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**REPORT OF THE NORTH-WESTERN WORKING GROUP**

Copenhagen, 1 - 8 May 1991

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\*General Secretary  
ICES  
Palægade 2-4  
DK-1261 Copenhagen K  
DENMARK

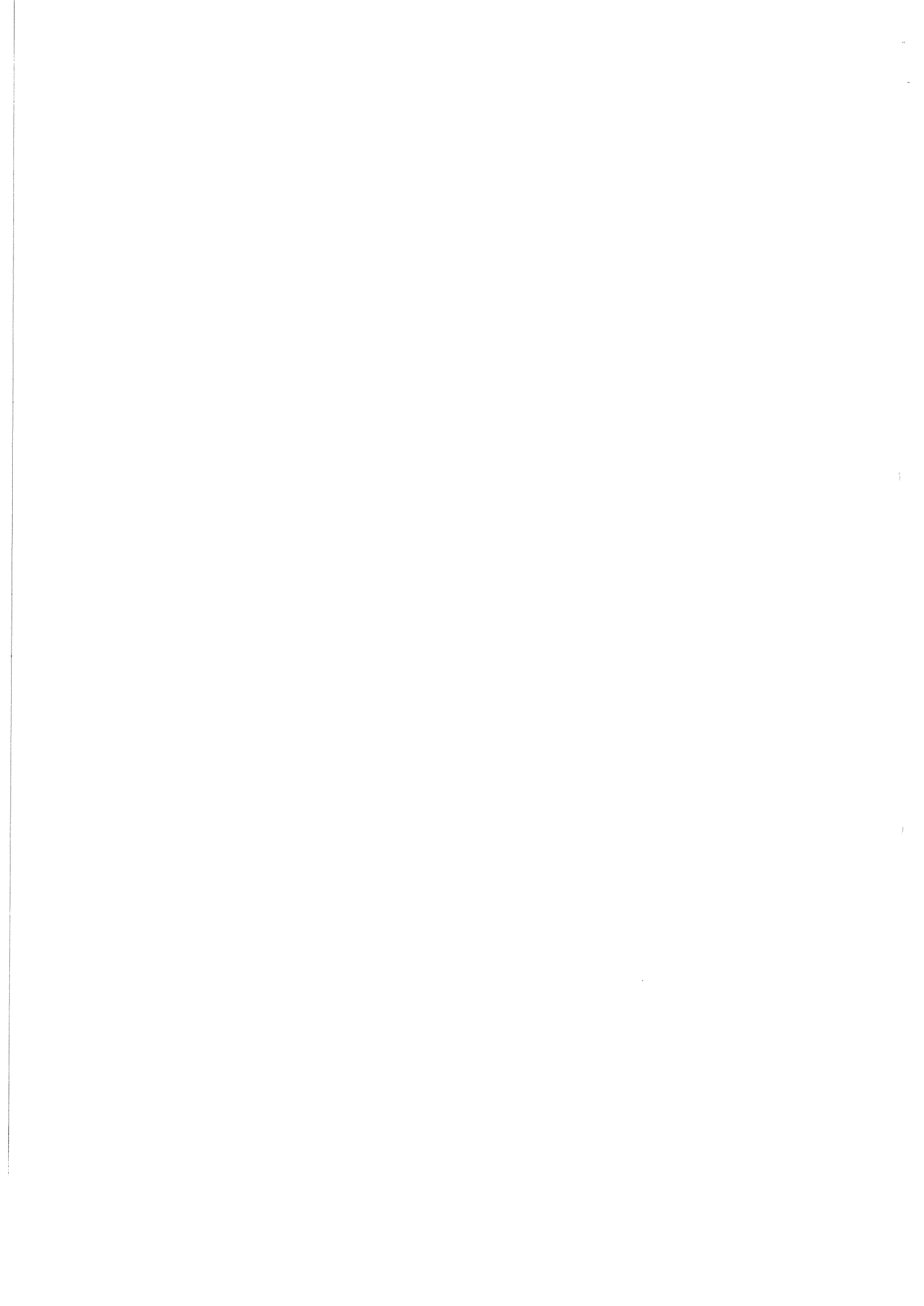


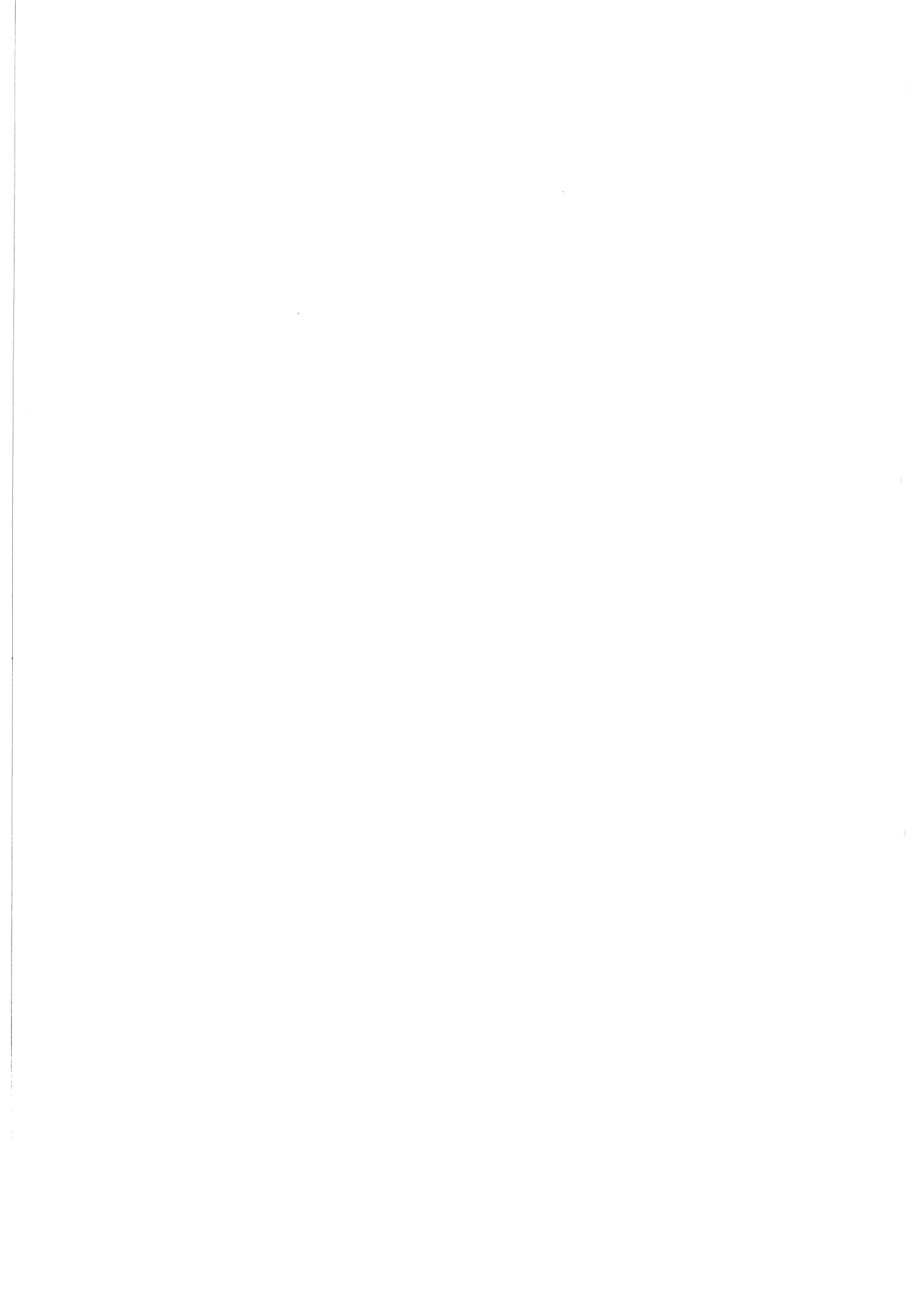
TABLE OF CONTENTS

| <u>Section</u>   | <u>Page</u> |
|--|-------------|
| 1 INTRODUCTION . . . . .   | 1           |
| 1.1 Participants . . . . .   | 1           |
| 1.2 Terms of Reference . . . . .   | 1           |
| 2 REDFISH IN SUB-AREAS V, VI, XII, AND XIV . . . . .   | 1           |
| 2.1 Study Group on Redfish Stocks . . . . .  | 1           |
| 2.2 Species and Stock Identification . . . . .   | 2           |
| 2.3 Stock Distribution with Respect to National Fisheries Zones . . . . .                                | 3           |
| 2.4 Landings and Trends in the Fisheries . . . . .   | 4           |
| 2.5 Trends in Effort and CPUE . . . . .  | 4           |
| 2.6 Recruitment Indices . . . . .  | 5           |
| 2.7 By-catch of Small Redfish in the Denmark Strait's Shrimp Fishery<br>(Figure 2.2) . . . . .           | 5           |
| 2.8 Redfish Assessment . . . . .   | 6           |
| 2.8.1 Methodological considerations . . . . .  | 6           |
| 2.8.2 Management considerations . . . . .  | 6           |
| 2.8.3 Landings by species and areas . . . . .  | 7           |
| 2.8.4 <i>Sebastes marinus</i> . . . . .  | 7           |
| 2.8.4.1 Landings . . . . .   | 7           |
| 2.8.4.2 Assessment . . . . .   | 7           |
| 2.8.5 <i>S. mentella</i> . . . . .   | 8           |
| 2.8.5.1 Landings . . . . .   | 8           |
| 2.8.5.2 Assessment . . . . .   | 8           |
| 2.8.6 Combined assessment of <i>S. marinus</i> and <i>S. mentella</i> . . . . .                          | 8           |
| 2.8.7 Oceanic-type <i>S. mentella</i> . . . . .  | 8           |
| 2.8.7.1 Landings . . . . .   | 8           |
| 2.8.7.2 Assessment . . . . .   | 8           |
| 2.8.7.3 Research vessel surveys in 1990 . . . . .  | 9           |
| 2.8.7.4 Evaluation of oceanic-type <i>S. mentella</i> acoustic surveys . . . . .                         | 9           |
| 2.8.7.5 Proposals for future international research work on oceanic-type<br><i>S. mentella</i> . . . . . | 10          |
| 3 GREENLAND HALIBUT IN SUB-AREAS V AND XIV . . . . .   | 10          |
| 3.1 Landings and Trends in the Fisheries (Tables 3.1-3.4) . . . . .                                      | 10          |
| 3.1.1 By-catch of small Greenland halibut in the Denmark Strait shrimp<br>fishery (Figure 3.1) . . . . . | 11          |
| 3.2 Effort Data (Table 3.5) . . . . .  | 11          |
| 3.3 Catch at Age (Table 3.6) . . . . .   | 11          |
| 3.4 Weight at Age (Table 3.7) . . . . .  | 11          |
| 3.5 Maturity at Age (Table 3.8) . . . . .  | 11          |
| 3.6 Assessments and Predictions . . . . .  | 11          |
| 3.6.1 Estimates of fishing mortalities (Tables 3.9-3.10 and Figure 3.2A) . . . . .                       | 11          |
| 3.6.2 Spawning stock biomass and recruitment (Table 3.11 and Figure 3.2B) . . . . .                      | 12          |
| 3.6.3 Catch predictions (Tables 3.12-13 and Figures 3.2C and D) . . . . .                                | 12          |
| 4 ICELANDIC SAITHE . . . . .   | 12          |

| Section | Page   |
|---------|--|
| 4.1     | Landings and Trends in the Fisheries (Table 4.1 and Figures 4.1A) . . . 12             |
| 4.2     | Effort Data (Table 4.2) . . . . . 12   |
| 4.3     | Catch at Age (Table 4.3) . . . . . 13  |
| 4.4     | Weight at Age (Table 4.4) . . . . . 13   |
| 4.5     | Maturity at Age (Table 4.5) . . . . . 13   |
| 4.6     | Assessment and Predictions . . . . . 13  |
| 4.6.1   | Tuning of VPA and estimates of fishing mortality (Tables 4.6 - 4.9) 13                 |
| 4.6.2   | Spawning stock biomass and recruitment (Table 4.9 and Figure 4.1B) 13                  |
| 4.6.3   | Biological reference points (Figures 4.1 and 4.2) . . . . . 14                         |
| 4.6.4   | Catch predictions (Table 4.11 and Figure 4.1) . . . . . 14                             |
| 5       | THE DEMERSAL STOCKS IN THE FAROE AREA . . . . . 14                                     |
| 5.1     | General Trends in the Demersal Fisheries in the Faroe Area (Table 5.1) . . . . . 14    |
| 6       | FAROE SAITHE . . . . . 14  |
| 6.1     | Landings and Trends in the Fishery (Table 6.1 and Figure 6.1) . . . . 14               |
| 6.2     | Catch at Age (Table 6.2) . . . . . 14  |
| 6.3     | Weight at Age in the Catch (Table 6.3) . . . . . 14                                    |
| 6.4     | Assessment and Prediction . . . . . 15   |
| 6.4.1   | Estimates of fishing mortality (Tables 6.4-6.7 and Figure 6.1A) . . 15                 |
| 6.4.2   | Population estimates and recruitment (Table 6.8 and Figures 6.1B and 6.2) . . . . . 15 |
| 6.4.3   | Catch predictions (Tables 6.9 and 6.10, Figures 6.1C and 6.1D) . . 15                  |
| 7       | FAROE COD . . . . . 15   |
| 7.1     | Landings and Trends in the Fishery (Tables 7.1, 7.2 and Figure 7.1A) 15                |
| 7.2     | Catch at Age (Table 7.3) . . . . . 16  |
| 7.3     | Weight at Age (Table 7.4) . . . . . 16   |
| 7.4     | Assessment and Predictions . . . . . 16  |
| 7.4.1   | Estimates of fishing mortality (Tables 7.5-7.8, and Figure 7.1A) . 16                  |
| 7.4.2   | Population estimates (Table 7.10 and Figure 7.1B) . . . . . 16                         |
| 7.4.3   | Catch predictions (Tables 7.11-7.13 and Figures 7.1C and D) . . . . 16                 |
| 7.4.4   | Faroe Bank cod (Table 7.2 and Figure 7.3) . . . . . 17                                 |
| 8       | FAROE HADDOCK . . . . . 17   |
| 8.1     | Landings and Trends in the Fishery (Tables 8.1 and 8.2) . . . . . 17                   |
| 8.2     | Catch at Age (Table 8.3) . . . . . 17  |
| 8.3     | Weight at Age (Table 8.4) . . . . . 17   |
| 8.4     | Assessment and Predictions . . . . . 17  |
| 8.4.1   | Estimates of fishing mortality (Tables 8.5-8.9) . . . . . 17                           |
| 8.4.2   | Population estimates (Tables 8.10) . . . . . 18  |
| 8.4.3   | Catch predictions (Table 8.10) . . . . . 18  |
| 9       | BLUE LING IN SUB-AREAS V, VI, AND XIV . . . . . 18                                     |



| Section  | Page |
|--|------|
| 9.1 Landings and Trends in the Fisheries (Tables 9.1-9.5)                        | 18   |
| 9.2 Effort Data (Table 9.6 and Figure 9.1)                                       | 19   |
| 9.3 Catch and Weight at Age (Table 9.7)  | 19   |
| 9.4 Estimates of Total Mortality (Figure 9.2)                                    | 19   |
| 9.5 Assessment and Predictions   | 19   |
| 9.6 SHOT Results and the Forecast of Status Quo Catch (Tables 9.8-9.9)           | 19   |
| <br>   |      |
| 10 LING IN SUB-AREAS V, VI AND XIV   | 20   |
| 10.1 Landings and Trends in the Fisheries (Tables 10.1-10.5)                     | 20   |
| 10.2 Effort Data (Table 10.6 and Figure 10.1)                                    | 20   |
| 10.3 Catch and Weight at Age Data  | 20   |
| 10.4 Assessment and Predictions  | 20   |
| 10.5 SHOT Results and the Forecast of <u>Status Quo</u> Catch (TAC) (Table 10.7) | 20   |
| <br>   |      |
| 11 TUSK IN SUB-AREAS V, VI AND XIV   | 21   |
| 11.1 Landings and Trends in the Fisheries (Tables 11.1-11.5)                     | 21   |
| 11.2 Effort Data (Table 11.6 and Figure 11.1)                                    | 21   |
| 11.3 Catch and Weight-at-Age Data  | 21   |
| 11.4 Assessment and Predictions  | 21   |
| 11.5 SHOT Results and the Forecast of Status Quo Catch (Table 11.7)              | 21   |
| <br>   |      |
| 12 ACFM PROPOSALS FOR REARRANGEMENT OF ICES ASSESSMENT WORKING GROUPS            | 21   |
| <br>   |      |
| 13 REFERENCES  | 22   |
| <br>   |      |
| 14 WORKING DOCUMENTS SUBMITTED TO THE MEETING                                    | 22   |
| <br>   |      |
| Tables 2.1 - 11.7  | 24   |
| Figures 2.1 - 11.1   | 97   |
| Appendix 1   | 111  |



