Herring (*Clupea harengus*) in subdivisions 20–24, spring spawners (Skagerrak, Kattegat, and western Baltic)

ICES advice on fishing opportunities

ICES advises that when the MSY approach is applied, there should be zero catch in 2021.

This advice applies to the catch of western Baltic spring-spawning herring (WBSS) in subdivisions 20–24 and the eastern part of Subarea 4.

Note: This advice sheet is abbreviated due to the Covid 19 disruption. Last year's advice is attached as Annex 1.

Stock development over time

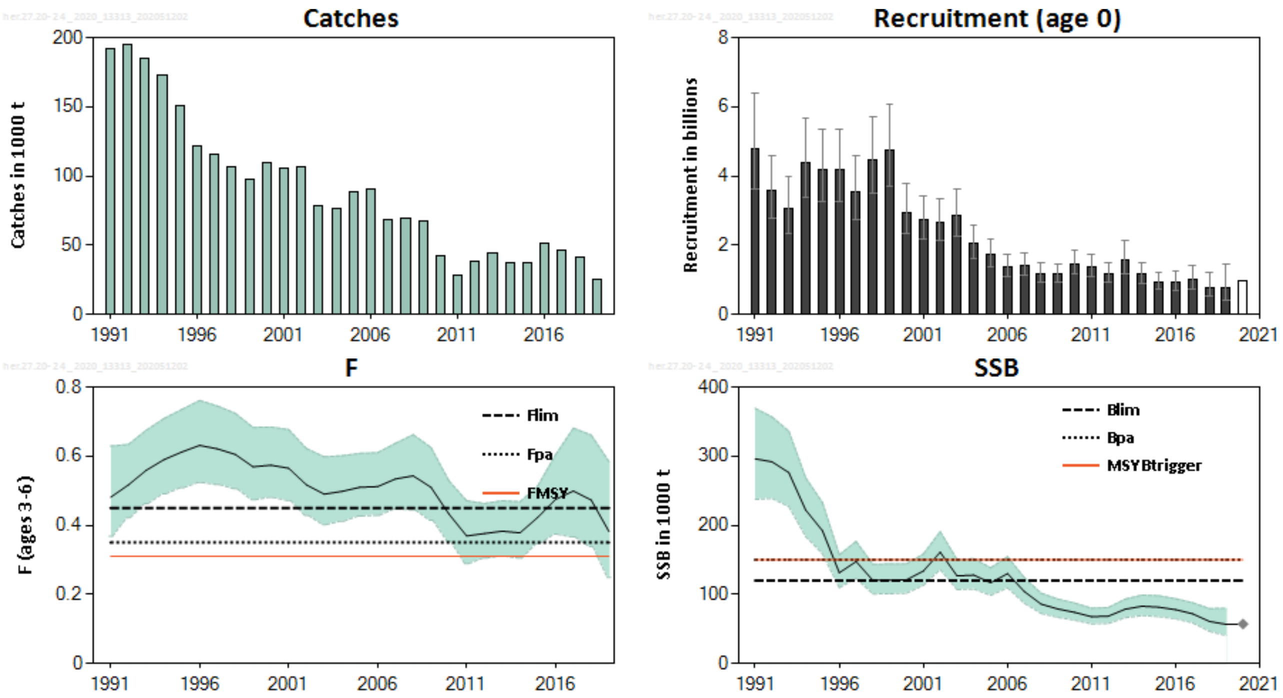

Figure 1 Herring in subdivisions 20–24, spring spawners. Commercial catches, recruitment, fishing mortality (F), and spawning-stock biomass (SSB) from the summary of the stock assessment; 95% confidence intervals are shown for SSB, F, and recruitment. Unshaded value of the recruitment is the average value of 2014–2018, and the grey diamond in the SSB plot is a predicted number for 2020.

Stock and exploitation status

Table 1 Herring in subdivisions 20–24, spring spawners. State of the stock and fishery relative to reference points.

	Fishing pressure					Stock size				
		2017	2018	2019			2018	2019	2020	
Maximum sustainable yield	F_{MSY}	✖	✖	✖	Above	MSY $B_{trigger}$	✖	✖	✖	Below trigger
Precautionary approach	F_{pa},F_{lim}	✖	✖	○	Increased risk	B_{pa},B_{lim}	✖	✖	✖	Reduced reproductive capacity
Management plan	F_{MGT}	–	–	–	Not applicable	B_{MGT}	–	–	–	Not applicable

Catch scenarios

The ICES MSY approach stipulates that F is reduced proportionally to SSB when the spawning stock size falls below MSY $B_{trigger}$. When SSB is below B_{lim}, measures should be taken so that SSB can be brought above B_{lim} in the short term. All catch scenarios, including zero catch, result in SSB remaining below B_{lim} in 2022.

Table 2 Herring in subdivisions 20–24, spring spawners. The basis for the catch scenarios. All weights are in tonnes and recruitment (R) is in thousands.

Variable	Value	Notes
$F_{ages\ 3–6}$ (2020)	0.170	Based on catch in 2020.
SSB (2020)	57 124	Based on catch in 2020.
$R_{age\ 0}$ (2020)	964 361	Average 2014–2018.
$R_{age\ 0}$ (2021)	964 361	Average 2014–2018.
Total catch (2020)	15 391	- A-fleet: 3 184 t (average catch 2017–2019) - C-fleet: 8 933 t including an assumed 50% transfer of the catch to the North Sea and 72.84% of WBSS in the catch (average split 2017–2019) - D-fleet: 123 t assuming 5.47% utilization of the 2020 TAC (average utilization 2017–2019) and 33.81% of WBSS in the catch (average split 2017–2019) - F-fleet: 3 150 t (2020 TAC)

Table 3 Herring in subdivisions 20–24, spring spawners. Annual catch scenarios. All weights are in tonnes. All scenarios, except the catch for bycatch fleets only, assume the F-fleet catches 50% of the total WBSS herring catch.

