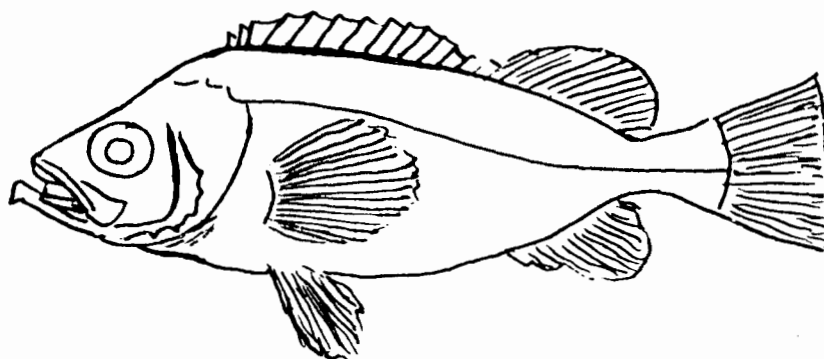
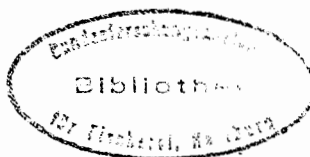


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International Council for the
Exploration of the Sea

C.M.1993/G:6



REPORT OF THE STUDY GROUP ON REDFISH STOCKS

Copenhagen, 12 - 14 May 1993

This document is a report of a Working Group of the International Council for the Exploration of the Sea and does not necessarily represent the views of the Council. Therefore, it should not be quoted without consultation with the General Secretary.

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TABLE OF CONTENTS

1	INTRODUCTION	1
1.1	Participants	1
1.2	Terms of Reference	1
2	JOINT INTERNATIONAL ACOUSTIC SURVEYS ON THE OCEANIC <i>S.MENTELLA</i>	1
2.1	Faroese and Icelandic surveys in 1993	1
2.2	Joint Surveys in 1994	2
2.3	Sampling Strategy	2
3	STOCK IDENTIFICATON	2
4	ASSESSMENT	3
4.1	Oceanic <i>S.mentella</i>	3
4.2	Redfish Stocks in General	4
5	OTHER RESEARCH	4
5.1	Age reading	4
5.2	Biological Research on the Infestation by <i>Sphyrion lumpi</i> and Abnormalities in the Pigmentation of the Oceanic <i>S. mentella</i>	4
5.3	Nursery areas	4
6	RECOMMENDATIONS	4
7	REFERENCES AND WORKING DOCUMENTS	5
	APPENDIX 1: LIST OF PARTICIPANTS	6
	APPENDIX 2: POSITION OF FIXED HAULS	7
	APPENDIX 3: REDFISH: STAGES OF MATURITY	8
	FIGURES 1 - 4	9

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1 INTRODUCTION

1.1 Participants

Engelstoft, J.J.	Greenland
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Magnússon, J. (Chairman)	Iceland
Magnússon, J.V.	Iceland
Nedreaas, K.H.	Norway
Pedersen, S.A.	Greenland
Reinert, J.	Faroe Islands
Shibanov, V.N.	Russia

(See Appendix 1 for addresses.)

1.2 Terms of Reference

At the ICES 80th Statutory Meeting, it was decided (C.Res. 1992/2:15) that the Study Group on Redfish Stocks should meet at ICES Headquarters from 12-14 May, 1993 to:

- a) coordinate national research programmes on the oceanic type *Sebastes mentella* in the Irminger Sea and adjacent waters;
- b) evaluate the results of the joint Icelandic-Russian acoustic survey conducted in 1992;
- c) report to the Demersal Fish Committee.

