

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

ICES stock advice

ICES advises that when the proposed Iceland management plan is applied, catches in the fishing year 2017/2018 should be no more than 38 712 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 poor recruitment, and is currently below $MSY B_{trigger}$. Fishing mortality (F) has been increasing after being at low levels at the beginning of the *Ichthyophonus* outbreak and is currently above F_{MSY} .

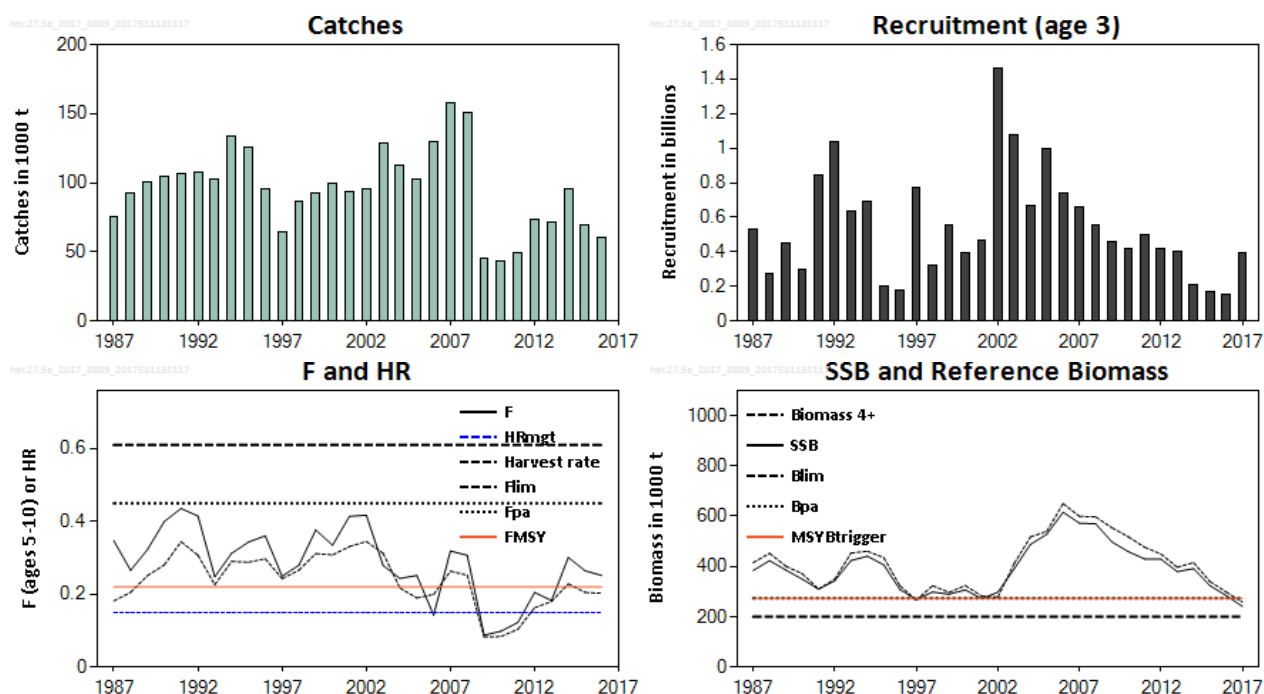


Figure 1 Herring in Division 5.a, summer-spawning herring. Summary of the stock assessment. Harvest rates are calculated based on biomass age 4+. All biomass reference points refer to SSB levels. HR_{MGT} and $MGT B_{trigger}$ correspond to the values in the proposed management plan. $MGT B_{trigger} = B_{lim}$; therefore, the horizontal lines displaying these points in the graph overlap.

Stock and exploitation status

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

		Fishing pressure			Stock size		
		2014	2015	2016	2015	2016	2017
Maximum Sustainable Yield	F_{MSY}	✗	✗	✗ Above	$MSY B_{trigger}$	✓	✗ Below trigger
Precautionary Approach	F_{pa} F_{lim}	✓	✓	✓ Harvested sustainably	B_{pa} B_{lim}	✓	⚠ Increased risk
Management plan	HR_{MGT}	—	—	— Not applicable	$MGT B_{trigger}$	—	— Not applicable

Catch options

Table 2 Herring in Division 5.a, summer-spawning herring. The basis for the catch options.

Variable	Value	Source	Notes
F ages 5–10 (2016/2017)	0.251	ICES (2017a)	Weighted F by number-at-ages 5–10.
SSB (2017)	240 578 t	ICES (2017a)	Estimated in the analytical assessment using NFT-Adapt. In July 2017 after accounting for <i>Ichthyophonus</i> infection in 2017.
B age 4+(2017)	258 077 t	ICES (2017a)	Estimated in the analytical assessment using NFT-Adapt (1st Jan.)
R age 3 (2017)	391 300 thousand	ICES (2017a)	Based on prediction from a survey estimate in 2015 at age 1.
R age 3 (2018)	496 005 thousand	ICES (2017a)	Based on prediction from a survey estimate in 2016 at age 1.
Total catch (2016/2017)	60 403 t	ICES (2017a)	Observed catch.

