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

Greenland halibut in ICES Subareas V, VI, XII and XIV 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 5a, 5b, and Subareas 6, 12 and 14 are presented for the years 1981–2016 in Tables 17.2.1–17.2.6 and since 1961 in Figure 17.2.1. Catches decreased in 2016 by 1% to 25,397 t. Landings in Icelandic 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 5b have developed. Landings have since 1997 been between 20 and 31 kt.

17.1.2 Fisheries and fleets

In 2016 quotas in Greenland EEZ and Iceland EEZ were fully 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 increased substantially in 2016 from 3,231 t to 4,658 t.

Most of the fishery for Greenland halibut in Divisions 5a, 5b and 14b is a directed trawl fishery, but also an gillnet and longline fishery takes place. Only minor catches in 5a and 14b are taken as by-catches in a redfish fishery (see section 21 on Greenland slope redfish). No or insignificant discarding has been observed in this fishery.

Spatial distribution of the 2016 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 about 1500 m at East Greenland. In 2016 the distribution of the fishery covered all areas but was discontinuous in its distribution (Fig 17.2.2).

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 6b,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 is 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 commonly a clean fishery with respect to 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 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 Icelandic and Greenland waters since 2002 is observed to have reduced by-catches considerably. Based on sampling 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 14b generally report discard rates less than 1% by weight in logbooks.

17.2 Trends in Effort and CPUE

17.2.1 Division 5a

Indices of CPUE for the Icelandic trawl fleet directed at Greenland halibut for the period 1985–2015 is provided in Table 17.3.1 and Figures 17.3.1-3. The overall CPUE index for the Icelandic fishery are compiled as the average of the standardised indices from the four areas (Fig 17.3.1-2.).

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 stable or slowly increasing. The overall tendency is the same for all fishing grounds in 5a (Figure 17.3.2) although the less important fishing grounds in north, east and southeast are more variable in trend.

17.2.2 Division 5b

Information from logbooks from the Faroese otterboard trawl fleet (>1000 hp) was available for the years 1991-2016 (Table 17.3.1, Figure 17.3.4.). The bulk of the fishery has historically been on the south-east slope of the Faroe Plateau. CPUE decreased drastically in the early period by more than 50 % coinciding with a significant increase in effort. Since 2005 CPUE has gradually increased and is recently above average of the time series.

17.2.3 Division 14b

CPUE and effort from logbooks in area 14 are provided in Table 17.3.1 and Figure 17.3.5-6. Following a period with relatively low CPUEs in 1999-2004, catch rates have been variable but increasing and reached in 2016 a record high for the second year. It should be noted that CPUE series from Divisions 5a, 5b and 14b have different trends over the time indicating that the populations/areas most likely have different dynamics.

17.2.4 Divisions 6b and 12b

Since 2001 a fishery developed in Divisions 6b and 12b 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 Div. 5a are rather stable from year to year. In Figure 17.4.1 length distributions are shown since 1996 from the western area of Iceland, comprising the most important fishing grounds. Distributions are stable over the entire period. Catch composition from all areas (5a,b and 14) by gear is provided for 2016 in Figure 17.4.2.

17.4 Survey information

The total surveyed area in 2016 for Greenland halibut in Divisions 5a and 14b is provided in Figure 17.5.1. The areas where commercial fishing takes place (Figure 17.2.2.) are covered by the annual surveys. The two surveys in 5a and 14b are combined to one index and used as input in the assessment model.

17.4.1 Division 5a

Since 2006 the total biomass of Greenland halibut has increased significantly in Icelandic waters (Figures 17.5.3) . Abundance of smaller fish (less than 40 cm) has been improving from a record low in recent two years .

17.4.2 Division 5b

The catch rates from the available time series of the Faroese survey have declined from a record high level in 2012-13 but is still high in 2016. (Figure 17.5.5).

17.4.3 Division 14b

A GLM analysis performed on the survey catch rates in 14b, taking into account the scattered coverage of area and depth between years did however showed a status quo from previous years (Figure 17.5.6-7.). The text table below provides information on the coverage and numbers of stations in 2016 along with the Iceland survey in Division 5a.

Survey /Division	No. hauls in 2016 (planned hauls)	Depth range (m)	Coverage (km2)
5a	203 (219)	32 - 1309?	-130 000
14b	100 (100)	400-1500	29 000

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 synthesize information from input priors and two independent series of Greenland halibut biomass indices and one series of catches by the fishery (Table 17.6.1). The two series of biomass indices are a revised and standardised series of annual commercial-vessel catch rates for 1985–2016, $CPUE_t$,; and a combined trawl-survey biomass index for 1996–2015, $Isur_t$,.

Total reported catch or WGs best estimates in ICES Subareas 5, 6, 12 and 14 1961-2015 was used as yield data (Table 17.6.1, 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.

17.5.1.2 Model performance

The model parameters were estimated (posterior) based on the prior assumptions (Table 17.6.2-3 and Figure 17.6.1). The data could not be expected to carry much information on the parameter P_{1960} – the stock size 25 years prior to when the series of stock biomass series start – and the posterior resembled the prior (Figure 17.6.1). The prior for K was somewhat updated to slightly higher values. However, the posterior still had a wide distribution with an inter-quartile range of 717-1067 ktons (Table 17.6.3).

The model was able to produce a reasonable simulation of the observed data (Figure 17.6.2). The probabilities of getting more extreme observations than the realised ones given in the data series on

stock size were in the range of 0.05 to 0.95 i.e. the observations did not lay in the extreme tails of their posterior distributions (Table 17.6.4). Exceptions are observed for the survey in 1997 (p=0.97) and in 2006 (p=0.03). The CPUE series was generally better estimated than the survey series (Figure. 17.6.2).

The retrospective runs suggest high consistency (Figure. 17.6.3).

17.5.1.3 Assessment results

The time series of estimated median biomass-ratios starts in 1960 as a virgin stock at K (Figure. 17.6.4 - 5). The fishery 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. 45% of B_{MSY}. In 2016 biomass was at 72% of B_{MSY}. The risk of the biomass being below B_{msy} in 2016 is 100% and 0 % of being below B_{LIM} (Table 17.6.5). The median fishing mortality ratio (F/Fmsy) has exceeded F_{msy} since the 1990s and estimated at 1.10 F_{msy} in 2016. (Figure. 17.6.4 and 17.6.5). This parameter can only be estimated with relatively large uncertainty and the posteriors therefore also include values below F_{msy}. However, the probability that the F has exceeded F_{msy} is high for most of the series.

The posterior for *MSY* was positively skewed with upper and lower quartiles at 27 ktons and 39 ktons (Table 17.6.3). As mentioned above MSY was relatively insensitive to changes in prior distributions.

Within a one-year perspective the sensitivity of the stock biomass to alternative catch options seems rather low. This is due to the inertia of the model used (see annex) and the low growth rate of the population. Risk associated with seven optional catch levels for 2018 are given in Table 17.6.5.

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 ktons were investigated (Figure 17.6.6.-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 highly unrealistic.

Scenarios of fixed levels of fishing mortality ratios within the range of 0.3 to 1.7 were conducted and are shown in Fig. 17.6.8. Present biomass is above the MSY Btrigger (50% of B_{MSY}) and a fishery at F_{MSY} is advised according the ICES MSY AR. Fishing at Fmsy will result in catches of 24 kt in 2018 (Figure 15.6.8 panel D) and a stock size of 74% of B_{MSY} in 2018 (Table 17.6.5).

17.5.2 Short-term forecast and management options

Biomass scenarios at various catch options are provided in Table 17.6.5 and Figures 17.6.6-7. 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. Catches of 24 kt in 2018 will correspond to fishing at F_{MSY}. This will result in an increase in biomass and risk of exceeding F_{LIM} will remain unchanged from 2017 (Table 17.6.5). At catches of 24 kt the biomass is not expected to reach B_{MSY} within the next decade although biomass will increase over the period.

17.5.3 Reference points

Reference points were unchanged from last benchmark in 2013 (WKBUT)

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 have limited the overall catches in recent years and assured that fishing pressure is about Fmsy.

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). This lack of optimal usage af available biomass indices need to be solved at the next benchmark.

17.8 Proposals and recommendations

Stock structure and connectivity between the main fishing areas remains partly unknown. Basic biological information on spawning and nursery grounds for the juveniles also remains poorly known. Biomass indices over the entire assessment area are not similar with respect to trend over time and may suggest different dynamics between areas. Further, recent 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 should be made in order to review whether present stock areas are appropriate for assessment purposes. Such a compilation should be evaluated outside NWWG, eg. by WGSIM.

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 behavior in relation to the biomass indices. The models use of process error and sensitivity to various priors should be further scrutinized. A generic review of the model's performance could potentially be by WGMG.

At the benchmark in 2013 (WKBUT) an alternative assessment model, Gadget, was presented. The group encouraged this model to be fully developed in order to replace the stock production model. Presently the Gadget model is not fully developed and several issues need further exploration (see section 17.7) and especially age data from the stock 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 calibration. However, IMR in Norway have now developed a promising method to age Greenland halibut and an ageing workshop is scheduled in August 2016 (WKARGH). With the aim to revert to an age based assessment, it is suggested that cooperation between institutes is initiated and an inter calibration protocol is established. This task is a major task since a number of sampled otoliths back in time have to be read, and the time horizon for this project is therefore expected to exceed the near future. It is foreseen that the stock will be benchmarked in within the next years addressing the above issues.

Table 17.2.1 Greenland halibut. Nominal landings (tonnes) by countries in Sub-area V.VI XII and XIV. as officially reported to ICES and estimated by WG

Table 17.2.1 GREENLAND HALIBUT. Nominal landings (tonnes) by countries, in Sub-areas V, VI, XII and XIV , 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
Denmark	-	-	-	-	-	-	-	-	-	-
Estonia	-	8	-	-	5	3	-	-	-	-
Faroe Islands	121	334	458	338	1,150	855	1,141	-	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	-	-	-	-	-	2,819	-
Iceland	16,590	#REF!	20,366	15,478	13,023	11,798	-	-	-	13,293
Ireland	56	#REF!	-	-	-	-	-	-	-	-
Lithuania	-	-	2	1	-	2	3	566		-
Norway	2,243	1,998	1,074	1,233	1,124	1,097	692	639	124	233
Poland	2	16	93	207	-	-	-	1,354	988	960
Portugal	6	130	-	-	-	1,094	-	-	-	-
Russia	187	#REF!	-	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	7,301	9,744	5,974	22,901
Working Group estimate	20,703	19,714	20,680	27,102	24,978	21,466	21,873	15,379	28,197	25,995

Country	2011 [1]	2012 [1]	2013 [1]	2014	2015 [1]	2016 [1]
Estonia	-	-	-	429	-	-
Faroe Islands	1,705	2,811	2,788	3,393	3,214	4,656
France	150	67	133	-	117	88
Germany	5,782	4,620	3,814	3,701	3,808	4,420
Greenland	3,415	5,239	3,251	1,897	3,642	1,511
Iceland	13,192	13,749	14,859	9,861	12,400	12,652
Ireland	-	-	-	-	-	-
Lithuania	-	99	-	-	-	-
Norway	171	856	614	764	1,126	1,007
Poland	-	786	-	-	-	-
Portugal	-	-	-	-	-	-
Russia	1,095	1,168	1,369	587	600	600
Spain	-	-	-		110	94
United Kingdom	323	12	95		127	348
Total	25,693	29,407	26,923	20,743	25,145	25,377
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 Va, as officially reported to ICES and estimated by WG.

Table 17.2.2 GREENLAND HALIBUT. Nominal landings (tonnes) by countries, in Division Va, 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	25
Germany	13	22	50	31	23	10	6	1	228
Greenland									
Iceland	11,087	14,507	2,310 [4]	2,277 [4]	20,360	15,478	13,023	11,798	
Norway							100		691
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	945
Working Group estimate		14,607	16,752	19,714	20,415	15,477	13,172	11,817	10,525

Country	2008 [1]	2009 [1]	2010 [1]	2011 [1]	2012 [1]	2013 [1]	2014 [1]	2015 [1]	2016 [1]
Faroe Islands			37	123	585	103	30	18	15
Germany	4	423	797	576	269	386	587	265	
Greenland				157		92		1	
Iceland			13,293	13,192	6,459	14,859	9,859	12,309	12,652
Norway									
Russia	4								
Poland		270							
UK	179								
Total	187	693	14,128	14,048	7,313	15,440	10,476	12,593	12,667
Working Group estimate	11,859	15,782	14,128	14,048	7,313	15,440	10,476	12,593	12,667

1) Provisional data

2) Includes 223 t catch by Norway.

