

## Herring (*Clupea harengus*) in subareas 1, 2, and 5, and in divisions 4.a and 14.a, Norwegian spring-spawning herring (the Northeast Atlantic and the Arctic Ocean)

### ICES stock advice

Please note: This advice was updated in October 2017 (ICES, 2017).

ICES advises that when the long-term management plan agreed by the EU, Faroe Islands, Iceland, Norway, and Russia in 1999 is applied, catches in 2018 should be no more than 546 472 tonnes.

### Stock development over time

Fishing mortality has had an overall declining trend since 2010 and was well below  $F_{MSY}$  in 2016. The stock is declining and estimated to be below  $MSY B_{trigger}$  in 2017. Since 1998 four large year classes have been produced (1998, 2000, 2002, and 2004). All year classes since 2005 are estimated to be average or small.

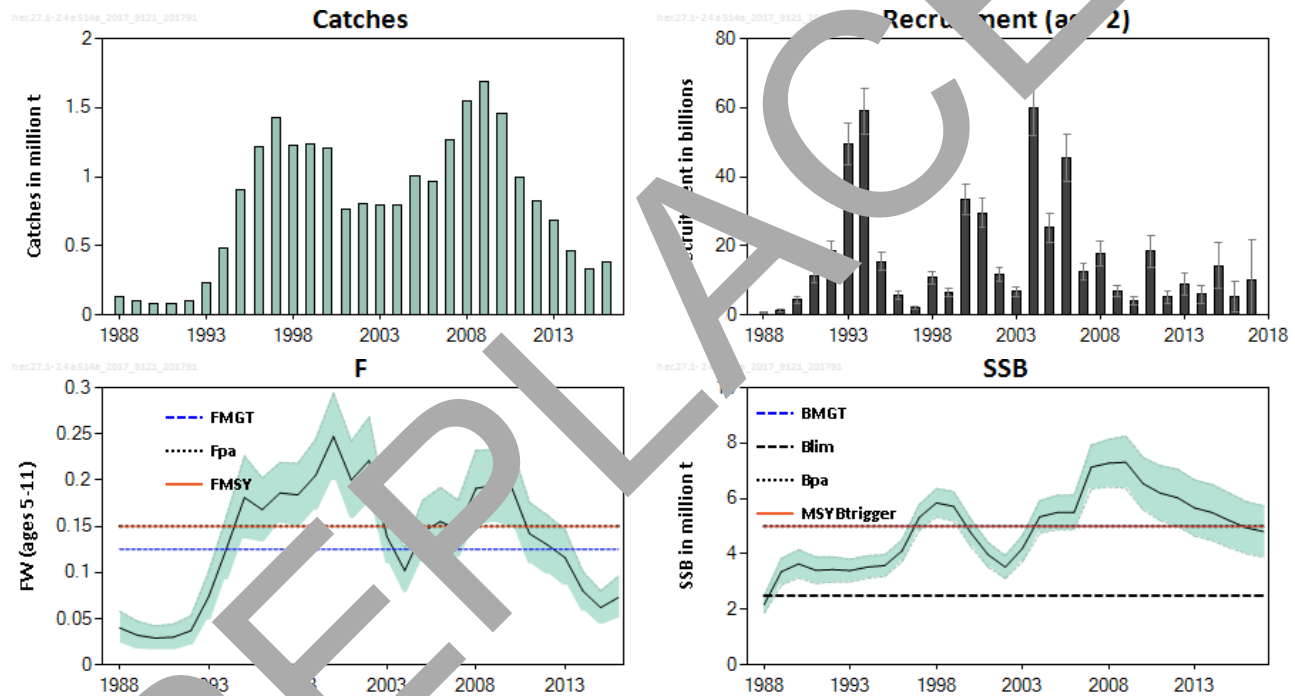


Figure 1 Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). Summary of the stock assessment. Confidence intervals (95%) are included in the recruitment, fishing mortality, and spawning-stock biomass estimates. The fishing mortality is the fishing mortality weighted by the population numbers.

