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

Book 2
Iceland and East Greenland

International Council for the Exploration of the Sea

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BOOK 2

2 ICELAND AND EAST GREENLAND

2.1 Ecosystem overview

2.1.1 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-marine canyons. Beyond the shelf the seafloor falls away to over 1000 m, although 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 bottom topography are heavily serrated with canyons, and bottom topography is generally rough with hard bottom types.

The Polar Front lies between Greenland and Iceland and 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 2.1.1). South and southeast of Iceland the North Atlantic Current flows towards the Norwegian Sea. The Irminger Current flows northwards over and along the Reykjanes Ridge into the Denmark Strait where it divides and one branch continues northeastward and eastward to the waters north of Iceland and the other branch flows south-westward parallel to the East Greenland Current. North of Iceland in the Iceland Sea a branch out of the East Greenland Current flows over the Kolbeinsey Ridge an continues to the southeast along the northeastern shelf brake as the East Icelandic Current. This current is a part of a cyclonic gyre in the Iceland Sea.

Physical and Chemical Oceanography (temperature, salinity, nutrients)

Icelandic waters are relatively warm due to Atlantic influence and are generally ice free. 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 west of Iceland are usually within the range of 6-10oC whereas on the North-Icelandic shelf mixing of Atlantic and Arctic waters means temperatures cool from west (~4-6 oC) to East (<4 oC). The water masses of the Iceland Sea are much colder than those of the Icelandic shelf .

Hydrobiological conditions are much less variable in the Atlantic water south and west of Iceland than in the waters north and east of the country where considerable seasonal as well as inter-annual variations of hydrography are observed. On longer timescales changes in the strength of major currents and properties of water masses probably tied to NAO regime shifts combine to have a large influence on the marine ecosystem of the north Icelandic shelf (Figure 2.1.2) (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.

In 2005 Greenlandic waters were warmer than long-term average, continuing a trend that started earlier in this decade. The warming was stronger in West Greenland than East Greenland, where a strong inflow of Irminger Sea water was present as far north as Fylla Bank, resulting in temperatures that were the warmest in more than 50 years. However, in the last quarter of 2005 there was a marked by a cooling of waters around Greenland, declining to near long-term average surface temperatures. There was also much greater than average melting of glaciers and snow on both coasts of Greenland, increasing the input of freshwater runoff to coastal areas. Has that not been for some time or is it special for 2005 ?

Broad-scale climate & Oceanographic features & drivers

The NAO has a strong effect on ocean climate and water mass distributions in these waters, and environmental regimes are thought have changed 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. In 2005 the NAO was in a condition of transition. After being strongly positive for several years, in the past year or slightly more it has changed to near average conditions. The position and strength of the Icelandic Low appears to be without a clear trend towards a state that is either strongly negative or positive.

The deep Greenland Sea is an important area for deep sea convection of heat and salt in the ocean. The nature and timing of water mass formation in the Greenland Sea 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 gC/m2-yr) 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-April rather than the more usual mid-May. "Cold" years, with less influence of North Atlantic Current waters north of Iceland tend to have lower primary productivity in comparison to years when the influence of the Atlantic water as has been as extensive as has been predominant during the last decade.

The East Greenland Shelf is a low productivity (<150 gC/m2-yr) 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

The waters around Iceland foster such boreal and arctic types of zooplankton as *Calanus finmarchicus, C. hyperboreus* and *C. glacialis*, *Metridia longa,* euphasuiids, amphipods and others, with the boreal copepod species*C. finmarchicus* commonly comprising 60-80% of the spring zooplankton bloom. Zooplankton productivity is generally highest in the Atlantic Water south and west of Iceland and lowest in waters of Atlantic-Arctic mixture to the north and east of the island. 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). Monitoring series indicate that in the early part of this decade zooplankton biomass was relatively high both north and south of Iceland but began to decline in 2002 in both areas. Zooplankton biomass was near historic lows in the north by 2003 and in the south in 2004 but has shown an increasing trend since then (WGZE report 2005).

As off Iceland, 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.

These zooplankters, 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. 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, 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. Species diversity of the hyperbenthic family Eusiridae have been shown to be lower in the deeper parts of the Nordic Seas, i.e. the Norwegian, Greenland and Iceland Seas,compared with areas south of the Greenland-Scotland Ridge (Weisshappel et al., 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 among isopods and amphipods has been shown to increase with depth (Svavarsson 1997; 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 smaller scale, with bottom topography (Weisshappel and Svavarsson 1998). Also, it has been shown that large differences occur in species composition around the Kolbeinsey Ridge, in the Iceland Sea, with greater abundances and diversity among pericarid crustaceans 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).

Survey measurements indicate that shrimp biomass in Icelandic waters, both in inshore and offshore waters, has been declining in recent year. 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.

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 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.

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 500 and 600 m depth.

Based on information from fishermen (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 considerably 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 fishermen on 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 off Iceland. Evidence on 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 were relatively uncommon on the shelf (< 500 m depth) but are generally found in relatively high numbers in deep waters (> 500 m) off the South, West and North 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 (Garcia et al.,in press). .

Aggregation of large sponges ("ostur" or sponge grounds) is known to occur off Iceland (Klitgaard and Tendal 2004). North of Iceland, particularly in the Denmark Strait, "ostur" was found at several locations at depths of 300-750 m, which some are classified as sponge grounds. Comprehensive "ostur" and sponge grounds occur off north and south Iceland, and around the Reykjanes Ridge. (Garcia et al., in press). .

Hydrothermal vents and mearl are sensitive to fishing

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, haddock, saithe, redfish, herring, capelin, blue whiting, wolffish, tusk *(Brosme brosme)*,ling *(Molva molva)*, Greenland halibut and various other flatfish, plus sandeel 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 capelins 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 then have increased since 1970 and has been at historical high level in last decade. 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 status and trends of non-commercial species are collected in extensive bottom trawl surveys conducted in early spring and autumn but information on 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 heads 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 2.1.3), but many of the cod returned to spawn at Iceland. The Greenland cod stock collapsed in the 1970s because of worsening climatic conditions and overfishing. After 1970, all year classes of cod of any importance at East Greenland have been of Icelandic origin.

Warm conditions returned since the mid 1990 and, in particular off East Greenland, some increase in the abundance of juvenile cod has been observed in recent years and the 2003 year class is well above the recent average. However, recruitment has remained below what was seen at comparable hydrographic conditions before, suggesting that other factors might have become more prominent. Possible contributing factors include as the younger age structure of the cod spawning stock at Iceland (reduced egg quality and changed location and timing of larval hatch) and the by-catch of small cod in the increased fishery for northern shrimp. However the year-classes from 2002 and possibly more recently are beginning to support substantial increases in cod biomass off Greenland. Management of this biomass, including decisions on when, where, and how much cod and shrimp to harvest, must take into account the potential for rebuilding spawning biomass off Greenland, the consequences of increased shrimp for the shrimp fishery, and the possibility that as the cod year-classes mature they will return to Icelandic waters.

Birds and Mammals: Dominant species composition, productivity (esp. seabirds), spatial distribution (esp. mammals)

The seabird community in Icelandic waters is composed of relatively few but abundant species, accounting for roughly ¼ of total number and biomass of seabirds within the ICES area (ICES 2002). Auks and petrel are 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 (*Fratercula arctica*), northern fulmar (*Fulmarus glacialis*), Common (*Uria aalge*) and Brunnich's (*Uria lomvia*) guillemot, black-legget kittiwake (*Rissa tridactyla*) and common eider (*Somateria mollissima*).. The estimated annual food consumption is on the order of 1.5 million tonnes.

At least 12 species of cetaceans occur regularly in Icelandic waters, and 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 (> 80cm) 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 tons). 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 as 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 deep water 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 whale (*Balaenoptear musculus*) is the least abundant of the large whales regularly seen off Iceland with 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.

2.1.2 Major environmental influences on ecosystem dynamics

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 of temperature of about 1°C and salinity by one unit (0.1 promille).

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

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 on 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 not reached as far west along the south coast as was normal in most earlier years. The semi-pelagic blue whiting has lately been found and fished in east-Icelandic water in far larger quantities than ever before. Finally, after almost thirty years of absence, a part of the Norwegian spring spawning herring, has been observed and fished off east Iceland during the last decade with highest proportion in last two years.

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. 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 the Icelandic cod 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 of the spawning stock biomass since 1993. This improvement in the SSB biomass has however not resulted in significant increase in production in recent years, despite increased inflow of warmer Atlantic water.

2.2 Human impacts of the ecosystem

2.2.1 Fishery effects on benthos and fish communities

Many of the demersal fisheries use mobile gears and fish on hard bottoms. This can have 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.

The ITQ system used in Icelandic fisheries has a build-in incentive for the fleet to direct effort to more valuable fish (high-grading). When juveniles are a high proportion of the fishable biomass or when the TAC is relatively low compared to the biomass, this may lead to increased discard of the target species. According to extensive discarding measurements that have been carried out in the Icelandic fisheries since 2001 (Pálsson 2003, 2004) discards as a proportion landings in weight has been in the range of 0.6-7.1% for the main exploited demersal species (cod, haddock, saithe, redfish, plaice). Reliable information on non-target species taken as bycatch in these fisheries are not available.

2.2.2 References

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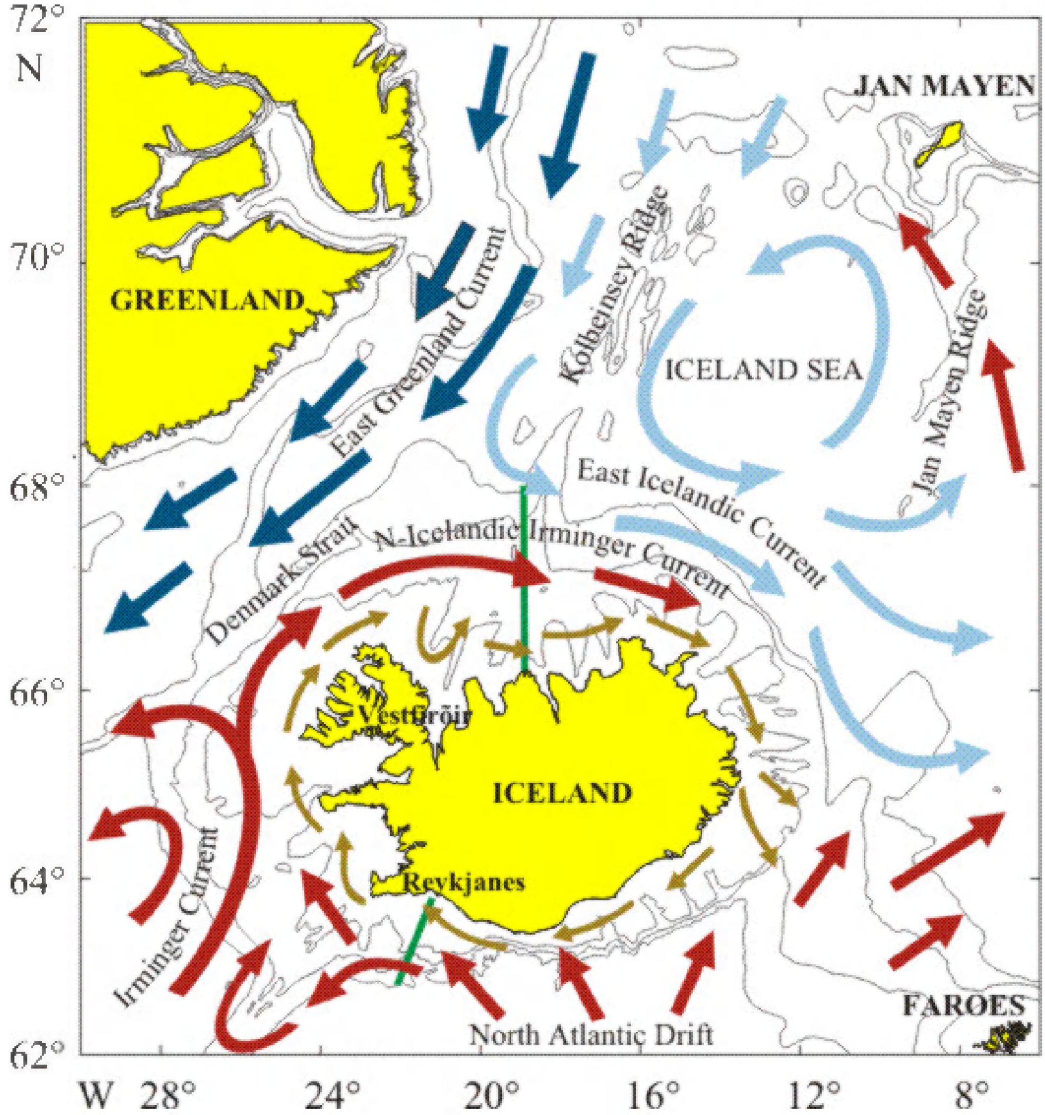

Figure 2.1.1 The system of ocean currents around Iceland and in the Iceland Sea

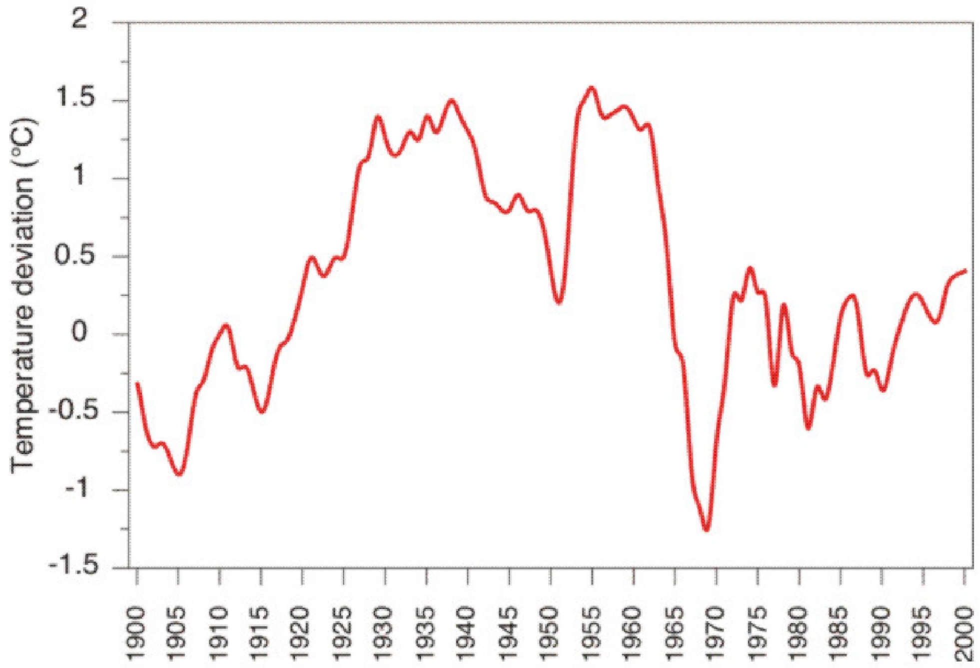

Figure 2.1.2 Temperature deviations north of Iceland 1900-200, five year running averages.

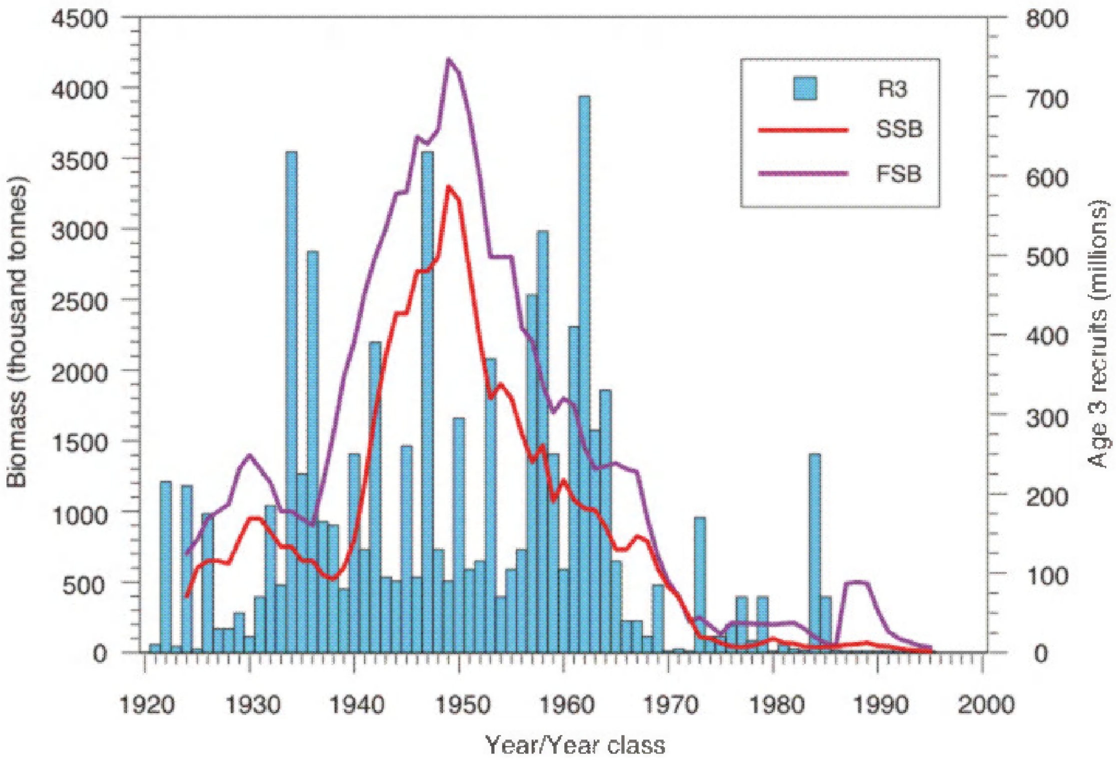

Figure 2.1.3 Recruitment at age 3, spawning biomass and fishable biomass of cod off West Greenland.

2.3 Assessments and Advice

2.3.1 Assessments and advice regarding protection of biota and habitats

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

2.3.2 Assessments and advice regarding fisheries

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 which is fished in waters deeper than 500 m west and southeast of Iceland. The bycatch in the Greenland halibut fishery in these areas 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 2.3.2.7 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 2.3.2.1 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.	-	187 000 t for 2006/2007.	-	-	187 000 t for 2006/2007.
Icelandic haddock	-	Increased risk	-	-	-	112 000 t in 2006/2007.	-	112 000 t in 2005/2006.
Icelandic saithe	Full reproductive capacity.	Increased risk.	-	-	-	81 000 t in 2006/2007.	-	81 000 t in 2005/2006.
Greenland halibut	-	-	-	-	-	Adaptive management plan, start at 15 000 t.	-	Adaptive management plan, start at 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 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, no directed fishery in XIV.
Pelagic *Sebastes mentella*	-	-	-	-	-	No fishing		No fishing
Icelandic summer-spawning herring	-	-	-	-	-	110 000 t in 2006/2007.	-	110 000 t.

The advice for Ling, Blue ling, Tusk and Argentines appears in Volume 9 on widely distributed and migratory stocks.

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, 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 2.3.2.1. 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.**
2. **For deep-sea fisheries the advice is given in Volume 9**
3. **Concerning the fisheries in the East Greenland area (Division XIV) in 2007 there should be no fishery on Greenland cod and *Sebastes spp.***
4. **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 2.3.2.8 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 efficiency over time. Present catch rates can therefore not directly be compared with those in previous periods. However, a marked decline in CPUE is still indicative of a decline in stock abundance. 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. Estimates of uncertainty, although covering only a portion of the total uncertainty, are available for the gadoid stocks and could be used as a basis for a probabilistic advice.

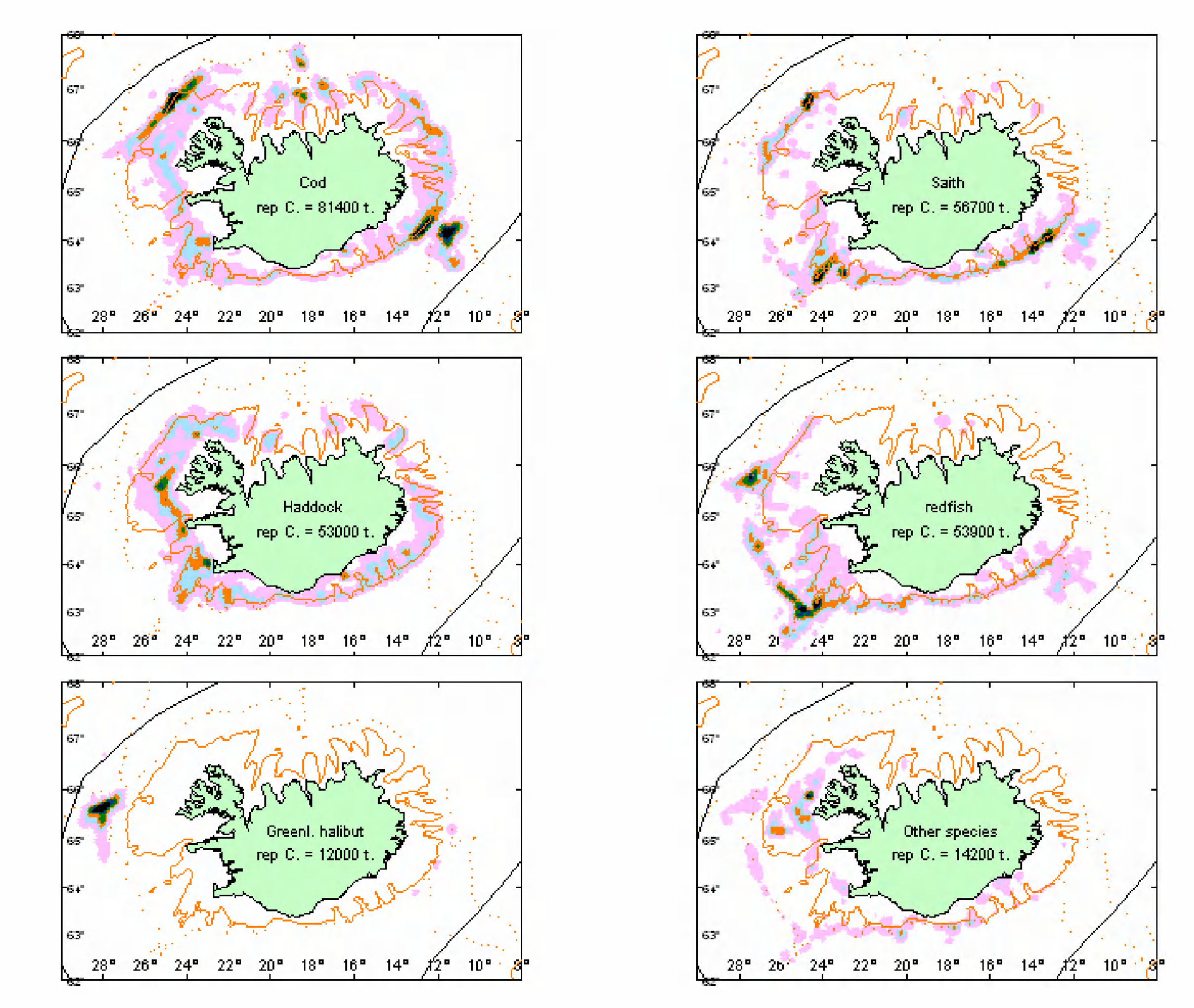

Figure 2.3.2.1 Location of catches of cod, saithe, haddock, redfish, Greenland halibut and others caught with bottom trawl 2005.

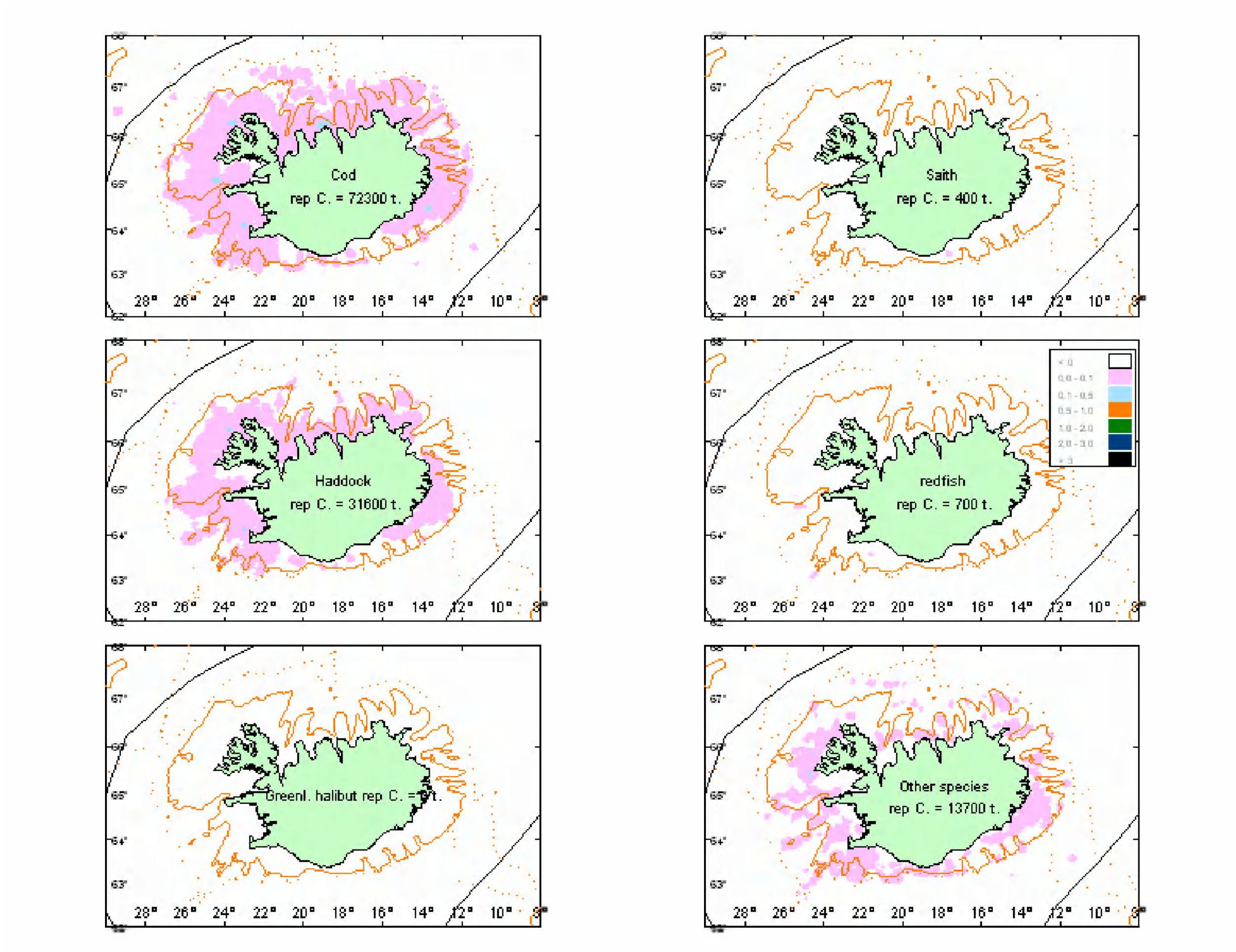

Figure 2.3.2.2 Location of catches of cod, saithe, haddock, redfish, Greenland halibut and others caught with longline in 2005.

