

Herring (*Clupea harengus*) in subdivisions 30 and 31 (Gulf of Bothnia)

ICES advice on fishing opportunities

ICES advises that when the MSY approach is applied, catches in 2019 should be no more than 88 703 tonnes.

Stock development over time

The spawning-stock biomass (SSB) has decreased in the last five years and has been above MSY $B_{trigger}$ since 1987. Fishing mortality (F) was below F_{MSY} until 2012*, but above since 2013*. Recruitment shows an overall increasing trend over time.

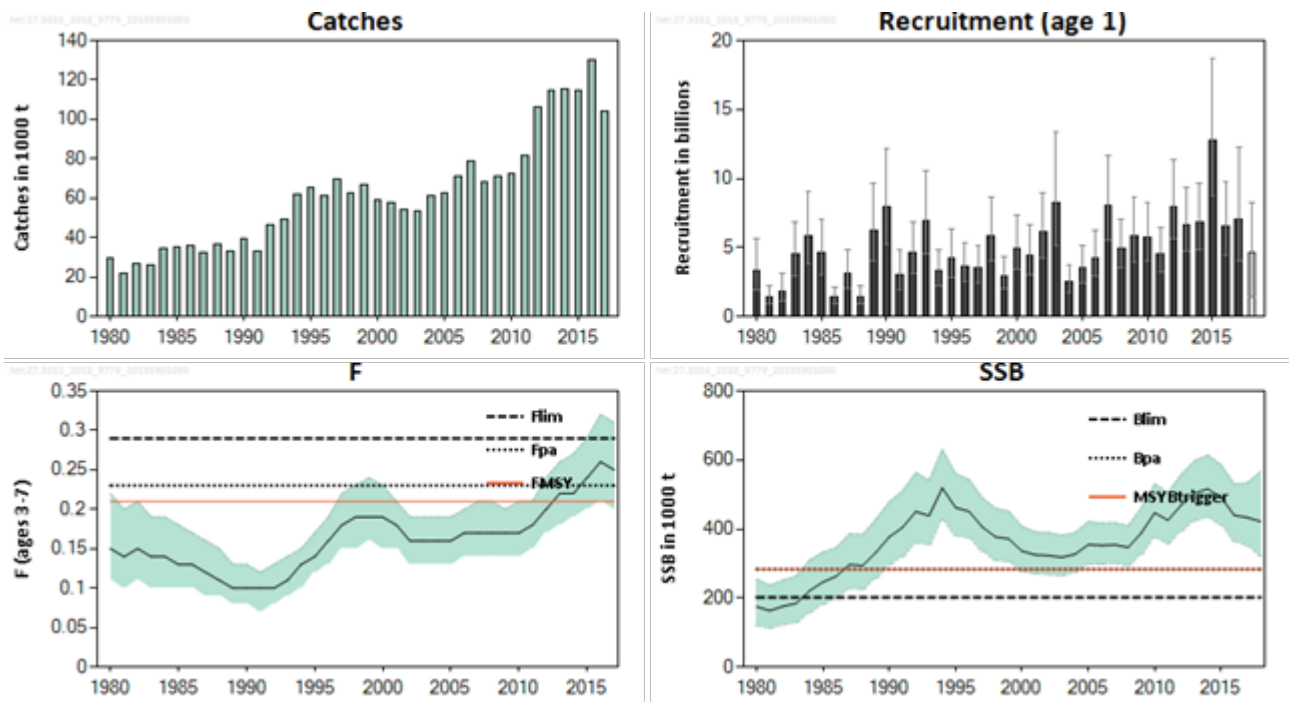


Figure 1 Herring in subdivisions 30 and 31. Summary of the stock assessment. Recruitment and SSB in 2018 are predicted. Recruitment, F, and SSB have confidence intervals (95%) in the plot. Predicted recruitment values are unshaded.

Stock and exploitation status

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

Table 1 Herring in subdivisions 30 and 31. 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}	✘	✘	✘ Above	MSY	✔	✔ Above trigger
Precautionary approach	F_{pa} , F_{lim}	○	○	○ Increased risk	B_{pa} , B_{lim}	✔	✔ Full reproductive capacity
Management plan	F_{MGT}	-	-	- Not applicable	SSB_{MGT}	-	- Not applicable

* Version 2: years corrected

Catch scenarios

Table 2 Herring in subdivisions 30 and 31. Assumptions made for the interim year and in the forecast. Weights are in tonnes. Recruitment is in thousands.

