ICES ADVICE 2006

AVIS DU CIEM

Books 1- 10

Report of the ICES Advisory Committee on Fishery Management, Advisory Committee on the Marine Environment and Advisory Committee on Ecosystems, 2006

Book 3

The Barents and the Norwegian Seas

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

H.C. Andersens Boulevard 44-46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

Report of the ICES Advisory Committee on Fishery Management, Advisory Committee on the Marine Environment and Advisory Committee on Ecosystems, 2006.

Books 1 - 10
December 2006

Recommended format for purposes of citation:

ICES. 2006. Report of the ICES Advisory Committee on Fishery Management, Advisory Committee on the Marine Environment and Advisory Committee on Ecosystems, 2006. ICES Advice. Books 1 - 10. 3, 89 pp.

ISBN 87-7482-053-2

BOOK 3

Section | **Page**

3 THE BARENTS SEA AND THE NORWEGIAN SEA

3.1 Ecosystem overview

3.1.1 Ecosystem Components

General geography

The Barents Sea is a shelf area of approx. 1.4 million km2, which borders to the Norwegian Sea in the west and the Arctic Ocean in the north, and is part of the continental shelf area surrounding the Arctic Ocean. The extent of the Barents Sea are limited by the continental slope between Norway and Spitsbergen in west, the continental slope towards the Arctic Ocean in north, Novaja Zemlya in east and the coast of Norway and Russia in the south (Figure 3.1.1). The average depth is 230 m, with a maximum depth of about 500 m at the western entrance. There are several bank areas, with depths around 50-200 m.

The Norwegian Sea is traditionally defined as the ocean bounded by a line drawn from the Norwegian Coast at about 61°N to Shetland, further to the Faroes-East Iceland-Jan Mayen-the southern tip of Spitsbergen-the Vesterålen at the Norwegian coast and the along the coast. In addition a wedge shaped strip along the western coast of Spitsbergen is included in area D. The offshore boundaries follow in large part the mid Atlantic subsurface ridges.

The Norwegian Sea has an area 1,1 million km^2 and a volume of more than 2 million km^3, i.e. an average depth of about 2000m. The Norwegian Sea is divided into two separate basins with 3000m to 4000m depth, with maximum depth 4020m. Along the Norwegian coast there is a relatively narrow continental shelf, between 40 and 200 km wide and with varied topography and geology. It has a relatively level sea bottom with depths between 100 and 400 m. The shelf is crossed by several troughs deeper than 300. Moraine deposits dominate the bottom substratum on the shelf, but soft layered clay is commonly found in the deeper parts. Gravelly and sandy bottoms are found near the shelf break and on ridges where the currents are strong and the sedimentation rates low.

General oceanography

The general circulation pattern in the Barents Sea is strongly influenced by topography. Warm Atlantic waters from the Norwegian Atlantic Current with a salinity of approx. 35 flow in through the western entrance. This current divides into two branches, one southern branch, which follows the coast eastwards against Novaja Zemlya and one northern branch, which flow into the Hopen Trench. The relative strength of these two branches depends on the local wind conditions in the Barents Sea, South of the Norwegian Atlantic Current and along the coastline flows the Norwegian Coastal Current. The Coastal Water is fresher than the Atlantic water, and has a stronger seasonal temperature signal. In the northern part of the Barents Sea fresh and cold Arctic water flows from northeast to southwest. The Atlantic and Arctic water masses are separated by the Polar Front, which is characterised by strong gradients in both temperature and salinity. In the western Barents Sea the position of the front is relatively stable, but in the eastern part the position of this front has large seasonal, as well as year- to-year variations. Ice conditions show also large seasonal and year-to year variations. In the winter the ice can cover most of the Barents Sea, while in the summer the whole Sea may be ice-free. In general, the Barents Sea is characterised by large year-to-year variations in both heat content and ice conditions. The most important cause of this is variation in the amount and temperature of the Atlantic water that enters the Barents Sea.

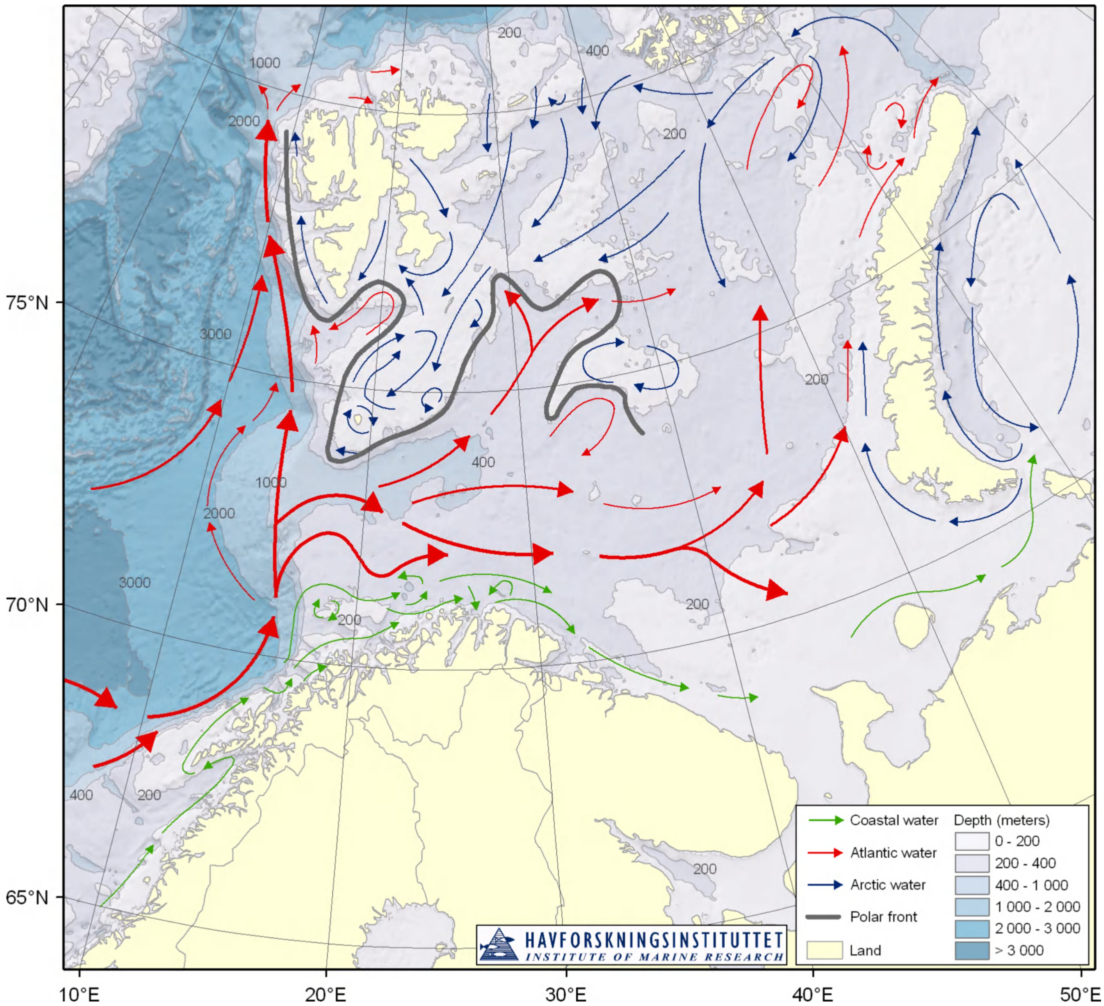


Figure 3.1.1 Bottom contours and current systems in the Barents Sea.

The water temperatures in the Barents Sea have been relatively high during most of the 1990s, with a continuous warm period from 1989-1995. During 1996-1997, the temperature was just below the long-term average before it turned warm again at the end of the decade, and has remained warm until present. 2005 was one of the warmest years recorded and with a record salinity (Figure 3.1.2).

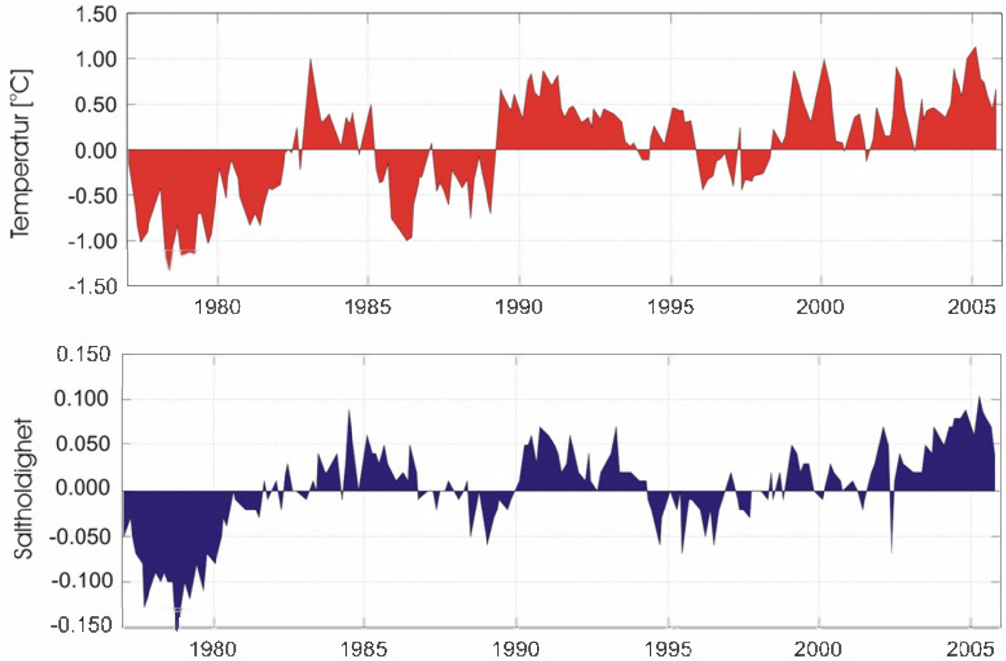


Figure 3.1.2 Temperature (upper graph) and salinity (lower graph) anomalies in the Fugløya – Bjørnøya transect during the period 1977 - 2005.

The circulation in the Norwegian Sea (Figure 3.1.3) is strongly affected by the topography. On the continental shelf at the eastern margin of the area flows the low salinity Norwegian Coastal Current. It enters the area from the North Sea in the south and exits to the Barents Sea in the north east. The inflow of water from the north Atlantic to the Norwegian Sea takes place through the Faroe-Shetland Channel and flow over the Iceland-Faroe Ridge. At the northern slope of the ridge the warm Atlantic water meets the cold Arctic water and the boundary between these waters are called the Iceland Faroe Front. The major part of the warm and high salinity Atlantic Water continues northward as the Norwegian Atlantic Current along the Norwegian shelf, but parts of it branches into the North Sea and also to the more central parts of the Norwegian Sea. At the western boundary of the Barents Sea, the Norwegian Atlantic Current further bifurcates into the North Cape Current flowing eastwards into the Barents Sea and the West Spitsbergen Current flowing northwards into the Fram Strait (Furevik 2001).

The border zones between the domains of the Norwegian Atlantic Current and the Arctic waters to the west are known as the Arctic and Jan Mayen Fronts, located north and south of Jan Mayen, respectively. Cold and low salinity Arctic Water flows into the southern Norwegian Sea in the East Icelandic Current. At the northern flank of the Iceland Faroe Ridge the East Icelandic Current meets the warm Atlantic Water that crosses the ridge into the Norwegian Sea and this boundary is called the Iceland Faroe Front. The front has a clear surface signature, but a part of the Arctic Water submerges under the Atlantic Water and thus becomes Arctic Intermediate Water.

With respect to the underlying waters, there is evidence that the Arctic Intermediate Water has been expanding in volume in recent decades (Blindheim, 1990; Blindheim et al., 2000). The Arctic Intermediate water manifests itself as a salinity minimum in the water column and it blankets the entire Norwegian Sea and thus precludes direct contact between the warm surface waters and the dense deep waters (T<-0.5°C) whose properties are defined by inflows from the Greenland Sea. The circulation in the deep waters is topographically influenced and clockwise in the two basins. Cold deep water flows out of the Norwegian Sea through the Faroe Bank channel, the deepest connection to the North Atlantic.

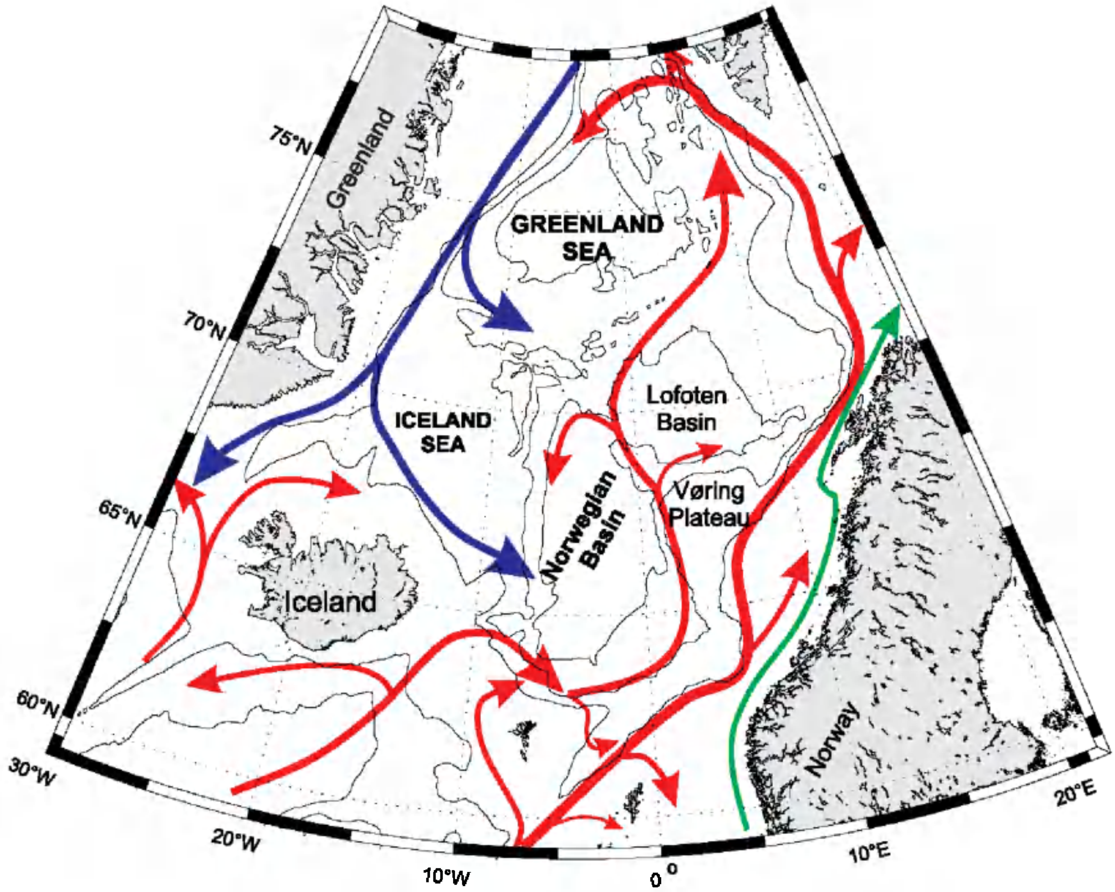


Figure 3.1.3 Norwegian Sea main circulation pattern. Red lines indicate warm currents, blue lines indicate cold currents and green lines show low salinity coastal water.

Between Iceland and Jan Mayen variations in the volume of Arctic waters carried by the East Icelandic Current (EIC) may result in relatively large shifts of the front between the cold Arctic waters and the warm Atlantic water. Fluctuations in fluxes and water-mass properties in the two major current systems are therefore of decisive importance for the structure and distribution of the water masses in the Nordic Seas. A high NAO index with strong westerly winds results in increased transport in the EIC. E.g. in the early 1990s the NAO index was high and the Arctic water occupied a larger portion of the Norwegian Sea. The volume of and properties of the Arctic water carried directly into the Norwegian Sea by the EIC play a larger role than previously believed in the creation of variability in the distribution of water masses and their properties in the Nordic Seas (Blindheim et al. 2000).

Phytoplankton

The Barents Sea is a spring bloom system and during winter the primary production is close to zero. The timing of the phytoplankton bloom is variable throughout the Barents Sea, and has also high interannual variability. In early spring, the water is mixed but even though there are nutrients and light enough for production, the main bloom does not appear until the water becomes stratified. The stratification of the water masses in the different parts of the Barents Sea may occur in different ways: Through fresh surface water along the marginal ice zone due to ice melting, through solar heating of the surface waters in the Atlantic water masses, and through lateral spreading of coastal water in the southern coastal (Rey 1981). The dominating algal group in the Barents Sea is diatoms like in many other areas (Rey 1993). Particularly, diatoms dominate the first spring bloom, and the most abundant species is *Chaetoceros socialis*. The concentrations of diatoms can reach up to several million cells per liter. The diatoms require silicate and when this is consumed other algal groups such as flagellates take over. The most important flagellate species in the Barents Sea is *Phaeocyctis pouchetii*. However, in individual years other species may dominate the spring bloom.

For the Norwegian Sea, the annual rate of primary production in the Atlantic Water has been estimated to be about 80 g C m^{-2} $year^{-1}$ (Rey 2004). Of this production about 60% is new production, i.e. the remainder 40% of the production is assumed to be based on regenerated nutrients. The new production represents the potential for harvest in the ocean. The spring bloom, defined as the time of the maximum chlorophyll concentration, occurs in the mean around 20th of May, but may occur a month earlier or later. The most important group of phytoplankton is the diatoms, with most of the species belonging to the Order Centralis, and the most important representatives are species of the genus *Thalassiosira* and *Chaetoceros*. After the diatom spring bloom the phytoplankton community is often dominated by the flagellate *Phaeocystis pouchetii*. In the Norwegian Coastal Current the primary production varies from 90-120 g C m^{-2} $year^{-1}$.

Zooplankton

Zooplankton biomass has shown large variation among years in the Barents Sea. Crustaceans form the most important group of zooplankton, among which the copepods of the genus Calanus play a key role in the Barents Sea ecosystem. *Calanus finmarchicus*, which is the most abundant in the Atlantic waters, is the main contributor to the zooplankton biomass. *Calanus glacialis* is the dominant contributor to zooplankton biomass of the Arctic region of the Barents Sea. The Calanus species are predominantly herbivorous, feeding especially on diatoms (Mauchlin 1998). Krill (euphausiids) is another group of crustaceans playing a significant role in the Barents Sea ecosystem as food for both fish and sea mammals. The Barents Sea community of euphausiids is represented by four abundant species: neritic shelf boreal *Meganyctiphanes norvegica*, oceanic arcto-boreal *Thysanoessa longicaudata*, neritic shelf arcto-boreal *Th. inermis* and neritic coastal arcto-boreal *Th. raschii* (Drobysheva 1994). The two latter species make up 80-98% of the total euphausiids abundance. Species ratio in the Barents Sea euphausiid community is characterized by year-to-year variability, most probably due to climatic changes (Drobysheva 1994). The observations showed that after cooling the abundance of *Th. raschii* increases and of *Th. inermis* decreases, while after the number of warm years, on the contrary, the abundance of *Th. inermis* grows and the number of cold-water species becomes smaller (Drobysheva, 1967). The advection of species brought from the Norwegian Sea is determined by the intensity of the Atlantic water inflow (Drobysheva 1967, Drobysheva *et al.* 2003). Three abundant amphipod species are found in the Barents Sea; *Themisto abyssorum* and *T. libellula* are common in the western and central Barents Sea, while *T. compressa* is less common in the central and northern parts of the Barents Sea. *T. abyssorum* is predominant in the sub-arctic waters. In contrast, the largest of the Themisto species, *T. libellula*, is mainly restricted to the mixed Atlantic and Arctic water masses. A very high abundance of *T. libellula* is recorded close to the Polar Front.

The zooplankton community of the Norwegian Sea is dominated by copepods and euphausids. The main copepod is *Calanus finmarchicus* in the Atlantic water while *Calanus hyperboreus* is the dominant species in the arctic watermasses. The main euphausids are *Meganychthiphanes norvegica*, *Thysanoessa inermis* and *Thysanoessa longicaudata*. Other important zooplankton are the hyperids *Themisto libellula* and *Themisto abyssorum*. The plankton community show varying productivity with concentrations of the most important species *Calanus finmarchicus* varying for instance between about 8 g/m^2 dryweight in 1997 to 28 g/m^2 dryweight in 1995. The highly variable availability of zooplankton is an important factor for fish stocks productivity.

Benthic habitats

Barents Sea

Benthic organisms (benthos) in the Barents Sea are found on or buried in the seabed, but their composition is highly dependent on the predominating type of water (Arctic or Atlantic water, or at their convergence), the bottom substrate and the depth. The richest communities of benthic animals are found along the Norwegian coast and the coast of Svalbard, where the hard-bottom communities display an unusually high richness of species. Among these, kelp is a key species along the Norwegian coast, whereas other species of seaweeds dominate in Svalbard. The kelp forests are extremely valuable biotopes and home to a large number of invertebrates and fish that spawn and grow up here. Sea urchins, *Strongylocentrotus droebachiensis*, are attached to this biotope and graze on the kelp stalks. Another example of a biotope containing a particularly large number of species is the deep-water coral reefs, especially those with the stone coral, *Lophelia pertusa*. These reefs have been mapped in recent years, and large ones have been discovered off Røst. Reefs are also known on the shelf off Finnmark. Just as the coral reefs offer space for an associated abundance of animal life, the occurrences of sponges in the Barents Sea are valuable for the species diversity. Large aggregations of sponges (for example *Geodia*) have been found on Tromsøflaket, and these are currently being mapped. The deeper parts of the Barents Sea are covered by fine-grained sediment, sand and mud, and the infauna (benthic animals living in the sediment) are dominated by polychaetes (bristleworms). The echinoderms, brittle stars and sea urchins, are important constituents of the bottom fauna. On the shallower banks, the sediment is coarser due to current activity, and there are larger numbers of bivalves here, such as the Iceland scallop, *Chlamys islandica*. This species has been fished quite extensively.

A relationship has been found between the biomass of benthic animals and the ice edge in the Barents Sea. This increase in the biomass is correlated, among other things, with the high seasonal pulse in the growth of algae during the short, intense spring, and with processes in the water that cause the food to sink to the bottom. However, as the ice margin may vary by several hundred kilometres from year to year, the benthic animals must also tolerate large fluctuations in the accessibility of food.

Red king crab (*Paralithodes camtschatica*) was introduced to the Barents Sea in the 1960s (Jørgensen and Hop). The stock is growing and expanding eastwards and along the Norwegian coast westwards. Adult red king crabs are opportunistic omnivores.

Norwegian Sea

Northern shrimp (*Pandalus borealis)* is an important prey for several fish species, especially cod, but also other fish stocks like blue whiting (ICES 2005). Consumption by cod significantly influences shrimp population dynamics. The estimated amount of shrimp consumed by cod is on average much higher than shrimp landings. Shrimp is most abundant in central parts of the Barents Sea and close to Svalbard, mostly on 200 – 350 meter depths (Aschan, 2000). It is common close to the sea floor, preferably silt or fine-grained sand. Shrimp in the southern parts of the Barents Sea grow and mature faster than shrimp in the central or northern parts.

Coral reefs formed by the cold-water coral *Lophelia pertusa* are quite common in the eastern shelf area of the Norwegian Sea. Nowhere else in the world similar densities and sizes of such reefs have been found. The largest reef, or reef complex (comprising several closely situated individual reefs) known as the Røst Reef, is situated south west of Lofoten. *Lophelia* reefs offers habitats (microhabitats) for a great diversity of other species. Redfish (*Sebastes* spp.) are common on the reefs. The great abundances of this fish has been known by local fishers for a long time. More recent fishery practice employing rock hopper trawl gear close to or directly on these reefs has led to severe damages. Other corals such as gorgonians also form habitats utilised by fish and other organisms. These habitats are often called "gorgonian forests", and are common in some fjords and along the shelf break.

Fish communities

Barents Sea

The Barents Sea is a relatively simple ecosystem with few fish species of potentially high abundance. These are Northeast Arctic cod, haddock, Barents Sea capelin, polar cod and immature Norwegian Spring-Spawning herring. The last few years there has in addition been an increase of blue whiting migrating into the Barents Sea. The composition and distribution of species in the Barents Sea depends considerably on the position of the polar front. Variation in the recruitment of some species, including cod and herring, has been associated with changes in the influx of Atlantic waters into the Barents Sea.

Capelin (*Mallotus* villosus) plays a major role in the Barents Sea ecology, even though the stock has fluctuated greatly in recent years. In summer, they migrate northwards and feed on the zooplankton as the ice margin retreats. Here, they have continuous access to new food resources in the productive zone that has just become ice-free. In September-October, the capelin may have reached 80ºN before they migrate southwards again to spawn on the coasts of north Norway and Russia. In the central and southern Barents Sea, the capelin become prey for cod. Some marine mammals and seabirds also have a strong preference for capelin. Their feeding migration means that capelin function as transporters of biomass from the ice margin to the Norwegian coast, and that the production from areas covered by ice in winter is available for the cod. The capelin were heavily fished in the 1970s and the first half of the 1980s at a time when there were few herring in the area. In the mid-1980s, the stock collapsed and has since varied greatly. Fishing is permitted when the stock is both strong enough for good recruitment and to cover the consumption by cod.

Polar cod (*Boreogadus saida*) are adapted to cold water and live mainly in the eastern and northern Barents Sea. They are an important prey for many marine mammals and seabirds, but have little commercial significance.

Cod (*Gadus morhua*) are the most important predator fish in the Barents Sea and take a variety of prey. They spawn along the Norwegian coast from Møre to Finnmark, and after hatching they are dependent on *Calanus finmarchicus* nauplii in the initial phase of their growth before they begin to take larger plankton and small fish. In addition to capelin, shrimps and amphipods are important prey.

Haddock (*Melanogrammus aeglefinus*) feed on somewhat smaller prey, especially among the benthic fauna. The stock has substantial natural fluctuations, but is currently strong.

Saithe (*Pollachius virens*) are the third large member of the cod family with substantial economic importance, and occurs in comparatively warm, coastal waters. Like cod, saithe fry depend upon zooplankton, but saithe subsequently become important predators on other fish.

Blue whiting (M*icromesistius poutassou*) are a smaller member of the cod family, and has its main distribution in the southern part of the northeast Atlantic. It mostly eats plankton, but larger individuals also take small fish. It can enter the southern Barents Sea in warm years.

Norwegian spring-spawning herring (*Clupea harengus*) spawn along the Norwegian coast from Lindesnes in the south to Vesterålen, grow up in the Barents Sea and feed in the Norwegian Sea as adults. In years when recruitment is good, most of the 0-group individuals drift passively into the Barents Sea, where they remain until they are around three years old. The young herring are predators on capelin larvae, and when there are many herring in the Barents Sea the capelin recruitment and the capelin stock will be depleted. This has great consequences for the balance between the species of fish in the area and for the ecosystem in general. A depleted capelin stock means less transport of production from the northern to the southern Barents Sea, and less supply of capelin for cod and other predators. It appears as though herring only to a limited extent replace capelin as prey for cod; hence, there will also be less production of species that depend upon capelin. Young herring are not fished in the Barents Sea, but some catches of adult herring are taken in the southwestern part of the management area.

Deep-water redfish (*Sebastes mentella*) and golden redfish (*Sebastes marinus*) are slow-growing, deep-water species that have been heavily fished, and their fishing is now strictly regulated to rebuild the stocks. Redfish fry eat plankton, whereas larger individuals take larger prey, including fish.

Greenland halibut (*Reinhardtius hippoglossoides*) have an extensive distribution in deep water along the continental slope between the Barents Sea and the Norwegian Sea. It is also found in the deeper parts of the Barents Sea and north of Spitsbergen. Juveniles live in the northern parts of the Barents Sea. Fish, squids, octopi and crustaceans are the most important food of the Greenland halibut. The Greenland halibut stock is depleted at present, and fishing is strictly regulated.

Norwegian Sea

The Norwegian Sea fish community is characterised by a number of large stocks of medium sized highly migratory pelagic species exploiting the pelagic zone of the vast areas with large bottom depths, smaller mesopelagic species exploiting the same areas and several demersal and pelagic stocks exploiting and/or spawning in the marginal eastern continental shelf areas. The large stocks exploiting the area for feeding must be regarded key species in the ecosystem. The main pelagic stocks feeding in the area are the blue whiting *Micromesistius poutassou*, NE Atlantic mackerel *Scomber scombrus* and Norwegian spring spawning herring *Clupea harengus*. The herring also spawns in the eastern shelf areas. With regard to horizontal distribution in the feeding areas the herring is the most northern one, mackerel more southern while the blue whiting seems distributed over most of the area. With regard to vertical distribution during the feeding season the mackerel is closest to the surface, the herring somewhat deeper, while the blue whiting as a mesopelagic species with the deepest mean depth distribution. Other important mesopelagic species in the area are redfish *Sebastes sp*., pearlsides *Maurolicus muelleri* and lanternfishes *Benthosema glaciale*. The open Norwegian Sea all way into the polar front is an important nursery areas for the lumpsucker *Cyclopterus lumpus* and the northeastern shelf areas are important spawning grounds. Local stocks of herring exist in many fjords along the Norwegian coastline. The stocks make limited migration out in to the open waters for feeding.

None of the main pelagic species has its entire life cycle within the Norwegian Sea ecosystem. The blue whiting spawns west of the British Isles and perform a northerly and westerly feeding migration into the Faroes ecosystem and the Norwegian Sea ecosystem. The mackerel spawns west of the British Isles and in the North Sea and performs northerly feeding migrations into the Norwegian Sea. The Norwegian spring spawning herring has its main spawning and feeding areas in the Norwegian Sea while the main nursery and young fish area is in the neighbouring Barents Sea ecosystem.
As pelagic feeders all the three stocks must be expected to have major influences on the ecosystem. Studies on this subject have only been carried out to a limited degree and are mainly of descriptive character. For instance was the highest catches of salmon ever (1970'ies) taken during a period when the herring stock was at a record low level. This has been suggested to be a potential effect of reduced competition beneficial for salmon stock productivity (Hansen et al., 2000).

The NE Arctic cod *Gadus morhua* and haddock *Melanogrammus aeglefinnus* have their main adult feeding and nursery areas in the Barents Sea while the main spawning areas are along the eastern shelf areas of the Norwegian Sea and into the SE parts of the Barents Sea ecosystem. There are local cod stocks connected to the coast and only doing limited migrations from the coast for feeding. The NE Arctic saithe also spawns along the eastern shelf areas of the Norwegian Sea and has important nursery areas on this coastline and into the Barents Sea on the Finmark coast. The migration of older and mature saithe are to a large degree linked with those of the Norwegian spring spawning herring out into the high seas areas of the Norwegian Sea. There are also stocks of ling *Molva molva* and tusk *Bromse brosme* along the eastern shelf region. Greenland halibut *Reinhardtius hippoglossoides* is found along the eastern shelf and also in the shelf areas of Jan Mayen Island. Other important species inhabiting the hydrographic transition zone include roughead grenadier *Macrourus berglax*, several species of eelpouts *zoarcids* and the rajiids *Raja hyperborean, R. radiata* and *Bathyraja spinicauda* (Bergstad et al., 1999).

