Greenland halibut (*Reinhardtius hippoglossoides*) in subareas 5, 6, 12, and 14 (Iceland and Faroes grounds, West of Scotland, North of Azores, East of Greenland)

ICES advice on fishing opportunities

ICES advises that when the MSY approach is applied, catches in 2020 should be no more than 21 360 tonnes.

Stock development over time

The stock biomass is stable and is above MSY $B_{trigger}$. Recent fishing mortality (F) is estimated to be above F_{MSY}.

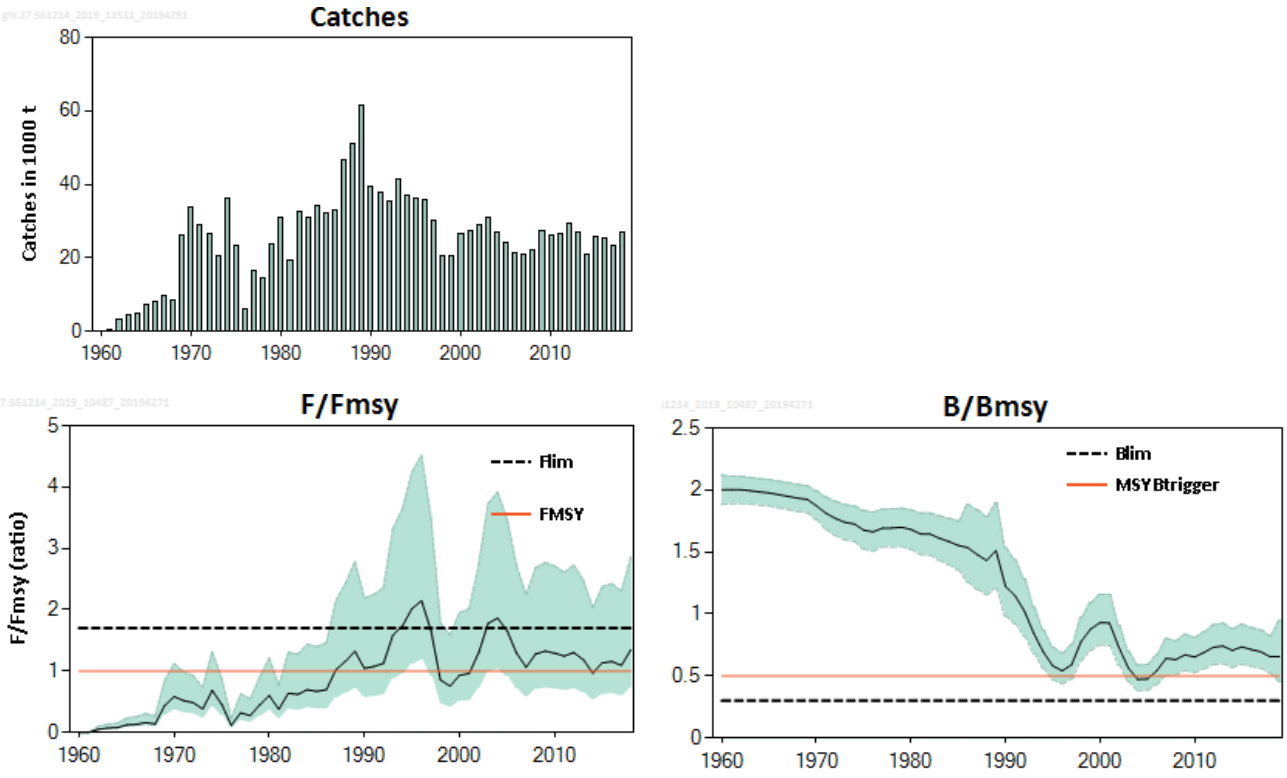

Figure 1 Greenland halibut in subareas 5, 6, 12, and 14. Summary of the stock assessment. Top: Catches. Bottom: Fishing mortality relative to F_{MSY} (left) and biomass relative to B_{MSY} (right) with medians and 90% confidence intervals.

Stock and exploitation status

ICES assesses that fishing pressure on the stock is above F_{MSY} and below F_{lim}, and spawning stock size is above MSY $B_{trigger}$ and B_{lim}.

Table 1 Greenland halibut in subareas 5, 6, 12, and 14. State of the stock and fishery relative to reference points.