## 1 INTRODUCTION

### 1.1 Participants

|                           |               |
|---------------------------|---------------|
| V. Blinov                 | USSR          |
| J. Boje                   | Greenland     |
| H.P. Cornus               | Germany       |
| N.R. Hareide              | Norway        |
| A. Kristiansen            | Faroe Islands |
| J. Lahn-Johannesson       | Norway        |
| J. Magnusson              | Iceland       |
| H. Müller                 | Germany       |
| A. Nicolajsen             | Faroe Islands |
| A. Pavlov                 | USSR          |
| J. Reinert                | Faroe Islands |
| S.A. Schopka (Chairman)   | Iceland       |
| G. Stefánsson (part-time) | Iceland       |
| B.Æ. Steinarsson          | Iceland       |
| M. Terceiro               | USA           |

The ICES Statistician, Dr R. Grainger, assisted the meeting in various ways.

### 1.2 Terms of Reference

At the 78th Statutory Meeting it was decided (C.Res. 1990/2:5:15) that the North-Western Working Group should meet at ICES Headquarters from 1-8 May 1991 to:

- a) assess the status of and provide catch options for 1992 within safe biological limits for the stocks of redfish and Greenland halibut in Sub-areas V and XIV, saithe in Division Va and Division Vb, and cod and haddock in Division Vb, and, if possible, consider the effects of technical and biological interactions.
- b) continue to compile the data necessary for assessing the stocks of blue ling, ling, and tusk in Sub-areas V, VI and XIV and evaluate the possibility of assessing these stocks.

In addition, at its Ninth Annual Meeting in November 1990, NEAFC requested ICES to provide additional information concerning "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".

In relation to this additional request from NEAFC, the problems are addressed in relevant sections of the report.

## 2 REDFISH IN SUB-AREAS V, VI, XII, AND XIV

### 2.1 Study Group on Redfish Stocks

According to C.Res.1990/2:12, the Study Group on Oceanic-Type Sebastes mentella has been renamed the Study Group on Redfish Stocks and will work by correspondence in 1991.

The Chairman of the Study Group (Dr J. Magnusson, Iceland) submitted a progress report to the Working Group in relation to each of the terms of reference of the Study Group. An account is given of the ongoing work of the Group. Some provi-

sions have been made to coordinate planned cruises and observations on the oceanic-type S. mentella and some other work related to the terms of reference of the Study Group (Appendix 1).

## 2.2 Species and Stock Identification

In the North-East Atlantic, there are at least three species of redfish: Sebastes viviparus, S. marinus, and S. mentella. Since S. viviparus has never been the subject of a commercial fishery, this species is not dealt with further in this report. The two other species have a wide distribution in the North Atlantic.

Within the ICES assessment working groups, these species have been considered as five separate stocks:

- 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.

The North-Western Working Group has to deal with and assess three of these stocks, i.e., the S. marinus and S. mentella Greenland/Iceland/Faroes stocks, and the oceanic stock of S. mentella in the Irminger Sea.

From time to time it has been questioned whether it was correct to consider S. marinus and S. mentella, respectively, from Greenland, Iceland, and Faroes waters as single stock units. At present, the Working Group has no evidence at hand which would justify splitting these stocks into separate stock units. The Working Group takes note of the work initiated by a Nordic group of scientists on S. marinus on issues which are related to this topic.

The Working Group considered specifically "the stock identity, migration", and "spawning" areas of the oceanic-type S. mentella.

In the report of the Study Group on oceanic-type Sebastes mentella (ICES, Doc. C.M.1990/G:2) and in last year's report of the North-Western Working Group (C.M.1990/Assess:20), several characteristics of this stock were stated. New data presented at the present meeting (Pavlov: Working paper) of the Working Group further supported the characteristics described previously. Further, the data support the hypothesis on the life-cycle presented in the Study Group report. New information from the USSR larval survey in 1990 show that there are two concentrations of newly extruded larvae: one between 60°N and 62°N and 27°W and 31°W and another further southwest between 56°N and 58°N and 30°W and 35°N (Figure 2.3). The larvae have not been determined to species, but control fishing tows for adults were taken. S. marinus have never been taken by pelagic trawl in the open ocean. The control catches were exclusively S. mentella and probably only the oceanic-type S. mentella. The northern larval concentration might, however, consist of larvae from the two S. mentella stocks.

It is assumed that the southernmost concentration represents the oceanic-type S. mentella only. Currents in this region would certainly carry fry from this concentration to the Davis Strait northwards along the West Greenland Continental Slope.

In the northerly regions off Maniitisoq (Sukkertoppen) and Sisimiut, 0-group redfish have been observed offshore. Juvenile redfish of S. mentella have been observed in the area between West-Greenland and Baffin Island.

Although the areal separation of the spawning stocks of the oceanic-type S. mentella and the traditional S. mentella has not yet been well defined, the Working Group considers the oceanic-type S. mentella a separate stock.

The spawning area of the oceanic-type S. mentella is in the Reykjanes Ridge region. The main concentrations seem to follow the 5-6°C isotherms at 200 m depth in SW-NE direction. This boundary may, at the time of extrusion of the larvae, be located at considerably different locations from one year to another and the main spawning zone will thus be situated more to the east or west depending on the hydrographic conditions (Figure 2.6).

It has been pointed out earlier (C.M.1990/G:2 and C.M.1990/Assess:20) that there appears to be a partial overlap of the "spawning" areas of the two stocks of S. mentella (oceanic and traditional). Further, the stocks do select different depths for the extrusion of larvae.

No further information on the separation of these stocks during "spawning" was available to the Working Group. The Working Group emphasizes the need for further investigations on the separation of these two stocks during the "spawning" period.

Many aspects of the migration pattern of this stock are still uncertain. The migration of maturing fish to the spawning areas is obvious although the migration route might still be unclear. Movements of the fishing fleet and survey results show certain shifts in the location of aggregations of fish which indicate the following migration pattern:

While the main spawning concentrations are in the eastern part of the distribution area (eastern Irminger Sea) extending far in a SW-NE direction, the feeding aggregations are found more to the west and south where concentrations have been observed in summer and late summer into September.

A USSR survey in 1990 showed the distribution of the adult stock extending further to the west, south of Greenland, than previously observed. This distribution attracted a pelagic fishery on this stock in the Labrador Sea (Figure 2.5).

### 2.3 Stock Distribution with Respect to National Fisheries Zones

The distribution of the S. marinus and the traditional S. mentella stocks in the national fisheries zones is reflected in the catch statistics. All catches taken in ICES Sub-area XIV are within the national fisheries zone of Greenland. Likewise, catches reported in Divisions Va and Vb are taken within the national fisheries zones of Iceland and the Faroes, respectively. In Sub-area VI, the catches could be taken within the fisheries zone of the EC (United Kingdom) or of the Faroe Islands, depending on where they are taken within Sub-area VI.

Considering the oceanic-type S. mentella stock, the conditions are different. Reported catches so far have all been taken in Sub-areas XII and XIV almost exclusively in international waters, i.e., outside the national fisheries zones of the neighbouring countries with the exception of minor catches within the national fisheries zone of Greenland.

From the distribution information available, it is obvious that a substantial part of the adult oceanic-type S. mentella is - at least at times - to be found within the national fisheries zones of Iceland and Greenland. Iceland has, for example, started a fishery (in April this year) on spawning concentrations of the oceanic stock within its zone. On the other hand, during the feeding migra-

tion, investigations indicate aggregations of this stock within the East Greenland zone. With the present state of knowledge, there is no way to quantify the proportion of the adult stock occurring in the respective national fisheries zones.

#### 2.4 Landings and Trends in the Fisheries

The total catch of redfish, excluding catch figures from the "oceanic" fishery, were somewhat lower in 1989 (110,000 t) than in 1988 (121,000 t), i.e., a decrease of about 9%. In 1990, the catches remained at the same level as in 1989 (110,000 t).

The catches in Division Va remained at the same level as in 1989. In Division Vb, the catches decreased about 1,000 t in 1989 and 2,000 t in 1990. In Sub-area XIV, the catches (excluding the oceanic-type S. mentella) decreased by about 7,000 t in 1989 but increased again in 1990 by about 4,000 t.

In Division Va (Iceland), the CPUE of the Icelandic fleet has been rather stable in recent years which is also reflected in relatively stable total redfish landings from the Division (Tables 2.1-2.2). The catch increased from about 89,000 t in 1987 to about 95,000 t in 1988 but has decreased slightly to about 92,000 t in 1989 and 1990.

In Division Vb (Faroes) (Tables 2.3-2.4), the biggest landings on record were taken in 1986 (about 21,000 t). Since then the catches steadily decreased to about 12,000 t in 1990. The decrease in landings is due to a decrease in the catches by the Federal Republic of Germany fleet from 5,142 t in 1986 to 441 t in 1990 (about 4,700 t) and a decrease in the Faroes landings from 15,224 t in 1986 to 10,014 t in 1990 (about 5,000 t). The landings by the French fleet increased from 582 t in 1988 to 1,410 t in 1990.

Landings from Sub-area VI have been of minor importance in recent years (Tables 2.5-2.6).

From Sub-area XIV (East Greenland) (Tables 2.9, 2.10 and 2.17), the total landings (excluding the oceanic-type S. mentella) were about 10,000 t in 1988, decreased to 3,000 t in 1989 but increased again to 7,000 t in 1990. The catches of the Federal Republic of Germany increased in 1990 by about 1,100 t and the Japanese catches (as reported to Greenland) by about 3,100 t. The proportion of S. marinus remained at a very low level.

The fishery on the oceanic-type S. mentella stock took place outside the national fisheries zones in Sub-areas XIV and XII (Table 2.17). The landings amounted to 91,400 t in 1988 but dropped to about 37,500 t in 1989 and 33,500 t in 1990. This drop in the landings took place in spite of two nations joining this fishery: Iceland in 1989 (3,289 t in 1989 and 3,911 t in 1990) and Norway in 1990 (4,543 t) (with similar CPUE as the USSR fleet in the late 1980s).

#### 2.5 Trends in Effort and CPUE

##### CPUE data for S. marinus

Data on catch and towing time are available for redfish in Division Va on a per-tow basis from the Icelandic trawl fisheries. A preliminary analysis of these data for the period 1973-1990 was made available to the Working Group (Table 2.11).

Three methods were used for the analysis. The classical method used earlier by

the Working Group involved computing the ratio of total catch and towing time for tows which contain at least 70% redfish. Secondly, a GLM model was fitted to data aggregated to a ship-month-square level, selecting those values where a vessel had caught at least 50% redfish. The model contained vessel, month and gear effects (on the log scale). The final analysis was a simple square averaging procedure, aggregating as in the GLM, but then using averages, first over vessels within squares, then squares within months, and finally over months within years.

The three series are shown in Table 2.11 and Figure 2.1. It can be seen that the classical and GLM indices are quite similar, whereas the square-averaging is somewhat different from the others. Based on these indices, there is no indication of a downward trend CPUE values in recent years.

It must be noted that these CPUE values do not necessarily reflect in any manner on the state of the stock of Sebastes marinus or S. mentella in Divisions Vb or XIV.

CPUE data are available on oceanic-type Sebastes mentella for USSR type BMRT vessels since 1982, for Bulgarian vessels since 1984, for GDR type FVSIV vessels since 1987, for the Icelandic fleet from 1989 to 1990, and for the Norwegian fleet for 1990 (Table 2.12).

After a sharp decline in 1986, the USSR catch rate remained at the same level (about 1 t/h) during the following years. Decreasing tendencies in CPUEs can also be seen from GDR and Bulgarian data series.

## 2.6 Recruitment Indices

Indices for 0-group redfish in the Irminger Sea and at East Greenland are available from the Icelandic 0-group surveys since 1970 (Table 2.13). During 1972-1974, the indices were well above the overall average of 15.2, suggesting good year classes in those years. During the ten-year period 1975-1984, the index was below average, particularly in 1976 and from 1979-1984. Values were high in 1985, 1987, and 1990 with the highest index on record since the reduction of the survey area in 1984. The 1986 and 1989 indices were slightly below average. Thus, the indices suggest generally strong year classes after 1984 following a period of poor ones (1975-1984).

## 2.7 By-catch of Small Redfish in the Denmark Strait's Shrimp Fishery (Figure 2.2)

Information on by-catch from a Greenland shrimp trawler fishing in Sub-area XIV between 64°N and 66°N was available from the period March/April 1991. The by-catch of redfish averaged about 4% by weight on the basis of 86 hauls with a total shrimp catch of 57 t. The bulk of the redfish was in the length range 10-20 cm with a mode at 13 cm (Figure 2.2). Since early in 1990 a minor part of the redfish 'box' has been opened to the shrimp fishery, but no information of the by-catches in this area was available apart from a shrimp survey conducted by Greenland. In this survey however, catches of shrimp were too sparse to be representative of the commercial fishery.

## 2.8 Redfish Assessment

### 2.8.1 Methodological considerations

The Working Group noted the concerns of the Study Group on Oceanic-type S. mentella (Anon., 1990b) relating to age-based (analytical) assessments of redfish in general and S. marinus in particular.

These concerns on the validity of (tuned) VPA for redfish stem from internal inconsistencies in the catch at age tables (lack of ability to follow year classes) and inconsistencies with length distributions from the Icelandic groundfish surveys (where an extreme variation in year class strength of S. marinus is seen, although this is not reflected in the VPA).

During the meeting of the Study Group on Oceanic-type S. mentella in Reykjavik in February 1990, length-based assessment methods were tried on the redfish (Anon., 1990b). The results did not indicate that these methods could solve the problems.

Based on the length distributions given in Anon. 1990b, it is seen, however, that the basic assumptions of slow growth and longevity must be correct for S. marinus. Due to the large number of year classes in the fisheries and in the recruiting phase, the assumption of stable recruitment to the exploited stock seems reasonable.

