

## 10 Pelagic *Sebastes mentella*

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This section includes information on the pelagic fishery for *S. mentella* both in the Irminger Sea and adjacent areas (Subarea XII, parts of Division Va, Subarea XIV and eastern parts of NAFO Divisions 1F, 2H and 2J).

The Working Group ToR c) and NEAFC special request 1.a) requesting new information on stock identity of *S. mentella* is dealt with in the introductory chapter 7, whereas the requested fishery and survey information on pelagic *S. mentella* (ToR d) and e)) is given in this chapter (10.1 and 10.2).

The pelagic redfish straddles in the ICES Div. Va, XII and XIV and NAFO Sub-areas 1 and 2, it occurs inside the EEZs of Iceland and Greenland and in the Regulatory Areas of NEAFC and NAFO. NEAFC is the responsible management body, and ICES the advisory body. Management of pelagic redfish is by TAC and technical measures (minimum mesh size in the trawls is set at 100 mm). TACs are both agreed among NEAFC and NAFO member states and also autonomously set in addition. Some NEAFC parties have objected to the decision of NEAFC and set their own national TAC. The NEAFC TAC for pelagic redfish for 2004 was 120,000 t. ACFM has advised for 2005 “that catches should not exceed catches exerted in the period 1989-1992, corresponding to less than 41 000 t.” For 2005, NEAFC has set a TAC of 75,200 t, “of which 4,700 tonnes will be allocated to NAFO, and 200 tonnes will be available to co-operating non contracting parties”.

### 10.1 Fishery

#### 10.1.1 Summary of the development of the fishery

Russian trawlers started fishing pelagic *S. mentella* in 1982. Vessels from Bulgaria, the former GDR and Poland joined those from in 1984. Total catches increased from 60 600 t in 1982 to 105 000 t. in 1986. Since 1987, the total landings decreased to a minimum in 1991 of 28 000 t mainly due to effort reduction. Since 1989, the number of countries participating in the pelagic *S. mentella* fishery gradually increased. As a consequence, total catches also increased after the 1991 minimum and reached a historical high of 180 000 t in 1996 (Tables 10.1.1–10.1.2, Figure 10.1.1). Since 2000, the WG estimate of the catch has been between 124 000 and 151 000 t, highest in 2003. This is probably an underestimate due to incomplete reporting of catches (see section 10.1.4), especially in Subarea XII, where significant catches were taken by some countries in the past. The recent increase in the total figures since 2000 is mainly due to significant catches in NAFO Divisions 1F and 2J, up to 24 000 t (16% of total catches) in 2004. As in previous years, a small fraction of the catches reported as demersal catches in Division Va (see chapter 9) was caught with pelagic trawls. To minimize the overlap between the pelagic and demersal fisheries, Icelandic authorities have introduced a “redfish line” as division measure (see details in chapter 10.1.2.4).

In the period 1982-1992, the fishery was carried out mainly from April to August. In 1993–1994, the fishing season was prolonged considerably, and in 1995, the fishery was conducted from March to December. 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 (see Figures 10.1.2 and 10.1.3). There is very little fishing activity in the period from November until late March or early April when the next fishing season starts. The fleets participating in this fishery have continued to develop their fishing technology, and most trawlers now use large pelagic trawls (“Gloria”-type) with vertical openings of 80-150

m. The vessels have operated at a depth range of 200 to 950 m in 1998-2004, but mainly deeper than 600 m in the first and second quarter but at depths shallower than 500 m in third and fourth quarter. Discard is at present not considered to be significant for this fishery (see 10.1.3). The WG acknowledges information on trawling depth as provided by some nations, but recommends that all nations should provide depth information in accordance with the NEAFC logbook format.

The following text table summarises the available information from fishing fleets in the Irminger Sea in 2004:

Faroese	4 factory trawlers
Germany	3 factory trawlers
Greenland	1 factory trawler
Iceland	22 factory trawlers
Portugal	5 factory trawlers
Russia	34 factory trawlers
Spain	10 factory trawlers

A summary of the catches by nation as estimated by the Working Group is given in Table 10.1.2.

## **10.1.2 Description on the fishery of various fleet**

### **10.1.2.1 Faroese**

The Faroese fishery for pelagic redfish in the Irminger Sea and adjacent waters started in 1986. During the first years, only 1-2 trawlers participated in the fishery. Fishing depths were mainly shallower than 500 m although some trials were made down to about 700 m. From 1994 onwards, several trawlers have made trips to this area fishing almost exclusively deeper than 500-600 m. In 1999, the Faroese fishery started in international waters in the NE part of the Irminger Sea in mid/late April (ICES Sub-area XIV). Up to late July, the fishing area was mainly between 61°N-62°N and 27°N-30°W, then they moved to the SW, to south of 60°N and west of 38°W (ICES Sub-area XII), fishing mostly within the Greenlandic EEZ. Four trawlers participated in 2003. The fishing depth from the beginning of the fishery to July was nearly exclusively deeper than 600 m, but from July onwards, the fish was taken at shallower depths than 600 m. In 2004, this pattern has not changed.

### **10.1.2.2 Germany**

The reported effort in 2004 is by far the lowest observed in the last nine years and amounted to 4 355 hours only (WD10). As observed in previous years, the majority of the 2004 effort was applied during the second and third quarters. During the second quarter in 2004, the hauls were almost exclusively distributed in NEAFC Regulatory Area of ICES Division XIV between the Greenland and Icelandic EEZs. As in 2003, there was significant fishing effort exerted in the NAFO Division 1F in 2004, mainly within the NAFO Regulatory Area. There was also some effort recorded in NAFO Division 2J since 2003. The overall decrease of annual landings continued in 2004 with a figure of 3,700 tons, representing a drastic drop to about one third of the average effort observed in previous years, due to a reallocation of effort to the Greenland halibut fishery off East Greenland. In 2004, 28 % or 1,048 tons of the total landings were taken in the NAFO Divisions. During 1995-1999, the overall unstandardised CPUE decreased from 2.06 t/h by 53 % to 0.97 t/h. In 2000-2004, the CPUE remained at that low level. Given the technical, temporal, geographical and depth changes of the fishing activities the relevance of the estimated reduction in CPUE as indicator of stock abundance remains diffi-

cult to assess. However, the continued reduction in CPUEs during 1996-1999 should be interpreted as reaction of the stock to removed biomass.

### **10.1.2.3 Greenland**

The Greenlandic fleet was fishing in the same area as the Icelandic fleet (see below), and therefore, the Greenlandic log-book data were included in the figure of the Icelandic fishery.

### **10.1.2.4 Iceland**

The Icelandic fleet targeting pelagic redfish is usually concentrated in the area between the Greenland EEZ and the Reykjanes Ridge. Since 1996, the catches have mostly been taken close to or inside the 200-mile boundary southwest of Iceland. In recent years, the fishery has started in April close to the Icelandic 200-mile boundary and then moved northward in May-July. In the springtime and until June, the largest proportions of the catches were taken deeper than 500 m. In 1998, the fishery expanded further north in July-September. In 1999, a similar pattern was observed, except that the fishery did not continue close to the shelf of Iceland. The few vessels that had quota left after that, moved about 480 nautical miles to Southwest, to the area S-SE of Cape Farewell (Sub-area XII), where they fished shallower than 500 m depth in July-September. In 2000, the fishery started in April at the same locations as in the past and moved slowly northward until the fishery ended in July due to quota limitation. The Icelandic trawlers fished mainly at a depth of 600-800 m during the period 1995-2000. In 2000, less than 8% of the catches in the log-books were reported shallower than 500 m depth and no catches were reported at depths shallower than 400 m. In 2001-2003, the fishery started in late April and until middle of July, the fishery was nearly exclusively within the Icelandic EEZ moving slowly in northward direction. In May – July over 90% of the catches were taken at depths deeper than 600 m. From the middle of July until the end of the fishing season, the fishery continued in the area Southeast of Cape Farwell, mostly between 38 and 42°W. In 2001 and 2002, about 33% and 15% of the catch was taken south of Cape Farewell, respectively, due to changes in effort regulation for the fishery. Each vessel was forced to fish given proportion of its catches south of ca. 62°N in order to spread the effort. Only about 11% of the Icelandic catches in 2003 were taken in the “south-western” fishing area shallower than 400 m depth. In 2004, only 36% were caught within the Icelandic EEZ and about 50% of the catches just outside the EEZ (WD 24). 10% of the catches were taken south of Cape Farewell in ICES Sub-area XII and NAFO Division 1F.

According to Icelandic legislation the captain shall report their catch as "pelagic redfish" while fishing redfish within given area and as a "shelf deep-sea redfish" east of that area. According to this legislation, all catch outside the Icelandic EEZ shall be reported as oceanic and in addition west of a line which was drawn approximately over the 1000 m isobath. This line (see Figure 10.1.4) was shifted further east in June 2003 due to pressure from fishermen who were following school of redfish during the pelagic redfish fishery. This new line is also shown in Figure 10.1.4. The figure also show the fishery aggregated catches of "deep-sea redfish" within the Icelandic EEZ. The fishing areas have approached each other in recent years and in 2003 they overlapped, as can be seen in Figure 10.1.5. This led to the fact that in June - July 2003 the fleet did actually, during the same day, both fish "pelagic redfish" and "shelf deep-sea redfish" according to the landing statistics and their log-books. After the school passed east of this pre-defined line, the fishery for "shelf deep sea redfish" continued in July and resulted in record high catches of shelf-mentella in July 2003.

### **10.1.2.5 Norway**

Information on the fishery in 1998 and 1999 indicated a depth shift in the fishery, from fishing 95% of its catch shallower than 500 m in 1998 to fishing exclusively deeper than 500 m in 1999. The catches in 1999 were taken in areas XII and XIV from April to August, at a ratio of

about 2:3. In 2000, Norway fished 6 075 t whereof 3 823 t were taken in ICES Subarea XIV and 2 252 t in Subarea XII. The fishing season was from April – September. In 2001- 2003, the fishery started in April, close to the Icelandic 200 miles boundary (Subarea XIV). The fishery continued there until June and over 80-85% of the total catch was caught below 600 m. Then the fleet moved to Subarea XII between 55 and 58°N and between 40 and 42°W. There is no information available on length distributions in the catches. In 2003 and 2004, 62% and 79% of the catches were taken in Subarea XIV, respectively.

#### **10.1.2.6 Poland**

The Group had a detailed description of the Polish fishery on pelagic redfish available for the first time (WD03). Poland began fishing of pelagic redfish in the Irminger Sea and adjacent waters in 1982. Redfish were fished irregularly in subsequent years. In 1997, the catch amounted to 776 t, followed by a pause in redfish catches until 2002. Since then, catches of this species have been taken regularly. In 2002, 428 t were caught, followed by 917 t in 2003, and 2907 t in 2004. In 2003, the Polish catches were begun in August in NAFO waters. Catches were conducted for two months in Div. 1F at 193-408 m depth (mean 334 m). A total of 776 tons of pelagic redfish were caught. The average CPUE was 1.5 t/h trawling in August and 1.2 t/h trawling in September. In total, 917 tons of pelagic redfish were caught in 2003; of this amount nearly 85% was caught in the NAFO area. In 2004, Polish pelagic redfish catches were begun early in April and continued uninterrupted for five months. Catches were begun in the Subarea XIV. From April to July, a total of 2010 tons of pelagic redfish were caught in this area at depths of 340-900 m (mean 645m). The average CPUE increased in subsequent months from 0.49 t/h trawling in April to 1.92 t/h trawling in July. Starting in the last ten days in July, catches were taken in NAFO waters. By mid August, a total of 897 tons of pelagic redfish had been caught at mean depths of 330-430 m (mean 381 m). The average CPUE was 1.3 t/h trawling in July and 2.6 t/h trawling in August. In contrast to 2002 and 2003, the majority of pelagic redfish catches (over 69 %) in 2004 were taken in fishing grounds located in the NEAFC region.

#### **10.1.2.7 Portugal**

The Portuguese fleet commenced the fishery in 1994. During the first years, the fishery was conducted in the Irminger Sea but in recent years the fishery has extended to NAFO Divisions 1F and 2J. Effort and CPUE data for the Portuguese trawl fishery in ICES Div. XII, XIVb and NAFO Div. 1F in 2004 were obtained through the revision of the skipper logbook from one trawler, kindly supplied by its owner (WD05). The CPUE varied between 0.11 to 0.85 t/h (mean 0.46 t/h).