	Fishing pressure					Stock size				
		2016	2017	2018			2017	2018	2019	
Maximum sustainable yield	F_{MSY}	✗	✗	✗	Above	MSY $B_{trigger}$	✓	✓	✓	Above trigger
Precautionary approach	F_{lim}, F_{pa}	?	?	?	Undefined	B_{lim}	✓	✓	✓	Full reproductive capacity
Management plan	F_{MGT}	–	–	–	Not applicable	B_{MGT}	–	–	–	Not applicable

Catch scenarios

Table 2 Greenland halibut in subareas 5, 6, 12, and 14. Assumptions made for the interim year and in the forecast. All weights are in tonnes.

Variable	Value	Notes
F (2019) (F/F_{MSY})	1.18	F corresponding to catches of 25 000 t.
Biomass (2019) (B/B_{MSY})	0.66	Estimated by the model.
Total catch (2019)	25 000 t	Based on TACs of Iceland, Greenland, and assumed catches from Faroe Islands.

Table 3 Greenland halibut in subareas 5, 6, 12, and 14. Annual catch scenarios (all weights are in tonnes).

Basis	Total catch (2020)	F_{total} (2020) F/F_{MSY}	Biomass (2020) B/B_{MSY}	% Biomass change*	% Advice change**
ICES advice basis					
MSY approach: F_{MSY}	21 360	1	0.68	3	−12
Other scenarios					
F = 0	0	0	0.74	12	−100
$F = F_{2019}$	24 490	1.18	0.67	2	1
$F = F_{lim}$	36 240	1.70	0.66	0	50

* Biomass 2020 relative to biomass 2019.
** Advice value for 2020 relative to the advice value for 2019.

Estimated biomass has decreased, which results in lower advised catch for 2020.

Basis of the advice

Table 4 Greenland halibut in subareas 5, 6, 12, and 14. The basis of the advice.

Advice basis	MSY approach.
Management plan	ICES is not aware of any agreed precautionary management plan for Greenland halibut in this area.

Quality of the assessment

The use of historical commercial catch rates prior to the early 1990s as biomass indicators may cause bias in the historical perspective of the stock development and reference points. This is a result of changes in technology, fleet behaviour, and management. The assessment and reference points are sensitive to the inclusion of these historical commercial catch rates.

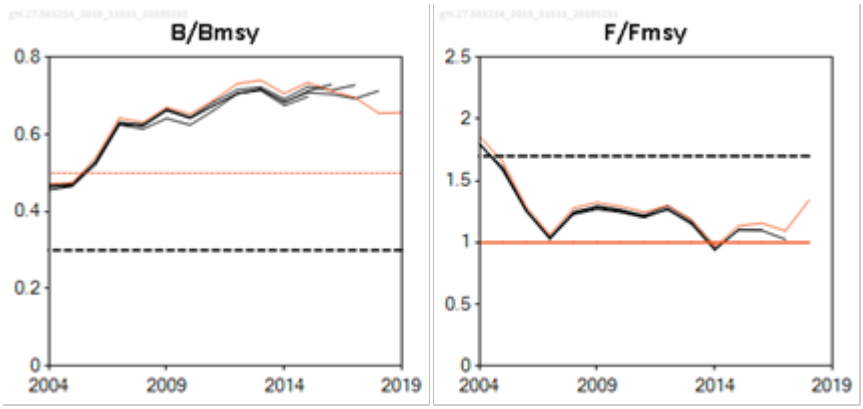

Figure 2 Greenland halibut in subareas 5, 6, 12, and 14. Historical assessment results.

Issues relevant for the advice

Greenland halibut is a relatively slow-growing and late-maturing species. Low abundance of smaller fish has been recorded in the surveys in recent years (ICES, 2019). These year classes are now entering the fishable biomass, which is likely to cause an overall reduction in total biomass in the future.

The connectivity to the Barents Sea stock (ICES subareas 1 and 2) is unquantified (Albert and Vollen, 2015; Westgaard *et al.*, 2017) and there may be different trends within the current assessment area. These issues add to the uncertainty in the assessment and advice.

Reference points

Table 5 Greenland halibut in subareas 5, 6, 12, and 14. Reference points, values, and their technical basis.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	0.5 B_{MSY}	B_{MSY} is estimated implicitly from the surplus production model.	ICES (2007)
	F_{MSY}	Relative value	F_{MSY} is estimated implicitly from the surplus production model. Fishing mortality values are expressed relative to F_{MSY}.	ICES (2007)
Precautionary approach	B_{lim}	0.3 B_{MSY}	Based on a fraction of B_{MSY} where production is reduced to 50% MSY.	ICES (2013)
	B_{pa}	Not defined		
	F_{lim}	1.7 F_{MSY}	The F that on average gives B_{lim}.	ICES (2013)
	F_{pa}	Not defined		
Management plan	SSB_{mgt}	Not defined		
	F_{mgt}	Not defined		

Basis of the assessment

Table 6 Greenland halibut in subareas 5, 6, 12, and 14. Basis of the assessment and advice.