Basis	Total catch (2021)	$F_{3–6}$ (2021)	SSB* (2021)	SSB* (2022)	% SSB change **	% advice change ***
ICES advice basis						
MSY approach: zero catch	0	0	66 824	87 890	32	0
Other scenarios						
MAP^: F = F_{MSY} × SSB_{2020}/MSY $B_{trigger}$	10 273	0.118	65 973	77 674	18	
MAP^: F = $F_{MSY\ lower}$ × (SSB_{2020}/MSY $B_{trigger}$)	7 291	0.082	66 230	80 610	22	
MAP^: F = $F_{MSY\ upper}$ × (SSB_{2020}/MSY $B_{trigger}$)	12 393	0.144	65 786	75 602	15	
F = F_{MSY}	24 535	0.31	64 618	64 275	−1	
F = F_{pa}	27 179	0.35	64 340	61 819	−4	
F = F_{lim}	33 356	0.45	63 650	56 155	−12	
SSB (2022) = B_{lim} ^^						
SSB (2022) = B_{pa} ^^						
SSB (2022) = MSY $B_{trigger}$ ^^						
F = F_{2020}	14 410	0.170	65 603	73 849	13	
Catch for bycatch fleets only ^^^	3 308	0.026	66 574	85 251	28	

* For spring-spawning stocks, the SSB is determined at spawning time and is influenced by fisheries and natural mortality between 1 January and spawning time (April).
** SSB (2022) relative to SSB (2021).
*** The advised catch in 2020 was 0 tonnes.
^ As SSB_{2020} is below MSY $B_{trigger}$, the F_{MSY}, $F_{MSY\ lower}$, and $F_{MSY\ upper}$ values in the MAP are adjusted by the SSB_{2020}/MSY $B_{trigger}$ ratio.
^^ The B_{lim} and B_{pa} cannot be achieved in 2022, even with zero catch advice.
^^^ Only the A-fleet that targets North Sea autumn-spawning (NSAS) herring and the D-fleet that targets sprat are allowed to fish, assuming the same catch as in the intermediate year 2020 (C- and F-fleets have zero catch).

Table 4 Herring in subdivisions 20–24, spring spawners. Medium-term catch scenarios. Different low F scenarios are provided, where $F_{2022} = F_{2021}$. All weights are in tonnes. All scenarios, except the constant catch 2020–2022 scenario, assume the F-fleet catches 50% of the total WBSS herring catch.

Basis	Total catch (2021)	Total catch (2022)	$F_{3–6}$ (2021)	SSB* (2021)	SSB* (2022)	SSB* (2023)	% SSB change (2021–2022)	% SSB change (2022–2023)
Medium-term catch scenarios								
F = 0	0	0	0	66 824	87 890	111 745	32	27
F = 0.05	4 506	5 726	0.05	66 462	83 450	102 017	26	22
F = 0.1	8 783	10 659	0.1	66 103	79 277	93 335	20	18
F = 0.15	12 843	14 905	0.15	65 746	75 353	85 569	15	14
Constant catch 2020–2022 **	15 391	15 391	0.150	65 726	74 580	85 273	13	14

* For spring-spawning stocks, the SSB is determined at spawning time and is influenced by fisheries and natural mortality between 1 January and spawning time (April).
** It is assumed that the fleets' 2020 catches (as defined in Table 2) are kept constant for 2021–2022.

Quality of the assessment

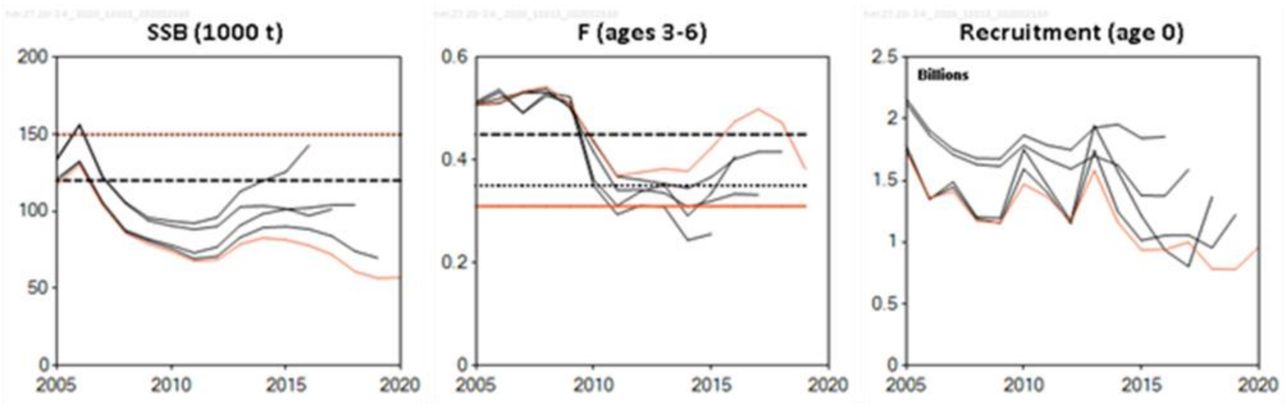

Figure 2 Herring in subdivisions 20–24, spring spawners. Historical assessment results; orange lines represent the most recent assessment (2020) following the benchmark in 2018. Final-year recruitment and SSB estimates are included.

Issues relevant to the advice

This stock is caught across three different management units and recovery will be impaired if catches of this stock are not minimized in all units. Without additional area and/or time restriction on the herring fishery in the North Sea in 2020, a catch of WBSS in the North Sea will be inevitable (it is estimated that 21% of the 2020 total catches from the stock are taken in Division 4.a). For the other two areas, catch shares in 2020 are estimated to be 59% for subdivisions 20–21 and 20% for subdivisions 22–24.

History of the advice, catch, and management

Table 5 Herring in subdivisions 20–24, spring spawners. ICES advice, TACs, and ICES estimated catch. All weights are in tonnes.

Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC Division 3.a***	Agreed TAC subdivisions 22–24	ICES estimated catch ^			
					Subdiv. 22–24	Division 3.a	Subarea 4	Total
1987	Reduction in F	224000	218000		102000	59000	14000	175000
1988	No increase in F	196000	218000		99000	129000	23000	251000
1989	TAC	174000	218000		95000	71000	20000	186000
1990	TAC	131000	185000		78000	118000	8000	204000
1991	TAC	180000	155000		70000	112000	10000	192000
1992	TAC	180000	174000		85000	101000	9000	195000
1993	Increased yield from reduction in F; reduction in juvenile catches	188000	210000		81000	95000	10000	186000
1994	TAC	130000–180000	191000		66000	92000	14000	172000
1995	If required, TAC not exceeding recent catches	168000–192000	183000		74000	80000	10000	164000
1996	If required, TAC not exceeding recent catches	164000–171000	163000		58000	71000	1000	130000
1997	3.a: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	66000–85000*	100000		68000	55000	1000	124000
1998	Should be managed in accordance with NSAS	-	97000		51000	53000	8000	112000
1999	3.a: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	-	99000		50000	43000	5000	98000
2000	3.a: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	~60000 for SDs 22–24	101000		54000	57000	7000	118000
2001	3.a: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	~50000 for SDs 22–24	101000		64000	42000	6000	112000
2002	3.a: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	~50000 for SDs 22–24	101000		53000	47000	7000	107000
2003	Reduce F	< 80000	101000		40000	36000	2000	78000
2004	Separate management regime. Reduce F	< 92000	91000		42000	28000	7000	77000
2005	Separate management regime. *Status quo* F	95000	120000		44000	38000	7000	89000
2006	Separate management regime. *Status quo* F	95000	102000	47500	42000	36000	11000	89000
2007	Separate management regime. *Status quo* F	99000	69000	49500	40000	28000	1000	69000
2008	Separate management regime. Reduce F 20% towards F0.1	71000	51700	45000	44000	25000	0	69000
2009	Separate management regime. Reduce F to F = 0.25	< 32800	37700	27200	31000	32000	4000	67000

Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC Division 3.a***	Agreed TAC subdivisions 22–24	ICES estimated catch ^			
					Subdiv. 22–24	Division 3.a	Subarea 4	Total
2010	Separate management regime. Reduce F to F = 0.25	< 39800	33900	22700	18000	24000	1000	42000
2011	MSY transition in 1–5 years and no increase in catches of WBSS herring in the North Sea	26500–53600	30000	15800	16000	12000	300	28000
2012	F_{MSY} = 0.25 and no increase in catches of WBSS herring in the North Sea	< 42700	45000	20900	21000	15000	2000	39000
2013	F_{MSY} = 0.25 and no optional transfer of catch scenarios to the North Sea	< 51900	55000	25800	26000	17000	500	44000
2014	Transition to MSY approach	< 41602	46800	19800	18000	16000	3000	37000
2015	MSY approach (F_{MSY} = 0.28)**	< 44439	43600	22200	22000	13000	2000	37000
2016	MSY approach (F_{MSY} = 0.32)	< 52547	51048	26274	25000	24000	2000	51000
2017	MSY approach (F_{MSY} = 0.32)	< 56802	50740	28401	26513	19195	632	46340
2018	MSY approach (F = 0.295)	< 34618	48427	17309	18992	19902	2164	41058
2019	MSY approach	0	29326	9001	9831	8832	6757	25420
2020	MSY approach	0	24528	3150				
2021	MSY approach	0						

* Catch in subdivisions 22–24.
** Advice for 2015 was for wanted catch.
*** Including mixed clupeid TAC and a bycatch ceiling in the small-meshed fisheries until 2005, and for 2007. For 2006, and from 2008, human consumption only, not including industrial bycatch or mixed clupeids, but including North Sea autumn-spawners catch in fleet C, with an optional 50% transfer from Division 3.a to Subarea 4 since 2011.
^ WBSS only.

Summary of the assessment

Table 6 Herring in subdivisions 20–24, spring spawners. Assessment summary. Weights are in tonnes. High and low refer to the 95% confidence intervals.

Year	Recruitment			Spawning-stock biomass			Catches	Fishing mortality		
	Recruitment (age 0, wr 0)	High	Low	SSB*	High	Low		F (ages 3–6)	High	Low
	thousands			tonnes			tonnes			
1991	4799683	6388484	3606013	296049	369171	237411	191573	0.48	0.63	0.37
1992	3569967	4568909	2789432	291869	356702	238821	194408	0.52	0.63	0.42
1993	3044671	3986913	2325112	276270	336154	227054	185010	0.56	0.68	0.46
1994	4380591	5679237	3378901	222218	268708	183770	172439	0.59	0.71	0.49
1995	4168930	5336279	3256947	192232	232838	158708	150820	0.61	0.74	0.51
1996	4186855	5348598	3277449	131342	157342	109638	121260	0.63	0.76	0.52
1997	3534281	4589058	2721940	147484	176615	123158	115585	0.62	0.75	0.52
1998	4460258	5716166	3480288	120118	143464	100572	107033	0.61	0.72	0.51
1999	4735476	6077482	3689806	120658	144174	100978	97234	0.57	0.68	0.47
2000	2955711	3773413	2315206	121179	144256	101793	109913	0.57	0.68	0.48
2001	2733279	3433623	2175782	133819	158469	113004	105806	0.56	0.68	0.47
2002	2658828	3341592	2115568	161101	190813	136016	106195	0.52	0.62	0.43
2003	2851159	3619824	2245718	126813	150380	106940	78310	0.49	0.60	0.40
2004	2043286	2587651	1613439	127885	151672	107828	76813	0.50	0.60	0.41
2005	1737092	2191867	1376675	116818	138476	98547	88404	0.51	0.61	0.43

Year	Recruitment			Spawning-stock biomass			Catches	Fishing mortality		
	Recruitment (age 0, wr 0)	High	Low	SSB*	High	Low		F (ages 3–6)	High	Low
	thousands			tonnes			tonnes			
2006	1361046	1729357	1071176	130128	154564	109556	90548	0.51	0.61	0.43
2007	1409637	1784154	1113736	104089	124219	87222	68179	0.53	0.64	0.45
2008	1171340	1481026	926411	85831	101668	72462	69489	0.54	0.66	0.45
2009	1156949	1464675	913876	78832	93135	66726	67259	0.51	0.63	0.42
2010	1470035	1858553	1162734	74002	87386	62667	42214	0.43	0.53	0.35
2011	1367582	1722663	1085691	67657	79994	57224	27771	0.37	0.47	0.29
2012	1169338	1482927	922063	68569	81150	57939	38646	0.38	0.46	0.31
2013	1581113	2117143	1180798	78598	93123	66338	43827	0.38	0.47	0.31
2014	1161332	1492675	903540	82818	98985	69291	37358	0.38	0.47	0.31
2015	937438	1225917	716843	81485	97964	67778	37490	0.42	0.51	0.35
2016	939669	1251061	705783	77854	93691	64693	51299	0.48	0.60	0.37
2017	1000047	1397529	715616	71908	87907	58822	46340	0.50	0.68	0.37
2018	783319	1204860	509261	60944	79539	46696	41058	0.47	0.66	0.34
2019	778899	1431060	423940	56621	79611	40271	25420	0.38	0.58	0.25
2020	964361**			57124***						

* SSB at spawning time (April).
** Recruitment is the average of 2014–2018.
*** SSB is predicted.

Sources and references

ICES 2020. Herring in Division 3.a and subdivisions 22–24, spring spawners (Update Assessment). *In* Herring Assessment Working Group for the Area South of 62°N (HAWG), Section 3. *In prep.* Section 3 is available separately at the HAWG website.

Recommended citation: ICES. 2020. Herring (*Clupea harengus*) in subdivisions 20–24, spring spawners (Skagerrak, Kattegat, and western Baltic). *In* Report of the ICES Advisory Committee, 2020. ICES Advice 2020, her.27.20-24, https://doi.org/10.17895/ices.advice.5928.

Annex 1

ICES Advice on fishing opportunities, catch, and effort
Baltic Sea and Greater North Sea Ecoregions
Published 29 May 2019

Herring (*Clupea harengus*) in subdivisions 20–24, spring spawners (Skagerrak, Kattegat, and western Baltic)

ICES advice on fishing opportunities

ICES advises that when the MSY approach is applied, there should be zero catch in 2020.

