.5 GREENLAND HALIBUT. Nominal landings (tonnes) by countries in Sub-area 12, as officially reported to the ICES and estimated by WG

Country	1996	1997	1998	1999	2000	2001	2002	2003 [1]	2004 [1]
Faroe Islands		47					40		
France					1			4	30
Ireland						49			
Lithuania								2	1
Poland						2		2	1
Spain [2]	2	42	67	137	751	1338	28	730	1145
UK					7	5			
Russia									
Norway	2				553	500	316	201	119
Estonia									
Total	4	89	67	137	1,312	1,894	384	939	1,296
WG estimate									

Country	2005 [1]	2006 [1]	2007 [1]	2008 [1]	2009 [1]	2010 [1]	2011 [1]	2012 [1]	2013 [1]
Faroe Islands							106		
France									
Ireland									
Lithuania		2	3	566				97	
Poland									
Spain [2]	501								
UK	3								
Russia		46	1		762				
Norway					94				
Estonia		2							
Total	504	50	4	566	856	0	106	97	0
WG estimate	504	50	4	566	856	0	106	97	0

Country	2014 [1]	2015 [1]	2016 [1]	2017 [1]	2018 [1]	2019 [1]
Faroe Islands						
France						
Ireland						
Lithuania						
Poland						
Spain [2]	67	91	78	74	95	62
UK						
Russia						
Norway			0			
Estonia						
Total	67	91	78	74	95	62
WG estimate	67	91	78	74	95	62

[1] Provisional data

[2] Based on estimates by observers onboard vessels

Table 17.2.6 GREENLAND HALIBUT. Nominal landings (tonnes) by countries in Sub-area 6, as officially reported to the ICES and estimated by WG.

Country	1996	1997	1998	1999	2000	2001	2002	2003 [1]	2004 [1]
Estonia							8		
Faroe Islands									
France							286	165	110
Poland							16	91	1
Spain [2]			22	88	20	350	1367	214	170
UK					159	247	77	42	10
Russia						1			1
Norway					35	317	21	26	
Total	0	0	22	88	214	915	1775	538	292
WG estimate									

Country	2005 [1]	2006 [1]	2007 [1]	2008 [1]	2009 [1]	2010 [1]	2011 [1]	2012 [1]	2013 [1]
Estonia	5	1							
Faroe Islands						1			0
France		22	8	114		38	8	54	113
Poland									
Spain [2]	3	33							
UK	217	74	15	80	12	11	3	11	93
Russia		1		32					
Norway		3		1	3	2	7	3	1
Lithuania				968				2	
Total	225	134	23	1195	15	52	18	70	207
WG estimate	225	134	23	1195	15	52	18	70	207

Country	2014 [1]	2015 [1]	2016 [1]	2017 [1]	2018 [1]	2019 [1]
Estonia						
Faroe Islands	1		1			
France		89	72	44	63	71
Poland						
Spain [2]		18	17	39	30	21
UK	42	119	348	58	12	24
Russia						0
Norway	0	1	3	1	0	0
Lithuania						
Total	43	227	440	142	105	117
WG estimate	43	227	440	142	105	117

[1] Provisional data

[2] Based on estimates by observers onboard vessels

Table 17.3.1. CPUE indices from trawl fleets in Division 5.a, 5.b and 14.b as derived from GLM multiplicative models.

area	year	rel. CPUE	% change in CPUE	landings (tonnes)	relative derived	% change in effort
Iceland 5a	1985	1.00		29,197	29	
	1986	0.98	-2	31.027	32	8
	1987	0.93	-5	44,659	48	52
	1988	0.88	-5	49,379	56	17
	1989	0.78	-11	59,272	76	35
	1990	0.75	-4	37,308	50	-34
	1991	0.74	-1	35,413	48	-4
	1992	0.67	-9	31,978	48	0
	1993	0.53	-21	34,134	64	34
	1994	0.44	-18	28.608	65	2
	1995	0.35	-20	27,391	78	19
	1996	0.30	-14	22,073	73	-7
	1997	0.32	6	16,792	52	-28
	1998	0.51	57	10,595	21	-60
	1999	0.57	12	11,138	20	-6
	2000	0.60	6	14,607	24	24
	2001	0.62	2	16,752	27	12
	2002	0.49	-21	19,714	41	49
	2003	0.36	-26	20,415	57	41
	2004	0.30	-17	15,477	52	-9
	2005	0.28	-6	13,172	47	-10
	2006	0.38	34	11,817	31	-33
	2007	0.47	25	10,525	22	-29
	2008	0.40	-13	9,580	24	5
	2009	0.42	4	15,782	37	58
	2010	0.42	-1	13.565	33	-13
	2011	0.44	4	14,048	32	-1
	2012	0.46	5	7,312	16	-50
	2013	0.47	2	15,439	33	107
	2014	0.43	-7	10,475	24	-27
	2015	0.46	8	12,593	27	12
	2016	0.45	-3	12,667	28	4
	2017	0.43	-5	12,207	29	1
	2018	0.41	-4	15.797	39	35
	2019	0.51	24	12,649	25	-36
Greenland 14b	1991	1.0		875	1	
	1992	1.0	-4	1,176	1	40
	1993	2.5	157	2,249	1	-26
	1994	3.2	30	3,125	1	7
	1995	3.2	0	5,077	2	62
	1996	3.1	-2	7,283	2	47
	1997	3.3	4	8.558	3	13
	1998	3.1	-3	5,940	2	-28
	1999	2.3	-28	5,376	2	26
	2000	2.1	-6	6,958	3	37
	2001	2.2	6	7,216	3	-2
	2002	2.4	8	6,621	3	-15
	2003	2.5	1	8,017	3	20
	2004	2.3	-7	9.854	4	32
	2005	3.2	40	10,185	3	-26
	2006	3.3	4	8590	3	-19
	2007	3.1	-6	10261	3	27
	2008	3.1	1	8,952	3	-13
	2009	2.6	-17	10,567	4	41
	2010	2.7	4	10,402	4	-5
	2011	2.7	0	10,761	4	4
	2012	3.2	18	12,475	4	-2
	2013	3.0	-7	12,476	4	8
	2014	3.1	5	7,526	2	-43
	2015	3.4	10	9,534	3	15
	2016	4.3	26	7,534	2	-37
	2017	4.2	-3	7,466	2	2
	2018	4.1	-3	8,228	2	13
	2019	3.9	-3	8,615	2	8
Faroe Islands 5b	1995	1.0		3,832	4	
	1996	0.9	-10	6,469	7	88
	1997	1.0	7	4,870	5	-30
	1998	0.8	-14	3,825	5	-8
	1999	1.0	19	4,057	4	-11
	2000	1.0	-1	5,079	5	26
	2001	0.9	-11	3,951	5	-12
	2002	0.7	-16	209	0	-94
	2003	0.9	27	265	0	0
	2004	0.7	-22	1,771	2	759
	2005	0.8	6	892	1	-52
	2006	0.8	8	873	1	-9
	2007	0.7	-18	1,060	2	48
	2008	0.8	17	1,759	2	42
	2009	0.9	14	1,739	2	-13
	2010	0.8	-10	1,413	2	-10
	2011	1.2	50	1.489	1	-30
	2012	1.1	-7	2,162	2	57
	2013	0.8	-30	2,582	3	71
	2014	1.0	21	2,958	3	-6
	2015	0.8	-17	3,231	4	32
	2016	0.9	10	4,658	5	31
	2017	0.7	-17	3,576	5	-7
	2018	0.5	-30	2.917	6	17
	2019	0.4	-12	1986	5	-22

Table 17.5.1. Assessment input data series: Catch by the fishery; three indices of stock biomass – a standardized catch rate index based on fishery data (CPUE) from the Iceland EEZ, a combined Icelandic and Greenland research survey index.

Year	Catch (ktons)	CPUE (index)	Survey (ktons)
1960	0	-	-
1961	0.029	-	-
1962	3.071	-	-
1963	4.275	-	-
1964	4.748	-	-
1965	7.421	-	-
1966	8.030	-	-
1967	9.597	-	-
1968	8.337	-	-
1969	26.200	-	-
1970	33.823	-	-
1971	28.973	-	-
1972	26.473	-	-
1973	20.463	-	-
1974	36.280	-	-
1975	23.494	-	-
1976	6.045	-	-
1977	16.578	-	-
1978	14.349	-	-
1979	23.622	-	-
1980	31.157	-	-
1981	19.239	-	-
1982	32.441	-	-
1983	30.891	-	-
1984	34.024	-	-
1985	32.075	1.76	-
1986	32.984	1.73	-
1987	46.622	1.64	-
1988	51.118	1.55	-
1989	61.396	1.84	-
1990	39.326	1.32	-
1991	37.950	1.31	-
1992	35.487	1.18	-
1993	41.247	0.94	-
1994	37.190	0.77	-
1995	36.288	0.62	-
1996	35.932	0.54	63.8
1997	30.309	0.57	81.1
1998	20.382	0.89	90.4
1999	20.371	1.00	87.9
2000	26.644	1.06	91.4
2001	27.291	1.09	104.0
2002	29.158	0.86	60.8
2003	30.891	0.63	48.8
2004	27.102	0.53	34.9
2005	24.249	0.49	54.7
2006	21.432	0.66	36.1
2007	20.957	0.83	46.9
2008	22.169	0.72	54.1
2009	27.349	0.74	78.4
2010	25.995	0.73	54.2
2011	26.424	0.77	67.3
2012	29.309	0.81	79.1
2013	27.045	0.82	83.8
2014	21.069	0.76	73.3
2015	25.677	0.82	78.7
2016	25.397	0.79	72.2
2017	23.466	0.75	84.0
2018	27.141	0.72	58.8
2019	23.428	0.89	45.8
2020*	25.000		

*assumed

Table 17.5.2. Priors used in the assessment model. ~ means "distributed as..", dunif = uniform-, dlnorm = lognormal-, dnorm= normal- and dgamma = gammadistributed. Symbols as in text.

Parameter		Prior	
Name	Symbol	Type	Distribution
Maximal Suatainable Yield	*MSY*	reference	dunif(1,300)
Carrying capacity	*K*	low informative	dnorm(750,300)
Catchability Iceland survey	q_{Ice}	reference	$\ln(q_{Ice})$~dunif(-3,1)
Catchability Greenland survey	q_{Green}	reference	$\ln(q_{Green})$~dunif(-3,1)
Catchability Iceland CPUE	q_{cpue}	reference	$\ln(q_{cpue})$~dunif(-10,1)
Initial biomass ratio	P_1	informative	dnorm(2,0.071)
Precision Iceland survey	$1/\sigma_{Ice}^2$	low informative	dgamma(2.5,0.03)
Precision Greenland survey	$1/\sigma_{Green}^2$	low informative	dgamma(2.5,0.03)
Precision Iceland CPUE	$1/\sigma_{cpue}^2$	low informative	dgamma(2.5,0.03)
Precision model	$1/\sigma_P^2$	reference	dgamma(0.01,0.01)

Table 17.5.3. Summary of parameter estimates: mean, standard deviation (sd) and 25, 50, and 75 percentiles of the posterior distribution of selected parameters (symbols as in the text).

	Mean	sd	25%	Median	75%
MSY (ktons)	32.51	10.06	26.29	32.08	38.05
K (ktons)	897	256	713	885	1069
r	0.16	0.07	0.11	0.15	0.20
q_{cpue}	0.003	0.001	0.002	0.003	0.003
q_{Survey}	0.24	0.09	0.18	0.22	0.28
P_{1985}	1559	0.12	1479	1561	1644
P_{2018}	0.67	0.09	0.61	0.67	0.73
σ_{cpue}	0.09	0.02	0.08	0.09	0.11
σ_{Survey}	0.20	0.03	0.18	0.20	0.22
σ_P	0.15	0.03	0.14	0.15	0.17

Table 17.5.4. Model diagnostics: residuals (% of observed value), probability of getting a more extreme observation (p.extreme; see text for explanation).

	CPUE		Survey	
Year	resid (%)	Pr	resid (%)	Pr
1985	-2.04	0.56		-
1986	-0.95	0.53		-
1987	0.84	0.47		-
1988	3.13	0.39		-
1989	-8.93	0.77		-
1990	3.50	0.39		-
1991	-2.11	0.57		-
1992	-3.22	0.60		-
1993	0.37	0.49		-
1994	0.78	0.48		-
1995	5.03	0.35		-
1996	11.81	0.17	-19.15	0.81
1997	14.79	0.11	-34.89	0.94
1998	-2.72	0.60	-18.57	0.80
1999	-1.85	0.56	-3.37	0.56
2000	-1.91	0.56	-1.40	0.52
2001	-4.83	0.66	-15.38	0.76

2002	-4.73	0.65	15.51	0.24
2003	0.61	0.48	11.91	0.29
2004	1.53	0.45	27.06	0.11
2005	8.40	0.24	-16.84	0.78
2006	-8.00	0.75	38.01	0.04
2007	-13.40	0.87	28.06	0.10
2008	-0.14	0.50	12.80	0.28
2009	1.33	0.46	-18.82	0.81
2010	-0.20	0.51	15.26	0.24
2011	0.08	0.50	-0.67	0.51
2012	1.66	0.44	-11.52	0.70
2013	0.92	0.47	-15.43	0.76
2014	4.05	0.37	-6.64	0.62
2015	0.31	0.49	-9.84	0.68
2016	1.16	0.46	-4.08	0.58
2017	3.84	0.37	-21.81	0.84
2018	2.89	0.40	8.82	0.34
2019	-11.69	0.82	8.82	0.03

Table 17.5.5. Stock status for 2019 and predicted to the end of 2020 assuming catches of 25000 t in 2020.

