Northwest Atlantic Fisheries Organization

**Serial No. N4852** **NAFO SCS Doc. 03/17**

**SCIENTIFIC COUNCIL MEETING – JUNE 2003**

# A Report on the Deliberations of the ICES North-Western Working Group, 2003

by

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## Introduction

The ICES North-Western Working Group (NWWG) meeting took place from 29 April to 8 May 2003 in Copenhagen. The present report focuses in the new information on the stock structure, distribution and state of the stock of *Sebastes mentella* in ICES Sub-areas V, XII and XIV and NAFO Divisions 1F, 2H and 2J analyzed in the NWWG 2003 of ICES.

## Stock structure of *S. mentella* in ICES Sub-areas V, XII and XIV and the NAFO Divisions 1F, 2H and 2J.

It is not known the stock structure and different hypotheses (Fig. 1) have been put forward based on comprehensive studies on growth, maturity, morphometrics, parasites as natural tags, and genetic and fatty acid differentiation of the species:

• **Single-stock hypothesis:** All *S. mentella* from the Faroe Islands to the Grand Banks is one stock and is segregated according to age/size.

• **Two-stock hypothesis:** The *S. mentella* living on the shelves (deep-sea *S. mentell*a) and those living in deeper pelagic waters of the Irminger Sea (pelagic deep-sea *S. mentell*a) is one stock unit, which is separated from the oceanic *S. mentella* living in the upper layers of the Irminger Sea.

• **Three-stock hypothesis:** The three described components are biologically different stocks.

Despite a lot of effort by the WG, there is not a consensus within the WG regarding which hypothesis is the most likely one.

New data presented in various working documents presents results of different methods that were used to investigate the issue of stock structure. Result in one paper (WD9) suggests some difference of the "pelagic deep sea *S. mentell*a" and the *S. mentella* caught in the demersal fishery on the slope, concluding that there was "no big exchange between redfish stocks distributed on the south-western slope of Iceland and in the pelagic sea". WD30 describes recent changes in the pelagic fishery, where fishing areas of the pelagic *S. mentella* and deep-sea *S. mentella* on the slope in Div. Va are now closer to each other. For management purposes the Icelandic authorities have separated these fisheries with the so-called redfish line, but this may not reflect two biologically different stocks. WD 8 suggests that for conservation and rational exploitation of the pelagic redfish stock a single TAC should be kept. Based on limited expertise of the WG it was concluded that the information presented did not justify a change in the perception of the stock structure in relation to the current way management advise is given.

There is consensus that NWWG is primarily an assessment group and does not have sufficient expertise to thoroughly review the scientific research of redfish stock identification. The WG agreed to recommend that a separate ICES group with the appropriate expertise would review both existing and pending scientific material. This could either dealt with in a special study group or possibly within the current ICES **Stock Identification Methods Working Grou**p. The group should report to the NWWG Meeting in 2004.

**Description of the fishery**

The fishery for oceanic *S. mentella* in ICES Subareas Va, XII, and XIV and in NAFO Div. 1F, 2H and 2J shows a persistent seasonal pattern in terms of geographical and depth distribution for the past five years. The main fishing occurs in the second and third quarter of the year. In the second quarter, the fishery takes place in the area east of 32°W and north of 61°N at depths deeper than 500 m. In the third quarter, the fleet moves towards the southwest to ICES Subarea XII and NAFO Convention areas and the depth of the hauls are in waters shallower than 500 m. There has traditionally been very little fishing activity from November until late March, and in 2002 no activity was reported during that time. The size of the fish caught in the southwest areas in the third quarter of the year is smaller than the fish caught in the northwest area in the second quarter. The fish caught in all seasons are sexually mature.

Based on the available information it was concluded that the fishing pattern in 2002 was similar as it was in the past five years.

**Trends in landings**

Total catches in 2002 is estimated to be about 132 000 tons, similar as in 2001 (129 000 tons). The catch estimates for 2002 might increase due to the lack of reporting from some countries participating in the fishery. Catches from the beginning of the fishery is given in Table 1.

In 2000, considerable amounts of the catches were taken in NAFO Div. 1F, as observed in this magnitude for the first time. In 2001 and 2002 about 6791 and 7 639 tons of pelagic *S. mentella* were reported in NAFO Div 1F, 2H and 2J, respectively.

**Assessment**

***Survey data***

There were no surveys conducted in 2002. The main results of the 2001 trawl-acoustic survey (ICES CM 2002/D:08 Ref.ACFM). are described in the report of the NWWG in 2002 and the results are given in Table 2 and 3. There will be new survey in June/July 2003 with participation of Russia, Germany and Iceland (ICES CM 2003/D:2).