### Stock and exploitation status

**Table 1** Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-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	$F_{MSY}$	✓	✓	✓	Below	$MSY B_{Trigger}$	✓	✗	✗	Below trigger
Precautionary Approach	$F_{pa}$ , $F_{lim}$	✓	✓	✓	Harvested sustainably	$B_{pa}$ , $B_{lim}$	✓	✗	✗	Increased risk
Management plan	$F_{MGT}$	✓	✓	✓	Below	$SSB_{MGT}$	✓	✗	✗	Below

### Catch options

**Table 2** Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). The basis for the catch options.

Variable	Value	Source	Notes
F ages 5–11 (2017)	0.163	ICES (2017)	Based on ICES estimated catch in 2017.
SSB (2018)	4364000 t	ICES (2017)	
$R_{age2}$ (2017)	9893000 thousand	ICES (2017)	Estimated from XSAM.
$R_{age2}$ (2018)	11586000 thousand	ICES (2017)	Median of stochastic recruitment estimated by XSAM, based on the years 1988–2017.
Catch (2017)	805142 t	ICES (2017)	Sum of declared national quotas.

**Table 3** Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). Annual catch options. All weights are in tonnes.

Basis	Total catch (2018)	$F_w$ (2018)	SSB (2019)	% SSB change **	% Catch change ***
ICES advice basis					
Agreed management plan <sup>^</sup>	15472	0.06	4132000	-5	-32
Other option					
MSY approach: $F_{MSY} \times SSB(2018)/MSY B_{trigger}$	60179	0.131	4028000	-8	-17
$F_{MSY}$	754509	0.15	3950000	-9	-6
$F = 0$	0	0	4613000	6	-100
$F_{pa}$	754509	0.15	3950000	-9	-6
$F_{lim}$ <sup>^^</sup>	---	---	---	---	---
$SSB(2019) = B_{lim}$	2437455	0.624	2500000	-43	203
$SSB(2019) = F_{pa} \times MSY B_{trigger}$	^^^	---	---	---	---
$F = F_{2017}$	813228	0.163	3899000	-11	1

\*  $F_w$  = Fishing mortality weighted by population numbers (age groups 5–11).

\*\* SSB 2019 relative to 2018.

\*\*\* Catch 2018 relative to estimated catch in 2017 (805 142 t).

<sup>^</sup> According to the harvest control rule in the management plan  $F(2018) = 0.125 \times (SSB(2018) - B_{lim}) / (B_{pa} - B_{lim}) + 0.05 \times (B_{pa} - SSB(2018)) / (B_{pa} - B_{lim})$ , where  $B_{pa} = 5$ ,  $B_{lim} = 2.5$  and  $SSB(2018) = 4.364$ , expressed in million t.

<sup>^^</sup>  $F_{lim}$  is presently undefined for this stock.

<sup>^^^</sup> Even with zero catch in 2018 the stock is predicted to be below  $B_{pa}$  and  $MSY B_{trigger}$  in 2019.