Table 17.2.3 Greenland Halibut. Nominal landings (tonnes) by countries, in Division Vb as officially reported to ICES and estimated by WG

Table 17.2.3 GREENLAND HALIBUT. Nominal landings (tonnes) by countries, in Division Vb 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	4633
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

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 XIV as officially reported to ICES and estimated by WG

Table 17.2.4 GREENLAND HALIBUT. Nominal landings (tonnes) by countries, in Sub-area XIV 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	0	9,805	10,402	10,761			7,526	9,534	7,534

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 XII, as officially reported to ICES and estimated by WG

Table 17.2.5 GREENLAND HALIBUT. Nominal landings (tonnes) by countries in Sub-area XII, 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]
Faroe Islands			
France			
Ireland			
Lithuania			
Poland			
Spain [2]	67	91	78
UK			
Russia			
Norway			0
Estonia			
Total	67	91	78
WG estimate	67	91	78

[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 VI, as officially reported to the ICES and estimated by WG

Table 17.2.6 GREENLAND HALIBUT. Nominal landings (tonnes) by countries in Sub-area VI, 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]
Estonia			
Faroe Islands	1		1
France		89	72
Poland			
Spain [2]		18	17
UK	42	119	348
Russia			
Norway	0	1	3
Lithuania			
Total	43	227	440
WG estimate	43	227	440

[1] Provisional data

[2] Based on estimates by observers onboard vessels

Table 17.3.1 CPUE indices of trawl fleets in Div 5a, 5b and 14b as derived from GLM

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

area	year	cpue	% change in CPUE between years	landings	relative derived effort	relative derived effort	% change in effort between years
Iceland 5a	1985	1.00		29,197	29	100	
	1986	0.99	-1	31,027	31	107	7
	1987	0.96	-3	44,659	47	149	39
	1988	0.91	-5	49,379	54	117	-21
	1989	1.05	16	59,272	56	103	-12
	1990	0.75	-28	37,308	49	88	-15
	1991	0.74	-3	35,413	48	97	11
	1992	0.67	-9	31,978	48	100	2
	1993	0.54	-20	34,134	64	133	33
	1994	0.44	-18	28,608	65	102	-23
	1995	0.36	-19	27,391	77	118	16
	1996	0.30	-14	22,073	73	94	-20
	1997	0.32	5	16,792	52	72	-23
	1998	0.50	57	10,595	21	40	-44
	1999	0.55	9	11,138	20	96	139
	2000	0.59	7	14,607	25	122	27
	2001	0.60	1	16,752	28	114	-7
	2002	0.48	-20	19,714	41	147	29
	2003	0.36	-25	20,415	57	139	-6
	2004	0.30	-17	15,477	52	91	-35
	2005	0.28	-7	13,172	48	91	1
	2006	0.37	32	11,817	32	68	-26
	2007	0.46	25	10,525	23	71	5
	2008	0.40	-13	9,580	24	105	48
	2009	0.42	4	15,782	38	158	51
	2010	0.41	-1	13,565	33	87	-45
	2011	0.43	5	14,048	33	99	13
	2012	0.44	3	7,312	17	51	-49
	2013	0.45	2	15,439	34	206	307
	2014	0.42	-7	10,475	25	73	-65
	2015	0.45	8	12,593	28	112	53
	2016	0.44	-4	12,667	29	105	-6
Greenland, 14b	1991	1.00		875	1	100	0
	1992	0.92	-8	1,176	1	145	45
	1993	2.45	166	2,249	1	72	-50
	1994	3.16	29	3,125	1	108	50
	1995	3.22	2	5,077	2	159	48
	1996	3.19	-1	7,283	2	145	-9
	1997	3.32	4	8,558	3	113	-22
	1998	3.24	-2	5,940	2	71	-37
	1999	2.27	-30	5,376	2	129	81
	2000	2.11	-7	6,958	3	140	8
	2001	2.19	4	7,216	3	100	-29
	2002	2.38	8	6,621	3	85	-15
	2003	2.33	-2	8,017	3	124	46
	2004	2.28	-2	9,854	4	126	2
	2005	3.15	38	10,185	3	75	-41
	2006	3.25	3	8590	3	82	9
	2007	3.07	-5	10261	3	126	54
	2008	3.11	1	8,952	3	86	-32
	2009	2.57	-17	10,567	4	143	65
	2010	2.69	5	10,402	4	94	-34
	2011	2.66	-1	10,761	4	105	11
	2012	3.14	18	12,475	4	98	-6
	2013	2.93	-7	12,476	4	107	9
	2014	3.07	5	7,526	2	57	-46
	2015	3.39	10	9,534	3	115	100
	2016	4.29	26	7,534	2	63	-46
Faroe Islands, 5b	1991	1.00		1,662	2	100	34
	1992	1.84	27	2,269	1	74	-26
	1993	1.03	-82	4,434	4	350	373
	1994	0.36	-36	5,225	15	340	-3
	1995	0.93	56	3,832	4	28	-92
	1996	0.91	-6	6,469	7	173	513
	1997	0.89	-2	4,870	5	77	-56
	1998	0.36	-58	3,825	11	194	153
	1999	0.38	2	4,265	11	105	-46
	2000	0.59	56	5,079	9	78	-26
	2001	0.11	-125	3,245	30	348	347
	2002	0.11	0	2,694	25	83	-76
	2003	0.32	199	2,426	8	30	-63
	2004	0.38	57	1,771	5	61	102
	2005	0.13	-80	892	7	154	151
	2006	0.30	44	873	3	42	-73
	2007	0.33	24	1,060	3	110	165
	2008	0.69	124	1735	3	77	-30
	2009	0.91	67	1760	2	77	0
	2010	1.31	59	1,413	1	56	-28
	2011	1.95	70	1,489	1	71	28
	2012	3.11	88	2,163	1	91	29
	2013	3.33	11	2,560	1	111	21
	2014	2.89	-14	2,958	1	133	20
	2015	1.58	-39	3,139	2	194	46
	2016	2.00	15	4,658	2	117	-39

Table 17.6.1. 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 Icelandic (Ice) and a Greenlandic (Green) 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	1.75	-
1987	46.622	1.69	-
1988	51.118	1.60	-
1989	61.396	1.86	-
1990	39.326	1.33	-
1991	37.950	1.29	-
1992	35.487	1.17	-
1993	41.247	0.94	-
1994	37.190	0.77	-
1995	36.288	0.63	-
1996	35.932	0.54	66
1997	30.309	0.56	90
1998	20.382	0.89	91
1999	20.371	0.97	90
2000	26.644	1.04	101
2001	27.291	1.05	110
2002	29.158	0.84	84
2003	30.891	0.63	52
2004	27.102	0.52	36
2005	24.249	0.49	56
2006	21.432	0.64	39
2007	20.957	0.81	50
2008	22.169	0.70	58
2009	27.349	0.73	80
2010	25.995	0.72	59
2011	26.424	0.76	71
2012	29.309	0.78	82
2013	27.045	0.79	85
2014	21.069	0.74	75
2015	25.677	0.80	80
2016	25.397	0.77	79
2017*	25.000		

*estimated

Table 17.6.2. 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 17.6.3. 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)	33.45	11.05	26.66	32.53	39.02
K (ktons)	899	250	717	884	1067
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}	0.26	0.09	0.19	0.24	0.30
P_{1985}	1.57	0.12	1.49	1.57	1.66
P_{2016}	0.73	0.10	0.66	0.72	0.79
σ_{cpue}	0.09	0.02	0.08	0.09	0.11
σ_{Survey}	0.18	0.03	0.15	0.17	0.20
σ_P	0.16	0.03	0.14	0.16	0.17

Table 17.6.4. Model diagnostics: residuals (% of observed value), probability of getting a more extreme observation (p.extreame; see text for explanation).

	CPUE		Survey	
Year	resid (%)	Pr	resid (%)	Pr
1985	-1.94	0.56		-
1986	-0.90	0.53		-
1987	0.36	0.49		-
1988	2.60	0.41		-
1989	-8.44	0.75		-
1990	3.21	0.39		-
1991	-1.45	0.55		-
1992	-2.96	0.59		-
1993	0.23	0.49		-
1994	0.82	0.48		-
1995	4.06	0.37		-
1996	11.44	0.17	-12.82	0.74
1997	16.73	0.09	-35.76	0.97
1998	-3.64	0.62	-10.30	0.70
1999	-1.68	0.56	1.19	0.47
2000	-1.50	0.55	-3.15	0.57
2001	-3.13	0.60	-12.71	0.75
2002	-1.20	0.54	-5.62	0.62
2003	-0.59	0.52	13.44	0.24
2004	-0.98	0.53	29.71	0.06
2005	6.61	0.28	-11.17	0.72
2006	-9.22	0.77	36.15	0.03
2007	-15.37	0.90	28.34	0.07
2008	-1.28	0.54	13.22	0.24
2009	0.76	0.47	-13.10	0.76
2010	-1.01	0.53	14.15	0.23
2011	-0.59	0.52	0.90	0.48
2012	1.53	0.45	-8.22	0.67
2013	1.19	0.46	-10.67	0.71
2014	3.38	0.39	-2.70	0.56
2015	-0.03	0.50	-4.38	0.59
2016	2.57	0.42	-5.05	0.60

Table 17.6.5. Upper: stock status for 2016 and predicted to the end of 2017. Lower: predictions for 2018 with catch options from 0 to 30 ktons and the catch option corresponding to Fmsy (50% prob of exceeding Fmsy).

Status	2016	2017 *
Risk of falling below $B_{msy\_trigger}$	0%	0%
Risk of falling below B_{MSY}	100%	93%
Risk of exceeding F_{MSY}	70%	56%
Risk of exceeding F_{lim} ($1.7F_{MSY}$)	16%	15%
Stock size (B/Bmsy), median	0.72	0.73
Fishing mortality (F/Fmsy),	1.10	1.07
Productivity (% of MSY)	92%	93%

*Predicted catch in 2017 = 25ktons

Catch option 2018 (ktons)	0	5	10	15	20	24	30
Prob. of falling belowB_{LIM}	0%	0%	0%	0%	0%	0%	0%
Risk of falling below B_{MSY}	81%	82%	83%	85%	85%	87%	86%
Risk of exceeding F_{MSY}	-	1%	5%	15%	35%	**50%**	55%
Risk of exceeding F_{lim} ($1.7F_{MSY}$)	-	0%	1%	3%	8%	15%	16%
Stock size (B/Bmsy), median	0.80	0.79	0.77	0.76	0.75	0.74	0.74
Fishing mortality (F/Fmsy),	-	0.20	0.40	0.61	0.83	0.99	1.05
Productivity (% of MSY)	96%	95%	95%	94%	94%	93%	93%

Table 17.6.6. Summary of assessment.

Year	Catch (ktons)	low	B/Bmsy	high	low	F/Fmsy	high
1960	0.000	1.891	2.004	2.117	0.000	0.000	0.000
1961	0.029	1.896	2.005	2.110	0.000	0.000	0.001
1962	3.071	1.899	2.004	2.108	0.029	0.047	0.090
1963	4.275	1.894	1.995	2.099	0.040	0.066	0.125
1964	4.748	1.886	1.986	2.091	0.045	0.074	0.140
1965	7.421	1.878	1.977	2.083	0.071	0.116	0.219
1966	8.030	1.864	1.963	2.071	0.077	0.126	0.238
1967	9.597	1.851	1.950	2.060	0.092	0.152	0.287
1968	8.337	1.836	1.935	2.046	0.080	0.133	0.251
1969	26.200	1.824	1.927	2.038	0.253	0.420	0.794
1970	33.823	1.765	1.875	1.998	0.334	0.558	1.051
1971	28.973	1.685	1.813	1.949	0.293	0.496	0.930
1972	26.473	1.633	1.773	1.916	0.272	0.465	0.871
1973	20.463	1.594	1.743	1.894	0.212	0.366	0.688
1974	36.280	1.581	1.731	1.883	0.377	0.653	1.235
1975	23.494	1.518	1.682	1.848	0.248	0.436	0.827
1976	6.045	1.505	1.669	1.841	0.064	0.113	0.216
1977	16.578	1.543	1.700	1.865	0.173	0.303	0.589
1978	14.349	1.542	1.701	1.867	0.149	0.262	0.512
1979	23.622	1.547	1.708	1.873	0.244	0.429	0.846

1980	31.157	1.526	1.690	1.860	0.323	0.572	1.134
1981	19.239	1.488	1.657	1.835	0.202	0.361	0.717
1982	32.441	1.484	1.658	1.837	0.340	0.607	1.218
1983	30.891	1.442	1.626	1.813	0.328	0.590	1.189
1984	34.024	1.408	1.601	1.793	0.365	0.660	1.339
1985	32.075	1.369	1.570	1.772	0.348	0.635	1.296
1986	32.984	1.278	1.572	1.944	0.345	0.653	1.351
1987	46.622	1.236	1.536	1.927	0.496	0.944	1.958
1988	51.118	1.192	1.486	1.874	0.560	1.069	2.223
1989	61.396	1.229	1.549	1.960	0.639	1.237	2.566
1990	39.326	0.993	1.243	1.576	0.513	0.984	2.037
1991	37.950	0.919	1.152	1.456	0.534	1.027	2.130
1992	35.487	0.822	1.028	1.302	0.559	1.074	2.222
1993	41.247	0.684	0.853	1.077	0.785	1.505	3.114
1994	37.190	0.564	0.702	0.889	0.860	1.646	3.404
1995	36.288	0.477	0.593	0.752	0.997	1.899	3.934
1996	35.932	0.439	0.547	0.699	1.072	2.035	4.238
1997	30.309	0.477	0.597	0.775	0.817	1.574	3.275
1998	20.382	0.622	0.777	0.985	0.423	0.818	1.700
1999	20.371	0.693	0.864	1.087	0.383	0.735	1.524
2000	26.644	0.745	0.928	1.168	0.465	0.894	1.854
2001	27.291	0.737	0.921	1.164	0.478	0.924	1.914
2002	29.158	0.604	0.751	0.945	0.630	1.209	2.506
2003	30.891	0.458	0.568	0.709	0.893	1.692	3.508
2004	27.102	0.375	0.467	0.583	0.956	1.804	3.751
2005	24.249	0.382	0.473	0.596	0.837	1.590	3.293
2006	21.432	0.421	0.530	0.664	0.661	1.262	2.618
2007	20.957	0.497	0.631	0.793	0.540	1.037	2.153
2008	22.169	0.503	0.626	0.784	0.649	1.237	2.562
2009	27.349	0.536	0.666	0.839	0.667	1.279	2.653
2010	25.995	0.519	0.645	0.810	0.657	1.254	2.599
2011	26.424	0.551	0.684	0.859	0.629	1.203	2.495
2012	29.309	0.577	0.716	0.904	0.664	1.273	2.636
2013	27.045	0.581	0.723	0.913	0.606	1.164	2.411
2014	21.069	0.557	0.692	0.874	0.494	0.946	1.964
2015	25.677	0.582	0.724	0.912	0.576	1.103	2.297
2016	25.397	0.568	0.715	0.910	0.571	1.103	2.324
2017		0.513	0.7283	1.042	0.512	1.07	2.385