Based on the above considerations, the Working Group decided to emphasize the SHOT method for the redfish stocks, with minimal assumptions and using different values of the Y/B ratio.

There is in general a good agreement of age-reading results for oceanic S. mentella between USSR and Germany (former GDR) using scale samples. However, those results differ considerably (by up to 4-7 years in modal groups) from those provided for the first time to the Working Group by Norway using both scale and otolith samples. The reasons for these discrepancies could not be explained during the Working Group meeting.

This issue will be discussed during the Meeting of the Workshop on Age Determination of Redfish to be held on 26-30 August in Murmansk (C.Res.1990/2:14).

These contradictory results provide the Working Group with an additional reason to reject the use of VPA for oceanic-type Sebastes mentella.

### 2.8.2 Management considerations

When considering the management of the two stocks, S. marinus and the traditional S. mentella in Sub-areas V and XIV, there are several aspects which the Working Group would like to draw attention to:

- 1) While the S. marinus landings have been maintained at a relative high level in Division Va, they have decreased both in Sub-area XIV and Division Vb.
- 2) There were some actual technical difficulties in the splitting of the landings in Division Va into S. marinus and S. mentella. Therefore, there is a certain doubt about the accuracy of the proportion of these stocks in the landings in Division Va in 1990 and even 1989.
- 3) Nothing is known about recruitment of the oceanic-type S. mentella.



- 4) The fishery on the oceanic-type S. mentella stock is exclusively directed on the adult (spawning) stock.
- 5) The fishery on the oceanic-type S. mentella has taken place exclusively in international waters until 1991 when fishing on this stock started within the national fishery zone of Iceland.

### 2.8.3 Landings by species and areas

Based on Tables 2.2 to 2.10 the landings were split into species using the split factors of Tables 2.5 to 2.7 of Anon. 1990, which give the factors by year and country up to 1989. The factors used in 1990 are given in Table 2.14 of this report. The resultant landings by area on a stock basis are shown in Tables 2.15 to 2.17 for Sebastes marinus, Sebastes mentella and Sebastes mentella oceanic-type, respectively.

### 2.8.4 Sebastes marinus

#### 2.8.4.1 Landings

The total landings of S. marinus increased to a peak of about 130,000 t in 1982, decreased then to a level of about 71,000 t (Table 2.15). The largest proportion is from Division Va which contributes about 90% on an average over the years reported. In Division Vb a decline can be seen from about 9,000 t in 1985 to about 2,300 t in 1990. Much more drastic is the decline of landings from Sub-area XIV from a peak of 30,000 t in 1982 to only 750 t in 1990 which cannot be explained only by reduced effort. The catches in Sub-area VI are of minor importance.

Obviously there has been a change of the proportion of S. marinus compared to S. mentella in Sub-area XIV since the mid-1980s. At the same time there has also been a decline in the proportion of S. marinus in the landings from Division Vb.

#### 2.8.4.2 Assessment

The SHOT method (as provided in a spreadsheet at ICES) was used for projections. Since the level of fishing mortalities in relation to growth is somewhat uncertain, several values of the yield/biomass ratio were tested. The total landings for the stock in all regions (Va, Vb, VI and XIV) were used in these forecasts.

The average landings in the period 1978-1990 amounted to some 85,000 t. The status quo TAC for 1991 based on the SHOT method ranged from 78,000 t to 85,000 t (Tables 2.18 to 2.20) as the yield/biomass ratio ranged from 0.3 to 0.7.

Taking into account the fact that the Icelandic CPUE values in Division Va do not show any downwards trend, the landings of S. marinus could remain close to 80,000 t, as indicated by the SHOT results; however, trends in landings from Sub-area XIV and Division Vb are a source of some concern.

## 2.8.5 S. mentella

### 2.8.5.1 Landings

The total landings of S. mentella for the period 1984-1990 averaged 41,000 t (Table 2.16). About 54% of the landings are from Division Va for this time period, whereas about 27% are from Division Vb. The rest is from Sub-area XIV, which has been relatively constant since 1987, except for 1989. Landings in Sub-area VI have been of minor importance since 1984.

### 2.8.5.2 Assessment

The SHOT method was used for catch projection. As in the case of S. marinus, the yield per biomass ratio is uncertain because of problems in age determination and consequently uncertain growth rates. Three SHOT runs with three assumed levels of yield per biomass of 0.3, 0.5 and 0.7 for moderately exploited, heavily and very heavily exploited stocks, respectively, were carried out. Constant recruitment was assumed because little is known about recruitment of this stock.

The average level of the landings was 37,977 t. The SHOT method provided a status quo TAC of about 41,000 t for all three yield per biomass ratios (Tables 2.21 to 2.23).

## 2.8.6 Combined assessment of S. marinus and S. mentella

The SHOT method was applied to the combined total landings of S. marinus and S. mentella. The estimated status quo TAC for 1991 results in 119,000 t (Table 2.24) which is exactly the sum of the estimated status quo catches for S. marinus and S. mentella assessed separately.

## 2.8.7 Oceanic-type S. mentella

### 2.8.7.1 Landings

The landings of S. mentella oceanic-type are only from Sub-areas XII and XIV (Table 2.17). This fishery started 1982 on an unexploited stock with landings of about 60,000 t rising to about 105,000 t in 1986. The landings dropped suddenly in 1989 from about 90,000 t to about 37,000 t and remained on that level in 1990. Since 1985, the landings from Sub-area XIV have been greater than those from Sub-area XII.

### 2.8.7.2 Assessment

A VPA was tried based on catch in number from the Soviet, Bulgarian and GDR fleets. There were discrepancies between the age compositions of the catches of the Bulgarian and the other fleets in 1987. CPUE data for the Soviet fleet were used for the tuning. As in other pelagic fisheries these may not correctly reflect the development of stock size because of the schooling behaviour of pelagic stocks. In addition, this fishery is exploiting only the adult and spawning part of the stock. Displacement of the thermal front in the vicinity of the Reykjanes ridge (Pavlov, 1989), may have affected stock distribution and density, influencing the catchability.

Given these problems, the Working Group decided not to accept the VPA run. The SHOT method was used to forecast catches in 1991. The same problems arise in determining parameters for the SHOT model as in the other two redfish stocks. Three runs with yield per biomass ratios of 0.3, 0.5 and 0.7 result in catch predictions for 1991 of 42,000 t, 50,000 t and 58,000 t, respectively (Tables

2.25 to 2.27). The SHOT method is not appropriate when there are drastic changes in the catch level from year to year combined with an absence of recruitment and effort data. The decline in catches from 91,000 t in 1988 to 37,000 t in 1989 is such an event. The Working Group recognized the uncertainties of the level of yield per biomass ratio due to the relative short time series of that fishery and the poor knowledge on the recruitment processes.

#### 2.8.7.3 Research vessel surveys in 1990

In 1990, the USSR conducted research work using R/V MI-0771 "Professor Marti" with particular emphasis on biomass assessment of the species by means of acoustic and ichthyoplankton surveys.

An ichthyoplankton survey using a Bongo plankton sampler took place from 16 April to 21 May (Figure 2.3). The data obtained during the ichthyoplankton survey probably contained larvae of both types of S. mentella; S. mentella were found at most stations, with maximum densities being observed in the northern and southern sectors of the area (Figure 2.3). Biological indices for both types of S. mentella were determined for each of three parts of its reproductive area, i.e., south and north of 59°N in international waters and within the 200-mile Icelandic zone (Table 2.28). From the indices obtained for abundance, the redfish spawning stock was estimated at 858,000 t and its abundance at  $13.1 \times 10^8$  (Table 2.29).

A trawl and acoustic survey of oceanic-type S. mentella was conducted by R/V "Professor Marti" from 9 June to 6 July 1990. The survey covered the area of the open waters from 53°N to 63°N between 29°W and 45°W. The area surveyed made up 92,000 mile<sup>2</sup>. It was not possible to survey inside the 200-mile zone of Greenland.

The methodology used on these trawl-acoustic surveys is given in previous papers presented at ICES (Pavlov *et al.*, 1989). The investigations were made using echosounders EK-400, EK-400 (SIMRAD), and an echointegrator (SIORS). Calibration of echointegrating complex was made using a calibrated copper sphere.

Oceanic-type S. mentella aggregations were mainly registered in the 100-300 m layer over the whole area surveyed. Maximum densities of aggregations (35-40 t/mile<sup>2</sup>) were found both in the northern sector (from 58°N to 60°N between 35°W and 37°W) and in the south of the area, including the eastern Labrador Sea (from 53°N to 57°N between 37°30'W and 45°W) (Figure 2.5). A considerable proportion of the stock (about 60% by biomass) was distributed in the southern area from 53°N to 57°N. No similar southerly distribution of redfish feeding migration was registered in surveys before (Pavlov *et al.*, 1989). Apparently, in the current year, fish migration mainly took place in international waters. On the whole, according to the results obtained in the survey, the oceanic-type S. mentella biomass constituted 995,000 t and abundance 1,759.2 million (Table 2.30).

#### 2.8.7.4 Evaluation of oceanic-type S. mentella acoustic surveys

Acoustic surveys carried out by the USSR in the Irminger Sea since 1982 have led to the results shown in Table 2.30. These assessment figures show a considerable variation over the years. Possible reasons for that are as follows:

- 1) Yearly surveys cover different parts of the whole, biologically-determined area of distribution of oceanic S. mentella encompassing both the international waters of the Irminger Sea, and oceanic parts of the adjacent 200-mile zones. In 1982-1985 and 1990, surveys were only carried out in the international waters of the Irminger Sea, and their results do not

appear to reflect the actual state of the stock. The 1986-1989 surveys covered the greater part of the assumed area of distribution of oceanic-type S. mentella. It is felt that these data can be considered as the most reliable acoustic evaluation, with a stock size of about 918-1,180,000 tonnes.

- 2) It is realised that variable environmental conditions are contributing to a great extent to the highly variable concentrations of oceanic S. mentella in the Irminger Sea.
- 3) Sources of error in the estimation of the oceanic-type S. mentella abundance by the USSR acoustic survey could possibly be due to: a) noisy signals from the scattering layer (particularly during night time); b) the frequent presence of dense concentrations of jellyfish associated with oceanic-type S. mentella concentrations in depth ranges of 50-500 metres; c) insufficient coverage of the area distribution; d) unknown migration pattern.
- 4) Difficulties in evaluating the target strength of oceanic-type S. mentella in the Irminger Sea could also be a reason for obtaining biased survey results.
- 5) These survey results should not be considered as the basis for VPA tuning. They need thorough revision due to possible methodological problems.

#### 2.8.7.5 Proposals for future international research work on oceanic-type S. mentella

The Working Group noted that the fishery for S. mentella oceanic type has developed in recent years as a broad international fishery. Despite this, the main burden concerning field research work is carried by the USSR. Moreover, it is known that S. mentella oceanic type does not only inhabit the international waters of the Irminger Sea, but also the oceanic parts inside the 200-mile zones of Iceland and Greenland.

The Working Group stresses that more effort should be made to advance the international research programme on the stock, including the placing of observers on board commercial fishing vessels and the granting of access to national fishery zones for research vessels. The main items of the programme have been specified in the 1988 Working Group Report (Anon., 1989), and it was stressed that combined national research efforts should concentrate on the following aspects:

- identification of the stock;
- joint conduct of acoustic surveys in the area on the basis of methodologically pure target strength calibration;
- improvement of reliability of stock size evaluation with either analytical or simplified methods.

### 3 GREENLAND HALIBUT IN SUB-AREAS V AND XIV

#### 3.1 Landings and Trends in the Fisheries (Tables 3.1-3.4)

Total annual catches for Divisions Va and Vb and Subarea XIV are presented for the years 1980-1990 (Tables 3.1-3.4). During the period 1982-1986 catches were stable at about 31,000-34,000 t. In the years 1987-1990 catches increased to about 61,000 t in 1989, followed by a decrease to about 38,000 t in 1990. More

than 90% of the total annual catch is taken by the Icelandic trawler fleet in Division Va.

### 3.1.1 By-catch of small Greenland halibut in the Denmark Strait shrimp fishery (Figure 3.1)

Observer data from a commercial shrimp trawler fishing in Sub-area XIV between 64°N and 66°N were available for the period of March/April 1991. By-catch of Greenland halibut averaged about 4% by weight on the basis of 86 hauls with a total shrimp catch of 57 t. By-catch of Greenland halibut varied significantly from one haul to another. The majority of the by-catch was in the length range 25-55 cm, with a mode at 29 cm (Figure 3.1).

### 3.2 Effort Data (Table 3.5)

Updated estimates of CPUE from the Icelandic trawler fleet for the period 1980-1990 are presented in Table 3.5. These indices are estimated using the NAG-statistical package. A multiplicative model taking into account changes in the Icelandic trawl catch due to ship, statistical square, month, and year effects provides an annual CPUE index for Greenland halibut. All hauls in which Greenland halibut exceeded 80% of the total catch were included in the CPUE estimation. This index in turn is used to estimate the total effort from the total catch.

### 3.3 Catch at Age (Table 3.6)

The catch in numbers at age were updated according to the final catch figures for the years 1988-1990, using the Icelandic catch-at-age estimates raised to the total catch for each year. No other length distributions or age/length keys were available.

### 3.4 Weight at Age (Table 3.7)

The mean weights at age are shown in Table 3.7. These estimates were derived using Icelandic data. The average of mean weights for 1988-1990 were used in the catch predictions.

### 3.5 Maturity at Age (Table 3.8)

Icelandic data on maturity at age for the years 1989-1990 were not considered reliable, and so as in previous assessments the maturity at age for the years 1986-1990 was estimated by averaging data from the years 1982-1984.

### 3.6 Assessments and Predictions

#### 3.6.1 Estimates of fishing mortalities (Tables 3.9-3.10 and Figure 3.2A)

Natural mortality was assumed to be 0.15. Estimates of total effort from Table 3.5 were used to tune the VPA. The results of the tuning are shown in Table 3.9. Only the sigma on age 5 is high, probably due to sampling errors. Sigma for the other ages is generally low, especially for ages 8-10, which are usually the most abundant age-classes in the catch (Table 3.6).

The Working Group noted a decrease in the log-catchability estimates for ages 5-11 from 1989 to 1990 (Table 3.9). This observation agrees with reports from the

fishery that Icelandic fishermen encountered some difficulties in finding Greenland halibut in 1990. The tuning gives an average F level of 0.54 for ages 8-13. This average F level was used as input in the separable VPA for reference age 10, with a selection factor of 1 set for age 15, and full weight given to all years 1980-1990. The matrix of residuals was well behaved for the ages contributing the bulk of the catch, but showed high residuals for ages 5-6 and 14-15, and for ages 6-7 and 7-8 in the years 1987-88.

The Working Group noted a pattern of positive residuals for all ages 5-10 in 1989-1990. Together, the patterns in the log-catchability estimates from the tuning and in the matrix of residuals from the separable VPA suggest that there may have been some changes in the availability of younger Greenland halibut from 1989 to 1990, violating the assumptions of the separable VPA. The Working Group, therefore, decided to use the estimates of F at age directly from the tuning to start a traditional VPA (Table 3.10).

### 3.6.2 Spawning stock biomass and recruitment (Table 3.11 and Figure 3.2B)

The assessment shows a stable spawning stock of 70,000 - 80,000 t in the years 1980-1985. In 1986, spawning stock biomass increases to 95,000 t and reaches a maximum in 1988 of 104,000 t, decreasing to 89,000 t in 1989 and 73,000 t in 1990.