***CPUE***

Non standardised CPUE series for Bulgarian, German, Icelandic, Spanish, Norwegian and Russian fleets are given. Fig. 2 and Fig. 3 show the overall CPUE from different fleets in recent years, in depths shallower and deeper than 500 m, respectively. In Fig. 2, along with estimated biomass derived from the international and Russian hydroacoustic surveys. In recent years, there is no trend in CPUE, both shallower and deeper than 500 m.

Standardised CPUE (Fig. 4), derived from a GLM CPUE model incorporating data from Germany (1995-2002), Iceland (1995-2002), Greenland (1999-2002), Faroe Island (1995-2001), Russia (1997-2001) and Norway (1995-2002) is given. The model takes into account year, month, vessel and area (ICES statistical square). The model was run on as desegregated data as possible from a joint database and the outcomes of 3 model runs are given in Table 4, 5 and 6. The model shows that the index is fluctuating both for the south-western and northeastern fishing area. The value in 2002 has increased for the norheastern part but remains similar for the southwestern area, compares with previous yea. Overall, the GLM model indicates a relatively stable CPUE since 1995 both shallower and deeper than 500 m. The minor changes seen in the series, compared with the run from last year, are because data from new nations have been added to the database (Russia 1997-2001 and Faroe Island form 1995-2001).

**State of the stock**

Tables 2 and 3 shows available survey estimates of stock size by acoustic and trawls. The biomass can be estimated acoustically for depths less than 500 m. The acoustic estimates from the last three surveys are considered minimum biomass estimates because trawl sets during those surveys have shown that there was considerable redfish biomass deeper than the depths where biomass can be estimated acoustically. However the proportion of fish above and below 500 m is not known to be stable over years and it cannot be concluded that acoustic biomass estimates prior to 1996 are minimum biomass estimates, because of high variances in the acoustic surveys for those years. These possible changes in the depth distribution above and below 500m combined with the differences in geographic coverage in different years mean that the acoustic biomass series cannot be interpreted as a consistent series showing relative changes in stock size. It is not known if the trawl survey biomass estimates are minimum or if they can overestimate stock size.

Adding the trawl biomass estimate below 500 m to the acoustic estimates (1.8 million tons) or adding the two trawl biomass estimates together (2.1 million tons) indicates that the biomass in 2001 is probably in the order of 2 million tonnes, distributed also in large portions of the NAFO Convention Area down to depth of 1 000 m.

Available CPUE series show that the pelagic redfish CPUE has remained stable since 1995 for all fishing areas as well as separated above and below 500 m depth. There are great seasonal, geographical and depth changes of the fishing activities and the fishery is on schooling aggregations. Therefore CPUE series might not indicate or reflect actual status of the stocks and might thus be to optimistic. Comparing figures of the fishery in recent years (Fig. 5) with the distribution from the surveys (Fig. 6) it can be seen that the fish accumulates in fishable concentrations in relatively small area, compared with the distribution area.

Taking into account the uncertainty in stock indicators, it is not known if the exploitation rate generated by recent catches is above or below 5% exploitation rate which has been suggested suitable for such a long lived species.

Based on all the available data, the recent exploitation level seems not to cause stock size reduction.

**Management considerations**

Catch rates shallower than 500 m remained steady but low, and deeper than 500 m remained steady. 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 more southwesterly fishing ground extended also into the NAFO Convention Area. The parameters analyzed so far do suggest, however, that the newly discovered aggregations in the NAFO Convention Area do not form a separate stock component. NAFO Scientific Council did agree with this conclusion. No new survey results were available to the working group, but the 1999 and 2001 surveys indicated that about one third of the stock is distributed in the NAFO Convention Area

Considering the uncertainty related to definition of stock units, action must be taken in accordance with the precautionary approach and attempts be made to manage each stock component separately until better knowledge on the relationship among units are known. Given the current fishing pattern (the deep water fishery in the northeastern area and the upper water fishery in the southwest area), seasonal or geographic separate management regimen could be applied to the fishery. That kind of approach would also account for depth separation. This would reduce the risk of overexploitation or depletion of the possibly separate units, which would occur if they would be managed under a common TAC.