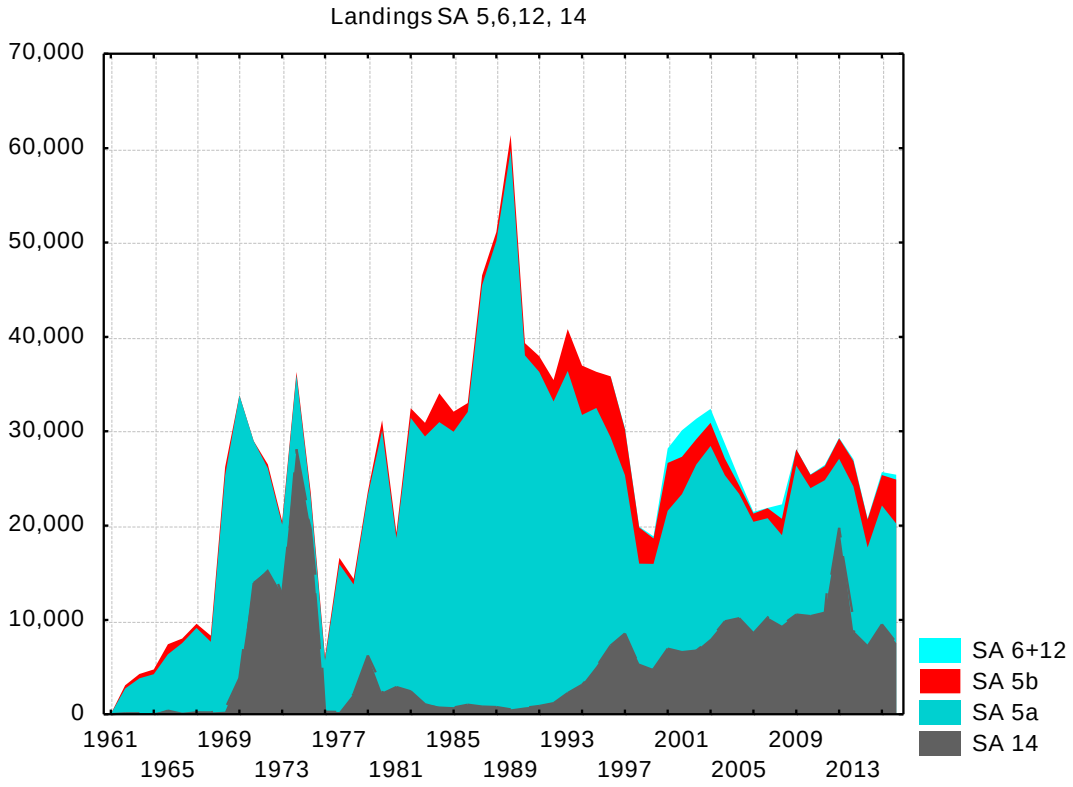

Fig. 17.2.1. Landings of Greenland halibut in Divisions 5, 6, 12 and 14. As the landings within Icelandic waters, since 1976, have not officially been separated and reported according to the defined ICES statistical areas, they are set under area 5a by the NWWG. In 2012 Icelandic landings in Div 14 were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

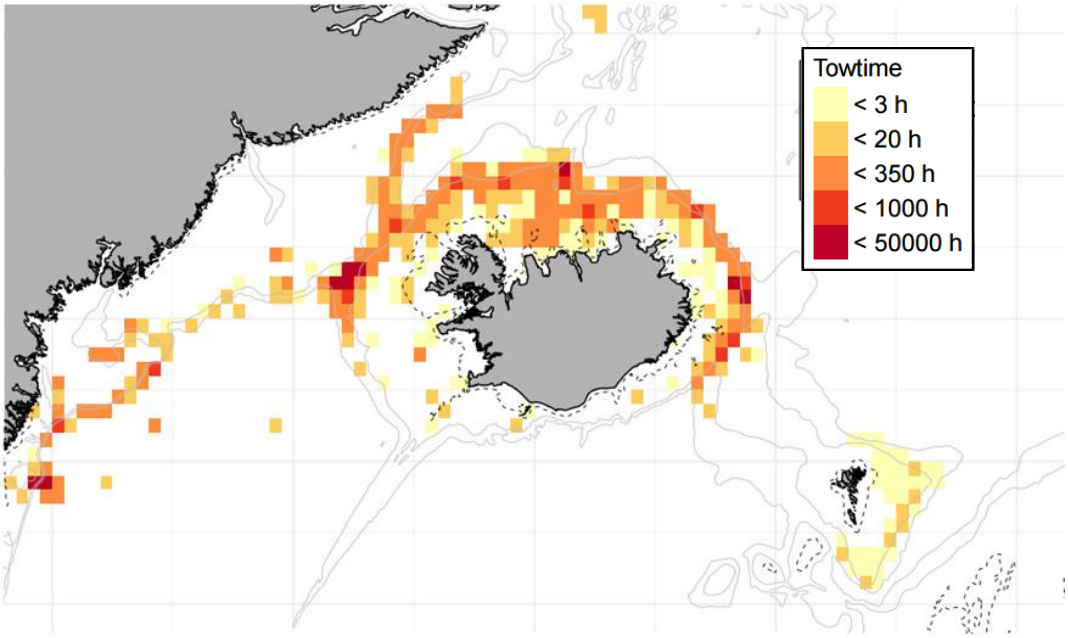

Fig. 17.2.2 Greenland halibut V+XIV. Distribution of fishing effort in 2016. 500m and 1000 m depth contours are shown.

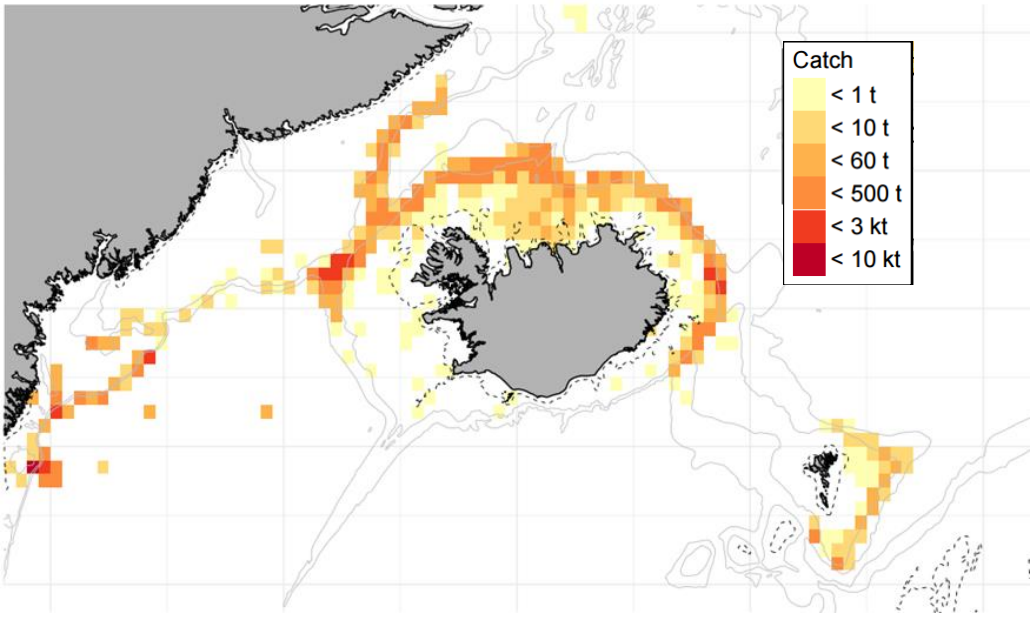

Fig. 17.2.3. Greenland halibut V+XIV. Distribution of catches in the fishery in 2016. 500m and 1000 m depth contours are shown.

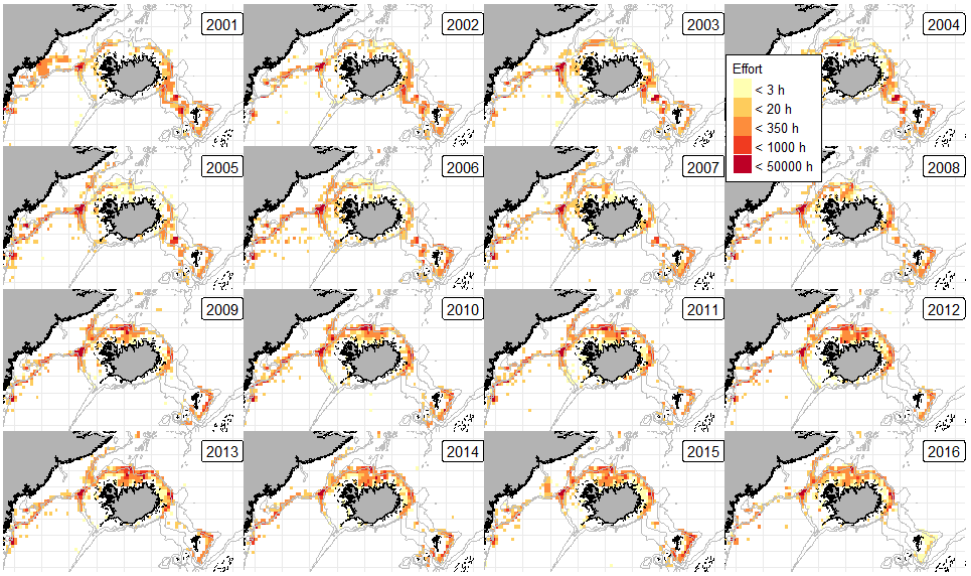

Fig. 17.2.4. Greenland halibut V+XIV. Distribution of total fishing effort 2000-2016. The 500m and 1000 m depth contours are shown.

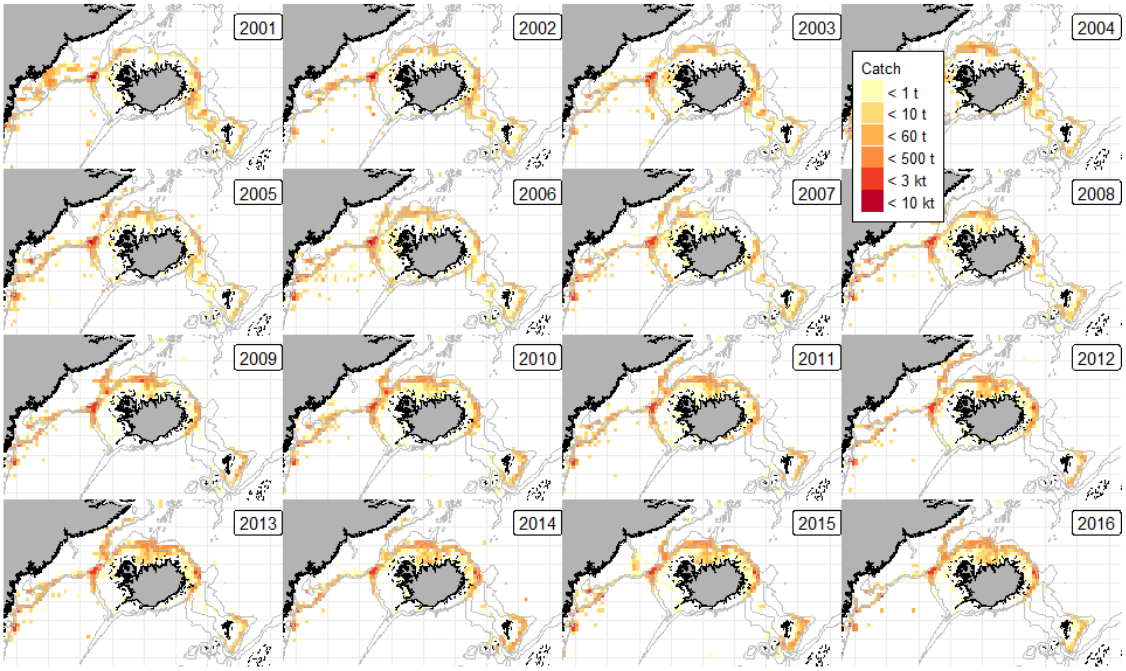

Fig. 17.2.5. Greenland halibut V+XIV. Distribution of total catches in the fishery 2000-2016 500m and 1000 m depth contours are shown.

