Herring (*Clupea harengus*) in Subarea 4 and divisions 3.a and 7.d, autumn spawners (North Sea, Skagerrak and Kattegat, eastern English Channel)

ICES advice on fishing opportunities

ICES advises that when the MSY approach is applied, catches in 2022 should be no more than 532 183 tonnes.

Stock development over time

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

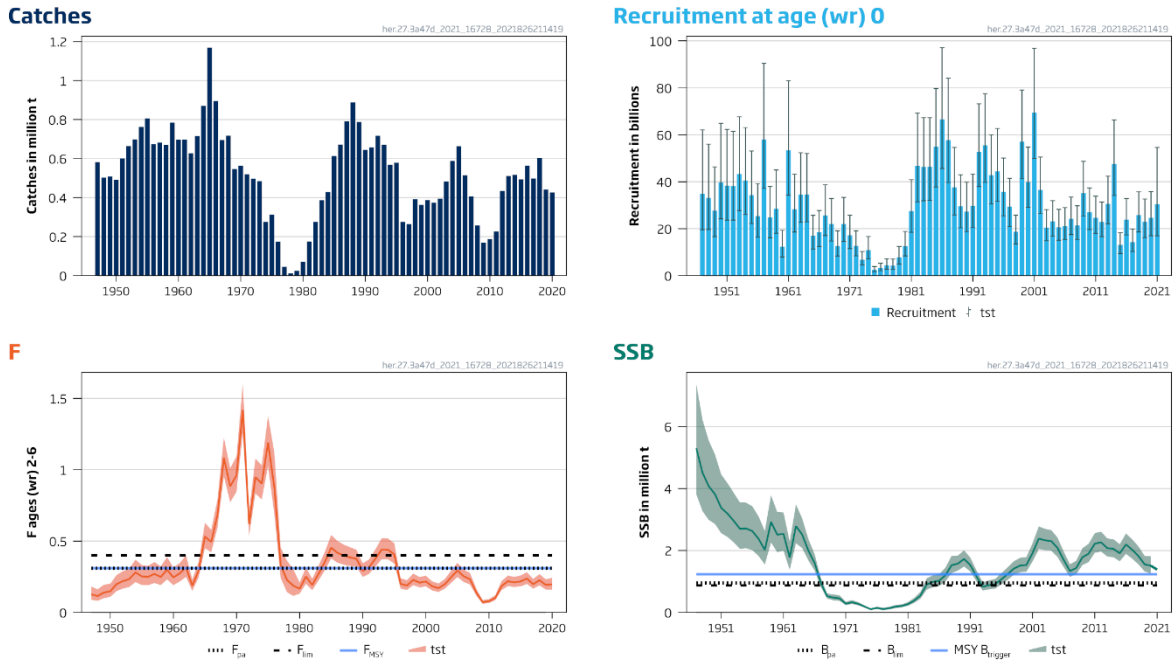

Figure 1 Herring in Subarea 4 and divisions 3.a and 7.d, autumn spawners. Summary of the stock assessment; 95% confidence intervals are shown for SSB, F, and recruitment.

Catch scenarios

Table 1 Herring in Subarea 4 and divisions 3.a and 7.d, autumn spawners. The basis for the catch scenarios. All weights are in tonnes and recruitment is in thousands.

Variable	Value	Notes
$F_{ages\ (wr)\ 2–6}$ (2021)	0.19	Based on 2021 assumed total catches
SSB (2021)	1 383 486	Calculated based on catch constraint (in tonnes)
$R_{age\ (wr)\ 0}$ (2021)	30 422 344	Estimated by assessment model (in thousands)
$R_{age\ (wr)\ 0}$ (2022)	23 599 592	Weighted mean by standard deveation over 2011–2020 (in thousands)
Total catch (2021)	370 667	Estimated realized catch of autumn-spawning herring derived from agreed TACs for A–D-fleets, the proportion of North Sea autumn spawners (NSAS) in the catch (for A-, C-, and D-fleets), the transfer of TAC to the North Sea (C-fleet), and the uptake of the bycatch quota (for B- and D-fleets).

Table 2 Herring in Subarea 4 and divisions 3.a and 7.d, autumn spawners. The intermediate year (2021) assumptions. Weights are in tonnes.

F by fleet and total						NSAS catches by fleet				SSB 2021
$F_{ages\ (wr)\ 2–6}$ A-fleet	$F_{ages\ (wr)\ 0–1}$ B-fleet	$F_{ages\ (wr)\ 1–3}$ C-fleet	$F_{ages\ (wr)\ 0–1}$ D-fleet	$F_{ages\ (wr)\ 2–6}$	$F_{ages\ (wr)\ 0–1}$	Catches A-fleet	Catches B-fleet	Catches C-fleet	Catches D-fleet	
0.185	0.03	0.004	0.002	0.186	0.036	360 884	6103	3330	351	1 383 486

Table 3 Herring in Subarea 4 and divisions 3.a and 7.d, autumn spawners. Annual catch scenarios. All weights are in tonnes.