Variable	Value	Notes
$F_{ages\ 3-7}$ (2018)	0.198	Based on a TAC constraint for 2018
SSB (2018)	421521	
R_{age1} (2018-2020)	4606695	Resampled from the distribution in 1980-2017
Total catch (2018)	84599	Based on a TAC constraint for 2018

Table 3 Herring in subdivisions 30 and 31. Annual catch scenarios. All weights are in tonnes.

Basis	Catch (2019)	F_{total} (2019)	SSB (2019)	SSB (2020)	% SSB change *	% TAC change **	% Advice change ***
ICES advice basis							
MSY approach: F_{MSY}	88703	0.21	414047	394945	-5%	5%	-7%
Other scenarios							
$F = 0$	0	0	427665	499703	17%	-100%	-100%
$F = F_{pa}$	96179	0.23	412682	386391	-6%	14%	1%
$F = F_{lim}$	117632	0.29	408765	361564	-12%	39%	23%
SSB (2020) = B_{lim}	264259	0.84	376633	202272	-46%	212%	177%
SSB (2020) = B_{pa}	189165	0.52	394597	283180	-28%	124%	98%
SSB (2020) = MSY $B_{trigger}$	189165	0.52	394597	283180	-28%	124%	98%
$F = F_{2018}$	84133	0.198	414846	399991	-4%	-1%	-12%
$F = \text{proposed } F_{MSY}$ lower \wedge	65662	0.151	418125	421393	1%	22%	-31% $\wedge\wedge$
$F = \text{proposed } F_{MSY}$ upper $\wedge\wedge$	88703	0.21	414047	394945	-5%	5%	-7% \ddagger

* SSB 2020 relative to SSB 2019.

** Catch in 2019 relative to TAC in 2018 (84 599 tonnes).

*** Advice value 2019 relative to advice value 2018.

\wedge Lower F_{MSY} range calculated during the stock benchmark in 2017 (ICES, 2017).

$\wedge\wedge$ Upper F_{MSY} range calculated during the stock benchmark in 2017 (ICES, 2017).

$\wedge\wedge\wedge$ Advice value for in 2019 relative to Advice value for the proposed $F_{MSY\ lower}$ 2018 (70617 tonnes).

\ddagger Advice value for in 2019 relative to Advice value for the proposed $F_{MSY\ upper}$ 2018 (95566 tonnes).

This year's advice is similar to last year's advice.

Basis of the advice

Table 4 Herring in subdivisions 30 and 31. The basis of the advice.

Advice basis	ICES MSY approach.
Management plan	The EU multiannual plan (MAP) in place for stocks in the Baltic Sea includes herring (EU, 2016). The plan formally covers herring in this area as two stocks, corresponding to subdivisions 30 and 31. The combined stock of herring in subdivisions 30 and 31 is not currently specified in the plan.

Quality of the assessment

The recruitment estimates shown for the final year are uncertain. This is due to the high degree of variation in the acoustic survey. The stock levels estimated by the model are sensitive to small changes in the acoustic survey index.

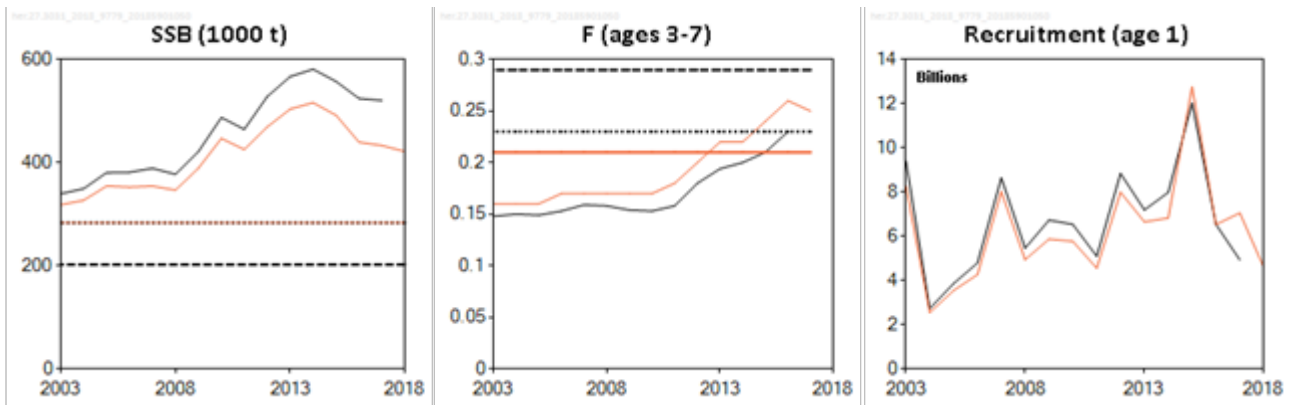


Figure 2 Herring in subdivisions 30 and 31. Historical assessment results. The stock was benchmarked in 2017 and subdivisions 30 and 31 were combined as one assessment unit.

