ECOREGION	Widely distributed and migratory stocks
STOCK	Herring in the Northeast Atlantic (Norwegian spring-spawning herring)

Advice for 2013

ICES advises on the basis of the management plan of EU, Faroe Islands, Iceland, Norway, and Russia that landings in 2013 should be no more than 619 000 t.

Stock status

F (Fishing Mortality)				
	2009	2010	2011	
MSY (F_{MSY})	✖	✖	✔	At target
Precautionary approach (F_{pa})	✖	✖	✔	At target
Management plan (F_{MP})	✖	✖	✖	Above target

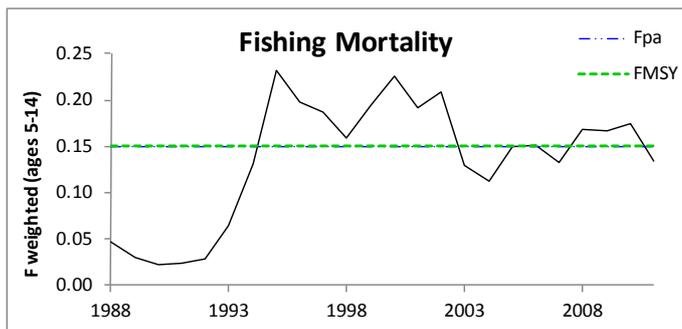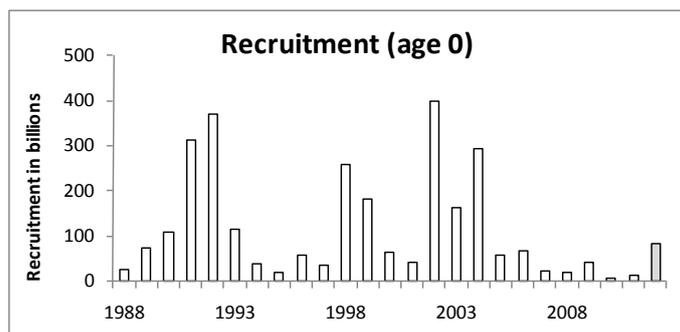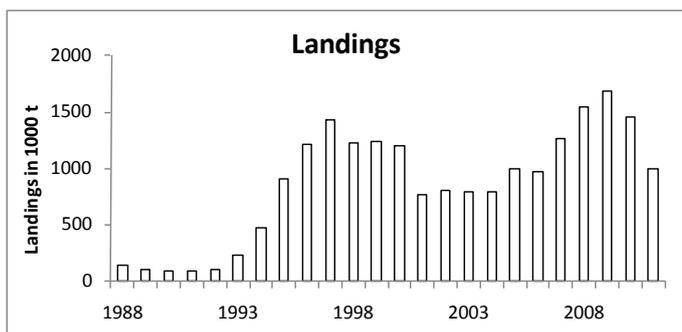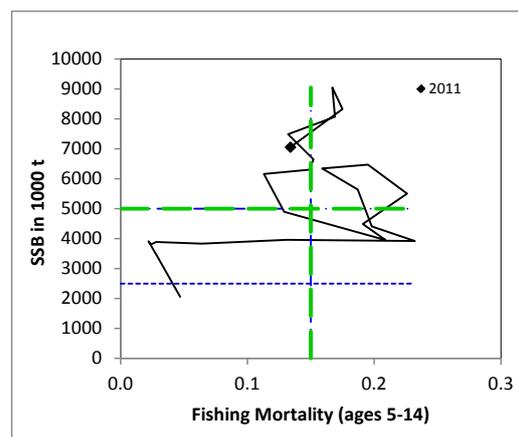| SSB (Spawning-stock Biomass)				
	2010	2011	2012	
MSY ($B_{trigger}$)	✔	✔	✔	Above trigger
Precautionary approach (B_{pa}, B_{lim})	✔	✔	✔	Full reproductive capacity
Management plan (SSB_{MP})	✔	✔	✔	Above trigger
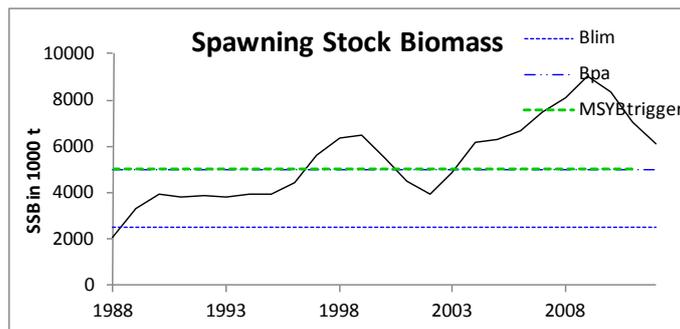
Figure 9.4.5.1   Herring in the Northeast Atlantic. Summary of stock assessment (the estimated shaded recruitment is the geometric mean 1988–2008). Top right: SSB and F over the years.