#### **10.1.2.8 Russia**

The regular Russian commercial fishery for pelagic redfish in the Irminger Sea started in 1982. The total catch of redfish taken by the USSR/Russia makes up about 0.8 mill. t or 40% of the total world catch for the whole period of the fishery in the Irminger Sea. In 1982-1988, the annual Russian catch of redfish constituted 60-85 thou. t. The fishery duration was 4-4.5 months and the fishing depth was nearly entirely shallower than 400 m (Figure 10.1.6), distributed over a large area in the Irminger Sea (Figure 10.1.7). In 1989-1994, the catch decreased to 9-25 thou. t. Fishing efficiency of STM-type vessels was 10-15 t per a vessel/fishing day. A shift of the fishery to the depths deeper than 500 m, and due to an increase in trawl size, an increase in fishing efficiency was observed in 1994. A reduction in redfish catches from the depths deeper than 500 m has been observed since 1997. The extension of fishing period to 8 months and extension of areas due to the increased fishery within the 200-mile zone of Greenland and adjacent areas of the Labrador Sea occurred simultaneously.

In 2004, the Russian fishery for pelagic *S. mentella* in the Irminger Sea and Divisions 1F, 2H and 2J of the NAFO Convention Area lasted from April to October (WD09). 34 trawlers of different types participated in the fishery. Fishing of *S. mentella* spawning concentrations started in April in the traditional area close to the Icelandic EEZ in a depth range of 600 to 900 m. During the second quarter, *S. mentella* were fished in the open waters of ICES Subarea XIV, where the CPUE was about 0.77 t/h. 48% of the catch and 57% of fishing effort were registered in the Southwest to ICES Subarea XII and the Greenlandic EEZ to the depth of 200-650 m. At the same time, in July-September, fishery for *S. mentella* was conducted in Subarea XIV in the 500-900 m depth range, where the CPUE was around 0.90 t/h. At the end of July, Russian vessels started to fish *S. mentella* in the NAFO Convention Area at a depth of 190-320 m. In July-September, the CPUE in the NAFO Convention Area was estimated at 1.29 t/h. The total Russian catch in 2004 is provisionally estimated to be 32,193 tonnes in ICES Subareas XII and XIV and 12,083 tonnes in the NAFO Area.

#### **10.1.2.9 Spain**

Four Spanish freezer trawlers fished pelagic redfish in 1995-1997, increasing to 6 vessels since 1998. The fleet has used a Gloria-type pelagic trawls, with a maximum vertical opening of 80-120 m. The Spanish pelagic fishery of redfish in ICES Subareas XII and XIV and in NAFO Divisions 1F and 2J between 2000 and 2004 showed a significant seasonal pattern in terms of its geographical and depth distribution. The effort in the first and fourth quarter is occasional and very low. Effort in 2004 increased by more than 150 fishing days, and most of this increase was carried out inside the Greenland EEZ in the third quarter. The fishing season occurs mainly during the second and third quarter of the year. In the second quarter, the fleet operates in Subarea XIV, between the Greenlandic and Icelandic EEZs, in depths greater than 500 meters capturing fish of bigger size. The proportion of females in the catches is greater than for the males, the female length distributions in the catches present two clear modes. The yields obtained in this quarter are larger. In the third quarter, the fleet moves towards the Southwest to ICES Subarea XII and NAFO Division 1F and 2J, and the depth of the hauls is less than 500 meters. The length distributions of the catches are smaller than those of the second quarter and show only one mode. The proportion of the males in the catches is larger than for the females. The yields are smaller than those of the second quarter. The fishery in NAFO Div. 1F and 2J is more similar to that one carried out in ICES Subarea XII than fishery in Subarea XIV, particularly in the characteristics of the catches (distributions of sizes, sex ratios, yield, etc.) and season.

#### **10.1.2.10 Other nations**

No information on the fishing areas, seasons and depths of other fleets was available to the Working Group.

#### **10.1.3 Discards**

Discard is at present not considered to be significant for this fishery. Icelandic landings of oceanic redfish were raised by 16% prior to 1996 taking into account discards of redfish infested with *Sphyrion lumpi*. This value was based on measurements from 1991-1993 when the fishery was mostly on depths shallower than 500 m. In May-July 1997, discard measurements on 10 vessels showed a discard rate of 10%. This was added to the landings in 1996 and 1997. Measurement from 1998 shows that the discard rate had decreased to 2%. Information from observers from 2000-2004 indicate that discards is negligible, and therefore no catches were added to the Icelandic landings during that period.

Norwegian fishermen have earlier reported approximately 3% discards of redfish infested with parasites. This percentage has in recent years become less due to a change in the production from Japanese cut to mainly fillets at present.

The Spanish discards are based on measurements made by the scientific observers. Discard of the Spanish fleet were often composed of fish infested with *Sphyrion lumpi*. In 1995, about 4% of the total catches were discarded, while in 1996, it was 6.5 %. In recent years, the discards quantities varied annually, from almost no discards in 2000 and 2001 to 6% of total catches in 2003. This variability can also be observed by area, and in 2004, the discarded percentage is larger in the Divisions XII, 1F and 2J. In Division XIV, this variability can be due to that the percentage of discards does not depend directly on fish infested by *Sphyrion lumpi*, but it is related with the haul catch. When the haul catch is very much, the fish is discarded under worse conditions by the lack of time to process the whole catch. When the catches are between the standard values, there is enough time to work up the whole fish, even the one infested, and there is not discards. In Subarea XII, Div. 1F and 2J, the discards rates are more related with parasite fish.

The level of redfish discarded by the Portuguese fleet, based on the observer reports, has been very small, between 0.6 and 1.0% of the catch. In 2003 and 2004, discards amounted to 3.8% and 2.1%, respectively.

No information on possible discards was available from other countries participating in this fishery.

#### **10.1.4 Illegal Unregulated and Unreported Fishing (IUU)**

The WG has during the last years identified problems with of unreported catches of pelagic redfish. There have been observations of individual vessels from nations not reporting catches to international organisations like ICES/NEAFC/FAO/NAFO. These unreported catches have, however, not been quantified as the number of nations not reporting has been unknown and hence the effort of their vessels is unknown. During the NWWG meeting in 2004, a presentation of ongoing EU project (IMPAST) dealing with this issue was given (WD29 of NWWG2004). Two studies were conducted by the EC Joint Research Centre using a satellite imagery vessel detection system (VDS) to detect fishing vessels in the NEAFC regulated redfish fishery, south west Iceland, and indicated that the unreported effort might be of significant amount and that during the observations in June 2002 and 2003, the effort could be more than 25% higher than reported to NEAFC.

#### **10.1.5 Trends in landings**

At the beginning of the fishery in 1982, landings of pelagic redfish were reported from both Subareas XII and XIV (Table 10.1.1). Most of these were taken in Subarea XII (40 000-60 000 t) prior to 1985, and then a greater fraction was reported from Subarea XIV. The landings from Subarea XII were again in the majority in 1994 and in 1995 with 94 000 t and 129 000 t landed, respectively. In 1996-1999, the main part of the total landings was taken from Div. Va and Subarea XIV (Table 10.1.1). Since 2000, considerable amounts of the landings were taken in NAFO Div. 1F, 2J and 2H. In 2004, about 24 000 t were caught in the NAFO Regulatory Area which is a record high. Pelagic *S. mentella* fishery in ICES Div. Va started in 1992. The landings varied from 2 000-14 000 from 1992-1995. From 1995 to 2000, the landings in Div. Va increased to about 45 000 t (Table 10.1.1). Landings in Va in 2004 decreased significantly to 14 000 t.

Total landings estimated for 2003 (about 151 000 t) were the highest since 1996. The landings estimates for most recent years might increase due to the lack of reporting from some countries participating in the fishery, particularly evident in Subarea XII. Furthermore, as described in section 10.1.4, there is information on vessels from nations not reporting catches to any international organisation. As the effort of vessels from these nations is unknown, the WG had no possibilities to estimate them. Therefore the catches given in Tables 10.1.1-10.1.2 are to be considered as an underestimation of the actual catches, at least in most recent years. Accord-

ing to the data available to the Group, the total estimated landings in 2004 amounted to 124 000 t.

### 10.1.6 Biological sampling from the fishery

Length distributions of pelagic *S. mentella* from German, Icelandic, Polish, Portuguese, Russian and Spanish commercial catches were reported for 2004 (WD10, WD24, WD03, WD05, WD09, WD19). The length distributions by ICES and NAFO areas are given in Figures 10.1.9 and 10.1.10 for 2000-2004. The peak length in ICES Subarea XIV was usually 41-42 cm, whereas it was around 35 cm in ICES Subarea XII and NAFO Division 1F and 2J. This mostly reflects the general pattern of a fishery in deeper layers in Subarea XIV and shallower layers in Subarea XII and NAFO 1F and 2J. In 2001, the German catches in Subarea XIV were taken in shallower depths, resulting in markedly smaller fish landed (Figure 10.1.9). In 2004, the landed fish were generally slightly smaller than in previous years.

The biological sampling from catches and landings of pelagic *S. mentella* in each Subarea/Division and by gear type in 2004 is shown in the text table below.

COUNTRY	AREA	GEAR	LANDINGS (T)	NO. OF SAMPLES	NO. OF FISH MEASURED
Germany	XII, XIV and NAFO 1F, 2J	Pelagic	3,377	59	102,064
Iceland	XII, XIV and Va	Pelagic	35,725	60	7,935
Poland	XIV and NAFO 1F	Pelagic	2,907	?	14,582
Portugal	XII, XIV and NAFO 1F	Pelagic	4,419	102	8,160
Russia	XII, XIV and NAFO 1F, 2J	Pelagic	44,275	358	109,671
Spain	XII, XIV and NAFO 1F, 2J	Pelagic	11,675	70	14,110

Biological samples from the catches in recent years, and also the acoustic survey in 1999, suggested that a new cohort is entering into the fishable stock of pelagic redfish (Stransky, 2000). Age readings within an otolith exchange between Germany, Iceland, Norway, and Spain, based on material collected in July 1999, showed that this cohort is mainly consisting of 10 year old fish and that ageing error for fish older than 20 years is relatively high (Stransky *et al.*, 2005a). If agreement is defined as  $\pm 5$  years, approximately 90% agreement would be obtained. A second set of age reading results within an otolith exchange program between Germany, Iceland, Norway and Spain based on material collected in 1998 and 1999 (Stransky *et al.*, 2005a), showed the same results. Radiometric ageing (Stransky *et al.*, 2005b), however, indicated that especially larger pelagic *S. mentella* from depths >500 m are generally underestimated by traditional otolith annuli counts.

## 10.2 Trends in survey and CPUE indices

### 10.2.1 Acoustic data

Since the last available survey results are from May-June 2003, and the next survey will be carried out in June-July 2005, the trends in survey indices have to be re-evaluated after the availability of the next survey's report in late August 2005.

The most recent trawl-acoustic survey on pelagic redfish (*S. mentella*) in the Irminger Sea and adjacent waters was carried out by Germany, Iceland and Russia from late May to late June 2003. Approximately 405 000 NM<sup>2</sup> were covered. A total biomass of less than 100 000 tonnes was estimated at depths between 0 and 500 m and about 700 000 tonnes deeper than 500 m by using a standardized "trawl method". The redfish biomass of less than 100 000 t estimated acoustically down to the deep-scattering layer or about 350 m, with redfish having a mean length of 35.3 cm, is the lowest ever obtained since the beginning of the joint measurements. The highest concentrations of redfish were found around 60°N, east of Cape Farwell. Below 500 m, the densest concentrations were found in the NE part of the area. The average length of

the fishes caught below 500 m was 39.0 cm. The estimated abundance derived from the trawl data is considered highly uncertain.

**The results of the survey series are inconsistent and thus do hardly indicate the actual stock status of pelagic redfish.** To which extent biological effects or slight changes in the survey design (RV Walther Herwig III covered the south-western survey area in 2003 about 4 weeks earlier than in 2001) contributed to this inconsistency is unknown. The fishery in the area south of Cape Farwell does not support the outcome of the survey as the CPUE from July and onwards show a similar situation as has been observed in recent years.

The main results of the 2003 trawl-acoustic survey (ICES CM 2003/D:08) are given in Tables 10.2.1-10.2.3 and the results of earlier surveys are also given in Table 10.2.1.

Since 1994, the results of the acoustic estimate (<500 m depth) show a drastic decreasing trend. The estimate was only 700 000 and 100 000 t in 2001 and 2003, respectively, compared to 2.2, 1.6, and 0.6 mio. t in 1994, 1996 and 1999, respectively. This represents a reduction of about 2 mio. t in the period. During the same period, the total catch (not divided by depth) has been about 1 mio. t. Therefore, the removed biomass alone cannot explain the changes in the stock estimate. During this period, the fishery has also developed towards greater depths and towards bigger fish, and in recent years, the majority of the catch has been caught at depths > 500 m. Thus, acoustic estimates cannot be considered as accurate measures of relative changes in stock size of the upper layer fish, as availability may have changed during the surveyed period, both horizontally and vertically.