In addition to this at its 11th Annual Meeting in November 1992, NEAFC requested ICES to provide additional information concerning:

- a) the stock identity, migration, spawning areas and state of exploitation of the "Oceanic" stock of *Sebastes mentella*; especially paying attention to the question of the assessment based on acoustic and catch data representing the whole exploitable stock taking into account data from 1992 and 1993 surveys.
- b) Evaluation of the consequences in the medium term of TAC levels in the range of 50,000-150,000 t and an indication as to whether these levels are within safe biological limits;

In a joint letter to the Chairman of the Study Group and the Chairman of the North-Western Working Group the Chairman of ACFM requests that the additional NEAFC items should be addressed by both these Working Groups.

2 JOINT INTERNATIONAL ACOUSTIC SURVEYS ON THE OCEANIC *S. MENTELLA*

During the last meeting of the Study Group on Redfish Stocks in May 1992, the Group was informed that Russia and Iceland had agreed to carry out a joint acoustic survey in the Irminger Sea, on the oceanic *S. mentella*. The Study Group worked out a joint survey plan for these cruises. This joint survey plan could, however, not be performed as planned mainly due to the short time space between the meeting of the group and the start of one of the surveys. Both cruises were, nevertheless, carried out resulting in a common acoustic estimate for an area of appr. 165,000 nm² (Magnússon *et al.* 1992; Shibanov *et al.* 1992).

An attempt was made to get more countries into a joint survey in June-July 1993 without success. However, the group was informed at the present meeting that the Russians were already carrying out their traditional ichthyoplankton and acoustic surveys in the Irminger Sea in April to July 1993.

Since several countries showed their readiness to participate in a joint international acoustic survey during the time interval June-July 1994, and two countries (Iceland and the Faroes) also during September 1993, it was decided to use the present meeting of the Study Group to coordinate the prospective joint surveys in 1993 and, in particular, those to be carried out in 1994. The priority task of the surveys is to obtain an acoustic estimate of the stock size of the oceanic *S. mentella*.

2.1 Faroese and Icelandic surveys in 1993

Since there was no plan for a joint survey in June/July 1993, Iceland decided to conduct an acoustic survey in September 1993 in order to examine the feasibility of an acoustic assessment at that time of the year as recommended at the meeting of the Study Group in 1992 (Anon. 1992). Fortunately, the Faroe Islands also decided to conduct an acoustic survey on the oceanic redfish in September 1993.

The time schedule for these surveys is already fixed:

1. R/V Magnus Heinason, Faroe Islands, 9-22.9.1993
2. R/V Bjarni Saemundsson, Iceland, 14.9.-1.10.1993

It was decided that Iceland and the Faroe Islands should cooperate and use the overlapping time in the field to intercalibrate between the vessels. Further, both countries are going to follow the sampling procedure agreed by the Study Group and reported below. Each country is to prepare a cruise report which will probably be combined by correspondence and presented at the next meeting of the Study Group which, hopefully, will be held in 1994.

2.2 Joint Surveys in 1994

In 1994, Germany, Iceland, Norway and Russia intend to conduct acoustic surveys on the oceanic *S. mentella*. Iceland, Norway and Russia plan to conduct their surveys in June/July. Germany has difficulties with vessel time during that period and has planned its cruise in April/May. Since this time period is, however, rather inappropriate for an acoustic survey, Germany will examine the possibility of getting its time schedule altered.

The exact timing of the surveys of the other nations has not yet been determined but it is aimed to have a joint survey in June/July.

The area which is to be covered has already been agreed during this meeting (Figure 1). It is outlined between 52°N to 63°N and 30°W to 52°W. The survey tracks run parallel to lines of latitudes with 30 nm. spacing except for a Russian hydrographic section (3K) running from NW to SE. The full extent of the track lines total approximately 11,600 nm. Counting for station time and assuming a speed of 10 knots it will take approximately 65 vessel days to cover the outlined area provided the weather conditions are favourable. There was agreement on 18 fixed trawl stations distributed over the survey area (Figure 1 and Appendix 2). It was also decided that the participating vessels should meet for intercalibration at the earliest convenience. An allocation of the area to each vessel and a detailed time schedule (e.g., for the intercalibration) could not be fixed at this point. However, a sampling strategy for the joint survey was agreed. It is aimed to use standardized working maps.