ICES stock data category	1 (ICES, 2018).
Assessment type	A probabilistic (Bayesian) version of a surplus production model that uses catches in the model and in the forecast (ICES, 2019).
Input data	Commercial catches (international landings); one combined survey index (GRL-deep 1998–2016, and IS-SMH since 1996); one commercial index (Icelandic trawlers (since 1985)).
Discards and bycatch	Discarding and bycatch are considered negligible.
Indicators	None.
Other information	A benchmark was conducted in 2013 (WKBUT; ICES, 2013).
Working group	North-Western Working Group (NWWG)

Information from stakeholders

The different catch per unit effort trends across the stock distribution are not taken into account in the assessment.

History of the advice, catch, and management

Table 7 Greenland halibut in subareas 5, 6, 12, and 14. ICES advice and catch. All weights are in tonnes.

Year	ICES advice	Catch corresponding to advice	TAC for Iceland EEZ *	TAC for Greenland EEZ	ICES catch subareas 5, 6, 12, and 14
1987	No increase in F	28000	30000		46622
1988	No increase in F	28000	30000		51118
1989	TAC	33000	30000		61396
1990	No advice	-	45000		39326
1991	TAC	40000	30000		37950
1992	TAC	30000	25000		35487
1993	No increase in effort	28000	30000		41247
1994	No increase in effort	34000	30000		37190
1995	TAC	32000	30000		36288
1996	TAC	21000	20000		35932
1997	60% reduction in F from 1995	13000	15000		30309
1998	70% reduction in F from 1996	11000	10000	8100	20382
1999	65% reduction in F from 1997	11000	10000	8000	20371
2000	60% reduction in F from 1998	11000	10000	8000	26644

Year	ICES advice	Catch corresponding to advice	TAC for Iceland EEZ *	TAC for Greenland EEZ	ICES catch subareas 5, 6, 12, and 14
2001	Catch less than 1998–1999 catch	< 20000	20000	14500	27291
2002	F reduced below 0.67 × F_{MSY}	< 21000	20000	14500	29158
2003	F reduced below 0.67 × F_{MSY}	< 23000	23000	14500	30891
2004	F reduced below 0.67 × F_{MSY}	< 20000	23000	14100	27102
2005	Effort reduced to 1/3 of the 2003 level	< 15000	15000	12000	24249
2006	Effort reduced to 1/3 of the 2003 level	< 15000	15000	10000	21432
2007	Adaptive management plan, start at 15 000 t	< 15000	15000	11700	20957
2008	Adaptive management plan, start at 15 000 t	< 15000	15000	11000	22169
2009	Adaptive management plan, reduce to 5000 t	< 5000	15000	10000	27349
2010	Adaptive management plan, reduce to 5000 t	< 5000	12000	12000	25995
2011	Adaptive management plan, reduce F substantially below F_{MSY}	< 5000	13000	12000	26424
2012	No directed fishery, multi-annual management plan to be developed and implemented	-	13000	13000	29309
2013	F reduced to F_{MSY}	< 20000	15000	10000	27045
2014	F reduced to F_{MSY}	< 20000	12500	8300	21069
2015	F reduced to F_{MSY}	< 25000	14100	9500	25677
2016	Fishing at F_{MSY}	< 22000	12400	8300	25397
2017	Fishing at F_{MSY}	< 24000	13500	9000	23466
2018	Fishing at F_{MSY}	< 24000	13535	9024	27142
2019	MSY approach	< 24150	13621	9080	
2020	MSY approach	≤ 21360			

* For the fishing year ending 31 August.

History of the catch and landings

Table 8 Greenland halibut in subareas 5, 6, 12, and 14. Catch distribution by fleet in 2018 as estimated by ICES.

Catch (2018)	Landings		Discards
27 142 tonnes	Bottom trawl/shrimp trawl 64%	Gillnet/longlines 36%	Discarding is negligible
	27 142 tonnes		

Table 9 Greenland halibut in subareas 5, 6, 12, and 14. History of commercial catch; both the official and ICES estimated values are presented by area for each country participating in the fishery. All weights are in tonnes.