**Basis of the advice**

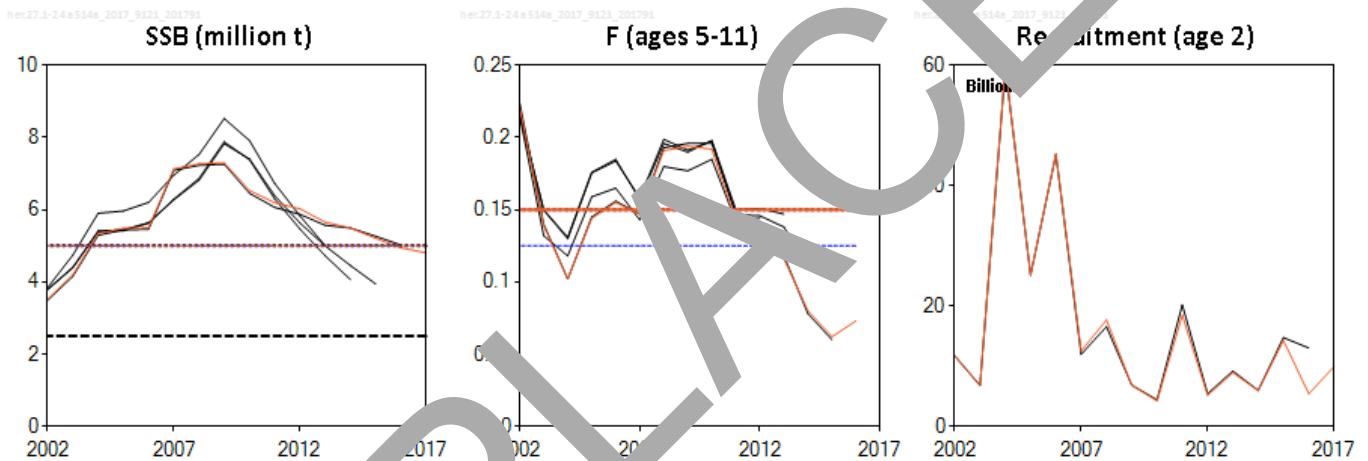
**Table 4** Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). The basis of the advice.

Advice basis	Management plan.
Management plan	A long-term management plan was agreed by the EU, Faroe Islands, Iceland, Norway, and Russia in 1999 (see Annex 9.3.11.1 in ICES, 2014). ICES has evaluated the plan and concluded that it is consistent with the precautionary approach (ICES, 2013a).

**Quality of the assessment**

The perception of the stock has not changed since last year’s assessment. The stock estimates for recent years from exploratory runs with other models are within the confidence intervals of the current assessment.

This year’s forecast deals with the intermediate year (2017) in a different way from what was done in 2016. This is because the approach used in 2016 was forecasting substantial change in the selection pattern for the intermediate and forecast years relative to what had been estimated for the final years in the assessment, and it was unclear such a change was realistic.



**Figure 2** Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). Historical assessment results. Prior to the 2016 assessment, estimates of F refer to ages 5–14. Recruitment estimates from assessments conducted before 2016 are not shown as they refer to age 0 instead of age 2.

**Issues relevant for the advice**

The F in the management plan and reference points refers to ages 5–14, whereas the F from the current assessment is for ages 5–11. A complete exploration of this issue is still needed. When this is done, taking into account the substantial changes that are estimated to have occurred historically on the selection pattern, it will be appropriate to consider if there are harvest strategies that are more robust to significant changes in the estimated selection in the fisheries (e.g. applying a constant selection pattern in the harvest control rule).

## Reference points

**Table 5** Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). Reference points, values, and their technical basis.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	5.0 million t	$B_{pa}$	
	$F_{MSY}$	0.15	Stochastic equilibrium analysis using a Beverton–Holt stock–recruitment relationship with data from 1950 to 2009.	ICES (2013b)
Precautionary approach	$B_{lim}$	2.5 million t	MBAL (accepted in 1998).	ICES (2013b)
	$B_{pa}$	5.0 million t	$B_{lim} \times \exp(0.4 \times 1.645)$ .	ICES (2013b)
	$F_{lim}$	Not defined.	-	
	$F_{pa}$	0.15	Based on medium-term simulations.	ICES (2013b)
EU–Faroes–Iceland–Norway–Russia long-term management strategy	$SSB_{mgt\_lower}$	2.5 million t	Medium-term simulations conducted in 2001 and 2014.	ICES (2014)
	$SSB_{mgt}$	5.0 million t		
	$F_{mgt\_lower}$	0.05		
	$F_{mgt}$	0.125		