The Study Group agreed upon the strata system to be used during the international research surveys for the oceanic *S. mentella* (Figure 2). In Figure 3, the area of the planned survey in June/July 1994 has been shown together with the strata system.

2.3 Sampling Strategy

1. **Target strength:** The Study Group sees a need for continued target strength measurements on oceanic *S. mentella* in order to further evaluate the variation by fish size, depth and time. The measurements should be carried out routinely where possible in order to confirm earlier target strength measurements (Reynisson 1992).
2. **Hauls:** Duration of the hauls should be between 1/2 - 2 hours according to the situation. In addition to the normal haul procedure during

acoustic surveys it was agreed to take 18 hauls at fixed positions evenly distributed in the survey area (the fixed haul positions are given in Figure 1 and Appendix 2). Hauls for deep-sea *S. mentella* (>500 m) should be spread over the survey area.

3. **Standard biological sampling:** Total length, sex, stage of maturity (see Appendix 3) and individual weight should be measured on 200-300 redfish from each haul. When the catches are large a sub-sample of between 200-300 redfish should be taken. When the catches are small all redfish should be measured.
4. Scales and otoliths should be collected from the whole survey area in order to investigate areal variation in the age composition and for comparing various ageing methods.
5. The infestation rate of *Sphyrion lumpi*, its remnants and spots, as well as observations on the stomach fullness, should be investigated on 50-100 randomly sampled redfish from each haul. These observations should be made on the same specimens as used for the general sample (see 3). A sampling scheme is given in Figure 4.
6. The qualitative stomach content observations should be rated on the following scale: 1) everted, 2) empty, 3) little content, 4) full stomach. In 3) and 4) the prey occurrence should be recorded. It is up to the participants to sample stomachs for more detailed stomach content analyses.
7. Temperature and salinity should preferably be taken with CTD at a distance of 50 nm. and to a depth of 800 m or an XBT sampler to the same depth. The vessel operating in the northern part of the survey area should take the Russian hydrographical section 3K.
8. Plankton sampling is optional.

3 STOCK IDENTIFICATION

Within the ICES assessment working groups, five separate stocks of redfish have been defined:

- S. marinus* - Barents Sea/Norwegian stock
- S. marinus* - Greenland/Iceland/Faroes stock
- S. mentella* - Barents Sea/Norwegian stock
- S. mentella* - Greenland/Iceland/Faroes stock
- S. mentella* - Irminger Sea Oceanic stock.

However, recent research work has raised some doubts about this stock distribution. Analyses of biochemical variation by means of electrophoresis have been carried out in Norway. Preliminary results for *S. marinus* reveal no difference between specimens sampled in Norwegian, Faroese and Icelandic waters, whereas a different polymorphism was found in the samples from East Greenland in haemoglobin and a liver-enzyme. More intensive sampling of haemoglobin and liver covering the whole area of distribution, especially at Greenland, is needed to verify these results.

For *S. mentella*, no polymorphism has been found in any of the investigated enzymes, and the pattern from the electrophoresis seems identical for all the areas investigated (Nedreaas and Nævdal, 1991). In addition specimens from West Greenland have also been analysed. However, before any conclusions can be made it is necessary to get more samples of especially haemoglobin of good quality from both oceanic and deep-sea *S. mentella* from the whole area of distribution. New approaches, for example analysis of mitochondrial- and nuclear DNA, should be incorporated.

Morphometric and meristic studies have been conducted by the Fisheries Laboratory of the Faroes, and preliminary results were presented at the 1992 Statutory Meeting (Reinert and Lastein 1992). For *S. marinus*, the results reveal three separate groups in Icelandic, Faroese and Norwegian waters, the difference between the specimens from Norwegian and Faroese waters being less than that between specimens from either of these areas and those from Icelandic waters. More intensive sampling is, however, needed before any conclusion can be drawn.

