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1 ICELAND AND EAST GREENLAND

1.1 Ecosystem overview

1.1.1 Ecosystem components

Bottom topography, substrates, and circulation

The bottom topography of this region is generally irregular, with hard rocky bottom prevailing in most areas. The shelf around Iceland extends out often over 150 km in some areas, but is cut by many sub-sea canyons. Beyond the shelf the seafloor falls away to over 1000 m, although sub-sea ridges extend to the north (Jan Mayen and Kolbeinsey Ridges) and southwest (Reykjanes Ridge).

The seafloor drops rapidly from the Greenland coast to depths over 1000 m. In the areas seasonally ice-free, the Shelf area is rarely more than 75 km wide. The coastline and sub-sea topography are heavily serrated with canyons, and bottom topography is generally rough with hard bottom types.

The Polar Front extends between Greenland and Iceland. It separates the cold and relatively less saline south-flowing East Greenland Current from the Irminger Current, the westernmost branch of the warmer and more saline North Atlantic Current (Figure 1.1.1.1). To the south and east of Iceland the North Atlantic Current flows towards the Norwegian Sea, dominating the water mass properties between Iceland and the Faroes and Norway. The Irminger Current flows northeasterly to the west of the Reykjanes Ridge, before splitting into an arm which flows eastward to the north of Iceland and an arm which flows southwestward parallel to the East Greenland Current. Further north of Iceland the cold East Icelandic Current (an arm of the East Greenland Current) forms a counter-clockwise gyre around the Iceland Sea.

The strong, cold East Greenland Current dominates the hydrographic conditions along the coast of Greenland. In some years the warmer Irminger Current extends somewhat further west, transporting heat and biological organisms from Iceland into Greenland waters.

Physical and chemical oceanography (temperature, salinity, nutrients)

Icelandic waters are relatively warm due to Atlantic influence and generally ice-free under normal circumstances. Infrequently for short periods in late winter and spring drift ice may come close inshore and even become landlocked off the north and east coasts. Waters to the south and east of Iceland are usually within the range of 6–10°C, whereas on the North-Icelandic shelf mixing of Atlantic and Arctic waters means temperatures cool from west (~4–6°C) to East (<4°C). The water masses of the Iceland Sea are much colder than those of the Icelandic shelf.

Hydrobiological conditions are quite stable in the domain of Atlantic water south and west of Iceland, whereas there may be large seasonal as well as inter-annual variations of hydrography in the mixed waters on the N- and E-Icelandic shelf. On longer timescales changes in the strength and position of major currents and water masses, probably tied to the NAO regime shifts, combine to have a large influence on the marine ecosystem of the north Icelandic shelf (Figure 1.1.1.2) (Malmberg *et al.*, 1999).

East Greenlandic waters are much colder than those surrounding Iceland. The surface layer is dominated by cold polar water, while relatively warm mixed water of Atlantic origin is found at depths between 150 and 800 m north to about 64°N. Mixing and diffusion of heat between these two layers, as well as changes of the relative strength of flow of these two main water components are fundamental in determining physical marine climatic conditions as well as primary and secondary production off W-Greenland. Large changes in water temperature regimes have been documented on time-scales of decades or longer in both East and West Greenlandic waters.

Broad-scale climate and oceanographic features and drivers

The NAO has a strong effect on the ocean climate and water mass distributions in these waters, and environmental regimes are thought to have altered several times over the past decades. These regimes are thought to have affected the productivity of many exploited fish stocks, as well as the fish and zooplankton on which they feed.

The deep Greenland Basin is an important area for deep-sea convection of heat in the ocean. The nature and timing of water mass formation in the Greenland Basin plays a significant role in global climate change.

Phytoplankton – timing, biomass/abundance, and major taxonomic composition

The Iceland Shelf is a moderately high (150–300 g C m^{-2} yr^{-1}) productivity ecosystem based on SeaWiFS global primary productivity estimates. Productivity is higher in the southwest regions than to the northeast, and higher on the shelf areas than in the oceanic regions (Gudmundsson, 1998). There are marked changes in the spring development of phytoplankton from one year to another, depending on local atmospheric conditions, but spring blooms may start as early as mid-March rather than the more usual mid-April. Particularly on the shelf primary productivity appears to have been trending upward since the 1970s, but year-to-year variation has been as much as 3- to 4-fold during that period. This variation has corresponded with substantial variability of year-classes in a number of fish stocks during that period. "Cold" years, with less influence of North Atlantic Current waters tend to have lower primary productivity than warmer years.

The East Greenland Shelf is a low productivity (<150 g C m^{-2} yr^{-1}) ecosystem based on SeaWiFS global primary productivity estimates. The melting of the ice in the summer has significant effects on ecological conditions, causing large amounts of nutrients to be transported into the waters around East Greenland. Owing to these climatic factors and to the high latitude of the region, the seasonal phytoplankton production is of short duration and of limited extent. The plankton bloom is dominated by diatoms, but in some years the flagellate *Phaeocyctis* may also contribute. http://na.nefsc.noaa.gov/lme/text/lme19.htm

Zooplankton

Collectively, the Iceland Sea water fosters such arctic types of zooplankton as *Calanus finmarchicus*, *C. hyperboreus* and *C. glacialis*, *Metridia longa*, amphipods and others, with *C. finmarchicus* commonly comprising 60–80% of the spring zooplankton bloom. Zooplankton productivity is highest along the frontal area to the south and east of Iceland, along the North Atlantic Current, and lowest to the west and north of Iceland. Zooplankton production has shown a trend interannually, although with different patterns in the Arctic, the Atlantic, and the mixed Arctic/Atlantic waters. Zooplankton production tended to increase in all three water masses throughout the 1990s (Astthorsson and Vilhjalmsson, 2002). These zooplankton, particularly calanoid copepods and krill, are eaten by adult herring and capelin, juvenile stages of numerous other fish species as well as by baleen whales. The larvae of both pelagic and demersal fish also feed on eggs and juvenile stages of the zooplankton.

Zooplankton biomass is generally much lower in East Greenland than in Icelandic waters, but has varied extensively over the historic period. Zooplankton production in East Greenlandic waters is dominated by *Calanus*, but late in summer, smaller plankton species may become common. http://na.nefsc.noaa.gov/lme/text/GIWAGreenlandreport.pdf.

In the pelagic ecosystem off Greenland and Iceland the population dynamics of calanoid copepods and to some extent krill are considered to play a key role in the food web as a direct link to fish stocks, baleen whales (*Mysticeti*) and some important seabirds, such as little auk (*Alle alle*) and Brünnitch's guillemot (*Uria lomvia*).

Benthos, larger invertebrates (cephalopods, crustaceans, etc.), biogenic habitat taxa

The Greenland-Scotland Ridge represents a biogeographical boundary between the North Atlantic Boreal Region and the Arctic Region and major faunistic changes around Iceland are mainly associated with the ridge. The Nordic Seas, i.e. the Norwegian, Greenland, and Iceland Seas, are relatively low in species diversity, at least for some benthic groups, compared with areas south of the Greenland-Scotland Ridge (e.g. Weisshappel, 2000). This has been explained partly by a short evolutionary time of the fauna within this environment, but in particular due to isolation caused by the Greenland-Scotland Ridge, which acts as a barrier against the immigration of species into the Nordic Seas (Svavarsson *et al.*, 1993). Studies, based on material from the BIOICE programme , indicate that in the Iceland Sea and the western part of the Norwegian Sea, the benthic diversity increases with depth to about 320 to 1100 m (shelf slope), below which the diversity again decreased (Svavarsson, 1997). South of the Ridge the species diversity has been shown to increase with depth (Weisshappel and Svavarsson, 1998).

The underlying features which appear to determine the structures of benthic communities around Iceland are salinity (as indicator of water masses) and sediment types. Accordingly, the distribution of benthic communities is closely related to existing water masses and, on a smaller scale, with bottom topography. It has also been shown that large differences occur in species composition around the Kolbeinsey Ridge, in the Iceland Sea, with greater abundances and diversity of benthos on the western slope of the ridge, compared with the east slope (Brandt and Piepenburg, 1994). This will indicate that benthos abundance and diversity is determined by differences in bottom topography and food supply (largely pelagic primary production).

Biogenic habitat taxa

Lophelia pertusa was known to occur in 39 places in Icelandic waters (Carlgren, 1939; Copley *et al.*, 1996). The distribution was mainly confined to the Reykjanes Ridge and near the shelf break off the south coast of Iceland. The depth range was from 114 to 875 m, with most occurrences between depths of 500 and 600 m.

Based on information from fishers (questionnaires), eleven coral areas were known to exist close to the shelf break off NW- and SE-Iceland at around 1970. Since then more coral areas have been found, reflecting the development of the bottom trawling fisheries extending into deeper waters in the 70s and 80s. At present very large coral areas exist on the Reykjanes Ridge and off SE-Iceland (Hornafjarðardjúp deep and Lónsdjúp deep). Other known coral areas are small (Steingrímsson and Einarsson, 2004).

In 2004 a research project was started on mapping coral areas off Iceland (using a Remote Operated Vehicle, ROV), based on the results from questionnaires to fishers on the occurrence of such areas. The aim of the project is to assess the species composition (including *L. pertusa*), diversity, and the status of coral areas in relation to potential damages by fishing practices. In the first survey, intact *Lophelia* reefs were located in two places on the shelf slope off the south coast of Iceland. Evidence of bottom trawling activities in these areas was not observed.

The database of the BIOICE programme provides information on the distribution of soft corals, based on sampling at 579 locations within the territorial waters of Iceland. The results show that gorgonian corals occur all around Iceland. They are relatively uncommon on the shelf (< 500-m depth) but are generally found in relatively high numbers in deep waters (> 500 m) off the southern, western, and northern coasts of Iceland. Similar patterns were observed in the distribution of pennatulaceans off Iceland. Pennatulaceans are relatively rare in waters shallower than 500 m but more common in deep waters, especially off South Iceland.

Aggregations of large sponges ("ostur" or sponge grounds) are known to occur off Iceland (Klittgard and Tendal, 2004). North of Iceland, particularly in the Denmark Strait, "ostur" was found at several locations at depths of 300–750 m, some of which are classified as sponge grounds. Comprehensive "ostur" and sponge grounds occur off south Iceland, especially around the Reykjanes Ridge.

Survey measurements indicate that shrimp biomass in Icelandic waters, in both inshore and offshore waters, has been declining in recent years. Consequently the shrimp fishery has been reduced and is now banned in most inshore areas. The decline in the shrimp biomass is in part considered to be environmentally driven, both due to increasing water temperature north of Iceland and due to increasing biomass of younger cod.

The shrimp biomass off East Greenland and Denmark Strait has been relative stable in the last years considering standardized CPUE data, which include most but not all of the fleets participating in the fishery (see e.g. NAFO SCS Doc. 04/20). Other information, e.g. survey-based results on shrimp/cod interaction, do not exist for this area.

Fish community

Icelandic waters are comparatively rich in species and contain over 25 commercially exploited stocks of fish and marine invertebrates. Main species include cod, saithe, redfish, capelin, haddock, wolffish, tusk *(Brosme brosme)*,ling *(Molva molva)*, Greenland halibut and various other flatfish, plus polar cod *(Boreogadus saida)* and sand eel which are not exploited commercially. Most fish species spawn in the warm Atlantic water off the south and southwest coasts. Fish larvae and 0-group drift west and then north from the spawning grounds to nursery areas on the shelf off NW-, N-, and E-Iceland, where they grow in a mixture of Atlantic and arctic water.

Capelin is important in the diet of cod as well as a number of other fish stocks, marine mammals, and seabirds. Unlike other commercial stocks, adult capelin undertake extensive feeding migrations north into the cold waters of the Denmark Strait and Iceland Sea during summer. Capelin abundance has been oscillating on roughly a decadal period since the 1970s, producing a yield of >1600 Kt at the most recent peak. Herring were very abundant in the early 1960s, collapsed, and have then increased since 1970. The abundance of demersal species has been trending downward irregularly since the 1950s, with aggregate catches dropping from over 800 Kt to under 500 Kt in the early 2000s.

A number of species of sharks and skates are known to be taken in the Icelandic fisheries, but information on catches is incomplete, and the status of these species is not known. Information on the status and trends of non-commercial species, including species considered to be rare or vulnerable, and their catches in fisheries, is not available.

The Greenlandic commercial fish and invertebrate fauna counts fewer species and is characterized by coldwater ones such as Greenland halibut *(Hippoglossoides Reinhardtius)*, northern shrimp *(Pandalus borealis)*, capelin, and snow crab *(Chionoecetes opilio)*. Redfish *(Sebastes spp.)* are also found, but mainly in Atlantic waters outside the cold waters of the E-Greenland continental shelf. Greenlandic waters also contain capelin populations that spawn at the mouths of numerous fjords on the west and east coasts.

Cod can be plentiful at W-Greenland in warm periods, when larvae are thought to drift from Iceland to Greenland. The drift of larval and 0-group cod from Iceland waters to Greenland was especially extensive during the warm period of the 1920s and 1940s; however, such drift occurred intermittently on a smaller scale until 1984. The fishable and spawning components of the West Greenland cod are believed to have reached more than 3 and 4 million tonnes respectively in their heyday in the 1940s (Figure 1.1.1.3), but many of the cod returned to spawn at Iceland. The Greenland cod stock collapsed in the 1970s because of deteriorating climatic conditions and overfishing. After 1970, all year classes of cod of any importance at East Greenland have been of Icelandic origin.

Warm conditions have returned since the mid-1990s and, in particular off East Greenland, some increase in the abundance of juvenile cod has been observed in the most recent years and the 2003 year class is well above the recent average. However, recruitment has remained much below what has been seen at comparable hydrographic conditions before. This indicates that other factors might have become more prominent, such as the age structure of the cod spawning stock at Iceland (reduced egg quality and changed location and timing of larval hatch) and the bycatch of small cod in the increased fishery for northern shrimp.

Birds and mammals: Dominant species composition, productivity (especially seabirds), and spatial distribution (especially mammals)

The seabird community in Icelandic waters is composed of relatively few but abundant species, accounting for roughly ¼ of the total number and biomass of seabirds within the ICES area (ICES, 2002). Auks and petrel are the most important groups, comprising almost 3/5 and ¼ of both abundance and biomass in the area, respectively. The most abundant species are Atlantic puffin, northern fulmar, Common and Brunnich's guillemot, black-legged kittiwake, and common eider. The estimated annual food consumption is in the range of 1.5 million tonnes.

At least 12 species of cetaceans occur regularly in Icelandic waters, and an additional 10 species have been recorded more sporadically. Reliable abundance estimates exist for most species of large whales while such estimates are not available for small cetaceans. In the continental shelf area, minke whales (*Balaenoptera acutorostrata*) probably have the largest biomass. According to a 2001 sightings survey, 67 000 minke whales were estimated in the Central North Atlantic stock region, with 44 000 animals in Icelandic coastal waters (NAMMCO, 2004; Borchers *et al.*, 2003; Gunnlaugsson, 2003). Minke whales have opportunistic feeding habits, their diet ranging from planktonic crustaceans (krill) to large (> 80 cm) cod. Little information is available on the diet composition of minke whales in Icelandic and adjacent waters, but their annual consumption has been estimated to be of the same order of magnitude as the total catch of the Icelandic fishing fleet (2M tonnes). Fin whales (*Balaenoptera physalus*) are mainly distributed along the continental slope and further offshore. The abundance of the East Greenland-Iceland stock of fin whales was estimated around 23 thousand animals in 2001 (Pike *et al.*, 2003). This stock has been increasing during the last 20 years, mainly in the waters between Iceland and East Greenland. The diet of Icelandic fin whales is known only from the whaling grounds west of Iceland where it consists overwhelmingly of krill, mainly *Meganychtiphanes norwegica*.

Sei whale (*Balaenoptera borealis*) abundance is estimated around 10 thousand animals. The species has similar distribution and diet in Icelandic waters as fin whales.

Humpback whale (*Megaptera novaeangliae*) abundance was estimated at around 14 thousand animals in 2001 (Pike *et al.*, 2002). The abundance of this species has been increasing rapidly (10–14% per year) during the last 30 years, but the species was previously very rare. Feeding habits of humpback whales off Iceland are virtually unknown, but the species seems to be closely related to the distribution of capelin at certain times of the year. Humpback whales are primarily distributed on the continental shelf area in Icelandic waters.

Sperm whales (*Physeter macrocephalus*) are a deepwater species, feeding on cephalopods and various fish species. They are relatively common in Icelandic waters, but no reliable absolute abundance estimate is available because of the long diving habits of the species.

Blue whales (*Balaenoptear musculus*) is the least abundant of the large whales with an estimated stock size of 1–2 thousand animals. This species feeds exclusively on krill.

As mentioned above, no reliable estimates are available for most species of medium-sized and small cetaceans. The exceptions are long-finned pilot whales (*Globicephala melas*) with estimated abundance of around 800 thousand animals in the Icelandic-Faroes area, and northern bottlenose whales (40 thousand in the NE Atlantic). Some of these small cetaceans (e.g. white-beaked dolphins (*Lagenorhynchus albirostris*) and harbour porpoises (*Phocoena phocoena*)) are piscivorous and mainly distributed in coastal waters and may thus have significant interactions with fisheries.

1.1.2 Environmental forcing on fish stock dynamics and fisheries

The environmental conditions particularly to the north and west of Iceland have a major effect on the biology and distribution of many key species. Around the mid-1990s a rise in both temperature and salinity were observed in the Atlantic water south and west of Iceland. The positive trend has continued ever since and west of Iceland amounts to an increase in temperature of about 1°C and in salinity by one unit (0.1 promille). These are very large changes for Atlantic water in this area and are shown in Figure 1.1.2.1.

A similar trend is observed off central N-Iceland, but it is of necessity more irregular since this is an area of variable mixing of warm and cold water masses. Nevertheless, the trend is unmistakable and is indeed larger than in the Atlantic water off W-Iceland (the same has been observed off SE-Iceland as well). The increase in temperature and salinity north of Iceland in the last 10 years is on average about 1.5°C and 1.5 salinity units, as shown in Figure 1.1.2.2.

It appears that these changes have had considerable effects on the fish fauna of the Icelandic ecosystem. Such changes would be expected to first affect pelagic species and indeed have been observed for herring, capelin, and blue whiting. The Icelandic summer-spawning herring have increased their distribution in the last few years. Capelin have both shifted their larval drift and nursing areas far to the west to the colder waters off E-Greenland, the arrival of adults to the overwintering grounds on the outer shelf off N-Iceland has been delayed, and migration routes to the spawning grounds off S- and W-Iceland have been located farther off N- and E-Iceland and have not reached as far west along the south coast as was normal in most earlier years. However, these changes did not have a negative effect on the size of the capelin stock. The semi-pelagic blue whiting has lately been found and fished in east-Icelandic water in far larger quantities than ever before. Finally, part of the Norwegian spring-spawning herring, albeit very small, was observed and fished east of Iceland in autumn 2004. This has not happened since 1968.

The effect of warmer waters has also been conspicuous for those demersal species, which are at or near their northern distribution limit in Icelandic waters (Figure 1.1.2.3). The most obvious examples of increased abundance of such species in the mixed water area north of Iceland are haddock, whiting, monkfish, lemon sole, and witch. On the other hand, coldwater species like Greenland halibut and northern shrimp have become more scarce.

However, there is one demersal stock (not shown in Figure 1.1.2.3), which apparently has not taken advantage, or not been able to take advantage, of the milder marine climate of Icelandic waters. This is the Icelandic cod, which flourished during the last warm epoch, which began around 1920 and lasted until 1965. By the early 1980s the cod had been fished down to a very low level as compared to previous decades and has remained relatively low since. During the last 20 years the Icelandic cod stock has not produced a large year class and the average number of age 3 recruits in the last 20 years is about 150 million fish per annum, as compared to 205–210 recruits in almost any period prior to that, even the ice years of 1965–1971. Immigrants from Greenland are not included in this comparison. It is not possible to pinpoint exactly what has caused this change, but a very small and young spawning stock is the most obvious common denominator for this protracted period of impaired recruitment to the Icelandic cod stock. Regulations, particularly the implementation of the catch rule in 1993 have resulted in lower fishing mortalities in the last ten years compared with the ten years prior and has, despite low recruitment resulted in almost doubling the spawning stock biomass since 1993. This improvement in the SSB biomass has not, however, resulted in a significant increase in the production in recent years, despite increased inflow of warmer Atlantic water.

Associated with the large warming of the 1920s was a well documented drift of larval and 0-group cod as well as some other fish species, from Iceland across the northern Irminger Sea to E- and then W-Greenland. Although many of these fish apparently returned to Iceland to spawn and did not leave again, there is little doubt that those cod, remaining in W-Greenland waters which had also warmed, were instrumental in establishing a self-sustaining Greenlandic cod stock that eventually became very large. It seems that significant numbers of cod of the 2003 year class have drifted across to Greenland in that year and are now growing at W-Greenland.

Since 2003 the ocean around Iceland has been anomalously warm. This has lead to less abundance of capelin being distributed near the edges of the continental shelf from northwest to northeast Iceland in summer, autumn, and early winter, resulting in reduced availability of capelin for feeding by the Icelandic cod stock. This reduction in available capelin for cod can be seen in stomach samples from the Icelandic autumn survey and from cod stomachs sampled by crews of fishing vessels throughout the year. Stomach samples from the March survey in 2003–2005 indicate that very little capelin spawned on the traditional spawning grounds south and west of Iceland, but in 2004 and especially in 2005 large quantities of spawning capelin were found in cod stomachs north and northwest of Iceland, indicating a change in the spawning areas of capelin. These capelin seem to have been around the Icelandic continental shelf for a relatively short period, so their impact on cod is not as great as the capelin that have been around the edges of the continental shelf since October–November.

Cod has to be able to compensate for the reduced abundance of available capelin, and the mean weights-at-age have been reduced by 10–20% since 2002. Cod inhabiting the waters south and east of Iceland prey on blue whiting for a large part of the year. Increased abundance of cod has been seen in these areas in recent years and the proportion of the trawl catch taken in this area has been increasing, both due to increased abundance and better conditions for cod in this area. Stomach samples do indicate, though, that it is mostly relatively large cod that are able to prey on blue whiting.

The transport of cod larvae from Iceland to East Greenland has been a major ecological feature of this region. Its strong decadal signal, tied to climatic regimes, has significant impacts on stock sizes in both areas, but particularly in East Greenland. Because of the strong influence of cod eggs and larvae transported from Iceland on the dynamics of the East Greenland cod (and in some periods return migration of adult cod to Iceland has an impact on the cod fisheries in Iceland), management strategies designed for stocks whose dynamics are determined by local biomass and environmental conditions cannot be counted on to ensure sustainable use of at least the East Greenland cod. The scientific community should give priority to development of sustainable management strategies for fisheries on stocks whose dynamics are not primarily determined by stock sizes and environmental conditions in the local management area.

1.1.3 Ecosystem effects of the fisheries

Many of the demersal fisheries use mobile gears and fish on hard bottoms. This presents an opportunity for substantial impacts on seafloor structural habitats and benthos. If the recent changes in distribution of major fish stocks continue, there may be incentives for these fisheries to relocate to new fishing grounds. This, in turn could potentially increase the amount of habitat altered by these gears, and should be discouraged until information is available on the nature and vulnerability of any new areas to be fished.

1.1.4 References

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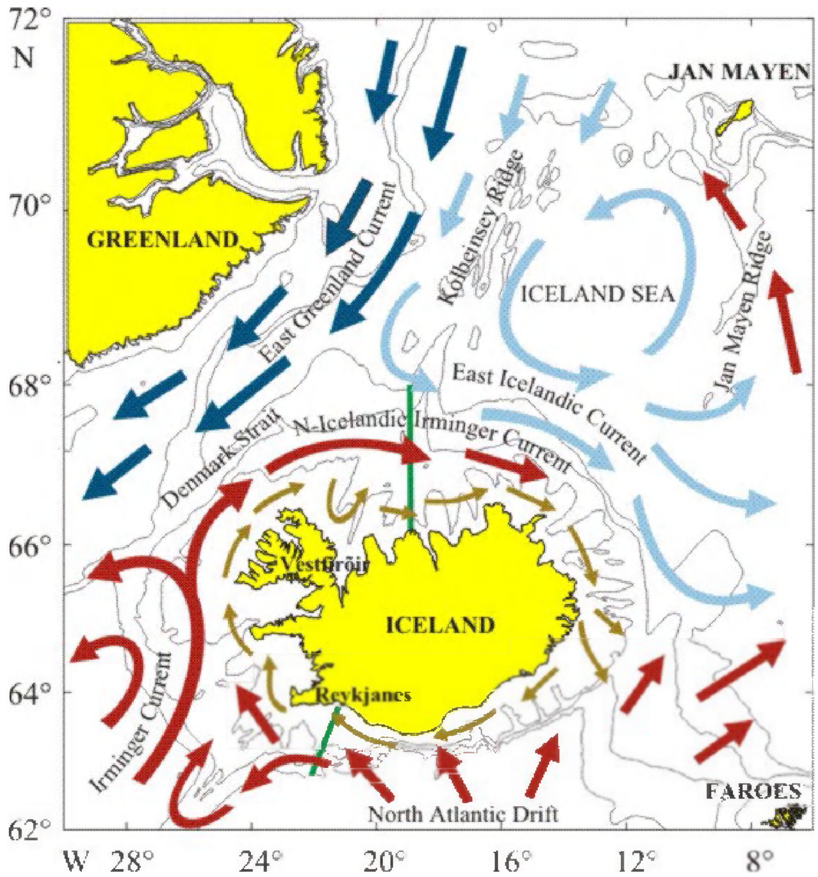


Figure 1.1.1.1 The system of ocean currents around Iceland and in the Iceland Sea.

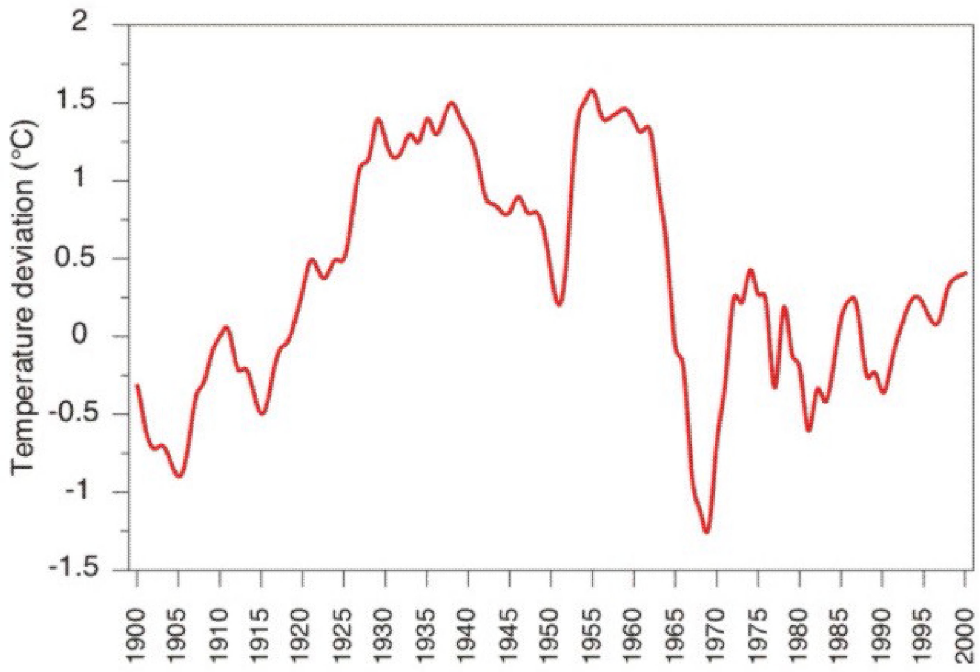


Figure 1.1.1.2 Temperature deviations north of Iceland 1900–200, five-year running averages.

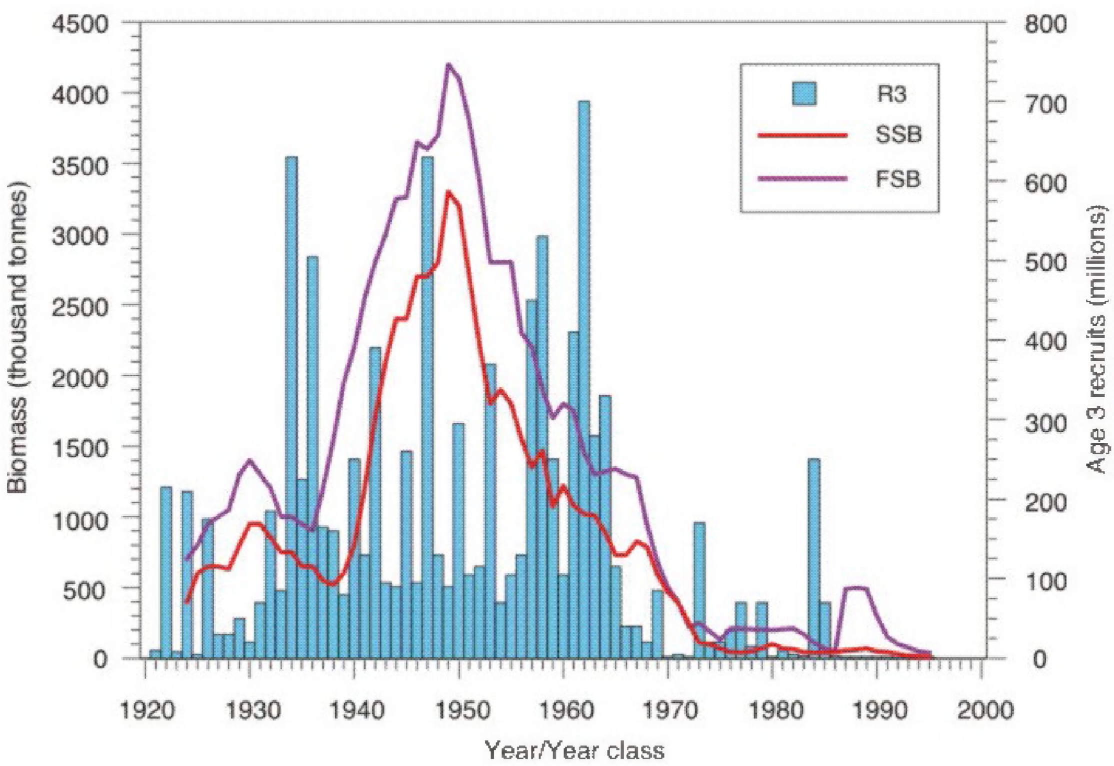


Figure 1.1.1.3. Recruitment at age 3, spawning biomass and fishable biomass of cod off West Greenland.

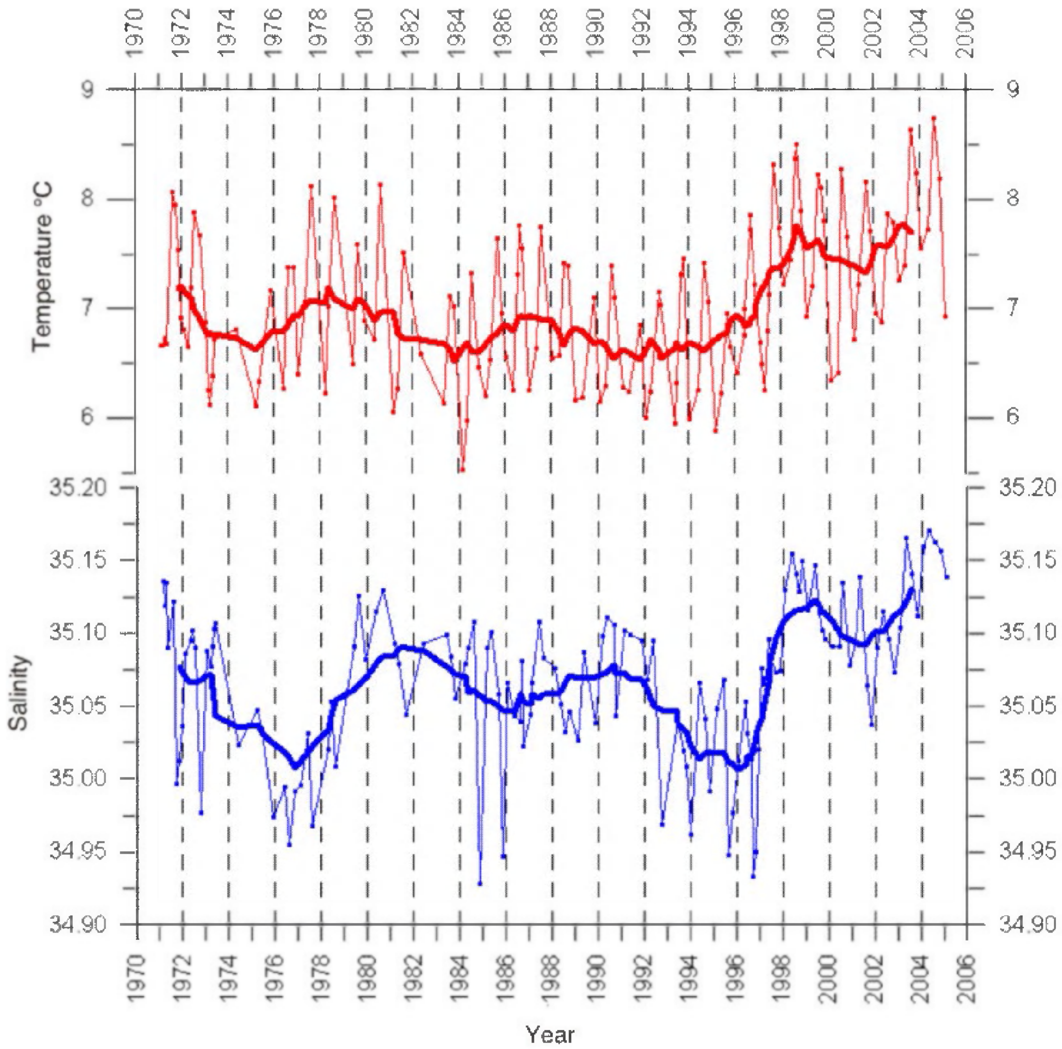


Figure 1.1.2.1 Changes of temperature and salinity west of Iceland 1970–2005.

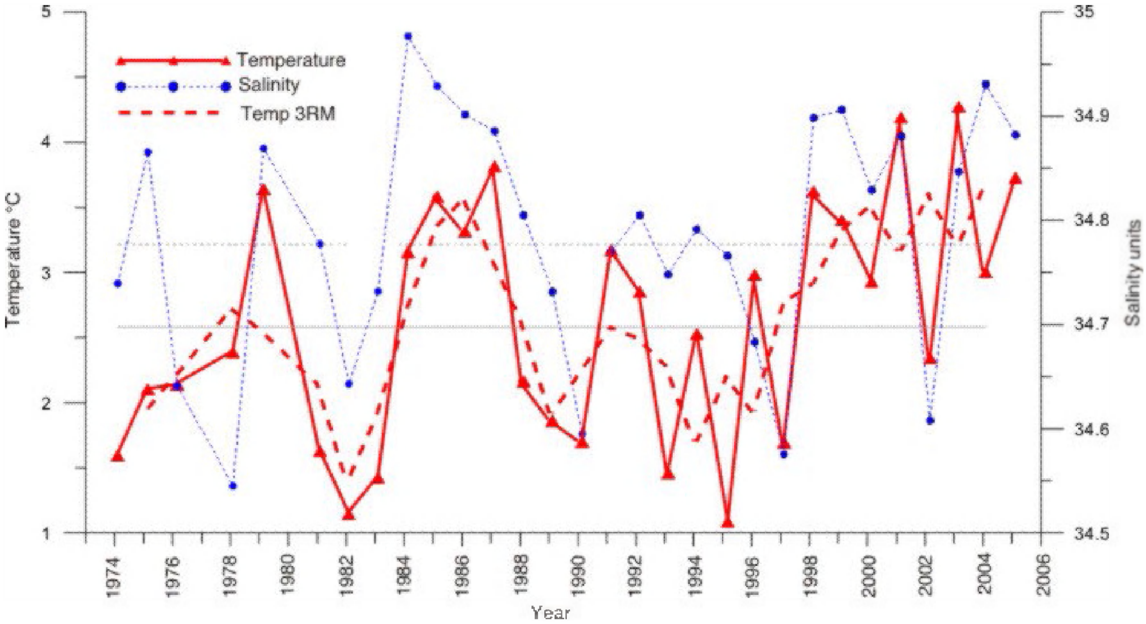


Figure 1.1.2.2 Changes of temperature and salinity off central North-Iceland 1970–2004.

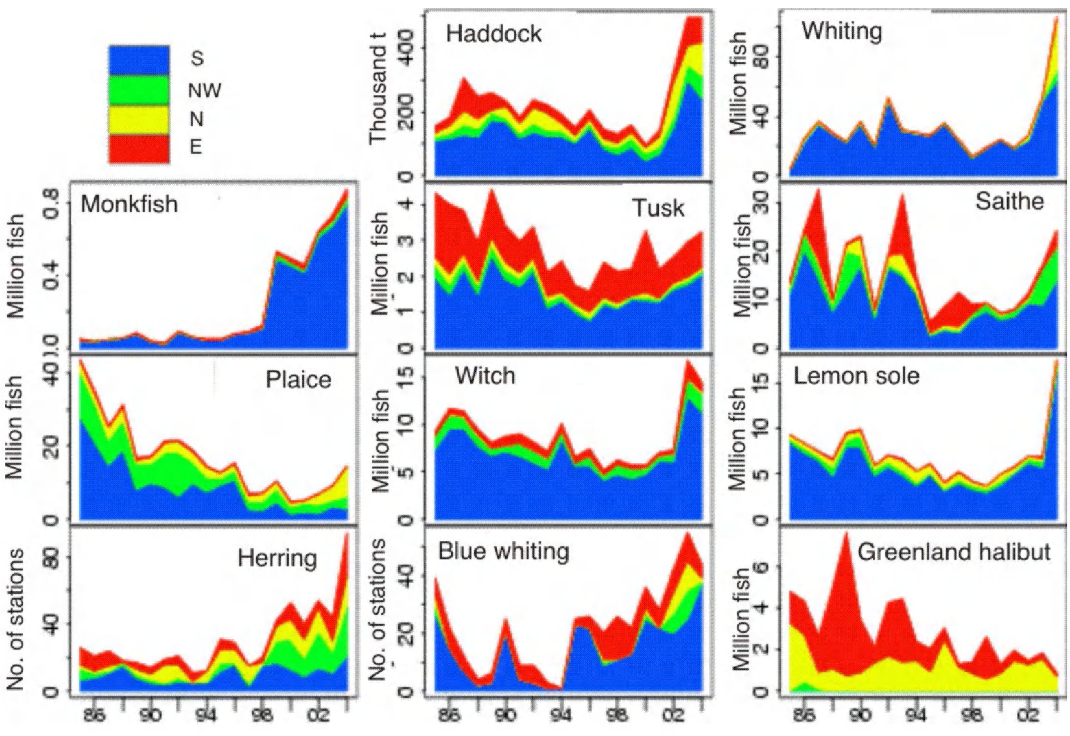


Figure 1.1.2.3 Changes of indices of abundance and geographical distribution of several fish stocks in Icelandic waters, 1985–2005. The denotations S, NW, N, and E beside the color code shown in the top left corner stand for South-, Northwest-, North-, and East-Iceland, in that order.