Recruitment shows a decrease in the period 1980-1983 from 40 million to about 26 million. Recruitment then increased during 1985-1987, averaging 42 million.

### 3.6.3 Catch predictions (Tables 3.12-13 and Figures 3.2C and D)

The input data for the predictions are shown in Table 3.12. The Working Group felt that recruitment for the years 1989-1990 was relatively poorly determined by the VPA. The long term mean recruitment for the years 1975-1987 was adopted as an estimate of annual recruitment at age 5 in 1989-1990 and as the basis for input to the predictions. Biological reference points were estimated as  $F_{0.1} = 0.13$  and  $F_{max} = 0.36$ . A catch level of 35,000 t, equal to the TAC already set, was used as the estimate of the total catch in 1991.

Table 3.13 shows the results of the predictions. In the beginning of 1991, the total stock is estimated at about 203,000 t and the spawning stock at about 70,000 t. Given average recruitment, catches of about 35,000 t in 1991 and 1992 will provide a stable level of SSB of about 70,000 t.

## 4 ICELANDIC SAITHE

### 4.1 Landings and Trends in the Fisheries (Table 4.1 and Figures 4.1A)

Landings of saithe from Icelandic grounds (Division Va) have been fluctuating without a trend between 50,000 and 70,000 t in the period 1977-1986. During 1987-1989, annual landings were stable about 80,000 t. In 1990, landings increased by more than 20% to 98,000 t of which 97% were taken by Iceland.

### 4.2 Effort Data (Table 4.2)

Effort data for Icelandic trawlers are available since 1978. As the trawler fishery is a mixed fishery for different demersal species, these were analyzed in order to define a criterion on the effort directed towards saithe. CPUE and effort were only derived from those hauls in which the proportion of saithe in the catch exceeded 70% of the total catch. The total effort directed towards

saithe was estimated by dividing the CPUE into the total landings (Table 4.2).

#### 4.3 Catch at Age (Table 4.3)

Minor changes were made to the age composition of 1989 to account for revised total landings in that year. For 1990, age composition data were available for landings by Iceland which represented more than 97% of the total landings. These data were used to calculate the catch at age of the total landings used as input for the VPA (Table 4.3).

#### 4.4 Weight at Age (Table 4.4)

Weight-at-age data were available for the Icelandic landings in 1990 (Table 4.4). For both catch predictions and stock biomass calculations, the mean weights at age were averaged over the 1988 to 1990 period (Table 4.10).

#### 4.5 Maturity at Age (Table 4.5)

Maturity-at-age data were available for the Icelandic catch in 1990. The 1990 values are similar to those in the years 1985-1987. The reason for the low maturity at age in 1988 and 1989 is possibly due to poorer sampling. For the spawning biomass projections, therefore the average values for the 1985-1987 period were used (Table 4.9).

#### 4.6 Assessment and Predictions

##### 4.6.1 Tuning of VPA and estimates of fishing mortality (Tables 4.6 - 4.9)

It was decided by the Working Group to use the tuning module of the ICES VPA program to obtain initial VPA results. No disaggregated effort by age was available, so the available data were applied to all age groups.

The resulting fishing mortalities of the tuning analysis are shown in Table 4.6. A separable VPA with  $F = 0.425$  for age group 6 and  $S = 1$  for age 13 was selected to provide the average level of fishing mortality indicated for the reference age groups 4-9 by the tuning. The resulting residual matrix is shown in Table 4.7.

Full weight has been assigned to all years for the period under review. The matrix of residuals does not show any large residuals that should cause rejection of the results.

Following the recommended procedure, the terminal population of the separable VPA was used to start the extended VPA. The results of this VPA are given in Table 4.8 and Figure 4.1A.

##### 4.6.2 Spawning stock biomass and recruitment (Table 4.9 and Figure 4.1B)

Spawning stock biomass is shown in Figure 4.1B and Table 4.9. After a decline from 1970-1980, the spawning stock biomass increased to 216,000 t in 1983. In 1985-1987, the spawning stock biomass was at the level of 190,000 - 200,000 t, but declined to 147,000 t in 1988 and 1989. Estimated spawning stock biomass in 1990 is 184,000 t.

Estimates of recruitment at age 3 are plotted in Figure 4.1B. Recruitment has fluctuated in recent years without any clear trend. The 1983 and 1984 year

classes are well above the 1961-1985 long-term average (47 million). It was believed that after two years of good recruitment a poorer recruitment might be expected. Therefore, the size of the 1985 and 1986 year classes from the VPA were taken at face value for the prediction.

As no information is available for the younger year classes, the 1987-1990 year classes were set at the same level as the average recruitment for the 1967-1985 year classes, excluding the very strong year classes in the early 1960s.

#### 4.6.3 Biological reference points (Figures 4.1 and 4.2)

The yield- and spawning stock biomass-per-recruit (age 3) curves shown in Figure 4.1C have been calculated using the exploitation pattern from the separable VPA and weight-at-age data given in Table 4.10. Compared to the 1990 fishing mortality level of  $F_{4-9} = 0.42$ , the reference values for  $F_{max}$  and  $F_{0.1}$  are 0.35 and 0.16, respectively. From Figure 4.2 showing the recruit/spawning stock relationship and Figure 4.1C showing the spawning stock biomass-per-recruit relationship  $F_{med} = 0.30$  and  $F_{high} = 0.75$  were estimated.

#### 4.6.4 Catch predictions (Table 4.11 and Figure 4.1)

The input data for catch projections are shown in Table 4.10. It is assumed that the recommended TAC of 90,000 t will be taken in 1991. Based on these landings, options for 1992 were calculated and are given in Table 4.11 and Figure 4.1D.

### 5 THE DEMERSAL STOCKS IN THE FAROE AREA

#### 5.1 General Trends in the Demersal Fisheries in the Faroe Area (Table 5.1)

Data on catches for Faroese fleet categories fishing for saithe, cod and haddock are given in Table 5.1., This is an update of a table given in previous reports of the North-Western Working Group.

### 6 FAROE SAITHE

#### 6.1 Landings and Trends in the Fishery (Table 6.1 and Figure 6.1)

The catches of saithe in the Faroe area were stable at around 40,000-45,000 t in the period 1985 to 1989. In 1990, the catches increased to above 60,000 t, the highest on record. The catch figures for the first three months of 1991 are about 20% higher than in 1990, while the catch rates are about the same as in the corresponding months in 1990. This indicates increased effort directed towards saithe.

#### 6.2 Catch at Age (Table 6.2)

Catches at age in the years 1987-1989 were revised according to final catch figures. For 1990, an age composition is only available for Faroese landings. The total catch at age in numbers was then raised using the catch at age distribution for the Faroese catches (Table 6.2).

#### 6.3 Weight at Age in the Catch (Table 6.3)

The SOP for 1990 shows a discrepancy of 2% and this was not corrected for by the Working Group. During the 1980s, there has been a decreasing trend in the mean



weight at age which now seems to have stabilized at a lower level. An exception is age group 7, which continued to decrease significantly from 1989 to 1990.

#### 6.4 Assessment and Prediction

##### 6.4.1 Estimates of fishing mortality (Tables 6.4-6.7 and Figure 6.1A)

No reliable survey data were available for the saithe stock. The effort and corresponding catch at age in numbers for the group of pair trawlers used for tuning the saithe stock VPA, as described in last year's report, were updated (Table 6.4). The group consists of vessels of the same size and horsepower which have been fishing entirely for saithe for more than 10 years. They account for a total catch of saithe of up to 10,000 t per year.

The estimates of fishing mortality derived from VPA tuning with the effort series are presented in Table 6.5. The tuning gives sensible results for most of the age groups. The average fishing mortality for age groups 4 to 8 is estimated to be 0.74.

A separable VPA with  $F = 0.545$  for age group 5 and terminal  $S = 1$  was then run (Table 6.6) and resulted in the average level of fishing mortality indicated by the tuning. The fishing mortality from the extended analysis is shown in Table 6.7.

##### 6.4.2 Population estimates and recruitment (Table 6.8 and Figures 6.1B and 6.2)

The stock size in numbers and stock biomass as estimated by the terminal population run of the separable VPA is given in Table 6.8. Due to recruitment above the average level from year classes 1983 to 1985, the spawning stock increased from 1987, as these year classes reached maturity. The 1986 year class is expected to be at the long-term average level. The stock/recruitment relationship is shown in Figure 6.2.

##### 6.4.3 Catch predictions (Tables 6.9 and 6.10, Figures 6.1C and 6.1D)

The input data for the prediction are given in Table 6.9. The year classes up to 1986 are from the final VPA, while the average level for the period 1961 to 1985 was used for the 1987 and later year classes. Mean weights at age used in the prediction were the average for 1988 to 1990. The exploitation pattern used in the prediction was derived from the separable VPA scaled to give the same mean  $F$  for age groups 4 to 8 as in the extended analysis.

The results of the prediction are shown in the management option table (Table 6.10). Assuming unchanged fishing mortality compared to that estimated for 1990, the yields predicted in 1991 and 1992 are 49,000 and 37,000 t, respectively.

## 7 FAROE COD

### 7.1 Landings and Trends in the Fishery (Tables 7.1, 7.2 and Figure 7.1A)

The landings of cod from Faroe Plateau (Vb1) and the Faroe Bank (Vb2) have been decreasing since 1985, and landings from the Faroe Plateau in 1990 of 11,000 t are the lowest on record. The level of landings from the Faroe Plateau in the period 1983-1986 were around 34,500-39,500 t, dropping to around 20,800-22,500 t in the period 1987-1989. Landings from the Faroe Bank declined from about 3,500 t in 1987 to 673 t in 1990.

The assessment refers only to the Faroe Plateau cod as the data for the Faroe Bank do not allow any analytical assessment of that stock.

## 7.2 Catch at Age (Table 7.3)

Catch in numbers at age in 1990 was provided for the Faroe fishery (Table 7.3). The catch in numbers for the Faroese fleet was calculated from the age composition in each fleet category raised by their respective catches. Catch in numbers for other fleets fishing at the Plateau were raised using the overall Faroese data.

## 7.3 Weight at Age (Table 7.4)

Data on mean weight at age in the catches (also used for stock weights) in 1990 were provided for the Faroe fishery (Table 7.4). They yielded a difference in the sum of products check for 1990 of 1%.

## 7.4 Assessment and Predictions

### 7.4.1 Estimates of fishing mortality (Tables 7.5-7.8, and Figure 7.1A)

In addition to the groundfish survey data (Table 7.5), two CPUE series from small longliners were used for tuning of the VPA (Tables 7.6a-7.6b). These consist of effort measured in hook units and the corresponding catch at age in number from the spring and autumn season. The estimates of catches in numbers per age per unit time in the survey were used as if they represented one fleet with the same effort for all the years in the tuning process.

The estimates of fishing mortality derived from the tuning are given in Table 7.7. The level of fishing mortality for the fully recruited age groups 3-7 is about 0.32.

To reproduce the same level of fishing mortality as from the tuning, the separable VPA was run with a terminal  $F$  of 0.29 on age 4 and terminal  $S = 1$ . The matrix of residuals and estimates of the exploitation pattern are given in Table 7.8. The values for fishing mortality from the extended analysis are shown in Table 7.9. According to this, there has been a significant decrease of  $F$  in 1990 compared to 1989.

### 7.4.2 Population estimates (Table 7.10 and Figure 7.1B)

The stock size in numbers and stock biomass is given in Table 7.10. The spawning stock biomass has steadily decreased since 1986 and was in 1990 at a very low level of 39,000 t. The 1987 year class appears to be well above the average level of 19 million. As this year class is expected to reach maturity in 1991, there should be a comparatively large increase in the spawning stock biomass. Stock/recruitment relationship is shown in Figure 7.2.

### 7.4.3 Catch predictions (Tables 7.11-7.13 and Figures 7.1C and D)

The year classes up to 1987 are from the final VPA. The 1988 and 1989 year classes were estimated using 0-group and groundfish survey data as input to the RCRTINX2 program (Table 7.11), while the subsequent year classes were assumed to be at the average long-term level for the period 1961-1988. The input data for the prediction are given in Table 7.12.

The exploitation pattern used in the prediction was derived from the separable VPA scaled to give the same mean F for age groups 3-7 as in the extended analysis. Mean weight at age was the average for 1988 to 1990.

The results of the prediction are shown in the management option table (Table 7.13). Assuming the same fishing mortality in 1991 and 1992 as in 1990, the catches are predicted to be 19,000 and 20,000 t, respectively.

#### 7.4.4 Faroe Bank cod (Table 7.2 and Figure 7.3)

In Section 7.1 the major decrease of cod catches on Faroe Bank was noted. No data on which to base an assessment of the Faroe Bank cod stock were available to the Group. This year, data from the Faroese groundfish surveys since 1983 were reported to the Group (Figure 7.3). These show a continuous decrease in the catch per trawl hour from 1986. This rapid decrease followed the opening of the Bank to trawlers at the beginning of the 1980s.

Last year ACFM advised the Faroese authorities to close the Bank for all fishing and this advice was implemented from 1 June 1990. This might be one reason for the low catches in 1990, but the low catch rates in the groundfish survey in 1991 do not show any significant increase in the stock. The Working Group, therefore, believes that the closure should be continued.

## 8 FAROE HADDOCK

### 8.1 Landings and Trends in the Fishery (Tables 8.1 and 8.2)

Catches of haddock from the Faroe Plateau increased from a low level of 10,000 t in 1982 to 14,000 t in 1987. Since then they were very stable at this level until 1990 when they decreased to 12,600 t (Table 8.1). Catches from Faroe Bank have varied in recent years between 700 and 1,500 t, with the lowest catch in 1989. The catch increased in 1990 to 1,350 t, despite the fishery on the shallower parts of the Bank being closed from 1 June 1990 (Table 8.2).

### 8.2 Catch at Age (Table 8.3)

For the Faroese landings, catch-at-age data were only provided for fish taken from the Faroe Plateau. For Faroese catches on the Faroe Bank and other nations' catches in Divisions Vb1 and Vb2, age compositions from the Faroese fishery in Division Vb1 were assumed (Table 8.3), and the catches in number were raised to total landings from the Faroe area. The most recent data were revised according to final catch figures.

### 8.3 Weight at Age (Table 8.4)

Weight-at-age data were provided for the Faroese fishery (Table 8.4). The sum of products check for 1990 showed a discrepancy of 2%.

## 8.4 Assessment and Predictions

### 8.4.1 Estimates of fishing mortality (Tables 8.5-8.9)

Catch and effort data from the Faroese Groundfish Surveys and commercial longliners in spring and autumn, respectively, were used for tuning of the VPA in the same way as described for cod in Section 7.4.1. (Tables 8.5.a-8.5.c). Age 1 was not included in the VPA because catch numbers have been very low in most

years and the data are noisy.

The estimates of fishing mortalities derived from the tuning are given in Table 8.6, together with log-catchability estimates and summary statistics. The values of fishing mortality are very low, the mean for age groups (4-7) of 0.154 is below the assumed level of natural mortality ( $M = 0.20$ ). A separable VPA with terminal  $F$  of 0.154 on age 4 and terminal  $S$  of 1.0 provided the matrix of residuals and estimates of the exploitation pattern given in Table 8.7.