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

Basis	Total catch (2017/2018)	HR (2017/2018)*	F total (2017/18)	Biomass of age 4+ (2018)	SSB (2018)	% SSB change **	% TAC change ***
ICES advice basis							
HCR 5 §	38712	0.15	0.18	253517	247570	3	-39
Other options							
HCR 2 §§	30807	0.119	0.14	260600	254232	6	-51
HCR 3 §§§	29395	0.114	0.13	261865	255422	6	-53
HCR 4 ^^	38712	0.15	0.18	253517	247570	3	-39
$F_{MSY} \times SSB_{2017} / MSY B_{trigger}$ (= HCR 1 ^^)	40800	0.158	0.19	251646	245811	2	-35
F = 0	0	0	0	288186	280195	16	-100

* Catch in 2017/2018 divided by B(age 4+) in 2017.

** SSB 2018 relative to SSB 2017 (240 578 t, accounting for infection mortality).

*** Catch in 2017/2018 relative to TAC in 2016/2017 (63 000 t).

§ HCR 5: Because SSB_{2017} without infection mortality (256 000 t) is above MGT $B_{trigger}$ (200 000 t), the HR is $HR_{MGT} = 0.15$.

§§ HCR 2: Because SSB_{2017} without infection mortality (256 000 t) is below MGT $B_{trigger}$ (273 000 t), and *Ichthyophonus* outbreak is observed in 2017, the HR is $HR_{MGT} \times (SSB_{2017} / MGT B_{trigger}) \times 0.67 = 0.19 \times (256/273) \times 0.67 = 0.119$.

§§§ HCR 3: Because SSB_{2017} without infection mortality (256 000 t) is above MGT $B_{trigger}$ (200 000 t), and *Ichthyophonus* outbreak is observed in 2017, the HR is $HR_{MGT} \times 0.67 = 0.17 \times 0.67 = 0.114$.

^^ HCR 4: Because SSB_{2017} without infection mortality (256 000 t) is above MGT $B_{trigger}$ (150 000 t), the HR is $HR_{MGT} = 0.15$.

^^ HCR 1: Because SSB_{2017} with infection mortality (240 578 t) is below MGT $B_{trigger}$ (273 000 t), the F is $F_{MGT} \times (SSB_{2017} / MGT B_{trigger}) = 0.22 \times (240578/273000) = 0.19$. Note: for HCR 1, $F_{MGT} = F_{MSY}$ and $MGT B_{trigger} = MSY B_{trigger}$.

Basis of the advice

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

Advice basis	Proposed Iceland management plan
Management plan	<p>The Icelandic Ministry of Industries and Innovation has communicated to ICES its intention to formally adopt a management plan based on the following harvest control rule. The rule has been evaluated by ICES 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:</p> <p>When SSB_Y is equal to or above MGT $B_{trigger}$: $TAC_{Y/Y+1} = HR_{MGT} * B_{Ref,Y}$</p> <p>When SSB_Y is below MGT $B_{trigger}$: $TAC_{Y/Y+1} = HR_{MGT} * (SSB_Y / MGT B_{trigger}) * B_{Ref,Y}$</p> <p>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.</p>

Quality of the assessment

The assessment is considered consistent in recent years. The working group revised the *Ichthyophonus* infection mortality applied for the years 2009–2011 in accordance with new studies (ICES, 2017a), causing a revision of historical stock size. This is considered to improve the assessment quality and provide a more robust view on the development of the historical stock size.

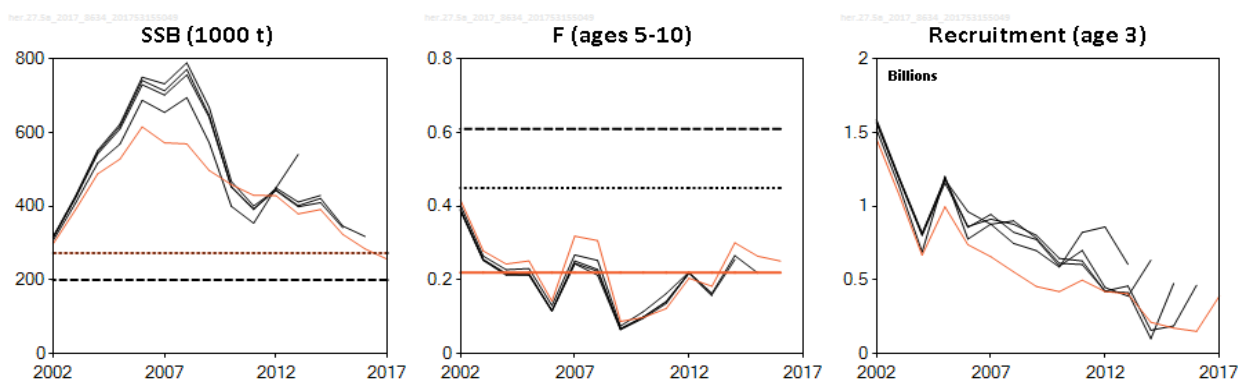


Figure 2 Herring in Division 5.a, summer-spawning herring. Historical assessment results.