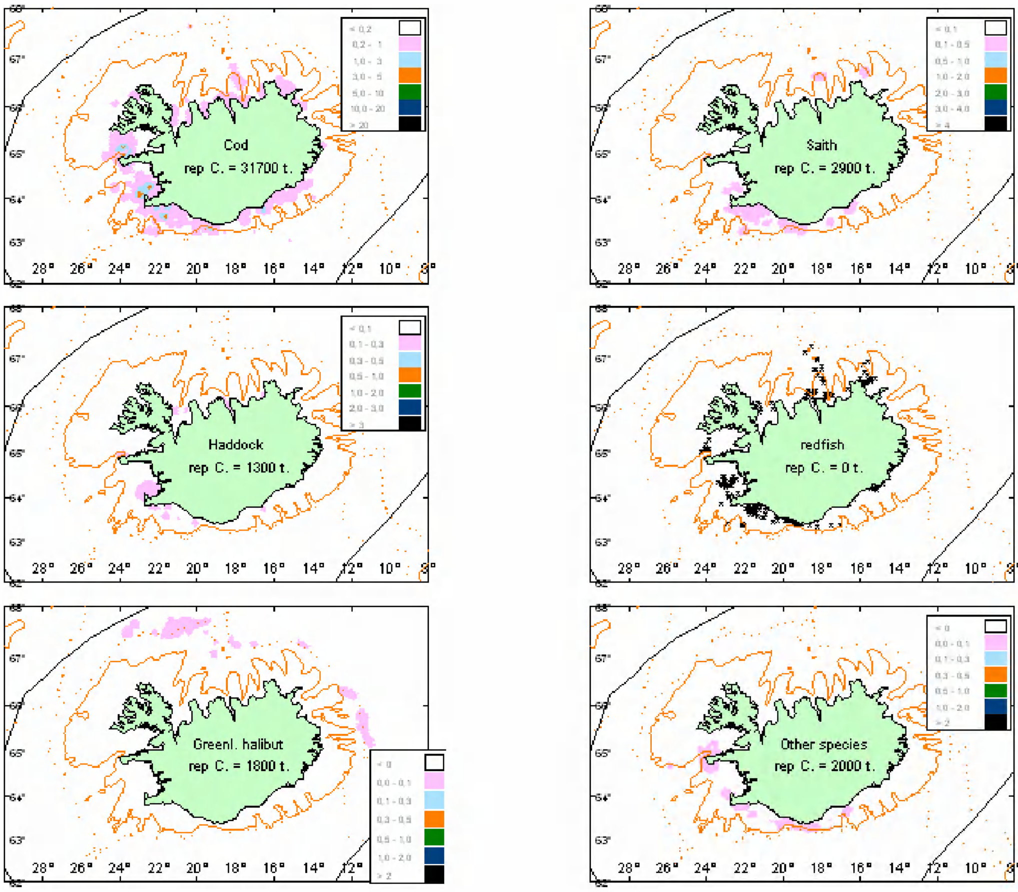

Figure 2.3.2.3 Location of catches of cod, saithe, haddock, redfish, Greenland halibut and others caught with gillnets in 2005.

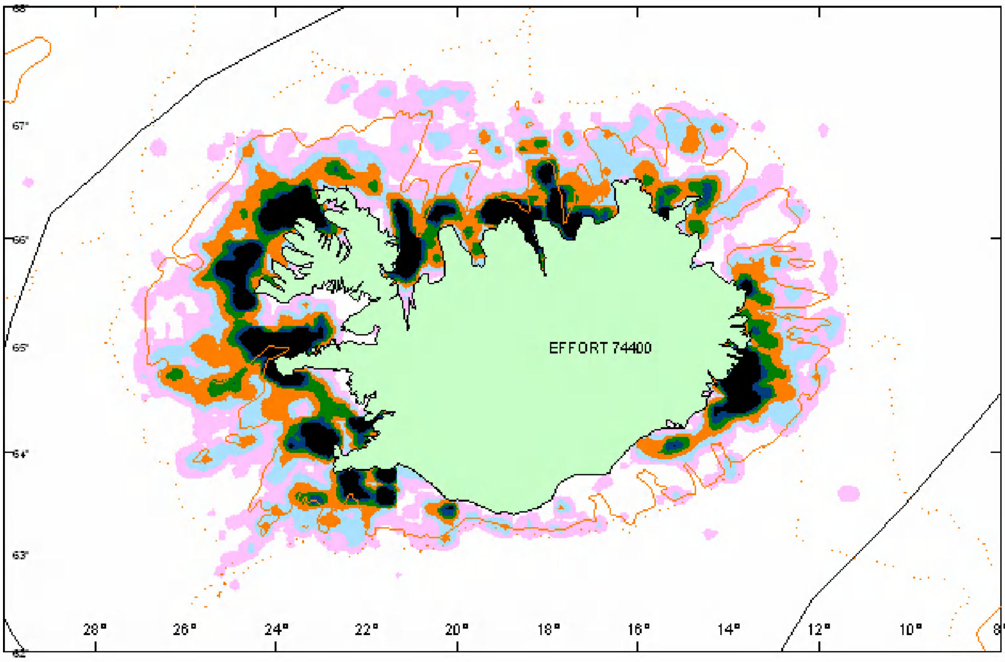

Figure 2.3.2.4 Effort in the longline fleet in 2005. The dark colours show the areas of the greatest fishing effort to be off the northwest and west coast, but fishing is also concentrated along the entire southwest and south coast. The main targeted species for longline fishing are cod, haddock, catfish, and tusk.

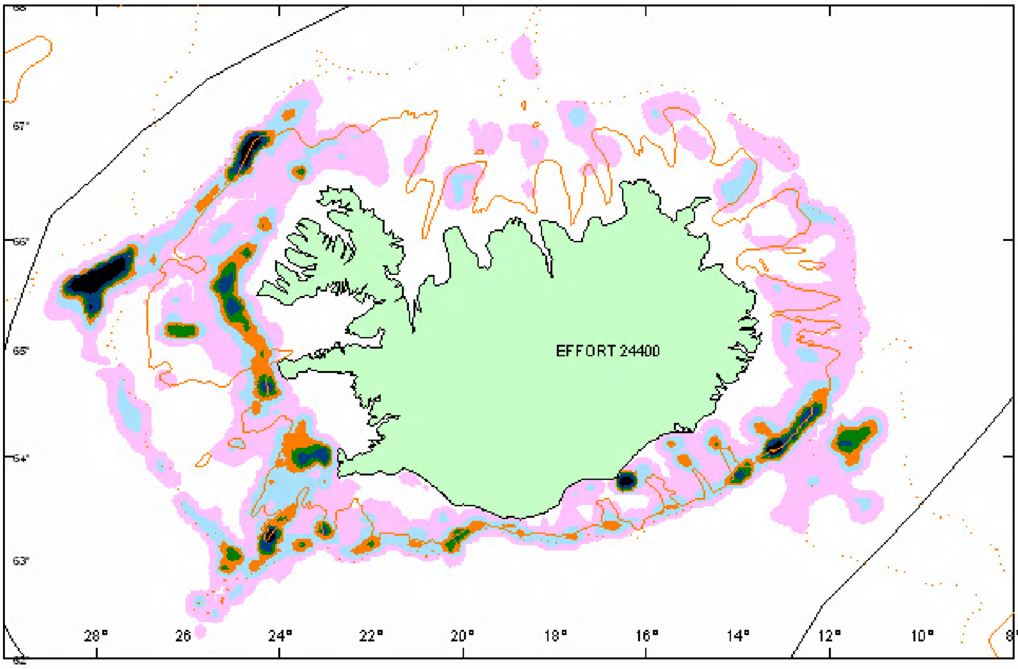

Figure 2.3.2.5 Effort of the trawler fleet in 2005. The dark colours show the areas of the greatest fishing effort to be off the southeast to the west coast and off Northwest Iceland.

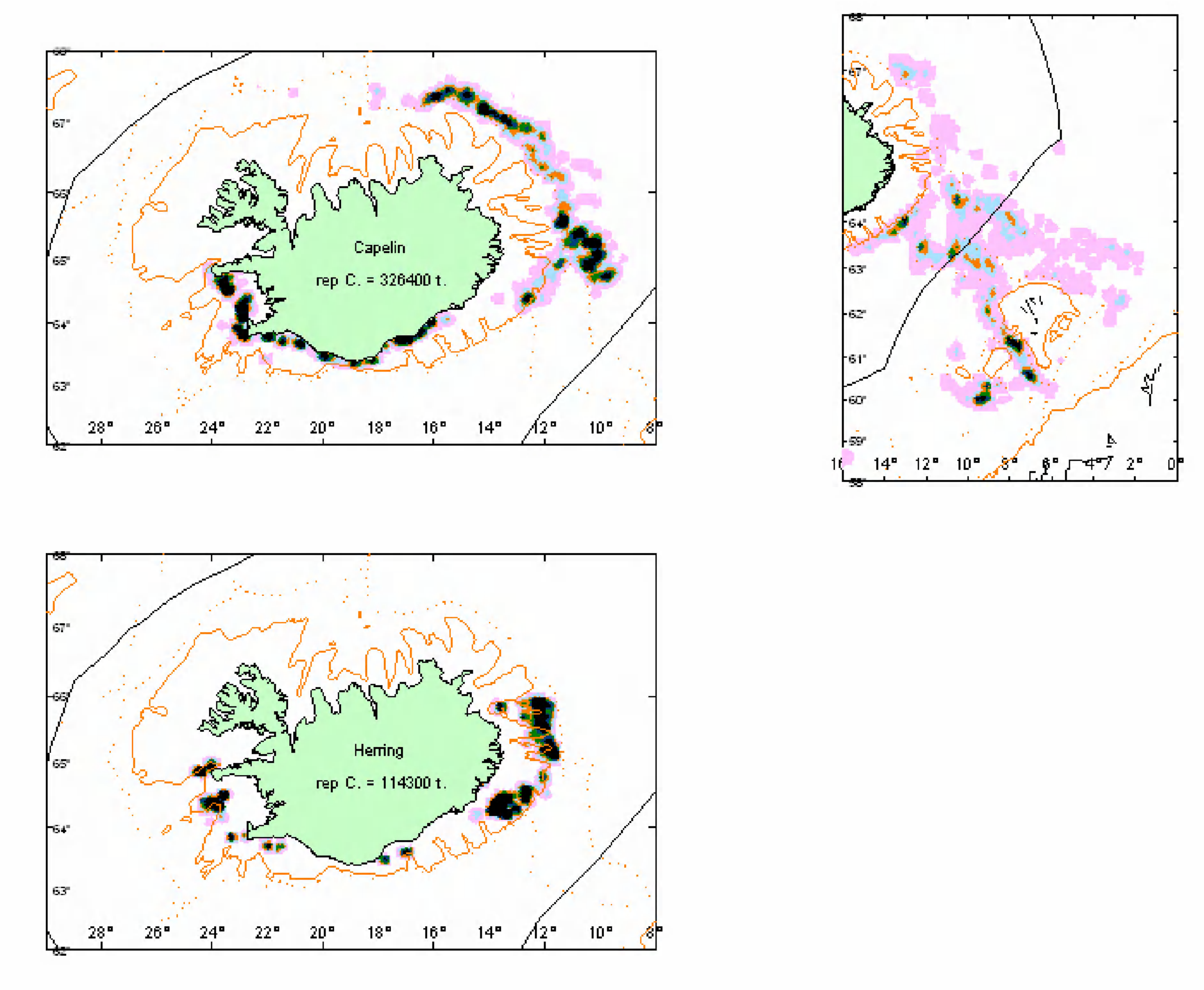

Figure 2.3.2.6 Location of catches of capelin, Icelandic spring spawning herring and blue whiting with purse seine and pelagic trawls in 2005.

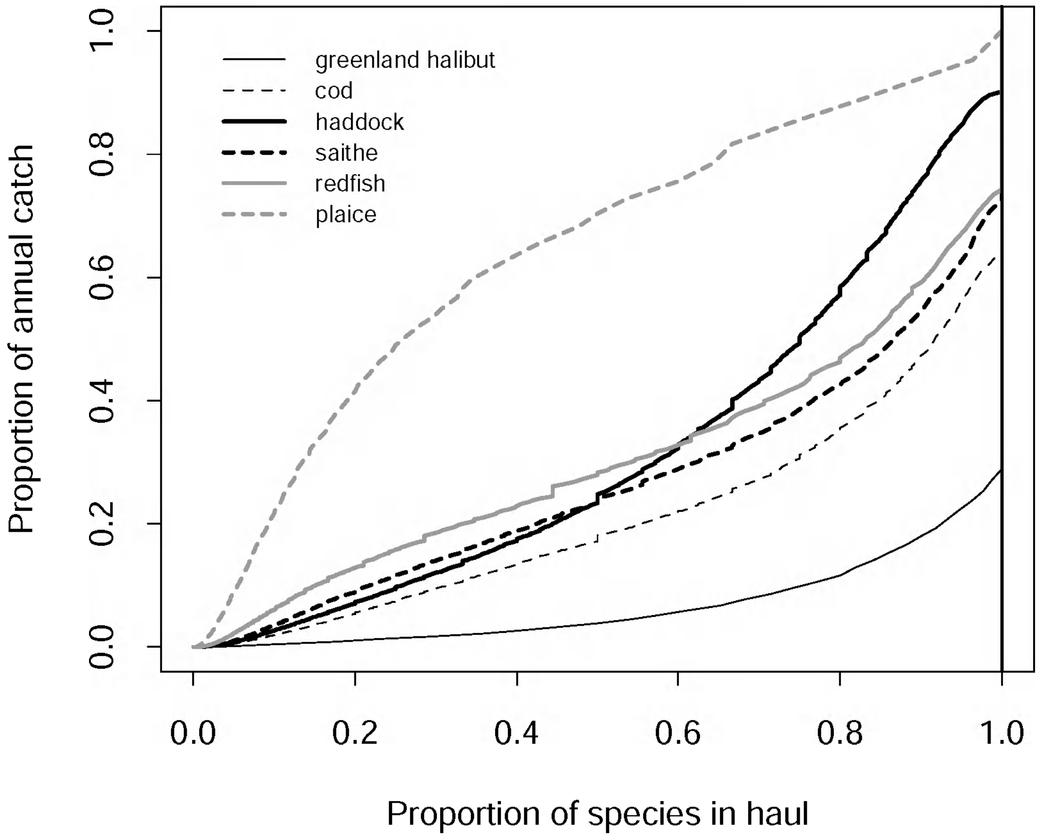

Figure2.3.2.7 Cumulative plot for bottom trawl in 2004. An example describes this probably best. Looking at the figure above it can be seen from the dashed lines that 30% of the catch of haddock comes from hauls where haddock is less than 50% of the total catch, while only 4% of the catch of Greenland 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.

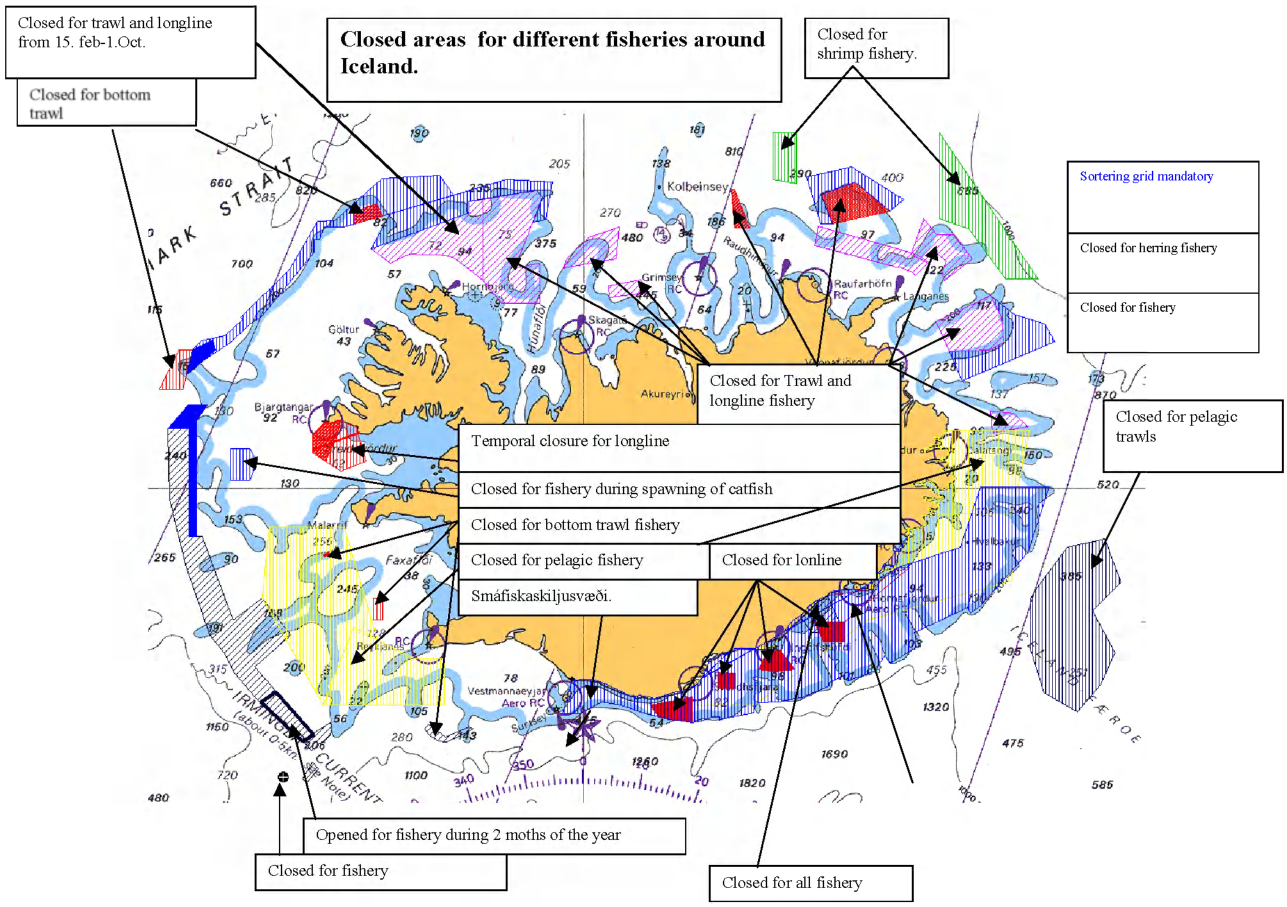

Figure 2.3.2.8 Overview of closed areas around Iceland in 2004. The boxes are of a different nature and can be closed for different time periods and gear type.

Table 2.3.2.1 Overview of the 2005 landings of fish and shrimp caught in Icelandic waters by the Icelandic fleet categorized by gear type in 2005. 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.

SPECIES	BOTTOM TR.	DANISH SEINE	GILLNET	JIGGERS	LONGLINE	PEL TRAWL	PURSE SEINE	SHRIMP TR.	TOTAL
40	2030	0	0	0	0	0	0	0	2030
Angler, monkfish	996	379	1407	1	14	0	0	0	2798
Atlantic wolffish, catfish	7329	1568	78	3	5872	11	0	0	14861
Black scabbard fish	19	0	0	0	0	0	0	0	19
Blueling, European ling	1259	118	9	0	108	7	0	0	1500
Cod, Atlantic cod	90142	12803	31245	2094	65222	448	16	58	202028
dab	20	2079	12	0	3	0	0	0	2113
Deepwater redfish	16636	0	1	0	0	538	1	0	17176
Greater argentine,	4395	0	0	0	0	87	0	0	4482
Greenland halibut	11246	0	1587	0	11	182	2	6	13033
Greenland shark	40	0	10	0	0	0	0	0	50
haddock	54407	10702	1418	70	28331	714	0	16	95658
Halibut, Atlantic halibut	225	54	32	3	194	4	0	0	512
lemon sole	933	1652	1	0	0	9	0	0	2596
ling	1509	253	512	3	2012	8	0	0	4296
Long rough dab	120	753	0	0	3	0	0	0	876
Lumpsucker, lumpfish	0	0	3	0	0	0	0	0	4
megrim	42	106	0	0	0	0	0	0	148
Norway haddock	4	0	0	0	0	0	0	0	4
Orange roughy	8	0	0	0	0	0	0	0	8
others	47	0	0	0	0	0	0	0	47
Pel. Redfish	3194	0	0	0	0	12811	0	0	16005
plaice	1714	3944	165	0	60	8	0	0	5891
porbeagle	0	0	0	0	0	0	0	0	0
Rabbitfish (rat fish)	0	0	0	0	0	0	0	0	0
Redfish, golden redfish	42277	1031	84	33	747	807	0	2	44981
Roughhead grenadier	5	0	0	0	0	0	0	0	5
Roundnose grenadier,	76	0	0	0	0	1	0	0	76
sailray	1	0	0	0	19	0	0	0	20
Saith, pollock	58847	1379	2998	814	602	1638	0	0	66278
shagreen ray	4	1	0	0	11	0	0	0	16
skate	67	44	10	0	43	0	0	2	166
spotted wolffish, leopardfish	1656	14	11	0	1542	9	0	1	3233
spurdog, spiny dogfish	4	12	38	0	22	0	0	0	76
starry ray, thorny skate	148	258	55	0	186	2	0	0	648
tusk, torsk, cusk	117	0	19	14	3336	0	0	0	3486
whiting	513	63	6	1	188	5	0	0	777
witch, witch flounder	359	1967	0	0	0	0	0	0	2327
other	2357	7	83	1	0	29	0	0	2478
Shrimp	0	0	0	0	0	0	0	8659	8659
Atlantic mackerel	238		59	36					362795
blue whiting						265887			265887
capelin						188516	415993		604509
herring, Atlantic herring	17					180619	84042		264678
Grand Total	303000	39187	39845	3073	108526	1014802	500055	8745	2017233

2.3.3 Special Requests

2.3.3.1 Special requests from NEAFC on *Sebastes mentella*

NEAFC has requested ICES to provide advice:

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

    a) Continue to provide information of stock identity of *Sebastes mentella* components fished in pelagic and demersal fisheries on the continental shelf and slope. ICES is asked to describe concepts upon 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;
    c) to provide clear definitions of the following terms with respect to *Sebastes mentella* in the Irminger Sea:

        population;
        stock;
        management unit, and
        stock component.

a) Additional information on stock identity and management units of *S. mentella*

The "Study Group on Stock Identity and Management Units of Redfishes" (SGSIMUR, 31 August–3 September 2004, Bergen, Norway) reviewed the stock structure of demersal and pelagic *S. mentella*. The evaluation by SGSIMUR was largely to assemble evidence from separate investigations with mixed results, none of which were designed to test the alternative hypotheses. As no consensus about the stock structure could be reached at SGSIMUR, ICES concluded to "maintain the current advisory units until more information becomes 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 2.3.3.1.1.

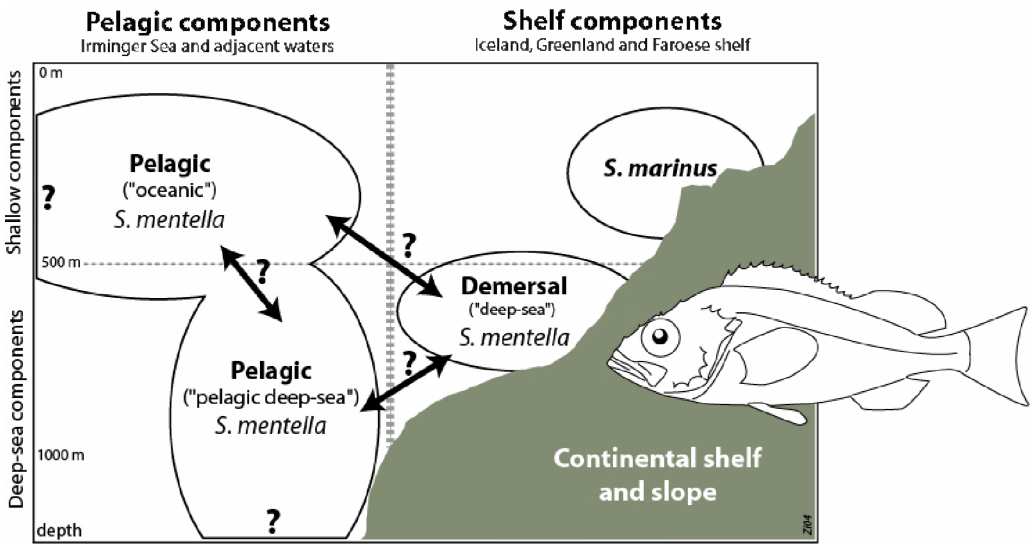

Figure 2.3.3.1.1 Possible relationship between redfish occurrences in the Irminger Sea and adjacent waters.

Some new information has been presented since then. A working document was presented to ICES, which argues that concentrations of pelagic and demersal *S. mentella* are ecological groups of a biologically single population of *S. mentella* in the Irminger Sea and adjacent waters. Two studies on geographic variation in otolith shapes and otolith microchemistry (Stransky *et al.*, 2005a, b) have been published recently, showing high individual variation within areas and low separation between areas across the entire North Atlantic. Recent underwater tagging experiments (Sigurdsson *et al.*, 2006) showed that *S. mentella* tagged in the pelagic fisheries areas southwest off Iceland were recaptured in shelf areas in Division Va.

The ICES working group on the assessment of *S. mentella* did not have sufficient expertise to thoroughly review the scientific content of these documents, nor to integrate these findings with previous information. Drawing firm conclusions on the stock identity of *S. mentella* in the Irminger Sea would require a broad critical synthesis of all existing information, including identifying shortcomings in the existing information, and drawing on experience with stock identity problems in general.

In the absence of firm conclusions on the stock identity, ICES continues to provide advice for the pelagic *S. mentella* unit in the Irminger Sea and adjacent waters separately from the demersal *S. mentella*.

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

In Section 2.4.6 in the advisory report, ICES provides maps showing the seasonal horizontal distribution of the international fishery of *S. mentella*, according to the available data. Furthermore, more detailed information, including horizontal and vertical distribution as well as length distributions, is presented, but only for the Icelandic fishery, for which such data were readily available.

The main feature of the fishery in recent years is a clear distinction between two widely separated grounds (Southwestern and Northeastern) fished at different seasons and different depths. Since 2000, the Southwestern fishing grounds extended also into the NAFO Convention Area. 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, found at greater depths and earlier in the year than in the Southwestern area. A side effect of restrictive quotas, which should be prevented, is that most of the fishery may be concentrated in the Northeastern area, which is typically exploited early in the year.

ICES again had difficulties in obtaining catch estimates from the various fleets as in the past, and information presented during the meeting indicates that unreported catches might be substantial. Furthermore, landings data were missing from some nations. ICES encourages NEAFC to try to provide ICES with all information that might enable the WG to come up with more reliable catch statistics.

c) to provide clear definitions of the following terms with respect to *Sebastes mentella* in the Irminger Sea: population; stock; management unit and stock component"

ICES refers to general definitions given in the literature and recently reviewed definitions of the terms "population" and "stock" with regard to *S. mentella* in the Irminger Sea and adjacent waters (Saborido-Rey *et al.*, 2004). Waldman in Cadrin *et al.*, (2005) states "Fisheries science is based on the notion of an idealised "unit stock", a discrete entity with its own origin, demographic, and fate." He concludes that the terms "population" and "stock" generally are used with slightly different definitions and that in several cases the terms "population" and "stock" are synonymous.

For advisory purposes ICES defines a "stock" as a proxy for a "unit stock".

"Population" is used for a group of fish of the same species that occur together but where the "stock" to which they belong is not known.

A "management unit" is an entity that can be clearly defined in management terms. The term is used for a fleet or fishery that can be clearly distinguished from other vessels or fishing operations. It is also used for an area or a season.

The term "stock component" and its use with regard to *S. mentella* in the Irminger Sea remains unclear but seems synonymous to "population". The implication of the term is that these fish belong to a stock that has a wider distribution than the fish considered.

References

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Stransky, C., Gudmundsdottir, S., Sigurdsson, T., Lemvig, S., Nedreaas, K., and Saborido-Rey, F. 2005a. Age determination and growth of Atlantic redfish (*Sebastes marinus* and *S. mentella*): bias and precision of age readers and otolith preparation methods. ICES J. Mar. Sci., 62, 655-670.

Stransky, C., Kanisch, G., Krüger, A., and Purkl, S. 2005b. Radiometric age validation of golden redfish (*Sebastes marinus*) and deep-sea redfish (*S. mentella*) in the Northeast Atlantic. Fish. Res., 74: 186-197.