An error was detected in the BIAS 2015 index data during this year’s assessment. The corrected values have been used in the assessment and while they had a slight effect on the perception of the stock development, they had no effect on the stock status.

Issues relevant for the advice

The two stocks in subdivisions 30 and 31 were merged into one stock during a benchmark (WKBALT; ICES, 2017). The reference points for the merged stock therefore differ from the ones in the Baltic MAP that were relevant to the two stocks when they were divided in herring in SD 30 and herring in SD 31 (EU, 2016). The reference points calculated by the benchmark are presented in Table 5. The resulting F_{MSY} value is 0.21. Corresponding F_{MSY} ranges were calculated and resulted in $F_{MSY\ lower} = 0.15$ and $F_{MSY\ upper} = 0.21$. For this stock, there is a 5% probability that $SSB < B_{lim}$ in the long term when F_{MSY} is used in combination with the ICES advice rule (i.e. where F is adjusted by the factor $SSB/MSY\ B_{trigger}$ when SSB is below $MSY\ B_{trigger}$). Therefore, $F_{MSY\ upper}$ coincides with F_{MSY} .

Reference points

Table 5 Herring in subdivisions 30 and 31. Reference points, values, and their technical basis. Weights in tonnes.

Framework	Reference point	Value	Technical basis	Source
MSY approach	$MSY\ B_{trigger}$	283180	5 th percentile of the distribution of SSB when fishing at F_{MSY} , based on stochastic simulations.	ICES (2017)
	F_{MSY}	0.21	Maximizes median long-term yield, based on stochastic simulations.	ICES (2017)
Precautionary approach	B_{lim}	202272	$B_{pa}/1.4$ (as it is not possible to estimate B_{lim} from stock–recruitment data).	ICES (2017)
	B_{pa}	283180	$MSY\ B_{trigger}$ (as it is not possible to estimate B_{lim} from stock–recruitment data).	ICES (2017)
	F_{lim}	0.29	F that results in 50% probability of being above or below B_{lim} , based on stochastic simulations.	ICES (2017)
	F_{pa}	0.23	$F_{lim} \times \exp(-1.645 \times \sigma)$, with $\sigma = 0.14$	ICES (2017)
Management plan	SSB_{mgt}	Not defined		
	F_{mgt}	Not defined		

Basis of the assessment

Table 6 Herring in subdivisions 30 and 31. Basis of assessment and advice.

ICES stock data category	1 (ICES, 2016).
Assessment type	Age-based analytical assessment, SAM, (ICES, 2018) that uses catches in the model and in the forecast.
Input data	Commercial catches; two tuning fleets: one acoustic survey, 2007–2017 (BIAS), and one commercial survey 1990–2006 (trapnet). Annual maturity data from Finnish commercial trawl catches before spawning; natural mortalities (0.15 for all ages).
Discards and bycatch	Not included, considered negligible.
Indicators	None.
Other information	Last benchmarked in 2017 (ICES, 2017).
Working group	Baltic Fisheries Assessment Working Group (WGBFAS)

Information from stakeholders

There is no additional information available.

History of the advice, catch, and management

Table 7a Herring in subdivisions 30 and 31. ICES advice, TACs and catches. All weights are in tonnes.

Year	ICES advice for SD 30	ICES advice for SD 31	Catch corresponding to advice	Agreed TAC*	ICES catch
1987					33100
1988					36800
1989					33400
1990					38800
1991	TAC for eastern part of SD, allowance for western part	TAC for eastern part of SD, allowance for western part	41000	84000	32800
1992	<i>Status quo</i> F	<i>Status quo</i> F	47000	84000	45500
1993	<i>Status quo</i> F	Increase in yield by increasing F	39000	90000	49200
1994	No specific advice	Increase in yield by increasing F	41000	90000	61800
1995	TAC	Increase in yield by increasing F	91400	110000	65700
1996	TAC	Increase in yield by increasing F	91400	110000	61200
1997	$F(97) = 1.4 \times F(95)$	Increase in yield by increasing F	78000	110000	70300
1998	<i>Status quo</i> F	Increase in yield by increasing F	50000	110000	62600
1999	Reduce catches	Increase in yield by increasing F	-	94000	66200
2000	Reduce catches	Increase in yield by increasing F	-	85000	58500
2001	$F_{pa} = 0.21$	Exploitation rate should not be increased	36000	72000	57800
2002	F below F_{pa}	Exploitation rate should be decreased	53000	64000	53800
2003	F below F_{pa}	No increase in catches	53000	60000	54000
2004	F below F_{pa}	No increase in catches	53000	61200	61000
2005	F below F_{pa}	No increase in catches	63700	64000	63000
2006	F below F_{pa}	Less than average catches (2002–2004)	92600/97600	91600	72000
2007	F below F_{pa}	Less than average catches (2002–2005)	88100	82800	78200
2008	F below F_{pa}	No increase in catch	70300	87000	67900
2009	Same advice as last year	Same advice as last year	70300	82700	71300
2010	F below F_{pa}	Same advice as last year	112600	103300	73800
2011	F below F_{pa}	No basis for advice	118000	104400	81900
2012	MSY framework	No increase in catches	107000	106000	106000
2013	MSY framework (F_{MSY})	Reduce catches by more than 20%	99100	106000	114400