The SSB is declining but still above B_{pa} in 2012. Presently three large year classes (2002, 2003, and 2004) dominate the stock. All year classes from 2005 onwards have been small, generally less than half the geometric mean. Fishing mortality in 2011 is estimated below F_{MSY} and F_{pa}.

Management plans

A long-term management plan was agreed by the EU, Faroe Islands, Iceland, Norway, and Russia in 1999 (Section 9.4.5.1 Annex). The management plan aims to constrain harvesting within safe biological limits and is designed to

provide sustainable fisheries in the long term. ICES has evaluated the plan and concluded that it is consistent with the precautionary approach.

Biology

Norwegian spring-spawning herring is a widely migrating stock. The feeding grounds of the adults are in the Norwegian Sea. Spawning takes place in late winter and early spring along the Norwegian coast. In general, most juveniles occur in the Barents Sea and move to the Norwegian Sea when they mature.

Environmental influence on the stock

Norwegian spring-spawning herring migrations have been linked to changes in climate and to the distribution of zooplankton, the herring main prey. The average biomass of zooplankton in the Norwegian Sea in May declined between 2002 and 2010, but has stabilized in 2011 and 2012 at a low level. Over this period, no stock-wide negative impact has been observed on the condition of herring..

The fisheries

In general, the fishery follows the migration of the stock as it moves from the wintering and spawning grounds along the Norwegian coast to the summer feeding grounds in the Faroese, Icelandic, Jan Mayen, Svalbard, and international areas.

Catch distribution	Total catch (2011) = 992 998 t, where 100% are landings (mainly purse-seiners and pelagic trawls). Discards in 2011 are considered to be low, but some slippage is known to occur.

Effects of the fisheries on the ecosystem

Little information is available on the impact of the herring fishery on the ecosystem. The fishery is entirely pelagic. There is little quantitative information on the bycatches in the fisheries for herring, but these are thought to be small in most fisheries.

Quality considerations

Previous assessments have shown a retrospective pattern that overestimates SSB and underestimates F; this is also the case with the present assessment. The decline of year classes in the recent surveys is faster than in the catches. Estimates of recruiting year-class strength are uncertain. However, all available information indicates that year classes from 2005 onward are weak. Recruitment estimates do not have a large influence on the predicted yields and SSBs in the short-term forecasts.

Several potential causes can explain the fast decline of year-class cohorts in the recent surveys; this will require further investigations. In particular, studies are required to investigate the change of catchability of herring in the survey in relation to changes in the behaviour of herring.

Herring in the Northeast Atlantic (Norwegian spring-spawning herring)
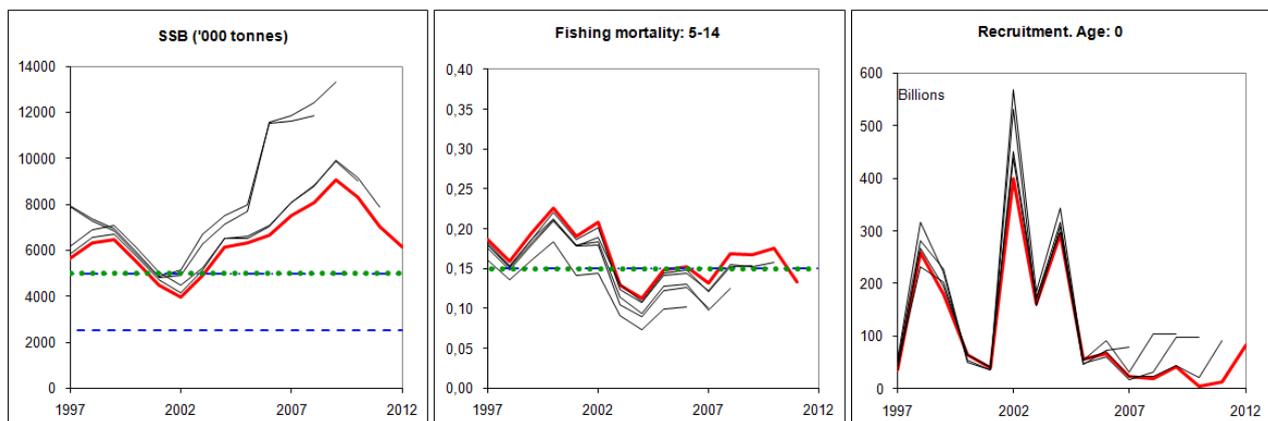
Figure 9.4.5.2   Herring in the Northeast Atlantic. Historical assessment results (final-year recruitment estimates included).