Basis	F values by fleet and total						NSAS catches by fleet				Total stock catch	Biomass*				% Advice change ^
	A-fleet $F_{ages\ (wr)\ 2–6}$	B-fleet $F_{ages\ (wr)\ 0–1}$	C-fleet $F_{ages\ (wr)\ 1–3}$	D-fleet $F_{ages\ (wr)\ 0–1}$	Total $F_{ages\ (wr)\ 2–6}$	Total $F_{ages\ (wr)\ 0–1}$	A-fleet	B-fleet	C-fleet#	D-fleet#		SSB 2022	SSB 2023**	%SSB change ***	A-fleet **** %TAC change	
ICES advice basis																
MSY approach	0.31	0.051	0	0	0.31	0.053	523438	8745	0	0	532183	1280829	1286757	−7.4	47	45
Other scenarios																
$F = F_{MSY}$	0.31	0.051	0	0	0.31	0.053	523438	8745	0	0	532183	1280829	1286757	−7.4	47	45
F = 0	0	0	0	0	0	0	0	0	0	0	0	1614283	1998030	17	−100	−100
No change in TAC^^	0.197	0.032	0.006	0.002	0.2	0.039	356357	5619	6405	351	368732	1387630	1481508	0.3	0	0.8
$F = F_{2021}$	0.186	0.031	0	0	0.186	0.032	339749	5334	0	0	345083	1401049	1513391	1.3	−4.7	−5.7
F_{pa}	0.31	0.051	0	0	0.31	0.053	523438	8745	0	0	532183	1280829	1286757	−7.4	47	45
F_{lim}	0.4	0.066	0	0	0.4	0.069	640910	11169	0	0	652079	1202140	1153649	−13	80	78
$SSB_{2022} = B_{pa}$	0.743	0.122	0	0	0.744	0.128	995805	19986	0	0	1015791	956483	802300	−31	179	178
$SSB_{2022} = B_{lim}$	0.886	0.146	0	0	0.887	0.153	1111504	23480	0	0	1134984	874198	703021	−37	212	210
$SSB_{2022} = MSY\ B_{trigger}$	0.364	0.06	0	0	0.364	0.063	595343	10204	0	0	605547	1232828	1204229	−10.9	67	66
MSY approach^^ with $F_{ages\ 0-1} = 0.05$ target	0.31	0.047	0	0	0.31	0.05	523477	8162	0	0	531639	1280829	1286893	−7.4	47	45
MSY approach with C- and D-fleet catches and C-fleet TAC transfer	0.314	0.05	0.003	0.002	0.316	0.057	529663	8653	3330	351	541997	1275260	1274284	−7.8	49	48
MSY approach with C- and D-fleet catches and no C-fleet TAC transfer	0.307	0.05	0.006	0.002	0.31	0.059	519293	8653	6405	351	534702	1280821	1281588	−7.4	46	46

* For autumn-spawning stocks, the SSB is determined at spawning time and is influenced by fisheries between 1 January and spawning.
** Assuming same catch scenario in 2023 as in 2022.
*** SSB (2022) relative to SSB (2021).
**** A-fleet catches (2022) relative to TAC 2021 for the A-fleet (356 357 tonnes).
^ Advice value 2022 relative to advice value 2021, using catches for all fleets (365 792 tonnes).
^^ Based on the agreed TACs for A-, C-, and D-fleets in 2021, the average proportion in 2018–2020 of NSAS herring in the catch (for A-, C-, and D-fleets), no C-fleet TAC transfer to the A-fleet, and the average uptake in 2018–2020 of the bycatch quota (for B- and D-fleets).
# The catch for C- and D-fleets are set to zero because of the zero catch advice given for 2022 for the western Baltic spring-spawning herring stock.

The basis for the 45% increase in catch advice is twofold. First, the recent interbenchmark on the stock has led to changes in both the assessment model and the reference points and associated increase in F_{MSY}. Second, the 2021 data suggest that the rate of stock decline has decreased.

Basis of the advice

Table 4 Herring in Subarea 4 and divisions 3.a and 7.d, autumn spawners. The basis of the advice.

Advice basis	MSY approach
Management plan	ICES is not aware of any agreed precautionary management plan for herring in this area

Quality of the assessment

The stock went through an interbenchmark process in 2021 (ICES, 2021a). The main focus of the interbenchmark was the handling of new natural mortality estimates in the assessment (ICES, 2021b). The process resulted in the improvement of the assessment model.

Sensitivity testing revealed that the derivation of reference points for herring in the North Sea is very sensitive to the choice of time periods and stock–recruitment models used.

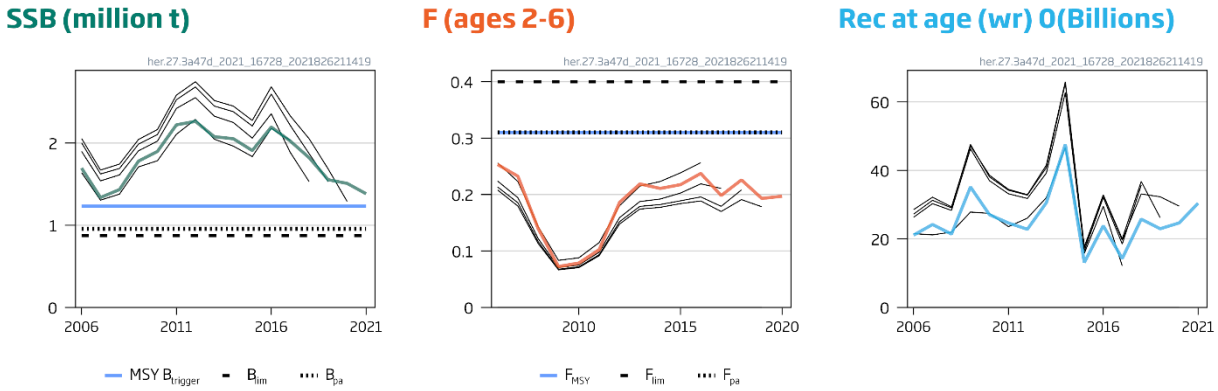

Figure 2 Herring in Subarea 4 and divisions 3.a and 7.d, autumn spawners. Historical assessment results. Final-year recruitment estimates included. This stock was benchmarked in 2018.