### **10.2.2 Trawl estimate**

In addition to the acoustic measurements, an attempt was made to estimate the redfish within and below the deep-scattering layer, using the same methods as was applied in the 2001 survey. This was done by correlating catches and acoustic values at depths between 100 and 450 m. The obtained correlation was used to convert the trawl data at greater depths to acoustic values and from there to abundance (ICES CM 2003/D:08). For that purpose, standardised trawl hauls were carried out at different depth intervals (three depths intervals in hauls >500 m depth and two depth intervals in shallower hauls), evenly distributed over the survey area (Figure 10.2.1 and Figure 10.2.2). Data for the correlation calculations between trawl catches and the acoustic results were obtained during the trawl - acoustic survey in 2001, as the acoustic values in 2003 did not allow such regression during the survey. As the correlation between the catch and acoustic values is very low, the abundance estimation obtained from this exercise makes the method questionable and also the assumption that the catchability of the trawl is the same, regardless of the trawling depth. Estimates based on the above-described calculations, both above and below 500 m depth, must be considered as a very rough measure with high uncertainty as the applicability of the method can only be verified after replicate measurements.

By applying the trawl approach, biomass in the depth layers from 0-500 depth, including the layer where the redfish are mixed with the deep-scattering layer, was estimated less than 100 000 t, nearly the same value as with the acoustics.

About 700 000 t was estimated by the trawl-acoustic method deeper than 500 m. At these depths, the densest concentrations were found in the NE part of the survey area (Fig. 10.2.2). The average length of the fishes caught deeper than 500 m was 39.0 cm. Hydrographic observations indicated that the highest concentrations of redfish deeper than 500 m were associated with eddies and fronts.

### 10.2.3 CPUE

Non-standardised CPUE series for the largest fleets (representing about 80% of landings) are given Table 10.2.4 and Figures 10.2.3a-c. Figures 10.2.3.a and 10.2.3.b show the CPUE from different fleets in recent years, in depths shallower and deeper than 500 m, respectively. Since 1995, there is no trend in CPUE, both shallower and deeper than 500 m, except for the Icelandic fleet where the CPUE has been increasing slightly. The difference between these indices might be because the Icelandic EEZ is closed for other fleets and therefore only Icelandic vessels can follow the migration of the fish when it has entered the Icelandic EEZ. In 2004, the CPUE indices decreased markedly in the deeper layer (Figure 10.2.3b).

Standardised CPUE (Figure 10.2.4), derived from a GLM CPUE model incorporating data from Germany (1995-2003), Iceland (1995-2004), Greenland (1999-2004), Faroe Island (1995-2004), Russia (1997-2004) and Norway (1995-2003) is given. The model takes into account year, month, vessel and area (North - South; see Figure 10.2.5). The model was run on data from a joint database (WD13) and the outcome of three model runs are given in Tables 10.2.4a-c. The model shows that the index is fluctuating both for the south-western and north-eastern fishing area. The model gives an increasing trend in 2002 and 2003 in the northern area with values similar to that in 2000. The CPUE in the southwestern area remains similar as in previous years. In 2004, the combined CPUE decreased again to the 2000 level, mainly due to the decrease of the Icelandic CPUE in the northern area (Figure 10.2.4). It has to be noted, however, that data from Germany and Norway are not included yet for 2004.

### 10.2.4 Ichthyoplankton assessment

The traditional ichthyoplankton survey, conducted by Russia in 1982-1995 has not been carried out since 1996. The historical series of ichthyoplankton surveys was presented in the 2000 Working Group report (ICES CM 2000/ACFM:15).

## 10.3 State of the stock

At present, the state of the stock is unknown.

The results of the international trawl-acoustic survey series are inconsistent in terms of inter-annual variation of the acoustic estimates and thus do hardly indicate the trend or actual stock status of pelagic redfish.

Although varying, the available commercial CPUE series has remained stable since 1995. It is, however, not known to what extent CPUE series reflect change in stock status of pelagic *S. mentella*. The fishery is focusing on aggregations.

Above average recruitment can be derived from recent survey observations on the East Greenland shelf, which is assumed to contribute to the pelagic stock.

The Group compiled all data except the results from the international survey in June/July 2005, and a review and final advice will be given in October to include the survey data.

## 10.4 Management considerations

The working group had again difficulties in obtaining catch estimates from the various fleets like in the past and information presented during the meeting indicates that unreported catches might be of substantial amount. Furthermore, landings data were missing from some ICES nations. The group encourages NEAFC to try to provide ICES with all information that might enable the WG to come up with more reliable catch statistics. Despite these problems with unreported catches, catch figures that were available to the WG shows that the catches are rising in the last years, exceeding the quota of 120 000 t set by NEAFC by more than 20%.

An update on the pelagic fishery, in particular with respect to seasonal and area distribution, was requested in the ToR. Catch rates in the southwestern area (almost exclusively shallower than 500 m) remained steady but low, and in the northeastern area (deeper than 500 m) fluctuated but remained steady overall. The main new feature of the fishery in recent years is a clear distinction between two widely separated grounds fished at different seasons and different depths. Since 2000, the southwestern fishing ground extended also into the NAFO Convention Area. The parameters analysed so far do suggest, however, that the aggregations in the NAFO Convention Area do not form a separate stock component. NAFO Scientific Council agrees with this conclusion (NAFO, 2005).

ToR d) requested to “update survey and fishery information on the stocks of redfish in Subareas V, VI, XII and XIV. In particular, update information on the on the horizontal and vertical distribution of pelagic redfish and fisheries in the Irminger Sea and adjacent waters as well as seasonal and inter annual changes in distribution. This information should allow NEAFC to further consider the appropriateness of separate management measures of different geographical areas/seasons”.

The Group concludes that at this time there is not enough scientific basis available to propose an appropriate split of catches among the two fisheries/areas.

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 (2<sup>nd</sup> quarter) is mainly targeting at larger and postspawning fish.

The Group expects that under the current TAC regulations, a greater share of the catches in 2005 will be taken in the northeastern area.

The values of the parameters used in the age-based production model in the NWWG Report 1995 (ICES, 1995) that was the basis to suggest a 5% exploitation rate, are not considered the most appropriate regarding the current knowledge of the fishery and the biology of the species. Since 1995, the fishery was conducted predominantly in depths >500 m, targeting at bigger fish with a peak length around 40 cm and maximum lengths of 50 cm. These fish also show a significantly slower growth than previously assumed, as recent radiometric age validation results have shown (Stransky *et al.*, 2005b). The basic assumptions of  $L_{inf}=40$  cm and  $k=0.12$  (ICES, 1995) are, therefore, not valid for the estimation of exploitation rates. The sensitivity of changes in the parameters of the model have, however, not been fully evaluated yet.

## 10.5 Comments on the assessment

The results of the international trawl-acoustic survey are given in chapters 10.2.1 and 10.2.2. Given the high variability in the correlation between trawl and acoustic estimates as well as the assumptions that need to be made about constant catchability with depth and across stocks, the uncertainty of these estimates is very high.

It is not known to what extent CPUE reflect changes in the stock status of pelagic *S. mentella*. The fishery is focusing on aggregations. Therefore, CPUE series might not indicate or reflect actual trends in stock size.

The WG has during the last years identified problems with of unreported catches of pelagic redfish. There have been observations of individual vessels from nations not reporting catches. These unreported catches have, however, not been quantified as the number of nations not reporting has been unknown and hence the effort of their vessels is unknown.

## 10.6 Pelagic Surveys on *S. mentella*

The survey to monitor the pelagic redfish has been conducted in international collaboration with Iceland, Russia and Germany in 2-3 years intervals. During the last decade, the survey

design changed as the fishery explored new fishing grounds in horizontal and vertical extension. The latest surveys consistently covered an area of 405 000 nautical square miles in ICES Div. Va, XII, XIV and NAFO Divisions 1F, 2GHJ, which is believed the horizontal stock extension, although there are strong indications for relationships with the demersal redfish on the continental shelves at certain areas and seasons (Icelandic fishery in 2003 close to the shelves and recruitment impulses from East Greenland). Vertical coverage of the hydro-acoustic recording of redfish varied among years in relation to the upper boundary of the deep scattering layer, in which redfish echoes are difficult to identify. Since 2001, the varying depth layer of the deep scattering layer and below down to 1 000 m were covered by standard trawl hauls to account for the incompletely covered vertical depth distribution of the pelagic redfish. Such survey hauls were converted into hydro-acoustic measured by means of regression. The stock abundance estimates deeper than 500 m are considered highly uncertain.

Previously, the survey results have not been used for provision of management advice. They indicated a steep decrease in stock size which hardly could be explained by the fishery. Especially the most recent results derived in 2003 are inconsistently low in the depth zone shallower than 500 m, i.e. the survey did not identify redfish concentrations which supported a successful fishery just few weeks later. It remains unknown to which extent the tight research vessel employments in 2003, which caused a change in the survey timing to one month earlier than usual (May/June instead of June/July), affected the mismatch between the survey results and the fishery data.

Taking the importance of the availability of fishery independent information about the pelagic redfish resource and the recent changes in the survey design and their results into account, the NWWG recommends a continuation of the international survey. In order to avoid unknown seasonal effects, the survey will be conducted in June/July 2005, the period when both the pelagic redfish shallower and deeper than 500 m can be monitored.

The Study Group on Redfish Stocks [SGRS] met in January 2005 to review the survey design of the international trawl-acoustic surveys in the Irminger Sea and adjacent waters, to advise on the required frequency, number of vessels needed and the timing of the future surveys and to plan the international survey on redfish to be carried out in June/July 2005 (ICES CM 2005/D:02). Recommendations for the upcoming survey in June/July 2005 and for future work were developed by the Group. Especially the signal-to-noise ratios and target strength models applied within the hydroacoustic measurements require further experimental work. The use of a lower transducer frequency (18 kHz) was also considered as a possibility for the estimation of redfish density below the DSL. Three vessels from Germany, Iceland and Russia will participate in the survey and operate within an area of around 400 000 NM<sup>2</sup> in the Irminger and Labrador Sea in June-July 2005 to estimate the abundance and biomass of pelagic redfish. In the depth zone that can be surveyed by hydroacoustic measurements, i.e. shallower than the "deep-scattering layer" (DSL) (down to about 350 m), hydroacoustic measurements and identification trawls will be carried out, whereas within and below the DSL (down to about 1000 m), redfish abundance can currently only be estimated by trawls. Although an annual survey would certainly allow an improved estimation of interannual changes in distribution and abundance, the SGRS felt that the continuation of bi-annual surveys would be more realistic, considering limitations in national budgets for survey time. SGRS recommends that at least four vessels should participate to allow a sufficiently dense coverage of the survey area. The efforts directed at involving other nations in the survey should be continued. Since the most recent survey in May-June 2003 was carried out about 3 weeks earlier than previous surveys and pointed to considerable seasonal effects, SGRS recommends to keep the timing of the survey from (mid-)June to (mid- to late) July.

## **10.7 Environmental conditions**

### **10.7.1 Water masses shallower than 500 m**

Strong positive anomalies of temperature observed in the upper layer of the Irminger Sea with a maximum in 1998, are related to an overall warming of water Irminger Sea and adjacent areas in 1994-2003. These changes were also observed in the Irminger Current above Reykjanes Ridge (Pedchenko, 2001), off Iceland (Malmberg *et al.*, 2001; Malmberg and Valdimarsson, 2003) and in the Labrador Sea water (Mortensen and Valdimarsson, 1999). Thus, an increase in temperature and salinity has been found in the Irminger Current since 1997 to higher values than for decades, as well as a withdrawal of the Labrador Sea water due to a slow-down of its formation by winter convection since the extreme year 1988 (ICES, 2002). In May-June 2003, a continuing warming-up of the 0-200 m layer was discovered, mainly northern part of the Irminger Sea around Irminger Current. At the same time decreasing temperature is observed in the southwest and spreading LCW and LSW in up 200-meters layers was recorded due to southern shift border of NACW. At depths between 200 and 500 m, a positive anomalies on the most part of the observation area was observed, but increasing temperature as compared to last survey in June-July 2001 was obtained only north of 60° N in flow Irminger Current above Reykjanes Ridge and northwestern part sea. Within the known spawning areas of redfish near Reykjanes Ridge, decreasing temperature on depth below 400 m was observed. These changes of oceanographic condition might have an effect on the seasonal distribution of redfish, places and periods of spawning, direction and time of feeding migrations and as a result, peculiarities of redfish aggregations.

### **10.7.2 Water masses deeper than 500 m**

Deeper than 500 m, a positive anomaly on the most part of the observation area was observed. Increasing temperature as compared to the last survey in June-July 2001 was obtained only north of 60°N in the Irminger Current above the Reykjanes Ridge and the northwestern part of the Irminger Sea. Within the known spawning areas of redfish near Reykjanes Ridge, decreasing temperature on depth below 400 m was observed.