Scientific basis

Assessment type	Age-based analytical (TASACS).
Input data	Assessment period 1988–2011. Fishery-independent data: eight survey indices of which three have not been continued in recent years. The active surveys are: one larvae survey (NHLS), two recruitment surveys (indices from Eco-NoRu-Q3 (Aco), and two surveys covering the adult stock (indices from IESNS). Catch-at-age data.
Discards and bycatch	Total discards not available and considered to be low.
Indicators	None.
Other information	This stock was benchmarked in 2008.
Working group report	WGWIDE 2012

ECOREGION	Widely distributed and migratory stocks
STOCK	Herring in the Northeast Atlantic (Norwegian spring-spawning herring)

Reference points

	Type	*Value*	*Technical basis*
Management plan	SSB_{MP}	5.0 million t	Medium-term simulations conducted in 2001.
	F_{MP}	0.125	Medium-term simulations conducted in 2001.
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.
Precautionary Approach	B_{lim}	2.5 million t	MBAL (accepted in 1998).
	B_{pa}	5.0 million t	$B_{lim} * \exp(0.4*1.645)$.
	F_{lim}	Not defined.	-
	F_{pa}	0.15	Based on medium-term simulations.

 (unchanged since: 2010)

Outlook for 2013

Basis: $F_w(2012)^{1)}$ = 0.141; SSB (2013) = 5 080 thousand tonnes; Recruitment (2012–2014) = 82 billions (GM recruitment 1988–2008); Landings (2012) = 833 thousand tonnes (= TAC 2012).

Rationale	Landings (2013)	Basis	F(2013)	SSB(2014)	% SSB change [2]	% TAC change [3]
Agreed management plan	619	F management plan	0.125	4 300	−15	−26
MSY	734	F_{MSY}	0.150	4 198	−17	−12
Precautionary Approach	734	F_{pa}	0.150	4 198	−17	−12
Zero catch	0	F=0	0.000	4 850	−5	−100
Other options	661	F_{2011}	0.134	4 263	−16	−21
	162	$F_{management}*0.25$	0.031	4 706	−7	−81
	322	$F_{management}*0.5$	0.063	4 564	−10	−61
	619	$F_{management}*1.0$	0.125	4 300	−15	−26
	681	$F_{management}*1.1$	0.138	4 244	−16	−18
	758	$F_{management}*1.25$	0.156	4 176	−18	−9

Landings and stock biomass weights in thousand tonnes.
[1] F_w = Fishing mortality weighted by population numbers (age groups 5–14).
[2] SSB 2014 relative to SSB 2013.
[3] Catch/landings 2013 relative to TAC 2012.

Management plan

Following the long-term management plan agreed by the EU, Faroe Islands, Iceland, Norway, and Russia implies a TAC of 619 000 tonnes in 2013. This is expected to lead to an SSB in 2014 of 4.3 million tonnes. This is below $B_{trigger}$ in the management plan. Even without any fishery in 2013 SSB is expected to drop below $B_{trigger}$.

MSY approach

Following the ICES MSY framework implies a fishing mortality of 0.15, resulting in landings of 734 000 tonnes in 2013. This is expected to lead to a decline in SSB in 2014 to 4.2 million tonnes.

Fishing mortality in 2010 is at F_{MSY}, therefore the transition scheme towards the ICES MSY framework does not apply.

Precautionary approach

Following the precautionary approach implies a fishing mortality in 2013 no higher than F_{pa} (0.15), corresponding to landings of less than 734 000 tonnes in 2013. This is expected to lead to a decline in SSB in 2014 to 4.2 million tonnes.