Issues relevant for the advice

The new assessment model resulted in a lower estimated stock size and higher fishing mortality than in the previous assessment. The interbenchmark process also led to an update of the reference points for the stock. With the new stock-recruitment model, the new biomass limit reference point B_{lim} has increased to 874 198 tonnes. MSY reference points have been updated with a lower MSY $B_{trigger}$ (1 232 828 tonnes) and a higher F_{MSY} (0.31). The increase in F_{MSY} in particular, is mainly the result of changing selection patterns in the fishery and the stock–recruitment model used in the estimation process. The 2021 data suggest that the steep decline of the stock observed since 2016 has stalled, and the spawning-stock biomass is now above MSY $B_{trigger}$. The decrease in the rate of stock decline and the higher F_{MSY} leads to higher catch advice for 2022 compared to 2021.

This advice implies a large increase in the TAC in 2022. The F_{MSY} estimate is sensitive to assumptions on the productivity of the stock and recent changes in selection. Stability elements such as TAC constraints could be considered to dampen fluctuations in catch in the coming years (notably in case of further revisions to the target) given the downward stock trajectory.

EU, UK, and Norway set the 2021 A-fleet TAC based on F_{MSY}. To date, no management strategy has been agreed upon and the A-fleet advice for 2022 is based on ICES MSY approach. For the B-fleet, fishing mortality is scaled with the A-fleet fishing mortality and results in a fishing pressure of 0.051. The C-fleet and D-fleet catches are set to zero, which is consistent with the zero catch advised for Western Baltic Spring Spawners (WBSS).

North Sea Autumn spawners (NSAS) have several spawning components, including the Downs herring that spawns in divisions 4.c and 7.d. These components are fished on individual spawning grounds and in a mixed-component fishery in the central and northern North Sea. Only the Downs component is caught in the southern North Sea. To help protect these components, sub-TACs have been set for divisions 4.c and 7.d, as well as for the remainder of the area. Such measures should be continued in order to give continued protection to the different components. To ensure the maximum productivity of the stock, all components within the stock should be protected under a long-term management strategy.

Catch scenarios in Table 3 by stock and area for NSAS and WBSS (ICES, 2021d) are based on fleet-wise predictions for five fleets (A, B, C, D, and F). The catch scenarios for the five fleets are interlinked and are therefore calculated simultaneously. This is to ensure that options are consistent among stocks and areas. For technical details see ICES (2021d).

When addressing NSAS options, catch by the A-, B-, C-, and D-fleets in Subarea 4 and divisions 3.a and 7.d have to be considered all at once. For the A-, C-, and D-fleets it is expected that a yearly varying proportion of the catch consists of NSAS. The A-fleet catches almost exclusively NSAS herring in Subarea 4 and Division 7.d. The C- and D-fleets in Division 3.a catch a mixture of WBSS and NSAS. ICES advice is zero catch for WBSS; this implies that if the TAC for Division 3.a is set to zero in 2022, the catches of NSAS by the C- and D-fleets would also be zero.

Setting any TAC in Division 3.a and allowing for a transfer of catches from Division 3.a into the North Sea, as has been done in recent years, will result in an increased catch and fishing mortality of NSAS.

Catches of WBSS are expected to occur in the herring fishery in the eastern part of Division 4.a. The catch of WBSS in the North Sea in recent years has been substantial but variable. Without additional area and seasonal restrictions on the herring fishery in the North Sea in 2022, the catch of WBSS in the North Sea could be of a similar magnitude to previous years (5241 t as average over the 2018–2020 period).

Activities that have a negative impact on the spawning habitat of herring should not occur unless the effects of these activities have been assessed and shown not to be detrimental (ICES, 2003; 2015).

Possible changes may occur in 2021–2022 to both fishing grounds and subsequent exploitation patterns in the North Sea herring fisheries as a consequence of the Brexit agreements.

Reference points

Table 5 Herring in Subarea 4 and divisions 3.a and 7.d, autumn spawners. Reference points, values, and their technical basis. Weights in tonnes.