For *S. mentella*, the analysis revealed significant differences between the Irminger Sea shallower than 500 m, Faroese and Norwegian waters. No differences were found between stations in the Irminger Sea reflecting a homogeneous group in the Irminger Sea, at least shallower than 500 m. On the other hand, significant differences were found between all stations in Faroese waters. It is difficult to explain these results with so few samples, but the heterogeneity in Faroese waters could imply that this area is a transition area with fish from each of the neighbouring areas, and in addition a local stock component could be present. When each of the stations in Faroese waters were compared with the Norwegian and Irminger Sea stations, they all seemed more closely related to the Irminger Sea than to the Norwegian station. These results have to be verified through more intensive sampling, including other areas as well.

At the Fisheries Laboratory of the Faroes a different approach has been tried to investigate the stock distribution of redfish in the Northeast Atlantic. Results from a

pilot study aimed at analyzing the Cs-137 content in redfish from Norwegian, Faroese and Icelandic waters were presented at the 1992 Statutory Meeting (Reinert *et al.* 1992). The Cs-137 activity in Norwegian waters is more than an order of magnitude higher than in Icelandic and Faroese waters, and the present analysis shows that this is reflected in the fish. It should, therefore, be possible to detect possible relationships between these areas. Although the data set is too small to evaluate statistical significance, the preliminary analyses indicate that *S. marinus* at the Faroes is more closely related to the Norwegian than to the Icelandic *S. marinus*. This also applied to most of the *S. mentella* investigated except for one station which had Cs-137 content at the same level as the Icelandic *S. marinus*; no *S. mentella* from Icelandic or Greenland waters have so far been analyzed.

Although some progress has been made in separating different stocks of redfish in the North Atlantic, the Study Group recommends that ongoing research in this matter be intensified and the area sampled be expanded to cover the whole area of distribution. In addition to the above-mentioned areas and stocks, more work is needed to evaluate the status of the deep-sea *S. mentella* in the Irminger Sea. Different methods should be applied to the same samples in order to test their accuracy.

4 ASSESSMENT

4.1 Oceanic *S. mentella*

Due to uncertainties in the age readings regarding this stock it is for the time being impossible to conduct a traditional VPA assessment. The North-Western Working Group (May 1993), therefore, carried out simulations with various input parameters in order to examine the possible response of this stock to fishing. The 1992 Icelandic acoustic survey estimated a stock biomass of 1.3 million t in the area surveyed by Iceland. In an area not covered by the Icelandic survey, but covered at the same time by Russia, a biomass of 630,000 t was estimated giving an estimate of 1.9 million t for the area covered in the two surveys. Stock simulations were run so that the fishable stock from 1982 (virgin state) onwards should match this acoustic estimate in 1992. Since the survey did not cover the entire area of distribution and since there may be uncertainties in this estimate, projections were also made using biomass estimates of 1.0, 1.5 and 2.5 mill. t.

The North-Western Working Group concluded that, in view of the uncertainties concerning the oceanic *S. mentella* stock dynamics, it must be monitored with acoustic surveys, and that under the current state of knowledge it is conceivable that a catch of over 100 thousand t would reduce the stock to below 50% of its virgin level.

The assessment described above is to a large extent based on the progress made in the combined trawl-acoustic surveys. These surveys have been carried out by Russia since 1982 and by Iceland since 1990. The Study Group is of the opinion that acoustics is for the time being the best and most appropriate method of estimating the stock of oceanic *S. mentella*.

It is further concluded that the acoustic surveys should be conducted regularly while harvesting commences, in order to determine more precisely the effects of catches on this stock. It is important that the entire area of distribution should be covered. In order to achieve this, joint international surveys should be conducted at least every 3 years.