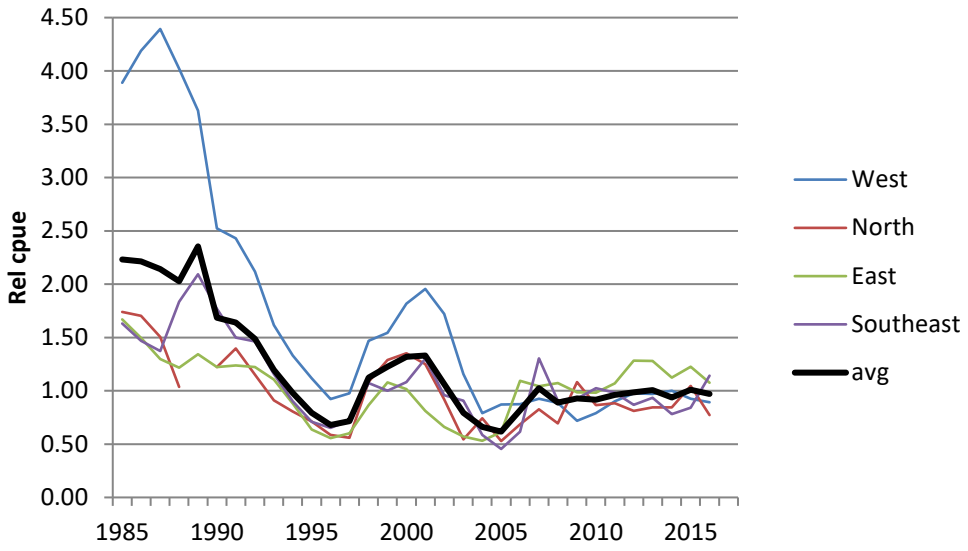

Fig. 17.3.1. Standardised CPUEs from the Icelandic trawler fleet in Va. Area 1-4 are west, north, east and south-east. The average index of the four areas are used as biomass indicator in the stock production model.

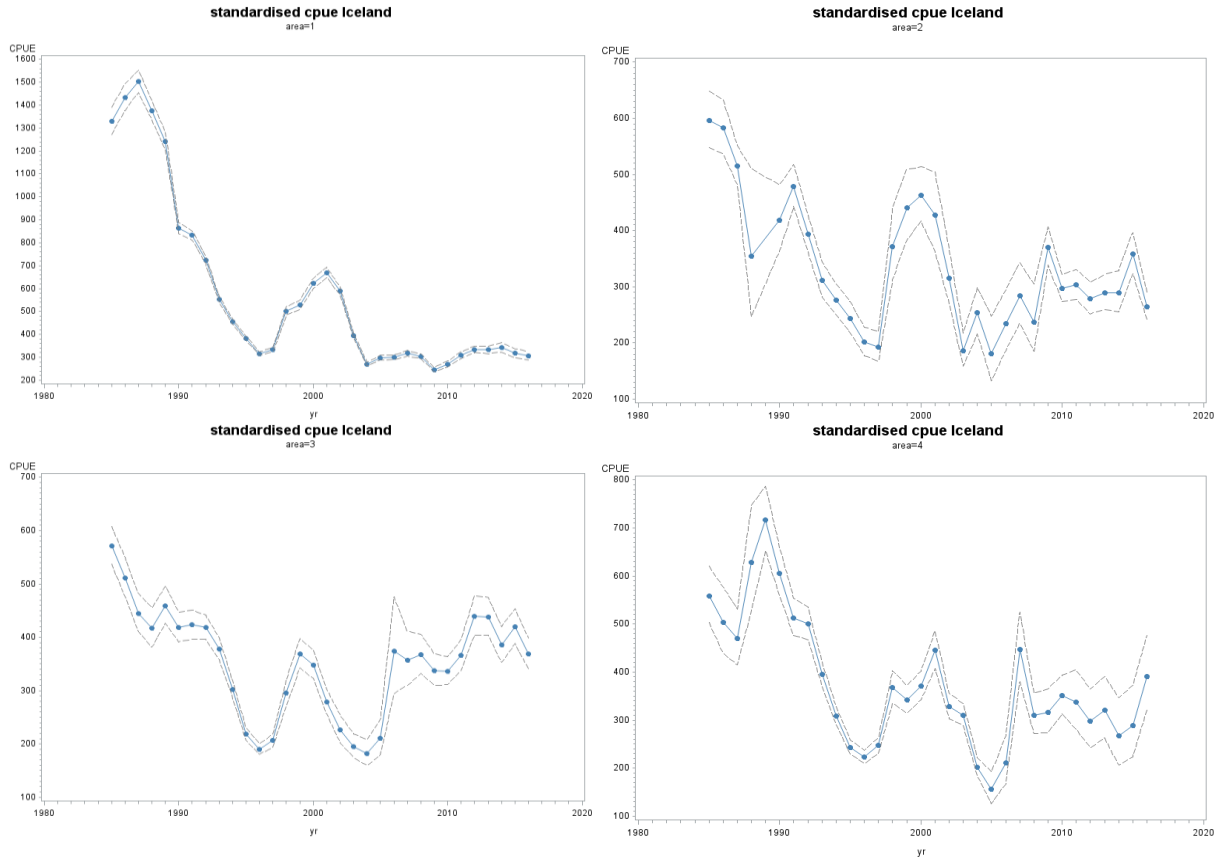

Fig. 17.3.2 Standardised CPUE from the Icelandic trawler fleet in 5a by four main fishing areas in 5a. 95% CI indicated.

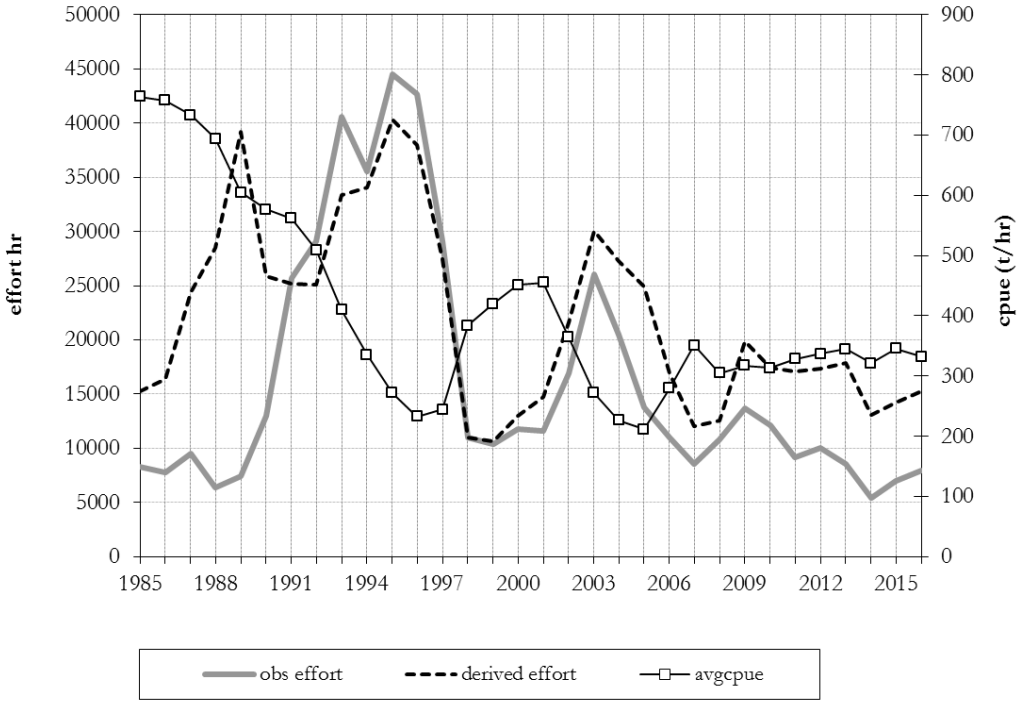

Fig. 17.3.3. Standardised CPUE, observed and derived effort from Icelandic trawl fishery.

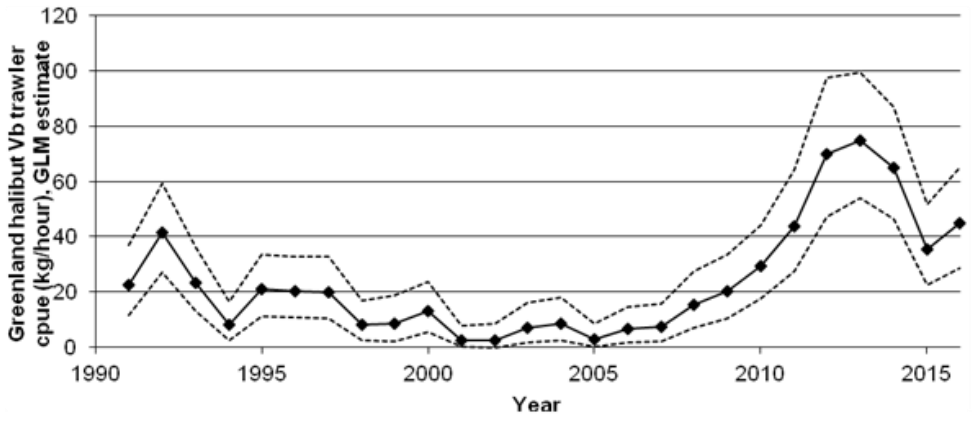

Figure 17. 3.4. Standardised CPUE from the Faroese trawler fleet. 95% CI indicated

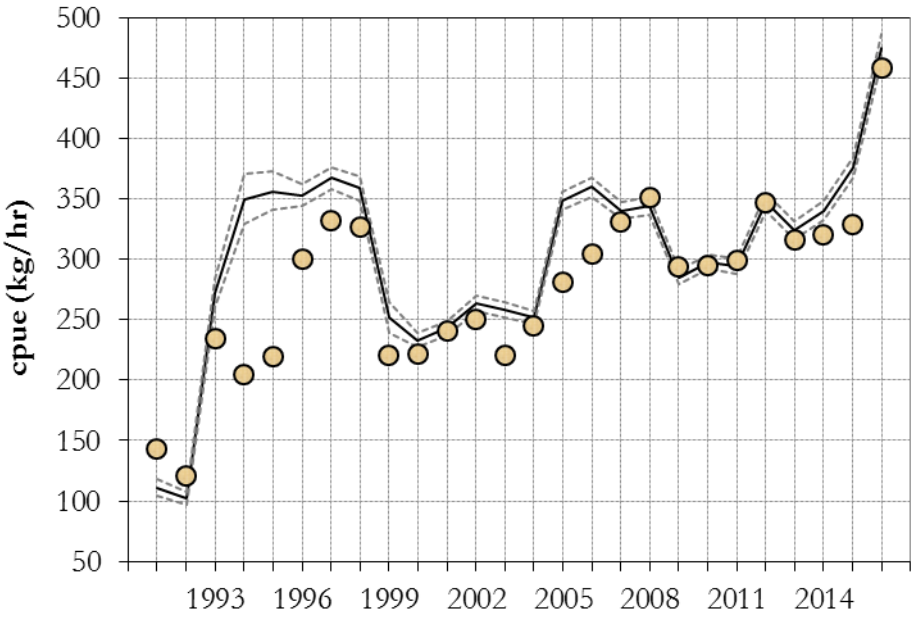

Fig. 17.3.5. Standardised CPUE from trawler fleets in 14b. 95% CI indicated. Points are observed CPUE (avg).

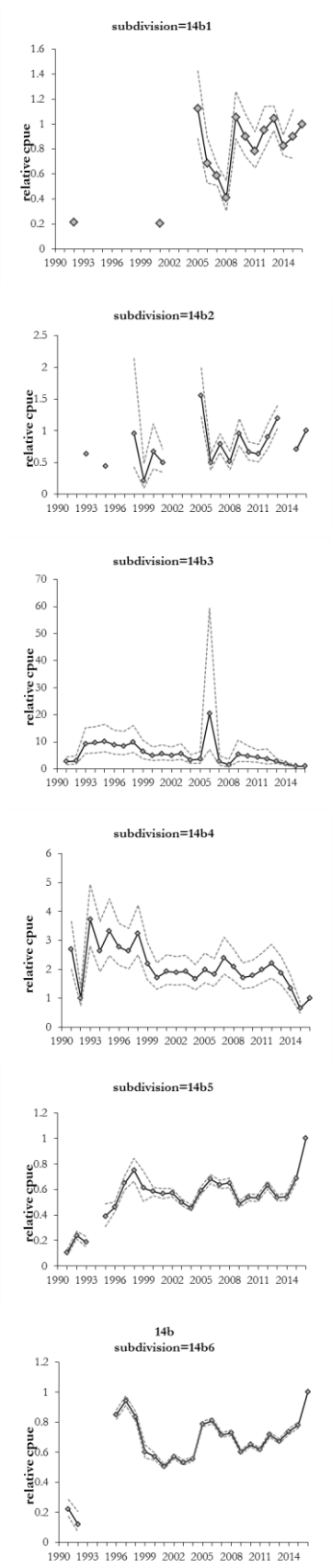

Fig. 17.3.6. Standardised CPUE from trawler fleets in 14b shown by subdivisions in a north-south direction. 95% CI indicated.

