

1.4.5 Norwegian spring-spawning herring

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
full reproductive capacity	Harvested sustainably		

Based on the most recent estimates of SSB and fishing mortality, ICES classifies the stock as having full reproductive capacity and being harvested sustainably. The strong 1991 and 1992 year classes are now largely reduced. The 1998 and 1999 year classes dominate the current spawning stock. These year classes were smaller than the 1991-1992 year classes, but still relatively large. With the recruitment of 1991 and 1992 the spawning stock increased to about 7 million t in 1997. Thereafter, SSB has declined to just below 4 million t in 2001 and increased again to 6.5 million t in 2004. The 2002 year class is strong and will recruit to the fishery in 2006 and 2007. The 2004 year class is shown to be strong but the evidence for this is weak

Management objectives

The EU, Faroe Islands, Iceland, Norway, and Russia agreed to implement 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.*

ICES considers that this agreement is consistent with the precautionary approach.

Reference points

	ICES considers that:	ICES proposed that:
Precautionary Approach reference points	B_{lim} is 2.5 million t	B_{pa} be set at 5.0 million t
	F_{lim} is not considered relevant for this stock	F_{pa} be set at $F = 0.15$

Target Reference Points

Management has defined a maximum fishing mortality at 0.125

Technical basis:

B_{lim} : MBAL	B_{pa} : $=B_{lim} * \exp(0.4*1.645)$ (ICES Study Group 1998)
F_{lim} : -	F_{pa} : ICES Study Group 1998

Single stock exploitation boundaries

Exploitation boundaries in relation to existing management plans

The management plan implies maximum catches of 732 000 t in 2006 which is expected to lead to spawning stock of 7.7 million tonnes in 2007.

Exploitation boundaries in relation to high long term yield, low risk of depletion of production potential and considering ecosystem effects

The target defined in the management plan is consistent with high long-term yield and has a low risk of depleting the production potential.

Exploitation boundaries in relation to precautionary limits

The current long-term management plan is considered to be consistent with the precautionary approach.

Short term implications

The catches calculated for 2006 are sensitive to the choice of projected exploitation rate of the strong 2002 year class (4 year old fish in 2006). The 2002 year class is special in that a part of it grew up in the Norwegian Sea, in contrast to all other recent strong year classes that grew up in the Barents Sea. The herring growth rate is significantly higher in the Norwegian Sea than in the Barents Sea. It is expected that this year class will mix with the older herring in the Norwegian Sea and therefore recruit early to the fishery. So for the purposes of estimating catches in 2006 exploitation rate of this yearclass is assumed to be equal to that of the 2001 year class (5 year old fish in 2006).

Outlook for 2006

Basis: Landings (2005) = 1.000¹⁾; $F_w(2005)^2 = F_{sq} = 0.185$; $SSB(2005) = 6.133$;

The fishing mortality applied according to the agreed management plan ($F(\text{management plan})$) is 0.125

Rationale	Landings (2006)	Basis	F(2006)	SSB(2006)	SSB(2007)
Zero catch	0	F=0	0	6489	8490
Status quo	1054	F(2005)	0.185	6384	7366
Agreed management plan	75	F(management plan)*0.1	0.013	6482	8411
	178	F(management plan)*0.25	0.031	6471	8301
	363	F(management plan)*0.50	0.063	6453	8105
	541	F(management plan)*0.75	0.094	6436	7916
	650	F(management plan)*0.90	0.113	6425	7800
	732	F(management plan)	0.125	6418	7712
	803	F(management plan)*1.1	0.138	6411	7637
	900	F(management plan)*1.25	0.156	6400	7535

Shaded scenarios considered not consistent with the precautionary approach.

¹⁾ There was no agreement on the allocations of the TAC in 2005. The sum of autonomous allocations from the individual Parties amounts to 1,000,664 t.