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989
Denmark							6	+	
Faroe Islands	767	1532	1146	2502	1052	853	1096	1378	2319
France	8	27	236	489	845	52	19	25	
Germany	3007	2581	1142	936	863	858	565	637	493
Greenland	+	1	5	15	81	177	154	37	11
Iceland	15457	28300	28360	30080	29231	31044	44780	49040	58330
Norway			2	2	3	+	2	1	3
Total	19239	32441	30891	34024	32075	32984	46622	51118	61156
ICES estimate	-	-	-	-	-	-	-	-	61396

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998
Denmark	-	-	-	-	-	-	1	-	
Faroe Islands	1803	1566	2128	4405	6241	3763	6148	4971	3817
France	-	-	3	2	-	-	29	11	8
Germany	336	303	382	415	648	811	3368	3342	3056
Greenland	40	66	437	288	867	533	1162	1129	747
Iceland	36557	34883	31955	33987	27778	27383	22055	18569	10728
Norway	50	34	221	846	1173	1810	2164	1939	1367
Russia	-	-	5	-	-	10	424	37	52
Spain									89
UK (Engl. and Wales)	27	38	109	811	513	1436	386	218	190
UK (Scotland)	-	-	19	26	84	232	25	26	43
Total	38813	36890	35259	40780	37305	36006	35762	30242	20360
ICES estimate	39326	37950	35423	40817	36958	36300	35825	30309	20382
Country	1999	2000	2001	2002	2003	2004	2005	2006	2007
Estonia				8			5	3	
Faroe Islands	3884		121	334	458	338	1150	855	1141
France		2	32	290	177	157		62	17
Germany	3082	3265	2800	2050	2948	5169	5150	4299	4930
Greenland	200	1740	1553	1887	1459				
Iceland	11180	14537	16590	19224	20366	15478	13023	11798	9567
Ireland			56						
Lithuania					2	1		2	3
Norway	1187	1750	2243	1998	1074	1233	1124	1097	78
Poland			2	16	93	207			
Portugal			6	130				1094	
Russia	138	183	187	44		262		552	501
Spain		779	1698	1395	3075	4721	506	33	
UK (Engl. and Wales)	261	370	227	71	40	49	10	1	
UK (Scotland)	69	121	130	181	367	367	391	1	
United Kingdom		166	252	255	841	1304	220	93	17
Total	20001	22913	25897	27609	30900	29286	21579	19890	16410
ICES estimate	20371	26644	27291	29158	30891	27102	24249	21432	20957
Country	2008	2009	2010	2011	2012	2013	2014	2015	2016
Estonia							429		
Faroe Islands	26	270	1408	1705	2811	2788	3393	3214	4656
France	114			150	67	133		117	88
Germany	4846	427	5287	5782	4620	3814	3701	3808	4420
Greenland		2819		3415	5239	3251	1897	3642	1511
Iceland	11671		13293	13192	13749	14859	9861	12400	12652
Lithuania	566				99				
Norway	639	124	233	171	856	614	764	1126	1007
Poland	1354	988	960		786				
Russia	799	762	1070	1095	1168	1369	587	600	600
Spain								110	2105
United Kingdom	422	581	577	323	12	95		127	348
Total	9744	5974	22901	25693	29407	26923	20743	25145	27388
ICES estimate	22169	27349	25995	26424	29309	27045	21069	25677	25397
Country	2017	2018*							
Faroe Islands	3999	2949							
France	51	71							
Germany	2994	4463							
Greenland	2692	2970							
Iceland	11926	15214							
Norway	1002	937							
Russia	599	400							
Spain	114	125							
United Kingdom	90	13							
Total	23466	27142							
ICES estimate	23466	27142							

* Provisional data.

Summary of the assessment

Table 10 Greenland halibut in subareas 5, 6, 12, and 14. Assessment summary. Catch weights are in tonnes. High and low values correspond to 90% confidence intervals.