The terminal populations from the separable VPA was used to start an extended VPA. The results of this VPA are given in Tables 8.8 and 8.9. These low values of  $F$  produce stock sizes far larger than would be expected given the consistently low catches and the generally stable situation in the haddock fishery. The Working Group did not accept the results from the tuning analysis. Several additional tuning runs were made with different combinations of fleets, but all of them produced  $F$ -values below the natural mortality level.

In last year's Working Group report, a separable VPA was presented which indicated a stable level of  $F$  in recent years. That exercise was attempted this year as well, with input values of terminal  $F$  of 0.25 on 4-6 and  $S = 1$ . All of these runs produced unrealistically high levels of stock biomass. The Working Group did not accept the VPA and the resultant stock size in numbers and biomass (Table 8.9).

#### 8.4.2 Population estimates (Tables 8.10)

The Working Group decided to try the SHOT method for this stock. Four runs were made with different recruitment levels, one with constant recruitment and three with recruitment levels from the Groundfish Surveys.

The indices from the Faroese O-Group Surveys are not believed to accurately reflect the year-class strength for haddock, and the estimates from the Groundfish Surveys are also doubtful as indices for future recruitment. The Working Group doubted the results of the SHOT runs with indices from the Groundfish Surveys, and believed the version with constant recruitment to be more reliable, despite the acknowledgement of varying recruitment for haddock in general (Table 8.10).

#### 8.4.3 Catch predictions (Table 8.10)

The SHOT method with constant recruitment estimated status quo catches for 1991 and 1992 of about 13,200 t and 13,400 t, respectively.

### 9 BLUE LING IN SUB-AREAS V, VI, AND XIV

#### 9.1 Landings and Trends in the Fisheries (Tables 9.1-9.5)

The total annual landings in the decade 1980-1989 averaged 20,100 t (Table 9.5). They were slightly above the long-term mean in 1985 and 1986, slightly below in 1987 and 1988. Landings decreased to 16,800 t in 1989 and further dropped to 12,700 t in 1990. There has been a significant decline in the landings from Division Vb since 1988 and from Sub-area VI since 1989. In 1990, about half of the landings derived from Sub-area V, and these were fairly evenly split between Divisions Va and Vb. The other half derived from Sub-area VI, mainly Division VIa. Landings from Sub-area XIV were insignificant.

## 9.2 Effort Data (Table 9.6 and Figure 9.1)

The time series from the French trawl fishery in Sub-area VI and Division Vb as presented in last year's report was revised and updated for 1990 (Table 9.6). Total international effort was estimated by raising the French catch and effort figures to total international catch. Compared with the period 1975-1985, the French effort nearly doubled during the most recent years, reaching a maximum of 151 million hours in 1990. The total international effort, however, declined from 369 million hours in 1988 to 222 in 1989 and further down to 199 million hours in 1990. The corresponding CPUE values were well below the long-term mean.

CPUE data were also available from the Faroese Groundfish Surveys for the years 1983-1991 (Figure 9.1). The time series reflects considerable annual fluctuations and a possible decreasing trend.

## 9.3 Catch and Weight at Age (Table 9.7)

French data from the directed trawl fishery in Division VIa were made available for 1990. They are presented in Table 9.7 along with preceding data from 1988 and 1989.

## 9.4 Estimates of Total Mortality (Figure 9.2)

Total mortality ( $Z$ ) was estimated graphically by the catch curves from the French trawl fishery in Division VIa for the most recent years (1988-1990).

## 9.5 Assessment and Predictions

Biological investigations made in conjunction with the directed trawl fishery for blue ling in Divisions Va, Vb and Sub-areas VI and XIV, which took place in the early 1980s, indicated the existence of at least two different adult stocks within the whole area; one in Division Va and Sub-area XIV and another one in Sub-area VI and adjacent waters in Division Vb.

In recent years a directed trawl fishery has continued in Sub-area VI whereas blue ling mainly occur as by-catches in fisheries elsewhere. The Working Group noted that an assessment based on age structure data was not possible for all areas and, therefore, chose to make an assessment based on catch data only by means of the SHOT method.

The estimated  $Z$  value of 0.33 derived from the French trawl fishery in Division VIa roughly corresponds to a  $Y/B$  ratio equal to 0.2, assuming  $M = 0.1$  on the older age groups. Recruitment was assumed to be constant.

## 9.6 SHOT Results and the Forecast of Status Quo Catch (Tables 9.8-9.9)

The input data for the predictions are given in Tables 9.8 and 9.9. The prediction for Division Va and Sub-area XIV was accepted, despite negative actual production in 1984 and 1985 which was caused by the termination of the directed trawl fishery on spawning concentrations. Since then, blue ling has mainly occurred as by-catch. Predicted landings for the years 1991-1993 are 2,600 t, 3,100 t and 3,400 t, respectively (Table 9.8).

The prediction for Division Vb and Sub-area VI was rejected because the negative actual production in 1989 and 1990 suggests a recent decline in the landings (Table 9.9).

## 10 LING IN SUB-AREAS V, VI AND XIV

### 10.1 Landings and Trends in the Fisheries (Tables 10.1-10.5)

The total annual landings in the decade 1980-1989 averaged 24,200 t (Table 10.5). Since 1982 they have usually been above the level of the long-term mean. Landing figures for 1989 and 1990 are incomplete, but assuming that the missing figures have followed the same pattern as the available ones, estimated total landings would have been 25,300 t in 1989 followed by a decline to 17,500 t in 1990.

### 10.2 Effort Data (Table 10.6 and Figure 10.1)

The time series derived from the Norwegian long-line fisheries in Divisions Vb, VIa and VIb as presented in last year's report was revised and updated to 1990 (Table 10.6). Total international effort was estimated by raising the Norwegian catch and effort figures to total international catch. Except for 1986, when the effort was particularly high and the corresponding CPUE values comparatively low, there has been a continuous long-term decline to about half the level of 1984.

CPUE data were also available from the Faroese Groundfish Surveys for the years 1983-1991 (Figure 10.1). The time series reflects variations in recent years without trend.

### 10.3 Catch and Weight at Age Data

Such data were not available for 1990.

### 10.4 Assessment and Predictions

So far there is no biological evidence to assume the existence of separate stock units of adult ling within Sub-areas V, VI and XIV.

A traditional long-line fishery aimed at ling has been conducted in Sub-areas V and VI, but in other fisheries ling mainly occur as by-catch.

As no age-length keys were available for recent years, with the exception of 1989, the Working Group decided to use the SHOT method for assessment purposes.

The 1989 Working Group estimated a Z value of 0.47 for ling in Division Vb and of 0.61 in Division VIa. The lower of these values roughly corresponds to a Y/B ratio equal to 0.3 in Division Vb and of 0.4 in Division VIa assuming  $M = 0.1$  on the older age groups. No Z value was estimated in Division VIb due to great differences in year-class strength. The recruitment was assumed to be constant.

### 10.5 SHOT Results and the Forecast of Status Quo Catch (TAC) (Table 10.7)

The input data for the prediction are given in Table 10.7. The SHOT estimates for 1991 and future years were rejected, however, due to possible discrepancies in the estimated landing figures for 1989 and 1990.

## 11 TUSK IN SUB-AREAS V, VI AND XIV

### 11.1 Landings and Trends in the Fisheries (Tables 11.1-11.5)

The total annual landings in the decade 1980-1989 averaged 15,700 t (Table 11.5). In recent years they have stabilized around the level of the long-term mean. Tusk mainly occur as a by-catch in fisheries directed on other species.

### 11.2 Effort Data (Table 11.6 and Figure 11.1)

The time series derived from the Norwegian long-line fisheries in Divisions Vb, VIa and VIb as presented in last year's report was revised and updated for 1990 (Table 11.6). The annual effort data are the same as for ling. Except for 1986 when the effort was particularly high and the corresponding CPUE values comparatively low, the catch per unit effort has remained fairly stable.

CPUE data were also available from the Faroese Groundfish Surveys for the years 1983-1991 (Figure 11.1), and these show similar trends to the Norwegian long-line fishery.

### 11.3 Catch and Weight-at-Age Data

Such data were not available for 1990.

### 11.4 Assessment and Predictions

Similar considerations were made as for ling but the Working Group took note of the fact that in the long-line fisheries tusk mainly occur as by-catch except for the Faroese long-line fishery. No representative age-length keys were available for the recent years, and as a first attempt the Working Group chose to use the same input parameters as for ling to make a SHOT forecast.

### 11.5 SHOT Results and the Forecast of Status Quo Catch (Table 11.7)

The input data for the predictions are given in Table 11.7. The SHOT estimates which were accepted indicate a total landing of 16,100 t in 1991, 16,600 t in 1992, and 16,000 t in 1993.

## 12 ACFM PROPOSALS FOR REARRANGEMENT OF ICES ASSESSMENT WORKING GROUPS

The proposal drawn up by ACFM for rearrangement of ICES assessment working groups was discussed. The main proposals concerning North-Western Working Group are as follows:

- 1) The Working Group on Cod Stocks off East Greenland be dissolved, and terms of reference of this Working Group be included with those of the North Western Working Group. The North Western Working Group will also assume responsibility for assessing the capelin stock in Iceland, East Greenland, Jan Mayen area.
- 2) Responsibility for ling, blue ling and tusk should probably be transferred to Sub-area VI, Working Group on the Assessment of Demersal Stocks.

Views expressed by the Working Group members were different. Few were totally against the proposal of including the terms of reference of the Working Group on

Cod Stocks off East Greenland but there were some reservation expressed that the number of participants will increase to 20-25 or far above the present (optimum) level. On the other hand, there are arguments favouring this proposal.

At present ICES (ACFM) only gives advice for one of the two stocks at Greenland, i.e., East Greenland cod, but in recent years the Working Group has also found it necessary to assess the West Greenland stock as there is a strong interrelationship between these stocks. It is also well known that cod from Greenland migrate to Iceland. For the time being assessment on Icelandic cod has not taken place through the ICES machinery, but it seems sensible to look closer on the interrelationship of all these three stocks together.

As the cod at East Greenland is also caught in mixed fisheries for redfish, it is quite logical that assessment work on these stocks shall be carried out by the North-Western Working Group as some of the demersal stocks dealt with like redfish and Greenland halibut are also caught in a mixed demersal fisheries both at Greenland and Iceland.

It should be noted that some of the scientists involved attend both working groups.

Views were also expressed by some Working Group members that it may be more appropriate to merge all redfish stocks into one redfish assessment working group or a study group, as redfish assessments are still at an experimental stage.

If the Working Group on Cod Stocks off East Greenland does merge with North-Western Working Group, the opinion of the Working Group members is that the responsibility for blue ling, ling and tusk should be transferred following the ACFM proposal to a new Sub-area VI Demersal Stock Assessment Working Group.

It was the general feeling in the Group that, for the time being, the responsibility of the assessment of capelin in Iceland, East Greenland, Jan Meyen area should not be transferred to the North-Western Working Group due to the different biology of this species (pelagic) and different assessment techniques used (acoustic surveys).

### 13 REFERENCES

- Anon. 1989. Report of the North-Western Working Group. ICES, Doc. C.M.1989/Assess:3.
- Anon. 1990a. Report of the North-Western Working Group. ICES, Doc. C.M.1990/Assess:20.
- Anon. 1990b. Report of the Study Group on Oceanic-Type Sebastes mentella. ICES, C.M.1990/G:2.
- Pavlov, A.I. 1989 The results of USSR investigations of Sebastes mentella Travin in ICES Sub-areas XII, XIV in 1981-1988. ICES, Doc. C.M.1989/G:17.

### 14 WORKING DOCUMENTS SUBMITTED TO THE MEETING

- Boje, J. By-catch of redfish and Greenland halibut as observed on the Greenland trawler "Tasiilaq" in March/April 1991 at East Greenland in the area 64° 49' N-66° 30' N, 35° 56' W-35° 59' W.



Pavlov, A.I. Results from investigations on Sebastes mentella in the Irminger Sea in 1990.

Pedersen, S.A. Abundance estimates of redfish (Sebastes spp.) derived from groundfish surveys conducted off East Greenland (1987-1988) and West Greenland (1988)

Reinert, J. Four working documents presenting data on fishery and biology:

1. of ling in ICES Division Vb,
2. of blue ling in ICES Division Vb,
3. of tusk in ICES Division Vb,
4. of Greenland halibut in ICES Division Vb,
5. of redfish in ICES Division Vb.

Stefánsson, G. Some comments on the structure of working group tables.

**Table 2.1** Nominal catch of REDFISH (in tonnes) by countries in Division Va (Iceland) as reported officially to ICES.

| Country       | 1978          | 1979          | 1980          | 1981          | 1982           | 1983           | 1984           |
|---------------|---------------|---------------|---------------|---------------|----------------|----------------|----------------|
| Belgium       | 1,549         | 1,385         | 1,381         | 924           | 283            | 389            | 291            |
| Faroe Islands | 242           | 629           | 1,055         | 1,212         | 1,046          | 1,357          | 686            |
| Iceland       | 33,318        | 62,253        | 69,780        | 93,349        | 115,051        | 122,749        | 108,270        |
| Norway        | 93            | 43            | 33            | 32            | 11             | 32             | 12             |
| <b>Total</b>  | <b>35,202</b> | <b>64,310</b> | <b>72,249</b> | <b>95,517</b> | <b>116,391</b> | <b>124,527</b> | <b>109,259</b> |

| Country       | 1985          | 1986          | 1987          | 1988          | 1989           | 1990 <sup>1</sup> |
|---------------|---------------|---------------|---------------|---------------|----------------|-------------------|
| Belgium       | 400           | 423           | 398           | 372           | 190            | 70                |
| Faroe Islands | 291           | 144           | 332           | 372           | 394            | 624               |
| Iceland       | 91,381        | 85,992        | 87,768        | 93,995        | 91,536         | 90,189            |
| Norway        | 8             | 2             | 7             | 7             | 1 <sup>1</sup> | -                 |
| <b>Total</b>  | <b>92,080</b> | <b>86,561</b> | <b>88,505</b> | <b>94,746</b> | <b>92,121</b>  | <b>90,883</b>     |

<sup>1</sup> Provisional data.

