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Report of the ICES Advisory Committee 2012

Book 3

The Barents Sea and the Norwegian Sea

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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BOOK 3

Section **Page**

3 THE BARENTS SEA AND THE NORWEGIAN SEA

3.1 Ecosystem overview

This Section has not been updated in 2012. The most recent ecosystem overview is available in ICES Advisory Report 2009, Section 3.1. This overview can also be found on the ICES website:
http://www.ices.dk/committe/acom/comwork/report/2009/2009/Barents%20Sea%20Ecosystem%20overviews.pdf

3.2 Human impacts on the ecosystem

3.2.1 Fishery effects on benthos and fish communities

This Section has not been updated in 2012. The most recent description on Fishery effects on benthos and fish communities is available in ICES Advisory Report 2009, Section 3.2. This description can also be found on the ICES website: http://www.ices.dk/committe/acom/comwork/report/2009/2009/Barents%20Sea%20Ecosystem%20overviews.pdf

3.3 Assessments and Advice

3.3.1 Assessment and advice regarding protection of biota and habitats

In 2011, ICES has not provided advice regarding protection of biota and habitats for this area.

3.3.2 Assessments and Advice regarding fisheries

Mixed fisheries and fisheries interactions

This Section has not been updated in 2012. The most recent description on mixed fisheries and fisheries interactions is available in ICES Advisory Report 2009, Section 3.3. This description can also be found on the ICES website:
http://www.ices.dk/committe/acom/comwork/report/2009/2009/Barents%20Sea%20Ecosystem%20overviews.pdf

The state and advice of the individual stocks are presented in the stock sections. The state of stocks and advice are summarized in the table below.

Table 3.3.2.1 State of the stock and advice in the Barents Sea and Norwegian Sea ecoregion.

Stock	**State of the stock**				**Outlook options**			**ICES advice for 2012** (in tonnes or effort)
	Fishing mortality in relation to F_{MSY}	**Fishing mortality in relation to precautionary approach (F_{PA}/F_{lim})**	**Spawning biomass in relation to MSY $B_{trigger}$**	**Spawning biomass in relation to precautionary approach (B_{PA}/B_{lim})**	**MSY approach** (within the precautionary approach)	**Precautionary approach / considerations**	**Management plan**	
Cod in Subareas I and II (Northeast Arctic cod)	Appropriate	Harvested sustainably	Above trigger	Full reproductive capacity	Landings of no more than 1141 000 t	-	940 000 t	Management plan: 940 000 t
Cod in Subareas I and II (Norwegian coastal waters cod)	Qualitative evaluation: Variable without trend		Qualitative evaluation: close to its lowest		Catches should be reduced	-	Rebuilding plan: Depending on spawning stock index in the 2012 autumn survey	Rebuilding plan: Depending on spawning stock index in the 2012 autumn survey
Haddock in Subareas I and II (Northeast Arctic)	Appropriate	Harvested sustainably	Above trigger	Full reproductive capacity	Landings of no more than 154 000 t	Landings of less than 195 000 t	238 000 t	Management plan: Catches no more than 238 000 t
Saithe in Subareas I and II (Northeast Arctic)	Undefined	Harvested sustainably	Undefined	Full reproductive capacity	-	Landings of less than 176 000 t	164 000 t	Management plan: Catches no more than 164 000 t
Greenland halibut in Subareas I and II	Unknown	Unknown	Qualitative evaluation: Increasing trend		-	Catches should not be allowed to increase and should not exceed 15 000 t	-	Precautionary considerations: Catches should not be allowed to increase and should not exceed 15 000 t
Beaked redfish (*Sebastes mentella*) in Subareas I and II	Unknown	Unknown	Qualitative evaluation:		Catches of no more than 47 000 t	-	-	MSY approach: Catches of no more than 47 000 t
Golden redfish (*Sebastes marinus*) in Subareas I and II	Unknown	Unknown	Qualitative evaluation: SSB lowest in time series		-	No fishery	-	Precautionary considerations: No fishery
Northern shrimp (*Pandalus borealis*) in Subareas I and II (Barents Sea)	Below target	Harvested sustainably	Above trigger	Full reproductive capacity	Catches no more than 60 000 t	Catches no more than 90 000 t	-	MSY approach: Catches no more than 60 000 t
Capelin in Subareas I and II, excluding Division IIa west of 5°W (Barents Sea capelin)	Not relevant	Not relevant	Undefined	Above limit reference point	-	-	Catches no more than 200 000 t	Management plan: Catches no more than 200 000 t

The advice for deep-water stocks in this area appears in 2012 in Volume 9 on widely distributed and migratory stocks. This advice is issued only every second year.

Table 3.3.2.2 Summary of the stock categories in the Barents Sea and Norwegian Sea ecoregion (see section 1.2 for category definitions).

Total Number of stock in the ecoregion	9
Data rich stocks	5
Data-limited stocks	4

Table 3.3.2.3 Status of data rich stocks (n=5) for the Barents Sea and Norwegian Sea ecoregion relative to MSY and PA reference points for Fishing Mortality (F) and Spawning Stock Biomass (SSB). Table shows percentage of stocks per stock status. Values in brackets denote the number of data rich stocks per stock status.

			Spawning Stock Biomass…			
			is at or above MSY $B_{trigger}$ $SSB_{2012} \geq$ MSY $B_{trigger}$	is below MSY $B_{trigger}$ $SSB_{2012} <$ MSY $B_{trigger}$		is not defined
MSY Approach	**Fishing Mortality…**		✓	✗		?
	is at or below MSY ($F_{2011} \leq F_{MSY}$)	✓	60% (3)	-		-
	is above MSY ($F_{2011} > F_{MSY}$)	✗	-	-		-
	is not defined	?	-	-		40% (2)
			is at or above PA $SSB_{2012} \geq B_{pa}$	is at increased risk $B_{pa} > SSB_{2012} > B_{lim}$	is below limit $SSB_{2012} < B_{lim}$	is not defined
Precautionary Approach	**Fishing Mortality…**		✓	o	✗	?
	is at or below PA ($F_{2011} \leq F_{pa}$)	✓	100% (5)	-	-	-
	is at increased risk ($F_{lim} > F > F_{pa}$)	o	-	-	-	-
	is above PA ($F_{2011} > F_{pa}$)	✗	-	-	-	-
	is not defined	?	-	-	-	-

ECOREGION Barents Sea and Norwegian Sea
STOCK Cod in Subareas I and II (Northeast Arctic cod)

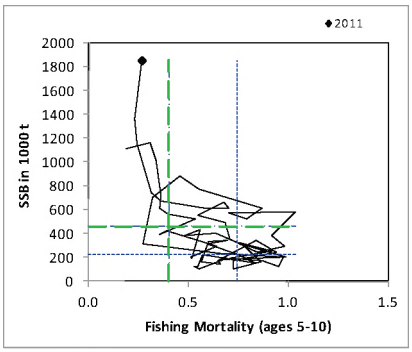
Advice for 2013

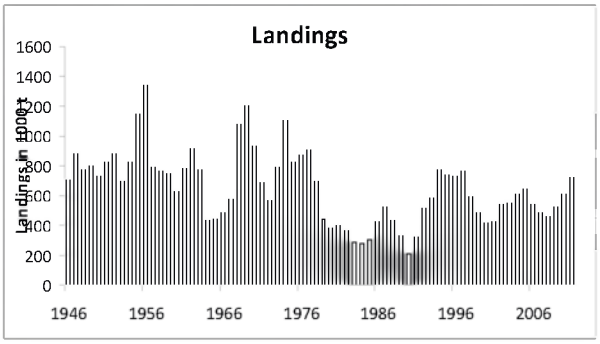
ICES advises on the basis of the Joint Russian–Norwegian Fisheries Commission management plan that catches in 2013 should be no more than 940 000 t. Coastal cod and *Sebastes marinus* bycatches should be kept as low as possible.

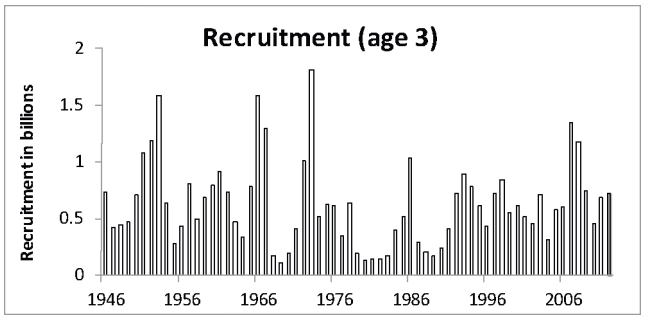
Stock status

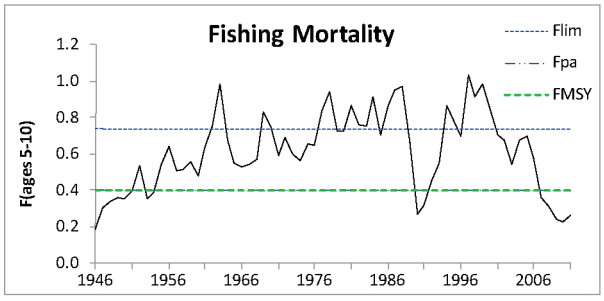
F (Fishing Mortality)	2009	2010	2011
MSY (F_{MSY})	✓	✓	✓ Appropriate
Precautionary approach (F_{pa},F_{lim})	✓	✓	✓ Harvested sustainably
Management plan (F_{MP})	✓	✓	✓ Below target

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









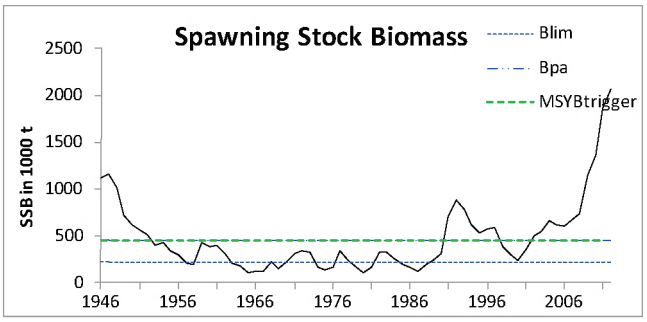


Figure 3.4.1.1 Cod in Subareas I and II. Summary of stock assessment (weights in thousand tonnes). Top right: SSB/F for the time-series used in the assessment.

The SSB has been above MSY $B_{trigger}$ since 2002 and is now record high. The total stock biomass is close to the highest observed. Fishing mortality was reduced from well above F_{lim} in 1997 to below F_{MSY} in 2007 and is now close to its lowest value. Surveys indicate that year classes 2009–2011 are above average.

Management plans

A management plan has been implemented since 2004 (Annex 3.4.1) with the objectives of maintaining high long-term yield, year-to-year stability of landings, and full utilization of all available information on stock dynamics. The plan was evaluated in 2010 and ICES considers that it is to be in accordance with the precautionary approach and not in

contradiction to the MSY framework. At the 2010 meeting of the Joint Russian–Norwegian Fisheries Commission it was agreed that the plan will be in force until 2015.

Environmental influence on the stock

Among the factors influencing cod growth and recruitment are water temperature, food supply, and cod population abundance. Environmental drivers were used to estimate recruitment and temperature to estimate cod cannibalism. Changes in growth, maturity, and cod cannibalism are linked to the abundance of capelin. This linkage appears to be less pronounced in the recent period compared to the 1980s and 1990s. Capelin abundance is at present intermediate. The distribution area of cod has expanded northwards and eastwards in recent years, and is now the widest ever reported (north to 80°N and east to 56°E during the ecosystem survey in August–September).

The fisheries

Cod is a target species caught in a mixed fishery together with haddock and saithe. In coastal areas, Northeast Arctic cod and coastal cod are caught in the same fishery during parts of the year. Redfish (both *Sebastes mentella* and *S. marinus*) are caught as bycatch in the cod fishery. TAC regulations are in place. Unreported catches have decreased in the recent years and were close to zero in 2009–2011. Discarding is illegal in Norway and Russia. Data on discarding are scarce, but attempts to obtain better quantification continue. The fisheries are controlled by inspections at sea by a requirement to report to catch control points when entering and leaving the EEZs to land fish, and by VMS satellite tracking for some fleets.

Catch distribution Total landings (2011) are 720 kt (70% demersal trawls and 30% other gear types).

Effects of the fisheries on the ecosystem

Fisheries of cod in the Barents Sea do not only influence the targeted stock. Because of strong species interactions the removal of cod, which is an important predator in the ecosystem, by fisheries influences the abundance of prey stocks such as capelin, haddock, and redfish.

Quality considerations

The uncertainties in this assessment relate both to catch and survey data. Unreported catches (Illegal, Unregulated, and Unreported (IUU)) have been a problem in recent years, but do not affect the data collected in 2009–2011. Due to technical problems with a Norwegian survey vessel the spatial coverage in the 2012 Joint winter survey was incomplete.

Norwegian sampling of commercial catches is believed to be less precise because of the termination of a Norwegian port sampling programme in mid-2009. The poor sampling caused problems in estimating Norwegian catches for the oldest ages in 2010. A small Norwegian port sampling programme from 2011 and onwards and an expansion of the high seas reference fleet has improved the situation somewhat. But there is still a lack of samples from certain gears and areas and the working group recommends an increase in port sampling effort.

Russian sampling of commercial catches has also shown a declining trend.

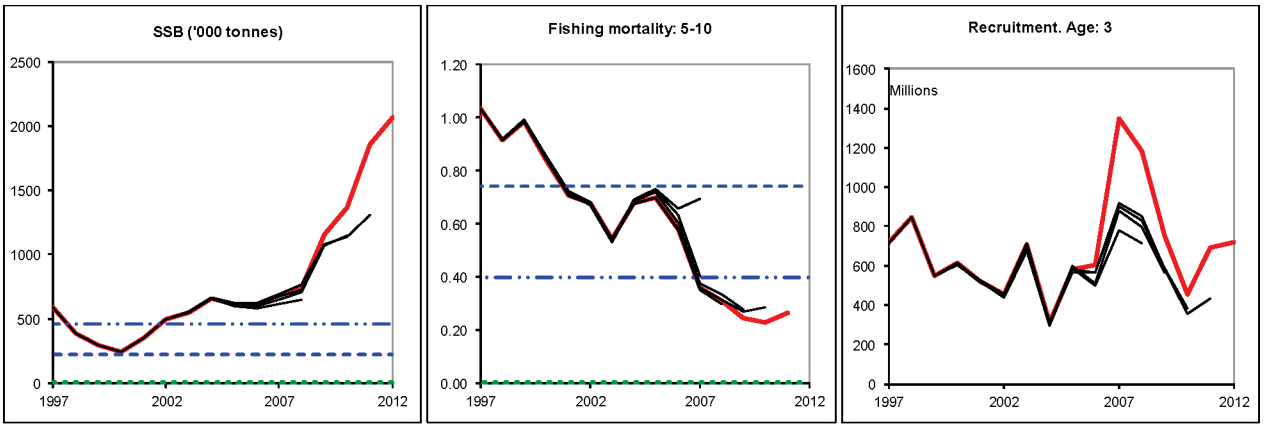


Figure 3.4.1.2 Cod in Subareas I and II. Historical performance of the assessment (final-year estimates included).

Scientific basis

Assessment type	Age-based analytical assessment (XSA) with cannibalism included.
Input data	Three survey indices: Joint bottom trawl survey Barents Sea, Feb–Mar (BS-NoRu-Q1 (BTr)); Joint acoustic survey Barents Sea and Lofoten, Feb–Mar (BS-NoRu-Q1 (Aco)); Russian bottom trawl survey, Oct–Dec (RU-BTr-Q4). One commercial cpue index; data from the Russian trawl fisheries.
Discards and bycatch	Discards are not accounted for. Bycatch of undersized cod in shrimp fisheries is unknown but believed to be minor.
Indicators	None.
Other information	None.
Working group report	AFWG

ECOREGION Barents Sea and Norwegian Sea
STOCK Cod in Subareas I and II (Northeast Arctic cod)

Reference points

	Type	*Value*	*Technical basis*
Management Plan	SSB_{MP}	460 000 t	B_{pa}, TAC linearly reduced from F_{pa} at SSB = B_{pa} to 0 at SSB equal to zero.
	F_{MP}	0.40	$F_{pa,}$ average TAC for the coming 3 years based on F_{pa}.
MSY Approach	MSY $B_{trigger}$	460 000 t	B_{pa}, and trigger point in HCR.
	F_{MSY}	0.40	Long-term simulations.
Precautionary Approach	B_{lim}	220 000	Change point regression.
	B_{pa}	460 000 t	The lowest SSB estimate having >90% probability of remaining above B_{lim}.
	F_{lim}	0.74	F corresponding to an equilibrium stock = B_{lim}.
	F_{pa}	0.40	The highest F estimate having >90% probability of remaining below F_{lim}.

(updated in 2012)

Yield and spawning biomass per Recruit F-reference points (2012):

	Fish Mort Ages 5–10	Yield/R	SSB/R
Average last 3 years	0.25	0.79	2.35
F_{max}*	-	-	-
$F_{0.1}$	0.11	0.71	4.69
F_{med}	0.69	0.72	0.65

* F_{max} is poorly defined.

Outlook for 2013

Basis: $F_{2012} = F_{2011} = 0.26$; SSB (2013) = 2225; R (2012) = 721 million; landings (2012) = 857.

Rationale	**Landings (2013)**	**Basis**	**F (2013)**	**SSB (2014)**	**%SSB change** [1)]	**%TAC change** [2)]
Management plan [3)]	940	F_{MP}	0.30	2025	−9	+25
MSY approach	1191	F_{MSY}	0.40	1802	−19	+59
Zero catch	0	$0*F_{sq}$	0	2887	+30	−100
Status quo	844	F_{sq}	0.26	2109	−5	+12

Weights in thousand tonnes.

[1)] SSB 2014 relative to SSB 2013.

[2)] Catch 2013 relative to TAC 2012.

[3)] Forecast based on catch corresponding to F = 0.30.

Management plan

In accordance with the adopted management plan the catch in 2013 should be based on F=0.30, corresponding to landings of 940 000 t. This is expected to keep SSB above B_{pa} in 2014 and at the historical high.

MSY approach

Fishing at F_{MSY} (= 0.40) corresponds to landings of no more than 1191 kt in 2013. This is expected to keep SSB above MSY $B_{trigger}$ in 2014 and at the historical high.

Additional considerations

Management considerations

Predicted landings in 2012 are 14% higher than the predicted TAC, mostly because of the big revision in SSB in recent years. The estimates of unreported landings by the Joint Norwegian–Russian analysis group were reduced considerably compared to the period 2006–2008. For 2009–2011, the estimate of unreported landings is very close to zero.

Management plan

The plan aims to maintain F at F_{pa} = 0.40 and to restrict between-year TAC changes to ±10% unless SSB falls below B_{pa}, in which case the target F should be reduced.

The management plan was amended in 2009, adding a new condition: "If the TAC, by following such a rule, corresponds to a fishing mortality (F) lower than 0.30 the TAC should be increased to a level corresponding to a fishing mortality of 0.30", when SSB is above B_{pa}. This condition applies for 2013.

Regulations and their effects

The reduction in fishing mortality in recent years is largely a result of the implementation of the harvest control rule and the absence of IUU fishing. In addition to quotas, fisheries are regulated by mesh size limitations, a minimum catching size, a maximum bycatch of undersized fish, maximum bycatch of non-target species, closure of areas with high densities of juveniles, and other seasonal and area restrictions. Since January 1997, sorting grids have been mandatory for the trawl fisheries in most of the Barents Sea and Svalbard area. From 2011 onwards, the minimum mesh size for bottom trawl fisheries for cod and haddock is 130 mm for the entire Barents Sea (before 2011 the minimum mesh size was 135 mm in the Norwegian EEZ and 125 mm in the Russian EEZ). This change is expected to have a minor impact on the total exploitation pattern for this stock; thus, a recent average exploitation pattern is used in the predictions.

A real-time closure system has been in force along the Norwegian coast and in the Barents Sea since 1984, aimed at protecting juvenile fish. Based on scientific research data and mapping of areas by hired fishing vessels, fishing is prohibited in areas where the proportion by number of undersized cod, haddock, and saithe combined has been observed by inspectors to exceed 15% (the size limits vary by species). The time of notice before a closure of an area comes into force is 2–4 hours for national vessels and 7 days for foreign vessels. Before or parallel to a closure, the Coast Guard requests vessels not to fish in an area where too many small fish have been observed during their inspections. A closed area is not opened until it is documented by trial fishing to contain less than 15% undersized fish. A preliminary evaluation of the effectiveness of the system up to 1998 showed a clear decrease in the discarding of small cod and haddock.

From 1 January 2011, the technical regulations for the demersal fisheries were harmonized so that they are now the same in the Norwegian and Russian EEZs. The minimum size is now 44 cm for cod (previously 47 in the Norwegian and 42 cm in the Russian EEZ). The maximum allowable percentage of fish below the minimum size is 15% by number of cod, haddock, and saithe combined in the Norwegian EEZ, and 15% by number of cod and haddock combined in the Russian EEZ. Previously, the maximum percentage was 15% for each species (cod and haddock) in the Russian EEZ. The effect of these changes is expected to be minor as long as the fishing mortality is kept low, as implied by the agreed harvest control rule.

Information from fishing industry

Norwegian fishing vessels provide regular sampling data for length and age. These data are used to estimate catch-at-age for the corresponding fleets. Russian fishing vessels with observers onboard provide similar information on catch length distribution, sampling fish to obtain data on length–age matrices.

Data and methods

The analytical assessment is based on catch-at-age data, using one commercial cpue series and three survey series. Estimates of cod cannibalism are included in the natural mortality.

Uncertainties in assessment and forecast

The abundance of the year classes 2004 and 2005 in the last two years (at ages 6–8) is far above any previous observations for these age groups. This means that the choice of age range for stock size-dependent catchability has a considerable impact on the assessment. Also the stock dynamics (growth, maturation, cannibalism) are hard to predict at the present high stock sizes, although a further increase in stock abundance is not expected.

Adjustments for incomplete spatial coverage in some surveys in 2012 have been made. This mainly affects the recruitment estimates (2009–2011 year classes). The *status quo* F assumption for 2012 in the forecast implies a catch in 2012 which is 14% above the agreed TAC. However, the prediction uncertainty associated with this is less than that associated with, e.g. the choice of age range for stock size-dependent catchability.

Comparison with previous assessment and advice

Compared to last year's assessment, the current assessment estimate of SSB in 2011 is 40% higher and the F in 2010 is 20% lower. All age groups have been adjusted upwards from last year's assessment, with the largest adjustments for the strong 2004 and 2005 year classes. For these year classes we now have more observations of record-high indices at older ages (6–8) than were available last year; thus, these high observations have been given more weight than last year. The basis of the advice is the same as last year.

Sources

ICES. 2011. Report of the Arctic Fisheries Working Group, 28 April–4 May 2011. ICES CM 2011/ACOM:05.
ICES. 2012. Report of the Arctic Fisheries Working Group, 20 April–26 April 2012. ICES CM 2012/ACOM:05.

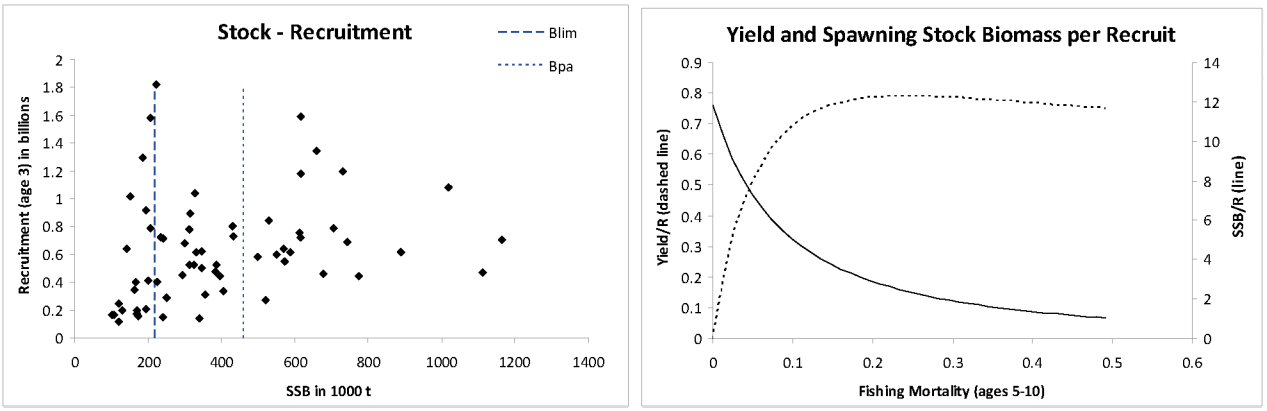


Figure 3.4.1.3 Cod in Subareas I and II (Northeast Arctic cod). Stock–recruitment plot and yield-per-recruit analysis.

Table 3.4.1.1 Cod in Subareas I and II (Northeast Arctic cod). ICES advice, management, and landings.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings	ICES landings	Unreported landings (included in ICES landings)
1987	Gradual reduction in F	595	560	552	523	
1988	F = 0.51; TAC (Advice November 87, revised advice May 88)	530 (320–360)	590 451	459	435	
1989	Large reduction in F	335	300	348	332	
1990	F at F_{low}; TAC	172	160	210	212	25
1991	F at F_{low}; TAC	215	215	294	319	50
1992	Within safe biological limits	250	356	421	513	130
1993	Healthy stock	256	500	575	582	50
1994	No long-term gains in increased F	649	700	795	771	25
1995	No long-term gains in increased F	681	700	763	740	
1996	No long-term gains in increased F	746	700	759	732	
1997	Well below F_{med}	< 993	850	792	762	
1998	F less than F_{med}	514	654	615	593	
1999	Reduce F to below F_{pa}	360	480	506	485	
2000	Increase B above B_{pa} in 2001	110	390		415	
2001	High prob. of SSB>B_{pa} in 2003	263	395		426	
2002	Reduce F to well below 0.25	181	395		535	90
2003	Reduce F to below F_{pa}	305	395		552	115
2004	Reduce F to below F_{pa}	398	486		606	117
2005	Take into account coastal cod and redfish bycatches. Apply catch rule.	485	485		641	166
2006	Take into account coastal cod and redfish bycatches. Apply amended catch rule	471	471		538	67
2007	Take into account coastal cod and redfish bycatches. F_{pa}	309	424		487	41
2008	Take into account coastal cod and redfish bycatches. Apply catch rule	409	430		464	15
2009	Take into account coastal cod and redfish bycatches. Apply catch rule	473	525		523	0
2010	Take into account coastal cod and redfish bycatches. Apply catch rule	577.5	607		610	0
2011	Take into account coastal cod and redfish bycatches. Apply catch rule	703	703		720	0
2012	Take into account coastal cod and redfish bycatches. Apply catch rule.	751	751			
2013	Take into account coastal cod and *S. marinus* bycatches. Apply catch rule.	940				

Weights in thousand tonnes.

Table 3.4.1.2 Cod in Subareas I and II (Northeast Arctic cod). Total landings (t) by fishing areas.