**References:**

Shibanov V. and S.Melnikov; “Pelagic Sebastes mentella stock structure in ICES Subareas XII, XIV and NAFO Conventional Area by the results of Russian investigations”; WD 8 (ICES CM 2002/ACFM:24)

S. P. Melnikov, Yu. I. Bakay and I. V. Bakay; “Ecological and biological characteristics of redfish Sebastes mentella in Va and XIVb Divisions of ICES; WD 9 (ICES CM 2002/ACFM:24)

Kristján Kristinsson and Þorsteinn Sigurðsson; "Request from North-East Atlantic Fisheries Commission Regarding Redfish Stocks - Terms of Reference C.; WD 30 (ICES CM 2002/ACFM:24)

North-Western Working Group Report, 29 April – 8 May 2003 (ICES CM 2002/ACFM:24)

North-Western Working Group Report, 29 April – 8 May 2002 (ICES CM 2002/ACFM:20)

Thorsteinn Sigurdsson et al.(2001). Draft report on the Join German/Icelandic/Norwegian/Russian Trawl Acoustic Survey on Pelagic Redfish in the Irminger Sea and Adjacent Waters in June / July 2001. *NAFO SCR Doc. 01/161*. Serial N. 4555

Table.1 Pelagic *S. mentella*. Landings (tons) by area as used by the Working Group.

| Year | Va | Vb | VI | XII | XIV | NAFO 1F | NAFO 2J | NAFO 2H | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1982 | 0 | 0 | 0 | 39,783 | 20,798 | | | | 60,581 |
| 1983 | 0 | 0 | 0 | 60,079 | 155 | | | | 60,234 |
| 1984 | 0 | 0 | 0 | 60,643 | 4,189 | | | | 64,832 |
| 1985 | 0 | 0 | 0 | 17,300 | 54,371 | | | | 71,671 |
| 1986 | 0 | 0 | 0 | 24,131 | 80,976 | | | | 105,107 |
| 1987 | 0 | 0 | 0 | 2,948 | 88,221 | | | | 91,169 |
| 1988 | 0 | 0 | 0 | 9,772 | 81,647 | | | | 91,419 |
| 1989 | 0 | 0 | 0 | 17,233 | 21,551 | | | | 38,784 |
| 1990 | 0 | 0 | 0 | 7,039 | 24,477 | 385 | | | 31,901 |
| 1991 | 0 | 0 | 0 | 10,061 | 17,089 | 458 | | | 27,608 |
| 1992 | 1,968 | 0 | 0 | 23,249 | 40,745 | | | | 65,962 |
| 1993 | 2,603 | 0 | 0 | 72,529 | 40,703 | | | | 115,835 |
| 1994 | 15,472 | 0 | 0 | 94,189 | 39,028 | | | | 148,689 |
| 1995 | 1,543 | 0 | 0 | 132,039 | 42,260 | | | | 175,842 |
| 1996 | 4,744 | 0 | 0 | 42,603 | 132,975 | | | | 180,322 |
| 1997 | 15,301 | 0 | 0 | 19,822 | 87,812 | | | | 122,935 |
| 1998 | 40,612 | 0 | 0 | 22,446 | 53,910 | | | | 116,968 |
| 1999 | 36,524 | 0 | 0 | 24,085 | 48,521 | 534 | | | 109,665 |
| 2000 | 44,677 | 0 | 0 | 19,862 | 50,722 | 10,815 | | | 126,076 |
| 2001 | 28,148 | | | 31,751 | 62,148 | 5,299 | 1,284 | 208 | 128,838 |
| 2002[1] | 37,388 | | | 23,954 | 62,684 | 7,639 | | | 131,665 |

1) Provisional data

Table 2. 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 $NM^2$) | Acoustic estimates < 500 m ($10^6$ ind.) | Acoustic estimates < 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 |

Table 3. Pelagic redfish *S. mentella*. 1999 and 2001 survey biomass estimates 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 shallower than 500 m * | 540 | 46.3 | 626 | 53.7 | 1166 |
| 1999 deeper than 500 m | 74 | 11.6 | 564 | 88.4 | 638 |
| 1999 Sum | 614 | 34.0 | 1190 | 66.0 | 1804 |
| | | | | | |
| 2001 shallower than 500 m | 686 | 63.8 | 390 | 36.2 | 1076 |
| 2001 deeper than 500 m | 165 | 15.6 | 892 | 84.4 | 1057 |
| 2001 Sum | 851 | 39.9 | 1282 | 60.1 | 2133 |