Additional considerations

Ecosystem considerations

Herring in the Northeast Atlantic is a widely distributed stock. Juveniles and adults of this stock form an important part of the ecosystem in the Northeast Atlantic. Herring are an important food resource for higher trophic level predators (e.g. large fish, seabirds, and marine mammals), and are also a consumer of zooplankton in the Norwegian Sea and a predator of capelin larvae in the Barents Sea.

Management considerations

Since 1999 catches have been regulated through an agreed management plan (Section 9.4.5.1 Annex). The management plan is considered to be precautionary. The management plan target fishing mortality of 0.125 is in the range of fishing mortalities that would lead to MSY and implies a low risk of the stock falling below B_{lim} (Figure 9.4.5.5). There is no significant long-term gain in yield by increasing the current F target.

Historically, stock abundance has shown large variations and a dependency on the irregular occurrence of very strong year classes. Between 1998 and 2004, the stock has produced five strong year classes which led to a large increase in SSB. The SSB in 2009 was the highest in the last 20 years.

In the absence of strong year classes after 2004, the stock has declined since 2009 and is expected to decline further in the near future even when fishing according to the management plan. New year classes mature between ages 4 and 6. This means that it will take at least four years after they are born until they can contribute to an increase in the SSB. Surveys carried out in recent years in the Norwegian and Barents seas show no signs of new strong year classes after 2004.

The short-term prognoses indicate a decline in SSB from 6.1 million tonnes in 2012 to 5.1 and 4.3 million tonnes in 2013 and 2014, respectively, assuming exploitation in 2012 and 2013 is according to the management plan. SSB in 2014 is expected to be below B_{pa} and $B_{trigger}$. In that situation, from 2013 onwards, article 3 of the Management Plan would need to be applied, to set TACs for 2014 and future years. This implies a lower F until the SSB has increased to $B_{trigger}$. Given the low recruitment in recent years, it is expected that SSB will decline further even if catches are low.

Catches in recent years have been consistent with ICES advice according to the management plan, but the realised F has been higher than F_{MP} and closer to F_{MSY} due to an underestimation of F in the assessment.

In recent years the distribution area of mackerel has expanded to the north and west and now overlaps the distributional area of herring in summer. As a consequence, mackerel and herring catches are now mixed in these areas. This implies a potential for discarding.

Data and methods

The present assessment is an updated assessment, using the models, configurations, and procedures agreed at the benchmark held in 2008.

While discarding of this stock is considered to be low, slippage occurs. The amount of slippage is unquantified and thus cannot be accounted for in the assessment.

The International Ecosystem Survey in the Nordic Seas (IESNS) in May is the most important survey in the assessment and is expected to remain the main basis for future assessments. It is important that this survey be maintained and that the vessels participating in the survey have access to the survey grounds. It is essential to maintain good geographical survey coverage to avoid increases in assessment uncertainty and to maintain the integrity of the assessment.

Revisions in data and methodologies

From 2010 onwards, new maturity-at-age information was used for the whole time-series. This revision contributes to the change in perception of estimated SSB in the 2010 and later assessments compared to previous assessments.

Uncertainties in assessment and forecast

The retrospective behaviour of the assessment affects the accuracy of the forecast. The recent assessment indicates that the stock biomass has been lower than assumed by previous assessments and that TACs, based on the target fishing mortality, have been taken with fishing mortalities higher than intended. Assumptions on recent recruitment have little impact on the prediction of the catch and the SSB in the projected period.

Comparison with previous assessment and advice

The assessment was conducted in the same way as last year. In the current assessment, the SSB in 2011 is about 800 000 tonnes (10%) lower than estimated last year. The fishing mortality in 2010 is now estimated about 10% higher than in last year's assessment. The basis for advice is the same as last year.