1.2 The human use of the ecosystem

1.2.1 Overall impacts

1.2.2 Fisheries

Since the mid-seventies stocks in Division Va have mainly been exploited by Icelandic vessels. However, vessels of other nationalities have also operated in the pelagic fishery on capelin, herring, and blue whiting, and a few trawlers and longliners targeting redfish, tusk, and ling have been operating in the region.

The fishery off West Greenland has traditionally consisted of an offshore trawl fishery and an inshore fishery mostly using poundnets and longlines. The cod catches have fluctuated substantially, but declined dramatically after 1989, and the offshore fishery has now ceased.

Cod catches off East Greenland have also fluctuated widely and decreased sharply in 1993, when the directed cod fishery failed totally due to very low catch rates.

The fishery for Greenland halibut in Subareas V and XIV is conducted by various nations but is still dominated by Icelandic trawlers in Division Va and XIV. The fishery in Divisions XIVb and Vb now constitutes about one third of the total fishery for Greenland halibut within Subareas V and XIV. Surveys have only recently been initiated for Greenland halibut.

Fisheries in Icelandic waters are characterised by the most sophisticated technological equipment available in this field. This applies to navigational techniques and fish-detection instruments as well as the development of more effective fishing gear. The most significant development in recent years is the increasing size of pelagic trawls and, with increasing engine power the ability to fish deeper with them. There have also been substantial improvements with respect to technological aspects of other gears such as bottom trawl, longline, and handline. Each fishery uses a variety of gears and some vessels frequently shift from one gear to another within each year. The most common demersal fishing gear are otter trawls, longlines, seines, gillnets, and jiggers, while the pelagic fisheries use pelagic trawls and purse seines. The text table below gives an overview of the Icelandic fleet composition as of May 2004, based on information from the Icelandic Directorate of Fisheries. The definition of type may be very complicated as some vessels operate both as large factory vessels fishing for demersal species and as large purse seiners and pelagic trawlers fishing for pelagic fishes during different times of the year.

Type	No. of vessels	Gear type used
Trawlers	79	(Pelagic and bottom trawl)
Other large vessels within the TAC system	253	(Purse seine, longline, gillnet, Danish seine, pel. trawl)
Small vessels within the TAC system	884	(Jiggers, longline, gillnet, purse seine)
Vessels within the effort system	308	(Small jiggers)
Total	1561	

The total catch in Icelandic waters in 2004 was 1.6 million tonnes, of which pelagic fishes comprised 1.1 million tonnes. Discard is banned in the Icelandic demersal fishery, but is allowed in the pelagic fishery when the catch exceeds the capacity of the vessels. Table 1.2.2.1 provides an overview of the catches in 2004 by species and gear type. The effort by gear type based on logbook data is presented below:

Gear type	No. of hauls/sets
Pelagic trawl	5 446
Bottom trawl	64 438
Shrimp trawl	9 129
Nephrops trawl	5 326
Gillnet	18 231
Longline	20 977
Purse seine	3 112
Jiggers *	17 319
Danish seine	45 268

* number of fishing days

Figures 1.2.2.1, 1.2.2.2, and 1.2.2.3 provide an overview of where the catches of most important demersal species were taken in 2004 by gear type. Figures 1.2.2.4 and 1.2.2.5 provide information on the distribution of effort by gear type. In general, the trawlers operate further offshore than do the longliners.

Pelagic fishery

The fishery for the main pelagic species, Icelandic summer-spawning herring and capelin in the Iceland-East Greenland-Jan Mayen area, is almost exclusively carried out by vessels operating with both purse seine and pelagic trawl. The pelagic fisheries mainly target capelin, herring, redfish (*S. mentella*), and blue whiting. Except for the summer fishery northwest of Iceland, the capelin fishery is mostly during the spawning migration, which goes clockwise around the country. The herring fishery is conducted from autumn until February the following year, both west and east of Iceland, using both purse seine and pelagic trawls. The blue whiting fishery has developed rapidly in recent years and is conducted off the southeast and the east coast, using large pelagic trawls. For further information on the blue whiting, see Volume 9 (Widely migratory stocks).

The main fishing season of the pelagic redfish fishery takes place during the second quarter. The fishery starts in the northeast part of the Irminger Sea close to and within the Icelandic EEZ in early April at depths below 600 m. In July, the fishery moves into international and Greenland EEZ waters in the southwestern part of the Irminger Sea to continue fishing at water depths of less than 500 m. The distance between the two fishing areas is currently more than 500 km. The fleets participating in this fishery have continued to develop their fishing technology, and most trawlers now use large pelagic trawls ("Gloria"-type) with vertical openings of 80–150 m. Discard is at present not considered to be significant for this fishery.

Most of the landings of pelagic species capelin, herring, and blue whiting are used for fish meal and oil production; however, the proportion used for human consumption is increasing. While bycatch of other species usually do not occur in this fishery, juveniles of other species are taken in some cases. When this occurs, the fishing areas have been closed for fishing, temporarily or permanently. Figure 1.2.2.6 provides an overview of where capelin, herring, and blue whiting are caught with pelagic trawls and purse seiners.

Demersal fishery

Demersal fisheries in Icelandic waters usually target a mixture of roundfish species or a mixture of flatfish species, with varying amounts of redfish as a bycatch. Demersal fisheries in East Greenland (XIVb) only target redfish and Greenland halibut. A fishery directed towards golden (*Sebastes marinus*) and demersal redfish (*S. mentella*) exists along the shelf edge from southeast to northwest of Iceland. The saithe fishery is conducted also along the shelf edge, often in the same areas as the redfish fisheries, and the fleets often target redfish during daytime and saithe during night. Therefore, the fishery for each of those species is relatively clean even though they take place in the same area. A directed Greenland halibut fishery also exists and this fishery has very little bycatch (see Table 1.2.2.2, Figures 1.2.2.7 and 1.2.2.9). A targeted fishery for deep-sea species (mainly tusk) takes place from the southeast of Iceland to the southwest coast, often with cod and haddock as bycatch.

Demersal fisheries take place all around Iceland, deploying a variety of gears and boats of all sizes. The most important fleets targeting them are:

- <u>Large and small trawlers using demersal trawl</u>. This fleet is the most important one fishing cod, haddock, saithe, and redfish, as well as a number of other species. This fleet operates throughout the year; mostly outside 12 nautical miles from the shore.
- <u>Vessels (< 300 GRT) using gillnet</u>. These boats mostly target cod, but cod, haddock, and a number of other species are taken. This fleet operates mostly close to the shore.
- <u>Vessels using longlines</u>. These boats are both small boats (< 10 GRT) operating in shallow waters as well as much larger vessels operating in deeper waters. Cod and haddock are the main target species of this fleet, but a number of less important species are also caught, some of them in directed fisheries.
- <u>Vessels using jiggers</u>. These are small boats (<10 GRT), operating within the TAC system. Cod is the most important target species of this fleet, with saithe following as the second most important species.
- <u>Vessels using Danish seine (20–300 GRT)</u>. The most important species for this fleet are cod and haddock, but this fleet is the most important fleet fishing for a variety of flatfishes like plaice, dab, and witch.

In addition to those fleets a number of other fleets targeting invertebrates and pelagic fishes can affect demersal fish stocks, both through discarding and other hidden mortality.

Fisheries for redfish

Redfish in Division Va are mainly caught by trawlers using demersal and pelagic trawl. *S. marinus* is the predominant species down to depths of about 500 m, whereas deep-sea *S. mentella* contributes mostly to the catches at greater depths. The Icelandic fleet takes the major part of the catches, but vessels from Germany, UK, and Faroe Islands also fish in Division Va. In recent years the Icelandic fleet has also caught pelagic *S. mentella* in the deeper parts of Division Va using pelagic trawl.

In Division Vb, redfish are mainly caught by trawlers using demersal trawls. Down to about 500 m, *S. marinus* is the most important redfish species, and pair-trawlers are the most important fleet. Deeper than about 500 m, redfish catches consist almost exclusively of demersal *S. mentella* taken mostly by otter-board trawlers larger than 1 000 HP. The Faroese catches constitute more than 90% of the redfish catches in this division. Otter-board trawlers from Germany and France occasionally target these stocks. The remainder of the total catches is mainly bycatch in other demersal fisheries.

Redfish catches taken by several countries in Subarea VI are considered to be mainly bycatch in demersal fisheries. These catches are negligible in comparison with redfish catches in Subareas V, XII, and XIV.

Catches in Subarea XII are mainly pelagic *S. mentella* and are taken by trawlers using pelagic trawls. At least 13 fleets have joined this fishery mainly from Russia, Germany, Iceland, Faroe Islands, and Norway.

In Subarea XIV both *S. marinus* and *S. mentella* stocks are exploited. On the Greenland shelf and slopes, *S. marinus* dominates the trawl catches above 500 m, whereas demersal *S. mentella* dominates below 500 m. Most of the catches are taken by German freezer trawlers. In 1982 a pelagic trawl fishery started exploiting the pelagic *S. mentella* in the deeper parts of Subarea XIV. Since 1990 the main fleets are from Russia, Norway, Iceland, and Germany. In recent years, vessels from several other countries have joined this fishery, mainly outside the EEZs of Iceland and Greenland.

In Division Va and Subareas XII and XIV, a pelagic fishery has developed at depths greater than 500 m to target *S. mentella*. In recent years, a substantial proportion of the pelagic *S. mentella* catch has been taken below depths of 500 m. Since autumn 2000, there has been a significant fishing effort extending from ICES Division XII into the NAFO Convention Area. There are indications of a significant amount of unreported effort, at least in recent years.

Stock status

Most of the largest stocks have been at low levels during the most recent decade. The pelagic *S. mentella* is now considered to be at a low level compared to the stock size in the early 1990s. The stock size of demersal *S. mentella* on the shelf also appears to be decreasing. Due to good recruitment in recent years, the haddock is expected to increase rapidly. Trends in the Greenland halibut stock vary among areas. Indices from Subarea XIV and Division Vb suggest that the stock has stabilised, while indices from Division Va suggest a low biomass in recent years compared to the mid-1980s, and a recent decline. Further information on the demersal stocks at Greenland and Iceland is given in Section 1.3.

All available information confirms the severely depleted state of the cod stock off Greenland. The offshore stock may be considered to be almost non-existent at the present time. Strong year classes observed at Iceland as 0-groups in 1997–1999 only appeared as moderate at age 1 in bottom trawl surveys in Greenland waters. A rise in water temperatures at East and West Greenland may provide the basis for a higher recruitment to the West Greenland area. The inshore stock component has historically been small and available information suggests moderate recruitment in the northern part of West Greenland. In Icelandic waters the cod stock has shown signs of some recovery due to better recruitment of the 1997–2000 year classes after a long period of poor recruitment. The Icelandic haddock has for more than a decade been exploited at a very high fishing mortality. The stock is increasing from a low level in recent years. Several strong year classes are entering the fishery.

Table 1.2.2.1 Overview of Icelandic fish (+ shrimp) catches in Icelandic waters by gear type in 2004. The fishery for capelin, blue whiting, and herring are fished in both pelagic trawls and purse seine, but those gears are combined. Based on landing statistics from the Directorate of Fisheries. Landings are given in t.

Spec.	Longline	Gillnets	Jiggers	Danish seine	Bottom trawl	Pelagic trawl	Nephrops trawl	Purse seine	Shrimp trawl	Other gears	Total
Capelin						161529		439521		0	601050
blue whiting						361865		0		0	361865
Herring	0				2	44517		77274		0	121793
Cod	57416	37348	14686	14224	95129	345	1334	0	44	585	221111
Haddock	23199	1701	68	8175	49850	350	419	0	30	18	83810
Saithe	1058	2220	2629	1334	54613	635	154	0	0	37	62680
Redfish	843	144	139	589	33289	48	443	0	8	0	35504
Deep water prawn		0				0		0	17036	0	17036
Greenland halibut	170	1392		0	13618	297		0	1	0	15478
Atlantic wolffish	5746	71	11	2011	5214	5	82	0	16	16	13173
deepwater redfish	1	0	0	0	12232	110		0		0	12343
Plaice	56	204	0	4040	1360	2	4	0	4	34	5705
ling	2016	545	7	174	656	0	320	0	0	7	3726
greater argentine,					3565	80		0		0	3645
spotted wolffish, leoparc	1412	11	0	22	1820	6	3	0	1	4	3279
tusk, torsk, cusk	3006	28	8	0	85	0	7	0		0	3135
Dab	6	18	0	2896	33	0	0	0		0	2953
Monkfish	16	780	1	278	308	0	353	0		488	2224
Lemon sole	0	5	0	1569	609	1	25	0	1	0	2210
Witch	0	0		1732	57	0	333	0		0	2122
Long rough dab	6	4	0	1780	144	0	35	0	1	0	1970
Norway lobster			0			0	1437	0		0	1437
blueling, European ling	145	5		39	876	2	23	0		0	1090
whiting	224	24	2	84	690	0	22	0		0	1048
starry ray, thorny skate	314	133	0	440	117	1	0	0	0	7	1012
Other species											12708
Total	**95634**	**44633**	**17553**	**39389**	**274269**	**569794**	**4996**	**516795**	**17142**	**1195**	**1594109**

Table 1.2.2.2 Catches of Greenland halibut (in kg) within the areas given in Figure 1.2.2.7, as reported in the logbooks of the bottom trawlers. The data are also given as a percentage.

Species	Western	Eastern	Grand Total	Western	Eastern	Grand Total
Greenland halibut	16282551	1226180	17508731	90.13	62.03	87.36
saithe	7736	7889	15625	0.04	0.40	0.08
S. marinus	141420	22270	163690	0.78	1.13	0.82
cod	34298	530203	564501	0.19	26.82	2.82
haddock	0	6500	6500	0.00	0.33	0.03
catfish	1001	325	1326	0.01	0.02	0.01
plaice	5559	0	5559	0.03	0.00	0.03
halibut	500	0	500	0.00	0.00	0.00
ling	6513	0	6513	0.04	0.00	0.03
blue ling	7897	0	7897	0.04	0.00	0.04
S.mentella	1578693	183328	1762021	8.74	9.27	8.79

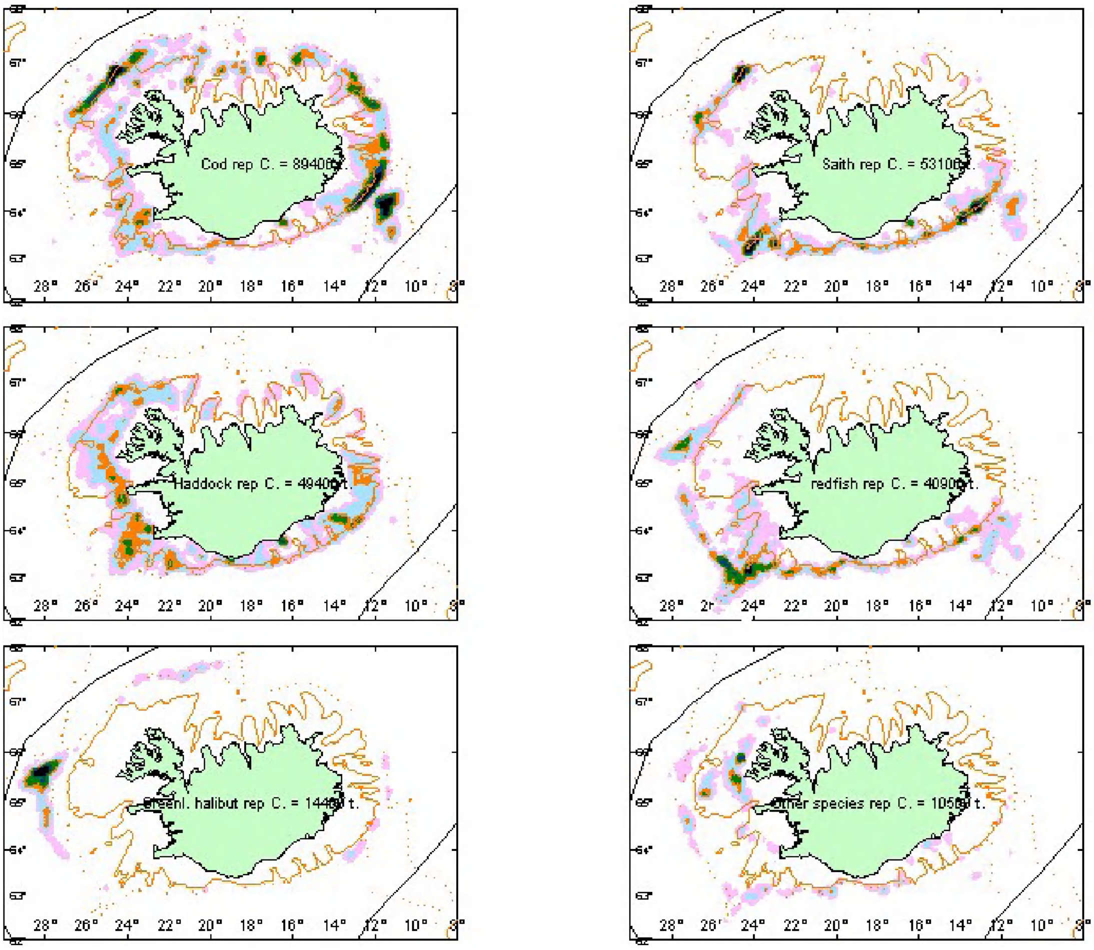


Figure 1.2.2.1 Location of catches of cod, saithe, haddock, redfish, Greenland halibut and others caught with bottom trawl 2004.

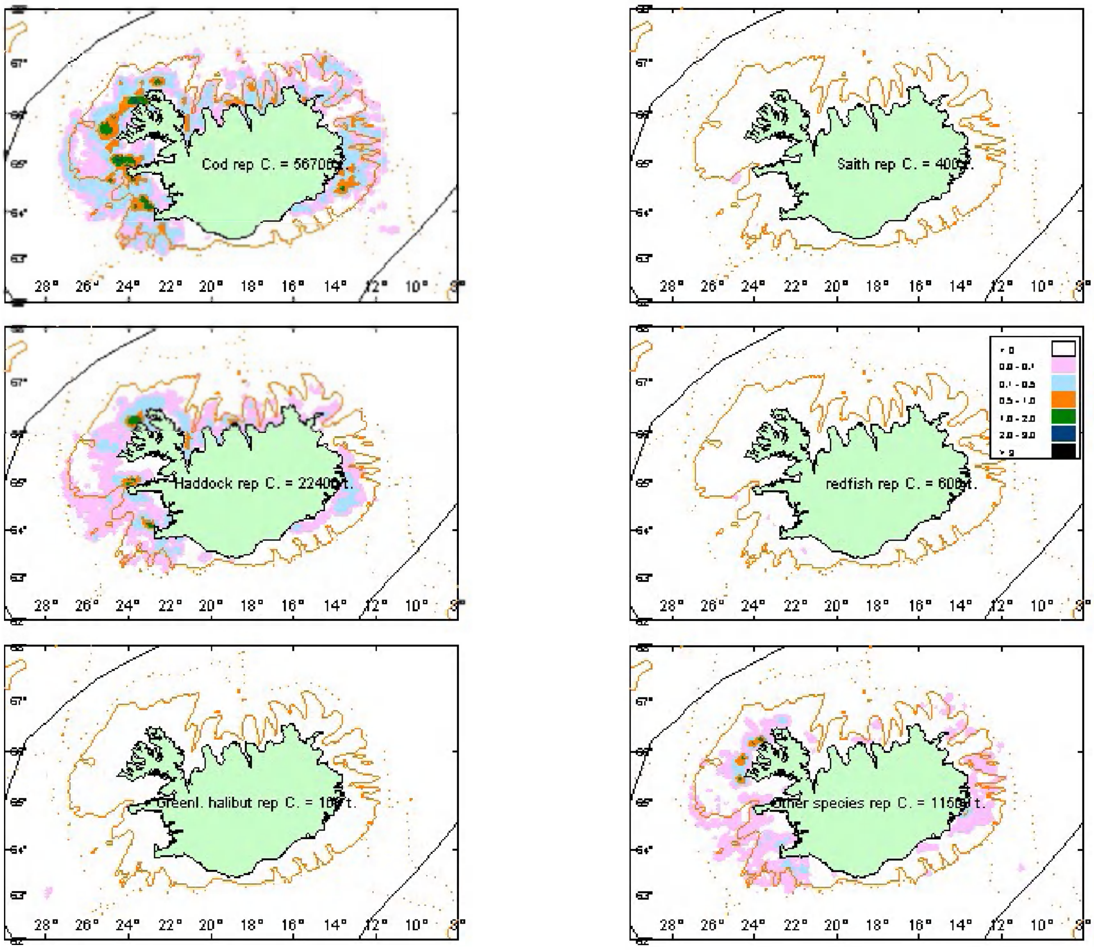


Figure 1.2.2.2 Location of catches of cod, saithe, haddock, redfish, Greenland halibut and others caught with longline in 2004.

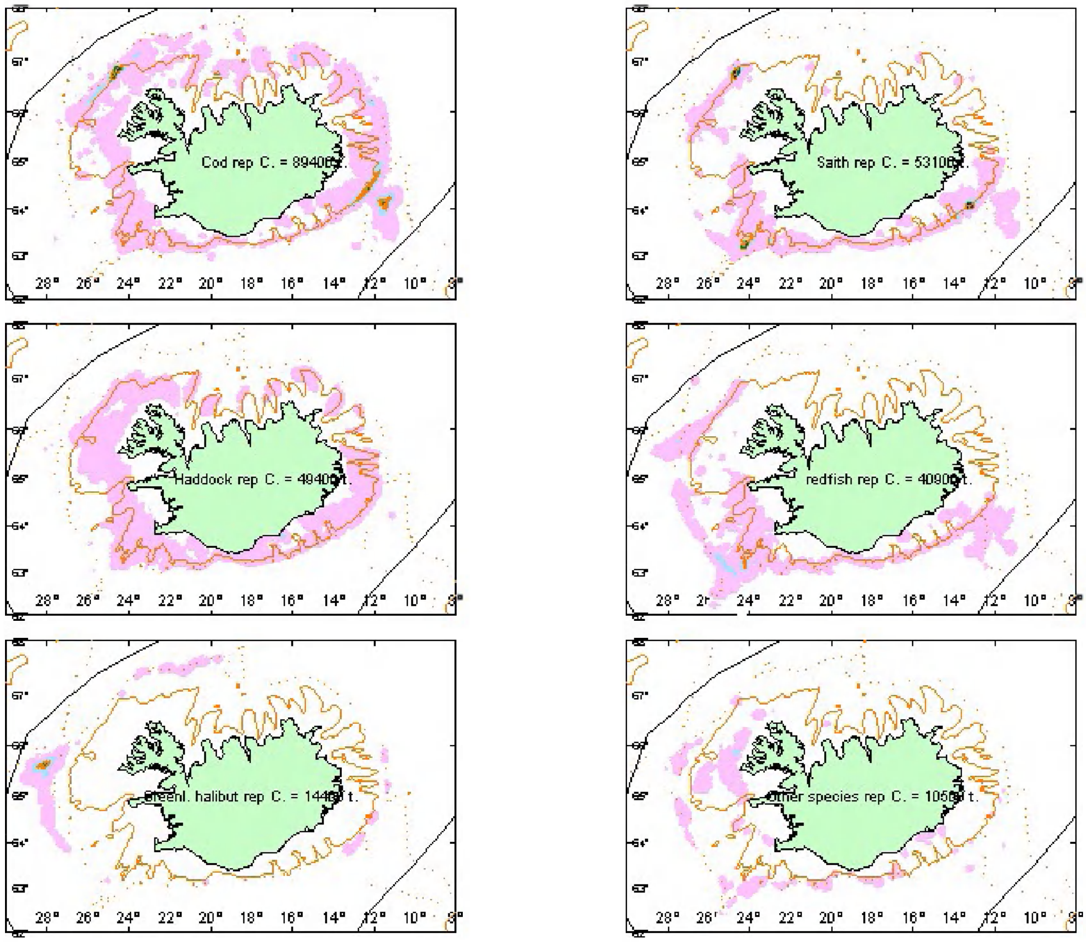


Figure 1.2.2.3 Location of catches of cod, saithe, haddock, redfish, Greenland halibut and others caught with gillnets in 2004.

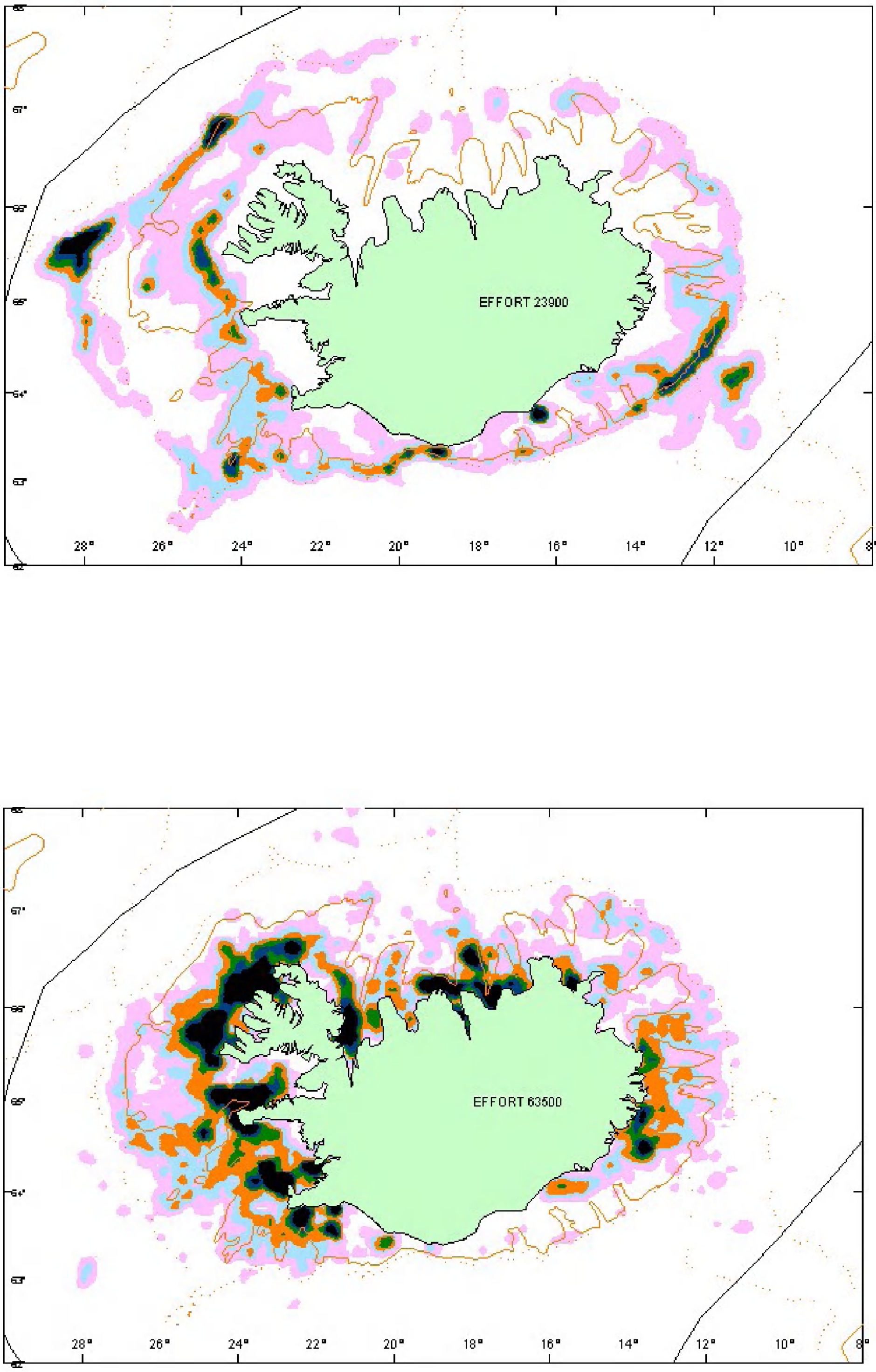


Figure 1.2.2.4 Effort of the trawler fleet in 2004. The dark colours show the areas of the greatest fishing effort to be off the southeast to the west coast and off Northwest Iceland.

Figure 1.2.2.5 Effort in the longline fleet in 2004. The dark colours show the areas of the greatest fishing effort to be off the northwest and west coast, but fishing is also concentrated along the entire southwest and south coast. The main targeted species for longline fishing are cod, haddock, catfish, and tusk.

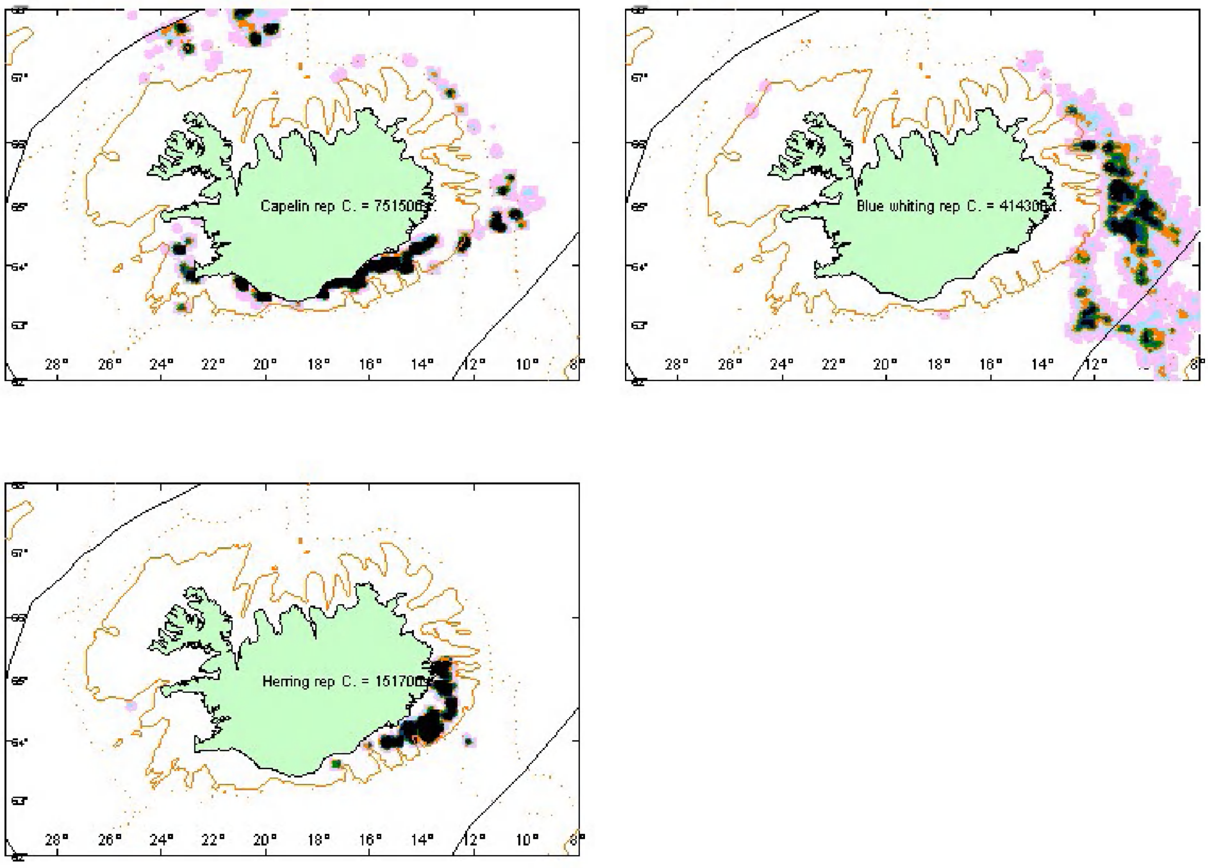


Figure 1.2.2.6 Location of catches of capelin, Icelandic spring-spawning herring, and blue whiting with purse seine and pelagic trawls in 2004.

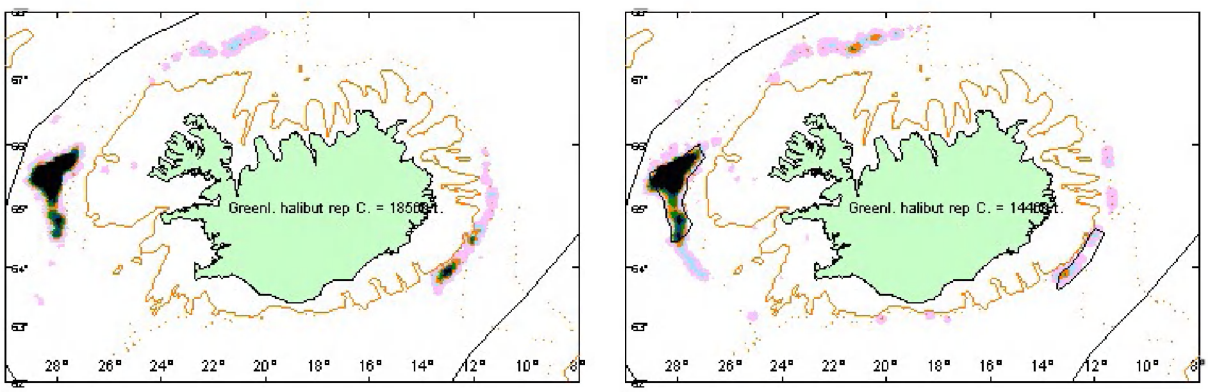


Figure 1.2.2.7 Greenland halibut catches in 2004. The boxed-in areas are the ones referred to in Table 1.2.2.2.

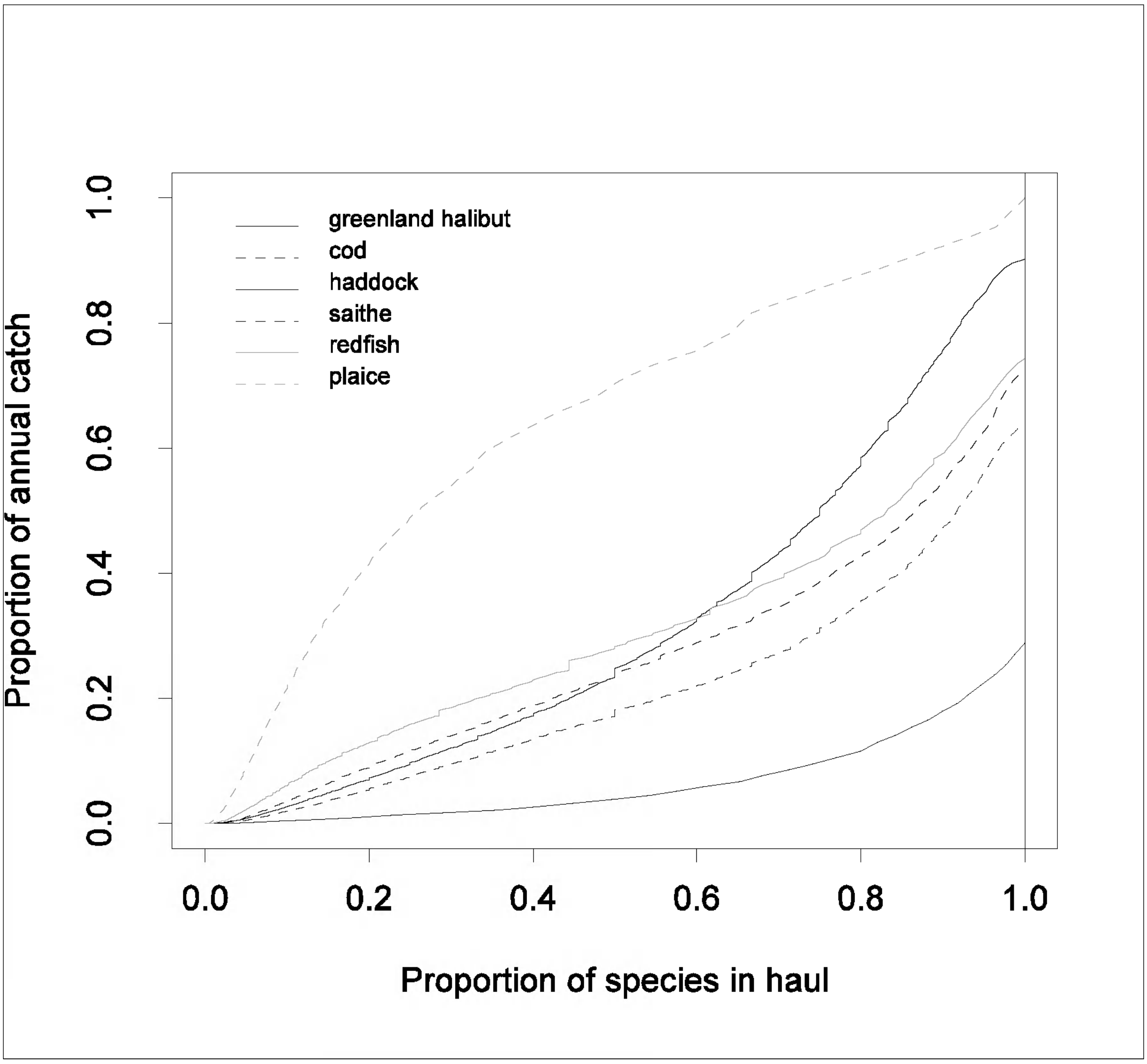


Figure 1.2.2.8 Cumulative plot for bottom trawl in 2004. An example describes this probably best. Looking at the figure above it can be seen from the dashed lines that 30% of the catch of haddock comes from hauls where haddock is less than 50% of the total catch, while only 4% of the catch of Greenland halibut comes from hauls where it is less than 50% of the total catch. 75% of the plaice is on the other hand caught in hauls where plaice is a minority of the catches. The figure also shows that 70% of the catch of Greenland halibut comes from hauls where nothing else is caught but only 15% of the haddock. Of the species shown in the figure plaice is the one with the largest proportion taken as bycatch, while Greenland halibut is the one with the largest proportion caught in mixed fisheries.

