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Herring (*Clupea harengus*) in Division 5.a, summer-spawning herring (Iceland grounds)

ICES advice on fishing opportunities

ICES advises that when the Iceland management plan is applied, catches in the fishing year 2018/2019 should be no more than 35 186 tonnes.

Stock development over time

Strong year classes in 1999–2002 led to an increase in the spawning-stock biomass (SSB), reaching the highest estimated levels in the late 2000s. SSB has declined since then because of high natural mortality caused by an *Ichthyophonus* infection (2009–2011 and 2017) and poor recruitment. The harvest rate increased after being at low levels at the beginning of the *Ichthyophonus* outbreak but is currently near the management target of 0.15.

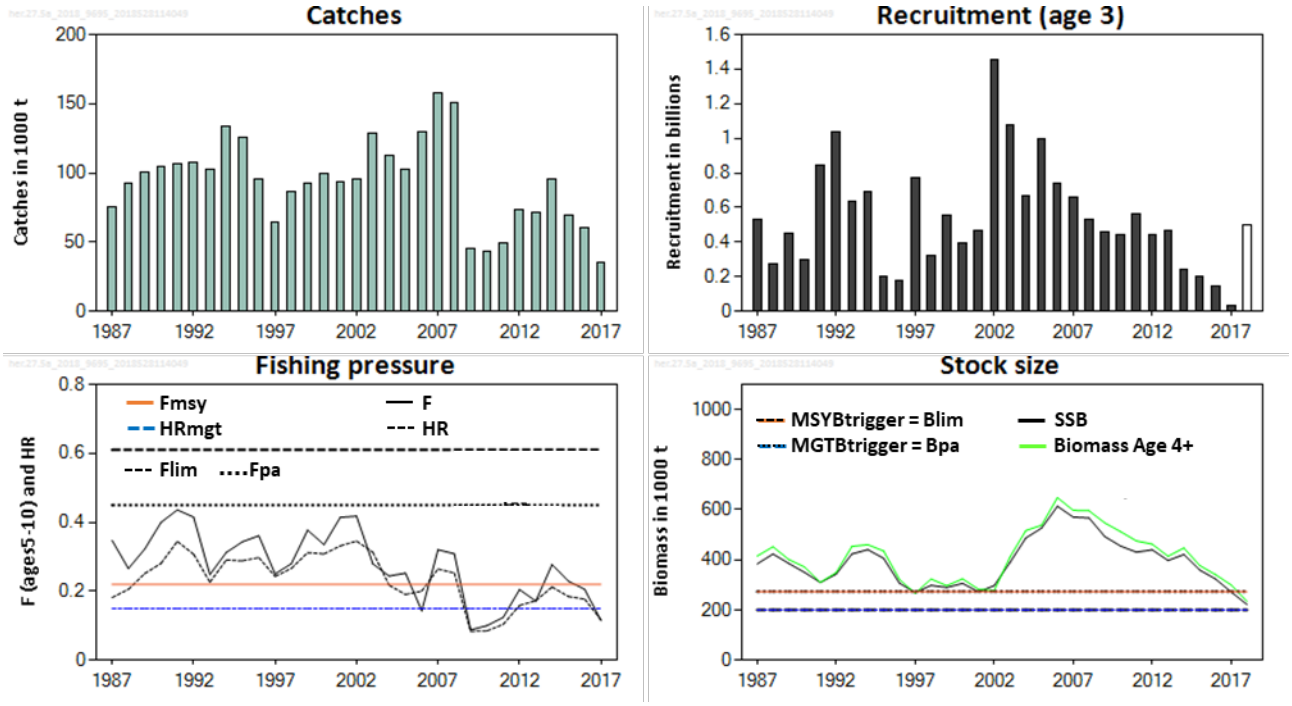

Figure 1 Herring in Division 5.a, summer-spawning herring. Summary of the stock assessment. Harvest rates are calculated based on biomass age 4+. All biomass reference points refer to SSB levels (SSB is shown as a black line). HR_{MGT} and MGT $B_{trigger}$ correspond to the values in the management plan. MGT $B_{trigger}$ = B_{lim} and B_{pa} = MSY $B_{trigger}$; therefore, the horizontal lines displaying these points in the graph overlap. The recruitment estimate for 2018 is a survey estimate and not estimated by the model.