**Table 10.1.1 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 Sub-areas XII and XIV is only approximate in latest years.**

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

**Table 10.1.2 Pelagic *S. mentella* catches (in tonnes) in ICES Div. Va, Sub-areas XII, XIV and NAFO Div. 1F, 2H and 2J by countries used by the Working Group.**

Year	Bulgaria	Canada	Estonia	Faroes	France	Germany	Greenland	Iceland	Japan	Latvia	Lithuania	Nederland	Norway	Poland	Portugal	Russia	Spain	UK	Ukraine	Total
1978	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1980	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0	0	0	0	0	0	581	0	60.000	0	0	0	60.581
1983	0	0	0	0	0	155	0	0	0	0	0	0	0	0	0	60.079	0	0	0	60.234
1984	2.961	0	0	0	0	989	0	0	0	0	0	0	0	239	0	60.643	0	0	0	64.832
1985	5.825	0	0	0	0	5.438	0	0	0	0	0	0	0	135	0	60.273	0	0	0	71.671
1986	11.385	0	0	5	0	8.574	0	0	0	0	0	0	0	149	0	84.994	0	0	0	105.107
1987	12.270	0	0	382	0	7.023	0	0	0	0	0	0	0	25	0	71.469	0	0	0	91.169
1988	8.455	0	0	1.090	0	16.848	0	0	0	0	0	0	0	0	0	65.026	0	0	0	91.419
1989	4.546	0	0	226	0	6.797	567	3.816	0	0	0	0	0	112	0	22.720	0	0	0	38.784
1990	2.690	0	0	0	0	7.957	0	4.537	0	0	0	0	7.085	0	0	9.632	0	0	0	31.901
1991	0	0	2.195	115	0	571	0	8.783	0	0	0	0	6.197	0	0	9.747	0	0	0	27.608
1992	628	0	1.810	3.765	2	6.447	9	15.478	0	780	6.656	0	14.654	0	0	15.733	0	0	0	65.962
1993	3.216	0	6.365	7.121	0	17.813	710	22.908	0	6.803	7.899	0	14.990	0	0	25.229	0	0	2.782	115.835
1994	3.600	0	17.875	2.896	606	17.152	0	53.332	0	13.205	7.404	0	7.357	0	1.887	17.814	0	0	5.561	148.689
1995	3.800	602	16.854	5.239	226	18.985	1.856	34.631	1.237	5.003	22.893	13	7.457	0	5.125	44.182	4.554	0	3.185	175.842
1996	3.500	650	7.092	6.271	0	21.245	3.537	62.903	415	1.084	10.649	0	6.842	0	2.379	45.748	7.229	260	518	180.322
1997	0	111	3.720	3.945	0	20.476	0	41.276	31	0	0	0	3.179	886	3.674	36.930	8.707	0	0	122.935
1998			3.968	7.474	0	18.047	1.463	48.519	31		1.768		1.139	12	4.133	25.837	4.577	0		116.968
1999			2.108	4.656	0	16.489	4.269	43.923	0				5.435	6	4.302	17.957	10.332	188		109.665
2000			11.811	2.837	0	12.499	4.204	45.232	0		450		5.194	0	3.731	29.224	10.894	0	0	126.076
2001			887	7.703		10.669	3.309	42.472			15.689		5.222		2.514	30.012	10.082			128.559
2002				4.475		13.212	4.099	44.492		1.061	14.656		5.291	429	3.086	36.219	8.407			135.427
2003				4.432		10.608	4.450	48.398		371	14.321		8.399	917	3.989	44.056	10.835			150.776
2004				5.018		3.377	3.169	35.725		613	3.697		9.052	2.907	4.419	44.276	11.675			123.927

**Table 10.1.3 Pelagic *S. mentella* catches (in tonnes) in 2004 by countries and depth (A), and in 1996-2004 by depth (B). (Working Group figures and/or as reported to NEAFC).**

<b>A.</b>	<b>TOTAL</b>	<b>NOT SPLITTED</b>	<b>SHALLOWER THAN 600 M</b>	<b>DEEPER THAN 600 M</b>
Faroese	5.018		19 %	81 %
Germany	3.377		47 %	53 %
Greenland	3.169			100 %
Iceland	35.725		20 %	80 %
Lithuania	3.697	100 %		
Norway	9.052	100 %		
Poland	2.907		40 %	60 %
Portugal	4.419		11 %	89 %
Russia	44.275		34 %	66 %
Spain	11.675		14 %	86 %
Total				

**Derived from effort data**

<b>B.</b>	<b>TOTAL</b>	<b>NOT SPLITTED</b>	<b>SHALLOWER THAN 600 M</b>	<b>DEEPER THAN 600 M</b>
1996	180.322	18 %	20 %	62 %
1997	122.935	7 %	24 %	69 %
1998	116.968	0 %	21 %	79 %
1999	109.665	5 %	20 %	75 %
2000	126.076	23 %	28 %	49 %
2001	128.559	23 %	27 %	50 %
2002	135.427	26 %	19 %	55 %
2003	150.776	10 %	25 %	65 %
2004	123.927	10 %	23 %	67 %

**Table 10.2.1 Pelagic redfish *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).**

YEAR	AREA COVERED (1000 NM <sup>2</sup> )	ACOUSTIC ESTIMATES < 500 M (10 <sup>6</sup> IND.)	ACOUSTIC ESTIMATES < 500 M (1000 T)	TRAWL ESTIMATES < 500 M (10 <sup>6</sup> IND.)	TRAWL ESTIMATES < 500 M (1000 T)	TRAWL ESTIMATES > 500 M (10 <sup>6</sup> 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

**Table 10.2.2a. Results from experimental estimation of redfish between 0 and 500 m in May-June 2003.**

Subarea	Area, sq. nm	Mean Sa (tr) sq. m/sq. nm	Mean Density, tonn/sq. nm	Mean Length, cm	Mean Weight, g	Abundance, 10 <sup>6</sup> sp	Biomass, 10 <sup>3</sup> tonn
<b>A</b>	114288.5	0.48	0.22	35.45	540.02	45.9	24.770
<b>B</b>	120560.8	0.88	0.39	35.03	517.74	91.8	47.549
<b>C</b>	31930.7	0.16	0.08	37.00	633.67	4.0	2.547
<b>D</b>	41127.8	0.20	0.10	36.87	613.39	6.4	3.927
<b>E</b>	62742.4	0.47	0.22	34.07	514.42	26.6	13.694
<b>F</b>	8217.1	0.00	0.00			0.0	0.000
<b>Total</b>	<b>378867.3</b>	<b>0.54</b>	<b>0.24</b>	<b>35.11</b>	<b>529.25</b>	<b>174.8</b>	<b>92.488</b>

**Table 10.2.2b Results from experimental estimation of redfish at depths below 500m in May-June 2003.**

Subarea	Area, sq. nm	Mean Sa (tr) sq. m/sq. nm	Mean Density, tonn/sq. nm	Mean Length, cm	Mean Weight, g	Abundance, 10 <sup>6</sup> sp	Biomass, 10 <sup>3</sup> tonn
<b>A</b>	114288.5	8.18	4.16	39.36	746.86	637.1	475.854
<b>B</b>	120560.8	2.39	1.17	38.37	688.14	205.8	141.648
<b>C</b>	31930.7	1.36	0.62	36.18	561.72	35.0	19.677
<b>D</b>	41127.8	0.71	0.32	35.65	532.91	24.6	13.098
<b>E</b>	62742.4	0.99	0.44	33.84	478.13	57.3	27.411
<b>F</b>	8217.1	0.06	0.03	32.50	425.94	0.5	0.222
<b>Total</b>	<b>378867.3</b>	<b>3.58</b>	<b>1.79</b>	<b>38.60</b>	<b>705.83</b>	<b>960.4</b>	<b>677.909</b>

**Table 10.2.3 Pelagic redfish *S. mentella*. 1999, 2001 and 2003 survey biomass estimates (trawl data) and area splitting between NAFO and NEAFC Convention areas by depth (shallower and deeper than 500 m).**

	NAFO (000 T)	NAFO %	NEAFC (000 T)	NEAFC %	SUM (000 T)
1999 < 500 m *	540	46.3	626	53.7	1166
1999 > 500 m	74	11.6	564	88.4	638
1999 Sum	614	34.0	1190	66.0	1804
2001 < 500 m	686	63.8	390	36.2	1076
2001 > 500 m	165	15.6	892	84.4	1057
2001 Sum	851	39.9	1282	60.1	2133
2003 < 500 m	18	19	75	81	93
2003 > 500 m	41	6	637	94	678
2003 Sum	59	8	712	92	771

\* acoustically measured

**Table 10.2.4 Pelagic *S. mentella*. Catch per unit effort (t/h) by country in Sub-areas XII and XIV.**

YEAR	BULGARIA	GERMANY <sup>2</sup>	ICELAND	NORWAY	USSR-RUSSIA (BMRT)
1982	-	-	-	-	1.99
1983	-	-	-	-	1.60
1984	1.25	-	-	-	1.48
1985	1.85	-	-	-	1.68
1986	2.04	-	-	-	1.35
1987	1.22	0.79	-	-	1.10
1988	0.82	1.28	-	-	1.00
1989	-	0.70	1.11	-	1.00
1990	-	0.89	1.02	1.09	0.99
1991	-	-	1.50	1.42	0.80
1992	-	-	1.66	1.79	0.63
1993	-	-	3.27	2.02	0.63
1994	-	-	2.64	2.83	1.70
1995	-	2.06	2.00	2.05	1.00
1996	-	1.45	1.74	1.20	1.30
1997	-	1.31	1.11	0.66	<sup>-3</sup>
1998	-	1.30	1.55	0.75	<sup>-3</sup>
1999	-	0.97	1.52	0.97	<sup>-3</sup>
2000	-	1.05	1.98	1.12	<sup>-3</sup>
2001	-	0.91	1.40	0.88	<sup>-3</sup>
2002	-	1.14	1.73	1.23	0.89
2003	-	1.09	2.67	-	1.10
2004	-	0.93	1.34	-	0.94

1 Preliminary

2 1987-1990 reported as GDR (FVSIV)

3 1997-2001 Russian effort data are only available as fishing days

**Table 10.2.5. a. Results of the GLM model to calculate standardized CPUE for pelagic redfish fishery, by depths shallower than 500 m (south-western area) including single tow data from Germany (1995-2003), Iceland (1995-2004), Greenland (1999-2004), Faroe Island (1995-2004), Russia (1997-2004) and Norway (1995-2003). Note that the full output is not shown.**

```
[1] "Southern area"

              Value Std..Error   t.value   ar     index
factor(yy)1996  0.345103061 0.27737622  1.24416959 1996 1.4121354
factor(yy)1997 -0.152816202 0.10859771 -1.40717701 1997 0.8582875
factor(yy)1998 -0.006889320 0.11223220 -0.06138452 1998 0.9931344
factor(yy)1999 -0.500055530 0.10181886 -4.91122691 1999 0.6064970
factor(yy)2000 -0.205182351 0.11761325 -1.74455140 2000 0.8144988
factor(yy)2001 -0.001802313 0.09969846 -0.01807764 2001 0.9981993
factor(yy)2002 -0.153116970 0.11205132 -1.36648970 2002 0.8580294
factor(yy)2003 -0.106097334 0.11122694 -0.95388164 2003 0.8993371
factor(yy)2004 -0.237537632 0.12720033 -1.86742934 2004 0.7885672

Gaussian model

Response: lafli

Terms added sequentially (first to last)
      Df Deviance Resid. Df Resid. Dev   Pr(Chi)
NULL                                545   1127.372
  ltoctimi  1  865.2478      544     262.125 0.0000000
  factor(yy)  9   35.3098      535     226.815 0.0000525
  factor(mm) 10   52.9378      525     173.877 0.0000001
  factor(vessel) 72  73.6781      453     100.199 0.4229887
```