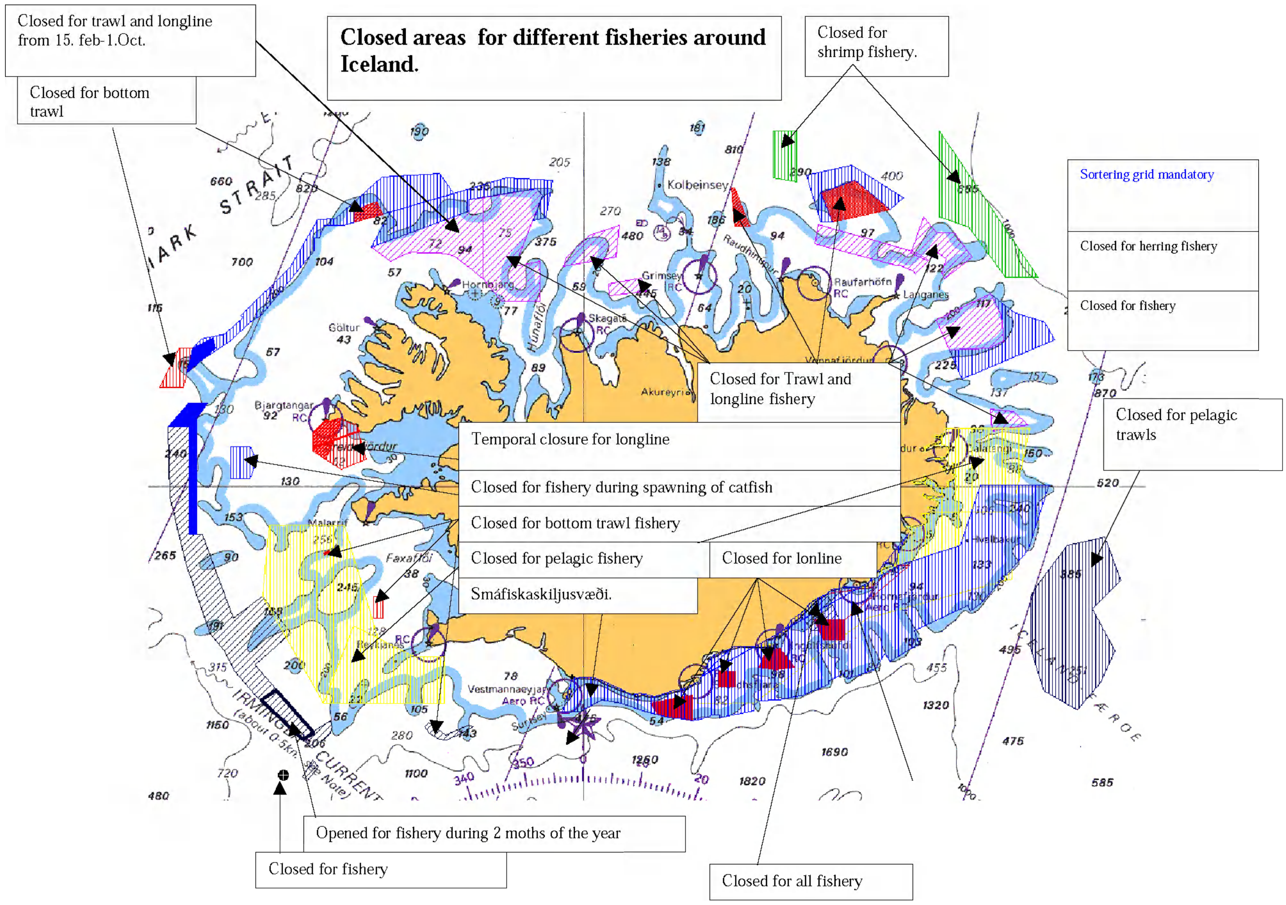


Figure 1.2.2.9 Overview of closed areas around Iceland in 2004. The boxes are of a different nature and can be closed for different time periods and gear type.

1.3 Assessments and advice

Mixed fisheries and fisheries interactions

The major fishery in Greenland is the shrimp fishery, with annual landings of about 100 000 t; this fishery is known to have bycatches of juvenile cod, redfish, and Greenland halibut. The magnitude of bycatches is not quantified but is expected to be reduced since the mandatory use of sorting grids (bar distance 26 mm) was introduced in this fishery. Large pelagic fisheries for *S. mentella* mainly southeast of Greenland are clean fisheries without bycatches. The only bottom trawl fisheries for fish are for Greenland halibut at depths of 500–1500 m; this fishery has some bycatches of roundnose grenadier and sharks. Small longline fisheries in East Greenland are rather clean with minor bycatches of roughhead grenadier, tusk, Atlantic halibut, and Greenland shark.

Some of the species caught in Icelandic waters are caught in fisheries targeting only one species, with very little bycatch. An example of this is the directed Greenland halibut fishery (Table 1.2.2.2) which is fished in waters deeper than 500 m west and southeast of Iceland. The bycatch in the Greenland halibut fishery in these areas (Table 1.2.2.2) show that it is a very clean fishery, with Greenland halibut comprising over 90% of the total catches in the western area where over 16 thousand tonnes are caught, and with deep-sea redfish being the most important bycatch species comprising less than 9% of the total catch in that area. Other bottom trawl fisheries are more mixed. Figure 1.2.2.8 indicates to what extent the 2004 catch of different species is bycatch. The x axis indicates the proportion of each species in regard to the total catch in the setting or haul, and the y axis shows the proportion of the annual catch of the species coming from hauls where the proportion of the species is less than the selected proportion. From this coarse analysis one may conclude that the fisheries of cod, haddock, saithe, and *S. marinus* is a relatively mixed fishery. However, the Greenland halibut fishery is relatively direct. Thus any advice given for the Greenland halibut should not influence the advice of gadoid stocks.

At present, ICES assesses only a few of the stocks currently exploited in Icelandic waters. However, many of the species listed in Table 1.2.2.1 are assessed by the Marine Research Institute, Reykjavik, Iceland, and TACs are advised. The Icelandic management authorities set TACs for these species.

If a proper fishery-based advice taking mixed fisheries issues into account should be given for the Icelandic fishery ICES would need to evaluate the status of these bycatch stocks. ICES is therefore not in a position to provide mixed fisheries advice for these fisheries.

Single-stock exploitation boundaries and critical stocks

The state of stocks and single-stock exploitation boundaries are summarised in the table below.

Species	State of the stock				ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2006
	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	in relation to agreed management plan	in relation to precautionary limits	in relation to target reference points	
Greenland cod	-	-	-	-	-	-	-	No fishery should take place.
Icelandic cod	-	-	Over-exploited.	-	198 000 t for 2005/2006.	-	-	198 000 t for 2005/2006.
Icelandic haddock	-	-	-	-	-	110 000 t in 2005/2006.	-	110 000 t in 2005/2006.
Icelandic saithe	Full reproductive capacity.	Increased risk.	-	-	-	78 000 t in 2005/2006.	-	78 000 t in 2005/2006.
Greenland halibut	-	-	-	-	-	Reduction in effort implying catches ~ 15 000 t.	-	Reduction in catches ~ 15 000 t.
Sebastes marinus	Full reproductive capacity (but based on fishable biomass).	-	-	-	-	37 000 t (total for Va and Vb); no directed fishery in XIV.	-	37 000 t37 000 t (total for Va and Vb): no directed fishery in XIV.
Demersal *Sebastes mentella*	-	-	-	-	-	22 000 t. No directed fishery for *S. mentella* in Subarea XIV.	-	22 000 t.
Icelandic summer-spawning herring	Full reproductive capacity.	-	-	-	-	110 000 t in 2005/2006.	-	110 000 t.
Capelin	-	-	-	-	No fishery until new information on stock size becomes available, showing a spawning stock biomass of at least 400 000 t in March 2006.	-	-	No fishery until new information on stock size becomes available, showing a spawning stock biomass of at least 400 000 t in March 2006.

Identification of critical stocks

The table above identifies the exploitation boundaries for single stocks in the area. The stocks which require closures or large reductions in fisheries are Greenland cod in the East Greenland area and capelin in the Iceland-East Greenland-Jan Mayen area, as well as pelagic redfish (*S. mentella*) and Greenland halibut in the Irminger Sea and adjacent areas.

Advice for fisheries management

The present advice does not cover all stocks taken in that area. If a proper fishery-based advice taking mixed fisheries issues into account should be given for the Icelandic fishery ICES would need to evaluate the status of all stocks listed in Table 1.2.2.1. ICES is therefore not in a position to provide mixed fisheries advice for these fisheries. For the stocks covered by the present advice ICES can provide the following advice:

For the area around Iceland Division Va, Subarea XII, and the East Greenland area (Division XIV) the following apply:

1. **The advice concerning pelagic *S. mentella*: includes all parts of the unit which occurs in the NAFO Convention Area and in Division Va and Subareas XII and XIV. The advice for this stock will be finalized in October 2005.**
2. **For deep-sea fisheries the advice will be finalized in October 2005.**
3. **For capelin there should be no catch until new information on stock size becomes available, showing a spawning stock biomass of at least 400 000 t in March 2006. As capelin is taken in a separate fishery there are no mixed fisheries concerns regarding protection of capelin.**
4. **Concerning the fisheries in the East Greenland area (Division XIV) in 2006 there should be no fishery on Greenland cod and *S. marinus*.**
5. **For other species, fishing of each species should be restricted within the precautionary limits as indicated in the table of individual stock limits above. Many of these stocks are confined to only part of the areas under consideration and the advice only pertains to the stock area.**

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.

Regulations in force and their effects

The Ministry of Fisheries is responsible for management of the Icelandic fisheries and implementation of the legislation. The Ministry issues regulations for commercial fishing for each fishing year, including an allocation of the TAC for each of the stocks subject to such limitations.

A system of boat quotas was introduced in 1984. The agreed quotas were based on the Marine Research Institute's TAC recommendations, taking some socio-economic effects into account, as a rule to increase the quotas. Until 1990 the quota year corresponded to the calendar year, but since then the quota, or fishing year, starts on September 1 and ends on August 31 the following year. This was done to meet the needs of the fishing industry.

In 1990, an individual transferable quota (ITQ) system was established for the fisheries and they were subject to vessel catch quotas. The quotas represent shares in the national total allowable catch (TAC) for each species, and most of the Icelandic fleets operate under this system.

With the extension of the fisheries jurisdiction to 200 miles in 1975, Iceland introduced new measures to protect juvenile fish. The mesh size in trawls was increased from 120 mm to 155 mm in 1977. A mesh size of 135 mm was only allowed in the fisheries for redfish in certain areas. Since 1998 a mesh size of 135 mm has been allowed in the codend in all trawl fisheries not using "Polish chaefer". A quick closure system has been in force since 1976 with the objective to protect juvenile fish. Fishing is prohibited for at least two weeks in areas where the number of small fish in the catches has been observed by inspectors to exceed a certain percentage (25% or more of <55-cm cod and saithe, 25% or more of <45-cm haddock, and 20% or more of <33-cm redfish). If, in a given area, there are several consecutive quick closures the Minister of Fisheries can with regulations close the area for longer time, forcing the fleet to operate in other areas. Inspectors from the Directorate of Fisheries supervise these closures in collaboration with the Marine Research Institute. In 2004, 73 such closures took place.

In addition to allocating quotas on each species, there are other measures in place to protect fish stocks. Based on knowledge on the biology of various stocks, many areas have been closed temporarily or permanently, aimed at protecting juveniles. In addition major spawning areas for cod, plaice, and catfish are closed during spawning time. Figure 1.2.2.9 shows a map of such legislation that was in force in 2004. Some of the closures were temporary, while other areas have been closed for decades. Furthermore there are regulations on the mesh size in the gillnet fishery for cod.

No evaluation of the effect of the measures above is available to ICES.

Since the implementation of the catch rule in 1995 realized reference fishing mortalities have been in the range of 0.56–0.76, in the last four years about 0.7. The expected long-term fishing mortality by the application of the catch rule was 0.4. One may therefore conclude that the objectives of the management system have not been realized.

Quality of assessments and uncertainties

The resources in the area have generally been managed on the basis of fairly long and detailed time-series of data. There are well-known difficulties with the assessments, for example age readings of slow-growing species such as redfish and Greenland halibut. The problems are the same in these areas as elsewhere. Greenland halibut, pelagic redfish (*Sebastes mentella*) in the Irminger Sea (Subareas XII and XIV), and demersal *S. mentella* on the shelf (Subareas V, XII, and XIV) are the stocks with the most apparent need for improvements in data analysis and in the gathering of auxiliary information. Such required auxiliary information is trawl abundance or acoustic stock indices. The time-series with information on the commercial catch per unit of effort of these species are considered to be biased because the gears by which these species are fished have increased in size over time. Present catch rates can therefore not directly be compared with those in previous periods. Information on the development of these gears is required to correct for the bias. Comprehensive assessment of these large and widely distributed stocks is a challenging task which requires full-scale international cooperation.

The assessments of Icelandic cod, haddock, saithe, and *Sebastes marinus* are all done as analytical assessments, using landings, catch-at-age data, and age-based indices from standardized scientific surveys. The quality of the sampling from the commercial fishery is considered adequate for all these stocks. However, long-term data on discarding and other illegal activities are not available, hampering a full evaluation on the quality of the assessments. Discard data are now available since 2002. The primary objective of the scientific survey is to obtain accurate stock indicators for cod and haddock. The uncertainties in the assessment of the gadoid stocks are thus largely a reflection of the different accuracy of the survey data for different stocks. Uncertainty estimates, although covering only a portion of the total uncertainty, are available for the gadoid stocks and could be used as a basis for the advice.

1.3.1 Special requests

1.3.1.1 NEAFC Request concerning redfish stocks in the Irminger Sea and adjacent areas

NEAFC requests ICES to provide the following:

1. Regarding redfish stocks in the Irminger Sea and adjacent areas:

a) Provide information of stock identity of *Sebastes mentella* fished in pelagic and demersal fisheries. ICES is asked to describe concepts on which management of *Sebastes mentella* can be based;

b) Provide quantitative information to allow spatial and temporal limitations in catches and other measures to avoid disproportionate exploitation rate of any one component, especially to prevent local depletion;

ICES Response

a) Some new information is available, but it must be reviewed in a comprehensive evaluation that integrates these results with those from other disciplines. ICES will assess the stock based on the current advisory units until a synthetic review of stock identification information becomes available. These units are: a demersal unit on the continental shelf in ICES Divisions Va, Vb, and Subarea XIV, and a pelagic unit in the Irminger Sea and adjacent areas (Subareas V, VI, XII, and XIV).

b) ICES does not have the required information to provide advice on spatial allocations to avoid disproportionate exploitation and local depletion. It is expected, however, that if a substantial reduction in TAC is implemented a greater share of the catches will be taken at depths below 500 m in the northeastern area. This could be prevented by seasonal and/or area regulations.

1.4 ICELAND AND EAST GREENLAND

1.4.1 Greenland cod in ICES Subarea XIV and NAFO Subarea 1

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
Reference points not defined	Reference points not defined	Unknown	

In the absence of defined reference points, the state of the stock cannot be evaluated in this regard. The offshore component has been severely depleted since 1990 with some recovery potential as derived from recent survey indices. The dramatic decrease in stock abundance was associated with changes in environmental conditions, emigration, and high fishing mortalities. Spawning stock biomass of the offshore component in 2004, as estimated by exploratory analyses and surveys, was between 10 000 and 30 000 tonnes, as compared to SSB greater than 1 million tonnes in the late 1950s. With the exception of two year classes, recruitment has been extremely low since the late 1960s. However, the last two surveys indicate that the 2003 year class is more abundant than other recent year classes, possibly similar to the 1984 year class.

Stock size and exploitation rate of the inshore component are unknown.

Management objectives

Greenland and EU established an agreement on fisheries valid from 2001 to 2006. A variable TAC regulation has been agreed, with annual TACs adjusted to take account of ICES advice on stock status. The agreement also provides for a transfer of catches into future years, should a rapid increase in stock occur.

Reference points

No reference points have been proposed for this stock.

Single-stock exploitation boundaries

Exploitation boundaries in relation to existing management plans

No reference points have been proposed for this stock, so the agreement cannot be evaluated relative to the Precautionary Approach. However, TAC for 2005 is not consistent with the current ICES advice, and ICES stresses that any multi-annual management plan should ensure that fisheries do not expand until a substantial increase in biomass and recruitment is evident.

Exploitation boundaries in relation to precautionary considerations

ICES recommends that no fishery should take place.

Management considerations

A recovery plan for both the inshore and offshore components should be developed in order to take advantage of strong year classes when they occur and to protect all inshore spawning components.

Exploratory analysis indicates that recruitment of the 2003 year class is expected to contribute approximately 100 000 tonnes of SSB in the medium term under a no-fishing scenario, providing a first opportunity to start rebuilding the stock. However, the projected SSB is still orders of magnitude less than historic levels (e.g., approximately 1.5 million tonnes SSB in the 1950s). Therefore, survival of the 2003 year class should be maximized to promote the production of more strong year classes to truly rebuild the stock.

Other measures should be taken to avoid bycatch of juvenile cod in the shrimp fishery and other fisheries.

Most of the recent catch derives from the inshore component. Due to the low offshore landings since 1993 and a recent increase in inshore landings (approximately 5 000 t in the last two years), the contribution of the inshore landings has increased, accounting for 50–90% of the total landings from 1993 to 2004.

The historical fishery mainly occurred in western Greenland waters. Unlike recent year classes, the potentially abundant 2003 year class has been observed in both eastern and western Greenland waters.

Factors affecting the fisheries and the stock

Regulations and their effects

The agreement between Greenland and EU stipulates TAC levels far above the expected catches. In the offshore fisheries the regulations in force include closed areas and minimum mesh size. The inshore fisheries are only regulated by a minimum landing size.

Changes in fishing technology and fishing patterns

Since 1989 a major shift in the shrimp fishery towards southern fishing grounds has occurred. Before the introduction of the sorting grid in 2000, juvenile cod might have been caught at higher rates in the shrimp fishery. Anecdotal information indicates that one- and two-year-old cod are still caught in the shrimp fishery in Greenland waters, but no quantitative estimates are available.

The environment

The present environmental and biological conditions, high temperatures, and large shrimp stock, have improved re-colonization of the offshore areas.

During the past decade, increased water temperatures have been favorable for cod in Greenland waters. Increase in size-at-age and earlier maturation that is indicated from survey results may be interpreted as the response of the stock to such favorable conditions.

In Greenland waters there are inshore fjord stocks and offshore stocks. Given suitable environmental conditions (water temperature), a high and sustained production of offshore cod is possible, and it has historically given rise to annual catches above 400 thousand tonnes. However, interaction between the East Greenland and Irminger currents during the early 1970s and 1980s has apparently rendered environmental conditions unsuitable for offshore cod in some years. Combined with high fishing mortality, this caused the offshore cod stock to be severely depleted. In order to take advantage of suitable climatic conditions when they occur, it is necessary to protect the remaining biomass of offshore cod.

Scientific basis

Data and methods

After its depletion in 1992, the stock is assessed by trends in research survey indices. Fishery data are sparse and commercial sampling is not conducted. Exploratory analyses were used to estimate the magnitude of the 2003 year class.

Comparison with previous assessment and advice

The advice is the same as last year.

Source of information

Report of the North-Western Working Group, 26 April–5 May 2005 (ICES CM 2005/ACFM:21).

Year	ICES advice for Subarea XIV[1]	Pred. catch corresp. to advice	Agreed TAC			ACFM Inshore Catch	ACFM total catch inshore + offshore		
			East	West	Total		East	West	Total
1987	TAC	5	11.5	12.5		8	7	12	19
1988	No increase in F	10[2]	11.5	53		23	9	63	72
1989	TAC	5	15	90		39	15	112	126
1990	No specific recommendation	-	15	110	125	30	34	98	132
1991	No advice	-	25	90	115	19	22	20	42
1992	No advice	-	17.25	66	99.25	6	11	6	17
1993	No fishing	0	17.25	66	83.25	2	1	2	3
1994	No fishing on offshore stock complex	0	17.25	66	83.25	2	< 1	2	3
1995	No fishing on offshore stock complex	0	17.25	66	83.25	2	< 1	2	2
1996	No fishing on offshore stock complex	0	17.25	66	83.25	1	< 1	1	1
1997	No fishing on offshore stock complex	0	17.25	66	83.25	1	< 1	1	1
1998	No fishing on offshore stock complex	0	17.25	66	83.25	< 1	< 1	< 1	< 1
1999	No fishing on offshore stock complex	0	17.25	66	83.25	< 1	< 1	< 1	< 1
2000	No commercial fishing	0	17.25	66	83.25	< 1	< 1	< 1	< 1
2001	No commercial fishing	0	17.25	66	83.25[3]	2	< 1	2	2
2002	No commercial fishing	0			54.25[3]	4	<1	4	4
2003	No commercial fishing	0			54.25[3]	5	<1	5	5
2004	No commercial fishing	0			5	5	<1	5	5
2005	No fishing	0			5				
2006	No fishing	0							

Weights in '000 t.

[1]Advice for NAFO Subarea 1 provided by NAFO Scientific Council.

[2]Preliminary catch corresponding to advice.

[3]Since 2001 the agreed TAC is based on a variable system accounting for the actual stock status and more flexibility between East and West Greenland. The given TAC figures represent maximum levels, which could be taken in case of stock recovery only.

Greenland cod landings from 1955-2004 (ICES Subarea XIV and NAFO Subarea 1)

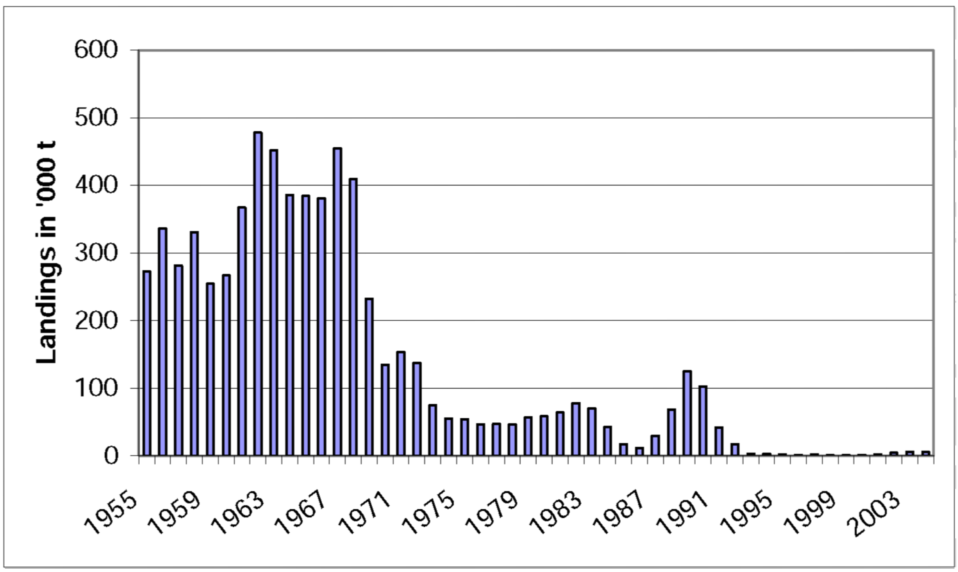


Table 1.4.1.1 Nominal catch (tonnes) of Cod in NAFO Subarea 1, 1988-2004 as officially reported to NAFO.

Country	1988	1989	1990	1991	1992	1993	1994
Faroe Islands	-	-	51	1	-	-	-
Germany	6.574	12.892	7.515	96	-	-	-
Greenland	52.135	92.152	58.816	20.238	5.723	1.924	2.115
Japan	10	-	-	-	-	-	-
Norway	7	2	948	-	-	-	-
UK	927	3780	1.631	-	-	-	-
Total	59.653	108.826	68.961	20.335	5.723	1.924	2.115
WG estimate	62.653 [2]	111.567 [3]	98.474 [4]	-	-	-	-

Country	1995	1996	1997	1998	1999	2000	2001
Faroe Islands	-	-	-				
Germany	-	-	-				
Greenland	1.710	948	904	319	622	764	1680
Japan	-	-	-				
Norway	-	-	-				
UK	-	-	-				
Total	1.710	948	904	319	622	764	1680
WG estimate	-	-	-	-	-	-	-

Country	2002	2003	2004[1]				
Faroe Islands							
Germany							
Greenland	3698		4948				
Japan							
Norway							
UK							
Total	3698		4948				
WG estimate	-	5215	-	-	-	-	-

[1]) Provisional data reported by Greenland authorities
[2]) Includes 3,000 t reported to be caught in ICES Subarea XIV
[3]) Includes 2,741 t reported to be caught in ICES Subarea XIV
[4]) Includes 29,513 t caught inshore

Table1.4.1.2 Nominal catch (tonnes) of cod in ICES Subarea XIV, 1988-2003 as officially reported to ICES.

Country	1988	1989	1990	1991	1992	1993	1994
Faroe Islands	12	40	-	-	-	-	1
Germany	12.049	10.613	26.419	8.434	5.893	164	24
Greenland	345	3.715	4.442	6.677	1.283	241	73
Iceland	9	-	-	-	22	-	-
Norway	-	-	17	828	1.032	122	14
Portugal							
Russia		-	-	-	126		-
UK (Engl. and Wales)	-	1.158	2.365	5.333	2.532	-	-
UK (Scotland)	-	135	93	528	463	163	-
United Kingdom	-	-	-	-	-	46	296
Total	12.415	15.661	33.336	21.800	11.351	-	408
WG estimate	9.457 [1]	14.669 [2]	33.513 [3]	21.818 [4]	-	736	-
						-	

Country	1995	1996	1997	1998	1999	2000	2001
Faroe Islands	-	-	-	-	6		
Germany	22	5	39	128	13	3	92
Greenland	29	5	32	37 [5]	+ [5]		4
Iceland	1	-	-		-	-	210
Norway	+	1	-	+	2	- [5]	43
Portugal				31	-	-	278
Russia	-	-	-				
UK (E/W/NI)	232	181	284	149	95	149	
UK (Scotland)	-	-	-				
United Kingdom							129
Total	284	192	355	345	116	152	756
WG estimate	-	-	-	-	-	-	

Country	2002	2003	2004[5]
Faroe Islands			329
Germany	5	1	
Greenland	232	78	23
Iceland			
Norway	13		5
Portugal			
Russia			
UK (E/W/NI)			
UK (Scotland)			
United Kingdom	34		
Total	284	79	357
WG estimate	448[6]	294	1 357

[1]) Excluding 3,000 t assumed to be from NAFO Division 1F and including 42 t taken by Japan
[2]) Excluding 2,741 t assumed to be from NAFO Division 1F and including 1,500 t reported from other areas assumed to be from Subarea XIV and including 94 t by Japan and 155 t by Greenland (Horsted, 1994)
[3]) Includes 129 t by Japan and 48 t additional catches by Greenland (Horsted, 1994)
[4]) Includes 18 t by Japan
[5]) Provisional data including 1000 t from anecdotal information

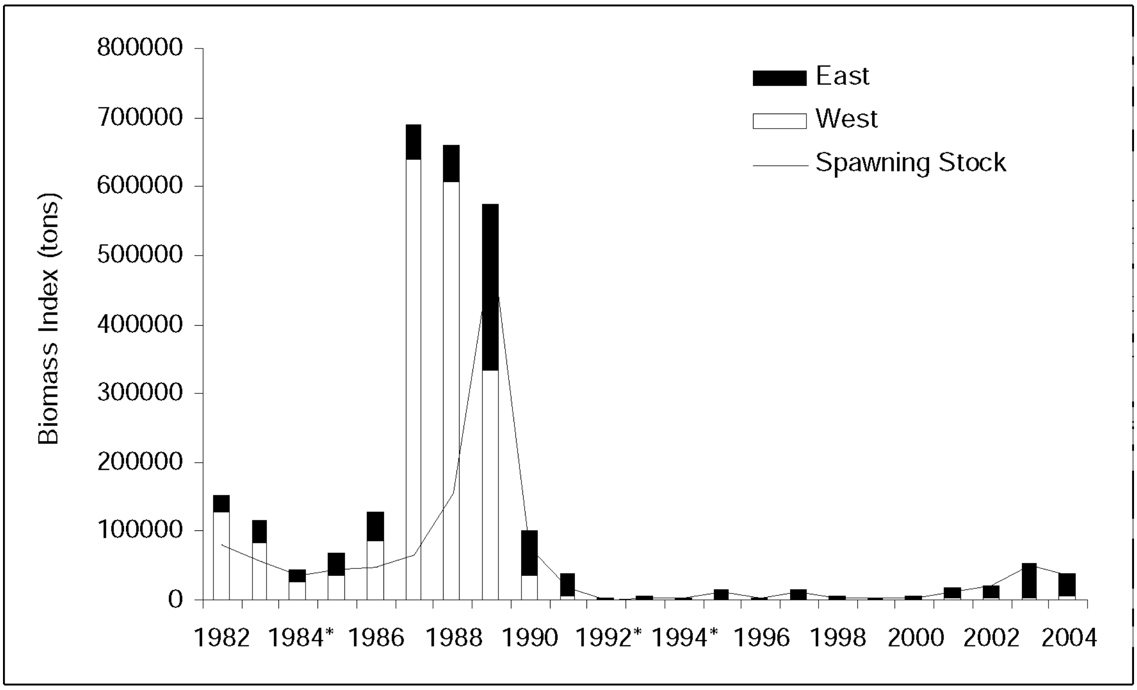


Figure 1.4.1.1 Cod off Greenland (offshore component), German survey. Aggregated survey biomass indices for West and East Greenland and spawning stock biomass, 1982–2004. *) incomplete survey coverage.

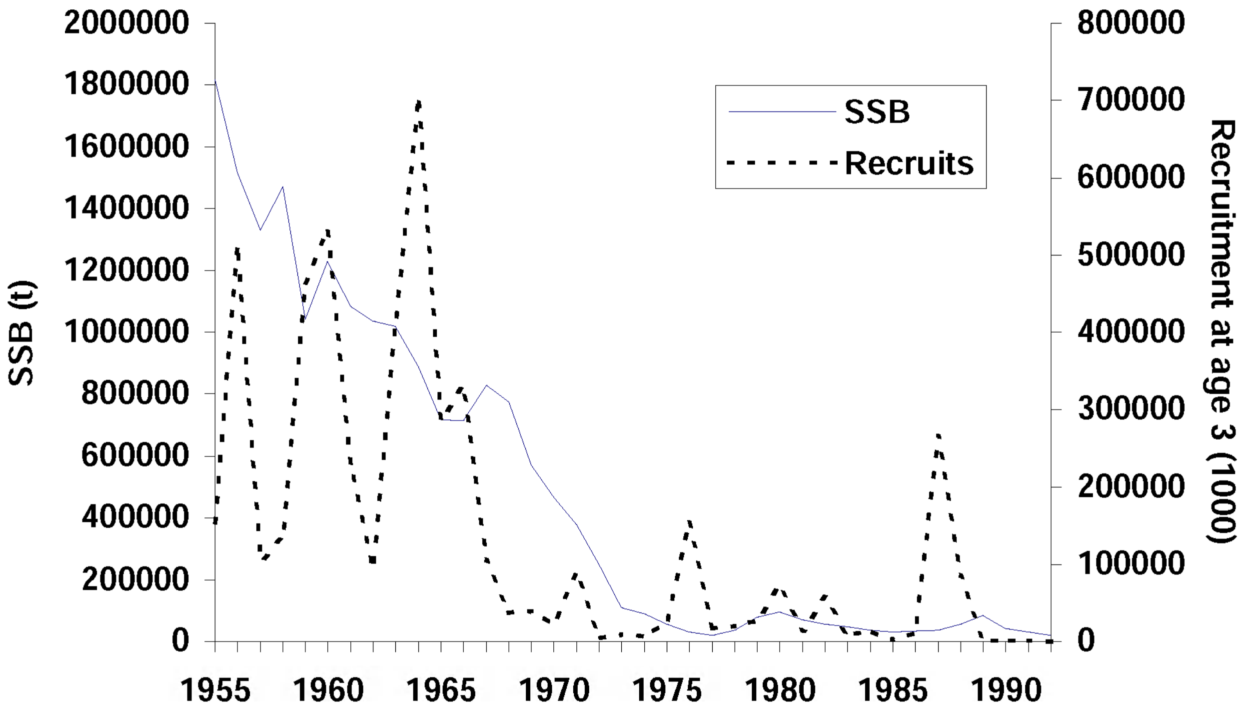


Figure 1.4.1.2 Greenland cod offshore component historic SSB.

1.4.2 Icelandic cod Division Va

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	Comment
Reference points not defined	F in 2004 was too high	Overexploited	

In the absence of defined reference points, the state of the stock cannot be evaluated in this regard. The fishing mortality (0.6) is above the intended average fishing mortality assumed in the harvest control rule (0.4). SSB in 2005 is currently estimated to be 262 000 t, 123 000 t above its historic low, but below the long-term average of 304 000 t. Recruitment was poor or below average for the year classes 1985–1996. The year classes after 1997–2000 and 2002 are estimated at average size, year classes 2001, 2003, and 2004 are now estimated as poor, and year classes 2001 and 2004 seem to be near historical low. Fishing mortality dropped markedly in 1995 and 1996 in accordance with the measures taken by Iceland to reduce fishing effort on cod, but then increased to above 0.7 in 2000–2001 and has decreased since then. This fishing mortality is well above the fishing mortalities that would give greater long-term yield.

Management objectives

A formal Harvest Control Rule was implemented for this stock in 1995. The TAC for a fishing year was set as a fraction (25%) of the "available biomass" which is computed as the biomass of age 4 and older fish B(4+), averaged over two adjacent calendar years. In the long term, this corresponds to a fishing mortality of about 0.4.

ICES's evaluation of the harvest control rule was based on simulations that lacked implementation error. ICES considers the 1995 harvest control rule to be consistent with the Precautionary Approach provided implementation error is minimal.

In spring 2000 the Icelandic government introduced an amendment to the catch rule, limiting interannual changes in catches to 30 000 t. Limited studies, using a similar approach as when the initial catch rule was adopted were the basis for this amendment. ICES has not evaluated the amendment. The 30 000 t stabilizer was in effect in the fishing years 2000/2001 and 2001/2002, but not thereafter.

The Harvest Control Rule was in a reviewing process in 2001–2004 by a group of scientists appointed by the Ministry of Fisheries. This group delivered a final report to the Minister in May 2004. The report has not been published and is only available in Icelandic. Based on simulation work the group recommended a new HCR using the average of last years TAC and 22% of the estimated reference biomass (B4+) in the assessment year. This HCR has not been adopted.

Reference points

Precautionary reference points have not been defined for this stock.

Yield and spawning biomass per Recruit
F-reference points

	Fish Mort Ages 5-10	Yield/R	SSB/R
Average last 3 years	0.620	1.748	1.558
$\mathbf{F}_{max}$	0.318	1.818	3.531
$\mathbf{F}_{0.1}$	0.139	1.641	7.944
$\mathbf{F}_{med}$	0.666	1.736	1.421

Single-stock exploitation boundaries

Exploitation boundaries in relation to existing management plans

Following the management plan would imply catches of 198 000 t in the fishing year 2005/2006.

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

The current fishing mortality (0.6) is well above fishing mortalities that would lead to high long-term yields ($\mathbf{F_{0.1}}$=0.14 and $\mathbf{F_{max}}$=0.32). This indicates that long-term yield will increase at Fs well below historical values.

Short-term implications

Outlook for 2006

Basis: F(2005) = 0.51; SSB(2006) = 276 B4+(2006)=822; catch (2005) = 205.

Rationale	TAC (2006)	Basis	F (2006)	B4+	SSB (2007)	%SSB change [1]	% TAC change [2]
Zero catch	0	F=0	0	1058	481	48	29
Status quo	214	$\mathbf{F_{sq}}$	0.51	814	267	-2	-1
High long-term yield	143	F(long-term yield)	0.31	895	332	14	9
Agreed management plan	20	TAC(man. plan) * 0.1	0.04	1035	461	44	26
	50	TAC(man. plan) * 0.25	0.10	1001	430	38	22
	99	TAC(man. plan) * 0.50	0.21	945	381	26	15
	148	TAC(man. plan) * 0.75	0.33	889	332	15	8
	178	TAC(man. plan) * 0.90	0.41	855	303	8	4
	198	TAC(man. plan)	0.46	833	281	2	1
	218	TAC(man. plan) * 1.1	0.52	810	264	-2	-1
	247	TAC(man. plan) * 1.25	0.61	777	236	-10	-6

Weights in '000 t.
Shaded scenarios are not considered consistent with the Precautionary Approach and management plan.
[1] SSB 2007 relative to SSB 2006.
[2] TAC 2006 relative to TAC 2005.

Management considerations

Catch quotas for the Icelandic cod stock have since 1994 been based on the 25% catch rule. This catch rule was based on extensive simulations and has been considered precautionary. Until 2000 the Icelandic government followed the catch rule with minimal deviations although it has turned out that the TAC has exceeded the 25% rule due to overestimation of the stock. In 2000 the Icelandic government changed the adopted 25% catch rule by limiting year-to-year changes in TAC to +/-30 000 t.

Since 1995 fishing mortalities have been stable in the range of 0.51–0.77, in the last four years about 0.64. With the application of the catch rule the expected long-term fishing mortality was 0.4. There have been problems with the implementation (the effort-controlled fleet takes more than provided for in the plan, and there has been overshooting of the TAC, decreasing from 14% in 2001 to 2% in 2004). Finally, previous assessments have in the past underestimated the fishing mortality.

At present, fishing mortality is high ($\mathbf{F}_{5\text{-}10}$ is about 0.6 in the year 2004) and age 8 and younger fish account for 96% of the fishable biomass (4+). The age composition of the spawning stock is highly truncated. Spawners at age 9 and younger will constitute about 96% of the spawning stock biomass in 2006. Given the relatively high proportions of younger fish in both the fishable and the spawning stock biomass, the relatively weak incoming year classes, and a low capelin abundance, lower fishing mortalities than those obtained by the Harvest Control Rule should be considered.

Management plan evaluations

Results of medium-term projections based on the current Harvest Control Rule indicate that the fishing mortality is expected to decrease, and catchable biomass 4+ will remain stable (Figure 1.4.2.1). The management plan has been in effect for about 10 years and the plan was re-evaluated by a group of Icelandic scientists in 2004, taking into account the experienced implementation problems and the assessment errors and biases. ICES is prepared to review this evaluation in 2006 if requested to do so.

Factors affecting the fisheries and the stock

Regulations and their effects

A quick closure system has been in force since 1976 with the objective to protect juvenile fish. Fishing is prohibited, for at least two weeks, in areas where the number of small cod (< 55 cm) in the catches has been observed by inspectors to exceed 25%. A preliminary evaluation of the effectiveness of the system indicates that the relatively small areas closed for a short time do most likely not contribute much to the protection of juveniles. On the other hand, several consecutive quick closures often lead to closures of larger areas for a longer time and force the fleet to operate in other areas. The effect of these longer closures has not been evaluated.