The Study Group emphasized that the knowledge of the oceanic *S. mentella* stock with regard to distribution and migrations is still poor, especially for the autumn and winter seasons. The Group pointed out that these periods of the year, e.g. time of copulation, could also be of importance for an acoustic estimate of the stock and better understanding of the stock structure. It was recommended that research along these lines should be carried out, and the planned Faroese and Icelandic surveys in September 1993 will be essential in this context.

Another gap in our knowledge about this stock is where the nursery areas are, and how these are connected to the adult stock in the Irminger Sea. Further research to improve our knowledge and understanding about this should be encouraged.

4.2 Redfish Stocks in General

It is a general and well-known problem regarding redfish stocks in the northeast Atlantic that it is difficult to make reliable VPA-based assessments. It is the opinion of the Study Group that the ongoing work to achieve more comparable age-readings between countries should continue, and that the possibility of running VPA-based assessments should continuously be investigated.

5 OTHER RESEARCH

5.1 Age reading

Although no progress has been made in the age reading of redfish since the last meeting of the Study Group on Redfish Stocks in 1992, the Group felt that adequate samples of scales and otoliths should be taken in different regions of the survey area. This is in order to maintain the time series in those countries exploiting this fish stock. The Group hopes that in spite of the different ageing methods, it will be possible to solve this problem in the future and thus to be able to evaluate the former

time series.

Correct ageing of oceanic *S. mentella* is very important for assessment purposes. For this reason a workshop on ageing should, as recommended at the 1992 meeting, be carried out in Bremerhaven in 1994, with Dr Kosswig as coordinator. For this workshop to be effective it is recommended that some preparatory work should be carried out by the laboratories concerned.

5.2 Biological Research on the Infestation by *Sphyrion lumpi* and Abnormalities in the Pigmentation of the Oceanic *S. mentella*

Infestation by the ectoparasite *Sphyrion lumpi* as well as abnormal pigmentation of the oceanic redfish has been problematical for the commercial processing of the fish. Research on this topic has been carried out for several years (e.g. Anon., 1989; Bakay, 1988; Nagel *et al.*, 1991; Magnusson, 1992). The international surveys planned in 1993 and in 1994 will give an excellent opportunity for carrying out further studies on this subject by covering a larger geographical part of the distributional area of the oceanic redfish than has been done previously.

It was agreed by the Study Group to use the sampling scheme applied by the Icelandic Marine Research Institute for several years (Figure 4).

5.3 Nursery areas

The East and West Greenland shelf areas are well known nursery areas for juvenile redfish (mainly *S. mentella*) and large quantities of juvenile redfish are caught as by-catch in the commercial shrimp fishery off West Greenland. The hydrographic conditions around Greenland, studies of 0-group drift from East to West Greenland and the information on the distribution of juvenile redfish in the Davis Strait give the Study Group good reasons to believe that the West Greenland shelf is a major nursery area for, especially, oceanic *S. mentella*. An attempt should be made to distinguish between the redfish species and the two types of *S. mentella*.

6 RECOMMENDATIONS

- 1) Further research on defining the nursery areas of the oceanic *S. mentella* should be promoted.
- 2) Research on stock identification of redfish, using different approaches such as, for example, biochemical (genetic), meristic, morphometric and radioactive isotope analysis, should continue and the results, including those from historical studies, should be summarized. This research should especially aim at finding objective and diagnostic criteria for distin-

guishing between the oceanic and the deep-sea *S. mentella* in the Irminger Sea and adjacent waters. It is important that the characteristics also enable a correct classification of O- and I-group fish.