**Table 10.2.5. b. Results of the GLM model to calculate standardized CPUE for pelagic redfish fishery, by depths deeper than 500 m (north-eastern area) including single tow data from Germany (1995-2003), Iceland (1995-2004), Greenland (1999-2004), Faroe Island (1995-2004), Russia (1997-2004) and Norway (1995-2003). Note that the full output is not shown.**

```
[1] "Northern area"

              Value Std..Error   t.value   ar     index
factor(yy)1996 -0.04241446 0.08632572 -0.4913306 1996 0.9584724
factor(yy)1997 -0.45634809 0.07858980 -5.8067089 1997 0.6335932
factor(yy)1998 -0.18624482 0.07954422 -2.3413998 1998 0.8300703
factor(yy)1999 -0.25639802 0.08269705 -3.1004494 1999 0.7738339
factor(yy)2000  0.04861440 0.08221893  0.5912799 2000 1.0498155
factor(yy)2001 -0.34152473 0.08069420 -4.2323329 2001 0.7106859
factor(yy)2002  0.02315355 0.08264182  0.2801674 2002 1.0234237
factor(yy)2003  0.11651492 0.08381810  1.3900926 2003 1.1235743
factor(yy)2004 -0.42658920 0.08561906 -4.9824096 2004 0.6527316

Response: lafli

Terms added sequentially (first to last)
      Df Deviance Resid. Df Resid. Dev   Pr(Chi)
NULL                                1342   2577.131
  ltoctimi  1 1945.697      1341     631.434 0.000000e+00
  factor(yy)  9   38.425      1332     593.009 1.462028e-05
  factor(mm) 11   43.519      1321     549.490 8.819300e-06
  factor(vessel) 86  274.022      1235     275.468 0.000000e+00
```

**Table 10.2.5. c. Results of the GLM model to calculate standardized CPUE for all pelagic redfish fishery, including single tow data from Germany (1995-2003), Iceland (1995-2004), Greenland (1999-2004), Faroe Island (1995-2004), Russia (1997-2004) and Norway (1995-2003). Note that the full output is not shown (lafli= log catch; ltogtimi=log trawling time).**

```
glm(formula = log(catch) ~ log(trawling_time) + factor(year) + factor(month) +
factor(vessel), family = gaussian(), data = tmp.data)
```

```
[1] "Combined areas"
```

	Value	Std..Error	t.value	ar	index
factor(yy)1996	-0.05890060	0.06935745	-0.8492326	1996	0.9428005
factor(yy)1997	-0.41527741	0.05794924	-7.1662269	1997	0.6601571
factor(yy)1998	-0.16511397	0.05928839	-2.7849291	1998	0.8477971
factor(yy)1999	-0.36185725	0.05895377	-6.1379831	1999	0.6963818
factor(yy)2000	-0.02506402	0.06085058	-0.4118946	2000	0.9752475
factor(yy)2001	-0.26798562	0.05882900	-4.5553323	2001	0.7649188
factor(yy)2002	-0.03634354	0.06108397	-0.5949767	2002	0.9643090
factor(yy)2003	0.02879823	0.06167302	0.4669502	2003	1.0292169
factor(yy)2004	-0.40196604	0.06574698	-6.1138332	2004	0.6690035

```
Gaussian model
```

```
Response: lafli
```

```
Terms added sequentially (first to last)
```

	Df	Deviance	Resid. Df	Resid. Dev	Pr(Chi)
NULL			1888	3719.004	
ltogtimi	1	2824.098	1887	894.906	0.00000000
factor(skip)	91	379.364	1796	515.542	0.00000000
factor(yy)	9	54.723	1787	460.820	0.00000001
factor(mm)	11	20.240	1776	440.580	0.04215951
factor(reitur)	1	7.642	1775	432.938	0.00570169

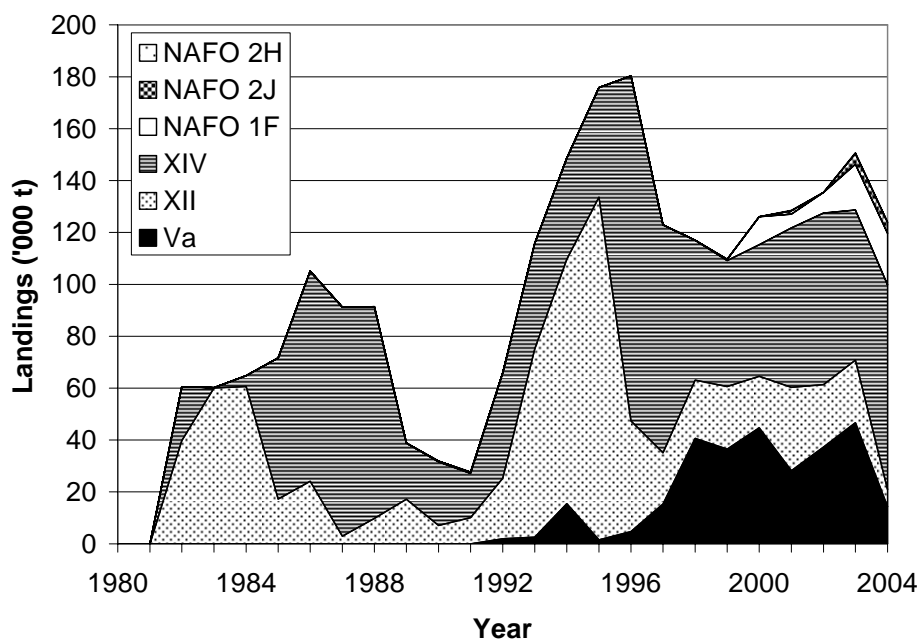


Figure 10.1.1 Landings of pelagic *S. mentella* (Working Group estimates, see Table 10.1.1).

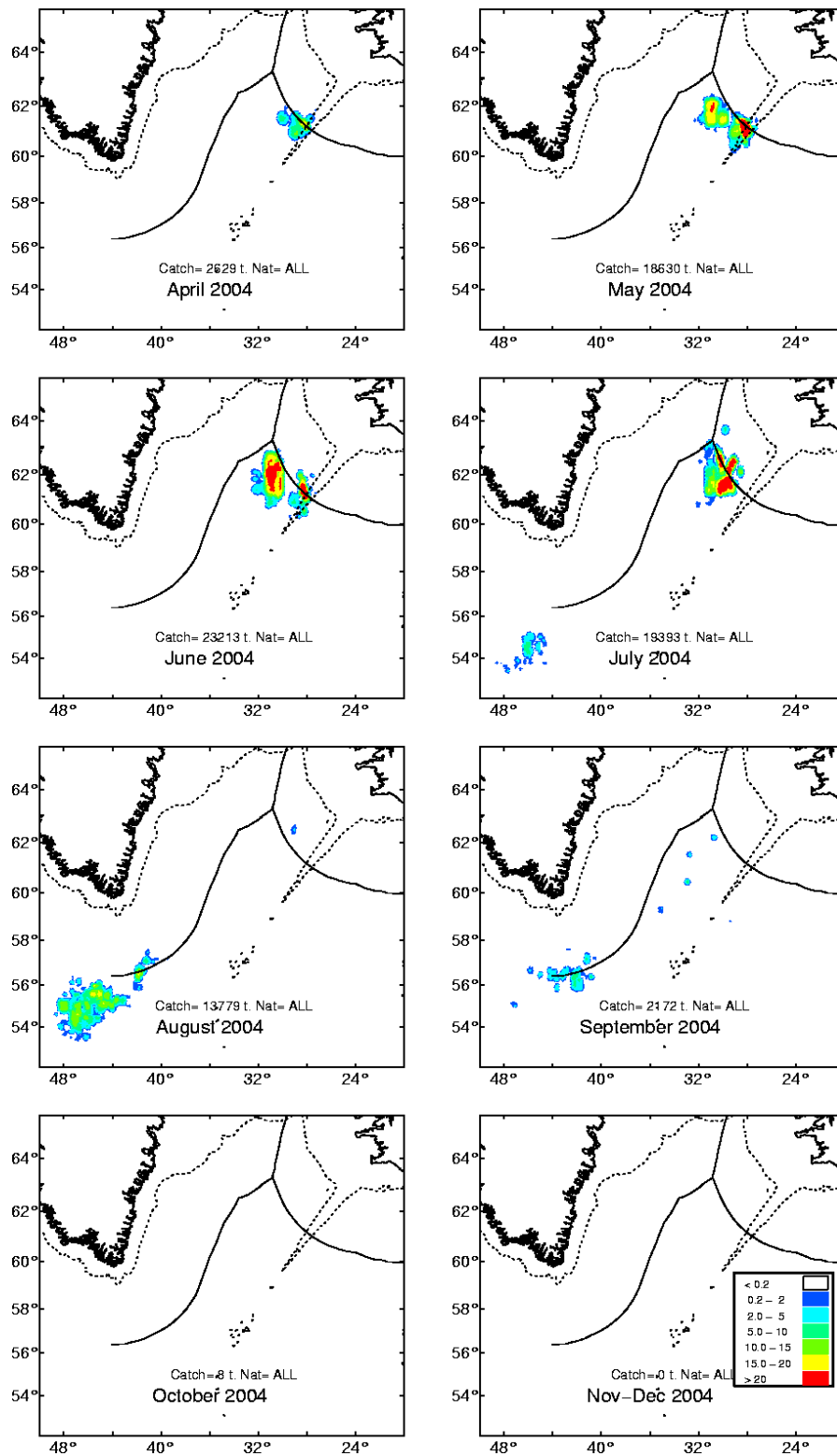
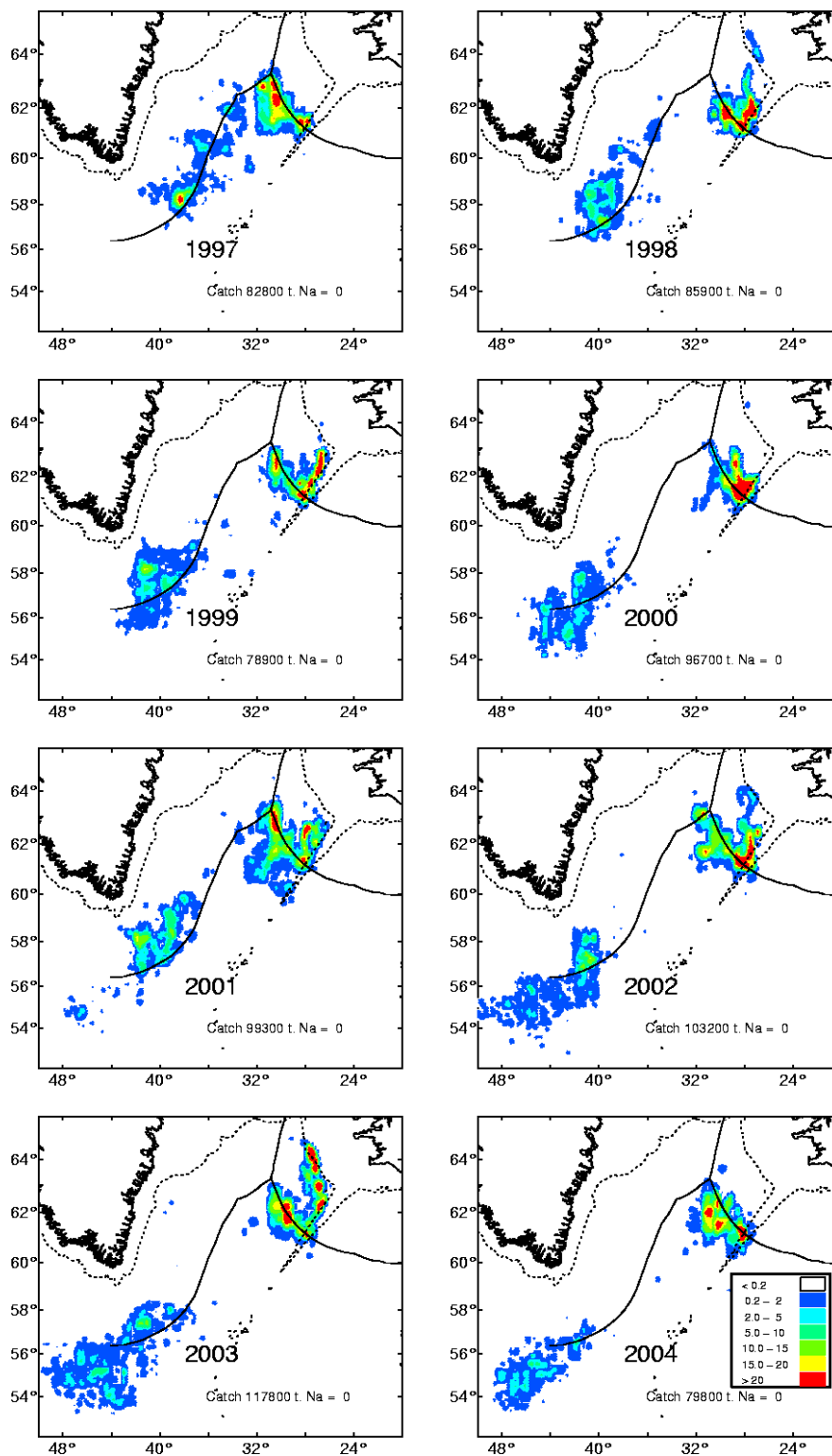
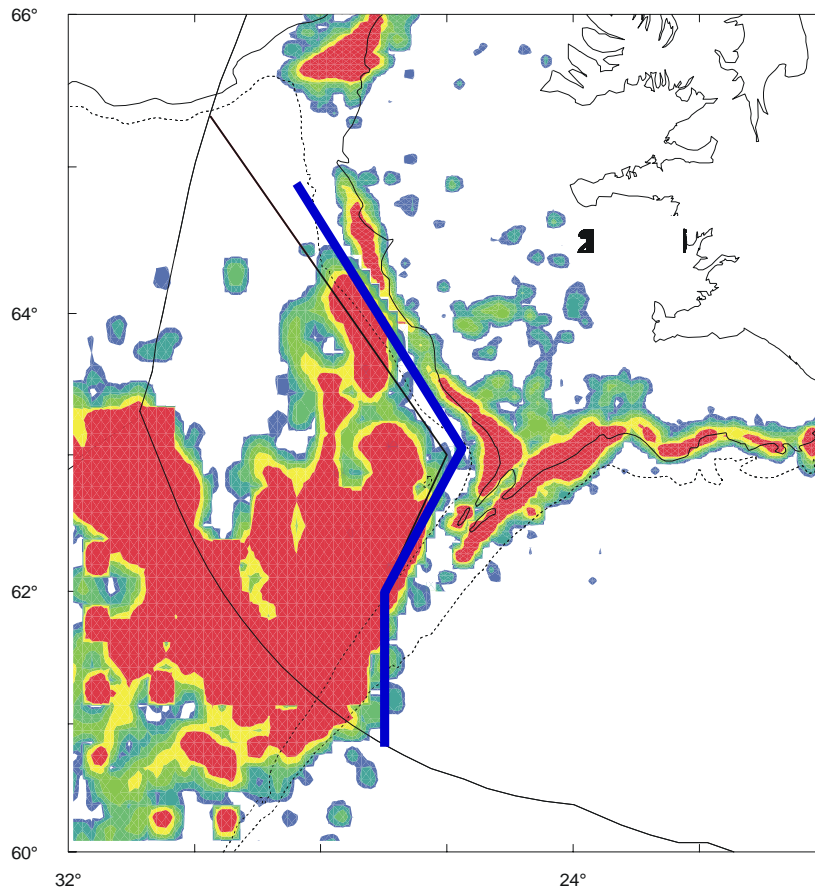