Since 1995, spawning areas have been closed during spawning season for 2–3 weeks for all fisheries. The intent of this measure was to protect spawning fish. In 2005, the maximum allowed mesh size in gillnets was decreased to 8 inches with the objective to protect the largest spawners.

The mesh size in the codend in the trawling fishery was increased from 120 mm to 155 mm in 1977. Since 1998 the minimum codend mesh size allowed is 135 mm, provided that a so-called "Polish cover" is not used. Numerous areas are closed temporarily or permanently for all fisheries or specific gears for protecting juveniles and habitat, or for socio-political reasons. The effects of these measures have not been evaluated.

The environment

Since 1991 a relationship between capelin biomass and the mean weight-at-age in the catches have been used to predict the mean weight-at-age in the stock for the most important age groups. The low biomass of capelin in 2004 and 2005 was reflected in the observed low weights-at-age in those years. These low weights were also used in forecasts, because the capelin biomass is expected to remain low.

In years of high recruitment a larval drift to Greenland is sometimes observed, resulting in a large year class at Greenland. In some other years an immigration of adult cod from Greenland has taken place, which has been taken into account in the assessment. Based on the present status of cod stocks in Greenland, no substantial immigration to Iceland can be expected in the near future.

An increased inflow of Atlantic waters has been observed in Icelandic waters since 1997, resulting in higher temperature and higher salinity in the stock area. At present, however, no relationships have been demonstrated between temperature or salinity and cod recruitment.

Since 1985, recruitment has fluctuated around a lower level than previously. This may be related to an environmental change.

The observed changes in hydrographic conditions may have affected the spatial distribution and abundance of capelin, the main food item of cod, or the spatial overlap between capelin and cod. The mean weights-at-age for cod are observed to be declining and no capelin were found in an echo-survey conducted in the conventional distribution area by the MRI in April this year.

Scientific basis

Data and methods

The data used in the assessment are catch-at-age and age-structured survey indices. The analytical assessment is based on catch and survey data using the AD-CAM (AD model builder statistical Catch-at-age Model) programme. Exploratory assessments using three different models gave consistent results. Catch-at-age data as well as survey indices are considered reliable.

Information from the fishing industry

A liaison group was established between fishers and the MRI working group on cod (The Icelandic Cod Council) in 2004. Active fishing captains representing various gears and fishing areas attend the annual meeting of the group. In a whole-day meeting the captains gave a short presentation, for each gear and area, of the fishery in the current year compared to previous years and their perspective of the status of the cod stock. Similarly, the fisheries biologists and stock assessment scientists in the group presented the latest available data on survey indices, CPUE from the commercial fleet, preliminary data on catch-at-age, maturity, and mean weights-at-age, etc.

Results were discussed, and if discrepancies were identified they were further scrutinized. In general there was a good consensus between the perspectives of fishers and scientists concerning the status of the cod stock in the first meeting of the group held at the end of November last year.

Uncertainties in assessment and forecast

The uncertainty in the biomass point estimate in the current year is estimated to be low. Uncertainty in the medium-term predictions are presented in Figure 1.4.2.1. These are likely underestimates of the uncertainty.

Comparison with previous assessment and advice

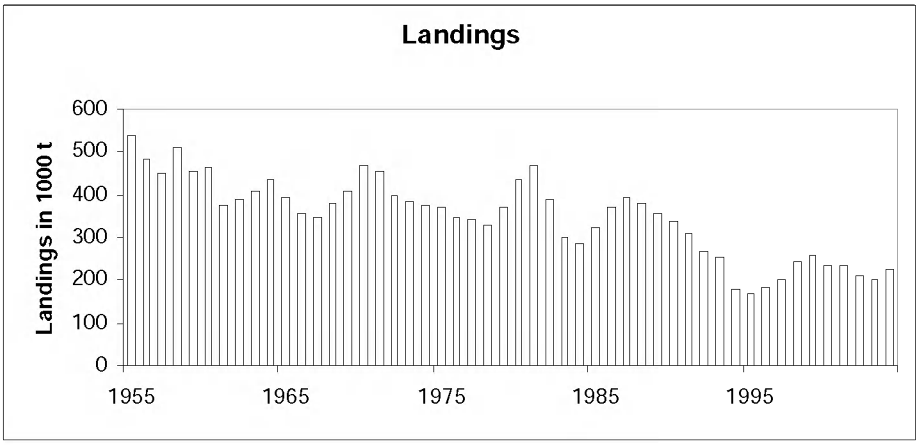
In the present assessment the estimated reference biomass (B4+) at the beginning of 2005 is 760 000 t compared to 785 000 t in last year's assessment. The reference biomass in 2004 was estimated at 854 000 t in last year's assessment, the same value as in the current assessment. The year classes 2000–2003 were estimated at 198, 68, 171, and 153 millions respectively in last year's assessment compared to 193, 69, 168, and 133 in the current assessment.

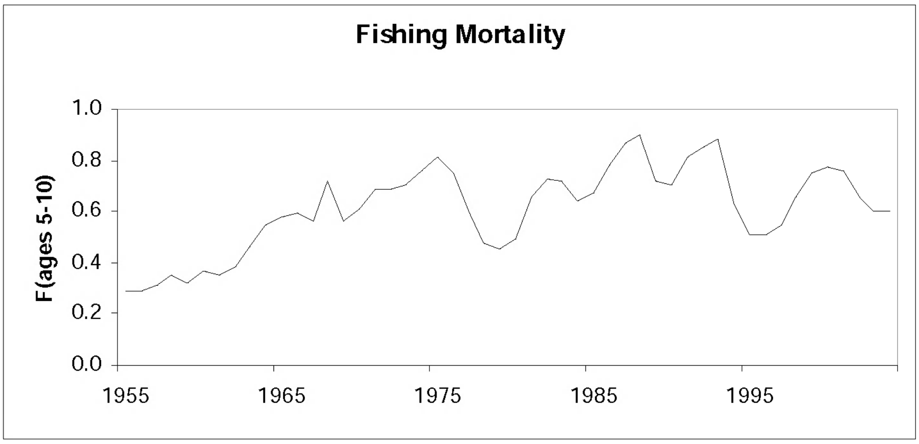
Source of information

Report of the North-Western Working Group, 26 April–5 May 2005 (ICES CM 2005/ACFM:21).

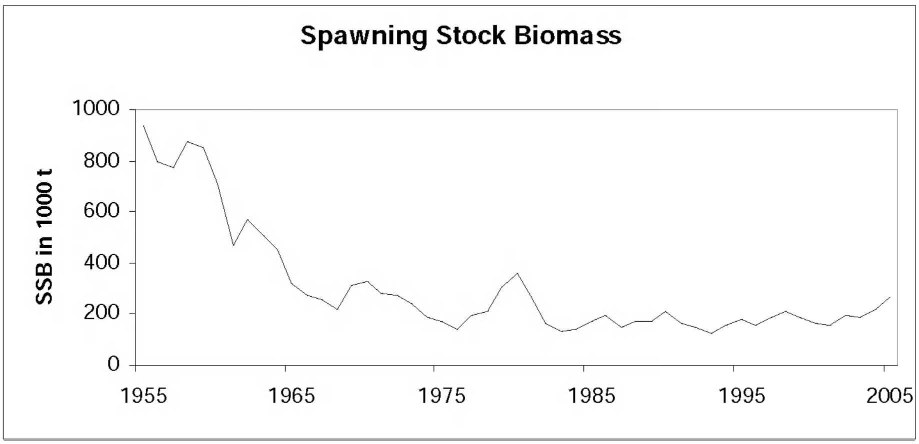
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	ACFM Catch for the fishing year	ACFM Catch for the calendar year
1988[1]	National advice	300	350		378
1989[1]	National advice	300	325		356
1990[1]	National advice	250	300		335
1991[1]	National advice	240	245		309
1991/1992[2]	National advice	250	265	274	274
1992/1993[2]	Reduce F by 40%	154	205	241	241
1993/1994[2]	Reduce F by 40%	150	165	197	197
1994/1995[2]	Reduce F by 50%	130	155	165	169
1995/1996[2]	Apply catch rule	155	155	170	182
1996/1997[2]	Apply catch rule	186	186	202	203
1997/1998[2]	Apply catch rule	218	218	227	243
1998/1999[2]	Apply catch rule	250	250	254	260
1999/2000[2]	Apply catch rule	247	250	257	236
2000/2001[2]	Apply catch rule	203	220[3]	221	235
2001/2002[2]	Apply catch rule	164	190[3]	217	209
2002/2003[2]	Apply catch rule	183	179[3]	198	202
2003/2004[2]	Apply catch rule	210	209	221	223
2004/2005[2]	Apply catch rule	205	205	210	205
2005/2006	Apply catch rule	198			

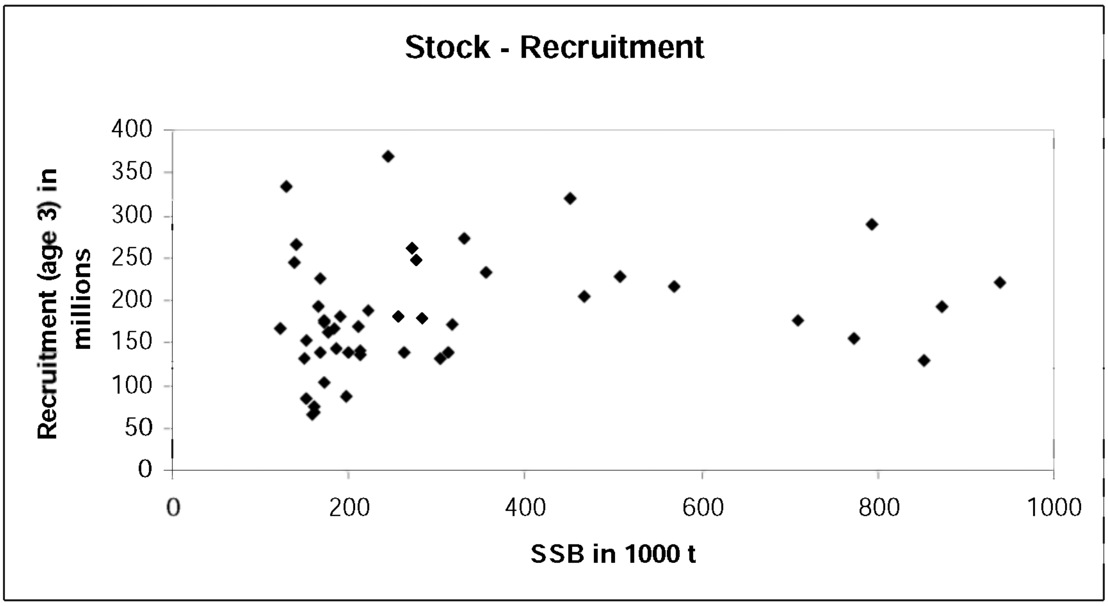
Weights in '000 t.
[1]Calendar year. [2]National fishing year ending 31 August;. [3] Amended catch rule.


Landings
Landings in 1000 t
600
500
400
300
200
100
0
1955
1965
1975
1985
1995


Fishing Mortality
F(ages 5-10)
1.0
0.8
0.6
0.4
0.2
0.0
1955
1965
1975
1985
1995


Recruitment (age 3)
Recruitment in millions
400
350
300
250
200
150
100
50
0
1955
1965
1975
1985
1995


Spawning Stock Biomass
SSB in 1000 t
1000
800
600
400
200
0
1955
1965
1975
1985
1995
2005


Stock - Recruitment
Recruitment (age 3) in millions
SSB in 1000 t
0
50
100
150
200
250
300
350
400
0
200
400
600
800
1000

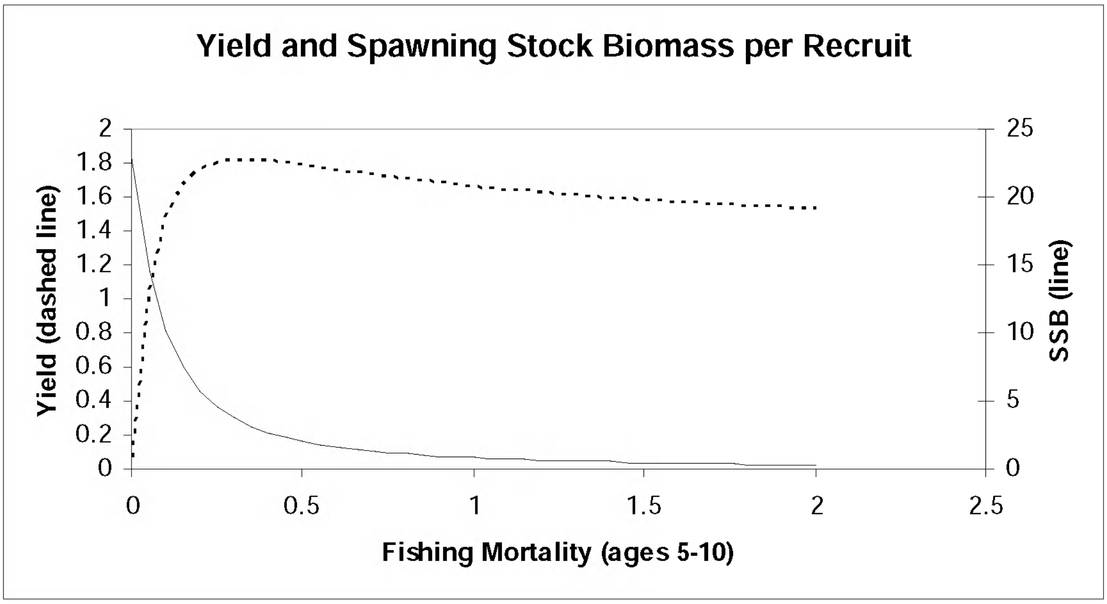

Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 5-10)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0
5
10
15
20
25
0
0.5
1
1.5
2
2.5

Table 1.4.2.1 Nominal catch (tonnes) of Cod in Division Va, by countries, 1997- 2003 as officially reported to ICES.

Country	1997	1998	1999	2000	2001	2002	2003	2004*
Faroe Islands	408	1,078	1,247					1,133
Germany	-	9	21	15	11	15	88	88
Greenland	-	-*	25*	-*	-*	-*		
Iceland	202,745	241,545	258,658	234,362	233,875	206,987	199,965	221,084
Norway	-	-	85	60	129*	76*	278	104
UK (E/W/NI)	-	-	12	10	15	19	...	405
UK (Scotland)	-	-	4	+	5	13	...	
United Kingdom							142	
Total	203,153	242,632	260,052					
WG estimate				235,623	235,164	208,298	201,570	222,814

*Preliminary.

Table 1.4.2.2 Icelandic cod (Division Va). Landings (tonnes), average fishing mortality of age groups 5-10, recruitment (at age 3 in thousands), spawning stock at spawning time (tonnes) and biomass 4+ (tonnes).

Year	Recruitment Age 3 thousands	SSB tonnes	Landings tonnes	Mean F Ages 5-10
1955	152031	938771	538130	0.29
1956	152871	793099	480709	0.29
1957	170674	773416	451909	0.31
1958	220658	873883	508683	0.35
1959	289039	853274	452504	0.32
1960	154437	708982	465023	0.37
1961	192870	467343	374916	0.35
1962	128979	569097	386876	0.38
1963	177607	508042	410050	0.46
1964	204024	451360	433605	0.55
1965	216450	317803	393636	0.58
1966	229213	277301	356755	0.59
1967	320419	256459	345022	0.56
1968	171957	221558	381070	0.72
1969	247888	313972	406411	0.56
1970	180588	331496	470757	0.61
1971	188700	283220	453052	0.69
1972	139121	272220	398528	0.69
1973	273239	245204	383446	0.70
1974	179152	186868	374770	0.76
1975	260994	168162	370991	0.81
1976	368245	138413	347849	0.75
1977	143281	198562	340050	0.59
1978	226891	212295	330390	0.48
1979	244004	304323	368064	0.45
1980	139718	356431	434344	0.49
1981	140723	263946	468659	0.66
1982	131992	166733	388387	0.73
1983	233367	129503	300056	0.72
1984	138837	140509	283822	0.64
1985	137859	171985	325267	0.67
1986	333541	197457	368633	0.78
1987	264919	148931	392253	0.87
1988	175580	171445	378076	0.90
1989	87482	171910	355954	0.72
1990	130763	213860	335390	0.70
1991	104636	160424	308560	0.81
1992	173493	151904	267767	0.85
1993	136831	123202	251979	0.88
1994	76146	152713	178809	0.63
1995	152412	177768	169424	0.51
1996	167068	158402	181658	0.51
1997	85317	189407	203153	0.55
1998	161210	211202	242632	0.66
1999	66553	184555	260052	0.75
2000	180462	166651	235687	0.77
2001	170038	160084	235374	0.76
2002	167823	195843	208777	0.66
2003	192960	189061	201705	0.60
2004	68734	214974	222814	0.60
2005	167992	262000		
Average	180780	303844	348449	0.61

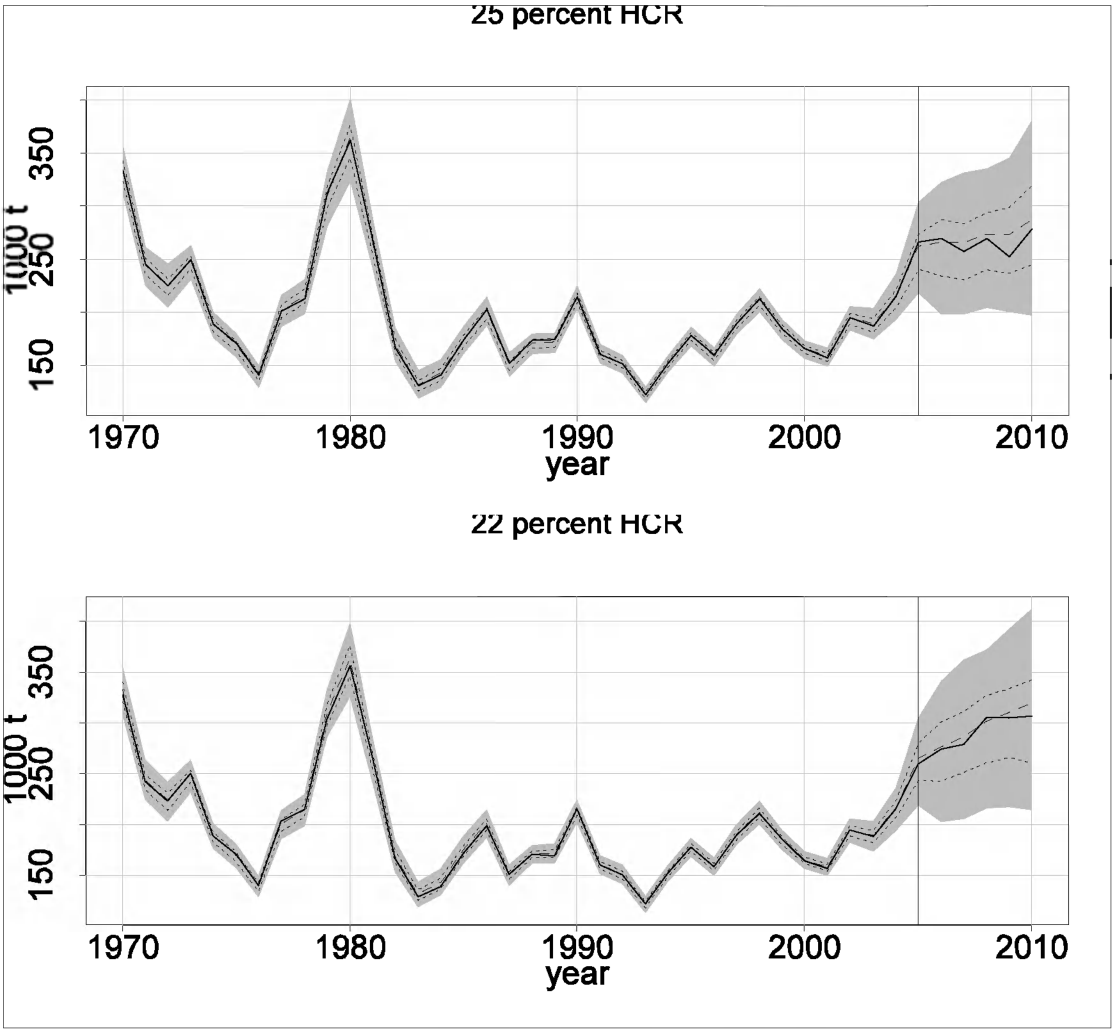


Figure 1.4.2.1 **AD-CAM** medium-term projections of SSB based on the amended Harvest Control Rule and 22 percent scenario. Recruitment after 2005 is estimated from a Ricker stock recruitment function assuming lognormal errors and a negative time trend in Rmax. Assessment error was assumed to be lognormal with 15% CV and 20% autocorrelation. Shown in the figure are 5 and 95 percentiles (shaded areas), 25 and 75 percentile (dashed lines), and the mean.

1.4.3 Haddock in Division Va

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
Reference points not defined	Reference points not defined	Unknown	There is no $\mathbf{B}_{pa}$, but the stock is above any candidate value

In the absence of a defined biomass reference point, the state of the stock cannot be evaluated in this regard. The SSB decreased from the early 1990s to 2000–2001 when it was the second lowest in the last two decades, but it increased from 2001 to 2005 due to the strong 1998–2000 year classes. All indications are that the current SSB is the highest in 25 years or more and is above any likely candidate for $\mathbf{B}_{pa}$. The assessment indicates that fishing mortality has declined in the last 5 years, but the estimate of 2004 F is somewhat uncertain. The year classes 1998–2000 and 2002–2003 appear to be well above average, and the 2003 year class is the strongest in the observed time-series.

Management objectives

There are no explicit management objectives for this stock.

Reference points

	ICES considers that:	**ICES proposed that:**
Precautionary Approach reference points	$\mathbf{B}_{lim}$: not defined	$\mathbf{B}_{pa}$: not defined
	$\mathbf{F}_{lim}$: not defined	$\mathbf{F}_{pa}$ be set at 0.47

Technical basis

$\mathbf{B}_{lim}$: -	$\mathbf{B}_{pa}$: -
$\mathbf{F}_{lim}$: -	$\mathbf{F}_{pa}$: $\mathbf{F}_{med}$ proposed in 2000

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits

Fishing mortality in 2006 should be less than the proposed $\mathbf{F}_{pa} = 0.47$. Forecasts at $\mathbf{F}_{pa}$ indicate catches of ~140 000 t for the calendar year 2006. However, this forecast includes 30 000 t of the 2003 year class. It is not likely that catches of this year class will be landed because of their small size and low value, fishing may be directed on older, more valuable age groups, and much of the 2003 year class may be discarded. This is expected to produce fishing mortality in excess of $\mathbf{F}_{pa}$. Therefore, the target landings should be less than 110 000 t in 2006.

Short-term implications

Outlook for 2006

Basis: F(2005) =0.41; SSB(2006) = 253 000 t; catch (2005) = 96 000 t.

Rationale	TAC (2006)[1]	Basis	F (2006)	SSB (2007)	%SSB change [1)]	% TAC change [2)]
Status quo	133	$\mathbf{F}_{sq}$	0.438	333	31.6	38.5
Precautionary limits	41	TAC($\mathbf{F}_{pa}$)* 0.25	0.118	402	58.9	-57.3
	78	TAC($\mathbf{F}_{pa}$)* 0.5	0.235	375	48.2	-18.7
	111	TAC($\mathbf{F}_{pa}$)* 0.75	0.352	350	38.3	15.6
	129	TAC($\mathbf{F}_{pa}$)* 0.90	0.423	336	32.8	34.4
	141	$\mathbf{F}_{pa}$ (=$\mathbf{F}_{sq}$)	0.47	327	29.2	46.9
	152	TAC($\mathbf{F}_{pa}$)* 1.1	0.517	319	26.0	58.3
	169	TAC($\mathbf{F}_{pa}$)* 1.25	0.588	307	21.3	76

Weights in '000 t.

Shaded scenarios are not considered consistent with the Precautionary Approach.

Management considerations

Abundance and growth of the 2003 year class are not well estimated because the calibration extrapolates beyond the observed range, and the year class appears to be growing slower than normal. That year class contributes approximately 30 000 t of the projected catch, but may not be landed because they are small and have low economic value. The fishery will likely target older age groups and discard much of the 2003 year class. Therefore, these projections may be overly optimistic, and a catch of 140 000 t in 2006 risks exceeding $\mathbf{F}_{pa}$. Furthermore, projections from an alternative calibration using another survey suggest that catch greater than 100 000 t in 2006 will result in F greater than $\mathbf{F}_{pa}$.

ICES advice is based on calendar years, but Icelandic TACs are based on the fishing year (September to August). Therefore, fishing commences three months before the ICES advice is implemented.

Haddock is to some extent taken as bycatch in the cod fishery. Due to the present low prices of haddock there is less interest for fishing haddock than fishing cod. Given the recent strong recruitment of haddock, an increase in haddock discards can be expected in the cod fishery.

Ecosystem considerations

Haddock is now becoming among the most abundant fish species in Icelandic waters and in the most recent groundfish survey haddock was found at every station shallower than 250 m. The previous increase in abundance makes it necessary to get more information on the diet of haddock.

Stomach samples from cod have indicated increasing predation on haddock in the last 2 years, probably reflecting increased haddock abundance although prey-switching by cod due to lack of capelin cannot be excluded. Nevertheless, haddock is only a minor part of the diet of cod at present (2–4%).

Factors affecting the fisheries and the stock

Regulations and their effects

The regulation is a TAC supplemented with technical measures like area closures for protecting juveniles and minimum mesh size. The regulatory system includes provision for real-time closures of areas with high juvenile densities. Trawl grids are mandatory in certain areas.

The environment

An increased inflow of Atlantic waters has been observed in Icelandic waters since 1997, resulting in higher temperature in the nursery grounds in the northern area. In 2003 a record high temperature and salinity were observed north and east of Iceland.

Haddock is in Icelandic waters near the northern boundary of its distribution. In cold periods the area north and east of Iceland is probably too cold for haddock, but in warmer periods the temperature in this area is suitable for haddock. The areas north and east of Iceland are a large part of the Icelandic continental shelf, so in warm periods much larger areas are available for haddock. Landing figures (over 100 000 tonnes/year for 6 years) from the early sixties support the observation that the stock can become very large in warm periods.

Other factors

Discard and mortality of haddock slipping through gear meshes is potentially a problem and is reducing productivity. Estimates on discards indicate that it was higher from 1994 to 1997 than at present. Largest discards are observed when available biomass is small and the recruiting year classes large (Pálsson, 2003), but the spatial distribution of the recruits in relation to the fishing effort is also important. Recent survey results indicate that large proportions of the younger age groups of haddock have been in the shallow areas off the north coast where there is relatively little fishing. However, if the overlap between fishing effort and the stock increase discarding will increase.

Scientific basis

Data and methods

The assessment is based on age-disaggregated landings from 1979–2003 as well as survey data from the March survey 1985–2004 and the autumn survey 1995–2004. Discard numbers are available back to the late 1980s, but are not included in the catch-in-numbers data.

Information from the fishing industry

CPUE from the most important fleets targeting haddock are available for 15 years or more. The CPUE does not show the same increase in recent years as the assessment. Part of the reason for the discrepancy is that a large part of the increase in haddock biomass is in areas north of Iceland where there is no fishing effort, but part of the discrepancy could be that low prices of haddock make fishers avoid haddock. The commercial CPUE are thus not considered a reliable indicator of stock size and are therefore not used in the analytical assessment.

Uncertainties in assessment and forecast

The assessment indicates that the stock is above any value observed over the period for which analytical data are available (1979–2004), although it may not have exceeded the likely stock size around 1960. Alternative analyses offer conflicting perspectives on fishing mortality: The accepted stock assessment indicates that current fishing mortality is less than $\mathbf{F}_{pa}$, but another valid assessment indicates that F is greater than $\mathbf{F}_{pa}$. The accepted assessment is calibrated with a longer time-series with more tows in haddock habitats. All assessments indicate that the 2003 year class is much larger than any year class seen in recent years, but the abundance of that year class is uncertain because it can only be estimated through extrapolation. This year class will enter the fisheries in 2006, leading to increased uncertainty in projected TACs.

Environment conditions

The prognosis is based on the premise that sudden cooling, like the one that occurred between 1994 and 1995, does not occur. The effects of that kind of cooling are not known except that it is nearly certainly negative for the haddock stock.

Comparison with previous assessment and advice

The same assessment procedure was used as last year. However, an alternative assessment was also developed using the autumn survey as a tuning index. The alternative assessment was used to express uncertainty in the 2006 TAC associated with $\mathbf{F}_{pa}$. The advice was the same as last year, except that the contribution of the 2003 year class was removed from the 2006 TAC associated with $\mathbf{F}_{pa}$.

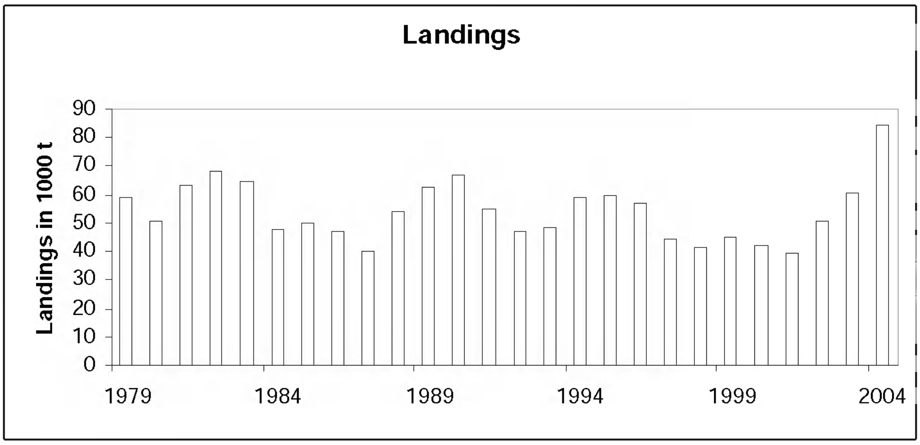
Source of information

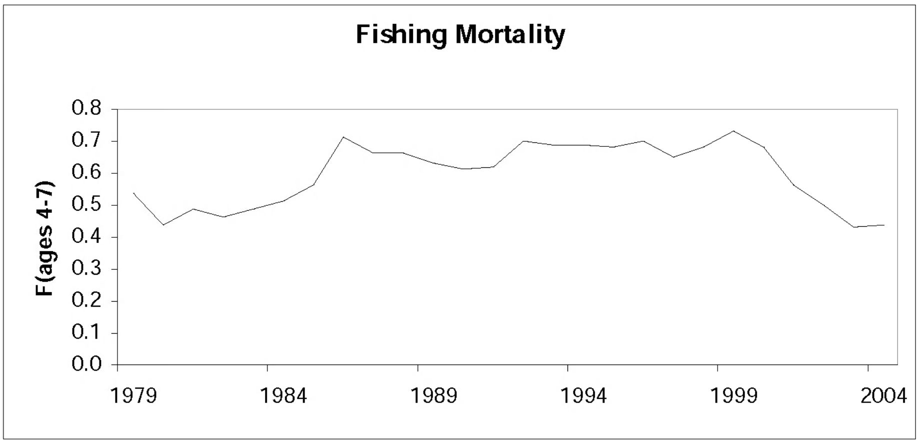
Report of the North-Western Working Group, 26 April–5 May 2005 (ICES CM 2005/ACFM:21).

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	ACFM Catch for the fishing year	ACFM Catch for the calendar year
1987	National advice	<50	60		41
1988[1]	National advice	<60	65		54
1989[1]	National advice	<60	65		63
1990[1]	National advice	<60	65		67
1991[2]	National advice	<38	48		54
1991/1992[3]	National advice	<50	50	48	47
1992/1993[3]	National advice	<60	65	48	49
1993/1994[3]	National advice	<65	65	57	59
1994/1995[3]	National advice	<65	65	61	61
1995/1996[3]	National advice	<55	60	54	57
1996/1997[3]	National advice	<40	45	51	44
1997/1998[3]	National advice	<40	45	38	41
1998/1999[3]	National advice	<35	35	46	45
1999/2000[3]	F reduced below $\mathbf{F}_{med}$	<35	35	42	42
2000/2001[3]	F reduced below provisional $\mathbf{F}_{pa}$	<31	30	40	40
2001/2002[3]	F reduced below provisional $\mathbf{F}_{pa}$	<30	41	45	50
2002/2003[3]	F reduced below provisional $\mathbf{F}_{pa}$	<55	55	56	61
2003/2004[3]	F reduced below provisional $\mathbf{F}_{pa}$	<75	75	79	84
2004/2005[3]	F reduced below provisional $\mathbf{F}_{pa}$	<97	90		
2005/2006[3]	F reduced below provisional $\mathbf{F}_{pa}$	<110			

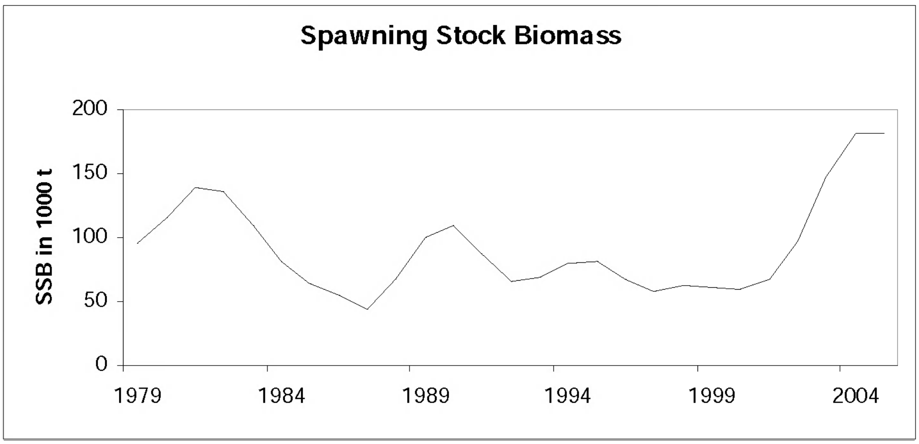
Weights in '000 t.

[1] Calendar year. [2] January/August. [3] National TAC for year ending 31 August.


Landings
Landings in 1000 t
90
80
70
60
50
40
30
20
10
0
1979
1984
1989
1994
1999
2004


Fishing Mortality
F(ages 4-7)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1979
1984
1989
1994
1999
2004


Recruitment (age 2)
Recruitment in millions
600
500
400
300
200
100
0
1979
1984
1989
1994
1999
2004


Spawning Stock Biomass
SSB in 1000 t
200
150
100
50
0
1979
1984
1989
1994
1999
2004

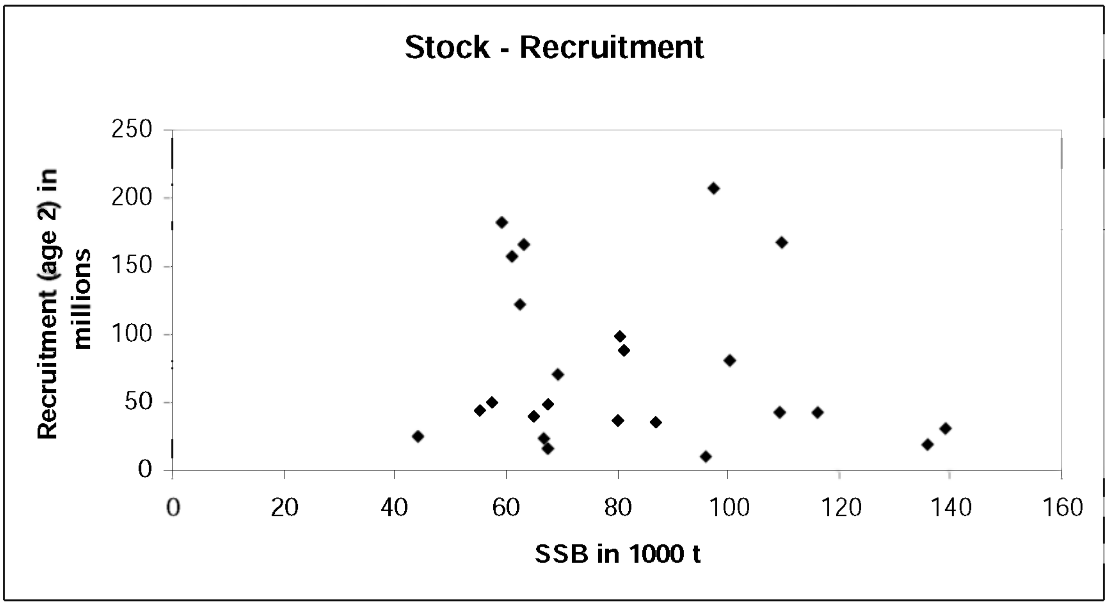

Stock - Recruitment
Recruitment (age 2) in millions
250
200
150
100
50
0
0
20
40
60
80
100
120
140
160
SSB in 1000 t

Table 1.4.3.1 Haddock in Division Va. Landings by nation (t).