**Table 2.2** Landings of REDFISH in Va (in tonnes) by countries in Division Va as used by the working group.

|      | Belgium | Faroes | Iceland | Norway | Total  |
|------|---------|--------|---------|--------|--------|
| 1978 | 1549    | 242    | 33318   | 93     | 35202  |
| 1979 | 1385    | 629    | 62253   | 43     | 64310  |
| 1980 | 1381    | 1055   | 69780   | 33     | 72249  |
| 1981 | 924     | 1212   | 93349   | 32     | 95517  |
| 1982 | 283     | 1046   | 115051  | 11     | 116391 |
| 1983 | 389     | 1357   | 122749  | 32     | 124527 |
| 1984 | 291     | 686    | 108270  | 12     | 109259 |
| 1985 | 400     | 291    | 91381   | 8      | 92080  |
| 1986 | 423     | 253    | 85992   | 2      | 86670  |
| 1987 | 398     | 332    | 87768   | 7      | 88505  |
| 1988 | 372     | 372    | 93995   | 7      | 94746  |
| 1989 | 190     | 394    | 91536   | 1      | 92121  |
| 1990 | 70      | 624    | 90831   | 0      | 91525  |

**Table 2.3** Nominal catch of REDFISH (in tonnes) by countries in Division Vb (Faroe Islands) as reported officially to ICES.

| Country           | 1978         | 1979          | 1980          | 1981         | 1982         | 1983         | 1984          |
|-------------------|--------------|---------------|---------------|--------------|--------------|--------------|---------------|
| Denmark           | -            | -             | -             | -            | -            | -            | -             |
| Faroe Islands     | 1,525        | 5,693         | 5,509         | 3,232        | 3,999        | 4,642        | 8,770         |
| France            | 448          | 862           | 627           | 59           | 204          | 439          | 559           |
| Germany, Fed.Rep. | 7,767        | 6,108         | 3,891         | 3,841        | 4,660        | 4,300        | 4,460         |
| Iceland           | -            | -             | -             | -            | 1            | -            | -             |
| Netherlands       | +            | -             | -             | -            | -            | -            | -             |
| Norway            | 9            | 11            | 12            | 13           | 7            | 3            | 1             |
| UK                | 57           | +             | -             | -            | -            | -            | -             |
| USSR              | -            | -             | -             | -            | -            | -            | 142           |
| <b>Total</b>      | <b>9,806</b> | <b>12,674</b> | <b>10,039</b> | <b>7,145</b> | <b>8,871</b> | <b>9,384</b> | <b>13,932</b> |

| Country           | 1985          | 1986          | 1987          | 1988          | 1989            | 1990 <sup>1</sup> |
|-------------------|---------------|---------------|---------------|---------------|-----------------|-------------------|
| Denmark           | -             | 36            | 176           | 8             | -               | +                 |
| Faroe Islands     | 12,634        | 15,224        | 13,477        | 12,966        | 12,636          | 10,014            |
| France            | 1,157         | 752           | 819           | 582           | -               | -                 |
| Germany, Fed.Rep. | 5,091         | 5,142         | 3,060         | 1,595         | 1,191           | 403               |
| Iceland           | -             | -             | -             | -             | -               | -                 |
| Netherlands       | -             | -             | -             | -             | -               | -                 |
| Norway            | 4             | 2             | 5             | 5             | 21 <sup>1</sup> | 21                |
| UK                | -             | -             | -             | -             | -               | -                 |
| USSR              | -             | -             | -             | -             | -               | -                 |
| <b>Total</b>      | <b>18,886</b> | <b>21,156</b> | <b>17,537</b> | <b>15,156</b> | <b>13,848</b>   | <b>10,438</b>     |

<sup>1</sup>Provisional data.

Table 2.4 Landings of REDFISH (in tonnes) by countries in Division Vb as used by the Working Group.

|      | Denmark | Faroes | France | FRG  | Iceland | Norway | UK | USSR | Total |
|------|---------|--------|--------|------|---------|--------|----|------|-------|
| 1978 | 0       | 1525   | 448    | 7767 | 0       | 9      | 57 | 0    | 9806  |
| 1979 | 0       | 5693   | 862    | 6108 | 0       | 11     | 0  | 0    | 12674 |
| 1980 | 0       | 5509   | 627    | 3891 | 0       | 12     | 0  | 0    | 10039 |
| 1981 | 0       | 3232   | 59     | 3841 | 0       | 13     | 0  | 0    | 7145  |
| 1982 | 0       | 3999   | 204    | 5230 | 1       | 7      | 0  | 0    | 9441  |
| 1983 | 0       | 4642   | 439    | 4300 | 0       | 3      | 0  | 0    | 9384  |
| 1984 | 0       | 8770   | 559    | 4460 | 0       | 1      | 0  | 142  | 13932 |
| 1985 | 0       | 12634  | 1157   | 5091 | 0       | 4      | 0  | 868  | 19754 |
| 1986 | 36      | 15224  | 752    | 5142 | 0       | 2      | 0  | 320  | 21476 |
| 1987 | 176     | 13478  | 819    | 3060 | 0       | 5      | 0  | 0    | 17538 |
| 1988 | 8       | 13318  | 582    | 1595 | 0       | 5      | 0  | 0    | 15508 |
| 1989 | 0       | 12860  | 928    | 1191 | 0       | 21     | 0  | 0    | 15000 |
| 1990 | 0       | 10014  | 1410   | 441  | 0       | 21     | 0  | 2    | 11888 |

Table 2.5 Nominal catch of REDFISH (in tonnes) by countries in Division VI as reported officially to ICES.

|      | France | FRG | Norway | Spain | UK | Total |
|------|--------|-----|--------|-------|----|-------|
| 1978 | 307    | 18  | 4      | 0     | 2  | 331   |
| 1979 | 215    | 604 | 4      | 0     | 1  | 824   |
| 1980 | 202    | 907 | 2      | 0     | 0  | 1111  |
| 1981 | 24     | 983 | 3      | 1     | 0  | 1011  |
| 1982 | 44     | 604 | 4      | 0     | 2  | 654   |
| 1983 | 52     | 359 | 1      | 2     | 0  | 414   |
| 1984 | 48     | 563 | 9      | 0     | 2  | 622   |
| 1985 | 146    | 76  | 0      | 0     | 1  | 223   |
| 1986 | 142    | 24  | 14     | 0     | 12 | 192   |
| 1987 | 119    | 0   | 2      | 0     | 20 | 141   |
| 1988 | 123    | 16  | 1      | 0     | 81 | 221   |
| 1989 | 0      | 1   | 2      | 0     | 8  | 11    |
| 1990 | 0      | 0   | 0      | 0     | 0  | 0     |

Table 2.6 Landings of REDFISH (in tonnes) by countries in Division VI as used by the Working Group.

|      | Faroes | France | FRG | Norway | Spain | UK | Total |
|------|--------|--------|-----|--------|-------|----|-------|
| 1978 |        | 307    | 18  | 4      |       | 2  | 331   |
| 1979 |        | 215    | 604 | 4      |       | 1  | 824   |
| 1980 |        | 202    | 907 | 2      |       |    | 1111  |
| 1981 |        | 24     | 983 | 3      | 1     |    | 1011  |
| 1982 |        | 44     | 604 | 4      |       | 2  | 654   |
| 1983 |        | 52     | 359 | 1      | 2     |    | 414   |
| 1984 |        | 48     | 563 | 9      |       | 2  | 622   |
| 1985 |        | 146    | 76  |        |       | 1  | 223   |
| 1986 |        | 142    | 24  | 14     |       | 12 | 192   |
| 1987 |        | 119    |     | 2      |       | 20 | 141   |
| 1988 |        | 123    | 16  | 1      |       | 81 | 221   |
| 1989 | 61     |        | 1   | 2      |       | 8  | 72    |
| 1990 |        |        | 6   | 5      |       | 35 | 46    |

Table 2.7 Nominal catch of REDFISH (in tonnes) by country in Sub-area XII as reported officially to ICES.

| Country            | 1982          | 1983          | 1984          | 1985          | 1986          |
|--------------------|---------------|---------------|---------------|---------------|---------------|
| German Dem. Rep.   | -             | -             | -             | -             | -             |
| Germany, Fed. Rep. | 5,696         | 2,209         | -             | -             | -             |
| Iceland            | -             | -             | -             | -             | -             |
| Poland             | -             | -             | -             | -             | -             |
| USSR               | 39,783        | 60,079        | 60,643        | 17,300        | 24,131        |
| <b>Total</b>       | <b>45,479</b> | <b>62,288</b> | <b>60,643</b> | <b>17,300</b> | <b>24,131</b> |

| Country            | 1987         | 1988         | 1989          | 1990 <sup>1</sup> |
|--------------------|--------------|--------------|---------------|-------------------|
| German Dem. Rep.   | -            | -            | 352           | -                 |
| Germany, Fed. Rep. | -            | -            | 1             | -                 |
| Iceland            | -            | -            | 567           | 185               |
| Poland             | -            | -            | 112           | -                 |
| USSR               | 2,948        | 9,772        | 15,543        | 7,600             |
|                    | <b>2,948</b> | <b>9,772</b> | <b>16,575</b> | <b>9,785</b>      |

<sup>1</sup> Provisional.

Table 2.8 Landings of REDFISH (in tonnes) by countries in Division XII as used by the Working Group.

|      | Bulgaria | Iceland | Norway | GDR | Poland | USSR  | Total |
|------|----------|---------|--------|-----|--------|-------|-------|
| 1978 |          |         |        |     |        |       | 0     |
| 1979 |          |         |        |     |        |       | 0     |
| 1980 |          |         |        |     |        |       | 0     |
| 1981 |          |         |        |     |        |       | 0     |
| 1982 |          |         |        |     |        | 39783 | 39783 |
| 1983 |          |         |        |     |        | 60079 | 60079 |
| 1984 |          |         |        |     |        | 60643 | 60643 |
| 1985 |          |         |        |     |        | 17300 | 17300 |
| 1986 |          |         |        |     |        | 24131 | 24131 |
| 1987 |          |         |        |     |        | 2948  | 2948  |
| 1988 |          |         |        |     |        | 9772  | 9772  |
| 1989 |          | 567     |        | 352 | 112    | 15543 | 16574 |
| 1990 |          | 185     | 636    |     |        | 7600  | 8421  |

**Table 2.9** Nominal catch of REDFISH (in tonnes) by countries in Sub-area XIV (East Greenland) as reported officially to ICES.

| Country           | 1982          | 1983          | 1984          | 1985               | 1986               |
|-------------------|---------------|---------------|---------------|--------------------|--------------------|
| Bulgaria          | -             | -             | 2,961         | 5,825              | 11,385             |
| Denmark           | 11            | -             | -             | -                  | -                  |
| Faroe Islands     | -             | 27            | -             | -                  | 5                  |
| German Dem. Rep.  | -             | 155           | 989           | 5,438              | 8,574              |
| Germany, Fed.Rep. | 37,119        | 28,878        | 14,141        | 5,974              | 5,584              |
| Greenland         | +             | 1             | 10            | 5,519 <sup>2</sup> | 9,542 <sup>2</sup> |
| Iceland           | 17            | -             | -             | +                  | -                  |
| Norway            | -             | -             | 17            | -                  | -                  |
| Poland            | 581           | -             | 239           | 135                | 149                |
| UK                | -             | -             | -             | -                  | -                  |
| USSR              | 20,217        | -             | -             | 42,973             | 60,863             |
| <b>Total</b>      | <b>57,945</b> | <b>29,061</b> | <b>18,357</b> | <b>65,864</b>      | <b>96,102</b>      |

| Country           | 1987          | 1988          | 1989          | 1990 <sup>1</sup> |
|-------------------|---------------|---------------|---------------|-------------------|
| Bulgaria          | 12,270        | 8,455         | 4,546         | -                 |
| Denmark           | -             | -             | -             | -                 |
| Faroe Islands     | 382           | 1,634         | 226           | -                 |
| German Dem.Rep.   | 7,023         | 16,848        | 6,444         | 7,950             |
| Germany, Fed.Rep. | 4,691         | 5,734         | 2,372         | 3,451             |
| Greenland         | 670           | 42            | 3             | 24                |
| Iceland           | -             | -             | 814           | 3,726             |
| Norway            | -             | -             | -             | 4,543             |
| Poland            | 25            | -             | -             | -                 |
| UK                | -             | -             | 5             | -                 |
| USSR              | 68,521        | 55,254        | 7,177         | 4,973             |
| <b>Total</b>      | <b>93,582</b> | <b>87,967</b> | <b>21,587</b> | <b>24,667</b>     |

<sup>1</sup> Provisional data.

<sup>2</sup> Fished mainly by the Japanese fleet.

Table 2.10 Landings of REDFISH (in tonnes) by country in Division XIV, as used by the Working Group.

|      | Bulgaria          | Greenl | Faroes | France | GDR   | FRG   | Iceland | Japan | Norway | Poland | UK | USSR  | Total |
|------|-------------------|--------|--------|--------|-------|-------|---------|-------|--------|--------|----|-------|-------|
| 1978 | 0                 | 3      | 0      | 0      | 0     | 20711 | 151     | 0     | 2      | 0      | 13 | 0     | 20880 |
| 1979 | 0                 | 0      | 0      | 490    | 0     | 20428 | 0       | 0     | 0      | 0      | 0  | 0     | 20918 |
| 1980 | 0                 | 0      | 0      | 0      | 0     | 32520 | 89      | 0     | 0      | 0      | 0  | 0     | 32609 |
| 1981 | 0                 | 1      | 18     | 0      | 0     | 42980 | 0       | 0     | 0      | 0      | 0  | 0     | 42999 |
| 1982 | 0                 | 0      | 0      | 0      | 0     | 42815 | 17      | 0     | 0      | 581    | 0  | 20217 | 63630 |
| 1983 | 0                 | 1      | 27     | 0      | 155   | 30815 | 0       | 0     | 0      | 0      | 0  | 0     | 30998 |
| 1984 | 2961              | 10     | 0      | 0      | 989   | 14141 | 0       | 0     | 15     | 239    | 0  | 0     | 18355 |
| 1985 | 5825              | 5519   | 0      | 0      | 5438  | 5974  | 0       | 0     | 0      | 135    | 0  | 42973 | 65864 |
| 1986 | 11385             | 9542   | 5      | 0      | 8574  | 5584  | 0       | 0     | 0      | 149    | 0  | 60863 | 96102 |
| 1987 | 12270             | 2912   | 382    | 0      | 7023  | 4691  | 0       | 0     | 0      | 25     | 0  | 68521 | 95824 |
| 1988 | 8455              | 3751   | 1634   | 0      | 16848 | 5734  | 0       | 0     | 0      | 0      | 0  | 55254 | 91676 |
| 1989 | 4546              | 285    | 41     | 0      | 6444  | 2372  | 2722    | 307   | 0      | 0      | 5  | 7177  | 23899 |
| 1990 | 4500 <sup>1</sup> | 24     | 0      | 0      | 7950  | 3451  | 3726    | 3450  | 3907   | 0      | 75 | 4973  | 32056 |

<sup>1</sup>Estimated.

Table 2.11 CPUE values for the Icelandic fleet in the *S. marinus* and *S. mentella* traditional fishery in Division Va.

| Year | Indices (kg/h) |        |            |
|------|----------------|--------|------------|
|      | Classic        | Glim   | Averageing |
| 1973 | 828            | 1000.0 | 522        |
| 1974 | 946            | 1017.7 | 614        |
| 1975 | 957            | 1053.7 | 694        |
| 1976 | 816            | 0948.1 | 603        |
| 1977 | 838            | 1023.1 | 624        |
| 1978 | 997            | 1290.5 | 823        |
| 1979 | 1,177          | 1332.0 | 765        |
| 1980 | 1,224          | 1500.4 | 833        |
| 1981 | 1,237          | 1524.4 | 955        |
| 1982 | 1,187          | 1459.2 | 840        |
| 1983 | 1,004          | 1250.6 | 755        |
| 1984 | 996            | 1304.3 | 796        |
| 1985 | 1,012          | 1282.5 | 828        |
| 1986 | 1,060          | 1292.1 | 773        |
| 1987 | 1,100          | 1478.8 | 960        |
| 1988 | 1,068          | 1335.6 | 818        |
| 1989 | 1,070          | 1336.8 | 853        |
| 1990 | 1,005          | 1316.9 | 893        |
| 1991 | -              | 1397.0 | 1069       |

Table 2.12 Catch per unit effort for oceanic Sebastes mentella in Sub-areas XII and XIV

| Year | CPUE (t/h) |             |         |        |             |
|------|------------|-------------|---------|--------|-------------|
|      | Bulgaria   | GDR (FVSIV) | Iceland | Norway | USSR (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 | 1.22       | 1.28        | -       | -      | 1.00        |
| 1989 | 0.82       | 0.70        | 1.19    | -      | 1.00        |
| 1990 | -          | 0.89        | 1.11    | 1.08   | 0.99        |

Table 2.13 Number of O-group REDFISH (millions)/ nautical mile<sup>2</sup> from the Icelandic O-group survey.

| Year | Number            |
|------|-------------------|
| 1970 | 8.6               |
| 1971 | 12.6              |
| 1972 | 31.1              |
| 1973 | 74.0              |
| 1974 | 23.6              |
| 1975 | 12.6              |
| 1976 | 5.8               |
| 1977 | 13.0              |
| 1978 | 6.5               |
| 1979 | 1.3               |
| 1980 | 3.0               |
| 1981 | 9.0               |
| 1982 | 2.7               |
| 1983 | 0.7               |
| 1984 | 4.3 <sup>1</sup>  |
| 1985 | 22.6 <sup>1</sup> |
| 1986 | 12.1 <sup>1</sup> |
| 1987 | 22.9 <sup>1</sup> |
| 1988 | 17.0 <sup>1</sup> |
| 1989 | 14.3 <sup>1</sup> |
| 1990 | 23.5 <sup>1</sup> |

<sup>1</sup> Reduced area.