The demersal species are in general connected to the eastern shelf area and the presence of the largest stocks are connected to spawning. The fishes then migrate back to the Barents Sea for feeding. The fry also in general drift out of the Norwegian Sea and into the Barents Sea. As compared to the pelagic species the demersal stocks must accordingly be regarded as less significant for the Norwegian Sea ecosystem as a whole.

Seabirds

The Barents Sea holds one of the largest concentrations of seabirds in the world (Norderhaug *et al.* 1977; Anker-Nilssen *et al.* 2000). About 20 million seabirds harvest approximately 1.2 million tonnes of biomass annually from the area (Barrett *et al.* 2002). About 40 species are thought to breed regularly around the northern part of the Norwegian Sea and the Barents Sea. The most typical species belong to the auk and gull families, and some of them are listed below.

There are about 1 750 000 breeding pairs of Brünnich's guillemot (*Uria lomvia*) in the Barents region. They live on fish, particularly polar cod, and ice fauna.

The population of common guillemots (*Uria aalge*) is about 140 000 breeding pairs. Capelin is the most important food source all the year round.

There are thought to be more than 1.3 million pairs of little auk (*Alle alle*) in the Barents Sea. It is found in the area throughout most of the year and many probably winter along the ice margin between Greenland and Svalbard and in the Barents Sea. Small pelagic crustaceans are the main food for this species, but they may also feed on small fish.

The black-legged kittiwake (*Rissa tridactyla*) breeds around the whole of Svalbard, but like the Brünnich's guillemot it is most common on Bjørnøya, Hopen and around Storfjorden. Its most important food items in the Barents Sea are capelin, polar cod and crustaceans. The breeding population seems stable, comprising 850 000 pairs in the Barents region.

The northern fulmar (*Fulmarus glacialis*) is an abundant Arctic and sub-Arctic species living far out to sea except in the breeding season. It lives on plankton and small fish taken from the surface. The population estimates are uncertain, but high (100 000 - 1 000 000 pairs).

The Atlantic puffin (*Fratercula arctica*) is the most abundant seabird on the mainland and in the Norwegian Sea, but may also breed on Bjørnøya and on Svalbard.

No other information was available on the Norwegian Seabirds.

Marine mammals

Barents Sea

About 24 species of marine mammals regularly occur in the Barents Sea, comprising 7 pinnipeds (seals), 12 large cetaceans (large whales) and 5 small cetaceans (porpoises and dolphins). Some of these species (including all the baleen whales) have temperate/tropical mating and calving areas and feeding areas in the Barents Sea (*e.g.* minke whale *Balaenoptera acutorostrata*), others reside in the Barents Sea all year round (*e.g.* white-beaked dolphin *Lagenorhynchus albirostris* and harbour porpoise *Phocoena phocoena*). Only the beluga whale (*Delphinapterus leucas*), the bowhead whale (*Balaena mysticetus*) and the narwhal (*Monodon monoceros*) remain in the area throughout the year.

The currently available abundance estimates of the most abundant cetaceans in the north-east Atlantic (*i.e.* comprising the North, Norwegian, Greenland and Barents Seas) are: minke whales 107,205; fin whales *B. physalus* 5,400; humpback whales *Megaptera novaeangliae* 1,200; sperm whales *Physeter macrocephalus* 4,300 (Skaug *et al.* 2002, Øien 2003, Skaug *et al.* 2004).

Lagenorhyncus dolphins are the most numerous smaller cetaceans, with an abundance of 130,000 individuals (Øien 1996). The population of harbour porpoises (*Phocoena phocoena*) has been estimated to 11 000 (Bjørge and Øien, 1995) in the Barents Sea, mostly along the coast.

Beluga whales may occur in groups varying from a few individuals to more than 1000. It is one of the most commonly observed whales off Svalbard. It may feed on everything from benthic invertebrates, octopi and squids to fish.

The bowhead whale is an arctic species closely attached to the sea ice, but is rarely observed in the Barents Sea. No estimates of the Barents Sea population exist but it is agreed that it is small, maybe in the tens. Before it was decimated by whaling, the bowhead whale was very numerous in the fjords and along the coast of Spitsbergen. It feeds on various species of zooplankton.

The killer whale also enters the Barents Sea, but its life cycle presently is tightly connected to the migrations of the Norwegian spring spawning herring.

Harp seals are the most numerous seal in the Barents Sea with approximately 2.2 million individuals. The Norwegian coast has experienced periodical invasions of harp seals.

Ringed seals are abundant in the Svalbard area and the ice-covered parts of the Barents Sea. They mostly live solitarily and take polar cod, shrimps and amphipods beneath the ice.

The bearded seal is another common, solitary species. It lives in the ice-covered parts of the Barents Sea and the fjords around Svalbard taking benthic organisms like shells, crabs and shrimps, which it finds in shallow water.

The harbour seal mainly lives in colonies along the Norwegian coast and in other coastal areas. In 1994-1998, close to 1300 individuals were recorded along the Norwegian coast. In addition, there is a small population off Svalbard.

Marine mammals are significant ecosystem components. In the Barents Sea the marine mammals may eat 1.5 times the amount of fish caught by the fisheries. Minke whales and harp seals may consume 1.8 million and 3-5 million tonnes of prey per year, respectively (*e.g.*, crustaceans, capelin, herring, polar cod and gadoid fish; Folkow *et al.* 2000, Nilssen *et al.* 2000). Functional relationships between marine mammals and their prey seem closely related to fluctuations in the marine systems. Both minke whales and harp seals are thought to switch between krill, capelin and herring depending on the availability of the different prey species (Lindstrøm *et al.* 1998, Haug *et al.* 1995, Nilssen *et al.* 2000).

Norwegian Sea

There are two seal stocks of particular importance in the Norwegian Sea: Harp and hooded seals. Both species are mainly connected to the Norwegian Sea through feeding. They show opportunistic feeding patterns in that different species are consumed in different areas and at different times of the year.

Due to topographical and hydrographic characteristics beneficial for production the Norwegian Sea has abundant stocks of whales feeding on plankton, pelagic fishes and Cephalopods. Besides minke whale, fin whale, blue whale, sperm whale, humpback and killer whales are important species in the area. All except the killer whale are seasonal migrators visiting the Norwegian Sea for feeding during the summer.

The minke whale *Balaenoptera acutorostrata* is the smallest in size and most numerous in stock size of the baleen whales in the Norwegian Sea. It is found throughout the area, in particular along the eastern shelf area and in the Jan Mayen area. The species is an opportunistic feeder with special preference for herring in the Norwegian Sea ecosystem. The killer whale *Orcinus orca* in the area is closely linked to the yearly migrations of the Norwegian spring spawning herring. In the present wintering area of the herring, the Vestfjord, Tysford and Ofotfjord an estimated 500 killer whales have been feeding on herring during the winter months. A total estimate of killer whales for the Norwegian Sea and the Barents Sea it is at some few thousands individuals.

Knowledge gaps

Barents Sea

Inflow of water from the Norwegian Sea to the Barents Sea brings with it populations of phyto- and zoo-plankton which become part of the Barents Sea production system. A study of the volume and timing of inflow events and plankton production in the Barents Sea would be helpful in understanding this part of the production system.

Gjøsæter et al. (2002) showed that there is a connection between measured zooplankton biomass and capelin growth during the following year. Further work on the connection between zooplankton production and the production of pelagic forage fishes (capelin, polar cod, herring and possibly blue whiting) would be important in understanding the mechanisms of food supply for cod and larger predators like harp seals and minke whales.

Data about stomach contents and prey consumption for cod is available for a number of years and is used by AFWG. Information about predator/prey relationships is needed for more of the quantitatively important consumer species and groups.

Fisheries statistics from the Barents Sea does not fully reflect landings and discards, as has been described for cod in AFWG reports.

More information on these points would improve the qualitatative and quantitative understanding of the production system being harvested through fishing, and the effects of fishing on the ecosystem.

3.1.2 Major significant ecological events and trends

Norwegian Sea

Generally warming climate during the last 20 years with about 0.7°C increase since 1978 in the Atlantic Water on the Svinøy section. The years 2002-2005 are all warm years, but there was a small drop in temperature from 2004 till 2005. The salinity, however, has continued to increase and was record high in 2005 in the Atlantic Water on the Svinøy section.

In 2005, there was an increased influence of Arctic water, from the East Icelandic Current, in the southern Norwegian Sea compared to 2004, and thus lower temperatures. Otherwise no major hydrographic events in 2005.

Generally low zooplankton in the central Norwegian Sea for several years.

Large stocks of all major pelagic stocks. The total stock of highly migratory plankton feeders is high at ~20-25 million tonnes.

Changes in herring feeding migration occurred during the summers 2004 and 2005 when increasing amounts of herring started to feed in the southwestern Norwegian Sea. At the same time we observed that increasing numbers of herring were not wintering in the fjords of northern Norway, but in the deep waters off the shelf. This winter (2005/2006) the main wintering area was off the shelf north of Vesterålen to 72°N.

Reduced herring growth since 2001. Continued poor growth conditions could be expected unless major migration or productivity changes occur.

3.2 Human impacts on the ecosystem

3.2.1 Fisheries effects on benthos and fish communities

Barents Sea

In order to conclude on the total impact of trawling, an extensive mapping of fishing effort and bottom habitat would be necessary. However, its qualitative effects have been studied to some degree (ICES 2000). The most serious effects of otter trawling have been demonstrated for hard-bottom habitats dominated by large sessile fauna, where erected organisms such as sponges, anthozoans and corals have been shown to decrease considerably in abundance in the pass of the ground gear. In sandy bottoms of high seas fishing grounds trawling disturbances have not produced large changes in the benthic assemblages, as these habitats may be resistant to trawling due to natural disturbances and large natural variability. Studies on impacts of shrimp trawling on clay-silt bottoms have not demonstrated clear and consistent effects, but potential changes may be masked by the more pronounced temporal variability in these habitats (Løkkeborg, 2004). The impacts of experimental trawling have been studied on a high seas fishing ground in the Barents Sea (Kutti *et al.*, 2005). Trawling seems to affect the benthic assemblage mainly through resuspension of surface sediment and through relocation of shallow burrowing infaunal species to the surface of the seafloor. Lost gears such as gillnets may continue to fish for a long time (ghost fishing). The catching efficiency of lost gillnets has been examined for some species and areas, but at present no estimate of the total effect is available. Other types of fishery-induced mortality include burst nets, and mortality caused by contact with active fishing gear such as escape mortality. Some small-scale effects are demonstrated, but the population effect is not known. The harbour porpoise (*Phocoena phocoena*) is common in the Barents Sea region south of the polar front and is most abundant in coastal waters. The harbour porpoise is subject to by-catches in gillnet fisheries (Bjørge and Kovacs 2005). In 2004 Norway initiated a monitoring program on by-catches of marine mammals in fisheries. Several bird scaring devices has been tested for long-lining, and a simple one, the bird-scaring line (Løkkeborg 2003), not only reduces significantly bird by-catch, but also increases fish catch, as bait loss is reduced. This way there is an economic incentive for the fishermen, and where bird by-catch is a problem, the bird scaring line is used without any forced regulation.

Fishing on capelin has the potential to disrupt the food chain between zooplankton and predators like cod, harp seals, minke whales and some birds. However, fishing on capelin is only permitted when the stock is sufficiently large enough both to sustain the predation by cod and to allow good recruitment.

Estimates on unreported catches on cod the last years indicate that this is a considerable problem; at least 20% in addition to official catches (ICES, 2005b).

Norwegian Sea

Destruction of deepwater coral reefs has been documented in the eastern shelf areas. These descriptions have resulted in management measures like area closures for bottom trawling. Effects on bottom fauna could be expected from bottom trawling activities in the eastern shelf areas.

Work is carried out within the framework of ICES in order to sort out the scale of unintentional bycatch of salmon in the pelagic fisheries in the Norwegian Sea (SGBYSAL) but no such major effects have been documented so far.

Mortality of seabirds occurs in longline fisheries. Magnitude and species composition is unknown.

Bycatch of harbour porpoise is routinely observed in net fisheries. In episodes of coastal invasion of arctic seals large mortality of seals has been observed in net fisheries. This mortality has not been regarded as problematic for the state of the seal stocks due to the general good condition and low harvesting level of the stocks.

Mortality of large marine mammals due to bycatch has not been described and is probably low.

Ghost fishing has been documented through dredging of lost gear along the eastern shelf area. A programme for retrieval of such gears is in effect along the Norwegian coast towards the Norwegian Sea, and a high number of ghost fishing nets are retrieved yearly. The need for such activity is probably larger than what is currently carried out, given the fish mortality observed in retrieved nets.

A major collapse in the herring stock was observed during the late 1960'ies. Various analyses have shown that the fisheries were a major factor driving the collapse.

3.2.2 References

Anker-Nilssen, T, Bakken, V., Strøm, H., Golovkin, A.N., Bianki, V.V. and Tatarinkova, I.P. 2000 The status of marine birds breeding in the Barents sea region. Norsk Polarinstitutt rapport 113: 213 pp.

Aschan, M. 2000. Spatial Variability in Length Frequency Distribution and growth of Shrimp (*Pandalus borealis* Krøyer 1838) in the Barents Sea. J. Northw. Atl. Fish. Sci., Vol. 27: 93-105.

Bjørge, A. and Kovacs, K.M. (sci. eds.) 2005. Report of the Working Group on Seabirds and Mammals. The Scientific Basis for Environmental Quality Objectives (EcoQOs) for the Barents Sea Ecosystem. Norway,2005. (http://barentshavet.imr.no/)

Bjørge, A. and Øien, N. 1995. Distribution and Abundance of Harbour Porpoise *Phocoena phocoena* in Norwegian waters. Rep. Int. Whal. Commn., Special issue Ser. 16: 89-98.

Drobysheva, S.S. 1967. The role of specific composition in the formation of the Barents Sea euphausiid abundance. Trudy PINRO. Vyp.20. p.195-204 (in Russian).

Drobysheva, S.S. 1994. The Barents Sea euphausiids and their role in the formation of fishing biological production. Murmansk: PINRO Press, 1994. 139 p. (in Russian).

Drobysheva, S.S., Nesterova, V.N., Nikiforov, A.G. And N.G.Zhukova. 2003. The role of warm water component in the formation of local concentrations of euphausiids in the southern Barents Sea. Voprosy rybolovstva, 2003, tom 4, No.2 (14) p.209-216 (in Russian).

Folkow, L.P., Haug, T., Nilssen, K.T. and Nordøy, E.S. 2000. Estimated food consumption of minke whales *Balaenoptera acutorostrata* in Northeast Atlantic waters in 1992-1995. NAMMCO Scientific Publications 2: 65-81.

Gjøsæter, H., Dalpadado, P. and Hassel, A. 2002. Growth of Barents Sea capelin (*Mallotus villosus*) in relation to zooplankton abundance. ICES Journal of Marine Science 59: 959-967.

Haug, T., Gjøsæter, H., Lindstrøm, U., and Nilssen, K. T. 1995. Diet and food availability for northeast Atlantic minke whales (Balaenoptera acutorostrata), during the summer of 1992. ICES Journal of Marine Science 52, 77-86.

ICES. 2000. Report of the Advisory Committee on the Marine Environment, 2000.

ICES Cooperative Research Report, 241. 263 pp.

ICES 2005a. Report of the Pandalus Assessment Working Group of 2004. ICES CM. 2005/ACFM:05.

ICES 2005b. Report of the Arctic Fisheries Working Group (AFWG), 19-28 April 2005, Murmansk, Russia. ACFM:20. 504 pp.

Jørgensen and Hop (sci. eds) 2005. Report of the Working Group on Bottom Fauna and Habitats. The Scientific Basis for Environmental Quality Objectives (EcoQOs) for the Barents Sea Ecosystem. Norway, 2005. (http://barentshavet.imr.no/)

Kutti, T., Høisæter, T., Rapp, H.T., Humborstad, O.B., Løkkeborg, S. and Nøttestad, L. 2005. Immediate effects of experimental otter trawling on a sub-arctic benthic assemblage inside Bear Island Fishery Protection Zone in the Barents Sea. In Benthic Habitats and the Effects of Fishing. P.W. Barnes and J.P. Thomas (Eds.). American Fishery Society Symposia.

Lindstrom, U., Harbitz A., Haug, T. and Nilssen, K. 1998. Do harp seals Phoca groenlandica exhibit particular prey preferences? ICES Journal of Marine Science 55, 941-953.
Løkkeborg, S. 2003. Review and evaluation of three mitigation measures - bird-scaring line, underwater setting and line shooter - to reduce seabird by-catch in the North Atlantic longline fishery . Fisheries Research 60 (1): 11-16.
Løkkeborg, S. 2004. Impacts of trawling and scallop dredging on benthic habitats and communities. FAO Technical Paper no. 472. Food and Agricultural Organization of the United Nations (FAO), Rome , 66 pp.
Mauchline J. 1998. The biology of calanoid copepods. Advances in MarinBiology 33, Academic Press, London. 710 p.
Nilssen, K.T., Pedersen, O-P., Folkow, L. and Haug, T. 2000. Food consumption estimates of Barents Sea harp seals. NAMMCO Scientific Publications 2: 9-27.
Norderhaug, M., Bruun, E. & Møllen, G.U. 1977. Barentshavets sjøfuglressurser. Norsk Polarinstitutts Meddelelser 104: 119 pp.
Rey, F. 1981. The development of the spring phytoplankton outburst at selected sites off the Norwegian coast. In: Sætre, R, Mork, M, editors. The Norwegian Coastal Current. Bergen: University of Bergen. Pp 649-680.
Rey, F. 1993. Planteplanktonet og dets primærproduksjon I det nordlige Barentshavet. Fisken og Havet, 10. 39 p.
Skaug, H.J., Øien, N., Bøthun, G. and Schweder, T. 2002. Abundance of northeastern Atlantic minke whales for the survey period 1996-2001. International Whaling Commission, SC/54/RMP5.
Skaug, H.J., Øien, N., Schweder, T., and Bøthun, G. 2004. Abundance of Minke Whales (Balaenoptera Acutorostrata) in the Northeast Atlantic: Variability in Time and Space. Canadian Journal of Fisheries and Aquatic Sciences 61, 870-886.
Øien N. 1996. Lagenorhynchus species in Norwegian waters as revealed from incidental observations and recent sighting surveys. Paper SC/48/SM15 to the IWC Scientific Committee, Aberdeen.
Øien, N. 2003. Distribution and abundance of large whales in the northeast Atlantic, 1995. Working Paper NAMMCO SC/11/MF/10 to the Working Group on Minke and Fin Whales, Copenhagen, Denmark, 20-22.

General background literature

Anon 2005. Havets ressurser og miljø 2005. Fisken og havet, særnr. 1-2005. 212 pp. (In Norwegian, with English summaries) http://www.imr.no/dokumenter/ressurs_og _miljo_2005
Anon 2006 (*In prep.*). Havets ressurser og miljø 2006. Fisken og havet, særnr. 1-2005. (In Norwegian)
ICES 2005b. Report of the Arctic Fisheries Working Group (AFWG), 19-28 April 2005, Murmansk, Russia. ACFM:20. 504 pp.
C.H. von Quillfeldt and A. Dommasnes (Sci. eds.). Proposals for indicators and environmental quality objectives for the Barents Sea. Norwegian Polar Institute and Institute of Marine Research, Bergen. October 2005. 178pp. (In Norwegian, English and Russian versions in preparation). http://barentshavet.imr.no/

3.3 Assessments and Advice

3.3.1 Assessments and advice regarding protection of biota and habitats

ICES has not in 2006 provided advice regarding protection of biota and habitats.

3.3.2 Assessments and advice regarding fisheries

Mixed fisheries and fisheries interactions

The major fisheries in the area are:

1. Factory and freezer trawlers operating in the whole area all year round, targeting mainly cod, haddock, and saithe and taking other species as bycatch. The number of these vessels has been stable in recent years, at a lower level than previously.
2. Fresh fish trawlers operating in Subarea I and Division IIa all year round, targeting mainly cod and haddock, taking other species as bycatch. The number of these vessels has been reduced in recent years.
3. Freezer trawlers operating in Subarea I and Division IIb fishing shrimp. The number of these vessels has been stable.
4. Large purse seiners and pelagic trawlers targeting herring, mackerel, blue whiting, capelin, and polar cod in seasonal fisheries in this region. These vessels fish some of the same species in other areas as well.
5. Small fresh fish trawlers targeting shrimp and capelin in near-coast areas in Subarea I. The size of this fleet has decreased in recent years.
6. A fleet of vessels using conventional gears (gillnet, longline, handline, and Danish seine) mainly in nearshore fisheries, targeting various demersal species all around the year. This fleet, together with fleets 7 and 8, accounts for approximately 30% of the landings of demersal stocks. This share is maintained by quota allocation. When vessels in this fleet are modernised or replaced, there is a trend towards medium-sized (app. 15–20 m) multi-gear vessels with crews of 3–5.

7. Small purse seiners targeting saithe in coastal waters in a seasonal fishery, to a large extent vessels belonging to the group using conventional gears.
8. Longliners operating offshore, targeting non TAC-restricted species, mainly ling, blue ling, and tusk. These vessels are generally larger than those in the coastal fisheries and use technologically advanced auto-line systems.
9. Small vessels using gillnets, longlines, handlines, and Danish seine operating in nearshore waters along the Norwegian coast north of 62°N, exploiting coastal cod, and Northeast Arctic cod.

Some of these fisheries are mixed fisheries, with many stocks exploited together in various combinations. In cases where significant interactions occur, management advice must consider both the state of individual stocks and their simultaneous exploitation. Stocks in the poorest condition, particularly those having reduced reproductive capacity, necessarily become the overriding concern for the management of mixed fisheries where stocks are exploited either as a targeted species or as a bycatch.

Single-stock exploitation boundaries

The state and the limits to exploitation of the individual stocks are presented in the stock sections (Sections 3.4.1 to 3.4.8). ICES considers limits to exploitation of single stocks as follows:

Species	State of the stock			ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary .Tonnes or effort in 2007
	Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to target reference points	in relation to agreed management plan	in relation to precautionary limits	in relation to target reference points	
Northeast Arctic cod	Full reproductive capacity	Harvested unsustainably	Overexploited	Implies a TAC of 366 000 t in 2007.	Management plan not enforced. So TAC for $\mathbf{F}_{pa}$ in 2007 of 309 000.		309 000 t
Norwegian Coastal cod	NA	NA	NA		No-catch. Develop recovery plan		No catch
Northeast Arctic haddock	Full reproductive capacity	Unknown	NA	ICES in the process of evaluating the management plan.	Limit catches		< 130 000 t
Northeast Arctic saithe	Full reproductive capacity	Harvested sustainably	NA		Less than 247 000 t.		< 247 000 t
Greenland halibut	Unknown	Unknown	NA		Do not exceed recent low catches (13 000 t).		< 13 000 t
Sebastes mentella	Reduced reproductive capacity	Unknown	NA		No directed trawl fishery, area closures and low bycatch limits.		0 t
Sebastes marinus	Reduced reproductive Capacity	Unknown	NA		More stringent protective measures.		0 t
Shrimp							*Available in november*

Identification of critical stocks

The table above identifies the stocks that have reduced reproductive capacity, i.e. Norwegian coastal cod and the two redfish stocks in Subareas I and II (*Sebastes marinus* and *Sebastes mentella*). These stocks are an overriding concern in the management advice. In addition, Northeast Arctic cod is presently overexploited with a fishing mortality that is not sustainable.

ICES advice for fisheries management

The fisheries in the Northeast Arctic should therefore be managed such that the following rules apply simultaneously:

1. **For Norwegian coastal cod, there should be no catch.**
2. **For Northeast Artic cod, the fishing mortality is unsustainable and should be reduced.**
3. **For *Sebastes marinus* and *Sebasted mentella* in Subareas I and II, there should be no directed fishery and stronger regulations are advised to reduce bycatch.**
4. **The fishing of all other species should be restricted within the precautionary limits or according to the management plan as indicated in the table of individual stock limits above.**

Furthermore, unless ways can be found to harvest species caught in a mixed fishery within precautionary limits for <u>all</u> those species individually, then fishing should not be permitted.

Management considerations

ICES notes that this advice presents a strong incentive to fisheries to avoid catching species when their reproductive capacity is reduced. If industry-initiated programmes aim at reducing catches of species with reduced reproductive capacity to levels close to zero in mixed fisheries, then these programmes could be considered in the management of these fisheries. Industry-initiated programmes to pursue incentives should be encouraged, but must include a high rate of independent observer coverage, or other fully transparent methods for ensuring that their catches of species with reduced reproductive capacity are fully and credibly reported.

The demersal fisheries are highly mixed, usually with a clear target species dominating, and with low linkage to the pelagic fisheries (see table below). Although the degree of mixing may be high, the effect of the fisheries will vary among the species. More specifically, the coastal cod stock and the two redfish stocks are presently at very low levels. Therefore, the effect of the mixed fishery will be largest for these stocks. In order to rebuild these stocks, further restrictions through regulations should be considered (e.g. closures, moratorium, restrictions in gears) and this will also help reduce exploitation on NEA cod. A quantification of the degree of mixing and impact among species requires detailed information about the target species and mix per catch/landing and gear. Such data exist for some fleets (e.g. the trawler fleet), but is incomplete for other fleets. The available data has not yet been gathered and compiled for a quantitative analysis.

Under-reporting of catches now appears to be occurring for both NEA cod and NEA haddock. These two stocks are often caught in the same fisheries. This misreporting is in apparent conflict with the precautionary objectives of the management agreements. Management must strive to reduce misreporting to zero.

Flexibility in coupling between the fisheries. Fleets and impact on the other species (H - high, M - medium, L - low and 0 - nothing). The lower diagonal indicates which gears couple the species, and the strength of the coupling is given in the upper diagonal. The gears are abbreviated as: trawl roundfish (TR), trawl shrimp (TS), longline (LL), gillnet (GN), handline (HL), purse seine (PS), Danish seine (DS), and trawl pelagic (TP).

Species	Cod	Coastal cod	Haddock	Saithe	Wolffish	*S. mentella*	*S. marinus*	Greenland halibut	Capelin	Shrimp
Cod		H	H	H	M	M	M	M	L	M-H juvenile cod
Coastal cod	TR, PS, GN, LL, HL, DS		H	H	L	L	M-L	L	0-L	L
Haddock	TR, PS, GN, LL, HL, DS	TR, PS, GN,LL, HL, DS		H	M	M	M	L	0-L	M-H juvenile haddock
Saithe	TR, PS, GN, LL, HL, DS	TR, PS, GN,LL, HL, DS	TR, PS, GN, LL, HL, DS		L	L	M	0	0	0
Wolffish	TR, GN, LL, HL	TR,GN, LL, HL	TR, GN, LL, HL	TR, GN, LL, HL		M	M	M	0	M juvenile wolffish
S. mentella	TR	TR	TR	TR	TR		M	H	H juvenile *Sebastes*	H juvenile *Sebastes*
S. marinus	TR,GN, LL	TR,GN, LL	TR,GN, LL	TR,GN	TR, LL	TR		L	0	L-M juvenile *Sebastes*
Greenland halibut	TR, GN, LL,DS	TR,GN, LL	TR, GN, LL,DS	TR, GN, LL,DS	TR, LL	TR	TR		0	M-H juvenile
Capelin	TR, PS, TS, TP	PS, TP	TR, PS, TS, TP	PS	TP	TP	TP	None		L
Shrimp	TS	TS	TS	TS	TS	TS	TS	TS	TS	

Accordingly, at least the following fisheries are suspected of having significant interactions that deserve attention in setting up TACs applying to single stocks:

- Norwegian coastal cod are caught together with Northeast Arctic cod in some fisheries.
- For *Sebastes marinus*, some of the catches by Norway, and most of the catches taken by other countries, are taken in mixed trawl fisheries.
- *Sebastes mentella* is caught as a bycatch in the cod fishery, the pelagic fishery for blue whiting and NSS herring, and as juveniles in the shrimp trawl fisheries.
- Shrimp trawl fishery with bycatch of juvenile redfish and Greenland halibut.
- Directed pelagic trawl fisheries targeting herring and blue whiting in the Norwegian Sea where 15% catch of redfish is allowed.

The catch options that would apply if single stocks could be exploited independently of others are presented in the sections on individual stocks (Sections 1.5.1 to 1.5.8).

However, for the mixed demersal fisheries, catch options must be based on the expected catch in specific combinations of effort in the various fisheries, taking into consideration the advice given above. The distributions of effort across fisheries should be responsive to objectives set by managers, but must also result in catches that comply with the scientific advice presented above.

At the 31st meeting of the Joint Russian-Norwegian Fisheries Commission, the Parties agreed on a harvesting strategy for Northeast Arctic cod and haddock. In 2004 ICES evaluated HCR for cod and stated that the rule was incomplete in the last part. It was amended by ICES for performing the evaluation. The amended HCR was considered by ICES as consistent with the Precautionary Approach. At the 33rd Session of The Joint Norwegian-Russian Fishery Commission the HCR was amended for rebuilding situations and ICES was requested to evaluate the new rule and provide advice in accordance to it. For Northeast Arctic cod, ICES evaluated the rules as amended and concluded that a management plan based on these rules is in agreement with the Precautionary Approach, provided that the spawning biomass is above $\mathbf{B}_{\text{lim}}$ and that the assessment uncertainty and implementation error are not greater than those calculated from historical data. The harvest strategy has not been evaluated for haddock.

ICES has been asked to calculate management options for 2006 on the basis of the harvest control rule as amended. The calculated catches and SSBs are given in Sections 1.5.1 and 1.5.3.

Regulations in force and their effects

The fisheries in Subareas I and II are managed by TAC constraints for the main stocks and by allocation of TAC shares amongst states with established fishing interests. These Subareas consist mainly of waters within EEZs, but also contain some waters outside EEZs.

For the main species, the fisheries in the EEZs are regulated by quotas at a variety of scales (vessels, fleets, species, seasons). Management measures also regulate minimum landing size, mesh size, and use of sorting grids. Since January 1997, the use of sorting grids in the trawl fisheries has been mandatory for most of the Barents Sea and Svalbard area. Minimum landing size is also a minimum catching size, implying that vessels have to avoid fishing grounds with small-sized fish. Discarding is prohibited in some EEZs. Time and area closures may be implemented to protect small fish.

Compilation of effort data relevant to the different species is difficult when the fisheries are regulated by vessel quotas. In some cases the effort targeted at the main species, e.g., cod, may be calculated, but it is almost impossible to calculate effort for non-target species.

Quality of assessments and uncertainties

The unreported landings for Northeast Arctic cod and haddock have apparently increased sharply in 2002 and have remained at this level since. The main mechanism used for avoiding quota control seems to be trans-shipping of fish from the Barents Sea. The assessment includes estimates of non-reported landings. The catch forecast refers to total catch, which would only be equivalent to a TAC if no unreported landings occur in the future. This has to be taken into account when using the results of the catch forecasts.

References

ICES 2004. Report of the ICES Advisory Committee on Fishery Management, 2004. ICES Advice, 2004.

3.3.3 Special requests

3.3.3.1 Harvest control rules for Northeast Arctic haddock (Subareas I and II)

At the 33rd meeting of the Joint Russian-Norwegian Fisheries Commission (JRNC) in November 2004, the following decision was made:

"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 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.*

The Parties agreed on similar decision rules for haddock, based on F_{pa} and B_{pa} for haddock, and with a fluctuation in TAC from year to year of no more than +/-25% (due to larger stock fluctuations)."

ICES comments

The evaluation of the harvest control rule is provided below. The advice on levels of catch and effort for 2007 consistent with the harvest control rule for North East Arctic haddock is provided in Section 3.4.3.