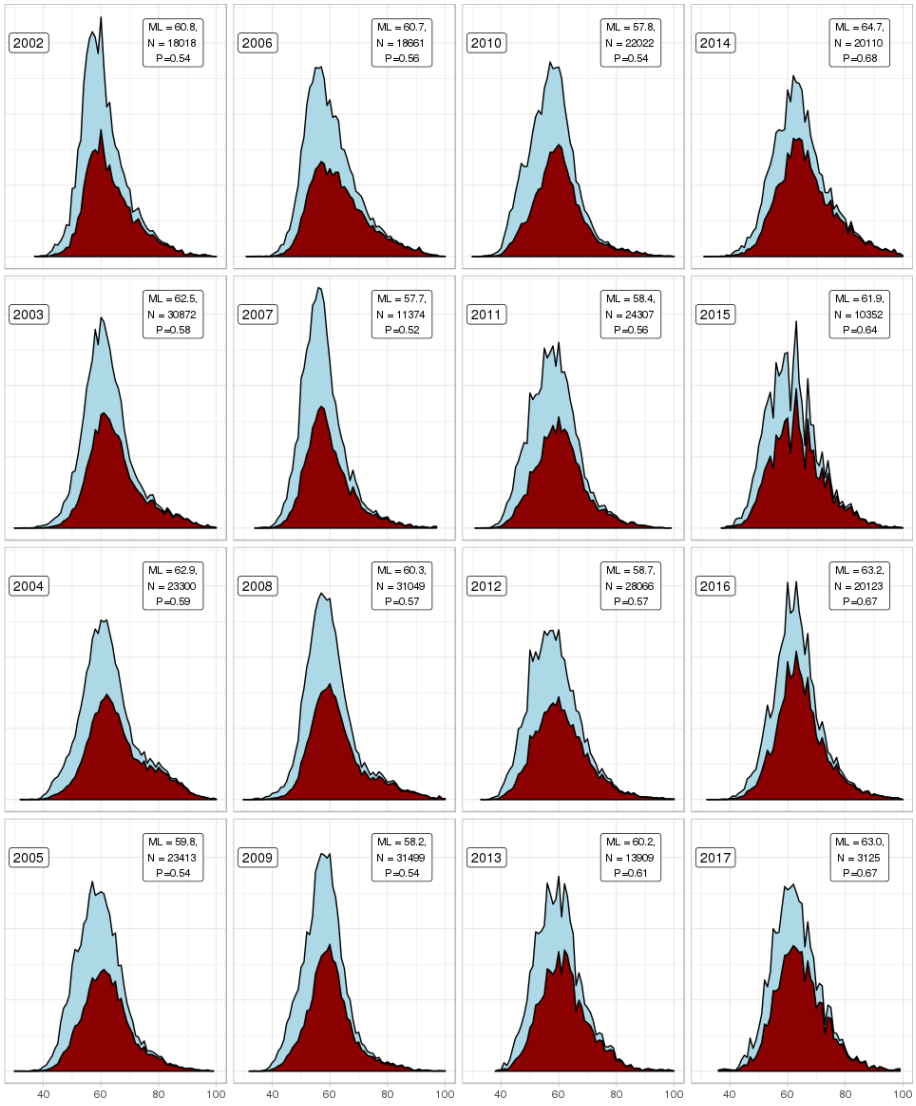

Fig. 17.4.1. Length distributions from the commercial trawl fishery in the western fishing grounds of Iceland (5a) in the years 2002-2017. Blue indicate males and red indicates females.

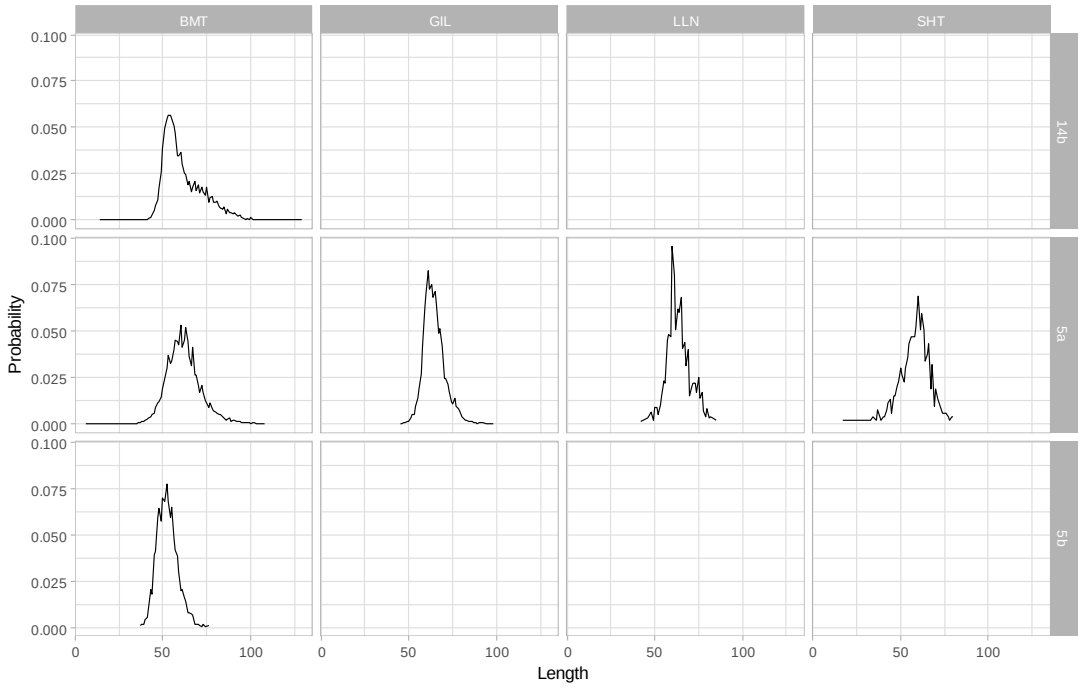

Fig. 17.4.2. Length distributions from the commercial fishery in Subareas 5 and 14 by gear (BMT=bottom trawl, LLN=longlines, SHT=shrimp trawl and GIL = gillnets) in 2016.

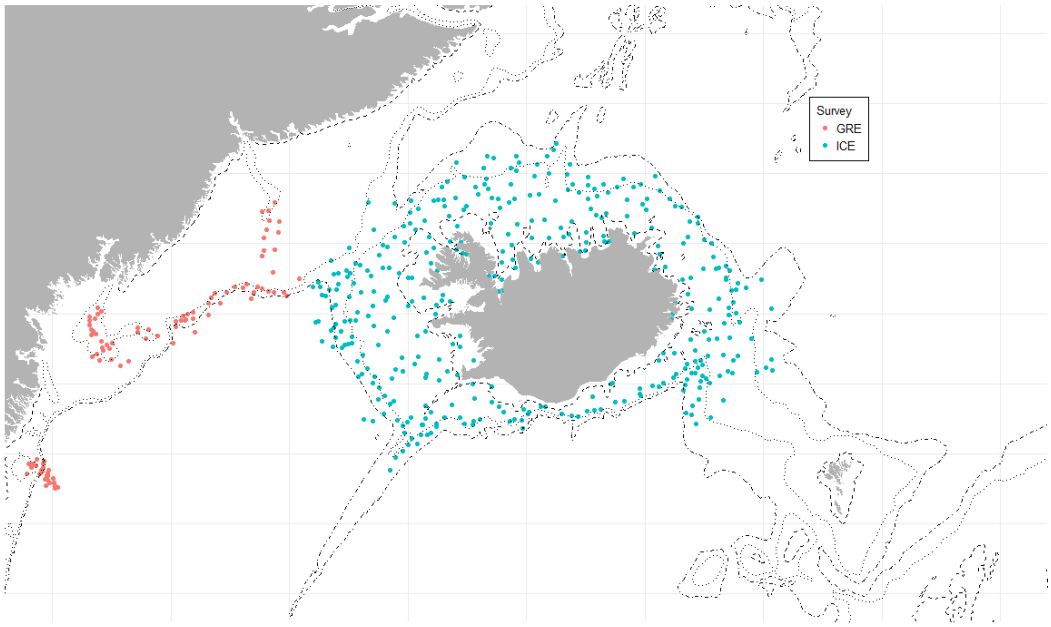

Fig. 17.5.1. Stations covered by scientific surveys in XIV+V indicated as station positions in 2016 by the Greenland (n= 97) and Iceland (n=372).

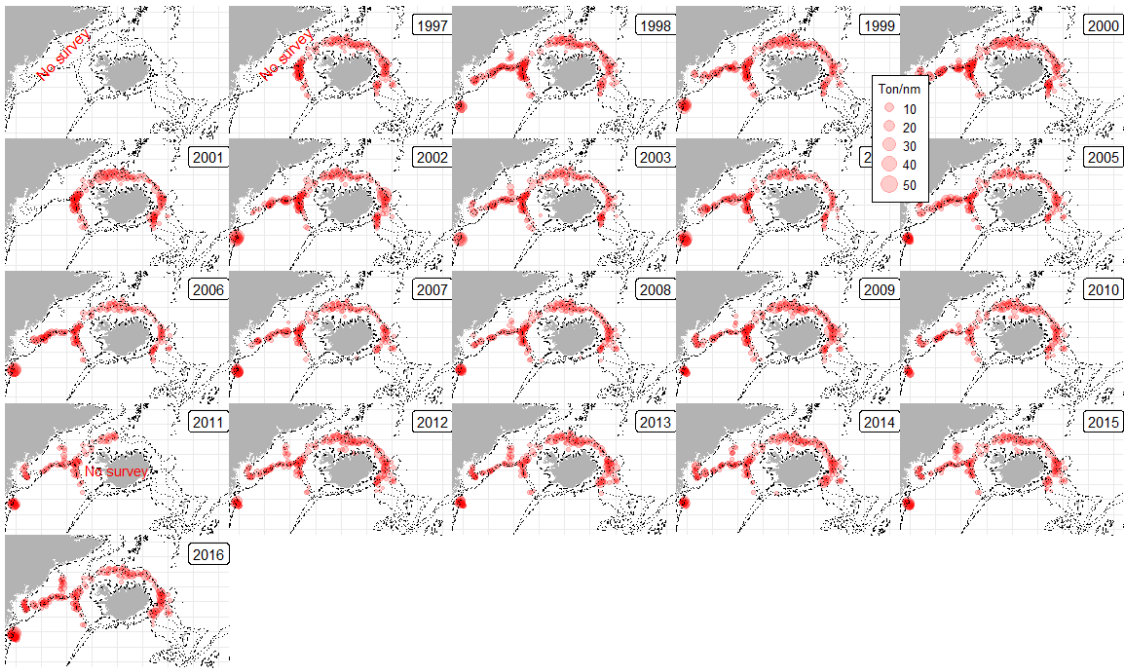

Fig. 17.5.2. Distribution of Greenland halibut catch rates from the combined Greenland-Icelandic fall survey since 1996.

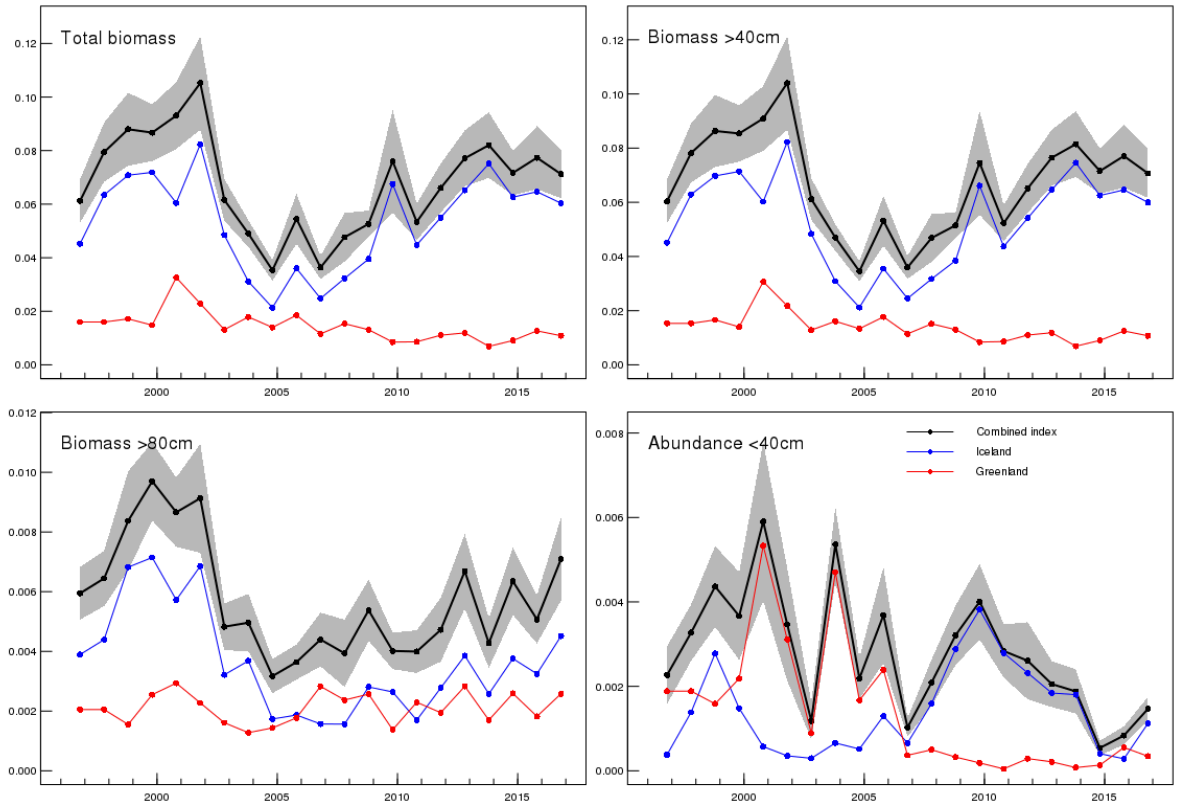

Fig. 17.5.3. Index of Greenland halibut in the Iceland, Greenland and the combined survey. No Iceland survey was conducted in 2011.