Year	ICES advice for SD 30	ICES advice for SD 31	Catch corresponding to advice	Agreed TAC*	ICES catch
2014	MSY approach (F_{MSY})	Increase catches by no more than 20%	142300	138000	115300
2015	MSY approach (F_{MSY})	Increase catches by no more than 20%	186434	158470	114900
2016	MSY approach ($F_{MSY} = 0.15$)	Precautionary approach ($\leq 20\%$ increase in catch)	103254	103254	128330
2017	MSY approach ($F_{MSY} = 0.15$)	Precautionary approach	140998	140998	104 358

* TAC for subdivisions 29N, 30 and 31 (IBSFC Management Unit 3), and from 2005 for subdivisions 30 and 31.

Table 7b Herring in subdivisions 30 and 31. ICES advice, TAC and catches. All weights are in tonnes.

Year	ICES advice	Catch corresponding to advice	Agreed TAC	ICES catch
2018	MSY approach ($F_{MSY} = 0.21$)	$\leq 95\ 566$	84 599	
2019	MSY approach ($F_{MSY} = 0.21$)	$\leq 88\ 703$		

History of the catch and landings

Table 8 Herring in subdivisions 30 and 31. Catch distribution by fleet in 2017 as estimated by ICES.

Catch (2017)	Landings			Discards
	96% trawls	3.3% trap nets	0.7% gillnets	
104 358 tonnes	104 358 tonnes			Negligible

Table 9 Herring in subdivisions 30 and 31. History of commercial catch and landings; both the official and ICES estimated values are presented by area for each country participating in the fishery. All weights are in tonnes.

Year	Finland		Sweden		Total		Grand total
	SD 30	SD 31	SD 30	SD 31	SD 30	SD 31	
1980	18758	8899	1392	760	20150	9659	29809
1981	12410	7206	1290	620	13700	7826	21526
1982	16117	7982	1730	670	17847	8652	26499
1983	16104	7011	2397	696	18501	7707	26208
1984	23228	8322	2401	594	25629	8916	34545
1985	24235	8595	1885	717	26120	9312	35432
1986	23988	8754	2501	336	26489	9090	35579
1987	22615	7788	1905	320	24520	8108	32628
1988	24478	8501	3172	267	27650	8768	36418
1989	25453	4005	3205	423	28658	4428	33086
1990	28815	7603	2467	295	31282	7898	39180
1991	23219	6800	3000	400	26219	7200	33419
1992	35610	6900	3700	400	39310	7300	46610
1993	36600	8752	3579	383	40179	9135	49314
1994	53860	5195	2520	411	56380	5606	61986
1995	58806	3898	2280	563	61086	4461	65547
1996	54372	5080	1737	114	56109	5194	61303
1997	63532	4195	1995	86	65527	4281	69808
1998	54115	5358	2777	224	56892	5582	62474
1999	60483	3909	1862	248	62345	4157	66502
2000	54886	2479	1374	113	56260	2592	58852
2001	52987	2755	1997	67	54984	2822	57806
2002	46315	3532	3903	219	50218	3751	53969
2003	45932	3855	3707	150	49639	4005	53644
2004	50236	5831	5214	142	55450	5973	61423
2005	55422	4800	2520	169	57942	4969	62911
2006	66962	2684	1403	269	68365	2953	71318
2007	72116	2992	3317	253	75433	3245	78678
2008	61756	2309	3674	175	65430	2484	67914
2009	64881	2166	3992	209	68873	2375	71248
2010	68760	1898	1755	177	70515	2075	72590
2011	75130	3218	3370	132	78500	3350	81850
2012	94248	5206	6392	161	100640	5367	106007
2013	98935	4486	10849	126	109784	4612	114396
2014	97779	4637	12755	195	110534	4832	115366
2015	96414	4370	14001	157	110415	4527	114942
2016	103432	4371	22067	159	125499	4530	130029
2017*	90490	3068	10672	127	101162	3195	104358

*Preliminary

Summary of the assessment

Table 10 Herring in subdivisions 30 and 31. Assessment summary. Weights are in tonnes; recruitment in thousands. High and low refers to 95% confidence intervals.