Year	Faroe Islands	France	German Dem.Rep.	Fed.Rep. Germany	Norway	Poland	United Kingdom	Russia[2]		Others	Total all countries
1961	3 934	13 755	3 921	8 129	268 377	-	158 113	325 780		1 212	783 221
1962	3 109	20 482	1 532	6 503	225 615	-	175 020	476 760		245	909 266
1963	-	18 318	129	4 223	205 056	108	129 779	417 964		-	775 577
1964	-	8 634	297	3 202	149 878	-	94 549	180 550		585	437 695
1965	-	526	91	3 670	197 085	-	89 962	152 780		816	444 930
1966	-	2 967	228	4 284	203 792	-	103 012	169 300		121	483 704
1967	-	664	45	3 632	218 910	-	87 008	262 340		6	572 605
1968	-	-	225	1 073	255 611	-	140 387	676 758		-	1 074 084
1969	29 374	-	5 907	5 543	305 241	7 856	231 066	612 215		133	1 197 226
1970	26 265	44 245	12 413	9 451	377 606	5 153	181 481	276 632		-	933 246
1971	5 877	34 772	4 998	9 726	407 044	1 512	80 102	144 802		215	689 048
1972	1 393	8 915	1 300	3 405	394 181	892	58 382	96 653		166	565 287
1973	1 916	17 028	4 684	16 751	285 184	843	78 808	387 196		276	792 686
1974	5 717	46 028	4 860	78 507	287 276	9 898	90 894	540 801		38 453	1 102 434
1975	11 309	28 734	9 981	30 037	277 099	7 435	101 843	343 580		19 368	829 377
1976	11 511	20 941	8 946	24 369	344 502	6 986	89 061	343 057		18 090	867 463
1977	9 167	15 414	3 463	12 763	388 982	1 084	86 781	369 876		17 771	905 301
1978	9 092	9 394	3 029	5 434	363 088	566	35 449	267 138		5 525	698 715
1979	6 320	3 046	547	2 513	294 821	15	17 991	105 846		9 439	440 538
1980	9 981	1 705	233	1 921	232 242	3	10 366	115 194		8 789	380 434
						Spain					
1981	12 825	3 106	298	2 228	277 818	14 500	5 262	83 000		-	399 037
1982	11 998	761	302	1 717	287 525	14 515	6 601	40 311		-	363 730
1983	11 106	126	473	1 243	234 000	14 229	5 840	22 975		-	289 992
1984	10 674	11	686	1 010	230 743	8 608	3 663	22 256		-	277 651
1985	13 418	23	1 019	4 395	211 065	7 846	3 335	62 489		4 330	307 920
1986	18 667	591	1 543	10 092	232 096	5 497	7 581	150 541		3 505	430 113
1987	15 036	1	986	7 035	268 004	16 223	10 957	202 314		2 515	523 071
1988	15 329	2 551	605	2 803	223 412	10 905	8 107	169 365		1 862	434 939
1989	15 625	3 231	326	3 291	158 684	7 802	7 056	134 593		1 273	332 481
1990	9 584	592	169	1 437	88 737	7 950	3 412	74 609		510	187 000
1991	8 981	975	**Greenland**	2 613	126 226	3 677	3 981	119 427 [3]		3 278	269 158
1992	11 663	2	3 337	3 911	168 460	6 217	6 120	182 315	**Iceland**	1 209	383 234
1993	17 435	3 572	5 389	5 887	221 051	8 800	11 336	244 860	9 374	3 907	531 611
1994	22 826	1 962	6 882	8 283	318 395	14 929	15 579	291 925	36 737	28 568	746 086
1995	22 262	4 912	7 462	7 428	319 987	15 505	16 329	296 158	34 214	15 742	739 999
1996	17 758	5 352	6 529	8 326	319 158	15 871	16 061	305 317	23 005	14 851	732 228
1997	20 076	5 353	6 426	6 680	357 825	17 130	18 066	313 344	4 200	13 303	762 403
1998	14 290	1 197	6 388	3 841	284 647	14 212	14 294	244 115	1 423	8 217	592 624
1999	13 700	2 137	4 093	3 019	223 390	8 994	11 315	210 379	1 985	5 898	484 910
2000	13 350	2 621	5 787	3 513	192 860	8 695	9 165	166 202	7 562	5 115	414 870
2001	12 500	2 681	5 727	4 524	188 431	9 196	8 698	183 572	5 917	5 225	426 471
2002	15 693	2 934	6 419	4 517	202 559	8 414	8 977	184 072	5 975	5 484	445 045
2003	19 427	2 921	7 026	4 732	191 977	7 924	8 711	182 160	5 963	6 149	436 990
2004	19 226	3 621	8 196	6 187	212 117	11 285	14 004	201 525	7 201	6 082	489 445
2005	16 273	3 491	8 135	5 848	207 825	9 349	10 744	200 077	5 874	7 660	475 276
2006	16 327	4 376	8 164	3 837	201 987	9 219	10 594	203 782	5 972	6 271	470 527
2007	14 788	3 190	5951	4619	199 809	9 496	9298	186 229	7316	5 101	445 796
2008	15 812	3 149	5 617	4 955	196 598	9 658	8 287	190 225	7 535	7 336	449 171
2009	16 905	3 908	4 977	8 585	224 298	12 013	8 632	229 291	7 380	7 442	523 431
2010	15 977	4 499	6 584	8 442	264 701	12 657	9 091	267 547	11 299	9 185	609 983
2011 [1]	13 429	1 173	7 155	4 621	331 535	13 291	8 210	310 326	12 734	17 354 [4]	719 829

[1] Provisional figures.
[2] USSR prior to 1991.
[3] Includes Baltic countries.
[4] Includes unspecified EU catches.

Table 3.4.1.3 Cod in Subareas I and II (Northeast Arctic cod). Summary of the assessment. Landings include unreported landings.

Year	Recruitment	SSB	Landings	Mean F
	Age 3			Ages 5-10
	thousands	tonnes	tonnes	
1946	728153	1112830	706000	0.1857
1947	425197	1165041	882017	0.3047
1948	442672	1019065	774295	0.3398
1949	468394	729858	800122	0.3619
1950	704902	615348	731982	0.3566
1951	1083765	568704	827180	0.3966
1952	1193117	520597	876795	0.5348
1953	1590386	396417	695546	0.3572
1954	641573	429693	826021	0.3879
1955	272785	346918	1147841	0.5437
1956	439609	299820	1343068	0.6401
1957	804793	207838	792557	0.5089
1958	496822	195377	769313	0.5169
1959	683686	432488	744607	0.5596
1960	789650	383478	622042	0.4789
1961	916839	404227	783221	0.6348
1962	728336	311676	909266	0.7576
1963	472070	208207	776337	0.9866
1964	338682	186570	437695	0.6789
1965	776925	102315	444930	0.5533
1966	1582567	120722	483711	0.5302
1967	1295405	129784	572605	0.5439
1968	164952	227214	1074084	0.5704
1969	112038	151870	1197226	0.8292
1970	197103	224482	933246	0.7493
1971	404768	311662	689048	0.5956
1972	1015331	346511	565254	0.6928
1973	1818945	332913	792685	0.6020
1974	523917	164491	1102433	0.5633
1975	621618	142028	829377	0.6595
1976	613942	171238	867463	0.6457
1977	348053	341385	905301	0.8379
1978	638492	241536	698715	0.9406
1979	198489	174698	440538	0.7264
1980	137736	108253	380434	0.7241
1981	150868	166925	399038	0.8632
1982	151830	326132	363730	0.7583
1983	166828	327181	289992	0.7560
1984	397854	251086	277651	0.9161
1985	523672	193855	307920	0.7038
1986	1038709	170729	430113	0.8649
1987	286365	121243	523071	0.9510
1988	204645	202589	434939	0.9743
1989	172780	234716	332481	0.6602
1990	242762	316418	212000	0.2710
1991	411745	704747	319158	0.3210
1992	721292	887567	513234	0.4550
1993	894864	775193	581611	0.5528
1994	783483	614890	771086	0.8677
1995	615764	528858	739999	0.7878
1996	439935	571871	732228	0.6983
1997	717325	588981	762403	1.0327
1998	846346	386598	592624	0.9147
1999	549795	293881	484910	0.9831
2000	613588	241295	414868	0.8430
2001	520652	356389	426471	0.7051
2002	454916	498812	535045	0.6798
2003	709786	551075	551990	0.5430
2004	310760	660436	606445	0.6765
2005	580529	616415	641276	0.6997
2006	602424	613470	537642	0.5819
2007	1345550	679620	486883	0.3578
2008	1180151	742736	464171	0.3101
2009	750030	1154345	523430	0.2430
2010	457192	1364521	609983	0.2301
2011	691437	1857157	719830	0.2644
2012	721000	2062626		
Average	625770	475934	651654	0.6176

Annex 3.4.1 Northeast Arctic Cod Management Agreement

At the 38th meeting of the Joint Russian–Norwegian Fisheries Commission (JRNFC) in November 2009, the previously used management plan was amended (marked in bold) and currently states:

"The Parties agreed that the management strategies for cod and haddock should take into account the following:

conditions for high long-term yield from the stocks
achievement of year-to-year stability in TACs
full utilization of all available information on stock development

On this basis, the Parties determined the following decision rules for setting the annual fishing quota (TAC) for Northeast Arctic cod (NEA cod):

estimate the average TAC level for the coming 3 years based on F_{pa}. TAC for the next year will be set to this level as a starting value for the 3-year period.

the year after, the TAC calculation for the next 3 years is repeated based on the updated information about the stock development, however the TAC should not be changed by more than +/- 10% compared with the previous year's TAC. ***If the TAC, by following such a rule, corresponds to a fishing mortality (F) lower than 0.30 the TAC should be increased to a level corresponding to a fishing mortality of 0.30.***

if the spawning stock falls below B_{pa}, the procedure for establishing TAC should be based on a fishing mortality that is linearly reduced from F_{pa} at B_{pa}, to F= 0 at SSB equal to zero. At SSB-levels below B_{pa} in any of the operational years (current year, a year before and 3 years of prediction) there should be no limitations on the year-to-year variations in TAC[1].

At the 39th Session of the Joint Russian–Norwegian Fisheries Commission in October 2010 it was agreed that the current management plan should be used 'for five more years' before it is evaluated.

[1] This quotation is taken from Annex 14 in the Protocol of the 38th Session of the Joint Russian–Norwegian Fisheries Commission and translated from Norwegian to English. For an accurate interpretation, please consult the text in the official languages of the Commission (Norwegian and Russian).

ECOREGION Barents Sea and Norwegian Sea
STOCK Cod in Subareas I and II (Norwegian coastal waters cod)

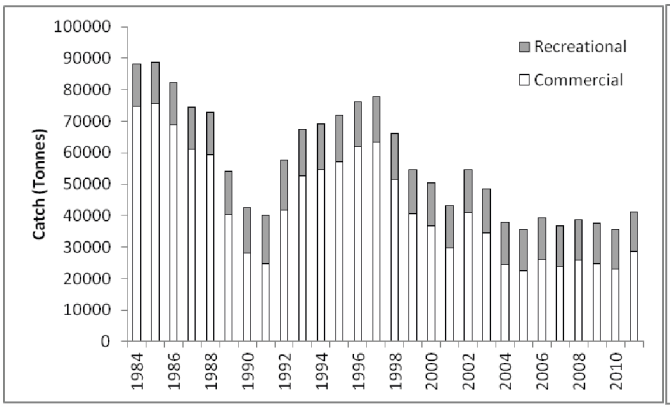
Advice for 2013

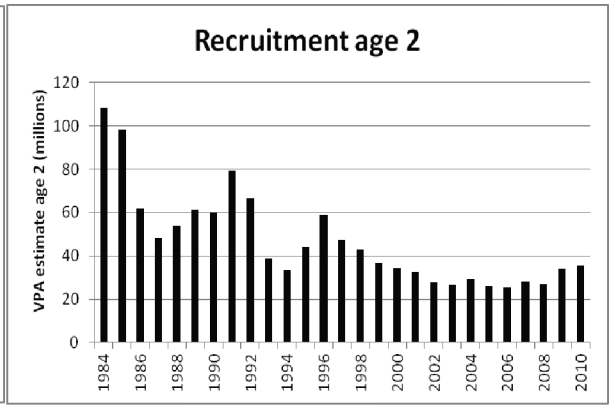
ICES advises on the basis of the Norwegian rebuilding plan which require 2012 autumn survey results available in December. If the spawning-stock index in the 2012 autumn survey is lower than the index in 2011, the fisheries regulations should aim at a reduction of F in 2013 of at least 30% relative to 2009. If the survey index is higher than in 2011, the measures taken in 2012 should continue in 2013.

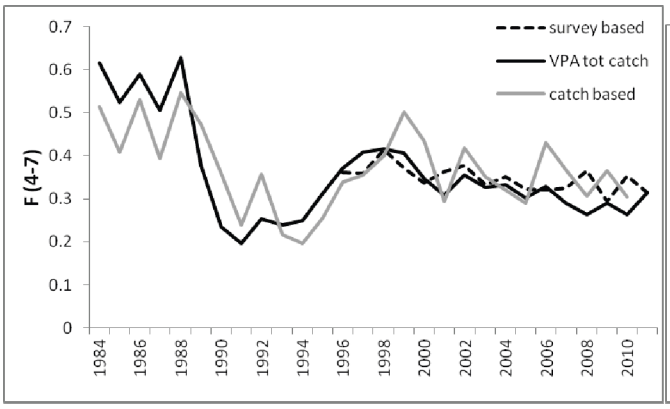
Stock status

F (Fishing Mortality)		2009–2011
MSY (F_{MSY})	?	Unknown
Precautionary approach (F_{pa},F_{lim})	?	Unknown
Qualitative evaluation	→	Variable without trend

SSB (Spawning-Stock Biomass)		2009–2011
MSY ($B_{trigger}$)	?	Unknown
Precautionary approach (B_{pa},B_{lim})	?	Unknown
Qualitative evaluation	✗	Close to its lowest







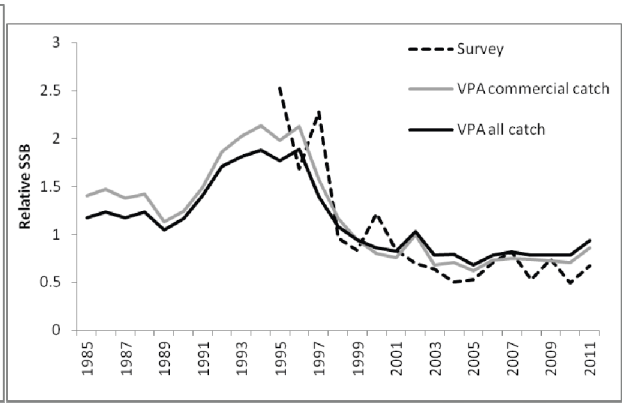


Figure 3.4.2.1 Cod in Subareas I and II (Norwegian coastal waters cod). Landings, recruitment, fishing mortality estimates, and relative SSB estimates (1 = average 1995–2010).

This is a trends-based assessment. The survey indicates that the SSB is close to its lowest value. Recruitment has remained low in recent years. F appears variable without a clear trend since 2000.

Management plans

A rebuilding plan as agreed by the Norwegian authorities (Annex 3.4.2) was evaluated by ICES in 2010 (ICES, 2010). ICES considers the proposed plan to be provisionally consistent with the precautionary approach.

Biology

Genetic studies indicate that the cod in some fjords may be separate stocks. An assessment of the combined stocks is not likely to detect fluctuations of the smaller components, and thereby the current assessment approach involves some risk to local stocks. The stock complex is still not fully mapped, but the existence of local stocks also calls for special attention to protect genetic diversity and smaller components.

The geographical distribution of coastal cod and Northeast Arctic cod overlap, particularly in the first half of the year, when the Northeast Arctic cod migrates to the Norwegian coast to spawn. Also, immature Northeast Arctic cod migrate to the Norwegian coast to feed on spawning capelin.

The fisheries

Catch distribution	Commercial landings (2011) = 28.6 kt (51% gillnets, 26% Danish seine, 21% longline/handline, and 2% bottom trawl). Unreported catches in recreational fishing were estimated at 12.7 kt in 2009.

Quality considerations

Estimated catches in the recreational fishery represented about 35% of the total catch in 2009. However, these estimates are not monitored on an annual basis and are considered to be uncertain.

Scientific basis

Assessment type	Based on survey trends.
Input data	Catch-at-age and an acoustic survey (coastal survey, NOcoast-Aco-4Q).
Discards and bycatch	Estimate of recreational catches available.
Indicators	F from VPA initiated with terminal F from regression with survey Z.
Other information	None.
Working group report	AFWG

ECOREGION Barents Sea and Norwegian Sea
STOCK Cod in Subareas I and II (Norwegian coastal waters cod)

Reference points

No reference points have been defined for this stock.

Outlook for 2013

A trends-based assessment is provided for this stock. No fishing possibilities can be projected on this basis.

Rebuilding plan

The rebuilding plan (Annex 3.4.2) was put into operation in 2011. The plan specifies the following reductions in fishing mortality:

Action year	1	2	3	4	5	6	7
Reduction of F relative to F_{2009}	15%	30%	45%	60%	75%	90%	100%

A new action year kicks in when the latest survey index for SSB is lower than the index in the second latest year (and at the same time the latest estimate of F is above 0.10).

The spawning biomass index in the 2010 survey was below the index in the 2009 survey. Thus 2011 was Action year 1. This means that the regulation in 2011 was aimed at a 15% reduction of F relative to F_{2009}. The 2011 survey gave a higher spawning-biomass index than in 2010, allowing the regulation for Action year 1 to continue in 2012.

If the spawning stock index in the 2012 autumn survey is lower than the index in 2011, the fisheries regulations should aim at a reduction of F in 2013 of at least 30% relative to 2009. If the survey index is above the 2011 index, the regulations should ensure that F in 2013 is at least 15% below the 2009 value. The trend for the stock appears stable. Therefore, a 30% reduction in F will imply a reduction of catches in 2013 of about 30% compared to the 2009 catch.

ICES has evaluated the plan and considers it to be provisionally consistent with the precautionary approach (ICES, 2010) but it has not been evaluated against the MSY framework.

MSY approach

The survey indicates that the SSB is stable and close to its lowest value while F appears variable without a clear trend since 2000. Therefore, catches should be reduced.

Additional considerations

Management considerations

In order to minimize catches of the Norwegian coastal cod, strong restrictions should apply to all fisheries catching cod where coastal cod mixes with Northeast Arctic cod. The Norwegian–Russian TAC system for cod (Northeast Arctic and coastal) does not in practice restrict the overall catches of coastal cod. From the mid-1970s to 2003 an expected catch of 40 000 t from the coastal cod was added annually to the quota for Northeast Arctic cod. Since 2004, the additional catches expected from this stock has been set around 20 000 t.

The implementation of the rebuilding plan requires measures to further reduce the effective fishing effort in all fisheries where coastal cod are caught, including recreational fisheries. The regulations introduced over the period 2004–2009 may have just marginally reduced F compared to the preceding years. There are no evidences that the regulations in 2011 have succeeded in obtaining the 15% reduction in F implied by the rebuilding plan. Catches in 2011 increased compared to 2010 and are 10% higher than the 2009 catches instead of 15% lower as prescribed in the plan. Stronger measures are required to obtain the reductions in F specified in the rebuilding plan.

Regulations and their effects

Landings of cod are counted against the overall cod TAC for Norway, where the expected catch of coastal cod is in the order of 10%. Catches of coastal cod are thereby not effectively restricted by quotas. The fishery is regulated by the same minimum size, the same minimum mesh size on fishing gears as for Northeast Arctic cod, maximum bycatch of undersized fish, closure of areas having high densities of juveniles, and by seasonal and area restrictions. In addition to the mixed fishery with Northeast Arctic cod, coastal cod is also caught as bycatch in the saithe fishery.

A number of regulations are aimed at the protection of coastal cod: Trawl fishing for cod is not allowed inside the 6-nautical mile line except for about ten fresh-fish trawlers which in a few areas had a dispensation until autumn 2010 to fish between the 4- and 6-mile line in the period 15 April–15 September. In 2011 no dispensations were given for fresh fish trawlers to fish inside 6 nautical miles. Since the mid-1990s the fjords in Finnmark and northern Troms (areas 03 and 04) have been closed for fishing with Danish seine. Since 2000, the large longliners have been restricted to fishing outside the 4-nautical mile line. To achieve a reduction in landings of coastal cod additional technical regulations in coastal areas were introduced in May 2004 (after the main fishing season) and continued with small modifications in 2005 and 2006. In the new regulations "fjord lines" are drawn to close the fjords for direct cod fishing with vessels larger than 15 meters. A box closed to all fishing gears except handline and fishing rod is defined in the Henningsvær–Svolvær area. This is an area where spawning concentrations of coastal cod is usually observed and where the catches of coastal cod has been high. Since the coastal cod is fished under a merged coastal cod/Northeast Arctic cod quota, the main objective of these regulations is to move the traditional coastal fishery from areas with high fractions of coastal cod to areas where the proportion of Northeast Arctic cod is higher.

Further restrictions were introduced in 2007 by not allowing pelagic gillnet fishing for cod and by reducing the allowed bycatch of cod when fishing for other species inside fjord lines from 25% to 5%, and outside fjord lines from 25% to 20%. The regulations were maintained in 2008. In addition, since 2009 the most important spawning area in the southern part of the stock distribution area (Borgundfjorden near Ålesund) has been closed to fishing (except for handline and fishing rod) during the spawning season.

The 2011 commercial landings were estimated to be 28 600 t, i.e. above the expected catch (21 000 t) set at the quota agreement. The regulations have not reduced catches, and current catches are considered to be too high.

In the recreational fishery the allowance for selling cod is reduced from 2000 kg to 1000 kg per person per year. The maximum gill net length per person in the recreational fishery is reduced from 210 m to 165 m. Minimum size now also applies to recreational and tourist fishing. For cod this is set to 44 cm in the area north of 62°N. In 2010 and 2011 7000 t of the Norwegian cod quota was set aside to cover the catches taken in the recreational and tourist fisheries and to cover catches taken by young fishers (to motivate young people to become fishers).

Some reallocation of unfished quotas late in the year in 2011 lead to increased cod catches for parts of the coastal fleet, thereby increasing the catch of coastal cod.

Information from the fishing industry

Since 2005, a reference fleet of coastal vessels, mainly gillnetters, provide regular sampling data for length, age, and stock separation. These data are used to estimate catch-at-age for the corresponding fleets.

Uncertainties in assessment and forecast

Estimated catches in the recreational fishery have been added to the commercial catch. These represented about 30-35% of the total catch as estimated in 2009. The accuracy of this estimate was not available. Changes in the landings sampling programme lead to increased uncertainty in the estimated quantity and age composition of commercial catches of coastal cod in 2010. The sampling improved somewhat in 2011.

The catches and survey indices are estimated by distinguishing between coastal cod and Northeast Arctic cod through the inspection of the otoliths. The precision and accuracy of the method has been investigated by comparison of different otolith readers and results from genetic investigation. The results indicate high accuracy when using the otolith method, but the adequacy of sampling has not been investigated.

Comparison with previous assessment and advice

The stock situation is similar to last year. As in last year, the advice is based on the rebuilding plan, which provisionally is considered to be in accordance with the precautionary approach.

Sources

ICES. 2010. Report of the ICES Advisory Committee, 2010. ICES Advice, 2010. Book 3, Section 3.3.3.1, pp. 3–5.
ICES. 2011. Report of the Arctic Fisheries Working Group, 28 April–4 May 2011. ICES CM 2011/ACOM:05.
ICES. 2012. Report of the Arctic Fisheries Working Group, 20 April–26 April, 2012. ICES CM 2012/ACOM:05.

Table 3.4.2.1 Cod in Subareas I and II (Norwegian coastal waters cod). ICES advice, management, and landings.

Year	ICES Advice	Predicted catch corresp.to advice	Agreed TAC[1]	Official landings[3]	ICES landings[2]
1987	Not assessed		40		61
1988	Not assessed		40		59
1989	No advice		40		40
1990	No advice		40		28
1991	Included in TAC for Subareas I and II		40		25
1992	Shot forecast included in TAC for I and II		40		42
1993	Shot forecast included in TAC for I and II		40		53
1994	No advice		40		55
1995	No advice		40		57
1996	No advice		40		62
1997	No advice		40		63
1998	No advice		40		52
1999	No advice		40		41
2000	No advice		40		37
2001	Reduce F considerably	22	40		30
2002	catches should be reduced by the same proportion as for Northeast Arctic cod	13	40		41
2003	Reduce F considerably	8	40		35
2004	A recovery plan	0	20		24
2005	A recovery plan	0	21		22
2006	A recovery plan	0	21		26
2007	A recovery plan	0	21		23
2008	A recovery plan	0	21		26
2009	Zero catch and a recovery plan	0	21		25
2010	Zero catch and a recovery plan	0	21		23
2011	Same advice as last year	0	21[4]		29
2012	Rebuilding plan, action dependent on autumn survey	-	21[4]		
2013	Rebuilding plan, action dependent on autumn survey				

Weights in thousand tonnes.
[1] Until 2003 40 000 tonnes were added annually to the agreed TAC of Northeast Arctic cod; 20 000 t were added in 2004 and 21 000 t in 2005–2012.
[2] Estimated according to otolith type, does not include estimated recreational catches.
[3] No official landings.
[4] Additional regulations were introduced to meet the objectives of the recovery plan, while the 21 000 t were still included in the combined TAC for coastal cod and NEA cod.

Annex 3.4.2 Rebuilding plan

The rebuilding plan, as communicated to ICES by the Norwegian Ministry of Fisheries and Coastal Affairs, states:

"The overarching aim is to rebuild the stock complex to full reproductive capacity, as well as to give sufficient protection to local stock components. Until a biologically founded rebuilding target is defined, the stock complex will only be regarded as restored when the survey index of spawning stock in two successive years is observed to be above 60 000 tons[1]*. Importantly, this rebuilding target will be redefined on the basis of relevant scientific information. Such information could, for instance, include a reliable stock assessment, as well as an estimate of the spawning stock corresponding to full reproductive capacity.*

Given that the survey index for SSB does not increase, the regulations will aim to reduce F[2] *by at least 15 per cent annually compared to the F estimated for 2009. If, however, the latest survey index of SSB is higher than the preceding one – or if the estimated F for the latest catch year is less than 0.1 – the regulations will be unchanged.*

Special regulatory measures for local stock components will be viewed in the context of scientific advice. A system with stricter regulations inside fjords than outside fjords is currently in operation, and this particular system is likely to be continued in the future.

The management regime employed is aiming for improved ecosystem monitoring in order to understand and possibly enhance the survival of coastal cod. Potential predators are – among others – cormorants, seals and saithe.

When the rebuilding target is reached, a thorough management plan is essential. In this regard, the aim will be to keep full reproductive capacity and high long-term yield."

[1] The average survey index in the years 1995–1998.
[2] Ages 4–7.