## Basis of the assessment

**Table 6** Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). Basis of the assessment and advice.

ICES stock data category	1 (ICES, 2016a).
Assessment type	Statistical assessment model (XSAM; ICES, 2017) that uses catches in the model and in the forecast and also includes error structures in catches and abundance indices.
Input data	Assessment period 1988–2017: Commercial catch-at-age (stock weight-at-age from surveys and since 2009 from catch sampling). Three survey indices: Norwegian acoustic survey on spawning grounds in February/March (NASF, 1994–2005, 2015–2017); International Ecosystem Survey in the Nordic Seas (IESNS) covering the adult stock in the Nordic seas (1996–2017) and the juvenile stock in the Barents Sea (1991–2017). Maturity ogive variable by year-class length. Natural mortalities are fixed values from historical analyses (age 2 = 0.9, ages greater than 3 = 0.15).
Discards and bycatch	Not included, considered negligible.
Indicators	None.
Other information	This stock was benchmarked in 2016 (ICES, 2016b). A re-evaluation of reference points and the current management plan is scheduled to take place before WGWISE 2018.
Working group	Working Group on Widely Distributed Stocks (WGWISE)

## Information from stakeholders

Over the last year the EU–Faroe–Iceland–Norway–Russia fishery has conducted its fishery on the traditional fishing grounds. No changes in distribution have been observed. The fishery in 2016 and 2017 has been characterized by large shoals in both the January fishery and in the autumn season, with higher catch rates than in previous years.

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

**Table 7** Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). ICES advice and landings. All weights are in tonnes.

Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC	ICES catch
1987	TAC	150000	115000	127306
1988	TAC	120000–150000	120000	135301
1989	TAC	100000	100000	103830
1990	TAC	80000	80000	86411
1991	No fishing from a biological point of view	0	76000	84683
1992	No fishing from a biological point of view	0	70000	104448
1993	No increase in F	119000	200000	232457
1994	Gradual increase in F towards $F_{0.1}$ ; TAC suggested	334000	450000	479228
1995	No increase in F	513000	900000*	905501
1996	Keep SSB above 2.5 million t	-	1250000*	1220283
1997	Keep SSB above 2.5 million t	-	1500000	1426507
1998	Do not exceed the harvest control rule	-	1300000	1223131
1999	Do not exceed the harvest control rule	1263000	1300000	1235433
2000	Do not exceed the harvest control rule	Max 1500000	1250000	1207201
2001	Do not exceed the harvest control rule	750000	850000	766136
2002	Do not exceed the harvest control rule	850000	850000	807795
2003	Do not exceed the harvest control rule	710000	711000*	789510
2004	Do not exceed the harvest control rule	825000	825000*	794066
2005	Do not exceed the harvest control rule	850000	1000000*	1003243
2006	Do not exceed the harvest control rule	1220000	967000*	968958
2007	Do not exceed the harvest control rule	1280000	1280000	1266993
2008	Do not exceed the harvest control rule	1518000	1518000	1545656
2009	Do not exceed the harvest control rule	1643000	1643000	1687371
2010	Do not exceed the harvest control rule	1483000	1483000	1457015
2011	See scenarios	980000–1170000	988000	992997
2012	Follow the management plan	833000	833000	826000
2013	Follow the management plan	619000	692000*	684743
2014	Follow the management plan	418487	436893*	461306
2015	Follow the management plan	283013	328206*	328740
2016	Follow the management plan	≤ 316876	376612*	383174
2017	Follow the management plan	≤ 646075	805142*	
2018	Follow the management plan	≤ 546472		

\* There was no agreement on the TAC; the number is the sum of autonomous quotas from the individual Parties.

### History of the catch and landings

**Table 8** Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). Catch distribution by fleet in 2016 as estimated by ICES.

Catch (2016)	Landings		Discards
	49% purse seine	51% pelagic trawl	
383 174 t	383 174 t		Discarding is considered to be negligible, but some slippage is known to occur.

**Table 9** Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). History of commercial landings; ICES estimated values are presented for each country participating in the fishery. All weights are in tonnes.