Table 4. Results of the GLM model to calculate standardized CPUE for all pelagic redfish fishery, including single tow data from Germany (1995-2002), Iceland (1995-2002), Greenland (1999-2002), Faroe Island (1995-2001), Russia (1997-2001) and Norway (1995-2002). Note that the full output is not shown (afli=catch; ltogtimi=trawling time; ices = ices statistical squere; skip= vessel).

```
Analysis of Deviance Table
Quasi-likelihood model
Response: afli
Terms added sequentially (first to last)
             Df Deviance Resid. Df Resid. Dev  F Value Pr(F)
        NULL                 36012  181689865
    ltogtimi   1  1404554     36011  180285311 397.0146     0
  factor(yy)   7  7548837     36004  172736474 304.8246     0
  factor(mm)  11  6036235     35993  166700238 155.1106     0
factor(skip)  84 28456849     35909  138243390  95.7581     0
factor(ices) 230  9371695     35679  128871694  11.5175     0

Call: glm(formula = afli ~ ltogtimi + factor(yy) + factor(mm) + factor(skip) +
factor(     ices), family = quasi(link = log, variance = mu), data = testdata)
Deviance Residuals:
       Min        1Q    Median       3Q      Max
 -251.8473 -42.12827 -4.760622 32.18028 409.4896

Coefficients:
                     Value  Std. Error      t value
     (Intercept)  8.941645120 0.510787055  17.50562202
        ltogtimi  0.156644728 0.006553003  23.90426746
  factor(yy)1996  0.044604410 0.018704515   2.38468677
  factor(yy)1997 -0.241500209 0.017338001 -13.92895327
  factor(yy)1998 -0.122250482 0.017869202  -6.84140676
  factor(yy)1999 -0.193460622 0.017892690 -10.81227140
  factor(yy)2000 -0.019415520 0.018040945  -1.07619194
  factor(yy)2001 -0.058639607 0.017632108  -3.32572859
  factor(yy)2002  0.081719833 0.018402326   4.44073398
     factor(mm)2 -1.433731141 0.447433982  -3.20434120
     factor(mm)3 -0.216129982 0.270511180  -0.79896876
     factor(mm)4  0.168043623 0.267596974   0.62797281
     factor(mm)5  0.407939738 0.267589020   1.52450103
     factor(mm)6  0.307642616 0.267602810   1.14962401
     factor(mm)7  0.138641428 0.267760706   0.51778108
     factor(mm)8  0.265633370 0.267983037   0.99123203
     factor(mm)9  0.202804060 0.268085695   0.75648967
    factor(mm)10  0.100219041 0.268289993   0.37354744
    factor(mm)11  0.016326485 0.269664939   0.06054360
    factor(mm)12 -0.131193760 0.296476477  -0.44250985
 (Dispersion Parameter for Quasi-likelihood family taken to be 3537.789 )
    Null Deviance: 181689865 on 36012 degrees of freedom
Residual Deviance: 128871694 on 35679 degrees of freedom
Number of Fisher Scoring Iterations: 4
```

Table 5. Results of the GLM model to calculate standardized CPUE for pelagic redfish fishery, by depths shallower than 500 m (south-western area) including singlel tow data from Germany (1995-2002), Iceland (1995-2002), Greenland (1999-2002), Faroe Island (1995-2001), Russia (1997-2001) and Norway (1995-2002). Note that the full output is not shown.

```
Analysis of Deviance Table

Quasi-likelihood model

Response: afli
Terms added sequentially (first to last)
             Df Deviance Resid. Df Resid. Dev  F Value Pr(F)
        NULL                 9213   52614579
    ltogtimi   1   316778      9212   52297802  87.0662     0
  factor(yy)   7  4303329      9205   47994472 168.9670     0
  factor(mm)   9  3437250      9196   44557223 104.9697     0
factor(skip)  67  8856328      9129   35700895  36.3307     0
factor(ices) 131  2557084      8998   33143811   5.3650     0
Call: glm(formula = afli ~ ltogtimi + factor(yy) + factor(mm) + factor(skip) +
factor(ices), family = quasi(link = log, variance = mu), data = testdata)
Deviance Residuals:
       Min        1Q   Median       3Q      Max
 -239.9342 -39.58192 -5.26949 31.50438 373.4299

Coefficients:
                     Value Std. Error     t value
     (Intercept)  8.04681561 0.52609392  15.2953974
        ltogtimi  0.18135630 0.01207254  15.0222096
  factor(yy)1996  0.07412931 0.05551622   1.3352730
  factor(yy)1997 -0.15569141 0.04114485  -3.7839825
  factor(yy)1998 -0.07993046 0.03846676  -2.0779101
  factor(yy)1999 -0.43158288 0.03580414 -12.0539925
  factor(yy)2000 -0.12360495 0.03800673  -3.2521858
  factor(yy)2001 -0.05944216 0.03598037  -1.6520722
  factor(yy)2002 -0.07248747 0.03899156  -1.8590554
     factor(mm)4  1.52691065 0.25476278   5.9934605
     factor(mm)5  1.73895938 0.24385059   7.1312493
     factor(mm)6  1.24732778 0.24404510   5.1110544
     factor(mm)7  1.16946407 0.24290056   4.8145796
     factor(mm)8  1.41474266 0.24220915   5.8409960
     factor(mm)9  1.32889393 0.24214161   5.4880858
    factor(mm)10  1.23371829 0.24256991   5.0860317
    factor(mm)11  0.90064532 0.24630319   3.6566531
    factor(mm)12  1.22066784 0.28604795   4.2673540
```