Country	1979	1980	1981	1982	1983	1984	1985	1986
Belgium	1010	1144	673	377	268	359	391	257
Faroe Islands	2161	2029	1839	1982	1783	707	987	1289
Iceland	52152	47916	61033	67038	63889	47216	49553	47317
Norway	11	23	15	28	3	3	+	
€UK								
Total	55334	51112	63560	69425	65943	48285	50933	48863

HADDOCK Va

Country	1987	1988	1989	1990	1991	1992	1993	1994
Belgium	238	352	483	595	485	361	458	248
Faroe Islands	1043	797	606	603	773	757	754	911
Iceland	39479	53085	61792	66004	53516	46098	46932	58408
Norway	1	+						1
UK								
Total	40761	54234	62881	67202	53774	47216	48144	59567

HADDOCK Va

Country	1995	1996	1997	1998	1999	2000	2001	2002
Belgium								
Faroe Islands	758	664	340	639	624	968	609	878
Iceland	60061	56223	43245	40795	44557	41199	39038	49591
Norway	+	4						
UK								
Total	60819	56891	43585	41434	45481	42167	39647	50469

Country	2003	2004
Belgium		
Faroe Islands	833	1035
Iceland	59970	83799
Norway	30	9
UK	51	
Total	60884	84843

Table 1.4.3.2 Haddock in Division Va. Summary table from the selected final runs March survey tuning

Year	Recruitment age 2 million	Biomass 3+ 1000 tonnes	SSB 1000 tonnes	Landings 1000 tonnes	$F_{4\text{-}7}$	Yield/SSB
1979	79	163	96	59	0.537	0.617
1980	37	192	116	51	0.442	0.439
1981	10	204	139	63	0.487	0.457
1982	42	179	136	69	0.457	0.504
1983	30	144	109	65	0.49	0.591
1984	19	111	81	48	0.506	0.593
1985	42	99	63	50	0.564	0.792
1986	88	92	55	47	0.708	0.853
1987	166	105	44	40	0.659	0.91
1988	44	153	67	54	0.662	0.804
1989	25	169	100	63	0.631	0.625
1990	24	143	110	67	0.613	0.61
1991	81	118	87	55	0.625	0.628
1992	168	103	65	47	0.698	0.724
1993	36	128	69	49	0.693	0.702
1994	39	124	80	59	0.686	0.734
1995	71	118	81	60	0.675	0.746
1996	36	105	68	57	0.698	0.839
1997	99	86	58	44	0.655	0.765
1998	16	95	63	41	0.679	0.662
1999	51	87	61	45	0.725	0.738
2000	123	86	59	42	0.679	0.707
2001	157	113	67	40	0.557	0.586
2002	182	168	98	50	0.502	0.516
2003	49	218	147	61	0.428	0.413
2004	207	251	181	84	0.438	0.466
2005	481	278	182	**96**	0.412	**0.520**

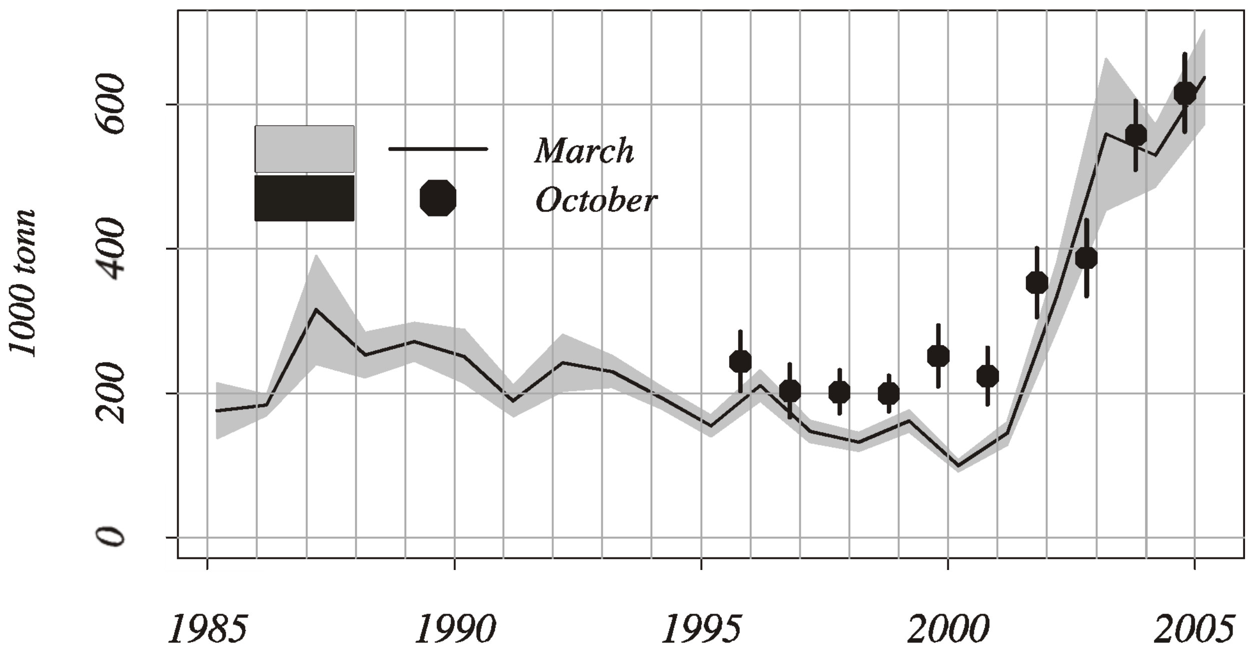


Figure 1.4.3.1 Icelandic haddock. Total biomass indices from the groundfish surveys in March (lines and shading) and the groundfish survey in October vertical segments. The standard error in the estimate of the indices is shown in the figure.

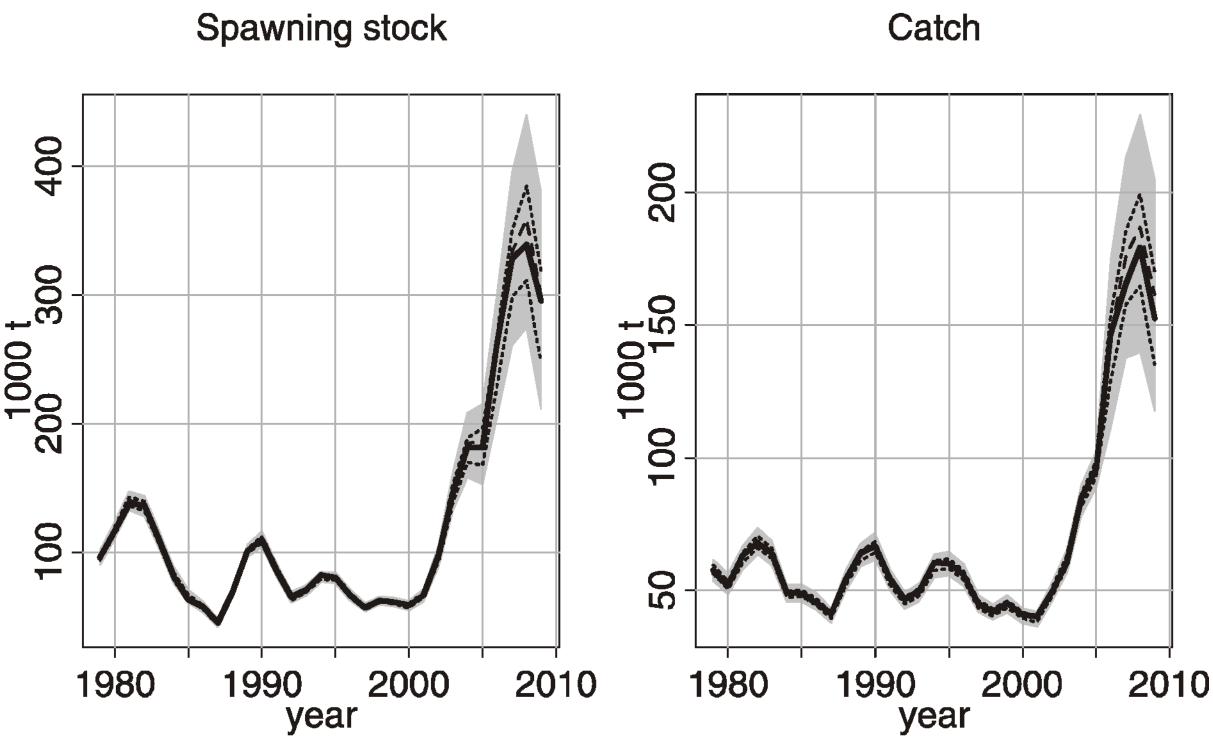


Figure 1.4.3.2 Haddock in Division Va. Results from short-term simulations based on the model using the March survey, assuming fishing at F=0.47 after 2005 and TAC constraint of 96 kt in 2006.

1.4.4 Saithe in Division Va

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
Full reproductive capacity	Increased risk	Unknown	

Based on the most recent estimates of SSB and fishing mortality ICES classifies the stock as being at full reproductive capacity, but is at risk of being harvested unsustainably. SSB in 2005 is estimated to be well above $\mathbf{B}_{pa}$. Present fishing mortality is slightly above $\mathbf{F}_{pa}$. Recent recruitment has been above average. The 2001 year class is not well estimated but is indicated to be low.

Management objectives

There is no explicit management objective for this stock.

Reference points

	ICES considers that:	ICES proposed that:
Precautionary Approach reference points	$\mathbf{B}_{lim}$ 90 000	$\mathbf{B}_{pa}$ be set at 150 000 t
	$\mathbf{F}_{lim}$ is not defined	$\mathbf{F}_{pa}$ be set at 0.3

Technical basis

$\mathbf{B}_{lim}$: $\mathbf{B}_{loss}$ estimate in 1998	$\mathbf{B}_{pa}$: observed low SSB values in 1978–1993
$\mathbf{F}_{lim}$: -	$\mathbf{F}_{pa}$: fishing mortality sustained for 3 decades

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits

Fishing mortality in 2006 should be below $\mathbf{F}_{pa}$ = 0.30, which corresponds to a catch of less than 78 000 t. At this fishing mortality it is expected that SSB will be above $\mathbf{B}_{pa}$ in 2007.

Short-term implications

	2005					**2006**					**2007**			**2008**		
Stock	*SSB*	F			*Stock*	*SSB*	F		*Stock*	*SSB*	F	*Stock*	*SSB*			
Age 4+			*Catch*	*Catch*	*Age 4+*			*Catch*	*Age 4+*			*Age 4+*		Basis	Fmult	
343	205	0.319	75	0	381	228	0.00	0	447	307	0.00	508	384	No catch	0	
				83	381	228	0.32	83	353	231	0.32	318	219	F_{sq}	1	
				9	381	228	0.03	12	437	299	0.03	484	363	Fpa*0.1	0.094	
				22	381	228	0.07	27	422	287	0.07	451	335	Fpa*0.25	0.234	
			F_{pa}	42	381	228	0.15	49	399	268	0.15	403	292	Fpa*0.5	0.469	
				61	381	228	0.22	67	378	251	0.22	362	257	Fpa*0.75	0.703	
				71	381	228	0.27	75	366	241	0.27	340	238	Fpa*0.9	0.844	
				78	381	228	0.30	80	358	235	0.30	326	226	Fpa	0.938	
				85	381	228	0.33	85	351	229	0.33	314	215	Fpa*1.1	1.031	
				94	381	228	0.37	91	340	220	0.37	296	200	Fpa*1.25	1.172	

Outlook for 2006

Basis: F(2005) =0.32; SSB(2006) = 228; catch (2005) = 75.

Rationale	TAC (2006)[1]	Basis	F (2006)	Landings	SSB (2007)	%SSB change [1)]	% TAC change [2)]
Zero catch	0	F=0	0	0	307	34.65	-100.00
Status quo	83	$\mathbf{F}_{sq}$	0.32	83	231	1.32	10.67
Precautionary limits	9	TAC($\mathbf{F}_{pa}$)* 0.1	0.03	9	299	31.14	-88.00
	22	TAC($\mathbf{F}_{pa}$)* 0.25	0.07	22	335	25.88	-70.67
	42	TAC($\mathbf{F}_{pa}$)* 0.5	0.15	42	268	17.54	-44.00
	61	TAC($\mathbf{F}_{pa}$)* 0.75	0.22	61	251	10.09	-18.67
	71	TAC($\mathbf{F}_{pa}$)* 0.90	0.27	71	241	5.70	-5.33
	78	$\mathbf{F}_{pa}$ (=$\mathbf{F}_{sq}$ *0.94)	0.30	78	235	3.07	4.00
	85	TAC($\mathbf{F}_{pa}$)* 1.1	0.33	85	229	0.44	13.33
	94	TAC($\mathbf{F}_{pa}$)* 1.25	0.37	94	220	-3.51	25.33

Weights in '000 t.
Shaded scenarios are not considered consistent with the Precautionary Approach.
[1)] SSB 2007 relative to SSB 2006.
[2)] TAC 2006 relative to TAC 2005.

Management considerations

After a period of low stock size, saithe is now recovering due to better recruitment. Saithe are caught in directed saithe fisheries and in mixed demersal fisheries, which has cod as their target.

The autumn survey and samples from pelagic trawl indicate that a proportion of the saithe stock is far off the south and southeast coast of Iceland. The blue whiting fishery has a bycatch of saithe (e.g., 3000 t in 2004), but that bycatch is composed of both Icelandic and Faroese saithe stocks.

Factors affecting the fisheries and the stock

Regulations and their effects

The fishery is regulated by quotas, minimum mesh size in fishing gears, and area closures.

The environment

Blue whiting is a forage species for saithe. A proportion of the saithe stock is far off the south and southeast coast, probably preying on blue whiting. The blue whiting fishery thus also affects saithe by removing blue whiting.

In Icelandic water saithe is near the northern boundary of its distribution, and a relatively small part of the stock inhabits the waters off the north and east coast except in warm years. The fishery and the survey show more northerly distribution in the recent year, possibly because of relative warming in the northern waters.

Observations of weight-at-age from fishery and survey samples suggest slower growth in recent years, which may be related to environmental factors.

Scientific basis

Data and methods

The assessment is based on age-disaggregated landings from 1963–2003 and spring survey indices 1985–2004.

Uncertainties in assessment and forecast

Estimates of recent and predicted SSB and TACs are sensitive to uncertain mean weights and maturity estimates. Estimates of SSB are based on catch weights which are much lower than survey weights at most ages in the stock. No catch weights for 2004 were available. Catch weights for 2004 and forecast years are based on an average from previous years.

Comparison with previous assessment and advice

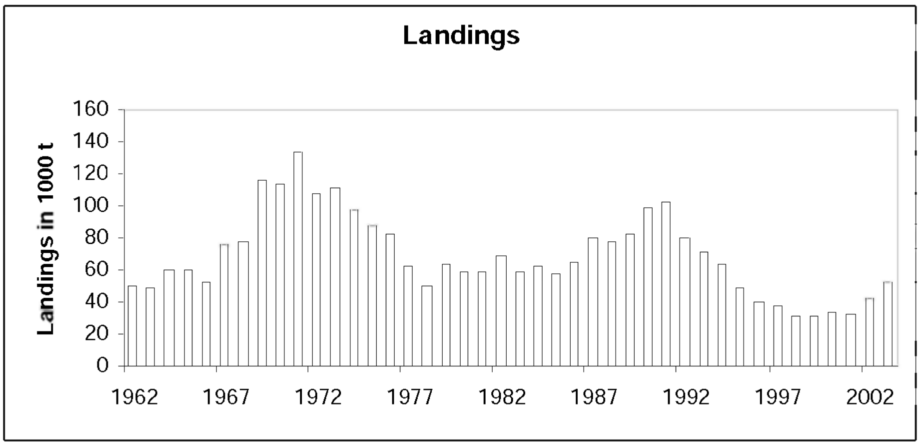
The current assessment is consistent with the 2004 assessment, and the advice is unchanged.

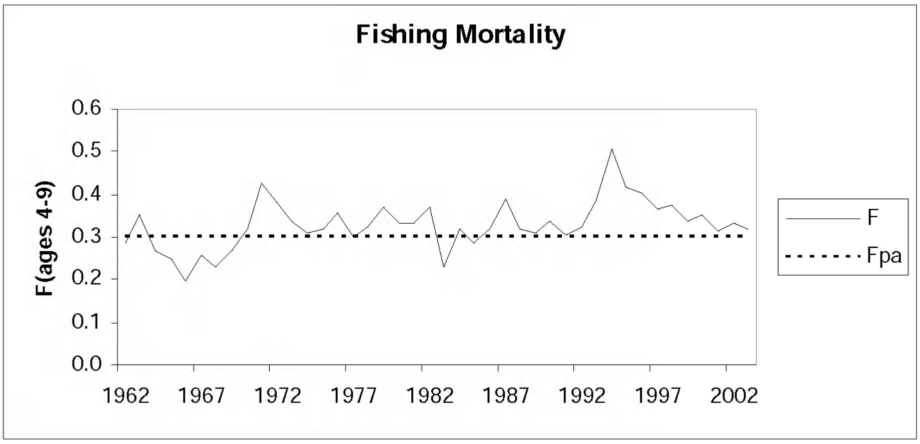
Source of information

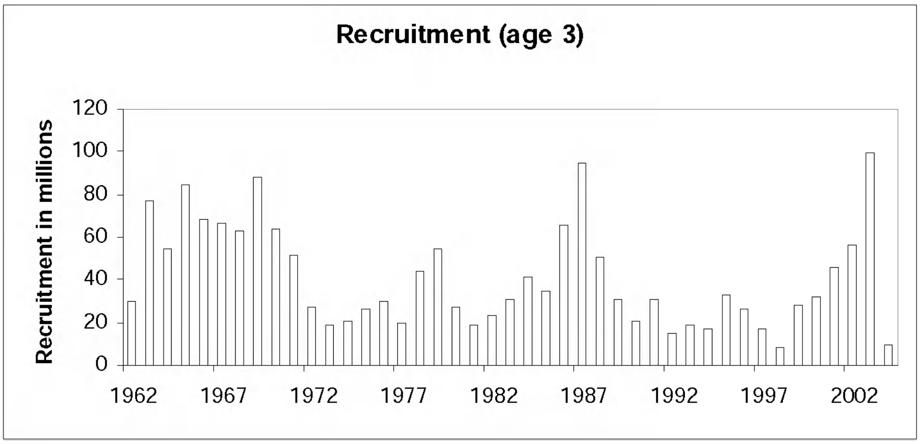
Report of the North-Western Working Group, 26 April–5 May 2005 (ICES CM 2005/ACFM:21).

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	ACFM Catch
1987	TAC	64	70	81
1988	TAC	64	80	77
1989	TAC	80	80	82
1990	TAC	80	90	98
1991	TAC	87	65	103
1992	TAC	70	75[2]	80
1993	Marginal gains from increase in F	75[1]	95[2]	72
1994	No measurable gains from increase in F	84[1]	85[2]	64
1995	No measurable gains from increase in F	72[1]	75[2]	49
1996	No measurable gains from increase in F	65[1]	70[2]	41
1997	No measurable gains from increase in F	52[1]	50[2]	37
1998	F below $\mathbf{F}_{med}$ = 0.23	30[3]	30[2]	32
1999	F below 60% of F(97)	28	30[2]	31
2000	F below 60% of F(98)	24	30[2]	33
2001	F=70% of F(99)	25	30[2]	32
2002	No directed fishing	-	37[2,3]	42
2003	2/3 $\mathbf{F}_{pa}$ to rebuild stock	24	45[4]	52
2004	No advice	NA	50	65
2005	Fpa	69	70	
2006	Fpa	78		

Weights in '000 t.
[1]Catch at *status quo* F. [2]For year ending 31 August. [3]TAC set originally set at 30, changed to 37 at the end of 2001.
[4]TAC originally set at 37, changed to 45 at the beginning of 2003.


Landings
Landings in 1000 t
160
140
120
100
80
60
40
20
0
1962
1967
1972
1977
1982
1987
1992
1997
2002


Fishing Mortality
F(ages 4-9)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1962
1967
1972
1977
1982
1987
1992
1997
2002
F
Fpa


Recruitment (age 3)
Recruitment in millions
120
100
80
60
40
20
0
1962
1967
1972
1977
1982
1987
1992
1997
2002

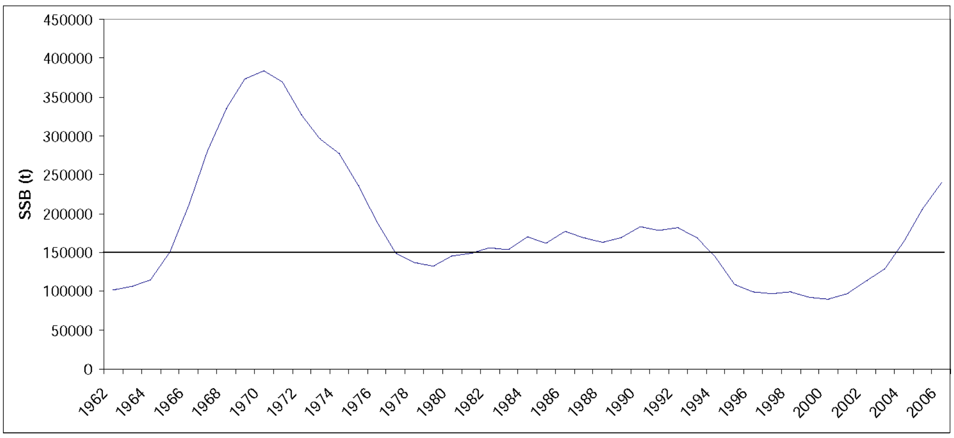

SSB (t)
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006

Table1.4.4.1 Nominal catch (tonnes) of SAITHE in Division Va by countries, 1997-2001, as officially reported to ICES with working group estimates where data are missing

Country	1997	1998	1999	2000	2001	2002	2003*	2004
Faroe Islands	716	997	700	228**	128**	366**	143	214
Germany	-	3	2	1	14	6	56	157
Iceland	36548	30531	30583	32914	31854	41687	51857	62614
Norway	-	-	6	1	44*	3*	164	1
UK (E/W/NI)	-	-	1	2	23	7	...	105
UK (Scotland)	-	-	1	-	-	2	...	
United Kingdom							35	
Total	37264	31531	31293				52091	63091
Bycatch							403	1700
WG estimate				33146	32063	42071	52494	64791

*Preliminary.
**WG estimate.

Table 1.4.4.2 Icelandic saithe (Division Va).

	Age-3 Rec	BIO 4+	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 4-9
1962	29546	186983	101089	50409	0.5	0.29
1963	76762	205210	106734	48449	0.45	0.35
1964	54227	288717	114350	60417	0.53	0.27
1965	84200	359818	150138	60108	0.4	0.25
1966	68248	471160	212005	52176	0.25	0.2
1967	66853	559333	280155	76270	0.27	0.26
1968	62993	603648	335541	77946	0.23	0.23
1969	88011	631775	373502	116347	0.31	0.27
1970	63534	667242	384236	113315	0.3	0.32
1971	51807	641413	370210	133891	0.36	0.43
1972	27060	552956	327231	107873	0.33	0.38
1973	18487	460783	295893	111113	0.38	0.34
1974	20614	382706	277911	97568	0.35	0.31
1975	26126	316701	235820	87924	0.37	0.32
1976	29746	269212	190066	81945	0.43	0.36
1977	19582	237145	149177	62026	0.42	0.3
1978	44173	220394	136881	49672	0.36	0.32
1979	54210	239824	131960	63504	0.48	0.37
1980	27419	267971	145859	58347	0.4	0.33
1981	18638	260904	148765	59001	0.4	0.33
1982	23127	244434	156369	68910	0.44	0.37
1983	31306	226467	153572	58266	0.38	0.23
1984	41600	257945	170239	62719	0.37	0.32
1985	34529	278027	162085	57072	0.35	0.29
1986	65401	298192	176614	64868	0.37	0.32
1987	94706	313759	168616	80531	0.48	0.39
1988	50506	397249	162974	77247	0.47	0.32
1989	31377	384704	169212	82425	0.49	0.31
1990	20886	367006	182907	98127	0.54	0.34
1991	31172	298773	178174	102316	0.57	0.31
1992	15317	281120	182357	79597	0.44	0.32
1993	18635	238289	169129	71648	0.42	0.39
1994	17372	191950	143981	64339	0.45	0.5
1995	32428	147610	108656	48629	0.45	0.42
1996	26063	151166	99020	40101	0.41	0.4
1997	16928	157594	97403	37264	0.38	0.37
1998	8137	156340	99119	31531	0.32	0.37
1999	27006	126755	92631	31293	0.34	0.33
2000	31526	132016	90350	33146	0.37	0.35
2001	49513	152995	96913	32063	0.33	0.31
2002	62272	203352	112864	42071	0.37	0.32
2003	97485	264384	129019	52494	0.41	0.3
2004	21774	347540	164673	64791	0.39	0.32
2005	68974	343388	205198			
Mean	41894	311762	180232	68689	0.4	0.33

1.4.5 Greenland halibut in Subareas V, VI, XII, and XIV

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
Reference points not defined	Reference points not defined	Unknown	

In the absence of defined reference points, the state of the stock cannot be evaluated in this regard. Survey and fishery indices, however, suggest that the present stock biomass is near a historic low in most areas. Commercial CPUE indices from Division Va suggest a low biomass in recent years compared to the mid-1980s, and survey indices in Division Va support the perception of a declining trend in the past two years. In Division Vb indices suggest a decreasing biomass being at a low level. In Division XIVb, survey and CPUE indices suggest that biomass has been low in recent years compared to the period 1996–1998. There are no signs of strong year classes entering the stock from survey information.

Management objectives

There is no explicit management objective for this stock.

Reference points

The reference points used previously were linked to the specific assessment model used and this model is no longer applicable. Therefore, these reference points are no longer relevant.

Single-stock exploitation boundaries

Given the continued poor state of the stock, there is a need to reduce effort considerably. ICES proposes to implement a management plan covering the whole stock area to ensure that effort in the future is kept within sustainable limits. It cannot be estimated what sustainable effort or catches would be in the longer term. It is therefore proposed to implement an adaptive management plan with initial reductions in effort and catches. Within such an adaptive management plan and as an initial step, ICES recommends that the effort covering the whole area should be reduced to 1/3 of the 2003 level because historically, such effort levels have been associated with stock increases. The relation between effort and catch is not precisely known but catches at the time were taken from a much larger stock than the present stock size. The same effort would to-day generate a significantly lower catch and ICES proposes a total catch in the area of less than 15 000 t in 2006. Upwards or downwards adjustments in future years would then be decided in response to stock development.

Management considerations

The stock is not managed according to international agreements and there is no management plan in place. Indices covering the most important parts of the stock suggest that the stock is at a low level and there is a requirement to revert that trend, which can only be done if agreements and a management plan are in place. There is not sufficient information to allow an analytical forecast of the response of the stock to various catch or effort levels and thus to estimate the catch level which would enable a stock increase. It is therefore advised that an adaptive management plan is implemented in order to gain knowledge about the sustainable level of fishing. Within an adaptive management plan, effort and catches should initially be limited to levels which historically have been associated with increases in stock size. This corresponds to an effort as in the years 1998–99 where the stock increased. The relation between effort and expected catch are not precisely known but based on historical evidence a reduction of effort to 1/3 of the level in 2003 fishing on a stock which is considerably lower than in 1998-1999 would imply landings for the whole area of less than 15 000 t. In order to allow the stock to rebuild within an adaptive framework covering the whole area the effort in 2006 should thus initially be reduced to 1/3 of the level in 2003 and catch in the total areas should initially be less than 15 000 t. The management plan should include monitoring of the effort and stock development and a framework for adapting future fishing according to the response of the stock.

Stock status is based on surveys and commercial CPUE from Areas Va, Vb, and XIV, which provide consistent perspectives. Commercial CPUE in Areas Va and Vb indicate a gradual decrease in stock biomass to low levels in the mid-1990s. The increase in commercial CPUE in Area XIV in the early 1990s probably reflects initial learning and changes in fishing behaviour. Similarly, the increase in CPUE in Area Va in the late 1990s may have resulted from technological advances. The Icelandic groundfish survey indicates a substantial decrease in stock biomass since 2001. The Greenland survey shows a substantial decrease in stock biomass from 2000 to 2002.

Survey and CPUE indices suggest a decrease in stock size to historic low levels. Normally, if a reduction in abundance of this magnitude is caused by high fishing mortality, larger fish would be expected to become progressively less abundant over time. In the Greenland halibut case, however, the size composition of the Icelandic catch on the principal fishing ground off the west coast have remained stable from 1985–2003, suggesting that fishing mortality is not affecting markedly the size composition of Greenland halibut in the area of the fishery. Such a discrepancy could be explained if the Icelandic fishing ground were regularly re-supplied by fish from neighbouring areas that are more lightly fished. Under this hypothesis, the decrease in abundance could be the result of the removal rate on the Icelandic ground being in excess of the re-supplying rate. If this hypothesis were true, the decrease in the survey index and in the CPUE would not necessarily cause concern for the conservation of the resource. From a management perspective, however, there could be advantages to reducing fishing mortality to better match it with the hypothesised re-supplying rates from neighbouring areas. However, alternative hypotheses can also explain stable size structures during decreasing stock sizes, such as reduced recruitment of younger ages.

Most of the fisheries for Greenland halibut are taken in directed fisheries with minor bycatch of other species. Given the uncertainties about overall stock size, stock structure, and abundance in the area of the fishery, a better way to reduce fishing mortality could be through effort reductions rather than through TAC reductions.

Since the nursery grounds are not known and therefore not monitored, and as Greenland halibut is a slow-growing species, which first appears in the catches at age 5, a possible recruitment failure will only be detected in the fishery some 5–10 years after it occurs.

Factors affecting the fisheries and the stock

Regulations and their effects

No formal agreement on the management of the Greenland halibut exists among the three coastal states, Greenland, Iceland, and the Faroe Islands. In Greenland and Iceland the fishery is regulated by TAC and in the Faroe Islands by effort limitation (number of fishing licenses). The regulation schemes of those states have previously resulted in catches well in excess of TACs advised by ICES.

For a number of years total catches have exceeded the advised TAC. The management approaches in the three areas (Divisions Va, Vb, and XIVb) differ. At present the fishery in Division Vb is only effort limited (number of licenses) while the fisheries in Divisions XIVb and Va are catch limited. The TACs in Division Va and XIV summed to twice the recommended TAC for the entire area in 2005.

Scientific basis

Data and methods

The data are insufficient for an analytical assessment. There are a number of indices of the biomass development available. These are of varying quality and cover different time spans. The indices emanate from surveys and from the commercial fishery.

In the absence of an analytical assessment, the advice is based on a judgement on basis of the range of data available. These data include research surveys and data from the commercial fisheries. The judgement considers the historical trends in catches and biomass indices. The conclusion that significant reductions in fishing mortality and thus effort are required is based on the clear indications that the stock is at a low level and has continued to decline. The advice regarding the reduction in effort and catches is based on evidence from periods when the effort exerted enabled the stock to increase or to remain stable.

Source of information

Report of the North-Western Working Group, 26 April–5 May 2005 (ICES CM 2005/ACFM:21).

	ICES Advice	Predicted catch Corresp. to advice	TAC for Icelandic EEZ	Greenland TAC	Catch in Va	ACFM Catch V, VI, XII, and XIV
1987	No increase in F	28	30		45	47
1988	No increase in F	28	30		49	51
1989	TAC	33	30		59	61
1990	No advice	-	45		37	39
1991	TAC	40	30		35	38
1992	TAC	30	25		32	35
1993	No increase in effort	28[1]	30[2]		34	41
1994	No increase in effort	34[1]	30[2]		29	37
1995	TAC	32	30[2]		27	36
1996	TAC	21	20[2]		22	36
1997	60% reduction in F from 1995	13	15[2]		18	30
1998	70% reduction in F from 1996	11	10[2]		11	20
1999	65% reduction in F from 1997	11	10[2]		11	21
2000	60% reduction in F from 1998	11	10[2]		15	26
2001	catch less than 98-99 catch	<20	20[2]		17	28
2002	F reduced below 0.67*$\mathbf{F}_{MSY}$	<21	20[2]		20	29
2003	F reduced below 0.67*$\mathbf{F}_{MSY}$	<23	23[2]		20	30
2004	F reduced below 0.67*$\mathbf{F}_{MSY}$	<20	23[2]		15	28
2005	Effort reduced to 1/3 of the 2003 level	<15	15	14.125		
2006	Effort reduced to 1/3 of the 2003 level	<15				

Weights in '000 t.
[1]Catch at *status quo* F. [2]Year ending 31 August.

Landings

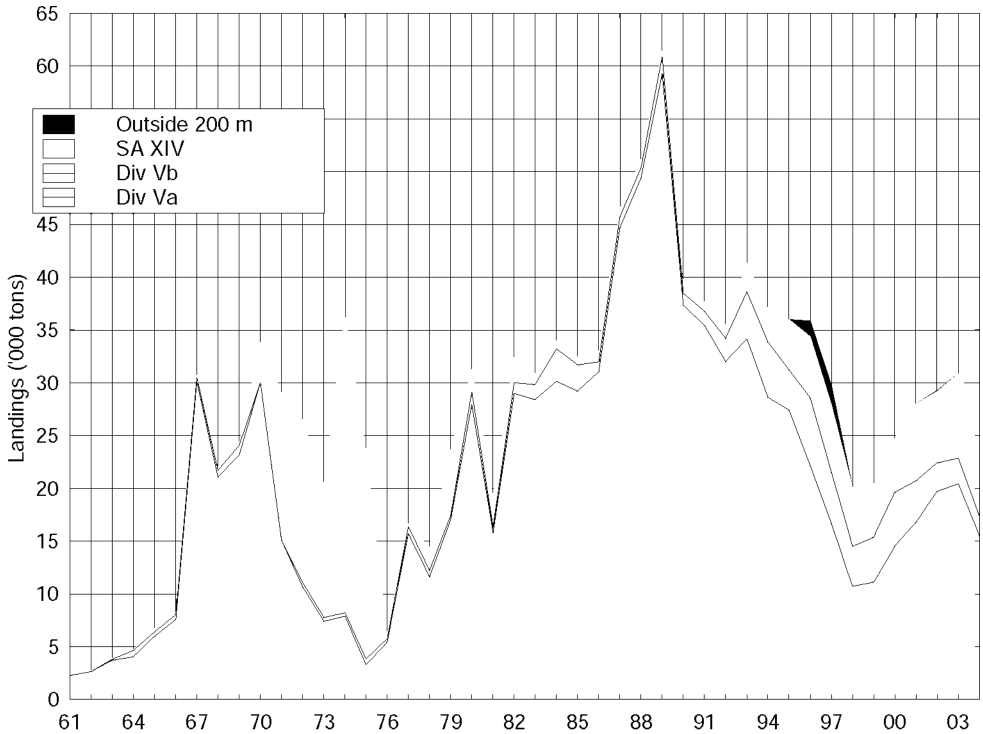


Table 1.4.5.1 GREENLAND HALIBUT. Nominal landings (tonnes) by countries, in Subareas V, VI, XII and XIV 1981-2004, as officially reported to ICES and estimated by WG.

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989
Denmark	-	-	-	-	-	-	6	+	-
Faroe Islands	767	1,532	1,146	2,502	1,052	853	1,096	1,378	2,319
France	8	27	236	489	845	52	19	25	-
Germany	3,007	2,581	1,142	936	863	858	565	637	493
Greenland	+	1	5	15	81	177	154	37	11
Iceland	15,457	28,300	28,360	30,080	29,231	31,044	44,780	49,040	58,330
Norway	-	-	2	2	3	+	2	1	3
Russia	-	-	-	-	-	-	-	-	-
UK (Engl. and Wales)	-	-	-	-	-	-	-	-	-
UK (Scotland)	-	-	-	-	-	-	-	-	-
United Kingdom	-	-	-	-	-	-	-	-	-
Total	19,239	32,441	30,891	34,024	32,075	32,984	46,622	51,118	61,156
Working Group estimate	-	-	-	-	-	-	-	-	61,396

Country	1990	1991	1992	1993	1994	1995	1996 [1]	1997 [1]	1998 [1]
Denmark	-	-	-	-	-	-	1	-	
Faroe Islands	1,803	1,566	2,128	4,405	6,241	3,763	6,148	4,971	3,817
France	-	-	3	2	-	-	29	11	8
Germany	336	303	382	415	648	811	3,368	3,342	3,056
Greenland	40	66	437	288	867	533	1,162	1,129	747
Iceland	36,557	34,883	31,955	33,987	27,778	27,383	22,055	18,569	10,728
Norway	50	34	221	846	1,173 [1]	1,810	2,164	1,939	1,367
Russia	-	-	5	-	-	10	424	37	52
Spain									89
UK (Engl. and Wales)	27	38	109	811	513	1,436	386	218	190
UK (Scotland)	-	-	19	26	84	232	25	26	43
United Kingdom									
Total	38,813	36,890	35,259	40,780	37,305	36,006	35,762	30,242	20,360
Working Group estimate	39,326	37,950	35,423	40,817	36,958	36,300	35,825	30,267 9	20,449

Country	1999 [1]	2000 [1]	2001 [1]	2002 [1]	2003 [1]	2004 [1]
Denmark		-	0	0	0	0
Faroe Islands	3,884	-	0	0	0	1,860
France	-	21	25	20	33	0
Germany	3,082	3,271	2,807	2,148	2,948	6,906
Greenland	200	1,740	1,553	0 0	0	1,420
Iceland	11,180	14,537	16,590	2,277	20,371	15,478
Ireland		-	7			
Norway	1,187	1,272	1,483	1,328	1,114	1,250
Poland						206
Portugal			6			0
Russia	138	183	186	44 0	0	265
Spain		8	10	0 0	0	256
UK (Engl. and Wales)	261	370	227	71 0	0	
UK (Scotland)	69	121	130	157 0	0	
United Kingdom	-	-		239	1,205	20
Total	20,001	21,523	23,024	6,284	25,671	27,660
Working Group estimate	20,371	26,839	28,021	30,574	31,133	27,788

1) Provisional data

Table 1.4.5.2 GREENLAND HALIBUT. Nominal landings (tonnes) by countries, in Division Va 1981-2004, as officially reported to ICES and estimated by WG.

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989
Faroe Islands	325	669	33	46			15	379	719
Germany									
Greenland									
Iceland	15,455	28,300	28,359	30,078	29,195	31,027	44,644	49,000	58,330
Norway			+	+	2				
Total	15,780	28,969	28,392	30,124	29,197	31,027	44,659	49,379	59,049
Working Group estimate									59,272 [2]

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998
Faroe Islands	739	273	23	166	910	13	14	26	6
Germany					1	2	4		9
Greenland					1				[1]
Iceland	36,557	34,883	31,955	33,968	27,696	27,376	22,055	16,766	10,580
Norway								[1]	[1]
Total	37,296	35,156	31,978	34,134	28,608	27,391	22,073	16,792	10,595
Working Group estimate	37,308 [2]	35,413 [2]							

Country	1999	2000	2001	2002	2003 [1]	2004 [1]
Faroe Islands	9					
Germany	13	22	50	31	23	10
Greenland	[1]					
Iceland	11,087	14,507	2,310 [4]	2,277	20,371	15,478
Norway			6			
UK (E/W/I)	26	73	50	21		
UK Scottland	3	5	12	16		
UK				37	21	10
Total	11,138	14,607	2,428	2,382	20,415	15,497
Working Group estimate		14,519 [3]	16,752	19,714		

1) Provisional data
2) Includes 223 t catch by Norway.
3) Includes 12 t catch by Norway.
4) 14280 t fished in Icelandic EEZ, previously reported in Va, are in 2002 moved to ICES XIV b.

Table 1.4.5.3 GREENLAND HALIBUT. Nominal landings (tonnes) by countries, in Division Vb 1981-2004, as officially reported to ICES and estimated by WG.