Year	Norway	USSR/ Russia	Denmark	Faroes	Iceland	Ireland	Nether- lands	Green- land	UK (Scotland)	Germa- ny	France	Poland	Sweden	Total
1986	199256	26000	-	-	-	-	-	-	-	-	-	-	-	225256
1987	108417	18889	-	-	-	-	-	-	-	-	-	-	-	127306
1988	115076	20225	-	-	-	-	-	-	-	-	-	-	-	135301
1989	88707	15123	-	-	-	-	-	-	-	-	-	-	-	103830
1990	74604	11807	-	-	-	-	-	-	-	-	-	-	-	86411
1991	73683	11000	-	-	-	-	-	-	-	-	-	-	-	84683
1992	91111	13337	-	-	-	-	-	-	-	-	-	-	-	104448
1993	199771	32645	-	-	-	-	-	-	-	-	-	-	-	232457
1994	380771	74400	-	2911	21146	-	-	-	-	-	-	-	-	479228
1995	529838	101987	30577	57084	174109	-	7969	600	881	556	-	-	-	905501
1996	699161	119290	60681	52788	164957	19541	19664	-	46131	11978	-	-	22424	1220283
1997	860963	168900	44292	59987	220154	11179	8694	-	2514	6190	1500	-	19499	1426507
1998	743925	124049	35519	68136	197789	2437	-	-	271	7003	605	-	14863	1223131
1999	740640	157328	37010	55527	203381	2412	-	-	19207	-	-	-	14057	1235433
2000	713500	163261	34968	68625	186035	8939	-	-	14096	3298	-	-	14749	1207201
2001	495036	109054	24038	34170	77693	6070	64	-	12230	1588	-	-	9818	766136
2002	487233	113763	18998	32302	127197	1699	939	-	3482	3017	-	1226	9486	807795
2003	477573	122846	14144	27943	117910	1400	8678	-	9214	3371	-	-	6431	789510
2004	477076	115876	23111	42771	102787	11	17369	-	1869	4810	400	-	7986	794066
2005	580804	132099	28368	65071	156	-	215	-	-	17676	0	561	680	1003243
2006*	567237	120836	18449	63137	17474	465	1225	-	12523	9958	80	-	2946	968958
2007	779089	162434	22911	64251	173621	6411	29764	4897	13244	6038	0	4333	0	1266993
2008	961603	193119	31128	74261	217607	7903	28155	3810	19737	8338	0	0	0	1545656
2009	101667	210105	32320	5098	54	10014	24021	3730	25477	14452	0	0	0	1687371
2010	871113	199472	26792	80281	20664	8061	26695	3453	24151	11133	0	0	0	1457015
2011	572641	144428	267	53271	1510	5727	8348	3426	14045	13296	0	0	0	992997
2012	491005	118595	2664	361	120956	4813	6237	1490	12310	11945	0	0	705	826000
2013	359458	78521	171	7003	9079	3815	5626	11788	8342	4244	0	0	23	684743
2014	263253	60292	12513	8529	828	706	9175	13108	4233	669	0	0	0	461306
2015	176321	4585	105	31	42625	1400	5255	12434	55	2660	0	0	0	328740
2016	197501	5355	384	44	50418	2048	3519	17508	4031	2582	0	0	0	383174

\* In 2006 Scotland and Northern Ireland combined.