For Northeast Arctic haddock, ICES is requested to comment on "*aspects of the agreed harvest control rule in relation to the recruitment dynamics for the haddock stock*". ICES evaluated the above decision rules through simulation studies, for details see the Technical Annex below.

The evaluation indicates that the management plan based on a 3-year rule and with constraints on the interannual variation in TACs is only in agreement with the Precautionary Approach in the absence of implementation error. In that situation the risk to $\mathbf{B}_{\mathrm{lim}}$ is estimated as close to 0% and the risk to $\mathbf{F}_{\mathrm{lim}}$ at 5%.

Unreported landings have increased in recent years (2002-2005) and are considered to be similar to those for Northeast Arctic cod; i.e. ~30% of the agreed TAC. When implementation errors of this order of magnitude are used in the simulations, the agreed management plan is no longer in agreement with the Precautionary Approach because the risk to $\mathbf{F}_{\mathrm{lim}}$ is estimated around 63%.

ICES comments that a 1-year rule in connection with a maximum change of 25% in TAC appears to perform much better compared to the 3-year rule because it is less sensitive to implementation error (under the assumption that the implementation error can be estimated and used in the assessment process).

ICES has evaluated the harvest control rule for this stock taking into account the historic pattern of sporadic recruitment, which may need specific measures to protect large year-classes as they recruit to the fishery.

Technical Annex to the ICES response

For North-East Arctic haddock, ICES evaluated the decision rule in June 2006.

The evaluation of HCRs for NEA haddock has been carried out using simulation models. Important issues for the evaluation of harvest control rules are the choice of population model, inclusion of uncertainty in population model, the choice of initial values for simulations, the formulation of harvest control rules for use in the evaluation (constant F rules, how to reduce F when SSB<$\mathbf{B}_{pa}$, limit on year-to-year variation in catch, etc.), and performance measures for harvest control rules (yield, stock size, F, probability of SSB<$\mathbf{B}_{lim}$, annual variation in catches, etc.). The evaluation of the HCR takes implementation error into account. The harvest control rule for NEA haddock is summarized in Figure 3.3.3.1.1.

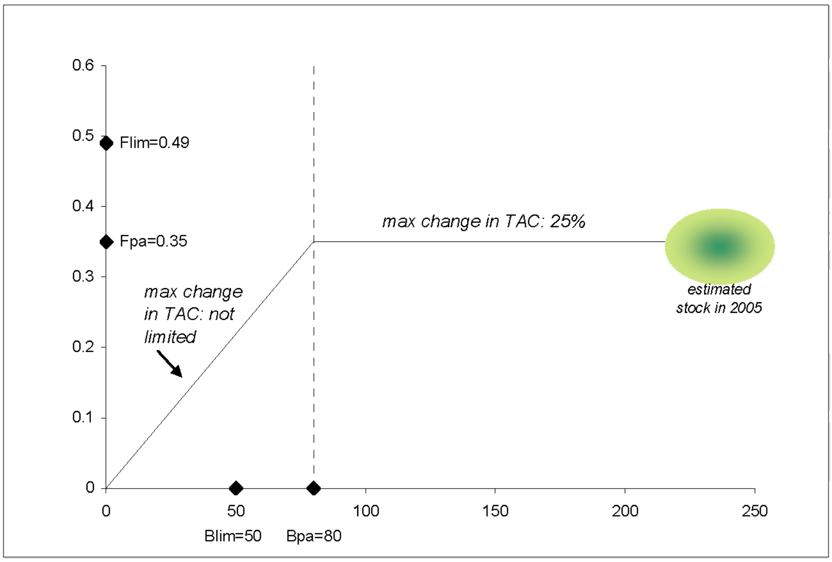


Figure 3.3.3.1.1 Harvest control rule for NEA haddock with estimated (uncertain) stock size in 2005.

Reference points

	ICES considers that:	**ICES proposed that:**
Precautionary Approach reference points	$\mathbf{B}_{lim}$ is 50 000 t.	$\mathbf{B}_{pa}$ be set at 80 000 t.
	$\mathbf{F}_{lim}$ is 0.49.	$\mathbf{F}_{pa}$ is set at 0.35.

Recruitment estimation

The recruitment pattern of a spasmodic spawner like NEA haddock is an important feature of the stock dynamics. The initial analysis suggested grouping the recruitment in three classes: (1) “low” recruitment, (2) periodic good recruitment possibly linked to the “outstanding” year classes and (3) the “outstanding” year classes themselves. The length of the periods with “low” recruitment is highly variable. The latter part of the series (after 1980) shows period of length 4 or 5 years. The seventies was a long period with “low” recruitment while the early part had a more varying pattern.

The recruitment cycle that was implemented in the simulations consisted of 4 years with ”Low recruitment”, 1 year with ”Good recruitment”, 1 year with either “Outstanding” (Prob=0.3) or ”Good” (Prob=0.7) recruitment and then 1 year with ”Good recruitment”. This simulation will be similar to the conditions observed in the 1980’s and early 1990’s.

Scenarios

Several different scenarios were evaluated (see Table 3.3.3.1.1):

- The (agreed) 3-year rule with different levels of implementation bias
- A 1-year rule with different levels of implementation bias
- A 1-year rule without constraints on interannual variations in TACs and different levels of implementation bias
- A 1-year rule with a higher (145 kT) trigger level.

Simulations are carried out over 120 years. Only the results for the last 100 years are considered in the summary statistics (20 years *burn-in time*).

Results of the evaluation

The agreed HCR appears to perform well under the assumption that no implementation bias exists. In that case the probability of being below $\mathbf{B}_{lim}$ is 0% and the probability of fishing mortality above F_{lim} is 5%. When implementation bias of 30% is assumed (close to recently estimated bias), there is still a low probability of being below $\mathbf{B}_{lim}$ (2%) but with a high probability of being above $\mathbf{F}_{lim}$ (63%). Therefore, the 3-year rule is not very robust to implementation errors.

The 1-year rule is much more robust to implementation error. The simulations assume that the implementation error is known and accounted for in the following assessment. Therefore the effect is similar to setting a TAC corresponding to a higher F. These simulations represent a situation where it is still is possible to track trends in F and stock size. The simulations do not cover the situation where information of unreported landings is not available. In those situations the assessments are likely to be biased.

The stock-recruitment analysis that forms the basis of the simulations, suggests increased recruitment for SSB above 150 kt. This indicates that a triggerpoint higher than 80 kt could be considered (see scenario 16).

The risks of being below $\mathbf{B}_{lim}$ under different scenarios and with different implementation errors are shown in figure 3.3.3.1.1.

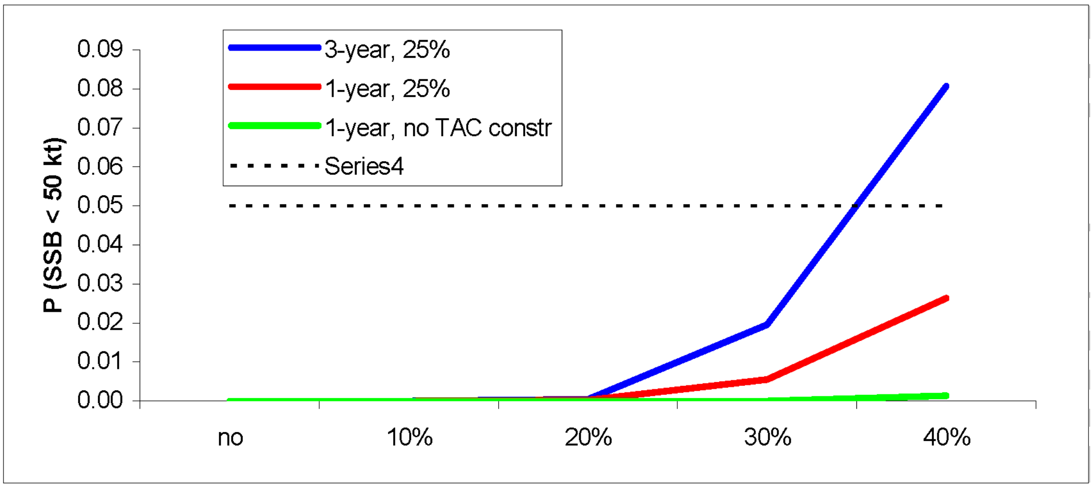


Figure 3.3.3.1.2 The probability of SSB being below 50000 tonnes (y-axis) associated with implementation error (x-axis) for the 3-year rule with 25% TAC constraint (blue), for the 1-year rule with 25% TAC constraint (red), and for the 1-year rule with no TAC constraint (green).

Table 3.3.3.1.1 Summary table of simulation settings and results.

Run no	Rule	TAC constr.	Trigger point	Impl. error	Intended F	Realised F	Catch (tonnes)	SSB (tonnes)	Prob. SSB<Blim (50kt)	Prob. SSB<Bpa (80kt)	Prob. F>Flim
1	3-year	25 %	80	no	0.35	0.36	170583	285771	0.00	0.000	0.05
2	3-year	25 %	80	10 %	0.38	0.43	166415	225059	0.00	0.00	0.23
3	3-year	25 %	80	20 %	0.41	0.53	146807	166376	0.00	0.03	0.49
4	3-year	25 %	80	30 %	0.43	0.64	132582	129565	0.02	0.20	0.63
5	3-year	25 %	80	40 %	0.44	0.72	122663	108073	0.08	0.35	0.72
6	1-year	25 %	80	no	0.35	0.35	170185	289197	0.00	0.00	0.01
7	1-year	25 %	80	10 %	0.35	0.39	169244	249254	0.00	0.00	0.08
8	1-year	25 %	80	20 %	0.35	0.44	158765	207645	0.00	0.01	0.26
9	1-year	25 %	80	30 %	0.35	0.50	143088	166750	0.01	0.06	0.48
10	1-year	25 %	80	40 %	0.36	0.57	125689	125637	0.03	0.22	0.63
11	1-year	No	80	no	0.35	0.36	171332	280743	0.00	0.00	0.01
12	1-year	No	80	10 %	0.35	0.40	170216	239414	0.00	0.00	0.08
13	1-year	No	80	20 %	0.35	0.45	160677	196835	0.00	0.00	0.28
14	1-year	No	80	30 %	0.35	0.50	143145	154704	0.00	0.02	0.53
15	1-year	No	80	40 %	0.34	0.55	127700	124576	0.00	0.12	0.70
16	1-year	25 %	145	no	0.35	0.40	170923	240182	0.00	0.00	0.08

Reality check

In order to check the realism of this recruitment function, a reality check was carried out. The historic mean value of fishing mortality was used to check that recruitment, stock size and catches were close to the historic averages calculated from the VPA. The simulation was based on F=0.48 (independent of SSB), a 1-year rule, no limit on annual variation in TAC and the settings for weight, M, maturity and fishing pattern as used by AFWG, except that the simulations are now made for 120 years, of which the results for the last 100 are considered (20 years of burn-in time). The reality check gave a higher recruitment (+14%), higher SSB (+23%) and higher catch (+17%) compared to the historic mean. This is probably linked to two different aspects:

- The historic time series has long periods with fishing mortalities well above the average (F=0.48) driving the stock to down to low and less productive levels.
- The present exploitation pattern (used in the simulations) is probably more favourable than the historic pattern.

The higher SSB and recruitment in the reality check could indicate that the risks to $\mathbf{B}_{lim}$ that are calculated in the simulation trials could be underestimated.

Conclusions

The evaluation indicates that the management plan based on a 3-year rule and with constraints on the interannual variation in TACs is only in agreement with the Precautionary Approach in the absence of implementation error. In that situation the risk to $\mathbf{B}_{lim}$ is estimated as close to 0% and the risk to $\mathbf{F}_{lim}$ at 5%.

Unreported landings have increased in recent years (2002-2005) and are considered to be similar to those for Northeast Arctic cod; i.e. ~30% of the agreed TAC. When implementation errors of this order of magnitude are used in the simulations, the agreed management plan is no longer in agreement with the Precautionary Approach because the risk to $\mathbf{F}_{lim}$ is estimated around 63%.

The simulation indicate that a 1-year rule in connection with a maximum change of 25% in TAC appears to perform much better compared to the 3-year rule because it is less sensitive to implementation error (under the assumption that the implementation error can be estimated and used in the assessment process).

3.3.3.2 Request from the Norwegian Government regarding Greenland Sea hooded seals.

The Government of Norway has requested ICES to provide:

"…An assessment of the status of the stocks of harp and hooded seals in the Greenland Sea and harp seals in the White Sea/Barents Sea. Furthermore, ICES should assess the impact on these stocks of an annual harvest of:

a. Current harvest levels,
b. Sustainable catches (defined as the fixed annual catches that stabilizes the future 1+ population),
c. Twice the sustainable catches as defined above."

ICES response to the request

The request involves two issues:

a. Assessment of the status of the stocks of harp and hooded seals in the Greenland Sea ("West Ice") and harp seals in the White Sea/Barents Sea,
b. Assessment of the impact on these stocks of three different levels of annual harvest.

The request concerns three populations of seals: Greenland Sea harp seals, White Sea/Barents Sea harp seals and Greenland Sea hooded seals (see Figure 3.3.3.2.1). The advice on the Greenland Sea harp seals and the White Sea/Barents Sea harp seals has already been issued in 2005 (ICES 2005) and will not be reiterated here. The focus of this reply to the request will therefore be on the Greenland Sea hooded seals

Figure 3.3.3.2.1 Locations of North Atlantic harp and hooded seal stocks. Green spots mark the whelping and moulting areas for the White Sea (also called the East Ice) stock of harp seals, the Greenland Sea or West Ice stocks of harp and hooded seals (West Ice), and the northwest Atlantic stocks (Front and Gulf areas) of harp and hooded seals. Dark blue marks the entire distributional areas.

3.3.3.2.1 Greenland Sea Hooded Seals

State of stock/exploitation

Results from a pup survey conducted in 2005 suggest that current pup production (15,200 pups, CV = 0.25) may be lower than observed in the 1997 survey (23,762 pups, CV = 0.19). Model explorations indicate a substantial decrease in population abundance from the late 1940s and up to the early 1980s. In the most recent two decades, the stock appears to have stabilized at a low level, but the current trajectory remains uncertain. The stock is estimated to be well below $\mathbf{N}_{lim}$. Harvest of hooded seals has decreased substantially from the high catches in the 1950s and 1960s (figure 3.3.3.2.1, table 3.3.3.2.1)

Management objectives

There are no explicit management objectives for this stock. Sealing regulations for 1979-2006 are given in Table 3.3.3.2.2.

Reference points

ICES considers the concept of N_{lim} to be similar to the B_{lim} abundance limit that is estimated for many fish stocks. ICES has recommended previously that N_{lim} be set at 30% of N_{max}. (the largest observed abundance) The best estimate of N_{max} is 750 000 individuals so that the N_{lim} should be set at 225 000 individuals.

Single-stock exploitation boundaries

ICES was requested to give options for three different catch scenarios:

1. Current catch level (average of the catches in the period 2001 – 2005)
2. Sustainable catches (defined in the request as the fixed annual catches that stabilizes the future 1+ population)
3. Two times the sustainable catches.

Ad. 1 The current (2005) catch level for the stock was 3,826 seals (Table 3.3.3.2.1). The current stock size of Greenland Sea hooded seals is likely well below $\mathbf{N}_{lim}$ (225 000). Though model runs suggest that the population may have stabilized since the 1970s, the stock trajectory remains uncertain because of the small size of the Greenland Sea hooded seal stock and the low precision in the population estimates. The 1997 and 2005 estimates of pup production suggest that the population has declined over the period. Combined with earlier harvest data, it appears the population has declined substantially since the 1950s. ICES concludes that harvesting at the current level could result in a continued stock decline.

Ad 2. and 3. Due to the 'data poor' situation for the Greenland hooded seals stock, ICES is not in the position to estimate future 1+ populations and can therefore not estimate sustainable catches.

ICES reviewed the data available on Greenland Sea hooded seals. Although a survey was carried out in 2005, this population is still considered as 'data poor'.

For 'data poor' stocks like Greenland Sea hooded seals, the concept of the Potential Biological Removal level (PBR) could be used to set catch limits. The PBR approach identifies the maximum allowable removals that will ensure that the risk of the population falling below the $\mathbf{N}_{lim}$ reference point is only 5% and that would allow a stock that dropped below $\mathbf{N}_{lim}$ to recover.

The PBR approach is likely somewhat lower than the sustainable catch option from the Norwegian request. Using the PBR approach, the catch limit can be calculated as 2,189 animals.

However, because the stock is estimated to be well below $\mathbf{N}_{lim}$ ICES concludes that even harvesting at the PBR level could result in a continued stock decline or a lack of recovery.

ICES concludes that harvesting should not be permitted with the exception of catches for scientific purposes.

Management considerations

ICES reviewed the data available on Greenland Sea hooded seals. Although a survey was carried out in 2005, the Working Group concluded that this population should still be considered as 'Data Poor'.

The 1997 and 2005 estimates of pup production suggest that the population has declined over the period. Combined with earlier harvest data, it appears the population has declined substantially since the 1950s.

Total catches (Table 3.3.3.2.1) were 4,881 (4,217 pups) in 2004 and 3,826 (3,633 pups) in 2005. The quota was implemented such that parts of, or the whole quota, could be taken as weaned pups assuming 1.5 pups equalled one 1+ animal. Between 1990 and 2000 less than 30% of the quota was taken each year.

Scientific basis

Data and methods

Data from these surveys, catch data, and age structure and sexual maturity of collected seals were input to model runs performed over a range of M_{1+}, M_0 values (0.09 to 0.13, 0.27 to 0.36) with standard deviations of either 0.01 or 0.05. Summary statistics for the model run using the fitted model and model diagnostics for the prior distribution of M_{1+} = 0.11 (std = 0.05) are shown in Figure 3.3.3.2.2.

The model is very ensitive to M_{1+} which is poorly estimated because it is fit to only two data points. Information from other similar populations was used as input to the model in the form of a prior distributions (mean and standard deviation) for M1+. The resulting estimate M_{1+} varied slightly depending upon the prior but was always in the 0.14-0.16 range. All model runs gave very similar results with regard to present abundance which is due to the 2005 pup production estimate. Using a prior value of M_{1+} of 0.11 (std 0.05), a 2005 abundance of N_{1+} 71,400 was obtained. A 95% confidence interval for this N_{1+}(2005) was 38,430 – 104,370.

Source of information

Report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals, Copenhagen, Denmark, 12-16 June 2006, (CM 2006/ACFM:6).

ICES (2005). Report of the Advisory Committee on Fishery Management, Advisory Committee on the Marine Environment and Advisory Committee on Ecosystems, 2005. ICES Advice. Volume 3, The Barents Sea and the Norwegian Sea. 108 p.

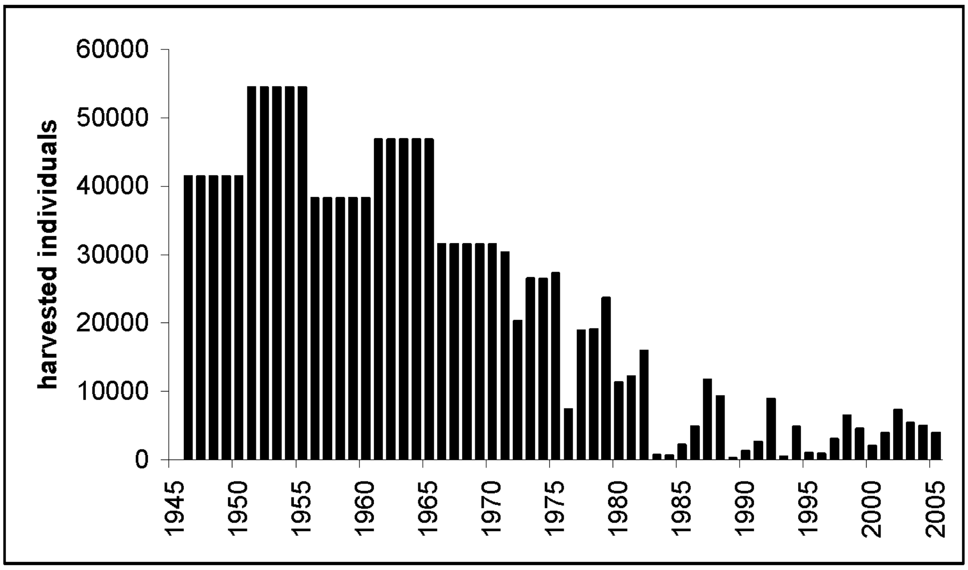


Figure 3.3.3.2.2 Catches of **hooded seals** in the Greenland Sea ("West Ice"), 1946–2005[a], incl. catches for scientific purposes. Catches prior to 1970 are only available as average catches per 5 years.

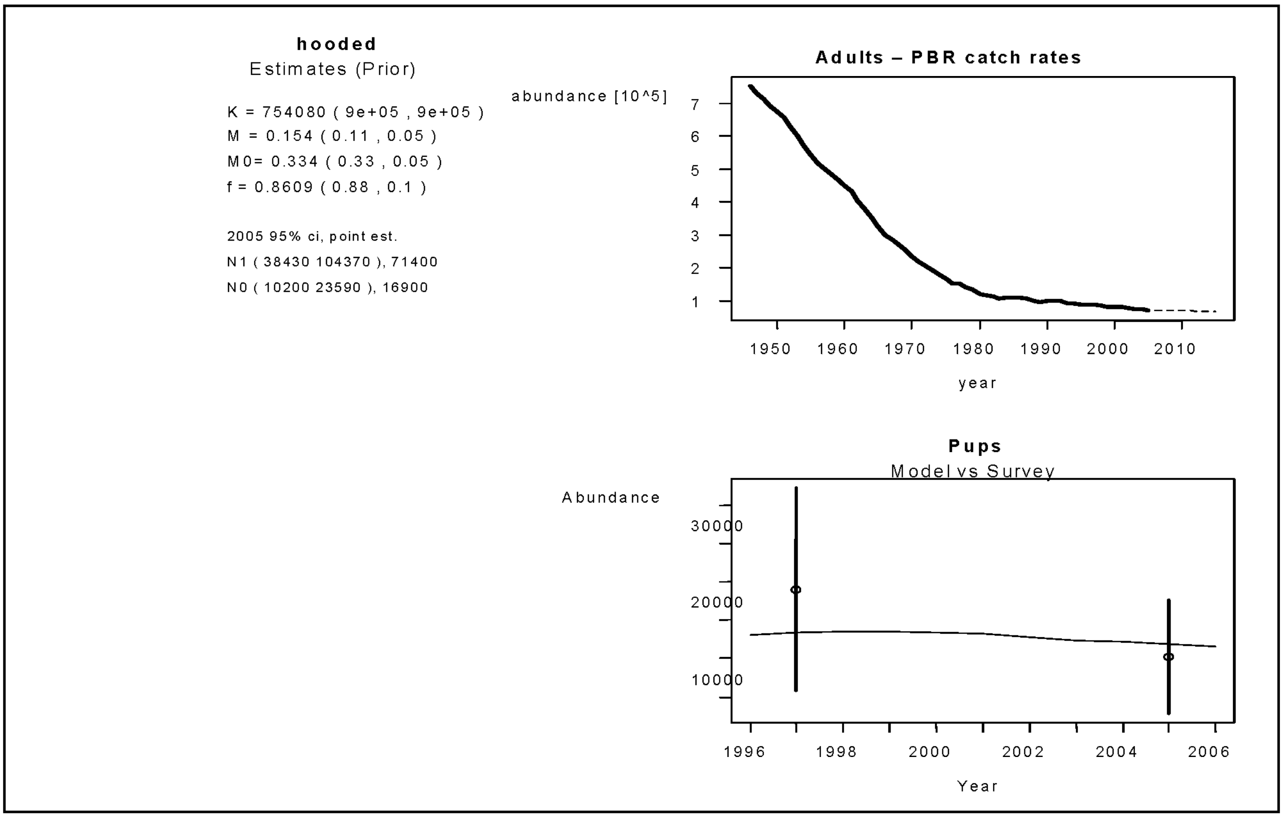


Figure 3.3.3.2.3 Greenland Sea hooded seal stock abundance estimate using prior values of M_{1+} = 0.11 (std = 0.05), M_0 = .33 (std = 0.05) , and F = .88 (std = 0.1).

Table 3.3.3.2.1 Catches of **hooded seals** in the Greenland Sea ("West Ice"), 1946–2005[a], incl. catches for scientific purposes. Catches prior to 1970 are only available as average catches per 5 years.

	Norwegian catches			Russian catches			Total catches		
Year	Pups	1 year and older	Total	Pups	1 year And Older	total	Pups	1 year and older	Total
1946–50	31152	10257	41409	-	-	-	31152	10257	41409
1951–55	37207	17222	54429	-	-	-[b]	37207	17222	54429
1956–60	26738	9601	36339	825	1063	1888[b]	27563	10664	38227
1961–65	27793	14074	41867	2143	2794	4937	29936	16868	46804
1966–70	21495	9769	31264	160	62	222	21655	9831	31486
1971	19572	10678	30250	-	-	-	19572	10678	30250
1972	16052	4164	20216	-	-	-	16052	4164	20216
1973	22455	3994	26449	-	-	-	22455	3994	26449
1974	16595	9800	26395	-	-	-	16595	9800	26395
1975	18273	7683	25956	632	607	1239	18905	8290	27195
1976	4632	2271	6903	199	194	393	4831	2465	7296
1977	11626	3744	15370	2572	891	3463	14198	4635	18833
1978	13899	2144	16043	2457	536	2993	16356	2680	19036
1979	16147	4115	20262	2064	1219	3283	18211	5334	23545
1980	8375	1393	9768	1066	399	1465	9441	1792	11233
1981	10569	1169	11738	167	169	336	10736	1338	12074
1982	11069	2382	13451	1524	862	2386	12593	3244	15837
1983	0	86	86	419	107	526	419	193	612
1984	99	483	582	-	-	-	99	483	582
1985	254	84	338	1632	149	1781	1886	233	2119
1986	2738	161	2899	1072	799	1871	3810	960	4770
1987	6221	1573	7794	2890	953	3843	9111	2526	11637
1988	4873	1276	6149[c]	2162	876	3038	7035	2152	9187
1989	34	147	181	-	-	-	34	147	181
1990	26	397	423	0	813	813	26	1210	1236
1991	0	352	352	458	1732	2190	458	2084	2542
1992	0	755	755	500	7538	8038	500	8293	8793
1993	0	384	384	-	-	-	0	384	384
1994	0	492	492	23	4229	4252	23	4721	4744
1995	368	565	933	-	-	-	368	565	933
1996	575	236	811	-	-	-	575	236	811
1997	2765	169	2934	-	-	-	2765	169	2934
1998	5597	754	6351	-	-	-	5597	754	6351
1999	3525	921	4446	-	-	-	3525	921	4446
2000	1346	590	1936	-	-	-	1346	590	1936
2001	3129	691	3820	-	-	-	3129	691	3820
2002	6456	735	7191	-	-	-	6456	735	7191
2003	5206	89	5295	-	-	-	5206	89	5295
2004	4217	664	4881	-	-	-	4217	664	4881
2005	3633	193	3826	-	-	-	3633	193	3826
2006	NA	NA	NA				NA	NA	NA

[a] For the period 1946–1970 only 5-year averages are given.

[b] For 1955, 1956 and 1957 Soviet catches of harp and hooded seals reported at 3,900, 11,600 and 12,900, respectively (Sov. Rep. 1975). These catches are not included.

[c] Including 1048 pups and 435 adults caught by one ship which was lost.

Table 3.3.3.2.2 Norwegian sealing regulations for hooded seals in the Greenland Sea (“West Ice”) in 1985–2005.

	Opening Date	Closing Date	Quotas[1]				Allocations	
			Total	Pups	Fem.	Males	Norway	Soviet/ Russia
1985	22 March	5 May	(20 000)[2]	(20 000)[2]	0[3]	Unlim.	8 000[4]	3 300
1986	18 March	5 May	9 300	9 300	0[3]	Unlim.	6 000	3 300
1987	18 March	5 May	20 000	20 000	0[3]	Unlim.	16 700	3 300
1988	18 March	5 May	(20 000)[2]	(20 000)[2]	0[3]	Unlim.	16 700	5 000
1989	18 March	5 May	30 000		0[3]	Incl.	23 100	6 900
1990	26 March	30 June	27 500	0	0	Incl.	19 500	8 000
1991	26 March	30 June	9 000	0	0	Incl.	1 000	8 000
1992-94	26 March	30 June	9 000	0	0	Incl.	1 700	7 300
1995	26 March	10 July	9 000	0	0	Incl.	1 700[5]	7 300
1996	22 March	10 July	9 000[6]				1 700	7 300
1997	26 March	10 July	9 000[7]				6 200	2 800[9]
1998	22 March	10 July	5 000[8]				2 200	2 800[9]
1999-00	22 March	10 July	11 200[10]				8 400	2 800[9]
2001-03	22 March	10 July	10 300[10]				10 300	
2004-05	22 March	10 July	5 600[10]				5 600	
2005-06	22 March	10 July	4 000				4 000	

1 Other regulations include: Prescriptions for date for departure Norwegian port; only one trip per season; licensing; killing methods; and inspection.
2 Basis for allocation of USSR quota.
3 Breeding females protected ; two pups deducted from quota for each female taken for safety reasons.
4 Adult males only.
5 Included 750 weaned pups under permit for scientific purposes.
6 Pups allowed to be taken from 26 March to 5 May.
7 Half the quota could be taken as weaned pups, where two pups equaled one 1+ animal.
8 The whole quota could be taken as weaned pups, where two pups equaled one 1+ animal.
9 Russian allocation reverted to Norway.
10 Quota given in 1+ animals, parts of or the whole quota could be taken as weaned pups, where 1,5 pups equaled one 1+ animal.

3.3.3.3 Request from the Russian Federation on North East Arctic Cod

The Russian Federation, in a letter dated 13 October 2006, requested ICES to re-evaluate the Northeast Arctic Cod assessment in view of information which had become available since ICES evaluated this stock. This information was provided as three annexes to the Russian request and dealt with: 1) Russian Cod and Haddock Fisheries/Transhipment at Sea in 2005; 2) and 3) Synoptic Monitoring of the Barents Sea Cod Stock based on advanced research techniques for the marine living resources.

This information was reviewed by Jan Horbowy (Poland), Niels Daan (Netherlands) and Alain Biseau (France). Asgeir Aglen (Norway) and Yuri Kovalev (Russian Federation, Chair of AFWG) were available for the reviewers to explain the work done by the ICES Arctic Fisheries Working Group (AFWG) in April 2006.

The reviews discuss two topics: 1) the level of IUU fishing in 2005; and 2) the estimate of the absolute cod biomass in 2005. These levels influence the TAC advice for 2007 but also the management plan evaluation (ICES Advisory report; spring 2006 section 3.4.1) is affected.

There was good agreement between the reviewers. To question 1) the reviewers concluded that there was not sufficient information available to judge whether the IUU fishing estimate used by AFWG or the one presented in the Russian information was the best. Concerning question 2) the reviewers supported the ICES June 2006 advice as they did not find the basis for the 'new' stock estimate sufficiently strong to reject the AFWG assessment.

ICES' response to the Russian Federation and the reviews are available from the ICES Secretariat on request.