ECOREGION Barents Sea and Norwegian Sea
STOCK Haddock in Subareas I and II (Northeast Arctic)

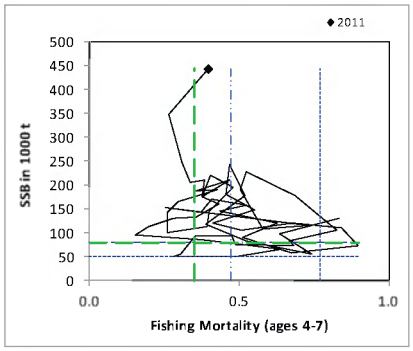
Advice for 2013

ICES advises on the basis of the Joint Russian–Norwegian Fisheries Commission management plan that catches in 2013 should be no more than 238 000 t.

Stock status

F (Fishing Mortality)	2009	2010	2011	
MSY (F_{MSY})	✓	✓	✓	Appropriate
Precautionary approach (F_{pa},F_{lim})	✓	✓	✓	Harvested sustainably
Management plan (F_{MP})	✓	✓	✓	Above target Within target range

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



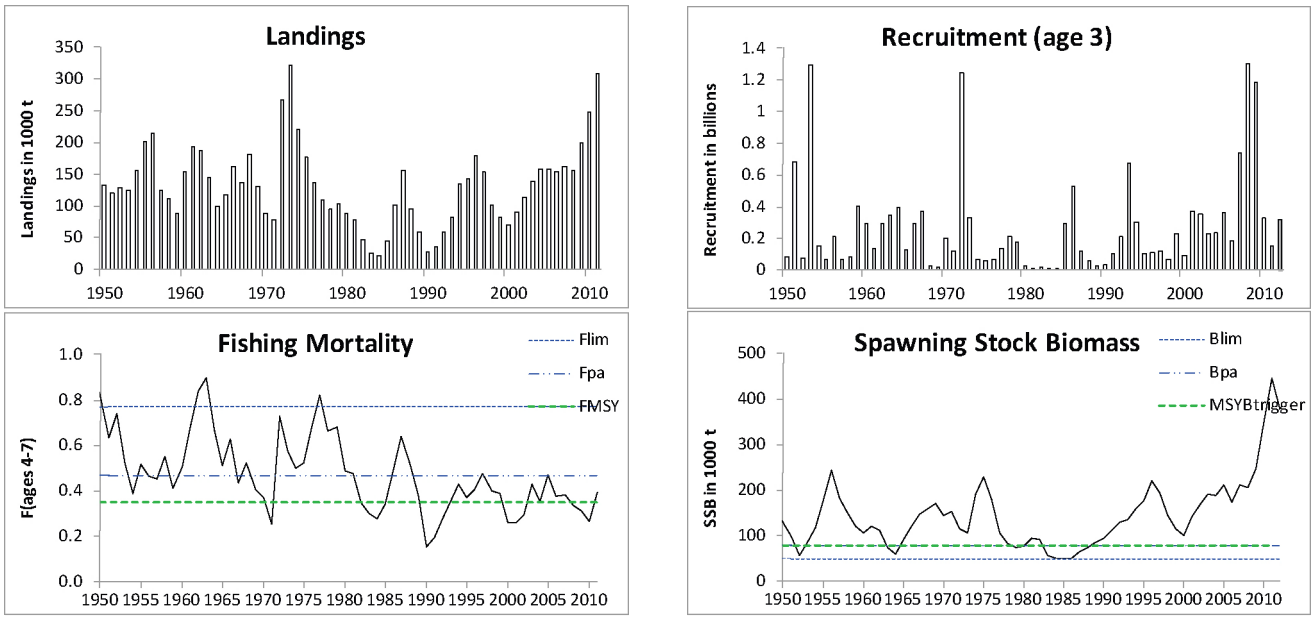


Figure 3.4.3.1 Haddock in Subareas I and II (Northeast Arctic). Summary of stock assessment (weights in thousand tonnes). Top right: SSB/F for the time-series used in the assessment.

The SSB has been above MSY $B_{trigger}$ since 1990, increasing since 2000 and reaching the series maximum in 2011. Fishing mortality has been around F_{MSY} since the mid-1990s. Recruitment-at-age 3 has been at or above average since 2000. The year classes 2004–2006 are estimated to be very strong and are now dominating the spawning stock. Surveys indicate that the year classes 2008 and 2010 are below average, while 2009 and 2011 year classes are above average.

Management plans

A management plan has been agreed upon by the Joint Russian–Norwegian Fisheries Commission in 2004 (see Annex 3.4.3). It was modified in 2007 from a three-year rule to a one-year rule on the basis of the harvest control rule (HCR) evaluation conducted by ICES. The plan is to be used until 2015. ICES has evaluated the modified management plan

and concluded that it is in accordance with the precautionary approach and not in contradiction with the maximum sustainable yield (MSY) framework.

Biology

Haddock can vary their diet and eat fish, plankton, or benthos. During the spawning migration of capelin, haddock prey on capelin and their eggs on the spawning grounds. When the capelin abundance is low or when their areas do not overlap, haddock can compensate for the lack of capelin with other fish species such as young herring, or with euphausiids and benthos, which are predominant in the haddock diet throughout the year. Density-dependent growth has been observed for this stock and the present growth rate is low. Cod is the main predator on haddock and this predation is included in the natural mortality used in the assessment. The predation by cod on haddock has been high in recent years due to the large cod stock size.

Environmental influence on the stock

Variation in the recruitment of haddock has been associated with changes in the influx of Atlantic waters to the Barents Sea. Water temperature in the first and second years of the haddock life cycle is one of the factors that determine year-class strength; the probability of good recruitment is very low when the temperature is low. Additionally, a steep rise or fall of the water temperature shows a marked effect on the abundance of year classes. This information on environmental influence is not yet taken into account in the assessment. The distribution area of cod has expanded northwards and eastwards in recent years and is now the widest ever reported, stretching from northwest of Spitsbergen to the entrance to the Kara Sea in the southeast.

The fisheries

Haddock is mainly fished by trawl as bycatch in the fishery for cod, with some directed fisheries by longline and trawl.

TAC regulations are in place. Unreported catches have decreased in recent years and were close to zero in 2009–2011. Discarding is illegal in Norway and Russia. Data on discarding are scarce, but attempts to obtain better quantification continue. The fisheries are controlled by inspections at sea, by a requirement to report to catch control points when entering and leaving the EEZs to land fish, and by VMS satellite tracking for some fleets.

Catch distribution	Total landings (2011) = 310 kt, where 100% are landings (73% trawl, 17% longline, and 10% other gear types).

Quality considerations

The uncertainties in this assessment relate both to catch and survey data. Unreported catches (illegal, unregulated, and unreported (IUU)) have been a problem in recent years, but do not affect the data collected in 2009–2011. Due to technical problems with a Norwegian survey vessel the spatial coverage in the 2012 Joint winter survey was incomplete.

Norwegian sampling of commercial catches is believed to be less precise because of the termination of a Norwegian port sampling programme in mid-2009. The poor sampling caused problems in estimating Norwegian catches for the oldest ages in 2010. A small Norwegian port sampling programme from 2011 and onwards and an expansion of the high seas reference fleet has improved the situation somewhat. But there is still a lack of samples from certain gears and areas and the working group recommends an increase in port sampling effort.

Russian sampling of commercial catches has also shown a declining trend.

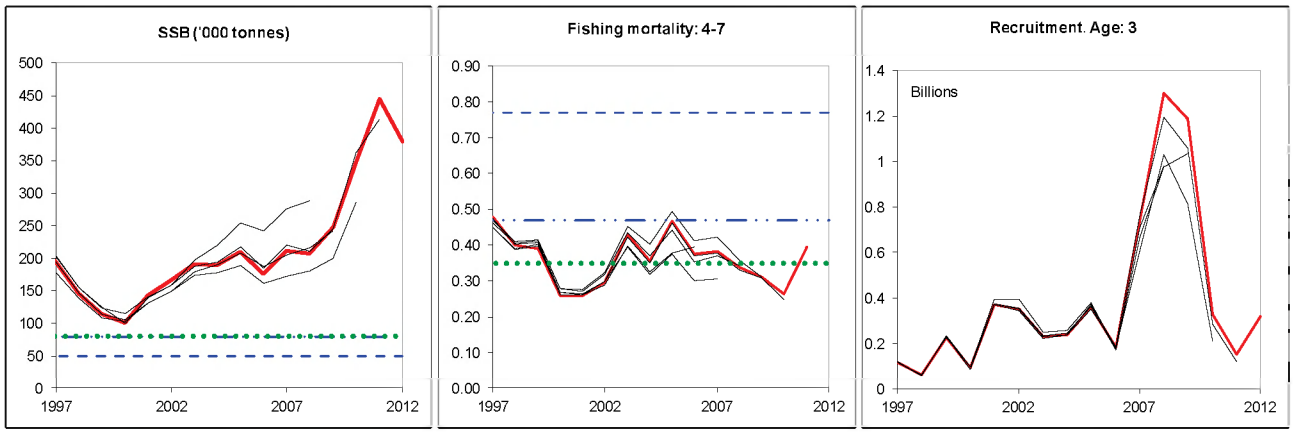


Figure 3.4.3.2 Haddock in Subareas I and II (Northeast Arctic). Historical assessment results (final-year recruitment estimates included).

Scientific basis

Assessment type	Age-based analytical assessment XSA.
Input data	Four tuning fleets were used: Russian bottom trawl survey (RU-BTr-Q4); Joint Barents Sea survey – acoustic (BS-NoRU-Q1(Aco)); Joint Barents Sea survey – bottom trawl (BS-NoRu-Q1 (BTr)); Joint Russian–Norwegian ecosystem autumn survey in the Barents Sea – bottom trawl (Eco-NoRu-Q3 (Btr)). Data on cod consumption of age 0–6 haddock is available from 1984.
Discards and bycatch	Discards are not included.
Indicators	None.
Other information	None.
Working group report	AFWG

ECOREGION Barents Sea and Norwegian Sea
STOCK Haddock in Subareas I and II (Northeast Arctic)

Reference points

	Type	*Value*	*Technical basis*
Management Plan	SSB_{MP}	80 000 t	B_{pa}. TAC is linearly reduced from F_{pa} at SSB = B_{pa} to 0 at SSB equal to zero.
	F_{MP}	0.35	Previous F_{pa} estimated prior to the revision of the historical time-series for this stock.
MSY Approach	MSY $B_{trigger}$	80 000 t	B_{pa}.
	F_{MSY}	0.35	Stochastic long-term simulations.
Precautionary Approach	B_{lim}	50 000 t	B_{loss}.
	B_{pa}	80 000 t	B_{lim}*exp (1.645*0.3).
	F_{lim}	0.77	Corresponds to SPR value of slope of line from origin at SSB = 0 to geometric mean recruitment at SSB = B_{lim}.
	F_{pa}	0.47	F_{lim}*exp (−1.645*0.3).

(unchanged in 2011)

Yield and spawning biomass per Recruit F-reference points (2012):

	Fish Mort Ages 4–7	Yield/R	SSB/R
Average last 3 years	0.32	0.30	0.43
F_{max}*	-	-	-
$F_{0.1}$	0.26	0.28	0.56
$F_{35\%SPR}$	0,16	0.24	0.87
F_{med}	0.16	0.24	0.87

*F_{max} is not well defined.

Outlook for 2013

Basis: $F_{2012} = F_{2011} = 0.39$; SSB (2013) = 311; R (2012) = 317 million; landings (2012) = 246.

Rationale	**Landings (2013)**	**Basis**	**F (2013)**	**SSB (2014)**	**%SSB change[1)]**	**%TAC change[2)]**
Management plan[3)]	238	F_{MP}	0.61	188	-40	-25
MSY Framework	154	F_{MSY}	0.35	252	-19	-52
Precautionary approach	195	F_{pa}	0.47	220	-29	-39
Zero catch	0	F = 0	0	375	+21	-100
Status quo	170	F_{sq}	0.39	240	-23	-47

Weights in thousand tonnes.
[1)] SSB 2014 relative to SSB 2013.
[2)] Catch 2013 relative to TAC 2012.
[3)] Forecast based on F_{MSY}.

Management plan

The current HCR is based on F_{MSY}. ICES advises the continued use of the HCR with target F = 0.35 and maximum +/- 25% change in TAC compared with the previous year's TAC. This implies F_{MP} = 0.61 in 2013, corresponding to landings of 238 000 t in 2013, which is expected to keep SSB above B_{pa} in 2014. The harvest control rule contains a 25% limit on change in TAC when the stock is above B_{pa}. Under certain circumstances this will lead to advisory F values substantially higher than F_{MSY}; this is expected to occur in 2013 due to three very large year classes followed by average recruitment.

MSY approach

Fishing at F_{MSY} = 0.35 in 2013 corresponds to landings of no more than 154 000 t. This is expected to keep SSB above MSY $B_{trigger}$ in 2014.

Precautionary approach

The fishing mortality in 2013 should be no more than F_{pa}, corresponding to landings of less than 195 000 t in 2013. This is expected to keep SSB above B_{pa} in 2014.

Additional considerations

Non-reported landings (IUU) for the period 2002–2008 were estimated as ranging from 6 kt to 40 kt (between 4% and 34% of the international reported landings). The IUU estimate for 2009–2011 is zero.

Regulations and their effects

The fishery is regulated by TACs. The fishery is also regulated by a minimum fish size, a minimum mesh size in trawls and Danish seine, a maximum bycatch of undersized fish, maximum bycatch of non-target species, closure of areas with high density of juveniles, and other area and seasonal restrictions. Since January 1997, sorting grids have been mandatory for the trawl fisheries in most of the Barents Sea and Svalbard area.

A real-time closure system has been in force along the Norwegian coast and in the Barents Sea since 1984, aimed at protecting juvenile fish. Based on scientific research vessel data and mapping of areas by hired fishing vessels, fishing is prohibited in areas where the proportion by number of undersized cod, haddock, and saithe combined has been observed by inspectors to exceed 15% (the size limits vary by species). The time of notice before a closure of an area comes into force is 2–4 hours for national vessels and 7 days for foreign vessels. Before or parallel to a closure, the Coast Guard requests vessels not to fish in an area where too many small fish have been observed during their inspections. A closed area is not opened until it is documented to be low in juvenile fish by trial fishing within the area by the Surveillance Service.

In addition to the temporary closed areas, some areas are permanently closed, either to protect juvenile cod and haddock (around Bear Island) or to reduce fishing pressure on coastal cod and to avoid gear conflicts. The use of selective gear technology in the demersal fisheries since 1997 has also reduced the catch and possible discarding of juveniles.

From 1 January 2011 onwards, the minimum mesh size for bottom trawl fisheries for cod and haddock is 130 mm for the entire Barents Sea (before 2011 it was 135 mm in the Norwegian EEZ and 125 mm in the Russian EEZ). This change is expected to have a minor impact on the total exploitation pattern for this stock; thus, a recent average exploitation pattern is used in the predictions.

From 1 January 2011, the technical regulations for the demersal fisheries were harmonized so that they now are the same in the Norwegian and Russian EEZs. The present minimum size is 40 cm for haddock (previously it was 44 cm in the Norwegian EEZ and 39 cm in the Russian EEZ). The maximum allowable percentage of fish below the minimum size is 15% by number of cod, haddock, and saithe combined in the Norwegian EEZ, and 15% by number of cod and haddock combined in the Russian EEZ. Previously, the maximum percentage was 15% for each species (cod and haddock) in the Russian EEZ. The effect of these changes is expected to be small as long as the fishing mortality is kept low, as implied by the agreed harvest control rule.

The fisheries are controlled by inspections of the trawler fleet at sea, by a requirement to report catches at control points when entering and leaving the EEZs, and by inspections of all fishing vessels when landing the fish. Keeping a detailed fishing logbook on board is mandatory for most vessels, and large parts of the fleet report to the authorities on a daily basis. Discarding is prohibited both in Russian and in Norwegian waters. However, discarding of haddock just below the minimum size is known to be a problem in the longline and trawl fisheries when those fish are abundant.

Data and methods

Varying natural mortality caused by predation from cod is taken into account in the assessment.

Information from the fishing industry

A reference fleet of Norwegian vessels provide regular sampling data for length and age. These data are used to estimate catch-at-age for the corresponding fleets. Russian fishing vessels with observers on board provide similar information on catch-length distribution and sample fish to receive data on length–age matrices.

Uncertainties in assessment and forecast

There are no estimates of discarding, but there is known to be a discarding problem in the longline and trawl fisheries. Assuming F *status quo* in the intermediate year (2012) gives a catch which is 23% lower than the TAC.

Comparison with previous assessment and advice

The current assessment estimated the total stock to be about 3% higher and the SSB 7% higher in 2011 compared to the estimates in the previous assessment. F in 2010 is 6% higher than that estimated last year.

The basis for the advice is the same as last year.

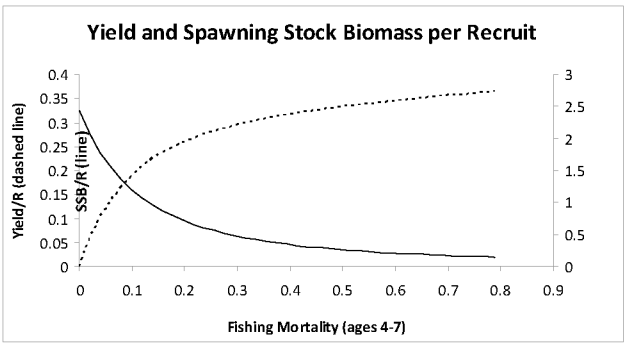
Sources

ICES. 2011a. Report of the Workshop on Implementing the ICES F_{MSY} Framework. 10–14 January 2011, ICES, Denmark. ICES CM 2011/ACOM:33.

ICES. 2011b. Report of the Arctic Fisheries Working Group. 28 April–4 May 2011. ICES CM 2011/ACOM:05.

ICES. 2011c. Report of the Benchmark Workshop on Roundfish and Pelagic Stocks (WKBENCH 2011). 24–31 January 2011, Lisbon, Portugal. ICES CM 2011/ACOM:38. 418 pp.

ICES. 2012. Report of the Arctic Fisheries Working Group. 20 April–26 April 2012. ICES CM 2012/ACOM:05.



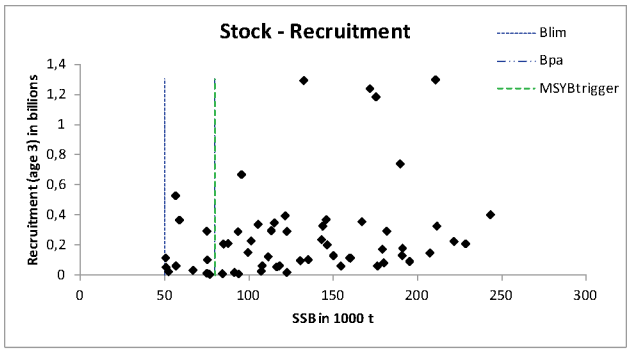


Figure 3.4.3.3 Haddock in Subareas I and II (Northeast Arctic). Yield-per-recruit analysis and stock–recruitment plot.

Table 3.4.3.1 Haddock in Subareas I and II (Northeast Arctic). ICES advice, management, and landings.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings[1]	Unreported landings (included in ICES landings)	ICES landings[1]
1987	No increase in F; TAC	160	250	155		155
1988	No increase in F	< 240	240	95		95
1989	Large reduction in F	69	83	59		59
1990	No directed fishery	-	25	27		27
1991	No directed fishery	-	28	36		36
1992	Within safe biological limits	35[2]	63	60		60
1993	No long-term gains in increasing F	56[2]	72	82		82
1994	No long-term gains in $F>F_{med}$	97[3]	120	135		135
1995	No long-term gains in $F>F_{med}$	122[3]	130	142		142
1996	No long-term gains in $F>F_{med}$	169[3]	170	178		178
1997	Well below F_{med}	< 242	210	154		154
1998	Below F_{med}	< 120	130	101		101
1999	Reduce F below F_{pa}	< 74	78	83		83
2000	Reduce F below F_{pa}	< 37	62	69		69
2001	Reduce F below F_{pa}	< 66	85	90		90
2002	Reduce F below F_{pa}	< 64	85	96	19	115
2003	Reduce F below F_{pa}	< 101	101	106	33	139
2004	Reduce F below F_{pa}	< 120	130	125	34	158
2005	Reduce F below F_{pa}	< 106	117	118	40	158
2006	Reduce F below F_{pa}	< 112	120	132	21	153
2007	Limit catches	< 130	150	147	15	162
2008	Limit catches to 2001–2004 average	< 130	155	150	6	156
2009	Apply management plan	< 194	194	200	0	200
2010	Apply management plan	< 243	243	249	0	249
2011	Apply management plan	< 303	303	310	0	310
2012	Apply management plan	< 318	318			
2013	Apply management plan	<238				

Weights in thousand tonnes.
[1] Haddock in Norwegian statistical areas 06 and 07 are included.
[2] Unreported landings in 2002–2008 are included.
[3] Predicted landings at F_{med}.

Table 3.4.3.2 Haddock in Subareas I and II (Northeast Arctic). Total nominal catch (t) by fishing areas. (Data provided by Working Group members).

Year	Subarea I	Division IIa	Division IIb	un-reported[2]	Total[3]	Used in assessment	Norw. stat. areas 06 and 07[4]
1960	125026	27781	1844	-	154651	154651	6000
1961	165156	25641	2427	-	193224	193224	4000
1962	160561	25125	1723	-	187409	187408	3000
1963	124332	20956	936	-	146224	146224	4000
1964	79262	18784	1112	-	99158	99158	6000
1965	98921	18719	943	-	118583	118578	6000
1966	125009	35143	1626	-	161778	161778	5000
1967	107996	27962	440	-	136398	136397	3000
1968	140970	40031	725	-	181726	181726	3000
1969	89948	40306	566	-	130820	130820	2000
1970	60631	27120	507	-	88258	88257	-
1971	56989	21453	463	-	78905	78905	-
1972	221880	42111	2162	-	266153	266153	-
1973	285644	23506	13077	-	322227	322226	-
1974	159051	47037	15069	-	221157	221157	10000
1975	121692	44337	9729	-	175758	175758	6000
1976	94054	37562	5648	-	137264	137264	2000
1977	72159	28452	9547	-	110158	110158	2000
1978	63965	30478	979	-	95422	95422	2000
1979	63841	39167	615	-	103623	103623	6000
1980	54205	33616	68	-	87889	87889	5098
1981	36834	39864	455	-	77153	77153	4767
1982	17948	29005	2	-	46955	46955	3335
1983	5837	16859	1904	-	24600	24600	3112
1984	2934	16683	1328	-	20945	20945	3803
1985	27982	14340	2730	-	45052	45052	3583
1986	61729	29771	9063	-	100563	100563	4021
1987	97091	41084	16741	-	154916	154916	3194
1988	45060	49564	631	-	95255	95255	3756
1989	29723	28478	317	-	58518	58518	4701
1990	13306	13275	601	-	27182	27182	2912
1991	17985	17801	430	-	36216	36216	3045
1992	30884	28064	974	-	59922	59922	5634
1993	46918	32433	3028	-	82379	82379	5559
1994	76748	50388	8050	-	135186	135186	6311
1995	75860	53460	13128	-	142448	142448	5444

1996	112749	61722	3657	-	178128	178128	5126
1997	78128	73475	2756	-	154359	154359	5987
1998	45640	53936	1054	-	100630	100630	6338
1999	38291	40819	4085	-	83195	83195	5743
2000	25931	39169	3844	-	68944	68944	4536
2001	35072	47245	7323	-	89640	89640	4542
2002	40721	42774	12567	18736/5310	114798/101372	114798	6898
2003	53653	43564	8483	33226/9417	138926/115117	138926	4279
2004	64873	47483	12146	33777/8661	158279/133163	158279	3743
2005	53518	48081	16416	40283/9949	158298/127964	158298	5538
2006	51124	47291	33291	21451/8949	153157/140655	153157	5410
2007	62904	58141	25927	14553/3102	161525/150074	161525	7110
2008	58379	60178	31219	5828/-	155604/149776	155604	6629
2009	57723	66045	76293	0	200061	200061	4498
2010	62604	86279	100318	0	249200	249200	3770
2011[1]	86951	99324	123600	0	309874	309874	4578

[1] Provisional figures. [2] USSR prior to 1991. [3] Figures based on Norwegian/Russian IUU estimates.
[4] Landings in Norwegian statistical areas 06 and 07 (from 1983) are included.

Table 3.4.3.3 Haddock in Subareas I and II (Northeast Arctic). Summary of the assessment.

Year	Recruitment Age 3 thousands	SSB tonnes	Landings tonnes	Mean F Ages 4–7
1950	83777	132405	132125	0.8325
1951	685114	99224	120077	0.633
1952	75457	56525	127660	0.742
1953	1296180	84705	123920	0.522
1954	154657	117926	156788	0.3872
1955	65108	179834	202286	0.52
1956	211035	243114	213924	0.4658
1957	66005	181643	123583	0.4532
1958	86262	149938	112672	0.5518
1959	405538	122328	88211	0.4105
1960	296038	105210	154651	0.506
1961	133694	121379	193224	0.679
1962	293925	111232	187408	0.84
1963	341919	74756	146224	0.8968
1964	399059	58530	99158	0.672
1965	126871	91108	118578	0.5122
1966	296726	122326	161778	0.6272
1967	369466	146241	136397	0.4368
1968	22556	159667	181726	0.5242
1969	22059	171606	130820	0.406
1970	204309	143577	88257	0.3718
1971	119042	154417	78905	0.2518
1972	1241920	116388	266153	0.7298
1973	329506	107678	322226	0.5778
1974	64722	190687	221157	0.5022
1975	59386	228397	175758	0.5242
1976	66851	179055	137264	0.684
1977	134855	107145	110158	0.8245
1978	212456	84114	95422	0.6662
1979	176240	74953	103623	0.6835
1980	30836	76563	87889	0.4878
1981	13702	93711	77153	0.4742
1982	16901	93336	46955	0.3505
1983	9294	56273	24600	0.3025
1984	12187	50410	20945	0.2795
1985	293453	50619	45052	0.3398
1986	531442	52070	100563	0.4908
1987	118589	66673	154916	0.6392
1988	56167	75127	95255	0.5092
1989	27448	87489	58518	0.3748
1990	36742	95399	27182	0.153
1991	105998	113057	36216	0.1975
1992	214813	130240	59922	0.2795
1993	671488	134968	82379	0.3562
1994	299849	160116	135186	0.4322
1995	100466	176035	142448	0.374
1996	107553	221524	178128	0.4045
1997	117151	195133	154359	0.479
1998	64811	145638	100630	0.4002
1999	228449	114921	83195	0.391
2000	95397	101100	68944	0.2598
2001	373317	142922	89640	0.26
2002	351091	166877	114798	0.2972
2003	231920	190991	138926	0.4288
2004	239247	189608	158279	0.3562
2005	359434	210523	158298	0.4682
2006	183233	175232	153157	0.376
2007	743256	211369	161525	0.3828
2008	1300846	207177	155604	0.3378
2009	1187060	248075	200061	0.31
2010	329645	349502	249200	0.264
2011	151339	444837	309874	0.3942
2012	317000	373646		
Average	268449	141026	131934	0.4723

Annex 3.4.3 Management plan

The current HCR for haddock is as follows (see details in Protocol of the 40th Session of the Joint Russian–Norwegian Fisheries Commission, 14 October 2011):

- *TAC for the next year will be set at level corresponding to Fmsy.*
- *The TAC should not be changed by more than ±25% compared with the previous year TAC.*
- *If the spawning stock falls below Bpa, the procedure for establishing TAC should be based on a fishing mortality that is linearly reduced from Fmsy at Bpa to F= 0 at SSB equal to zero. At SSB-levels below Bpa in any of the operational years (current year and a year ahead) there should be no limitations on the year-to-year variations in TAC.*

At the 39th Session of the Joint Russian–Norwegian Fisheries Commission in 2010 it was agreed that the current management plan should be used "for five more years" before it is evaluated.