- 3) A workshop on age reading of oceanic *S. mentella* should be carried out in 1994.
- 4) External infestation and abnormalities should be recorded during the joint international surveys in 1993 and 1994.
- 5) The Study Group notes the importance of the Russian trawl-acoustic surveys (TAS), conducted annually since 1982 to the present time (1993) and recommends that the Russian scientists should prepare a special report, summarizing all Russian TAS results in the Irminger Sea, to be published as a paper at the ICES Statutory Meeting in September 1994.
- 6) A written report on the joint Icelandic - Faroese survey in September 1993 should be submitted to the next Study Group Meeting.
- 7) The Study Group should meet in 1994 before the implementation of the joint international survey planned to be carried out in June/July.
- 8) The results of the joint international survey in 1994 should be combined immediately after finishing the survey in a summary report which should be presented to the ICES Statutory Meeting in September 1994.
- 9) Research vessel surveys, covering the whole distribution area of oceanic *S. mentella*, should be promoted at other seasons of the year in order to trace the migration patterns of the stock.
- 10) Joint international acoustic surveys, as outlined in this report, should be conducted on a regular basis in the future.

7 REFERENCES AND WORKING DOCUMENTS

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APPENDIX 1
STUDY GROUP ON REDFISH STOCKS
 Copenhagen, 12-14 May 1993

List of Participants

Name	Address	Telephone	FAX
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APPENDIX 2

Position of Fixed Hauls

STUDY GROUP ON REDFISH STOCKS

Copenhagen, 12-14 May 1993

Fixed hauls	Position
1	62°30'N 33°20'W
2	61°30'N 39°20'W
3	60°30'N 34°50'W
4	60°00'N 30°00'W
5	59°30'N 40°50'W
6	59°30'N 47°20'W
7	61°00'N 50°50'W
8	60°00'N 51°30'W
9	58°30'N 36°30'W
10	58°00'N 50°10'W
11	58°00'N 42°40'W
12	56°30'N 34°30'W
13	56°30'N 46°00'W
14	56°00'N 40°00'W
15	55°30'N 49°30'W
16	54°00'N 36°20'W
17	53°00'N 44°00'W
18	52°00'N 39°30'W

APPENDIX 3

STUDY GROUP ON REDFISH STOCKS

Copenhagen, 12-14 May 1993

REDFISH: Stages of Maturity

- Stage I: **Juvenile** (throughout the year). Gonads small in males often as white threads, in females light yellow.
- Stage II: **Ripening**. Male gonads thick, white (March-August) and soft in late stage. Female gonads (December-March) yellow with visible eggs
- Stage III: **"Spawning"**. Male gonads (September-December) are smaller again and running. Female gonads (March-June) in three steps:
- IIIa: Eggs are loose in the ovaries
- IIIb: The eyes of the larvae are visible
- IIIc: The ovaries are running, i.e. the larvae are at the stage of extrusion.
- Stage IV: **Spent**. Male gonads small, brownish. Female gonads limp and reddish