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989
Denmark	-	-	-	-	-	-	6	+	-
Faroe Islands	442	863	1,112	2,456	1,052	775	907	901	1,513
France	8	27	236	489	845	52	19	25	...
Germany	114	142	86	118	227	113	109	42	73
Greenland	-	-	-	-	-	-	-	-	-
Norway	2	+	2	2	2	+	2	1	3
UK (Engl. and Wales)	-	-	-	-	-	-	-	-	-
UK (Scotland)	-	-	-	-	-	-	-	-	-
United Kingdom	-	-	-	-	-	-	-	-	-
Total	566	1,032	1,436	3,065	2,126	940	1,043	969	1,589
Working Group estimate	-	-	-	-	-	-	-	-	1,606 [2]

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998
Denmark	-	-	-	-	-	-	-	-	
Faroe Islands	1,064	1,293	2,105	4,058	5,163	3,603	6,004	4750	3660
France 6	...	...	3 [1]	2	1	28	29	11	8 [1]
Germany	43	24	71	24	8	1	21	41	
Greenland	-	-	-	-	-	-	-	-	
Norway	42	16	25	335	53	142	281	42 [1]	114 [1]
UK (Engl. and Wales)	-	-	1	15	-	31	122		
UK (Scotland)	-	-	1	-	-	27	12	26	43
United Kingdom	-	-	-	-	-				
Total	1,149	1,333	2,206	4,434	5,225	3,832	6,469	4,870	3825
Working Group estimate	1,282 [2]	1,662 [2]	2,269 [2]	-	-		-	-	0

Country	1999	2000 [1]	2001 [1]	2002 [1]	2003 [1]	2004 [1]
Denmark						
Faroe Islands	3873					1,717
France		21	25 [1]	20	33	
Germany	22	6	7			
Iceland						
Ireland			+			
Norway	87	110 [1]	53 [1]	48	2	
UK (Engl. and Wales)	9	35	77	50		
UK (Scotland)	66	116	118	141		
United Kingdom					197	128
Total	4057	288	280 2	259	232	1,845
Working Group estimate	2694 [2]	5092 [3]	3,951	2,694	2,426	1,845

1) Provisional data
2) WG estimate includes additional catches as described in Working Group reports for each year and in the report from 2001.

Table 1.4.5.4 GREENLAND HALIBUT. Nominal landings (tonnes) by countries, in Division Vb 1981-2004, as officially reported to ICES and estimated by WG.

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989
Faroe Islands	-	-	-	-	-	78	74	98	87
Germany	2,893	2,439	1,054	818	636	745	456	595	420
Greenland	+	1	5	15	81	177	154	37	11
Iceland	-	-	1	2	36	17	136	40	+
Norway	-	-	-	+	-	-	-	-	-
Russia	-	-	-	-	-	-	-	-	+
UK (Engl. and Wales)	-	-	-	-	-	-	-	-	-
UK (Scotland)	-	-	-	-	-	-	-	-	-
United Kingdom	-	-	-	-	-	-	-	-	-
Total	2,893	2,440	1,060	835	753	1,017	820	770	518
Working Group estimate	-	-	-	-	-	-	-	-	-

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998
Denmark	-	-	-	-	-	-	1	+	+
Faroe Islands	-	-	-	181	168	147	130	148	151
Germany	293	279	311	391	639	808	3,343	3,301	3,399
Greenland	40	66	437	288	866	533	1,162	1,129	747 [1,7]
Iceland	-	-	-	19	82	7	-	1,803	148
Norway	8	18	196	511	1,120	1,668	1,881	1,897 [1]	1,253 [1]
Russia	-	-	5	-	-	10	424	37	52
UK (Engl. and Wales)	27	38	108	796	513	1405	264	218	190
UK (Scotland)	-	-	18	26	84	205	13		
United Kingdom	-	-	-	-	-	-	-		
Total	368	401	1,075	2,212	3,472	4,783	7,218	8,533	5940
Working Group estimate	736 [2]	875 [3]	1,176 [4]	2,249 [5]	3,125 [6]	5,077 [7]	7,283 [8]	8,558 [9]	

Country	1999	2000	2001 [1]	2002 [1]	2003 [1]	2004 [1]
Denmark						
Faroe Islands	2					143
Germany	3047	3243	2,750	2,117	2,925	6,896
Greenland	200 [1,4]	1740 [8]	1,553 [9]			1,420
Iceland	93	30	14,280			
Ireland			7			
Norway	1100	1162 [1]	1,424	1,280	1,112	1,131
Poland						205
Portugal			6			
Russia	138	183	186	44		264
Spain		8	10			
UK (Engl. and Wales)	226	262	100			
UK (Scotland)						
United Kingdom				202	987	
Total	4806	6628	20,316	3,643	5,024	10,059
Working Group estimate	5376 [11]	6588 [5]	6,588 [6]	6,750	8,017	

1) Provisional data
2) WG estimate includes additional catches as described in working Group reports for each year and in the report from 2001.
3) Includes 125 t by Faroe Islands and 206 t by Greenland.
4) Excluding 4732 t reported as area unknown.
5) Includes 1523 t by Norway, 102 t by Faroe Islands, 3343 t by Germany, 1910 t by Greenland, 180 t by Russia, as reported to Greenland authorities.
6) Includes 2849 t by Greenland, 142 t by Norway, 2750 t by Germany. Does not include 14280 t by Iceland as those are included in WG estimate of Va.
7) Excluding 138 t reported as area unknown.
8) Excluding 16 t reported as area unknown.
9) Excluding 20 t reported as area unknown
10) Includes 3370 t by Greenland, 3552 t as total for Germany and 959 t for Norway.

Table 1.4.5.5 GREENLAND HALIBUT. Nominal landings (tonnes) by countries, in Division VIb, as officially reported to ICES and estimated by WG.

Country	1996	1997	1998	1999	2000	2001	2002	2003 [1]	2004 [1]
Faroe Islands		47							
Norway	2								119
Poland									1
Spain 2	2	42	67	137	299	102	28	35	86
Total	2	47							120
WG estimate	4	89	67	137	299	102	28	35	206

[1] Provisional data

[2] Based on estimates by observers onboard vessels

Table 1.4.5.6 GREENLAND HALIBUT. Nominal landings (tonnes) by countries, in Subarea XII, as officially reported to ICES and estimated by WG.

Country	1996	1997	1998	1999	2000	2001	2002	2003 [1]	2004 [1]
Faroe Islands									
Norway							21	26	
Poland									1
Russia									1
Spain [2]			22	88	20	350	1367	214	170
UK									10
Total	0	0	22	88	20	350	1388	240	182
WG estimate									

[1] Provisional data

[2] Based on estimates by observers onboard vessels

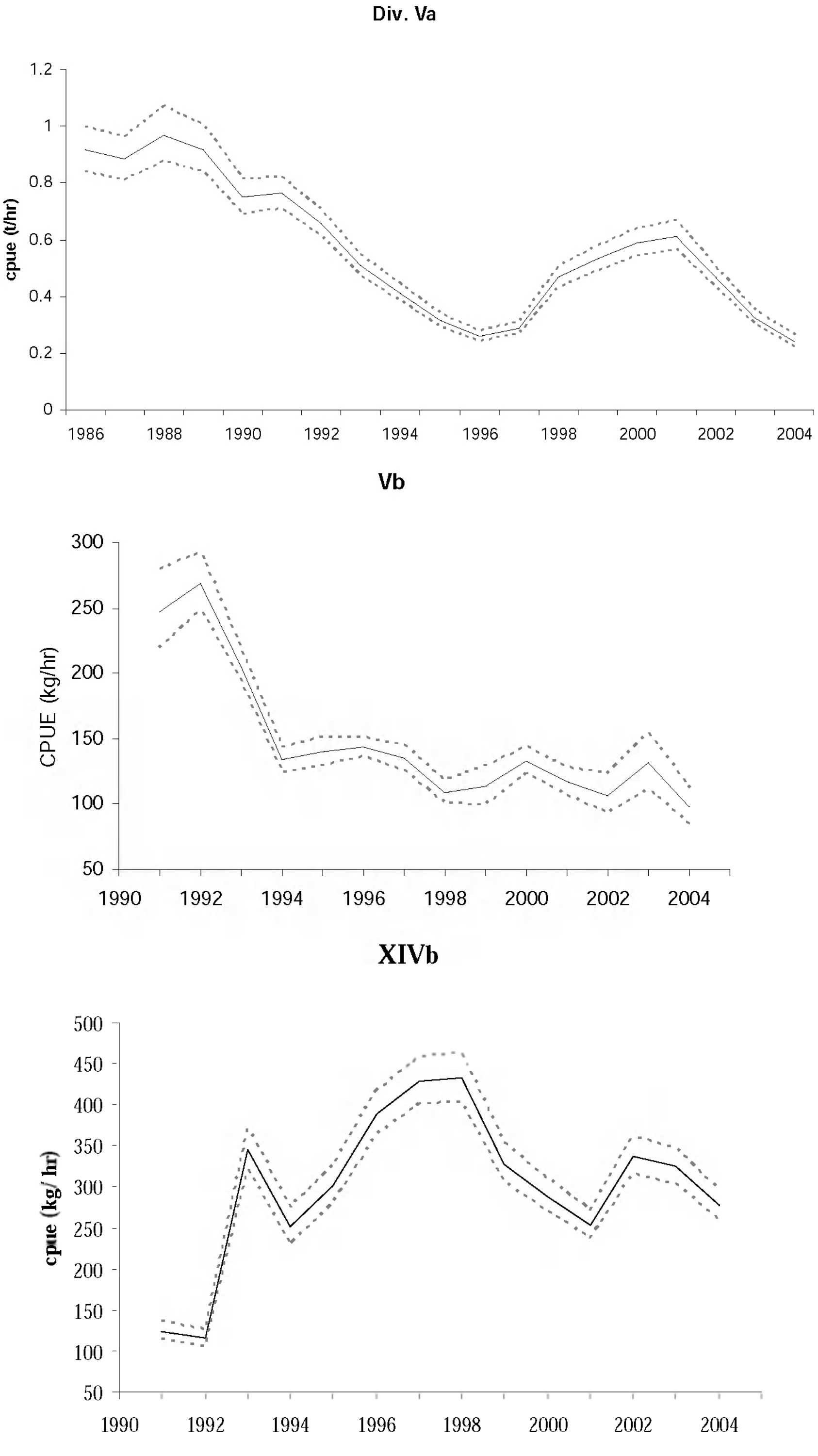


Figure 1.4.5.1 Standardised CPUE series from fleets in Divisions, Va, Vb, and XIVb with indication of 95% CI.

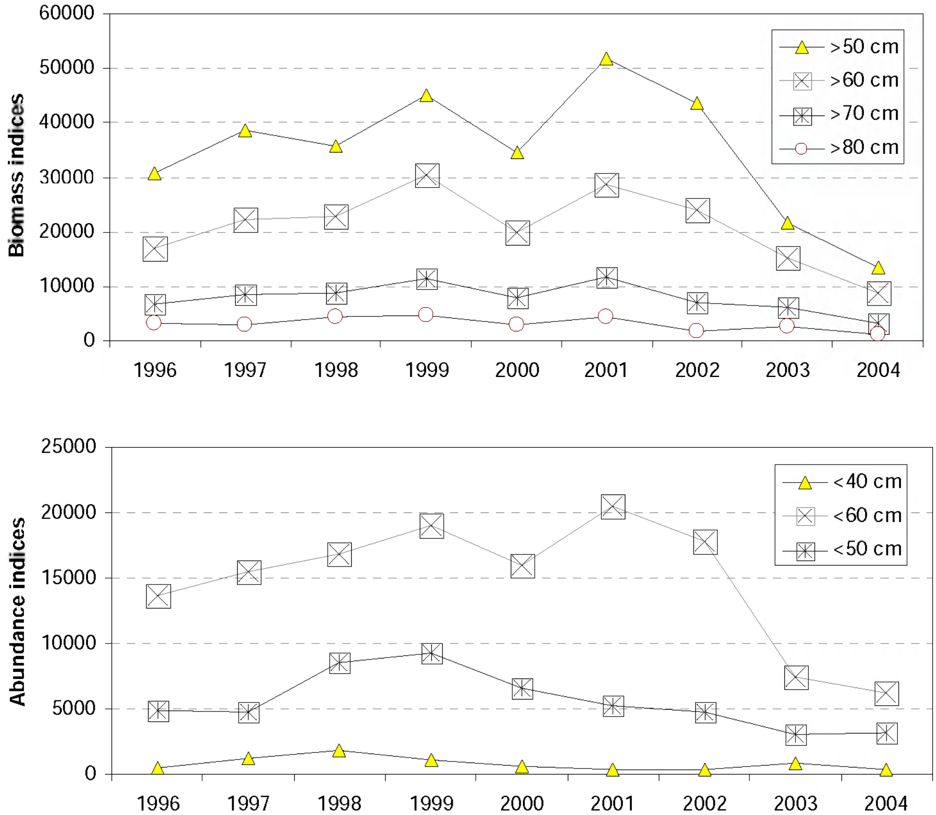


Figure 1.4.5.2 Greenland halibut in Icelandic fall groundfish survey (Va); a) upper: biomass indices of lengths larger than indicated and b) lower: abundance indices by lengths smaller than indicated.

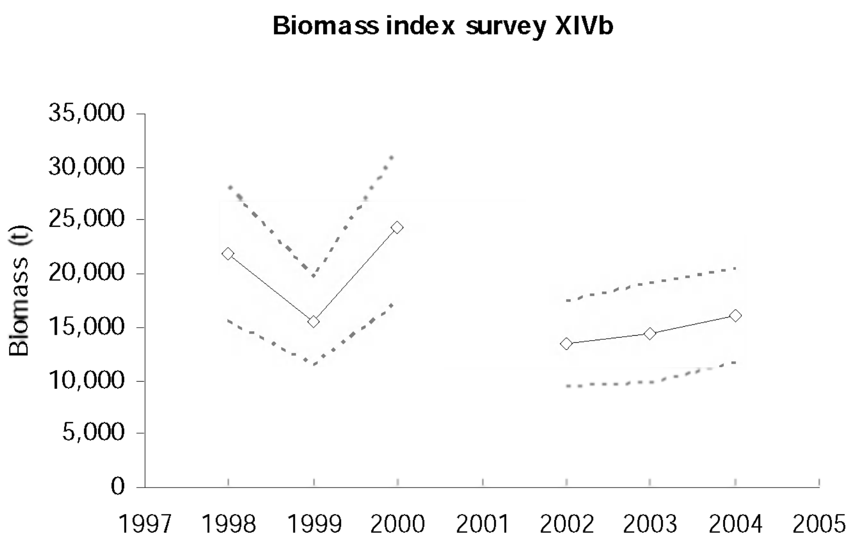


Figure 1.4.5.3 Biomass index from a Greenland survey in East Greenland waters with indication of 95% CI.

1.4.6 Redfish in Subareas V, VI, XII, and XIV

Introduction

Species of the genus *Sebastes* are common and widely distributed in the North Atlantic. They are found off the coast of Great Britain, along Norway and Spitzbergen, in the Barents Sea, off the Faroe Islands, Iceland, East and West Greenland, and along the east coast of North America from Baffin Island to Cape Cod.

There are three species of redfish commercially exploited in ICES Subareas V, VI, XII, and XIV, *S. marinus*, *S. mentella,* and *S. viviparus*. The last one has only been of minor commercial value in Icelandic waters and is exploited in two small areas south of Iceland at depths of 150–250 m.

Nominal landings and splitting of the landings into stocks

The official statistics reported to ICES do not divide the catch by species/stocks (Tables 1.4.6.1–5). Only preliminary official landings data were provided by NEAFC.

Information from various sources is used to split demersal landings into species. In Division Va, if no direct information is available on the catches for a given vessel, the landings are allocated based on logbooks and samples from the fishery. According to the proportion of biological samples from each cell (one fourth of ICES statistical square), the unknown catches within that cell is split accordingly and raised to the landings of a given vessel. For other areas, samples from the landings are used as basis for dividing the demersal redfish catches between *S. marinus* and *S. mentella*. Furthermore, according to Icelandic legislation, fishing vessels are obligated to divide their *S. mentella* catches into pelagic *S. mentella* or demersal *S. mentella*, depending on whether they are fishing west or east of the redfish line.

The pelagic *S. mentella* fishery in Division Va has in recent years moved more northwards, and in some years it merged with the demersal *S. mentella* fishery on the redfish line in June/July. When the pelagic *S. mentella* crossed the redfish line, it was recorded as demersal *S. mentella* and caught with bottom trawls, resulting in increased landings in 2003. Furthermore, the fraction of demersal *S. mentella* catches taken by pelagic trawls has been varying since 1993, based on logbook data, ranging between 0% in 2004 and 23% in 1994 (average 12%).

Abundance and distribution of 0-group and juvenile redfish

Available data on the distribution of juvenile *S. marinus* indicate that the nursery grounds are located in Icelandic and Greenland waters. No nursery grounds have been found in Faroese waters. The nursery areas for *S. marinus* in Icelandic waters are found all around Iceland, but are mainly located west and north of the island at depths between 50 and 350 m. The migration of juveniles is along the north coast towards the most important fishing areas off the west coast.

Abundance and biomass indices of juvenile (<17 cm) redfish (juveniles were only classified to the genus *Sebastes* spp. due to difficult identification) from the German annual groundfish survey, conducted on the continental shelf and slope of West and East Greenland down to 400 m, shows that juveniles were abundant in 1993 and 1995–1998 (Figure 1.4.6.2).

Discards and bycatch of small redfish

No information has been available in recent years to quantify the bycatch and about the length distribution of the fish caught. The documentation of the effect of sorting grids on the bycatches is needed in order to estimate the bycatch of young redfish in the shrimp fishery.

Stock identity and management units of *S. mentella*

ACFM decided to maintain the current advisory units until a synthetic review of stock identification information is available: a demersal unit on the continental shelf in ICES Divisions Va, Vb, and XIV and a pelagic unit in the Irminger Sea and adjacent areas (V, VI, XII, and XIV). This latter unit also includes pelagic redfish in the NAFO Convention Area. A schematic illustration of the horizontal and vertical distribution of redfish in these areas is given in Figure 1.4.6.1.

Landings: The total landings from the redfish stock complex (i.e. redfish in all Subareas) are given in Tables 1.4.6.1–5.

Table 1.4.6.1 REDFISH. Nominal catches (tonnes) by countries, in Division Va 1996-2002, as officially reported to ICES.

Country	1998	1999	2000	2001	2002	2003	2004*
Faroe Islands	280	255					
Germany	284	428	513	844	467	1,105	620
Greenland	-*	-*	-*	-*	3,341*		
Iceland	108,380	81,430	95,118	48,970	63,247	67,997	70,167
Norway	-	18	36	26*	16*	19	9
UK (E/W/NI)	-	542	734	1,037	432	...	...
UK (Scotland)	-	149	70	114	272	...	...
United Kingdom					704	1,081	1,008
Total	108,944	82,822					71,803

*Preliminary

Table 1.4.6.2 REDFISH. Nominal catches (tonnes) by countries, in Division Vb 1996-2002, as officially reported to ICES.

Country	1998	1999	2000	2001	2002	2003	2004*
Faroe Islands	6,484	6,191					
France	110*		250	189	221	262	
Germany	-	207	79	88	2	19	+
Greenland	-*	-*	-*	-*	13*		
Iceland	-	-	-	54	35	-	
Ireland	-	-	-	1	-		
Norway	39	37	41	24*	30*	31	19
Portugal							15
Russia	-	-	12	-	-	-	3
UK (E/W/NI)	4	15	111	92	120	...	...
UK (Scotland)	27	46	142	116	89	...	...
United Kingdom					409	89	152
Total	6,664						189

*Preliminary.

Table 1.4.6.3 REDFISH. Nominal catches (tonnes) by countries, in Division VI 1996-2002, as officially reported to ICES.

Country	1998	1999	2000	2001	2002	2003	2004*
Estonia	-	-	-	+	-	-	1
Faroe Islands	-	44					
France	297*		269	188	97	113	
Germany	1	+	+	1	-	-	1
Ireland	10	34	54	47	26		
Norway	3	8	11	5*	9*	7	2
Portugal	1	-	-	-	-	-	
Russia	-	243	461	88	19	94[1]	
Spain	-	38	16	4	784		
UK (E/W/NI)	12	4	20	44	7	...	...
UK (Scotland)	364	762	405	485	376	...	...
United Kingdom						950	517
Total	688						521

*Preliminary. [1]Reported as *S. mentella.*

Table 1.4.6.4 REDFISH. Nominal catches (tonnes) by countries, in Subarea XII 1996-2002, as officially reported to ICES.

Country	1998	1999	2000	2001	2002	2003	2004*
Estonia	3,968	2,108	4,000	-	-	-	
Faroe Islands	1,793	528					
France	3*	-*	+	+	-	1	
Germany	9,746	8,204	1,128	3,833	3,032	565	313
Greenland	1,180*	1,188*	124*	740*	-*		
Iceland	1,311	5,072	3,121	11,679	5,745	-	14,266
Latvia	-	-	-	-	1,061	371	+
Lithuania	-	-	-	-	-	14,321	
Norway	602	2,040	2,200	878*	1,094*	3,111	1,858
Poland	-	-	-	-	1	-	
Portugal	-	-	-	387	878	504[1]	1,727
Russia	89	7,698	9,243	4,509	6,090	2,430[2]	812[2]
Spain	2,231	1,723	576	1,332	854		
UK (E/W/NI)	+	187	-	-	+	...	...
UK (Scotland)	-	1	+	-	4	...	...
United Kingdom						1	+
Total	20,923	28,749					18,976

*Preliminary. [1]Reported as V/XII/XIVGRN. [2]Reported as *S. mentella*.

Table 1.4.6.5 REDFISH. Nominal catches (tonnes) by countries, in Subarea XIV 1996-2002, as officially reported to ICES.

Country	1998	1999	2000	2001	2002	2003	2004*
Estonia	-	-	3,811	599	-	-	
Faroe Islands	47	2					
Germany	9,709	8,935	7,840	6,758	9,576	7,050	2,336
Greenland	296*	3,152*	3,545*	2,587*	1,171*		
Iceland	6,441	23,770[1]	17,999	31,786	41,805	43,063[2]	123
Norway	525	3,253	3,699	4,258*	4,215*	5,073	6,964
Poland	-	-	-	-	-	141[4]	2,011
Portugal	4,133	4,302	4,154	2,116	2,208	2,116[3]	2,693
Russia	25,748	16,652	14,851	23,851	25,309	28,687[4]	31,381[4]
Spain	4,660	4,175	2,657	4,982	-		
UK (E/W/NI)	43	68	45	179	16	...	...
UK (Scotland)	-	-	-	-	17	...	...
United Kingdom						378	338
Total	51,602	64,309					45,846

*Preliminary. [1]Note Excluding 58 t reported as area unknown . [2]Oceanic redfish. [3]Reported as V/XII/XIV. [4]Reported as *S. mentella.*

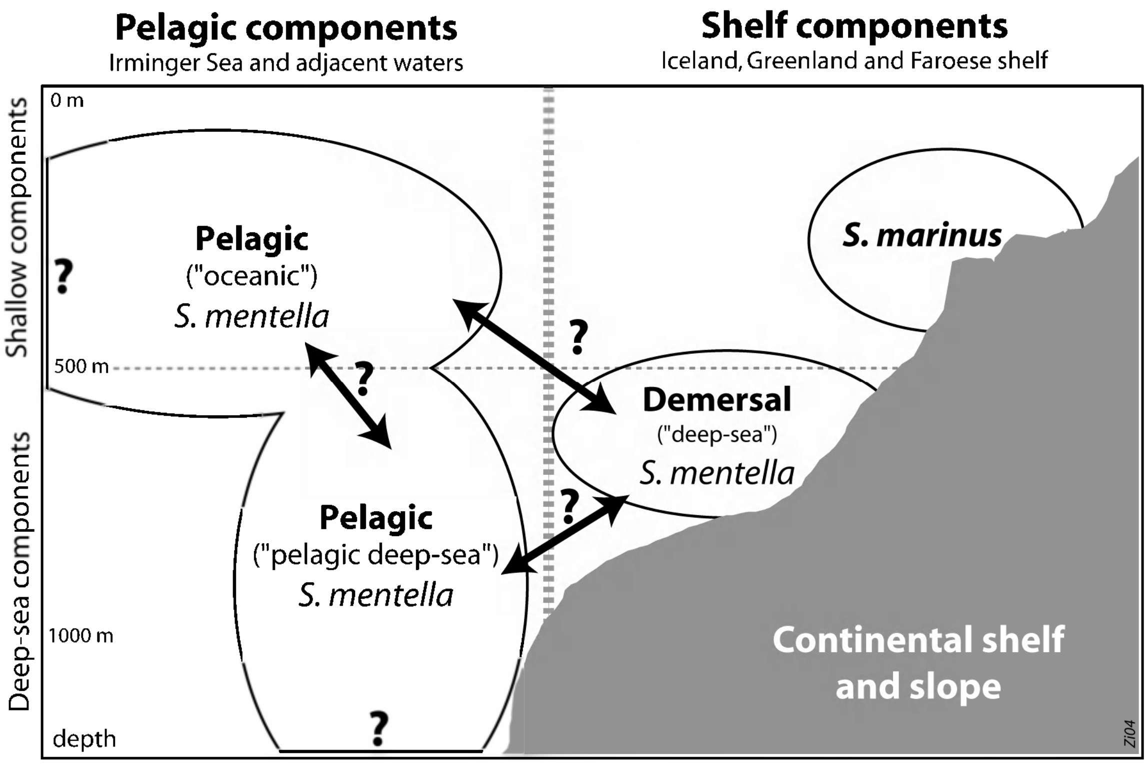


Figure 1.4.6.1 Schematic presentation of the vertical distribution of *Sebastes marinus* and *Sebastes mentella* in the ICES area and the stock definitions as used for the present advice.

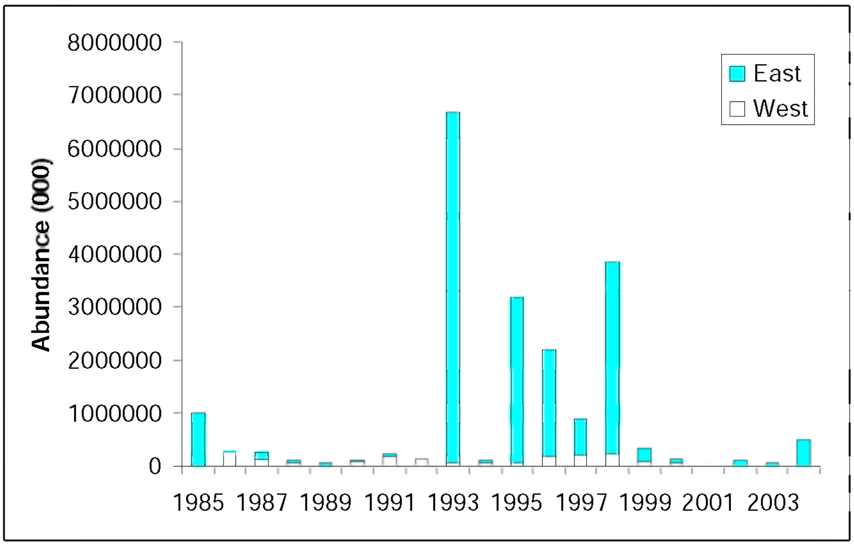


Figure 1.4.6.2 The Figure shows survey abundance indices of *Sebastes* spp. (<17 cm) from the German groundfish surveys conducted on the continental shelves of East and West Greenland 1985-2003. The abundance of small redfish varies substantially.

1.4.7 *Sebastes marinus* in ICES Divisions Va, Vb, VI, XII,and XIV

State of the stock

Fishable biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
Full reproductive capacity	Reference points not defined	Unknown	

Based on the most recent indicator of SSB ICES classifies the stock as having full reproductive capacity. According to information from the Icelandic groundfish survey, the stock in Division Va has fluctuated between $\mathbf{U}_{pa}$ and $\mathbf{U}_{lim}$ since 1990, but has been above $\mathbf{U}_{pa}$ since 2002. In Subarea XIV the German groundfish survey showed an almost continuous decrease in biomass indices by more than 90% in the period 1986–2001, but signs of increasing biomass have been observed since 2001. In Division Vb catches have declined since 1985 to a low level in recent years, and this decline is also reflected in the Faroes summer survey (Figure 1.4.7.3). The strong 1990 year class has started to recruit to the Icelandic fishery and should sustain the stock in the short and medium term. The surveys do not indicate further strong year classes, and therefore the stock is expected to be reduced in the long term.

Management objectives

There is no explicit management objective for this stock.

Reference points

ICES suggests that the relative state of the stock be assessed through survey CPUE index series (U).

	ICES considers that:	ICES proposed that:
Precautionary Approach reference points	$\mathbf{U}_{lim}$ is 20% of highest observed survey index.	$\mathbf{U}_{pa}$ be set at 60% of highest observed survey index.

Technical basis

The basis for the calculation of the $\mathbf{U}_{pa}$ is the Icelandic groundfish survey index series starting in 1985. Since 1990 the average **U** has been around half of $\mathbf{U}_{max}$. This has not resulted in any strong year classes compared to higher U's. A precautionary $\mathbf{U}_{pa}$ is therefore proposed at $\mathbf{U}_{max}$*0.6, corresponding to the U's associated with the most recent strong year class. U is regarded as proxy for SSB but represents the fishable biomass.

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits

Catches in ICES Divisions Va in 2006 should be less than 35 000 t. Maintaining catches below 35 000 t is expected to keep the stock above $\mathbf{U}_{pa}$ in the medium term. A small component in Division Vb should be accounted for and the total advised TAC for Divisions Va and Vb is therefore 37 000 t.

There should be no directed fishery for *S. marinus* in Subarea XIV as the fishable stock of *S. marinus* in Subarea XIV is depleted and the adult stock is non-migrating.

Short-term implications

Catches of 37 000 t in 2006 (35 000 t in Va) are expected to keep the stock at an acceptable level in the short term (Figure 1.4.7.4).

Management considerations

A large portion of the current catch comes from the relatively large 1985 and 1990 year classes. It is expected that these year classes will be a significant proportion of the catch in the medium term. All available data indicate that recent year classes are relatively poor. After the two strong year classes have passed the fishery, higher yield than about 20 000 t cannot be expected after 2010.

The present management scheme in Va sets a joint TAC for *S. marinus* and *S. mentella* on the shelf. This impedes direct management of *S. marinus*. TAC or effort allocated to demersal redfish fishery should be given separately for each of the redfish stocks.

Based on the low fishable biomass in Subarea XIV and its importance as a nursery area for the entire resource, ICES offers different advice for this area: the area should be closed to directed fishing for *S. marinus*.

Scientific basis

Data and methods

Survey data from: the Icelandic spring groundfish survey 1985–2005 and the Icelandic autumn survey 1996–2004 in Division Va; the German groundfish survey 1985–2004 in Subarea XIV; and the Faroe spring (1994–2005) and summer (1996–2004) surveys in Division Vb are used as stock indicators in the respective areas.

Data from the commercial catch in Va: length distribution, age-length key, and mean length-at-age.

The spring survey data in Va and the data from the commercial catch in Va are used for tuning in the BORMICON model, which is an age- and length-based cohort model used for the assessment and medium-term projection in Va.

Source of information

Report of the North-Western Working Group, 26 April–5 May 2005 (ICES CM 2005/ACFM:21).

Year	ICES Advice	Predicted catch Corresp. to advice	*S. marinus* ACFM catch
1987	No increase in F	83	77
1988	No increase in F	84	90
1989	TAC[1]	117[1]	57
1990	TAC[1]	116[1]	67
1991	Precautionary TAC	77(117[1])	56
1992	Precautionary TAC	76(116[1])	56
1993	Precautionary TAC[1]	120[1]	50
1994	Precautionary TAC, if required	100[1]	43
1995	TAC	90[1]	45
1996	TAC for Va (28); precautionary TAC for Vb and XIV (4)	32[2]	37
1997	Effort 75% of 1995 value	32[2]	40
1998	Effort reduced in steps of 25% from the 1995 level	37.2[2]	39
1999	Effort not increased compared to 1997	35[2]	42
2000	Catch not increased compared to 1998	35[2]	44
2001	Effort not increased compared to 1999	33[2,3]	37
2002	25% reduction in effort	29[4]	51
2003	25% reduction in effort(2001)	31[4]	39
2004	25% reduction in effort(2002)	37.4[4]	34
2005	Maintain fishable biomass above $\mathbf{U_{pa}}$	37[4]	
2006	Maintain fishable biomass above $\mathbf{U_{pa}}$	37[4]	

Weights in '000 t. [1] Deep-sea *S. mentella* and *S. marinus* combined. [2]*S. marinus* only. [3] In Va only. [4]Both Va and Vb and XIV.

Total landings of *Sebastes marinus* in ICES Divisions V, VI, XII, and XIV

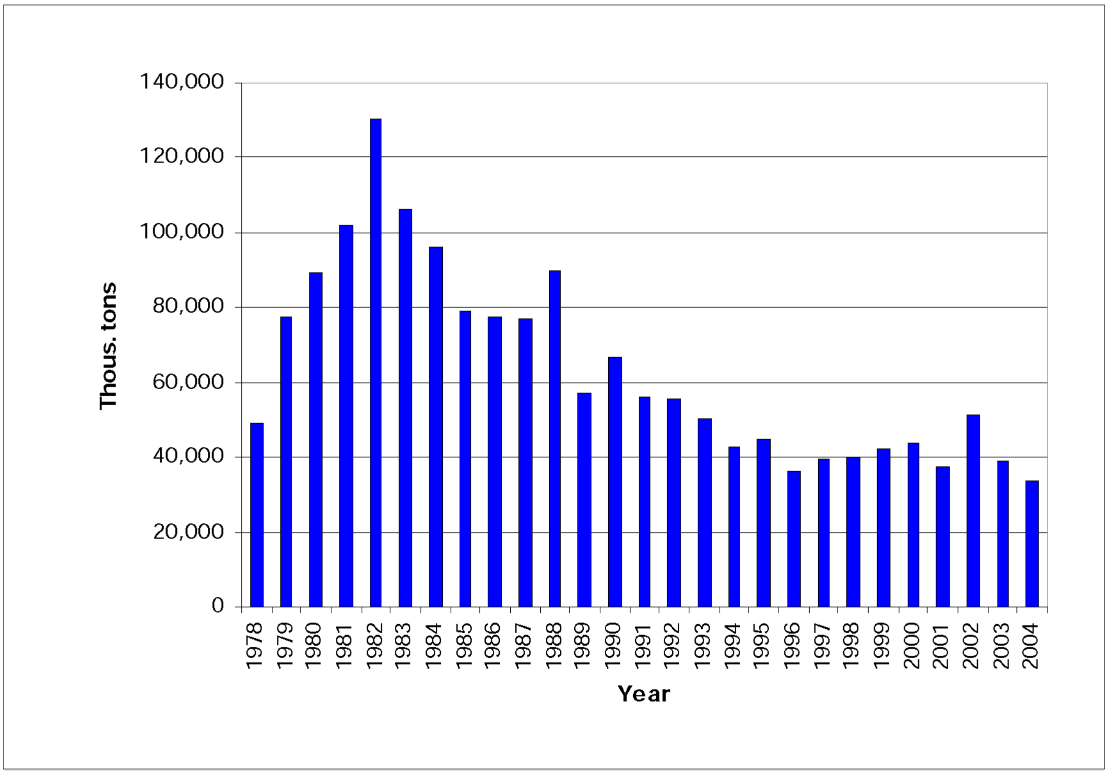


Table 1.4.7.1 Official landings (in tonnes) of *S. marinus*, by ICES Division 1978–2004 as officially reported to ICES.

	ICES Division				
Year	Va	Vb	VI	XIV	Total
1978	31,300	2,039	313	15,477	49,129
1979	56,616	4,805	6	15,787	77,214
1980	62,052	4,920	2	22,203	89,177
1981	75,828	2,538	3	23,608	101,977
1982	97,899	1,810	28	30,692	130,429
1983	87,412	3,394	60	15,636	106,502
1984	84,766	6,228	86	5,040	96,120
1985	67,312	9,194	245	2,117	78,868
1986	67,772	6,300	288	2,988	77,348
1987	69,212	6,143	576	1,196	77,127
1988	80,472	5,020	533	3,964	89,989
1989	51,852	4,140	373	685	57,050
1990	63,156	2,407	382	687	66,632
1991	49,677	2,140	292	4,255	56,364
1992	51,464	3,460	40	746	55,710
1993	45,890	2,621	101	1,738	50,350
1994	38,669	2,274	129	1,443	42,515
1995	41,516	2,581	606	62	44,765
1996	33,558	2,316	664	59	36,597
1997	36,342	2,839	542	37	39,761
1998	36,771	2,565	379	109	39,825
1999	39,824	1,436	773	7	42,040
2000	41,187	1,498	776	89	43,550
2001	35,067	1,631	535	93	37,326
2002	48,570	1,941	392	189	51,092
2003	36,577	1,459	968	215	39,220
2004[1)]	31,738	1,139	519	103	33,498

[1)] Provisional.

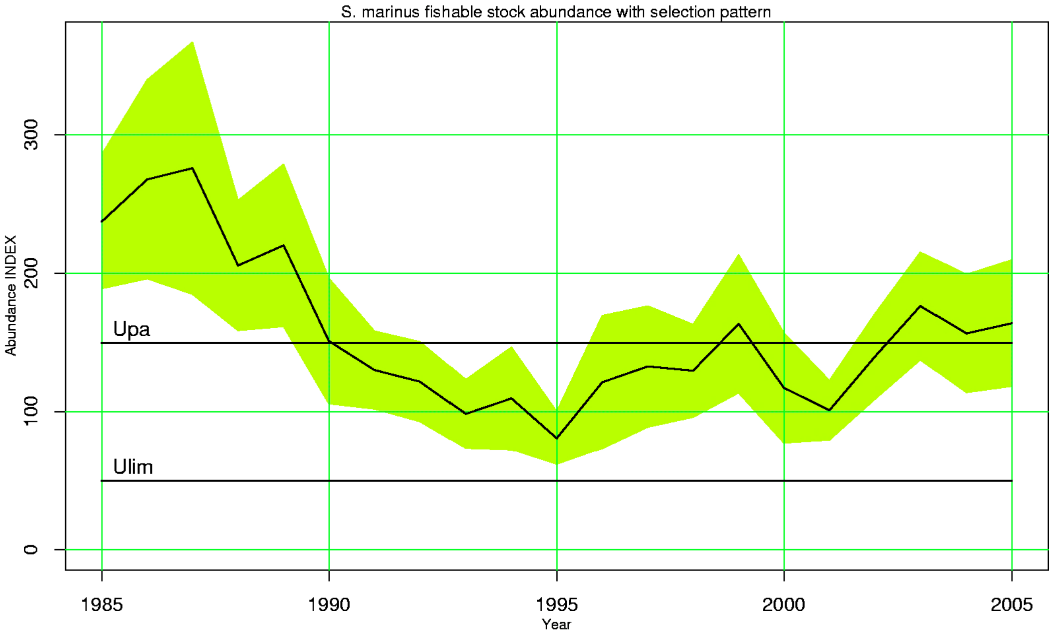


Figure 1.4.7.1 Index on the fishable stock of *S. marinus* from Icelandic groundfish survey and 95% confidence intervals. The index is based on all strata at depths from 0–400 m.