3 Stock Summaries (The Barents Sea and the Norwegian Sea)

3.4.1 Northeast Arctic cod

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits/management plan	Fishing mortality in relation to highest yield	Fishing mortality in relation to agreed target	Comment
Full reproductive capacity	Harvested unsustainably	Overexploited	Overexploited	Lack of enforcement of the management plan has resulted in exploitation above the level intended in the management plan

Based on the most recent estimates of SSB, ICES classifies the stock as having full reproductive capacity. Based on the most recent estimates of fishing mortality, the stock is exploited with an unsustainable fishing mortality (at $\mathbf{F}_{\mathrm{lim}}$), much higher than that intended under the management plan. The SSB has been above $\mathbf{B}_{\mathrm{pa}}$ since 2002. Fishing mortality was reduced significantly over the years 1999–2003 but has since then increased to a 2005 estimate equal to $\mathbf{F}_{\mathrm{lim}}$. Surveys indicate that recent year classes are at or below average.

Management objectives

At the 33rd meeting of the Joint Russian-Norwegian Fisheries Commission (JRNC) in November 2004, the following decision was made:

"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 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.*
- *The Parties agreed on similar decision rules for haddock, based on F_{pa} and B_{pa} for haddock, and with a fluctuation in TAC from year to year of no more than +/-25% (due to larger stock fluctuations).[1]"*

ICES has evaluated these decision rules for cod and a management plan based upon them is in accordance with the precautionary approach when the SSB is above $\mathbf{B}_{\mathrm{lim}}$. The agreed management plan was not evaluated with an implementation error as large as the one currently occurring in the fishery.

[1] This quotation is taken from point 5.1 in the Protocol of the 33rd session of The Joint Norwegian-Russian Fishery 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).

Reference points

	ICES considers that:	ICES proposed that:
Precautionary Approach reference points	$\mathbf{B}_{lim}$ is 220 000 t.	$\mathbf{B}_{pa}$ be set at 460 000 t.
	$\mathbf{F}_{lim}$ is 0.74.	$\mathbf{F}_{pa}$ be set at 0.40.

Technical basis:

$\mathbf{B}_{lim}$: change point regression.	$\mathbf{B}_{pa}$: the lowest SSB estimate having >90% prob. of being above $\mathbf{B}_{lim}$.
$\mathbf{F}_{lim}$: F corresponding to an equilibrium stock = $\mathbf{B}_{lim}$.	$\mathbf{F}_{pa}$: the highest F estimate having >90% prob. of being below $\mathbf{F}_{lim}$.

Yield and spawning biomass per Recruit
F-reference points

	Fish Mort Ages 5–10	Yield/R	SSB/R
Average last 3 years	0.649	1.118	1.119
$\mathbf{F}_{max}$	0.263	1.243	3.968
$\mathbf{F}_{0.1}$	0.142	1.150	7.345
$\mathbf{F}_{med}$	0.915	1.051	0.649

Single-stock exploitation boundaries

Exploitation boundaries in relation to existing management plans

The management plan implies a TAC of 366 000 t in 2007. This catch projection includes all catches and therefore the TAC must account for all misreported catches as well.

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

The current fishing mortality, estimated at 0.74, is above fishing mortalities that would lead to high long-term yields (indicated to be in the F range **0.25-0.5**). This indicates that long-term yield will increase at fishing mortalities well below the historic values. Fishing at such a lower mortality would lead to higher SSB and therefore lower the risk of observing the stock outside precautionary limits.

Exploitation boundaries in relation to precautionary limits

The agreed management plan has been evaluated to be consistent with the precautionary approach when the SSB is above $\mathbf{B}_{lim}$ and there is a low level of implementation error. However, the management plan is not fully enforced, resulting in non-reported landings and exploitation above what was intended in the management plan. Total catches in 2007 consistent with the Precautionary Approach reference points are below 309 000 t.

Conclusion on exploitation boundaries

Since the current management plan is not fully implemented ICES concludes that the exploitation boundaries for this stock should be based on the precautionary limits. Accordingly, total catches in 2007 should be below 309 000 t.

Short-term implications

Outlook for 2007:

For the forecast the F in 2006 is set equal to F in 2005, instead of using the recent 3-year average. This is because there is an increasing trend both in F and documented trawl effort over the years 2003–2005. Since the predicted SSB in 2007 is below $\mathbf{B}_{pa}$ the management rule states that the 10% limit for TAC change should not be applied and that the F for calculating the 3-year average catch should be scaled according to the SSB(2007)/$\mathbf{B}_{pa}$ ratio. The F used for calculating the 3-year average catch is thus 0.4*441/460=0.383.

Basis: F(2006) = $\mathbf{F}_{2005}$ =0.74; SSB(2007) =441 ; catch (2006) =551.

Rationale	TAC (2007)[1]	Basis	F (2007)	SSB (2008)	%SSB change [1)]	% TAC change [2)]
Zero catch	0	F=0	0	787	78	-100
Status quo	504	$\mathbf{F}_{2005}$	0.74	406	-8	7
High long-term yield	207	**simulations**	0.25	629	14	-56
Agreed management plan	366	TAC(man. Plan)	0.49	506	26	-22
Precautionary limits	309	$\mathbf{F}_{pa}$	0.40	548	24	-34

Weights in '000 t. Shaded scenarios are not considered consistent with the Precautionary Approach.
[1)] SSB 2008 relative to SSB 2007.
[2)] TAC 2007 relative to TAC 2006.

It is assumed that the TAC will be implemented and that the landings in 2007 therefore correspond to the TAC.

Management considerations

Concerns about under-reporting of catches in recent years continue. Estimates for 2005 indicate about 35% in addition to official catches due to unreported landings. Unreported landings will reduce the effect of management measures and will undermine the intended objectives of the harvest control rule. It is important that management agencies ensure that all catches are counted against the TAC.

Management plan evaluations

The recent high amount of unreported catch has not been considered in the evaluation. In a longer perspective it is unlikely that the rule itself under such conditions can protect the stock and future fisheries. Actions are needed to stop the unreported fishing.

Factors affecting the fisheries and the stock

Regulations and their effects

TAC regulations are in place and there is non-compliance, resulting in significant unreported catches. Estimates of non-reported landings were 90 000–117 000 t for 2002–2004 and 166 000 t for 2005. The main mechanism used for avoiding quota control seems to be trans-shipping of fish from the Barents Sea.

Discarding of cod, haddock, and saithe is thought to be significant in some periods although discarding is illegal in Norway and Russia. Data on discarding are scarce, but attempts to obtain better quantification continue.

In addition to quotas, the 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.

The fisheries are controlled by inspections of the trawler fleet at sea, i.e. by a requirement to report to catch control points when entering and leaving the EEZs, VMS satellite tracking for some fleets, and by inspections of all fishing vessels when landing the fish. Keeping a detailed fishing logbook onboard is mandatory for most vessels, and large parts of the fleet report to the authorities on a daily basis.

The effects of these regulations have not been evaluated.

Changes in fishing technology and fishing patterns

Since January 1997, sorting grids have been mandatory for the trawl fisheries in most of the Barents Sea and Svalbard area.

The environment

The Northeast Arctic cod is characterized by significant year-to-year variations in the growth rate. In different years the mean weight of fish at the same age may differ by a factor of 2 or 3. Among the factors influencing cod growth are water temperature, food supply, and cod population abundance.

Northeast Arctic cod is an important predator on other species in the ecosystem, notably capelin. The management of Arctic cod will therefore have implications on the dynamics of these stocks. Changes in growth, maturity, and 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. In recent years maturation, growth, and cannibalism have been fairly stable in spite of the variation in capelin stock.

Scientific basis

Data and methods

Analytical assessment is based on catch-at-age data, using one commercial CPUE series and three survey series. The total effect of the discarding is still unclear and requires more work before it can be included in the assessments. Estimates of cannibalism are included in the natural mortality.

Uncertainties in assessment and forecast

In view of the recent estimates of misreporting the assessment and the prediction using $\mathbf{F}_{sq}$ may be overoptimistic as there is an increasing trend in misreporting. A prediction based on a landings in 2006 plus 30% extra catch (based on average 2004-2005) results in an SSB 10% lower in 2007. In addition to this uncertainty, the current high fishing mortality (F close to $\mathbf{F}_{lim}$) also leads to a high uncertainty in the prediction. There were also no samples from the misreported component of the catch. There are also periods in the time-series of catch data that do not include estimates of misreporting. There is historical evidence of discarding of age groups 3 and 4, but this could not be quantified for 2004–2005. The effect of these factors has not been quantified but is likely to add uncertainty to the assessment.

The use of alternative assessment models suggests that the estimates of fishing mortality are fairly robust to model assumptions about the precision of the catch data.

Environmental conditions

The population dynamic parameters vary with the environment as described above. Recent changes in the environment have been taken into account by using the recent three-year average for maturation and cannibalism, and by prediction of weight-at-age.

Comparison with previous assessment and advice

The current assessment estimates the total biomass in 2005 to be 8% lower and the SSB 15% lower than in the previous assessment, while the fishing mortality for 2004 is now estimated to be 19% higher. Revised catch for 2004 explains 6% increase in F and 7% decrease in SSB.

The advice last year was based on the agreed management plan. The advice is now based on precautionary limits because the management plan has not been properly implemented.

Source of information

Report of the Arctic Fisheries Working Group, 19–28 April 2006 (ICES CM 2006/ACFM:25).

Year	ICES Advice	Single-stock exploitation boundaries	Predicted catch corresp. to advice	Predicted catch corresp. to single-stock exploitation boundaries	Agreed TAC	Official landings	ACFM landings	Unreported 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 $\mathbf{F}_{low}$; TAC		172		160	210	212	25
1991	F at $\mathbf{F}_{low}$; 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 $\mathbf{F}_{med}$		< 993		850	792	762	
1998	F less than $\mathbf{F}_{med}$		514		654	615	593	
1999	Reduce F to below $\mathbf{F}_{pa}$		360		480	506	485	
2000	Increase B above $\mathbf{B}_{pa}$ in 2001		110		390		415	
2001	High prob. of SSB>$\mathbf{B}_{pa}$ in 2003		263		395		426	
2002	Reduce F to well below 0.25		181		395		535	90
2003	Reduce F to below $\mathbf{F}_{pa}$		305		395		552	115
2004	Reduce F to below $\mathbf{F}_{pa}$		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			
2007	Take into account coastal cod and redfish bycatches	$\mathbf{F}_{pa}$	309					

Weights in '000 t.

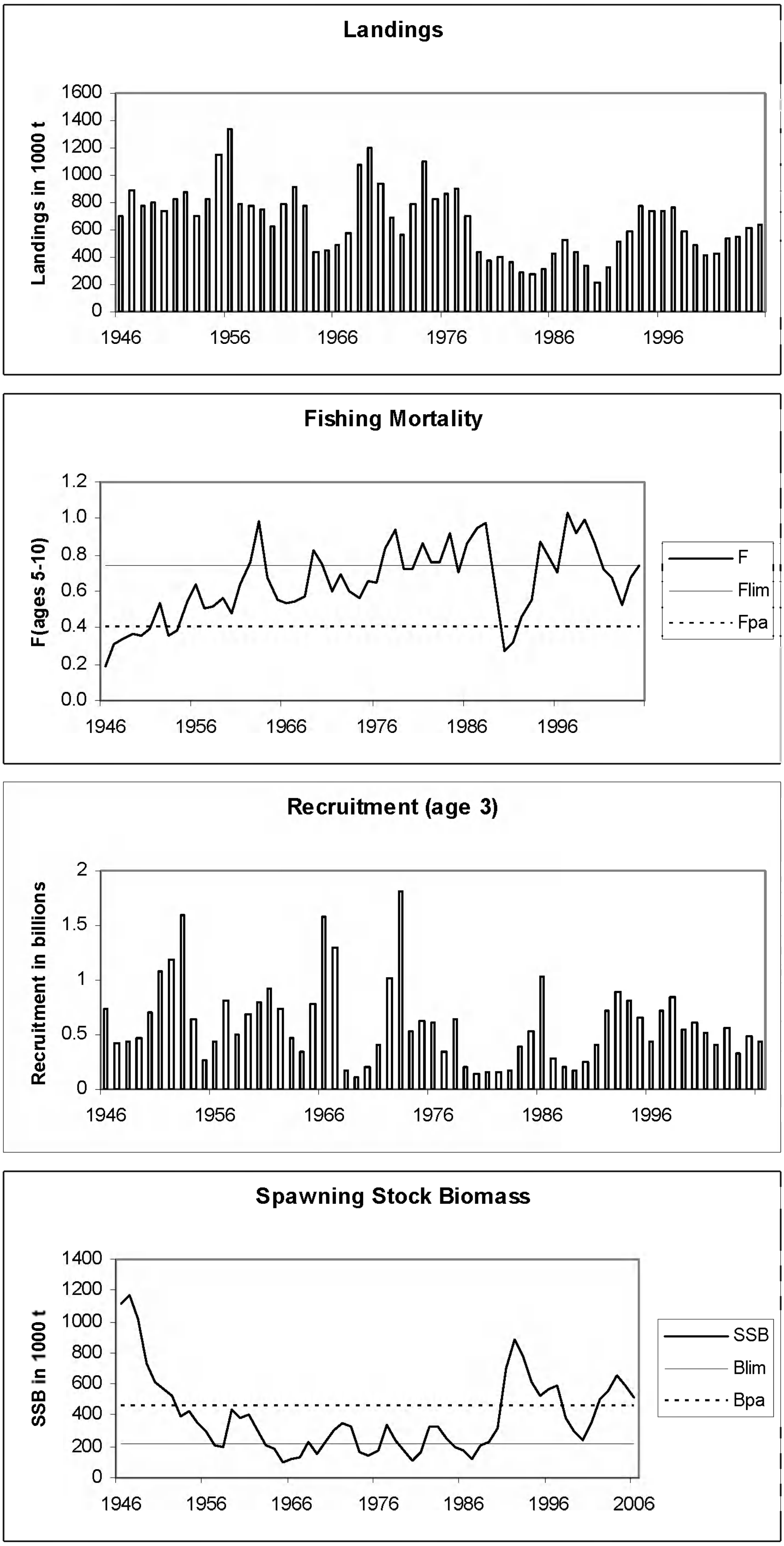


Figure 3.4.1.1 Northeast Arctic cod (Subareas I and II). Landings, fishing mortality, recruitment and SSB.

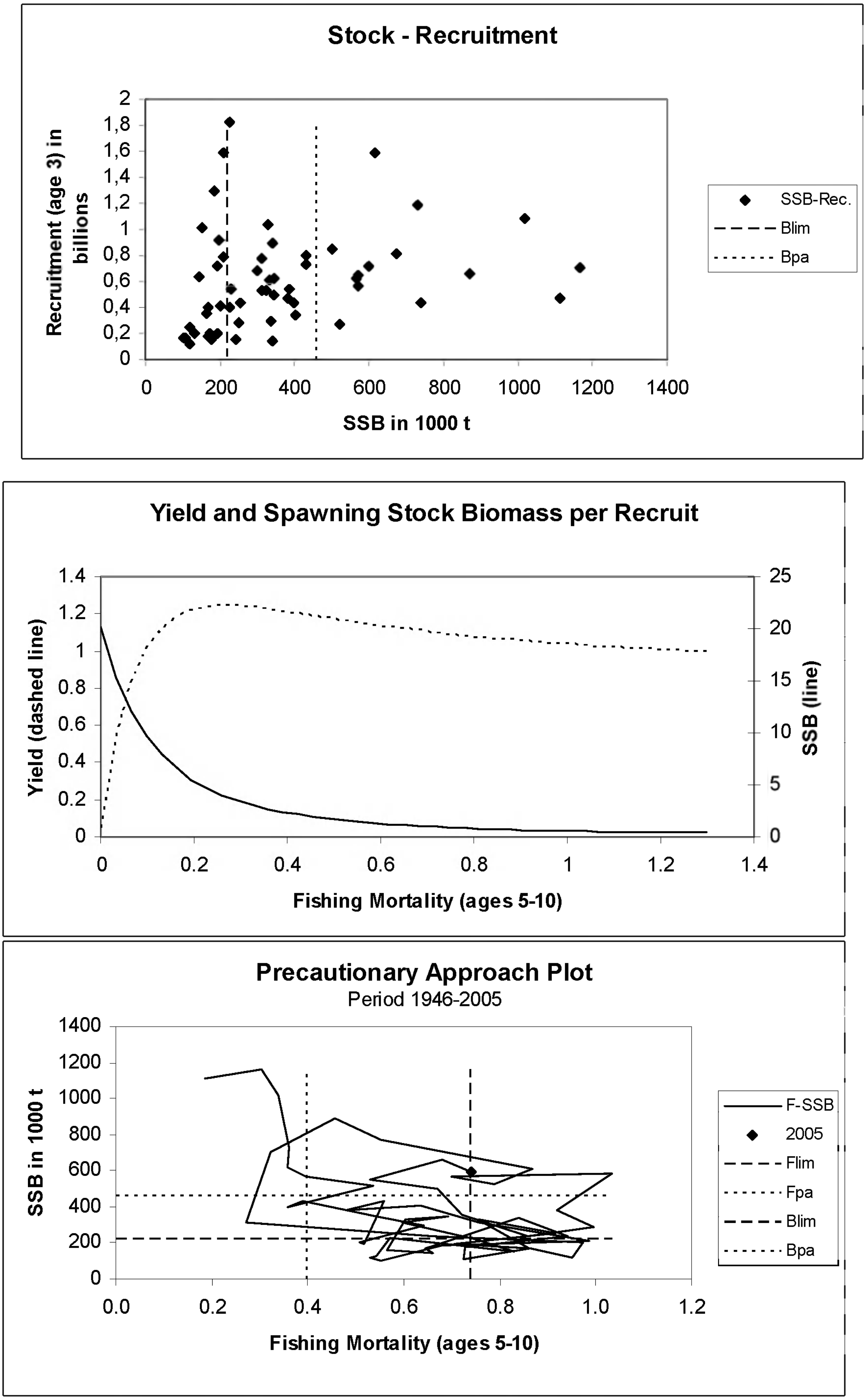


Figure 3.4.1.2 Northeast Arctic cod (Subareas I and II). Stock and recruitment; Yield and SSB per recruit.

Table 3.4.1.1 North-East Arctic COD. Total catch (t) by fishing areas and unreported catch. (Data provided by Working Group members.)

Year	Sub-area I	Division IIa	Division IIb	Unreported catches	Total catch
1961	409 694	153 019	220 508		783 221
1962	548 621	139 848	220 797		909 266
1963	547 469	117 100	111 768		776 337
1964	206 883	104 698	126 114		437 695
1965	241 489	100 011	103 430		444 983
1966	292 253	134 805	56 653		483 711
1967	322 798	128 747	121 060		572 605
1968	642 452	162 472	269 254		1 074 084
1969	679 373	255 599	262 254		1 197 226
1970	603 855	243 835	85 556		933 246
1971	312 505	319 623	56 920		689 048
1972	197 015	335 257	32 982		565 254
1973	492 716	211 762	88 207		792 685
1974	723 489	124 214	254 730		1 102 433
1975	561 701	120 276	147 400		829 377
1976	526 685	237 245	103 533		867 463
1977	538 231	257 073	109 997		905 301
1978	418 265	263 157	17 293		698 715
1979	195 166	235 449	9 923		440 538
1980	168 671	199 313	12 450		380 434
1981	137 033	245 167	16 837		399 037
1982	96 576	236 125	31 029		363 730
1983	64 803	200 279	24 910		289 992
1984	54 317	197 573	25 761		277 651
1985	112 605	173 559	21 756		307 920
1986	157 631	202 688	69 794		430 113
1987	146 106	245 387	131 578		523 071
1988	166 649	209 930	58 360		434 939
1989	164 512	149 360	18 609		332 481
1990	62 272	99 465	25 263	25 000	212 000
1991	70 970	156 966	41 222	50 000	319 158
1992	124 219	172 532	86 483	130 000	513 234
1993	195 771	269 383	66 457	50 000	581 611
1994	353 425	306 417	86 244	25 000	771 086
1995	251 448	317 585	170 966		739 999
1996	278 364	297 237	156 627		732 228
1997	273 376	326 689	162 338		762 403
1998	250 815	257 398	84 411		592 624
1999	159 021	216 898	108 991		484 910
2000	137 197	204 167	73 506		414 870
2001	142 628	185 890	97 953		426 471
2002	184 789	189 013	71 242	90 000	535 045
2003	163 109	222 052	51 829	115 000	551 990
2004	177 888	219 261	92 296	117 000	606 445
2005 [1]	159 573	194 644	121 059	166 000	641276

[1] Provisional figures.

Table 3.4.1.2 North-East Arctic COD. Nominal catch (t) by countries
(Sub-area I and Divisions IIa and IIb combined, data provided by Working Group members.)

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 [1]	16 273	3 491	8 135	5 848	207 825	9 349	10 744	200 077	5 874	7 660	475 276

[1] Provisional figures.
[2] USSR prior to 1991.
[3] Includes Baltic countries.

Table 3.4.1.3 Northeast Arctic cod (Subareas I and II).

Year	Recruitment Age 3 thousands	SSB tonnes	Landings tonnes	Mean F Ages 5-10
1946	728139	1112776	706000	0.1857
1947	425311	1165059	882017	0.3047
1948	442592	1019114	774295	0.3398
1949	468348	729879	800122	0.3619
1950	704908	615339	731982	0.3566
1951	1083753	568705	827180	0.3966
1952	1193111	520599	876795	0.5348
1953	1590377	396417	695546	0.3572
1954	641584	429694	826021	0.3879
1955	272778	346919	1147841	0.5437
1956	439602	299823	1343068	0.6401
1957	804781	207840	792557	0.5089
1958	496824	195377	769313	0.5169
1959	683690	432489	744607	0.5596
1960	789653	383479	622042	0.4789
1961	916842	404228	783221	0.6348
1962	728338	311678	909266	0.7576
1963	472064	208207	776337	0.9866
1964	338678	186570	437695	0.6789
1965	776941	102315	444930	0.5533
1966	1582560	120722	483711	0.5302
1967	1295416	129784	572605	0.5439
1968	164955	227215	1074084	0.5704
1969	112039	151870	1197226	0.8292
1970	197105	224482	933246	0.7493
1971	404774	311662	689048	0.5956
1972	1015319	346511	565254	0.6928
1973	1818949	332913	792685	0.6020
1974	523916	164491	1102433	0.5633
1975	621616	142028	829377	0.6595
1976	613942	171238	867463	0.6457
1977	348054	341385	905301	0.8379
1978	638490	241536	698715	0.9406
1979	198490	174699	440538	0.7264
1980	137735	108253	380434	0.7241
1981	150868	166926	399038	0.8632
1982	151830	326133	363730	0.7583
1983	166831	327181	289992	0.7560
1984	397831	251087	277651	0.9161
1985	523673	193856	307920	0.7038
1986	1038820	170729	430113	0.8649
1987	286370	121243	523071	0.9510
1988	204640	202589	434939	0.9743
1989	172781	234715	332481	0.6602
1990	242751	316414	212000	0.2710
1991	411780	704734	319158	0.3210
1992	720906	887541	513234	0.4550
1993	896029	775141	581611	0.5528
1994	810154	614827	771086	0.8679
1995	656754	528709	739999	0.7882
1996	437353	571408	732228	0.6989
1997	713245	588227	762403	1.0348
1998	845886	385426	592624	0.9200
1999	553079	292220	484910	0.9946
2000	608126	239925	414868	0.8586
2001	522815	354753	426471	0.7228
2002	407529	499238	535045	0.6715
2003	563398	552624	551990	0.5285
2004	334749	660115	606445	0.6783
2005	483585	594609	641276	0.7411
2006	431000	517304		
Average	596794	391852	661121	0.6475

3.4.2 Norwegian coastal cod (Subareas I and II)

State of the stock

In the absence of defined precautionary reference points the state of the stock cannot be fully evaluated. Despite the absence of precautionary limits, there is clear evidence that the stock is harvested unsustainably and SSB is below any candidate for $\mathbf{B}_{lim}$. The SSB is, at present, at the lowest observed level. The assessment is uncertain and only indicative of trends. Recruitment in recent years has decreased rapidly to very low levels. Recruitment is clearly impaired at estimated SSB below 100 000 t and, at present, SSB is well below this level. Fishing mortality reference points are not defined, but the present fishing mortality is far too high.

Management objectives

No management objectives have been specified.

Reference points

Precautionary references points have not been established for this stock.

Yield and spawning biomass per Recruit
F-reference points:

	Fish Mort Ages 4–7	Yield/R	SSB/R
Average recent 3 years	0.528	1.387	1.412
$\mathbf{F}_{max}$	0.513	1.387	1.470
$\mathbf{F}_{0.1}$	0.218	1.252	4.416
$\mathbf{F}_{med}$	0.199	1.221	4.827

Single-stock exploitation boundaries

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

The current estimated fishing mortality is high, considerably higher than a fishing mortality that would lead to high long-term yields ($\mathbf{F}_{0.1}$ = 0.22). Once the stock is recovered, fishing at such lower mortalities would lead to higher SSB and, therefore, lower risks of fishing outside precautionary limits.

Exploitation boundaries in relation to precautionary limits

No catch should be taken from this stock in 2007 and a recovery plan should be developed and implemented as a prerequisite to reopening the fishery.

Management considerations

The SSB is at a historical low level and the year classes recruiting to the SSB over the next few years are estimated to be poor. Continued fishing is expected to lead to a further decrease in the SSB.

The recovery plan should include monitoring the trajectory of the stock, clearly stating specified reopening criteria, and monitoring the fishery when it is reopened.

Norwegian coastal cod is managed as part of the Norwegian Northeast Arctic cod fishery. An expected yield of 40 000 t from the coastal cod has been added annually since the mid-1970s to the quota for Northeast Arctic cod, except for 2004 (20 000 t) and 2005 (21 000 t) and 2006 (21 000t). In order to avoid any catch of the Norwegian coastal cod stock, the restrictions should apply to all fisheries catching cod where it mixes with Northeast Arctic cod.

The landings of coastal cod are severely underestimated and the quota system is not restricting the overall catches as intended.

Factors affecting the fisheries and the stock

Regulations and their effects

In addition to quotas, the fishery is regulated by the same minimum catch size, minimum mesh size on the fishing gears as for the Northeast Arctic cod, maximum by-catch of undersized fish, closure of areas having high densities of juveniles, and by seasonal and area restrictions. The quota for Norwegian coastal cod was reduced from 40 000 t in 2003 to 20 000 t in 2004 and 21 000 t in 2005 and 2006.

In 2005, measures were taken to further reduce fishing on this stock, but there is no formal recovery plan though it is quite clear that the new regulations in 2004 and 2005 did not decrease the catches to any great extent and further action needs to be taken.

In the new regulations, several fjords are closed for direct cod fishing with vessels larger than 15 meters. These regulations are supposed to reduce the exploitation on cod in the fjords and to displace fishing to cod outside the fjords where the proportion of Northeast Arctic cod is higher and that of coastal cod lower. Furthermore, fishing vessels smaller than 15 meter fishing with gillnet is the fleet taking the highest amount of coastal cod. According to the new regulations, this fleet has no new restrictions and will probably still fish a considerable amount of coastal cod. The aim of the regulation system was to restrict the landings to a maximum of 21 000 t (for 2005), but at catches of this size and with the current productivity the stock is still expected to decline.

The 2005 landings were in the range of 31 000 t, i.e. above the 2005 TAC of 21 000 t.

Scientific basis

Data and methods

The assessment is based on catch-at-age data and on an acoustic survey. The assessment is considered indicative of stock trends and may not reflect absolute stock sizes. This assessment tends to overestimate fishing mortality and underestimate the stock size in the most recent years. This does not invalidate the overall conclusion.

Uncertainties in assessment and forecast

The landings of coastal cod are severely underestimated. Both tourist and recreational fishing activity are landing a considerable amount of coastal cod. These landings are not reported and not included in the official statistics. Although it certainly has been unreported for a long period, there are no available data for years other than 2003 (where it was estimated to be in the range of 30% of the commercial catch). It is also unknown whether the amount of unreported catch fluctuates with the stock size or with other factors. ICES therefore considered that unreported landings should not be included in the assessment until data is available for a longer time period.

The catches and survey indices are estimated by distinguishing between coastal cod and Northeast Arctic cod through 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. Preliminary results indicate an accuracy of more than 95%.

Comparison with previous assessment and advice

The assessment and advice are consistent with those in 2005.

Source of information

Report of the Arctic Fisheries Working Group, 19–28 April 2006 (ICES CM 2006/ACFM:25).

Year	ICES Advice	Predicted catch corresp.to advice	Agreed TAC[1]	Official landings[3]	ACFM 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		33
2005	A recovery plan	0	21		31
2006	A recovery plan	0	21		
2007	A recovery plan	0			

Weights in '000 t.
[1]40 000 tonnes has until 2003 been added annually to the agreed TAC of Northeast Arctic cod; 20 000 t were added in 2004 and 21 000 t in 2005 and 2006.
[2]Estimated according to otolith type. [3]No official landings.

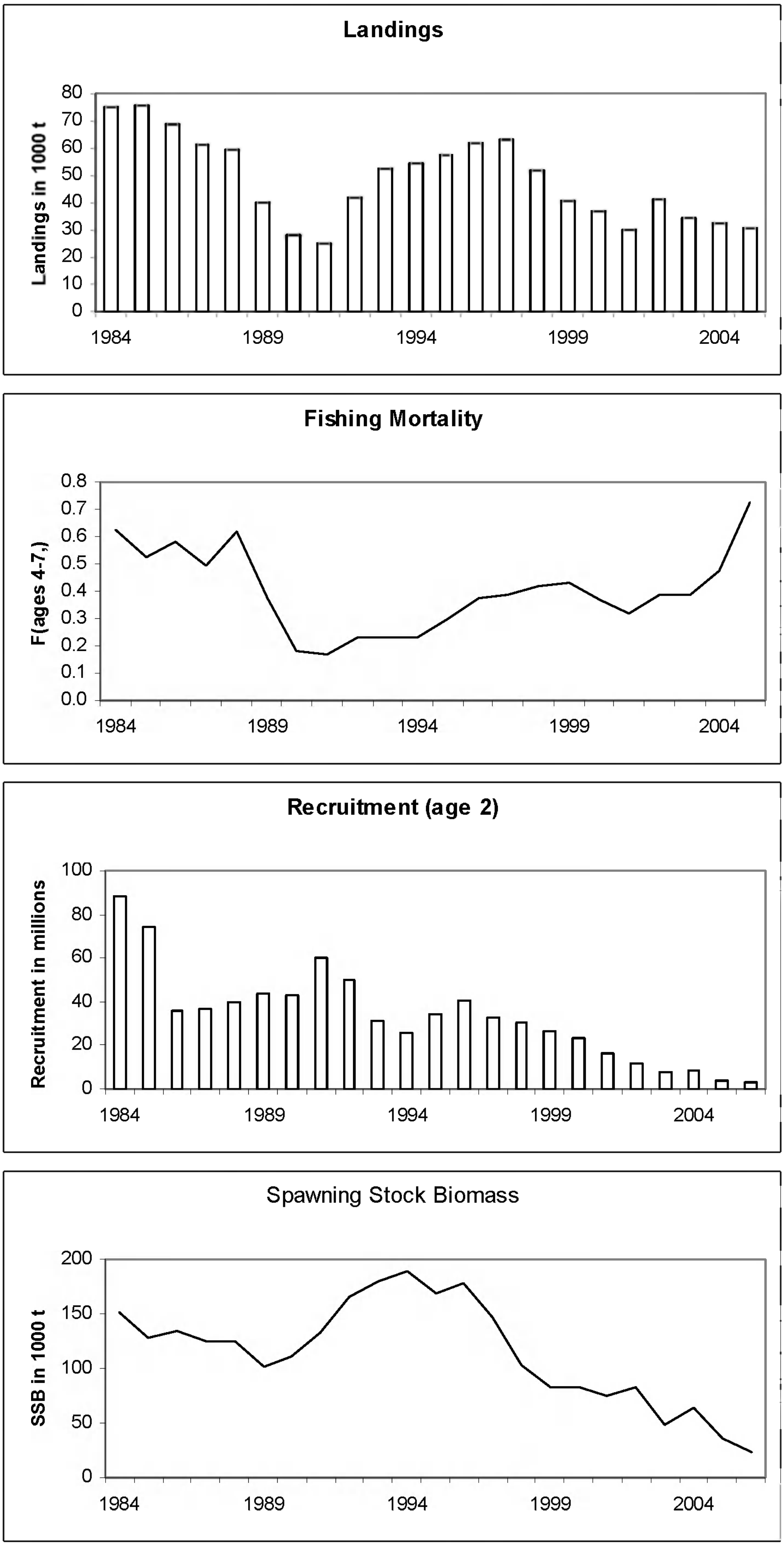


Figure 3.4.2.1 Norwegian Coastal cod. Landings, fishing mortality, recruitment and SSB.