Stock and exploitation status

ICES assesses that fishing pressure on the stock is below HR_{MGT}, F_{MSY}, F_{pa} and F_{lim}. Spawning stock size is above MGT $B_{trigger}$ and between B_{pa} and B_{lim}.

Table 1 Herring in Division 5.a, summer-spawning herring. State of the stock and fishery relative to reference points.

	Fishing pressure				Stock size			
		2015	2016	2017		2016	2017	2018
Maximum sustainable yield	F_{MSY}	✗	✓	✓ Appropriate	MSY $B_{trigger}$	✓	✗	✗ Below trigger
Precautionary approach	F_{pa},F_{lim}	✓	✓	✓ Harvested sustainably	B_{pa},B_{lim}	✓	○	○ Increased risk
Management plan	HR_{MGT}	✗	✗	✓ Appropriate	MGTBtrigger	✓	✓	✓ Above trigger

Catch scenarios

Table 2 Herring in Division 5.a, summer-spawning herring. Assumptions made for the interim year and in the forecast (ICES, 2018). All weights are in tonnes.

Variable	Value	Notes
F ages 5–10 (2017/2018)	0.115	Fishing mortality based on a catch constraint.
SSB (2018)	221547	Estimated in the analytical assessment after accounting for *Ichthyophonus* infection in 2018 and catches
$B_{age\ 4+}$ (2018)	234571	Estimated in the analytical assessment (1 Jan 2018)
$R_{age\ 3}$ (2018)	496	Based on prediction from a survey estimate in 2016 at age 1 (in millions)
$R_{age\ 3}$ (2019)	502	Geometric mean for 1987–2015 (in millions)
Total catch (2017/2018)	35034	Catch from June 2017 to end of the fishing season in 2018 (April)
Landings (2017/2018)	35034	Catch from June 2017 to end of the fishing season in 2018 (April)
Discards	0	Negligible

Table 3 Herring in Division 5.a, summer-spawning herring. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2018/2019)	HR(2018/2019)	F_{total} (2018/19)	Biomass of age 4+ (2019)	SSB (2019)	% SSB change *	% TAC change **	% Advice change ***
ICES advice basis								
Management plan§	35186	0.15	0.168	244821	231005	4.3	-9.8	-9.1

* SSB 2019 relative to SSB 2018.
** Advice value for 2018/2019 relative to TAC for 2017/2018 (39 000 t).
*** Advice value for 2018/2019 relative to advice value for 2017/2018 (38 712 t).
§Because SSB_{2018} (222 000 t) is above MGT $B_{trigger}$ (200 000 t), HR_{MGT} = 0.15.

The main reason for the 9.1% reduction in the advice is that the 2014 year class is low and the reference biomass is estimated to be in decline.

Basis of the advice

Table 4 Herring in Division 5.a, summer-spawning herring. The basis of the advice.

Advice basis	Iceland management plan Rule 5 (ICES, 2017a, b)
Management plan	The Icelandic Ministry of Industries and Innovation fisheries management plan has been implemented since 2017. The rule has been evaluated by ICES (ICES, 2017b) and is considered to be precautionary and conforms to the ICES MSY approach. According to the rule, the TAC for the fishing year Y/Y+1 (September 1 of year Y to August 31 of year Y+1) is calculated as follows: *When* SSB_Y *is equal to or above MGT* $B_{trigger}$: $TAC_{Y/Y+1} = HR_{MGT} * B_{Ref,Y}$ *When* SSB_Y *is below MGT* $B_{trigger}$: $TAC_{Y/Y+1} = HR_{MGT} * (SSB_Y / MGT\ B_{trigger}) * B_{ref,Y}$ The spawning-stock biomass trigger (MGT $B_{trigger}$) is defined as 200 kt, the reference biomass is defined as the biomass of herring of ages 4 and older, and the target harvest rate (HR_{MGT}) is set to 0.15.