ECOREGION Barents Sea and Norwegian Sea
STOCK Saithe in Subareas I and II (Northeast Arctic)

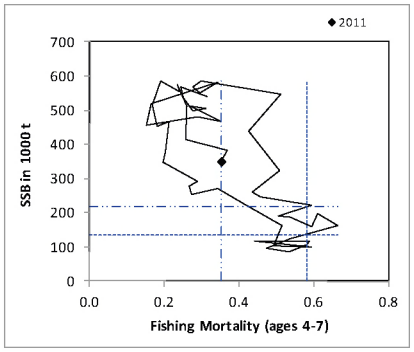
Advice for 2013

ICES advises on the basis of the management plan implemented by the Norwegian Ministry of Fisheries and Coastal Affairs that catches in 2013 should be no more than 164 000 t. Bycatches of coastal cod and *Sebastes marinus* should be kept as low as possible.

Stock status

F (Fishing Mortality)	2009	2010	2011
MSY (F_{MSY})	?	?	? Undefined
Precautionary approach (F_{pa},F_{lim})	✓	✓	✓ Harvested sustainably
Management plan (F_{MP})	✓	✓	✓ At target

SSB (Spawning-Stock Biomass)	2010	2011	2012
MSY ($B_{trigger}$)	?	?	? Undefined
Precautionary approach (B_{pa},B_{lim})	✓	✓	✓ Full reproductive capacity
Management plan (SSB_{MP})	✓	✓	✓ Above trigger



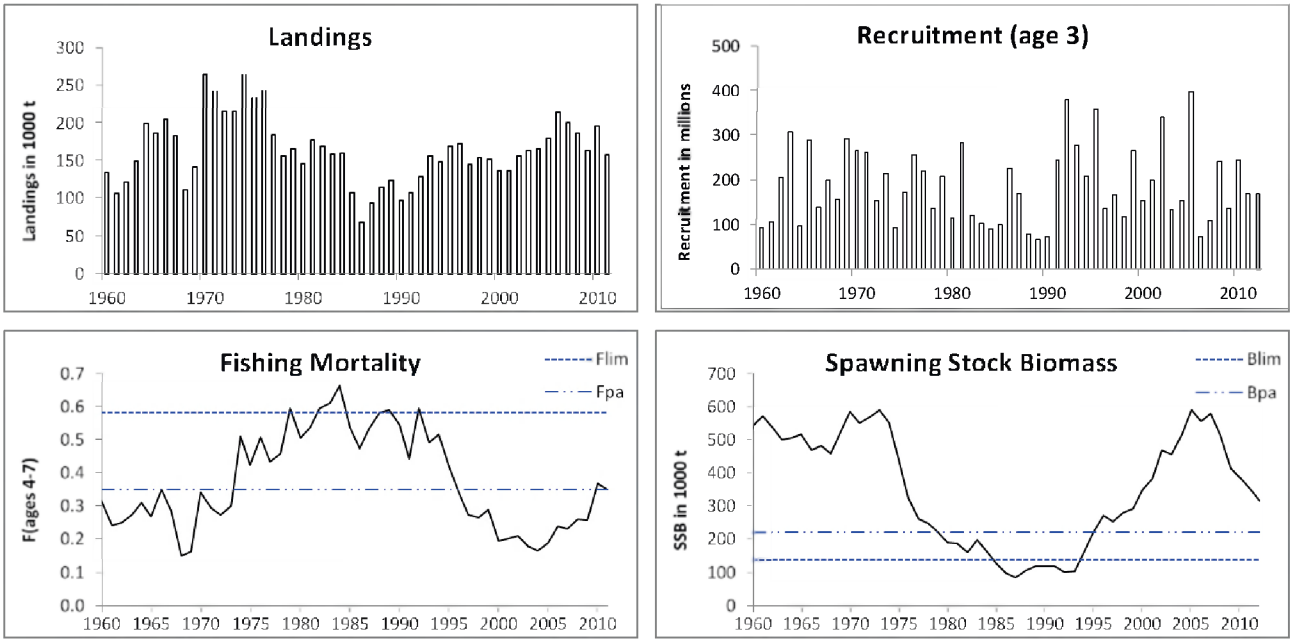


Figure 3.4.4.1 Saithe in Subareas I and II (Northeast Arctic). Summary of stock assessment (weights in thousand tonnes, recruitment estimates are shown in grey). Top right: SSB/F for the time-series used in the assessment.

Since 1995, SSB has been well above B_{pa} and has decreased in recent years. Fishing mortality was well below F_{pa} for a number of years after 1996, but has increased since 2005 to F_{pa} in 2010 and 2011. The 2005 and 2007 year classes are above average, while the 2006 and 2008 year classes seem to be below average strength.

Management plans

The Norwegian Ministry of Fisheries and Coastal Affairs implemented a harvest control rule (HCR) in autumn 2007 (see Annex 3.4.4). ICES evaluated the HCR in 2007 and concluded that it is consistent with the precautionary approach, providing the assessment uncertainty and error are not greater than those calculated from historical data. This also holds true for implementation error (difference between TAC and catch).

Biology

Saithe in Subareas I and II is an important predator on other species in the ecosystem, notably young herring, haddock, and Norway pout. Saithe is a typical migrating fish and makes both feeding and spawning migrations. There are examples of extensive migration of young saithe from the western part of the Norwegian coast to the North Sea and of older saithe migrating from more northern areas to Iceland and the Faroe Islands, and a few examples of migration to the Norwegian coast.

Environmental influence on the stock

There have been variations in distribution and migration patterns over the years, but the link with environmental parameters remains unclear.

The fisheries

Norway accounts for more than 90% of the landings. The gillnet fishery is most intense during winter, purse seine in the summer months, while the trawl fishery takes place more evenly year-round. Coastal cod and *S. marinus* are caught as bycatch in some of the saithe fisheries (ICES, 2011b, 2011c).

Catch distribution	Total landings (2011) are 157 kt (43% trawl, 29% purse-seine, 20% gillnet, and 8% other gear types). Discards are considered to be low.

Quality considerations

Norwegian sampling of commercial catches is believed to be less precise because of the termination of a Norwegian port sampling programme in mid-2009. The poor sampling caused problems in estimating Norwegian catches for the oldest ages in 2010. A small Norwegian port sampling programme from 2011 and onwards and an expansion of the high seas reference fleet has improved the situation somewhat. But there is still a lack of samples from certain gears and areas and the working group recommends an increase in port sampling effort.

After the 2010 benchmark the retrospective pattern of the assessment has been less severe.

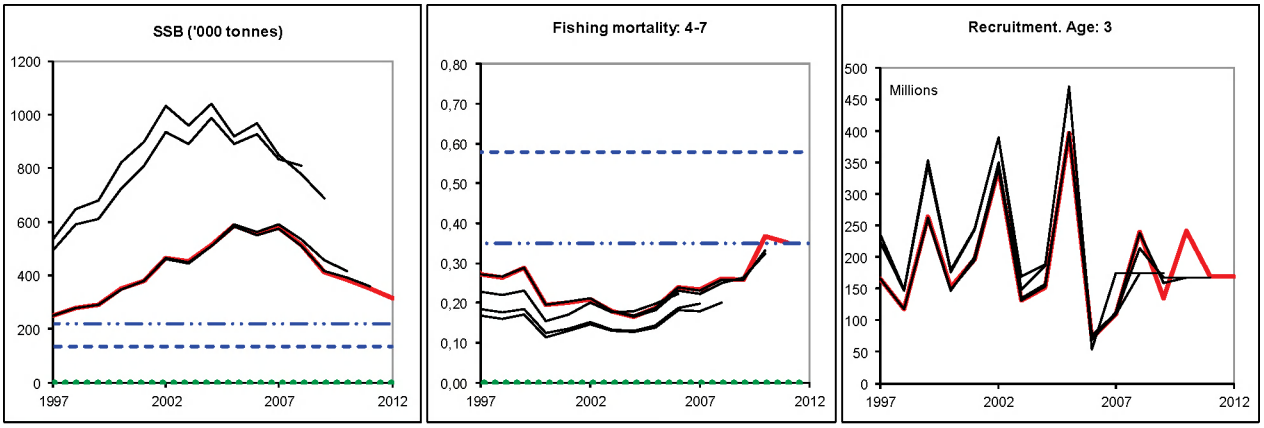


Figure 3.4.4.2 Saithe in Subareas I and II (Northeast Arctic). Historical assessment results (final-year recruitment estimates included).

Scientific basis

Assessment type	XSA with a 3–15+ catch matrix, two tuning time-series split in 2002, shrinkage (S.E. of the mean to which estimates are shrunk = 1.5), and no tapered time weighting.
Input data	Two tuning fleets (NOcoast-Aco-4Q), cpue data from the Norwegian trawl fisheries, and indices from the Norwegian acoustic survey, both split in 2002.
Discards and bycatch	Discarding is considered to be minor.
Indicators	None.
Other information	The latest benchmark was performed in 2010 (WKROUND, 2010).
Working group report	AFWG

ECOREGION Barents Sea and Norwegian Sea
STOCK Saithe in Subareas I and II (Northeast Arctic)

Reference points

	Type	*Value*	*Technical basis*
Management Plan	SSB_{MP}	220 000 t	B_{pa}, TAC is linearly reduced from F_{pa} at SSB = B_{pa} to 0 at SSB equal to zero.
	F_{MP}	0.35	Average TAC for the coming 3 years based on F_{pa}.
MSY Approach	MSY $B_{trigger}$	not defined	
	F_{MSY}	not defined	
Precautionary	B_{lim}	136 000 t	Change point regression.
	B_{pa}	220 000 t	B_{lim} * exp(1.645*σ), where σ = 0.3.
	F_{lim}	0.58	F corresponding to an equilibrium stock = B_{lim}.
	F_{pa}	0.35	F_{lim} * exp(−1.645*σ), where σ = 0.3. This value is considered to have a 95% probability of avoiding the F_{lim}.

(unchanged since: 2005)

Yield and spawning biomass per Recruit F-reference points (2012):

	Fish Mort Ages 4–7	Yield/R	SSB/R
Average last 3 years	0.33	0.82	1.41
F_{max} [*]	-	-	-
$F_{0.1}$	0.14	0.74	3.76
F_{med}	0.27	0.82	1.83
$F_{35\%SPR}$	0.14	0.74	3.76

[*] F_{max} is not well-defined.

Outlook for 2013

Basis: F_{2012} = TAC constraint = 0.31[1)]; Landings (2012) = 164; SSB (2013) = 302; R (2012 onwards) = geometric mean (1960–2009) = 169 millions.

Rationale	**Landings (2013)**	**Basis**	**F (2013)**	**SSB (2014)**	**%SSB change [2)]**	**%TAC change [3)]**
Management plan [4)]	164	F_{MP}	0.32	292	-3	0
Precautionary approach	176	F_{pa}	0.35	284	-6	+7
Zero catch	0	F=0	0	406	+34	-100
Status quo	89	F_{sq} * 0.5	0.16	344	+11	-46
	165	F_{sq} * 1.0	0.33	292	-3	+1
	199	F_{sq} * 1.25	0.41	269	-11	+21

Weights in '000 t.
[1)] It is assumed that the TAC will be implemented and that the landings in 2012 will correspond to the TAC.
[2)] SSB 2014 relative to SSB 2013.
[3)] TAC 2013 relative to TAC 2012.
[4)] Average TAC for the coming 3 years based on F_{pa}.

Management plan

Following the agreed management plan implies a TAC of 164 000 t in 2013. The SSB is expected to remain above B_{pa} at the beginning of 2014.

Precautionary approach

The fishing mortality in 2013 should be no more than F_{pa}, corresponding to landings of less than 176 000 t in 2013. This is expected to keep SSB above B_{pa} in 2014.

Additional considerations

The ICES advice is based on a harvest control rule adopted by the Norwegian authorities. The stock is exploited by fleets from a number of nations that acquire fishing rights by quota swaps with Norway. In addition, Russia sets a small quota for the Russian zone. ICES advice applies to all catches of Northeast Arctic saithe.

Preliminary stochastic simulations show that the highest long-term yield is obtained at F values lower than the F = 0.35 currently used in the management plan. More work on this is needed to determine an F_{MSY} value that may be considered as a basis for changing the harvest control rule.

Regulations and their effects

TAC regulations are in place for this stock. Norway and Russia have each set national measures applicable to their EEZ. Since 2007 the catch has been less than the TAC. However, in 2010–2011 this difference was less than in previous years.

In the Norwegian fishery, quotas may be transferred between fleets if it becomes clear that the quota allocated to one of the fleets will not be taken. In addition to quotas, the fisheries are managed by minimum mesh size, minimum fish size, bycatch regulations, area closures, and other area and seasonal restrictions. Furthermore, sorting grids are used in the trawl fishery.

Since the early 1960s, purse-seiners and trawlers have dominated the fishery, with a traditional gillnet fishery for spawning saithe as the third major component. The purse-seine fishery is conducted in coastal areas and fjords. Historically, purse-seiners and trawlers have taken, approximately, equal shares of the catches. Regulation changes led to a reduction in the amounts taken by purse-seiners after 1990.

Discarding is illegal, but may occur when trawlers targeting cod catch saithe without having a quota for saithe. In the purse-seine fishery, slipping has been reported, mainly related to minimum size of fish in the catch. There is no quantitative information on discards, but they are considered minor.

On 1 March 1999, the minimum fish size was increased to 45 cm for trawl and conventional gears, and to 42 cm (north of Lofoten) and 40 cm (between 62°N and Lofoten) for purse-seine, with an exception for the first 3000 t purse-seine catch between 62°N and 66°33′N, where the minimum fish size remains at 35 cm.

A real-time closure system has been in force along the Norwegian coast and in the Barents Sea since 1984, aimed at protecting juvenile fish. Based on scientific research data and mapping of areas by hired fishing vessels, fishing is prohibited in areas where the proportion by number of undersized cod, haddock, and saithe combined has been observed by inspectors to exceed 15% (the size limits vary by species). The time of notice before a closure of an area comes into force is 2–4 hours for national vessels and 7 days for foreign vessels. Before or parallel to a closure, the Coast Guard requests vessels not to fish in an area where too many small fish have been observed during their inspections. A closed area is not opened until a low percentage of juvenile fish is documented by trial fishing within the area by the Surveillance Service.

Uncertainties in assessment and forecast

The assessment is based on two tuning series which, in recent years, show divergent signals.

Lack of reliable recruitment estimates is still a major problem. Prediction of catches will, to a large extent, be dependent on assumptions of average recruitment, since fish from age four to seven constitute major parts of the catches. Since the saithe HCR is a three-year-rule, the estimation of average F_{pa} catch in the HCR will affect stock numbers up to age seven, and thereby heavily affect the total prognosis of the fishable stock and the quotas derived from it.

Comparison with previous assessment and advice

The current estimate of SSB for 2011 is consistent with the previous assessment.

The basis for the advice is the same as last year.

Sources

ICES. 2010. Report of the Benchmark Workshop on Roundfish (WKROUND), 9–16 February 2010, Copenhagen, Denmark. ICES CM 2010/ACOM: 36. 183 pp.
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ICES. 2011b. Cod in Subareas I and II (Norwegian coastal waters cod). Report of the ICES Advisory Committee, 2010. ICES Advice, 2010. Book 3, Section 3.4.2.
ICES. 2011c. Golden Redfish (*Sebastes marinus*) in Subareas I and II. Report of the ICES Advisory Committee, 2010. ICES Advice, 2010. Book 3, Section 3.4.6.
ICES. 2012. Report of the Arctic Fisheries Working Group, 20 April–26 April 2012. ICES CM 2011/ACOM:05.

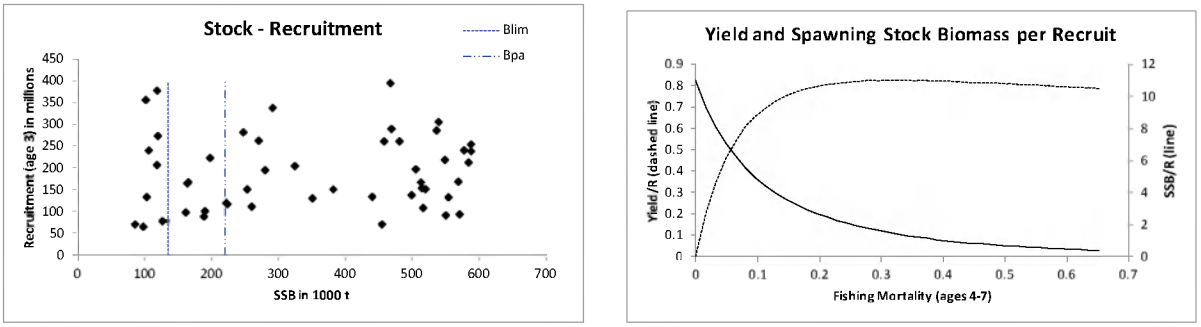

Figure 3.4.4.3 Saithe in Subareas I and II (Northeast Arctic). Stock–recruitment plot and yield-per-recruit analysis.

Table 3.4.4.1 Saithe in Subareas I and II (Northeast Arctic). ICES advice, management, and landings.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[2]	Official landings	ICES landings
1987	No increase in F; TAC; protect juveniles	90	-	92	92
1988	No increase in F	< 83	-	114	114
1989	*Status quo* F; TAC	120	120	123	123
1990	$F \leq F_{med}$; TAC	93	103	96	96
1991	F at F_{low}; TAC	90	100	107	107
1992	Within safe biological limits	115	115	128	128
1993	Within safe biological limits	132[1]	132	155	155
1994	No increase in F	158[1]	145	147	147
1995	No increase in F	221[1]	165	168	168
1996	No increase in F	158[1]	163	171	171
1997	Reduction of F to F_{med} or below	107	125	144	144
1998	Reduction of F to F_{med} or below	117	145[3]	153	153
1999	Reduce F below F_{pa}	87	144[4]	150	150
2000	Reduce F below F_{pa}	89	125[5]	136	136
2001	Reduce F below F_{pa}	<115	135	136	136
2002	Maintain F below F_{pa}	< 152	162[6]	155	155
2003	Maintain F below F_{pa}	< 168	164	162	162
2004	Maintain F below F_{pa}	< 186	169	165	165
2005	Take account of *Sebastes marinus* bycatch. Maintain F below F_{pa}	< 215	215	179	179
2006	Take account of *Sebastes marinus* bycatch. Maintain F below F_{pa}	< 202	193.5	213	213
2007	Take account of *Sebastes marinus* bycatch. Maintain F below F_{pa}	< 247	222.525	199	199
2008	Take account of *Sebastes marinus* bycatch. Maintain F below F_{hcr}	< 247	< 247	185	185
2009	Take account of *Sebastes marinus* bycatch. Apply management plan	< 225	225	162	162
2010	Take account of *Sebastes marinus* bycatch. Apply management plan	< 204	204	195	195
2011	Take account of *Sebastes marinus* bycatch. Apply management plan	< 173	173	157	157
2012	Take account of coastal cod and *Sebastes marinus* bycatch. Apply management plan.	< 164	164		
2013	Take account of coastal cod and *Sebastes marinus* bycatch. Apply management plan.	< 164			

Weights in thousand tonnes.
[1] Predicted catch at *status quo* F.
[2] Set by Norwegian authorities. TAC for Russian EEZ is not included.
[3] TAC first set at 125 000 t, then increased in May 1998 after an intersessional assessment.
[4] TAC set after an intersessional assessment in December 1998.
[5] TAC set after an intersessional assessment in December 1999.
[6] TAC first set at 152 000 t, then increased in June 2003 after the spring 2002 assessment.

Table 3.4.4.2 Saithe in Subareas I and II (Northeast Arctic). Nominal catch (t) by countries as officially reported to ICES.

Nominal catch (t) by countries as officially reported to ICES.

Year	Faroe Islands	France	Germany Dem.Rep	Fed.Rep. Germany	Iceland	Norway	Poland	Portugal	Russia[3]	Spain	UK	Others[5]	Total all countries
1960	23	1 700		25 948		96 050					9 780	14	133 515
1961	61	3 625		19 757		77 875					4 595	18	105 951
1962	2	544		12 651		101 895			912		4 699	4	120 707
1963		1 110		8 108		135 297					4 112		148 627
1964		1 525		4 420		184 700			84		6 511	186	197 426
1965		1 618		11 387		165 531			137		6 741	181	185 600
1966		2 987	813	11 269		175 037			563		13 078	41	203 788
1967		9 472	304	11 822		150 860			441		8 379	48	181 326
1968			70	4 753		96 641					8 781		110 247
1969	20	193	6 744	4 355		115 140					13 585	23	140 060
1970	1 097		29 362	23 466		151 759			43 550		15 469		264 924
1971	215	14 536	16 840	12 204		128 499	6 017		39 397	13 097	10 361		241 272
1972	109	14 519	7 474	24 595		143 775	1 111		1 278	13 125	8 223		214 334
1973	7	11320	12 015	30 338		148 789	23		2 411	2 115	6 841		213 859
1974	46	7119	29 466	33 155		152 699	2521		28 931	7 075	3 104	5	264 121
1975	28	3156	28 517	41 260		122 598	3860	6430	13 389	11 397	2 763	55	233 453
1976	20	5609	10 266	49 056		131 675	3164	7233	9 013	21 661	4 724	65	242 486
1977	270	5658	7 164	19 985		139 705	1	783	989	1 327	6 935		182 817
1978	809	4345	6 484	19 190		121 069	35	203	381	121	2 827		155 464
1979	1117	2601	2 435	15 323		141 346			3	685	1 170		164 680
1980	532	1016		12 511		128 878			43	780	794		144 554
1981	236	218		8 431		166 139			121		395		175 540
1982	339	82		7 224		159 643			14		732		168 034
1983	539	418		4 933		149 556			206	33	1 251		156 936
1984	503	431	6	4 532		152 818			161		335		158 786
1985	490	657	11	1 873		103 899			51		202		107 183
1986	426	308		3 470		63 090			27		75		67 396
1987	712	576		4 909		85 710			426		57	1	92 391
1988	441	411		4 574		108 244			130		442		114 242
1989	388	460 [2]		606		119 625			506	506	726		122 817
1990	1207	340 [2]		1 143		92 397			52		709		95 848
1991	963	77 [2]	**Greenland**	2 003		103 283			504 [4]		492	5	107 327
1992	165	1980	734	3 451		119 763			964	6	541		127 604
1993	31	566	78	3 687	3	140 604		1	9 509	4 [2]	415	5 [2]	154 903
1994	67 [2]	557	15	1 863	4 [2]	141 589		1 [2]	1 640 [2]	655 [2]	557	2	146 950
1995	172 [2]	358	53	935		165 001		5	1 148		688	18	168 378
1996	248 [2]	346	165	2 615		166 045		24	1 159	6	707	33	171 348
1997	193 [2]	560	363 [2]	2 915		136 927		12	1 774	41	799	45	143 629
1998	366	932	437 [2]	2 936		144 103		47	3 836	275	355	40	153 327
1999	181	638 [2]	655 [2]	2 473	146	141 941		17	3 929	24	339	32	150 375
2000	224 [2]	1438	651 [2]	2 573	33	125 932		46	4 452	117	454	8 [2]	135 928
2001	537	1279	701 [2]	2 690	57	124 928		75	4 951	119	514	2	135 853
2002	788	1048	1393	2 642	78	142 941		118	5 402	37	420	3	154 870
2003	2056	1022	929 [2]	2 763	80 [2]	150 400		147	3 894	18	265	18 [2]	161 592
2004	3071	255	891 [2]	2 161	319	147 975		127	9 192	87	544	14	164 636
2005	3152	447	817 [2]	2 048	395	162 338		354	8 362	25	630		178 568
2006	1795	899	786 [2]	2 779	255	195 462	89	339 [2]	9 823	21 [2]	532	42	212 822
2007	2048	966	810 [2]	3 019	219	178 644	99	412	12 168	53 [2]	558	12	199 008
2008	2314	1009	503 [2]	2 263	113	165 998	66	348	11 577	33	506	10	184 740
2009	1611 [2]	326	697	2 021	69	144 570	30	204 [2]	11 899	2 [2]	379	45 [2]	161 853
2010	1632	677	954	1 592	109 [2]	174 544	279	93	14 664	8	283	2 [2]	194 837
2011 [1]	112	357	445	1 371	110	143 252		43	10 007	2 [2]	972	15	156 686

1 Provisional figures.

2 As reported to Norwegian authorities.

3 USSR prior to 1991.

4 Includes Estonia.

5 Includes Denmark,Netherlands, Ireland and Sweden

6 As reported by Working Group members

Table 3.4.4.3 Saithe in Subareas I and II (Northeast Arctic). Assessment summary.