2.4 Stock Summaries (Iceland and East Greenland)

2.4.1 Greenland cod in ICES Subarea XIV and NAFO Subarea 1

State of the stock

In the absence of defined reference points the state of the stock cannot be fully evaluated. 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. Biomass estimates from surveys have increased in recent years, approaching the levels of the early 1980s. However, the stock has historically been far larger (Figure 2.4.1.3). With the exception of two year classes, recruitment has been extremely low since the late 1960s. 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, but the distribution of the 2003 year class is more easterly than those in the 1980s.

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 the 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

The existing management agreement has not been evaluated by ICES. 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 in 2007.

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.

Survey information indicates that recruitment of the 2003 year class is higher than in previous years, and may be in the order of magnitude seen in 1984. Survival of the 2003 year class should be maximized to promote the production of several 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 5000 t in the last three years), the contribution of the inshore landings has increased, accounting for 50–90% of the total landings from 1993 to 2005.

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

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

Analytical assessment is available up to 1992. After its depletion in 1992, the stock could only be assessed by trends in research survey indices. Fishery data are sparse and commercial sampling is not conducted. The perception of the magnitude of the 2003 year class is based on survey information.

Comparison with previous assessment and advice

The advice is the same as last year.

Source of information

Report of the North-Western Working Group, 25 April–4 May 2006 (ICES CM 2006/ACFM:26).

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	6	<1	6	7
2006	No fishing	0			5				
2007	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.

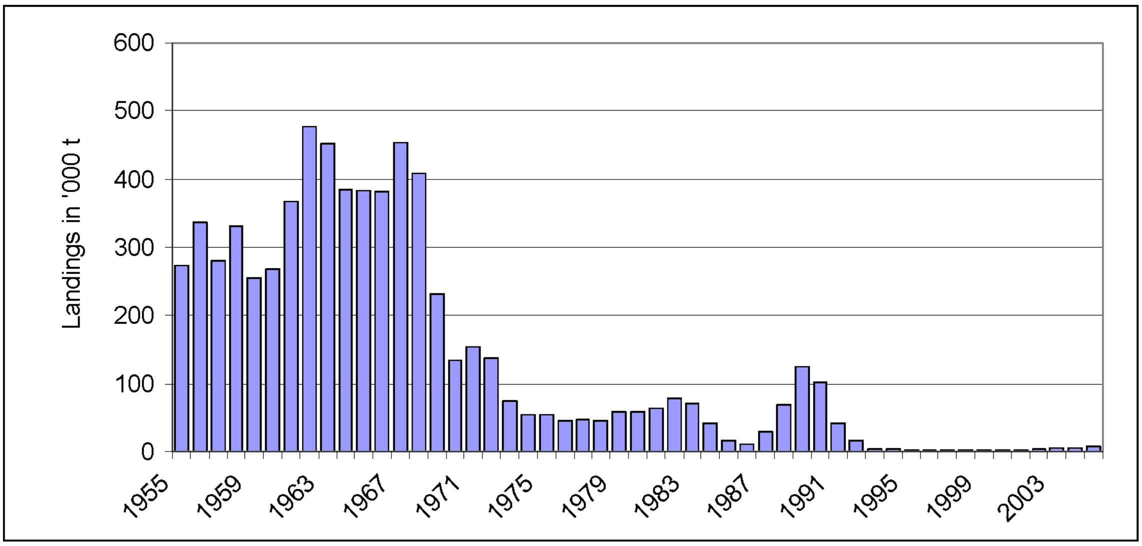


Figure 2.4.1.1 Greenland cod landings from 1955–2005 (ICES Subarea XIV and NAFO Subarea 1)

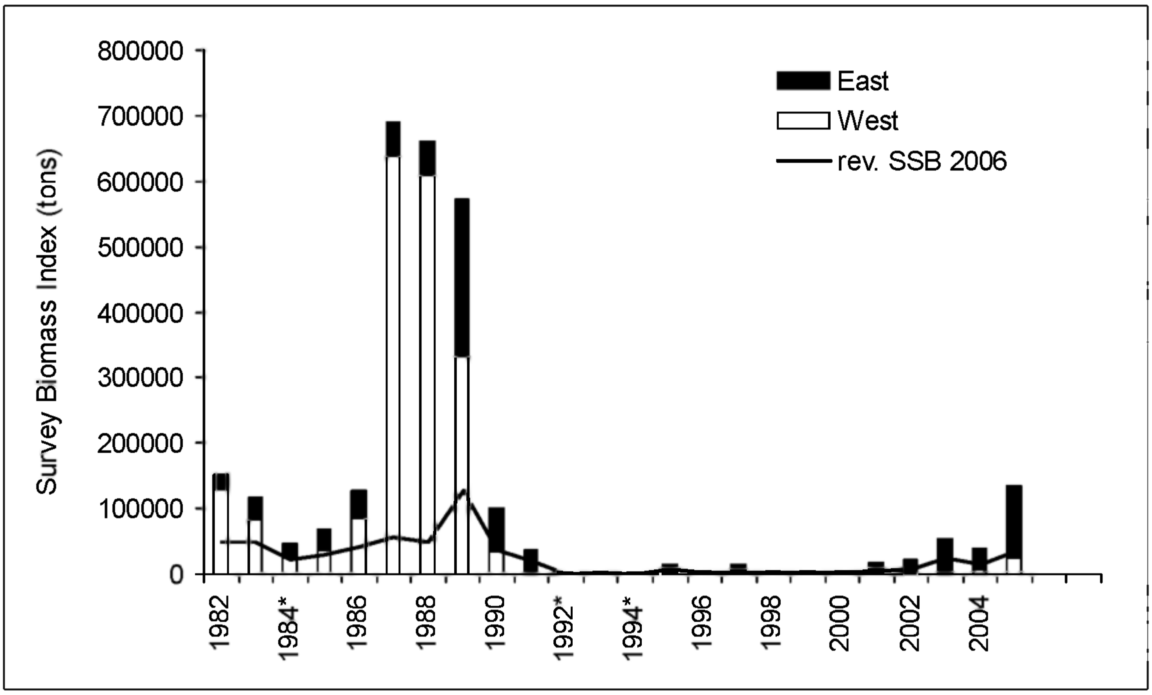


Figure 2.4.1.2 Cod off Greenland (offshore component), German survey. Aggregated survey biomass indices for West and East Greenland and revised spawning stock biomass, 1982–2005. Incomplete survey coverage in 1984, 1992, and 1994.

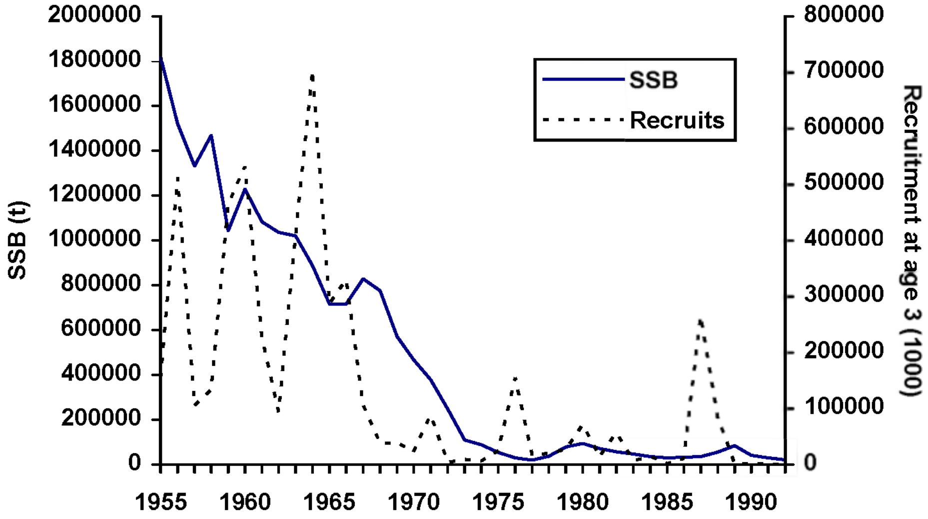


Figure 2.4.1.3 Greenland cod (offshore component). Trends in spawning stock biomass (SSB) and recruitment until 1992.

Table 2.4.1.1 Nominal catch (t) of cod in NAFO Sub-area 1, 1988–2005 as officially reported to ICES.

COUNTRY	1988	1989	1990	1991	1992	1993
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
Japan	10	-	-	-	-	-
Norway	7	2	948	-	-	-
UK	927	3780	1.631	-	-	-
Total	59.653	108.826	68.961	20.335	5.723	1.924
WG estimate	62.653 [2]	111.567 [3]	98.474 [4]	-	-	-

COUNTRY	1994	1995	1996	1997	1998	1999
Faroe Islands	-	-	-	-		
Germany	-	-	-	-		
Greenland	2.115	1.710	948	904	319	622
Japan	-	-	-	-		
Norway	-	-	-	-		
UK	-	-	-	-		
Togo	2.115	1.710				
Total	-	-	948	904	319	622
WG estimate			-	-	-	-

COUNTRY	2000	2001	2002[1]	2003[1]	2004[1]	2005
Faroe Islands						
Germany						
Greenland	764	1680	3698	3989	4948	
Japan						
Norway				693 [5]		
UK						
Togo				533 [5]		
Total	764	1680	3698	5215		
WG estimate	-	-				6043

[1]) Provisional data reported by Greenland authorities
[2]) Includes 3,000 t reported to be caught in ICES Sub-area XIV
[3]) Includes 2,741 t reported to be caught in ICES Sub-area XIV
[4]) Includes 29,513 t caught inshore
[5]) Transshipment from local inshore fishers

Table 2.4.1.2 Nominal catch (t) of cod in ICES Subarea XIV, 1988–2005 as officially reported to ICES.

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

COUNTRY	1994	1995	1996	1997	1998	1999
Faroe Islands	1	-	-	-	-	6
Germany	24	22	5	39	128	13
Greenland	73	29	5	32	37 [5]	+ [5]
Iceland	-	1	-	-		-
Norway	14	+	1	-	+	2
Portugal					31	-
UK (E/W/NI)	-	232	181	284	149	95
United Kingdom	296					
Total	408	284	192	355	345	116
WG estimate	-	-	-	-	-	-

COUNTRY	2000	2001	2002[5]	2003[5]	2004	2005
Faroe Islands					329	205
Germany	3	92	5	1		
Greenland		4	232	78	23	1
Iceland	-	210				
Norway	- [5]	43	13		5	507
Portugal	-	278				
UK (E/W/NI)	149	129				55
United Kingdom			34			
Total	152	756	284	79	357	
WG estimate	-		448[6]	294[7]		836[8]

[1]) Excluding 3,000t assumed to be from NAFO Division 1F and including 42t taken by Japan
[2]) Excluding 2,74 t assumed to be from NAFO Division 1F and including 1,500t reported from other areas assumed to be from Sub-area XIV and including 94t by Japan and 155t by Greenland (Horsted, 1994)
[3]) Includes 129t by Japan and 48 t additional catches by Greenland (Horsted, 1994)
[4]) Includes 18t by Japan
[5]) Provisional data
[6]) Includes 164t from Faroe Islands
[7]) Includes 215t from Faroe Islands
[8]) Includes 68t from Norway

2.4.2 Icelandic cod 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
Undefined	Undefined	Overexploited	The exploitation rate (0.30) is slightly above what is intended in the management plan(0.25)

In the absence of defined reference points the state of the stock cannot be fully evaluated.

SSB has been at a low level since the middle of the eighties and recruitment has been well below the historical average. In the most recent years some increase in SSB has been observed, but the SSB still consists of relatively high proportions of younger fish. Three of the five recent year classes are estimated to be poor (2001, 2003, and 2004), while the 2002 and 2005 year classes are below the long-term average.

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", computed as the biomass of age 4 and older fish B(4+) averaged over two adjacent (intermediate and projection year) calendar years.

ICES 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 the implementation error is minimal. The harvest control rule has been modified since then with a constraint on year-to-year variation of the TAC. This modification has not been evaluated by ICES. This constraint has not been applied after 2001–2002.

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	0.594	1.755	1.673
$\mathbf{F}_{max}$	0.336	1.804	3.336
$\mathbf{F}_{0.1}$	0.148	1.632	7.651
$\mathbf{F}_{med}$	0.662	1.734	1.414

Single-stock exploitation boundaries

Exploitation boundaries in relation to existing management plans
Following the management plan would imply catches of 187 000 t in the fishing year 2006/2007. ICES considers the 1995 harvest control rule to be consistent with the Precautionary Approach provided the implementation error is minimal.

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

The current fishing mortality (0.57) is well above fishing mortalities that would lead to high long-term yields ($\mathbf{F}_{0.1}$=0.15 and $\mathbf{F}_{max}$=0.34). This indicates that the long-term yield will increase at Fs well below historical values.

Exploitation boundaries in relation to precautionary limits

The agreed management plan is considered consistent with the precautionary approach. Exploitation boundaries in relation to precautionary limits are already included under exploitation boundaries in relation to existing management plans.

Short-term implications

Outlook for 2007

Basis: F(2006) = 0.53; SSB(2007) = 245 B4+(2007)=745; catch (2006) = 204.

Rationale	TAC (2007)	Basis	F (2007)	B4+	SSB (2008)	%SSB change 1)	% TAC change 2)
Zero catch	0	F=0	0	922	422	45	
Status quo	201	$\mathbf{F}_{sq}$	0.52	694	234	-3	-2
High long-term yield	133	F(long-term yield)	0.32	771	296	14	-33
Agreed management plan	19	TAC(man. plan) * 0.1	0.04	901	404	41	-91
	47	TAC(man. plan) * 0.25	0.10	869	377	34	-76
	93	TAC(man. plan) * 0.50	0.22	816	333	24	-53
	140	TAC(man. plan) * 0.75	0.34	763	289	12	-29
	169	TAC(man. plan) * 0.90	0.42	731	263	5	-15
	187	TAC(man. plan)	0.48	710	248	1	-6
	206	TAC(man. plan) * 1.1	0.54	689	229	-5	4
	234	TAC(man. plan) * 1.25	0.63	657	204	-12	18

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

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 fluctuating in the range of 0.51–0.76, in the last three years about 0.6. 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 5% in 2004 and 2005). Finally, previous assessments have in the past underestimated the fishing mortality and overestimated the stock.

At present, fishing mortality is high ($\mathbf{F}_{5\text{-}10}$ is about 0.6 in the year 2005) and age 9 and younger fish account for 99% of the fishable biomass (4+). The spawning stock consists of very few ages. This may have a negative effect on reproductive potential. Spawners at age 10 and younger will constitute about 95% of the spawning stock biomass in 2007. Given the relatively high proportions of younger fish in the fishable as well as in 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.

The current fishing mortality is well above $\mathbf{F}_{max}$, indicating that candidate target fishing mortalities should be well below the current F.

Management plan evaluations

The management plan has been in effect for about 10 years. 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 as well as proposals for revision 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, aimed at protecting 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 for 2–3 weeks during the spawning season 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 in order 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

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 these environmental indicators and cod recruitment, but the shift in distribution of capelin may be linked to these hydrographic changes.

In the past, weights-at-age of the cod have been clearly related to the biomass of capelin. The recent reduced mean weights-at-age are likely to be linked to the disappearance of juvenile capelin from the feeding areas for cod. 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.

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 (a statistical Catch-at-age Model using AD model builder) 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 perception of the cod stock in the last 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. The variance in the medium-term predictions (Figure 2.4.2.3) are likely underestimates of the uncertainty.

Since 1985, recruitment has fluctuated around a lower level than previously. This may be related to an environmental change. Results of medium-term projections based on the current Harvest Control Rule indicate that the fishing mortality is expected to decrease, while the catchable biomass 4+ will remain stable (Figure 2.4.2.3). These projections cover only the short time span when the stock is dominated by year classes that have already been measured in surveys.

Comparison with previous assessment and advice

In the present assessment the estimated reference biomass (B4+) at the beginning of 2006 is 753 000 t, compared to the 823 000 t estimated in last year's assessment. The reference biomass in 2005 is estimated at 715 000 t in the current assessment, compared to 760 000 t in last year's assessment. The retrospective pattern of recruitment estimates in recent years, both historical and analytical, indicates a minor but constantly downward revision. The advice is consistent with previous years advice.

Source of information

Report of the North-Western Working Group, 25 April–4 May 2006 (ICES CM 2006/ACFM:26).

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	206
2003/2004[2]	Apply catch rule	210	209	225	226
2004/2005[2]	Apply catch rule	205	205	214	215
2005/2006	Apply catch rule	198	198		
2006/2007	Apply catch rule	187			

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

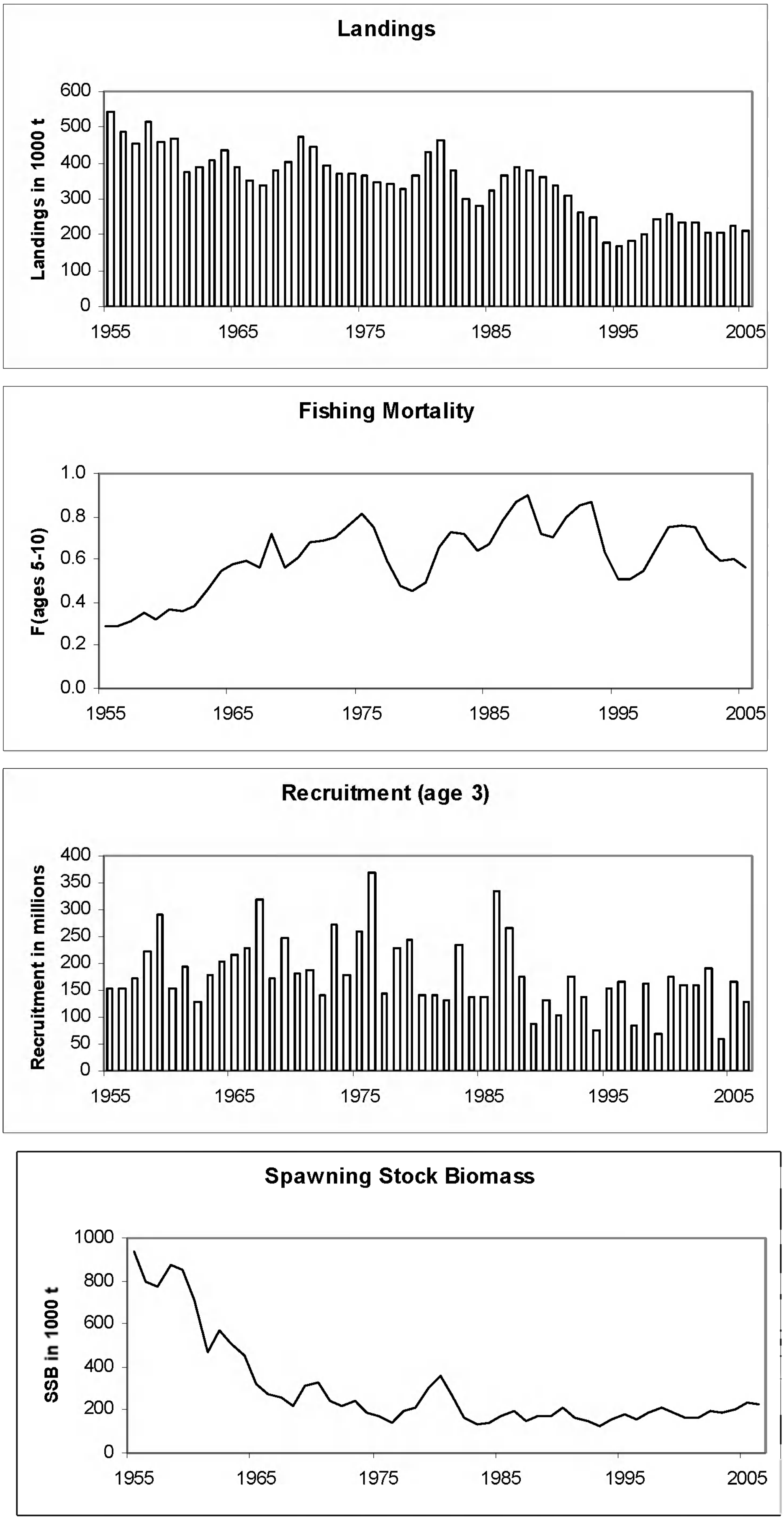
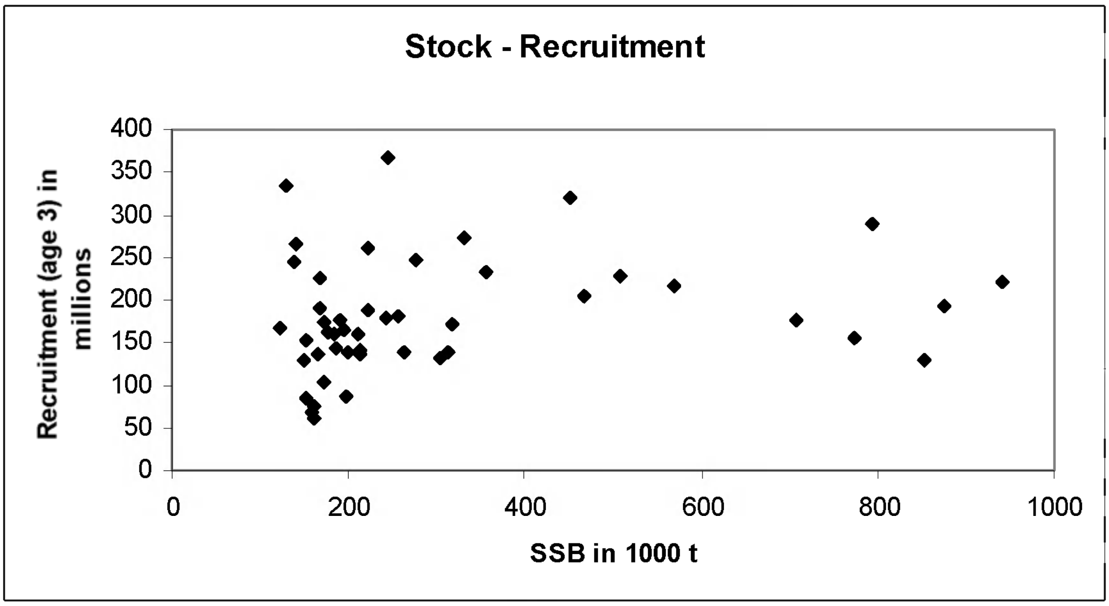


Figure 2.4.2.1 Icelandic cod (Division Va). Landings, fishing mortality, recruitment and SSB.



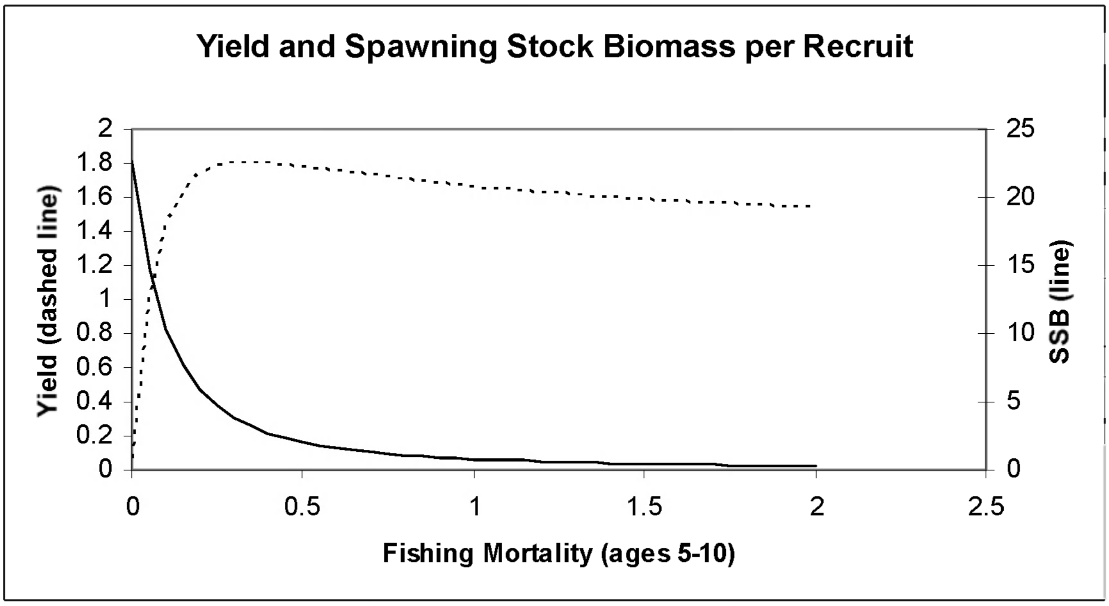


Figure 2.4.2.2 Icelandic cod (Division Va). Stock and recruitment; Yield and SSB per recruit.

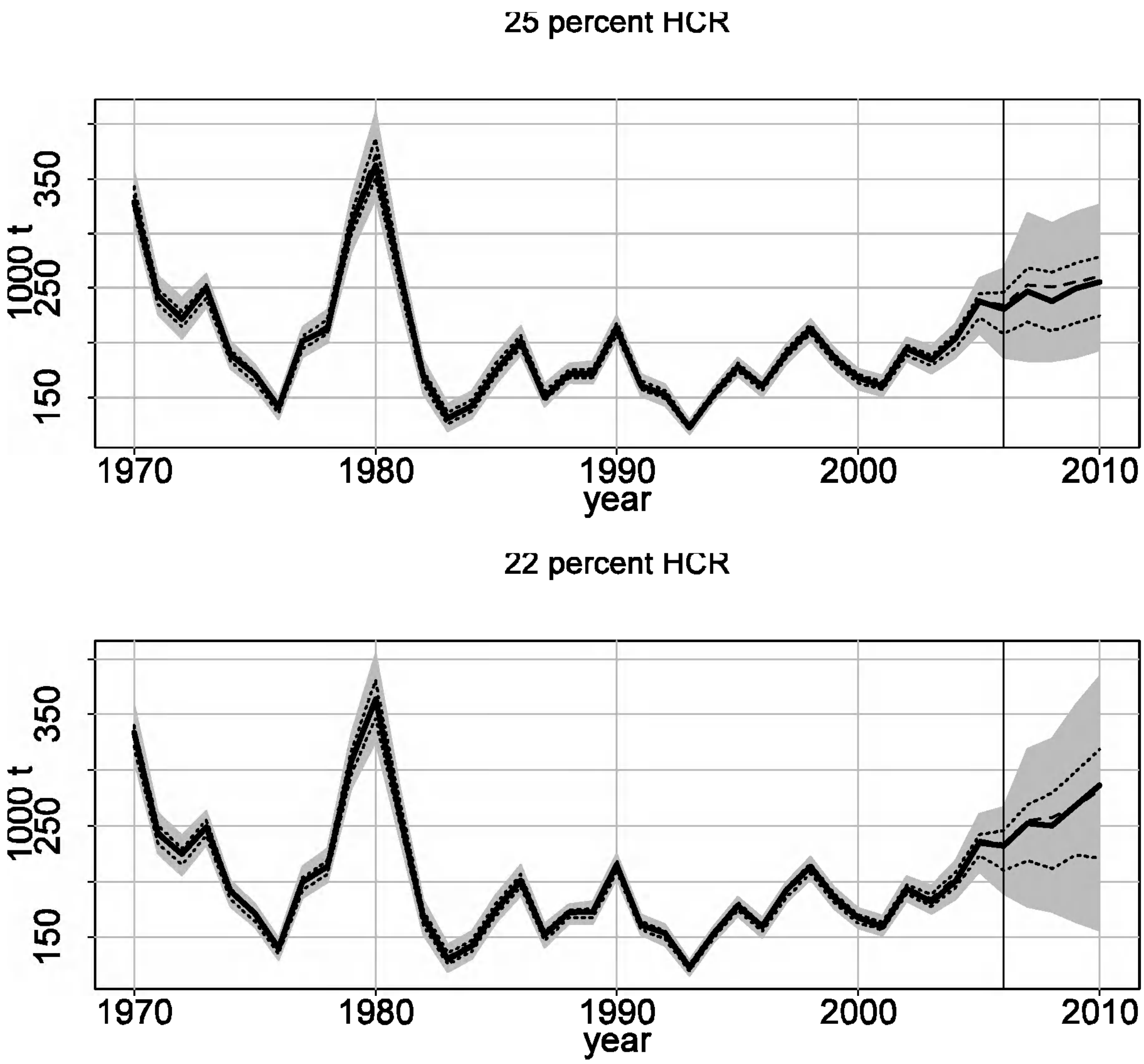


Figure 2.4.2.3 ADCAM medium-term projections of SSB based on the amended Harvest Control Rule and 22 percent scenario. Recruitment after 2006 is estimated from the Ricker stock recruitment function assuming lognormal errors and a negative trend in Rmax. Assessment error was assumed to be lognormal with 15% CV and 20% autocorrelation. Shown in the figure are 5 and 95 percentiles (shaded areas), and 25 and 75 percentile (dashed lines, and the mean).