Figure 10.1.2 Fishing areas and total catch of the pelagic redfish (*S. mentella*) by month in 2004, derived from catch statistics provided by Faroes, Greenland, Iceland and Russia. The scale for the catch is in tonnes per squared nautical mile. Total catch for each period is also given.



**Figure 10.1.3** Fishing areas and total catch of the pelagic redfish (*S. mentella*) in the Irminger Sea and adjacent waters 1997-2004. Data are from the Faroes (1995-2004), Germany (1995-2003), Greenland (1999-2004), Iceland (1995-2004), Norway (1995-2003) and Russia (1997-2004). The scale given is tonnes per square nautical mile.



**Figure 10.1.4. Icelandic redfish catch southwest of Iceland in 2001-2003. The catch west of the “redfish line” (blue line) is from the pelagic redfish as the catch north and east of the line is of “shelf type”). The thin line is the "old redfish line"; the thick line is the line set in 2003.**

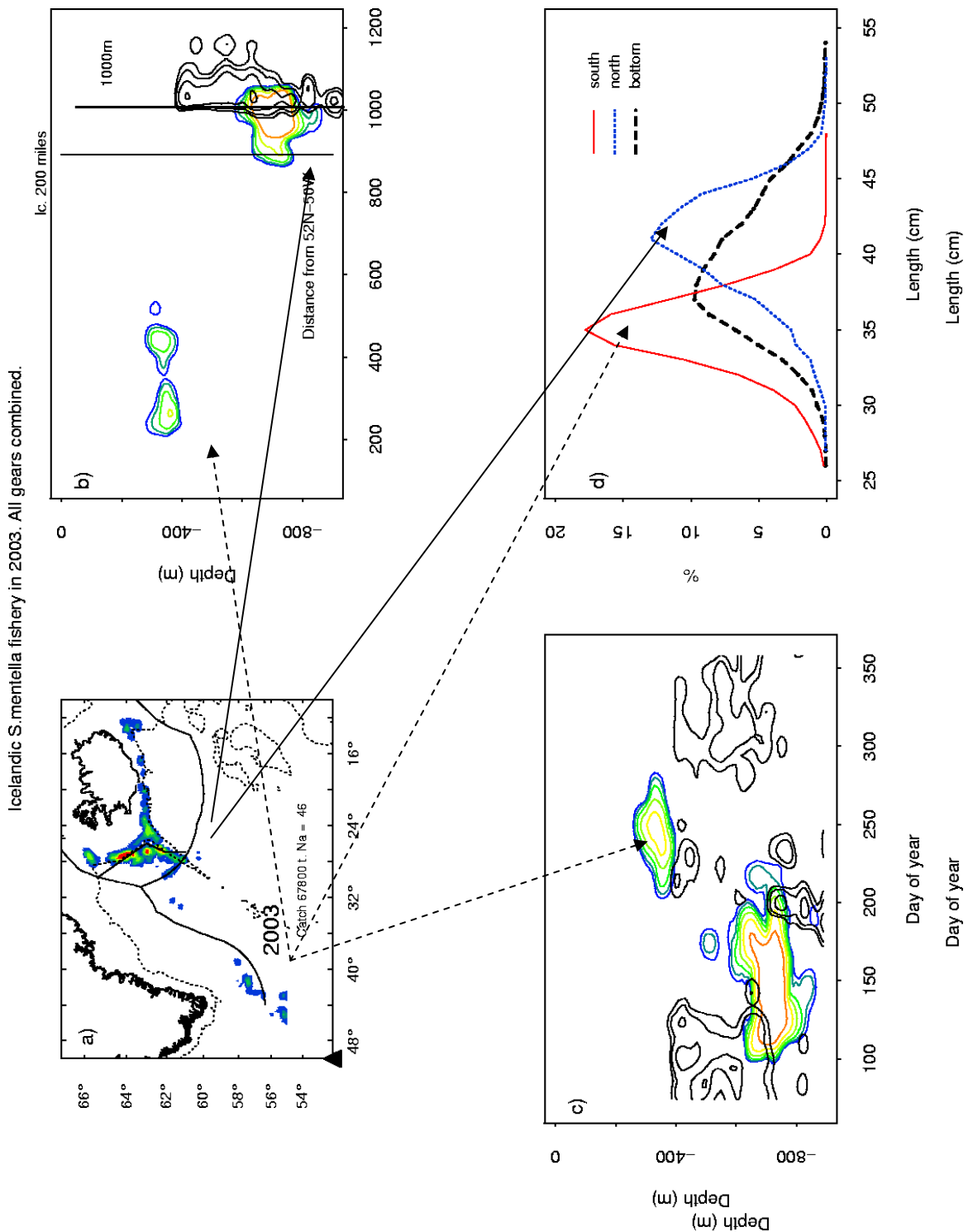


Figure 10.1.5. Graphic presentation on the *S. mentella* fishery in 2003. a) Geographic distribution of the catches where the colour indicates catches at each position. b) Distance-depth plot where distance (in miles) from fixed position is given. The fixed position is 52N-55W, indicated as ▲ on a). The contour lines indicate catches at given area and distance. The coloured contour represents the pelagic fishery, and the black contour indicates demersal fishery. c) Depth-time plot, where the y-axis is depth, x-axis is day of the year and the colour indicates the catches taken at given depth. Black = demersal, colour = pelagic fishery. d) Length distributions from different areas/gears. The lines on the figures explain the concordance between the different presentation of the data.

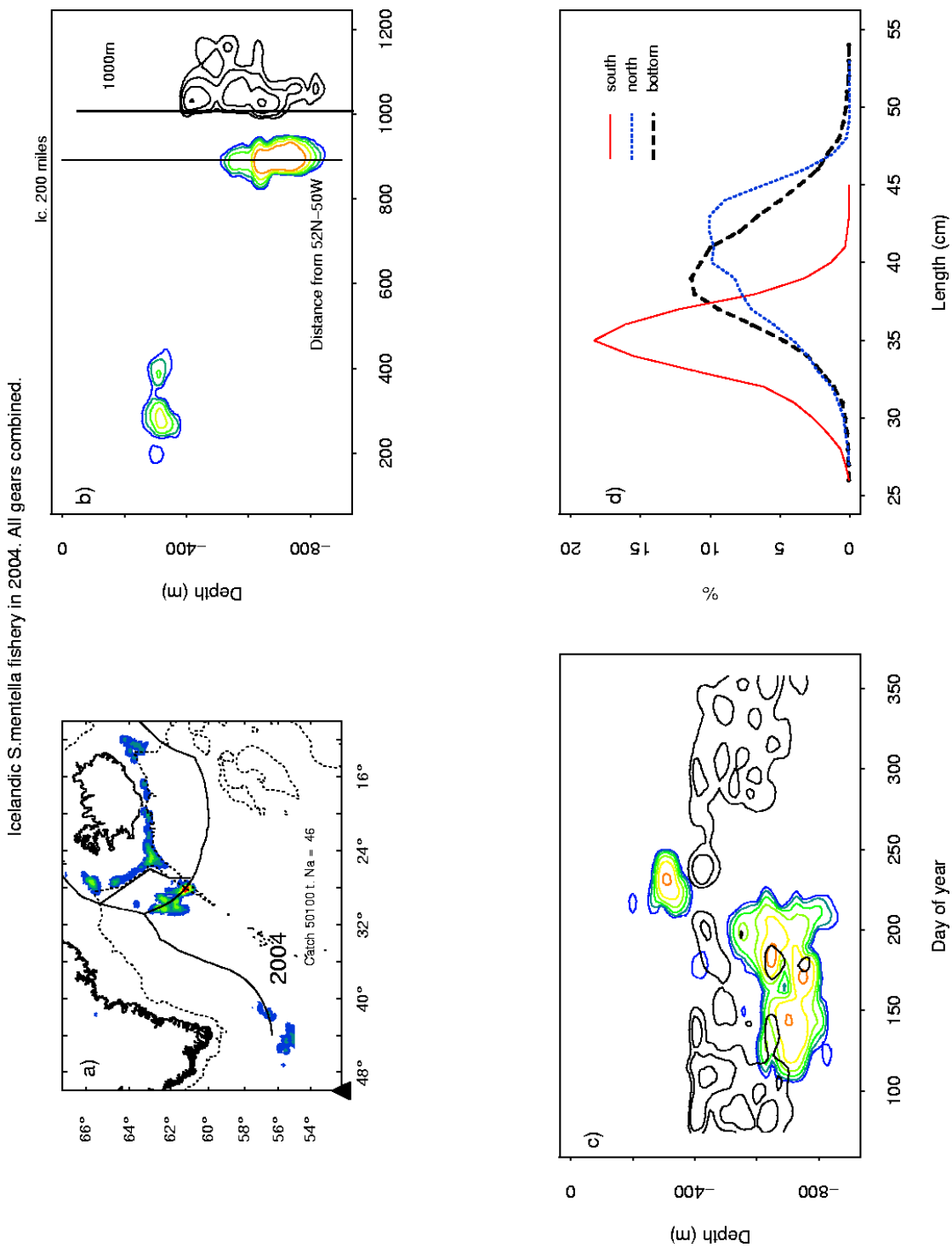


Figure 10.1.6. Graphic presentation on the *S. mentella* fishery in 2004. See Figure 10.1.5 for explanations.



Figure 10.1.7 Percentage of the catch of *S. mentella* by Russian vessels by depth in the Irminger Sea in 1982-2004.