Status	2019	2020
Risk of falling below Blim (0.3BMSY)	0%	0%
Risk of falling below BMSY	100%	88%
Risk of exceeding FMSY	54%	55%
Risk of exceeding Flim (1.7FMSY)	11%	15%
Stock size (B/Bmsy), median	0.73	0.75
Fishing mortality (F/Fmsy),	1.04	1.06
Productivity (% of MSY)	93%	94%

Table 17.5.6. Summary of assessment.

Year	B/Bmsy	high	low	Catch (ktons)	F/Fmsy	high	low
1960	2.000	2.114	1.884	0.000	0.000	0.001	0.000
1961	2.000	2.108	1.889	0.029	0.000	0.001	0.000
1962	2.000	2.105	1.892	3.071	0.048	0.091	0.031
1963	1.992	2.096	1.886	4.275	0.067	0.128	0.043
1964	1.983	2.087	1.878	4.748	0.075	0.142	0.048
1965	1.974	2.078	1.870	7.421	0.118	0.223	0.075
1966	1.959	2.067	1.856	8.030	0.128	0.243	0.082
1967	1.946	2.056	1.843	9.597	0.154	0.291	0.098
1968	1.931	2.042	1.827	8.337	0.135	0.255	0.086
1969	1.922	2.035	1.816	26.200	0.427	0.807	0.271
1970	1.869	1.993	1.756	33.823	0.568	1.067	0.359
1971	1.809	1.943	1.678	28.973	0.505	0.942	0.315
1972	1.768	1.908	1.626	26.473	0.473	0.884	0.293
1973	1.738	1.882	1.590	20.463	0.372	0.697	0.229
1974	1.726	1.870	1.577	36.280	0.664	1.256	0.407
1975	1.678	1.831	1.513	23.494	0.444	0.841	0.269
1976	1.665	1.822	1.499	6.045	0.115	0.220	0.069
1977	1.695	1.844	1.538	16.578	0.308	0.598	0.186
1978	1.697	1.846	1.536	14.349	0.266	0.521	0.161
1979	1.703	1.852	1.540	23.622	0.436	0.861	0.263
1980	1.686	1.838	1.517	31.157	0.581	1.154	0.350
1981	1.651	1.812	1.477	19.239	0.366	0.730	0.219
1982	1.652	1.814	1.472	32.441	0.617	1.242	0.369
1983	1.618	1.791	1.432	30.891	0.601	1.214	0.355
1984	1.592	1.774	1.398	34.024	0.673	1.369	0.395
1985	1.561	1.752	1.358	32.075	0.647	1.325	0.377

1986	1.543	1.893	1.266	32.984	0.673	1.388	0.378
1987	1.490	1.849	1.207	46.622	0.984	2.041	0.553
1988	1.440	1.794	1.165	51.118	1.118	2.311	0.626
1989	1.519	1.899	1.213	61.396	1.278	2.654	0.704
1990	1.231	1.541	0.990	39.326	1.008	2.083	0.561
1991	1.156	1.446	0.929	37.950	1.036	2.146	0.573
1992	1.031	1.287	0.827	35.487	1.088	2.248	0.603
1993	0.849	1.061	0.686	41.247	1.529	3.170	0.852
1994	0.698	0.874	0.565	37.190	1.675	3.462	0.935
1995	0.586	0.737	0.475	36.288	1.943	4.023	1.092
1996	0.546	0.689	0.442	35.932	2.065	4.293	1.166
1997	0.593	0.755	0.479	30.309	1.604	3.309	0.897
1998	0.780	0.978	0.628	20.382	0.826	1.701	0.456
1999	0.884	1.100	0.713	20.371	0.727	1.504	0.404
2000	0.937	1.167	0.756	26.644	0.896	1.856	0.498
2001	0.927	1.157	0.747	27.291	0.930	1.926	0.514
2002	0.739	0.918	0.596	29.158	1.245	2.578	0.693
2003	0.571	0.708	0.462	30.891	1.703	3.530	0.955
2004	0.476	0.590	0.385	27.102	1.792	3.706	1.009
2005	0.479	0.598	0.388	24.249	1.590	3.289	0.895
2006	0.550	0.682	0.440	21.432	1.232	2.550	0.685
2007	0.648	0.809	0.514	20.957	1.024	2.124	0.564
2008	0.639	0.794	0.517	22.169	1.228	2.540	0.688
2009	0.675	0.841	0.547	27.349	1.277	2.640	0.713
2010	0.656	0.815	0.530	25.995	1.249	2.586	0.698
2011	0.694	0.863	0.562	26.424	1.199	2.480	0.669
2012	0.732	0.911	0.593	29.309	1.262	2.608	0.704
2013	0.745	0.930	0.603	27.045	1.145	2.371	0.635
2014	0.712	0.889	0.575	21.069	0.932	1.924	0.520
2015	0.740	0.922	0.599	25.677	1.093	2.259	0.609
2016	0.719	0.896	0.582	25.397	1.112	2.301	0.621
2017	0.701	0.877	0.568	23.466	1.055	2.174	0.587
2018	0.668	0.831	0.540	27.141	1.279	2.659	0.716
2019	0.716	0.900	0.561	23.428	1.034	2.183	0.567
2020	0.729	1.049	0.503				

Table 17.5.7. Catch forecast. Assumptions for 2020 and catch scenarios for 2021.

Variable		Value		Notes	
F (2020) (F/F_{MSY})		1.06		F corresponding to catches of 25 000t	
Biomass (2021) (B/B_{MSY})		0.76		Estimated by the model	
Total catch (2020)		25000 t		Based on TACs of Iceland, Greenland, and assumed catches in 5b.	
Basis	Total catch (2021)	F_{total} (2021) F/F_{MSY}	Biomass (2022) B/B_{MSY}	% Biomass change	% advice change*
ICES advice basis					
MSY approach: F_{MSY}	23530	1.0	0.78	1.6	10.2
Other scenarios					
F = 0	0	0	0.80	5.5	-100
$F = F_{2019}$	24930	1.06	0.76	0.07	16.7
$F = F_{lim}$	40070	1.70	0.72	-5.1	88.6

17.11 Figures

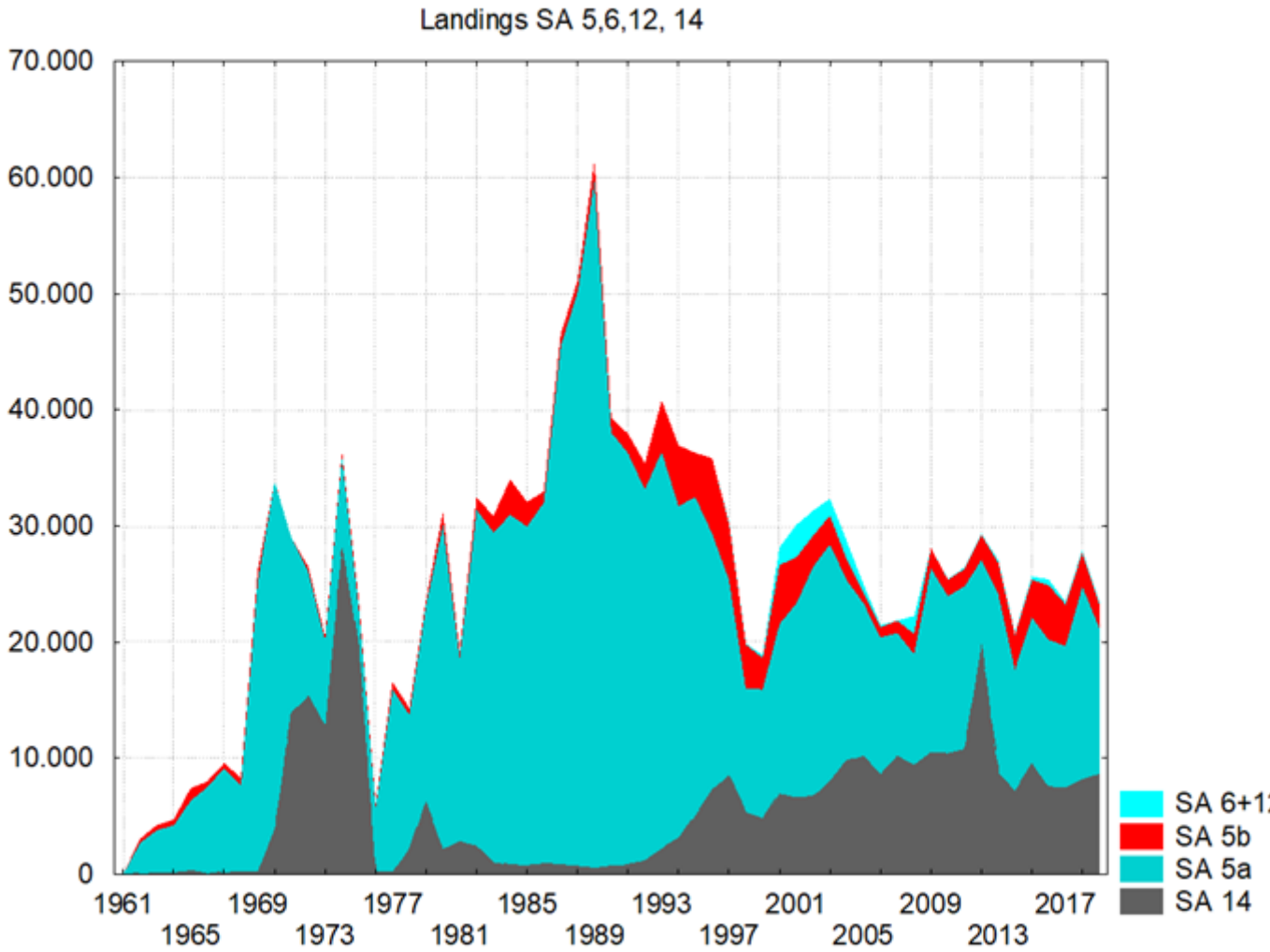

Fig. 17.2.1. Landings of Greenland halibut in Divisions 5, 6, 12 and 14. As the landings within Icelandic waters, since 1976, have not officially been separated and reported according to the defined ICES statistical areas, they are set under area 5a by the NWWG. In 2012 Icelandic landings in Div 14 were only partly recorded in 14, while for remaining years all landings are recorded in 5a.

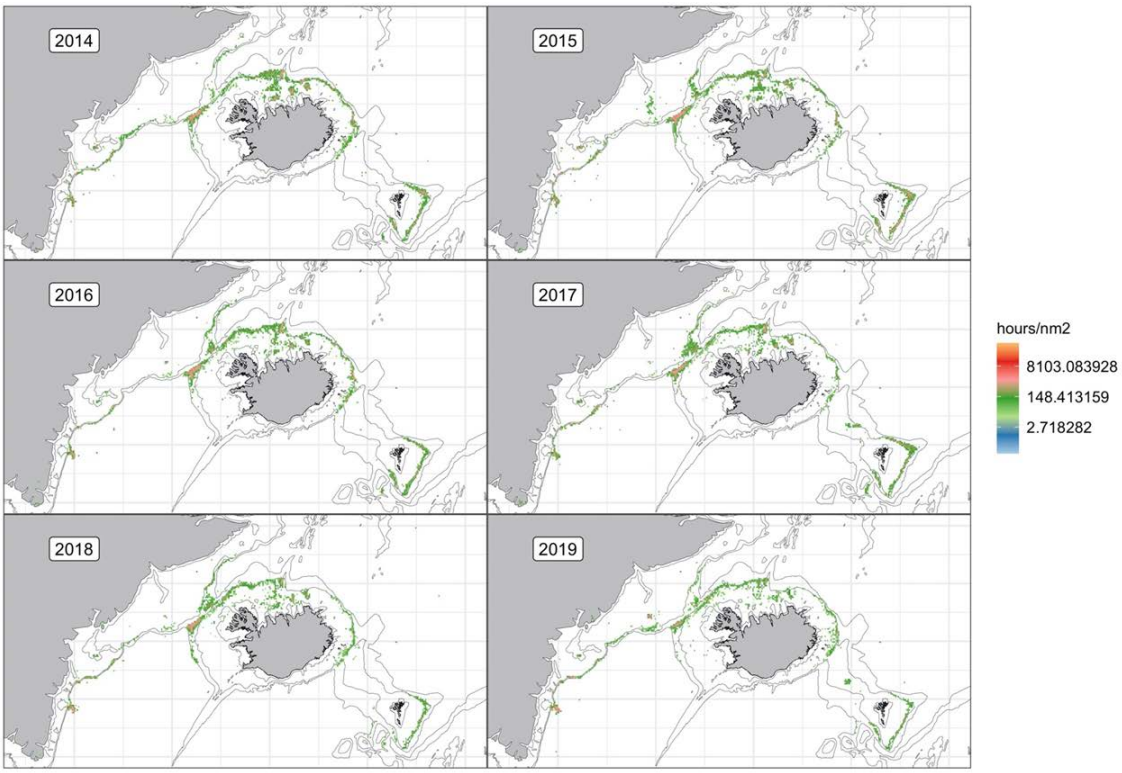

Fig. 17.2.2 Greenland halibut 5+14. Distribution of fishing effort 2014-19. 500m and 1000 m depth contours are shown.