Quality of the assessment

A downward revision of historical SSB is explained by lower total *Ichthyophonus* infection mortality set for the years 2009–2011. In the same way, the small upward revision for the last years is caused by the increased infection mortality set for 2017. Observations of increased infection rates since 2016 result in increased natural mortality, which is accounted for in the current stock advice. Recruitment in the final year of the assessment is consistently overestimated.

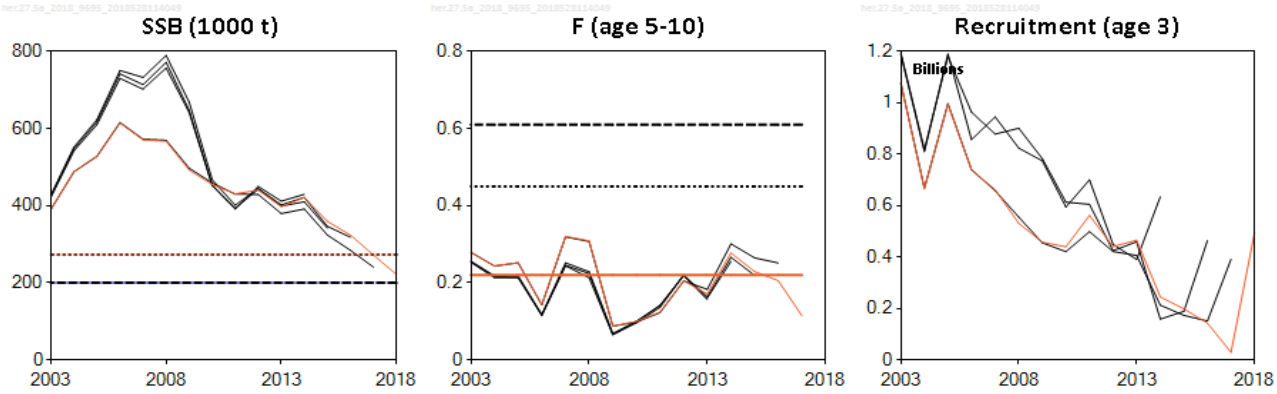

Figure 2 Herring in Division 5.a, summer-spawning herring. Historical assessment results.

Issues relevant for the advice

The infection rates of *Ichthyophonus* remains high, and this is taken into account in the assessment and indirectly in the management plan rule by applying a low harvest rate.

Reference points

Table 5 Herring in Division 5.a, summer-spawning herring. Reference points, values, and their technical basis. All weights are in tonnes.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	273000	B_{pa}	ICES (2016a, 2017a)
	F_{MSY}	0.22	HCS model for simulated harvest rules	ICES (2016a, 2017a)
Precautionary approach	B_{lim}	200000	SSB with a high probability of impaired recruitment	ICES (2016a)
	B_{pa}	273000	$B_{pa} = B_{lim} \times e^{1.645\sigma}$, where $\sigma = 0.19$	ICES (2016a)
	F_{lim}	0.61	The F that leads to SSB = B_{lim}, given mean recruitment	ICES (2016a)
	F_{pa}	0.45	$F_{pa} = F_{lim} \times \exp(-1.645 \times \sigma)$, where $\sigma = 0.18$	ICES (2016a)
Management plan	MGT $B_{trigger}$	200000	Stochastic simulations	ICES (2017a)
	HR_{MGT}	0.15	Management plan, independent of *Ichthyophonus* infection in the assessment year	ICES (2017a)

Basis of the assessment

Table 6 Herring in Division 5.a, summer-spawning herring. Basis of assessment and advice.