Year	Recruitment Age 3 thousands	SSB tonnes	Landings tonnes	Mean F Ages 4–7
1960	92382	539004	133515	0.315
1961	104182	570302	105951	0.242
1962	203732	536072	120707	0.250
1963	307190	498806	148627	0.274
1964	95252	504704	197426	0.310
1965	287982	513878	185600	0.268
1966	139613	468328	203788	0.351
1967	199107	480490	181326	0.288
1968	156042	457349	110247	0.150
1969	291446	519126	140060	0.164
1970	263215	583641	264924	0.341
1971	262608	549539	241272	0.295
1972	153304	568220	214334	0.275
1973	214898	587140	213859	0.300
1974	93077	548068	264121	0.510
1975	170518	439590	233453	0.424
1976	256069	323825	242486	0.506
1977	220593	259383	182817	0.433
1978	135546	246457	155464	0.456
1979	206194	221057	164680	0.593
1980	113271	189652	144554	0.505
1981	283643	187844	175540	0.537
1982	121615	160760	168034	0.595
1983	102847	196833	156936	0.610
1984	90673	164444	158786	0.662
1985	99780	125880	107183	0.535
1986	225093	97133	67396	0.473
1987	169531	84694	92391	0.532
1988	80036	105373	114242	0.580
1989	67032	117873	122817	0.587
1990	72454	118864	95848	0.543
1991	242239	117525	107327	0.441
1992	379449	100832	127604	0.593
1993	275340	102283	154903	0.492
1994	208334	163026	146950	0.515
1995	357793	223290	168378	0.419
1996	135206	269802	171348	0.343
1997	166453	252383	143629	0.273
1998	118881	279192	153327	0.265
1999	264486	290589	150375	0.289
2000	152720	349961	135928	0.195
2001	197163	381287	135853	0.202
2002	339679	466516	154870	0.210
2003	132172	454004	161592	0.179
2004	152800	515685	164636	0.167
2005	396629	587497	178568	0.188
2006	72303	553524	212822	0.240
2007	109848	577136	199008	0.233
2008	240154	512341	184740	0.260
2009	134796	413820	161853	0.257
2010	242458	383279	194837	0.368
2011	169149	351241	156686	0.351
2012	169149	314684		
Average	187474	351400	162954	0.373

Annex 3.4.4 Implemented management strategy for saithe in Subareas I and II

The harvest control rule as communicated to ICES by the Norwegian Ministry of Fisheries and Coastal Affairs contains the following elements:

- *Estimate the average TAC level for the coming 3 years based on F_{pa}. TAC for the next year will be set to this level as a starting value for the 3-year period.*
- *The year after, the TAC calculation for the next 3 years is repeated based on the updated information about the stock development. However, the TAC should not be changed by more than +/− 15% compared with the previous year's TAC.*
- *If the spawning-stock biomass (SSB) in the beginning of the year for which the quota is set (first year of prediction), is below B_{pa}, the procedure for establishing TAC should be based on a fishing mortality that is linearly reduced from F_{pa} at SSB = B_{pa} to 0 at SSB equal to zero. At SSB levels below B_{pa} in any of the operational years (current year and 3 years of prediction) there should be no limitations on the year-to-year variations in TAC.*

ECOREGION Barents Sea and Norwegian Sea
STOCK Beaked redfish (*Sebastes mentella*) in Subareas I and II

Advice for 2013

ICES advises on the basis of the MSY approach that a commercial fishery can operate on *Sebastes mentella* in Subareas I and II, given that the total catch level, including bycatches and discards, does not exceed 47 000 tonnes. Measures currently in place to protect juveniles have proven successful and should be maintained.

Stock status

F (Fishing Mortality)	2009–2011	
MSY (F_{MSY})	✓	Appropriate
Precautionary approach (F_{pa},F_{lim})	?	Unknown

SSB (Spawning-Stock Biomass)	2009–2011	
MSY ($B_{trigger}$)	?	Unknown
Precautionary approach (B_{pa},B_{lim})	?	Unknown
Qualitative evaluation	→	

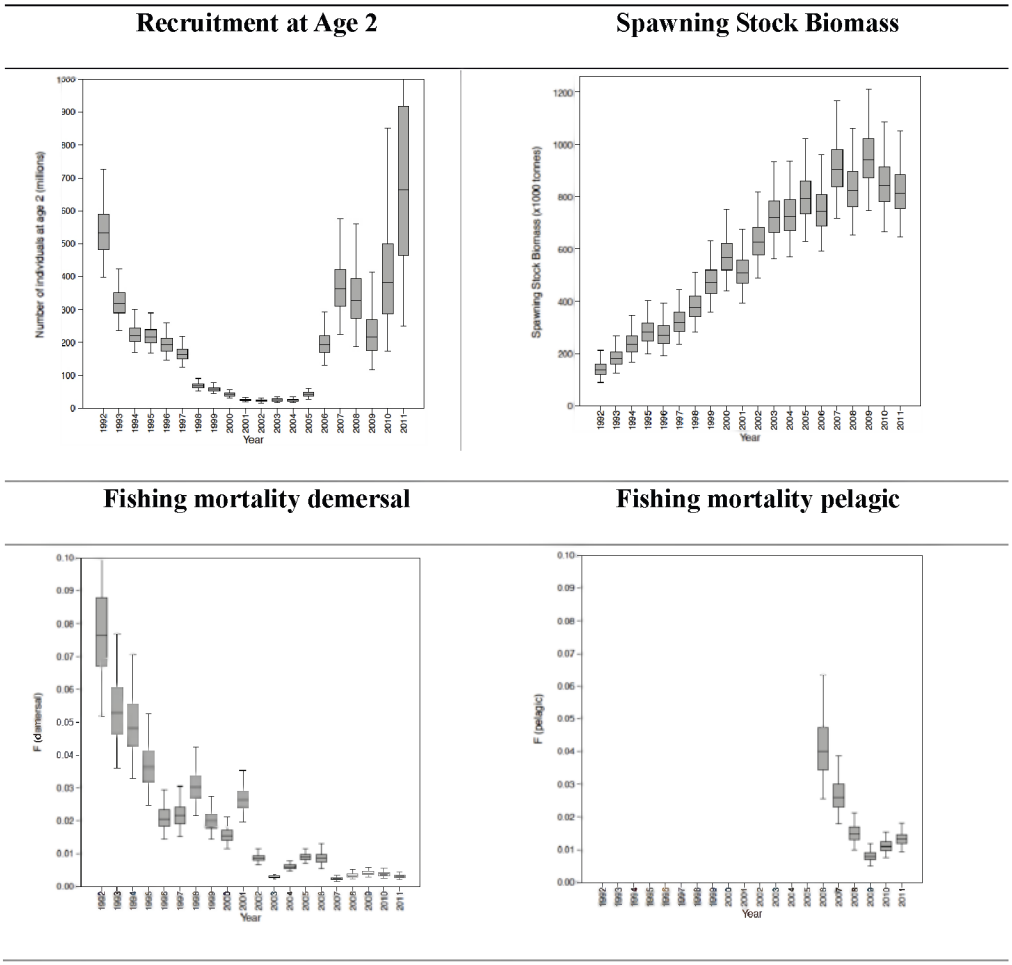

Figure 3.4.5.1 Results from the statistical catch-at-age assessment run showing the estimated recruitment-at-age 2, spawning-stock biomass from 1992 to 2011, and annual fishing mortality coefficients from the demersal and pelagic fleets.

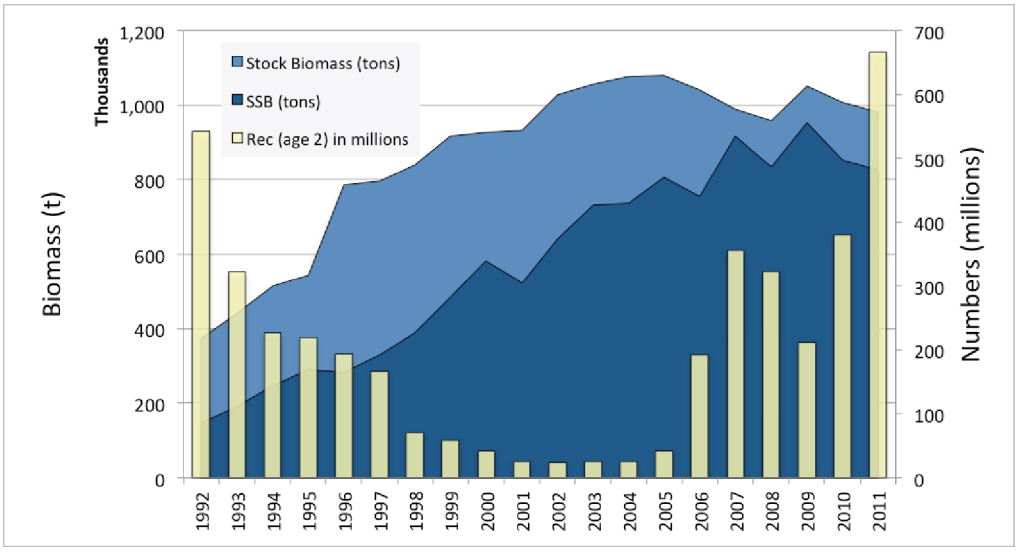

Figure. 3.4.5.2 Beaked redfish *Sebastes mentella* in Subareas I and II. Recruitment-at-age 2, spawning-stock biomass and total stock biomass estimated from statistical catch-at-age for the period 1992–2011.

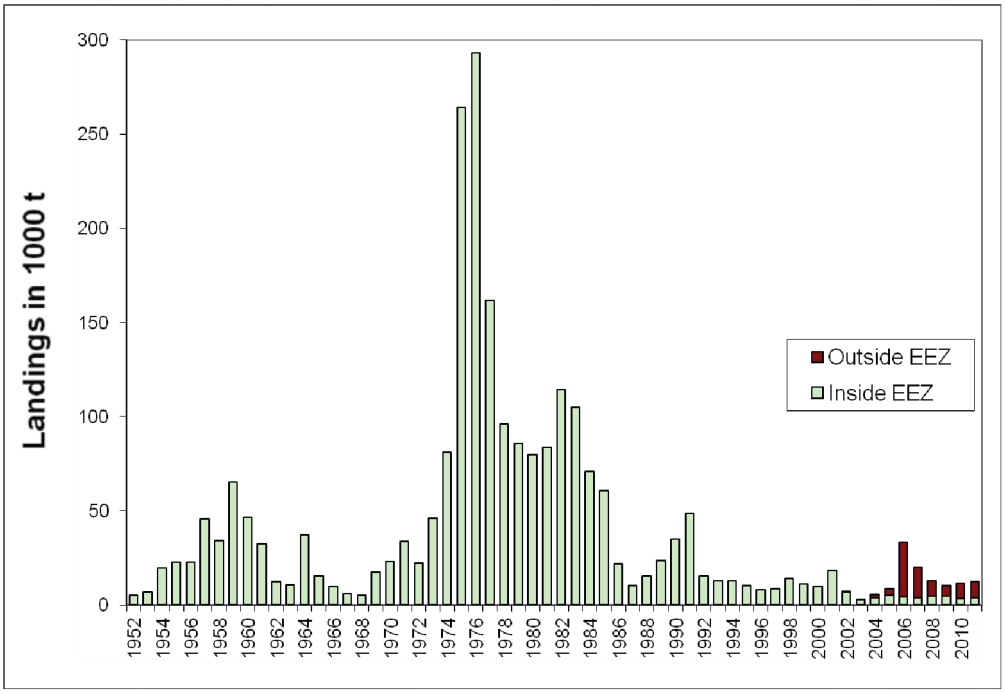

Figure 3.4.5.3 *Sebastes mentella* in Subareas I and II. Total international landings 1965–2011 in national and international waters.

Spawning-stock biomass has steadily increased from 1992 to 2005. Due to poor year classes during the period 1996–2003, the spawning-stock biomass is decreasing.

Management plans

No specific management objectives have so far been implemented.

Biology

This species is long-lived (maximum age 75 years), and inhabits pelagic and epibenthic habitats from 300 to 1400 m in the North Atlantic. The male and female aggregate to mate; the female releases live larvae (ovoviviparous) along the continental slope from 62°N to 74°N during March–April. The size and age at first maturity (50%) are 31 cm and 11 years. Larvae are pelagic and drift northward along the continental slope in the surface layers and eventually disperse over the shelf in the Barents Sea. The juveniles are predominantly distributed in the Barents Sea and Svalbard areas. Adults are widely distributed on the shelf, slope, and the open ocean, but south of 69°N hardly on the shelf.

The fisheries

A pelagic fishery for *S. mentella* has developed in the Norwegian Sea outside EEZs since 2004. This fishery is managed by the North-East Atlantic Fisheries Commission (NEAFC) who, by consensus, adopted a TAC for 2012 of 7500 t. Other catches of *S. mentella* are taken as bycatches in the demersal cod/haddock/Greenland halibut fisheries, as juveniles in the shrimp trawl fisheries, and occasionally in the pelagic blue whiting and herring fisheries in the Norwegian Sea.

Catch distribution	Total landings (2011) = 12.4 kt, of which 67% is taken by pelagic trawl in international waters in the Norwegian Sea and 33% as bycatch in the Barents Sea and adjacent waters.

Scientific basis

Assessment type	Statistical catch-at-age 1992–2011. The Gadget model and the Schaefer biomass model are used in addition.
Input data	Catch numbers-at-age from the pelagic and demersal fleets and numbers-at-age from three surveys in the Barents Sea (BS-NoRu-Q1-Btr, Eco-NoRu-Q3-Btr, Ru-Q4-Btr).
Discards and bycatch	Not available.
Indicators	Additional information from the Norwegian Sea pelagic surveys, international 0-group survey in Barents Sea (Eco-NoRu-Q3), and Norwegian Sea slope surveys. Cod consumption on juveniles (BS-NoRu-Q1-Btr, Eco-NoRu-Q3-Btr, Ru-Q4-Btr).
Other information	Last benchmark was in February 2012 (ICES, 2012b). Assessment methodology has been revised.
Working group report	AFWG (ICES, 2012a)

ECOREGION Barents Sea and Norwegian Sea
STOCK Beaked redfish (*Sebastes mentella*) in Subareas I and II

Reference points

At present, no fishing mortality or biomass reference points are defined for this stock. $F_{0.1}$ = 0.065 is considered as a good candidate for F_{MSY} proxy, and used as a basis for advice.

Outlook for 2013

Basis: $F_{2012} = F_{2011}$ = 0.016; SSB (2013) = 797; R (2012) = 127 million (age 2); landings (2012) = 12.1.

Rationale	Landings (2013)	Basis	F (2013)	SSB (2014)	%SSB change [1)]	%TAC change [2)]
Zero catch	0	$0*F_{sq}$	0	795	0	−100
Status quo	12	F_{sq}	0.016	784	−2	0
$F_{0.1}$	47	$F_{0.1}$	0.065	750	−6	+288

Weights in thousand tonnes.
[1)] SSB 2014 relative to SSB 2013.
[2)] Catch 2013 relative to TAC 2012.

Considering the low productivity of the stock and the longevity of *S. mentella*, projections are shown for longer periods, e.g. 3- and 8-year periods (respectively until 2015 and 2020) in addition to the usual short-term prediction.

The table below provides expected changes in SSB by 2015 and 2020 assuming three different catch scenarios for the years 2013–2020. The SSB levels are given as percentages of the SSB in 2011.

SSB (2011=100%)	Fishing scenario		
Projection year	zero catch	F_{sq}	$F_{0.1}$
2015	98	96	88
2020	129	121	101

Catch in thousand tonnes	Fishing scenario		
	zero catch	F_{sq}	$F_{0.1}$
Average 2013–2015	0	11	44
Average 2013–2020	0	11	40

MSY approach

Following the ICES MSY approach implies a fishing mortality of 0.065, corresponding to landings of no more than 47 000 t in 2013. This is expected to keep SSB at the present level in 2020.

Additional considerations

The assessment model used and its outputs are an appropriate basis for advice. In contrast to the qualitative assessment last year which concluded that the stock needed to be rebuilt, estimates of biomass this year show that SSB has increased by more than 300% since 1992. In the absence of biomass reference points for this stock, it is considered that this is sufficient to allow a fishery.

The current estimate of fishing mortality is far below the assumed natural mortality (0.05) and F_{MSY} proxy ($F_{0.1}$). Fishing at $F_{0.1}$, which is close to the assumed value of natural mortality is considered not to be detrimental to the stock.

However, following several consecutive low recruitments (1998–2005) for this long-lived, late-maturing species, SSB is expected to decline in the near future, together with landings. Explorations of a multi-annual TAC advice would lead to predicted landings of 44 kt for 2013–2015, or 40 kt for 2013–2020.

Documentation of the fishing effort involved and the catches taken in the international fishery is very important, and NEAFC is requested to continue to provide timely and consistent information for future stock assessments and advice. National reporting of length distributions in the demersal and pelagic commercial catches needs to be increased.

Uncertainties

The current analytical assessment should be expanded to include separate age groups up to 30 years. Furthermore, it is important that every nation should follow the ICES recommendations for the age reading of mature fish of 20 years or more. The sample size of aged *S. mentella* should be increased to ensure that reliable age–length keys can be estimated.

In order to assess the state of the stock, it is necessary to survey the whole distribution area of *S. mentella* in Subareas I and II, both the pelagic and the demersal components. Currently, the survey series do not appropriately cover the geographical distribution of the adult population. Priority should be given to data collection over the slope and open Norwegian Sea regions, where the adult population is most abundant, and to including these new surveys in the analytical assessment in the future. The acoustic/trawl survey conducted in 2008 and 2009 and planned in 2013 in the Norwegian Sea could be considered as a biomass index of the mature fish, but the time-series is still too short.

Comparison with previous assessment and advice

The assessment methodology was revised during the redfish stocks benchmark meeting in February 2012 (ICES, 2012b). The implementation of a new analytical assessment model in 2012 and the updated data for 2011 (landings and survey) have changed the perception of the stock. The new assessment indicates a significant increase in the spawning-stock biomass over the last two decades and in the number of juveniles in recent years.

Last year's advice was for no directed fishery and limited bycatch. This year's advice is based on the MSY approach.

Assessment and management areas

The analytical assessment and advice are provided for ICES Subareas I and II combined. The fishery for *S. mentella* operates in national and international waters, which are managed under different schemes and by different management organizations. In international waters, the fishery is managed by NEAFC and, in recent years, an Olympic fishery has been conducted with a set TAC, which is not derived from a harvest control rule. In national waters, the redfish fishery is a bycatch fishery with specific bycatch regulations. It is important that management decisions taken at national and international levels are coordinated to ensure that the total catch in ICES Subareas I and II does not exceed the recommended level.

Sources

ICES. 2012a. Report of the Arctic Fisheries Working Group, 20–26 April 2012, Copenhagen, Denmark. ICES CM 2012/ACOM:05.

ICES. 2012b. Report of the Benchmark Workshop on Redfish Stocks, 1–8 February 2012, Copenhagen, Denmark. ICES CM 2012/ACOM:48.

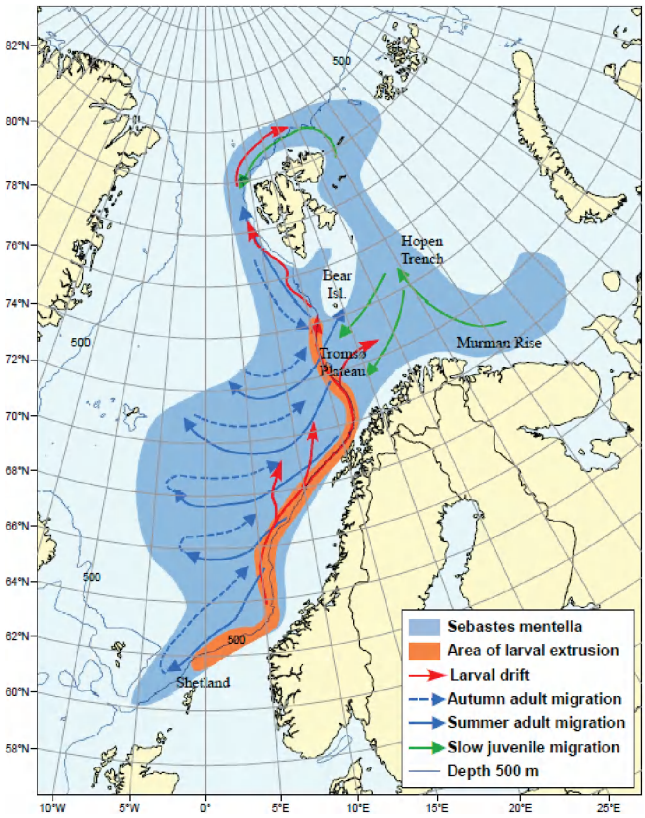

Figure 3.4.5.4 Beaked redfish *Sebastes mentella* in Subareas I and II. Distribution, area of larval extrusion, larval drift, and migration routes.

Table 3.4.5.1 Beaked redfish (*Sebastes mentella*) in Subareas I and II. ICES advice, management, and landings.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings[1]	ICES Catch
1987	Precautionary TAC	70[1]	85	35	11
1988	$F \leq F_{0.1}$; TAC	11	-	41	16
1989	*Status quo* F; TAC	12	-	47	24
1990	*Status quo* F; TAC	18	-	63	35
1991	F at F_{med}; TAC	12	-	68	49
1992	If required, precautionary TAC	22	-	32	16
1993	If required, precautionary TAC	18	18	30	13
1994	If required, precautionary TAC	-	-	31	13
1995	Lowest possible F	-	-	26	10
1996	Catch at lowest possible level	-	-	26	8
1997	Catch at lowest possible level	-	-	26	9
1998	No directed fishery, reduce bycatch	-	-	33	14
1999	No directed fishery, reduce bycatch	-	-	30	11
2000	No directed fishery, bycatch at lowest possible level	-	-	25	10
2001	No directed fishery, bycatch at lowest possible level	-	-	29	18
2002	No directed fishery, bycatch at lowest possible level	-	-	17	7
2003	No directed fishery, bycatch at lowest possible level	-	-	10	3
2004	No directed trawl fishery and low bycatch limits	-	-	13	5[2]
2005	No directed trawl fishery and low bycatch limits	-	-	16	8[2]
2006	No directed trawl fishery and low bycatch limits	-	-	40	33[2]
2007	No directed trawl fishery and low bycatch limits	-	15.5[3]	27	20[2]
2008	Protection of juveniles, no directed trawl fishery and low bycatch limits	-	14.5[3]	20	13[2]
2009	Protection of juveniles, no directed trawl fishery and low bycatch limits	-	10.5[3]	16	10[2]
2010	Protection of juveniles, no directed trawl fishery and low bycatch limits	-	8.6[3]	19	12[2]
2011	Protection of juveniles, no directed trawl fishery and low bycatch limits	-	7.9[3]	16	12[2]
2012	Protection of juveniles, no directed fishery and low bycatch limits	-	7.5[3]		
2013	$F_{0.1}$	47			

Weights in thousand tonnes.
[1] Includes both *Sebastes mentella* and *S. marinus*.
[2] Includes the pelagic catches in the Norwegian Sea outside the EEZ.
[3]TAC set by the North-East Atlantic Fisheries Commission (NEAFC) for an Olympic fishery in international waters.

Table 3.4.5.2 Beaked redfish (*Sebastes mentella*) in Subareas I and II. Nominal catch (t) by country, as used by the working group. For some countries landings are provided as redfish (*Sebastes* spp.) and the allocation to *S. marinus* is performed during the working group meeting.

Year	Canada	Estonia	Faroe Islands	France	Germany	Iceland	Latvia	Lithuania	Norway	Poland	Portugal	Russia	Spain	UK	Others	Total
1993	8	0	13	50	35	0	0	0	5,182	0	963	6,260	5	293	5	12,814
1994	0	0	4	74	18	0	0	0	6,511	0	895	5,021	30	136	32	12,721
1995	0	0	3	16	176	0	0	0	2,646	0	927	6,346	67	97	6	10,284
1996	0	0	4	75	119	0	0	0	6,053	0	467	925	328	99	5	8,075
1997	0	0	4	37	81	0	0	0	4,657	1	474	2,972	272	78	22	8,598
1998	0	0	20	73	100	0	0	0	9,733	13	125	3,646	177	134	23	14,045
1999	0	0	73	26	202	0	0	0	7,884	6	65	2,731	29	140	53	11,209
2000	0	0	50	12	62	48	0	0	6,020	2	115	3,519	87	130	30	10,075
2001	0	0	74	16	198	3	0	0	13,937	5	179	3,775	90	120	21	18,418
2002	0	15	75	58	99	41	0	0	2,152	8	242	3,904	190	188	22	6,993
2003	0	0	64	22	32	5	0	0	1,210	7	44	952	47	124	13	2,520
2004	0	0	588	13	10	10	0	0	1,375	42	235	2,879	257	76	8	5,493
2005	0	5	1,147	46	33	4	0	0	1,760	0	140	5,023	163	95	50	8,465
2006	433	396	3,808	215	2,483	2,513	341	845	4,710	2,496	1,804	11,413	710	1,027	67	33,261
2007	0	684	2,197	234	520	1,587	349	785	3,209	1,081	1,483	5,660	2,181	202	46	20,219
2008	0	0	1,849	187	16	9	267	117	2,214	8	713	7,117	463	83	47	13,089
2009	0	0	1,343	15	42	33	0	0	2,567	338	806	3,843	177	80	892[2]	10,135
2010	0	0	979	175	21	2	243	457	2,245	0	293	6,414	831	79	12	11,751
2011[1]	0	0	755	104	835	0	536	512	2,690	11	620	5,037	1,267	55	0	12,422

[1] Provisional figures.
[2] Including EU catches not split by country.

Table 3.4.5.3 Beaked redfish *(Sebastes mentella)* in Subareas I and II. Nominal catch (t) by country in the pelagic fishery in international waters in Division IIa. These catches are also included in Table 3.4.5.2.

Year	Canada	Estonia	Faroe Islands	France	Germany	Iceland	Latvia	Lithuania	Norway	Poland	Portugal	Russia	Spain	UK	Total
2002	-	-	-	-	9	-	-	-	-	-	-	-	-	-	9
2003	-	-	-	-	40	-	-	-	-	-	-	-	-	-	40
2004	-	-	500	-	2		-	-	-	-	-	1,510		-	2,012
2005	-	-	1,083	-	20	-	-	-	-	-	-	3,299		-	4,402
2006	433	396	3,766	192	2,475	2,510[2]	341	845	2,862	2,447	1,697	9,390	575	841	28,770
2007	-	684	1,968[2]	226	497	1,579[2]	349	785	1,813[2]	1,079	1,377	3,645	2,155	-	16,157
2008	-	-	1,797[2]	-	-	-	267	117	3,302	-	641	4,901	390[1]	EU[3]	8,443
2009	-	-	1,253	-	-	-	-	-	-	337	701	1,975	135	889	5,290
2010[1]	-	-	912	-	-	-	243	457	450	-	244	5,103	820	-	8,229
2011[1]	-	-	740[2]	104	693[4]	-	536	507	342	-	601	3,621	1,237	-	8,380

[1] Provisional figures.
[2] As reported to NEAFC.
[3] EU not split by country.
[4] As reported in a working document.

ECOREGION Barents Sea and Norwegian Sea
STOCK Golden redfish (*Sebastes marinus*) in Subareas I and II

Advice for 2013

ICES advises on basis of the precautionary approach that there should be no fishing on this stock.

Stock status

F (Fishing Mortality)		
		2009–2011
MSY (F_{MSY})	?	Unknown
Precautionary approach (F_{pa},F_{lim})	?	Unknown

SSB (Spawning-Stock Biomass)		
		2009–2011
MSY ($B_{trigger}$)	?	Unknown
Precautionary approach (B_{pa},B_{lim})	?	Unknown
Qualitative evaluation	✗	SSB lowest in time series

SSB has been decreasing since the 1990s and is currently at the lowest level in the time-series. Fishing mortality has been increasing since 2005 and is currently at the highest level in the time-series. Recruitment is very low.

The fisheries

Sebastes marinus is fished both in a directed gillnet and longline fishery and as bycatch in trawl fisheries targeting cod and saithe. All directed fishery except by handline is closed in the period 20 December-31 July and in September. Directed trawl fishery is not allowed. There are regulations on minimum size and on the percentage of allowed bycatch of *S. marinus* when fishing for other species.

Catch distribution	Commercial landings (2011) are 5.8 kt, of which 37% are taken by trawl, 39% by gillnet, 22% by longline, and 2% by other gears.