Framework^	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	1 232 828	50th percentile of biomass at F_{MSY}	ICES, 2021a
	F_{MSY}	0.31	Stochastic simulations (EqSim) with a segmented regression stock–recruitment curve fitted to data from the low productivity period (2002–2020) assuming a break-point at B_{lim}	ICES, 2021a
Precautionary approach	B_{lim}	874 198	Breakpoint in the segmented regression of the stock–recruitment time-series (1947–2016, excluding the recovery period 1979–1990)	ICES, 2021a
	B_{pa}	956 483	$B_{pa} = B_{lim} \times \exp(1.645 \times \sigma)$ with $\sigma \approx 0.06$, based on the σ from the terminal assessment year	ICES, 2021a
	F_{lim}	0.40	The F that on average leads to B_{lim}	ICES, 2021a
	F_{pa}	0.31	The F that provides a 95% probability for SSB to be above B_{lim} (F_{P05} with advice rule [AR])	ICES, 2021a

Basis of the assessment

Table 6 Herring in Subarea 4 and divisions 3.a and 7.d, autumn spawners. Basis of the assessment and advice.

ICES stock data category	1 (ICES, 2021c)
Assessment type	Age-based analytical assessment, SAM (ICES, 2021d) that uses catches in the model and in the forecast
Input data	Commercial catches and five survey indices (IBTS Q1 1-ringer G1022), IBTS0 (I8304), LAI as SSB index (I2359, I9086, I2687), HERAS 1–8 ringers A5092, IBTS Q3 0–5-ringers G2829); annual maturity data from HERAS survey, natural mortalities from SMS North Sea multispecies model (ICES, 2021b)
Discards	Discarding is considered to be negligible
Indicators	None
Other information	This stock was interbenchmarked and reference points were updated in 2021 (ICES, 2021a)
Working group	Herring Assessment Working Group for the Area South of 62°N (HAWG)

History of the advice, catch, and management

Table 7 Herring in Subarea 4 and divisions 3.a and 7.d, autumn spawners. ICES advice, TACs, official landings, and ICES catch estimates. All weights are in tonnes.

Year	ICES advice	Predicted catch corresponding to advice	Agreed TAC *	B-fleet ###	ICES landings in 4, 7.d #	ICES catch in 4, 7.d ##	ICES catch of autumn spawners in 3.a, 4, 7.d
1987	TAC	610 000	600 000		625 000	625 000	792 000
1988	TAC	515 000	530 000		710 000	710 000	888 000
1989	TAC	514 000	514 000		669 000	717 000	787 000
1990	TAC	403 000	415 000		523 000	578 000	646 000
1991	TAC	423 000	420 000		537 000	588 000	657 000
1992	TAC	406 000	430 000		518 000	572 000	716 000
1993	No increase in yield at F > 0.3	340 000	430 000		495 000	540 000	671 000
1994	No increase in yield at F > 0.3	346 000	440 000		463 000	498 000	571 000
1995	Long-term gains expected at lower F	429 000	440 000		510 000	516 000	579 000
1996	50% reduction of agreed TAC **	156 000	156 000 ***	44 000	207 000	233 000	275 000
1997	F = 0.2	159 000	159 000	24 000	175 000	238 000	264 000
1998	F(adult) = 0.2, F(juv) < 0.1	254 000	254 000	22 000	268 000	338 000	392 000
1999	F(adult) = 0.2, F(juv) < 0.1	265 000	265 000	30 000	290 000	333 000	363 000
2000	F(adult) = 0.2, F(juv) < 0.1	265 000	265 000	36 000	284 000	346 000	388 000
2001	F(adult) = 0.2, F(juv) < 0.1	See scenarios	265 000	36 000	296 000	323 000	363 000
2002	F(adult) = 0.2, F(juv) < 0.1	See scenarios	265 000	36 000	304 000	353 000	372 000
2003	F(adult) = 0.25, F(juv) = 0.12	See scenarios	400 000	52 000	414 000	450 000	48 0000
2004	F(adult) = 0.25, F(juv) = 0.1	See scenarios	460 000	38 000	484 000	550 000	567 000
2005	F(adult) = 0.25, F(juv) = 0.1	See scenarios	535 000	50 000	568 000	639 000	664 000
2006	F(adult) = 0.25, F(juv) = 0.12	See scenarios	455 000	43 000	490 000	511 000	515 000
2007	Bring SSB above B_{pa} by 2008	See scenarios	341 000	32 000	361 000	388 000	407 000
2008	F(adult) = 0.17, F(juv) = 0.08 (management plan [MP])	See scenarios	201 000	19 000	228 000	245 000	258 000

Year	ICES advice	Predicted catch corresponding to advice	Agreed TAC *	B-fleet ###	ICES landings in 4, 7.d #	ICES catch in 4, 7.d ##	ICES catch of autumn spawners in 3.a, 4, 7.d
2009	Adopt one of the new proposed HCRs	See scenarios	171 000	16 000	167 000	166 000	168 000
2010	F(adult) = 0.15, F(juv) = 0.05 (MP)	See scenarios	164 000	14 000	175 000	175 000	188 000
2011	See scenarios	See scenarios	200 000	16 000	218 000	218 000	226 000
2012	2008 management plan	See scenarios	405 000	18 000	425 000	425 000	435 000
2013	2008 management plan	See scenarios	478 000	14 000	498 000	498 000	511 000
2014	2008 management plan	See scenarios	470 000	13 000	504 000	508 000	517 000
2015	2008 management plan	See scenarios	445 000	16 000	480 000	482 000	494 000
2016	2014 management strategy	555 086	518 000	13 000	559 700	559 900	563 600
2017	2014 management strategy	458 926	481 608	11 375	491 693	491 693	498 662
2018	2014 management strategy	517 891	600 588	9 669	602 328	602 328	603 536
2019	ICES MSY approach	311 572	385 008	13 190	444 001	445 631	442 886
2020	ICES MSY approach	431 062	385 008	8 954	424 799	427 321	426 928
2021	ICES MSY approach	365 792	356 357	7 750			
2022	ICES MSY approach	532 183					

* Catch in directed fishery in Subarea 4 and Division 7.d (A-fleet).
** Revision of advice given in 1995.
*** Revised in June 1996, down from 263 000 tonnes.
# Landings are provided by ICES and do not in all cases correspond to official statistics.
ICES catch includes unallocated and misreported landings, discards, and slipping. Includes catches for WBSS in the North Sea.
Bycatch ceiling up to 2012 and TAC from 2013.