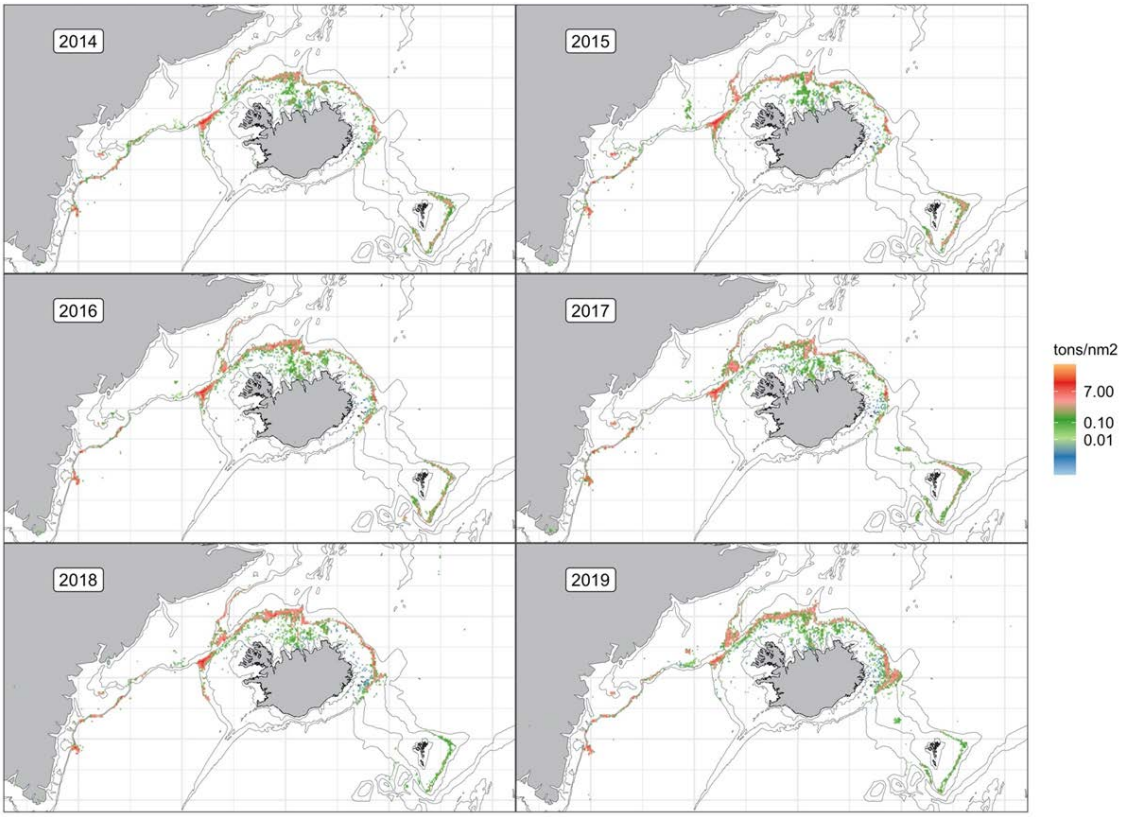

Fig. 17.2.3. Greenland halibut V+XIV. Distribution of catches in the fishery 2014-2019. 500m and 1000 m depth contours are shown.

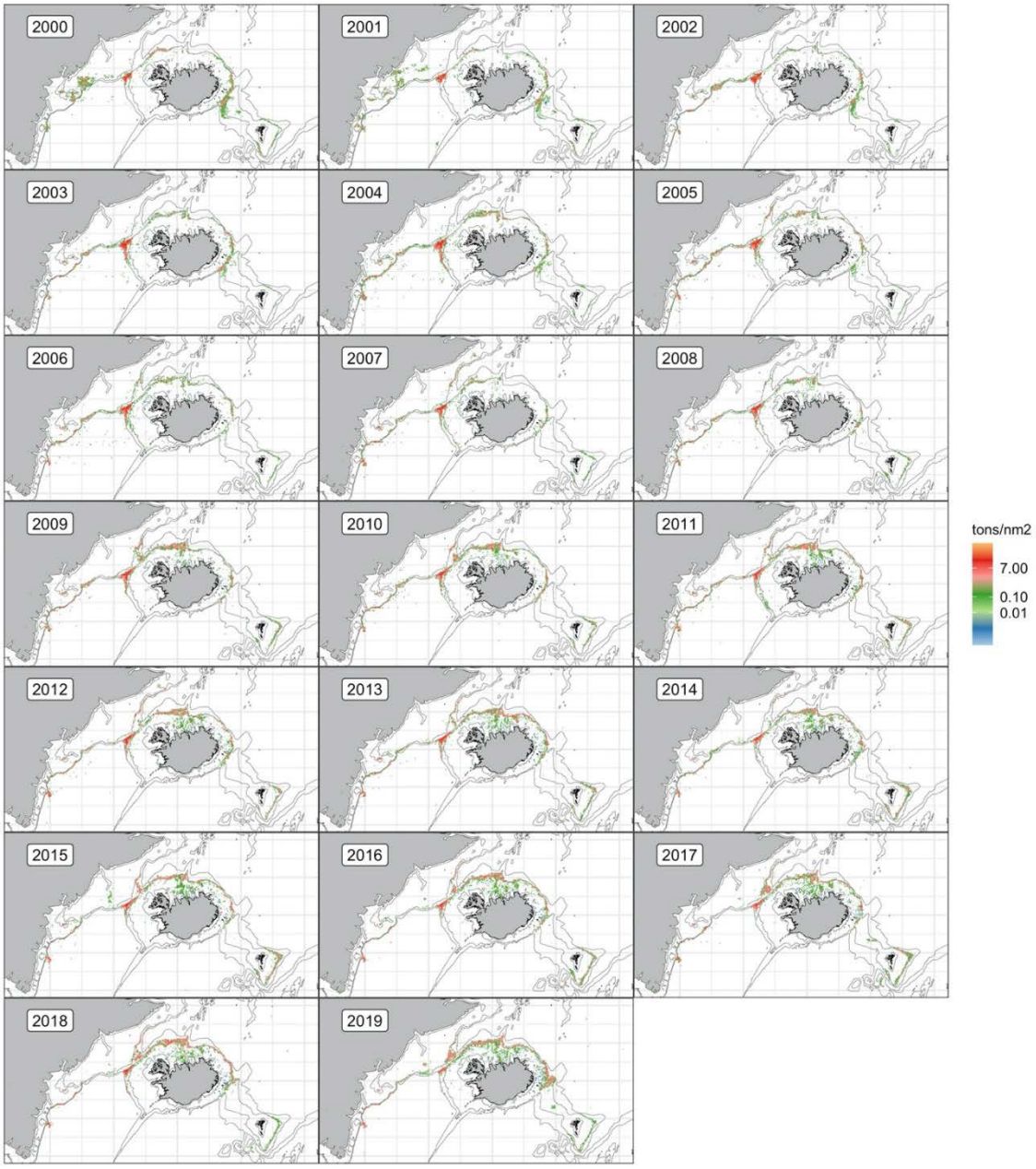

Fig. 17.2.4. Greenland halibut 5+14. Distribution of total fishing effort 2000-2019. The 500m and 1000 m depth contours are shown.

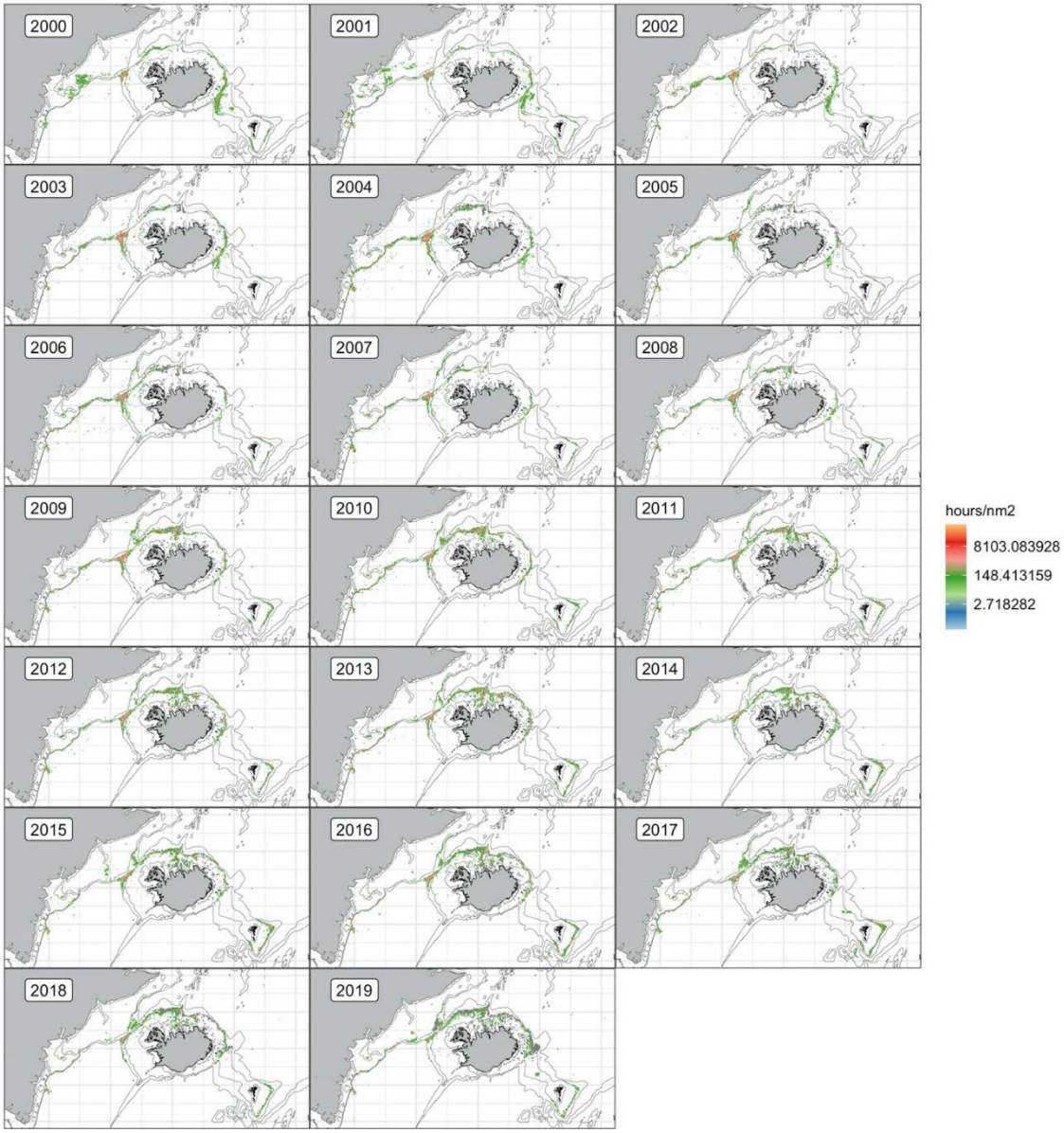

Fig. 17.2.5. Greenland halibut 5+14. Distribution of total catches in the fishery 2000-2019 500m and 1000 m depth contours are shown.

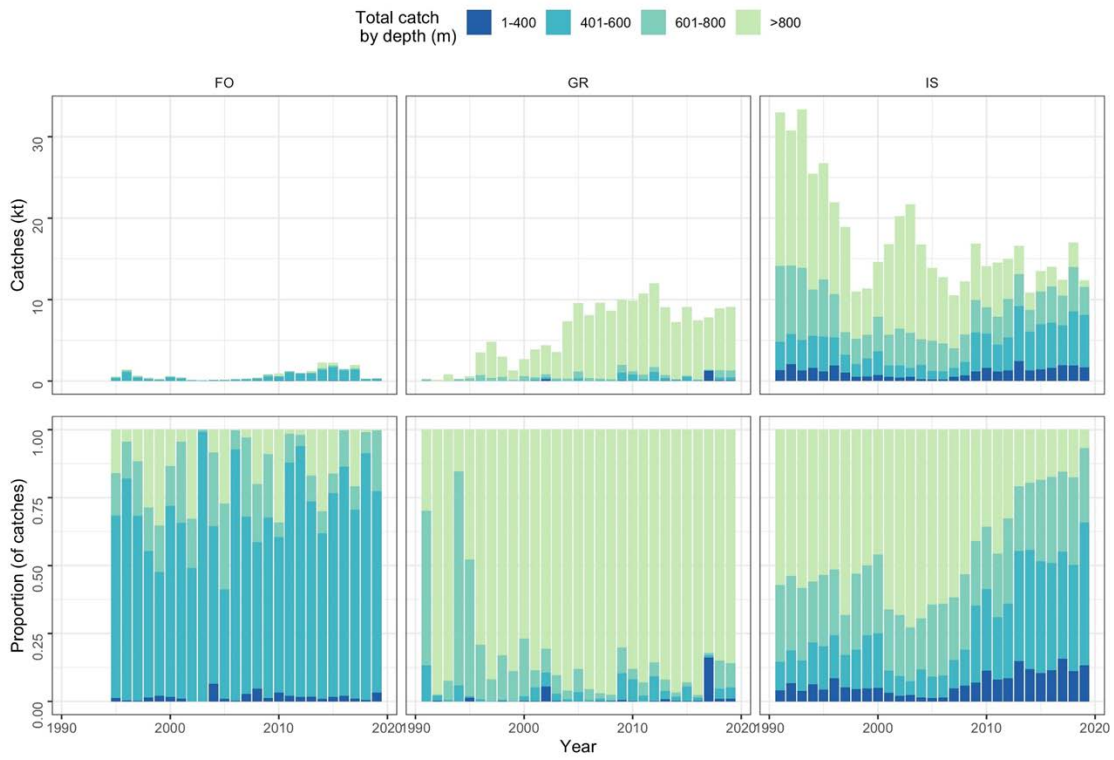

Fig 17.2.6. Greenland halibut 5+14. Depth distribution by EEZ from 1990 to 2019.