This advice applies to the catch of western Baltic spring spawning herring (WBSS) in subdivisions 20–24 and the eastern part of Subarea 4.

Stock development over time

The spawning-stock biomass (SSB) has been below B_{lim} since 2007. After a decrease in the first half of the 2010s, fishing mortality (F) has increased since 2014 and remains well above F_{MSY}. Recruitment has been low since the mid-2000s.

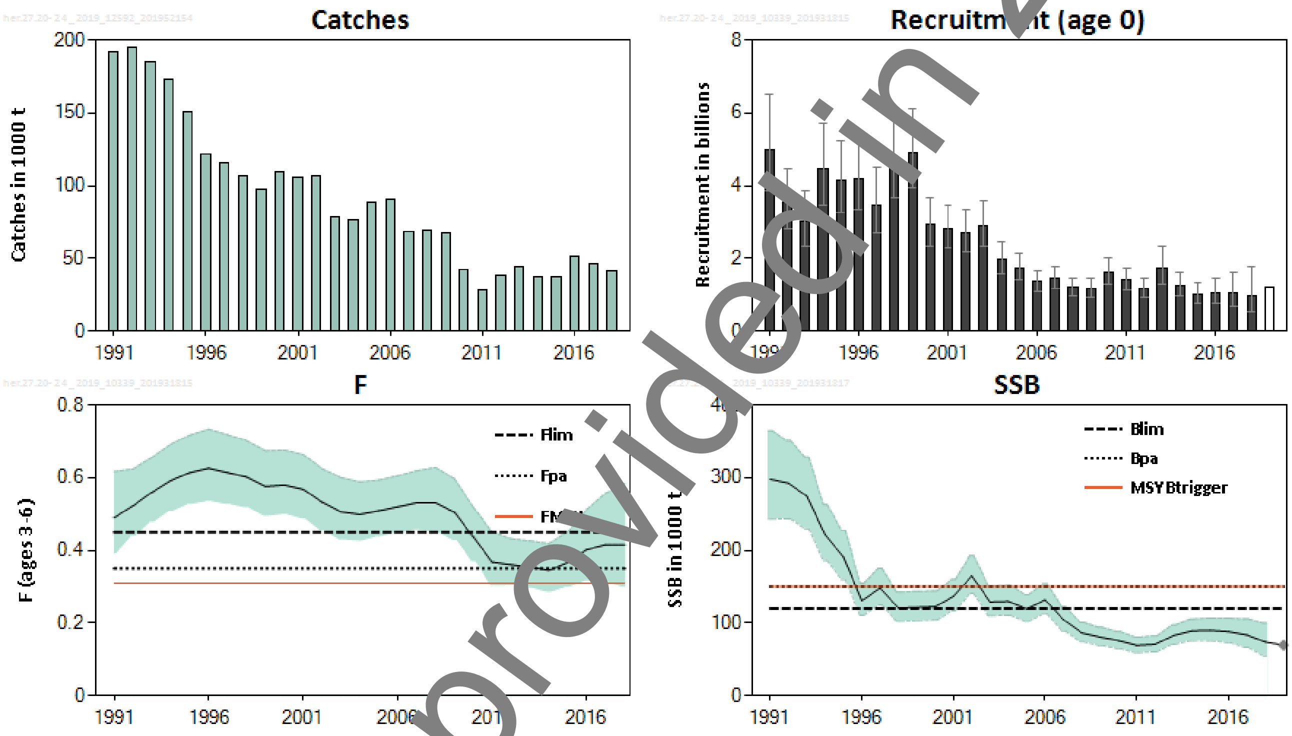

Figure 1 Herring in subdivisions 20–24, spring spawners. Commercial catches, recruitment, fishing mortality (F), and spawning-stock biomass (SSB) from the summary of the stock assessment; 95% confidence intervals are shown for SSB, F, and recruitment. Unshaded value of the recruitment is the average value of 2013–2017 and 2019 SSB (grey diamond) is a predicted number.

Stock and exploitation status

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

Table 1 Herring in subdivisions 20–24, spring spawners. 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 $B_{trigger}$	✖	✖	✖	Below trigger
Precautionary approach	F_{pa},F_{lim}	○	○	○	Increased risk	B_{pa},B_{lim}	✖	✖	✖	Reduced reproductive capacity
Management plan	F_{MGT}	–	–	–	Not applicable	B_{MGT}	–	–	–	Not applicable

Catch scenarios

The ICES MSY approach stipulates that F is reduced proportionally to SSB when the spawning stock size falls below MSY $B_{trigger}$. When SSB is below B_{lim}, measures should be taken so that SSB can be brought above B_{lim} in the short term. All catch scenarios, including zero catch, result in SSB remaining below B_{lim} in 2021.

Table 2 Herring in subdivisions 20–24, spring spawners. The basis for the catch scenarios. All weights are in tonnes and recruitment is in thousands.

Variable	Value	Notes
F_{ages} 3–6 (2019)	0.238	Based on catch in 2019.
SSB (2019)	69 743	Based on catch in 2019.
R_{age} 0 (2019)	1 223 484	Average 2013–2017.
R_{age} 0 (2020)	1 223 484	Average 2013–2017.
Total catch (2019)	23 367	- A-fleet: 1 545 t (average catch 2016–2018) - C-fleet: 12 352 t including an assumed 48% transfer (given by the Pelagic Advisory Council) of the catch to the North Sea and 81% (average split 2016–2018) of WBSS in the catch - D-fleet: 469 t assuming 16% utilization of the TAC (average utilization 2016–2018) and 44% of WBSS in the catch (average split 2016–2018) - F-fleet: 9 001 t (TAC)

Table 3 Herring in subdivisions 20–24, spring spawners. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2020)	$F_{3–6}$ (2020)	SSB* (2020)	SSB (2021)	% SSB change **	% advice change ***
ICES advice basis						
MSY approach: zero catch	0	0	76 273	101 269	33%	0%
Other scenarios						
MAP ^: F = F_{MSY} × SSB_{y-1}/MSY $B_{trigger}$	14 619	0.144	75 138	87 270	16%	
MAP^: F = $F_{MSY\ lower}$ × (SSB_{y-1}/MSY $B_{trigger}$)	10 359	0.1[illegible]	75 483	91 298	21%	
MAP^: F = $F_{MSY\ upper}$ × (SSB_{y-1}/MSY $B_{trigger}$)	17 609	0.176	74 889	84 458	13%	
F_{MSY}	29 215	0.[illegible]1	73 852	73 874	0.03%	
F = F_{pa}	32 413	0.[illegible]5	73 546	70 975	-3%	
F = F_{lim}	39 917	0.45	72 786	64 257	-12%	
SSB (2021) = B_{lim} ^^	0	0	76 273	101 269	33%	
SSB (2021) = B_{pa} ^^	0	0	76 273	101 269	33%	
SSB (2021) = MSY $B_{trigger}$ ^^	0	0	76 273	101 269	33%	
F = F_{2019}	23 157	0.238	74 407	79 426	7%	

* For spring-spawning stocks, the SSB is determined at spawning time and is influenced by fisheries and natural mortality between 1 January and spawning time (April).
** SSB (2021) relative to SSB (2020).
*** The advised catch in 2019 was 0 tonnes.
^ Revised Baltic MAP (2019) which refers to using the most recent reference points. As SSB_{2019} is below MSY $B_{trigger}$, the F_{lower} and F_{upper} values in the MAP are adjusted by the SSB_{y-1}/MSY $B_{trigger}$ ratio.
^^ The B_{lim} and B_{pa} cannot be achieved in 2021 even with zero catch advice.