History of the catch and landings

Table 8 Herring in Subarea 4 and divisions 3.a and 7.d, autumn spawners. Catch distribution by fleet and area in 2020 as estimated by ICES.

Area where NSAS are caught	Fleet	Fishery	NSAS 2020 catches (tonnes)
North Sea fisheries (Subarea 4, Division 7.d)	A	Directed herring fisheries	417 457
	B	Bycatches of herring	9 864
Division 3.a	C	Directed herring fisheries	5 985
	D	Bycatches of herring	425

Table 9 Herring in Subarea 4 and divisions 3.a and 7.d, autumn spawners. Catch distribution in 2020 as estimated by ICES.

Catch (2020)	Landings		Discards
433 730 tonnes	Directed fishery 98%	Bycatch 2%	~ 0 tonnes
	433 730 tonnes		

Table 10 Herring in Subarea 4 and divisions 3.a and 7.d, autumn spawners. History of commercial catch and landings of all stocks of herring caught in the North Sea; official or ICES estimated values are presented by area for each country participating in the fishery. All weights are in tonnes. These figures do not in all cases correspond to the official statistics and cannot be used for legal purposes.

Country	2005	2006	2007	2008	2009	2010	2011
Belgium	6	3	1	-	-	-	4
Denmark *	128380	102322	84697	62864	46238	45869	58726
Faroe Islands	738	1785	2891	2014	1803	3014	-
France	38829	49475	24909	30347	18114	17745	16693
Germany	46555	40414	14893	8095	5368	7670	9427
Netherlands	81531	76315	66393	23122	24552	23872	34708
Norway	156802	135361	100050	59321	50445	46816	60705
Poland	458	-	-	-	-	90	-
Sweden	13464	10529	15448	13840	5299	4395	8086
USSR/Russia	99	-	-	-	-	-	-
UK (England)	25311	22198	15993	11717	652	10770	11468
UK (Scotland)	73227	48428	35115	16021	14006	14373	18564
UK (N. Ireland)	2912	3531	638	331	-	-	17
Unallocated landings	57788	18764	26641	17151	−726	-	-
Total landings	626101	509125	387669	244823	165751	174614	218398
Discards	12824	1492	93	224	91	13	-
Total catch	638925	510617	387762	245047	165842	174627	218398
Parts of the catches that have been allocated to spring-spawning stocks							
WBSS	7039	10954	1070	124	3941	774	308
Thames Estuary **	74	65	2	7	48	85	2
Norw. spring spawners ***	417	626	685	2721	44560	56900	12178

Country	2012	2013	2014	2015	2016	2017	2018	2019	2020
Belgium	3	14	27	18	26	13	32	60	119
Denmark *	105707	117367	124423	113481	133962	110318	132231	91680	95615
Faroe Islands	-	-	118	981	833	442	497	614	804
France	23819	30122	29679	30269	35177	28801	31505	25288	19768
Germany	24515	46922	36767	44377	44231	43707	51636	37699	29439
Netherlands	72344	80462	74647	70076	98859	84914	111302	79465	75036
Norway	119253	143718	142002	134349	150183	134132	162594	128614	115879
Lithuania	-	-	9830	-	-	-	-	-	-
Sweden	14092	15615	15583	13184	16625	18518	19408	13184	13149
Ireland	-	221	68	183	127	868	515	3	235
UK (England)	25346	19079	19287	18897	20485	16997	19591	12685	16241
UK (Scotland)	34414	39243	45119	48332	59240	49514	66005	50771	49692
UK (N. Ireland)	4794	5738	6612	5948	-	3469	6916	3938	2681
Unallocated landings	321	-	3292	1516	8	0	0	0	0
Total landings	424608	498501	507454	481611	559756	491693	602232	444001	424800
Discards/BMS	-	-	31	-	170	-	96	1 630	2 522
Total catch	424608	498501	507485	481611	559926	491693	602328	445631	427321
Parts of the catches that have been allocated to spring-spawning stocks									
WBSS	2095	452	2953	2205	1839	632	2164	8832	6802
Thames Estuary **	63	20	10	10	1	0	10	-	-
Norw. spring spawners ***	9619	3150	2307	2191	216	83	310	5	88

* Including any bycatches in the industrial fishery.

** Landings from the Thames Estuary area are included in the North Sea catch figure for UK (England).

*** These catches (including some local fjord-type spring spawners) are taken by Norway under a separate quota south of 62°N and are not included in the Norwegian North Sea catch figure for this area.