²⁾ F_w = Fishing mortality weighted by population numbers

Management considerations

This stock has shown a large dependency on the occasional appearance of very strong year classes. In recent years the stock has tended to produce strong year classes more regularly. However, if strong year classes should become more intermittent, the stock is expected to decline.

There has been no international agreement on quota allocations in the two last years. This has led to an escalation in the F exerted on the stock ($F_{2005} > F_{pa}$), with the fisheries in 2005 probably ending close to 1 million tonnes, over 100 000 tonnes more than the TAC recommended under the long-term management plan ($F = 0.125$).

Ecosystem considerations

Juveniles and adults of this stock form an important part of the ecosystems in the Barents Sea, the Norwegian Sea and the Norwegian coast. The herring has an important role as transformer of the plankton production to higher trophic levels (cod, seabirds, and marine mammals). Recent changes in the herring migration have led to increased proportion feeding in Faeroese and Icelandic waters in the southwestern Norwegian Sea. The growth of these herring is faster than those feeding further east and north. A relationship between climate and herring growth is used to predict weights for the short term forecast.

Factors affecting the fisheries and the stock

The Effects of Regulations

In the rebuilding phase of the stock in the 1980s and beginning of 1990s (SSB < MBAL = 2.5 million t), the objective was to keep the fishing mortality below 0.05. With the exception of few years, this objective was followed. A minimum landing size regulation of 25 cm has been in place since 1977. This has avoided the exploitation of young herring. These regulations have contributed to a rebuilding of the stock to levels well above precautionary limits. When the fishery expanded in the mid 1990s, a long term management plan was agreed; this plan is cited above.

For 2005 the coastal states (European Union, Faroe Islands, Iceland, Norway, and Russia) did not reach any agreement regarding the allocation of the quota. As per March 1st 2005 Norway increased its quota by 14%. The increase was followed by Iceland and the Faroes. The sum of national quotas thus reached 1 million tonnes, which according to the current assessment leads to a fishing mortality exceeding F_{pa} (0.15).

Changes in fishing technology and fishing patterns

The main catches in 2004 were taken by Norway (477 000 t), Russia (116 000 t), Iceland (101 000 t), and Faroe Islands (43 000 t). Lesser catches were taken by EU fleets (55 000 t). The fishery in general follows the migration of the stock closely 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. The Norwegian fishery exploits the stock as it migrates to and remains in the wintering areas and during the spawning period. The Icelandic fishery takes place mainly in May, June and July, and the catches were taken mainly in the international waters and the Svalbard fishery protection zone. The main Russian catches are taken along the shelf region of the Norwegian EEZ in spring as the stock moves from the spawning grounds, and also in August and September in the eastern part of the international area and along the continental slope in the NE part of the Norwegian zone. The Faroese catches, taken in summer, are mainly from the international waters and the Svalbard fishery protection zone. Most of the EU catches are taken in the international area and the Svalbard fishery protection zone. A change in the migration pattern in 2004 with concentrations of herring in the Icelandic and Faroese zones in May was observed to be more pronounced in 2005 and the fishery for larger herring in this area increased during the 2005 season compared to 2004.

A large increase in fishing effort, new technology, and environmental changes contributed to the collapse of this stock around 1970. Recruitment failed in the second half of 1960s when the SSB was reduced below 2.5 million t. Starting in 1989 a succession of above-average to very strong year classes were produced, promoting full recovery of the SSB and allowing an expansion of the fishery. Since 1992 the coastal fishery has increased sharply. Until 1994, the fishery was almost entirely confined to Norwegian coastal waters. During the summer of 1994 there were also catches in the offshore areas of the Norwegian Sea for the first time in 26 years. The geographical extent of this fishery increased in 1995, with nine nations participating and the total catch exceeding 900 000 t. The fishery expanded further in 1996 and the annual level of the fishery was in the order of 1.2-1.5 million t in the period 1996-2000. After 2000 the fishery has dropped to a level between 700-1.000 thousand tonnes.