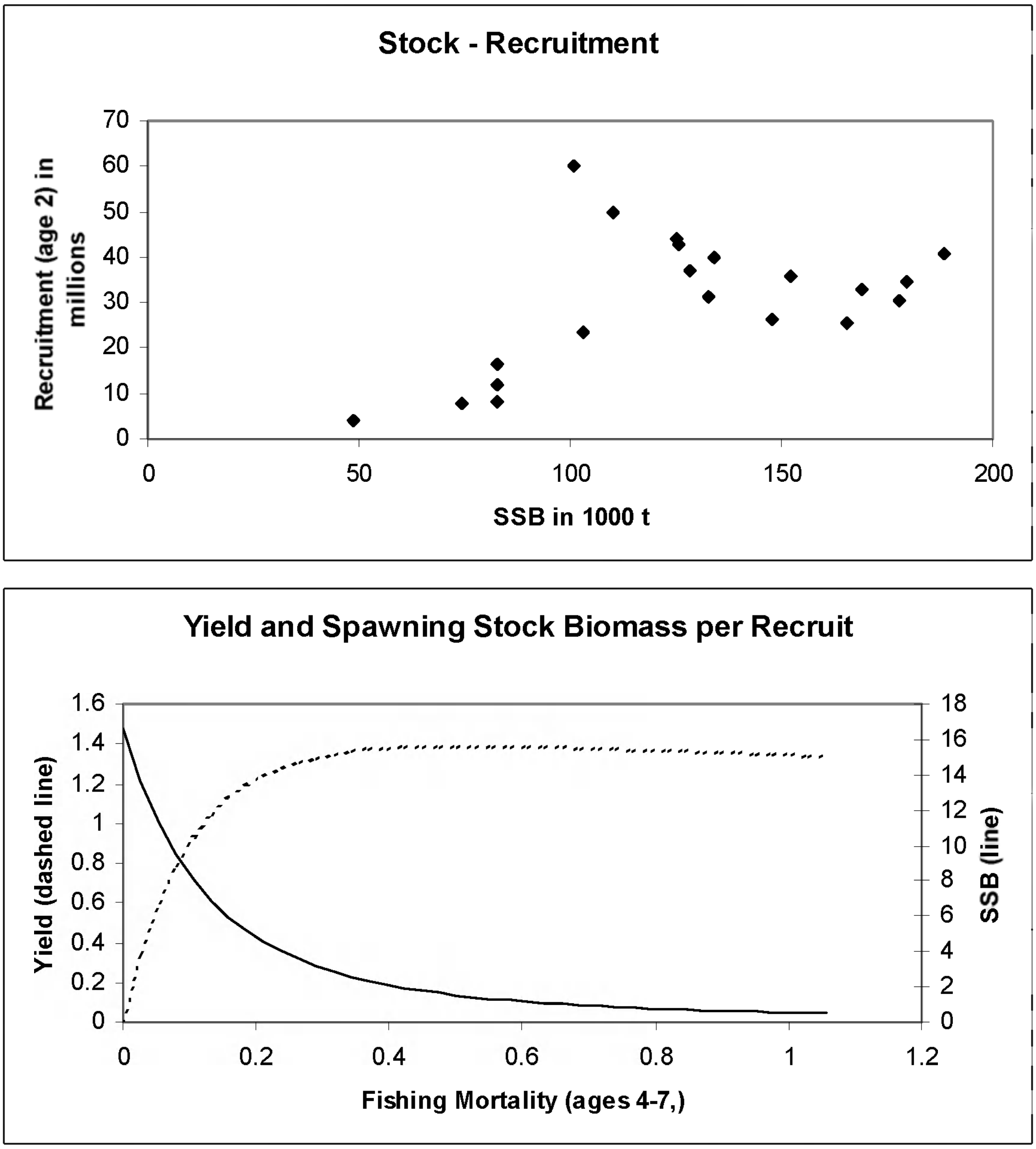


Figure 3.4.2.2 Norwegian Coastal cod (Subareas I and II). Recruitment and SSB.

Table 3.4.2.1 Norwegian Coastal cod.

Year	Landings tonnes
1984	74824
1985	75451
1986	68905
1987	60972
1988	59294
1989	40285
1990	28127
1991	24822
1992	41690
1993	52557
1994	54562
1995	57207
1996	61776
1997	63319
1998	51572
1999	40732
2000	36715
2001	29699
2002	40994
2003	34635
2004	32599
2005	30936
Average	48258

3.4.3 Northeast Arctic haddock (Subareas I and II)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Fishing mortality in relation to agreed target	Comment
Full reproductive capacity	unknown	unknown	unknown	The assessment is uncertain, but all indications are that the stock is well above $\mathbf{B}_{pa}$.

Based on the most recent estimates of SSB, ICES classifies the stock as having full reproductive capacity. The assessment is uncertain due to a major revision of data and substantial unreporting of landings, but believed to be indicative for trends. Recent recruitment has been average with no large year classes.

Management objectives

At the 33rd meeting of the Joint Russian-Norwegian Fisheries Commission (JRNC) in November 2004, the following decision was made:

"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 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.*
- *The Parties agreed on similar decision rules for haddock, based on F_{pa} and B_{pa} for haddock, and with a fluctuation in TAC from year to year of no more than +/-25% (due to larger stock fluctuations).[2]"*

Reference points

	ICES considers that:	ICES proposed that:
Precautionary Approach reference points	$\mathbf{B}_{lim}$ is 50 000 t.	$\mathbf{B}_{pa}$ be set at 80 000 t.
	$\mathbf{F}_{lim}$ is 0.49.	$\mathbf{F}_{pa}$ is set at 0.35.
Target reference points	**NA**	**NA**

[2] This quotation is taken from point 5.1 in the Protocol of the 33rd session of The Joint Norwegian-Russian Fishery 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).

Single-stock exploitation boundaries

Exploitation boundaries in relation to existing management plans

The Joint Russian-Norwegian Fisheries Commission has agreed on a harvest control rule for NEA haddock. The HCR is currently being evaluated by ICES.

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

There are indications that the current fishing mortality is above fishing mortalities that would lead to high long-term yields. This indicates that long-term yield will increase at fishing mortalities well below the historic values. Fishing at such a lower mortality would lead to higher SSB and therefore lower the risk of observing the stock outside precautionary limits.

Exploitation boundaries in relation to precautionary limits

The recent increase in SSB (through the years 2001–2004) has been associated with catches less than 130 000 tonnes (including misreported catches). In the absence of a reliable assessment and since these catches appear to have led to an increase in the stock, ICES recommends keeping catches below this level.

Short-term implications

Outlook for 2007

Due to the uncertainty associated with the assessment there are no projections for NEA haddock for 2007.

Management considerations

The dynamics of this stock have in the past been driven by sporadic strong year classes that lead to wide fluctuations in the SSB. In recent years, recruitment has been more stable; this could be attributed to the good state of the spawning stock biomass and favourable high water temperature conditions. At the same time the reduced level of the capelin stock in the Barents Sea leads to increased predation by cod.

Haddock is taken both as a directed fishery and as bycatch in the NEA cod fishery.

Concerns about under-reporting of catches in recent years continue. Unreported landings will reduce the effect of management measures and will undermine the intended objectives of the harvest control rule. It is important that management agencies ensure that all catches are counted against the TAC.

Management plan evaluations

ICES is in the process of evaluating the management plan and the response will be ready by early July 2006.

Factors affecting the fisheries and the stock

Regulations and their effects

The fishery is regulated by quotas. The fishery is also regulated by a minimum landing 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.

The fisheries are controlled by inspections of the trawler fleet at sea, both by a requirement to report to catch control points when entering and leaving the EEZs, and by inspections of all fishing vessels when landing the fish. Keeping a detailed fishing logbook onboard is mandatory for most vessels, and large parts of the fleet report to the authorities on a daily basis. The present catch control and reporting systems are not sufficient to prevent under-reporting of catches and discards, and there are indications that discarding and under-reporting is an increasing problem.

The environment

Variation in the recruitment of haddock has been associated with the changes in the influx of Atlantic waters to the Barents Sea. Water temperature at the first and second years of the haddock life cycle is an indicator of year class strength. If mean annual water temperature in the bottom layer during the first two years of haddock life does not exceed 3.75°C (Kola-section), the probability of the appearance of strong year classes is very low, even considering the favourable effects of other factors. Besides, a steep rise or fall of the water temperature shows a marked effect on the abundance of year classes. Nevertheless, water temperature is not always a decisive factor in the formation of year-class abundance.

Haddock can vary their diet and act as both predator and plankton-eater or benthos-eater. During 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, i.e. young herring or euphausiids and benthos, which are predominant in the haddock diet throughout a year. Density-dependent growth has been observed for this stock.

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

Similar to cod, annual consumption of haddock by marine mammals, mostly seals and whales, depends on the stock size of capelin which is their main prey. In years when the capelin stock is large, the importance of haddock in the diet of marine mammals is minimal, while under a reduced capelin stock a considerable increase is observed in the consumption of haddock by marine mammals. So far this has not been considered in the assessment.

Scientific basis

Data and methods

This year there was a major revision of the data used in the assessment. An estimate of the under-reporting of catches was also added for the last four years. This resulted in a different perception of the stock, and until this difference is explained, the assessment was used to indicate trends in the stock only.

Uncertainties in assessment

None of the surveys have a complete coverage of the stock. The proportion of a year class being outside the coverage varies between year classes. There are unreported landings in the order of 35% of the TAC in 2005. The level of discarding is not known. Discarding is known to be a (varying) problem in the longline fisheries. It is related to the abundance of haddock close to, but below the minimum landing size. Year effects in a survey are quite common. The predictions of year classes are uncertain. The survival due to predation (to a large extent by cod) varies substantially from year to year. The uncertainty in the estimates caused by sampling can be considerable for some age groups in some years even if the total catch is known.

Comparison with previous assessment and advice

This year's assessment shows considerable changes in total biomass, spawning biomass, and fishing mortality in comparison with assessments of previous years, due to the revision of biological data, a small redefinition of the stock and a revision of the catch data, and could therefore not be used as a basis for advice.

Last year's advice was based on precautionary reference points. This year's advice includes also unreported landings and is based on catch in relation to perceived stock dynamics.

Source of information

Report of the Arctic Fisheries Working Group, 19–28 April 2006 (ICES CM 2006/ACFM:25).

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	Official landings[1]	ACFM landings[1,4]	Norwegian landings in statistical areas 06 and 07
1987	No increase in F; TAC	160	250	151	152	3
1988	No increase in F	<240	240	92	91	4
1989	Large reduction in F	69	83	55	54	5
1990	No directed fishery	-	25	26	24	3
1991	No directed fishery	-	28	34	33	3
1992	Within safe biological limits	35[2]	63	54	54	6
1993	No long-term gains in increasing F	56[2]	72	78	77	6
1994	No long-term gains in F>$\mathbf{F}_{med}$	97[3]	120	121	129	6
1995	No long-term gains in F>$\mathbf{F}_{med}$	122[3]	130	128	137	5
1996	No long-term gains in F>$\mathbf{F}_{med}$	169[3]	170	172	173	5
1997	Well below $\mathbf{F}_{med}$	<242	210	140	148	6
1998	Below $\mathbf{F}_{med}$	<120	130	94	94	6
1999	Reduce F below $\mathbf{F}_{pa}$	<74	78	82	77	6
2000	Reduce F below $\mathbf{F}_{pa}$	<37	62	61	64	5
2001	Reduce F below $\mathbf{F}_{pa}$	<66	85	82	85	5
2002	Reduce F below $\mathbf{F}_{pa}$	<64	85	84	110	7
2003	Reduce F below $\mathbf{F}_{pa}$	< 101	101	97	130	4
2004	Reduce F below $\mathbf{F}_{pa}$	< 120	130	116	151	4
2005	Reduce F below $\mathbf{F}_{pa}$	<106	117	114	149	5
2006	Reduce F below $\mathbf{F}_{pa}$	<112	120			
2007	Limit catches	<130				

Weights in '000 t. [1] Haddock in Norwegian statistical areas 06 and 07 is not included. [2]Predicted catch at *status quo* F. [3]Predicted landings at $\mathbf{F}_{med}$. [4]Unreported landings in 2002–2005 are included.

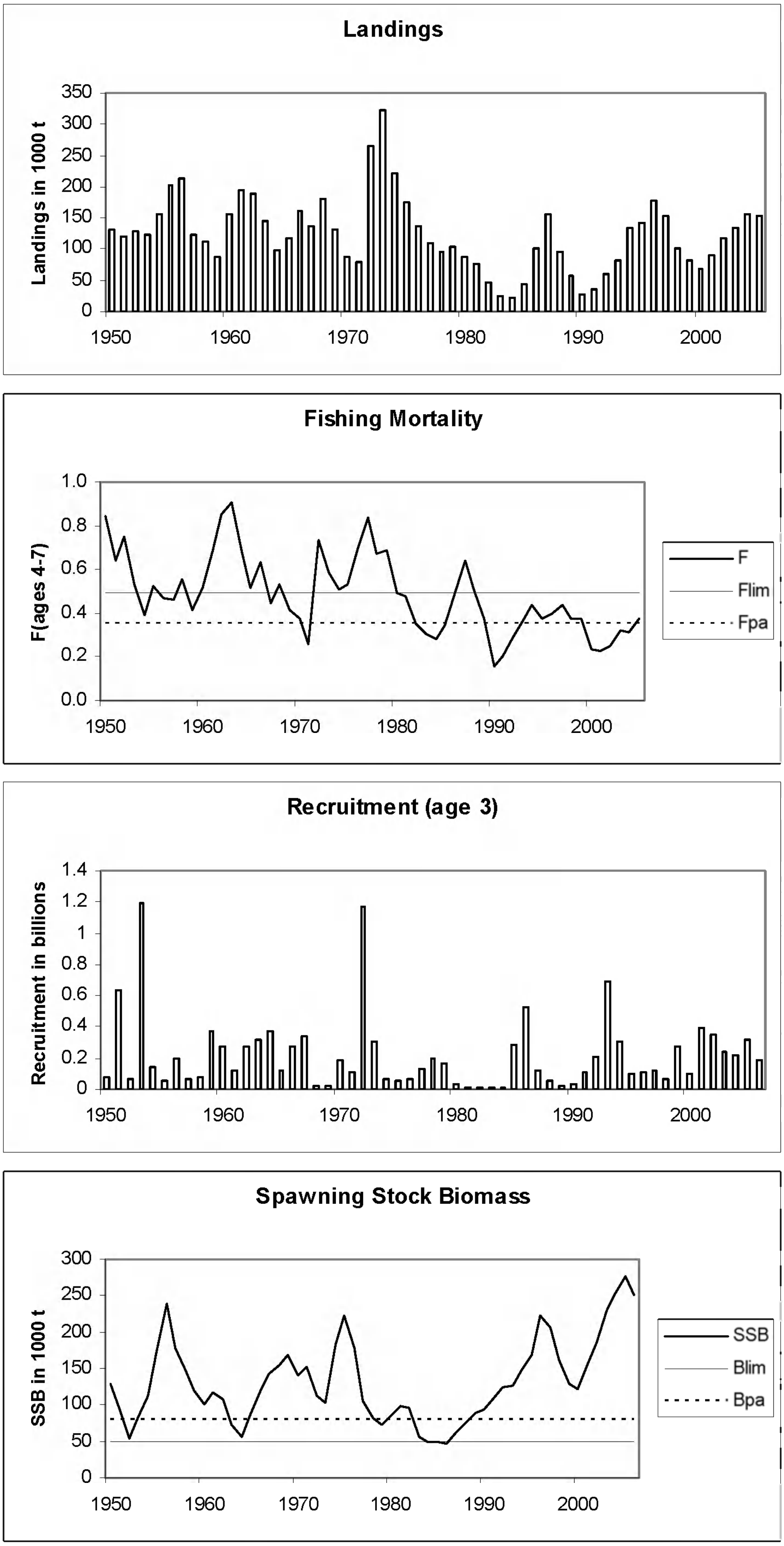


Figure 3.4.3.1 Northeast Arctic haddock (Subareas I and II). Landings, fishing mortality, recruitment and SSB.

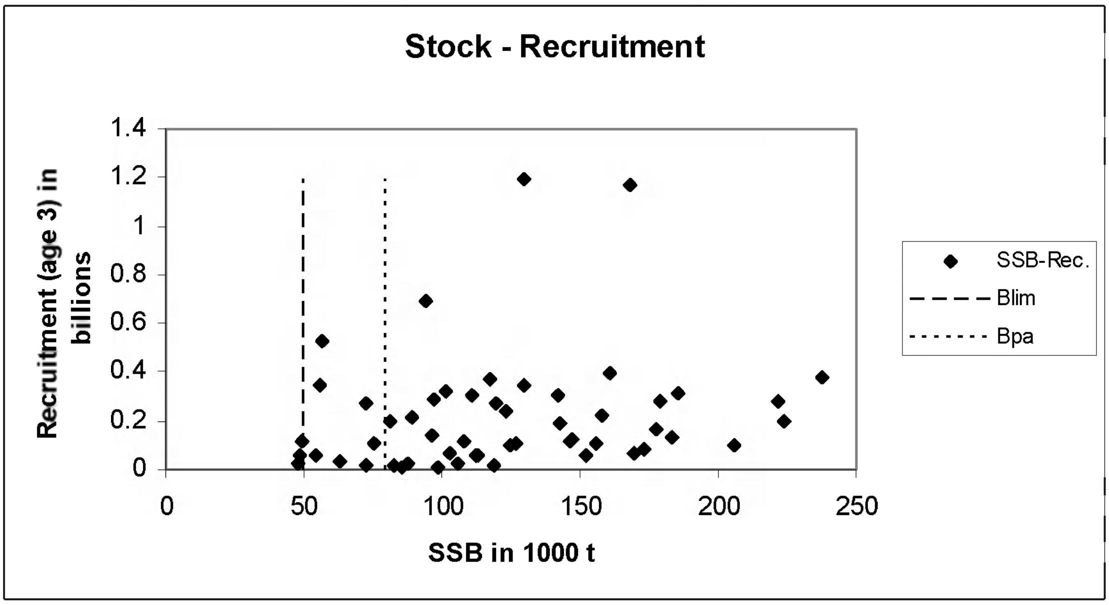


Figure 3.4.3.2 Northeast Arctic haddock (Subareas I and II). Recruitment.

Table 3.4.3.1 Northeast Arctic haddock (Subareas I and II).

Year	Landings tonnes
1950	132125
1951	120077
1952	127660
1953	123920
1954	156788
1955	202286
1956	213924
1957	123583
1958	112672
1959	88211
1960	154651
1961	193224
1962	187408
1963	146224
1964	99158
1965	118578
1966	161778
1967	136397
1968	181726
1969	130820
1970	88257
1971	78905
1972	266153
1973	322226
1974	221157
1975	175758
1976	137264
1977	110158
1978	95422
1979	103623
1980	87889
1981	77153
1982	46955
1983	24600
1984	20945
1985	45052
1986	100563
1987	154916
1988	95255
1989	58518
1990	27182
1991	36216
1992	59922
1993	82379
1994	135186
1995	142448
1996	178128
1997	154359
1998	100630
1999	83195
2000	68944
2001	89640
2002	116800
2003	134649
2004	154975
2005	154116
Average	123942

3.4.4 Northeast Arctic saithe (Subareas I and II)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Fishing mortality in relation to agreed target	Comment
Full reproductive capacity	Harvested sustainably	Appropriate (see comment)	No agreed target	In relation to the highest yield, the current fishing mortality is just above $\mathbf{F}_{0.1}$, i.e. the lowest fishing mortality that would lead to high long-term yields.

Based on the most recent estimates of SSB, ICES classifies the stock as having full reproductive capacity. Based on the most recent estimates of fishing mortality, ICES classifies the stock to be harvested sustainably. Fishing mortality is stable and has since 1996 been below $\mathbf{F}_{pa}$. The SSB has since 1994 been well above $\mathbf{B}_{pa}$. After a long period of low stock size, the stock recovered during the 1990s with the recruitment of several above-average year classes.

Management objectives

The Norwegian Directorate of Fishery has proposed a management strategy for Northeast Arctic saithe which has not, as yet, been adopted:

- At spawning stock levels above the precautionary approach level ($\mathbf{B}_{pa}$ = 220 000 tonnes), the TAC is based on the average of the TACs that a fishing mortality of 0.30 for reference ages 4-7 years would imply over the next three years.
- The TAC should not be changed by more than +/-10% from year to year.
- If the spawning stock falls below $\mathbf{B}_{pa}$ the procedure for establishing TAC should be based on a fishing mortality that is linearly reduced from 0.30 at $\mathbf{B}_{pa}$ to F=0 at SSB equal to zero. At such low SSB-levels there should be no limitation on the year-to-year variation in TAC.

ICES has not yet evaluated whether the proposed management strategy is in accordance with the Precautionary Approach.

Reference points

The reference points were recalculated at the 2005 WG using the standard approaches for the determination of reference points within ICES, taking into account the changes in the age groups used in the calculation of fishing mortality ($\mathbf{F}_{bar}$). The reference points, derived using standard ICES approach, are provided below.

	ICES considers that:	ICES proposed that:
Precautionary Approach reference points (revised in 2005)	$\mathbf{B}_{lim}$ is 136 000 t.	$\mathbf{B}_{pa}$ is set at 220 000 t.
	$\mathbf{F}_{lim}$ is 0.58.	$\mathbf{F}_{pa}$ be set at 0.35.

Technical basis

$\mathbf{B}_{lim}$ = change point regression.	$\mathbf{B}_{pa} = \mathbf{B}_{lim}$ * exp(1.645*σ), where σ=0.3.
$\mathbf{F}_{lim}$ = F corresponding to an equilibrium stock = $\mathbf{B}_{lim}$.	$\mathbf{F}_{pa} = \mathbf{F}_{lim}$ * exp(-1.645*σ), where σ=0.3. This value is considered to have a 95% probability of avoiding the $\mathbf{F}_{lim}$.
	$\mathbf{F}_y$: not defined.

Yield and spawning biomass per Recruit
F-reference points:

	Fish Mort Ages 4–7	Yield/R	SSB/R
Average Current	0.17	0.81	3.63
$\mathbf{F}_{max}$	0.32	0.85	2.05
$\mathbf{F}_{0.1}$	0.14	0.77	4.28
$\mathbf{F}_{med}$	0.40	0.85	1.62

Candidates for reference points that are consistent with taking high long-term yields and achieving a low risk of depleting the productive potential of the stock may be identified in the range of $\mathbf{F}_{0.1}$– $\mathbf{F}_{pa}$.

Single-stock exploitation boundaries

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

The current estimated fishing mortality (0.19) is just above the lowest fishing mortality that would lead to high long-term yields ($\mathbf{F}_{0.1}$ =0.14).

Exploitation boundaries in relation to proposed management plans

The proposed management plan implies a TAC of 194 000 t in 2007.

Exploitation boundaries in relation to precautionary limits

In the absence of an agreed management plan which has been evaluated to be in agreement with the Precautionary Approach, ICES proposes that in order to harvest the stock within precautionary limits, fishing mortality should be kept below $\mathbf{F}_{pa}$. This corresponds to landings of less than 247 000 t in 2007.

Short-term implications

Outlook for 2007

Basis: F(2006) =0.24; SSB(2006) = 650; catch (2006) = 193.5, SSB(2007)=604
The maximum fishing mortality, which would be in accordance with precautionary limits (F (precautionary limits)) is 0.35.

Rationale	TAC (2007)	Basis[1]	F (2007)	SSB (2008)	%SSB change [2)]	% TAC change [3)]
Zero catch	0	F=0	0	738	22	
Status quo	135	$\mathbf{F}_{sq}$	0.17	608	1	-30
High long-term yield	111	$\mathbf{F}_{0.1}$	0.14	631	5	-43
Proposed management plan	194	TAC(man. plan)	0.26	551	-9	0
Precautionary limits	29	$\mathbf{F}_{pa}$ * 0.1	0.035	709	17	-85
	71	$\mathbf{F}_{pa}$ * 0.25	0.0875	669	11	-63
	136	$\mathbf{F}_{pa}$ * 0.5	0.175	607	0	-30
	194	$\mathbf{F}_{pa}$ * 0.75	0.2625	551	-9	0
	227	$\mathbf{F}_{pa}$ * 0.90	0.315	520	-14	17
	247	$\mathbf{F}_{pa}$	0.35	501	-17	28

Weights in '000 t.
[1)] It is assumed that the TAC will be implemented and that the landings in 2006 therefore correspond to the TAC.
[2)] SSB 2008 relative to SSB 2007.
[3)] TAC 2007 relative to TAC 2006.

Management considerations

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 relatively less amounts being taken by purse seiners after 1990.

Discarding does occur when trawlers targeting cod catch saithe without having a quota for saithe. Discarding also occurs in the purse seine fishery. In 2005 the purse seine fleet had problems finding saithe of above minimum landing size, and areas were closed due to a too high percentage of undersized fish in the catches. In the second half of 2005, the minimum landing size was reduced from 42 to 40 cm north of Lofoten (the same size as south of Lofoten). The purse seine fleet was thereby able to target the relatively strong 2002 year class (3-year-olds).

Management plan evaluations

The Norwegian Directorate of Fishery has proposed a management strategy for Northeast Arctic saithe, but ICES has not yet been asked to evaluate the decision rules or whether a management plan based upon them is in accordance with the Precautionary Approach.

Factors affecting the fisheries and the stock

Regulations and their effects

TAC regulations are in place on this stock. Norway and Russia have set national measures applicable to their EEZ. 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 landing size, bycatch regulations, area closures, and other area and seasonal restrictions. Furthermore, sorting grids are used in the trawl fishery.

Changes in fishing technology and fishing patterns

On March 1st 1999, the minimum landing 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 65°30′N, where the minimum landing size remains at 35 cm.

Other considerations

There is a substantial migration of immature saithe to the North Sea from the Norwegian coast between 62ºN and 66ºN. In some years, there are also examples of mass migration from northern Norway to Iceland and, to a lesser extent, to the Faroe Islands.

Scientific basis

Data and methods

The analytical assessment is based on catch-at-age data, an acoustic survey, and CPUE data from one commercial fleet (Norwegian trawl).

Uncertainties in assessment and forecast

There are no estimates of discarding.

There is a tendency to overestimate the fishing mortality and underestimate stock size in the assessment year. The lack of recruitment indices is a major problem in the forecast. Prediction of catches beyond the TAC year will, to a large extent, be dependent on assumptions of average recruitment.

Comparison with previous assessment and advice

In comparison to the 2005 assessment, the total biomass for 2005 is 13% higher and the SSB is 15% higher, while the F in 2004 is now estimated to be 0.17 compared to 0.21 in the last assessment.

The advice is similar to last year.

Source of information

Report of the Arctic Fisheries Working Group, 19–28 April 2006 (ICES CM 2006/ACFM:25).

Year	ICES Advice	Single-stock exploitation boundaries	Predicted catch corresp. to advice	Predicted catch corresp. to single-stock exploitation boundaries	Agreed TAC[2]	Official landings	ACFM 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	122	122
1990	F ≤ $\mathbf{F}_{med}$; TAC		93		103	96	96
1991	F at $\mathbf{F}_{low}$; TAC		90		100	107	107
1992	Within safe biological limits		115		115	128	128
1993	Within safe biological limits		132[1]		132	154	154
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 $\mathbf{F}_{med}$ or below		107		125	144	144
1998	Reduction of F to $\mathbf{F}_{med}$ or below		117		145[3]	153	153
1999	Reduce F below $\mathbf{F}_{pa}$		87		144[4]	150	150
2000	Reduce F below $\mathbf{F}_{pa}$		89		125[5]	136	136
2001	Reduce F below $\mathbf{F}_{pa}$		<115		135	136	136
2002	Maintain F below $\mathbf{F}_{pa}$		< 152		162[6]	155	155
2003	Maintain F below $\mathbf{F}_{pa}$		< 168		164	160	160
2004	Maintain F below $\mathbf{F}_{pa}$		< 186		169	162	162
2005	Take account of *Sebastes marinus* bycatch	Maintain F below $\mathbf{F}_{pa}$		< 215	215	176	176
2006	Take account of *Sebastes marinus* bycatch	Maintain F below $\mathbf{F}_{pa}$		< 202	193.5		
2007	Maintain F below $\mathbf{F}_{pa}$	Maintain F below $\mathbf{F}_{pa}$		< 247			

Weights in '000 t.

[1] Predicted catch at *status quo* F. [2] Set by Norwegian authorities. [3] TAC first set at 125 000 t, increased in May 1998 after an inter-sessional assessment. [4] TAC set after an inter-sessional assessment in December 1998. [5] TAC set after an inter-sessional assessment in December 1999. [6] TAC first set at 152 000 t, increased in June 2003 after the spring 2002 AFWG assessment.