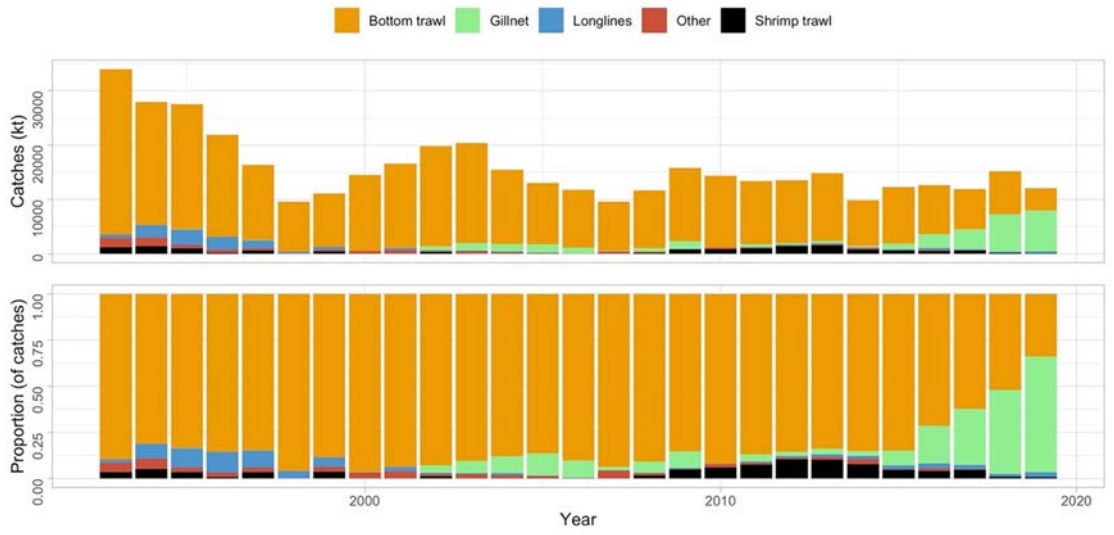

Fig. 17.2.7. Greenland halibut 5+14. Division of landings by gear in 5a.

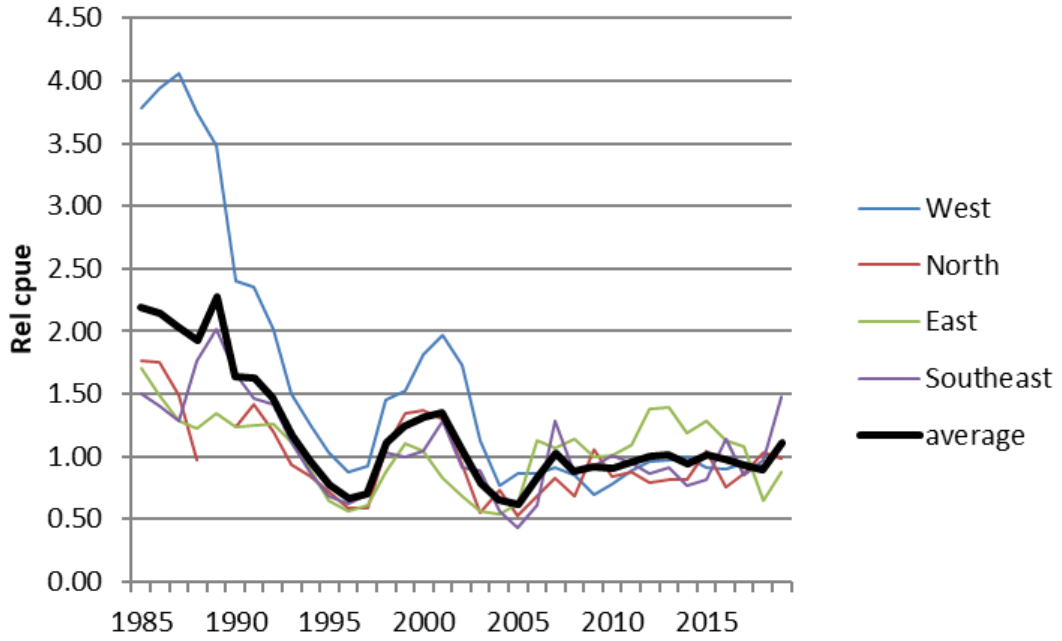

Fig. 17.3.1. Standardised CPUEs from the Icelandic trawler fleet in 5a. Area 1-4 are west, north, east and south-east, respectively. The average index of the four areas is used as biomass indicator in the stock production model.

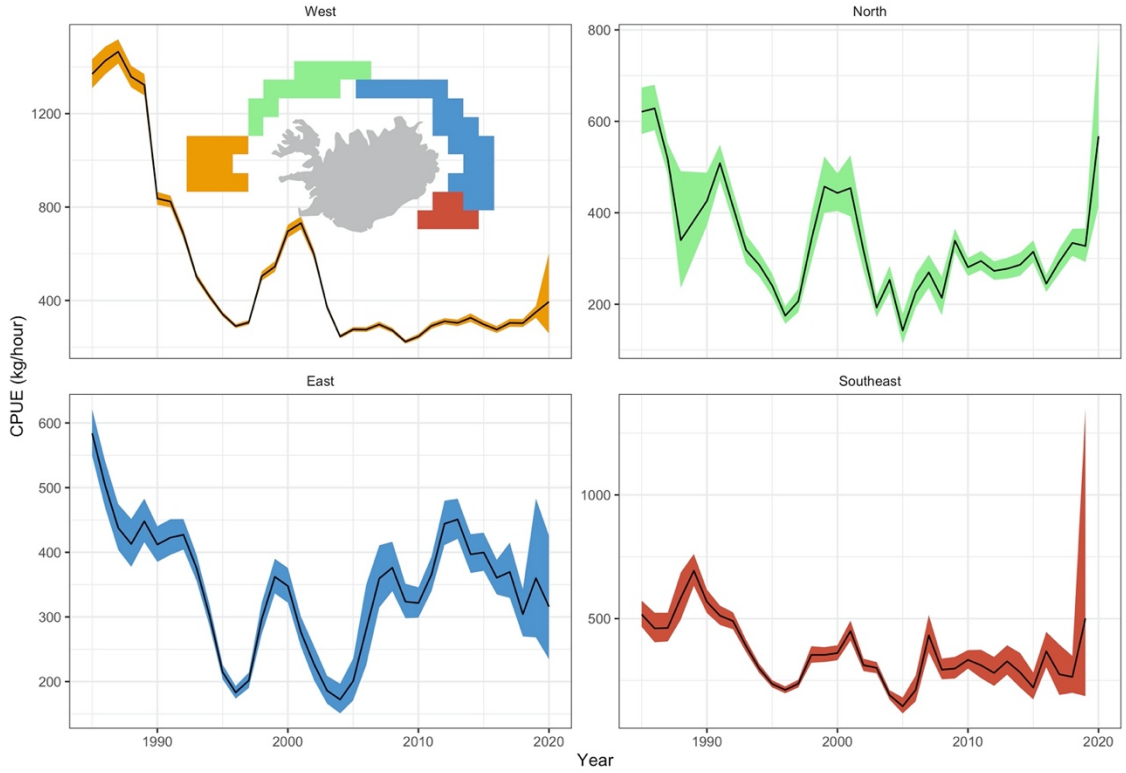

Fig. 17.3.2 Standardised CPUE from the Icelandic trawler fleet in Div 5a by four main fishing areas in 5a. 95% CI indicated. Areas 1-4 are West, North, East and South-east of Iceland, respectively.

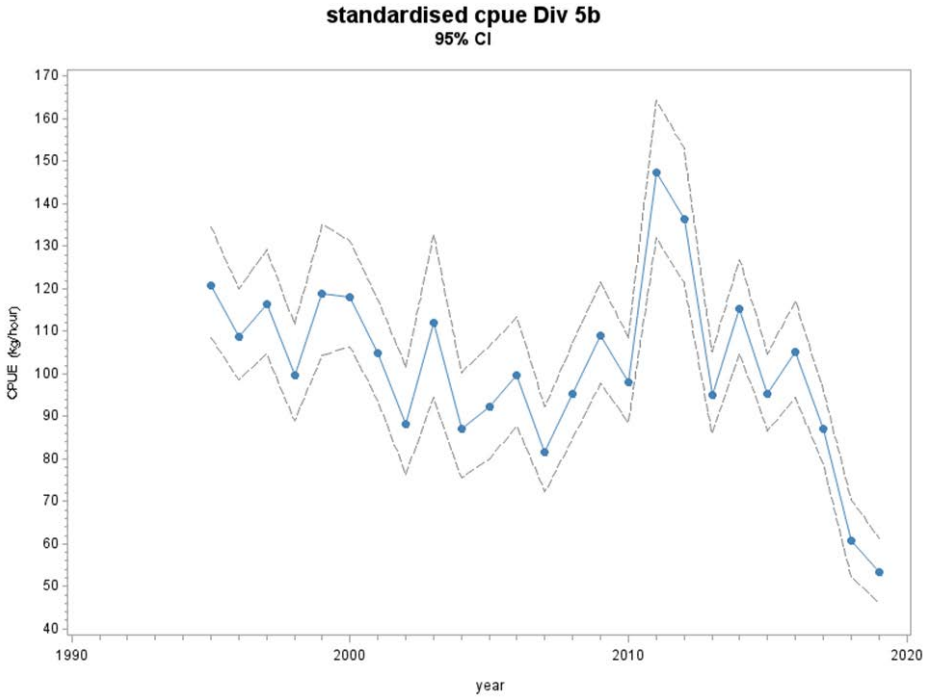

Figure 17. 3.3. Standardised CPUE from the Faroese trawler fleet. 95% CI indicated

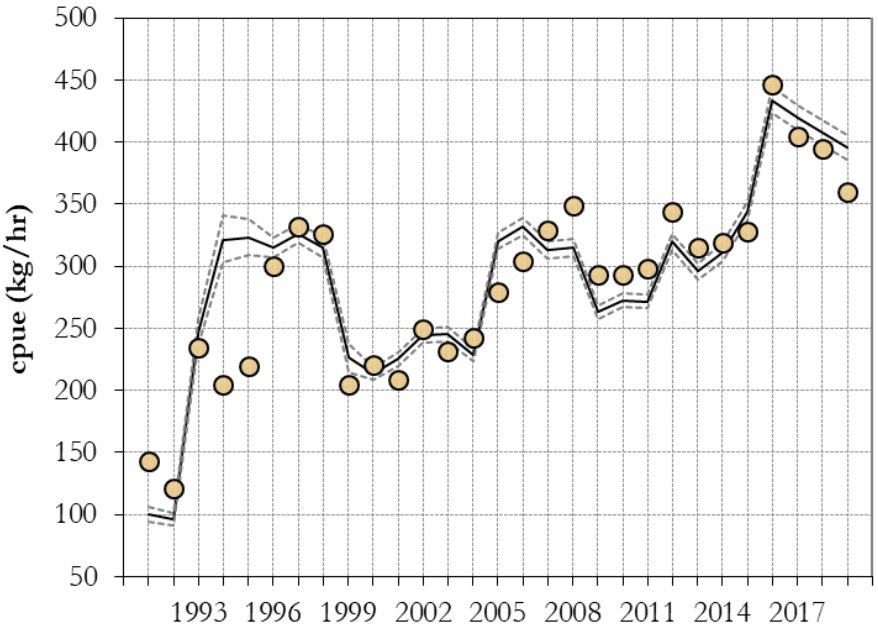

Fig. 17.3.4. Standardised CPUE from trawler fleets in 14b. 95% CI and observed CPUE (avg) indicated.