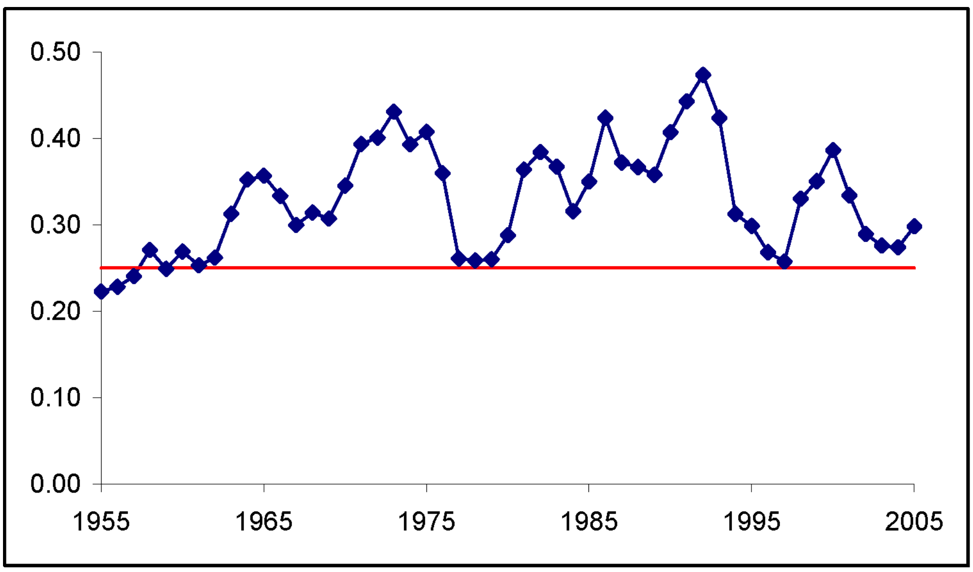


Figure 2.4.2.4 Icelandic cod (Division Va). Exploitation rate (landings / B4+ biomass)

Table 2.4.2.1 Iceland cod (Division Va). Stock summary

Year	Recruitment Age 4 Thousands	SSB Thous. tonnes	Mean F Ages 5-10	B4+ Thous. tonnes	Landings Thous. tonnes	Exploitation rate
1955	151999	941	0.29	2360	545	0.23
1956	152824	795	0.29	2084	487	0.23
1957	170655	774	0.31	1880	455	0.24
1958	220730	874	0.35	1867	517	0.28
1959	289146	852	0.32	1828	459	0.25
1960	154362	708	0.37	1753	470	0.27
1961	192924	467	0.36	1496	377	0.25
1962	128943	569	0.38	1492	389	0.26
1963	177569	508	0.46	1316	409	0.31
1964	204140	451	0.55	1219	437	0.36
1965	216454	318	0.58	1023	387	0.38
1966	229181	277	0.59	1032	353	0.34
1967	320272	256	0.56	1103	336	0.30
1968	171873	222	0.72	1223	382	0.31
1969	247573	314	0.56	1326	403	0.30
1970	180451	331	0.61	1337	475	0.36
1971	188614	242	0.68	1098	444	0.40
1972	139177	222	0.69	997	395	0.40
1973	273156	245	0.70	844	369	0.44
1974	178940	187	0.76	918	368	0.40
1975	260872	168	0.81	895	365	0.41
1976	367953	138	0.75	955	346	0.36
1977	143268	198	0.59	1290	340	0.26
1978	226858	212	0.48	1298	330	0.25
1979	244160	304	0.45	1396	366	0.26
1980	139817	356	0.49	1489	432	0.29
1981	140788	264	0.66	1242	465	0.37
1982	131962	167	0.73	971	380	0.39
1983	233316	129	0.72	791	298	0.38
1984	138571	141	0.64	914	282	0.31
1985	137466	172	0.67	928	323	0.35
1986	334232	198	0.78	850	365	0.43
1987	264967	149	0.87	1032	390	0.38
1988	174960	172	0.90	1041	378	0.36
1989	86896.4	172	0.72	1009	363	0.36
1990	130319	214	0.70	840	335	0.40
1991	104162	161	0.80	696	308	0.44
1992	173485	152	0.85	546	265	0.49
1993	136558	123	0.87	590	251	0.43
1994	75824.6	153	0.63	574	178	0.31
1995	152220	178	0.51	553	169	0.30
1996	166613	158	0.51	668	181	0.27
1997	85380.7	189	0.55	784	203	0.26
1998	162279	211	0.66	718	244	0.34
1999	67609	185	0.75	730	260	0.36
2000	177298	168	0.76	587	235	0.40
2001	160650	162	0.75	694	234	0.34
2002	161305	196	0.65	731	208	0.29
2003	190272	185	0.60	741	206	0.28
2004	60841.2	202	0.61	818	226	0.28
2005	164380	234	0.57	715	214	0.30
2006	127211	229		753		

2.4.3 Icelandic 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	Increased risk	Unknown	There is no $\mathbf{B}_{pa}$, but the stock is above any candidate value

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 several strong year classes. All indications are that the current SSB is the highest in 25 years or more and is above any likely candidate for $\mathbf{B}_{pa}$. Fishing mortality was well above $\mathbf{F}_{pa}$ (0.47) until 2001, and then declined to around 0.5. Since 1998, most year classes have been well above average, and the 2003 year class is the strongest in the observed time-series. The 2004 and 2005 year classes appear to be average.

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.

Yield and spawning biomass per recruit

Because the yield and spawning biomass per recruit are sensitive to variation in selection in the fishery, growth, and maturation, and because these parameters are currently undergoing rapid change, such calculations are not presented.

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits

Fishing mortality in 2007 should not exceed $\mathbf{F}_{pa}$, which corresponds to catches of less than 112 000 t in 2007.

Short-term implications

Outlook for 2007

Basis: F(2006) =0.56; SSB(2006) = 149 000 t; catch (2006) = 110 000 t.

Rationale	TAC (2007)[1]	Basis	F (2007)	SSB (2008)	%SSB change [1)]	% TAC change [2)]
Status quo (F2005)	125	$\mathbf{F}_{sq\ (2005}$	0.538	178	2.02	13.63
F as in 2006	129	$\mathbf{F}_{(2006)}$ 110 kt 2006	0.558	176	0.88	17.27
Precautionary limits	32	TAC(Fpa)* 0.25	0.118	232	32.97	-70.90
	61	TAC($\mathbf{F}_{pa}$)* 0.5	0.235	215	23.23	-44.54
	88	TAC($\mathbf{F}_{pa}$)* 0.75	0.352	199	14.06	-20
	103	TAC($\mathbf{F}_{pa}$)* 0.90	0.423	191	9.47	-6.36
	112	$\mathbf{F}_{pa}$	0.47	186	6.61	1.82
	121	TAC($\mathbf{F}_{pa}$)* 1.1	0.517	181	3.74	10
	134	TAC($\mathbf{F}_{pa}$)* 1.25	0.588	173	-0.84	21.8

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

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. This is taken into account by predicting similar growth in coming years as in 2005 when growth was estimated at the slowest in the time-series. In addition the selection of the fishery in the prediction is linked to stock weight rather than to age. In spite of this the 2003 year class is expected to contribute approximately 43 000 t of the projected catch in 2007. If selection of this year class is less than expected, fishing mortality of the older age groups would increase substantially, unless the TAC is adjusted accordingly.

ICES advice is based on calendar years, but Icelandic TACs are based on the fishing year (September to August).

Ecosystem considerations

Haddock has now become 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 haddock have been sampled in the Icelandic autumn survey since 1996 and in 2006 sampling of stomachs started in the March survey. Results from March 2006 indicate that haddock smaller than approximately 30 cm are not able to utilize spawning capelin, while larger haddock prey extensively on it. Results from the autumn survey show a more variable diet, but with a rather large proportion of fish preys. Of fish preys sandeel are the most important but now show a declining trend, in agreement with other observations of a recruitment failure in the sandeel stock in recent years.

Slow growth in 2005 is likely a stock size dependent phenomenon, but some effect of the shortage of sandeel cannot be excluded. Stomach samples from cod indicated increasing predation on haddock in 2003–2004, probably reflecting increased haddock abundance. However, haddock is only a minor part of the diet of cod—at present (2–4%)—and cod prey mostly on small haddock (age 1 and 2).

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 1960s 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 of discards indicate that they were higher from 1994 to 1997 than at present. The largest discards are observed when the 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 residing in the shallow areas off the north coast where fishing effort has been relatively low, although it is slowly increasing.

Scientific basis

Data and methods

The assessment is based on age-disaggregated landings from 1979–2005 as well as survey data from the March survey 1985–2006. Discard estimates are available back to the late 1980s, but are not included in the catch-in-numbers data.

Information from the fishing industry

Commercial 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 little fishing effort, but part of the discrepancy could be that low prices of haddock make fishers avoid haddock. Commercial cpue are therefore not used in the analytical assessment.

Uncertainties in assessment and forecast

Alternative assessment methods indicate the same overall trend, but differ somewhat in absolute values. Using the autumn survey instead of the spring survey to calibrate the assessment gives lower estimates of biomass. The reason for this discrepancy is not clear. The spring survey was used because it is a longer time-series and covers the haddock habitat better. All assessments indicate that the 2003 year class is much larger than any year class seen in recent years, although the absolute magnitude is uncertain. Growth of most age groups of haddock were very slow in 2005 and the forecast assumes continued slow growth. The selection by age is linked to stock weights rather than to age, reducing selection on the 2003 year class in 2006 and 2007.

Comparison with previous assessment and advice

The same assessment procedure was used as last year and the results are consistent with last year's assessment. The main difference this year is in the prediction, where growth is projected assuming the slow growth of 2005 in coming years and predicting selection from weight-at-age. Last year the possibility of slow growth was taken into account by setting the selection of age 3 in 2006 to zero.

The advice is consistent with last year's advice.

Source of information

Report of the North-Western Working Group, 25 April–4 May 2006 (ICES CM 2006/ACFM:26).

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	98	97
2005/2006[3]	F reduced below provisional $\mathbf{F}_{pa}$	<110	105		
2006/2007	F reduced below provisional $\mathbf{F}_{pa}$	< 112			

Weights in '000 t.

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

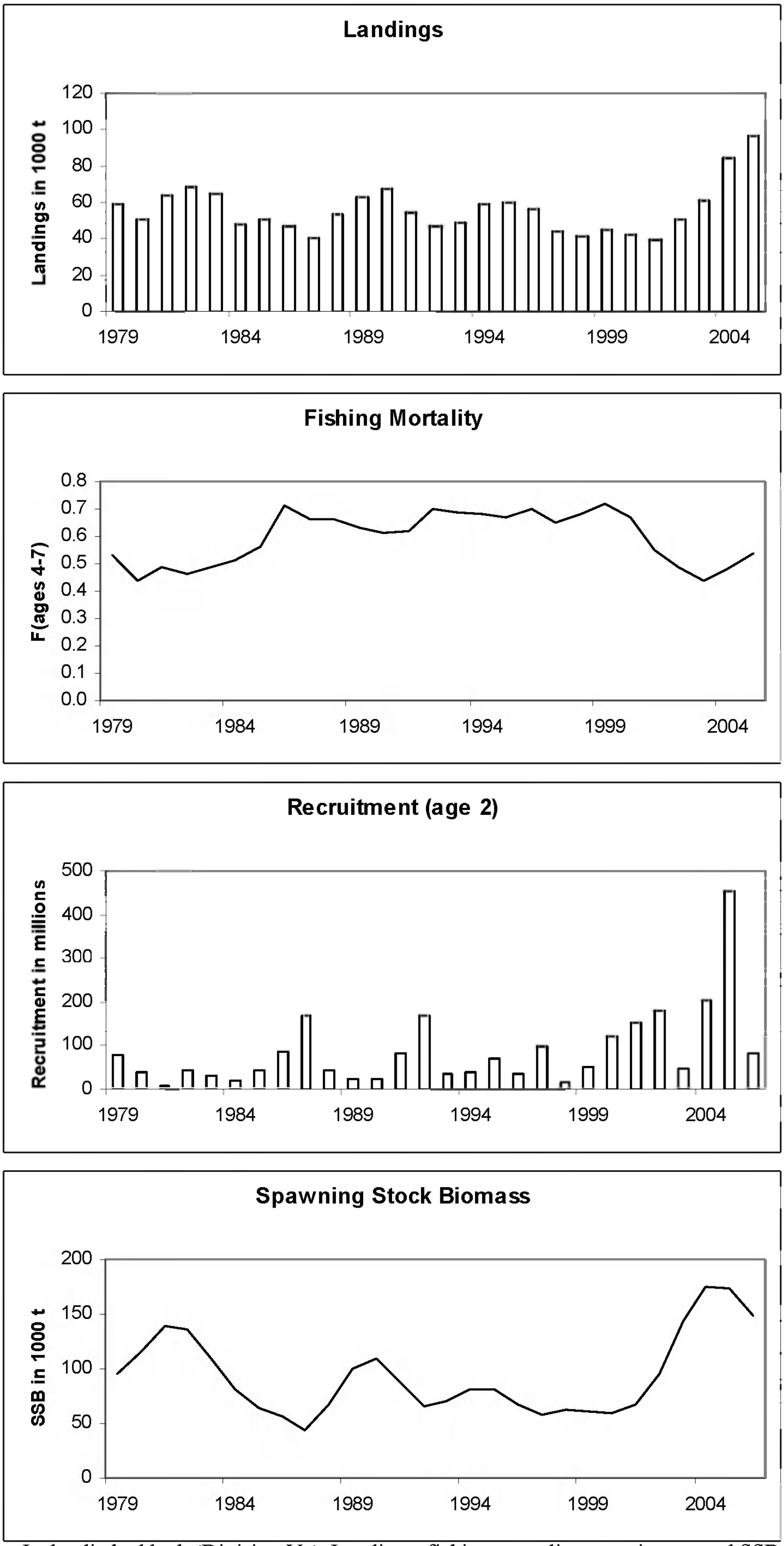


Figure 2.4.3.1 Icelandic haddock (Division Va). Landings, fishing mortality, recruitment and SSB.

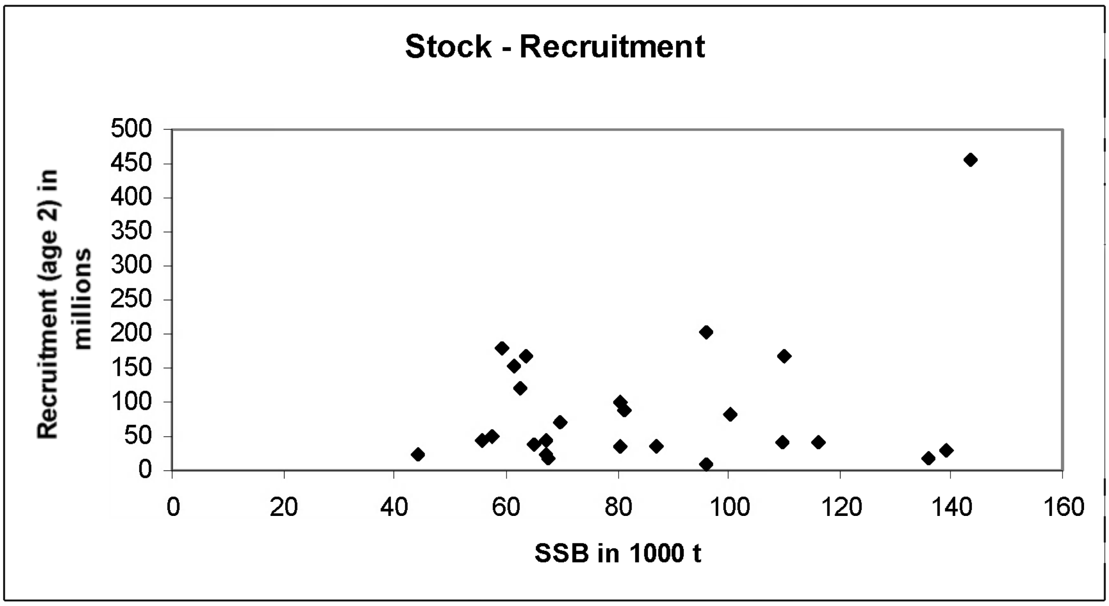


Figure 2.4.3.2 Icelandic haddock (Division Va). Recruitment.

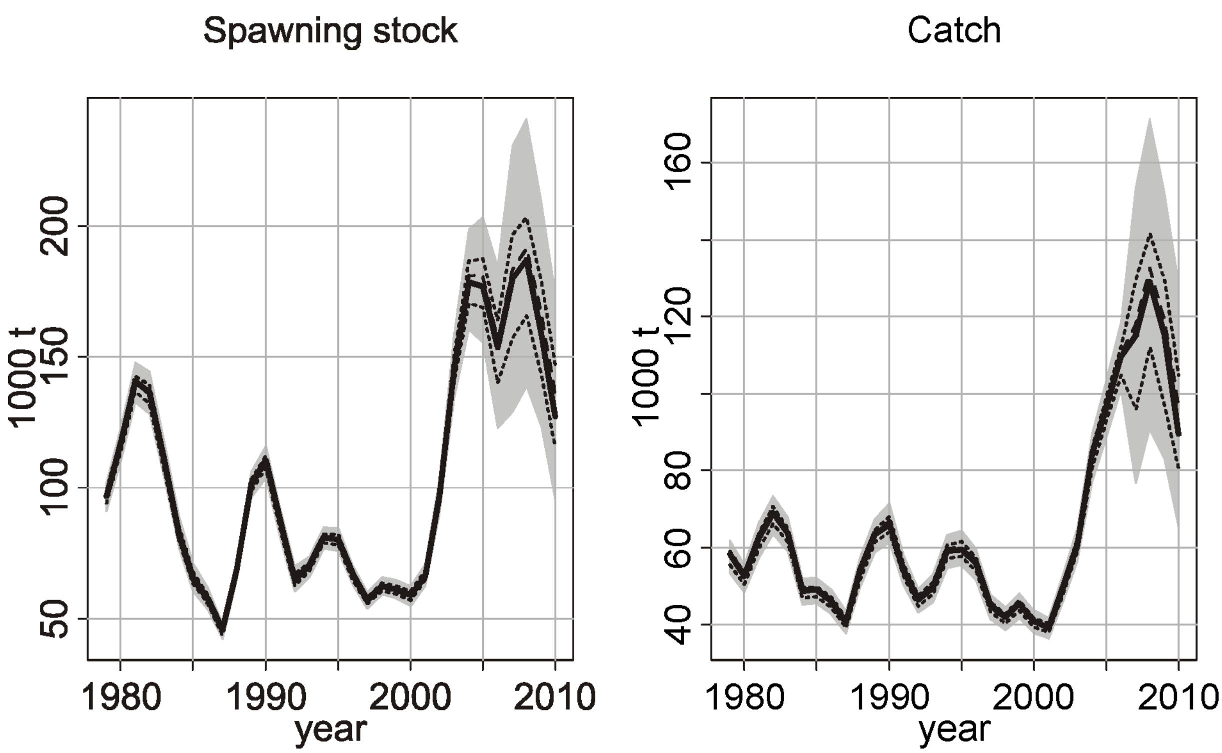


Figure 2.4.3.3 Haddock in Division Va. Medium-term simulation for catch and SSB assuming F=0.47 from 2007 onwards and error in future assessment with 15% CV.

Table 2.4.3.1 Icelandic haddock (Division Va).

Year	Recruitment Age 2 thousands	SSB tonnes	Landings tonnes	Mean F Ages 4-7
1979	78860	95972	59190	0.53
1980	37233	116115	50902	0.44
1981	9681	139242	63491	0.49
1982	42434	136047	68533	0.46
1983	30323	109603	64698	0.49
1984	18710	81320	48121	0.51
1985	42537	63683	50261	0.56
1986	87712	55606	47272	0.71
1987	166421	44206	40132	0.66
1988	43870	67077	53871	0.66
1989	24815	100386	62712	0.63
1990	23619	109918	67038	0.61
1991	81062	87168	54694	0.62
1992	167599	65099	47026	0.70
1993	35976	69597	48737	0.69
1994	39423	80486	59007	0.68
1995	70868	80717	60111	0.67
1996	36177	67731	56716	0.70
1997	99417	57689	44006	0.65
1998	16619	62731	41374	0.68
1999	49472	61552	45231	0.72
2000	120243	59376	41870	0.67
2001	152226	67058	39530	0.55
2002	180653	95907	50294	0.49
2003	45438	143423	60598	0.44
2004	202007	174848	84405	0.48
2005	454769	173381	96655	0.54
2006	80921	148503		
Average	87110	93373	55795	0.59

2.4.4 Icelandic 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. SSB in 2006 is estimated to be well above $\mathbf{B}_{pa}$. The present fishing mortality (.31) is slightly above $\mathbf{F}_{pa}$ (.30). The 2001 year class is estimated to be below average. First estimates of the 2002 year class indicate that it is large while the 2003 year class appears to be below average.

Management objectives

There are no explicit management objectives for this stock.

Reference points

	ICES considers that:	ICES proposed that:
Precautionary Approach reference points	$\mathbf{B}_{lim}$ 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.

In the absence of a valid yield-per-recruit analysis, there are no candidates for reference points which would be consistent with high long-term yields and a low risk of depleting the productive potential of the stock.

Single-stock exploitation boundaries

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

There are no candidates for reference points available which would be consistent with high long-term yields and a low risk of depleting the productive potential of the stock.

Exploitation boundaries in relation to precautionary limits

Fishing mortality in 2007 should be below $\mathbf{F}_{pa}$ = 0.30, which corresponds to a catch of less than 81 000 t.

Short-term implications

Outlook for 2007

Basis: F(2006) =0.31; SSB(2007) = 239; catch (2006) = 82.

Rationale	TAC (2007)[1]	Basis	F (2007)	Landings	SSB (2008)	%SSB change [1)]	% TAC change [2)]
Zero catch	0	F=0	0.00	0	308	29	-100
Status quo	85	$\mathbf{F}_{sq}$	0.31	84	225	-6	6
Precautionary limits	9	TAC($\mathbf{F}_{pa}$)* 0.1	0.03	9	299	25	-88
	23	TAC($\mathbf{F}_{pa}$)* 0.25	0.08	23	286	19	-71
	44	TAC($\mathbf{F}_{pa}$)* 0.5	0.15	44	265	11	-45
	64	TAC($\mathbf{F}_{pa}$)* 0.75	0.23	63	246	3	-20
	75	TAC($\mathbf{F}_{pa}$)* 0.90	0.27	74	235	-2	-6
	82	$\mathbf{F}_{pa}$ (=$\mathbf{F}_{sq}$ *0.94)	0.30	81	228	-5	3
	89	TAC($\mathbf{F}_{pa}$)* 1.1	0.33	88	221	-7	11
	99	TAC($\mathbf{F}_{pa}$)* 1.25	0.38	98	212	-11	24

Weights in '000 t. Shaded scenarios are not considered consistent with the Precautionary Approach.
[1)] SSB 2008 relative to SSB 2007.
[2)] TAC 2007 relative to TAC 2006 (quota year 05/06).

Management considerations

After a period of low stock size, saithe is now recovering due to better recruitment. Fishing mortality has stabilised close to $\mathbf{F}_{pa}$, which has been sustainable historically. 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 trawlers 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

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 recent years, 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. Immigration to Icelandic waters is also a possibility.

Scientific basis

Data and methods

The analytical assessment is based on age-disaggregated landings from 1962–2005 and spring survey indices 1985–2006. An autumn survey and commercial CPUE provide independent support to the assessment, although they are not included in the analysis.

Uncertainties in assessment and forecast

In previous years there has been a tendency to overestimate fishing mortality and underestimate SSB. The level of this bias decreased in recent years. Estimates of recent and predicted SSB and TACs are sensitive to uncertain mean weights and maturity estimates.

Comparison with previous assessment and advice

The current assessment is consistent with the 2005 assessment, and the advice is unchanged.

Source of information

Report of the North-Western Working Group, 25 April–4 May 2006 (ICES CM 2006/ACFM:26).

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	69
2006	Fpa	78	80	
2007	Fpa	81		

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.

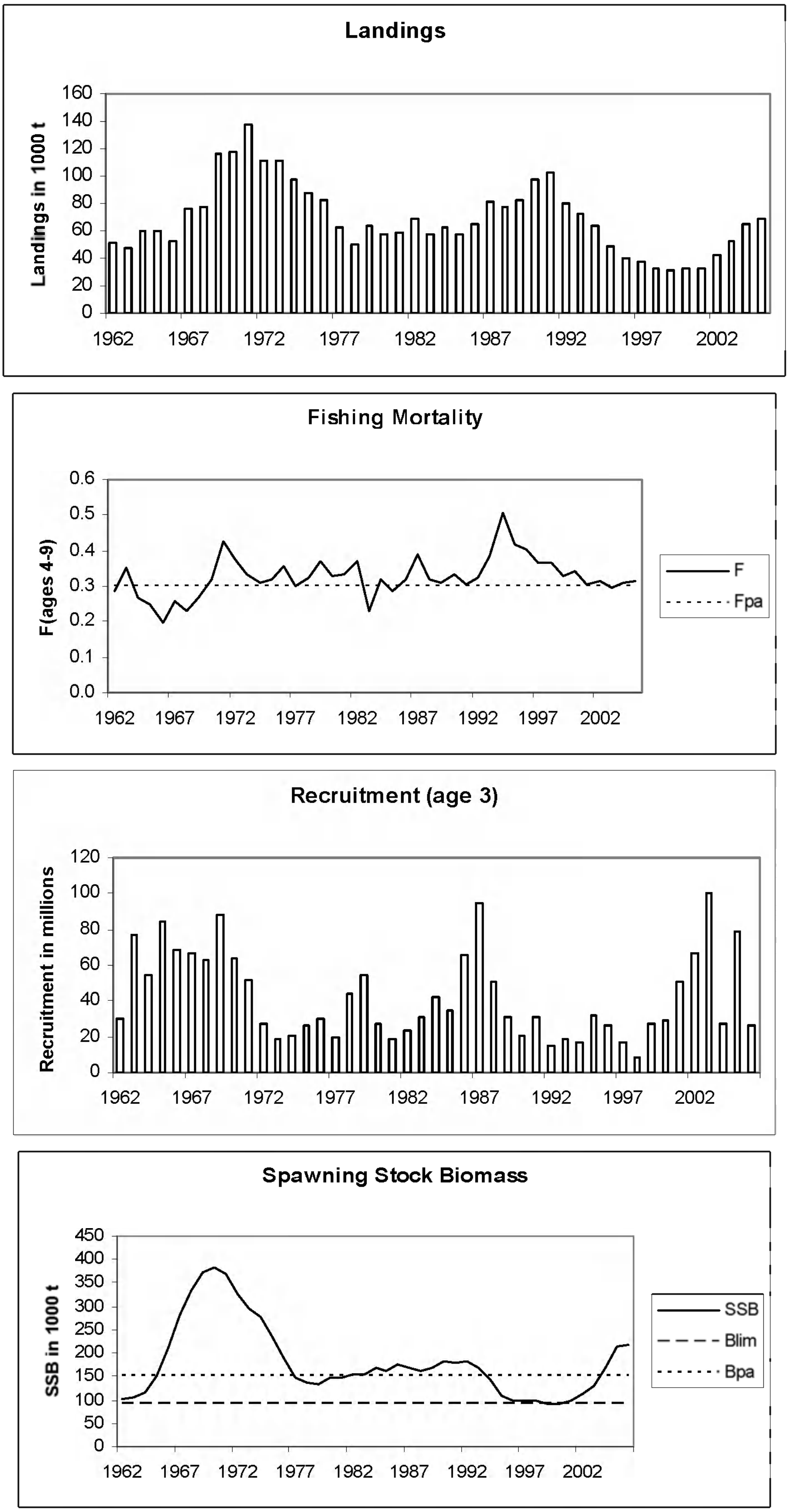


Figure 2.4.4.1 Icelandic saithe (Division Va). Landings, fishing mortality, recruitment and SSB.