The environment

The Norwegian spring spawning herring carries out extensive migrations in the NE Atlantic. Feeding has mainly taken place along the polar front from the island of Jan Mayen and NE-wards towards Bear Island. Over the last 25 years the southern and western Norwegian Sea has become colder and fresher while the eastern Norwegian Sea is warmed. During the last years the waters north and northeast of Iceland have warmed, although cold Arctic water again flowed south and eastwards during the winter 2004/2005. Average zooplankton biomass in the Norwegian Sea has decreased since 2002 and is now at a comparatively low level in the central Norwegian Sea. This is probably related to a low winter NAO index over the last years.

Scientific basis

Data and methods

The advice is based on an analytical assessment, which takes into consideration catch data, acoustic surveys of adults and juveniles, larval survey, and tagging data. This year the 2004 and 2005 summer survey estimates could be included in the assessment due to change of timing of the WG meeting.

Different model formulations have been applied to assess this stock. The estimates of SSB and F are uncertain and sensitive to the choice of the model and the tuning data. After an overall evaluation, also taking into account that this assessment is an update from last years the SeaStar assessment was chosen as the final.

Uncertainties in assessment and forecast:

There is a strong retrospective pattern in the assessment, which leads to an overestimation of the spawning stock biomass. There are also difficulties to predict maturity at age and selection pattern of the big 2002 year class, which has considerably different spatial distribution compared to all year classes in recent decades. This uncertainty will however not affect the perception of the SSB in relation to precautionary limits.

An alternative model suggests ca. 15% higher SSB in 2004 which leads to significantly higher catch opportunities for 2006. This is considered to be in the range of uncertainty of the assessment.

There is an apparent shift in wintering areas and partly summer feeding areas for this stock. These dynamics could affect the survey results, which in return would affect the assessment.

Comparison with previous assessment and advice:

The assessment of the Norwegian spring spawning herring was done using the same model as last year. This year's assessment gives a small downward revision of SSB (10-15% in four recent years) relative to last year's assessment.

Source of information:

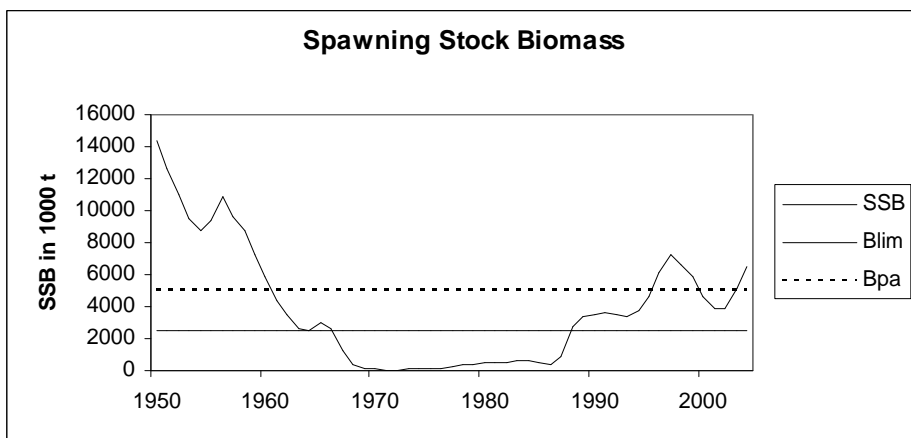
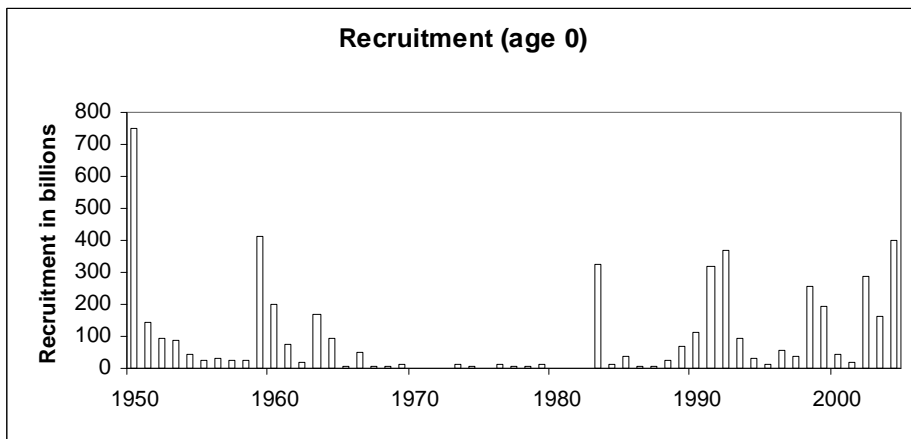
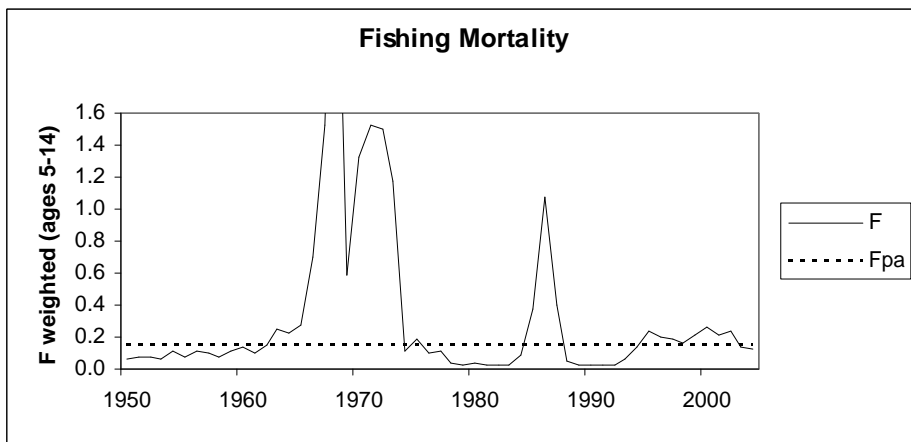
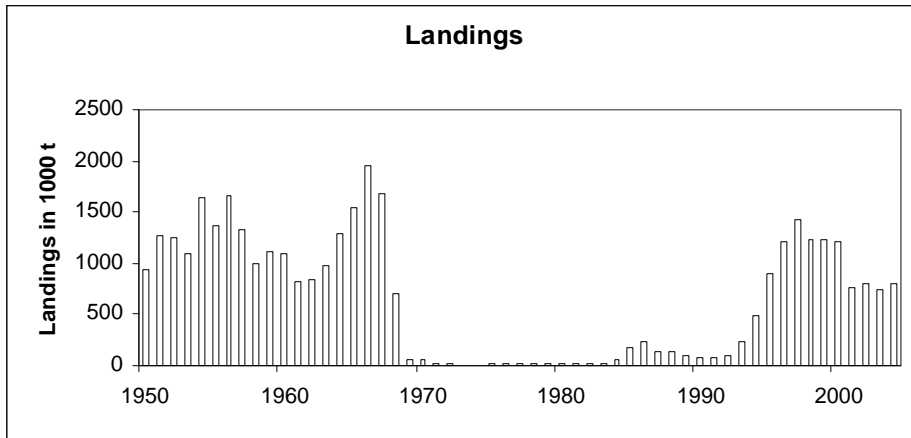
Report of the Northern Pelagic and Blue Whiting Fisheries Working Group, 25 August – 1 September 2005 (ICES CM 2006/ACFM:05).