Table 11 Herring in Subarea 4 and divisions 3.a and 7.d, autumn spawners. The "Wonderful Table", which shows herring TACs and catches by different fleets, areas, and stocks. Weights are in thousand tonnes.

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Subarea 4 and Division 7.d: TAC														
Agreed divisions 4.a–b	303.5	174.6	147.4	149	173.5	360.4	427.7	418.3	396.3	461.2	428.7	534.5	342.7	342.7
Agreed divisions 4.c, 7.d	37.5	26.7	23.6	15.3	26.5	44.6	50.3	51.7	49	57	53	66	42.4	42.4
Bycatch ceiling in the small-mesh fishery *	31.9	18.8	16	13.6	16.5	17.9	14.4	13.1	15.7	13.4	11.4	9.7	13.2	9.0
CATCH (Subarea 4 and Division 7.d)														
National catch divisions 4.a–b **	326.8	201.2	145	148.1	191.7	387.2	453.8	465.9	439	514	456.5	556.9	405.1	389.3
Unallocated catch divisions 4.a–b	21.9	14	−1.1	0	0	−3.0	0	3.3	1.5	0	0	0	0.0	0.0
Discard/slipping divisions 4.a–b ***	0.1	0.2	0.1	0	-	-	-	0	-	0.1	-	0	0.8	0.3
Total catch divisions 4.a–b[#]	348.8	215.4	143.9	148.1	191.7	384.2	453.9	469.2	440.5	514.1	456.5	556.9	405.9	389.6
National catch divisions 4.c, 7.d **	34.3	26.5	21.5	26.5	26.7	37.1	44.7	38.2	41.1	45.8	35.2	45.4	38.9	35.5
Unallocated catch divisions 4.c, 7.d	4.7	3.1	0.4	0	0	3.3	0	0	0	0	0	0	0.0	0.0
Discard/slipping divisions 4.c, 7.d ***	-	-	-	-	-	-	-	-	-	0.1	-	0.1	0.8	2.2
Total catch divisions 4.c, 7.d	39	29.6	21.9	26.5	26.7	40.4	44.7	38.2	41.1	45.8	35.2	45.5	39.8	37.7
Total catch Subarea 4 and Division 7.d as used by ICES [#]	387.8	245	165.8	174.6	218.4	424.6	498.5	507.5	481.6	559.9	491.7	602.3	445.6	427.3
CATCH BY FLEET/STOCK (Subarea 4 and Division 7.d) [##]														
North Sea autumn spawners directed fisheries (A-fleet)	379.6	236.3	152.1	164.8	209.2	411.8	489.9	490.5	471.5	543.6	484.1	591.7	440.5	417.5
North Sea autumn spawners industrial (B-fleet)	7.1	8.6	9.8	9.1	8.9	10.6	8.1	14	7.9	14.5	7	8.5	5.2	9.9
North Sea autumn spawners in Subarea 4 and Division 7.d total	386.7	244.9	161.9	173.9	218.1	422.5	498.1	504.5	479.4	558.1	491.1	600.2	436.8	420.5
Baltic-20–24-type spring spawners in Subarea 4	1.1	0.1	3.9	0.8	0.3	2.1	0.5	3	2.2	1.8	0.6	2.2	8.8	6.802
Coastal-type spring spawners	0	0	0	0.1	0	0.1	0	0	0	0	0	0	0.0	0.0
Norw. spring spawners caught under a separate quota in Subarea 4 [###]	0.7	2.7	44.6	56.9	12.2	9.6	3.2	2.3	2.2		0.1	0.3	0.0	0.1
Division 3.a: TAC														
Agreed herring TAC	69.4	51.7	37.7	33.9	30	45	55	46.8	43.6	51.1	50.7	48.4	29.3	24.5
Bycatch ceiling in the small-mesh fishery	15.4	11.5	8.4	7.5	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
CATCH (Division 3.a)														
National catch	47.3	38.2	38.8	37.3	20	27.7	31.2	28.9	27.8	29.9	26.8	23.3	14.9	17.8
Catch as used by ICES	47.4	38.2	38.8	37.3	20	27.7	31.2	28.9	27.8	29.9	26.8	23.3	14.9	17.8
CATCH BY FLEET/STOCK (Division 3.a) [##]														
Autumn spawners human consumption (C-fleet)	16.4	9.2	5.1	12	6.6	7.8	11.8	9.5	10.2	4.1	7.4	3.2	5.8	6.0
Autumn spawners mixed clupeoid (D-fleet)	3.4	3.7	1.5	1.8	1.8	4.4	1.6	3.3	4.4	1.4	0.2	0.2	0.3	0.4
Autumn spawners in Division 3.a total	19.8	12.9	6.5	13.8	8.4	12.2	13.4	12.8	14.7	5.5	7.6	3.4	6.1	6.4
Spring spawners human consumption (C-fleet)	25.3	23	29.4	23	10.8	14.5	16.6	15.4	11.3	23.3	19	19.7	8.8	10.9
Spring spawners mixed clupeoid (D-fleet)	2.3	2.2	2.9	0.5	0.8	1	1.3	0.6	1.8	1.1	0.2	0.2	0.0	0.5
Spring spawners in Division 3.a total	27.6	25.2	32.3	23.5	11.6	15.5	17.9	16.1	13.1	24.4	19.2	19.9	8.8	11.4
North Sea autumn spawners: Total as used by ICES	406.5	257.9	168.4	187.6	226.5	434.6	511.4	517.3	494.1	563.6	498.7	603.5	442.9	426.9

* Divisions 4.a–b and EC zone of Division 2.a. ** ICES estimates. *** Incomplete, only some countries providing discard information. [#] Includes spring spawners not included in assessment. [##] Based on sum-of-products (number × mean weight-at-age). [###] These catches (including local fjord-type spring spawners) are taken by Norway under a separate quota south of 62°N and are not included in the Norwegian North Sea catch figure.