Year	B/B_{MSY}*	B/B_{MSY} High*	B/B_{MSY} Low*	Total catch	F/F_{MSY}	F/F_{MSY} High	F/F_{MSY} Low
1960	2	2.12	1.88	0	0.00	0.00	0.00
1961	2	2.11	1.89	29	0.00047	0.00090	0.00029
1962	2	2.11	1.89	3071	0.049	0.096	0.031
1963	1.99	2.1	1.89	4275	0.069	0.134	0.043
1964	1.98	2.09	1.88	4748	0.077	0.149	0.048
1965	1.98	2.08	1.87	7421	0.121	0.23	0.076
1966	1.96	2.07	1.86	8030	0.132	0.25	0.083
1967	1.95	2.06	1.84	9597	0.158	0.31	0.099
1968	1.93	2.04	1.83	8337	0.139	0.27	0.087
1969	1.93	2.03	1.82	26200	0.44	0.85	0.27
1970	1.87	1.99	1.76	33823	0.58	1.12	0.36
1971	1.81	1.94	1.68	28973	0.52	0.99	0.32
1972	1.77	1.91	1.63	26473	0.49	0.93	0.29
1973	1.74	1.88	1.6	20463	0.38	0.73	0.23
1974	1.73	1.87	1.58	36280	0.68	1.32	0.41
1975	1.68	1.83	1.52	23494	0.46	0.88	0.27
1976	1.66	1.82	1.51	6045	0.118	0.23	0.070
1977	1.69	1.85	1.54	16578	0.32	0.63	0.188
1978	1.69	1.85	1.54	14349	0.27	0.55	0.162
1979	1.7	1.85	1.54	23622	0.45	0.90	0.27
1980	1.68	1.84	1.52	31157	0.60	1.21	0.35
1981	1.65	1.81	1.48	19239	0.38	0.77	0.22
1982	1.65	1.81	1.47	32441	0.64	1.30	0.37
1983	1.61	1.79	1.43	30891	0.62	1.27	0.36
1984	1.59	1.77	1.4	34024	0.70	1.44	0.40
1985	1.55	1.75	1.36	32075	0.67	1.39	0.38
1986	1.53	1.88	1.26	32984	0.70	1.46	0.38
1987	1.48	1.84	1.2	46622	1.02	2.1	0.56
1988	1.43	1.78	1.16	51118	1.16	2.4	0.63
1989	1.51	1.89	1.21	61396	1.32	2.8	0.71
1990	1.22	1.53	0.98	39326	1.05	2.2	0.57
1991	1.15	1.44	0.92	37950	1.07	2.2	0.58
1992	1.02	1.28	0.82	35487	1.13	2.4	0.61
1993	0.84	1.05	0.68	41247	1.59	3.3	0.86
1994	0.69	0.87	0.56	37190	1.74	3.6	0.95
1995	0.58	0.73	0.47	36288	2.0	4.2	1.11
1996	0.54	0.68	0.44	35932	2.1	4.5	1.18
1997	0.59	0.75	0.48	30309	1.66	3.5	0.90
1998	0.78	0.97	0.63	20382	0.85	1.78	0.46
1999	0.88	1.09	0.71	20371	0.76	1.59	0.41
2000	0.93	1.16	0.75	26644	0.93	1.96	0.50
2001	0.93	1.16	0.74	27291	0.96	2.0	0.51
2002	0.73	0.91	0.59	29158	1.30	2.7	0.70
2003	0.56	0.7	0.46	30891	1.78	3.7	0.97
2004	0.47	0.59	0.38	27102	1.86	3.9	1.02
2005	0.47	0.59	0.39	24249	1.66	3.5	0.90
2006	0.54	0.67	0.43	21432	1.29	2.7	0.70
2007	0.64	0.8	0.51	20957	1.06	2.2	0.57
2008	0.63	0.78	0.51	22169	1.28	2.7	0.70
2009	0.67	0.84	0.54	27349	1.32	2.8	0.72
2010	0.65	0.81	0.53	25995	1.29	2.7	0.70
2011	0.69	0.86	0.56	26424	1.25	2.6	0.68
2012	0.73	0.91	0.59	29309	1.30	2.7	0.71
2013	0.74	0.93	0.6	27045	1.19	2.5	0.64

Year	B/B_{MSY}*	B/B_{MSY} High*	B/B_{MSY} Low*	Total catch	F/F_{MSY}	F/F_{MSY} High	F/F_{MSY} Low
2014	0.71	0.88	0.57	21069	0.97	2.0	0.53
2015	0.73	0.92	0.59	25677	1.13	2.4	0.62
2016	0.71	0.89	0.58	25397	1.16	2.4	0.63
2017	0.7	0.87	0.56	23466	1.09	2.3	0.59
2018	0.66	0.82	0.52	27141	1.34	2.9	0.72
2019	0.66	0.95	0.45				

*B/B_{MSY} at the beginning of the year.

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