Source

ICES. 2012. Report of the Working Group on Widely Distributed Stocks (WGWIDE), 21–27 August 2012, Lowestoft, UK. ICES CM 2012/ACOM:16.
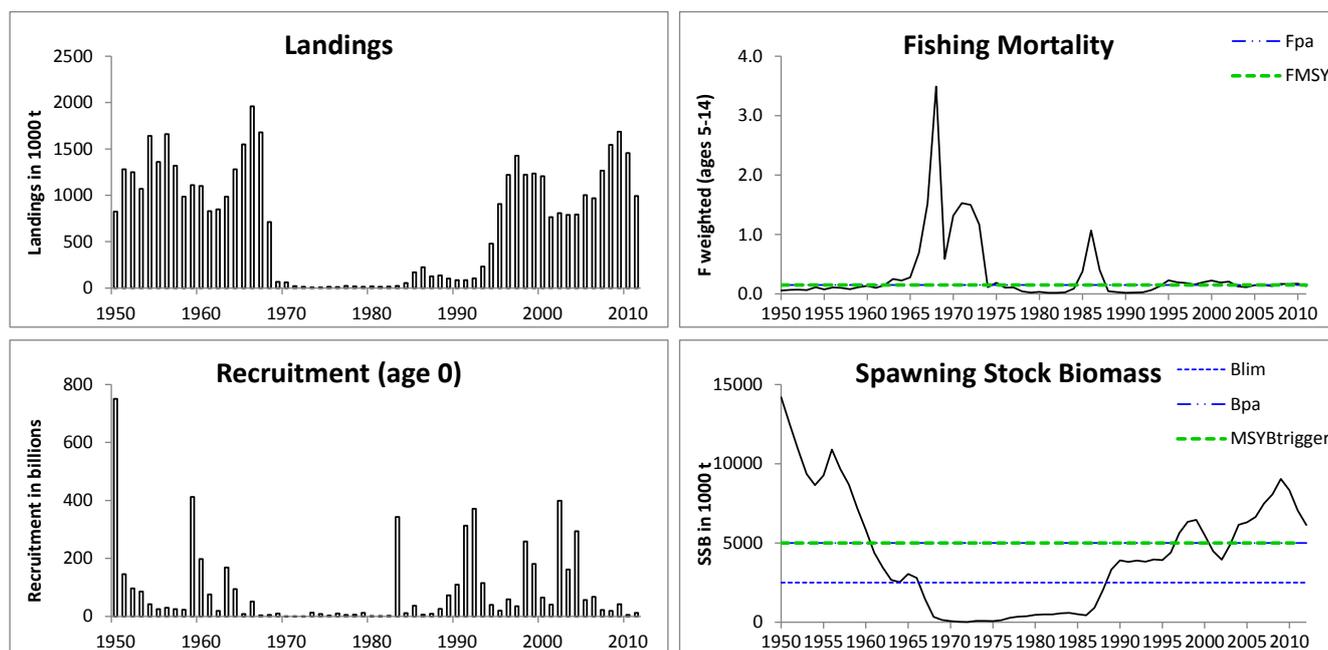
Figure 9.4.5.3   Herring in the Northeast Atlantic (Norwegian spring-spawning herring). Historical perspective of the stock. Data from 1950–1987 are from a previous assessment model that is no longer used. Data from 1988 to 2011 are from this year's assessment. Note that the SSB data prior to 1988 do not include the new maturity ogive.
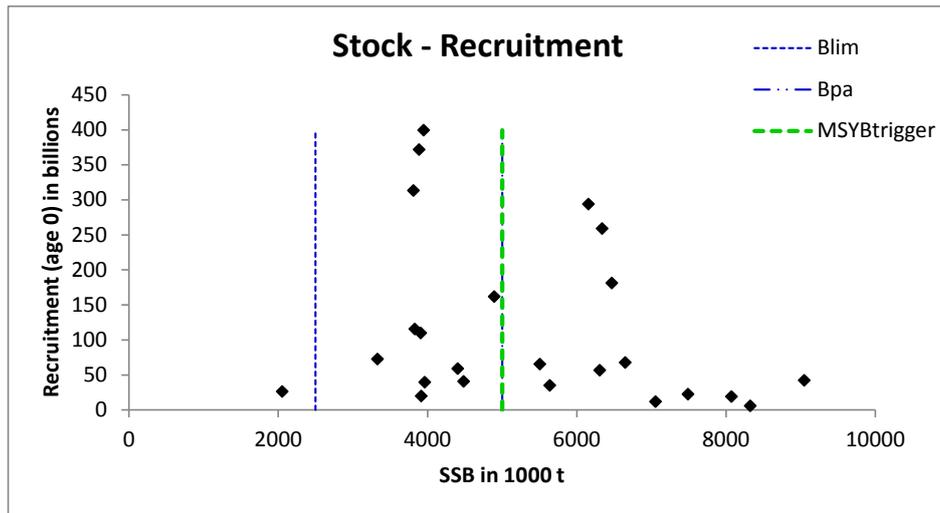
Figure 9.4.5.4   Herring in the Northeast Atlantic. Stock–recruitment observations for 1988–2011.
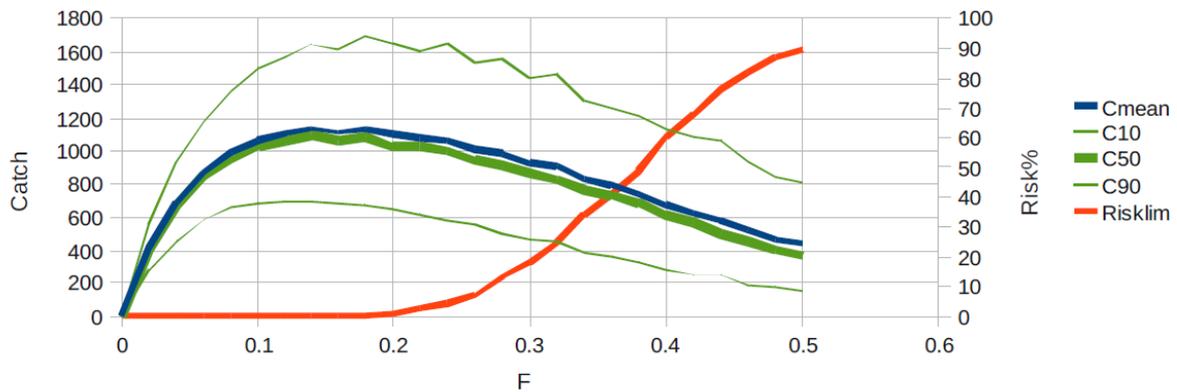
Figure 9.4.5.5   Herring in the Northeast Atlantic (Norwegian spring-spawning herring). Yield (catch) and the probability of the stock being below B_{lim} (2.5. million tonnes) after 50 years at target F, using the Beverton–Holt recruitment function. C10, C50, and C90 show the 10, 50, and 90 percentiles of catch. *Risklim* shows the probability of the stock falling below B_{lim} as a percentage of the model runs.