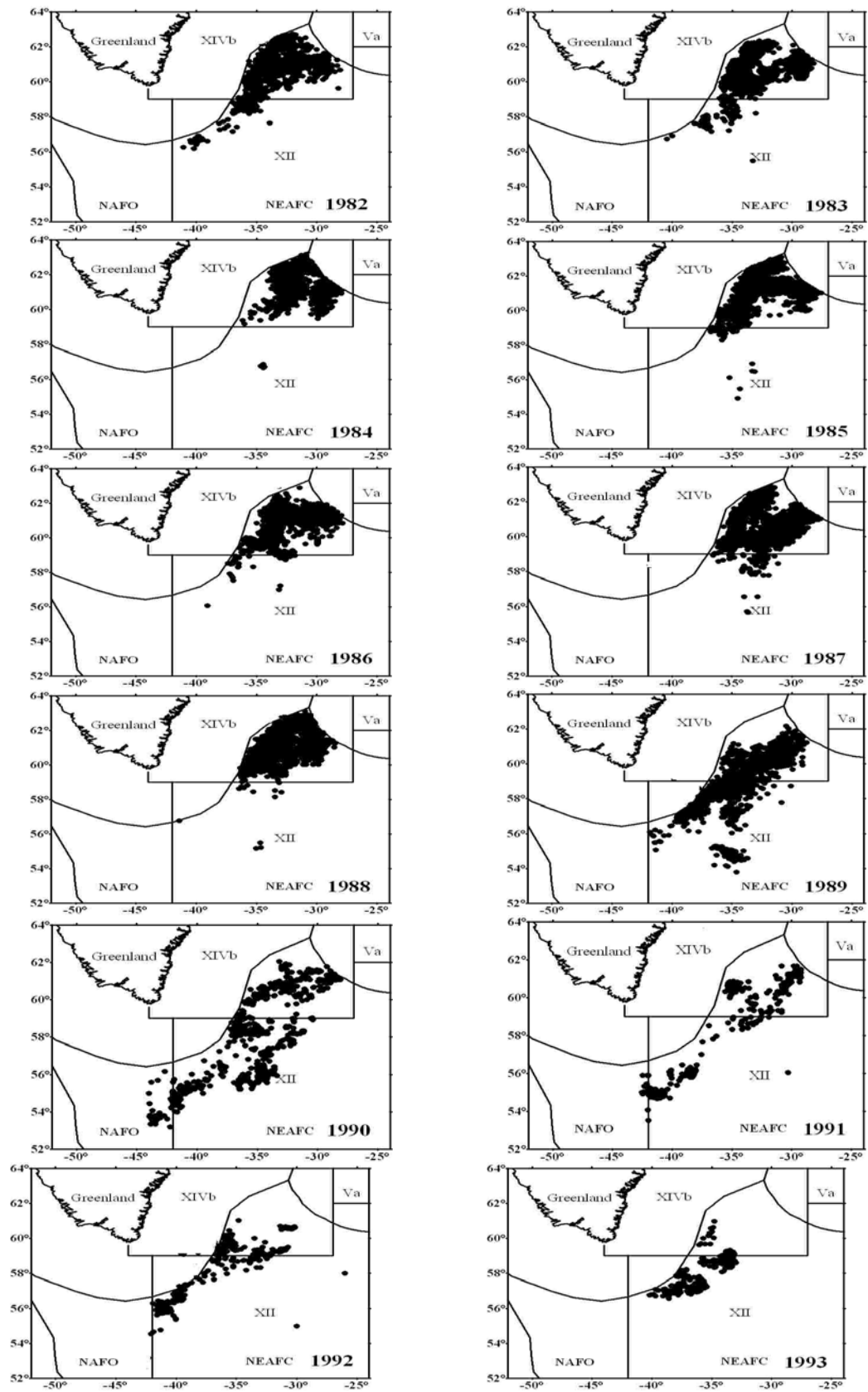


Figure 10.1.8. Location of the Russian fleet during fishery for *S. mentella* in the Irminger Sea in 1982-1993.

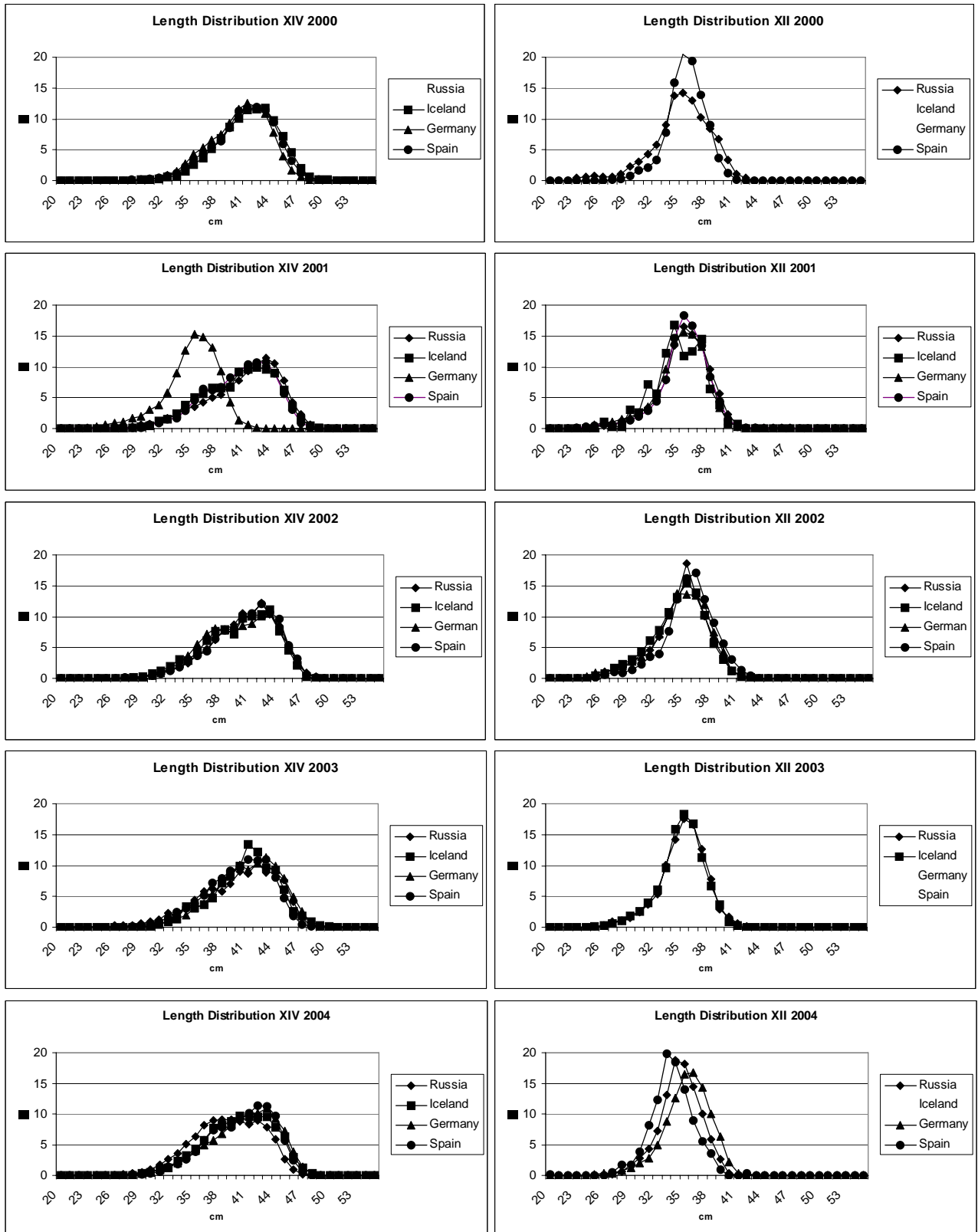


Figure 10.1.9 Length distributions from landings of pelagic *S. mentella* by ICES Sub-areas XII and XIV and country in 2000-2004.

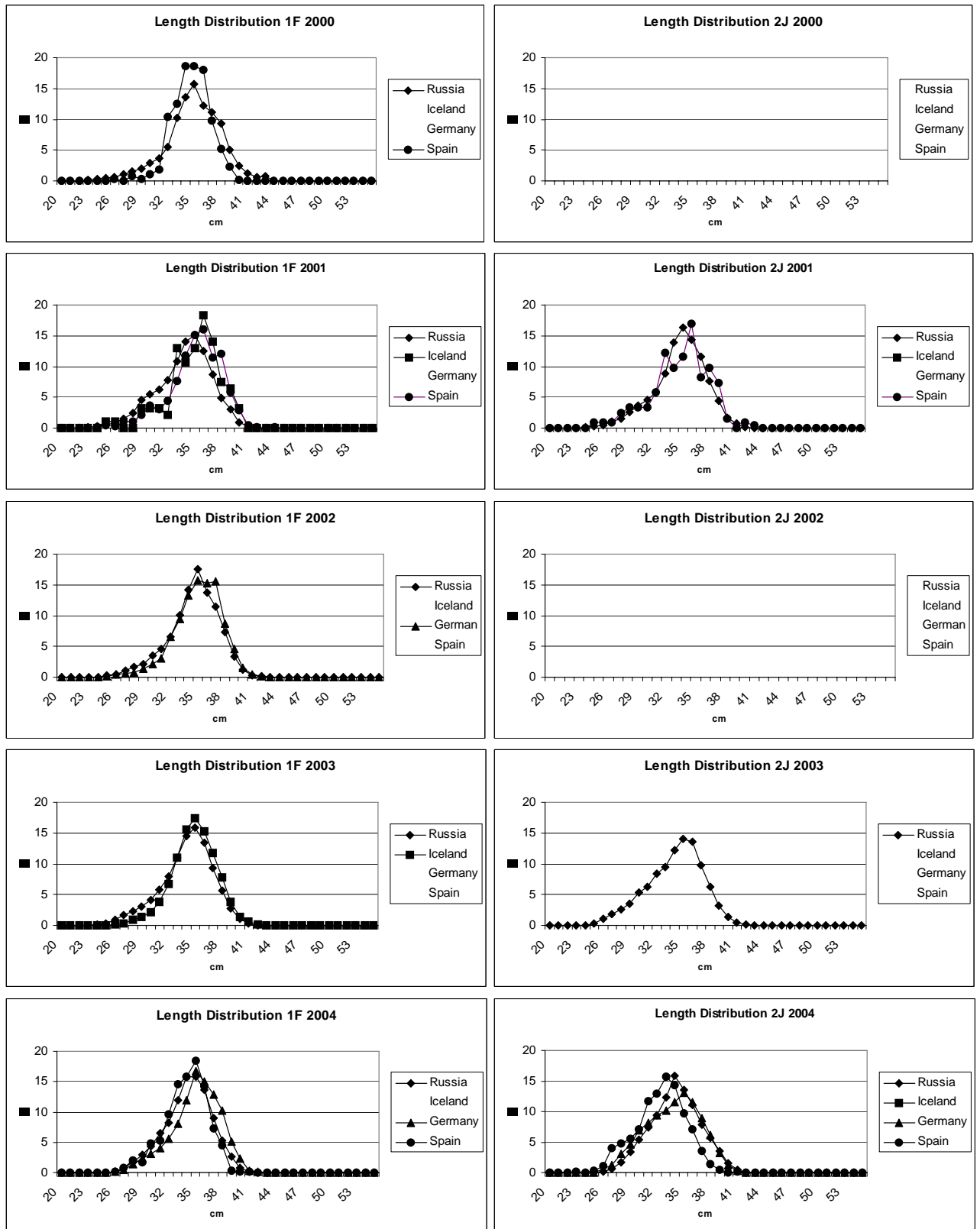
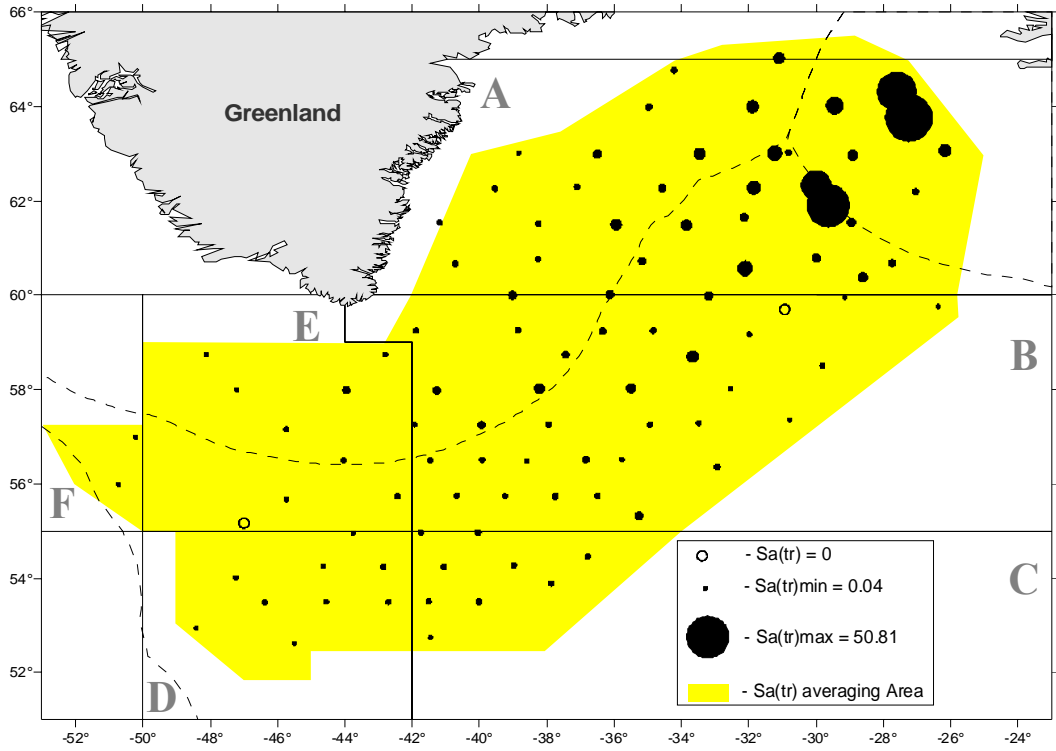
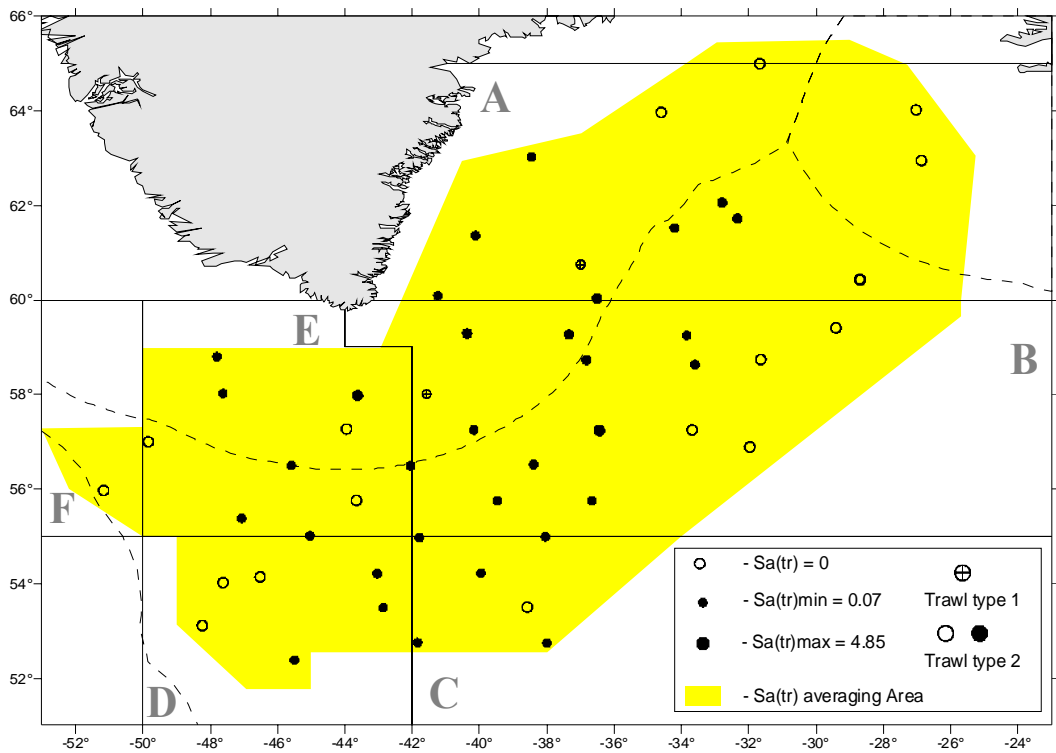