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	ACFM 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	1 217
1997	Keep SSB above 2.5 million t	-	1 500	1 420
1998	Do not exceed the harvest control rule	-	1 300	1 223
1999	Do not exceed the harvest control rule	1 263	1 300	1 235
2000	Do not exceed the harvest control rule	Max 1 500	1 250	1 207
2001	Do not exceed the harvest control rule	753	850	770
2002	Do not exceed the harvest control rule	853	850	809
2003	Do not exceed the harvest control rule	710	711 ³⁾	773
2004	Do not exceed the harvest control rule	825	825 ³⁾	794
2005	Do not exceed the harvest control rule	890	1.000 ³⁾	
2006	Do not exceed the harvest control rule	732		

¹Autonomous TACs totaling 900 000 t; ²Autonomous TACs totaling 1 425 000 t were set by April 1996.

³There was no agreement on the TAC, the number is the sum of autonomous quotas from the individual Parties. Weights in '000 t.

Norwegian spring-spawning herring



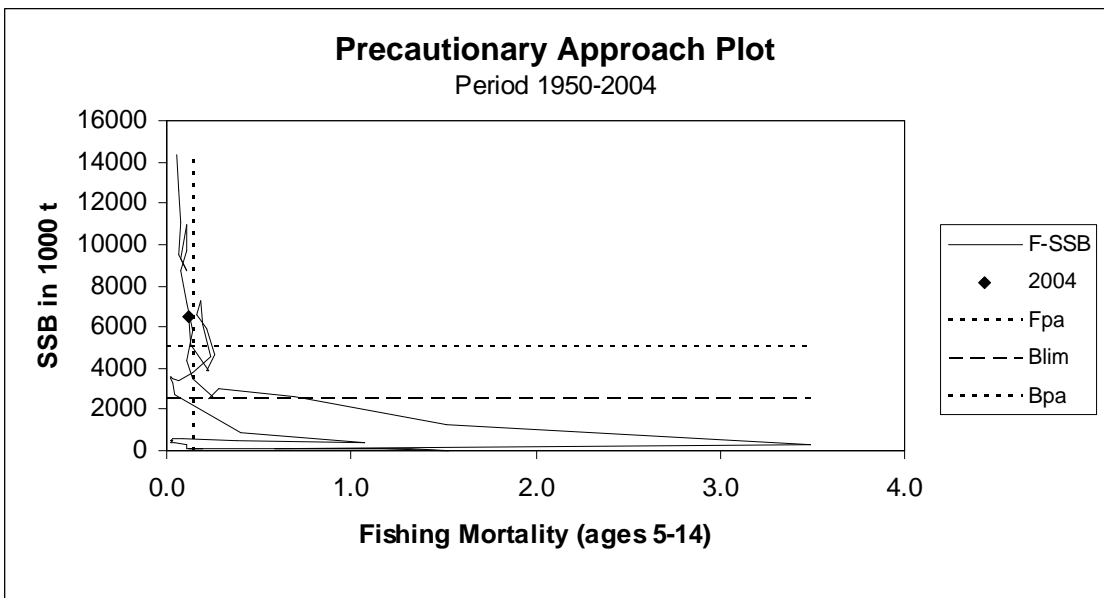
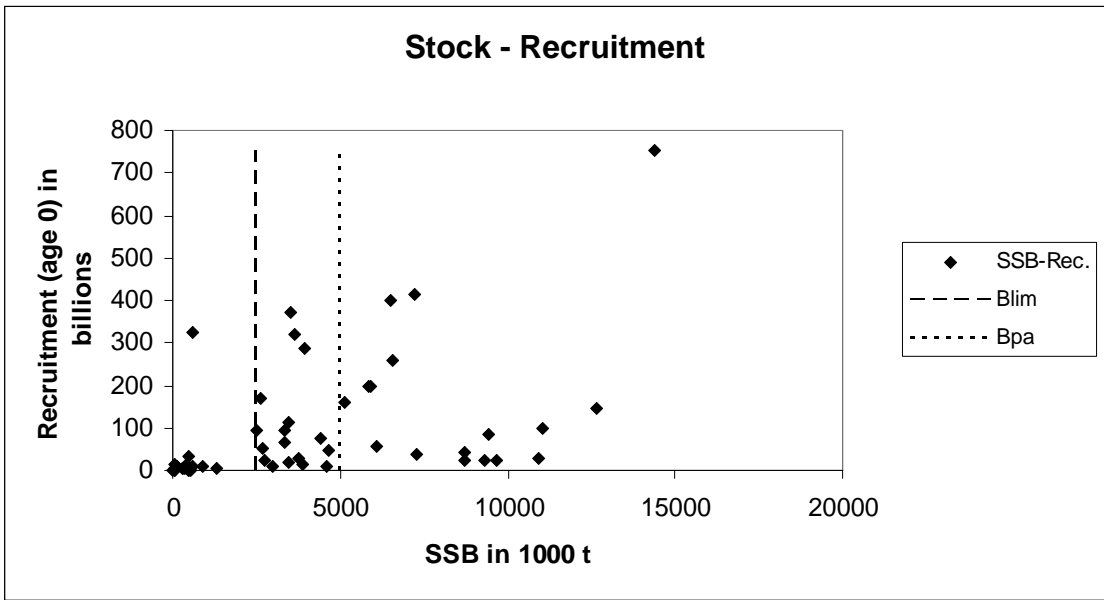