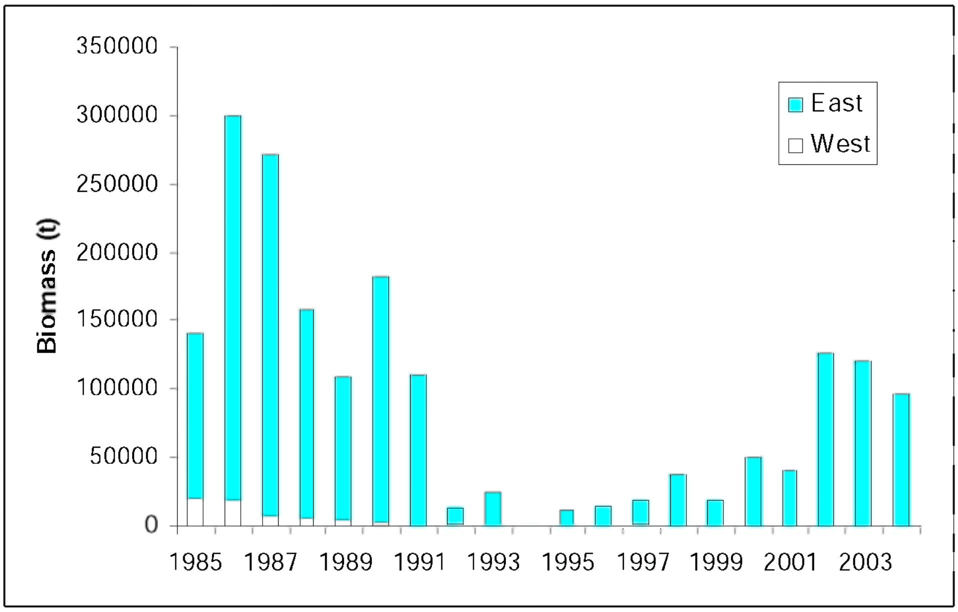


Figure 1.4.7.2 *S. marinus* (≥17 cm). Survey biomass indices for East and West Greenland, 1985–2004.

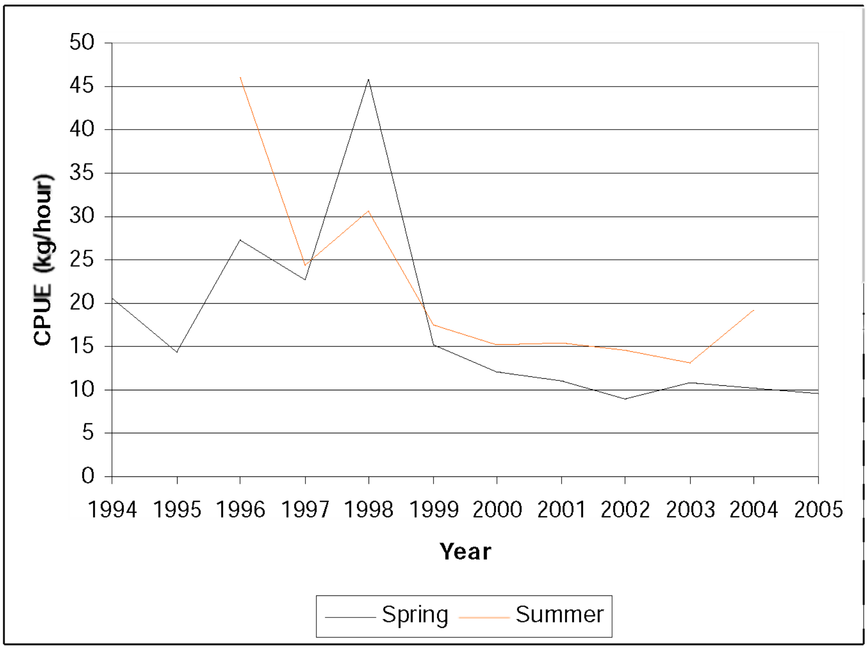


Figure 1.4.7.3 CPUE of *S.marinus* in the Faeroes spring groundfish survey 1994–2005 and the summer groundfish survey 1996–2004 in ICES Division Vb.

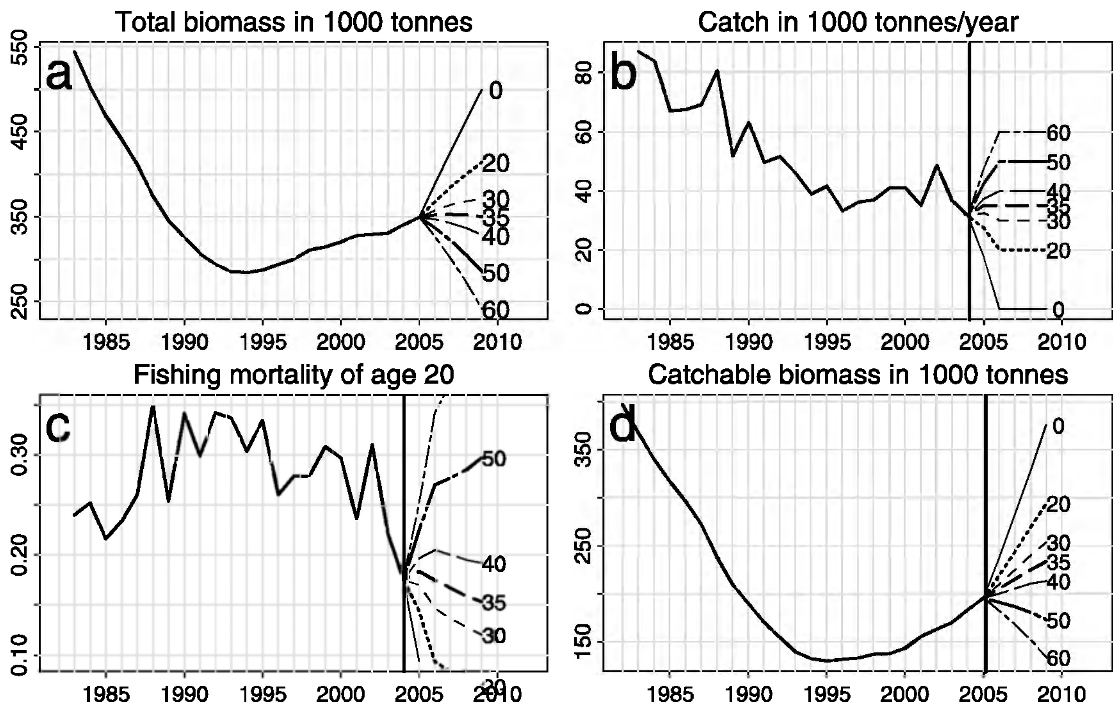


Figure 1.4.7.4 Results from the BORMICON model-BASE CASE, using catch data from ICES Division Va (about 2 000 t should be added to the projected catch to take account of the catches taken in Vb). Development of biomass and F, using different catch options (0–60 000 t indicated by labels) after 2004.

1.4.8 Demersal *Sebastes mentella* on the continental shelf in Subareas V, VI, and XIV

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
Reference points not defined	Reference points not defined	Unknown	

The available information is inadequate to evaluate spawning stock or fishing mortality relative to risk, so the state of the stock is unknown. Commercial CPUE indicates a general decrease in stock biomass from the late 1980s to the early 1990s. Survey biomass indices suggest another decrease after 2001. Survey indices of small fish in Division XIVb which is considered to be the nursery ground have increased in recent years.

Management objectives

There is no explicit management objective for this stock.

Reference points

No precautionary reference points are established.

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary considerations

There is no basis to change the advice from last year. Therefore, catches in 2006 should not exceed 22 000 t, and there should be no direct fishery for *S. mentella* in Subarea XIV.

Management considerations

The advice for 2005 catch was 22 500 t, which corresponded to the lowest observed catch in Subarea V since 1980, taken in 2001. The advised catch in 2005 and 2006 coincides with the only substantial increase in biomass indicated by the Icelandic groundfish survey (in 2001). The estimate of the 2001 catch in Subarea V was revised to 22 000 t.

As this stock is at a low level, the fishable biomass of *S. mentella* in Subarea XIV is low, and the area is considered to be a nursery ground, ICES advises that there should be no direct fishery for *S. mentella* in Subarea XIV.

Sebastes mentella is a deep-sea species with late maturation and slow growth and is hence considered to be vulnerable to overexploitation. It can therefore only sustain low exploitation and management should be based on that consideration.

The present management scheme in Division Va sets a joint TAC for *S. marinus* and *S. mentella* on the shelf. This impedes direct management of each stock, and ICES repeats its advice that the two species should be managed separately.

Factors affecting the fisheries and the stock

Changes in fishing technology and fishing patterns

In Division Va, demersal *S. mentella* are taken mainly by Icelandic trawlers at depths greater than 500 m. In Division Vb, the fishery is carried out mainly by Faroese trawlers, though some bycatch is taken by other countries fishing demersal species. In Subarea XIV, the catch is mainly taken as bycatch by German freezer trawlers targeting Greenland halibut. The total annual catches almost doubled in the early 1990s, but have since then decreased to the level of the 1980s. The increase was mainly caused by an increased catch in Division Va, both in the demersal and in a temporarily developed pelagic fishery, and by an increase in Subarea XIV in 1993–1994. The increased catch of *S. marinus* in Va in 2002 and decreased catch of *S. mentella* in 2001 and 2002 is due to a joint quota for *S. marinus* and *S. mentella* on the shelf, and the fishing fleet has increased the proportion taken from *S. marinus* in most recent years.

Scientific basis

Survey data are available from the German groundfish survey in Subarea XIV (1985–2003), and from the Icelandic groundfish survey in Va (2000–2003). CPUE data are available from Icelandic trawlers in Division Va (1986–2003) and from the Faroese fishery in Division Vb (1991–2003).

Prior to 2004, advice was based solely on CPUE indices from the fishery. The contradiction between stable or increasing CPUEs and the decreasing survey indices in the past 5–10 years suggests that recent CPUE does not reflect relative stock size. Technological advances in fishing gear have not been accounted for and are thought to be significant. The nature of the fishery is similar to pelagic fisheries, targeting schools of fish using advancing technology. The effect of technological advances is to increase CPUE. Therefore the general decrease in CPUE from the late 1980s to the early 1990s suggests a decreasing stock, but recent increase in CPUE is not considered to reflect biomass increases.

The German surveys in East Greenland cover nursery grounds for *S. mentella*. A strong cohort from 1989 was observed in the survey in 1995 to 1998. That cohort has emigrated from the survey area and has started to contribute to the fisheries. There are indications in the survey in 2003 and 2004 that strong year classes are entering the fishery. However, there are few fish smaller than 25 cm.

Uncertainties in assessment and forecast

Data did not allow for an analytical assessment.

Comparison with previous assessment and advice

The assessment and advice are the same as last year.

Sources of information

Report of the North-Western Working Group, 26 April–5 May 2005 (ICES CM 2005/ACFM:21).

Report of the North-Western Working Group *Sebastes mentella*, September 2004 (ICES CM 2004/ACFM:24).

Hans-Joachim Rätz, Thorsteinn Sigurdsson and Christoph Stransky (2004). Abundance and length composition for *Sebastes marinus* L., deep-sea *S. mentella* and juvenile redfish (Sebastes spp.) off Greenland and Iceland based on groundfish surveys 1985–2003. WD to the ICES NWWG, April–May 2004.

Year	ICES Advice	Predicted catch corresponding to advice	Deep-sea *S. mentella* ACFM catch
1987	Precautionary TAC	41–58	37.5
1988	Precautionary TAC	41–58	31.4
1989	TAC[1]	117[1]	53.9
1990	TAC[1]	116[1]	44.2
1991	Precautionary TAC	(40) 117[1]	67.9
1992	Precautionary TAC	(40) 116[1]	63.1
1993	Precautionary TAC	120[1]	74.2
1994	Precautionary TAC, if required	100[1]	83.6
1995	TAC	90[1]	55.7
1996	Precautionary TAC (45 in Va; 23 in VI and XIV)	68[2]	41.9
1997	Effort 75% of 95-value	39[2]	43.1
1998	Fishing mortality be further reduced towards the 86-90 levels		38.9
1999	Fishing mortality be further reduced towards the 86-90 levels		35.0
2000	Fishing effort be further reduced by 25%		38.1
2001	Fishing effort be reduced by 25% from 1998 level	22[3]	23.9
2002	*Status quo* fishing effort	36[4]	23.5
2003	Not higher fishing effort than recent average	30[4]	31.1
2004	Not higher fishing effort than recent average	26.4[4]	21.6
2005	Reduce catch to 2001 level in Subarea V	22.5[4]	
2006	Reduce catch to 2001 level in Subarea V	22.0[4]	

Weights in '000 t.
[1] Deep-sea *S. mentella* and *S. marinus* combined. [2]Deep-sea *S. mentella* only. [3]In Va only. [4] For entire Subarea V.

Table 1.4.8.1 Nominal landings (tonnes) of demersal *S. mentella* on the continental shelf and slopes 1978–2004, divided by ICES Division.

	ICES Division					
Year	Va	Vb	VI	XII	XIV	Total
1978	3 902	7 767	18	0	5 403	17 090
1979	7 694	7 869	819	0	5 131	21 513
1980	10 197	5 119	1 109	0	10 406	26 831
1981	19 689	4 607	1 008	0	19 391	44 695
1982	18 492	7 631	626	0	12 140	38 889
1983	37 115	5 990	396	0	15 207	58 708
1984	24 493	7 704	609	0	9 126	41 932
1985	24 768	10 560	247	0	9 376	44 951
1986	18 898	15 176	242	0	12 138	46 454
1987	19 293	11 395	478	0	6 407	37 573
1988	14 290	10 488	590	0	6 065	31 433
1989	40 269	10 928	424	0	2 284	53 905
1990	28 429	9 330	348	0	6 097	44 204
1991	47 651	12 897	273	0	7 057	67 879
1992	43 414	12 533	134	0	7 022	63 103
1993	51 221	7 801	346	0	14 828	74 196
1994	56 720	6 899	642	0	19 305	83 566
1995	48 708	5 670	536	0	819	55 733
1996	34 741	5 337	1 048	0	730	41 856
1997	37 876	4 558	419	0	199	43 051
1998	33 125	4 089	298	3	1 376	38 890
1999	28 590	5 294	243	0	865	34 992
2000	31 393	4 841	885	0	986	38 105
2001	17 230	4 696	36	0	927	23 889
2002	19 045	2 552	20	0	1 903	23 520
2003	28 478	2 114	197	0	348	31 137
2004[1)]	17584	3 931	6	0	38	21 559

1) Provisional

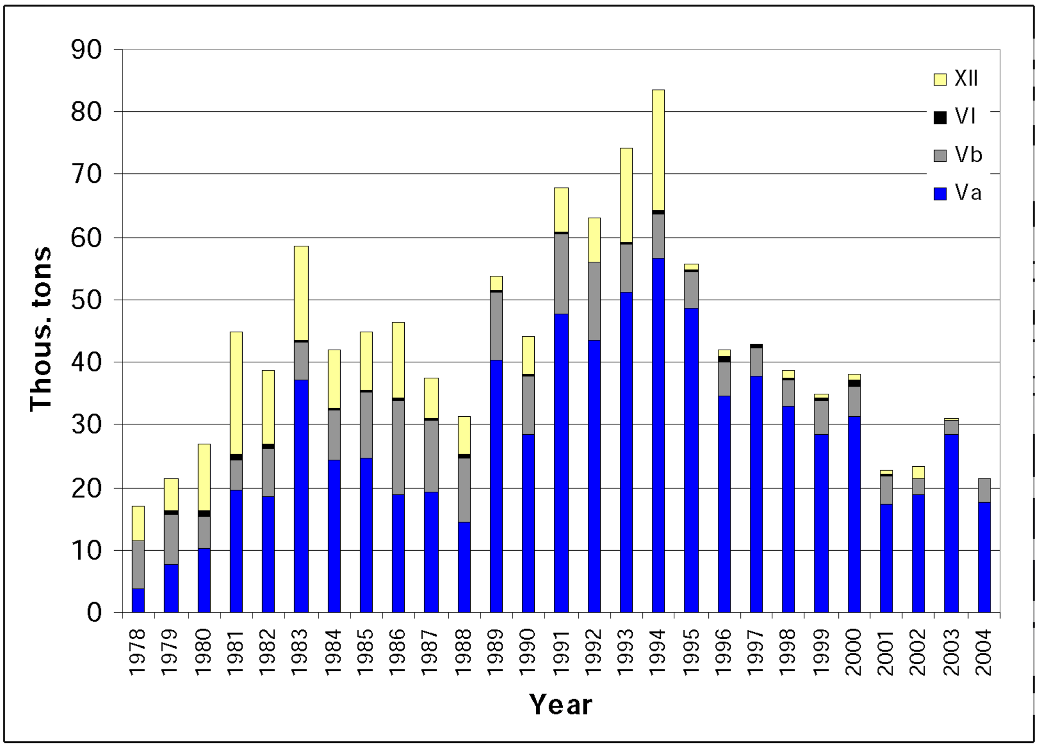


Figure 1.4.8.1 Landings of demersal *S. mentella* on the continental shelf from ICES Divisions Va, Vb, VI, and XIV in 1978–2004.

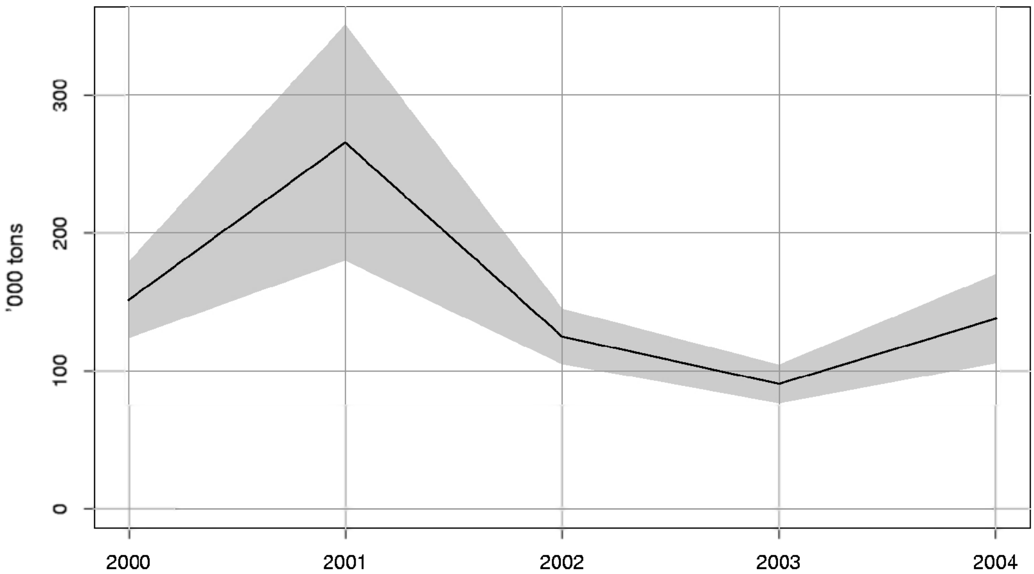


Figure 1.4.8.2 Demersal *S. mentella* on the continental shelf. Total biomass index derived from the Icelandic autumn survey conducted in Division Va in 2000–2004.

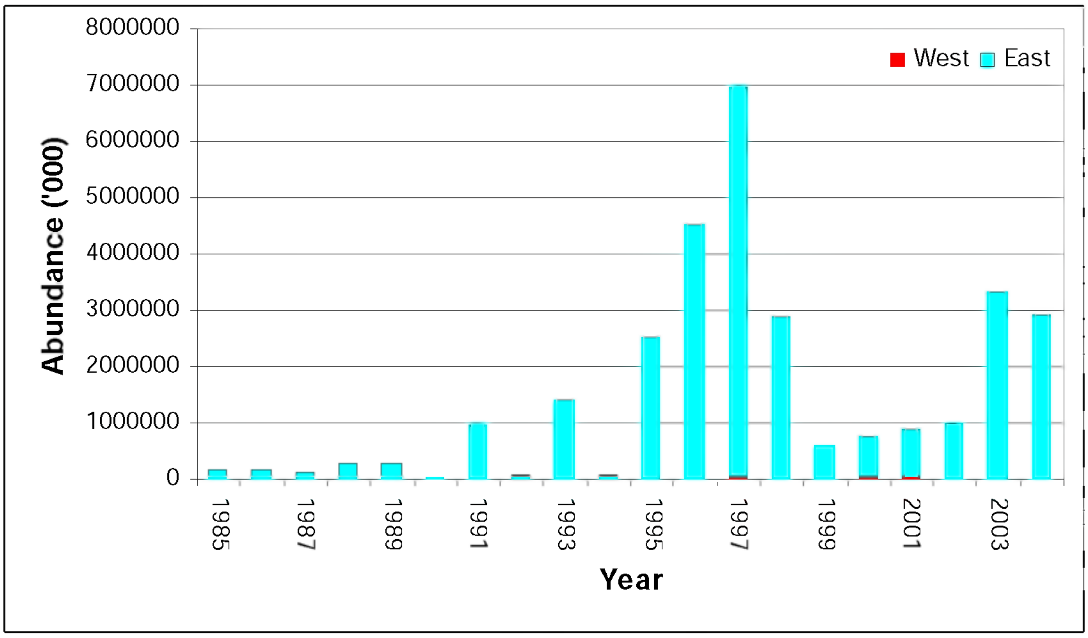


Figure 1.4.8.3 Demersal *S. mentella* (>=17 cm) on the continental shelf. Survey abundance indices for East and West Greenland derived from the German groundfish surveys 1985–2004.

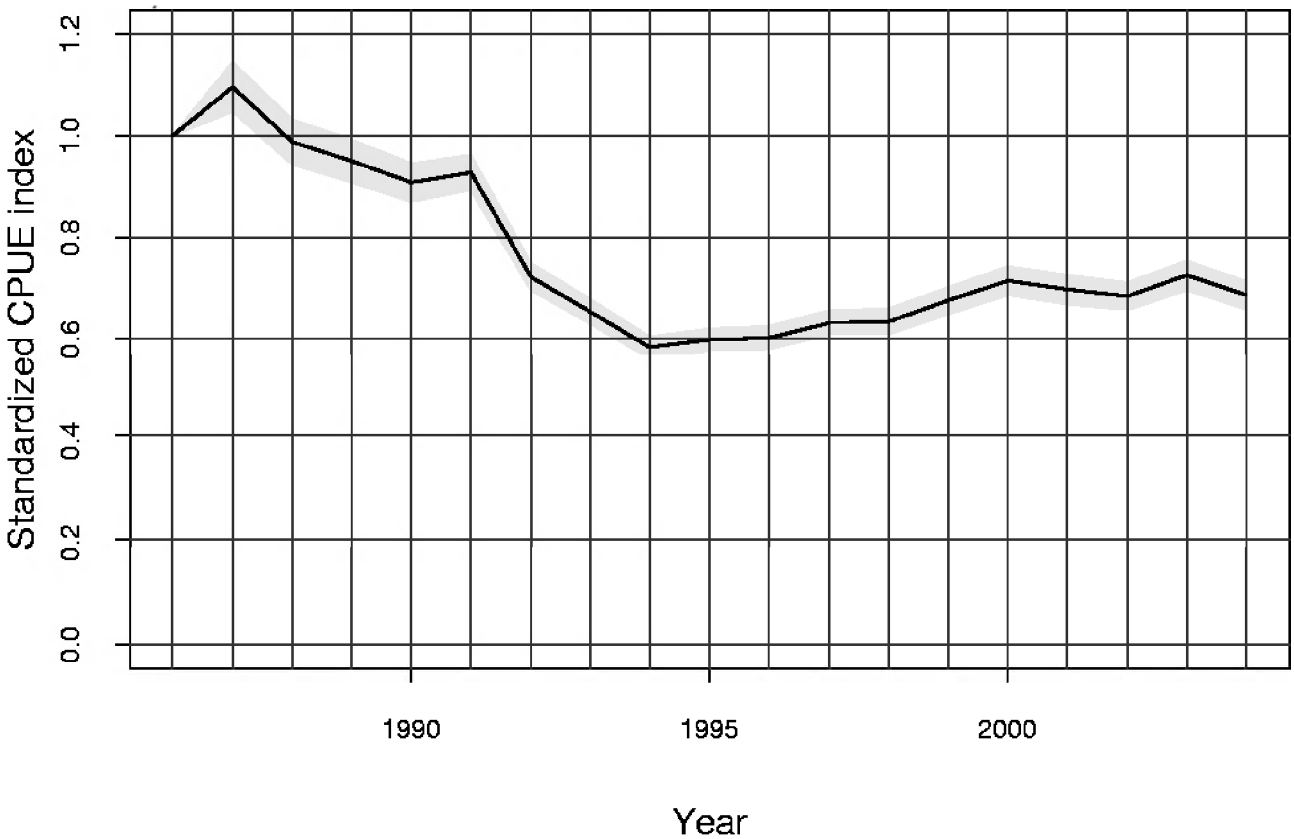


Figure 1.4.8.4 CPUE, relative to 1986, of demersal *S. mentella* from the Icelandic bottom trawl fishery in Division Va. CPUE based on a GLM model, based on data from logbooks and where at least 50% of the total catch in each tow was demersal *S. mentella*.

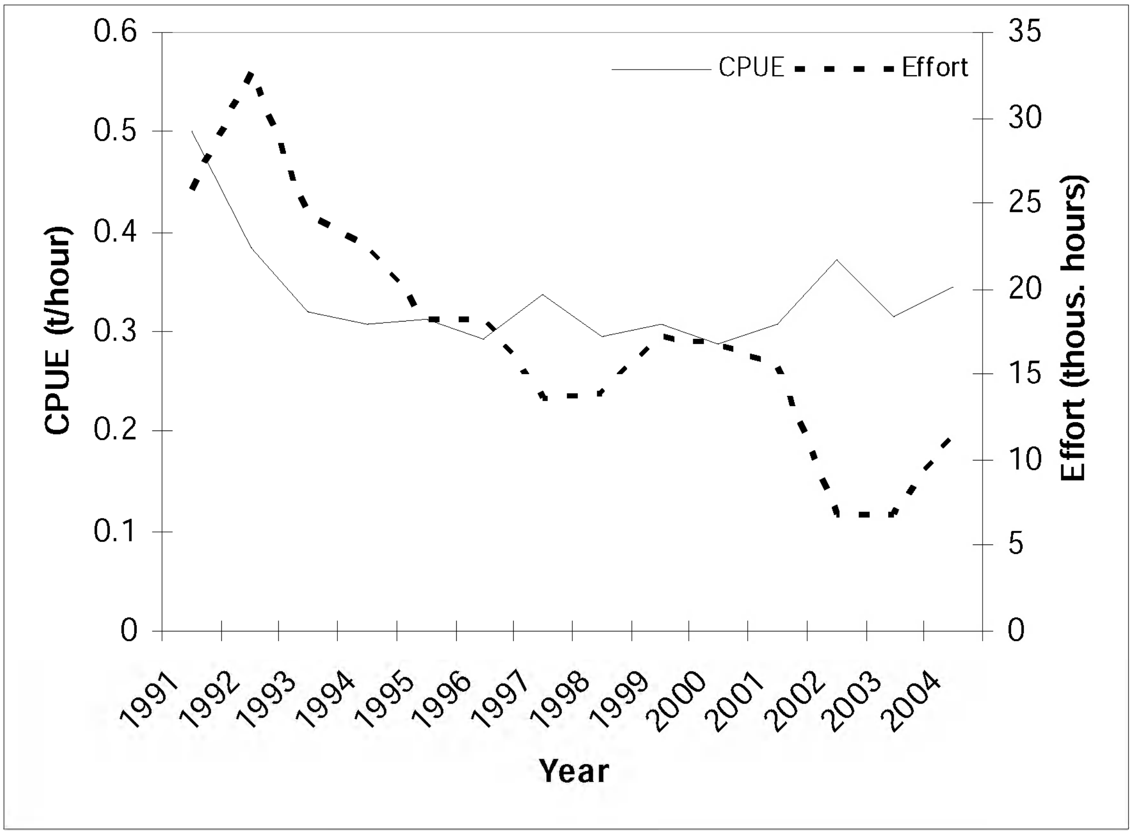


Figure 1.4.8.5 Demersal *S. mentella*. CPUE (t/hour) and fishing effort (in thousands hours) from the Faroese Single trawlers > 1000 HP fleet 1991–2004 and where 70% of the total catch was demersal *S. mentella*.

1.4.9 Pelagic *Sebastes mentella* in the Irminger Sea and adjacent areas (Subareas V, VI, XII, and XIV and the NAFO Subareas 1+2)

State of the stock

Fishable biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
Unknown	Reference points not defined	Unknown	

The available information is inadequate to evaluate spawning stock biomass or fishing mortality relative to risk, so the state of the stock is unknown. Stock status is based mainly on the perception of stock trends derived from survey indices. The internationally coordinated acoustic-trawl survey June/July 2005 indicates that the stock size is low compared to that in the early 1990s, but the stock size has not shown any clear trends since 1999. The 2005 survey also indicates a substantial decrease in the abundance of fish larger than 40 cm.

Commercial CPUE series were previously used to determine stock size. However, the fishery targets pelagic schooling fish and fishing technology is improving at an increasing rate. Therefore, stable or increasing CPUEs are not considered to reflect the stock status reliably, but decreasing CPUE likely indicates a decreasing stock. Overall CPUEs declined between 1994 and 1997 and have since fluctuated without a clear trend. However, all nations reported a decline in CPUE in 2004.

Management objectives

There are no explicit management objectives for this stock.

Reference points

No precautionary reference points have been established.

Single-stock exploitation boundaries

ICES advises for 2006 that catches should not exceed catches exerted in the period 1989–1992, corresponding to less than 41 000 t. This is the period with the lowest observed catches, prior to a decline of commercial CPUEs and prior to when biomass indices from acoustic surveys were stable. The advice includes those parts of the stock that are distributed in the NAFO Convention Area.

Management considerations

Sebastes mentella is a typical deep-sea species with late maturation, slow growth, and is hence considered to be vulnerable to over-exploitation. Therefore, advice has to be conservative. Since this is a relatively new fishery on a long-lived, slow-growing species, ICES notes that monitoring of the stock is essential in order to keep track of biomass changes as they occur. Similarly, it is important to gather information needed to evaluate the productivity of the stock. This includes information on recruitment, nursery areas, stock identification, and biomass estimation.

The advice is based mainly on the perception of stock trends derived from international trawl-acoustic survey indices and assumes that all fisheries are exploiting one population. Survey biomass indices derived from acoustic measurements were stable at a high level in the early period (1991–1995) and have since declined to a lower level in the survey years 1999, 2001, and 2005. The 2003 acoustic survey biomass was the lowest observed. However, this is not fully comparable with the rest of the time-series as the survey was carried out about one month earlier. The estimates for the biomass below the "deep-scattering layer" are based on trawling and these estimates have been fluctuating and without a trend since the series starts in 1999.

The pelagic fishery in the Irminger Sea only exploits the mature part (approximately 95% mature) of the stock. The fishery started in 1982 in the upper 500 m and expanded from 1991 onwards into deep waters where the majority of the catch is now taken. Catch rates in the southwestern area (almost exclusively shallower than 500 m) have remained steady, but low since 1997. In the northeastern area (deeper than 500 m) catches increased until 1997 and have been rather stable since then. The main new feature of the fishery in recent years is a clear distinction between two widely separated grounds fished at different seasons and different depths. Since 2000, the southwestern fishing ground extended also into the NAFO Convention Area. The parameters analysed so far do suggest, however, that the aggregations in the NAFO Convention Area do not form a separate stock component. The NAFO Scientific Council agrees with this conclusion (NAFO, 2005). Some biological features distinguish the fisheries in the two areas. The length distributions of the catches differ between the described two main fishing ground/seasons. The fisheries in the northeastern area (2nd quarter) mainly targets larger and post-spawning fish.

It is expected that if a substantial reduction in TAC is implemented a greater share of the catches will be taken in the northeastern area.

Preliminary information from the 2005 fishery shows a clear decline in catch rates. The fishery started at the same time as in previous years and had good catches initially, followed by a sudden decline. Most of the vessels left the fishing grounds relatively early this year without have taken their quota.

A comparison of the number of vessels fishing the resource and reporting to NEAFC by VMS with those visible on satellite images indicates that the unreported effort might be a significant amount. During the observation days in June 2002 and 2003 (in the main fishing season), the effort could be more than 20–30% higher than reported to NEAFC, and thus the unreported catch could be in that order of magnitude.

The stock structure of redfish *S. mentella* in Subareas V, VI, XII, and XIV, and in the NAFO Convention Area has been evaluated by an ICES expert study group (SGSIMUR) in August 2004. The outcome is not conclusive and supports different hypotheses (from a one-stock- to different multi-stock-hypotheses). Consequently, and solely for practical reasons, the perception of stock structure in this report is unchanged from the 2003 report. Additional information on stock structure has been available since 2004 and ICES recommends that this new information is reviewed in a comprehensive evaluation that integrates these results with those from other disciplines.

In 2003 and in previous years, ICES advised that "management action should be taken to prevent a disproportional exploitation rate of any one component." This advice has proven to open to a range of interpretations and is difficult to support with advice on sustainable catch in each area. Management should prevent a disproportional exploitation rate of the fish in the two distinct fishing areas to prevent local depletion. This should be done for two reasons: 1) to reduce the risk to local ecosystems, and 2) to avoid depletion of local populations in the light of the unresolved stock structure. However, at this time there is no available information to provide a quantitative estimate on the split between the two fisheries, which would warrant a sustainable exploitation of any local population.

Factors affecting the fisheries and the stock

Nursery areas for the stock are found at the continental slope off East Greenland. The juvenile redfish in these areas should therefore be protected, and measures already in place to reduce the bycatches in the shrimp fishery need to be continued.

Changes in fishing technology and fishing patterns

Since 1997, the main fishing season occurred during the second quarter. The pattern in the fishery has been reasonably consistent in the last 7 years and can be described as follows: In the first months of the fishing season (which usually starts in early April) the fishery is conducted in the area east of 32°W and north of 61°N, and in July (or August) the fleet moves to areas south of 60°N and west of about 32°W where the fishery continues until October. There is very little fishing activity in the period from November until late March or early April when the next fishing season starts. The fleets participating in this fishery have continued to develop their fishing technology, and most trawlers now use large pelagic trawls ("Gloria"-type) with vertical openings of 80–150 m. The vessels have operated at a depth range of 200 to 950 m in 1998–2004; mainly deeper than 600 m in the first and second quarters, and at depths shallower than 500 m in the third and fourth quarters. Discarding is at present not considered to be significant for this fishery.

Scientific basis

Data and methods

ICES again had difficulties in obtaining catch estimates from the various fleets and there are indications that unreported catches are substantial. Furthermore, landings data were missing from some ICES member countries. In spite of the best of efforts there is a need for a special action through NEAFC to provide ICES with all information that might lead to more reliable catch statistics.

CPUE series, catch and length information is available from the commercial fishery. Acoustic surveys conducted since 1991 in the Irminger Sea are available for estimation of the stock biomass above the deep-scattering layer. Trawl information from below this layer is available from 1999. Data on maturity-at-length and maturity-at-weight and some age-reading experiments were available from both fishery and survey.

Uncertainties in assessment and forecast

The acoustic estimates that are the main basis for the evaluation of the state of the stock for pelagic redfish only provide stock estimates for redfish distributed shallower than the deep-scattering layer (DSL). However, since 1996 only about 20–30% of the total catches have been taken from the shallow component.

The acoustic biomass estimates are not treated as absolute values due to varying coverage of the stock distribution area and methodological deficiencies. In addition, the survey results have indicated a steep decrease in stock size between 1995 and 1999, which could hardly be explained by reported landings only. There is, however, an unknown amount of unreported catch not being considered in the assessment of the stock. Recent investigations suggest that this could be in the order of 20–30% of the reported effort or catch.

The quality of the trawl biomass estimate cannot be verified, as the data series is very short. Therefore, the abundance estimates by the trawl-method must only be considered as a rough attempt to measure the abundance within and deeper than the DSL.

Comparison with previous assessment and advice

The basis for the advice is unchanged from last year and the 2005 advice has been repeated for 2006.

Sources of information

Report of the North-Western Working Group, 26 April–5 May 2005 (ICES CM 2005/ACFM:21).
Report of the Study Group on Redfish Stocks (SGRS), 25–27 July 2005 (ICES CM 2005/D:03).

Catch data for pelagic *S. mentella*

Year	ICES Advice	Predicted catch corresp. to advice	Agreed NEAFC TAC	ACFM Catch
1987	No assessment	-		91
1988	No assessment	-		91
1989	TAC	90–100		39
1990	TAC	90–100		32
1991	TAC	66		27
1992	Preference for no major expansion of the fishery	-		66
1993	TAC	50		116
1994	TAC	100		149
1995	TAC	100		176
1996	No specific advice	-	153	180
1997	No specific advice	-	153–158	123
1998	TAC not over recent (1993–1996) levels of 150 000 t		153	117
1999	TAC to be reduced from recent (1993–1996) levels of 150 000 t		153	110
2000	TAC set lower than recent (1997–1998) catches of 120 000 t	85	120	126
2001	TAC less than 75% of catch 1997–1999	<85	95	129
2002	TAC less than 75% of catch 1997–1999 – Revised to be below current catch levels	<85	Not agreed NEAFC proposal (95)	135
2003	TAC not exceed current catch levels	119	119	151
2004	TAC not exceed current catch levels	120	120	124
2005	Limit catch to 41 kt	41	80	
2006	Catch less than 41 kt	41		

Weights in '000 t.

Table 1.4.9.1 Pelagic *S. mentella*. Catches (in tonnes) by area as used by the Working Group. Due to the lack of area reportings for some countries, the exact share in Subareas XII and XIV is just approximate in the most recent years.

Year	Va	XII	XIV	NAFO 1F	NAFO 2J	NAFO 2H	Total
1982		39.783	20.798				60.581
1983		60.079	155				60.234
1984		60.643	4.189				64.832
1985		17.300	54.371				71.671
1986		24.131	80.976				105.107
1987		2.948	88.221				91.169
1988		9.772	81.647				91.419
1989		17.233	21.551				38.784
1990		7.039	24.477	385			31.901
1991		10.061	17.089	458			27.608
1992	1.968	23.249	40.745				65.962
1993	2.603	72.529	40.703				115.835
1994	15.472	94.189	39.028				148.689
1995	1.543	132.039	42.260				175.842
1996	4.744	42.603	132.975				180.322
1997	15.301	19.822	87.812				122.935
1998	40.612	22.446	53.910				116.968
1999	36.524	24.085	48.521	534			109.665
2000	44.677	19.862	50.722	10.815			126.076
2001	28.148	32.164	61.457	5.293	1.289	208	128.559
2002	37.279	24.027	66.179	7.942			135.427
2003	46.676	24.091	57.921	17.635	4.128	325	150.776
2004	14.264	6.668	78.890	19.847	4.259		123.927

Table 1.4.9.2 Pelagic *S. mentella*. Time-series of survey results, areas covered, hydro-acoustic abundance and biomass estimates shallower and deeper than 500 m (based on standardized trawl catches converted into hydro-acoustic estimates derived from linear regression models). Note that these values cannot be used as direct estimates of abundance or biomass.