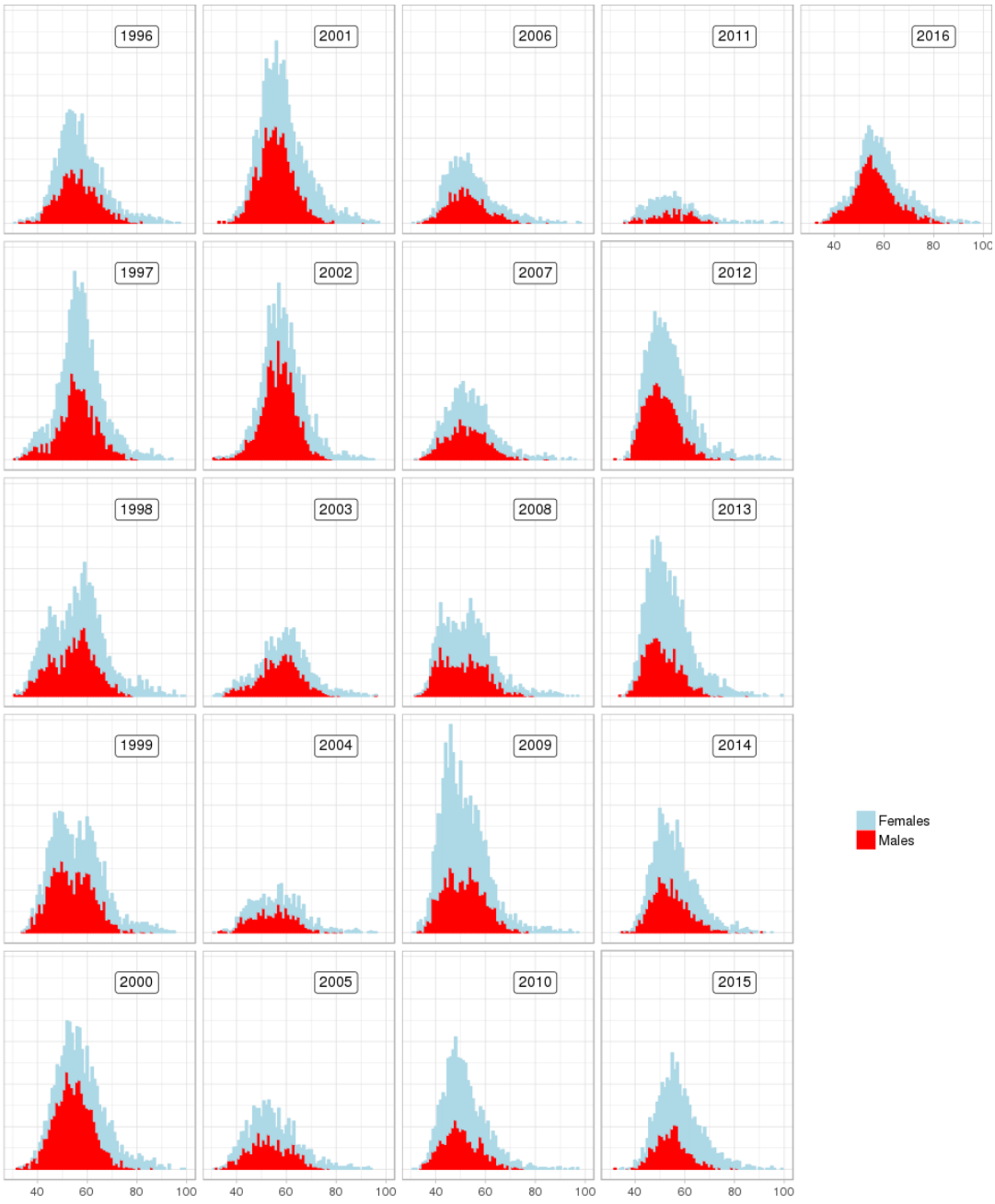

Fig. 17.5.4. Abundance indices by length for the Icelandic fall survey 1996-2015. No survey was conducted in 2011.

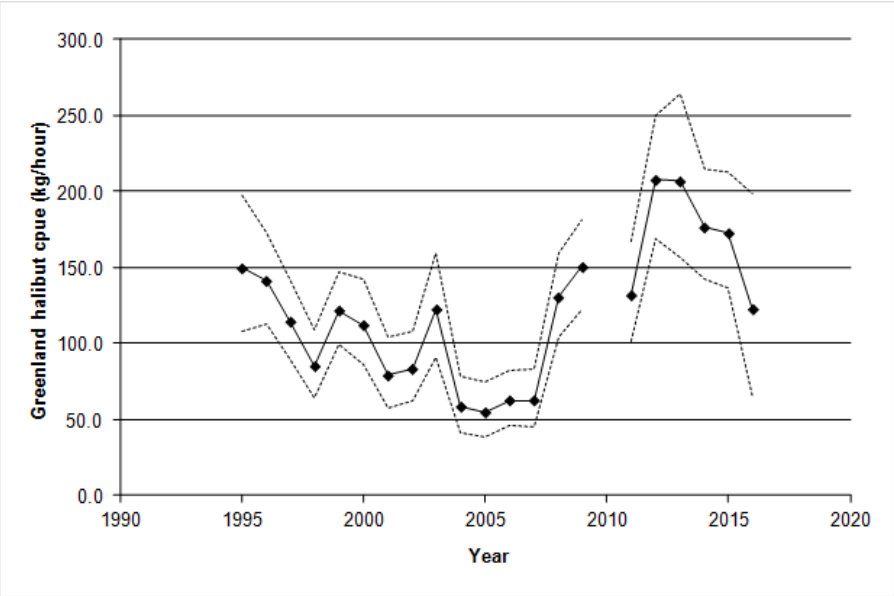

Figure 17.5.5. Catch rates from a combined survey/fisherman's survey in Vb. Estimates are from a GLM model.

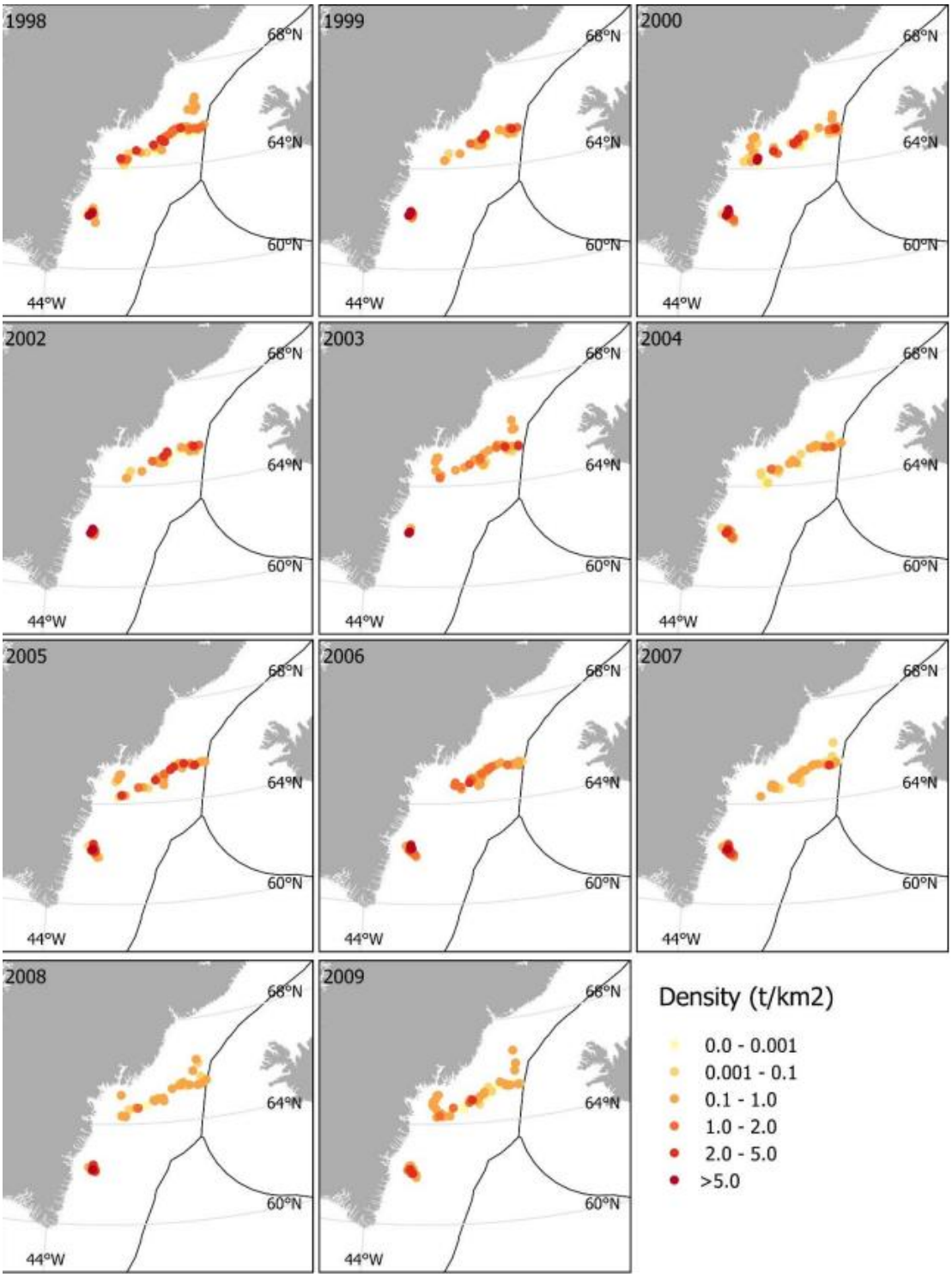

Fig. 17.5.6. Distribution of catches of Greenland halibut at East Greenland in 1998 – 2009 in the Greenland deep-water survey.

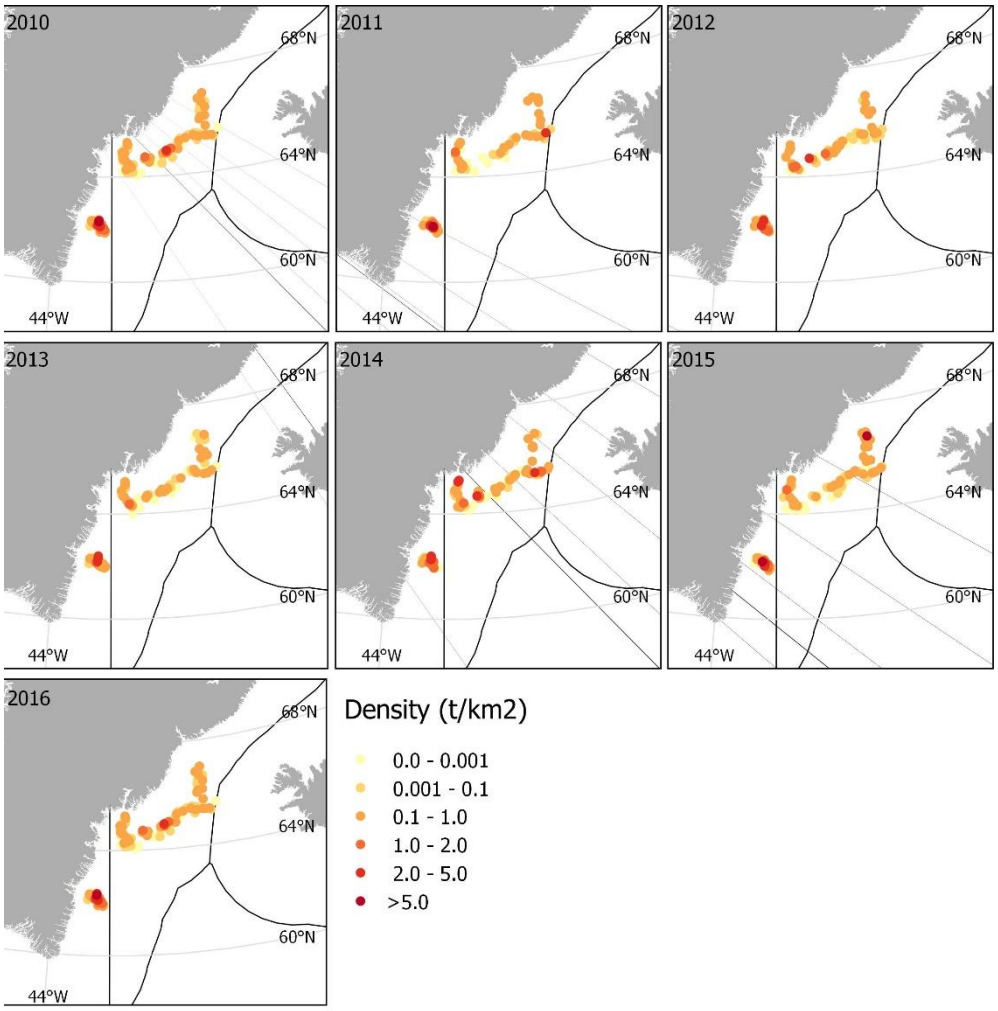

Fig. 17.5.6 continued. Distribution of catches of Greenland halibut at East Greenland in 2010 – 2016b in the Greenland deep-water survey.