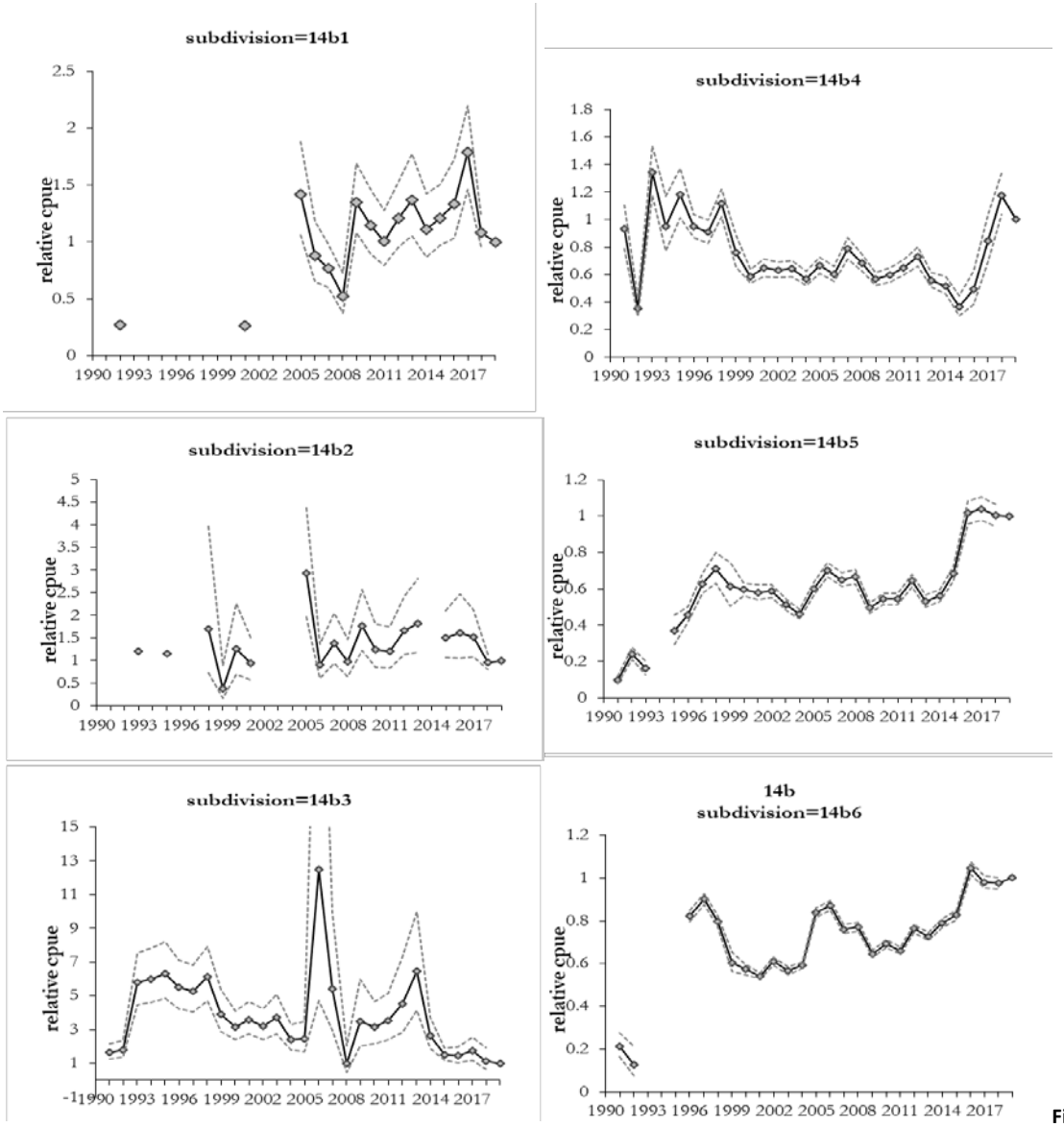

Fig. 17.3.5. Standardised CPUE from trawler fleets in 14b shown by subdivisions in a north-south direction. 95% CI indicated.

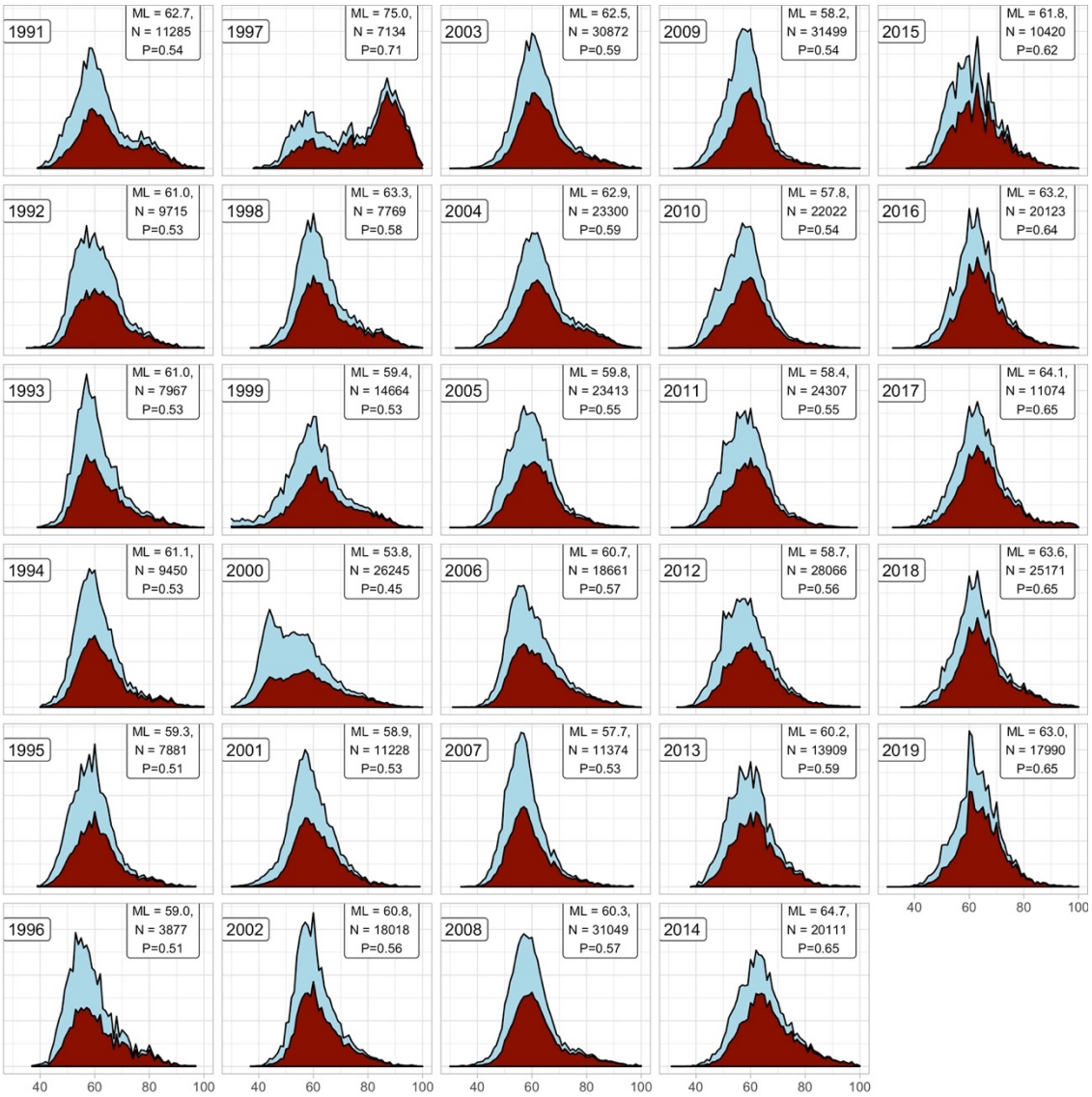

Fig. 17.3.1. Length distributions from the commercial trawl fishery in the western fishing grounds of Iceland (5a) in the years 2002-2019. Blue indicate males and red indicates females.

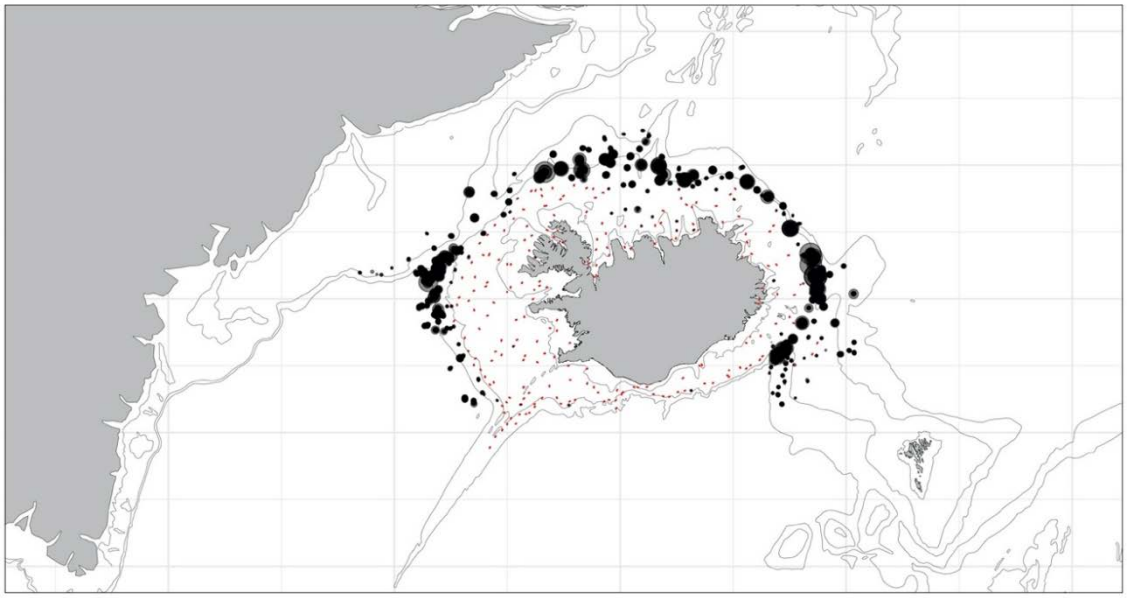

Fig. 17.4.1. Stations covered by scientific surveys in SA 5 and 14 in 2020 by Iceland (n=203). Red dots indicate tows, black circles positions where Greenland halibut was observed. Greenland survey has not been conducted since 2016.

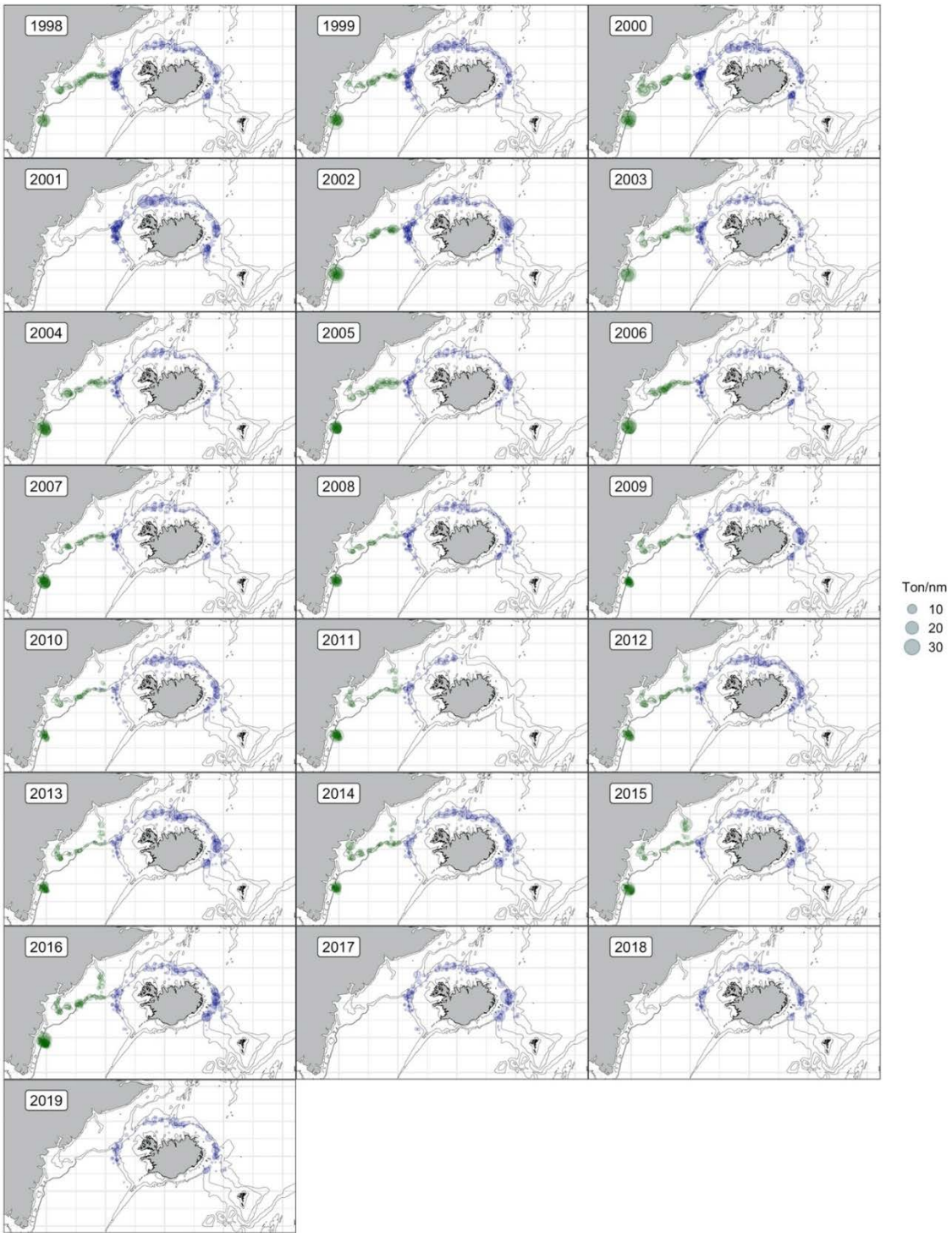

Fig. 17.4.2. Distribution of Greenland halibut catch rates from the combined Greenland-Icelandic fall survey since 1996.

