

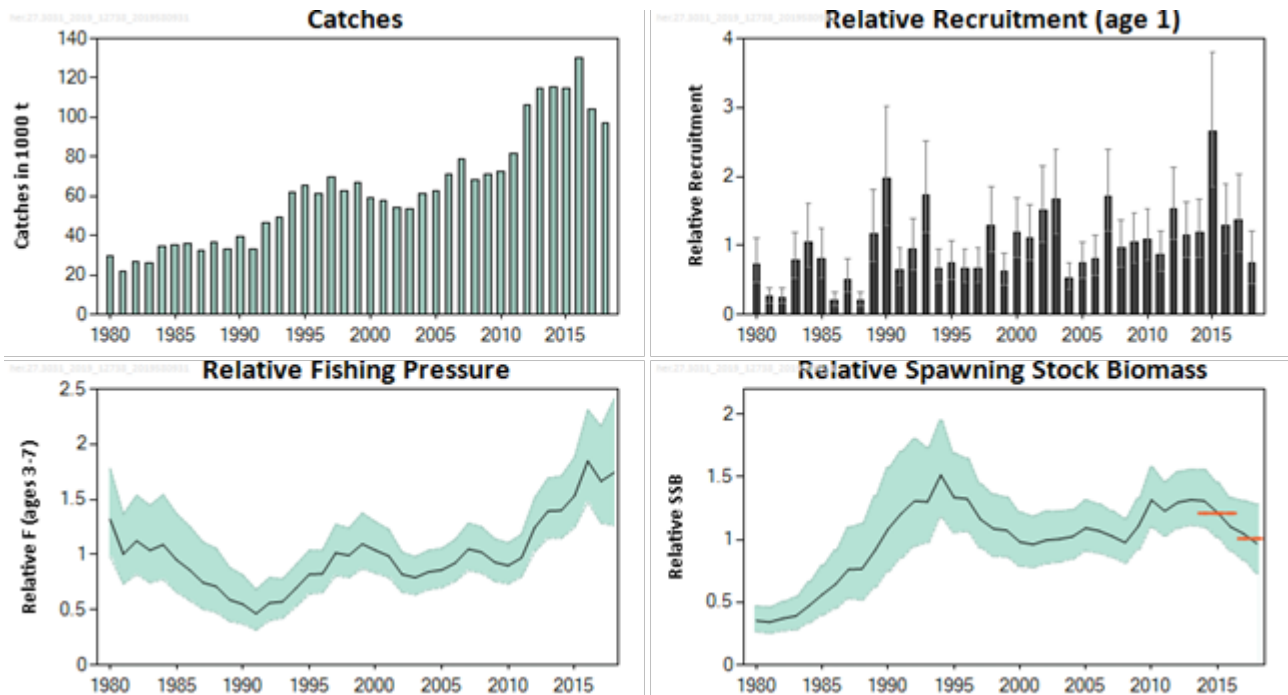
## Herring (*Clupea harengus*) in subdivisions 30 and 31 (Gulf of Bothnia)

### ICES advice on fishing opportunities

ICES advises that when the precautionary approach is applied, catches in 2020 should be no more than 65 018 tonnes.

### Stock development over time

The assessment is indicative of trends only. The relative spawning-stock biomass (SSB) has been decreasing in recent years. Recruitment shows an overall increasing trend. Fishing mortality (F) has shown an increasing trend since 2010, reaching a historical high in the last six years. This may not be sustainable.



**Figure 1** Herring in subdivisions 30 and 31. Summary of the stock assessment. Recruitment, F, and SSB are relative to the mean of the time-series. The dashed lines in the SSB plot indicate the average values of the respective years. Confidence intervals (95%) for recruitment, F, and SSB are shown in the plot.

### Stock and exploitation status

ICES cannot assess the stock and exploitation status relative to MSY and precautionary approach (PA) reference points because the reference points are undefined.