Summary of the assessment

Table 12 Herring in Subarea 4 and divisions 3.a and 7.d, autumn spawners. Assessment summary. Weights are in tonnes and numbers in thousands. High and low refer to the 95% confidence intervals.

Year	Recruitment			SSB			Total Catch	F		
	Recruitment at age (wr) 0	High	Low	SSB *	High	Low		Ages 2-6	High	Low
	thousands			tonnes			tonnes			
1947	34857900	62098800	19566800	5304809	7380551	3812859	581760	0.127	0.182	0.089
1948	33168700	56007300	19643200	4507224	6214025	3269228	502100	0.115	0.162	0.082
1949	27738900	46343700	16603100	4073143	5551502	2988470	508500	0.140	0.195	0.101
1950	39631100	64907600	24197800	3817484	5100980	2856938	491700	0.148	0.20	0.109
1951	38360300	62313700	23614600	3376403	4454607	2559170	600400	0.198	0.26	0.150
1952	38129500	61487000	23645000	3192340	4178525	2438907	664400	0.22	0.29	0.167
1953	43299000	67662900	27708000	2959020	3865337	2265210	698500	0.23	0.31	0.178
1954	40509200	63078400	26015200	2702263	3551653	2056007	762900	0.28	0.37	0.21
1955	34330900	53125000	22185600	2711088	3545086	2073292	806400	0.25	0.33	0.192
1956	25331400	39220100	16361000	2625707	3426140	2012275	675200	0.25	0.33	0.191
1957	57963500	90473700	37135300	2376135	3101074	1820665	682900	0.27	0.35	0.21
1958	24750800	38002200	16120100	2019640	2633536	1548848	670500	0.25	0.32	0.192
1959	28494500	44979700	18051200	2921352	3781181	2257045	784500	0.30	0.39	0.23
1960	12367200	19307000	7921910	2512220	3243147	1946027	696200	0.25	0.32	0.191
1961	53361600	83033700	34292800	2537990	3229781	1994375	696700	0.27	0.35	0.22
1962	28315700	43209900	18555400	1770623	2282950	1373269	627800	0.32	0.40	0.25
1963	34500400	52348800	22737400	2790589	3485127	2234463	716000	0.188	0.23	0.152
1964	34525400	52029100	22910300	2514252	3040190	2079298	871200	0.29	0.35	0.24
1965	17044600	25712700	11298600	1993503	2368128	1678142	1168800	0.53	0.63	0.45
1966	18512300	27732700	12357500	1595712	1879707	1354624	895500	0.49	0.58	0.42
1967	25695900	38685800	17067700	957124	1114612	821887	695500	0.69	0.80	0.60
1968	22010600	32862400	14742300	524139	612154	448778	717800	1.08	1.23	0.95
1969	12614000	19100500	8330230	479677	583968	394011	546700	0.88	1.01	0.77
1970	22028300	33322100	14562300	455651	555124	374003	563100	0.96	1.09	0.85
1971	17203800	25727400	11504100	285726	345738	236130	520100	1.42	1.60	1.26
1972	12689600	19112300	8425300	329391	398884	272004	497500	0.62	0.72	0.54
1973	6837980	10268300	4553640	278904	333878	232982	484000	0.95	1.08	0.83
1974	10910200	16651300	7148470	191534	227942	160941	275100	0.90	1.03	0.79
1975	2523740	3881290	1641010	105793	127939	87481	312800	1.19	1.38	1.03
1976	3316850	5272720	2086490	145064	191098	110119	174800	0.88	1.12	0.69
1977	4408470	7182880	2705690	109640	150847	79690	46000	0.33	0.46	0.24
1978	4284610	7058660	2600770	136400	186220	99908	11000	0.23	0.36	0.142
1979	7817490	12419100	4920900	186512	243517	142851	25100	0.188	0.30	0.116
1980	12579100	18805300	8414360	210081	263337	167595	70764	0.167	0.21	0.132
1981	27479700	40885200	18469700	269723	336935	215918	174879	0.25	0.32	0.20
1982	46668000	69270300	31440700	383532	472923	311037	275079	0.192	0.24	0.156
1983	46332100	67282200	31905300	547127	669392	447195	387202	0.27	0.33	0.22
1984	46430900	67291700	32037100	901451	1103309	736525	428631	0.35	0.43	0.30
1985	54857200	79710800	37752900	989707	1198946	816985	613780	0.45	0.54	0.38
1986	66589000	97121700	45655100	1026633	1236147	852629	671488	0.42	0.50	0.35
1987	57753700	84098500	39661800	1202006	1445361	999625	792058	0.40	0.48	0.33
1988	37584100	54598200	25872000	1526300	1828354	1274147	887686	0.39	0.46	0.33
1989	29601200	42982100	20386000	1575946	1836983	1352002	787899	0.38	0.44	0.32
1990	27314400	39801100	18745100	1727079	2008069	1485408	645229	0.29	0.34	0.25
1991	29768300	43294100	20468200	1531311	1773521	1322180	658008	0.32	0.37	0.27
1992	52688000	73190900	37928500	1164571	1352872	1002480	716799	0.38	0.44	0.32
1993	55478700	77482400	39723700	828950	973180	706094	671397	0.44	0.52	0.37
1994	42818500	60047400	30532900	881872	1037441	749630	568234	0.44	0.52	0.37
1995	44509500	62668100	31612400	914363	1083605	771554	579371	0.41	0.49	0.34
1996	35721100	50098000	25470100	1072305	1268260	906626	275098	0.20	0.24	0.167
1997	29399400	41449600	20852500	1239664	1459925	1052633	264313	0.189	0.23	0.158