**Summary of the assessment**

**Table 10** Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). Assessment summary. Weights are in tonnes.

Year	Recruitment age 2 (thousands)	Rec. 97.5th percentile	Rec. 2.5th percentile	Stock size: SSB (tonnes)	SSB 97.5th percentile	SSB 2.5th percentile	Catches (tonnes)	Fishing pressure F <sub>w</sub> (ages 5–11)	F <sub>w</sub> 97.5th percentile	F <sub>w</sub> 2.5th percentile
1988	654000	955000	353000	2173000	2483000	1863000	135301	0.04	0.058	0.023
1989	1169000	1641000	698000	3360000	3839000	2880000	103830	0.04	0.047	0.017
1990	4320000	5393000	3246000	3641000	4150000	3133000	86411	0.029	0.042	0.016
1991	11456000	13529000	9383000	3412000	3888000	2937000	84000	0.03	0.044	0.016
1992	18459000	21401000	15517000	3437000	3891000	2983000	104448	0.037	0.053	0.021
1993	49293000	55350000	43235000	3401000	3809000	2994000	132457	0.074	0.071	0.048
1994	58913000	65701000	52125000	3528000	3934000	3122000	479228	0.126	0.161	0.092
1995	15466000	18010000	12921000	3580000	3969000	3190000	905500	0.15	0.226	0.136
1996	5641000	6823000	4459000	4109000	4500000	3719000	127283	0.168	0.202	0.133
1997	2005000	2544000	1466000	5314000	5778000	4850000	1726507	0.186	0.219	0.153
1998	10731000	12642000	8820000	5843000	6353000	5000000	123131	0.184	0.218	0.15
1999	6504000	7813000	5195000	5715000	6248000	5181000	127100	0.205	0.244	0.167
2000	33358000	37919000	28797000	4764000	5253000	4275000	1207001	0.247	0.294	0.199
2001	29407000	33631000	25182000	3973000	4414000	3532000	766136	0.2	0.242	0.158
2002	11708000	13854000	9562000	3526000	3939000	3113000	807795	0.221	0.268	0.174
2003	6807000	8227000	5387000	4200000	4671000	3730000	789510	0.139	0.169	0.109
2004	59759000	67466000	52052000	5338000	5900000	4755000	794066	0.102	0.126	0.078
2005	25196000	29262000	21129000	5491000	6111000	4871000	1003243	0.144	0.178	0.111
2006	45300000	52183000	38417000	5501000	6170000	4876000	968958	0.155	0.192	0.118
2007	12529000	15081000	9977000	7134000	7260000	6342000	1266993	0.147	0.178	0.116
2008	17686000	21205000	14167000	7274000	8300000	6417000	1545656	0.191	0.232	0.151
2009	6832000	8552000	5112000	7308000	8380000	6369000	1687373	0.194	0.233	0.154
2010	4211000	5453000	2970000	6536000	7479000	5594000	1457014	0.192	0.235	0.149
2011	18477000	23065000	15880000	5950000	7183000	5206000	992998	0.142	0.176	0.109
2012	5147000	6843000	3452000	6000000	7057000	4999000	825999	0.13	0.162	0.098
2013	8905000	11942000	5868000	5657000	6662000	4652000	684743	0.116	0.146	0.086
2014	5918000	8455000	3700000	5494000	6505000	4483000	461306	0.08	0.101	0.058
2015	14276000	17011000	10740000	5211000	6195000	4227000	328740	0.062	0.08	0.044
2016	5406000	69773000	1100000	4946000	5882000	4009000	383174	0.073	0.096	0.05
2017	9893000	21727000	1100000	4809000	5737000	3881000				

## Sources and references

ICES. 2013a. NEAFC request to ICES to evaluate possible modifications of the long-term management arrangement for the Norwegian spring-spawning herring stock. *In* Report of ICES Advisory Committee, 2013. ICES Advice 2013, Book 9, Section 9.3.3.2.

ICES. 2013b. Report of the Blue Whiting/Norwegian Spring-Spawning (Atlanto-Scandian) Herring Workshop (WKBWNSSH), 11–13 March 2013, Bergen, Norway. ICES CM 2013/ACOM:69. 88 pp.

ICES. 2014. Herring in Subareas I, II, V and Divisions IVa and XIVa (Norwegian spring-spawning herring stock). Report of the ICES Advisory Committee, 2014. ICES Advice 2014, Book 9, Section 9.3.11.

ICES. 2016a. Advice basis. *In* Report of the ICES Advisory Committee, 2016. ICES Advice 2016, Book 1, Section 1.1.

ICES. 2016b. Report of the Benchmark Workshop on Pelagic Stocks (WKPELA), 29 February–4 March 2016, ICES Headquarters, Copenhagen, Denmark. ICES CM 2016/ACOM:34. 106 pp.

ICES. 2017. Report of the Working Group on Widely Distributed Stocks (WGWIDE), 30 August–5 September 2017, ICES HQ, Copenhagen, Denmark. ICES CM 2017/ACOM:23. In prep.

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