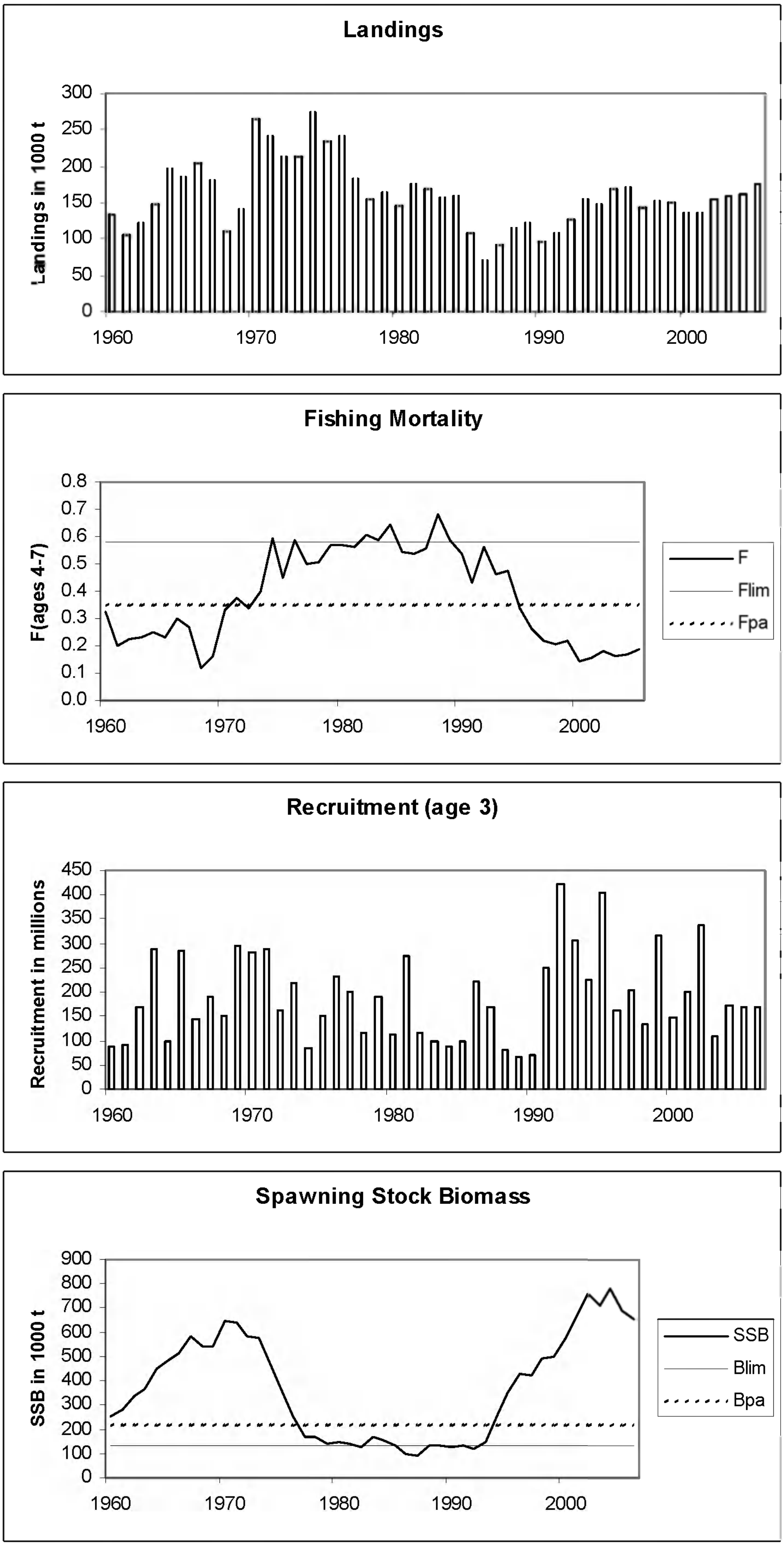
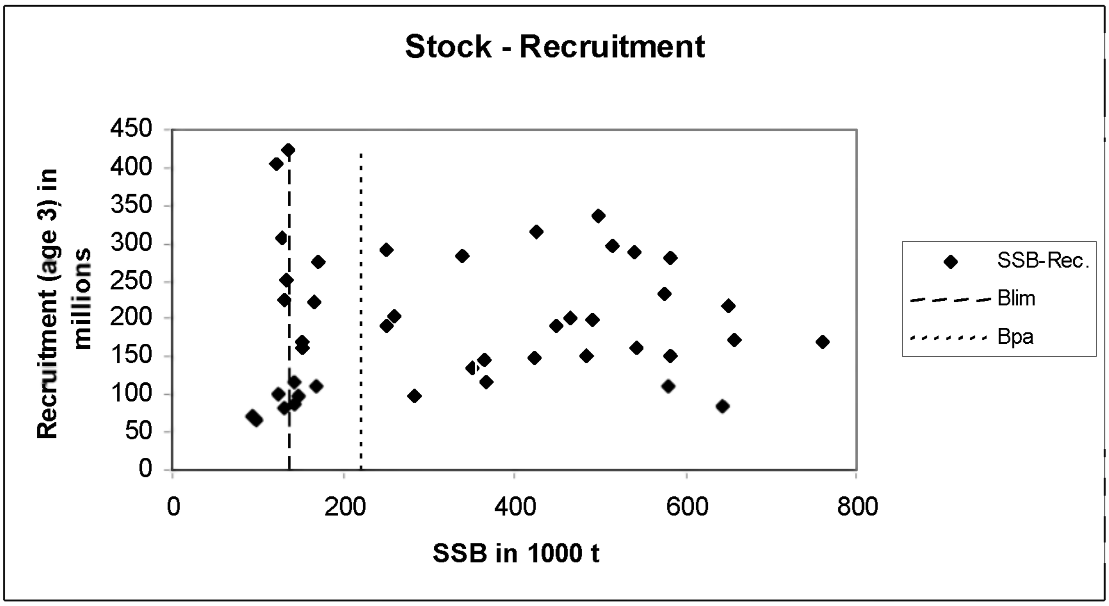
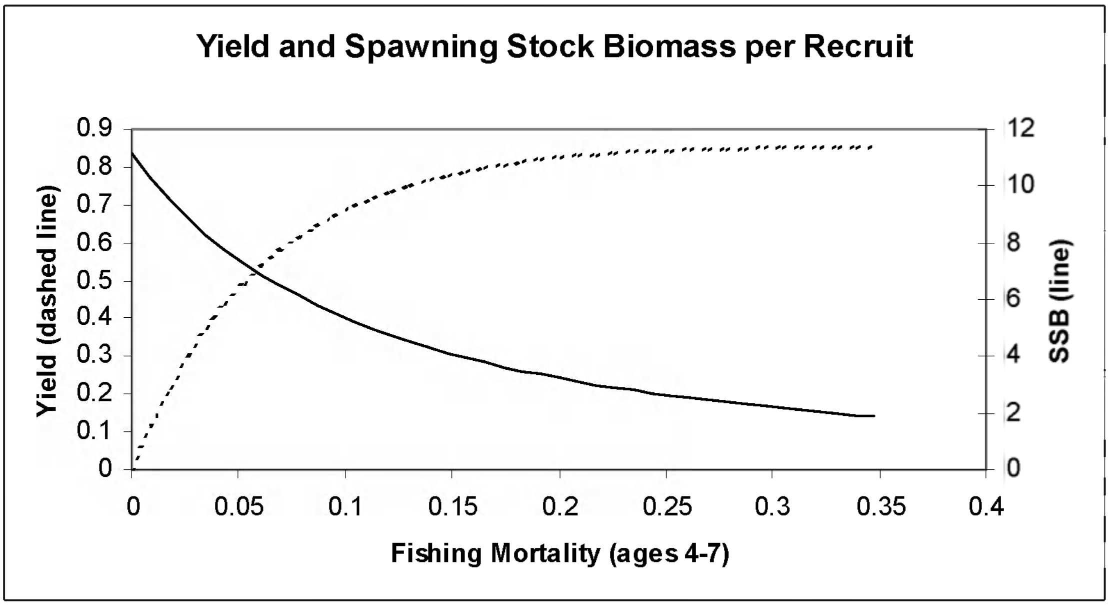


Figure 3.4.4.1 Northeast Arctic saithe (Subareas I and II). Landings, fishing mortality, recruitment and SSB.





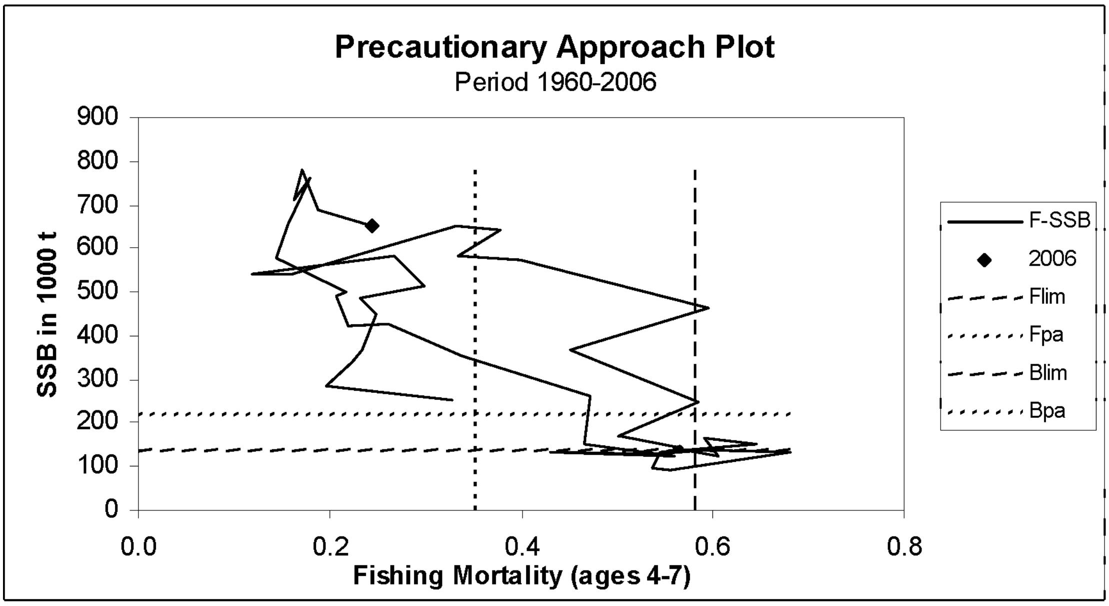


Figure 3.4.4.2 Northeast Arctic saithe (Subareas I and II). Stock and recruitment; Yield and SSB per recruit.

Table 3.4.4.1 Northeast Arctic saithe. Nominal catch (t) by countries as officially reported to ICES. (Subarea I and Divisions IIa and IIb combined.)

Year	Faroe Islands	France	Germany Dem.Rep	Fed.Rep. Germany	Norway	Poland	Portugal	Russia[3]	Spain	UK (England & Wales)	UK (Scotland)	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	20	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	5	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	2	-	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	221	-	264,924
1971	215	14,536	16,840	12,204	128,499	6,017	-	39,397	13,097	10,361	106	-	241,272
1972	109	14,519	7,474	24,595	143,775	1,111	-	1,278	13,125	8,223	125	-	214,334
1973	7	11,320	12,015	30,338	148,789	23	-	2,411	2,115	6,593	248	-	213,859
1974	46	7,119	29,466	33,155	152,699	2,521	-	38,931	7,075	3,001	103	5	274,121
1975	28	3,156	28,517	41,260	122,598	3,860	6,430	13,389	11,397	2,623	140	55	233,453
1976	20	5,609	10,266	49,056	131,675	3,164	7,233	9,013	21,661	4,651	73	47	242,468
1977	270	5,658	7,164	19,985	139,705	1	783	989	1,327	6,853	82	-	182,817
1978	809	4,345	6,484	18,190	121,069	35	203	381	121	2,790	37	-	154,464
1979	1,117	2,601	2,435	14,823	141,346	-	-	3	685	1,170	-	-	164,180
1980	532	1,016	-	12,511	128,878	-	-	43	780	794	-	-	144,554
1981	236	194	-	8,431	166,139	-	-	121	-	395	-	-	175,516
1982	339	82	-	7,224	159,643	-	-	14	-	731	1	-	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	66,152	-	-	27	-	54	21	-	70,458
1987	712	576	-	4,909	85,710	-	-	426	-	54	3	1	92,391
1988	441	411	-	4,574	108,244	-	-	130	-	436	6	-	114,242
1989	388	460 [2]	-	606	119,625	-	-	23	506	-	702	-	122,310
1990	1,207	340 [2]	-	1,143	92,397	-	-	52	-	681	28	-	95,848
1991	963	77 [2]	**Greenland**	2,003	103,283	-	-	504 [4]	-	449	42	5	107,326
1992	165	1,890 [2]	734	3,451	119,765	-	-	964	6	516	25	-	127,516
1993	31	566 [2]	78	3,687	139,288	-	1	9,509	4	408	7	5	153,584
1994	67	151 [2]	15	1,863	141,589	-	1	1,640	655	548	9	6	146,544
1995	172 [2]	358 [2]	53	935	165 001	-	5	1 148	-	589	99	18	168 378
1996	248 [2]	346 [2]	165 [2]	2 615	166 045	-	24	1 159	6 [2]	691 [2]	16	33 [2]	171 348
1997	193 [2]	560	363 [2]	2 915	136 927	-	12	1 774	41 [2]	676	123	45	143 629
1998	366 [2]	932	437 [2]	2 936	144 103	-	47 [2]	3 836	275 [2]	334	21	40 [2]	153 327
1999	181 [2]	638 [2]	655 [2]	2 473	141 941	-	17 [2]	3 929	24 [2]	336	3	178 [2]	150 375
2000	224 [2]	1438 [2]	651 [2]	2 573 [6]	125 950	-	46	4 452	117 [2]	445	9	40 [2]	135 945
2001	519	1279	701	2 690	125 495	-	75	4 951	119	352	162	59 [2]	136 402
2002	520 [2]	1048	1138 [2]	2 642 [6]	143 840	-	118	5 402	37 [2]	345	75	81 [2]	155 246
2003	561 [2]	848	929 [2]	2 763 [6]	150 244	-	143	3 893	13 [2]	265		98 [2]	159 757
2004	708 [2]	188 [2]	891 [2]	2 161 [6]	147 933	-	105	9 192	87	522	21	323 [2]	162 140
2005 [1]	1192 [2]	348 [2]	817 [2]	2 048 [6]	162 001	-	343	8 362	24	629		365 [2]	176 129

[1] Provisional figures.
[2] As reported to Norwegian authorities.
[3] USSR prior to 1991.
[4] Includes Estonia.
[5] Includes Denmark,Netherlands, Iceland, Ireland and Sweden
[6] As reported by Working Group members

Table 3.4.4.2 Northeast Arctic saithe (Subareas I and II).

Year	Recruitment Age 3 thousands	SSB tonnes	Landings tonnes	Mean F Ages 4-7
1960	88173	250637	133515	0.3276
1961	92920	283486	105951	0.1971
1962	170143	338725	120707	0.2228
1963	289935	365249	148627	0.2334
1964	97186	449676	197426	0.2487
1965	283653	484948	185600	0.2310
1966	144689	513916	203788	0.2983
1967	190738	581740	181326	0.2679
1968	150801	541059	110247	0.1193
1969	296371	543703	140060	0.1606
1970	280751	649873	264924	0.3330
1971	287484	642603	241272	0.3776
1972	161777	583002	214334	0.3346
1973	217484	575498	213859	0.3986
1974	83523	465234	274121	0.5961
1975	149692	367034	233453	0.4519
1976	231999	250078	242486	0.5855
1977	201094	168167	182817	0.5019
1978	117719	171143	154464	0.5040
1979	190763	142893	164180	0.5672
1980	111633	148286	144554	0.5666
1981	275151	142763	175516	0.5602
1982	115586	124375	168034	0.6061
1983	98957	165979	156936	0.5905
1984	86434	151690	158786	0.6460
1985	99373	131929	107183	0.5446
1986	221602	97579	70458	0.5374
1987	169535	93998	92391	0.5562
1988	81658	133130	114242	0.6801
1989	67246	136767	122310	0.5905
1990	71879	127727	95848	0.5400
1991	251043	130969	107326	0.4293
1992	422639	122006	127516	0.5597
1993	306582	151110	153584	0.4653
1994	225795	260787	146544	0.4731
1995	404569	351815	168378	0.3393
1996	162515	425935	171348	0.2615
1997	203444	424027	143629	0.2184
1998	134109	491781	153327	0.2078
1999	315131	499094	150373	0.2173
2000	147297	578960	135945	0.1445
2001	198813	658172	136402	0.1568
2002	336619	760063	155246	0.1800
2003	110396	709834	159757	0.1629
2004	171136	781759	162140	0.1712
2005	168937[1]	689993	176129	0.1879
2006	168937[1]	650829		0.2439
Average	188381	372554	160153	0.3786

[1] Geometric mean of 1960–2004.

3.4.5 Redfish (*Sebastes mentella*) in Subareas I and II

Table 3.4.5.1 REDFISH (*S. mentella* and *S. marinus*) in Subareas I and II. Nominal catch (t) by countries in Subarea I, Divisions IIa and IIb combined as officially reported to ICES.

Year	Canada	Denmark	Faroe Islands	France	Germany[4]	Greenland	Iceland	Ireland	Netherlands	Norway	Poland	Portugal	Russia[5]	Spain	UK (E&W)	UK (Scot.)	Total
1984	-	-	-	2,970	7,457	-	-	-	-	18,650	-	1,806	69,689	25	716	-	101,313
1985	-	-	-	3,326	6,566	-	-	-	-	20,456	-	2,056	59,943	38	167	-	92,552
1986	-	-	29	2,719	4,884	-	-	-	-	23,255	-	1,591	20,694	-	129	14	53,315
1987	-	+	450[3]	1,611	5,829	-	-	-	-	18,051	-	1,175	7,215	25	230	9	34,595
1988	-	-	973	3,349	2,355	-	-	-	-	24,662	-	500	9,139	26	468	2	41,494
1989	-	-	338	1,849	4,245	-	-	-	-	25,295	-	340	14,344	5[2]	271	1	46,688
1990	-	37[3]	386	1,821	6,741	-	-	-	-	34,090	-	830	18,918	-	333	-	63,156
1991	-	23	639	791	981	-	-	-	-	49,463	-	166	15,354	1	336	13	67,768
1992	-	9	58	1,301	530	614	-	-	-	23,451	-	977	4,335	16	479	3	31,773
1993	8[3]	4	152	921	685	15	-	-	-	18,319	-	1,040	7,573	65	734	1	29,517
1994	-	28	26	771	1026	6	4	3	-	21,466	-	985	6,220	34	259	13	30,841
1995	-	-	30	748	692	7	1	5	1	16,162	-	936	6,985	67	252	13	25,899
1996	-	-	42[3]	746	618	37	-	2	-	21,675	-	523	1,641	408	305	121	26,118
1997	-	-	7	1,011	538	39[2]	-	11	-	18,839	1	535	4,556	308	235	29	26,109
1998	-	-	98	567	231	47[3]	-	28	-	26,273	13	131	5,278	228	211	94	33,199
1999	-	-	108	61[3]	430	97	14	10	-	24,634	6	68	4,422	36	247	62	30,195
2000	-	-	67[3]	25	222	51	65	1	-	19,052	2	131	4,631	87		203[6]	24,537
2001	-	-	111[3]	46	436	34	3	5	-	23,071	5	186	4,738	91	Estonia	239[6]	28,965
2002	-	-	135[3]	89	141	49	44	4	-	10,713	8[3]	276	4,736	193[2]	15	234[6]	16,637
2003	Sw	-	173[3]	31	154	44[3]	9	5[3]	89	8,091[1]	7	50	1,431	47	-	258[6]	10,389
2004	1	-	64[3]	17[3]	78	24[3]	40	3	33	7,658[1]	42	240	3,601	260	-	146[6]	12,206
2005[1]	-	-	241[3]	46[3]	106	75[3]	25	4[3]	55	8,385	-	170	5,637	171	5	147[6]	15,068

[1] Provisional figures.
[2] Working Group figure.
[3] As reported to Norwegian authorities.
[4] Includes former GDR prior to 1991.
[5] USSR prior to 1991.
[6] UK(E&W)+UK(Scot.)

3.4.5.a *Sebastes mentella* in Subareas I and II

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
Reduced reproductive capacity	Unknown	Unknown	Recruitment failure since 1991.

In the absence of defined reference points the state of the stock cannot be fully evaluated. The only year classes that can contribute to the spawning stock are those prior to 1991 as the following 15 year classes are extremely poor. Surveys indicate that the stock, at present, is near a historical low. The 1991–2005 year classes are indicated to be well below those of the 1980s (see Figure 3.4.5.1).

Management objectives

There are no management objectives.

Reference points

No precautionary reference points have been established for this stock.

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits

The measures introduced in 2003 should be continued, i.e. there should be no directed trawl fishery on this stock and the area closures and low bycatch limits should be retained until a significant increase in the spawning stock biomass (and a subsequent increase in the number of juveniles) has been detected in the surveys. In addition, measures to prevent high bycatches in the pelagic trawl fisheries for blue whiting, herring, and mackerel in the Norwegian Sea seem necessary. An important contribution to rebuild the stock is also the agreement to reduce the maximum bycatch of redfish in the shrimp fishery from 10 to 3 specimens per 10 kilograms of shrimp from 2006 onwards.

Management considerations

Recruitment failure has been observed in surveys for more than a decade. In this regard, it is of vital importance that the juvenile age groups be given the strongest protection from being caught as bycatch in any fishery, e.g., the shrimp fisheries in the Barents Sea and Svalbard area. This will ensure that the recruiting year classes can contribute as much as possible to stock rebuilding.

The only year classes that can contribute to the spawning stock are those prior to 1991 as the following year classes are extremely poor. Consequently, these year classes need to be protected as they offer the only opportunity of increasing the spawning stock for a number of years to come. This should include the pelagic fisheries in the Norwegian Sea.

Based on estimates of current SSB and the size of year classes in the 1990s, this stock will not be able to support a directed fishery for several more years at least. Rather, it will be necessary to prevent the stock from declining further and to maintain measures to protect this stock from bycatch in other fisheries.

Factors affecting the fisheries and the stock

Regulations and their effects

Since January 1st 2003, all directed trawl fisheries for *S. mentella* have been forbidden in the Norwegian EEZ north of 62°N and in the Svalbard area. Additional protection for adult *S. mentella* comprises area closures. Outside permanently closed areas it is, however, legal to have up to 20% redfish (both species together) in round weight as bycatch per haul and onboard at any time when fishing for other species. Since January 1st, 2005, the bycatch percentage has been reduced to 15% (both species together). ICES considers this value to be appropriate only if it reflects the lowest rate of unavoidable redfish bycatch.

ICES considers that the area closures and low bycatch limits should be retained. An important management objective should be to ensure that the recruiting year classes get the highest possible protection (e.g., in the shrimp fishery) so that they can contribute as much as possible to stock rebuilding.

Changes in fishing technology and fishing patterns

Bycatches are taken in gadoid and shrimp-trawl fisheries. After the introduction of sorting grids in 1993, discarding in the shrimp fishery was reduced. Small redfish less than 18–20 cm are, however, not sorted out by the grid, and criteria for the maximum number of redfish per kilogram shrimp are enforced (from 2006 onwards, i.e. 3 juvenile redfish per 10 kg shrimp).

For 2004 and 2005, landings of *S. mentella* taken in the pelagic Russian fishery for herring and blue whiting in the Norwegian Sea were reported to ICES. Of a total Russian catch of 2879 tonnes in 2004 and 5023 tonnes in 2005, 1510 tonnes (52%) and 3299 tonnes (66%), respectively, were reported taken as bycatch in these pelagic fisheries (maximum 49% in each haul). Germany has also annually reported 2–40 tonnes *S. mentella* caught in their pelagic fisheries. The working group believes that similar bycatches of *S. mentella* may have been taken by other national fleets, but then either discarded or put together with the other species into meal production. Better statistics on this bycatch, and regulations to prevent this continuing, are needed.

Other factors

Traditionally, the directed fishery was conducted by Russia and other East-European countries on grounds from south of Bear Island towards Spitsbergen. From the mid-1970s to the mid-1980s, large catches were taken annually. From the mid-1980s, Norwegian trawlers started fishing along the continental slope (around 500-m depth) further south, on grounds never harvested before, and inhabited primarily by mature fish. After a sharp decrease in the landings from the traditional area until 1987, this fishery on new grounds resulted in a temporary increase in the landings until 1991, after which the landings declined. Since 1991, the fishery has been dominated by Norway and Russia. Since January 1st 2003, all directed trawl fisheries for *S. mentella* have been forbidden in the Norwegian EEZ north of 62°N and in the Svalbard area.

Scientific basis

Data and methods

No analytical assessment was possible. Information is based on Norwegian and Russian research vessel surveys carried out since 1980. These surveys provide information on both recruitment and spawning stock biomass.

Uncertainties in assessment and forecast

The signals of the various surveys are in agreement.

Comparison with previous assessment and advice

No change.

Source of information

Report of the Arctic Fisheries Working Group, 19–28 April 2006 (ICES CM 2006/ACFM:25).

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings[1]	ACFM landings of *S. mentella*
1987	Precautionary TAC	70[1]	85	35	11
1988	$F \leq \mathbf{F}_{0.1}$; TAC	11	-	41	16
1989	*Status quo* F; TAC	12	-	47	24
1990	*Status quo* F; TAC	18	-	63	35
1991	F at $\mathbf{F}_{med}$; 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	-	-	12	5
2005	No directed trawl fishery and low bycatch limits	-	-	15	8
2006	No directed trawl fishery and low bycatch limits	-	-		
2007	No directed trawl fishery and low bycatch limits				

Weights in '000 t.

[1] Includes both *S. mentella* and *S. marinus*.

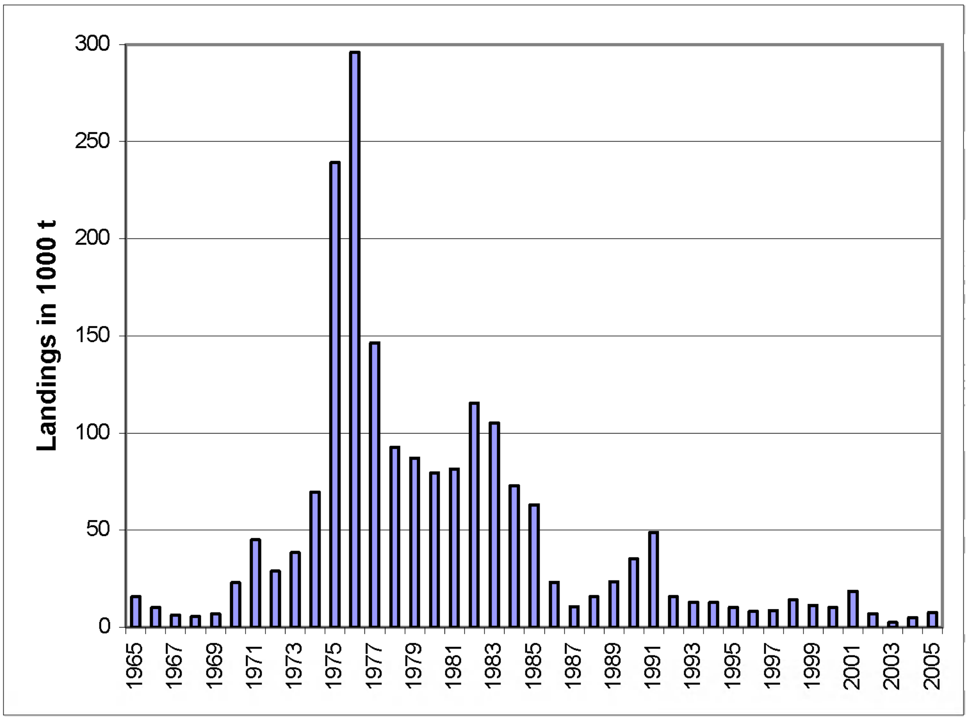


Figure. 3.4.5.1 *Sebastes mentella* in Subareas I and II. Total international landings 1965–2005 (thousand tonnes).

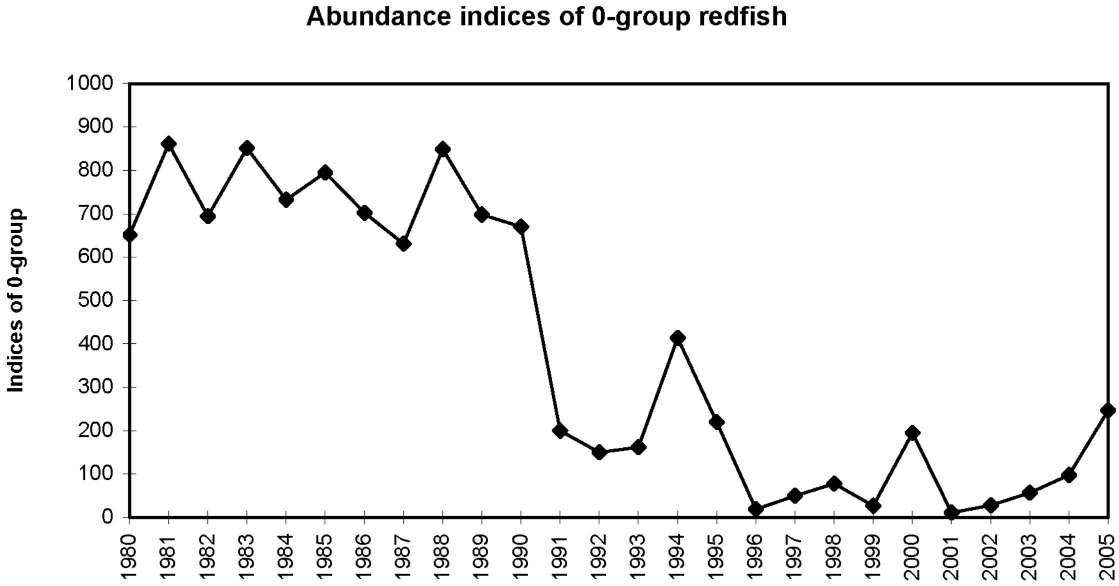


Figure 3.4.5.2 Abundance indices of 0-group redfish (believed to be mostly *S.mentella*) in the international 0-group survey in the Barents Sea and Svalbard areas in August-September 1980-2005. (ref. Table 1.1)

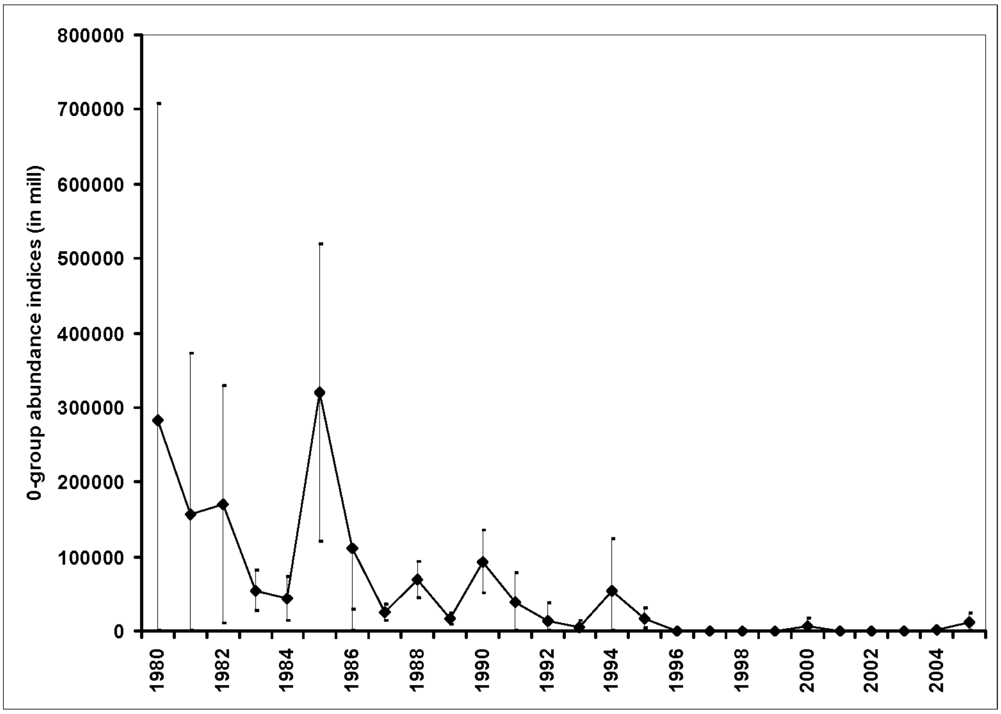


Figure 3.4.5.3 Abundance indices (in millions) with 95% confidence limits of 0-group redfish (believed to be mostly *S.mentella*) in the international 0-group survey in the Barents Sea and Svalbard areas in August-September 1980-2005, as calculated by the new method, and not corrected for catching efficiency. (ref. Table 1.4)

Table 3.4.5.1 *Sebastes mentella*. Nominal catch (t) by countries in Subarea I, Divisions IIa and IIb combined.