**Table 1\*** Herring in subdivisions 30 and 31. State of the stock and fishery relative to reference points.

		Fishing pressure			Stock size					
		2016	2017	2018	2016	2017	2018			
Maximum sustainable yield	$F_{MSY}$	?	?	?	Unknown	MSY	?	?	?	Unknown
Precautionary approach	$F_{pa}, F_{lim}$	?	?	?	Unknown	$B_{pa}, B_{lim}$	?	?	?	Unknown
Management plan	$F_{MGT}$	—	—	—	Not applicable	$B_{MGT}$	—	—	—	Not applicable
Qualitative evaluation	-	✗	✗	✗	Above possible reference points	-	✓	✓	✓	Above possible reference points

\* Version 2: year range for stock size updated to 2016, 2017, 2018.

## Catch scenarios

ICES framework for category 3 stocks was applied (ICES, 2012). The trends in relative SSB from the assessment were used as the index of stock development. The advice is based on the ratio of the mean of the last two index values (Index A) and the mean of the three preceding values (Index B), multiplied by the recent realized catch. The advised catch was not used because this is the first year the category 3 advice framework is applied to provide advice.

The index is estimated to have decreased by less than 20%; thus, the uncertainty cap was not applied.

The fishing mortality is thought to be above possible reference points; therefore, the precautionary buffer was applied to the advice.

**Table 2** Herring in subdivisions 30 and 31. Annual catch scenarios.

Index A (2017–2018)		1.01
Index B (2014–2016)		1.21
Index ratio (A/B)		0.83
Uncertainty cap	Not applied	-
Catch (2018)		97366 tonnes
Discard rate		Negligible
Precautionary buffer	Applied	0.8
Catch advice *		65018 tonnes
% advice change ^		-27%

The figures in the table are rounded. Calculations were made with unrounded inputs and computed values may not match exactly when calculated using the rounded figures in the table.

\* [Catch 2018] × [index ratio] × [precautionary buffer].

^ Advice value 2020 relative to advice value 2019.

Last year's advice was based on a category 1 assessment. Due to the strong retrospective bias in the assessment it was decided to downgrade it to category 3, which means the change in spawning-stock biomass is now used to calculate the advice. The declining trend in SSB and the application of the PA buffer results in a 27% reduction in the advised catch.

## Basis of the advice

**Table 3** Herring in subdivisions 30 and 31. The basis of the advice.

Advice basis	ICES precautionary approach.
Management plan	The EU multiannual plan (MAP) in place for stocks in the Baltic Sea includes herring in subdivisions 30 and 31 (EU, 2018). The plan cannot be applied as it requires a full analytical category 1 assessment.

## Quality of the assessment

The advice is based on an assessment accepted for trends and used as an indicator of stock size and fishing mortality. This is because the stock levels estimated by the model are sensitive to small changes in the acoustic survey index. The latest inter-benchmark failed to reduce the retrospective bias that has persisted in the stock for many years. There is a strong tendency for the assessment to overestimate SSB and underestimate F (the calculated Mohn's Rho on SSB was 37% and -27% on F). ICES considers that this bias renders the assessment unreliable.

Recruitment has been relatively good at recent stock sizes which is why the stock is qualitatively assessed to be above possible reference points. Fishing mortality and catches in recent years are close to the highest in the time series and SSB is declining despite the good recruitment, which is why the qualitative evaluation is that fishing mortality is above possible reference points.

### Issues relevant for the advice

The basis for the advice is the ICES precautionary approach (category 3 assessment) because the assessment was not of sufficient quality to be retained as a category 1 assessment. This implies that catch scenarios cannot be provided to support the implementation of the MAP.

### Reference points

**Table 4** Herring in subdivisions 30 and 31. Reference points, values, and their technical basis.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	Not defined		
	$F_{MSY}$	Not defined		
Precautionary approach	$B_{lim}$	Not defined		
	$B_{pa}$	Not defined		
	$F_{lim}$	Not defined		
	$F_{pa}$	Not defined		
	$F_{MSY lower}$	Not defined		
	$F_{MSY upper}$	Not defined		
Management plan	$SSB_{mgt}$	Not defined		

### Basis of the assessment

**Table 5** Herring in subdivisions 30 and 31. Basis of the assessment and advice.

ICES stock data category	3 ( <a href="#">ICES, 2018</a> ).
Assessment type	Age-based analytical assessment, SAM, considered indicative of trends only (ICES, 2019).
Input data	Commercial catches; two tuning fleets: one acoustic survey, 2007–2018 (BIAS), and one commercial survey 1990–2006 (trapnet). Annual maturity data from Finnish commercial trawl catches before spawning; natural mortalities.
Discards and bycatch	Not included, considered negligible.
Indicators	None.
Other information	Last inter-benchmarked in 2018 (ICES, 2019).
Working group	Baltic Fisheries Assessment Working Group ( <a href="#">WGBFAS</a> )

### Information from stakeholders

There is no additional information available.