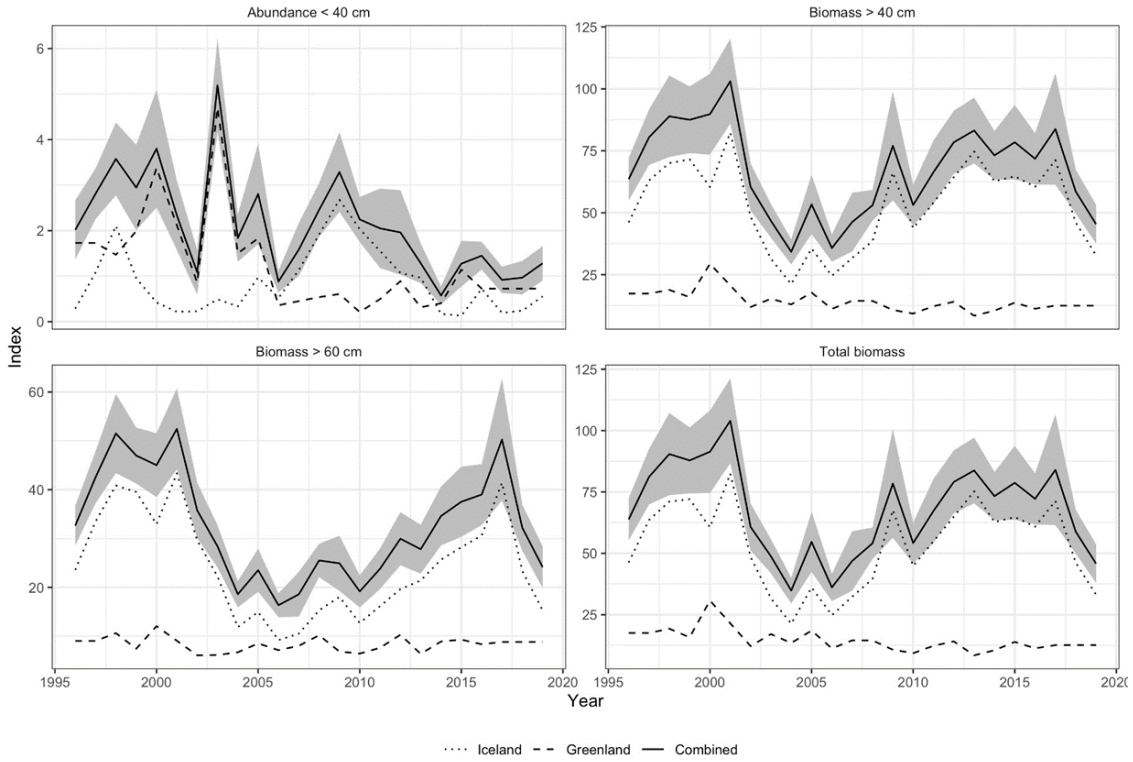

Fig. 17.4.3. Index of Greenland halibut in the Iceland, Greenland and the combined survey. No Iceland survey was conducted in 2011.

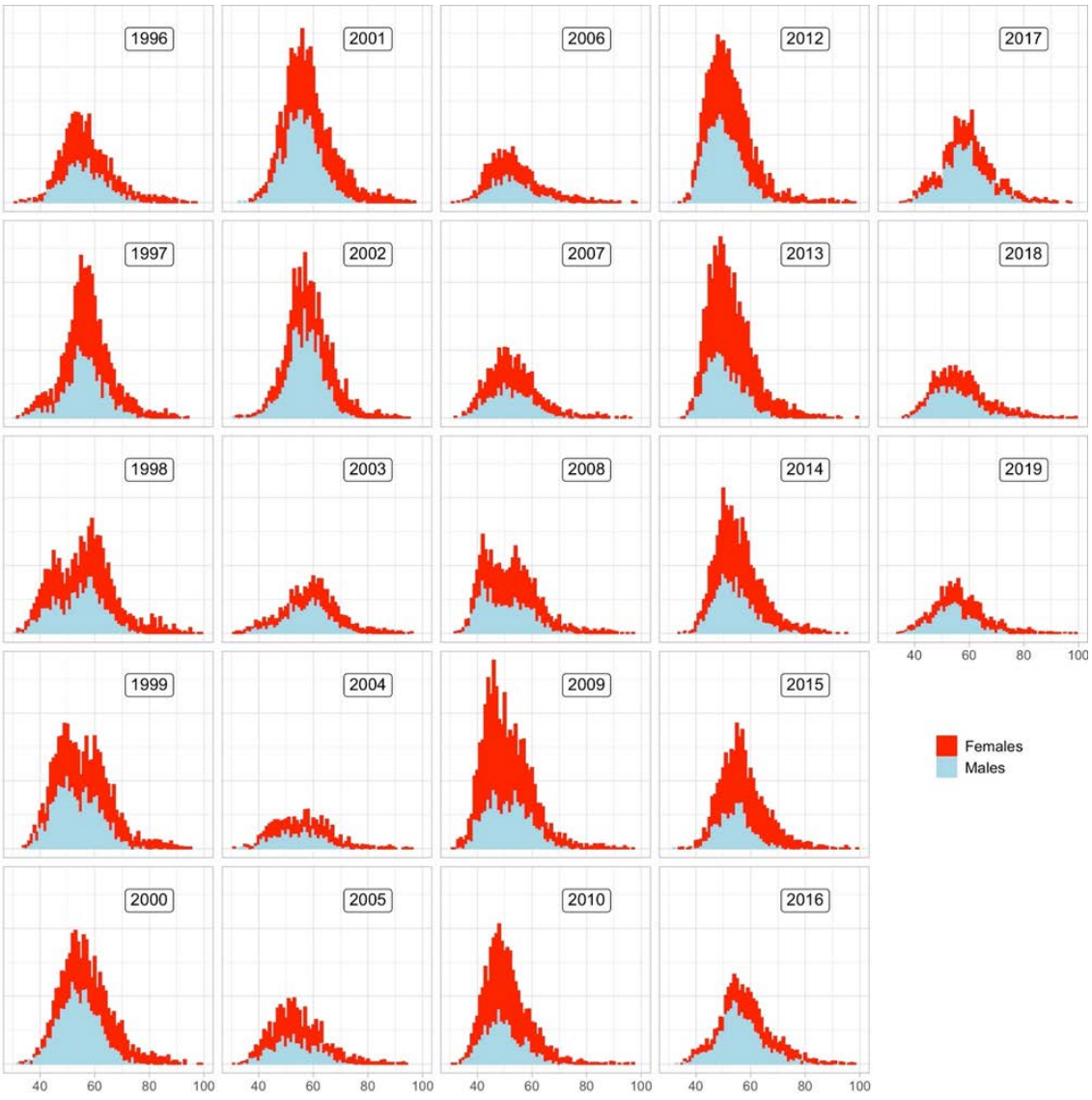

Fig. 17.4.4. Abundance indices by length for the Icelandic fall survey 1996-2019. No survey was conducted in 2011.

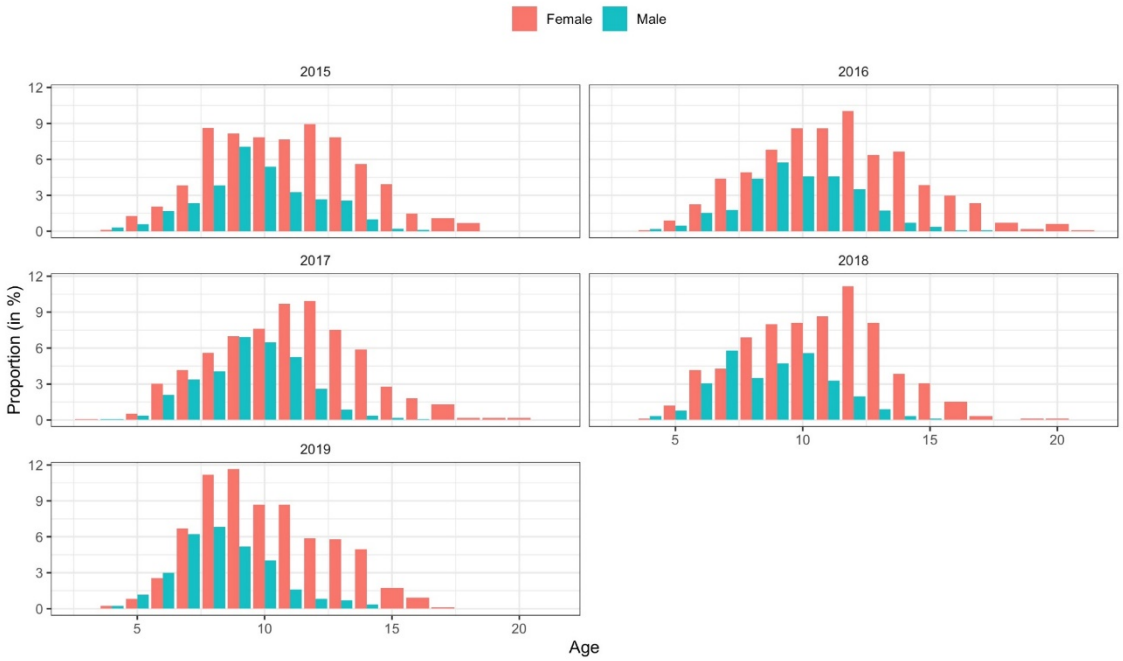

Figure 17.4.5. Age/sex distribution from Icelandic fall survey 2015-2019.

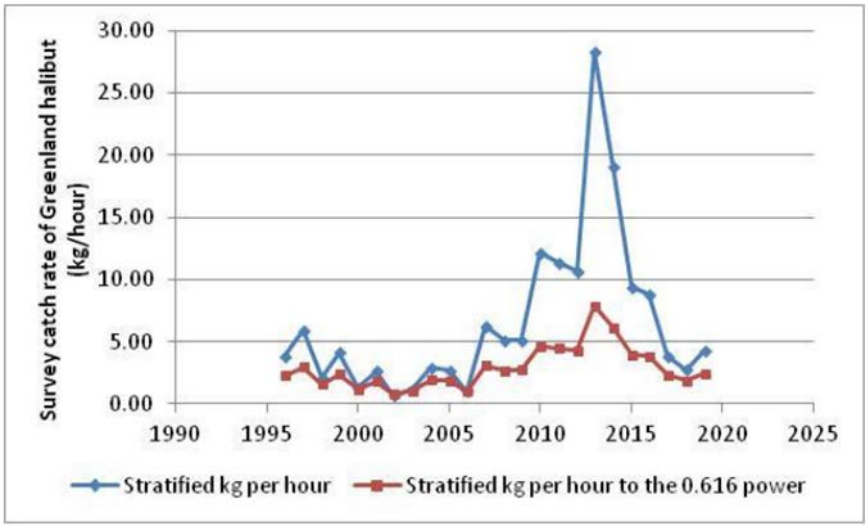

Figure 17.4.6.. Catch rates from a combined survey/fisherman's survey in 5b. Estimates are from a GLM model.

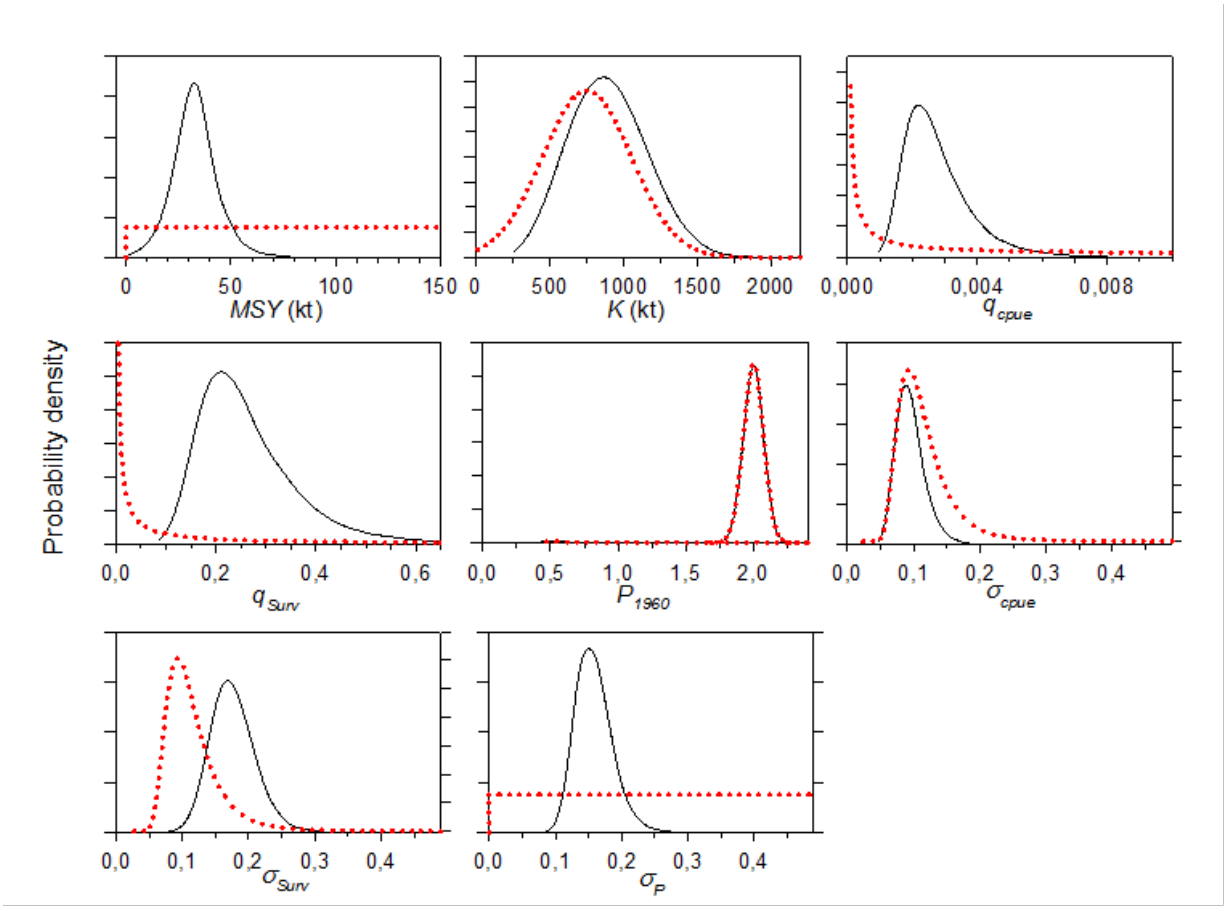

Figure 17.5.1. Probability density distributions of model parameters: estimated posterior (solid line) and prior (broken line) distributions.