Year	Recruitment			SSB			Total Catch	F		
	Recruitment at age (wr) 0	High	Low	SSB *	High	Low		Ages 2-6	High	Low
	thousands			tonnes			tonnes			
1998	18671600	25773400	13526700	1417070	1654729	1213544	391628	0.23	0.27	0.191
1999	57119000	79065800	41264100	1513149	1764826	1297362	363163	0.21	0.25	0.176
2000	39913800	54789000	29077200	1532129	1785716	1314553	388157	0.22	0.26	0.183
2001	69493500	96848600	49864900	1920016	2237239	1647772	374065	0.183	0.22	0.154
2002	36544700	50522700	26433900	2384603	2778911	2046244	394709	0.171	0.20	0.144
2003	20448100	28116400	14871300	2330323	2698770	2012177	482281	0.198	0.23	0.167
2004	23148600	31917300	16788900	2303309	2660148	1994338	587698	0.25	0.29	0.21
2005	20618300	28213400	15067700	2083193	2419918	1793322	663813	0.29	0.35	0.25
2006	21102300	28962600	15375200	1695789	1966853	1462083	514597	0.25	0.30	0.21
2007	24216500	33518200	17496100	1337668	1556993	1149238	406482	0.23	0.28	0.195
2008	21414800	29749400	15415200	1434468	1667445	1234043	257870	0.139	0.166	0.117
2009	35174000	48686000	25412000	1780448	2074372	1528170	168443	0.073	0.087	0.061
2010	27075900	37373200	19615800	1898246	2217649	1624846	187611	0.079	0.094	0.066
2011	24662200	33872200	17956500	2221861	2562606	1926424	226478	0.102	0.121	0.086
2012	22821000	31369700	16602000	2264241	2609092	1964970	434710	0.186	0.22	0.157
2013	30576500	42371300	22064900	2077294	2389854	1805613	511416	0.22	0.26	0.185
2014	47591400	66330400	34146400	2053097	2364749	1782519	517356	0.21	0.25	0.178
2015	13105000	18296700	9386470	1909564	2204797	1653864	494099	0.22	0.26	0.183
2016	23845000	32826600	17320900	2194754	2547726	1890684	563610	0.24	0.28	0.200
2017	14290300	19838000	10294000	2024908	2361382	1736379	498437	0.198	0.24	0.167
2018	25779000	35689200	18620700	1821019	2133770	1554109	603536	0.23	0.27	0.190
2019	22973800	32617100	16181600	1554082	1826974	1321951	442138	0.193	0.23	0.161
2020	24676200	35772800	17021700	1509337	1814799	1255290	426900	0.197	0.24	0.160
2021	30422300	54606100	16949000	1383260 ^						

* At spawning time (September).

^ Based on the assessment. The predicted 2021 SSB from the intermediate forecast, applying an exact biomass removed by each fleet, is 1 383 486 (see tables 2 and 3).

Sources and references

ICES. 2003. Report of the Working Group on Fish Ecology (WGFE), 3–7 March 2003, ICES Headquarters, Copenhagen, Denmark. ICES CM 2003/G:04. 113 pp.

ICES. 2015. Second Interim Report of the Working Group on Maritime Systems (WGMARS), 2–5 December 2014, ICES HQ, Copenhagen, Denmark. ICES CM 2014/SSGSUE:08. 35 pp.

ICES. 2021a. Inter-Benchmark Protocol of North Sea Herring (IBPNSHerring). ICES Scientific Reports. 3:98. http://doi.org/10.17895/ices.pub.8398

ICES 2021b. Working Group on Multispecies Assessment Methods (WGSAM; outputs from 2020 meeting). ICES Scientific Reports, 3:10. 231 pp. https://doi.org/10.17895/ices.pub.7695

ICES. 2021c. Advice on fishing opportunities. *In* Report of the ICES Advisory Committee, 2021. ICES Advice 2021, section 1.1.1. https://doi.org/10.17895/ices.advice.7720.

ICES. 2021d. Herring Assessment Working Group for the Area South of 62° N (HAWG). ICES Scientific Reports. 3:12. 838 pp. https://doi.org/10.17895/ices.pub.8214

Download the stock assessment data and figures.

Recommended citation: ICES. 2021. 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, 2021. ICES Advice 2021, her.27.3a47d, https://doi.org/10.17895/ices.advice.7770