### History of the advice, catch, and management

**Table 6a** Herring in subdivisions 30 and 31. ICES advice, TAC, and catches. All weights are in tonnes.

Year	ICES advice for Subdivision 30	ICES advice for Subdivision 31	Catch corresponding to advice	Agreed TAC*	ICES catch
1987					32628
1988					36418
1989					33086
1990					39180
1991	TAC for the eastern part of the subdivision, allowance for the western part	TAC for the eastern part of the subdivision, allowance for the western part	41000	84000	33419
1992	<i>Status quo</i> F	<i>Status quo</i> F	47000	84000	46610
1993	<i>Status quo</i> F	Increase in yield by increasing F	39000	90000	49314
1994	No specific advice	Increase in yield by increasing F	41000	90000	61986
1995	TAC	Increase in yield by increasing F	91400	110000	65547
1996	TAC	Increase in yield by increasing F	91400	110000	61303
1997	$F(97) = 1.4 \times F(95)$	Increase in yield by increasing F	78000	110000	69808

Year	ICES advice for Subdivision 30	ICES advice for Subdivision 31	Catch corresponding to advice	Agreed TAC*	ICES catch
1998	<i>Status quo</i> F	Increase in yield by increasing F	50000	110000	62474
1999	Reduce catches	Increase in yield by increasing F	-	94000	66502
2000	Reduce catches	Increase in yield by increasing F	-	85000	58852
2001	$F_{pa} = 0.21$	Exploitation rate should not be increased	36000	72000	57806
2002	F below $F_{pa}$	Exploitation rate should be decreased	53000	64000	53969
2003	F below $F_{pa}$	No increase in catches	53000	60000	53644
2004	F below $F_{pa}$	No increase in catches	53000	61200	61423
2005	F below $F_{pa}$	No increase in catches	63700	64000	62911
2006	F below $F_{pa}$	Less than average catches (2002–2004)	92600/97600	91600	71318
2007	F below $F_{pa}$	Less than average catches (2002–2005)	88100	82800	78678
2008	F below $F_{pa}$	No increase in catch	70300	87000	67914
2009	Same advice as last year	Same advice as last year	70300	82700	71248
2010	F below $F_{pa}$	Same advice as last year	112600	103300	72590
2011	F below $F_{pa}$	No basis for advice	118000	104400	81850
2012	MSY framework	No increase in catches	107000	106000	106007
2013	MSY framework ( $F_{MSY}$ )	Reduce catches by more than 20%	99100	106000	114396
2014	MSY approach ( $F_{MSY}$ )	Increase catches by no more than 20%	142300	138000	115366
2015	MSY approach ( $F_{MSY}$ )	Increase catches by no more than 20%	186434	158470	114942
2016	MSY approach ( $F_{MSY} = 0.15$ )	Precautionary approach ( $\leq 20\%$ increase in catch)	103254	103254	130029
2017	MSY approach ( $F_{MSY} = 0.15$ )	Precautionary approach	140998	140998	104358

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

**Table 6b** 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 ( $F_{MSY} = 0.21$ )	$\leq 95566$	84599	97366
2019	MSY approach ( $F_{MSY} = 0.21$ )	$\leq 88703$	88703	
2020	Precautionary approach	$\leq 65018$		

## History of the catch and landings

**Table 7** Herring in subdivisions 30 and 31. Catch distribution by fleet in 2018 as estimated by ICES.

Catch (2018)	Landings			Discards
	95.4% trawls	4.4% trapnets	0.1% gillnets	
97 366 tonnes	97 366 tonnes			Discarding is negligible

**Table 8** Herring in subdivisions 30 and 31. History of ICES commercial catches by subdivision (SD) 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
2018	78770	2100	16 210	286	94980	2386	97366