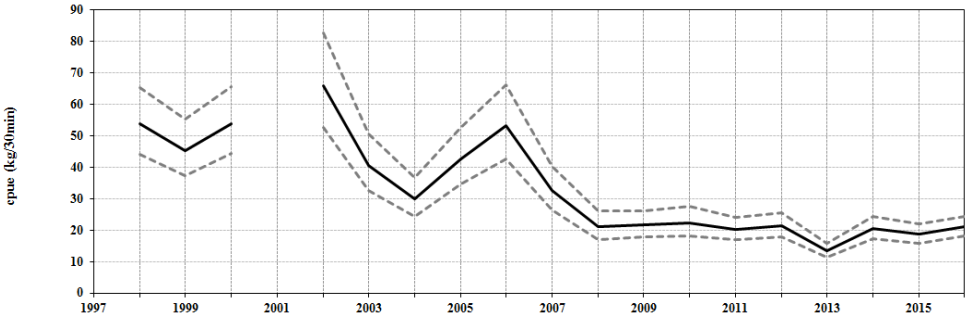

Fig. 17.5.7. Standardised catch rates from the Greenland survey.(95% CI indicated.)

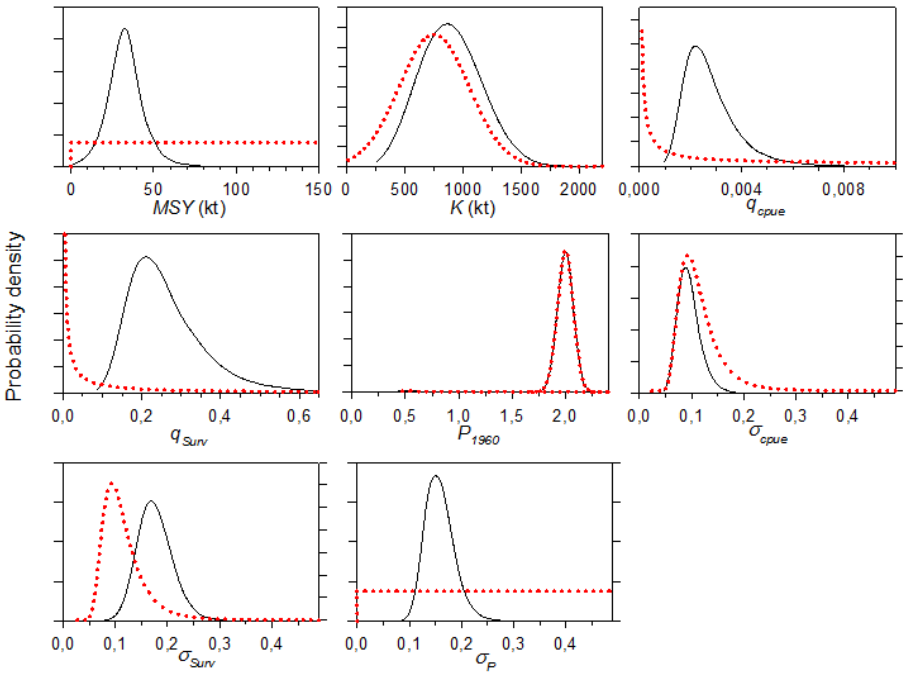

Figure 17.6.1. Probability density distributions of model parameters: estimated posterior (solid line) and prior (broken line) distributions.

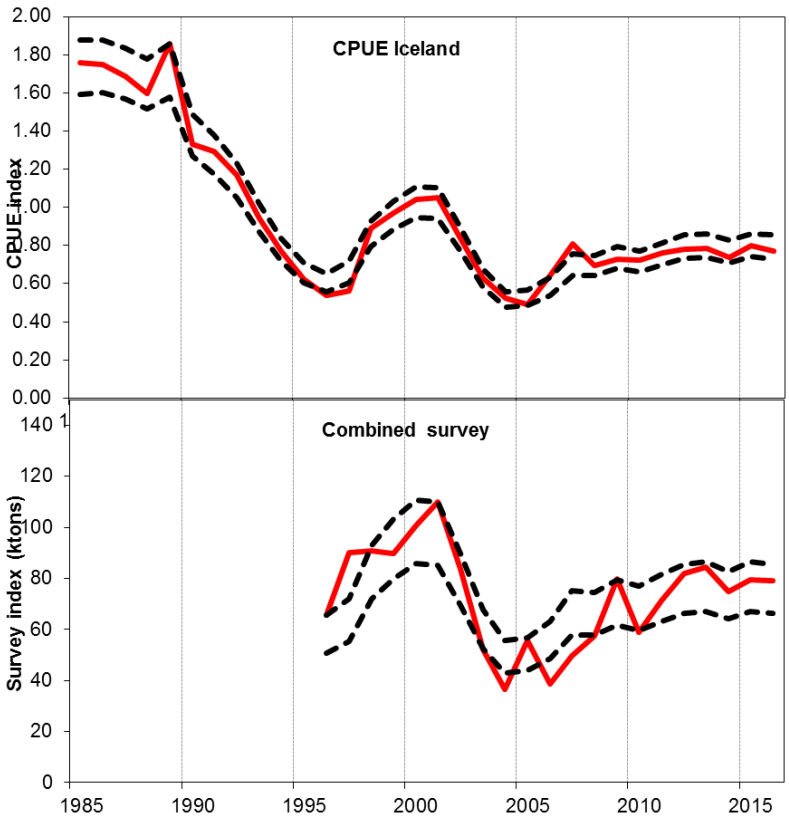

Figure 17.6.2. Observed (red curve) and predicted (dashed lines) series of the two biomass indices input to the model. Dashed lines are inter-quartile range of the posteriors.

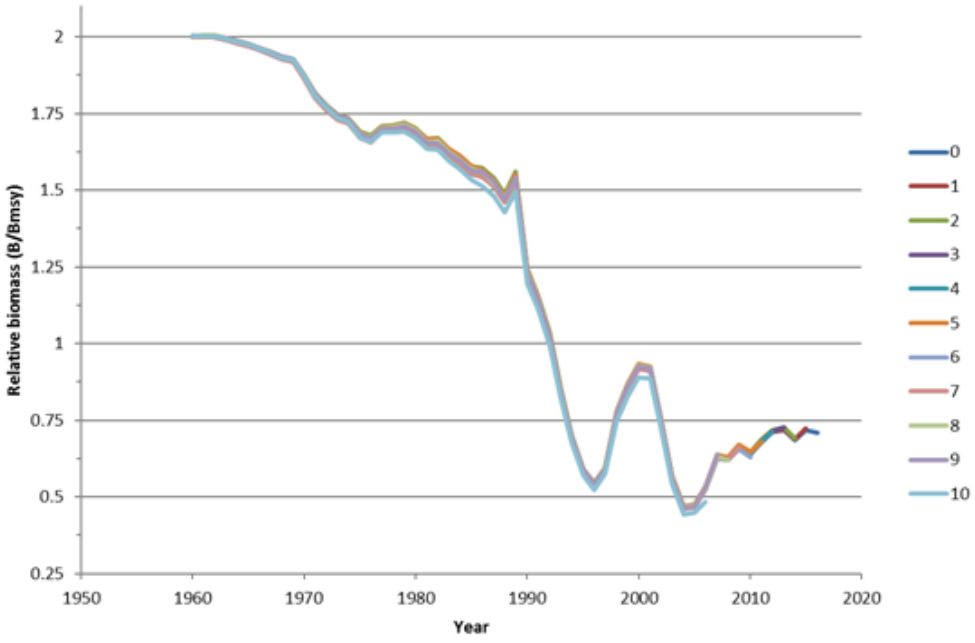

Figure 17.6.3. Retrospective plot of median relative biomass (B/B_{msy}).

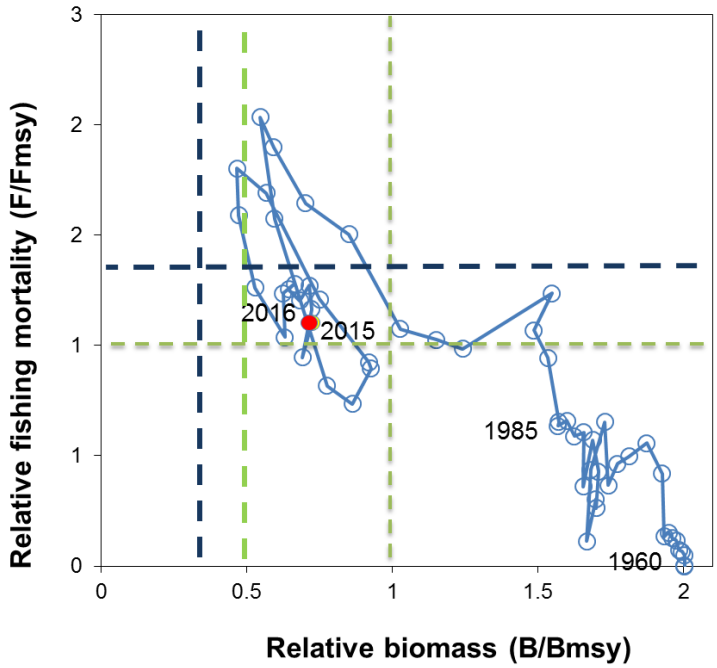

Figure 17.6.4. Stock trajectory. Estimated annual median biomass-ratio (B/BMSY) and fishing mortality-ratio (F/FMSY). B_{lim}, MSY $B_{trigger}$ and F_{lim} are indicated. 2015 and 2016 estimates are nearly equal (points on top of each other).

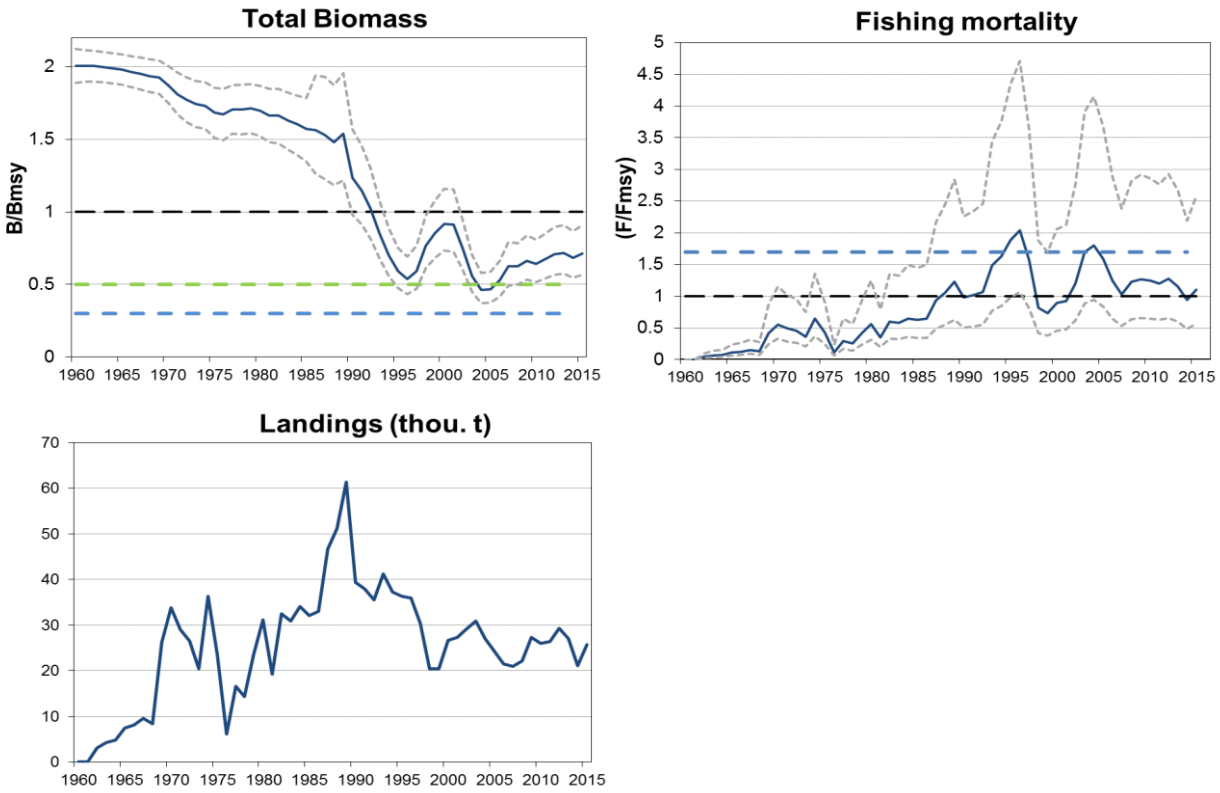

Figure 17.6.5. Stock summary, upper panel right: fishing mortality (F/Fmsy) and 95% conf limits, left: total biomass (B/Bmsy) and 95% conf limits and lower panel is landings since start of the fishery. MSY $B_{trigger}$ (green dashed line), B_{lim} and F_{lim} (blue dashed lines) are indicated.