Scientific basis

Assessment type	Gadget age–length-structured model.
Input data	Catch numbers-at-age and at-length from the trawl, gillnet, and longline fisheries. Numbers-at-age and at-length from the winter survey in the Barents Sea (BS-NoRu-Q1-Btr).
Discards and bycatch	Not available.
Indicators	-
Other information	Last benchmark was in February 2012 (WKRED). Assessment methodology based on Gadget was adopted.
Working group report	AFWG

ECOREGION Barents Sea and Norwegian Sea
STOCK Golden redfish (*Sebastes marinus*) in Subareas I and II

Reference points

No reference points are defined for this stock.

Outlook for 2013

Projections were conducted for this stock using the Gadget model. If catches are maintained at the current level (5.8 kt annually) and recruitment is similar to the average recruitment for recent years (2001–2011), the stock size is projected to be very low by 2017.

Precautionary approach

ICES advises that there should be no fishery, given the very low SSB (below any possible reference points) and poor recruitment.

Additional considerations

The current fishing mortality is around 0.3 and very high compared to the natural mortality of 0.05.

A benchmark assessment was conducted in February 2012. Gadget was accepted as the main analytical assessment model for *S. marinus* in Subareas I and II. The model is a single-species, age–length structured model, split into mature and immature components. There are two commercial fleets (a gillnet fleet and a combined trawl and other gears fleet), and two surveys.

Comparison with previous assessment and advice

The assessment methodology was evaluated during the redfish stocks benchmark meeting in February 2012. Gadget was adopted as the analytical assessment model for this stock and as the primary basis for the 2012 assessment. The annual natural mortality was revised to 0.05 (previously 0.1). The new assessment confirms the previous perception of the stock status and the advice for 2013 is no fishery.

Sources

ICES 2012a. Report of the Arctic Fisheries Working Group, 20 April–26 April 2012, Copenhagen, Denmark. ICES CM 2012/ACOM:05.

ICES 2012b. Report of the Benchmark Workshop on Redfish Stocks, 1–8 February 2012, Copenhagen, Denmark. ICES CM 2012/ACOM:48.

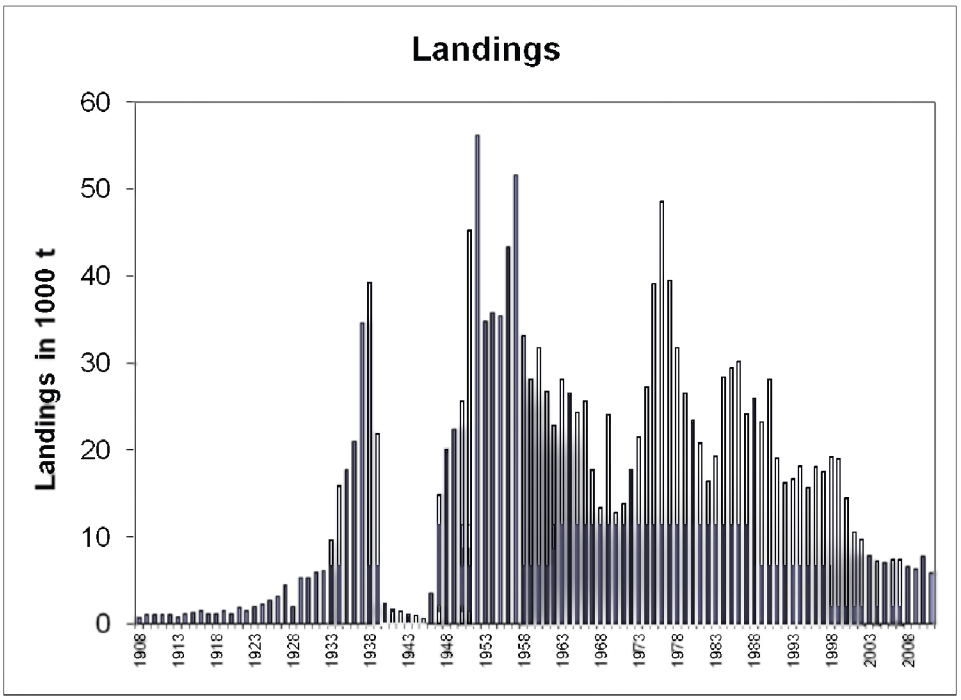

Figure 3.4.6.1 Golden redfish (*Sebastes marinus*) in Subareas I and II. Total international landings (thousand tonnes).

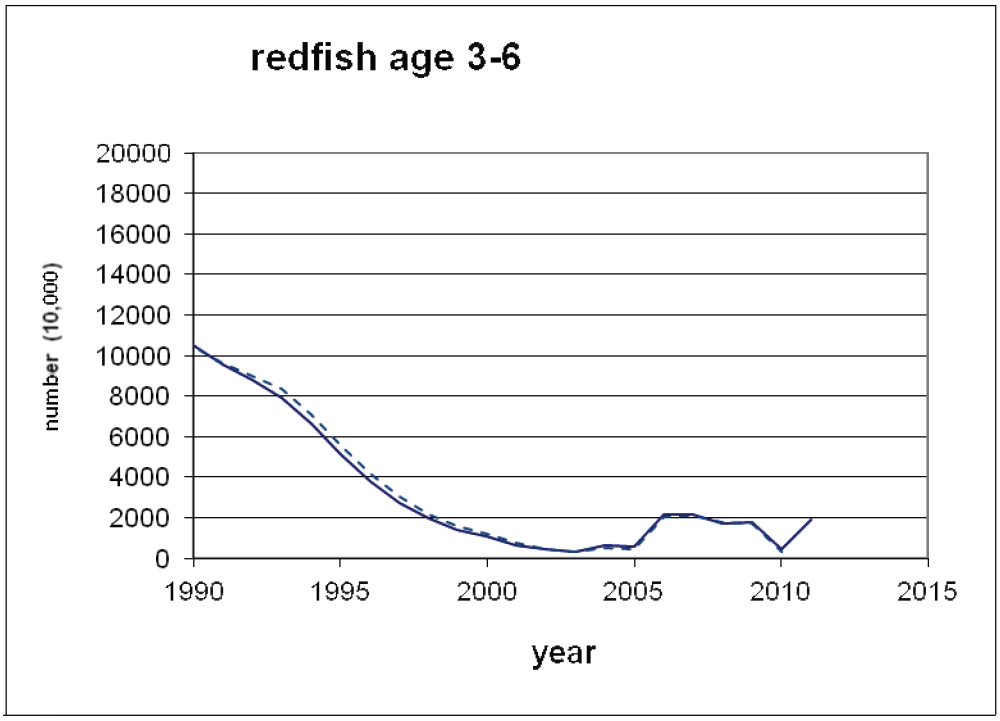

Figure 3.4.6.2 *Sebastes marinus* in Subareas I and II. Estimates of abundance at ages 3–6 by the Gadget model using two surveys as input. Gadget outputs provided at the 2010 AFWG (dashed line). Current results (solid lines).

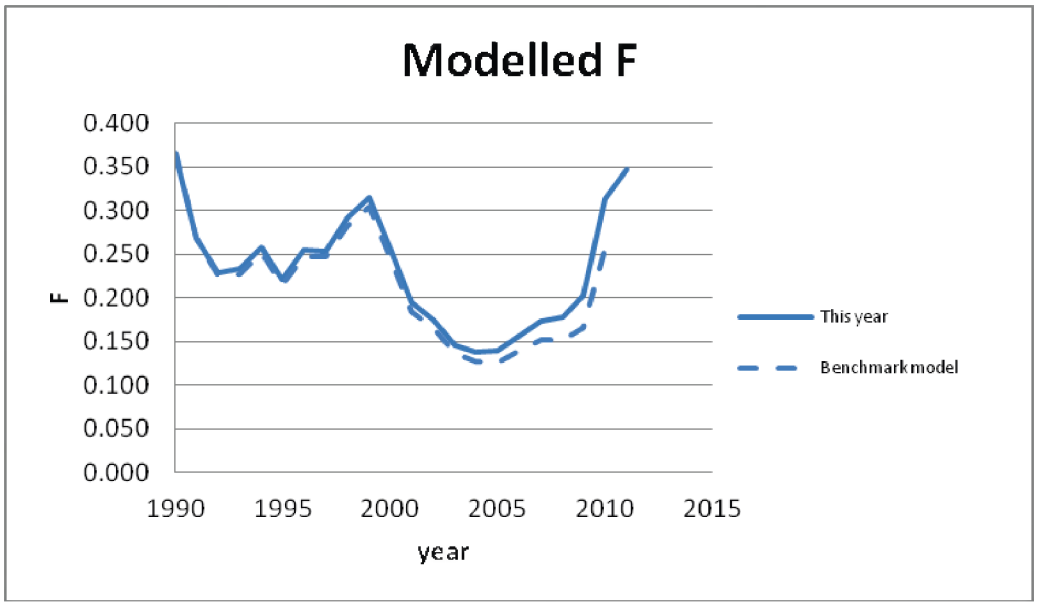

Figure 3.4.6.3 Golden redfish (*Sebastes marinus*) in Subareas I and II. Average fishing mortality of ages 12–19 as estimated by the Gadget model in 2012 (solid line) and at the benchmark assessment (data up to 2010, dashed line).

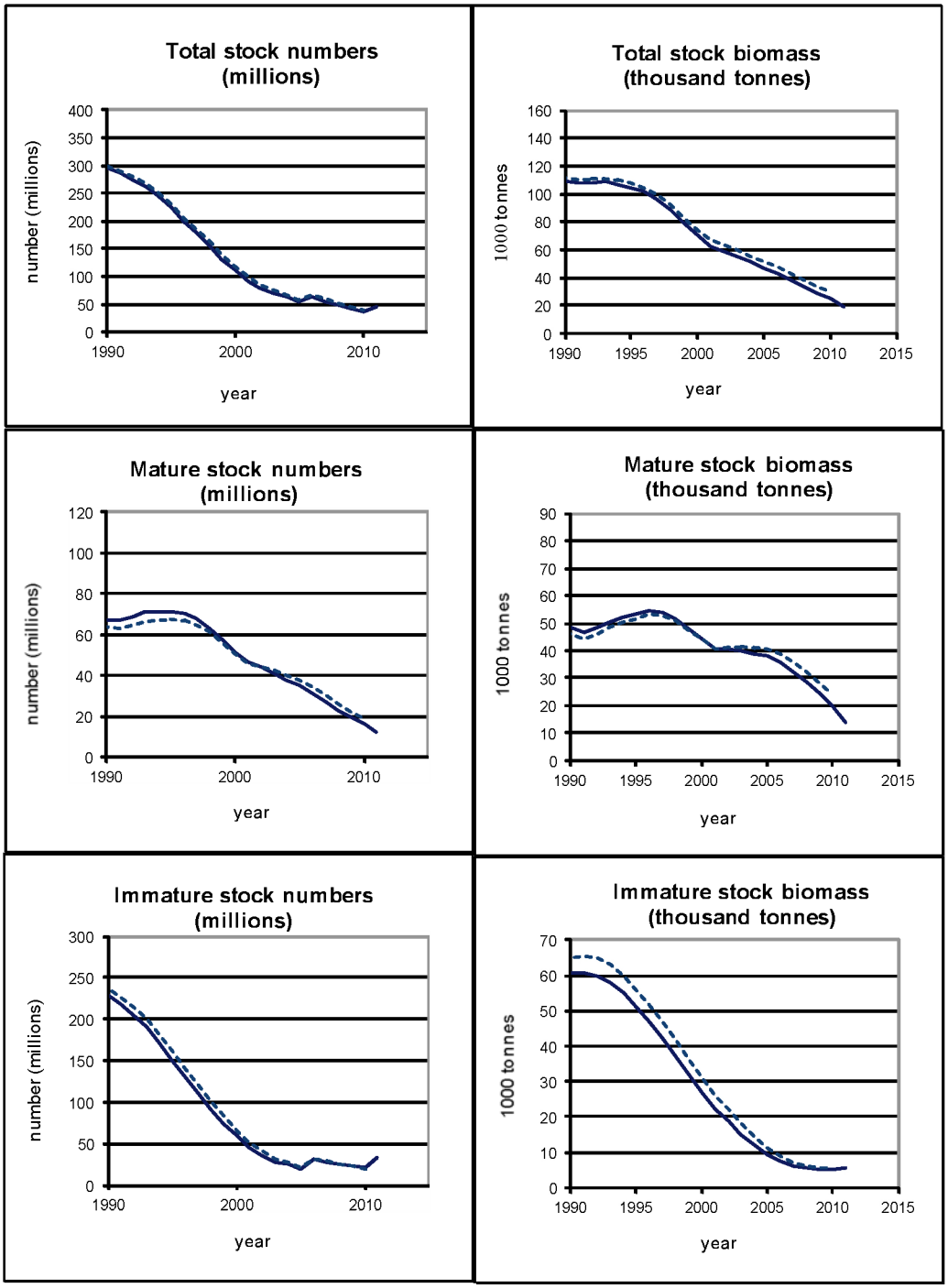

Figure 3.4.6.4 Golden redfish (*Sebastes marinus*) in Subareas I and II. Output from the Gadget model. Stock numbers (in millions) and biomass (in thousand tonnes) for the total stock (3+) (upper panels), the fishable and mature stock (middle panels), and the immature stock (lower panels). Retrospective run with data up to 2010 are indicated with dashed lines.

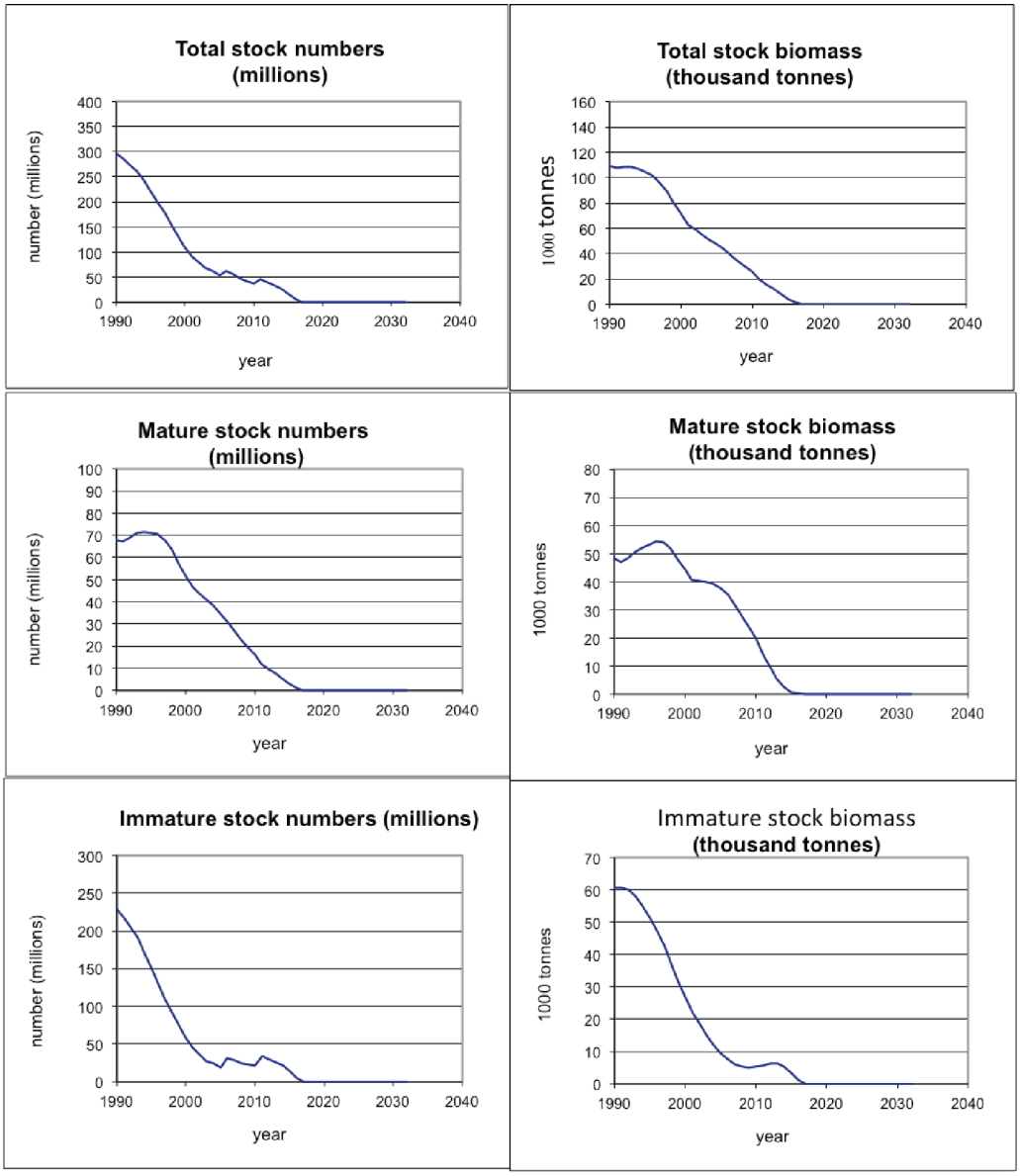

Figure 3.4.6.5. Golden redfish (*Sebastes marinus*) in Subareas I and II. Past status (1990–2011) and projections (2012–2032) from the Gadget model. Projections are made assuming constant recruitment at the mean 2001–2011 level and constant catches at the 2011 level (5.8 kt). Stock numbers (in millions) and biomass (in thousand tonnes) for the total stock (3+) (upper panels), the fishable and mature stock (middle panels), and the immature stock (lower panels).

Table 3.4.6.1 Golden redfish (*Sebastes marinus*) in Subareas I and II. ICES advice, management, and landings.

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Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings[1]	ICES landings of *S. marinus*
1987	Precautionary TAC	-	-	35	24
1988	Reduction in F; TAC	15	-	41	26
1989	*Status quo* F; TAC	24	-	47	23
1990	*Status quo* F; TAC	23	-	63	28
1991	Precautionary TAC	24	-	68	19
1992	If required, precautionary TAC	25	-	32	16
1993	Precautionary TAC	12	12	30	17
1994	If required, precautionary TAC	-	-	31	18
1995	If required, precautionary TAC	-	-	26	16
1996	If required, precautionary TAC	-	-	26	18
1997	If required, precautionary TAC	-	-	26	18
1998	Management plan required as a prerequisite to continued fishing	-	-	33	19
1999	Management plan required as a prerequisite to continued fishing	-	-	30	19
2000	Management plan required as a prerequisite to continued fishing	-	-	25	14
2001	Management plan required as a prerequisite to continued fishing	-	-	29	11
2002	Management plan required as a prerequisite to continued fishing	-	-	17	10
2003	Management plan required as a prerequisite to continued fishing	-	-	10	8
2004	No directed trawl fishery and low bycatch limits	-	-	13	7
2005	More stringent protective measures	-	-	16	7
2006	More stringent protective measures	-	-	40	7
2007	More stringent protective measures	-	-	27	7
2008	No directed fishery and low bycatch limits	-	-	20	7
2009	No directed fishery and low bycatch limits	-	-	16	6
2010	No directed fishery and low bycatch limits	-	-	19	8
2011	Same advice as last year	-	-	18	6
2012	Same advice as last year	-	-		
2013	No fishery				

Weights in thousand tonnes.

[1]Includes both *Sebastes mentella* and *S. marinus*. Redfish catches are allocated on species by the working group.

Table 3.4.6.2 Golden redfish *Sebastes marinus* in Subareas I and II. Nominal landings (t) by country, as used by the working group. For some countries landings are provided as redfish (Sebastes spp.) and the allocation to *S. marinus* is performed during the working group meeting.

Year	Faroe Islands	France	Germany[2]	Greenland	Iceland	Ireland	Netherlands	Norway	Portugal	Russia[3]	Spain	UK(Eng. & Wales)	UK (Scotl)[4]	Poland	Total
1989	3	796	412	-	-	-	-	20,662	-	1,264	-	97	-	-	23,234
1990	278	1,679	387	1	-	-	-	23,917	-	1,549	-	261	-	-	28,072
1991	152	706	981	-	-	-	-	15,872	-	1.052	-	268	10	-	19,041
1992	35	1,289	530	623	-	-	-	12,700	5	758	2	241	2	-	16,185
1993	139	871	650	14	-	-	-	13,137	77	1,313	8	441	1	-	16,651
1994	22	697	1,008	5	4	-	-	14,955	90	1,199	4	135	1	-	18,120
1995	27	732	517	5	1	1	1	13,516	9	639	-	159	9	-	15,616
1996	38	671	499	34	-	-	-	15,622	55	716	81	229	98	-	18,043
1997	3	974	457	23	-	5	-	14,182	61	1,584	36	164	22	-	17,511
1998	78	494	131	33	-	19	-	16,540	6	1,632	51	118	53	-	19,155
1999	35	35	228	47	14	7	-	16,750	3	1,691	7	135	34	-	18,986
2000	17	13	160	22	16	-	-	13,032	16	1,112	-	-	73	-	14,461
2001	37	30	238	17	-	1	-	9,134	7	963	1		119	-	10,547
2002	60	31	42	31	3	-	-	8,561	34	832	3		46	-	9,643
2003	109	8	122	36	4	-	89	6,853	6	479	-		134	-	7,840
2004	19	4	68	20	30	-	33	6,233	5	722	3		69	-	7,206
2005	47	10	72	36	8	-	48	6,085	56	614	8		52	-	7,037
2006	111	8	35	44	31	3	21	6,305	69	713	9		39	-	7,388
2007	146	15	67	84	68	13	20	5,784	225	890	5		55	-	7,372
2008	274	63	30	71	27	6	2	5,202	72	749	4		85	-	6,585
2009	70	1	58	81	66	-	1	5,225[1]	30	698	-		31	-	6,261
2010[1]	171	51	31	72	22	-	-	6,515	28	806	4		44	1	7,744
2011[1]	68	30	9	51	13	-	1	4,645	25	919	6		13	-	5,829

[1]Preliminary figures.
[2]Includes former GDR prior to 1991.
[3]USSR prior to 1991.
[4]UK (E&W) and UK (Scot.).

ECOREGION Barents Sea and Norwegian Sea
STOCK Greenland halibut in Subareas I and II

Advice for 2013

ICES advises on the basis of precautionary considerations that catches should not be allowed to increase and should not exceed 15 000 t.

Stock status

F (Fishing Mortality)	
	2008–2011
MSY (F_{MSY})	? Unknown
Precautionary approach (F_{pa},F_{lim})	? Unknown

SSB (Spawning-Stock Biomass)	
	2009–2012
MSY ($B_{trigger}$)	? Unknown
Precautionary approach (B_{pa},B_{lim})	? Unknown
Qualitative evaluation	Increasing trend

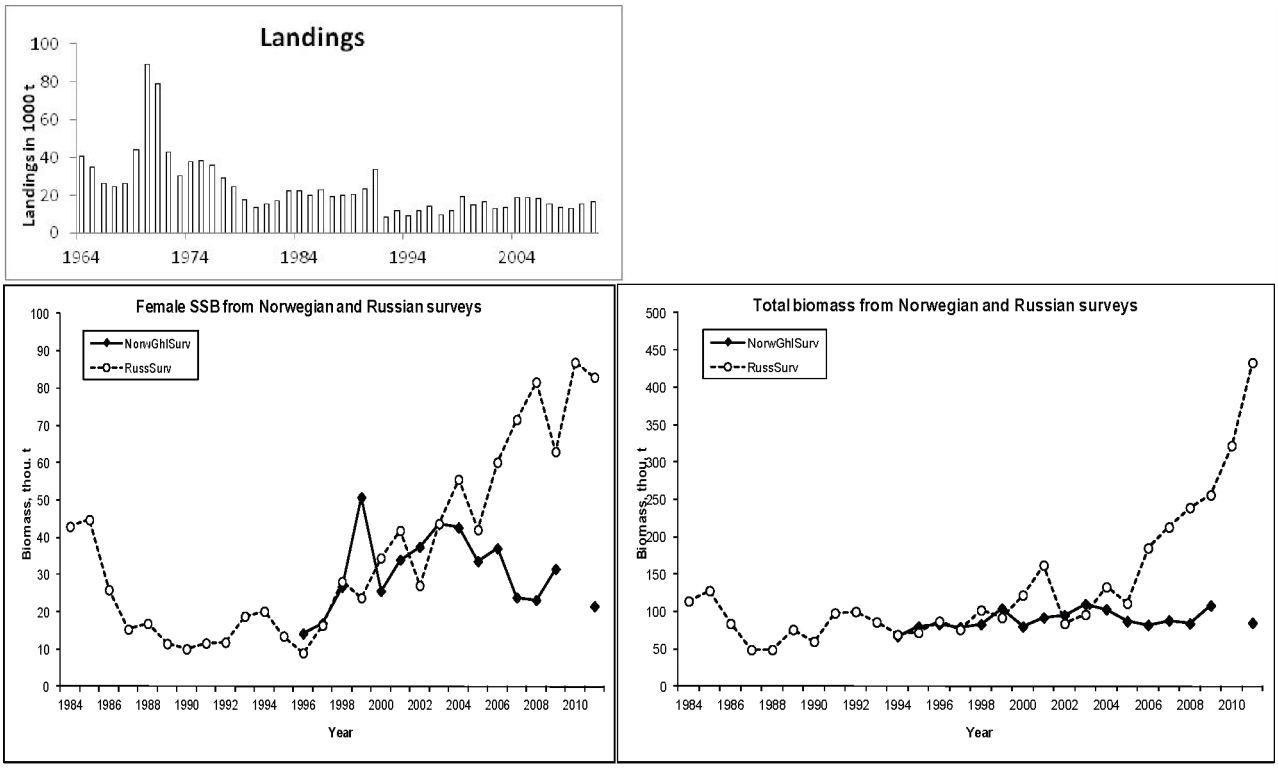

Figure 3.4.7.1 Greenland halibut in Subareas I and II. Top left: Landings. Below left: Biomass (swept area) estimate of the mature female biomass (Norwegian Greenland halibut survey along the continental slope in August and Russian autumn trawl survey). Below right: Total biomass estimates from the Norwegian Greenland halibut survey along the continental slope in August and Russian autumn trawl survey. No Norwegian survey in 2010.

Only landings and survey trends of biomass are available for this stock. Biomass estimates indicate a stable or increasing trend since 1992. There is no information on the exploitation rate of the stock.

Management plans

There are no explicit management objectives for this stock.

Biology

Greenland halibut is a long-lived species showing considerable sexual dimorphism in growth and maturation. Age-reading methodology for this stock has been reviewed in recent years and there is evidence to show that growth is slower than previously thought.

Tagging studies suggest that some mixing occurs with Greenland halibut in the Iceland/East Greenland area.

The fisheries

From 2010 the ban against targeted fishery was lifted by the Joint Russian–Norwegian Fisheries Commission (JRNFC) and since then Greenland halibut has been fished in a directed fishery, and also as bycatch in the fishery for other demersal species.

Catch by fleet	Total catch (2011) = 16.3 kt, where 100% landings (58% trawl, 31% longline, 10% gillnet, and 1% others). Not relevant for discards.