Figure 10.1.10 Length distributions from landings of pelagic *S. mentella* by NAFO Divisions 1F and 2J and country in 2000-2004.



**Figure 10.2.1** Geographical distribution patterns of standardised redfish catches deeper than 500 m in the joint trawl-acoustic survey in May-June 2003.



**Figure 10.2.2** Geographical distribution patterns of standardised redfish catches shallower than 500 m in the trawl-acoustic survey in May-June 2003.

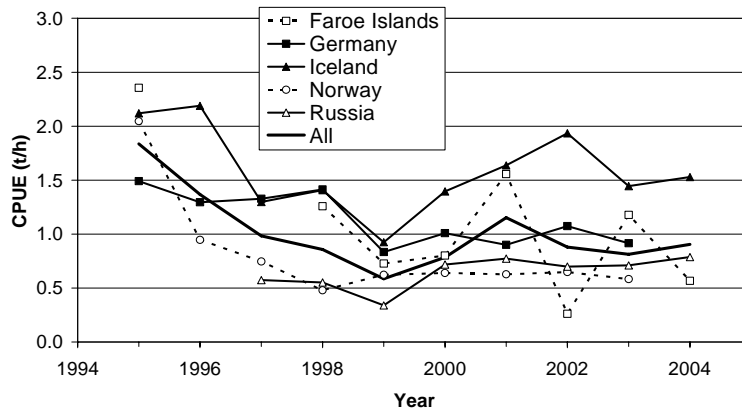


Figure 10.2.3a. Trends in unstandardised CPUE of pelagic *S. mentella* fishery in the Irminger Sea, shallower than 500m (southern area).

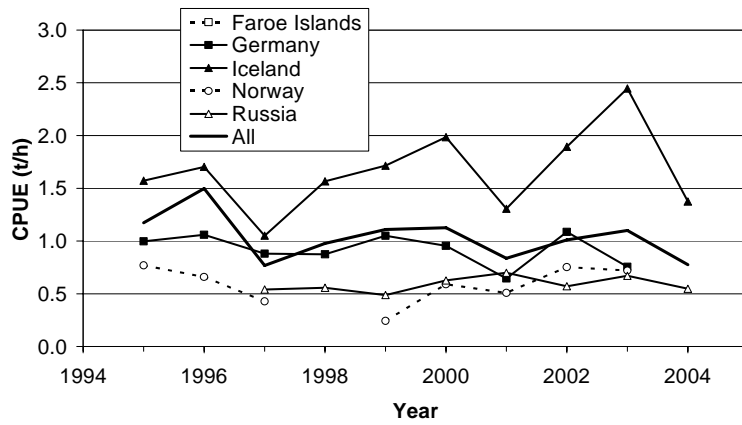


Figure 10.2.3b. Trends in unstandardised CPUE of pelagic *S. mentella* fishery in the Irminger Sea, deeper than 500m (northern area).

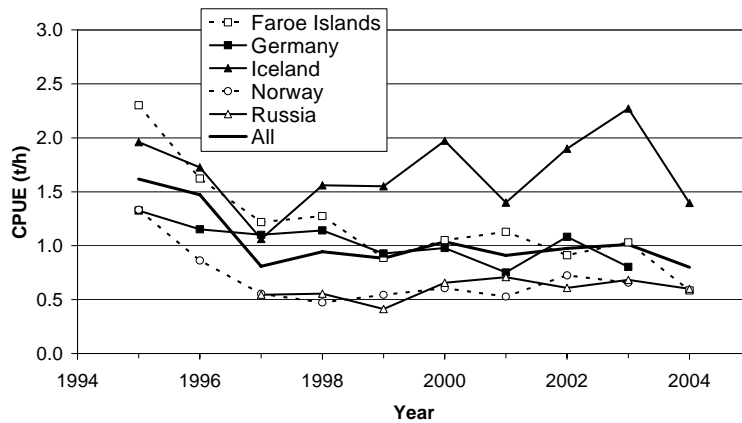
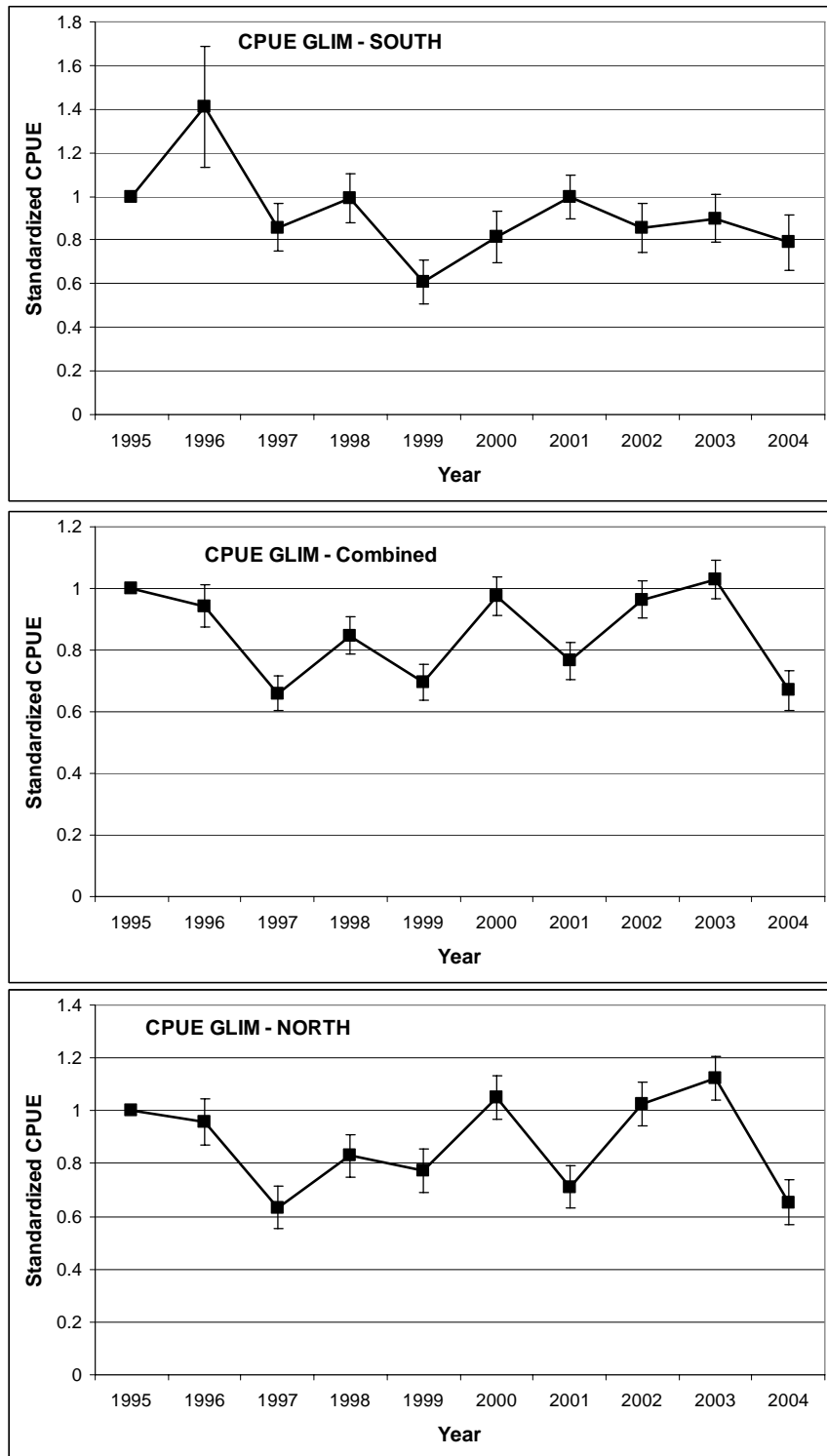
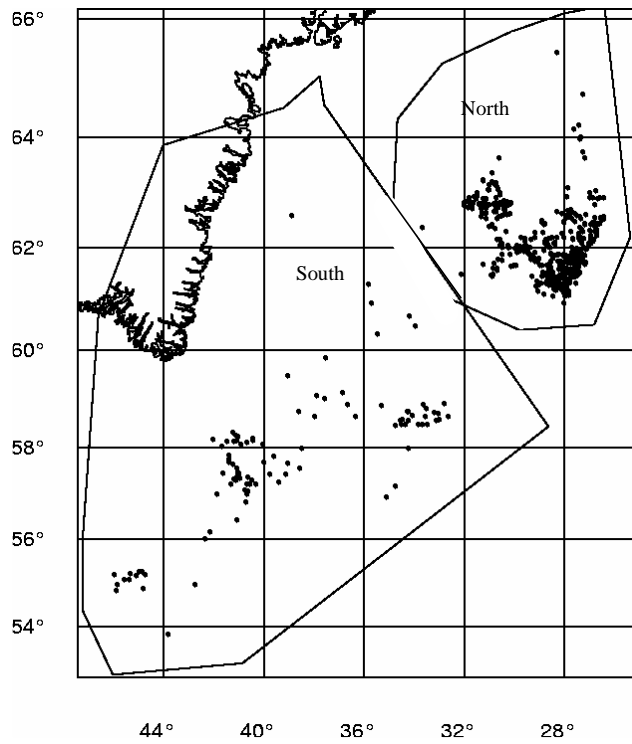


Figure 10.2.3c. Trends in unstandardised CPUE of pelagic *S. mentella* fishery in the Irminger Sea, all data.



**Figure 10.2.4** Standardised CPUE, as calculated by using data from Germany (1995-2004), Iceland (1995-2004), Greenland (1999-2004), Faroes (1995-2004), Russia (1997-2004) and Norway (1995-2003) in the GLM model (see chapter 10.2.3), divided by depths shallower (south-western area) and deeper than 500 m (north-eastern area) and both depth layers (areas) combined. 95% confidence limits are shown. Further details of the GLM models are given in Tables 10.2.5a-c.



**Figure 10.2.5. Division of areas between south and north. The points indicate positions of Icelandic available samples from the catches 1995-2004.**