Table 2.4.4.1 Icelandic saithe (Division Va).

SAITHE Va									
Country	1997	1998	1999	2000	2001	2002	2003*	2004	2005*
Faroe Islands	716	997	700	228**	128**	366**	143	214	322
Germany	-	3	2	1	14	6	56	157	224
Iceland	36,548	30,531	30,583	32,914	31,854	41,687	51,857	62614	
Norway	-	-	6	1	44*	3*	164	1	2
UK (E/W/NI)	-	-	1	2	23	7	...	105	
UK (Scotland)	-	-	1	-	-	2	...		
United Kingdom							35		312
Total	37,264	31,531	31,293				52091	63091	67283
WG estimate				33,146	32,063	42,071	52494	64791	69143

*Preliminary.
**WG estimate.

Table 2.4.4.2 Icelandic saithe (Division Va).

Year	Recruitment Age 3 thousands	SSB tonnes	Landings tonnes	Mean F Ages 4-9
1962	30000	101000	51000	0.287
1963	77000	107000	48000	0.350
1964	54000	115000	60000	0.268
1965	84000	150000	60000	0.248
1966	68000	212000	52000	0.198
1967	67000	280000	76000	0.257
1968	63000	335000	78000	0.229
1969	88000	373000	116000	0.267
1970	64000	384000	117000	0.318
1971	52000	370000	137000	0.427
1972	27000	327000	111000	0.377
1973	19000	296000	111000	0.335
1974	21000	278000	98000	0.309
1975	26000	236000	88000	0.320
1976	30000	190000	82000	0.357
1977	20000	149000	62000	0.301
1978	44000	137000	50000	0.322
1979	54000	132000	64000	0.368
1980	27000	146000	58000	0.330
1981	19000	149000	59000	0.332
1982	23000	156000	69000	0.368
1983	31000	153000	58000	0.228
1984	42000	170000	63000	0.318
1985	35000	162000	57000	0.285
1986	66000	177000	65000	0.319
1987	95000	169000	81000	0.390
1988	51000	163000	77000	0.318
1989	31000	169000	82000	0.311
1990	21000	183000	98000	0.335
1991	31000	178000	102000	0.304
1992	15000	182000	80000	0.323
1993	19000	169000	72000	0.386
1994	17000	144000	64000	0.504
1995	32000	109000	49000	0.418
1996	26000	99000	40000	0.403
1997	17000	98000	37000	0.364
1998	8000	100000	32000	0.366
1999	27000	93000	31000	0.327
2000	29000	91000	33000	0.344
2001	51000	97000	32000	0.305
2002	67000	113000	42000	0.314
2003	100000	131000	52000	0.295
2004	27000	169000	65000	0.308
2005	79000	216000	69000	0.312
2006	26000	218000		
Average	42222	181689	68818	0.326

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

State of the stock

In the absence of defined reference points, the state of the stock cannot be fully evaluated. Survey and fishery indices, however, suggest that the present stock biomass is near a historic low in most areas.

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 the exploitation of the stock 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 the 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 and gradual adaptation of the outtake depending on the response of the stock.

ICES has for several years recommended a total catch of less than 15 000 tonnes as a feasible initial step in an adaptive strategy. So far, catches have been well above that level. ICES maintains this advice since there is nothing to indicate that the stock responds favourably to the present level of catches.

Management considerations

Available biological information and information on distribution of the fisheries suggest that Greenland halibut in XIV and V belong to the same stock entity.

Stock status is based on surveys and commercial cpue from Areas Va, Vb, and XIV. Commercial cpue in Areas Va and Vb indicate a gradual decrease in stock biomass to low levels in the mid-1990s, an increase in 2000–2001, and a subsequent decrease to a historical low in 2004–2005. The increase in commercial cpue in Area XIV in the early 1990s probably reflects initial learning and changes in fishing behaviour. In recent years, both survey indices and CPUE in Area XIV have been relatively stable, but it is not known how the present level compares with the past.

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.

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.

Since Greenland halibut is slow growing it is expected that a change in stock dynamics may take several years and this should be considered for the adaptive management plan.

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 a 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.

Scientific basis

Data and methods

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

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 therefore 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, 25 April–4 May 2006 (ICES CM 2006/ACFM:26).

	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	12	13	24
2006	Effort reduced to 1/3 of the 2003 level	<15	15			
2007	Adaptive management plan, start at 15 000 t	<15				

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

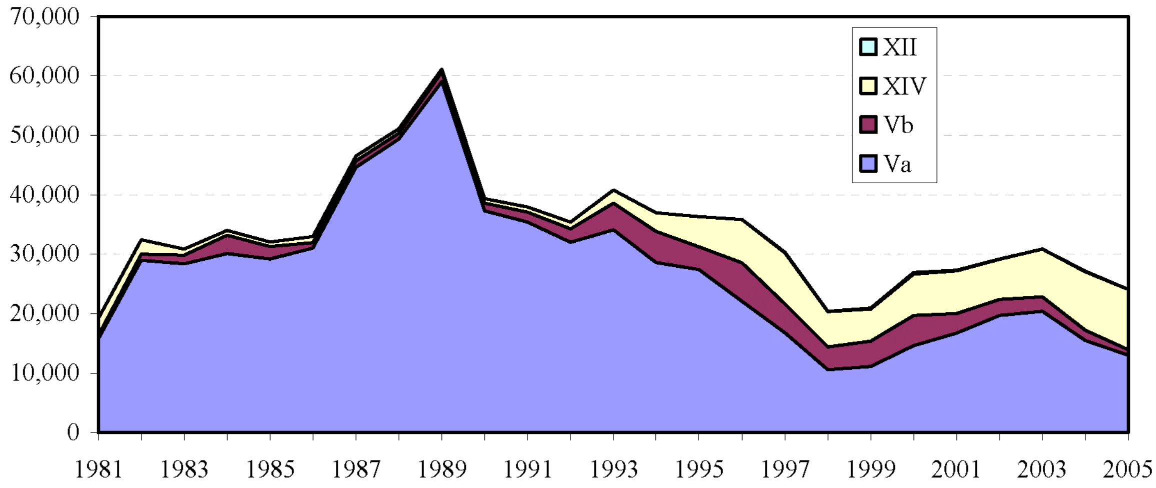


Figure. 2.4.5.1 Landings of Greenland halibut in Divisions V, XI, and XIV. As the landings within Icelandic waters, since 1976, have not officially been separated and reported according to the defined ICES statistical areas, they are included under Area Va by the North-Western Working Group.

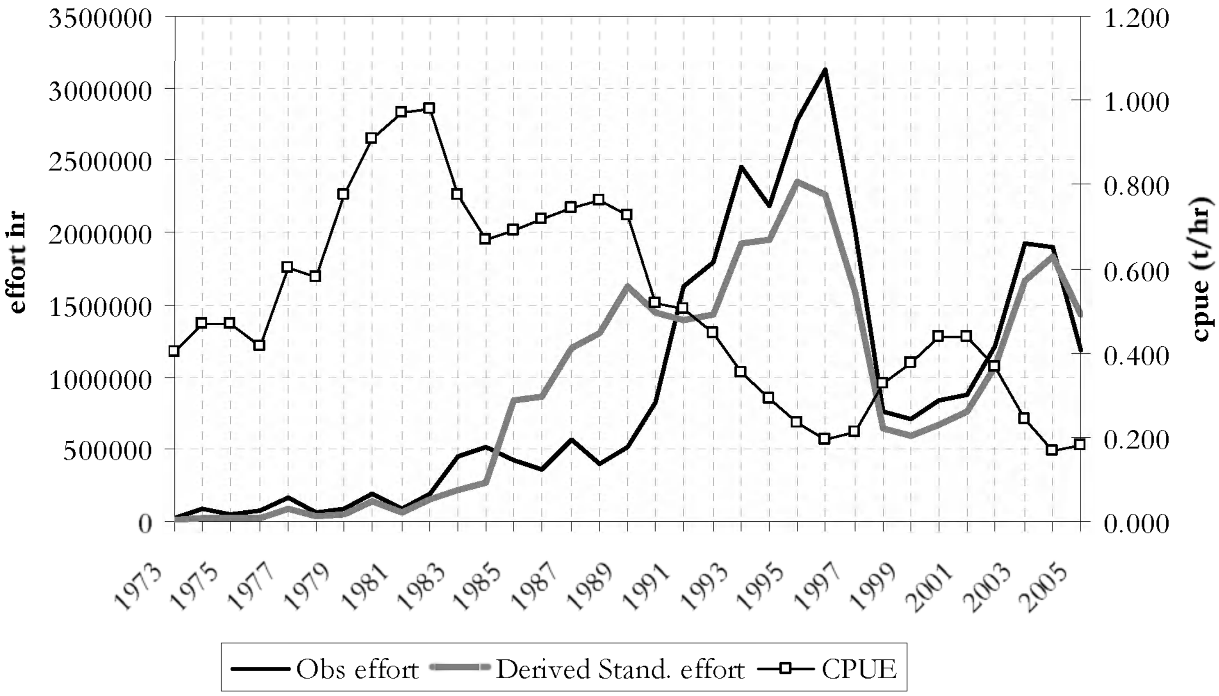


Figure 2.4.5.2 Standardised cpue from the Icelandic trawler fleet. Standardised cpue and standardised effort stem from GLM, and observed effort is summarized from logbooks.

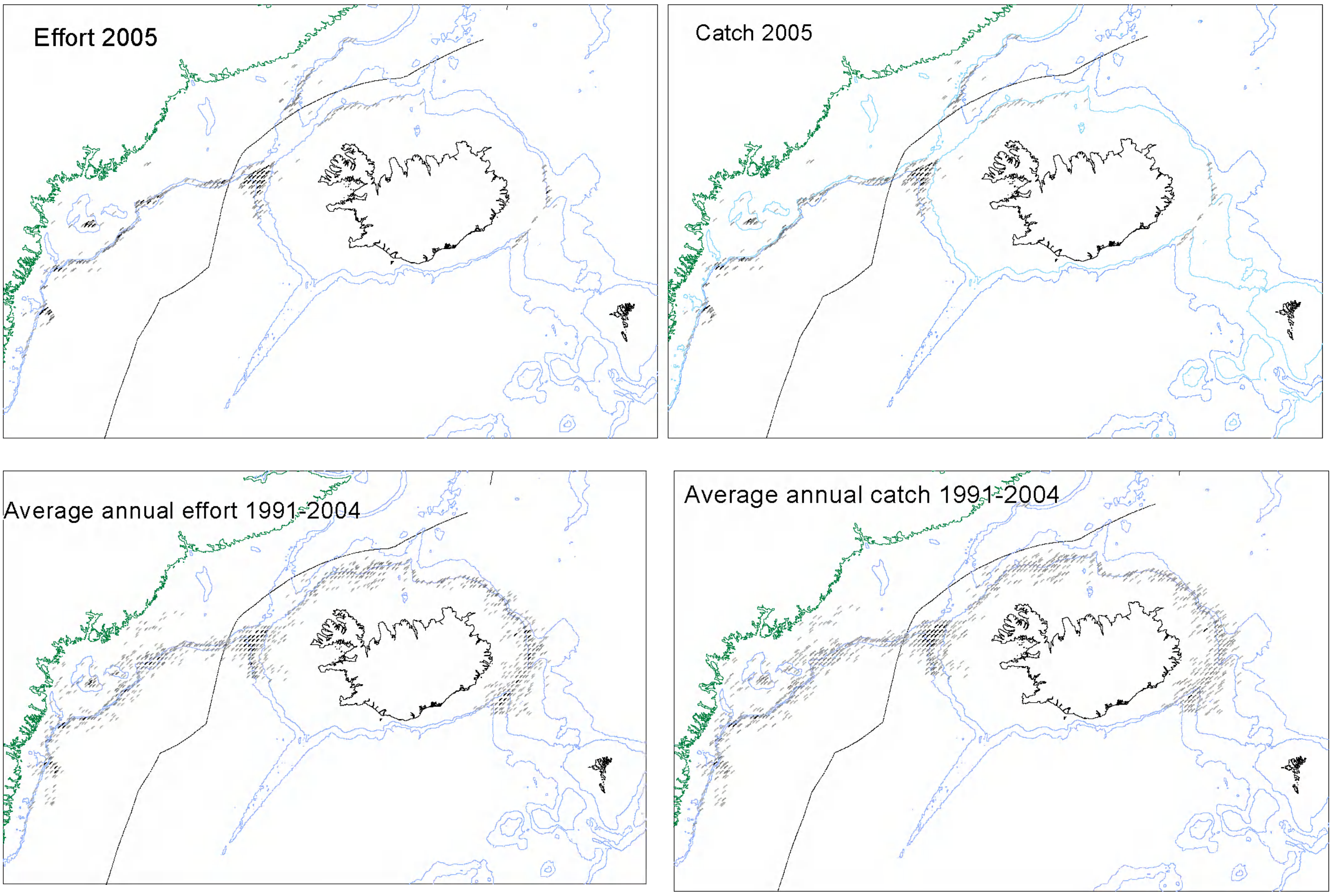


Figure 2.4.5.3 Catch and effort data for 2005 and average catch and effort from 1991-2004 based on logbook information from trawlers in Va and XIV.

2.4.6 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 (Table 2.4.6.1).

Nominal landings and splitting of the landings into species

The official statistics reported to ICES do not divide the catch by species/stocks. The splitting of the landings into species and stocks was performed with a set of criteria (Section 7.1 in the NWWG Report 2006).

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*.

S. mentella **fisheries and current management practice**

Detailed portrayals of the geographical, vertical and seasonal distribution of the *S. mentella* fisheries by Icelandic vessels as well as corresponding length distributions are given in Figures 2.4.6.1–2.4.6.4. These figures show that the fisheries within the pelagic *S. mentella* management unit are separated geographically, seasonally, and by depth. These figures also show that the northeastern fisheries of the pelagic *S. mentella* management unit that occurs at the start of the fishing season at depths below 500 m overlap to some extent with the fisheries on the demersal management unit on the continental slopes of Iceland. This overlap was most pronounced in 2003 when the Irminger sea pelagic fishery merged with the continental slope fishery.

The allocation of *S. mentella* catches is primarily according to the fishing gear. However, due to spatial and temporal overlap of the fisheries in the northeastern area, a pragmatic management measure has been in place in Iceland, where fishing vessels are obliged to report the *S. mentella* catches as pelagic *S. mentella* or demersal *S. mentella*, depending on whether they are fishing west or east of the “redfish line” (Figure 2.4.6.1). In response to the development of the Irminger sea fisheries in 2003, the Icelandic government moved the “redfish line” temporarily eastward.

Detailed descriptions of these fisheries are provided in the individual stock summaries (see Sections 2.4.8 and 2.4.9).

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, show that juveniles were abundant in 1993 and 1995–1998 (Figure 2.4.6.5).

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. Sorting grids have been mandatory in the shrimp fisheries in ICES Divisions XIVb since 2000 and Va since 1. September 1995. The effect of sorting grids on bycatches of redfish has so far not been evaluated.

Stock identity and management units of *S. mentella*

ICES 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 2.4.6.6.

Further information about distribution and stock identity of *S. mentella* can be found in the response to a special request from NEAFC (Section 2.3.3.1).

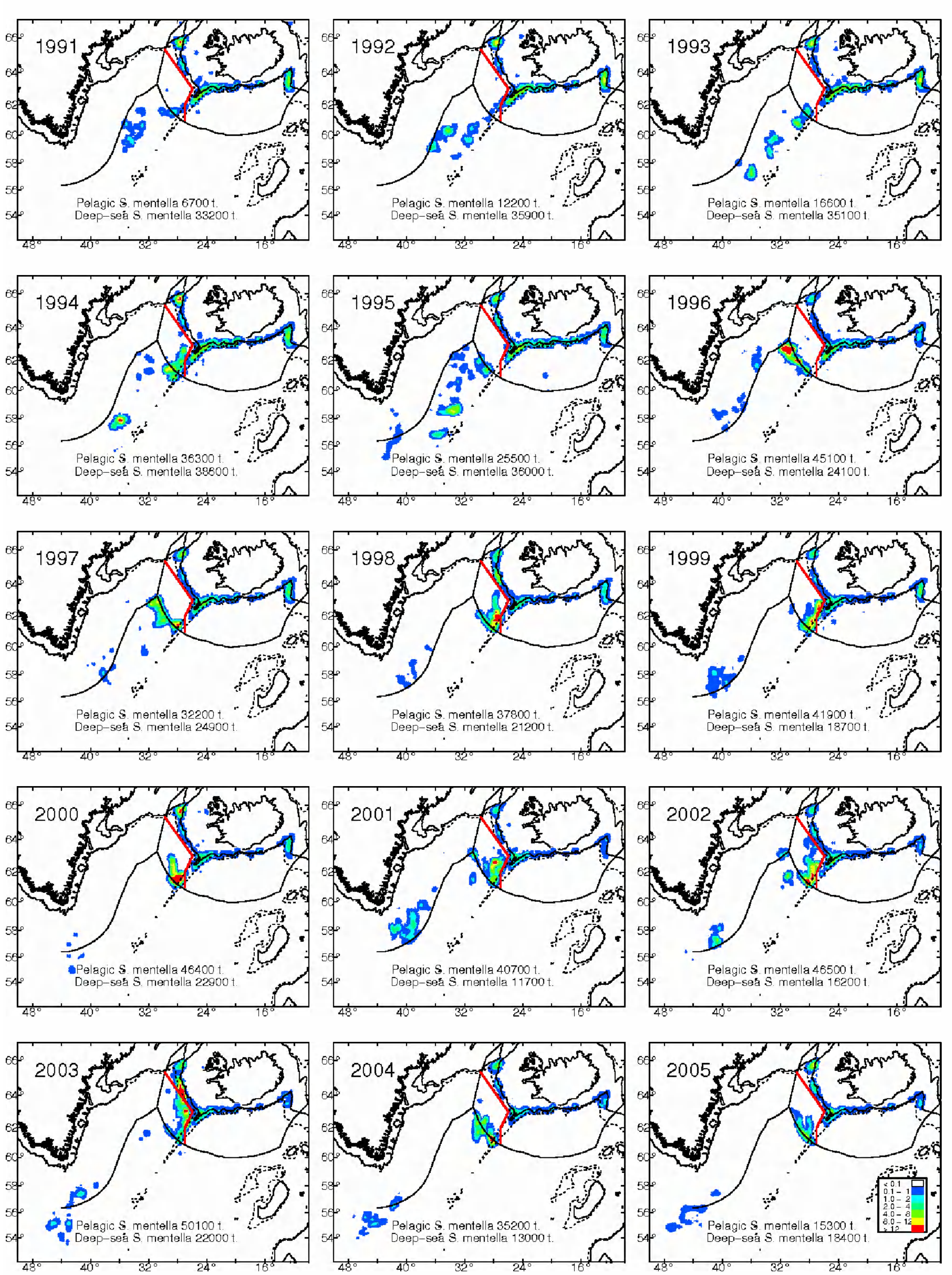


Figure 2.4.6.1 Geographical distribution of the Icelandic catches of *S. mentella*. The colour scale indicates catches (tonnes per NM^2).

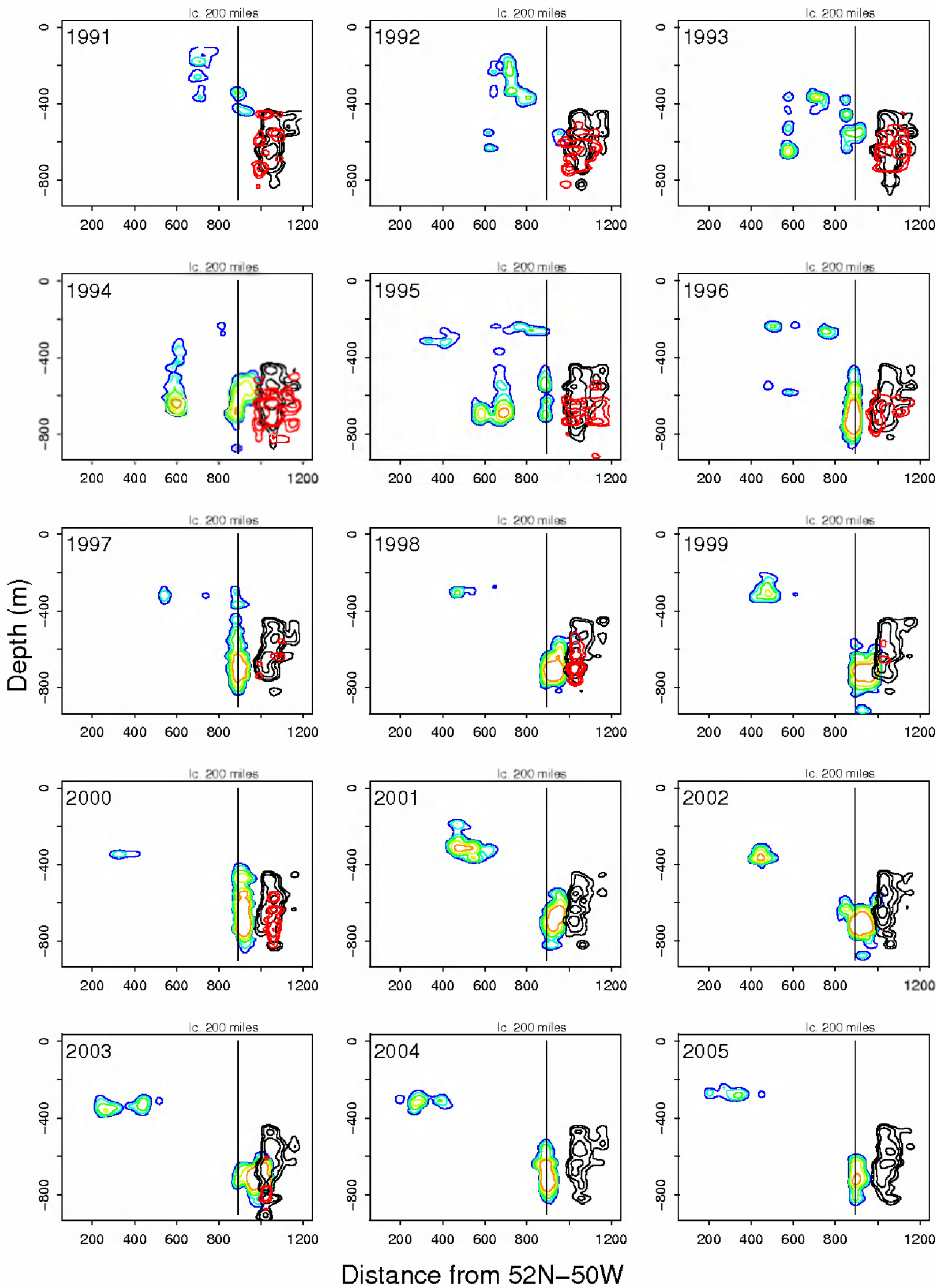


Figure 2.4.6.2 Location-depth plot for *S. mentella* catches as reported by Icelandic vessels. Location is represented by the distance (in NM in the SW-NE direction) from a fixed position (52°N 50°W). The contour lines indicate relative catches. The coloured contours represent the fishery on pelagic *S. mentella*, the black contours indicate bottom trawl catches of demersal *S. mentella*, and the red contours represent catches of demersal *S. mentella* taken with pelagic trawls. The Icelandic EEZ boundary is shown as a reference.

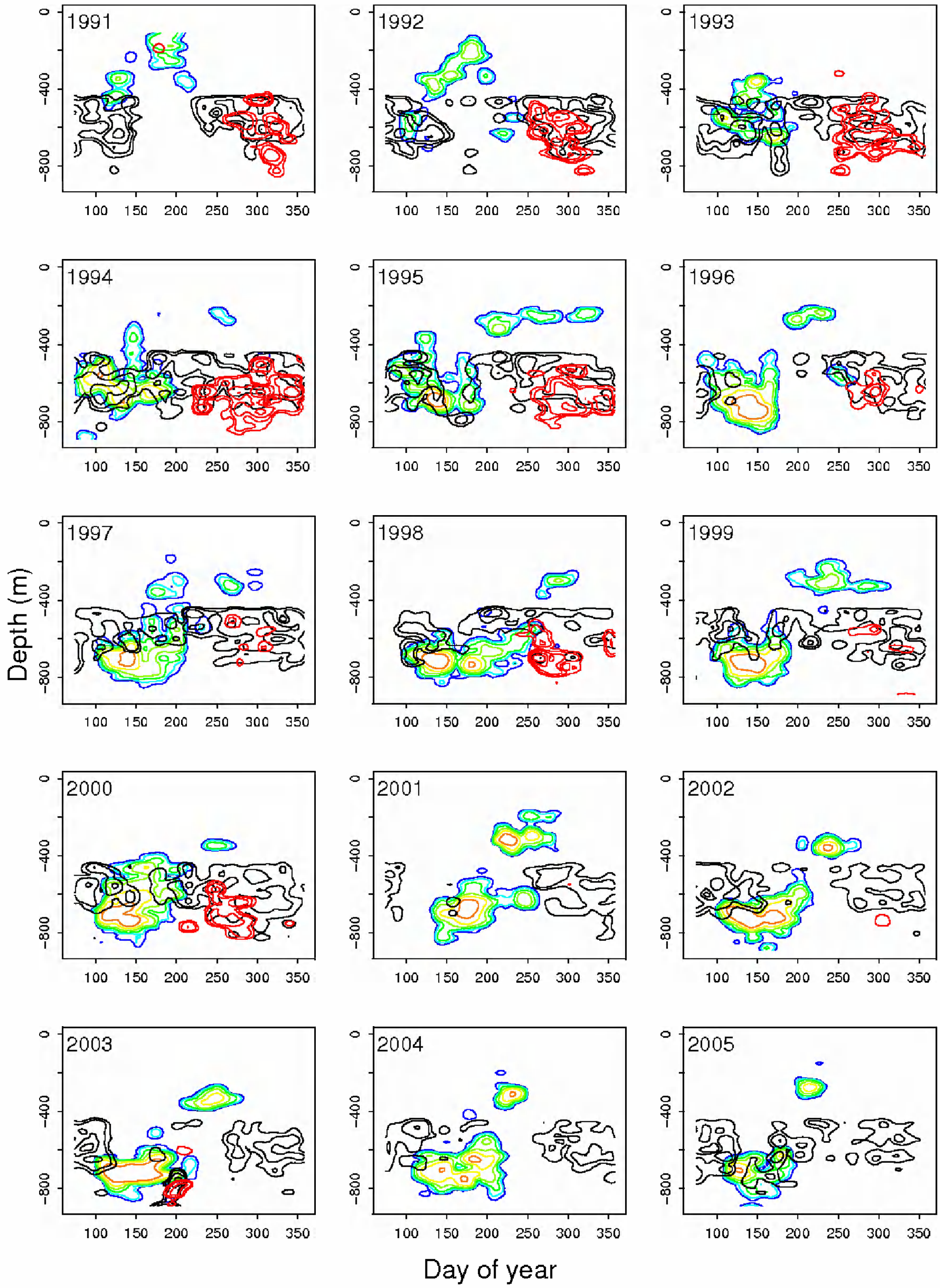


Figure 2.4.6.3 Depth-time plot for as reported by Icelandic vessels *S. mentella* catches, where the y-axis is depth, the x-axis is day of the year and the colour indicates the catches. The coloured contours represent the fishery on pelagic *S. mentella*, the black contours indicate bottom trawl catches of demersal *S. mentella*, and the red contours represent catches of demersal *S. mentella* taken with pelagic trawls.