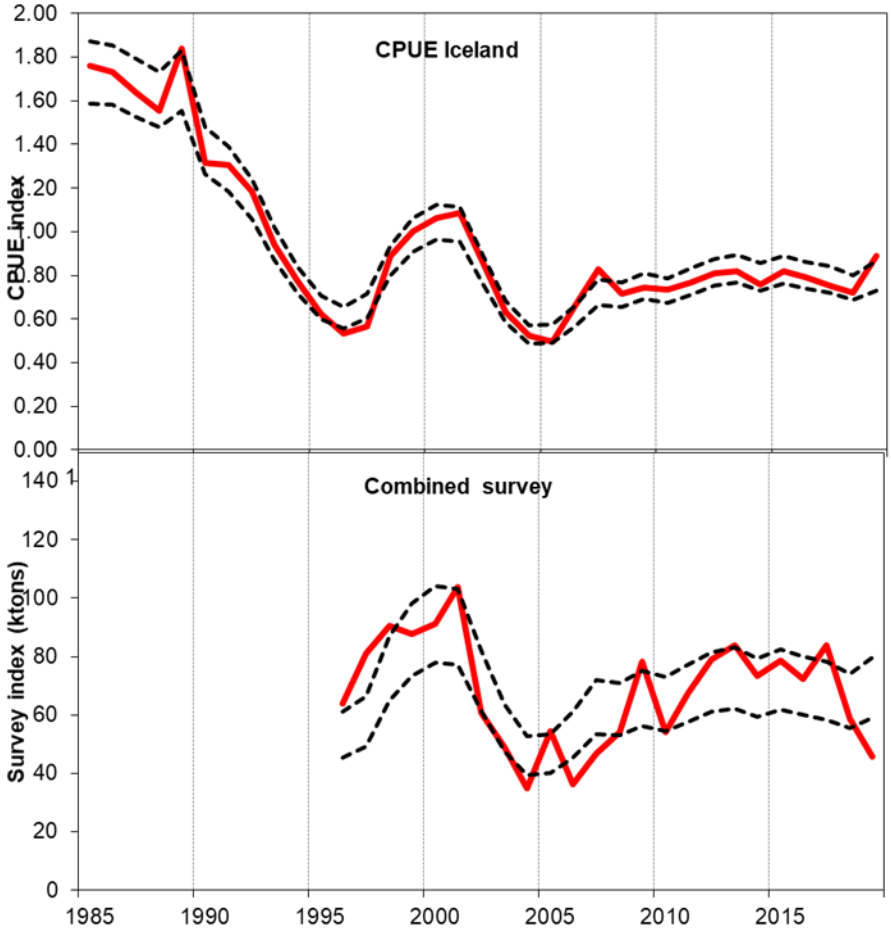

Figure 17.5.2. Observed (red curve) and predicted (dashed lines) series of the two biomass indices input to the model. Dashed lines are inter-quartile range of the model estimates.

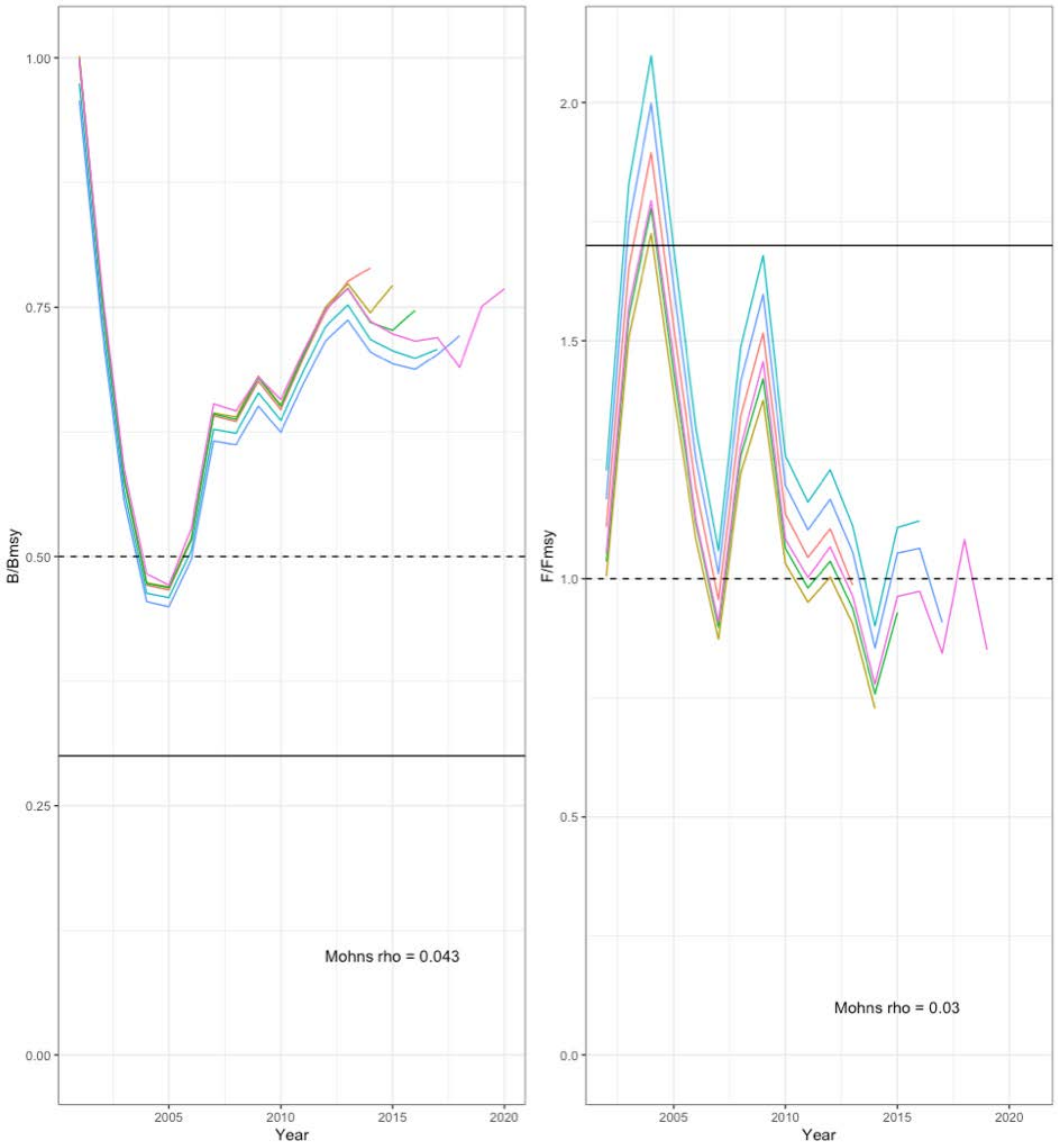

Figure 17.5.3. Retrospective analyses of medians of relative biomass (B/B_{msy}) and fishing mortality ($F/Fmsy$)

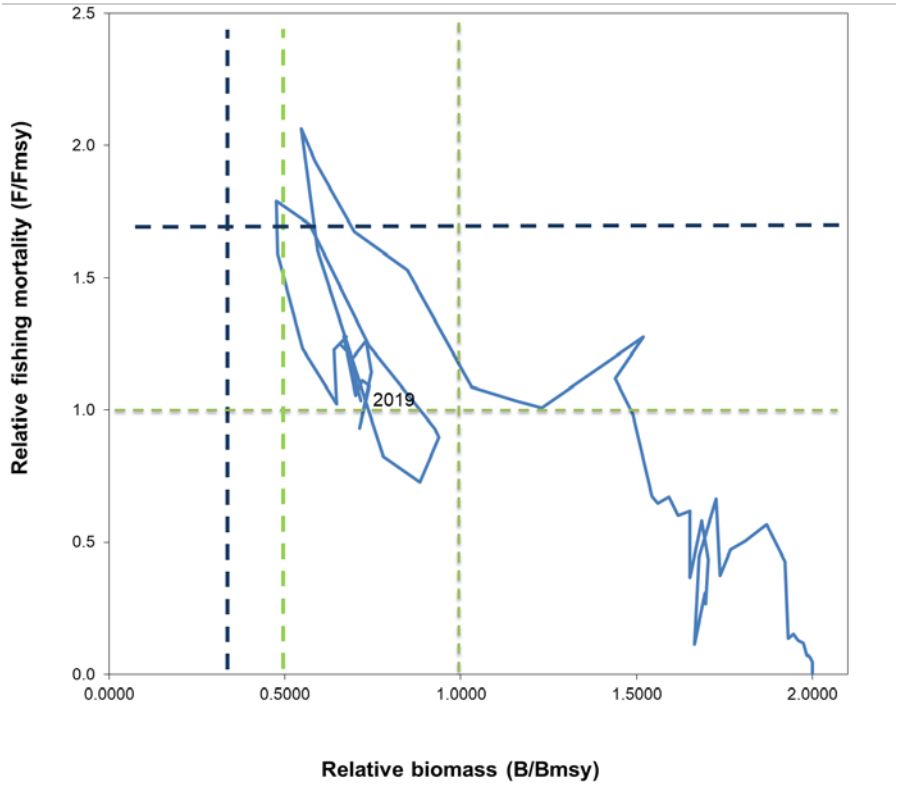

Figure 17.5.4. Stock trajectory 1960-2019. Estimated annual median biomass-ratio (B/BMSY) and fishing mortality-ratio (F/FMSY). B_{lim}, MSY $B_{trigger}$ and F_{lim} are indicated.

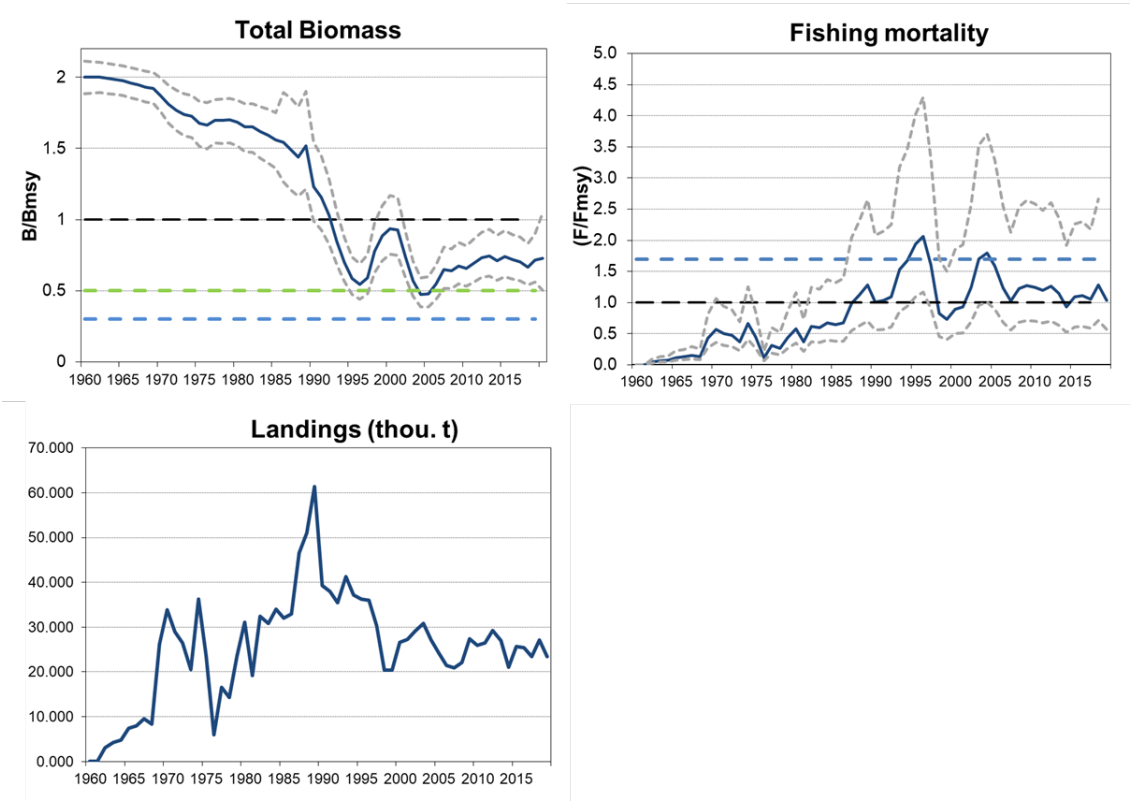

Figure 17.5.5. Stock summary, upper panel right: fishing mortality (F/Fmsy) and 95% conf limits, left: total biomass (B/Bmsy) and 95% conf limits and lower panel is landings since start of the fishery. MSY $B_{trigger}$ (green dashed line), B_{lim} and F_{lim} (blue dashed lines) are indicated.