Year	Canada	Denmark	Faroe Islands	France	Germany[3]	Greenland	Ireland
1986	-	-	-	-	1,252	-	-
1987	-	-	200	63	1,321	-	-
1988					No species specific data available by country.		
1989	-	-	335	1,111	3,833	-	-
1990	-	-	108	142	6,354	36	-
1991	-	-	487	85	-	23	-
1992	-	-	23	12	-	-	-
1993	8	4	13	50	35	1	-
1994	-	28	4	74	18	1	3
1995	-	-	3	16	176	2	4
1996	-	-	4	75	119	3	2
1997	-	-	4	37	81	16	6
1998	-	-	20	73	100	14	9
1999	**Iceland**	-	73	26	202	50	3
2000	48	**Estonia**	50	12	62	29	1
2001	3	-	74	16	198	17	4
2002	41	15	75	58	99	18	4
2003	5	-	64	22	32	8	5
2004	10	-	52	13	10	4	3
2005[1]	6	5	204	37	33	39	4

Year	Norway	Poland	Portugal	Russia[4]	Spain	UK (Eng. & Wales)	UK (Scotland)	Total
1986	1,274	-	1,273	17,815	-	84	-	23,112[2]
1987	1,488	-	1,175	6,196	25	49	1	10,455
1988					No species specific data available by country.			15,586
1989	4,633	-	340	13,080	5	174	1	23,512
1990	10,173	-	830	17,355	-	72	-	35,070
1991	33,592	-	166	14,302	1	68	3	48,727
1992	10,751	-	972	3,577	14	238	3	15,590
1993	5,182	-	963	6,260	5	293	-	12,814
1994	6,511	-	895	5,021	30	124	12	12,721
1995	2,646	-	927	6,346	67	93	4	10,284
1996	6,053	-	467	925	328	76	23	8,075
1997	4,657	1	474	2,972	272	71	7	8,598
1998	9,733	13	125	3,646	177	93	41	14,045
1999	7,884	6	65	2,731	29	112	28	11,209
2000	6,020	2	115	3,519	87		130[5]	10,075
2001	13,937	5	179	3,775	90		120[5]	18,418
2002	2,152	8	242	3,904	190	**Sweden**	188[5]	6,993
2003	1,214	7	44	952	47	-	124[5]	2,525
2004	1,312	42	235	2,879	257	1	76[5]	4,894
2005[1]	1,781	-	114	5,023	163	**Netherl** -7	95	7,511

[1] Provisional figures.
[2] Including 1,414 tonnes in Division IIb not split on countries.
[3] Includes former GDR prior to 1991.
[4] USSR prior to 1991.
[5] UK(E&W)+UK(Scot.)

Table 3.4.5.2 *Sebastes mentella*. Nominal catch (t) by countries in Subarea I.

Year	Faroe Islands	Germany[4]	Greenland	Norway	Russia[5]	UK(Eng. &Wales)	Iceland	Total
1986[3]	-	-	-	1,274	911	-	-	2,185
1987[3]	-	2	-	1,166	234	3	-	1,405
1988	No species specific data presently available							
1989	13	-	-	60	484	9[2]	-	566
1990	2	-	-	-	100	-	-	102
1991	-	-	-	8	420	-	-	428
1992	-		-	561	408	-	-	969
1993	2[2]	-	-	16	588	-	-	606
1994	2[2]	2	-	36	308	-	-	348
1995	2[2]	-	-	20	203	-	-	225
1996	-	-	-	5	101	-	-	106
1997	-	-	3[2]	12	174	1[2]	-	190
1998	20[2]	-	-	26	378	-	-	424
1999	69[2]	-	-	69	489	-	-	627
2000	-	-	-	47	406	-	48[2]	501
2001	-	-	-	8[1]	296	-	3[2]	307
2002	-	-	-	4[1]	587	-	-	591
2003	-	-	-	6	292	-	-	298
2004	-	-	-	2	355	-	-	357
2005[1]	-	-	-	3	327	-	-	330

[1] Provisional figures.
[2] Split on species according to reports to Norwegian authorities.
[3] Based on preliminary estimates of species breakdown by area.
[4] Includes former GDR prior to 1991.
[5] USSR prior to 1991.

Table 3.4.5.3 *Sebastes mentella.* Nominal catch (t) by countries in Division IIa.

Year	Faroe Islands	France	Germany[4]	Greenland	Ireland	Norway
1986[3]	-	-	1,252	-	-	-
1987[3]	200	63	970	-	-	149
1988	No species specific data presently available					
1989	312[2]	1,065[2]	3,200	-	-	4,573
1990	98[2]	137[2]	1,673	-	-	8,842
1991	487[2]	72[2]	-	-	-	32,810
1992	23[2]	7[2]	-	-	-	9,816
1993	11[2]	15[2]	35	1[2]	-	5,029
1994	2[2]	33[2]	16[2]	1[2]	2[2]	6,119
1995	1[2]	16[2]	176[2]	2[2]	2[2]	2,251
1996	-	75[2]	119[2]	3[2]	-	5,895
1997	-	37[2]	77	12[2]	2[2]	4,422
1998	-	73[2]	58[2]	14[2]	6[2]	9,186
1999	-	16[2]	160[2]	50[2]	3[2]	7,358
2000	50[2]	11[2]	35[2]	29[2]	-	5,892
2001	63[2]	12[2]	161[2]	17[2]	4[2]	13,636
2002	37[2]	54[2]	59[2]	18[2]	4[2]	1,937
2003	58[2]	18[2]	17[2]	8[2]	5[2]	1,017
2004	17[2]	8[2]	4[2]	4[2]	3[2]	1,028
2005[1]	18[2]	32[2]	17[2]	38[2]	4[2]	1,103

Year	Sweden	Portugal	Russia[5]	Spain	UK (Eng.& Wales)	UK (Scotland)	Total
1986[3]		1,273	16,904	-	84	-	19,513
1987[3]		1,156	4,469	-	34	1	7,042
1988	No species specific data presently available						
1989		251	9,749	-	158[2]	1[2]	19,309
1990		824	6,492	-	9	-	18,075
1991		159[2]	7,596	-	23[2]	-	41,147
1992		824[2]	1,096	-	27[2]	-	11,793
1993		648[2]	5,328	-	2[2]	-	11,069
1994		687[2]	4,692	8[2]	4[2]	-	11,564
1995		715[2]	5,916	65[2]	41[2]	2[2]	9,187
1996		429[2]	677	5[2]	42[2]	19[2]	7,264
1997		410[2]	2,341	9[2]	48[2]	7[2]	7,365
1998		118[2]	2,626	55[2]	65[2]	41[2]	12,242
1999		56[2]	1,340	14[2]	94[2]	26[2]	9,117
2000		98[2]	2,167	18[2]	Iceland	103[2, 6]	8,403
2001		105[2]	2,716	18[2]	-	95[2, 6]	16,827
2002		124[2]	2,615	8[2]	41[2]	157[2, 6]	5,055
2003		17[2]	448	8[2]	5[2]	102[2, 6]	1,704
2004	1[2]	86[2]	2,081	7[2]	10[2]	18[2, 6]	3,268
2005[1]	-	71[2]	3,307	20[2]	4[2]	15[2, 6]	4,629

[1] Provisional figures.
[2] Split on species according to reports to Norwegian authorities.
[3] Based on preliminary estimates of species breakdown by area.
[4] Includes former GDR prior to 1991.
[5] USSR prior to 1991.
[6]UK(E&W)+UK(Scot.)

Table 3.4.5.4 *Sebastes mentella.* Nominal catch (t) by countries in Division IIb.

Year	Canada	Denmark	Faroe Islands	France	Germany[5]	Greenland	Ireland
1986[4]	Data not available on countries						
1987[4]	-	-	-	-	349	-	-
1988	No species specific data presently available						
1989	-	-	10	28	633	-	-
1990	-	-	8[2]	5[2]	4,681	36[2]	-
1991	-	-	-	13[2]	-	23	-
1992	-	-	-	5[2]	-	-	-
1993	8[2]	4[2]	-	35[2]	-	-	-
1994	-	28[2]	-	41[2]	-	-	1[2]
1995	-	-	-	-	-	-	2[2]
1996	-	-	4[2]	-	-	-	2[2]
1997	-	-	4[2]	-	3	1[2]	4[2]
1998	-	-	-	-	42[2]	-	3[2]
1999	-	-	4[2]	10[2]	42[2]	-	-
2000	-	-	-	1[2]	27[2]	-	1[2]
2001	-	-	11[2]	4[2]	37[2]	-	-
2002	-	-	38[2]	4[2]	40[2]	-	-
2003	-	-	6[2]	4[2]	15[2]	-	-
2004	-	-	35[2]	5[2]	6[2]	-	-
2005[1]	**Netherl** -7	-	186[2]	5[2]	17[2]	1[2]	-

Year	Norway	Poland	Portugal	Russia[6]	Spain	UK(Eng. & Wales)	UK (Scotland)	Total
1986[4]	Data not available on countries							1,414
1987[4]	173	-	19	1,493	25	12	-	2,071
1988	No species specific data presently available							
1989	-	-	89	2,847	5	7[2]	-	3,619
1990	1,331	-	6	10,763	-	63[2]	-	16,893
1991	774	-	7	6,286	1	45[2]	3[2]	7,152
1992	374	-	148[2]	2,073	14	211[2]	3[2]	2,828
1993	137	-	315[2]	344	57[3]	291[2]	-	1,191
1994	356	-	208[2]	21	22[3]	120[2]	12[2]	809
1995	375	-	212[2]	227	2[3]	52[2]	2[2]	872
1996	153	-	38[2]	147	323[2]	34[2]	4[2]	705
1997	223	1[2]	64[2]	457	263[2]	22[2]	-	1,042
1998	521	13[2]	7[2]	642	122[2]	28[2]	1[2]	1,379
1999	457	6[2]	9[2]	902	15[2]	18[2]	2[2]	1,465
2000	82	2[2]	17[2]	946	69[2]		27[2,7]	1,172
2001	293	5[2]	74[2]	763	72[2]	Estonia	25[2,7]	1,284
2002	210	8[2]	118[2]	702	182[2]	15[8]	31[2,7]	1,348
2003	191	7	27[2]	212	39[2]	-	22[2,7]	523
2004	282	42[2]	149[2]	443	250[2]	-	58[2,7]	1,270
2005[1]	675	-	43[2]	1,389	143[2]	5	80[2,7]	2,553

[1] Provisional figures.
[2] Split on species according to reports to Norwegian authorities.
[3] Split on species according to the 1992 catches.
[4] Based on preliminary estimates of species breakdown by area.
[5] Includes former GDR prior to 1991.
[6] USSR prior to 1991.
[7] UK(E&W)+UK(Scot.)
[8] Split on species by Working Group.

3.4.6 Redfish (*Sebastes marinus*) in Subareas I and II

State of the stock

In the absence of defined reference points the state of the stock cannot be fully evaluated. Surveys and commercial CPUE show a substantial reduction in abundance and indicate that the stock at present is historically low. The year classes in the last decade have been very low and declining. Presently, this stock is in a very poor condition. Given the low productivity of this species, this situation is expected to remain for a considerable period.

Management objectives

There are no management objectives.

Reference points

There are no reference points.

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits

There should be no directed fishery and any bycatch in other fisheries should be kept as low as possible. ICES considers that the area closures should remain.

Management considerations

More stringent protective measures should be implemented, such as no directed fishing and extension of the limited moratorium, as well as a further improvement of the trawl bycatch regulations.

It is also of vital importance that the juvenile age groups be given the strongest protection from being caught as bycatch in any fishery, e.g. the shrimp fisheries in the coastal areas as well as in the Barents Sea and Svalbard area. This will ensure that the recruiting year classes can contribute as much as possible to slowing the decline of the stock.

S. marinus is currently being caught in a directed fishery and as bycatch in the pelagic trawl fisheries for herring and blue whiting in the Norwegian Sea. Better statistics on this bycatch, and regulations to prevent this continuing, are needed.

Factors affecting the fisheries and the stock

Regulations and their effects

Since January 1st 2003, all directed trawl fisheries for *S. marinus* have been forbidden in the Norwegian EEZ north of 62°N and in the Svalbard area.

Since January 1st 2005 it has , however, been legal to have up to 15% redfish (both species together) in round weight as bycatch per haul and onboard at any time when trawling for other species. ICES considers this value to be appropriate only if it reflects the lowest rate of unavoidable redfish bycatch.

A minimum legal landing size of 32 cm has been set for all Norwegian fisheries and international fisheries in the Norwegian EEZ, with an allowance to have up to 10% undersized (i.e., less than 32 cm) specimens of *S. marinus* (in numbers) per haul. In addition, closed seasons 1April–31 May and 1–30 September has been introduced in all fisheries except for trawling. When fishing for other species (also during the closed season), it is allowed to have up to 15% bycatch of redfish (in round weight) of the total catch during a week fishery from Monday to Sunday. From January 2006, it will be forbidden to use gillnets with mesh size less than 120 mm when fishing for redfish.

The closed seasons enforced in 2004 and 2005 seem to have reduced the gillnet catches by about 1000 t, while the catches taken by other gears have not decreased compared to the last three years. Unfortunately, this overall decrease is insufficient for preventing a further reduction in this stock.

Other factors

The fishery is mainly conducted by Norway, accounting for 80–90% of the historical total catch. The fish are caught mainly by trawl (at present only as bycatch) and gillnet, and to a lesser extent by long line, Danish seine, and handline, in that order. Some of the catches are taken in mixed fisheries together with saithe and cod. Important fishing grounds are the Møre area (Svinøy), Halten Bank, outside Lofoten and Vesterålen, and at Sleppen outside Finnmark.

Scientific basis

Data and methods

Information is based on Norwegian and Russian research vessel surveys carried out since 1986 as well as from CPUE (kg per trawl hour) from Norwegian trawlers since 1992.

An exploratory assessment was conducted using a simulation model covering the period 1986–2005. Input data to the model were two fishing fleets (gillnet and other gears) with catch in tonnes, by length and age on a quarterly basis, and the annual Barents Sea joint bottom trawl survey with catch in numbers by length and age. Work on that model is continuing.

Comparison with previous assessment and advice

All present available information confirms last year's evaluation of the stock status.

Source of information

Report of the Arctic Fisheries Working Group, 19–28 April 2006 (ICES CM 2006/ACFM:25).

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings[1]	ACFM 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	-	-	12	7
2005	More stringent protective measures	-	-	15	8
2006	More stringent protective measures	-	-		
2007	More stringent protective measures	-	-		

Weights in '000 t. [1]Includes both *S. mentella* and *S. marinus*.

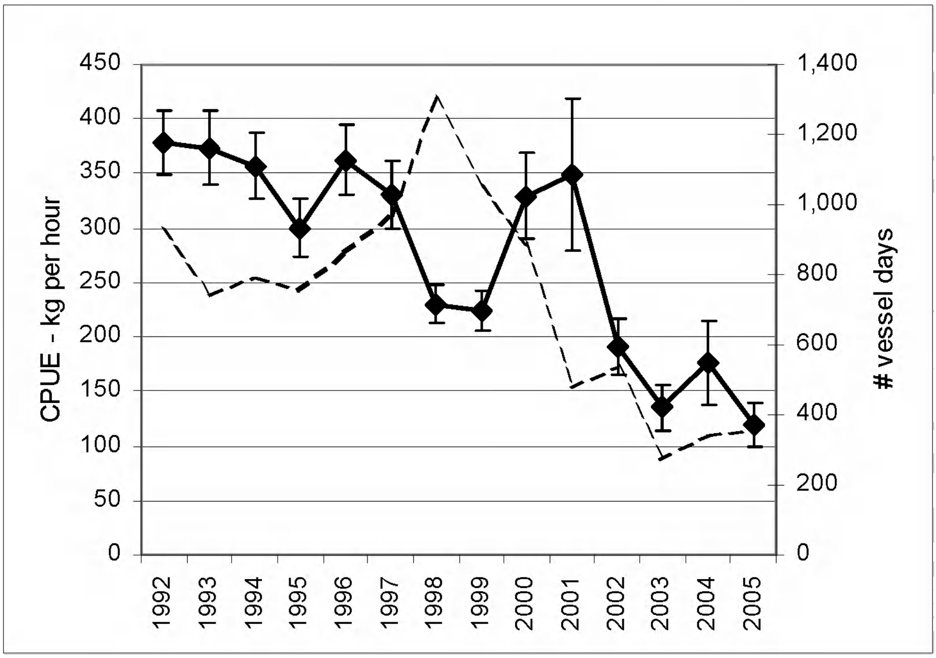


Figure 3.4.6.1 *Sebastes marinus*. Plot of simple mean CPUEs with 2 st. errors from the Norwegian trawl fishery, and numbers of vessel days (stippled curve) meeting the criterium of minimum 10% *S. marinus* in the catch per day. The figure is an illustration of the data given in Table D11.

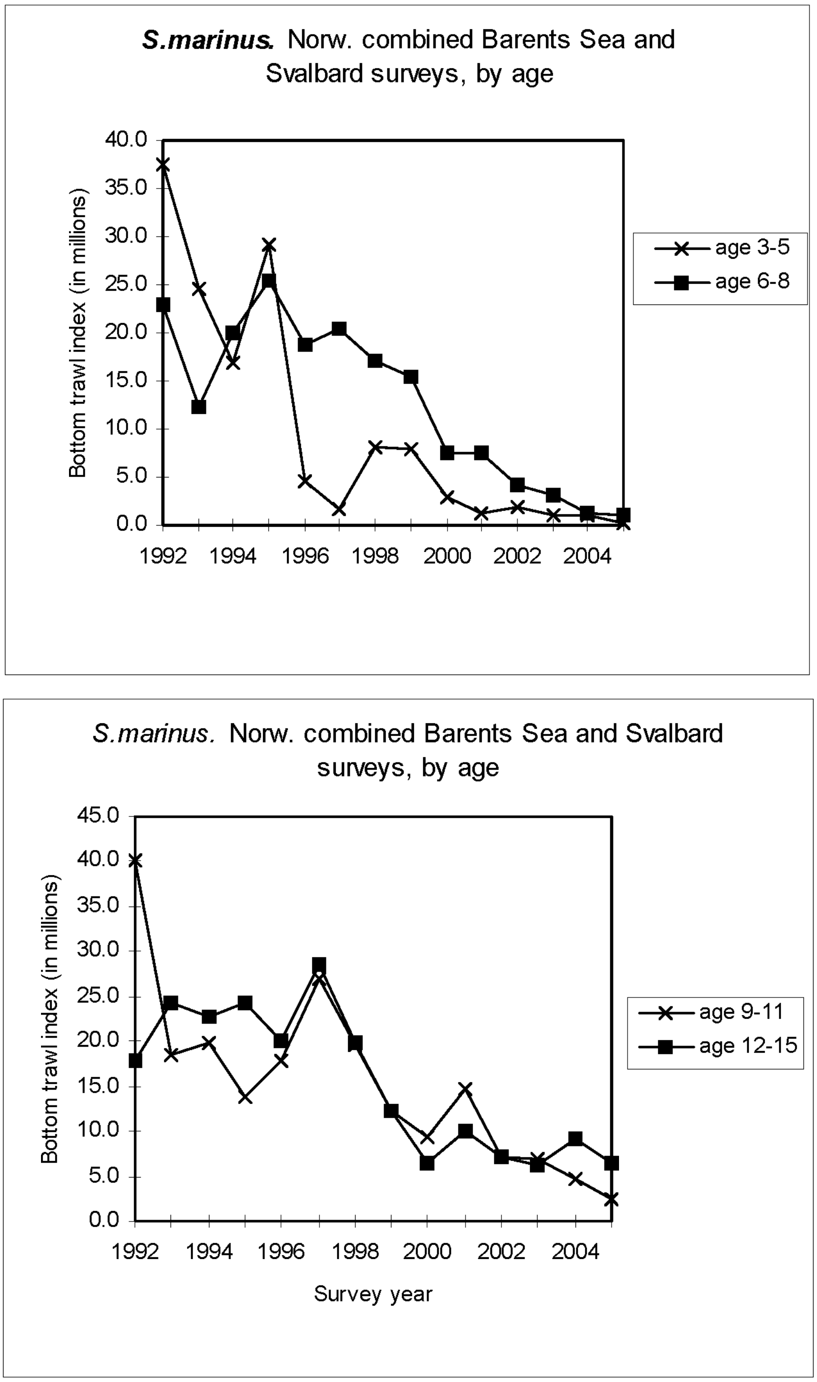


Figure 3.4.6.2 *Sebastes marinus.* Abundance indices (by age) when combining the Norwegian bottom trawl surveys 1992-2005 in the Barents Sea (winter) and at Svalbard (summer/fall).

Table 3.4.6.1 *Sebastes marinus*. Nominal catch (t) by countries in Sub-area I and Divisions IIa and IIb combined.

YEAR	FAROE ISLANDS	FRANCE	GERMANY[2]	GREENLAND	ICELAND	IRELAND	NETHERLANDS
1986	29	2,719	3,369	-	-	-	-
1987	250	1,553	4,508	-	-	-	-
1988	No species specific data presently available on countries						
1989	3	796	412	-	-	-	-
1990	278	1,679	387	1	-	-	-
1991	152	706	981	-	-	-	-
1992	35	1,289	530	623	-	-	-
1993	139	871	650	14	-	-	-
1994	22	697	1,008	5	4	-	-
1995	27	732	517	5	1	1	1
1996	38	671	499	34	-	-	-
1997	3	974	457	23	-	5	-
1998	78	494	131	33	-	19	-
1999	35	35	228	47	14	7	-
2000	17	13	160	22	16	-	-
2001	37	30	238	17	-	1	-
2002	60	31	42	31	3	-	-
2003	109	8	122	36	4	-	89
2004	12	4	68	20	30	-	33
2005[1]	37	9	72	36	19	-	48
Year	Norway	Portugal	Russia[3]	Spain	UK (Eng. & Wales)	UK (Scotl)	Total
1986	21,680	-	2,350	-	42	14	30,203
1987	16,728	-	850	-	181	7	24,077
1988	No species specific data presently available on countries						25,908
1989	20,662	-	1,264	-	97	-	23,234
1990	23,917	-	1,549	-	261	-	28,072
1991	15,872	-	1.052	-	268	10	19,041
1992	12,700	5	758	2	241	2	16,185
1993	13,137	77	1,313	8	441	1	16,651
1994	14,955	90	1,199	4	135	1	18,120
1995	13,516	9	639	-	159	9	15,616
1996	15,622	55	716	81	229	98	18,043
1997	14,182	61	1,584	36	164	22	17,511
1998	16,540	6	1,632	51	118	53	19,155
1999	16,750	3	1,691	7	135	34	18,986
2000	13,032	16	1,112	-		73[4]	14,461
2001	9,134	7	963	1		119[4]	10,547
2002	8,561	34	832	3		46[4]	9,643
2003	6,877[1]	6	479	-		134[4]	7,864
2004	6,346[1]	5	722	3		69[4]	7,312
2005[1]	6,605	56	614	8		52[4]	7,557

1 Provisional figures.

2 Includes former GDR prior to 1991.

3 USSR prior to 1991.

4UK(E&W)+UK(Scot.)

Table 3.4.6.2 ***Sebastes marinus.*** **Nominal catch (t) by countries in Sub-area I.**

Year	Faroe Islands	Germany[4]	Greenland	Iceland	Norway	Russia[5]	UK(Eng&Wales)	UK(Scotl)	Total
1986[3]	-	50	-	-	2,972	155	32	3	3,212
1987[3]	-	8	-	-	2,013	50	11	-	2,082
1988	No species specific data presently available								
1989	-	-	-	-	1,763	110	4[2]	-	1,877
1990	5	-	-	-	1,263	14	-	-	1,282
1991	-	-	-	-	1,993	92	-	-	2,085
1992	-	-	-	-	2,162	174	-	-	2,336
1993	24[2]	-	-	-	1,178	330	-	-	1,532
1994	12[2]	72	-	4	1,607	109		-	1,804
1995	19[2]	1[2]	-	1[2]	1,947	201	1[2]	-	2,170
1996	7[2]	-	-	-	2,245	131	3[2]	-	2,386
1997	3[2]	-	5[2]	-	2,431	160	2[2]	-	2,601
1998	78[2]	5[2]	-	-	2,109	308	30[2]	-	2,530
1999	35[2]	18[2]	9[2]	14[2]	2,114	360	11[2]	-	2,561
2000	-	1[2]	-	16[2]	1,983	146		12[6]	2,159
2001	4	11[2]	-	-	1,053	128	France	16[6]	1,212
2002	15	5[2]	-	-	693	220	1[2]	9[2,6]	943
2003	15	-	1	-	818[1]	140	-	4[2,6]	978
2004	-	-	-	-	1,178[1]	213	-	12[2,6]	1,403
2005[1]	-	-	-	-	1,551	61	1[2]	4[2,6]	1,617

1 Provisional figures.
2 Split on species according to reports to Norwegian authorities.
3 Based on preliminary estimates of species breakdown by area.
4 Includes former GDR prior to 1991.
5 USSR prior to 1991.
6UK(E&W)+UK(Scot.)

Table 3.4.6.3 *Sebastes marinus*. Nominal catch (t) by countries in Division IIa.

Year	Faroe Islands	France	Germany[4]	Greenland	Ireland	Netherlands	Norway	Portugal	Russia[5]	Spain	UK (Eng. & Wales)	UK (Scotl.)	Total
1986[3]	29	2,719	3,319	-	-	-	18,708	-	2,195	-	10	11	26,991
1987[3]	250	1,553	2,967	-	-	-	14,715	-	800	-	170	7	20,462
1988	No species specific data presently available												
1989	3[2]	784[2]	412	-	-	-	18,833	-	912	-	93[2]	-	21,037
1990	273	1,684[2]	387	-	-	-	22,444	-	392	-	261	-	25,441
1991	152[2]	706[2]	678	-	-	-	13,835	-	534	-	268[2]	10[2]	16,183
1992	35[2]	1,294[2]	211	614	-	-	10,536	-	404	-	206[2]	2[2]	13,302
1993	115[2]	871[2]	473	14[2]	-	-	11,959	77[2]	940	-	431[2]	1[2]	14,881
1994	10[2]	697[2]	654[2]	5[2]	-	-	13,330	90[2]	1,030	-	129[2]	-	15,945
1995	8[2]	732[2]	328[2]	5[2]	1[2]	1	11,466	2[2]	405	-	158[2]	9[2]	13,115
1996	27[2]	671[2]	448[2]	34[2]	-	-	13,329	51[2]	449	5[2]	223[2]	98[2]	15,335
1997	-	974[2]	438	18[2]	5[2]	-	11,708	61[2]	1,199	36[2]	162[2]	22[2]	14,623
1998	-	494[2]	116[2]	33[2]	19[2]	-	14,326	6[2]	1,078	51[2]	85[2]	52[2]	16,260
1999	-	35[2]	210[2]	38[2]	7[2]	-	14,598	3[2]	976	7[2]	122[2]	34[2]	16,030
2000	17[2]	13[2]	159[2]	22[2]	-	-	11,038	16[2]	658	-		61[6]	11,984
2001	33[2]	30[2]	227[2]	17[2]	1[2]	-	8,002	6[2]	612	1[2]	Iceland	103[2, 6]	9,031
2002	45[2]	30[2]	37[2]	31[2]	-	-	7,761	18[2]	192	2[2]	3[2]	32[2, 6]	8,151
2003	94[2]	9[2]	122[2]	35[2]	-	89[2]	5,991[1]	6[2]	264		4[2]	130[2, 6]	6,743
2004	12[2]	4[2]	68[2]	20[2]	-	33[2]	5,077[1]	5[2]	396	3[2]	30[2]	58[2, 6]	5,705
2005[1]	37[2]	9[2]	60[2]	36[2]	-	48[2]	4,831	56[2]	265	8[2]	19[2]	48[2,6]	5,416

1 Provisional figures.
2 Split on species according to reports to Norwegian authorities.
3 Based on preliminary estimates of species breakdown by area.
4 Includes former GDR prior to 1991.
5 USSR prior to 1991.
6UK(E&W)+UK(Scot.)

Table 3.4.6.4 *Sebastes marinus*. Nominal catch (t) by countries in Division IIb.

Year	Faroe Islands	Germany[5]	Greenland	Norway	Portugal	Russia[6]	Spain	UK(Eng. & Wales)	UK (Scotl.)	Total
1986	-									+
1987[4]	-	1533	-	-	-	-	-	-	-	1533
1988		No species specific data presently available								
1989	-	-	-	66	-	242	-	-	-	308
1990	-	-	1[2]	210	-	1157	-	-	-	1368
1991	-	303	-	44	-	426	-	-	-	773
1992	-	319	9[2]	2	5[2]	180	2	35[2]	-	552
1993	-	177	-	-	-	43	8[3]	10[2]	-	238
1994	-	282	-	18	-	60	4[3]	6[2]	1[2]	371
1995	-	187	-	103	7	33	-	-	-	330
1996	4	51[2]	-	27	5	136	76[2]	3[2]	-	302
1997	-	20	-	43	-	225	-	-	-	288
1998	-	10[2]	-	105	-	246	-	3[2]	-	364
1999	-	-	-	38	-	355	-	2[2]	-	395
2000	-	-	-	10	-	308	-	-	-	318
2001	-	-	-	79	1[2]	223	-	-	-	303
2002	-	-	-	107	16[2]	420	1[2]		5[2, 7]	549
2003	-	-	-	68[1]	-	75	-		-	143
2004	-	-	-	91[1]	-	113	-		-	204
2005[1]	-	13[2]	-	223	-	288	-		-	523

1 Provisional figures.
2 Split on species according to reports to Norwegian authorities.
3 Split on species according to the 1992 catches.
4 Based on preliminary estimates of species breakdown by area.
5 Includes former GDR prior to 1991.
6 USSR prior to 1991.
7UK(E&W)+UK(Scot.)

3.4.7 Greenland halibut in Subareas I and II

State of the stock

In the absence of defined reference points the status of the stock cannot be fully evaluated. The tentative assessment indicates that SSB has been low since the late 1980s, but a slight increase is indicated in recent years. There are indications of a decreasing trend in fishing mortality since the 1990s. Recruitment has been stable at a low level since the 1980s.

Management objectives

No explicit management objectives have been established for this stock.

Reference points

No precautionary reference points have been established for this stock. Due to problems in age readings, it is not possible to estimate fishing mortality reference points in absolute terms.

Single-stock exploitation boundaries

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

There is no estimate of high yield reference points.

Exploitation boundaries in relation to precautionary limits

The stock has remained at a relatively low size in the last 25 years at catch levels of 15 000–25 000 t. In order to increase the SSB, catches should be kept well below that range. Catches for 2007 should be below 13 000 t as advised in 2005; this is the level below which SSB has increased in the past.

Management considerations

The stock has been at a low level for several years and it is a long-lived species, which can only sustain low exploitation. Indications are that the stock has increased in recent years both in a tentative assessment and in fishery-independent surveys. During this period, catches in that fishery have been around 13 000 t. Given the state of the stock and the paucity of information, the fishery should not be above 13 000 t until there is better information and firm evidence of a larger stock size.