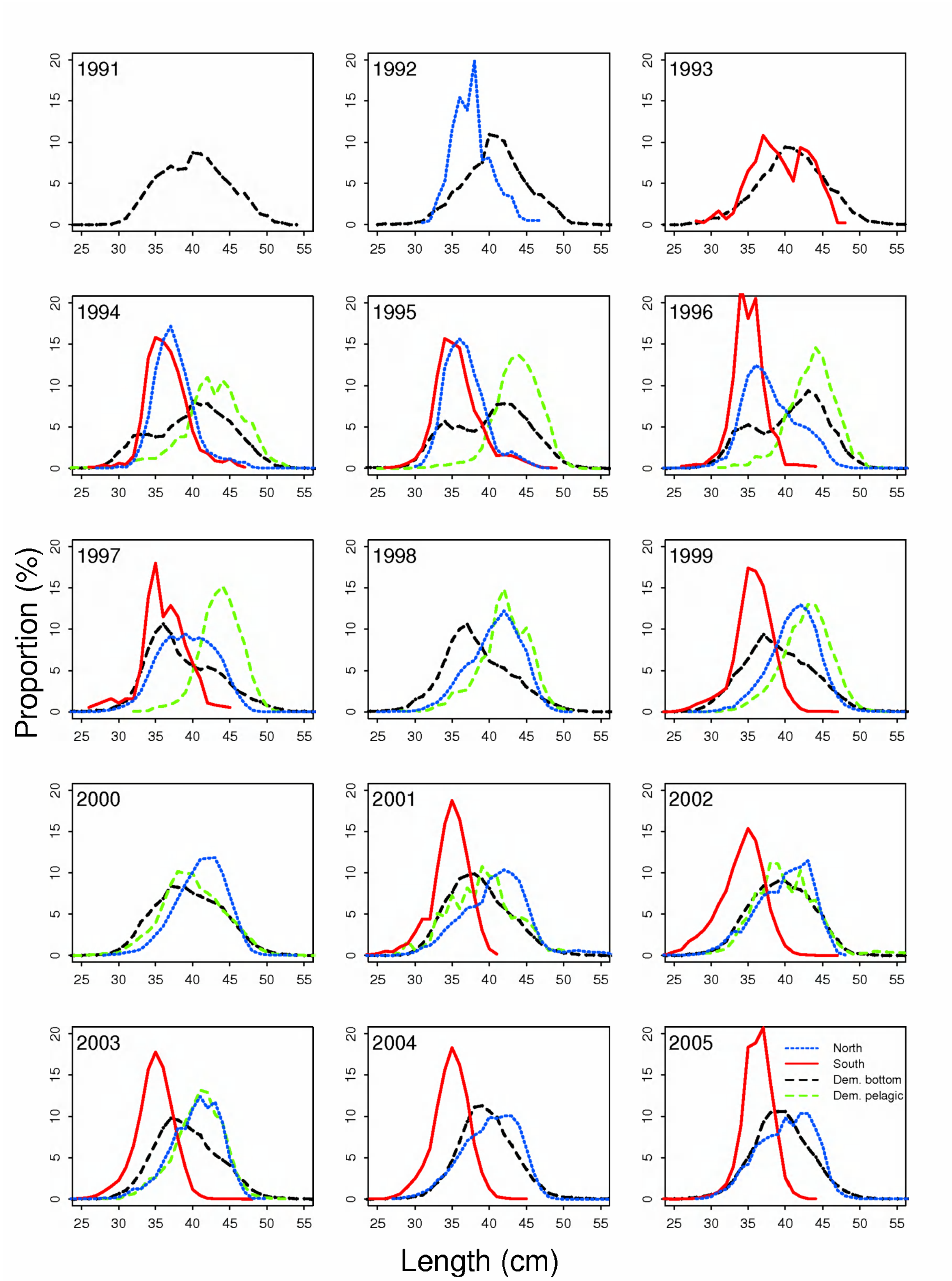


Figure 2.4.6.4 Length distributions from different *S. mentella* fisheries as reported by Icelandic vessels. The coloured contours represent the fishery on pelagic *S. mentella*, the black contours indicate bottom trawl catches of demersal *S. mentella*, and the red contours represent catches of demersal *S. mentella* taken with pelagic trawls.

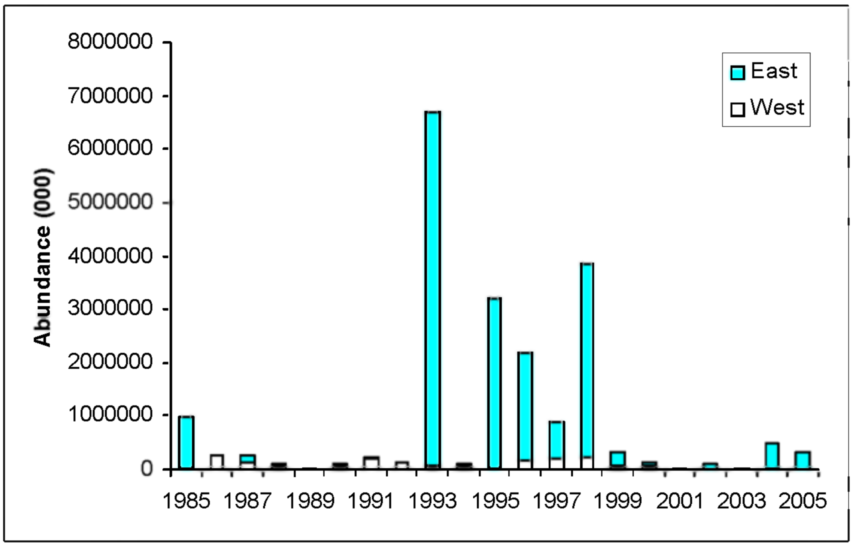


Figure 2.4.6.5 Survey abundance indices of juvenile *Sebastes* spp. (<17 cm) from the German groundfish survey conducted on the continental shelves off East and West Greenland 1985–2005.

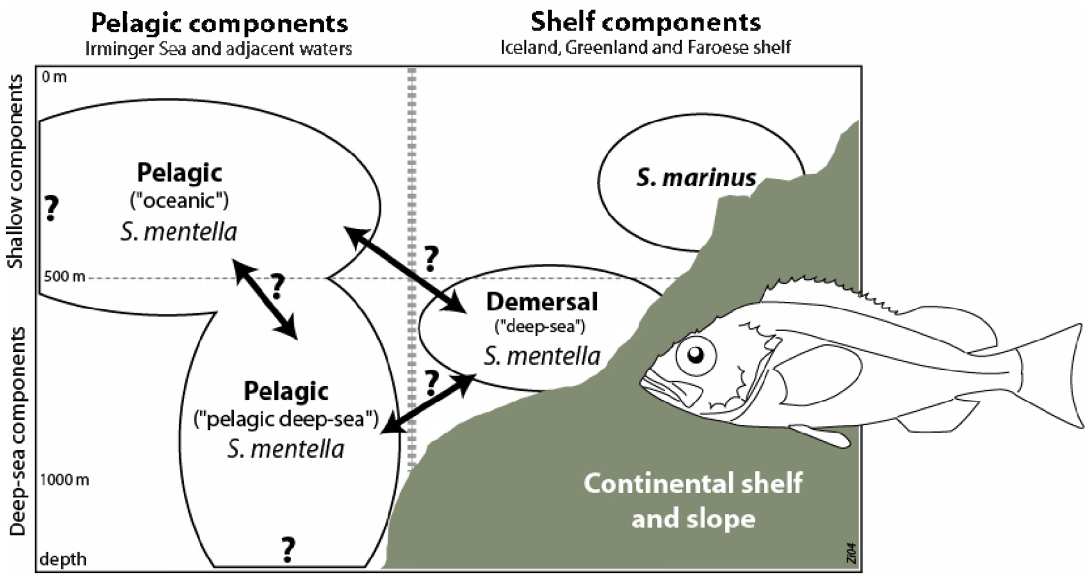


Figure 2.4.6.6 Possible relationship between redfish occurrences in the Irminger Sea and adjacent waters.

Table 2.4.6.1 Landings of *S. viviparus* in Division Va.

Year	Landings (t)
1996	22
1997	1159
1998	994
1999	498
2000	227
2001	21
2002	20
2003	3
2004	2
2005	4

2.4.7 *Sebastes marinus* in ICES Divisions Va, Vb, VI, 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. In recent years the survey index has been above the $\mathbf{U}_{pa}$ value with approximately 50% probability, and above $\mathbf{U}_{lim}$ with high (>95%) probability. Survey information indicates that the adult stock in the Greenland area is depleted.

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. This survey mainly reflects pre-recruit fish that will migrate out of the area when they reach fishable size.

In Division Vb the Faroese groundfish survey (covering 1994–2006) indicates that the abundance has been stable since 2001. Catches have declined since 1985 to a low level in recent years, and this decline is also reflected in the Faroes summer survey (Figure 2.4.7.4).

Management objectives

There are no explicit management objectives for this stock.

Reference points

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

	ICES considers that:	ICES proposed that:
Precautionary Approach reference points	$\mathbf{U}_{lim}$ is 55, which is 20% of highest observed survey index.	$\mathbf{U}_{pa}$ be set at 155, which is 60% of highest observed survey index.

Technical basis

The basis for the calculation of the $\mathbf{U}_{pa}$ is the Icelandic spring groundfish survey index series starting in 1985. Since 1990 the average **U** has been around half of $\mathbf{U}_{max}$ – the highest observed index in the time-series (276 in 1987) 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 a 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 2007 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 2007 (35 000 t in Division Va) are expected to keep the stock at an acceptable level in the short term (Figure 2.4.7.6).

Management considerations

The strong 1990 year class has recruited to the Icelandic fishery and should sustain the stock in the short term. No strong recruitment has been observed since. The Icelandic spring survey indicates that a recent year class, most likely born in 1998, may be stronger than other year classes since 1990. However, it is far smaller than the strong 1990 year class. Therefore the stock is expected to be reduced in the long term, and is not expected to sustain catches higher than about 20 000 t 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, the resident behavior of adults, and its importance as a nursery area for the entire resource, ICES recommends that the area should be closed to directed fishing for *S. marinus* and measures should be continued to reduce bycatch of juveniles.

Scientific basis

Data and methods

The basis for the advice is the same as last year. There are survey data from the Icelandic spring groundfish survey 1985–2006 and the Icelandic autumn survey 1996–2005 in Division Va, the German groundfish survey 1985–2005 in Subarea XIV, and the Faroe spring (1994–2006) and summer (1996–2005) surveys in Division Vb. Data from the commercial catch in Division Va include length distribution, age-length key, and mean length-at-age.

The state of the stock is classified according to results of the Icelandic spring groundfish survey. The quantitative advice is derived from analysis with an age-length based model (BORMICON).

The spring survey data in Division Va and the data from the commercial catch in Va are used in the BORMICON model, which is used for assessment of the past and current state of the stock in Division Va as well as for the medium-term projection.

Uncertainty in the assessment and forecast

The advice is based on survey information. The uncertainty in the survey indices are shown as confidence intervals.

Comparison with previous assessment and advice

The basis for the advice is similar to last year, and the advice is unchanged.

Source of information

Report of the North-Western Working Group, 25 April–4 May 2006 (ICES CM 2006/ACFM:26).

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
45.419	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]	33.4
2005	Maintain fishable biomass above $\mathbf{U_{pa}}$	37[4]	45.4
2006	Maintain fishable biomass above $\mathbf{U_{pa}}$	37[4]	
2007	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.

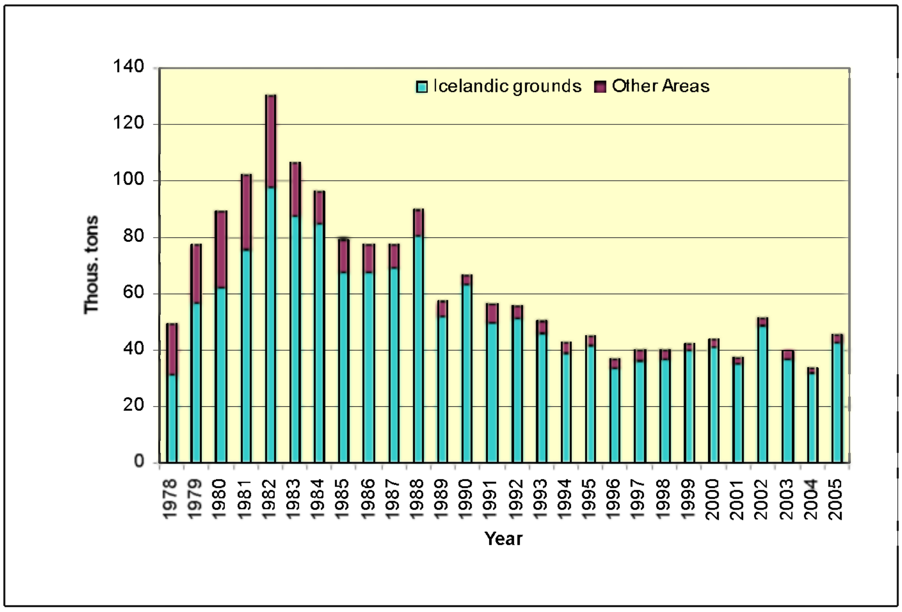


Figure 2.4.7.1 *Sebastes marinus*. Nominal landings in tonnes in ICES Division Va and in other areas (landing statistics for ICES Divisions Vb, VI, and XIV combined) 1978–2005. Landings statistics for 2005 are provisional.

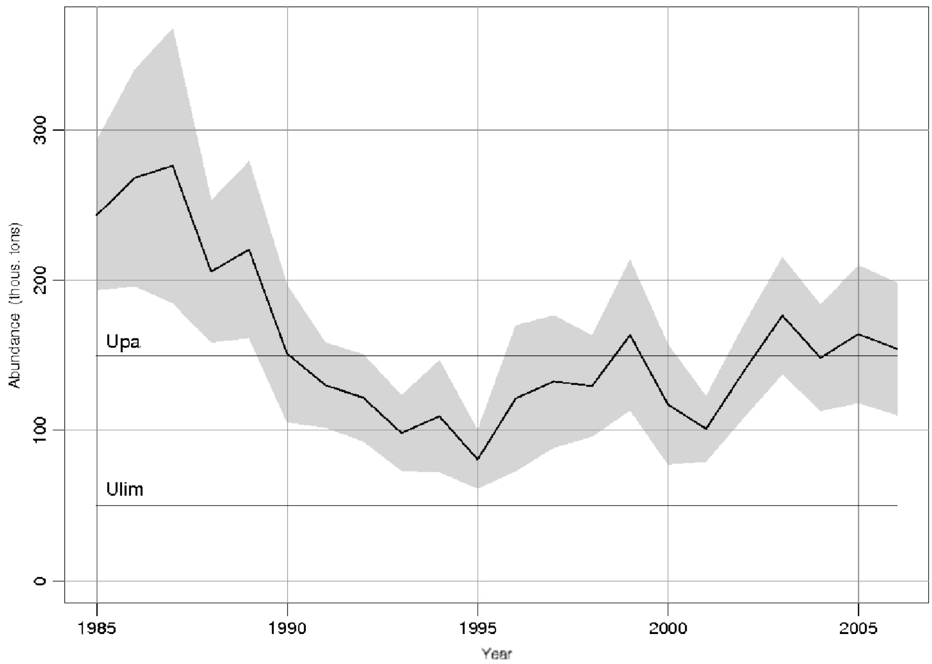


Figure 2.4.7.2 Index with ± two SD of the estimates on the fishable stock of *S. marinus* from Icelandic groundfish survey 1985–2006 and 95% confidence intervals. The index is based on all strata at depths from 0 to 400 m.

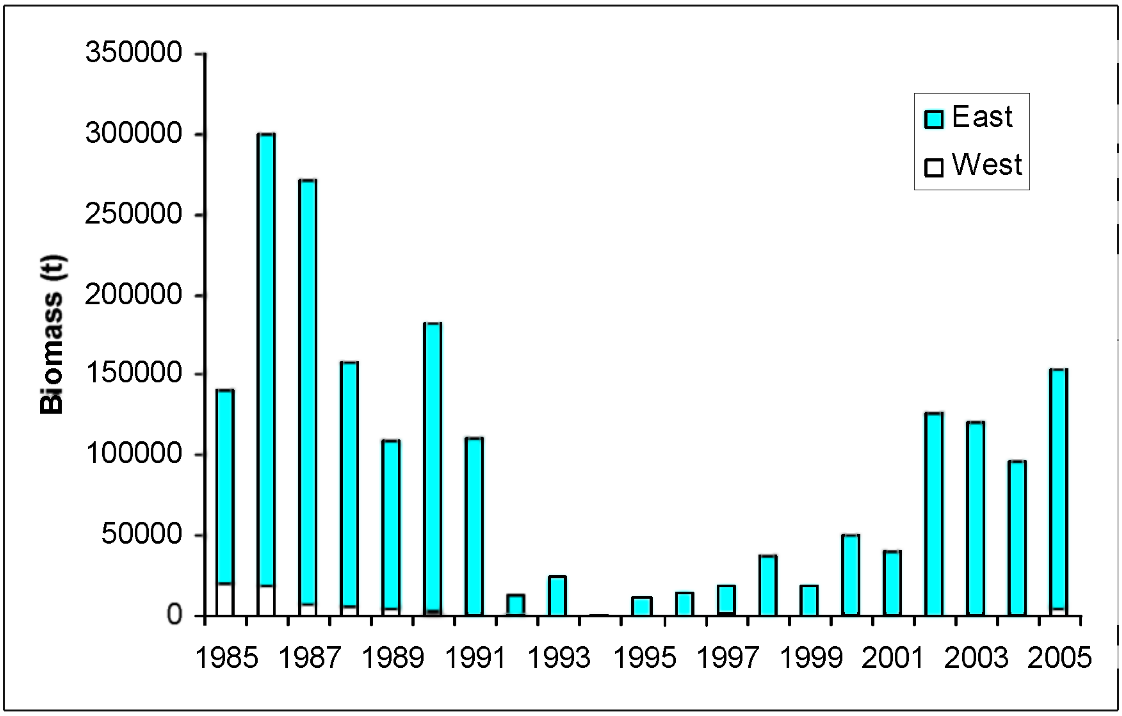


Figure 2.4.7.3 *S. marinus* (≥17 cm). Survey biomass indices for East and West Greenland, 1985–2005.

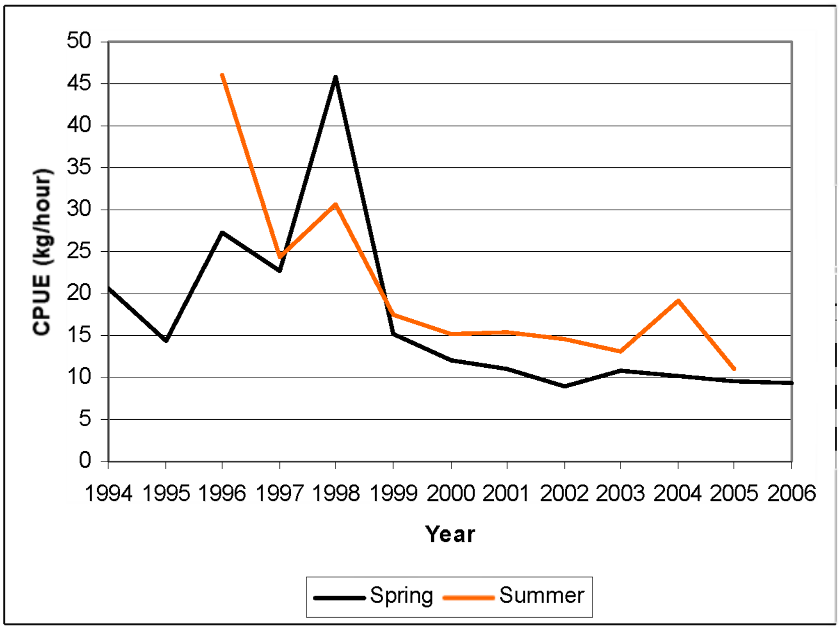


Figure 2.4.7.4 CPUE of *S.marinus* in the Faeroes spring groundfish survey 1994–2005 and the summer groundfish survey 1996–2005 in ICES Division Vb.

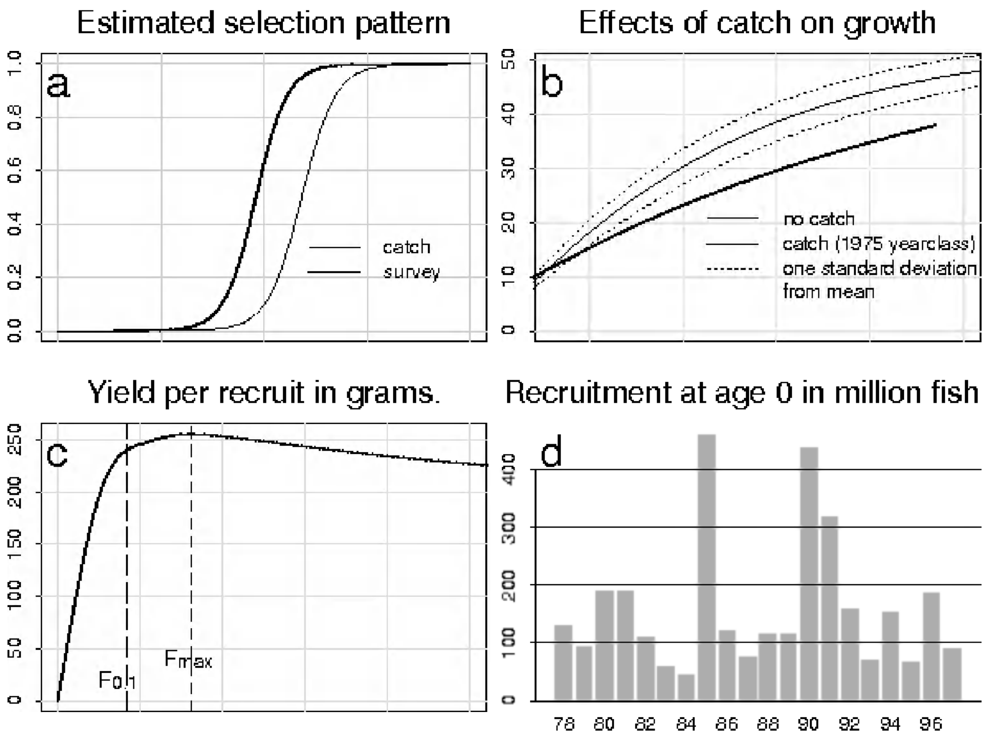


Figure 2.4.7.5 Results from the BORMICON assessment using catch data from ICES Division Va only. a) Estimated selection pattern of the commercial fleet and the survey, b) Mean length (the Figure also demonstrates the effect of catch on length-at-age), c) Yield-per-recruit, and d) Estimated recruitment at age 0.

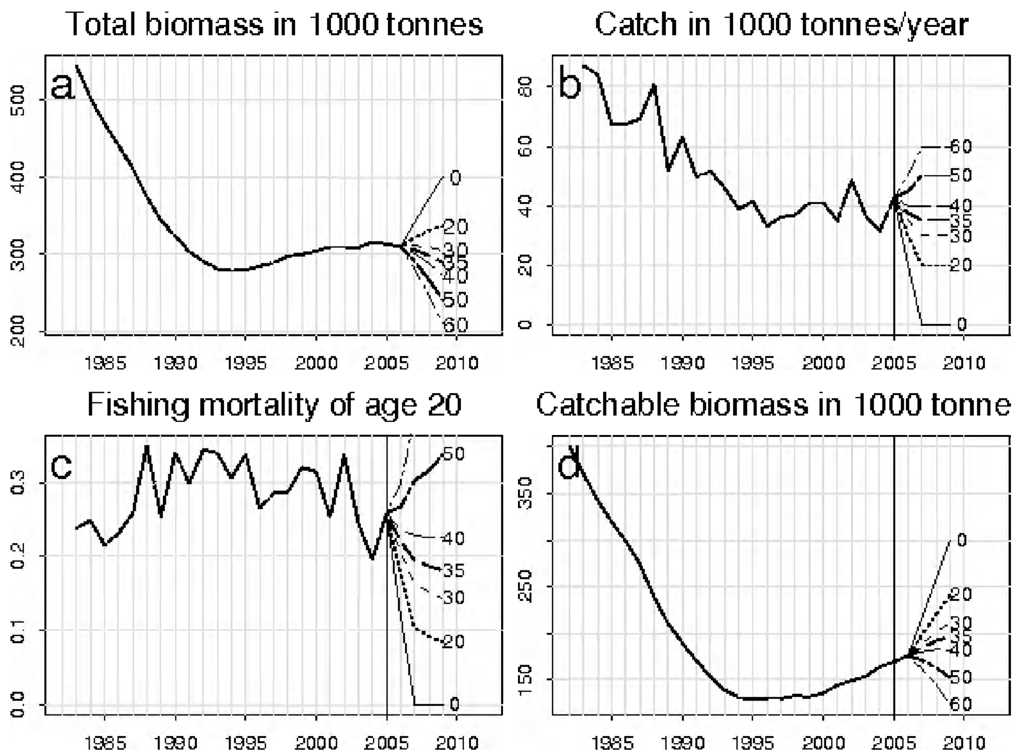


Figure 2.4.7.6 Results from the BORMICON assessment using catch data from ICES Division Va. To take account of the catches taken in Division Vb, about 2000 t should be added to the projected catch. Development of biomass and F using different catch options (0–60 000 t) after 2004.

Table 2.4.7.1 Official landings (in tonnes) of *S. marinus*, by ICES Division 1978–2005 as officially reported to ICES.

	Area				
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	31,686	1,139	519	107	33,451
2005[1)]	42,660	2,484	137	85	45,366

1) Provisional.

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

State of the stock

In the absence of reference points the state of the stock cannot be fully evaluated. Commercial cpue indicates a general decrease in stock biomass from the late 1980s to the early 1990s; after this it has been relatively stable. Survey biomass indices suggest another decrease after 2001.

Management objectives

There are no explicit management objectives 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 2007 should not exceed 22 000 t, and there should be no direct fishery for *S. mentella* in Subarea XIV.

Management considerations

The advice for 2006 catch was 22 000 t, which corresponded to the lowest observed catch in Subarea V since 1980, taken in 2001. The advised catch in 2006 and 2007 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 in 2005.

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.

From the German survey on the Greenland shelf there are indications of increase in biomass from 2003 and onwards. This fish reach fishable size in the coming years. However, it is not clear whether this fish will recruits to the pelagic stock or to the demersal stock.

The stock structure of redfish *S. mentella* in Subareas V, VI, XII, and XIV, and in the NAFO Convention Area has been evaluated by ICES (2005). 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. Drawing conclusions from this information would require a comprehensive evaluation that integrates these results with those from other disciplines.

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.

Analysis of logbook information from 1991–2005 shows that the pelagic fishery east of the "redfish line" occur in the same area as the bottom trawl fisheries, the fisheries often coinciding seasonally and occurring within the same depth range. Analysis based on the same source indicates that annual catch with pelagic gear east of the "redfish line" has been decreasing over the period. The average annual pelagic catch was around 13 thousand tonnes in the period 1991-1998 (4–25 thousand ton interannual range), but in more recent years the average annual catch has been less than 3 thousand tonnes (0–8 thousand ton interannual range).

Scientific basis

Survey data are available from the German groundfish survey in Subarea XIV (1985–2005), and from the Icelandic groundfish survey in Va (2000–2003). Cpue data are available from Icelandic trawlers in Division Va (1986–2005) and from the Faroese fishery in Division Vb (1991–2005). Faroese bottom trawl surveys are designed for other species and therefore are not considered as reliable indicators for *S. mentella*.

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. Prior to 2004, advice was based solely on cpue indices from the fishery. This is likely to be the cause of the discrepancy between the survey and the cpue trend.

Uncertainties in assessment and forecast

The available 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, 25 April–4 May 2006 (ICES CM 2006/ACFM:26).