ICES stock data category	1 (ICES, 2016b)
Assessment type	Age-based analytical (NFT-ADAPT) that uses catches in the model and in the forecast (ICES, 2018)
Input data	The data used in the assessment are catch-at-age and one age-structured acoustic survey index (IS-Her-Aco-Q4/Q1). Natural mortality is assumed to be 0.1, except for 2009–2011 and 2017, for which higher values are used to reflect mortality from *Ichthyophonus* infection.
Discards and bycatch	Discarding is considered negligible and is not included. Industrial bycatch is included.
Indicators	None
Other information	The stock was benchmarked in 2011 (ICES, 2011) and a management strategy evaluation took place in 2017 (ICES, 2017a, b).
Working group	North-Western Working Group (NWWG)

Information from stakeholders

There is no additional available information.

History of the advice, catch, and management

Table 7 Herring in Division 5.a, summer-spawning herring. ICES advice, agreed TACs and ICES catches. All weights are in tonnes.

Year	ICES advice	Catch corresponding to advice	Agreed TAC	ICES landings	ICES discards
1984		50000	-	50304	0
1985		50000	-	49368	0
1986		65000	-	65500	0
1987	$F_{0.1}$	70000	72900	75439	0
1988	$F_{0.1}$	~100000	90000	92828	0
1989	$F_{0.1}$	95000	90000	97270	3700
1990/1991**	*Status quo* F	90000	100000	101632	3500
1991/1992**	$F_{0.1}$	79000	110000	98538	11000
1992/1993**	$F_{0.1}$	86000	110000	106653	1800
1993/1994**	No gain in yield by fishing higher than $F_{0.1}$	110000*	110000	101496	1200
1994/1995**	No gain in yield by fishing higher than $F_{0.1}$	83000*	130000	131994	2000
1995/1996**	No gain in yield by fishing higher than $F_{0.1}$	120000*	110000	124963	900
1996/1997**	No gain in yield by fishing higher than $F_{0.1}$	97000*	110000	95882	0
1997/1998	No gain in yield by fishing higher than $F_{0.1}$	90000*	100000	64931	0
1998/1999	No gain in yield by fishing higher than $F_{0.1}$	90000*	90000	87238	0
1999/2000	Current F is sustainable	100000*	100000	92896	0
2000/2001	Current F is sustainable	110000*	110000	100332	0
2001/2002	Current F is sustainable	125000*	125000	95675	0
2002/2003	Current F is sustainable	113000*	105000	96208	0
2003/2004	Current F is sustainable	113000*	110000	125717	0
2004/2005	F = 0.22	106000	110000	114237	0
2005/2006	*Status quo* catch	110000	110000	103043	0
2006/2007	*Status quo* catch	110000	130000	135303	0
2007/2008	Average of the last 3 years' catch	117000	150000	158917	0
2008/2009	F_{pa} = 0.22	131000	130000	151780	0
2009/2010	F_{pa} = 0.22	75000	40000	46332	0
2010/2011***	Domestic advice autumn 2010	40000	40000	43533	0
2011/2012***	Domestic advice autumn 2011, no fishery until then	40000	45000	49446	0
2012/2013	F_{MSY} = 0.22	67000	68500	71976	0
2013/2014	F_{MSY} = 0.22	87000	87000	72058	0
2014/2015	F_{MSY} = 0.22	83000	83000	94975	0
2015/2016	F_{MSY} = 0.22	71000	71000	69729	0
2016/2017	F_{MSY} = 0.22	63000	63000	60403	0
2017/2018	HR_{MGT} = 0.15	38712	39000	35034	0
2018/2019	Management plan	35186			

* Catch at $F_{0.1}$.
** Season starting in October of first year.
*** No advice was given by ICES until new information on *Ichthyophonus* infection was available from survey monitoring in the following autumn.

History of the catch and landings

Table 8 Herring in Division 5.a, summer-spawning herring. Catch distribution by fleet in 2017 as estimated by ICES. All weights are in tonnes.