Table 2.14

Proportions used 1990 for splitting  
landings between stocks

|          | Va      |        | Vb      |        | VI      |        | XIV     |        | S.me.oc. |
|----------|---------|--------|---------|--------|---------|--------|---------|--------|----------|
|          | S. mar. | S.men. | S. mar. | S.men. | S. mar. | S.men. | S. mar. | S.men. |          |
| Belgium  | 1.00    | 0.00   |         |        |         |        |         |        |          |
| Bulgaria |         |        |         |        |         |        | 0.00    | 0.00   | 1.00     |
| Faroes   | 1.00    | 0.00   | 0.23    | 0.77   |         |        | 0.00    | 1.00   | 0.00     |
| France   |         |        | 0.00    | 1.00   |         |        |         |        |          |
| Germ. DR |         |        |         |        |         |        | 0.00    | 0.00   | 1.00     |
| Germ. FR |         |        | 0.00    | 1.00   | 0.00    | 1.00   | 0.19    | 0.81   | 0.00     |
| Greenl.  |         |        |         |        |         |        | 1.00    | 0.00   | 0.00     |
| Iceland  | 0.74    | 0.26   | 1.00    | 0.00   |         |        | 0.00    | 0.00   | 1.00     |
| Japan    |         |        |         |        |         |        | 0.00    | 1.00   | 0.00     |
| Norway   | 1.00    | 0.00   | 1.00    | 0.00   | 1.00    | 0.00   | 0.00    | 0.00   | 1.00     |
| UK       |         |        |         |        | 1.00    | 0.00   | 1.00    | 0.00   | 0.00     |
| USSR     |         |        |         |        |         |        | 0.00    | 0.00   | 1.00     |

Table 2.15 *S. marinus* landings by area as used by the Working Group.

|      | Va    | Vb   | VI  | XII | XIV   | Total  |
|------|-------|------|-----|-----|-------|--------|
| 1978 | 31300 | 2039 | 313 | 0   | 15477 | 49129  |
| 1979 | 56616 | 4805 | 5   | 0   | 15787 | 77213  |
| 1980 | 62052 | 4920 | 2   | 0   | 22203 | 89177  |
| 1981 | 75828 | 2538 | 3   | 0   | 23608 | 101977 |
| 1982 | 97899 | 1810 | 28  | 0   | 30692 | 130429 |
| 1983 | 87412 | 3394 | 40  | 0   | 15636 | 106482 |
| 1984 | 84766 | 6228 | 49  | 0   | 5040  | 96083  |
| 1985 | 67312 | 9194 | 111 | 0   | 2117  | 78734  |
| 1986 | 67772 | 6300 | 119 | 0   | 2988  | 77178  |
| 1987 | 69212 | 6143 | 119 | 0   | 1196  | 76670  |
| 1988 | 80547 | 5020 | 82  | 0   | 3964  | 89612  |
| 1989 | 59960 | 4140 | 30  | 0   | 685   | 64815  |
| 1990 | 68091 | 2347 | 40  | 0   | 754   | 71233  |

Table 2.16 *S. mentella* landings by area as used by the Working Group.

|      | Va    | Vb    | VI   | XII | XIV   | Total |
|------|-------|-------|------|-----|-------|-------|
| 1978 | 3902  | 7767  | 18   | 0   | 5403  | 17090 |
| 1979 | 7694  | 7869  | 819  | 0   | 5131  | 21513 |
| 1980 | 10197 | 5119  | 1109 | 0   | 10406 | 26831 |
| 1981 | 19689 | 4607  | 1008 | 0   | 19391 | 44695 |
| 1982 | 18492 | 7631  | 626  | 0   | 12140 | 38889 |
| 1983 | 37115 | 5990  | 374  | 0   | 15207 | 58686 |
| 1984 | 24493 | 7704  | 573  | 0   | 9126  | 41896 |
| 1985 | 24768 | 10560 | 113  | 0   | 9376  | 44816 |
| 1986 | 18898 | 15176 | 73   | 0   | 12143 | 46291 |
| 1987 | 19293 | 11395 | 22   | 0   | 6789  | 37499 |
| 1988 | 14199 | 10488 | 139  | 0   | 6065  | 30892 |
| 1989 | 32161 | 10860 | 42   | 0   | 2325  | 45388 |
| 1990 | 23434 | 9541  | 6    | 0   | 6246  | 39226 |

Table 2.17 *S. mentella* oceanic type by area as used by the Working Group

|      | Va | Vb | VI | XII   | XIV   | Total  |
|------|----|----|----|-------|-------|--------|
| 1978 | 0  | 0  | 0  | 0     | 0     | 0      |
| 1979 | 0  | 0  | 0  | 0     | 0     | 0      |
| 1980 | 0  | 0  | 0  | 0     | 0     | 0      |
| 1981 | 0  | 0  | 0  | 0     | 0     | 0      |
| 1982 | 0  | 0  | 0  | 39783 | 20798 | 60581  |
| 1983 | 0  | 0  | 0  | 60079 | 155   | 60234  |
| 1984 | 0  | 0  | 0  | 60643 | 4189  | 64832  |
| 1985 | 0  | 0  | 0  | 17300 | 54371 | 71671  |
| 1986 | 0  | 0  | 0  | 24131 | 80971 | 105102 |
| 1987 | 0  | 0  | 0  | 2948  | 87839 | 90787  |
| 1988 | 0  | 0  | 0  | 9772  | 81647 | 91419  |
| 1989 | 0  | 0  | 0  | 16574 | 20889 | 37463  |
| 1990 | 0  | 0  | 0  | 8421  | 25056 | 33477  |



Table 2.20 SHOT forecast for S. marinus in Sub-areas V, VI and XIV.

S. marinus SHOT forecast spreadsheet version 3  
Constant recruitment January 1989

running recruitment weights  
 older 0.25  
 central 0.50  
 younger 0.25

G-M = 0.00  
 exp(d) 1.00  
 ex exp(d/2) 1.00

| Year | Land -ings | Recrt Index | W'td Index | Y/B Ratio | Hang -over | Act'l Prodn | Est'd Prodn | Est'd SQC. | Act'l Expl Biom | Est'd Expl Biom | Est'd Land -ings |
|------|------------|-------------|------------|-----------|------------|-------------|-------------|------------|-----------------|-----------------|------------------|
| 1978 | 49129      | 1           |            | 0.70      | 0.30       |             |             |            | 70184           |                 |                  |
| 1979 | 77213      | 1           | 1          | 0.70      | 0.30       | 89249       |             |            | 110304          |                 |                  |
| 1980 | 89177      | 1           | 1          | 0.70      | 0.30       | 94304       |             |            | 127395          |                 |                  |
| 1981 | 101977     | 1           | 1          | 0.70      | 0.30       | 107463      |             |            | 145681          |                 |                  |
| 1982 | 130429     | 1           | 1          | 0.70      | 0.30       | 142623      | 97005       | 98497      | 186327          | 140709          | 98497            |
| 1983 | 106482     | 1           | 1          | 0.70      | 0.30       | 96219       | 108409      | 115015     | 152117          | 164307          | 115015           |
| 1984 | 96083      | 1           | 1          | 0.70      | 0.30       | 91627       | 105971      | 106124     | 137262          | 151606          | 106124           |
| 1985 | 78734      | 1           | 1          | 0.70      | 0.30       | 71299       | 103580      | 101331     | 112477          | 144759          | 101331           |
| 1986 | 77178      | 1           | 1          | 0.70      | 0.30       | 76511       | 98969       | 92898      | 110255          | 132712          | 92898            |
| 1987 | 76670      | 1           | 1          | 0.70      | 0.30       | 76452       | 96162       | 90467      | 109528          | 129238          | 90467            |
| 1988 | 89612      | 1           | 1          | 0.70      | 0.30       | 95159       | 93972       | 88781      | 128017          | 126830          | 88781            |
| 1989 | 64815      | 1           | 1          | 0.70      | 0.30       | 54188       | 94090       | 92747      | 92593           | 132496          | 92747            |
| 1990 | 71233      | 1           | 1          | 0.70      | 0.30       | 73983       | 67847       | 66937      | 101761          | 95625           | 66937            |
| 1991 |            | 1           | 1          | 0.70      | 0.30       |             | 90985       | 85059      |                 | 121513          | 85059            |
| 1992 |            | 1           | 1          | 0.70      | 0.30       |             | 90985       | 89207      |                 | 127439          | 89207            |
| 1993 |            | 1           |            |           |            |             |             |            |                 |                 |                  |

Table 2.21 SHOT forecast for S. mentella in Sub-areas V, VI and XIV.

S. mentella SHOT forecast spreadsheet version 3  
Constant recruitment January 1989

running recruitment weights  
 older 0.25  
 central 0.50  
 younger 0.25

G-M = 0.00  
 exp(d) 1.00  
 ex exp(d/2) 1.00

| Year | Land -ings | Recrt Index | W'td Index | Y/B Ratio | Hang -over | Act'l Prodn | Est'd Prodn | Est'd SQC. | Act'l Expl Biom | Est'd Expl Biom | Est'd Land -ings |
|------|------------|-------------|------------|-----------|------------|-------------|-------------|------------|-----------------|-----------------|------------------|
| 1978 | 17090      | 1           |            | 0.30      | 0.70       |             |             |            | 56967           |                 |                  |
| 1979 | 21513      | 1           | 1          | 0.30      | 0.70       | 31834       |             |            | 71711           |                 |                  |
| 1980 | 26831      | 1           | 1          | 0.30      | 0.70       | 39241       |             |            | 89438           |                 |                  |
| 1981 | 44695      | 1           | 1          | 0.30      | 0.70       | 86377       |             |            | 148984          |                 |                  |
| 1982 | 38889      | 1           | 1          | 0.30      | 0.70       | 25342       | 52484       | 47032      | 129631          | 156773          | 47032            |
| 1983 | 58686      | 1           | 1          | 0.30      | 0.70       | 104879      | 45698       | 40932      | 195621          | 136440          | 40932            |
| 1984 | 41896      | 1           | 1          | 0.30      | 0.70       | 2718        | 57535       | 58341      | 139653          | 194469          | 58341            |
| 1985 | 44816      | 1           | 1          | 0.30      | 0.70       | 51629       | 48399       | 43847      | 149386          | 146156          | 43847            |
| 1986 | 46291      | 1           | 1          | 0.30      | 0.70       | 49732       | 48860       | 46029      | 154302          | 153430          | 46029            |
| 1987 | 37499      | 1           | 1          | 0.30      | 0.70       | 16986       | 48969       | 47094      | 124998          | 156981          | 47094            |
| 1988 | 30892      | 1           | 1          | 0.30      | 0.70       | 15475       | 45415       | 39874      | 102973          | 132914          | 39874            |
| 1989 | 45388      | 1           | 1          | 0.30      | 0.70       | 79212       | 42421       | 34351      | 151294          | 114503          | 34351            |
| 1990 | 39226      | 1           | 1          | 0.30      | 0.70       | 24849       | 34324       | 42069      | 130754          | 140230          | 42069            |
| 1991 |            | 1           | 1          | 0.30      | 0.70       |             | 44960       | 40946      |                 | 136487          | 40946            |
| 1992 |            | 1           | 1          | 0.30      | 0.70       |             | 44960       | 42150      |                 | 140501          | 42150            |
| 1993 |            | 1           |            |           |            |             |             |            |                 |                 |                  |

Average landings 37,977 t.



Table 2.24 SHOT forecast for S. marinus and S. mentella combined in Sub-areas V, VI and XIV.

S. marinus + S.mentella  
Constant recruitment

SHOT forecast spreadsheet version 3  
January 1989

running recruitment weights

older 0.25  
central 0.50  
younger 0.25

G-M = 0.00  
exp(d) 1.00  
ex exp(d/2) 1.00

| Year | Land<br>-ings | Recrt<br>Index | W'td<br>Index | Y/B<br>Ratio | Hang<br>-over | Act'l<br>Prodn | Est'd<br>Prodn | Est'd<br>SQC. | Act'l<br>Expl<br>Biom | Est'd<br>Expl<br>Biom | Est'd<br>Land<br>-ings |
|------|---------------|----------------|---------------|--------------|---------------|----------------|----------------|---------------|-----------------------|-----------------------|------------------------|
| 1978 | 66219         | 1              |               | 0.30         | 0.70          |                |                |               | 220730                |                       |                        |
| 1979 | 98726         | 1              | 1             | 0.30         | 0.70          | 174576         |                |               | 329087                |                       |                        |
| 1980 | 116008        | 1              | 1             | 0.30         | 0.70          | 156333         |                |               | 386693                |                       |                        |
| 1981 | 146672        | 1              | 1             | 0.30         | 0.70          | 218221         |                |               | 488907                |                       |                        |
| 1982 | 169318        | 1              | 1             | 0.30         | 0.70          | 222159         | 183043         | 157583        | 564393                | 525278                | 157583                 |
| 1983 | 165168        | 1              | 1             | 0.30         | 0.70          | 155485         | 192822         | 176369        | 550560                | 587897                | 176369                 |
| 1984 | 137979        | 1              | 1             | 0.30         | 0.70          | 74538          | 185355         | 171224        | 459930                | 570747                | 171224                 |
| 1985 | 123550        | 1              | 1             | 0.30         | 0.70          | 89882          | 166885         | 146651        | 411833                | 488836                | 146651                 |
| 1986 | 123469        | 1              | 1             | 0.30         | 0.70          | 123280         | 155885         | 133250        | 411563                | 444168                | 133250                 |
| 1987 | 114169        | 1              | 1             | 0.30         | 0.70          | 92469          | 151809         | 131971        | 380563                | 439904                | 131971                 |
| 1988 | 120504        | 1              | 1             | 0.30         | 0.70          | 135286         | 145216         | 123483        | 401680                | 411610                | 123483                 |
| 1989 | 110203        | 1              | 1             | 0.30         | 0.70          | 86167          | 144223         | 127620        | 367343                | 425399                | 127620                 |
| 1990 | 110459        | 1              | 1             | 0.30         | 0.70          | 111056         | 104209         | 108405        | 368197                | 361349                | 108405                 |
| 1991 |               | 1              | 1             | 0.30         | 0.70          |                |                | 139528        | 119180                |                       | 119180                 |
| 1992 |               | 1              | 1             | 0.30         | 0.70          |                |                | 139528        | 125284                | 397265                | 119180                 |
| 1993 |               | 1              |               |              |               |                |                |               |                       | 417614                | 125284                 |

Table 2.25 SHOT forecast for oceanic-type S. mentella.