Quality considerations

None of the current surveys cover the complete stock distribution, but most of the adult distribution area is covered. Biomass estimates from the surveys are not consistent but give evidence of a stable or increasing stock

Scientific basis

Assessment type	Survey trends-based assessment.
Input data	Two survey indices (Norwegian slope survey (NO-GH-Btr-Q3), Russian autumn survey (RU-BTr-Q4)).
Discards and bycatch	Not included in the assessment.
Indicators	Survey indices. Discards are not included and are considered to be minor.
Other information	A benchmark is planned for 2013.
Working group report	AFWG

ECOREGION Barents Sea and Norwegian Sea
STOCK Greenland halibut in Subareas I and II

Reference points

No reference points are defined for this stock.

Outlook for 2013

No analytical assessment can be presented for this stock. Therefore, fishing possibilities cannot be projected.

Precautionary considerations

ICES advises on the basis of precautionary considerations that catches should not be allowed to increase above 15 000 t, the average catch for the last 10 years.

Additional considerations

Management considerations

There are signs that the regulations of the last two decades have improved the status of the stock, and measures should be taken to maintain the positive trends.

The 38th Session of the Joint Russian–Norwegian Fisheries Commission (JRNFC) in 2009 decided to cancel the ban against targeted Greenland halibut fishery and established the annual TAC at 15 000 t for 2010 until 2012. The 40th Session of JRNFC raised the TAC for 2012 to 18 000 t.

The benchmark for the Northeast Arctic (NEA) Greenland halibut stock is planned for 2013.

Data and methods

Age-reading issues have not yet been fully resolved for this stock. If the new age-reading methods are to be the basis for advice, a sufficient number of fish need to be aged annually. At present, a routine programme for reading otoliths with the new age-reading methods is being established in Norway.

The ICES Workshop on Age Reading of Greenland Halibut (WKARGH) in 2011 (ICES, 2011b) addressed this issue, and the Russian and Norwegian annual scientists' meeting in March 2012 recommended initiating annual or biannual exchange of otoliths and age-reading experts on these species in order to identify the differences in interpretation and to discuss possibilities for a common approach.

Surveys

The Norwegian August survey covers the continental slope from Norway to west of Spitsbergen (68–80°N, 400–1500 m depth) including the main spawning areas, and thus covers the adult part of the population. This survey was not conducted in 2010, but will be continued biennially from 2011 onwards. The Russian October–December survey (100–900 m depth) does not go as far south on the slope (ca 71°N), but covers adult areas on the northern slope and additionally extends east into central parts of the Barents Sea where catches contain a higher proportion of immature Greenland halibut.

Comparison with previous assessment and advice

The basis for the assessment and advice is the same as last year: precautionary considerations.

Sources

ICES. 2011a. Report of the Arctic Fisheries Working Group, 28 April–4 May 2011. ICES CM 2011/ACOM:05.
ICES. 2011b. Report of the Workshop on Age Reading of Greenland Halibut (WKARGH), 14–17 February 2011, Vigo, Spain. ICES CM 2011/ACOM:41. 39 pp.
ICES 2012. Report of the Arctic Fisheries Working Group, 20 April–26 May 2011. ICES CM 2012/ACOM:05.

Table 3.4.7.1 Greenland halibut in Subareas I and II. Advice, management, and landings.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official Landings	Discards	ICES Landings
1987	Precautionary TAC	-	-	19	-	19
1988	No decrease in SSB	19	-	20	-	20
1989	F = F(87); TAC	21	-	20	-	20
1990	F = F (89); TAC	15	-	23	-	23
1991	F at F_{med}; TAC; improved expl. pattern	9	-	33	-	33
1992	Rebuild SSB(1991)	6	7[1]	9	-	9
1993	TAC	7	7[1]	12	-	12
1994	F < 0.1	< 12	11[1]	9	-	9
1995	No fishing	0	2.5[2]	11	-	11
1996	No fishing	0	2.5[2]	14	-	14
1997	No fishing	0	2.5[2]	10	-	10
1998	No fishing	0	2.5[2]	13	-	13
1999	No fishing	0	2.5[2]	19	-	19
2000	No fishing	0	2.5[2]	14	-	14
2001	Reduce catch to rebuild stock	< 11	2.5[2]	16	-	16
2002	Reduce F substantially	< 11	2.5[2]	13	-	13
2003	Reduce catch to increase stock	< 13	2.5[2]	13	-	13
2004	Do not exceed recent low catches	< 13	2.5[2]	19	-	19
2005	Do not exceed recent low catches	< 13	2.5[2]	19	-	19
2006	Do not exceed recent low catches	< 13	2.5[2]	18	-	18
2007	Reduce catch to increase stock	< 13	2.5[2]	15	-	15
2008	Reduce catch to increase stock	< 13	2.5[2]	14	-	14
2009	Same advice as last year	< 13	2.5[2]	13	-	13
2010	Same advice as last year	< 13	15[3]	15	-	15
2011	Same advice as last year	< 13	15[3]	16	-	16
2012	No increase in catches	< 15	18[4]			
2013	No increase in catches	< 15				

Weights in thousand tonnes.
[1)]Set by Norwegian authorities.
[2)]Set by Norwegian authorities for the non-trawl fishery; allowable bycatch in the trawl fishery is additional to this.
[3)]Set by the Joint Russian–Norwegian Fisheries Commission for 2010–2012.
[4)]Set by the Joint Russian–Norwegian Fisheries Commission for 2012.

Table 3.4.7.2 Greenland halibut in Subareas I and II. Nominal catch (t) by countries as officially reported to ICES.

Year	Denmark	Estonia	Faroe Isl.	France	Fed. Rep. Germany	Gre enland	Iceland	Ireland	Lithuania	Norway	Poland	Portugal	Russia[3,4]	Spain	UK (England & Wales)	UK (Scotland)	Total
1984	0	0	0	138	2,165	0	0	0	0	4,376	0	0	15,181	0	23	0	21,883
1985	0	0	0	239	4,000	0	0	0	0	5,464	0	0	10,237	0	5	0	19,945
1986	0	0	42	13	2,718	0	0	0	0	7,890	0	0	12,200	0	10	2	22,875
1987	0	0	0	13	2,024	0	0	0	0	7,261	0	0	9,733	0	61	20	19,112
1988	0	0	186	67	744	0	0	0	0	9,076	0	0	9,430	0	82	2	19,587
1989	0	0	67	31	600	0	0	0	0	10,622	0	0	8,812	0	6	0	20,138
1990	0	0	163	49	954	0	0	0	0	17,243	0	0	4,764[2]	0	10	0	23,183
1991	11	2,564	314	119	101	0	0	0	0	27,587	0	0	2,490[2]	132	0	2	33,320
1992	0	0	16	111	13	13	0	0	0	7,667	0	31	718	23	10	0	8,602
1993	2	0	61	80	22	8	56	0	30	10,380	0	43	1,235	0	16	0	11,933
1994	4	0	18	55	296	3	15	5	4	8,428	0	36	283	1	76	2	9,226
1995	0	0	12	174	35	12	25	2	0	9,368	0	84	794	1 106	115	7	11,734
1996	0	0	2	219	81	123	70	0	0	11,623	0	79	1,576	200	317	57	14,347
1997	0	0	27	253	56	0	62	2	0	7,661	12	50	1,038	157[2]	67	25	9,410
1998	0	0	57	67	34	0	23	2	0	8,435	31	99	2,659	259[2]	182	45	11,893
1999	0	0	94	0	34	38	7	2	0	15,004	8	49	3,823	319[2]	94	45	19,517
2000	0	0	0	45	15	0	16	1	0	9,083	3	37	4,568	375[2]	111	43	14,297
2001	0	0	0	122	58	0	9	1	0	10,896[2]	2	35	4,694	418[2]	100	30	16,365
2002	0	219	0	7	42	22	4	6	0	7,011[2]	5	14	5,584	178[2]	41	28	13,161
2003	0	0	459	2	18	14	0	1	0	8,347[2]	5	19	4,384	230[2]	41	58	13,578
2004	0	0	0	0	9	0	9	0	0	13,840[2]	1[2]	50	4,662	186[2]	43	0	18,800
2005	0	170	0	32	8	0	0	0	0	13,011[2]	0[2]	23	4,883	660[2]	29	18	18,834
2006	0	0	204	46	8	0	8	0	196	11,119[2]	201[2]	26[2]	6,055	27[2]	6	0	17,897
2007	0	0	203	40	8	0	15	+	0	8,229[2]	200[2]	47[2]	6,484	11[2]	0	0	15,237
2008	0	0	640	42	5	0	28	0	0	7,394[2]	201[2]	46[2]	5,294	112	16	0	13,778
2009[1]	0	0	422	16	19	20	15	2	0	8,446[2]	204[2]	239	3,335	210[2]	69	0	12,996
2010[1]	0	0	272	102	14	15	16	0	0	7,685[2]	3[2]	11	6,888	190[2]	26	0	15,221
2011[1]	0	0	404	32	81	4	3	0	250	8,273[2]	169	21.5	7,053	8[2]	40	0	16,337

[1] Provisional figures.
[2] Working Group figures.
[3] As reported to Norwegian authorities.
[4] USSR prior to 1991.

ECOREGION **Barents Sea and Norwegian Sea**
STOCK **Capelin in Subareas I and II, excluding Division IIa west of 5°W (Barents Sea capelin)**

Advice for 2013

ICES advises on the basis of the management plan agreed by the Joint Norwegian–Russian Fisheries Commission (JNRFC) that catches in 2013 should be no more than 200 000 tonnes.

Stock status

F (Fishing Mortality)	2010	2011	2012	
MSY (F_{MSY})	-	-	-	Not relevant
Precautionary approach (F_{pa},F_{lim})	-	-	-	Not relevant

SSB (Spawning-Stock Biomass)	2011	2012	2013	
MSY ($B_{trigger}$)	?	?	?	Undefined
Precautionary approach (B_{lim})	✓	✓	✓	Above limit reference point

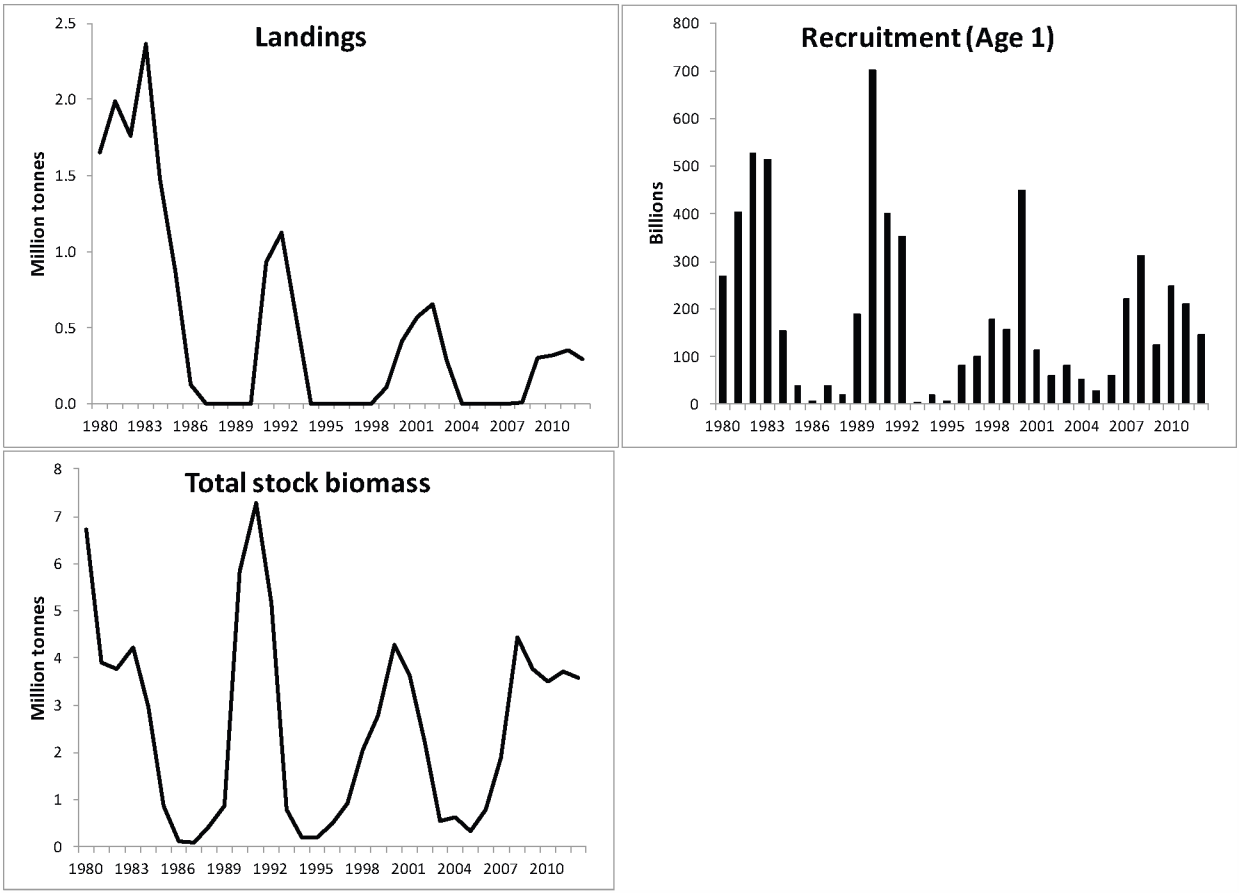

Figure 3.4.8.1 Capelin in Subareas I and II, excluding Division IIa west of 5°W (Barents Sea capelin). Summary of stock assessment (weights in million tonnes).

The maturing component in autumn 2012 was estimated to be 2.0 million tonnes. The spawning stock in 2013 will consist of fish from the 2009 and 2010 year classes. The survey estimate of the 2011 year class at age 1 is slightly below the long-term average while 0-group observations during the joint Russian–Norwegian ecosystem survey in August–September 2012 indicated that the 2012 year class is well above the long-term average.

Management plans

In 2002, the Joint Norwegian–Russian Fisheries Commission (JNRFC) agreed to adopt a management strategy in which the fishery is managed according to a target escapement strategy that takes the predation by cod into account. A basis for the management plan is that all catches are taken on pre-spawning capelin. The harvest control rule is designed to ensure that when the fishery is closed, the SSB remains above the proposed B_{lim} of 200 000 tonnes (with 95% probability). ICES considers the management plan to be consistent with the precautionary approach.

In 2010, the JNRFC decided that the management strategy should not be changed for the following 5 years.

Biology

Capelin has a life-span of 3–5 years, and almost all individuals die after spawning.

Environmental influence on the stock

Capelin is an important part of the diet for many predators, including cod, harp seals, minke whales, humpback whales, seabirds, and haddock. Capelin is the main prey item for cod. Growth, maturation, and cannibalism of cod are all affected by capelin abundance. The estimated annual consumption of capelin by cod has varied between 0.2 and 4.4 million tonnes over the period 1984–2011. Young herring consume capelin larvae, and this predation pressure is suggested to be among the main reasons for the poor year classes of capelin in the periods 1984–1986, 1992–1994, and 2001–2005. The abundance of young herring in the Barents Sea is expected to be at a low level in 2013.

Low capelin abundance has also in some periods had a negative impact on harp seal and seabird populations. However, these effects were much stronger during the first capelin collapse (associated with the 1983 year class of herring) than during the two subsequent collapses. After spawning, dead capelin may also be of importance as food for haddock and other benthic feeders.

The fisheries

Since 1979, the fishery has been regulated by a bilateral agreement between Norway and Russia (formerly USSR). The catches have been very close to the advice in all years since 1987.

Catch distribution	Total catches (2011) = 360 kt, where 360 kt are landings (0 kt discards, 0 kt industrial bycatch, and 0 kt unaccounted removals).

Quality considerations

The acoustic survey in September 2012 had a good coverage of the spatial distribution of the capelin stock. Sampling from commercial catches is considered to be adequate. The assessment takes into account the uncertainties both in the capelin survey estimate, the cod stock estimate, and in model parameters.

The overlap of mature cod with pre-spawning capelin can in some cases have a significant impact on the capelin stock. However, this issue is not included in the present model.

Scientific basis

Assessment type	Model estimating maturity, growth, and mortality (including predation by immature cod on pre-spawning capelin).
Input data	Russian–Norwegian acoustic surveys in September (Eco-NoRu-Q3 (Aco)), used as absolute estimate.
Discards and bycatch	Discards and industrial bycatch are not accounted for as these are both negligible.
Indicators	None.
Other information	Benchmark meeting in 2009.
Working group report	AFWG

ECOREGION Barents Sea and Norwegian Sea
STOCK Capelin in Subareas I and II, excluding Division IIa west of 5°W (Barents Sea capelin)

Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{trigger}$	Undefined.	
	F_{MSY}	Undefined.	
Precautionary Approach	B_{lim}	200 000 t	Above SSB_{1989}, the lowest SSB that has produced a good year class.
	B_{pa}	Undefined.	
	F_{lim}	Undefined.	
	F_{pa}	Undefined.	

(unchanged since: 2010)

Outlook for 2013

Management plan

Following the management plan agreed by the Joint Norwegian–Russian Fisheries Commission, catches in 2013 should be no more than 200 000 t. The harvest control rule in the management plan is designed to ensure that the SSB remains above the proposed B_{lim} of 200 000 t (with 95% probability).

Additional considerations

Management considerations

For this stock, a B_{lim} equal to the value of the 1989 spawning-stock biomass, which is the lowest SSB having produced an outstanding year class, is considered a good basis for such a reference point when abundance of young herring is low. The mean value of the 1989 spawning-stock biomass is less than 100 000 tonnes. However, the assessment method is unlikely to account for all sources of uncertainty. Thus, ICES considers it appropriate to use a somewhat higher B_{lim} and a value of 200 000 tonnes has been used in recent years.

The B_{lim} rule is intended to be a safeguard against recruitment failure. However, it is likely that the recruitment would be larger with a larger spawning stock, especially for moderate to good recruitment conditions. In such a situation it may be appropriate to apply a target-based control rule in addition to the B_{lim}-based rule. The negative influence of herring on capelin recruitment should be included in the B_{lim}-based rule if such a relationship can be described quantitatively. Adjustments to the harvest control rule should be investigated further and should take into account the uncertainty associated with the impacts of the environment and the predicted amount of spawners, and also the role of capelin as a prey item.

Regulations and their effects

Since 1979, the Barents Sea capelin fishery has been regulated by a bilateral fishery management agreement between Norway and Russia (former USSR), with a minimum landing size of 11 cm in force since 1979. A TAC has been set separately for the winter fishery and for the autumn fishery.

No commercial autumn fishery has taken place since 1999, but a small Russian experimental fishery has been conducted. The fishery was closed from 1 May to 15 August until 1984. After 1984, the fishery was closed from 1 May to 1 September. No commercial fishery took place from autumn 1986 to winter 1991, from autumn 1993 to winter 1999, and in all of 2004–2008. However, more recently, a commercial fishery in the winter–spring period started again in 2009.

Data and methods

The assessment and stock history is based on the joint Russian–Norwegian acoustic surveys in September each year. The spawning stock in 2013 is predicted from the acoustic survey in September 2012, by a model estimating maturity, growth, and mortality (including predation by cod).

Uncertainties in assessment and forecast

The assessment model takes account of uncertainties both in the survey estimate and in other input data.

Consumption of pre-spawning capelin by mature cod is neglected in the assessment model. Biological samples and information from commercial vessels in recent years have shown that this takes place and that mature cod may consume significant amounts of pre-spawning capelin. However, this factor is random and depends on many other conditions. Therefore it is difficult to take into account. In the present situation of an extremely large mature cod stock even a slight overlap of the distribution of cod and capelin may have a significant impact on capelin SSB.

Also, cod have been feeding intensely on maturing capelin in the extreme north of the Barents Sea in the autumn of recent years. Studies of the cod stomach content during the recent surveys confirm this assumption. These two shortcomings of the assessment model create an additional uncertainty even if natural mortality in October–December was chosen from periods that reflect the present situation as much as possible.

An assessment was made with an exploratory model, incorporating predation by cod in quarter 4, predation of pre-spawning capelin by mature cod, and predation of immature capelin in quarter 1. Results of this explanatory model give evidence that the catch advice should be somewhat lower than presented here. This model should be reviewed during a benchmark process.

Comparison with previous assessment and advice

The basis of the advice remains the same as last year.

Source

ICES. 2012. Annex 12: Update Barents Sea capelin assessment (October 2012). *In*: Report of the Arctic Fisheries Working Group (AFWG), 19 April–25 April 2012, Copenhagen, Denmark. ICES CM 2012/ACOM:05.

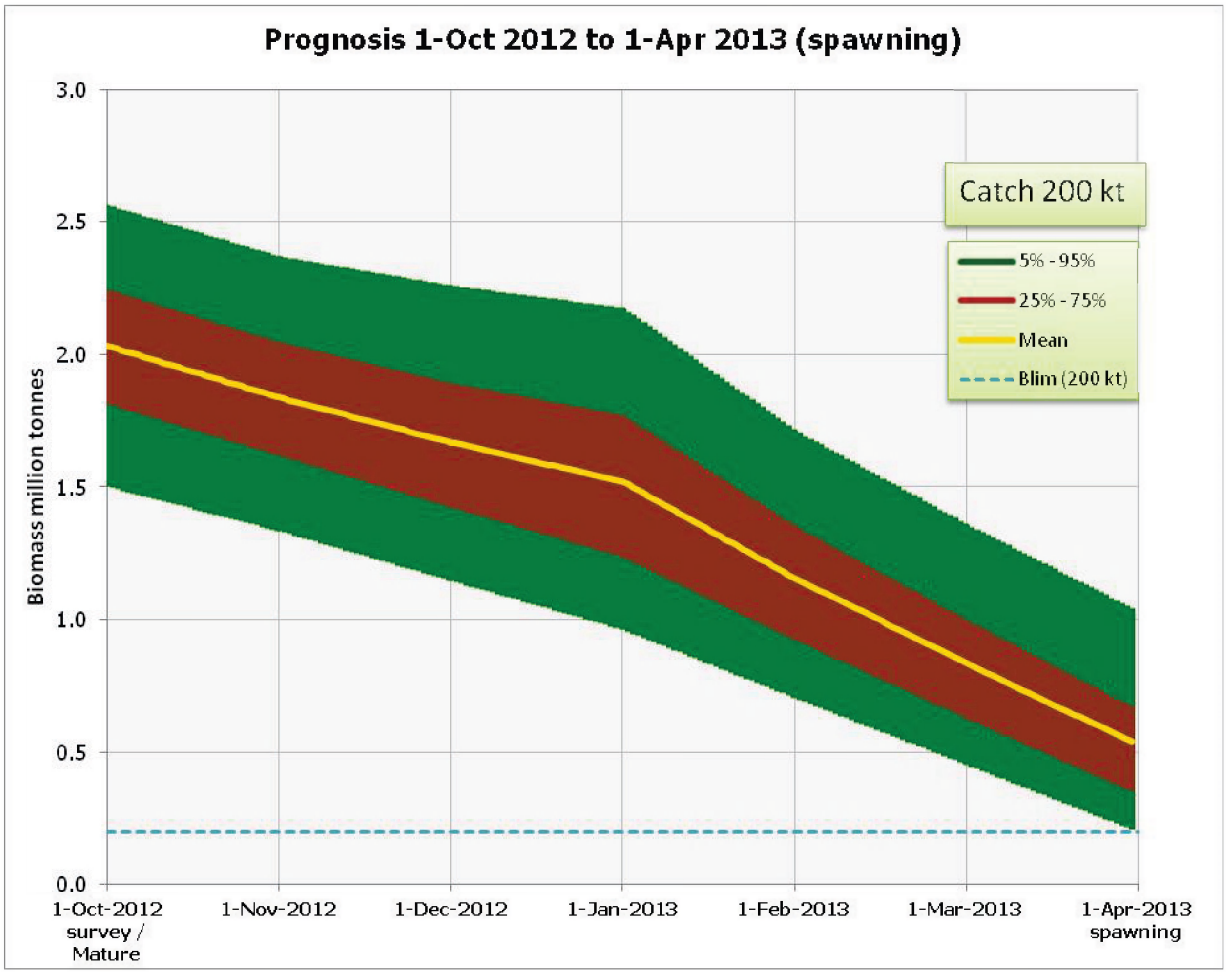

Figure 3.4.8.2 Capelin in Subareas I and II, excluding Division IIa west of 5°W (Barents Sea capelin). Probabilistic prognosis 1 October 2012–1 April 2013 (maturing stock, catch of 200 000 tonnes).

Table 3.4.8.1 Capelin in Subareas I and II, excluding Division IIa west of 5°W (Barents Sea capelin). ICES advice, management, and catches.

Year	ICES Advice	Recommended TAC	Agreed TAC	ICES catch
1987	Catches at lowest practical level	0	0	0
1988	No catch	0	0	0
1989	No catch	0	0	0
1990	No catch	0	0	0
1991	TAC	1000[1]	900	933
1992	SSB > 4–500 000 t	834	1100	1123
1993	A cautious approach, SSB > 4–500 000 t	600	630	586
1994	No fishing	0	0	0
1995	No fishing	0	0	0
1996	No fishing	0	0	0
1997	No fishing	0	0	1
1998	No fishing	0	0	1
1999	SSB> 500 000 t	79[1]	80	101
2000	5% probability of SSB< 200 000 t	435[1]	435	414
2001	5% probability of SSB< 200 000 t	630[1]	630	568
2002	5% probability of SSB< 200 000 t	650[1]	650	651
2003	5% probability of SSB< 200 000 t	310[1]	310	282
2004	No fishing	0	0	0
2005	No fishing	0	0	1[2]
2006	No fishing	0	0	0
2007	No fishing	0	0	4[2]
2008	No fishing	0	0	12[2]
2009	5% probability of SSB< 200 000 t	390[1]	390	307
2010	5% probability of SSB< 200 000 t	360[1]	360	323
2011	5% probability of SSB< 200 000 t	380[1]	380	360
2012	5% probability of SSB< 200 000 t	320[1]	320	296[3]
2013	5% probability of SSB< 200 000 t	200[1]		

Weights in thousand tonnes.
[1]Winter–spring fishery.
[2]Research catch.
[3]Preliminary.

Table 3.4.8.2 Capelin in Subareas I and II, excluding Division IIa west of 5°W (Barents Sea capelin). International catch (thousand tonnes) as used by the Working Group.