Table 9.4.5.1   Herring in the Northeast Atlantic (Norwegian spring-spawning herring). ICES advice, management, and catches.

| Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	ICES Catch
1987	TAC	150	115	127
1988	TAC	120–150	120	135
1989	TAC	100	100	104
1990	TAC	80	80	86
1991	No fishing from a biological point of view	0	76	85
1992	No fishing from a biological point of view	0	98	104
1993	No increase in F	119	200	232
1994	Gradual increase in F towards $F_{0.1}$; TAC suggested	334	450	479
1995	No increase in F	513	None[1]	906
1996	Keep SSB above 2.5 million t	-	None[2]	1220[4]
1997	Keep SSB above 2.5 million t	-	1500	1427[4]
1998	Do not exceed the harvest control rule	-	1300	1223
1999	Do not exceed the harvest control rule	1263	1300	1235
2000	Do not exceed the harvest control rule	Max 1500	1250	1207
2001	Do not exceed the harvest control rule	753	850	766[4]
2002	Do not exceed the harvest control rule	853	850	808[4]
2003	Do not exceed the harvest control rule	710	711[3]	790[4]
2004	Do not exceed the harvest control rule	825	825[3]	794
2005	Do not exceed the harvest control rule	890	1000[3]	1003
2006	Do not exceed the harvest control rule	732	967[3]	969
2007	Do not exceed the harvest control rule	1280	1280	1267
2008	Do not exceed the harvest control rule	1518	1518	1546
2009	Do not exceed the harvest control rule	1643	1642	1687
2010	Do not exceed the harvest control rule	1483	1483	1457
2011	See scenarios	988–1170	988	993
2012	Follow the management plan	833	833	
2013	Follow the management plan	619		

Weights in thousand tonnes.
[1]Autonomous TACs totaling 900 000 t.
[2]Autonomous TACs totaling 1 425 000 t were set by April 1996.
[3] There was no agreement on the TAC, the number is the sum of autonomous quotas from the individual Parties.
[4] Revised in 2010.

Table 9.4.5.2   Herring in the Northeast Atlantic (Norwegian spring-spawning herring). Total catch (tonnes) since 1987. Data provided by Working Group members.