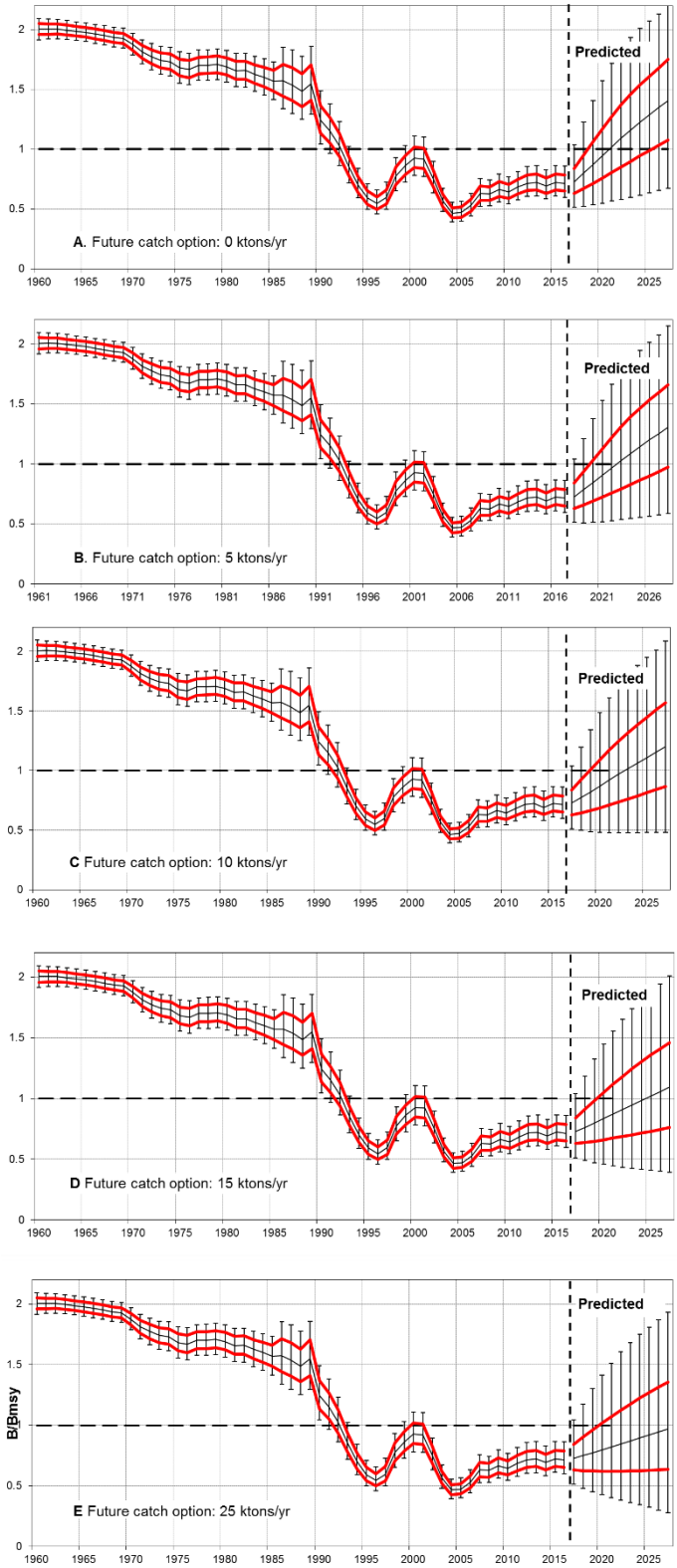

Fig. 17.6.6 Estimated time series of relative biomass (B_t/B_{msy}) under different catch option scenarios: 0, 5, 10, 15 and 25 kt from upper to lower panel. Bold red lines are inter-quartile ranges and the solid black line is the median; the error bars extend to cover the central 90 per cent of the distribution.

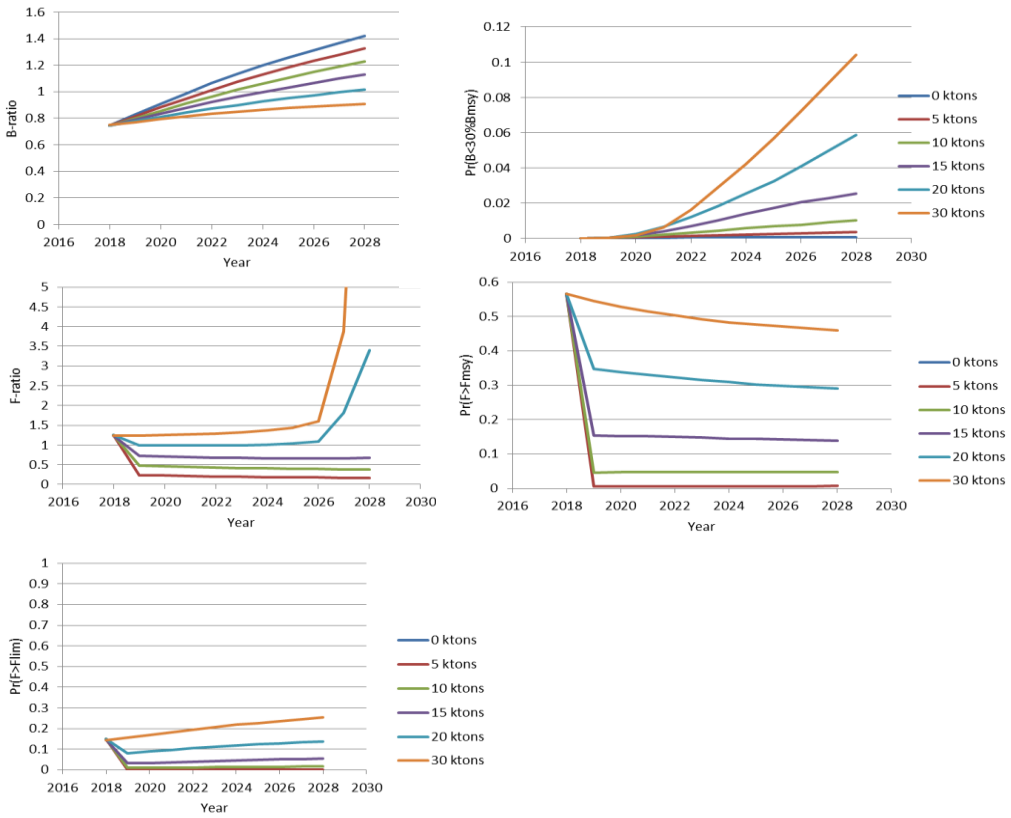

Figure 17.6.7. Projections: Medians of estimated posterior biomass- and fishing mortality ratios; estimated risk of exceeding F_{msy} or going below and $B_{MSYtrigger}$ given catch ranges at 0 -30 ktons.

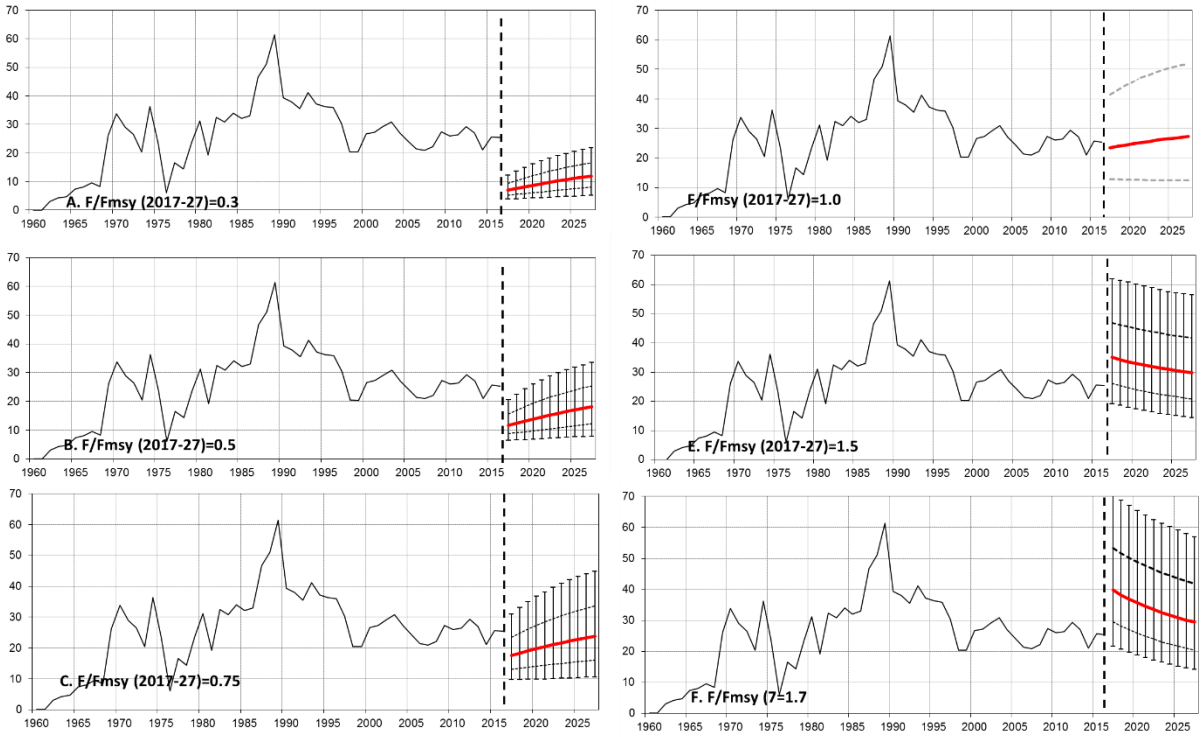

Figure 17.6.8. Historic landings and projected landings 2017-2027 under various F ratio options from 0.3-1.7 F/Fmsy Solid red line is median, quartiles and 90% conf limit indicated.

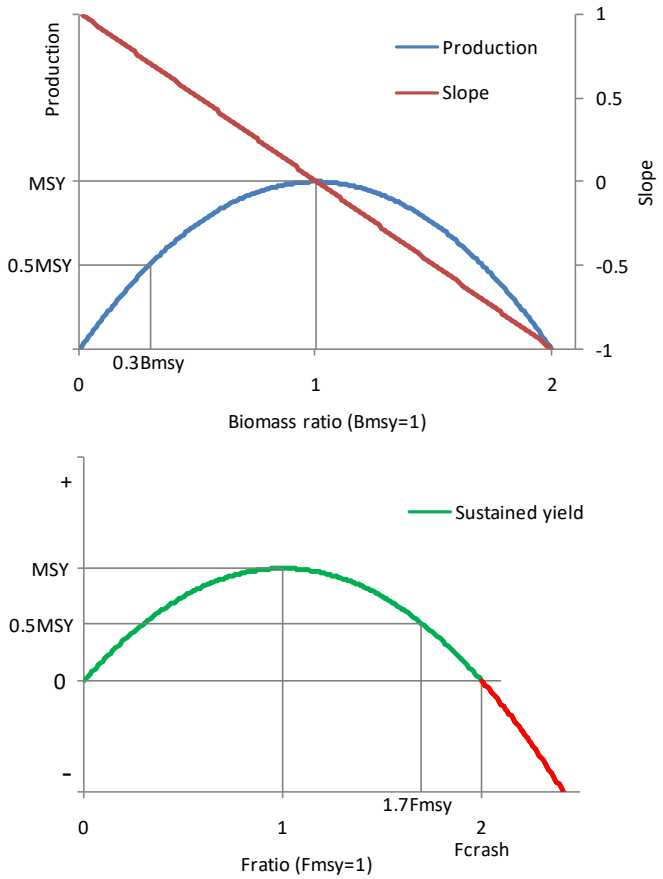

Figure 17.6.9. The logistic production curve in relation to stock biomass (B/Bmsy) (*upper*) and fishing mortality (F/Fmsy) (l*ower*). *Upper*: points of maximum sustainable yield (MSY) and corresponding stock size are shown as well as the slope (red line) of the production curve (blue line); *lower*: points of MSY and corresponding fishing mortality and Fcrash (F≥Fcrash do not have stable equilibriums and will drive the stock to zero).