Russia and the Norway could each catch up to 1500 t of Greenland halibut for research and surveillance purposes in 2002. This research quota has been increased in 2006 to 4500 t for each country, as compared to the advised maximum catch of 13 000 t. ICES cannot see the scientific need for research quotas of this magnitude.

Factors affecting the fisheries and the stock

Regulations and their effects

Since 1992, directed fishery has only been allowed by small coastal vessels fishing with longlines and gillnets. Bycatches of Greenland halibut in the trawl fisheries have been limited by rules on permissible bycatch per haul and allowable bycatch limit onboard the vessel. This regulation was changed in 2004. The regulation now refers to the catch proportions onboard a vessel, not the proportions in the catches. This allows the targeting of Greenland halibut, once cod fishing has ceased during a trip.

The regulations enforced in 1992 reduced the total landings of Greenland halibut by trawlers from 20 000 t to about 6000 t. Since then and until 1998 because of the change in allowable bycatch, annual trawler landings have varied between 5000 and 8000 t without any clear trend. The increase of trawler landings in 1999 and again in 2004 may be a result of less restrictive bycatch regulations. Landings of Greenland halibut from the directed longline and gillnet fisheries have also increased in recent years to well above the level of 2500 t set by the Norwegian authorities. This is attributed to the increased difficulties of regulating a fishery that only lasts for a few weeks.

Environment

Greenland halibut occur over a wide range of depths (from 20 to 2200 m) and temperatures (from –1.5 °C to 10°C). Young Greenland halibut occur mostly in the northeastern Barents Sea (Svalbard and further east to Franz Josef Land) where the presence of adult Greenland halibut or other predators appears to be minimal.

Scientific basis

Data and methods

An analytical assessment was based on commercial catch-at-age data, two survey series, and one commercial CPUE series.

Uncertainties in assessment and forecast

The assessment is uncertain due to age-reading problems and lack of contrast in the data. The age-reading issue is being addressed and should be resolved in future years, but corrections to past years are required.

Comparison with previous assessment and advice

In comparison to last year's assessment, recent trends are similar.

Source of information

Report of the Arctic Fisheries Working Group, 19–28 April 2006 (ICES CM 2006/ACFM:25).

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings	ACFM 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 $\mathbf{F}_{med}$; 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]		
2007	Reduce catch to increase stock	< 13			

Weights in '000 t.
[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.

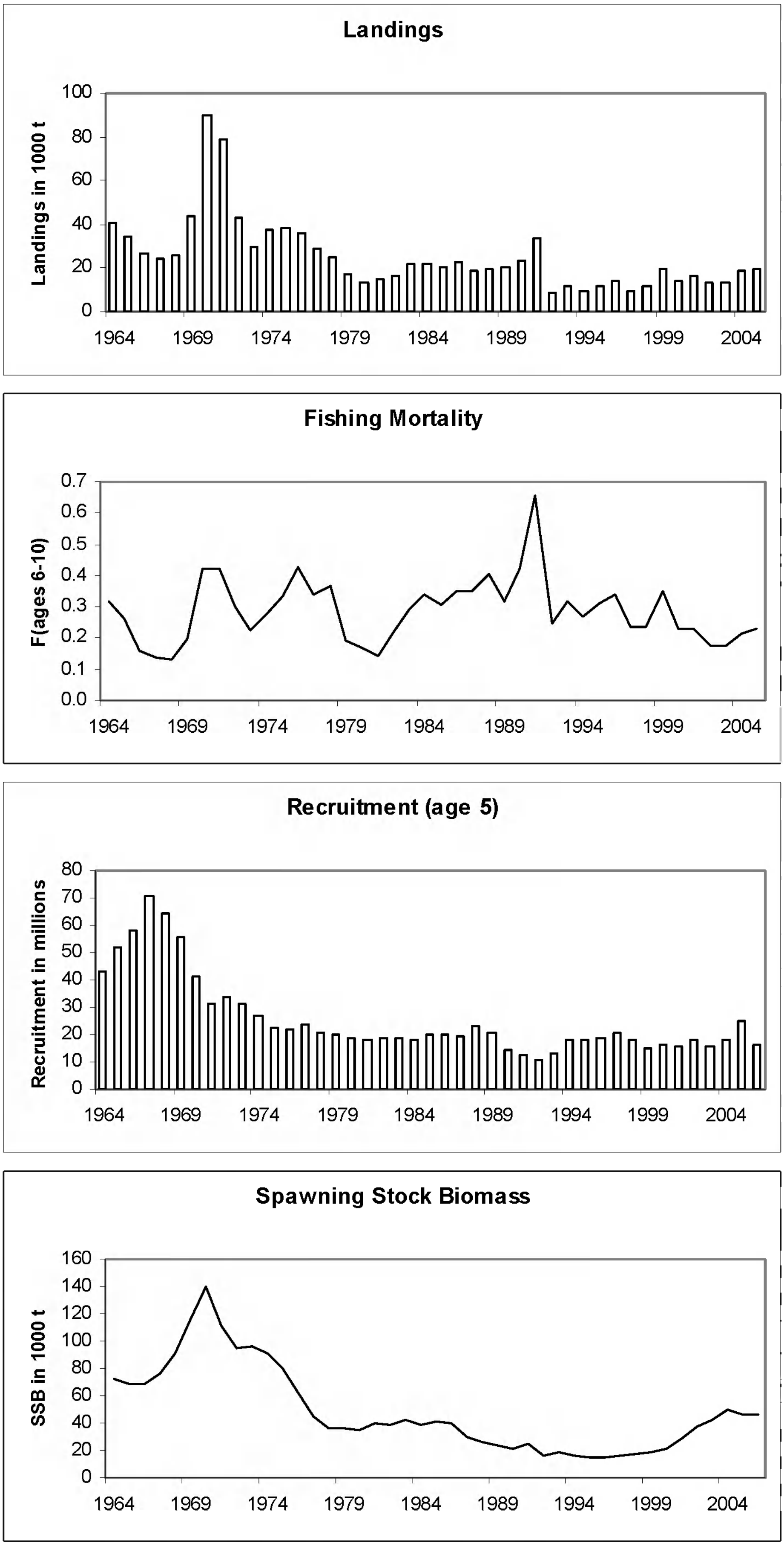


Figure 3.4.7.1 Greenland halibut in Subareas I & II. Landings, fishing mortality, recruitment and SSB.

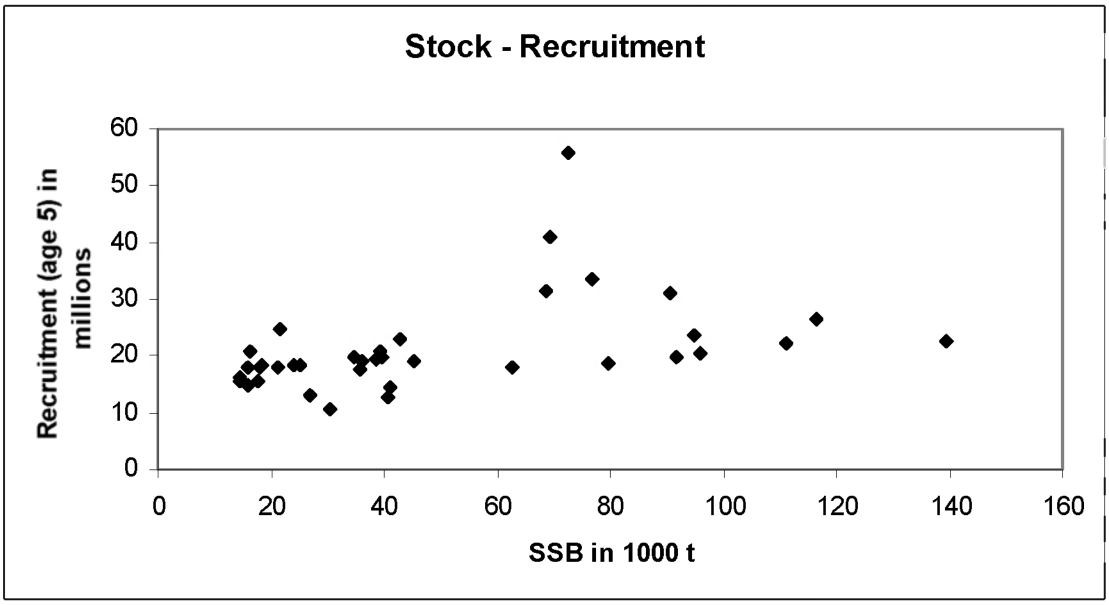


Figure 3.4.7.2 Greenland halibut in Subareas I & II. SSB per recruit.

Table 3.4.7.1 Greenland halibut. Nominal catch (t) by countries (Subarea I, Divisions IIa and IIb combined) as officially reported to ICES.

Year	Denmark	Estonia	Faroe Isl.	France	Germany	Greenland	Iceland	Ireland	Lithuania
1984	0	0	0	138	2,165	0	0	0	0
1985	0	0	0	239	4,000	0	0	0	0
1986	0	0	42	13	2,718	0	0	0	0
1987	0	0	0	13	2,024	0	0	0	0
1988	0	0	186	67	744	0	0	0	0
1989	0	0	67	31	600	0	0	0	0
1990	0	0	163	49	954	0	0	0	0
1991	11	2,564	314	119	101	0	0	0	0
1992	0	0	16	111	13	13	0	0	0
1993	2	0	61	80	22	8	56	0	30
1994	4	0	18	55	296	3	15	5	4
1995	0	0	12	174	35	12	25	2	0
1996	0	0	2	219	81	123	70	0	0
1997	0	0	27	253	56	0	62	2	0
1998	0	0	57	67	34	0	23	2	0
1999	0	0	94	0	34	38	7	2	0
2000[1]	0	0	0	45	15	0	16	0	0
2001[1]	0	0	0	122	58	0	9	1	0
2002[1]	0	219	0	6	42	22	0	0	0
2003[1]	0	0	459	2	18	14	0	1	0
2004	0	0	0	0	9	0	9	0	0
2005	0	170	0	32	8	0	0	0	0

Year	Norway	Poland	Portugal	Russia[3]	Spain	UK (E&W)	UK (Scot.)	Total
1984	4,376	0	0	15,181	0	23	0	21,883
1985	5,464	0	0	10,237	0	5	0	19,945
1986	7,890	0	0	12,200	0	10	2	22,875
1987	7,261	0	0	9,733	0	61	20	19,112
1988	9,076	0	0	9,430	0	82	2	19,587
1989	10,622	0	0	8,812	0	6	0	20,138
1990	17,243	0	0	4,764[2]	0	10	0	23,183
1991	27,587	0	0	2,490[2]	132	0	2	33,320
1992	7,667	0	31	718	23	10	0	8,602
1993	10,380	0	43	1,235	0	16	0	11,933
1994	8,428	0	36	283	1	76	2	9,226
1995	9,368	0	84	794	1,106	115	7	11,734
1996	11,623	0	79	1,576	200	317	57	14,347
1997	7,661	12	50	1,038	157[2]	67	25	9,410
1998	8,435	31	99	2,659	259[2]	182	45	11,893
1999	15,004	8	49	3,823	319[2]	94	45	19,517
2000[1]	9,083	3	37	4,568	375[2]	111	43	14,297
2001[1]	10,896[2]	2	35	4,694	418[2]	100	30	16,365
2002[1]	7,011[2]	5	14	5,584	178[2]	41	28	13,161
2003[1]	8,347[2]	5	19	4,384	230[2]	41	58	13,578
2004	13,840[2]	1	50	4,662	186[2]	43	0	18,800
2005	13,425[2]	0	23	4,883	660[2]	29	18	19,248

[1] Provisional figures.
[2] Working Group figures.
[3] USSR prior to 1991.

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

Year	Estonia	Faroe Islands	Fed. Rep. Germany	Greenland	Iceland	Norway	Poland	Russia[3]	Spain	UK (E & W)	UK (Scot.)	Total
1984	-	-	-	-	-	593	-	81	-	17	-	691
1985	-	-	-	-	-	602	-	122	-	1	-	725
1986	-	-	1	-	-	557	-	615	-	5	1	1,179
1987	-	-	2	-	-	984	-	259	-	10	+	1,255
1988	-	9	4	-	-	978	-	420	-	7	-	1,418
1989	-	-	-	-	-	2,039	-	482	-	+	-	2,521
1990	-	7	-	-	-	1,304	-	321[2]	-	-	-	1,632
1991	164	-	-	-	-	2,029	-	522[2]	-	-	-	2,715
1992	-	-	+	-	-	2,349	-	467	-	-	-	2,816
1993	-	32	-	-	56	1,754	-	867	-	-	-	2,709
1994	-	17	217	-	15	1,165	-	175	-	+	-	1,589
1995	-	12	-	-	25	1,352	-	270	84	-	-	1,743
1996	-	2	+	-	70	911	-	198	-	+	-	1,181
1997	-	15	-	-	62	610	-	170	-[2]	+	-	857
1998	-	47	+	-	23	859	-	491	-[2]	2	-	1,422
1999	-	91	-	13	7	1,101	-	1,203	-[2]	+	-	2,415
2000[1]	-	-	+	-	16	1,021	+	1,169	-[2]	1	-	2,206
2001[1]	-	-	-	-	9	925[2]	+	951	-[2]	2	-	1,887
2002[1]	-	-	3	-	+	791[2]	-	1,167	-[2]	+	-	1,961
2003[1]	-	48	+	2	+	949[2]	1	735	-[2]	+	+	1,736
2004	-	-	-	-	+	812[2]	-	633	-	3	-	1,449
2005	-	-	-	-	-	575[2]	-	595	-	3	-	1,174

[1]Provisional figures.
[2] Working Group figures.
[3] USSR prior to 1991.

Table 3.4.7.3 Greenland halibut. Nominal catch (t) by countries in Division IIa as officially reported to ICES.

Year	Estonia	Faroe Islands	France	Fed. Rep. Germ.	Greenland	Ireland	Norway	Portugal	Russia[5]	Spain	UK (E & W)	UK (Scot.)	Total
1984	-	-	138	265	-	-	3,703	-	5,459	-	1	-	9,566
1985	-	-	239	254	-	-	4,791	-	6,894	-	2	-	12,180
1986	-	6	13	97	-	-	6,389	-	5,553	-	5	1	12,064
1987	-	-	13	75	-	-	5,705	-	4,739	-	44	10	10,586
1988	-	177	67	150	-	-	7,859	-	4,002	-	56	2	12,313
1989	-	67	31	104	-	-	8,050	-	4,964	-	6	-	13,222
1990	-	133	49	12	-	-	8,233	-	1,246[2]	-	1	-	9,674
1991	1,400	314	119	21	-	-	11,189	-	305[2]	-	+	1	13,349
1992	-	16	108	1	13[4]	-	3,586	15[3]	58	-	1	-	3,798
1993	-	29	78	14	8[4]	-	7,977	17	210	-	2	-	8,335
1994	-	-	47	33	3[4]	4	6,382	26	67	+	14	-	6,576
1995	-	-	174	30	12[4]	2	6,354	60	227	-	83	2	6,944
1996	-	-	219	34	123[4]	-	9,508	55	466	4	278	57	10,744
1997	-	-	253	23	-[4]	-	5,702	41	334	1[2]	21	25	6,400
1998	-	-	67	16	-[4]	1	6,661	80	530	5[2]	74	41	7,475
1999	-	-	-	20	25[4]	2	13,064	33	734	1[2]	63	45	13,987
2000[1]	-	-	43	10	-[4]	+	7,536	18	690	1[2]	65	43	8,406
2001[1]	-	-	122	49	-[4]	1	8,740[2]	13	726	5[2]	56	30	9,751
2002[1]	-	-	7	9	22[4]	-	5,780[2]	3	849	-[2]	12	28	6,714
2003[1]	-	390	2	5	12[4]	+	6,778[2]	10	1,762	14[2]	5	58	9,036
2004	-	-	-	4	-[4]	-	11,633[2]	24	810	4[2]	1	-	12,485
2005	-	-	31	3	-[4]	-	11,756[2]	11	1406	+[2]	5	18	13,320

[1]Provisional figures.
[2]Working Group figure.
[3]As reported to Norwegian authorities.
[4]Includes Division IIb.
[5] USSR prior to 1991.

Table 3.4.7.4 Greenland halibut. Nominal catch (t) by countries in Division IIb as officially reported to ICES.

Year	Denmark	Estonia	Faroe Isl.	France	Fed. Rep. Germ.	Ireland	Lithuania	Norway	Poland	Portugal	Russia[4]	Spain	UK (E&W)	UK (Scot.)	Total
1984	-	-	-	-	1,900	-	-	80	-	-	9,641	-	5	-	11,626
1985	-	-	-	-	3,746	-	-	71	-	-	3,221	-	2	-	7,040
1986	-	-	36	-	2,620	-	-	944	-	-	6,032	-	+	-	9,632
1987	+	-	-	-	1,947	-	-	572	-	-	4,735	-	7	10	7,271
1988	-	-	-	-	590	-	-	239	-	-	5,008	-	19	+	5,856
1989	-	-	-	-	496	-	-	533	-	-	3,366	-	-	-	4,395
1990	-	-	23[2]	-	942	-	-	7,706	-	-	3,197[2]	-	9	-	11,877
1991	11	1,000	-	-	80	-	-	14,369	-	-	1,663[2]	132	+	1	17,256
1992	-	-	-	3[2]	12	-	-	1,732	-	16	193	23	9	-	1,988
1993	2[3]	-	-	2[3]	8	-	30[3]	649	-	26	158	-	14	-	889
1994	4	-	1[3]	8[3]	46	1	4[3]	881	-	10	41	1	62	2	1,061
1995	-	-	-	-	5	-	-	1,662	-	24	297	1,022	32	5	3,047
1996	+	-	-	-	47	-	-	1,204	-	24	912	196	39	+	2,422
1997	-	-	12	-	33	2	-	1,349	12	9	534	156[2]	46	+	2,153
1998	-	-	10	-	18	1	-	915	31	19	1,638	254[2]	106	4	2,996
1999	-	-	3	-	14	-	-	839	8	16	1,886	318[2]	31	-	3,115
2000[1]	-	-	-	2	5	-	-	526	3	19	2,709	374[2]	46	-	3,685
2001[1]	-	-	-	-	9	-	-	1,231[2]	2	22	3,017	413[2]	42	-	4,736
2002[1]	-	219	-	-	30	6	-	440[2]	5	11	3,568	178[2]	29	-	4,486
2003[1]	+	+	21	-	13	-	-	620[2]	4	9	1,887	216[2]	35	+	2,805
2004	-	-	-	-	5	-	-	1,395[2]	1	26	3,219	182[2]	39	-	4,866
2005	-	170	-	-	5	-	-	1,094[2]	-	12	2,882	660[2]	21	-	4,844

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

3.4.8 Barents Sea capelin (Subareas I and II, excluding Division IIa west of 5°W)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
Reduced reproductive capacity	Not defined	Not defined	There was no commercial fishery in 2005/06. The fishery is managed according to a target escapement strategy.

Based on the most recent estimates of SSB and recruitment, ICES classifies the stock as having reduced reproductive capacity. The SSB for April 2007 is predicted to be 189 000 t, i.e. below $\mathbf{B}_{\text{lim}}$. The abundance at age 1 (2005 year class) is estimated to be far below the long-term average, and this is the fifth weak year class in a row. Observations during the international 0-group survey in August–September 2006 indicated that the size of the 2006 year class is twice as high as the long-term mean.

Management objectives

The fishery is managed according to a target escapement strategy, with a harvest control rule allowing (with 95% probability) the SSB to be above the proposed $\mathbf{B}_{\text{lim}}$, taking predation by cod into account. ICES considers the management plans to be consistent with the precautionary approach.

Reference points

	ICES considers that:	ICES proposes that:
Precautionary approach reference points	$\mathbf{B}_{\text{lim}}$ is set equal to 200 000 t.	$\mathbf{B}_{\text{pa}}$ not defined (not relevant).
	$\mathbf{F}_{\text{lim}}$ not defined (not relevant).	$\mathbf{F}_{\text{pa}}$ not defined (not relevant).
Target reference points		$\mathbf{F}_{\text{msy}}$ not defined (not relevant).

Single-stock exploitation boundaries

Exploitation boundaries in relation to existing management plans

With zero catch in the first part of 2007, the predicted SSB in April 2007 would be 189 000 t. This biomass is below $\mathbf{B}_{\text{lim}}$ with a probability of more than 50%. Therefore, under the management plan, no catch can be permitted in 2007.

Short-term implications

Outlook for 2007

The spawning stock in 2007 is predicted from the acoustic survey in September 2006 by a model which estimates maturity, growth, and mortality (including predation by cod). The model takes into account uncertainties both in the survey estimate and in other input data. Even with no catch in 2007, the probability of having an SSB below 200 000 t is above 50% (Figure 4.1.6.1). Only catches of mature fish have been considered.

Management considerations

For this stock, a $\mathbf{B}_{\text{lim}}$ 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 in a non-herring situation. The mean value of the 1989 spawning stock biomass is less than 100 000 t. However, the assessment method may not yet account for all sources of uncertainty, and there are inconsistencies in the data series. Thus, it may be appropriate to use a somewhat higher $\mathbf{B}_{\text{lim}}$. In recent years ICES has used a $\mathbf{B}_{\text{lim}}$ of 200 000 t.

The $\mathbf{B}_{\text{lim}}$ rule is intended to be a safeguard against recruitment failure. However, it is likely that the recruitment would be larger at a larger spawning stock, especially for moderately good recruitment conditions. In such a situation, a target-based control rule in addition to the $\mathbf{B}_{\text{lim}}$-based rule could be appropriate. The negative influence of herring on capelin recruitment should be included in the $\mathbf{B}_{\text{lim}}$-based rule if such a relationship can be described quantitatively. Adjustments of the harvest control rule should be investigated further to take the uncertainty in the predicted amount of spawners and the role of capelin as a prey item into account.

Factors affecting the fisheries and the stock

Regulations and their effects

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

The environment

The estimated annual consumption of capelin by cod has varied between 0.2 and 3.0 million t over the period 1984–2005. Young herring consume capelin larvae, and this predation pressure is thought to be one of the causes for the poor year classes of capelin in the periods 1984–1986, 1992–1994, and from 2002. The abundance of herring in the Barents Sea is believed to stay at a high level in 2007.

Scientific basis

Data and methods

The assessment and stock history is based on joint Russian–Norwegian acoustic surveys during September each year. From 1998 onwards, a model incorporating predation by cod has been used for predicting SSB and for estimating the historical time-series of SSB.

Source of information: Report from the 2006 joint Russian–Norwegian meeting to assess the Barents Sea capelin stock, Kirkenes, 30 September–3 October 2006.

Year	ICES Advice	Recommended TAC	Agreed TAC	ACFM 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	5% probability of SSB< 200 000 t	0	0	0
2005	5% probability of SSB< 200 000 t	0	0	1[2]
2006	5% probability of SSB< 200 000 t	0	0	0
2007	5% probability of SSB< 200 000 t	0		

Weights in thousand tonnes.
[1]Winter-spring fishery. [2]Research quota.

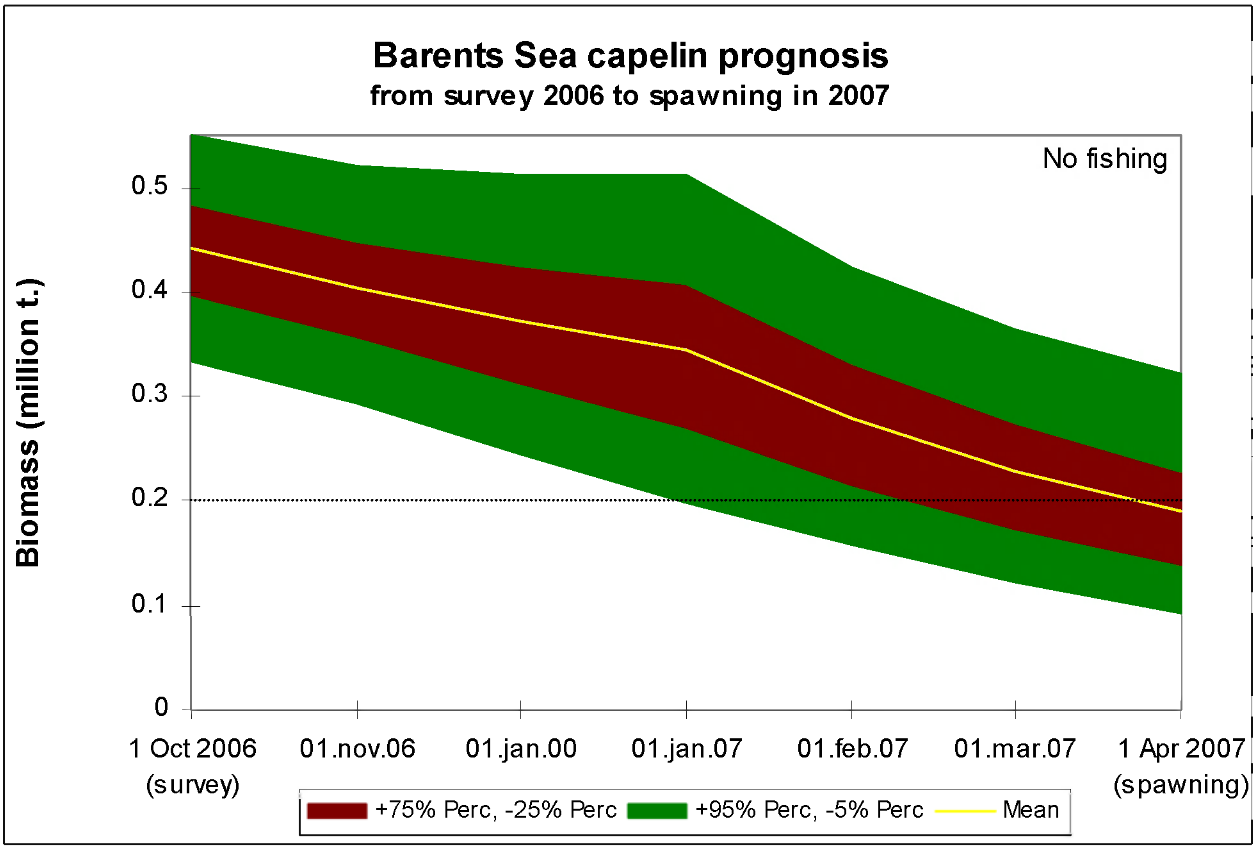


Figure 3.4.8.1 Probabilistic prognosis 1 October 2006–1 April 2007 for Barents Sea capelin (maturing stock, no catch). The dotted line is drawn at 200 000 tonnes, the $\mathbf{B}_{lim}$-value used by ICES in recent years.

Table 3.4.8.1 Barents Sea CAPELIN. International catch ('000 t) 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	11	358	1591
1973	1078	35	0	1112	213	10	223	1336
1974	749	80	0	829	237	82	319	1149
1975	559	301	43	903	407	129	536	1439
1976	1252	231	0	1482	739	366	1105	2587
1977	1441	345	2	1788	722	477	1199	2987
1978	784	436	25	1245	360	311	671	1916
1979	539	343	5	887	570	326	896	1783
1980	539	253	9	801	459	388	847	1648
1981	784	428	28	1240	454	292	746	1986
1982	568	260	5	833	591	336	927	1760
1983	751	374	36	1161	758	439	1197	2358
1984	330	257	42	628	481	367	849	1477
1985	340	234	17	590	113	164	278	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	156	20	704	31	195	226	929
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	0	0	0	0	1	1	1
1999	46	32	0	78	0	23	23	101
2000	283	95	8	386	0	28	28	414
2001	368	180	8	557	0	11	11	568
2002	391	228	17	635	0	16	16	651
2003	190	93	0	282	0	0	0	282
2004	0	0	0	0	0	0	0	0
2005	1	0	0	1	0	0	0	0
2006	0	0	0	0				

Table 3.4.8.2 Barents Sea CAPELIN. Stock summary table. Recruitment and total biomass are survey estimates back-calculated to 1 August (before the autumn fishing season). Maturing biomass is the survey estimate of fish above maturity length (14.0 cm). SSB is the median value of the modelled stochastic spawning stock biomass (after the winter/spring fishery).

Year	Stock biomass August 1	Maturing biomass survey Oct. 1	Recruitment Age 1, August 1	Forward Prediction of SSB as of April 1	Landings	Herring biomass age 1 and 2
1965					224	
1966					389	
1967					409	
1968					537	
1969					680	
1970					1314	
1971					1392	
1972	5831	2182			1592	
1973	6630	1350	1140	33	1336	1
1974	7121	907	737	*	1149	48
1975	8841	2916	494	*	1439	73
1976	7584	3200	433	253	2587	38
1977	6254	2676	830	22	2987	46
1978	6119	1402	855	*	1916	51
1979	6576	1227	551	*	1783	39
1980	8219	3913	592	*	1648	65
1981	4489	1551	466	316	1986	46
1982	4205	1591	611	106	1760	8
1983	4772	1329	612	100	2358	12
1984	3303	1208	183	109	1477	1263
1985	1087	285	47	*	868	1176
1986	157	65	9	*	123	171
1987	107	17	46	34	0	142
1988	361	200	22	*	0	53
1989	771	175	195	84	0	140
1990	4901	2617	708	92	0	371
1991	6647	2248	415	643	929	691
1992	5371	2228	396	302	1123	1653
1993	991	330	3	293	586	2615
1994	259	94	30	139	0	1785
1995	189	118	8	60	0	557
1996	467	248	89	60	0	199
1997	866	312	112	85	1	308
1998	1860	931	188	94	1	405
1999	2580	1718	171	382	106	1273
2000	3840	2099	475	599	414	1894
2001	3480	2019	128	626	568	1050
2002	2145	1290	62	496	651	401
2003	700	280	112	427	282	1468
2004	724	293	63	94	0	1943
2005	374	174	33	122	1	2858
2006	902	437	73	72	0	1966
2007				189		
Average	3392	1247	320	223	824	730

* Vanishing spawning stocks.

Table 3.4.8.3 Barents Sea CAPELIN. Larval abundance estimate (10^{12}) in June, and 0-group index in August.

Year	Larval abundance	0-group area index	New 0-group Index (10^6 ind.) Without K eff	With K eff
1980	-	502	217 454	809 193
1981	9.7	570	110 142	428 316
1982	9.9	393	181 125	611 698
1983	9.9	589	100 817	332 287
1984	8.2	320	73 228	168 660
1985	8.6	110	24 191	73 436
1986	0.0	125	13 519	56 472
1987	0.3	55	600	2 302
1988	0.3	187	28 826	92 075
1989	7.3	1300	258 741	881 764
1990	13.0	324	36 041	115 198
1991	3.0	241	55 879	164 819
1992	7.3	26	116	349
1993	3.3	43	257	776
1994	0.1	58	9 237	20 987
1995	0.0	43	614	2 067
1996	2.4	291	47 055	143 826
1997	6.9	522	57 585	196 013
1998	14.1	428	35 881	88 035
1999	36.5	722	88 855	294 999
2000	19.1	303	39 380	140 131
2001	10.7	221	5 212	19 895
2002	22.4	327	20 722	21 887
2003	11.9	630	130 672	458 890
2004	2.5	288	20 737	69 251
2005	8.8	348	47 256	154 692
2006	17.1	1031	170 851	525 357
Average	9.0	352	65 740	217 535