Year	Area covered (1000 NM^2)	Acoustic estimates[1] < 500 m (10^6 ind.)	Acoustic estimates[1] < 500 m (1000 t)	Trawl estimates < 500 m (10^6 ind.)	Trawl estimates < 500 m (1000 t)	Trawl estimates > 500 m (10^6 ind.)	Trawl estimates > 500 m (1000 t)
1991	105	3498	2235				
1992	190	3404	2165				
1993	121	4186	2556				
1994	190	3496	2190				
1995	168	4091	2481				
1996	253	2594	1576				
1997	158	2380	1225				
1999	296	1165	614			638	497
2001	420	1370	716	1955	1075	1446	1057
2003	405	160	89	175	92	960	678
2005	386	940	551			1083	674[2]

1) Acoustic estimate above the deep-scattering layer. The depth of the DSL varies, but on average the acoustic estimate corresponds to depths between the surface and approx. 350 m depth.
2) Estimates of abundance at depths greater than 350 m.

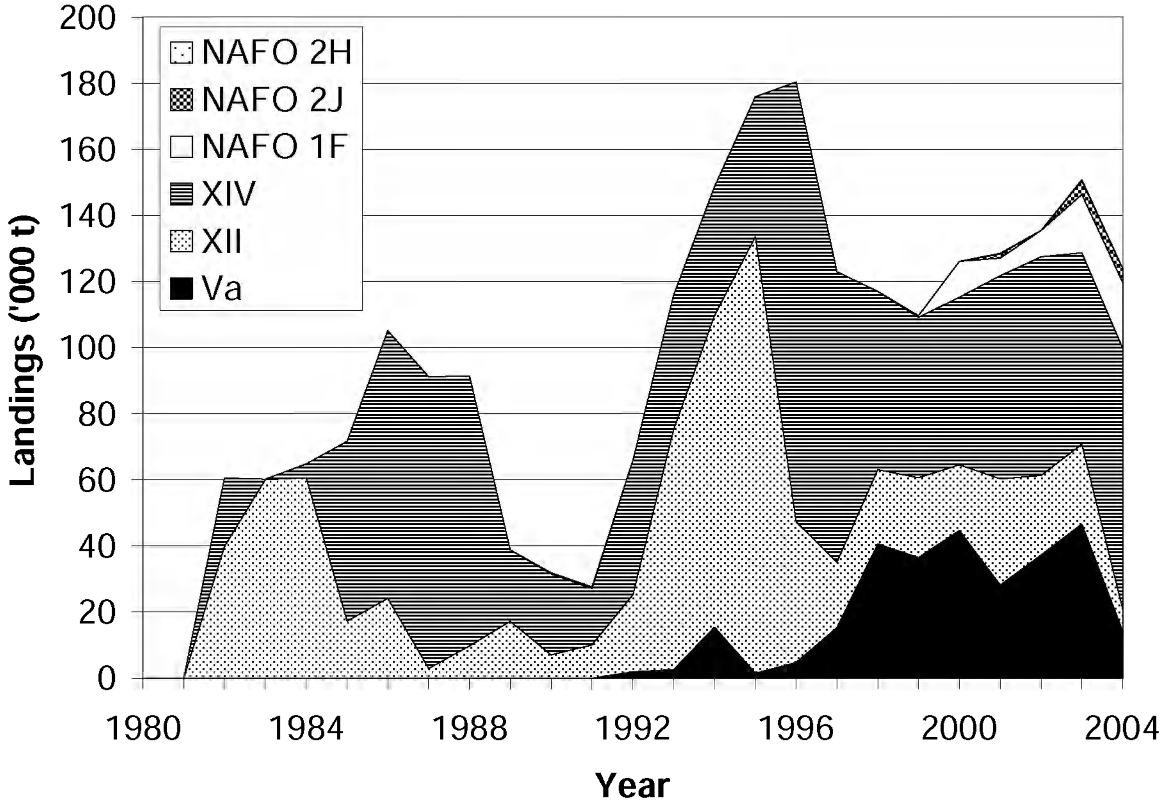


Figure 1.4.9.1 Pelagic *S. mentella* landings.

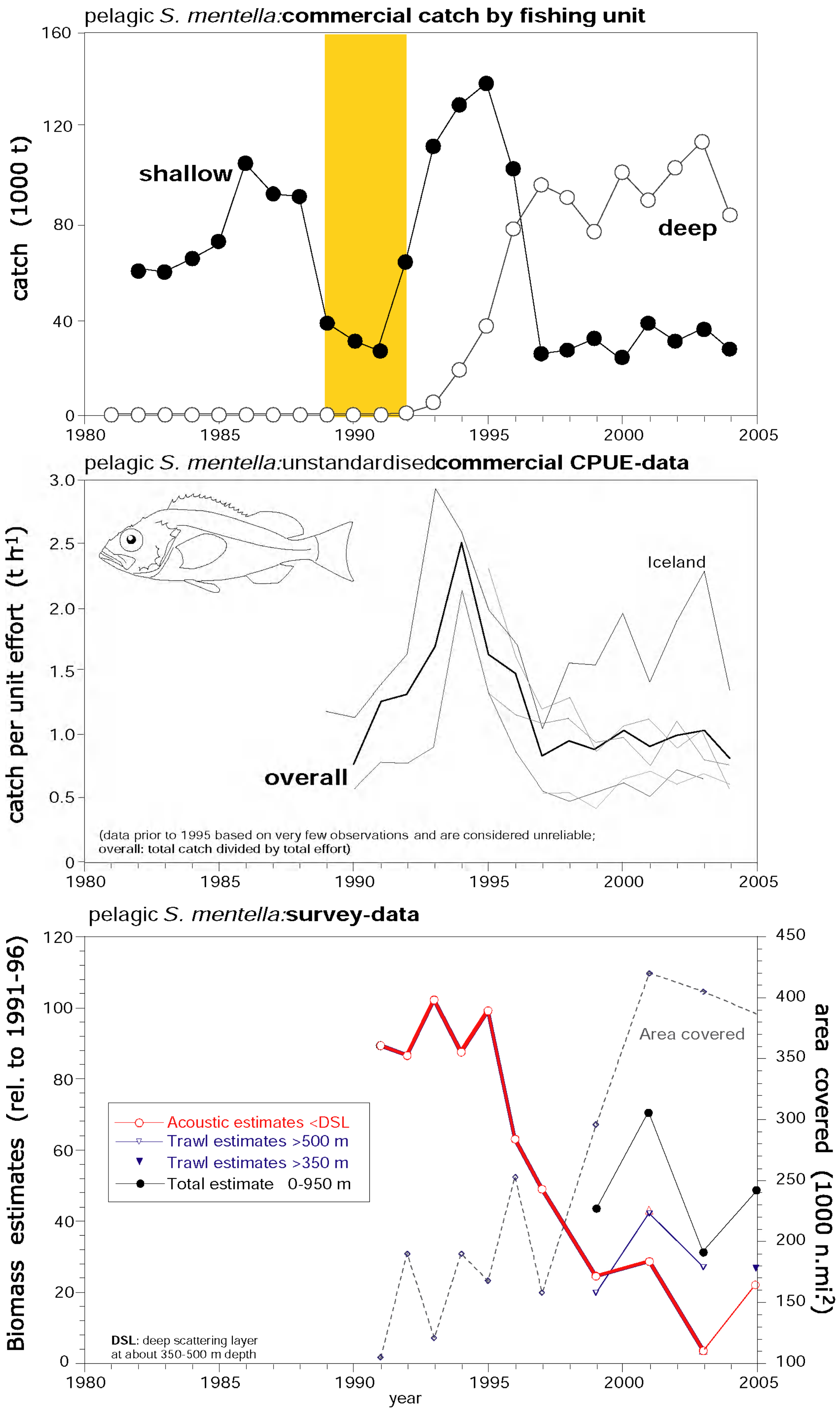


Figure 1.4.9.2 Pelagic *S. mentella*. Overview of landings, commercial CPUE, and survey indices in the Irminger Sea.

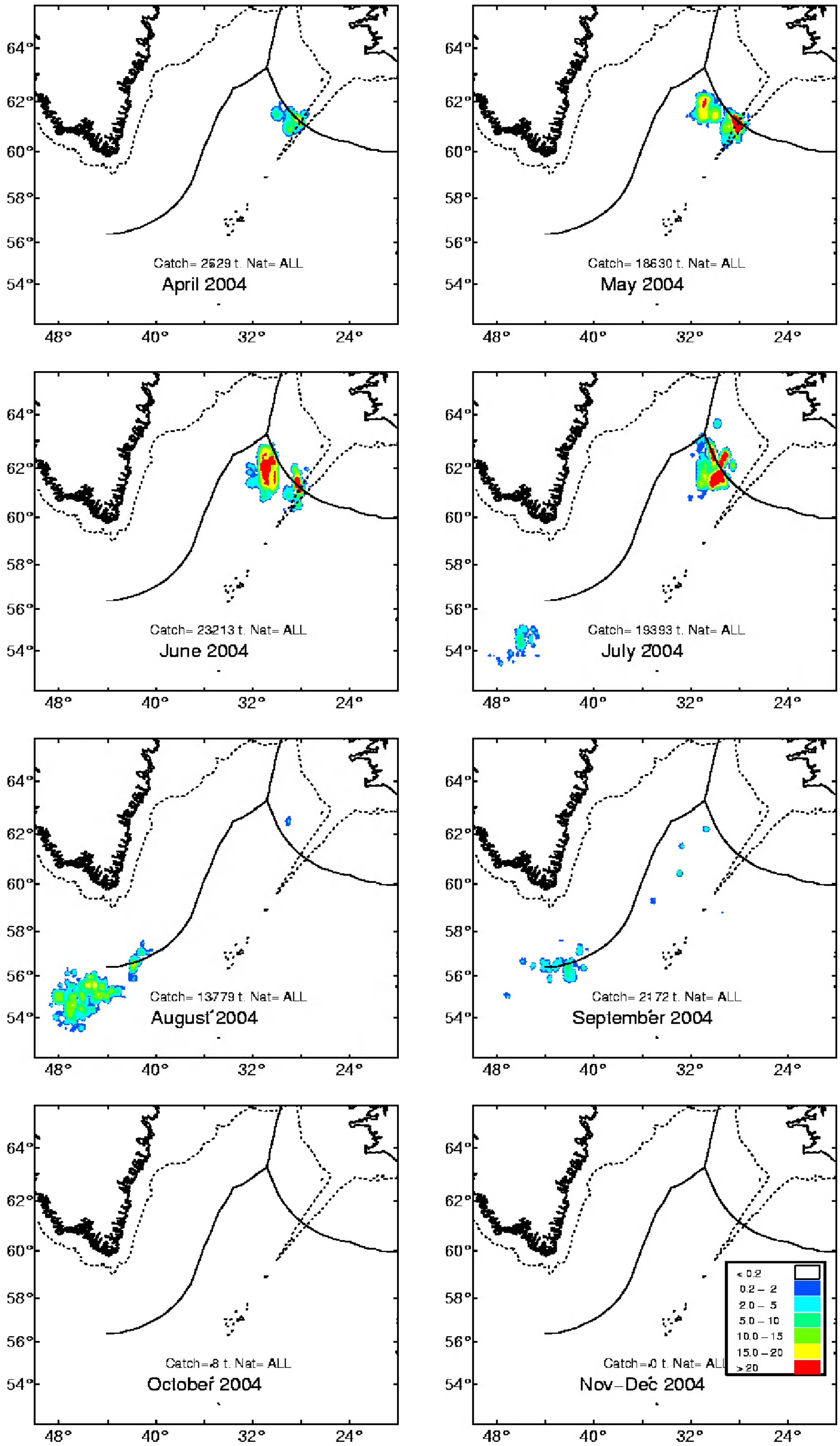


Figure 1.4.9.3 Fishing areas and total catch of the pelagic redfish (*S. mentella*) by month in 2004, derived from catch statistics provided by Germany, Norway, Iceland, and Greenland. The scale for the catch is in tonnes per square nautical mile. Total catch for each period is also given.

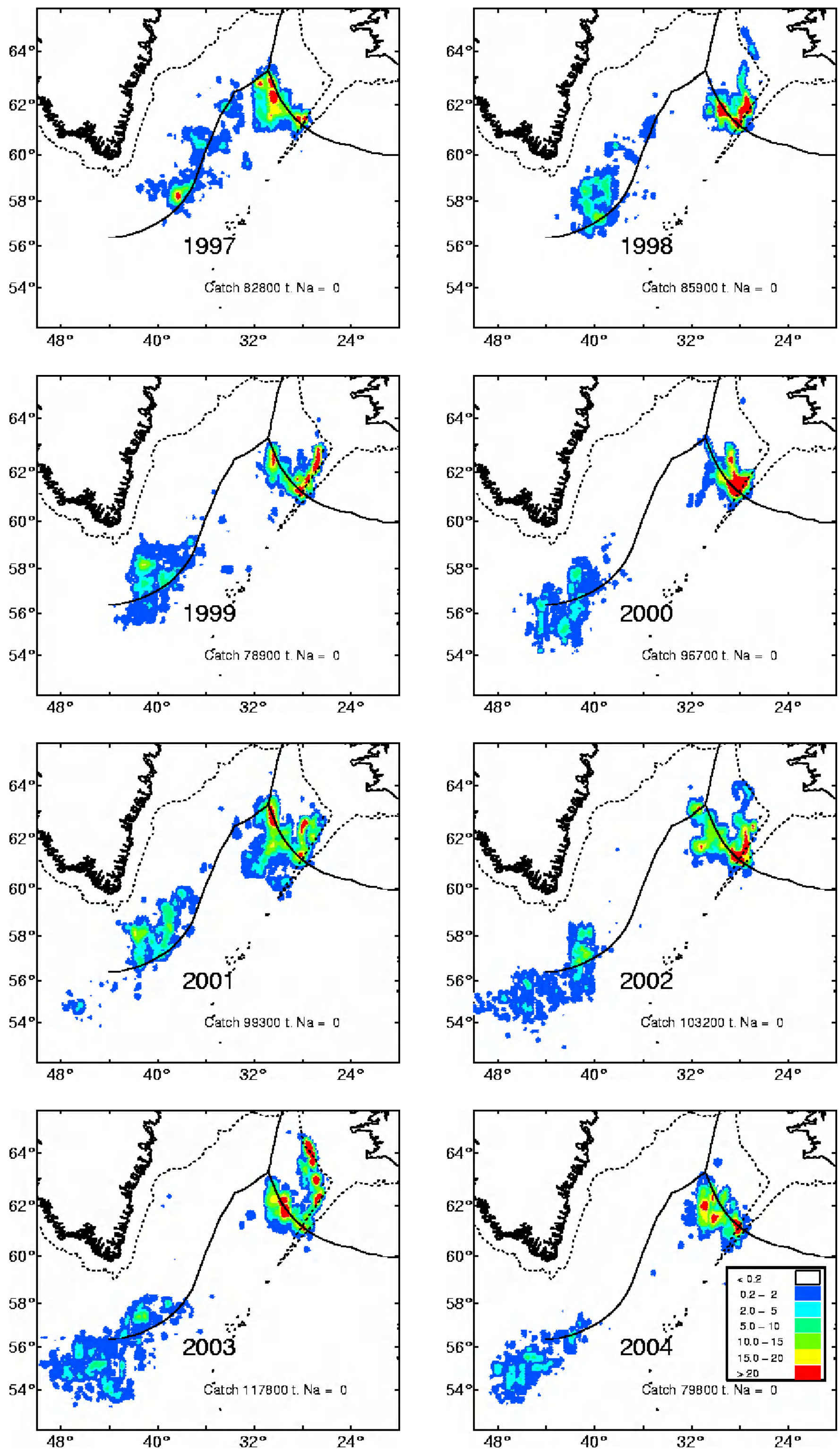


Figure 1.4.9.4 Fishing areas and total catch of the pelagic redfish (*S. mentella*) in the Irminger Sea and adjacent waters 1997–2004. Data are from the Faroes (1995–2004), Germany (1995–2003), Greenland (1999–2004), Iceland (1995–2004), Norway (1995–2003), and Russia (1997–2004). The scale given is tonnes per square nautical mile.

1.4.10 Icelandic summer-spawning herring (Division Va)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
Full reproductive capacity	Unknown	Unknown	The stock has been increasing above the most recent estimate of SSB, which was above $\mathbf{B}_{pa}$

Since no reliable estimates of SSB are available, the state of the stock cannot be defined. Icelandic surveys indicate that SSB has increased continuously since 1987 and the stock has full reproductive capacity. Exploratory analyses suggest that recent fishing mortality is slightly greater than $\mathbf{F}_{pa}$.

Management objectives

The practice has been to manage this stock at F=$\mathbf{F}_{0.1}$ (=$\mathbf{F}_{pa}$) for more than 20 years. However, no formal management strategy has been adopted.

ICES considers the current management practise to be consistent with the Precautionary Approach.

Reference points

	ICES considers that:	**ICES proposed that:**
Precautionary Approach reference points	$\mathbf{B}_{lim}$ is 200 000 t	$\mathbf{B}_{pa}$ be set at 300 000 t
	$\mathbf{F}_{lim}$ is undefined	$\mathbf{F}_{pa}$ be set at 0.22

Technical basis

$\mathbf{B}_{lim}$: SSB with a high probability of impaired recruitment	$\mathbf{B}_{pa}$: $\mathbf{B}_{pa} = \mathbf{B}_{lim}\, e^{1.645\,\boldsymbol{\sigma}}$, where $\boldsymbol{\sigma}$ = 0.25
$\mathbf{F}_{lim}$: –	$\mathbf{F}_{pa}$: $\mathbf{F}_{pa}$ = $\mathbf{F}_{0.1}$= 0.22 (based on a weighted average)

Target reference points

A candidate for a reference point which is consistent with taking high long-term yields and achieving a low risk of depleting the productive potential of the stock may be identified as $\mathbf{F}_{0.1}$ (=$\mathbf{F}_{pa}$) = 0.22.

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits

Fishing mortality should be limited to $\mathbf{F}_{pa}$. Given the apparent recent increase in stock size, catches in 2006 should not exceed 110 000 t, the TAC for the last two years.

Short-term implications

Given the apparent increase in the stock at recent catch levels, a catch of 110 000 t is not likely to decrease the stock in the short term, if recent productivity continues.

Management considerations

Icelandic TACs for herring apply from 1 September to 1 May the following year. The catch is normally taken from September to February.

Management plan evaluations

Current management practice has allowed an apparent increase in stock biomass.

Factors affecting the fisheries and the stock

Changes in fishing technology and fishing patterns

The catches of Icelandic summer-spawning herring increased rapidly in the early 1960s due to the development of the purse seine fishery off the south coast of Iceland. This resulted in a rapidly increasing exploitation rate until the stock collapsed in the late 1960s. A fishing ban was enforced during 1972–1975. Thereafter the catches have increased gradually to over 100 000 t. Previously the fleet consisted of multi-purpose vessels, mostly under 300 GRT, operating purse seines and driftnets. In recent years, larger vessels (up to 1500 GRT) have entered the fishery. These are a combination of purse seiners and pelagic trawlers operating in the herring, capelin, and blue whiting fisheries. Since the 1997/1998 fishing season, there has been a fishery for herring to the west and east of Iceland, which is unusual compared to earlier years when the fishable stock was only found south and east of Iceland. In the fishing season 2001/2002, for the first time, the majority of the catches were taken by pelagic trawlers (62%). This was also the case in the fishing season 2002/2003. The purse seiners took the majority of the catches in 2003/04 and also in 2004/05 (70%).

The fisheries follow the variation in the distribution of the stock.

The environment

In recent years, rises in sea water temperature for waters occupied by this stock have affected the distribution of the stock, which has expanded in a westerly direction.

Recent changes in distribution may be the result of water temperature changes and this may affect the fishery and the surveys used for management. Recent high recruitment may effect the fishery and have implications on selection assumed in the assessment models used for management.

Scientific basis

Data and methods

Acoustic survey estimates and information from the catch-at-age matrix were used to assess the stock status in a qualitative sense. Catch curves were explored to provide approximate estimates of fishing mortality.

Uncertainties in assessment and forecast

There are inconsistencies in the catch and survey data, which precluded an analytical assessment. A project is ongoing where all scales are being re-read back to 1992. The re-reading of scales from samples taken in the surveys has been completed, but the work on data from the catches was not completed prior to the meeting.

Comparison with previous assessment and advice

Last year's assessment was based on the catch-at-age model, despite known retrospective problems. The updated catch-at-age model was not considered to be reliable because of inconsistencies in the catch and survey data.

Source of information

Report of the North-Western Working Group, 26 April–5 May 2005 (ICES CM 2005/ACFM:21).

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	ACFM Catch
1984		50	-	50.3
1985		50	-	49.4
1986		65	-	65.5
1987	$\mathbf{F}_{0.1}$	70	72.9	75.4
1988	$\mathbf{F}_{0.1}$	~100	90	92.8
1989	$\mathbf{F}_{0.1}$	95	90	97.3
1990/1991[2]	*Status quo* F	90	100	101.6
1991/1992[2]	$\mathbf{F}_{0.1}$	79	110	98.5
1992/1993[2]	$\mathbf{F}_{0.1}$	86	110	106.7
1993/1994[2]	No gain in yield by fishing higher than $\mathbf{F}_{0.1}$	110[1]	110	101.5
1994/1995[2]	No gain in yield by fishing higher than $\mathbf{F}_{0.1}$	83[1]	130	132
1995/1996[2]	No gain in yield by fishing higher than $\mathbf{F}_{0.1}$	120[1]	110	125
1996/1997[2]	No gain in yield by fishing higher than $\mathbf{F}_{0.1}$	97[1]	110	95.9
1997/1998	No gain in yield by fishing higher than $\mathbf{F}_{0.1}$	90[1]	100	64.7
1998/1999	No gain in yield by fishing higher than $\mathbf{F}_{0.1}$	90[1]	90	87.0
1999/2000	Current F is sustainable	100[1]	100	92.9
2000/2001	Current F is sustainable	110[1]	110	100.3
2001/2002	Current F is sustainable	125[1]	125	95.3
2002/2003	Current F is sustainable	113[1]	105	93.6
2003/2004	Current F is sustainable	113[1]	110	125.2
2004/2005	F=0.22	106	110	114.2
2005/2006	*Status quo* catch	**110**		

Weights in '000 t.
1) Catch at $\mathbf{F}_{0.1}$.
2) Season starting in October of first year.

Table 1.4.10.1 Landings – Icelandic summer-spawning herring (Division Va).

Year	Landings tonnes
1978	37333
1979	45072
1980	53268
1981	39544
1982	56528
1983	58867
1984	50304
1985	49368
1986	65500
1987	75439
1988	92828
1989	101000
1990	105097
1991	109489
1992	108504
1993	102741
1994	134003
1995	125851
1996	95882
1997	64395
1998	86999
1999	92896
2000	100332
2001	95278
2002	93601
2003	125233
2004	114237
Average	84429

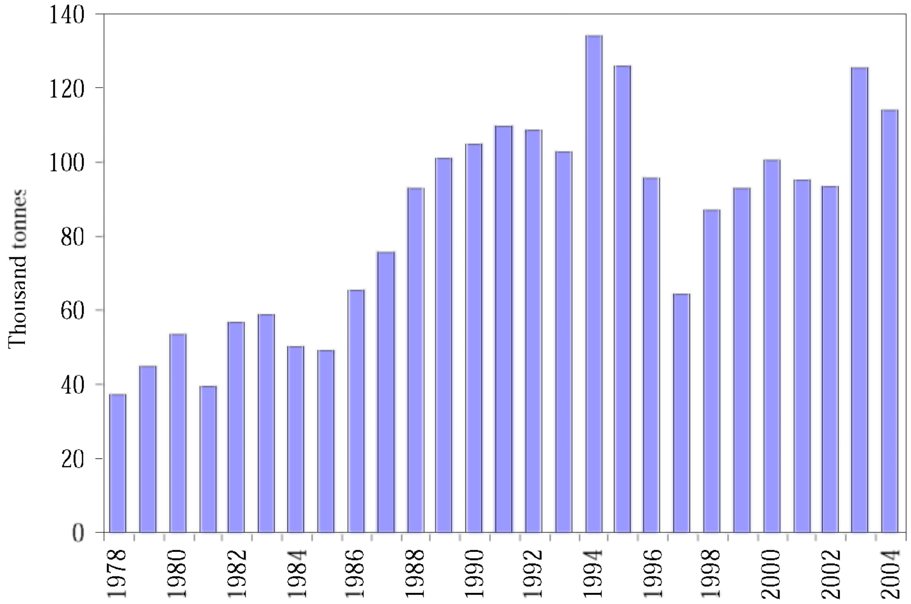


Figure 1.4.10.1. Icelandic summer-spawning herring – Total catch (in thousand tonnes) in 1978/79–2004/05.

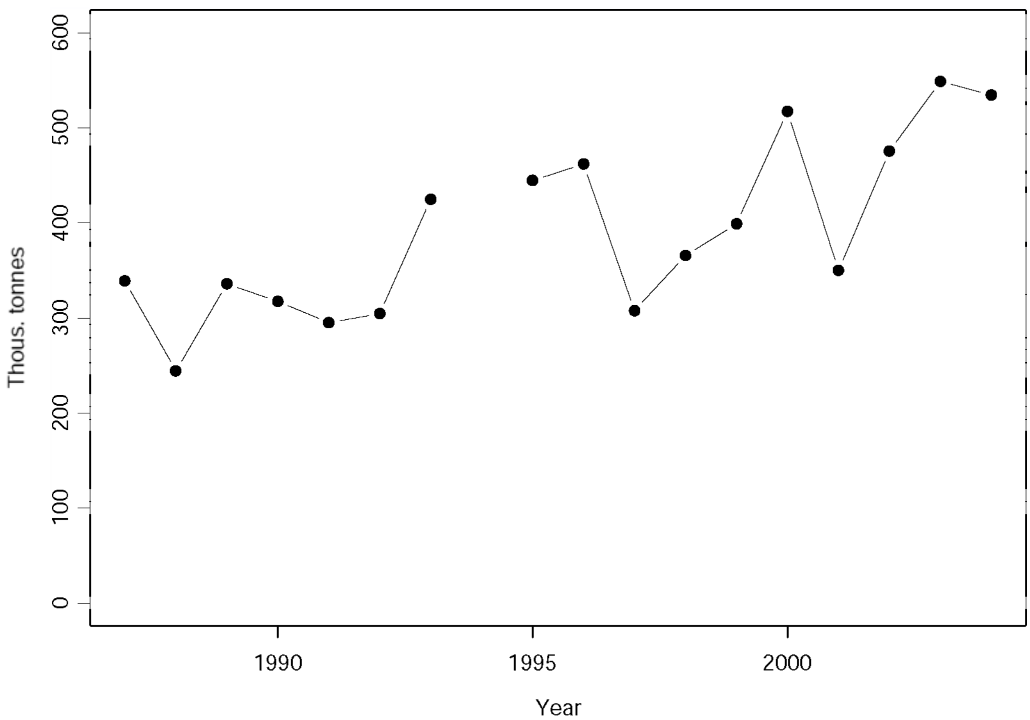


Figure 1.4.10.2 Icelandic summer-spawning herring – Total biomass from the survey for ages 4 and older in the years 1987–2004.

1.4.11 Capelin in the Iceland-East Greenland-Jan Mayen area (Subareas V and XIV and Division IIa west of 5°W)

State of the stock

Spawning biomass is in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
Reference points not defined	Reference points not defined	Unknown	

In the absence of defined reference points, the state of the stock cannot be evaluated in this regard. The SSB is highly variable because it is dependent on only two age groups. The current SSB is unknown. Immature capelin were absent in autumn 2004 and winter 2005 surveys.

Management objectives

The fishery is managed according to a two-step management plan which allows for a minimum spawning stock biomass of 400 000 t by the end of the fishing season. The first step in this plan is to set a preliminary TAC based on the results of an acoustic survey carried out to evaluate the immature (age 1 and most of age 2) part of the capelin stock about a year before it enters the fishable stock. This preliminary TAC is set at 2/3 of the TAC, calculated on the condition that 400 000 t of SSB should be left for spawning. The second step is based on the results of another survey conducted during the fishing season for the same year classes. This result is used to revise the TAC, still based on the condition that 400 000 t of SSB should be left for spawning.

ICES has not evaluated the management plan with respect to its conformity to the Precautionary Approach.

Single-stock exploitation boundaries

Exploitation boundaries in relation to existing management plans

There should be no fishery until new information on stock size becomes available and it shows a predicted spawning stock biomass of at least 400 000 t in March 2006 in addition to a sizeable amount for fishing.

Provided that appropriate abundances of immature (age 2) capelin are demonstrated, the 2005 summer/autumn season could be opened in late June; however, areas with high juvenile abundance should be closed in order to prevent the harvesting of a high proportion of juveniles.

Short-term implications

All surveys to assess the juvenile and immature part of the stock in autumn 2004 and winter 2005 on which catch forecasts are made have not found any immature capelin. Thus there are no data available for predicting the stock size in the 2005/2006 season. Preliminary TAC for the 2005/06 season cannot be set until new information on the abundance of the whole stock becomes available.

Management considerations

The fishery is mainly an industrial fishery based on maturing capelin, i.e. the 2- and 3-group in the autumn, which spawn at ages 3 and 4 in March of the following year.

Usually large capelin dominate the catches in July and the first half of August. From the second half of August, the average weight in the catches has often declined drastically due to the presence of juvenile fish and has not increased again until late autumn. To prevent catches of juvenile capelin (ages 1 and 2) it is recommended that the authorities responsible for the management of this stock (Greenland, Iceland, and Norway) should monitor the fishery and be prepared to intervene quickly on short notice, using area closure to prevent fishing on mixed concentrations of juveniles and adults.

Factors affecting the fisheries and the stock

Regulations and their effects

The fishery of the Icelandic capelin is regulated by a preliminary TAC set prior to each fishing season (July–December, January–March). The start quota is 2/3 of the preliminary TAC calculated for the season. The final TAC for each season is set according to estimates of the fishable stock in autumn and/or winter in that fishing season.

Discards are allowed when catches are beyond the carrying capacity of the vessel. Methods of transferring catches from the purse seine of one vessel to another vessel were invented long ago, and since skippers of purse seine vessels prefer to operate in groups discards are practically zero. In the pelagic trawl fishery such large catches rarely occur.

Fishing areas with high abundance of juveniles have been closed to the summer and autumn fishery.

The environment

Decline in stock abundance in the early 1990s are likely to be due to natural causes (Vilhjálmsson, 2002; Gudmundsdottir and Vilhjálmsson, 2002).

Distribution of the stock may have changed in response to environmental factors. Icelandic waters are characterized by highly variable hydrographical conditions, with temperatures and salinities depending on the strength of Atlantic inflow through the Denmark Strait and the variable flow of polar water from the north.

In summer 2002 there was a persistent increased inflow of Atlantic water to the areas north and east of Iceland resulting in high temperatures, salinity, and a relatively high zooplankton biomass. A strong inflow was also observed in 2004, with similar effects on zooplankton in north Icelandic waters in 2004. This change in temperature and probably also in the pattern ocean currents, may have led to a displacement of the juvenile part of the capelin stock to the north and west onto the East Greenland shelf.

Scientific basis

Data and methods

The basis for stock assessment and short-term forecasts of the Icelandic capelin are several acoustic surveys.

Source of information

Guðmundsdóttir, A. and H.Vilhjalmsson 2002. Predicting total allowable catches for Icelandic capelin, 1978-2001. ICES Mar. Sci. Symp. 216: 115-1115.

Vilhjálmsson, H., 2002. Capelin (*Mallotus villosus*) in the Iceland–East Greenland–Jan Mayen ecosystem. ICES Marine Science Symposia, 216:870-883.

Report of the North Western Working Group, 26 April–5 May 2005 (ICES CM 2005/ACFM: 21).

Year	ICES Advice	Predicted catch[1] corresp. to advice	Agreed [2] TAC	ACFM Catch[3]
1986	TAC	1,100	1,290	1,333
1987	TAC[1]	500	1,115	1,116
1988	TAC[1]	900	1,065	1,036
1989	TAC[1]	900	*	808
1990	TAC[1]	600	250	314
1991	No fishery pending survey results[1]	0	740	677
1992	Precautionary TAC[1]	500	900	788
1993	TAC[1]	900	1,250	1,179
1994	Apply the harvest control rule	950	850	842
1995	Apply the harvest control rule	800	1,390	930
1996	Apply the harvest control rule	1,100	1,600	1,571
1997	Apply the harvest control rule	850	1,265	1,245
1998	Apply the harvest control rule	950	1,200	1,100
1999	Apply the harvest control rule	866	1,000	934
2000	Apply the harvest control rule	650	1,090	1,071
2001	Apply the harvest control rule	700	1,300	1,250
2002	Apply the harvest control rule	690	1,000	988
2003	Apply the harvest control rule	835	900	741
2004	Apply the harvest control rule	*335	985	784
2005	Apply the harvest control rule	**No fishery		
2006	Apply the harvest control rule	**No fishery		

Weights in '000 t.
1)TAC advised for the July–December part of the season. 2)Final TAC recommended by national scientists for the whole season. 3)July–March of following year.
*Preliminary TAC set according to the results of an assessment survey in late June/early July 2004.
**All surveys of the prospective 2005/06 fishable stock abundance during the 2004/2005 season were unsuccessful. The advice is preliminary and subject to revision following results of further surveys.

Capelin, Iceland-East Greenland-Jan Mayen Area (V, XIV, and IIa west of 5°W)

Catches are for the fishing seasons beginning in the year indicated and ending in March of the following year. Spawning stock biomass is the amount left at the end of each season

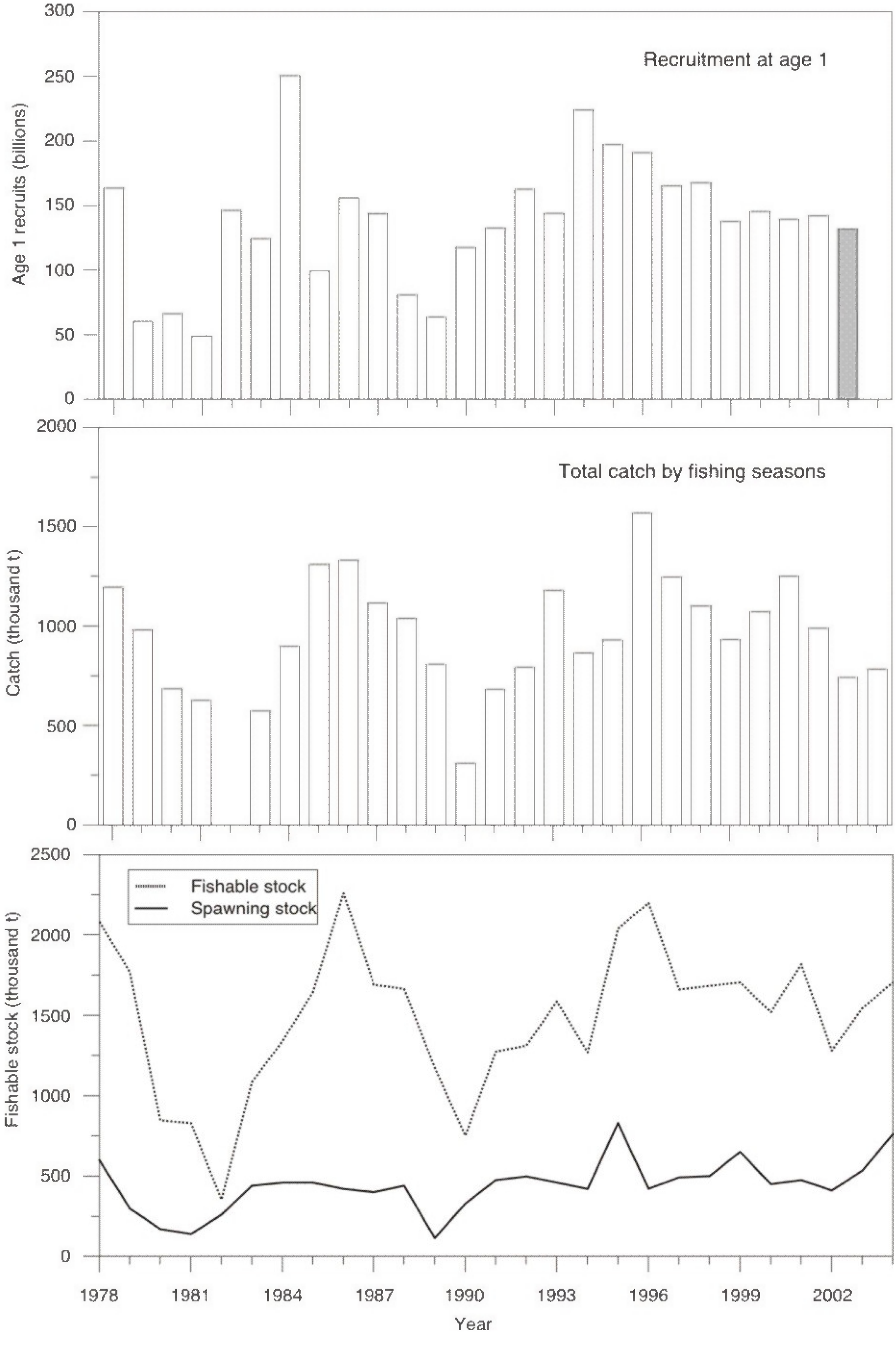


Table 1.4.11.1 Capelin in the Iceland-East Greenland-Jan Mayen area.
Landings are the sum of the total landings in the season starting in the summer/autumn of the year indicated and ending in March of the following year.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes
1978	164000	600000	1195000
1979	60000	300000	980000
1980	66000	170000	684000
1981	49000	140000	626000
1982	146000	260000	0
1983	124000	440000	573000
1984	251000	460000	897000
1985	99000	460000	1312000
1986	156000	420000	1333000
1987	144000	400000	1116000
1988	81000	440000	1037000
1989	64000	115000	808000
1990	118000	330000	314000
1991	133000	475000	677000
1992	163000	499000	788000
1993	144000	460000	1179000
1994	224000	420000	864000
1995	197000	830000	929000
1996	191000	430000	1571000
1997	165000	492000	1245000
1998	168000	500000	1100000
1999	138000	650000	933000
2000	146000	450000	1071000
2001	140000	475000	1249000
2002	142000	410000	988000
2003	*132000	535000	741000
2004	No data	765000	784000
Average	133115	429269	931154

* Preliminary