Table 1.4.5.1 Total catch of Norwegian spring-spawning herring (tonnes) since 1972. Data provided by Working Group members.

Year	Norway	USSR/ Russia	Denmark	Faroes	Iceland	Ireland	Nether- lands	Greenland	UK	Germany	France	Poland	Sweden	Total
1972	13,161	-	-	-	-	-	-	-	-	-	-	-	-	13,161
1973	7,017	-	-	-	-	-	-	-	-	-	-	-	-	7,017
1974	7,619	-	-	-	-	-	-	-	-	-	-	-	-	7,619
1975	13,713	-	-	-	-	-	-	-	-	-	-	-	-	13,713
1976	10,436	-	-	-	-	-	-	-	-	-	-	-	-	10,436
1977	22,706	-	-	-	-	-	-	-	-	-	-	-	-	22,706
1978	19,824	-	-	-	-	-	-	-	-	-	-	-	-	19,824
1979	12,864	-	-	-	-	-	-	-	-	-	-	-	-	12,864
1980	18,577	-	-	-	-	-	-	-	-	-	-	-	-	18,577
1981	13,736	-	-	-	-	-	-	-	-	-	-	-	-	13,736
1982	16,655	-	-	-	-	-	-	-	-	-	-	-	-	16,655
1983	23,054	-	-	-	-	-	-	-	-	-	-	-	-	23,054
1984	53,532	-	-	-	-	-	-	-	-	-	-	-	-	53,532
1985	167,272	2,600	-	-	-	-	-	-	-	-	-	-	-	169,872
1986	199,256	26,000	-	-	-	-	-	-	-	-	-	-	-	225,256
1987	108,417	18,889	-	-	-	-	-	-	-	-	-	-	-	127,306
1988	115,076	20,225	-	-	-	-	-	-	-	-	-	-	-	135,301
1989	88,707	15,123	-	-	-	-	-	-	-	-	-	-	-	103,830
1990	74,604	11,807	-	-	-	-	-	-	-	-	-	-	-	86,411
1991	73,683	11,000	-	-	-	-	-	-	-	-	-	-	-	84,683
1992	91,111	13,337	-	-	-	-	-	-	-	-	-	-	-	104,448
1993	199,771	32,645	-	-	-	-	-	-	-	-	-	-	-	232,457
1994	380,771	74,400	-	2,911	21,146	-	-	-	-	-	-	-	-	479,228
1995	529,838	101,987	30,577	57,084	174,109	-	7,969	2,500	881	556	-	-	-	905,501
1996	699,161	119,290	60,681	52,788	164,957	19,541	19,664	-	46,131	11,978	-	-	22,424	1,220,283
1997	860,963	168,900	44,292	59,987	220,154	11,179	8,694	-	25,149	6,190	1,500	-	19,499	1,426,507
1998	743,925	124,049	35,519	68,136	197,789	2,437	12,827	-	15,971	19,207	7,003	605	-	1,223,131
1999	740,640	157,328	37,010	55,527	203,381	2,412	5,871	-	14,096	-	-	-	14,057	1,235,433
2000	713,500	163,261	34,968	68,625	186,035	8,939	-	-	12,230	3,298	-	-	14,749	1,207,201
2001	495,036	109,054	24,038	34,170	77,693	6,070	6,439	-	3,482	1,588	-	-	9,818	766,136
2002	487,233	113,763	18,998	32,302	127,197	1,699	9,392	-	9,214	3,017	-	1,226	9,486	807,795
2003	438,140	122,846	14,144	27,943	117,910	1,400	8,678	-	1,869	3,371	-	-	6,431	750,077
2004 ¹	477,076	115,876	23,111	42,771	102,787	11	17,369	-	-	4,810	-	-	7,986	793,666