Issues relevant for the advice

A downward revision of historical SSB is explained by lower total *Ichthyophonus* infection mortality set for the years 2009–2011, which in addition to new catch and survey data give also a slight downward revision of the current stock size compared to last year’s assessment. Observations of increased new infection in 2016/2017 indicate increased natural mortality, which is accounted for in the current stock projection and will be taken into account in the future assessment of the stock. The future duration of the outbreak is uncertain.

Following evaluation of various candidate harvest control rules (HCRs) for an Iceland management plan, ICES advised that several HCRs, including HCR 5, could be considered precautionary and in accordance with the ICES MSY approach (ICES, 2017b). The advice for 2018 is based on HCR 5, in line with the request from the Icelandic Ministry of Industries and Innovation. The HCR is based on a $HR_{MGT} = 0.15$ on stock biomass of herring of age 4 and older, and has a trigger point for SSB at $MGT B_{trigger} = 200$ kt. The HR_{MGT} and $MGT B_{trigger}$ values will be included in the reference points table and used in the stock and exploitation status table next year, when it is expected that the plan will have been formally adopted.

Reference points

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

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	273 000 t	B_{pa}	ICES (2016a; 2017c)
	F_{MSY}	0.22	HCS model for simulated harvest rules.	ICES (2016a; 2017c)
Precautionary approach	B_{lim}	200 000 t	SSB with a high probability of impaired recruitment.	ICES (2016a)
	B_{pa}	273 000 t	$B_{pa} = B_{lim} \times e^{1.645\sigma}$, 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	SSB_{mgt}	Not defined		
	F_{mgt}	Not defined		

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.
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, for which higher values are used to reflect mortality from <i>Ichthyophonus</i> 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, 2017c).
Working group	North-Western Working Group (NWWG)

Information from stakeholders

There is no available information.

History of the advice, catch, and management

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

Year	ICES advice	Predicted catch corresp. 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

Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC	ICES landings	ICES discards
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	Proposed management plan (HR = 0.15)	38712			

* 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 2016 as estimated by ICES.

Catch (2016)	Landings	Discards
60 403 tonnes	Pelagic trawl 100%	Negligible
	60 403 tonnes	

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.

Year	Recruitment	Stock size		Catch (tonnes)	Fishing pressure	
	Age 3	SSB	Biomass age 4+		$F_{ages\ 5-10}$	Harvest rate age 4+
	(thousands)	(tonnes)	(tonnes)		per year	per year
1987	529829	383814	415359	75451	0.347	0.182
1988	270997	423302	452288	92814	0.266	0.205
1989	447334	385514	401085	100713	0.322	0.251
1990	300829	349856	371479	104227	0.4	0.281
1991	840577	309715	310177	106827	0.436	0.344
1992	1033139	343185	349477	107408	0.415	0.307
1993	635480	423592	453615	102629	0.248	0.226
1994	691770	440734	460664	133653	0.312	0.29
1995	202736	406181	435413	125481	0.343	0.288
1996	181415	307477	322318	95858	0.361	0.297
1997	772665	268888	266699	64806	0.25	0.243
1998	320563	298380	323454	86076	0.28	0.266
1999	552810	289701	296964	92569	0.377	0.312
2000	391662	306464	324264	99902	0.335	0.308
2001	469298	272096	282630	93635	0.414	0.331
2002	1458959	297670	278120	95969	0.417	0.345
2003	1077261	390306	411955	128818	0.279	0.313
2004	668463	487859	517682	112382	0.243	0.217
2005	996796	528126	539612	102447	0.252	0.19
2006	739557	615780	650184	129766	0.143	0.2
2007	658116	572472	599527	158030	0.319	0.264
2008	555459	569515	597008	150675	0.307	0.252
2009	455348	497454	553718	45728	0.088	0.083
2010	420784	458978	517970	43416	0.098	0.084
2011	498742	429948	476477	49389	0.122	0.104
2012*	421675	429087	449422	73319	0.205	0.163
2013	406124	379408	397096	71454	0.183	0.18
2014	212966	391405	415417	95004	0.301	0.229

Year	Recruitment	Stock size		Catch	Fishing pressure	
	Age 3	SSB	Biomass age 4+		F _{ages 5–10}	Harvest rate age 4+
	(thousands)	(tonnes)	(tonnes)		per year	per year
2015	173166	323671	340308	69746	0.264	0.205
2016	151331	284332	298278	60403	0.251	0.203
2017	391300***	240578**	258077			

* 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 2015.

Sources and references

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