Table 4 Herring in subdivisions 20–24, spring spawners. Medium-term catch scenarios. Different low F scenarios are provided, where $F_{2021} = F_{2020}$. All weights are in tonnes.

Basis	Total catch (2020)	Total catch (2021)	$F_{3–6}$ (2020)	SSB* (2020)	SSB* (2021)	SSB* (2022)	% SSB change (2020–2021)	% SSB change (2021–2022)
Medium-term catch scenarios								
F = 0	0	0	0	76 273	101 269	132 063	33%	30%
F = 0.05	5 301	6 665	0.05	75 877	96 189	120 704	27%	25%
F = 0.1	10 359	12 500	0.1	75 483	91 383	110 440	21%	21%
F = 0.15	15 186	17 594	0.15	75 092	86 838	101 160	1[illegible]%	16%
Constant catch 2019–2021 #	23 367	23 367	0.222	74 532	80 342	89 8[illegible]3	8%	12%

* For spring-spawning stocks, the SSB is determined at spawning time and is influenced by fisheries and natural mortality between 1 January and spawning time (April).
\# Assumptions for 2019 catches kept constant for 2020–2021 (as defined in Table 2).

The stock is estimated to be below B_{lim}. There are no catch scenarios that will rebuild the stock above B_{lim} by 2021. ICES continues to advise zero catch.

Basis of the advice

Table 5 Herring in subdivisions 20–24, spring spawners. The basis of the advice.

Advice basis	MSY approach
Management plan	An EU Baltic Sea Multiannual Plan (MAP; EU, 2016) was established in 2016 and updated in 2019 (MAP; EC, 2019). It applies to herring in subdivisions 22–24, which is part of the distribution area of the WBSS stock. This plan is not adopted by Norway and, thus, not used as basis of the advice for this shared stock.

Quality of the assessment

This stock was benchmarked in 2018 (ICES, 2018a), which led to a change in perception for the entire time series. The 2019 assessment (ICES, 2019) shows a downward revision in the SSB (e.g., 19% smaller for 2017) and upwards revision in F (e.g., 27% higher for 2017) estimates in recent years compared to the 2018 assessment. This revision is within the uncertainty bounds of last year's assessment.

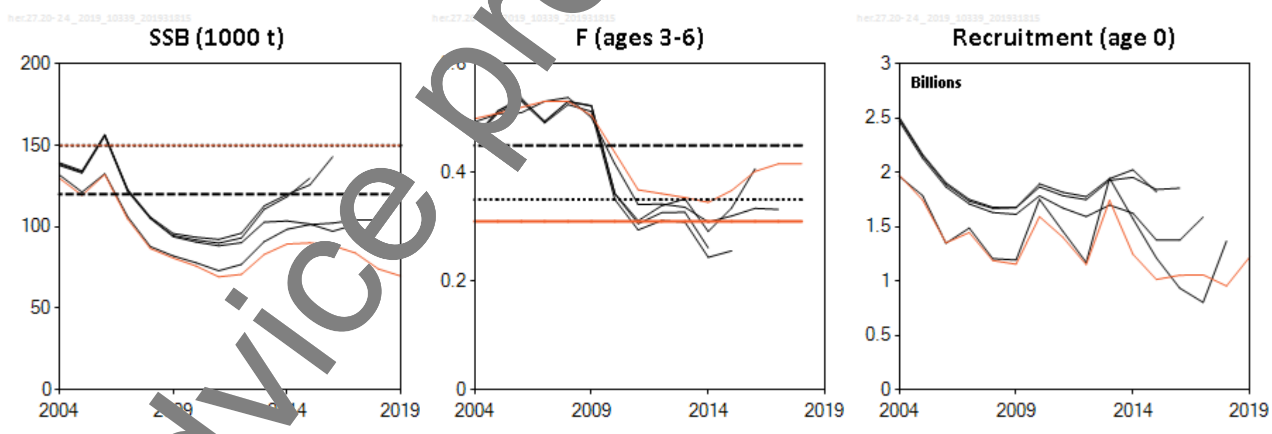

Figure 2 Herring in subdivisions 20–24, spring spawners. Historical assessment results; orange lines represent the most recent assessment (2019) following the benchmark in 2018. Final-year recruitment and SSB estimates are included.

The herring assessed in subdivisions 20–24 is a complex mixture of populations predominantly spawning in spring, but with local components also spawning in autumn and winter. The population dynamics and the relative contribution of these components is presently unknown, but are likely to affect the precision of the assessment. Moreover, mixing between WBSS and central Baltic herring in subdivisions 22–24 may contribute to uncertainty in the assessment.

There is inter-annual variability in the herring migration patterns and in the distribution of the fisheries (including the optional transfer of quotas between divisions 3.a and 4). Since these cannot be predicted, recent average proportions between stocks are assumed in projections. This is an added source of uncertainty in the catch forecasts.

Issues relevant for advice

Recruitment has been low since the mid-2000s and at an historic low for the last four years. Even with a closure of the fishery in 2020 it will not be possible to increase SSB above B_{lim} in the short-term (2021).

According to the forecasts, the implemented TAC in 2019 is expected to lead to a significant reduction in F, but will result in only a small increase in SSB by 2020.

To explore the potential development of the stock, projections until 2022 with different low F scenarios (where $F_{2021} = F_{2020}$) are provided in Table 4. Spawning-stock biomass is expected to remain below B_{lim} even with a fishing mortality of zero in 2021. The highest fishing mortality that brings SSB above B_{lim} in 2022 will be F = 0.05 with a yield of 5301 tonnes in 2020. This will carry a higher risk of not achieving B_{lim} in 2020 and 2021 compared to the zero catch scenario. ICES recommends that a rebuilding plan for this stock is developed.

The EU–Norway TAC-setting procedure used for herring in Division 3.a (EU–Norway, 2013) calculates the TAC for the combined stocks in the C-fleet as 41% of the ICES MSY advice for WBSS plus 5.7% of the TAC for the A-fleet. According to a safety clause in the EU–Norway TAC-setting procedure for herring in Division 3.a, the method should not apply to calculate the advised catch for the C-fleet as there are serious concerns about the status of the WBSS stock. The ICES advice for zero WBSS catch also implies that the herring catches for Division 3.a should be as close to zero as possible in 2020.