Catch (2017)	Landings	Discards
35034	Pelagic trawl 100%	0
	35034	

Summary of the assessment

Table 9 Herring in Division 5.a, summer-spawning herring. Assessment summary. Weights are in tonnes. 'Year' refers to fishing year, starting 1st of September each year; 1987 thus means the fishing year 1987/1988. Catch includes only age groups used in the assessment (ages 3+).

Year	Recruitment	Stock size		Fishing pressure		Catch
	Age 3 thousands	SSB	Reference biomass	F ages 5–10	Harvest rate (Per year)	
1987	529827	383813	415359	0.35	0.182	75439
1988	270995	423300	452287	0.27	0.205	92814
1989	447329	385512	401085	0.32	0.251	100714
1990	300823	349855	371477	0.40	0.281	104227
1991	840553	309712	310173	0.44	0.344	106828
1992	1033108	343178	349470	0.42	0.307	107409
1993	635442	423579	453601	0.25	0.226	102629
1994	691732	440712	460642	0.31	0.29	133653
1995	202712	406155	435385	0.34	0.288	125480
1996	181394	307447	322286	0.36	0.297	95859
1997	772577	268849	266661	0.25	0.243	64807
1998	320497	298332	323403	0.28	0.266	86077
1999	552653	289637	296900	0.38	0.312	92568
2000	391428	306368	324164	0.33	0.308	99900
2001	468866	271958	282490	0.41	0.331	93633
2002	1457240	297412	277894	0.42	0.345	95969
2003	1076467	389846	411450	0.28	0.313	125717
2004	665505	487106	516957	0.24	0.217	112382
2005	993766	526849	538286	0.25	0.19	102446
2006	738424	613918	648174	0.143	0.2	129764
2007	662072	570696	597502	0.32	0.264	158029
2008	530931	567326	595688	0.31	0.253	150674
2009	458046	492463	547263	0.088	0.084	45728
2010	440010	454982	512708	0.100	0.085	43415
2011	561890	430798	475484	0.124	0.104	49390
2012*	440725	440318	462472	0.20	0.159	71976
2013	465972	397348	414391	0.171	0.172	71454
2014	244732	421221	447583	0.28	0.212	94975
2015	198636	359306	377809	0.23	0.185	69729
2016	143105	323927	341069	0.21	0.177	60386
2017	29647	271722	299818	0.115	0.117	35034
2018	496000***	221547**	234571			

* The mass mortality of 52 thousand tonnes in Kolgrafafjörður in the winter 2012/2013 is not included in the landings, yield/SSB, and weighted F (WF), but is included in the analytical assessment.
** SSB calculated at spawning time (summer) after accounting for infection mortality.
*** Predicted from a survey index of number at age 1 in 2016.

Sources and references

ICES. 2011. Report of the Benchmark Workshop on Roundfish and Pelagic Stocks (WKBENCH 2011), 24–31 January 2011, Lisbon, Portugal. ICES CM 2011/ACOM:38. 418 pp.

ICES. 2016a. Report of the North-Western Working Group (NWWG), 27 April–4 May 2016, ICES Headquarters, Copenhagen. ICES CM 2016/ACOM:08.

ICES. 2016b. Advice basis. *In* Report of the ICES Advisory Committee, 2016. ICES Advice 2016, Book 1, Section 1.2.

ICES. 2017a. Workshop on MSEs for Icelandic herring, ling and tusk (WKICEMSE), 21–25 April 2017, ICES Headquarters, Copenhagen. ICES CM 2017/ACOM:45. 196 pp.

ICES. 2017b. Iceland request on evaluation of harvest control rules for a management plan for Icelandic summer-spawning herring (Division 5.a). *In* Report of the ICES Advisory Committee, 2017. ICES Advice 2017, ICES Special Request Advice sr.2017.11. Published 13 June 2017.
http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2017/Special_requests/iceland.2017.11.pdf

ICES. 2018. Report of the North-Western Working Group (NWWG), 26 April–3 May 2017, ICES HQ, Copenhagen. ICES CM 2018/ACOM:09.