Table 6. Results of the GLM model to calculate standardized CPUE for pelagic redfish fishery, by depths deeper than 500 m (south-western area) including singlel tow data from Germany (1995-2002), Iceland (1995-2002), Greenland (1999-2002), Faroe Island (1995-2001), Russia (1997-2001) and Norway (1995-2002). Note that the full output is not shown.

```
Analysis of Deviance Table
Quasi-likelihood model
Response: afli
Terms added sequentially (first to last)
             Df Deviance Resid. Df Resid. Dev  F Value Pr(F)
        NULL                 26784  128997336
    ltogtimi  1  1112446     26783  127884890 338.7725     0
  factor(yy)  7  8317519     26776  119567371 361.8469     0
  factor(mm) 11  3461155     26765  116106216  95.8203     0
factor(skip) 79 21486982     26686   94619234  82.8280     0
factor(ices) 98  4603244     26588   90015990  14.3043     0

Call: glm(formula = afli ~ ltogtimi + factor(yy) + factor(mm) + factor(skip) +
factor(ices), family = quasi(link = log, variance = mu), data = testdata)
Deviance Residuals:
       Min        1Q    Median      3Q      Max
 -227.6338 -41.14726 -4.220292 32.0225 347.7267

Coefficients:
                      Value  Std. Error     t value
     (Intercept)  8.434173631 0.293986897  28.6889440
        ltogtimi  0.164426840 0.007864836  20.9065829
  factor(yy)1996  0.006160440 0.022212893   0.2773363
  factor(yy)1997 -0.308500874 0.021407430 -14.4109256
  factor(yy)1998 -0.178554522 0.022136918  -8.0659160
  factor(yy)1999 -0.142140342 0.022462434  -6.3279136
  factor(yy)2000 -0.048003716 0.022319939  -2.1507100
  factor(yy)2001 -0.131483338 0.022143955  -5.9376629
  factor(yy)2002  0.061631469 0.022672005   2.7183951
     factor(mm)2 -1.516024853 0.431386362  -3.5143087
     factor(mm)3 -0.246928657 0.260973190  -0.9461840
     factor(mm)4  0.117444720 0.257913521   0.4553647
     factor(mm)5  0.353140305 0.257910067   1.3692382
     factor(mm)6  0.278962868 0.257922184   1.0815776
     factor(mm)7  0.151546367 0.258098647   0.5871645
     factor(mm)8  0.078455882 0.259091372   0.3028116
     factor(mm)9 -0.029399779 0.260322807  -0.1129359
    factor(mm)10 -0.167667805 0.261546422  -0.6410633
    factor(mm)11  0.127224735 0.262556194   0.4845619
    factor(mm)12 -0.865802042 0.360270199  -2.4032019
```

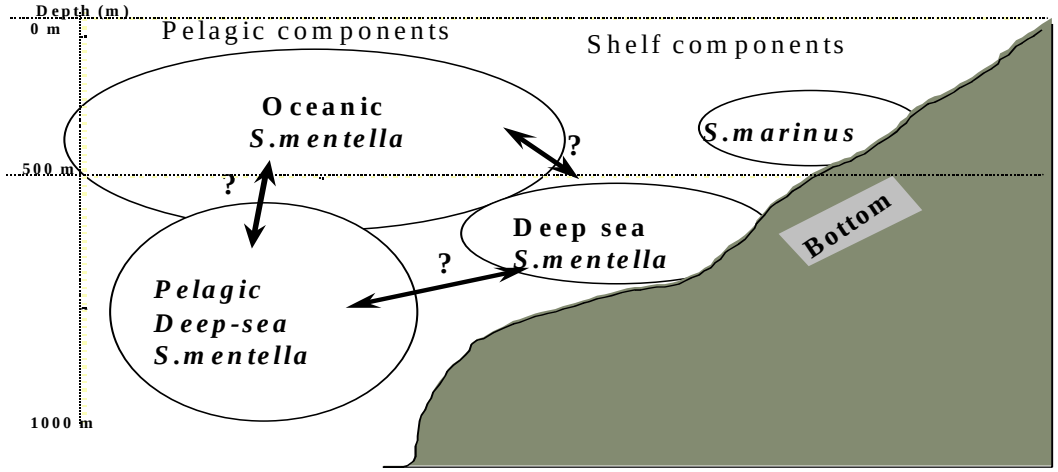


Fig. 1. Schematical representation of the possible relationship between different stocks of redfish in the Irminger Sea and adjacent waters.