Year	Recruitment (Age 1)	Recruitment High	Recruitment Low	SSB*	SSB High	SSB Low	Catches	F (Ages 3-7)	F High	F Low
1980	3300940	5676183	1919636	174870	254555	120129	29809	0.150	0.22	0.110
1981	1429817	2216923	922169	163465	236917	112786	21526	0.140	0.20	0.100
1982	1856906	3082078	1118758	176018	251487	123197	26499	0.150	0.21	0.110
1983	4502842	6825943	2970371	184797	263843	129433	26208	0.140	0.190	0.100
1984	5851774	9043215	3786624	221382	309792	158203	34545	0.140	0.190	0.100
1985	4626922	7004072	3056566	246283	332498	182423	35432	0.130	0.180	0.100
1986	1382123	2134832	894807	262924	345907	199849	35579	0.130	0.170	0.100
1987	3122030	4798107	2031440	296765	385667	228356	32628	0.120	0.160	0.090
1988	1380877	2190062	870669	294119	383808	225389	36418	0.110	0.150	0.090
1989	6255469	9648176	4055781	332719	428348	258439	33086	0.100	0.130	0.080
1990	7980319	12135305	5247951	376991	478616	296944	39180	0.100	0.130	0.080
1991	3044951	4829871	1919664	404399	509943	320700	33419	0.100	0.120	0.070
1992	4606695	6885166	3082227	450459	563489	360101	46610	0.100	0.130	0.080
1993	6940168	10583453	4551061	438417	540716	355472	49314	0.110	0.140	0.090
1994	3302312	4849881	2248563	518654	630282	426795	61986	0.130	0.150	0.100
1995	4266330	6354618	2864307	461665	559383	381017	65547	0.140	0.170	0.120
1996	3659363	5377887	2489999	451226	543656	374510	61303	0.160	0.190	0.130
1997	3487345	5118376	2376061	406142	490619	336211	69808	0.180	0.22	0.150
1998	5872662	8648235	3987884	377166	459667	309472	62474	0.190	0.23	0.150
1999	2911969	4298705	1972586	371586	451469	305838	66502	0.190	0.24	0.160
2000	4966313	7300922	3378240	335992	406978	277388	58852	0.190	0.23	0.150
2001	4458773	6640166	2994000	325075	391375	270007	57806	0.180	0.21	0.150
2002	6118013	8902193	4204591	323244	389151	268500	53969	0.160	0.190	0.130
2003	8269178	13326880	5130931	318171	381794	265150	53644	0.160	0.190	0.130
2004	2549248	3726614	1743853	326800	388853	274650	61423	0.160	0.190	0.130
2005	3545010	5136863	2446454	354655	421285	298564	62911	0.160	0.190	0.130
2006	4262309	6267049	2898857	352442	416701	298091	71318	0.170	0.20	0.140
2007	8014125	11651656	5512195	354372	417842	300544	78678	0.170	0.21	0.140
2008	4939559	6993762	3488716	346598	409488	293367	67914	0.170	0.21	0.140
2009	5869288	8664365	3975888	388950	461374	327894	71248	0.170	0.20	0.140
2010	5770320	8200724	4060201	446839	530478	376386	72590	0.170	0.21	0.140
2011	4554014	6413644	3233581	425372	505607	357870	81850	0.180	0.21	0.150
2012	7993952	11336123	5637136	469134	557735	394607	106007	0.20	0.24	0.170
2013	6650375	9324637	4743079	503974	597649	424982	114396	0.22	0.26	0.180
2014	6823909	9697389	4801884	516274	613788	434253	115366	0.22	0.27	0.190
2015	12767596	18709202	8712905	491636	586292	412262	114942	0.24	0.29	0.20
2016	6530521	9730483	4382898	439588	529771	364757	130029	0.26	0.32	0.21
2017	7054394	12271245	4055373	433092	533624	351499	104358	0.25	0.31	0.20
2018**	4606695	8269178	1380877	421521	567390	322008				

* SSB at spawning time.

** Predicted.

Sources and references

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