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]	21.9
2005	Reduce catch to 2001 level in Subarea V	22.5[4]	22.4
2006	Reduce catch to 2001 level in Subarea V	22.0[4]	
2007	Same advice as last year	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.

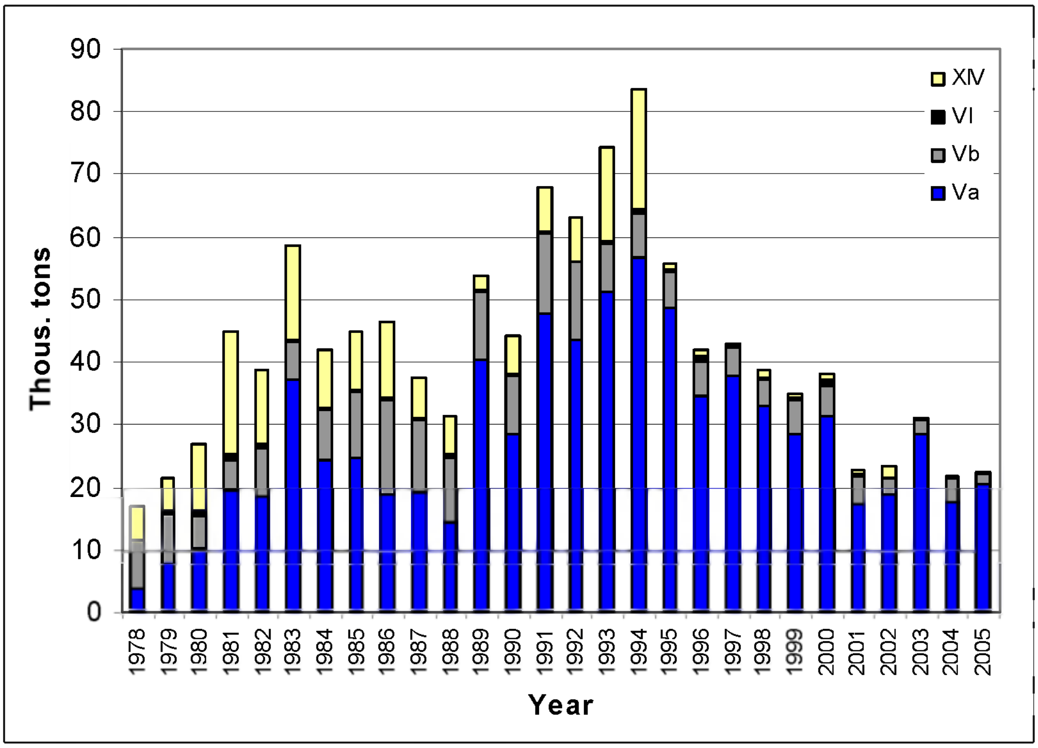


Figure 2.4.8.1 Landings of demersal *S. mentella* on the continental shelf from ICES Divisions Va, Vb, VI, and XIV, 1978–2005.

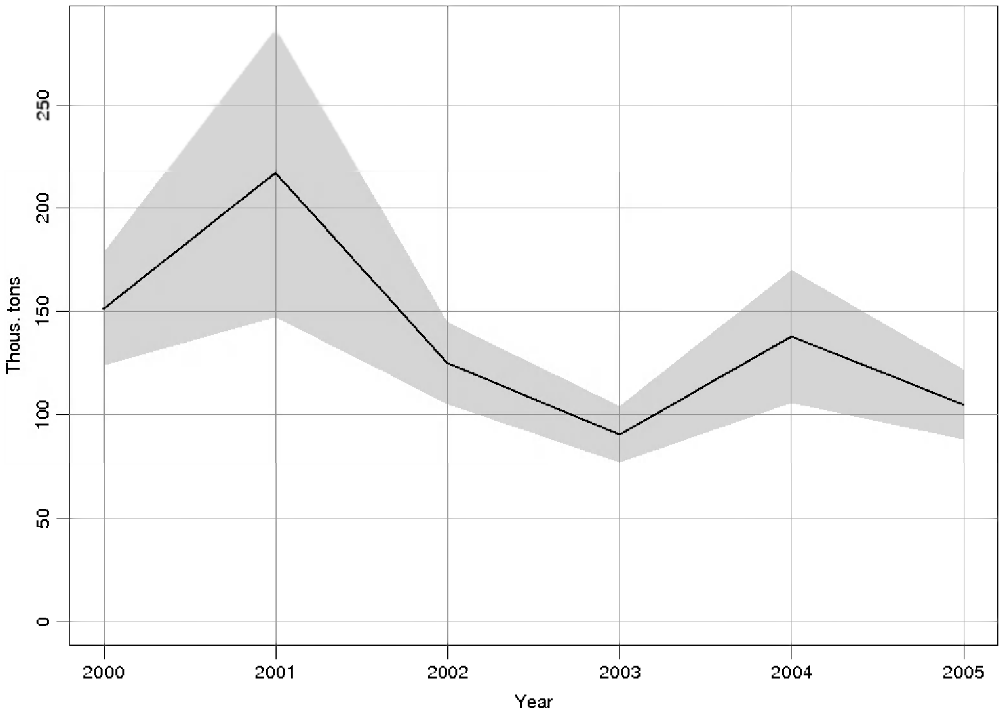


Figure 2.4.8.2 Demersal *S. mentella* on the continental shelf. Total biomass index derived from the Icelandic autumn survey conducted in Division Va in 2000–2005.

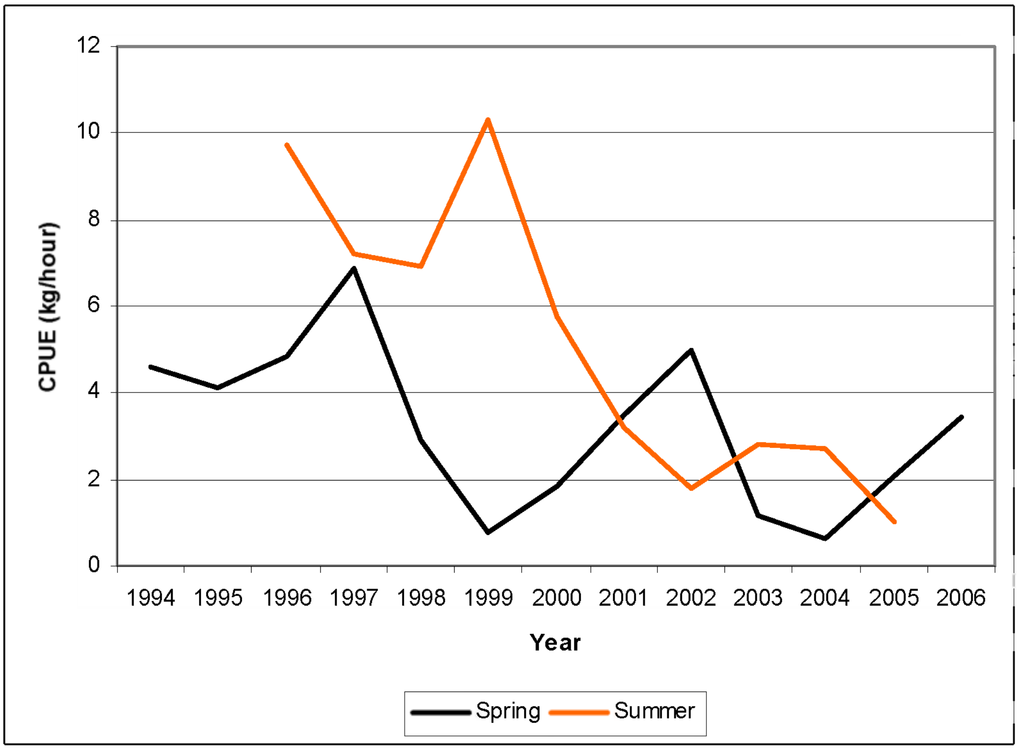


Figure 2.4.8.3 Demersal *S. mentella*. Cpue (kg/hour) from the Faeroese spring survey 1994–2006 and the summer survey 1996–2005 in ICES Division Vb.

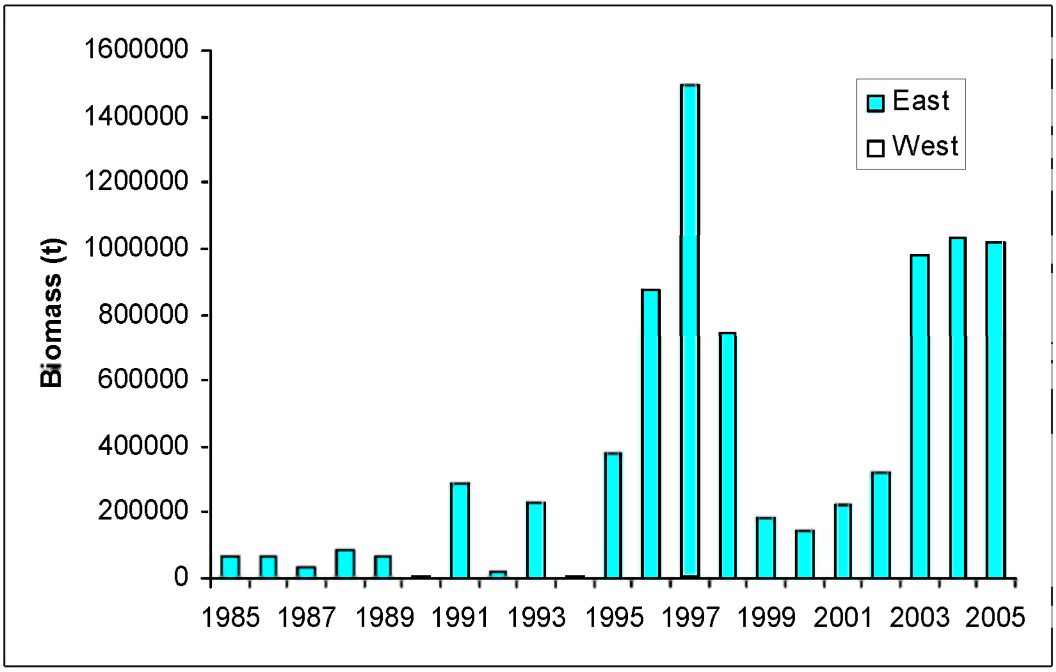


Figure 2.4.8.4. Demersal *S. mentella* (>=17 cm) on the continental shelf. Survey biomass indices for East and West Greenland, derived from the German groundfish surveys, 1985–2005.

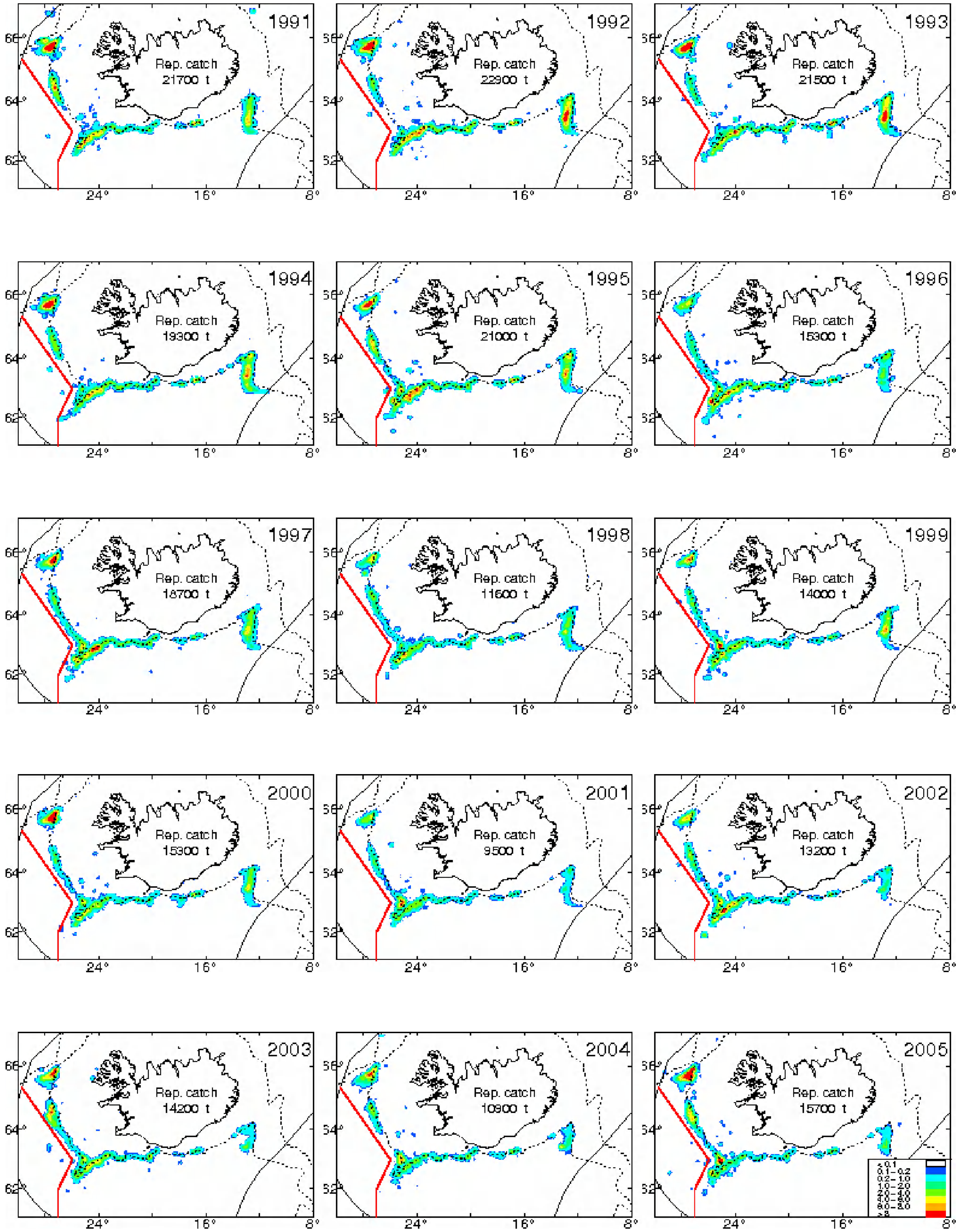


Figure 2.4.8.5 Demersal *S. mentella* on the continental shelf. Geographical location of the catch in Icelandic waters 1991–2005 as reported in logbooks from the Icelandic bottom trawl fleet.

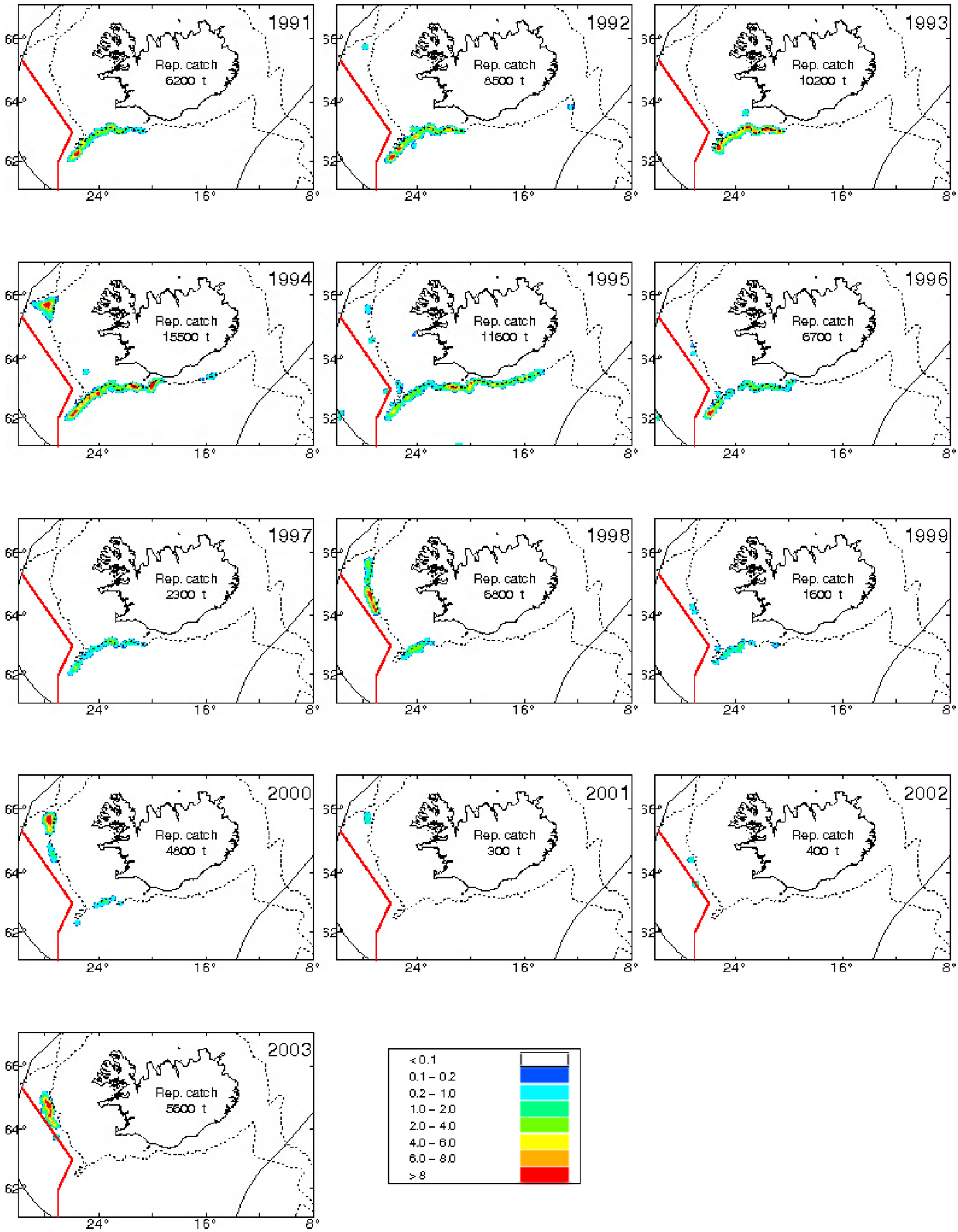


Figure 2.4.8.6 Geographical location of the demersal *S. mentella* catches in Icelandic waters 1991–2003 as reported in logbooks of the Icelandic fleet using pelagic trawl. The red line is the redfish line and the dotted line represents the 500-m isobaths.

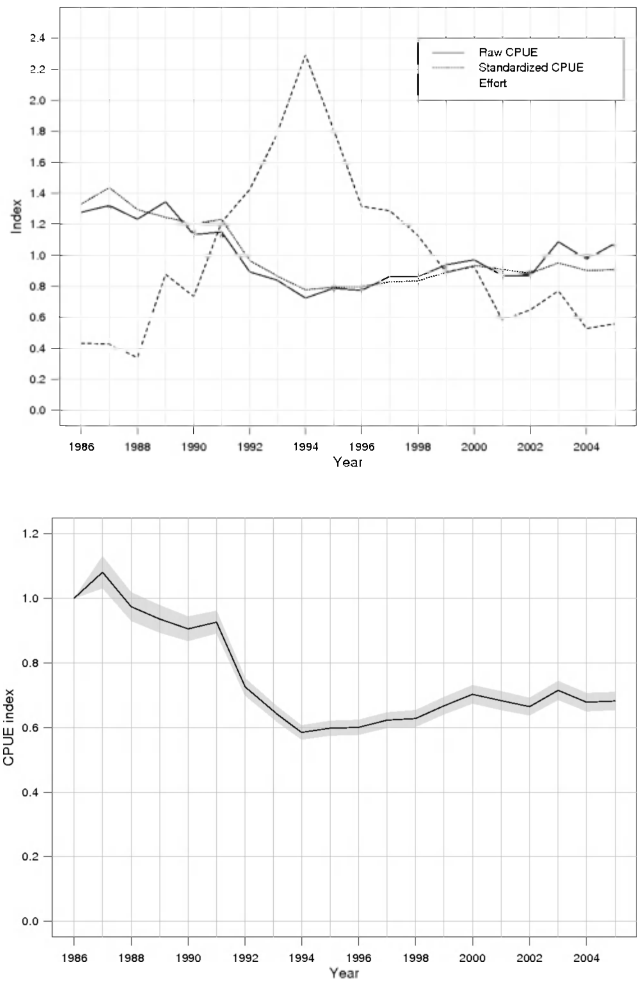


Figure 2.4.8.7 Demersal *S. mentella* on the continental shelf. Cpue, relative to 1986, from the Icelandic bottom trawl fishery in Division Va. Cpue based on a GLM model, based on data from logbooks and where at least 50% of the total catch in each tow was demersal *S. mentella*. Also shown is fishing effort (hours fished in thousands).

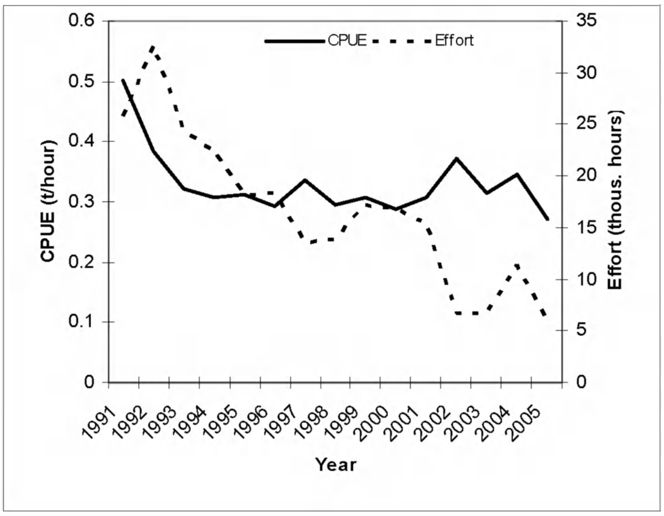


Figure 2.4.8.8 Demersal *S. mentella* on the continental shelf. Cpue (kg/hour) and fishing effort (in thousands) from the Faroese OB fleet 1991–2004 and where 70% of the total catch was deep-sea *S. mentella.*

Table 2.4.8.1 Nominal landings (tonnes) of demersal *S. mentella* on the continental shelf and slopes 1978–2005, 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	22 889
2002	19 045	2 552	20	0	1 903	23 520
2003	28 478	2 114	197	0	376	31 164
2004	17 604	3 931	6	0	389	21 930
2005[1)]	20 567	1 593	111	0	150	22 421

1) Provisional.

2.4.9 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

In the absence of reference points and an analytical assessment, the state of the stock cannot be fully evaluated. Even though the stock status is uncertain, trends in survey indices, the decline in cpue in 2004 and 2005, and the rapid decrease in catches from 2004 suggest that the stock is in a state of rapid depletion.

Management objectives

There are no explicit management objectives for this stock.

Reference points

No precautionary reference points have been established.

Single-stock exploitation boundaries

Even though the stock status is uncertain, trends in survey indices, cpue data, and the development of the fishery suggest that the stock is in a state of rapid depletion. Therefore, ICES recommends that no fishing takes place. The stock should continue to be monitored, and the fishery should not be reopened unless there are clear indications of recovery.

Management considerations

NEAFC Contracting Parties have agreed that "a maximum of 80% of the catches of pelagic redfish can be taken prior to 1 July 2006". It is expected that if a substantial reduction in TAC is implemented a greater share of the catches will therefore be taken prior to 1 July, i.e. in the northeastern area where fishery is conducted in the first half of the year.

ICES has in the last two years advised that catches should not exceed 41 000 t, i.e. the catches exerted in the period 1989–1992. After that period, quota and catches have always been far above that level. Cpue dropped steeply in 2004, and declined further in 2005, in particular in the NE part of the area. Cpue data are considered less reliable than survey indices, because cpue may remain stable in spite of a decline of the stock, in particular with fish that tend to aggregate, as *S. mentella* does. In recent years, hydographic conditions may have favoured such aggregation. In this situation, a sharp decline in cpue most likely signals that the resource is being exhausted. Catches in 2005 were markedly lower than in previous years. There is no international agreement on quotas in this fishery, but autonomous quotas have been in effect, and none of the major fleets have taken their quota in 2005. The acoustic survey estimate in 2005 was at the same low level as in 1999 and 2001, but much lower than in the early 1990s. Also, the acoustic survey covers only the upper part of the water column. The survey as well as the catches in 2005 indicates a substantial decrease in the abundance of fish larger than 40 cm. The trawl surveys only cover a short time span and show no trend, but are inconsistent from year to year.

These observations taken together raise serious concern that the stock is more depleted than previously assumed. *Sebastes mentella* is a typical deep-sea species with late maturation and slow growth, and is hence considered to be vulnerable to overexploitation, taking long to recover if depleted. All this, together with the unclear stock situation leads ICES to conclude that fishery on this stock cannot be recommended until there are clear indications of recovery.

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 the information needed to evaluate the productivity of the stock. This includes information on recruitment, nursery areas, stock identification, and biomass estimation.

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, 2003, and 2004 (in the main fishing season), the effort could be more than 15–33% higher than reported to NEAFC, and thus the unreported catch could be in that order of magnitude. No information is available for 2005.

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 study group in 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. Drawing conclusions from this information would require a comprehensive evaluation that integrates these results with those from other disciplines. It is suggested that this is done by a panel of selected experts on stock identity.

Commercial cpue series were previously used to determine stock size. However, the fishery targets pelagic aggregating 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 substantial decline in cpue in 2004 and 2005.

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 1998–2005; 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.

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. Catches in the southwestern area (almost exclusively shallower than 500 m) have remained relatively stable, but low since 1997, with a slight decline in the last 2 years. In the northeastern area (deeper than 500 m) catches increased until 1997 and then fluctuated without a clear trend until 2004. In 2005, the catches from this area dropped to about half the previous level. This was associated with a strong decline in cpue. The main 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. 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.

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 and NAFO 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. In recent years, data from most fishing nations have been compiled, and this enabled production of detailed charts showing the area and depth distribution of the fisheries (see Section 2.4.6).

Uncertainties in assessment and forecast

The acoustic estimates 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 layer.

The acoustic biomass estimates provide only approximate indexes of stock size due to varying coverage of the stock distribution area and methodological deficiencies.

There is 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 15–33% 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

ICES has previously recommended TACs of 41 000 t. The trends in survey indices, the decline of cpue in 2004 and 2005, and the development of the fishery suggest that the stock is in a state of rapid depletion. These observations, together with the fact that *Sebastes mentella* is a typical deep-sea species with late maturation and slow growth, and is therefore considered to be vulnerable to overexploitation, have lead ICES to recommend that no fishing takes place.

Sources of information

Report of the North-Western Working Group, 25 April–4 May 2006 (ICES CM 2006/ACFM:26).
Report of the Study Group on Stock Identity and Management Units of Redfishes (SGSIMUR), 31 August–3 September 2004, Bergen, Norway (ICES CM 2005/ACFM:10)

Year	ICES Advice	Predicted catch corresp. to advice	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)	146
2003	TAC not exceed current catch levels	119	Not agreed NEAFC proposal (119)	161
2004	TAC not exceed current catch levels	120	Not agreed NEAFC proposal (120)	126
2005	Limit catch to 41 kt	41	Not agreed NEAFC proposal (75)	73
2006	Catch less than 41 kt	41	Not agreed NEAFC proposal (62)	
2007	No fishery until clear indications of recovery of the stock	0		

Weights in '000 t.