YEAR	NORWAY	USSR/ RUSSIA	DENMARK	FAROES	ICELAND	IRELAND	NETHERLANDS	GREENLAND	UK (SCOTLAND)	GERMANY	FRANCE	POLAND	SWEDEN	TOTAL
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	2500	881	556	-	-	-	905501
1996	699161	119290	60681	52788	164957	19541	19664	-	46131	11978	-	-	22424	1220283
1997	860963	168900	44292	59987	220154	11179	8694	-	25149	6190	1500	-	19499	1426507
1998	743925	124049	35519	68136	197789	2437	12827	-	15971	7003	605	-	14863	1223131
1999	740640	157328	37010	55527	203381	2412	5871	-	19207	-	-	-	14057	1235433
2000	713500	163261	34968	68625	186035	8939	-	-	14096	3298	-	-	14749	1207201
2001	495036	109054	24038	34170	77693	6070	6439	-	12230	1588	-	-	9818	766136
2002	487233	113763	18998	32302	127197	1699	9392	-	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	156467	-	21517	-	-	17676	0	561	680	1003243
2006**	567237	120836	18449	63137	157474	4693	11625	-	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	217602	7903	28155	3810	19737	8338	0	0	0	1545656
2009	1016675	210105	32320	85098	265479	10014	24021	3730	25477	14452	0	0	0	1687371
2010	871113	199472	26792	80281	205864	8061	26695	3453	24151	11133	0	0	0	1457015
2011	572641	144428	26740	53271	151074	5727	8348	3426	14045	13296	0	0	0	992997

*In 2003 the Norwegian catches were raised by 39 433 tonnes to account for changes in percentages of water content.

**Scotland and Northern Ireland combined.

Table 9.4.5.3   Herring in the Northeast Atlantic (Norwegian spring-spawning herring). Summary of the stock assessment.

Year	Recruitment Age 0 in billions	Total biomass Million tonnes	Spawning-stock biomass Million tonnes	Landings tonnes	Unweighted F F5-14	Weighted F with stock numbers WF5-14
1988	26.067	3.493	2.054	135301	0.681	0.047
1989	72.568	4.158	3.332	103830	0.24	0.030
1990	109.442	4.696	3.911	86411	0.434	0.022
1991	313.107	5.337	3.812	84683	0.102	0.024
1992	371.619	6.385	3.889	104448	0.104	0.027
1993	115.129	7.466	3.832	232457	0.033	0.064
1994	39.472	8.53	3.964	479228	0.178	0.131
1995	19.595	9.335	3.919	905501	0.271	0.231
1996	58.595	9.425	4.405	1220283	0.227	0.198
1997	34.865	9.319	5.641	1426507	0.296	0.187
1998	258.971	8.186	6.342	1223131	0.212	0.159
1999	180.819	9.338	6.47	1235433	0.255	0.195
2000	65.352	8.741	5.506	1207201	0.325	0.226
2001	40.419	7.369	4.486	766136	0.184	0.191
2002	399.294	7.862	3.951	807795	0.213	0.209
2003	161.719	9.554	4.895	789510	0.211	0.129
2004	293.715	11.591	6.158	794066	0.301	0.113
2005	56.326	12.115	6.308	1003243	0.239	0.149
2006	67.440	13.076	6.652	968958	0.229	0.152
2007	22.370	12.429	7.491	1266993	0.175	0.132
2008	18.924	12.208	8.076	1545656	0.222	0.169
2009	42.183	11.302	9.049	1687373	0.231	0.167
2010	5.440	9.551	8.326	1457014	0.239	0.175
2011	11.869	7.788	7.055	992998	0.196	0.134
2012	82.000*		6.136			

* The GM recruitment over the years 1988–2008 is 82 billion.

9.4.5.1 Annex

The EU, Faroe Islands, Iceland, Norway, and Russia agreed in 1999 on a long-term management plan. This plan consists of the following elements:

1. *Every effort shall be made to maintain a level of Spawning Stock Biomass (SSB) greater than the critical level (B_{lim}) of 2 500 000 t.*
2. *For the year 2001 and subsequent years, the Parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality rate of less than 0.125 for appropriate age groups as defined by ICES, unless future scientific advice requires modification of this fishing mortality rate.*
3. *Should the SSB fall below a reference point of 5 000 000 t (B_{pa}), the fishing mortality rate referred to under paragraph 2, shall be adapted in the light of scientific estimates of the conditions to ensure a safe and rapid recovery of the SSB to a level in excess of 5 000 000 t. The basis for such an adaptation should be at least a linear reduction in the fishing mortality rate from 0.125 at B_{pa} (5 000 000 t) to 0.05 at B_{lim} (2 500 000 t).*
4. *The Parties shall, as appropriate, review and revise these management measures and strategies on the basis of any new advice provided by ICES.*