## Summary of the assessment

**Table 9** Herring in subdivisions 30 and 31. Assessment summary. Weights are in tonnes. 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
	Relative values			Relative values				Relative values		
1980	0.72	1.11	0.47	0.35	0.47	0.27	29809	1.32	1.78	0.98
1981	0.26	0.39	0.169	0.34	0.46	0.25	21526	1.00	1.37	0.73
1982	0.25	0.39	0.162	0.37	0.50	0.27	26499	1.12	1.54	0.82
1983	0.78	1.19	0.52	0.39	0.54	0.28	26208	1.04	1.45	0.75
1984	1.05	1.61	0.69	0.47	0.66	0.34	34545	1.09	1.54	0.78
1985	0.81	1.26	0.52	0.56	0.79	0.40	35432	0.95	1.37	0.66
1986	0.21	0.32	0.130	0.64	0.92	0.45	35579	0.86	1.26	0.59
1987	0.51	0.81	0.33	0.76	1.10	0.53	32628	0.75	1.11	0.51
1988	0.21	0.33	0.131	0.76	1.13	0.52	36418	0.71	1.06	0.48
1989	1.18	1.82	0.76	0.91	1.34	0.62	33086	0.59	0.88	0.40
1990	1.97	3.0	1.29	1.08	1.57	0.75	39180	0.55	0.82	0.37
1991	0.65	0.98	0.43	1.21	1.70	0.86	33419	0.46	0.68	0.32
1992	0.94	1.39	0.64	1.31	1.80	0.95	46610	0.56	0.79	0.40
1993	1.73	2.5	1.19	1.30	1.73	0.98	49314	0.57	0.78	0.43
1994	0.66	0.95	0.46	1.51	1.95	1.18	61986	0.69	0.91	0.53
1995	0.74	1.07	0.51	1.34	1.69	1.06	65547	0.82	1.04	0.64
1996	0.67	0.95	0.46	1.32	1.65	1.06	61303	0.83	1.04	0.65
1997	0.67	0.96	0.47	1.16	1.44	0.94	69808	1.02	1.27	0.81
1998	1.29	1.85	0.90	1.09	1.36	0.87	62474	0.99	1.24	0.79
1999	0.62	0.88	0.43	1.07	1.34	0.86	66502	1.10	1.38	0.87
2000	1.18	1.69	0.82	0.98	1.22	0.79	58852	1.04	1.30	0.83
2001	1.11	1.60	0.78	0.96	1.19	0.78	57806	0.99	1.23	0.79
2002	1.50	2.1	1.05	1.00	1.23	0.81	53969	0.82	1.02	0.66
2003	1.68	2.4	1.17	1.00	1.23	0.82	53644	0.79	0.98	0.64
2004	0.53	0.75	0.37	1.02	1.24	0.85	61423	0.84	1.04	0.68
2005	0.74	1.05	0.52	1.09	1.31	0.91	62911	0.86	1.06	0.70
2006	0.81	1.15	0.56	1.07	1.28	0.89	71318	0.92	1.14	0.76
2007	1.70	2.4	1.21	1.03	1.23	0.86	78678	1.05	1.28	0.86
2008	0.97	1.36	0.69	0.98	1.17	0.81	67914	1.02	1.25	0.83
2009	1.04	1.47	0.74	1.11	1.33	0.92	71248	0.93	1.14	0.76
2010	1.09	1.54	0.78	1.31	1.58	1.10	72590	0.90	1.11	0.73
2011	0.87	1.21	0.62	1.23	1.46	1.03	81850	0.97	1.18	0.80
2012	1.52	2.1	1.08	1.30	1.54	1.09	106007	1.25	1.52	1.03
2013	1.15	1.62	0.82	1.32	1.56	1.11	114396	1.39	1.69	1.15
2014	1.18	1.66	0.84	1.31	1.56	1.10	115366	1.40	1.71	1.15
2015	2.6	3.8	1.84	1.22	1.45	1.02	114942	1.53	1.88	1.25
2016	1.30	1.88	0.89	1.10	1.33	0.91	130029	1.85	2.3	1.48
2017	1.36	2.0	0.91	1.05	1.31	0.84	104358	1.66	2.2	1.28
2018	0.74	1.21	0.45	0.97	1.28	0.73	97366	1.74	2.4	1.26

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