¹ Preliminary, as provided by Working Group members.

Table 1.4.5.2

Norwegian spring-spawning herring

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	F weighted Ages 5-14
1950	750680000	14359000	933000	0.058
1951	146355000	12635000	1278000	0.070
1952	96644000	11042000	1254000	0.073
1953	86102000	9457000	1091000	0.066
1954	42086000	8703000	1645000	0.113
1955	24971000	9324000	1360000	0.078
1956	29858000	10934000	1659000	0.110
1957	25397000	9661000	1320000	0.103
1958	23094000	8731000	987000	0.079
1959	412478000	7200000	1111000	0.113
1960	197514000	5853000	1102000	0.136
1961	76103000	4403000	830000	0.104
1962	19003000	3443000	849000	0.146
1963	168931000	2641000	985000	0.253
1964	93903000	2479000	1282000	0.226
1965	8491000	2996000	1548000	0.278
1966	51409000	2658000	1955000	0.696
1967	3947000	1304000	1677000	1.519
1968	5187000	318000	712000	3.493
1969	9785000	142000	68000	0.590
1970	661000	69000	62000	1.320
1971	236000	32000	21000	1.525
1972	957000	16000	13000	1.497
1973	12884000	86000	7000	1.173
1974	8631000	91000	8000	0.114
1975	2971000	79000	14000	0.190
1976	10068000	139000	10000	0.106
1977	5095000	288000	23000	0.111
1978	6201000	360000	20000	0.043
1979	12498000	391000	13000	0.024
1980	1474000	475000	19000	0.034
1981	1100000	509000	14000	0.022
1982	2343000	507000	17000	0.020
1983	322362000	579000	23000	0.029
1984	11528000	603000	54000	0.090
1985	35051000	502000	170000	0.379
1986	6041000	401000	225000	1.074
1987	8945000	877000	127000	0.404
1988	25009000	2738000	135000	0.045
1989	67357000	3335000	104000	0.029
1990	114598000	3490000	86000	0.022
1991	318995000	3628000	85000	0.025
1992	371421000	3496000	104000	0.029
1993	92042000	3352000	232000	0.068
1994	29993000	3775000	479000	0.139
1995	9773000	4592000	906000	0.240
1996	57485000	6113000	1220000	0.197
1997	37573000	7308000	1427000	0.187
1998	258857000	6564000	1223000	0.168
1999	196635000	5930000	1235000	0.212
2000	45323000	4635000	1207000	0.262
2001	16362000	3878000	766000	0.213
2002	288899000	3918000	808000	0.232
2003	160617000	5107000	750000	0.132
2004	401287000	6513000	794000	0.119
Average	94785636	3866527	655400	0.341