WBSS herring are also caught in the herring fisheries in the eastern part of Division 4.a. The catch of WBSS in the North Sea was 2164 t in 2018. Without additional area and/or time restriction on the herring fishery in the North Sea in 2020, a catch of WBSS in the North Sea will be inevitable.

Reference points

Table 6 Herring in subdivisions 20–24, spring spawners. Reference points, values, and their technical basis. Weights in tonnes.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	150 000	B_{pa} equal to the upper 95% confidence limit of B_{lim}.	ICES (2018a)
	F_{MSY}	0.31	Stochastic simulations (EqSim) with Beverton-Holt, Ricker, and segmented regression stock–recruitment curve from the full time-series (1991–2016).	ICES (2018a)
Precautionary approach	B_{lim}	120 000	Chosen as the mean of the two lowest SSB (1998, 1999) values with above average recruitment.	ICES (2018a)
	B_{pa}	150 000	Upper 95% confidence limit of B_{lim} with σ ≈ 0.135 using the *CV* from the final-year SSB estimate in the assessment.	ICES (2018a)
	F_{lim}	0.45	$F_{P50\%}$ leading to 50% probability of SSB > B_{lim} under stochastic simulations with Beverton-Holt, Ricker, and segmented stock–recruitment from the full time-series (1991–2016).	ICES (2018a)
	F_{pa}	0.35	$F_{pa} = F_{lim} \times \exp(-1.645 \times \sigma)$ with σ ≈ 0.145, based on the *CV* from the terminal assessment year.	ICES (2018a)
Management plan (2018)	MAP (2018) MSY $B_{trigger}$	150 000	B_{pa} equal to the upper 95% confidence limit of B_{lim}.	ICES (2018a)
	MAP (2018) B_{lim}	120 000	Chosen as the mean of the two lowest SSB (1998, 1999) values with above average recruitment.	ICES (2018a)
	MAP (2018) F_{MSY}	0.31	Stochastic simulations (EqSim) with Beverton-Holt, Ricker, and segmented regression stock–recruitment curve from the full time-series (1991–2016).	ICES (2018a)
	MAP (2018) target range F_{lower}	0.216–0.310	Consistent with the ranges, resulting in no more than 5% reduction in long-term yield compared with MSY.	ICES (2018a)
	MAP (2018) target range F_{upper}	0.310–0.379	Consistent with the ranges, resulting in no more than 5% reduction in long-term yield compared with MS.	ICES (2018a)

Basis of the assessment

Table 7 Herring in subdivisions 20–24, spring spawners. Basis of assessment and advice.

ICES stock data category	1 (ICES, 2018b).
Assessment type	Age-based analytical assessment, multi-fleet SAM (ICES, 2019) that uses catches by fleet in the model and in the forecast.
Input data	Two acoustic, two trawl, and one larval survey indices (HERAS, GerAS (BIAS), IBTS/BITS Q1, IBTS/BITS Q3–4, and N20); catch statistics and corrections for historical area misreporting; otolith microstructure and morphometric methods to calculate the proportion of NSAS in the catches.
Discards and bycatch	Discarding is considered to be negligible. The amount of slippage in Division 3.a is unknown.
Indicators	None.
Other information	Last benchmarked in 2018 (ICES, 2018a).
Working group	Herring Assessment Working Group for the Area South of 62°N (HAWG).

Information from stakeholders

The 48% TAC transfer from Division 3.a to the North Sea in 2019, assumed for the human consumption fishery on herring in the catch forecast, was based on information provided by the Pelagic Advisory Council (AC).

History of the advice, catch, and management

Table 8 Herring in subdivisions 20–24, spring spawners. ICES advice, TACs, and ICES estimated catch. All weights are in tonnes.

Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC Division 3.a***	Agreed TAC subdivisions 22–24	ICES estimated catch ^			
					Subdiv. 22–24	Division 3.a	Subarea 4	Total
1987	Reduction in F	224000	218000		102000	59000	14000	175000
1988	No increase in F	196000	218000		99000	129000	23000	251000
1989	TAC	174000	218000		95000	71000	20000	186000
1990	TAC	131000	185000		78000	118000	8000	204000
1991	TAC	180000	155000		70000	112000	10000	192000
1992	TAC	180000	174000		85000	101000	9000	195000
1993	Increased yield from reduction in F; reduction in juvenile catches	188000	210000		81000	95000	10000	186000
1994	TAC	130000–180000	191000		66000	92000	14000	172000
1995	If required, TAC not exceeding recent catches	168000–192000	183000		74000	80000	10000	164000
1996	If required, TAC not exceeding recent catches	164000–171000	163000		58000	71000	1000	130000
1997	3.a: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	66000–85000*	100000		68000	55000	1000	124000
1998	Should be managed in accordance with NSAS	-	97000		51000	53000	8000	112000
1999	3.a: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	-	99000		50000	43000	5000	98000
2000	3.a: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	~60000 for SDs 22–24	101000		54000	57000	7000	118000
2001	3.a: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	~50000 for SDs 22–24	101000		64000	42000	6000	112000
2002	3.a: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	~50000 for SDs 22–24	101000		53000	47000	7000	107000
2003	Reduce F	< 80000	101000		40000	36000	2000	78000
2004	Separate management regime. Reduce F	< 92000	91000		42000	28000	7000	77000
2005	Separate management regime. Status quo F	95000	120000		44000	38000	7000	89000
2006	Separate management regime. Status quo F	95000	102000	47500	42000	36000	11000	89000
2007	Separate management regime. Status quo F	99000	69000	49500	40000	28000	1000	69000
2008	Separate management regime. Reduce F 20% towards F0.1	71000	51700	45000	44000	25000	0	69000
2009	Separate management regime. Reduce F to F = 0.25	< 32800	37700	27200	31000	32000	4000	67000

Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC Division 3.a***	Agreed TAC subdivisions 22–24	ICES estimated catch ^			
					Subdiv. 22–24	Division 3.a	Subarea 4	Total
2010	Separate management regime. Reduce F to F = 0.25	< 39800	33900	22700	18000	24000	1000	42000
2011	MSY transition in 1–5 years and no increase in catches of WBSS herring in the North Sea	26500–53600	30000	15800	16000	12000	[illegible]	28000
2012	FMSY = 0.25 and no increase in catches of WBSS herring in the North Sea	< 42700	45000	20900	21000	15000	2000	39000
2013	FMSY = 0.25 and no optional transfer of catch scenarios to the North Sea	< 51900	55000	25800	26000	17000	500	44000
2014	Transition to MSY approach	< 41602	46800	19800	18000	16000	3000	37000
2015	MSY approach (FMSY = 0.28)**	< 44439	43600	22200	22000	13000	2000	37000
2016	MSY approach (FMSY = 0.32)	< 52547	51048	26274	25000	24000	2000	51000
2017	MSY approach (FMSY = 0.32)	< 56802	50740	28401	26513	19195	632	46340
2018	MSY approach (F = 0.295)	< 34618	48427	17309	18992	19902	2164	41058
2019	MSY approach	0	29326	[illegible]				
2020	MSY approach	0						

* Catch in subdivisions 22–24.
** Advice for 2015 was for wanted catch.
*** Including mixed clupeid TAC and a bycatch ceiling in the small-meshed fisheries until 2005, and for 2007. For 2006, and from 2008, human consumption only, not including industrial bycatch or mixed clupeids, but including North Sea autumn-spawner catch in fleet C, with an optional 50% transfer from Division 3.a to Subarea 4 since 2011.
^ WBSS only.