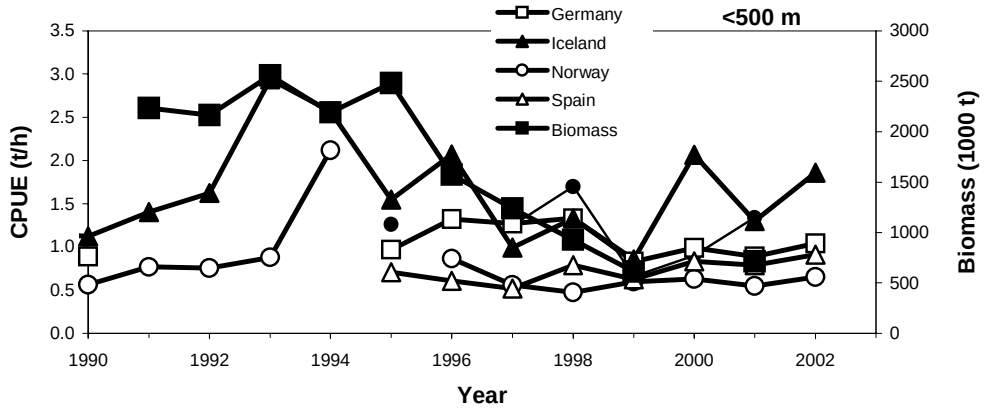


Fig. 2 Trends in CPUE of pelagic *S. mentella* fishery in the Irminger Sea, shallower than 500 m, and estimated acoustic biomass from surveys.

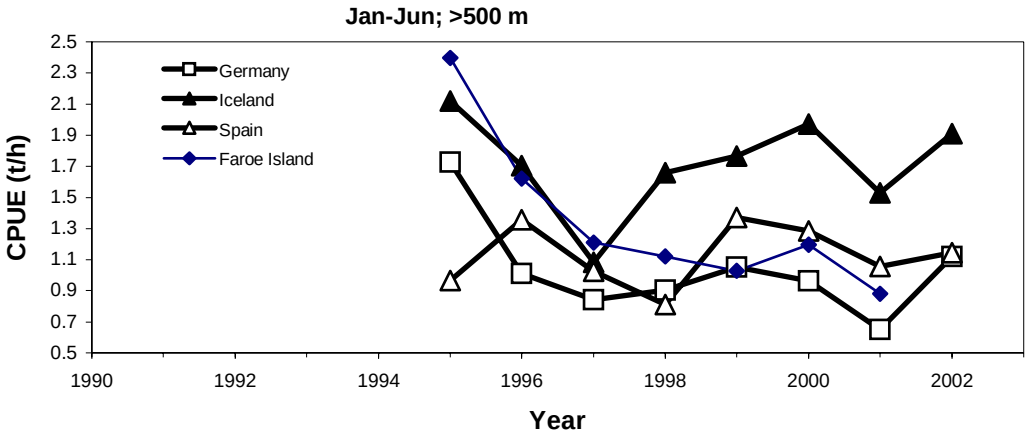


Fig. 3 Trends in CPUE of pelagic *S. mentella* fishery in the Irminger Sea, shallower than 500 m, and estimated acoustic biomass from surveys.