Year	Winter				Summer-Autumn			Total
	Norway	Russia	Others	Total	Norway	Russia	Total	
1965	217	7	0	**224**	0	0	**0**	**224**
1966	380	9	0	**389**	0	0	**0**	**389**
1967	403	6	0	**409**	0	0	**0**	**409**
1968	460	15	0	**475**	62	0	**62**	**537**
1969	436	1	0	**437**	243	0	**243**	**680**
1970	955	8	0	**963**	346	5	**351**	**1314**
1971	1300	14	0	**1314**	71	7	**78**	**1392**
1972	1208	24	0	**1232**	347	13	**360**	**1591**
1973	1078	34	0	**1112**	213	12	**225**	**1337**
1974	749	63	0	**812**	237	99	**336**	**1148**
1975	559	301	43	**903**	407	131	**538**	**1441**
1976	1252	228	0	**1480**	739	368	**1107**	**2587**
1977	1441	317	2	**1760**	722	504	**1226**	**2986**
1978	784	429	25	**1238**	360	318	**678**	**1916**
1979	539	342	5	**886**	570	326	**896**	**1782**
1980	539	253	9	**801**	459	388	**847**	**1648**
1981	784	429	28	**1241**	454	292	**746**	**1986**
1982	568	260	5	**833**	591	336	**927**	**1760**
1983	751	373	36	**1160**	758	439	**1197**	**2357**
1984	330	257	42	**629**	481	368	**849**	**1477**
1985	340	234	17	**591**	113	164	**277**	**868**
1986	72	51	0	**123**	0	0	**0**	**123**
1987	0	0	0	**0**	0	0	**0**	**0**
1988	0	0	0	**0**	0	0	**0**	**0**
1989	0	0	0	**0**	0	0	**0**	**0**
1990	0	0	0	**0**	0	0	**0**	**0**
1991	528	159	20	**707**	31	195	**226**	**933**
1992	620	247	24	**891**	73	159	**232**	**1123**
1993	402	170	14	**586**	0	0	**0**	**586**
1994	0	0	0	**0**	0	0	**0**	**0**
1995	0	0	0	**0**	0	0	**0**	**0**
1996	0	0	0	**0**	0	0	**0**	**0**
1997	0	0	0	**0**	0	1	**1**	**1**
1998	0	2	0	**2**	0	1	**1**	**3**
1999	50	33	0	**83**	0	22	**22**	**105**
2000	279	94	8	**381**	0	29	**29**	**410**
2001	376	180	8	**564**	0	14	**14**	**578**
2002	398	228	17	**643**	0	16	**16**	**659**
2003	180	93	9	**282**	0	0	**0**	**282**
2004	0	0	0	**0**	0	0	**0**	**0**
2005	1	0	0	**1**	0	0	**0**	**1**
2006	0	0	0	**0**	0	0	**0**	**0**
2007	2	2	0	**4**	0	0	**0**	**4**
2008	5	5	0	**10**	0	2	**0**	**12**
2009	233	73	0	**306**	0	1	**1**	**307**
2010	246	77	0	**323**	0	0	**0**	**323**
2011	273	87	0	**360**	0	0	**0**	**360**
2012	228	68	0	**296**				

Table 3.4.8.3 Capelin in Subareas I and II, excluding Division IIa west of 5°W (Barents Sea capelin). Stock summary table. Recruitment and total biomass are survey estimates back-calculated to 1 August (before the autumn fishing season) for 1985 and earlier; for 1986 and later it is the survey estimate. Maturing biomass is the survey estimate of fish above length of maturity (14.0 cm). SSB is the median value of the modelled stochastic spawning-stock biomass (after the winter/spring fishery).

Year	Estimated stock by autumn acoustic survey (10^3 t) 1 October		Spawning-stock biomass, assessment model, April 1 (10^3 t)	Spawning-stock biomass, by winter acoustic survey (10^3 t)	Recruitment Age 1, survey assessment 1 October 10^9 sp.	Young herring biomass at ages 1 and 2 in the Barents Sea (10^3 t)	Landings (10^3 t)
	total stock biomass	Mature stock biomass					
1972	6600	2727			152		1591
1973	5144	1350	33		528	2	1337
1974	5733	907	*		305	48	1148
1975	7806	2916	*		190	74	1441
1976	6417	3200	253		211	39	2587
1977	4796	2676	22		360	46	2986
1978	4247	1402	*		84	52	1916
1979	4162	1227	*		12	39	1782
1980	6715	3913	*		270	66	1648
1981	3895	1551	316		403	47	1986
1982	3779	1591	106		528	9	1760
1983	4230	1329	100		515	12	2357
1984	2964	1208	109		155	1313	1477
1985	860	285	*		39	1220	868
1986	120	65	*		6	155	123
1987	101	17	34	4	38	145	0
1988	428	200	*	10	21	68	0
1989	864	175	84	378	189	128	0
1990	5831	2617	92	94	700	352	0
1991	7287	2248	643	1769	402	640	933
1992	5150	2228	302	1735	351	1507	1123
1993	796	330	293	1498	2	2395	586
1994	200	94	139	187	20	1650	0
1995	193	118	60	29	7	525	0
1996	503	248	60		82	202	0
1997	909	312	85		99	279	1
1998	2056	932	94	414	179	321	3
1999	2775	1718	382		156	1063	105
2000	4273	2098	599	700	449	1518	410
2001	3630	2019	626		114	837	578
2002	2210	1291	496	1417	60	364	659
2003	533	280	427		82	1595	282
2004	628	294	94	105	51	1912	0
2005	324	174	122		27	1609	1
2006	787	437	72		60	1177	0
2007	2119	844	189		277	433	4
2008	4428	2468	330	469	313	305	12
2009	3765	2323	517	180	124	143	307
2010	3500	2051	504	452	248	217	315
2011	3707	2115	487	160	209	158	360
2012	3586	1997	504		146	60	296

* Very small spawning stock.

Table 3.4.8.4 Capelin in Subareas I and II, excluding Division IIa west of 5°W (Barents Sea capelin). Larval abundance estimate (10^{12}) in June, and 0-group indices (10^9) in August–September.

Year class	Larval abundance (10^{12})	0-group index (10^9 ind.) Not adjusted for trawl catchability of 0-group	0-group index (10^9 ind.) Adjusted for trawl catchability of 0-group
1980	-	197.3	740
1981	9.7	123.9	477
1982	9.9	168.1	600
1983	9.9	100.0	340
1984	8.2	68.1	275
1985	8.6	21.3	64
1986	0.0	11.4	42
1987	0.3	1.2	4
1988	0.3	19.6	65
1989	7.3	251.5	862
1990	13.0	36.5	116
1991	3.0	57.4	169
1992	7.3	1.0	2
1993	3.3	0.3	1
1994	0.1	5.4	14
1995	0.0	0.9	3
1996	2.4	44.3	137
1997	6.9	54.8	189
1998	14.1	33.8	113
1999	36.5	85.3	288
2000	19.1	39.8	141
2001	10.7	33.6	90
2002	22.4	19.4	67
2003	11.9	94.9	341
2004	2.5	16.7	54
2005	8.8	41.8	148
2006	17.1	166.4	516
2007	-	157.9	480
2008	-	288.8	995
2009	-	189.8	673
2010	-	91.7	319
2011	-	175.8	594
2012	-	313.4	989
Average	9.0	88.3	300

ECOREGION Barents Sea
STOCK Northern shrimp (*Pandalus borealis*) in Subareas I and II (Barents Sea)

Advice for 2013

ICES advises that catches of 60 000 tonnes in 2013 will maintain the stock at the current high biomass.

Stock status

F (Fishing Mortality)	2010	2011	2012	
MSY (F_{MSY})	✓	✓	✓	Below target
Precautionary approach (F_{lim})	✓	✓	✓	Harvested sustainably

SSB (Spawning-Stock Biomass)	2010	2011	2012	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{lim})	✓	✓	✓	Full reproductive capacity

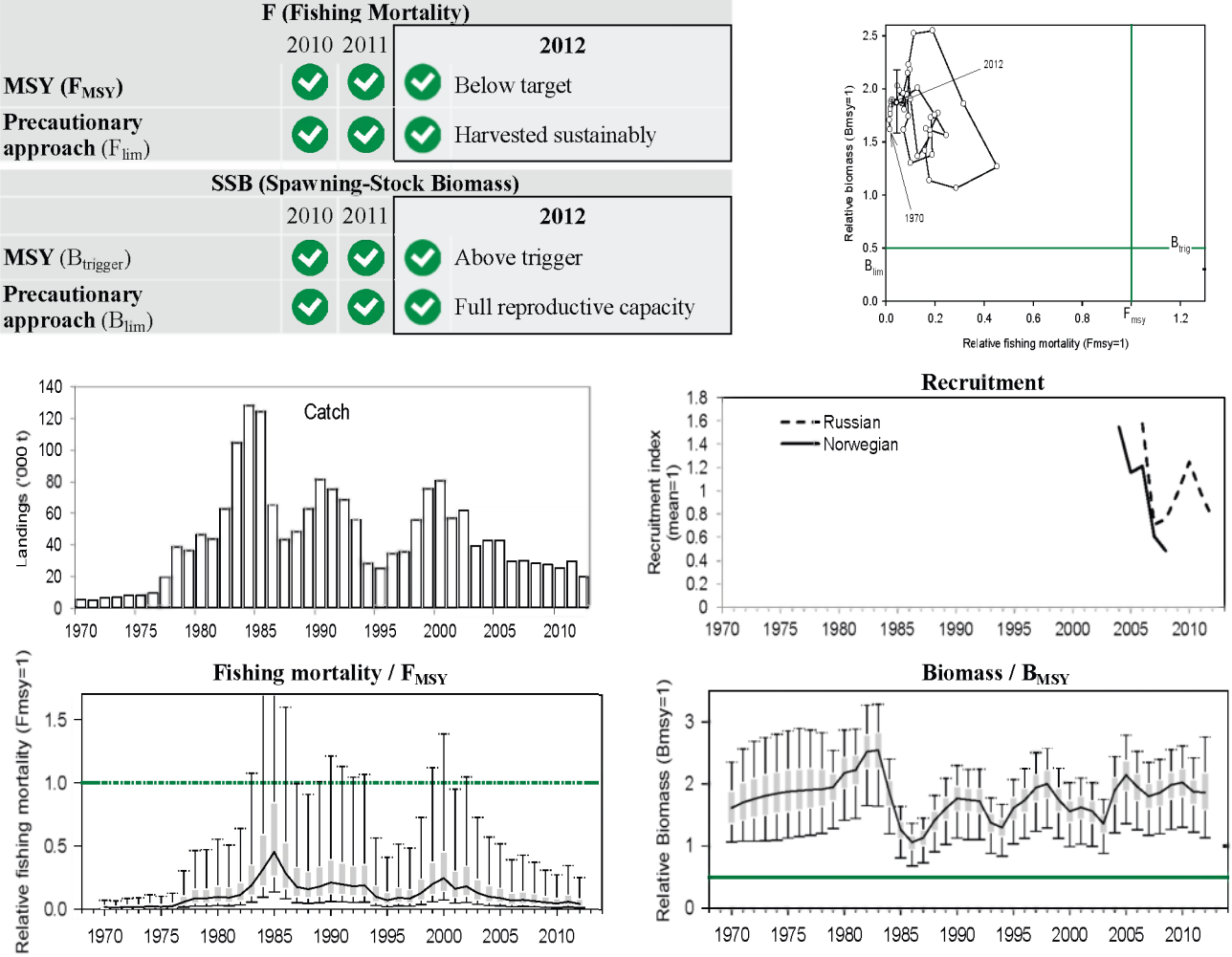

Figure 3.4.9.1 Northern shrimp in Subareas I and II (Barents Sea). Summary of stock assessment. Catches 2012 projected to the end of the year. Recruitment index: abundance of Northern shrimp at size 13–16 mm CL from Norwegian (2004–2008) and Russian (2006–2012) surveys. Below: Median estimates of the relative biomass (B/B_{MSY}) and fishing mortality (F/F_{MSY}): Grey boxes are inter-quartile ranges; the arms of each box are the 95% credibility interval of the distribution. Top right: Fishable biomass and F over the years.

The assessment is considered indicative of stock trends, and provides relative measures of stock status rather than absolute. Throughout the history of the fishery, estimates of stock biomass have been above $B_{trigger}$ and fishing mortality below F_{MSY}. The estimated risk of falling below $B_{trigger}$ and B_{lim} or of exceeding F_{MSY} by the end of 2012 is less than 1%. Recruitment indices showed no major changes in the period 2004–2012.

Management plans

No specific management objectives are known to ICES.

Biology

Northern shrimp are hermaphroditic. Individuals start out as males, but after 3–4 years they change sex and complete their lives as females. Various fish and marine mammal species prey on Northern shrimp, and predation is considered important in influencing Northern shrimp stock dynamics.

The fisheries

Norwegian and Russian vessels exploit the stock over the entire resource area, while vessels from other nations are restricted to the Svalbard fishery zone. No overall TAC has been established for this stock, and the fishery is partly regulated by effort control, licensing, and a partial TAC (Russian zone only). Bycatch is constrained by mandatory sorting grids and by temporary closures of areas where high bycatch occurs of juvenile cod, haddock, Greenland halibut, redfish, or small shrimp (< 15 mm). The minimum mesh size is 35 mm.

Catch by fleet	Total catch (2011) = 29.790 kt, where 100% are landings (100% trawl).

Effects of the fisheries on the ecosystem

Small-mesh trawls are used to catch Northern shrimp, frequently with a bycatch of juvenile fish. However, overall bycatch is considered to be relatively small due to the use of mandatory sorting grids and temporary closures of areas where high bycatch occurs.

Quality considerations

The assessment model best describes trends in stock development and is not fully sensitive to year-to-year changes. Large and rapid changes in recruitment may therefore not be fully captured in model predictions. If predation on Northern shrimp were to increase rapidly outside the range in the modelled period (1970–2012), the stock size might change more than the modelling results indicate.

Scientific basis

Assessment type	Bayesian version of a surplus-production model.
Input data	Three survey indices (the Norwegian shrimp survey 1982–2004, the Russian shrimp survey 1984–2005, and the Norwegian–Russian ecosystem survey Eco-Norw-Q3 since 2004); one commercial index (standardized cpue since 1970).
Discards and bycatch	Not included in the assessment.
Indicators	None.
Other information	Bayesian stock–production model introduced in 2006.
Working group report	NIPAG

ECOREGION Barents Sea
STOCK Northern shrimp (*Pandalus borealis*) in Subareas I and II (Barents Sea)

Reference points

	Type	Value	Technical basis
MSY approach	MSY $B_{trigger}$	0.5 of B_{MSY}*	50% of B_{MSY} (10^{th} percentile of the B_{MSY} estimate); relative value.
	F_{MSY}	*	Resulting from the production model.
Precautionary approach	B_{lim}	0.3 of B_{MSY}	30% of B_{MSY} (production reduced to 50% MSY); relative value.
	B_{pa}	Not defined.	Not needed: Risk of transgressing limits are directly estimated.
	F_{lim}	1.7 of F_{MSY}	1.7 F_{MSY} (the F that drives the stock to B_{lim}); relative value.
	F_{pa}	Not defined.	Not needed: Risk of transgressing limits are directly estimated.

(unchanged since: 2011)

* Fishing mortality is estimated in relation to F_{MSY} and total stock biomass is estimated in relation to B_{MSY}.

Outlook for 2013

Catch option 2013 (ktonnes)	30	40	50	60	70	90
Risk of falling below B_{lim} ($0.3B_{MSY}$)	< 1%	< 1%	< 1%	< 1%	< 1%	< 1%
Risk of falling below $B_{trigger}$ ($0.5B_{MSY}$)	< 1%	< 1%	< 1%	< 1%	< 1%	< 1%
Risk of exceeding F_{MSY}	1%	2%	3%	4%	6%	8%
Risk of exceeding 1.7 F_{MSY}	1%	1%	1%	2%	3%	4%
Stock size (B/B_{MSY}), median	1.86	1.85	1.84	1.83	1.83	1.80
Fishing mortality (F/F_{MSY}),	0.08	0.10	0.13	0.15	0.18	0.23
Productivity (% of MSY)	27%	28%	30%	30%	32%	36%

MSY approach

The stock is well above MSY $B_{trigger}$ and F is well below F_{MSY}. Catches of 60 000 t in 2013 will maintain the stock at current high biomass.

Precautionary approach

There is a low risk in 2013 of the stock falling below B_{lim} or of the fishing mortality rate exceeding F_{lim} at catch options up to 90 000 t.

Additional considerations

Both stock development and the rate at which changes might take place can be affected by changes in predation, in particular by cod, which has been estimated to consume large amounts of Northern shrimp. The Barents Sea cod stock has recently increased (ICES, 2012b). However, as the total predation on shrimp depends on the abundance of both cod and Northern shrimp, as well as alternate prey species (e.g. capelin), the effect of predation on the shrimp stock has been difficult to quantify. Continuing investigations to include cod predation explicitly in the shrimp assessment model have so far not been successful.

Temperatures in the Barents Sea have been high since 2004, largely due to increased inflow of warm water masses from the Norwegian Sea. An increase from 2011 to 2012 was observed in near-bottom temperatures primarily in the north and northwestern parts of the Barents Sea, but also in the southwest where temperatures at the bottom were the highest on record since 1951. Highest shrimp densities were observed between zero and 4°C, while the upper limit of their temperature preference appears to lie at about 6–8°C. The changes in shrimp distribution eastwards may be associated with the temperature changes observed.

Regulations and their effects

There is no overall TAC established for this stock, and the fishery is partly regulated by effort control, licensing, and a partial TAC (Russian zone only). Bycatch is constrained by mandatory sorting grids and by temporary closures of areas having a high bycatch of juvenile cod, haddock, Greenland halibut, redfish, or small shrimp (< 15 mm). The minimum stretched mesh size is 35 mm.

Changes in fishing technology and fishing patterns

A major restructuring of the fleet toward fewer and larger vessels has taken place since the mid-1990s. Since 1995, the average engine size of a shrimp vessel in Subareas I and II has increased from 1000 HP (horse powers) to more than 6000 HP in the early 2010s, and the number of vessels has markedly declined. Overall catches have decreased since 2000 (Figure 3.4.9.1), reflecting reduced economic profitability of the fishery.

Uncertainties in assessment and forecast

The assessment model best describes trends in stock development and is not fully sensitive to year-to-year changes. Large and rapid changes in recruitment may therefore not be fully captured in model predictions. Large changes have not been observed in the recent period (2004–2012). If predation on Northern shrimp were to increase rapidly outside the range in the modelled period (1970–2012), the stock size might change more than the modelling results indicate. The mechanisms behind the unexpected lack of correlation between Northern shrimp and cod remain under investigation.

Comparison with previous assessment and advice

This year's advice (as was last year's) was based on the Bayesian stock–production model introduced in 2006. The overall perception of stock dynamics and the advice are similar to last year.

Sources

ICES. 2012a. Report of the Joint NAFO/ICES *Pandalus* Assessment Working Group (NIPAG), 17–24 October 2012, Tromsø, Norway. ICES CM 2012/ACOM:14.

ICES. 2012b. Report of the Arctic Fisheries Working Group, 20–26 April 2012, ICES Headquarters. ICES CM 2012/ACOM:05. 648 pp.

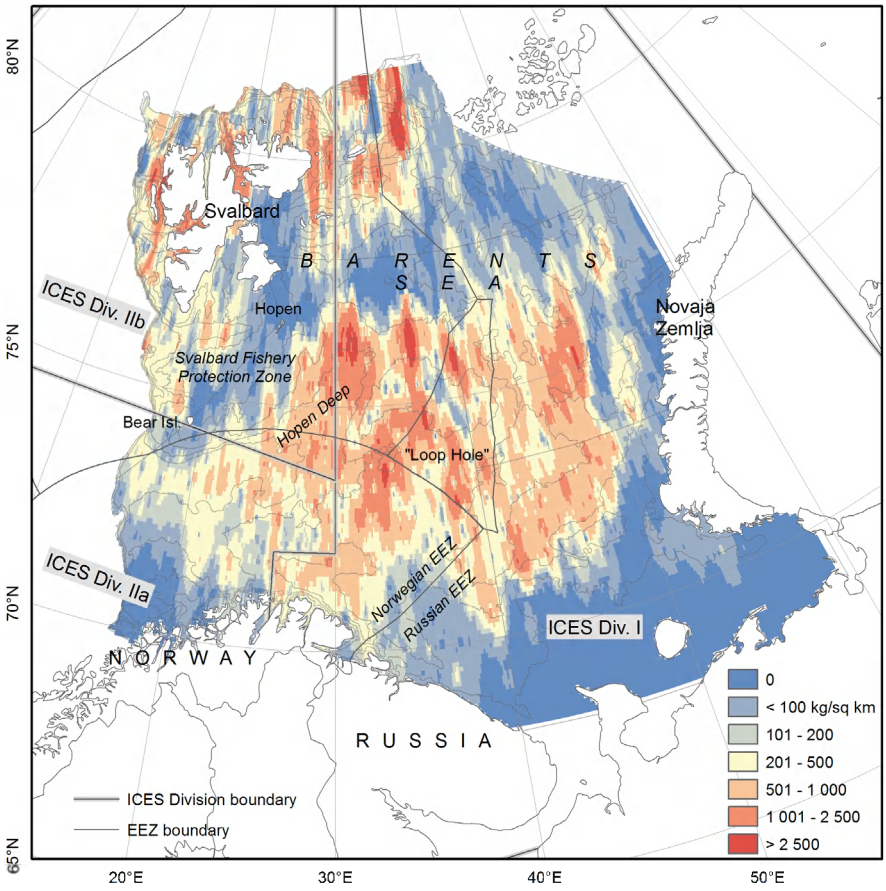

Figure 3.4.9.2 Northern shrimp (*Pandalus borealis*) in Subareas I and II (Barents Sea). Stock distribution mean density (kg km^{-2}) based on survey data 2000–2010.

Table 3.4.9.1 Northern shrimp (*Pandalus borealis*) in Subareas I and II (Barents Sea). Advice, management, and landings.

Year	ICES Advice / Single-stock exploitation boundaries	Predicted landings corresp. to single-stock exploitation boundaries	Agreed TAC	ICES landings
2005	No increase compared to 2004	43.6	-	42.6
2006	No increase in catch above recent level	40	-	29.6
2007	Catch that will prevent exceeding F_{lim} in the long term	50	-	29.9
2008	Catch that will prevent exceeding F_{lim} in the long term	50	-	28.2
2009	Catch that will prevent exceeding F_{lim} in the long term	50	-	27.3
2010	Catch that will prevent exceeding F_{lim} in the long term	50	-	25.2
2011	Catch that will prevent exceeding F_{MSY} in the long term	60	-	29.8
2012	Catch that will prevent exceeding F_{MSY} in the long term	60		20.0
2013	Catch that will maintain stock at current high biomass	60		

Weights in thousand tonnes.
2012 catches predicted to the end of the year.

Table 3.4.9.2 Northern shrimp (*Pandalus borealis*) in Subareas I and II (Barents Sea). Stock status risk table.

Status	2011	2012
Risk of falling below B_{lim} ($0.3B_{MSY}$)	< 1%	< 1%
Risk of falling below $B_{trigger}$ ($0.5B_{MSY}$)	< 1%	< 1%
Risk of exceeding F_{MSY}	1%	1%
Risk of exceeding 1.7 F_{MSY}	< 1%	< 1%
Stock size (B/B_{MSY}), median	1.87	1.87
Fishing mortality (F/F_{MSY}), median	0.06	0.04
Productivity (% of MSY)	24%	25%

Table 3.4.9.3 Northern shrimp (*Pandalus borealis*) in Subareas I and II (Barents Sea). Catch by the fishery and four indices of fishable biomass – a standardized catch rate index based on fishery data (cpue), a Norwegian research survey index discontinued in 2004 (Survey 1), a Russian survey index discontinued in 2005 (Survey 2) and the current joint Russian/Norwegian survey started in 2004 (Survey 3).

Year	Catch (ktonnes)	cpue (index)	Survey 1 (ktonnes)	Survey 2 (ktonnes)	Survey 3 (ktonnes)
1980	46.3	1.000	-	-	-
1981	43.6	1.194	-	-	-
1982	62.8	1.150	327	-	-
1983	104.8	1.306	429	-	-
1984	128.1	1.382	471	661	-
1985	124.5	1.145	246	468	-
1986	65.3	0.677	166	399	-
1987	43.4	0.533	146	346	-
1988	48.7	0.573	181	233	-
1989	62.7	0.722	216	603	-
1990	81.2	0.736	262	1028	-
1991	75.3	0.778	321	1192	-
1992	68.6	0.903	239	876	-
1993	55.9	0.974	233	892	-
1994	28.3	0.800	161	404	-
1995	25.2	0.669	193	248	-
1996	34.5	0.838	276	441	-
1997	35.7	0.799	300	765	-
1998	55.8	0.969	341	576	-
1999	75.7	1.019	316	966	-
2000	80.7	0.902	247	800	-
2001	57.3	0.909	184	468	-
2002	61.5	0.896	196	980	-
2003	39.2	0.880	212	-	-
2004	42.7	0.751	151	-	261
2005	42.6	1.039	-	656	446
2006	29.6	1.139	-	-	517
2007	29.9	1.022	-	-	426
2008	28.2	1.044	-	-	317
2009	27.3	1.061	-	-	343
2010	25.2	0.988	-	-	482
2011	29.8	1.101	-	-	442
2012	20.0	0.861	-	-	487

Table 3.4.9.4 Northern shrimp (*Pandalus borealis*) in Subareas I and II (Barents Sea). ICES landings (thousand tonnes) by nation. Other countries consist of EU countries (Portugal, Spain, Great Britain, Lithuania, Estonia), Iceland, Faroes, and Greenland. 2012 projected to the end of the year.

Year	Norway	Russia	Others	Total
1970	5.508	0	0	5.508
1971	5.116	0	0.026	5.142
1972	6.772	0	0	6.772
1973	6.921	0	0	6.921
1974	8.008	0	0	8.008
1975	8.197	0	0.002	8.199
1976	9.752	0	0	9.752
1977	14.700	0	4.854	19.554
1978	20.484	18.27	0.189	38.943
1979	25.435	10.474	0.39	36.299
1980	35.061	11.219	0	46.280
1981	32.713	9.886	1.011	43.610
1982	43.451	15.552	3.835	62.838
1983	70.798	29.105	4.903	104.806
1984	76.636	43.180	8.246	128.062
1985	82.123	32.104	10.262	124.489
1986	48.569	10.216	6.538	65.323
1987	31.353	6.690	5.324	43.367
1988	32.021	12.32	4.348	48.689
1989	47.064	12.252	3.432	62.748
1990	54.182	20.295	6.687	81.164
1991	39.663	29.434	6.156	75.253
1992	39.657	20.944	8.021	68.622
1993	32.663	22.397	0.806	55.866
1994	20.162	7.108	1.063	28.333
1995	19.337	3.564	2.319	25.220
1996	25.445	5.747	3.320	34.512
1997	29.079	1.493	5.163	35.735
1998	44.792	4.895	6.103	55.790
1999	52.612	10.765	12.293	75.670
2000	55.333	19.596	5.768	80.697
2001	43.031	5.846	8.408	57.285
2002	48.799	3.790	8.899	61.488
2003	34.172	2.776	2.277	39.225
2004	35.918	2.410	4.406	42.734
2005	37.253	0.435	4.930	42.618
2006	27.352	0.004	2.271	29.627
2007	25.558	0.192	4.181	29.931
2008	20.662	0.417	7.109	28.188
2009	19.784	0.000	7.488	27.272
2010	16.779	0.000	8.419	25.198
2011	19.923	0.000	9.867	29.790
2012	13.000	0.000	7.000	20.000