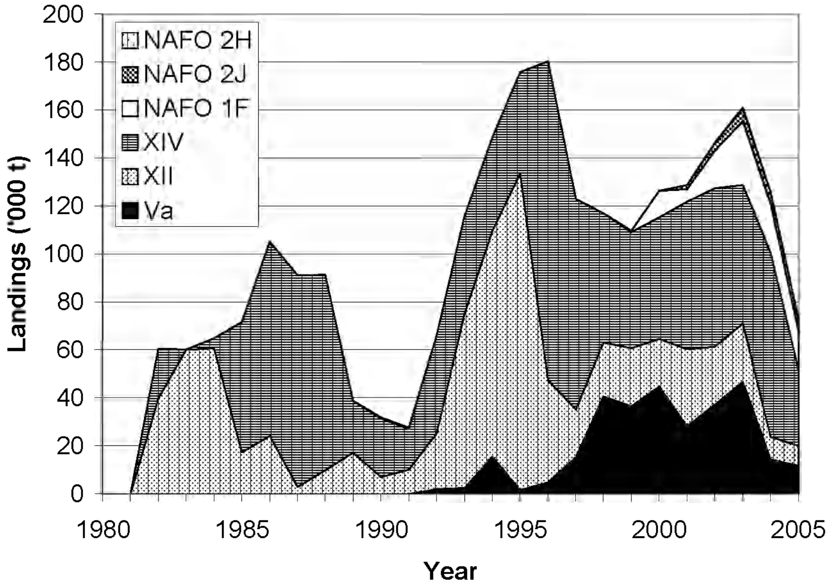


Figure 2.4.9.1 Pelagic *S. mentella*. Landings by area.

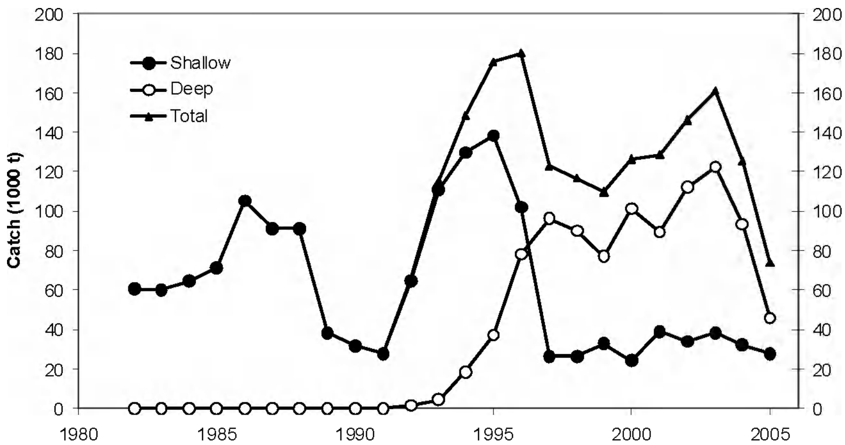


Figure 2.4.9.2 Pelagic *S. mentella*. Landings by depth strata.

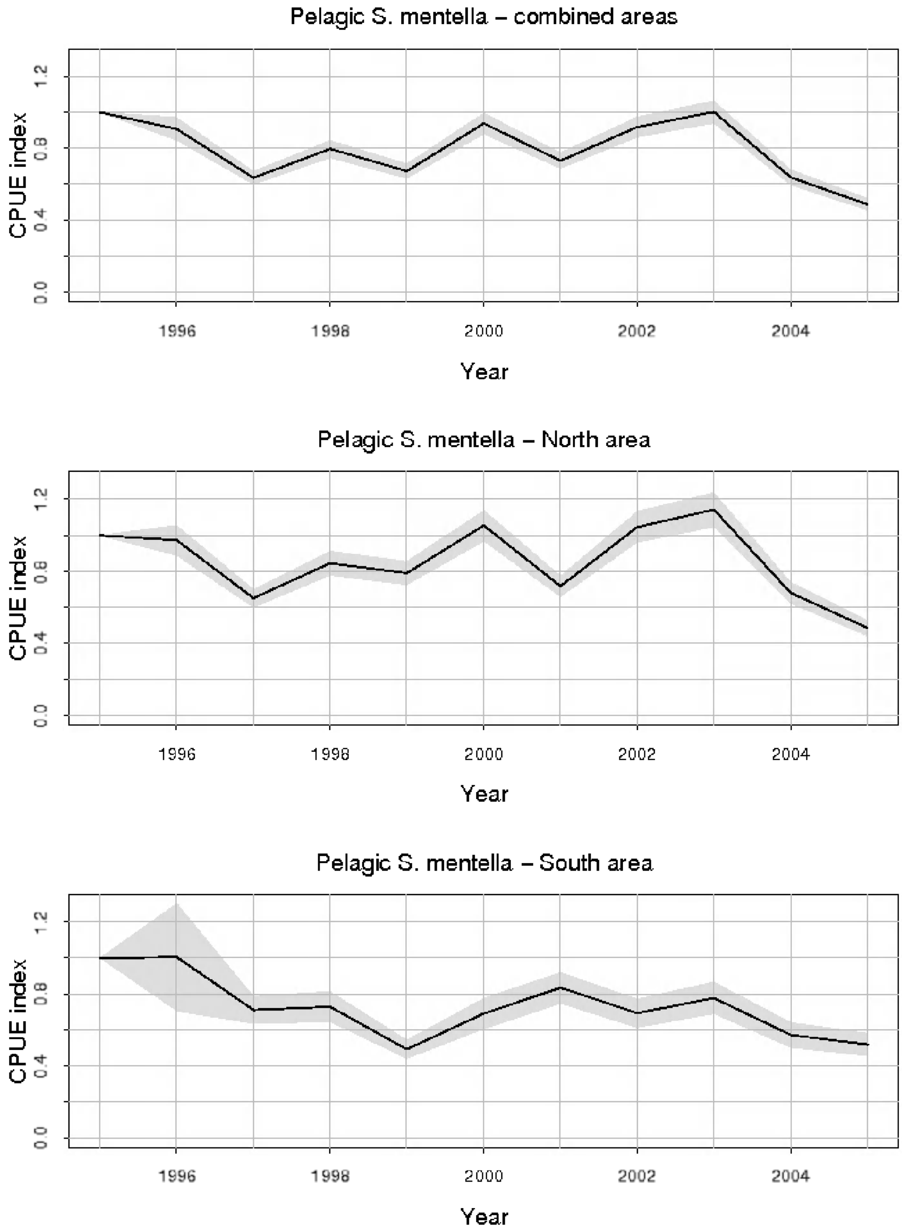


Figure 2.4.9.3 Pelagic S. *mentella*. International cpue by area.

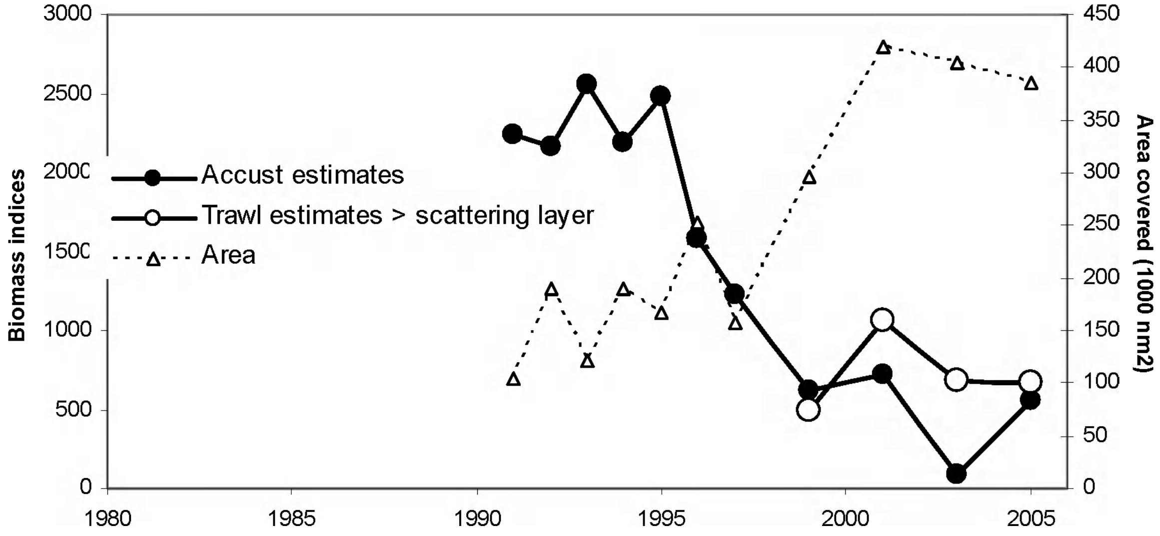


Figure 2.4.9.4 Pelagic *S. mentella*. Overview of survey indices in the Irminger Sea.

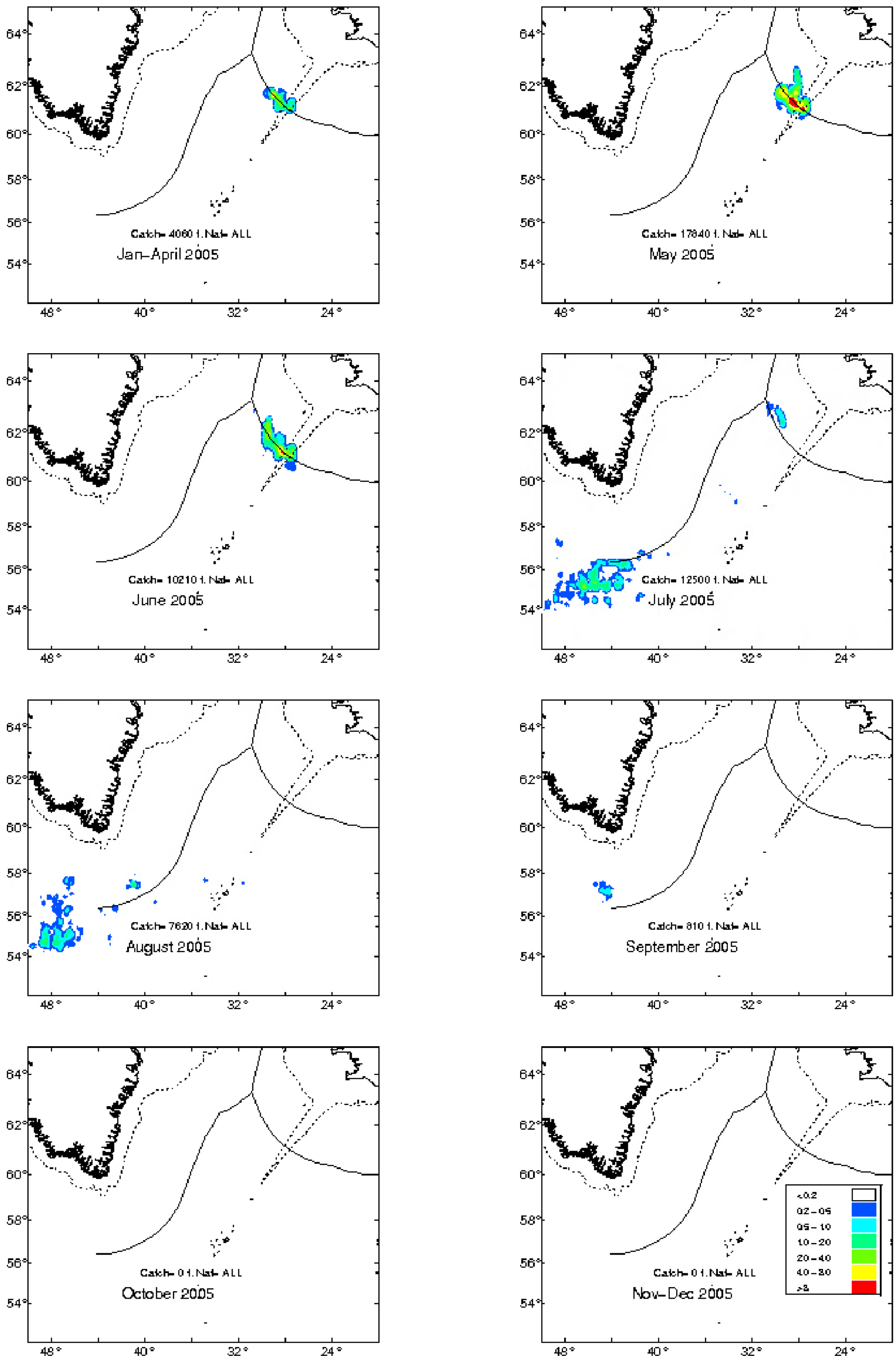


Figure 2.4.9.5 Fishing areas and total catch of the pelagic redfish (*S. mentella*) by month in 2005, derived from catch statistics provided by Germany, Norway, Iceland, and Greenland. The scale for the catch is in tonnes per square nautical mile. Total catch for each period is also given.

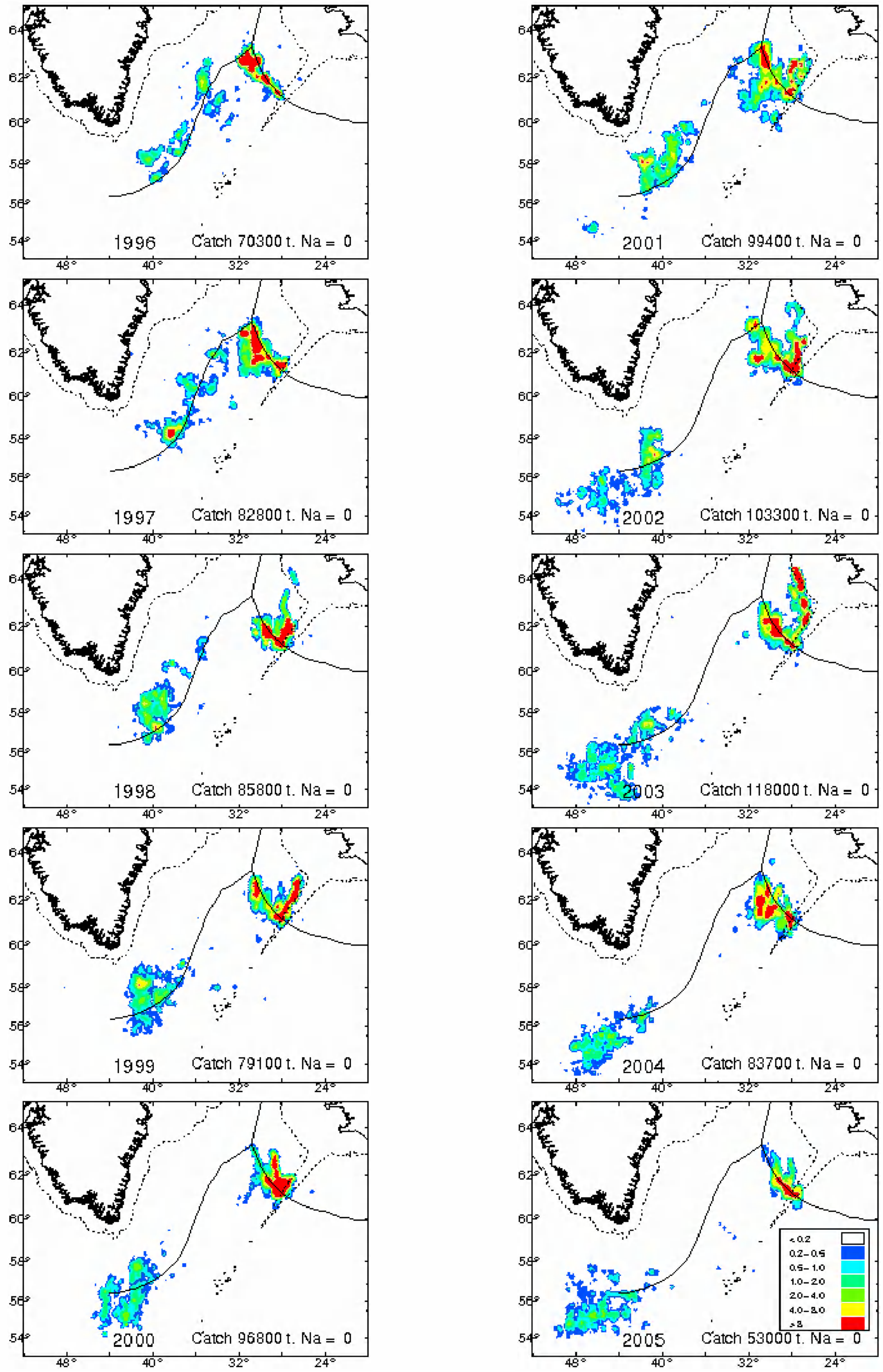


Figure 2.4.9.6 Fishing areas and total catch of the pelagic redfish (*S. mentella*) in the Irminger Sea and adjacent waters 1996–2005. Data are from the Faroes (1995–2005), Germany (1995–2005), Greenland (1999–2003), Iceland (1995–2005), Norway (1995–2003), and Russia (1997–2005). The scale given is tonnes per square nautical mile.

Table 2.4.9.1 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	19,826	87,698				122,825
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	11,052			126,313
2001	28,148	32,164	61,457	5,290	1,751	8	128,818
2002	37,279	24,026	66,194	15,702	3,143		146,344
2003	46,676	24,232	57,780	26,594	5,377	325	160,984
2004	14,456	9,679	76,656	20,336	4,778		125,905
2005	11,726	8,206	32,627	16,260	4,899	5	73,723

Table 2.4.9.2 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. *international surveys

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 approx. 350 m.

2.4.10 Icelandic summer-spawning herring (Division Va)

State of the stock

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.

Management objectives

The practice has been to manage this stock at F=$\mathbf{F}_{0.1}$ (= 0.22 =$\mathbf{F}_{pa}$) for more than 20 years. However, no formal management strategy has been adopted.

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.	$\mathbf{B}_{pa}$: $\mathbf{B}_{pa} = \mathbf{B}_{lim}\, e^{1.645\sigma}$, where σ = 0.25.
$\mathbf{F}_{lim}$: –	$\mathbf{F}_{pa}$: $\mathbf{F}_{pa} = \mathbf{F}_{0.1}$= 0.22 (based on a weighted average).

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits

Fishing mortality should be limited to $\mathbf{F}_{pa}$. The stock size has increased in recent years according to the acoustic survey. However, in the absence of a full analytical assessment and given the uncertainties in the survey, catches in 2007 should not exceed 110 000 t until the increased stock size has been confirmed from other sources. This is consistent with the TAC for the last three years.

Management considerations

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

In the absence of an assessment the advice is conservative. If a reliable analytical assessment can be produced, advice on catches can be derived in relation to the target exploitation rate.

Management plan evaluations

Current management practice has allowed an 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. The catches have since 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 both 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. Pelagic trawl fisheries were introduced in 1997/98 and have since then contributed to approximately 40–60% of the catches.

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 in the last 10 years.

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 affect the fishery and could have implications on selection assumed in the assessment models used for management.

Scientific basis

Data and methods

Acoustic survey estimates were used to assess the relative trends in the stock.

The catch-at-age data for the fishing seasons 2000/2001 to 2004/2005 have been re-calculated since the last assessment in 2005. Catch data for the earlier fishing seasons have yet to be reworked in the same way, but this process is currently ongoing.

Uncertainties in assessment and forecast

There are inconsistencies in the catch and survey data, which precluded an analytical assessment.

Comparison with previous assessment and advice

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

Source of information

Report of the North-Western Working Group, 25 April–4 May 2006 (ICES CM 2006/ACFM:26).

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	110	103
2006/2007	*Status quo* catch	110		

Weights in '000 t.

[1)] Catch at $\mathbf{F}_{0.1}$.

[2)] Season starting in October of first year.

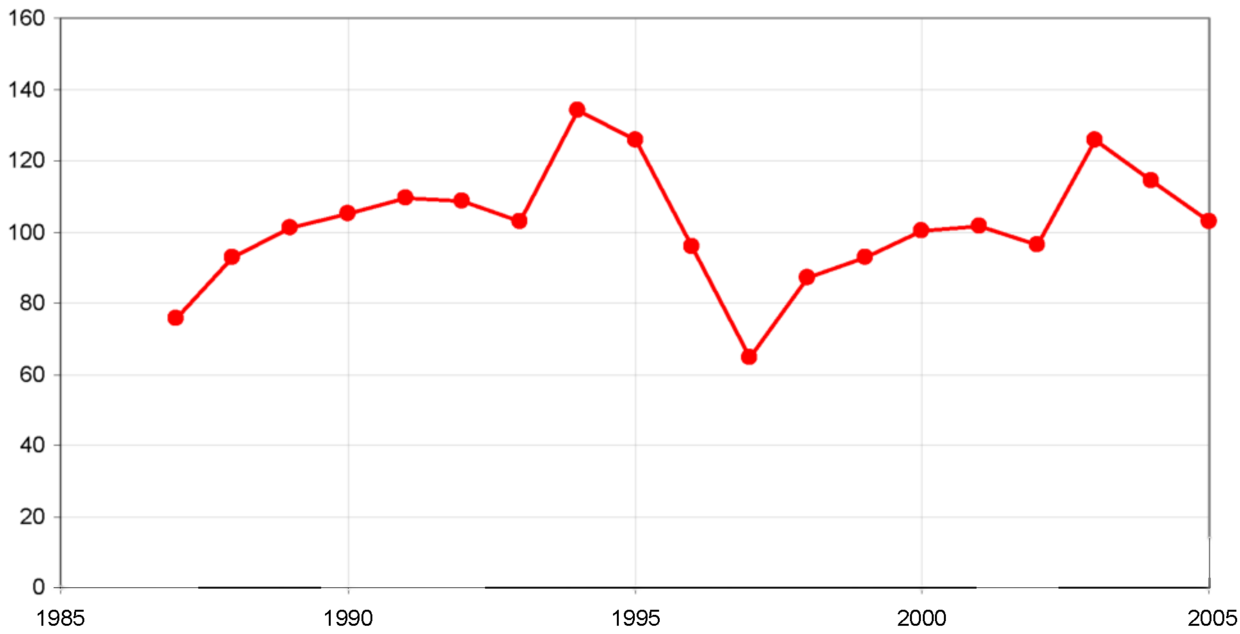


Figure 2.4.10.1 Icelandic summer-spawning herring. Total catch (in thousand tonnes) in 1978/79 to 2005/06.

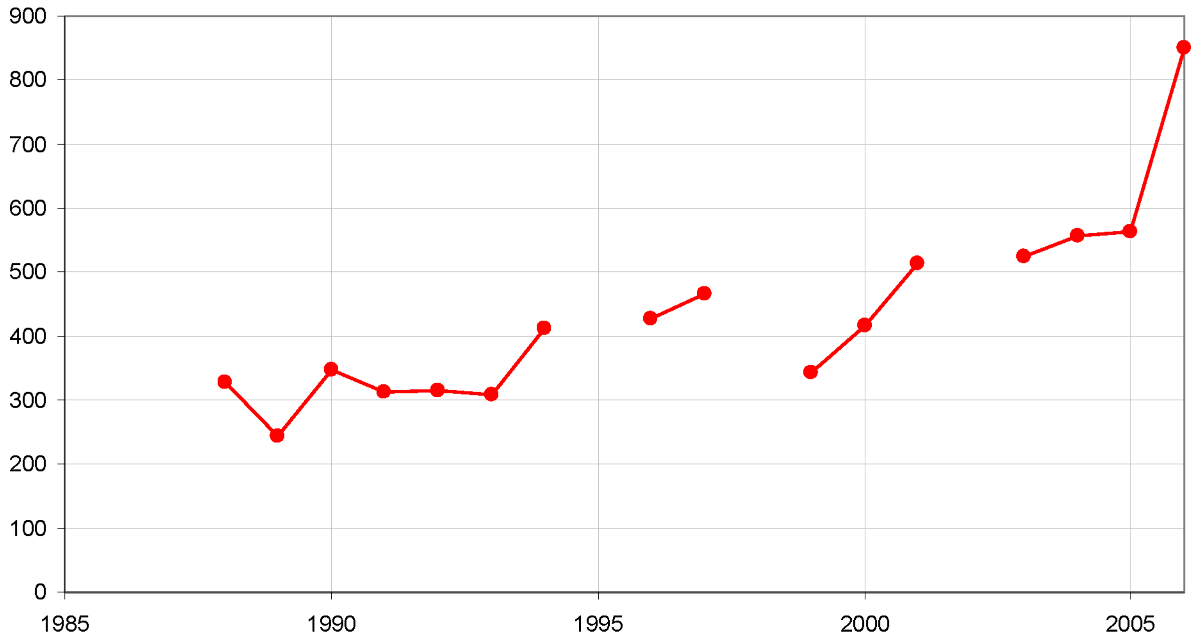


Figure 2.4.10.2 Icelandic summer-spawning herring. Spawning stock biomass from the survey for ages 4 and older in the years 1987–2004.

Table 2.4.10.1 Icelandic summer-spawning herring (Division Va).

Year	Landings tonnes
1978	37000
1979	45000
1980	53000
1981	40000
1982	59000
1983	59000
1984	50000
1985	49000
1986	66000
1987	75000
1988	93000
1989	101000
1990	104000
1991	107000
1992	108000
1993	103000
1994	134000
1995	125000
1996	96000
1997	64000
1998	86000
1999	93000
2000	100000
2001	94000
2002	96000
2003	129000
2004	112000
2005	102000
Average	99400

2.4.11 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 in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
Unknown	Unknown	Unknown	

In the absence of defined reference points, the state of the stock is unknown. The SSB is highly variable because it is dependent on only two age groups. The current SSB level is probably low as evidenced from recent surveys. Immature capelin were also absent in autumn 2005, as well as in the winter and summer 2006 surveys, indicating likely low recruitment.

Management objectives

The fishery is managed according to a two-step management plan which requires 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. The initial quota is set at 2/3 of the preliminary TAC, calculated on the condition that 400 000 t of the 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 the 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 shows a predicted spawning stock biomass of at least 400 000 t in March 2007.

Short-term implications

As all surveys failed to locate any but a few immature capelin, the preliminary TAC for the 2006/07 season is set to zero. This may be revised when 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. age 2 and age 3 capelin in the autumn, which spawn at ages 3 and 4 in March of the following year.

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 initial 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 of capelin rarely occur.

A regulation calling for immediate, temporary area closures when high abundance of juveniles are measured in the catch (more than 20% of the catch composed of fish less than 13 cm) is enforced, using on-board observers.

Ecosystem considerations

Capelin is an important forage fish and declines in stock may be expected to have implications for the abundance of their predators.

The environment

The decline in stock abundance in the early 1990s is 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 the last four years, great difficulties have been encountered in locating and assessing the juvenile part of the stock (ages 1 and 2; and ages 2 and 3 after 31 December). In this period, the quarterly monitoring of environmental conditions of Icelandic waters shows a rise in sea temperatures north and east of Iceland, which probably also reaches farther north and northwest. The temperature increase is so great that it may have led to displacements of the juvenile part of the capelin stock. On the basis of experience gained before and during assessment surveys of the 2002/2003 season, these displacements have obviously been so large that juvenile capelin, in particular the 2001 year class, were not available to the autumn 2002 assessment survey as it was carried out. Therefore, while the very low numbers of immature capelin of the 2001 and later year classes should be taken seriously and do suggest a radical decline of the adult fishable stock, there may be distributional changes that compromise the interpretation of survey results.

Scientific basis

Data and methods

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

Sources 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 Northern Pelagic and Blue Whiting Working Group, 24–30 August 2006 (ICES CM 2006/ACFM:34).

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	235	238
2006/07	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.

Table 2.4.11.1 Capelin in the Iceland–East Greenland–Jan Mayen area 1978–2006. Recruitment of 1-year-old fish (unit 10^9) and total stock biomass ('000 t) are given for 1 August. Spawning stock biomass ('000 t) is given at the time of spawning (March next year). Landings ('000 t) 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	Total Stock biomass	Landings	Spawning stock biomass
1978	164	2832	1195	600
1979	60	2135	980	300
1980	66	1130	684	170
1981	49	1038	626	140
1982	146	1020	0	260
1983	124	2070	573	440
1984	251	2427	897	460
1985	99	2811	1312	460
1986	156	3106	1333	420
1987	144	2639	1116	400
1988	81	2101	1037	440
1989	64	1482	808	115
1990	118	1293	314	330
1991	133	1975	677	475
1992	163	2058	788	499
1993	144	2287	1179	460
1994	224	2287	864	420
1995	197	3007	929	830
1996	191	2885	1571	430
1997	165	2348	1245	492
1998	168	2197	1100	500
1999	138	2315	933	650
2000	146	2164	1071	450
2001	140	2432	1249	475
2002	142	1993	988	410
2003	132	2540	635	535
2004	NA	NA	750	725
2005	NA	NA	552	400
2006	NA	NA	238	400

*Preliminary.
NA: Not available.