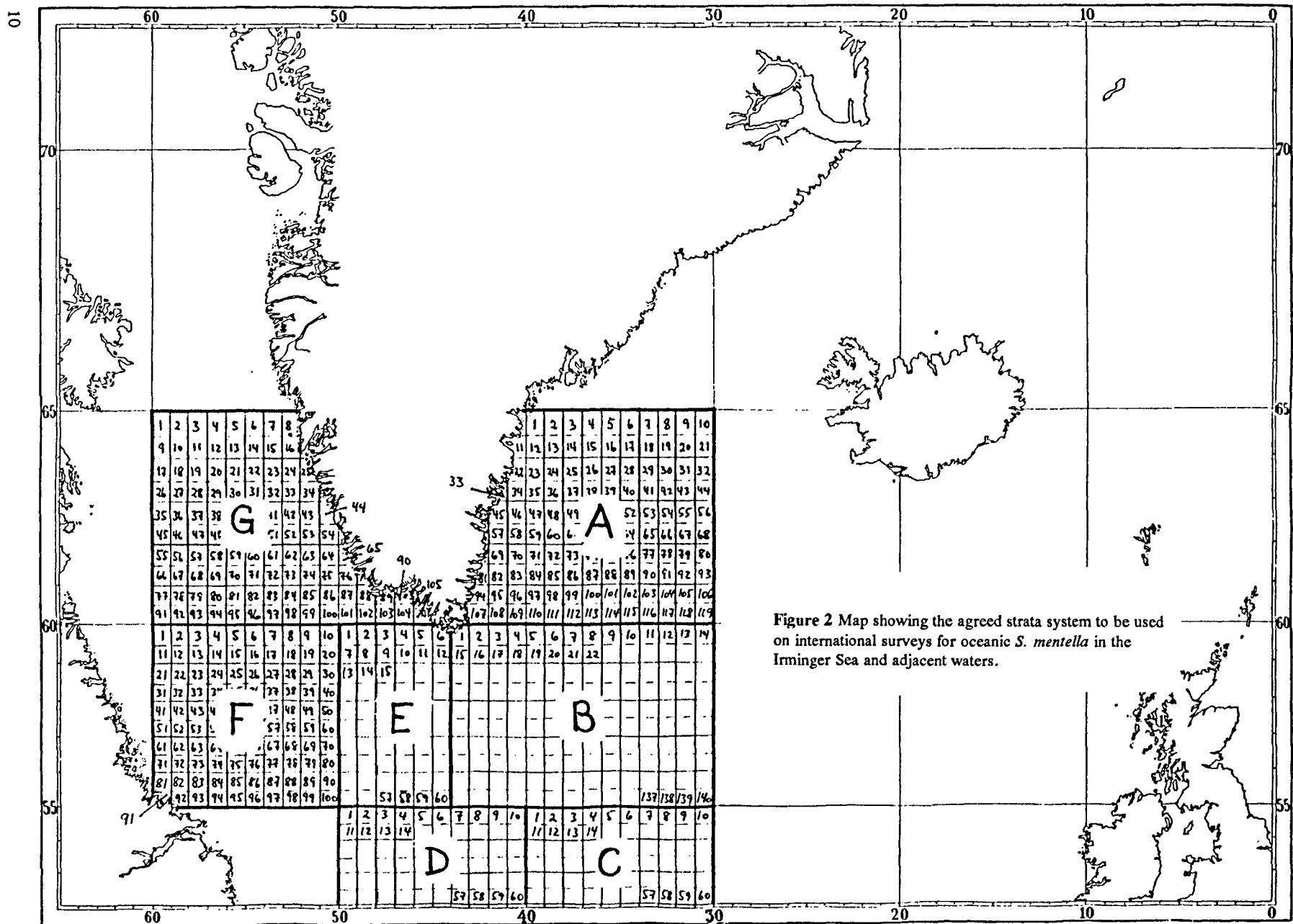


Figure 2 Map showing the agreed strata system to be used on international surveys for oceanic *S. mentella* in the Irminger Sea and adjacent waters.