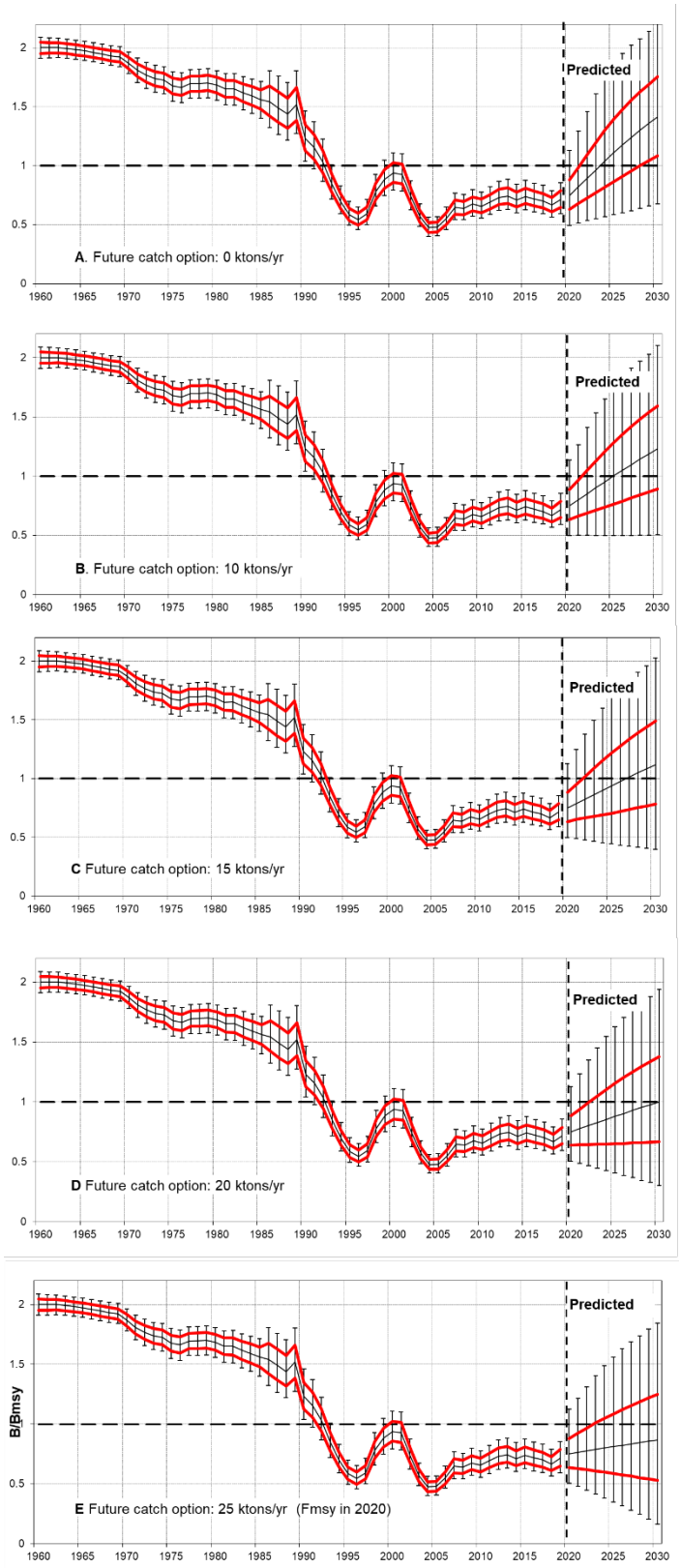

Fig. 17.5.6 Estimated time series of relative biomass (B_t/B_{msy}) under different catch option scenarios: 0, 10, 15, 20 and 25 kt catch from upper to lower panel. Bold red lines are inter-quartile ranges and the solid black line is the median; the error bars extend to cover the central 90 per cent of the distribution.

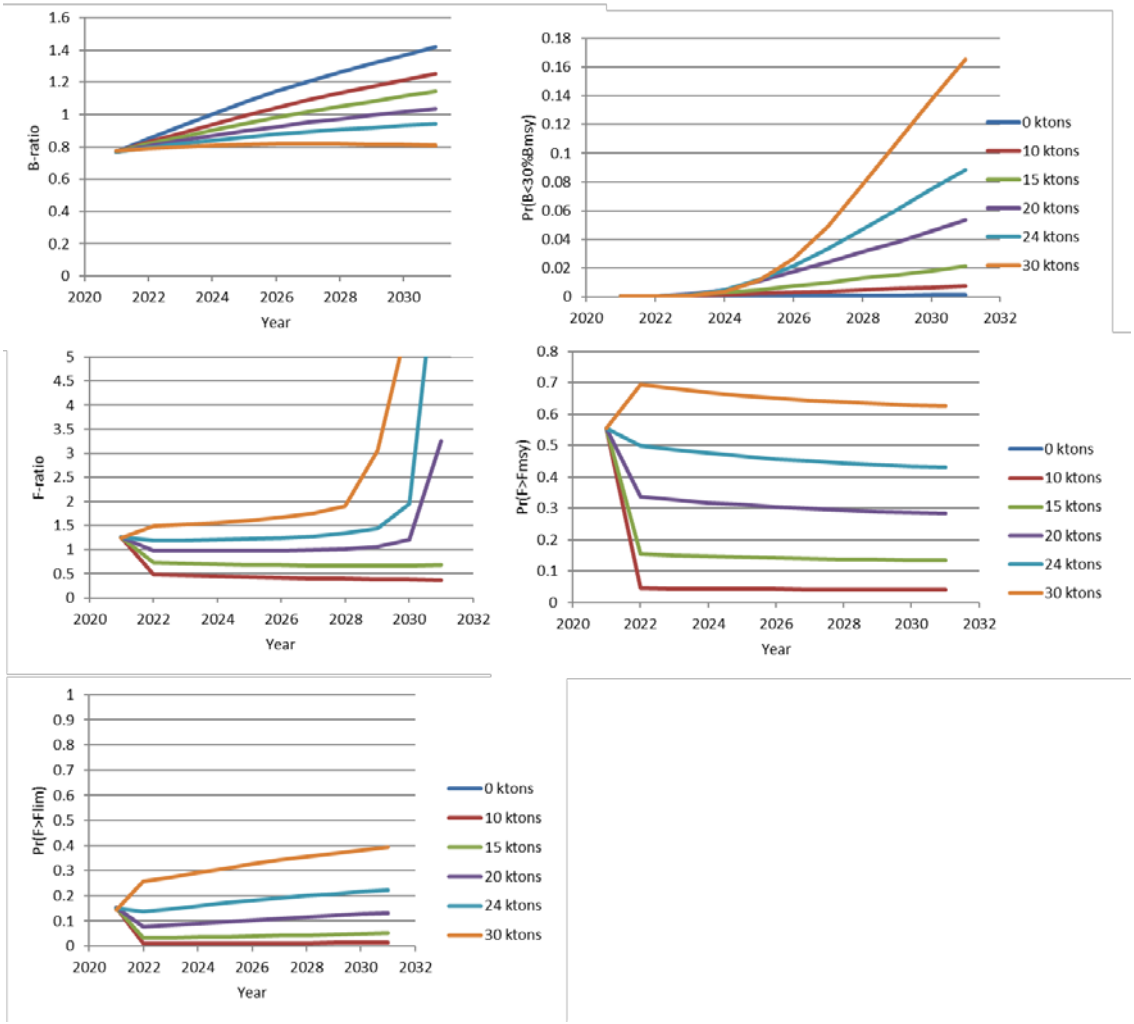

Figure 17.5.7. Projections: Medians of estimated posterior biomass- and fishing mortality ratios; estimated risk of exceeding F_{msy} or going below and $B_{MSYtrigger}$ given catch ranges at 0 -30 ktons.

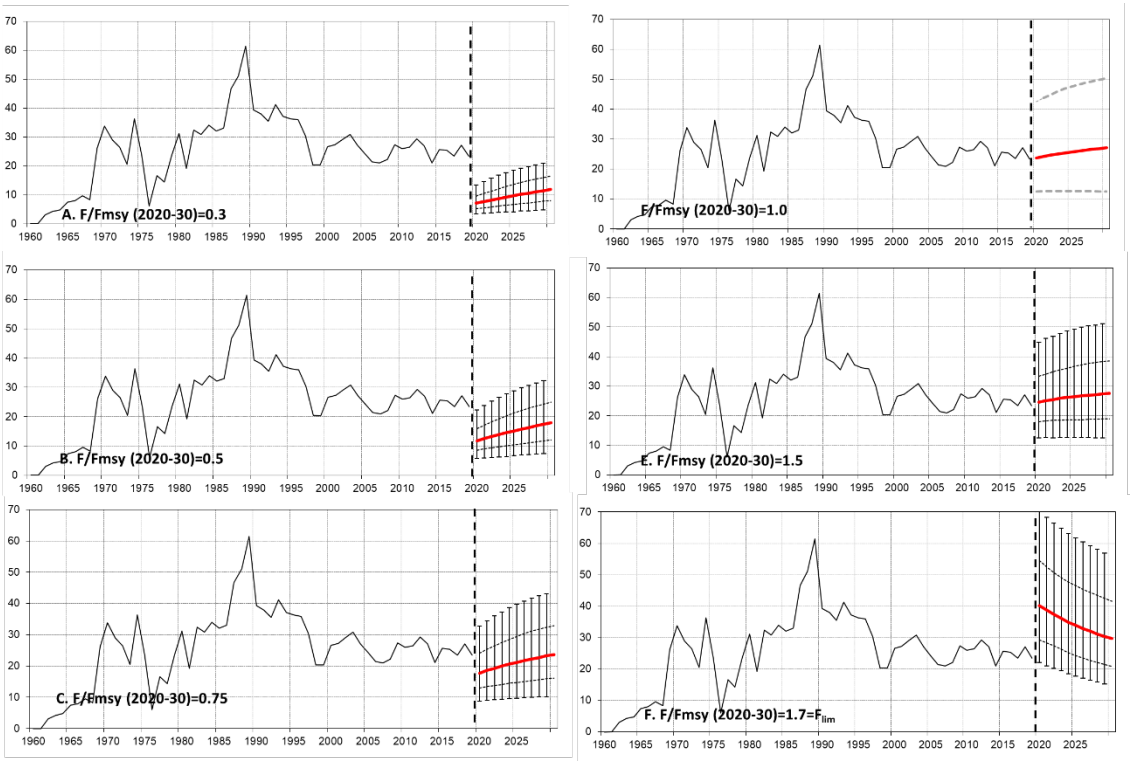

Figure 17.5.8. Historic landings and projected landings 2020-2030 under various F ratio options from 0.3-1.7 F/Fmsy Solid red line is median, quartiles and 90% conf limit indicated.

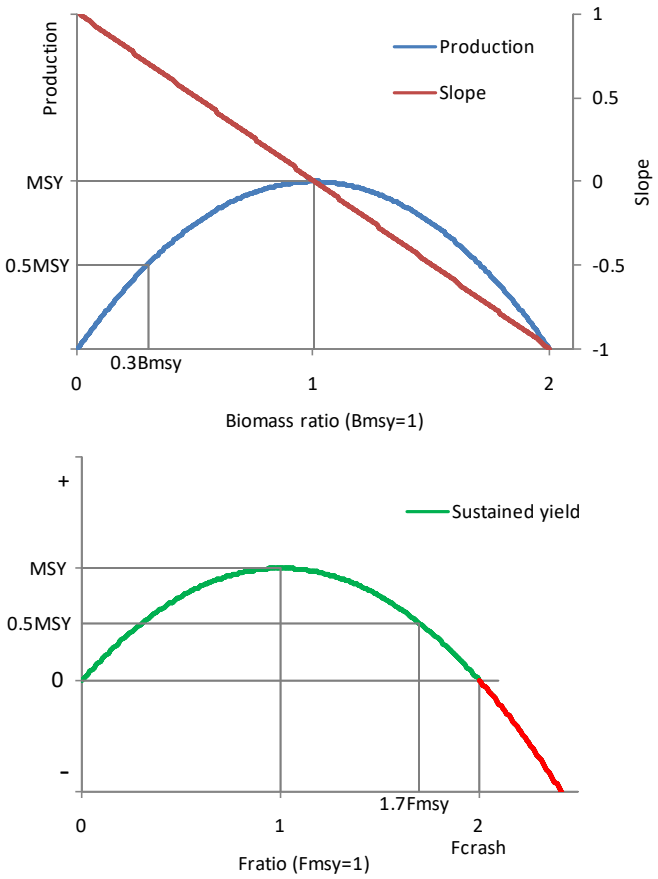

Figure 17.5.9. The logistic production curve in relation to stock biomass (B/Bmsy) (*upper*) and fishing mortality (F/Fmsy) (*lower*). *Upper*: points of maximum sustainable yield (MSY) and corresponding stock size are shown as well as the slope (red line) of the production curve (blue line); *lower*: points of MSY and corresponding fishing mortality and Fcrash (F≥Fcrash do not have stable equilibriums and will drive the stock to zero).