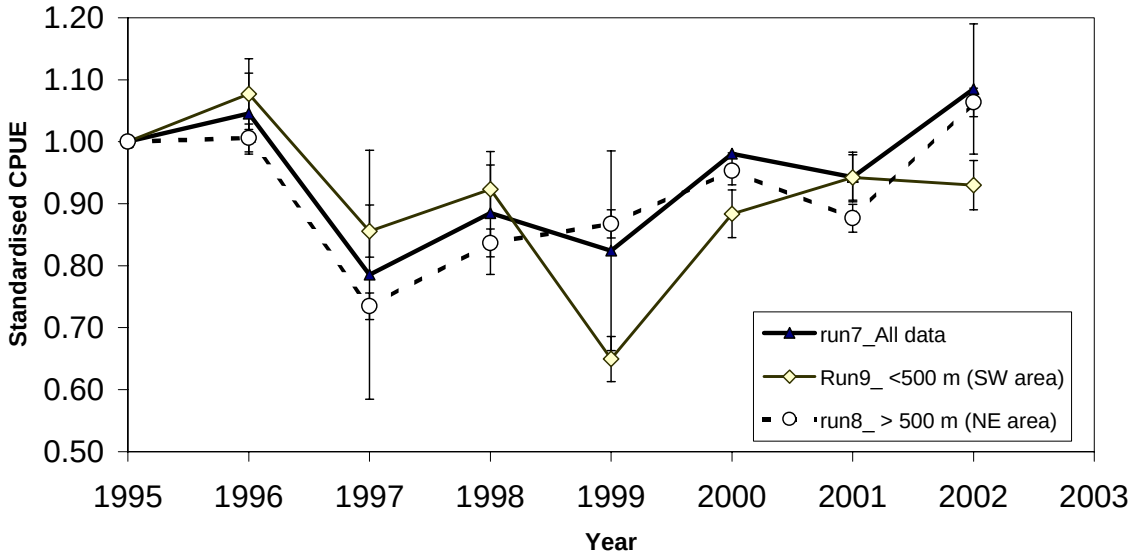


Fig. 4 Standardised CPUE, as calculated by using data from Germany (1995-2002), Iceland (1995-2002), Greenland (1999-2002), Faroe Island (1995-2001), Russia (1997-2001) and Norway (1995-2002) in the GLM model, divided by depths shallower (south-western area) and deeper than 500 m (north-eastern area) and both depth layers (areas) combined.