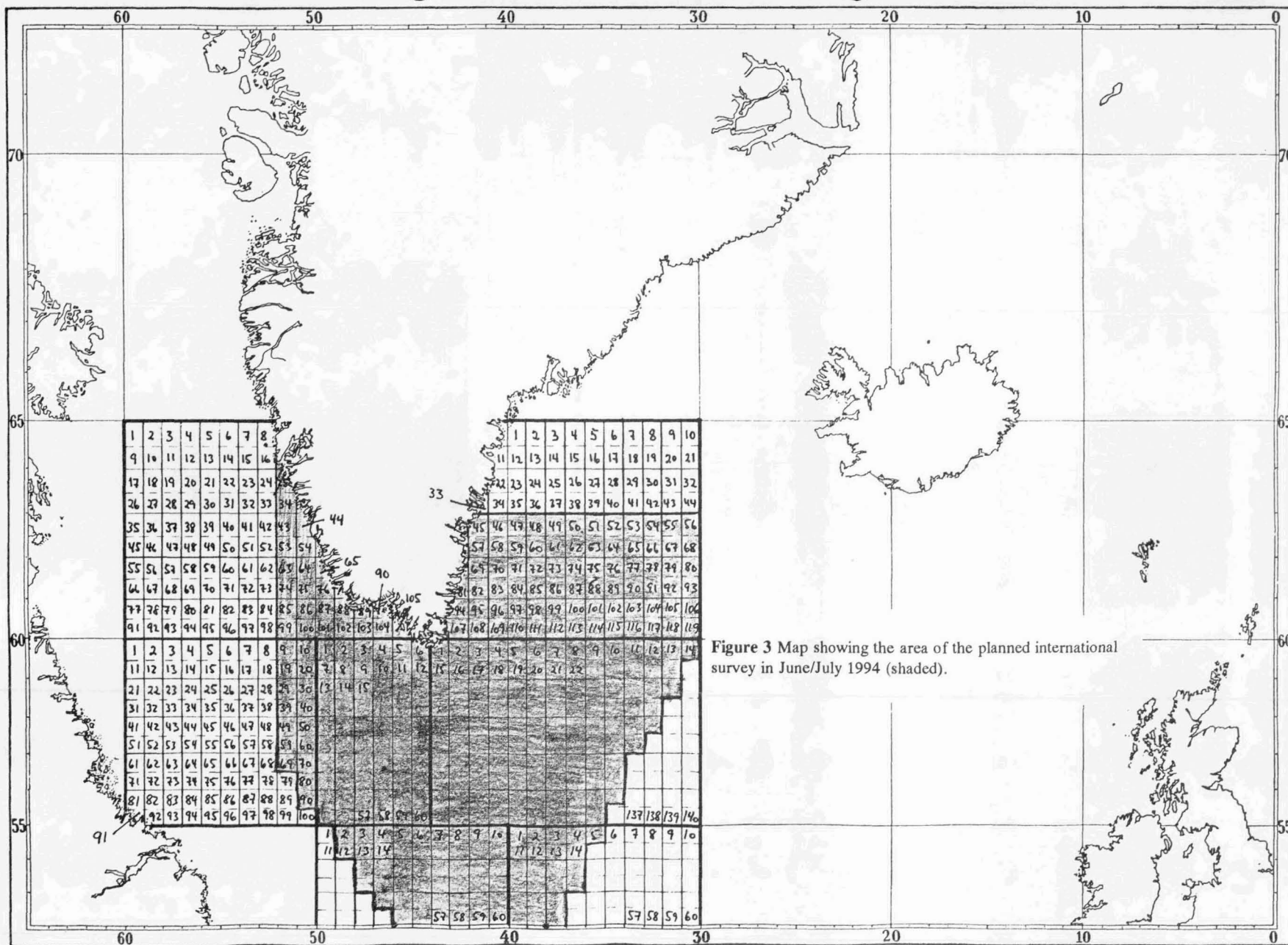


Figure 3 Map showing the area of the planned international survey in June/July 1994 (shaded).

65 H 249 Length 35 cm
 Sex ♂ NATS. 3
 Weight 570 KG
 Stomach 0

SPESIES *Stenopoma*
 STATION 88-41-354
 DATE

250 Length 41 cm
 Kyn 9 Kynbr. 4
 Prong 840 kg
 Aths 0

64

251 Length 39 cm
 Kyn 8 Kynbr. 4
 Prong 715 kg
 Aths 0

63

252 Length 38 cm
 Kyn 8 Kynbr. 4
 Prong 630 kg
 Aths 0

62

253 Length 43 cm
 Kyn 9 Kynbr. 2
 Prong 1020 kg
 Aths 10

61

254 Length 38 cm
 Kyn 9 Kynbr. 4
 Prong 860 kg
 Aths 240

60

Figure 4 An example of a sampling sheet for the external parasites and for abnormalities in the pigmentation as well as notes on the stomach fullness (Magnusson, J.V., 1992. Working Document submitted to the meeting of the Study Group in 1992).