History of the catch and landings

Table 9 Herring in subdivisions 20–24, spring spawners. Catch distribution, by stock and by fleet, of WBSS and NSAS herring in 2018 as estimated by ICES.

Area where WBSS are caught	Fleet	Fisheries	WBSS 2018 catch (t)	NSAS 2018 catch (t)
Division 3.a	C	Directed herring fisheries with purse-seiners and trawlers	19 751	3163
	D	Bycatches of herring caught in the small-meshed fisheries	151	209
Subdivisions 22–24	F	All herring fisheries in subdivisions 22–24.	18 992	0
Subarea 4	A	Directed herring fisheries with purse-seiners and trawlers	2164	-
Total area	C,D,F,A	All	41 058	3372

Table 10 Herring in subdivisions 20–24, spring spawners. Catch distribution of WBSS in 2018 as estimated by ICES.

Total catch (2018)	Landings		Discards
41 058 tonnes	99.6% directed fishery	0.4% bycatch*	Negligible
	41 058 tonnes		

* Sprat fishery closed early in 2018 by agreement with fishers, due to whiting by-catch in the sprat fishery.

Table 11 Herring in subdivisions 20–24. History of commercial catch as estimated by ICES, by area and country for all herring stocks caught within the management area for subdivisions 20–24. Values prior to 2002 are rounded. Weights are in tonnes.

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Skagerrak														
Denmark	47400	62300	58700	64700	87800	44900	43700	28700	[illegible]	10300	10100	16000	16200	25968
Norway	1600	5600	8100	13900	24200	17700	16700	9400	8800	8000	7400	9700	0	0
Sweden	47900	56500	54700	88000	56400	66400	48500	32700	[illegible]	46900	36400	45800	30800	26354
Total	96900	124400	121500	166600	168400	129000	108900	70800	[illegible]	65200	53900	71500	47000	52322
Kattegat														
Denmark	57100	32200	29700	33500	28700	23600	16900	17200	[illegible]	23700	17900	18900	18800	18609
Sweden	37900	45200	36700	26400	16700	15400	30800	27000	[illegible]	29900	14600	17300	16200	7246
Total	95000	77400	66400	59900	45400	39000	47700	[illegible]	26800	53600	32500	36200	35000	25855
Subdivisions 22 and 24														
Denmark	21700	13600	25200	26900	38000	39500	36800	[illegible]	30500	30100	32500	32600	28300	13066
Germany	56400	45500	15800	15600	11100	11400	13400	[illegible]	12800	9000	9800	9300	11400	22400
Poland	8500	9700	5600	15500	11800	6300	7300	6000	6900	6500	5300	6600	9300	0
Sweden	6300	8100	19300	22300	16200	7400	15800	9000	14500	4300	2600	4800	13900	10717
Total	92900	76900	65900	80300	77100	64600	73300	[illegible]	64700	49900	50200	53300	62900	46184
Subdivision 23														
Denmark	1500	1100	1700	2900	3300	1500	[illegible]	700	2200	400	500	900	600	4572
Sweden	100	100	2300	1700	700	300	[illegible]	300	100	300	100	100	200	0
Total	1600	1200	4000	4600	4000	1800	[illegible]	1000	2300	700	600	1000	800	4572
Grand total	286400	279900	257800	311400	294900	234400	[illegible]	172700	149800	169400	137200	162000	145700	128932

Year	2003	2004	2005	2006**	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Skagerrak														
Denmark	15477	11782	14768	5156	3595	3867	12720	5309	3577	3244	4886	6449	4137	3554
Faroe Islands	0	0	440	0	0	[illegible]	552	447	0	0	0	0	480	318
Netherlands	725	484	751	600	454	1566	255	145	54	629	194	84	128	125
Germany	0	0	0	0	0	[illegible]	0	395	0	0	0	0	0	0
Lithuania	0	0	0	0	0	0	0	0	0	0	0	0	30	0
Norway	0	0	0	0	[illegible]	4024	3295	3281	116	446	3019	2048	2475	3924
Sweden	25830	21806	32545	26000	[illegible]	16501	12869	17445	9458	16210	16677	12594	12857	13321
Total	42032	34073	48504	31756	26937	25958	29691	27023	13205	20530	24776	21175	20107	21242
Kattegat														
Denmark	15952	7563	11109	8617	[illegible]	7020	4896	7567	5155	6326	3877	4266	3976	2448
Sweden	10236	9626	9986	10800	[illegible]	5213	3612	2693	1661	800	2586	3412	3752	6206
Germany	0	0	0	0	0	0	631	0	0	0	0	0	0	0
Total	26188	17189	21095	[illegible]	20334	12234	9140	10260	6800	7126	6464	7678	7728	8653
Subdivisions 22 and 24														
Denmark	6143	7305	5311	[illegible]	2839	3073	2146	762	3089	4105	5060	4283	4487	5714
Germany	18776	18493	21040	[illegible]	24583	22823	15981	12239	8187	11170	14591	10241	13289	14427
Poland	4398	5512	6292	[illegible]	2945	5535	5232	1799	1803	2394	3110	2381	2648	2918
Sweden	9379	9865	9171	9604	7220	7024	4050	2034	2179	2706	2067	1078	1497	1659
Total	38696	41175	41814	[illegible]	37587	38456	27409	16833	15258	20400	24800	17983	21922	24718
Subdivision 23														
Denmark	2315	94	[illegible]	1827	2871	5324	2817	1***	26	38	44	47	30	26
Sweden	243	317	[illegible]	652	0	327	807	934	544	681	632	319	192	332
Total	2558	411	[illegible]	2479	2871	5651	3623	1000	600	700	700	366	222	359
Grand total	109473	92848	[illegible]	93035	87729	82298	69863	55200	35863	48755	56740	47202	49978	54972

Year	2017	2018*
Skagerrak		
Denmark	2699	858
Faroe Islands	400	149
Netherlands		
Germany	85	205
Lithuania		
Norway	3337	3411
Sweden	11936	11332
Total	18458	15956
Kattegat		
Denmark	912	1258
Sweden	7426	6044
Germany		0
Total	8338	7302
Subdivisions 22 and 24		
Denmark	5586	4487
Finland		1
Germany	14694	11304
Poland	3330	1773
Sweden	2287	943
Total	25898	18507
Subdivision 23		
Denmark	260	69
Sweden	356	416
Total	616	485
Grand total	53309	42250

* Preliminary data.
** 2000 t of Danish catches are missing (ICES, 2007).
*** 3103 t officially reported catches (ICES, 2011).