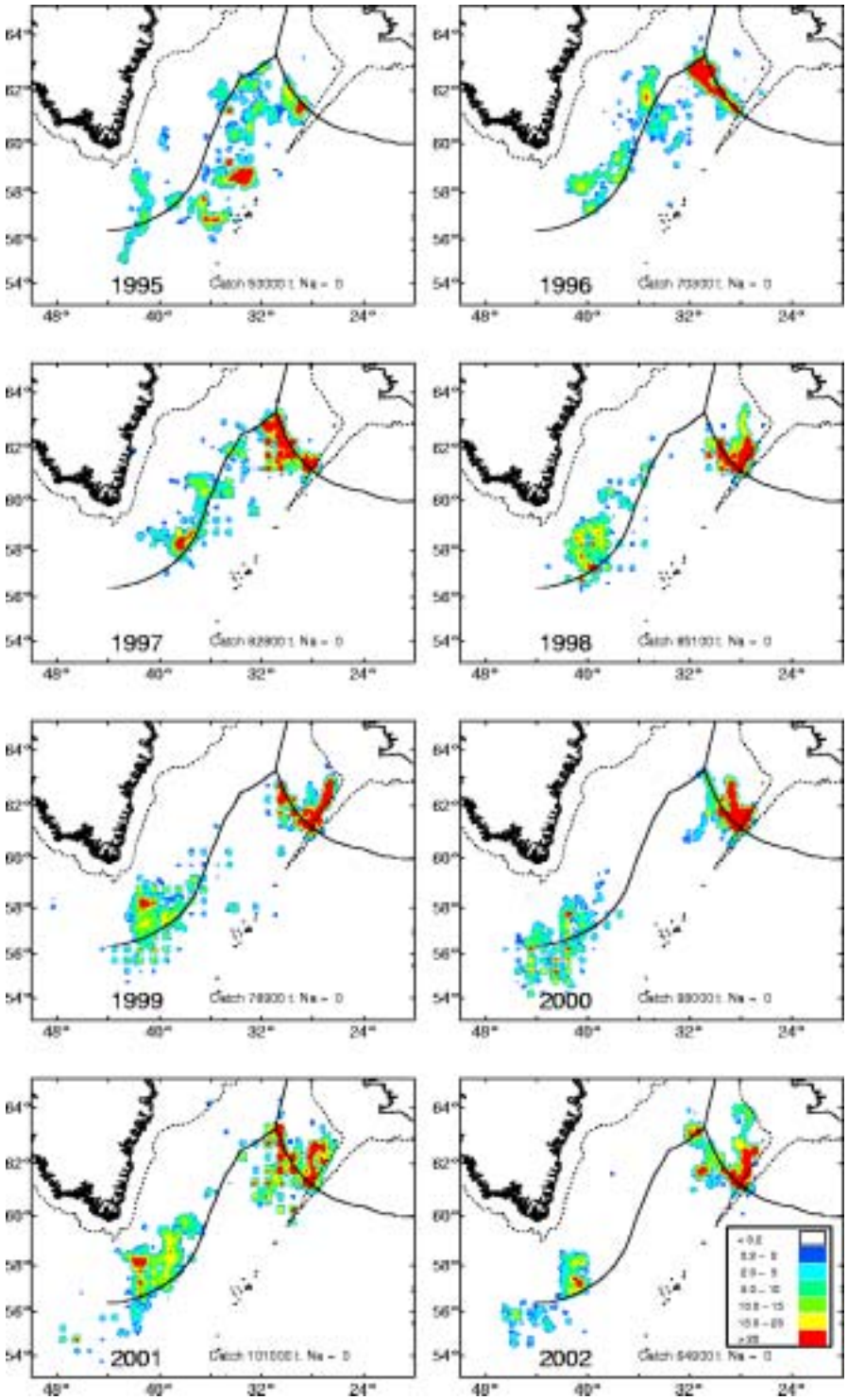


Fig. 5 Fishing areas and total catch of the pelagic redfish (*S. mentella*) in the Irmenger Sea and adjacent waters 1995-2002. Data are from Germany (1995-2002), Norway (1995-2002) Greenland (1999-2002), Russia (1997-2001), Faroese (1995-2001), and Iceland (1995-2002). The scale given is tons per square nautical mile.

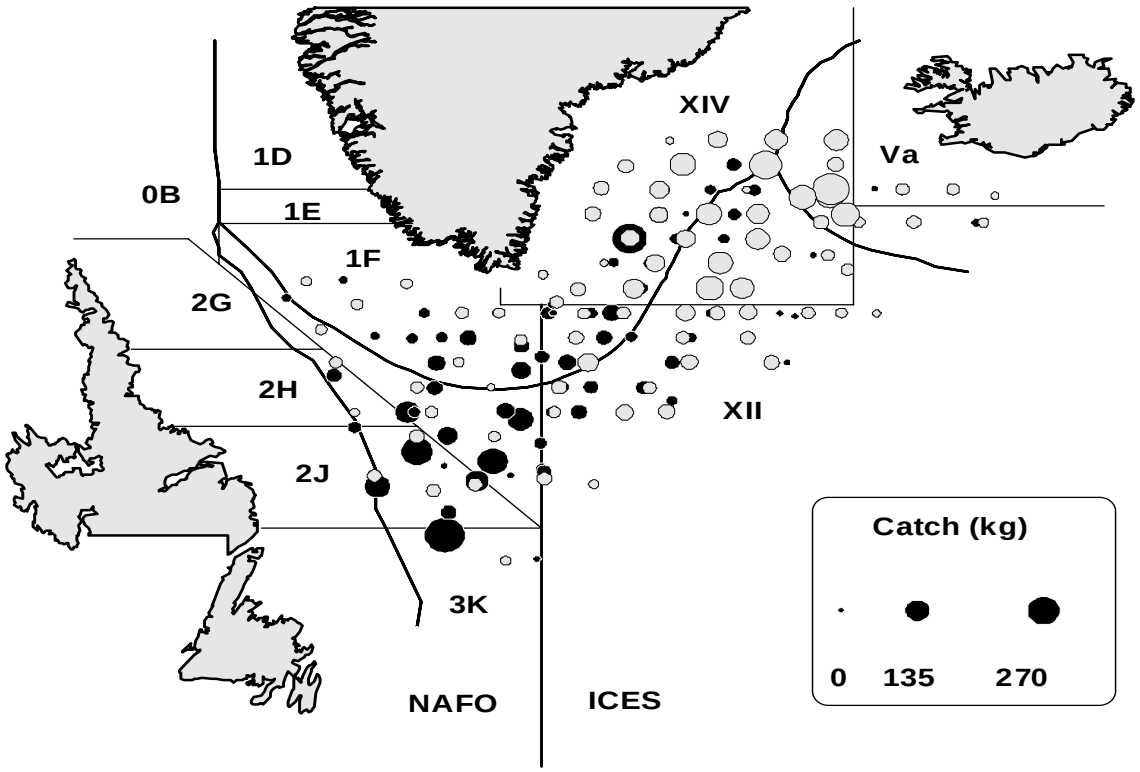


Fig. 6. Pelagic redfish *S. mentella*. Survey catches in June/July 2001 shallower than 500 m depth (black) and deeper than 500 m depth (grey).