Summary of the assessment

Table 12 Herring in subdivisions 20–24, spring spawners. Assessment summary. Weights are in tonnes. High and low refer to the 95% confidence intervals.

Year	Recruitment (age 0)	Recruitment High	Recruitment Low	SSB*	SSB High	SSB Low	Catches	F (ages 3–6)	F High	F Low
1991	4994620	6495110	3840771	297743	364614	243137	191573	[illegible]	[illegible]	0.39
1992	3542228	4443621	2823683	292363	350921	243576	194408	0.52	[illegible]	0.44
1993	3004215	3849874	2344313	274789	328247	230037	185010	[illegible]	0.66	0.48
1994	4456350	5719437	3472205	221515	263259	186391	[illegible]	0.59	0.69	0.51
1995	4132201	5220793	3270593	190874	227491	160150	[illegible]	0.61	0.72	0.53
1996	4186672	5270907	3325467	131122	154908	110988	[illegible]	0.63	0.73	0.53
1997	3474711	4496643	2685029	148064	175078	125219	[illegible]	0.61	0.72	0.53
1998	4623046	5840333	3659476	120878	142556	102496	[illegible]	0.60	0.70	0.52
1999	4896152	6091709	3935234	121711	143523	103214	[illegible]	0.58	0.67	0.49
2000	2921274	3670689	2324862	122677	144224	[illegible]	109913	0.58	0.68	0.50
2001	2822649	3465930	2298761	136818	160017	[illegible]	[illegible]	0.57	0.66	0.49
2002	2694436	3324505	2183779	164949	192890	[illegible]	106195	0.53	0.63	0.45
2003	2894969	3567520	2349207	129138	151118	[illegible]	78310	0.51	0.60	0.43
2004	1976097	2463565	1585086	129940	[illegible]	111175	76813	0.50	0.59	0.43
2005	1747738	2141622	1426297	119352	[illegible]	102382	88404	0.51	0.59	0.44
2006	1352125	1664228	1098553	132111	[illegible]	113193	90548	0.52	0.61	0.45
2007	1446726	1773130	1180408	104839	[illegible]	89580	68179	0.53	0.62	0.46
2008	1189959	1464028	967196	86646	[illegible]	74402	69489	0.53	0.63	0.45
2009	1155814	1430963	933572	[illegible]	[illegible]	69388	67259	0.51	0.60	0.43
2010	1593242	1994526	1272694	[illegible]	88408	65286	42214	0.44	0.52	0.37
2011	1403676	1718514	1146518	[illegible]	80700	59508	27771	0.37	0.45	0.30
2012	1152037	1447335	916988	[illegible]	82558	60753	38646	0.36	0.43	0.30
2013	1743986	2342439	1298427	[illegible]	97148	70988	43827	0.35	0.43	0.30
2014	1247045	1591663	977042	[illegible]	105538	75831	37358	0.35	0.42	0.28
2015	1014505	1322280	[illegible]	90109	106972	75905	37490	0.37	0.45	0.30
2016	1054035	1444655	[illegible]	88443	106793	73246	51299	0.40	0.51	0.32
2017	1057849	1593028	[illegible]	83895	105676	66603	46340	0.42	0.56	0.31
2018	954391	1778279	[illegible]	74132	99751	55092	41058	0.42	0.58	0.30
2019	1223484**			69743***						

* SSB measured at spawning time (April).
** Recruitment is the average of 2013–2017.
*** SSB is predicted.

Sources and references

EU–Norway. 2013. Report from the Working Group on Management Measures for Herring in ICES Division IIIa (Skagerrak and Kattegat). Bergen, 19–20 June 2013. 10 pp.

EC. 2019. Regulation (EU) 2019/472 of the European Parliament and of the Council of 19 March establishing a multiannual plan for stocks fished in the Western Waters and adjacent waters, and for fisheries exploiting those stocks, amending Regulations (EU) 2016/1139 and (EU) 2018/973, and repealing Council Regulations (EC) No 811/2004, (EC) No 2166/2005, (EC) No 388/2006, (EC) No 509/2007 and (EC) No 1300/2008. Official Journal of the European Union, L 83, 25.3.2019. http://data.europa.eu/eli/reg/2019/472/oj

EU. 2016. Regulation (EU) 2016/1139 of the European Parliament and of the Council of 6 July 2016 establishing a multiannual plan for the stocks of cod, herring and sprat in the Baltic Sea and the fisheries exploiting those stocks, amending Council Regulation (EC) No 2187/2005 and repealing Council Regulation (EC) No 1098/2007. Official Journal of the European Union, L 191, 15.7.2016. http://data.europa.eu/eli/reg/2016/1139/oj

ICES. 2007. Report of the Herring Assessment Working Group for the Area South of 62°N (HAWG), 13–22 March 2007, ICES Headquarters, Copenhagen, Denmark. ICES CM 2007/ACFM:11. 538 pp.

ICES. 2011. Report of the Herring Assessment Working Group for the Area South of 62°N (HAWG), 16–24 March 2011, ICES Headquarters, Copenhagen, Denmark. ICES CM 2011/ACOM:06 .749 pp.

ICES. 2017. Herring (*Clupea harengus*) in Subarea 4 and divisions 3.a and 7.d, autumn spawners (North Sea, Skagerrak and Kattegat, eastern English Channel). *In* Report of the ICES Advisory Committee, 2017. ICES Advice 2017, her.27.3a47d.

ICES. 2018a. Report of the Benchmark Workshop on Pelagic Stocks (WKPELA 2018), 12–16 February 2018, ICES HQ, Copenhagen, Denmark. ICES CM 2018/ACOM:32. 313 pp.

ICES. 2018b. Advice basis. In Report of the ICES Advisory Committee, 2018. ICES Advice 2018, Book 1, Section 1.2. https://doi.org/10.17895/ices.pub.4503

ICES. 2019. Herring in Division 3.a and subdivisions 22–24, spring spawners. Section 3. *In* Report of the Herring Assessment Working Group for the Area South of 62 deg N (HAWG). ICES Scientific Reports. VOL 1:ISS 2. Section 3 is available separately at the HAWG website.

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