S.mentella oceanic  
constant recruitment

SHOT forecast spreadsheet version 3  
January 1989

running recruitment weights

older 0.25  
central 0.50  
younger 0.25

G-M = 0.00  
exp(d) 1.00  
ex exp(d/2) 1.00

| Year | Land<br>-ings | Recrt<br>Index | W'td<br>Index | Y/B<br>Ratio | Hang<br>-over | Act'l<br>Prodn | Est'd<br>Prodn | Est'd<br>SQC. | Act'l<br>Expl<br>Biom | Est'd<br>Expl<br>Biom | Est'd<br>Land<br>-ings |
|------|---------------|----------------|---------------|--------------|---------------|----------------|----------------|---------------|-----------------------|-----------------------|------------------------|
| 1982 | 60581         | 1              |               | 0.30         | 0.70          |                |                |               | 201937                |                       |                        |
| 1983 | 60234         | 1              | 1             | 0.30         | 0.70          | 59424          |                |               | 200780                |                       |                        |
| 1984 | 64832         | 1              | 1             | 0.30         | 0.70          | 75561          |                |               | 216107                |                       |                        |
| 1985 | 71671         | 1              | 1             | 0.30         | 0.70          | 87629          |                |               | 238903                |                       |                        |
| 1986 | 105102        | 1              | 1             | 0.30         | 0.70          | 183108         | 74205          | 72431         | 350340                | 241437                | 72431                  |
| 1987 | 90787         | 1              | 1             | 0.30         | 0.70          | 57385          | 101430         | 104001        | 302623                | 346668                | 104001                 |
| 1988 | 91419         | 1              | 1             | 0.30         | 0.70          | 92894          | 92621          | 91337         | 304730                | 304458                | 91337                  |
| 1989 | 37463         | 1              | 1             | 0.30         | 0.70          | -88434         | 92667          | 91793         | 124877                | 305978                | 91793                  |
| 1990 | 33477         | 1              | 1             | 0.30         | 0.70          | 24176          | 66795          | 46263         | 111590                | 154209                | 46263                  |
| 1991 |               | 1              | 1             | 0.30         | 0.70          |                |                | 61468         | 41874                 |                       | 41874                  |
| 1992 |               | 1              | 1             | 0.30         | 0.70          |                |                | 61468         | 47752                 | 139581                | 41874                  |
| 1993 |               | 1              |               |              |               |                |                |               |                       | 159174                | 47752                  |

Average landings 1982-1990: 68,386 t.



**Table 2.28** Biological indices for oceanic- and ordinary types of *S. mentella* in April-May 1990.

| Index  | Open waters        |                    | 200-mile zone<br>of Iceland |
|--|--------------------|--------------------|-----------------------------|
|  | Southern<br>sector | Northern<br>sector |                             |
| Portion of females in pre-spawning<br>and spawning conditions, % ( $S_t + P_t$ ) | 27.4               | 8.4                | 6.3                         |
| Portion of females in catches, % (f)   | 48.3               | 48.3               | 63.7                        |
| Mean weight of males, g ( $W_M$ )  | 563.0              | 563.0              | 690.0                       |
| Mean weight of females, g ( $W_F$ )  | 627.0              | 627.0              | 750.0                       |
| Mean fecundity of females,<br>'000 spec. (C)                                     | 35.9               | 35.9               | 35.9                        |
| Coefficient of mortality, % (B)  | 85.0               | 85.0               | 85.0                        |
| Larval abundance during surveys,<br>$x 10^{11}$ spec. ( $N_1$ )                  | 6.5                | 11.9               | 8.7                         |

**Table 2.29** Results from *S. mentella* (oceanic- and ordinary types) spawning stock assessment by data from ichthyoplankton survey in April-May 1990.

| Index  | Open waters        |                    | 200-mile<br>Icelandic zone | Whole<br>area |
|--|--------------------|--------------------|----------------------------|---------------|
|  | Southern<br>sector | Northern<br>sector |                            |               |
| Area surveyed, '000 mile <sup>2</sup>                  | 35.0               | 46.0               | 37.5                       | 118.5         |
| Area of larval distribution,<br>'000 mile <sup>2</sup> | 21.8               | 31.6               | 28.5                       | 81.9          |
| Abundance of females, $x 10^8$ spec.                   | 1.7                | 2.4                | 2.0                        | 6.1           |
| Abundance of males, $x 10^8$ spec.                     | 2.0                | 2.7                | 2.3                        | 7.0           |
| Total abundance, $x 10^8$ spec.                        | 3.7                | 5.1                | 4.3                        | 13.1          |
| Female biomass, '000 t                                 | 124.9              | 172.3              | 144.7                      | 441.9         |
| Male biomass, '000 t                                   | 118.1              | 162.0              | 136.0                      | 316.1         |
| Total biomass, 7000 t                                  | 243.0              | 334.3              | 280.7                      | 858.0         |



Table 2.30 Abundance and biomass of *S. mentella* oceanic type as estimated from trawl acoustic surveys in June-July 1982-1990.

| Year              | Area surveyed<br>( <sup>1</sup> 000 sq miles) | Abundance at<br>actual sex ratio<br>(millions) | Biomass at actual sex ratio<br>( <sup>1</sup> 000 t) |
|-------------------|---|--|--|
| 1982 <sup>1</sup> | 40  | 790  | 560  |
| 1983 <sup>1</sup> | 50  | 960  | 700  |
| 1984 <sup>1</sup> | 40  | 660  | 526  |
| 1985 <sup>1</sup> | 71  | 1,122  | 700  |
| 1986              | 74  | 2,003  | 1,180  |
| 1987              | 215   | 1,951  | 1,120  |
| 1988              | 163   | 1,510  | 956  |
| 1989              | 148   | 1,610  | 918  |
| 1990 <sup>1</sup> | 92  | 1,759  | 995  |

<sup>1</sup>Data for the international waters of the Irminger Sea.

**Table 3.1** GREENLAND HALIBUT. Nominal catches (tonnes) in Sub-areas V and XIV, 1980-1990, as reported to ICES.

| Country  | 1980          | 1981          | 1982          | 1983          | 1984          | 1985          | 1986          | 1987          | 1988          | 1989          | 1990 <sup>1</sup> |
|--|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|-------------------|
| Denmark  | -             | -             | -             | -             | -             | -             | -             | 6             | +             | -             | -                 |
| Faroe Islands  | 1,042         | 767           | 1,532         | 1,146         | 2,502         | 1,052         | 853           | 1,096         | 1,378         | 2,319         | 1,803             |
| France   | 51            | 8             | 27            | 236           | 489           | 845           | 52            | 19            | 25            | 17*           | -                 |
| Germany, Fed.Rep.                                      | 2,318         | 3,007         | 2,581         | 1,142         | 936           | 863           | 858           | 565           | 637           | 493           | 333               |
| Greenland  | -             | +             | 1             | 5             | 15            | 81            | 177           | 154           | 37            | 13            | 32                |
| Iceland  | 27,838        | 15,455        | 28,300        | 28,360        | 30,080        | 29,231        | 31,044        | 44,780        | 49,040        | 58,330        | 35,800            |
| Norway   | 3             | 2             | +             | 2             | 2             | 3             | +             | 2             | 1             | 226*          | 15                |
| <b>Total</b>   | <b>31,252</b> | <b>19,239</b> | <b>32,441</b> | <b>30,888</b> | <b>34,024</b> | <b>32,075</b> | <b>32,984</b> | <b>46,622</b> | <b>51,118</b> | <b>61,398</b> | <b>37,983</b>     |
| Total used <sub>2</sub> in the assessment <sup>2</sup> | 31,252        | 19,239        | 32,441        | 30,888        | 34,024        | 32,075        | 32,984        | 46,622        | 51,118        | 61,398        | 38,486            |

<sup>1</sup> Preliminary.

<sup>2</sup> Catches by Japan and from Sub-area IIa included.

**Table 3.2** GREENLAND HALIBUT. Nominal catches (tonnes) in Division Vb, 1980-1990, as reported to ICES.

| Country  | 1980         | 1981       | 1982         | 1983         | 1984         | 1985         | 1986       | 1987         | 1988       | 1989         | 1990 <sup>1</sup> |
|--|--------------|------------|--------------|--------------|--------------|--------------|------------|--------------|------------|--------------|-------------------|
| Denmark  | -            | -          | -            | -            | -            | -            | -          | 6            | +          | -            | -                 |
| Faroe Islands  | 951          | 442        | 863          | 1,112        | 2,456        | 1,052        | 775        | 907          | 901        | 1,513        | 1,064*            |
| France   | 51           | 8          | 27           | 236          | 489          | 845          | 52         | 19           | 25         | 17           | -                 |
| Germany, Fed.Rep.                                      | 172          | 114        | 142          | 86           | 118          | 227          | 113        | 109          | 42         | 73           | 42                |
| Norway   | 3            | 2          | +            | 2            | 2            | 2            | +          | 2            | 1          | 3            | -                 |
| <b>Total</b>   | <b>1,177</b> | <b>566</b> | <b>1,032</b> | <b>1,436</b> | <b>3,065</b> | <b>2,126</b> | <b>940</b> | <b>1,043</b> | <b>969</b> | <b>1,606</b> | <b>1,106</b>      |
| Total used <sub>2</sub> in the assessment <sup>2</sup> | -            | -          | -            | -            | -            | -            | -          | -            | -          | -            | 1,239             |

<sup>1</sup> Preliminary data.

\* 1,197 t (Working Group data for assessment catches taken in Sub-area IIa).

Total used in assessment

1,239

**Table 3.3** GREENLAND HALIBUT. Nominal catches (tonnes) in Division Va, 1980-1990, as reported officially to ICES.

| Country       | 1980          | 1981          | 1982          | 1983          | 1984          | 1985          | 1986          | 1987          | 1988          | 1989          | 1990 <sup>1</sup> |
|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|-------------------|
| Faroe Islands | 91            | 325           | 669           | 33            | 46            | -             | -             | 15            | 379           | 719           | 739               |
| Iceland       | 27,836        | 15,455        | 28,300        | 28,359        | 30,078        | 29,195        | 31,027        | 44,644        | 49,000        | 58,330        | 35,800            |
| Norway        | -             | +             | -             | +             | +             | 1             | -             | -             | -             | 223           | 12                |
| <b>Total</b>  | <b>27,927</b> | <b>15,780</b> | <b>28,969</b> | <b>28,392</b> | <b>30,124</b> | <b>29,196</b> | <b>31,027</b> | <b>44,659</b> | <b>49,379</b> | <b>59,272</b> | <b>36,551</b>     |

<sup>1</sup> Preliminary data.

**Table 3.4** GREENLAND HALIBUT. Nominal catches (tonnes) in Sub-area XIV, 1980-1990, as reported to ICES.

| Country   | 1980         | 1981         | 1982         | 1983         | 1984       | 1985       | 1986         | 1987       | 1988       | 1989       | 1990 <sup>1</sup> |
|---|--------------|--------------|--------------|--------------|------------|------------|--------------|------------|------------|------------|-------------------|
| Faroe Islands                                   | -            | -            | -            | -            | -          | -          | 78           | 74         | 98         | 87         | -                 |
| Germany, Fed.Rep.                               | 2,146        | 2,893        | 2,439        | 1,054        | 818        | 636        | 745          | 456        | 595        | 420        | 291               |
| Greenland                                       | -            | +            | 1            | 5            | 15         | 81         | 177          | 154        | 37         | 13         | 32                |
| Iceland   | 2            | -            | -            | 1            | 2          | 36         | 17           | 136        | 40         | +          | -                 |
| Norway  | -            | -            | -            | -            | +          | -          | -            | -          | -          | -          | 3                 |
| UK (Engl.& Wales)                               | -            | -            | -            | -            | -          | -          | -            | -          | -          | +          | -                 |
| <b>Total</b>                                    | <b>2,148</b> | <b>2,893</b> | <b>2,440</b> | <b>1,060</b> | <b>835</b> | <b>753</b> | <b>1,017</b> | <b>820</b> | <b>707</b> | <b>520</b> | <b>326</b>        |
| <b>Total used in the assessment<sup>2</sup></b> | <b>-</b>     | <b>-</b>     | <b>-</b>     | <b>-</b>     | <b>-</b>   | <b>-</b>   | <b>-</b>     | <b>-</b>   | <b>-</b>   | <b>-</b>   | <b>696</b>        |

<sup>1</sup> Preliminary data.

<sup>2</sup> Catches by Japan included.

Table 3.5 GREENLAND HALIBUT. CPUE and effort for Icelandic trawlers in Division Va and derived total international effort.

| Year | Cpue (t/hr) | Total Catch (t) | Total Effort (hr) |
|------|-------------|-----------------|-------------------|
| 1977 | 1.000       | 16,578          | 16,578            |
| 1978 | 0.939       | 14,349          | 15,281            |
| 1979 | 0.938       | 23,616          | 25,177            |
| 1980 | 1.904       | 31,252          | 16,414            |
| 1981 | 1.273       | 19,239          | 15,113            |
| 1982 | 1.507       | 32,441          | 21,527            |
| 1983 | 2.074       | 30,887          | 14,892            |
| 1984 | 2.236       | 34,024          | 15,216            |
| 1985 | 2.012       | 32,075          | 15,942            |
| 1986 | 1.684       | 32,984          | 19,587            |
| 1987 | 1.627       | 46,623          | 28,656            |
| 1988 | 1.253       | 51,118          | 40,796            |
| 1989 | 1.767       | 61,398          | 34,747            |
| 1990 | 1.417       | 38,486          | 27,066            |

Table 3.6 SOP.

Greenland Halibut in the Iceland and Faroes Grounds and East Greenland (Fishing Areas V and XIV)  
CATEGORY: TOTAL

| CATCH IN NUMBERS | UNIT: thousands |       |       |       |       |       |       |       |       |       |       |  |
|------------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--|
|                  | 1980            | 1981  | 1982  | 1983  | 1984  | 1985  | 1986  | 1987  | 1988  | 1989  | 1990  |  |
| 0                |                 |       |       |       |       |       |       |       |       |       |       |  |
| 5                | 47              | 26    | 8     | 10    | 84    | 128   | 247   | 182   | 130   | 510   | 186   |  |
| 6                | 502             | 158   | 300   | 240   | 277   | 451   | 616   | 3123  | 747   | 1642  | 444   |  |
| 7                | 1536            | 580   | 1140  | 1611  | 891   | 1039  | 1039  | 4863  | 2081  | 4481  | 1489  |  |
| 8                | 2630            | 1160  | 2451  | 2651  | 2139  | 2350  | 1954  | 2586  | 3004  | 5988  | 3430  |  |
| 9                | 3126            | 1430  | 2646  | 3060  | 3568  | 3535  | 3001  | 2156  | 3186  | 5750  | 4079  |  |
| 10               | 2324            | 1764  | 2456  | 2443  | 2800  | 2819  | 3115  | 3476  | 2984  | 3236  | 3055  |  |
| 11               | 1739            | 1299  | 1803  | 1693  | 1825  | 1490  | 1693  | 1847  | 1860  | 1602  | 1193  |  |
| 12               | 849             | 664   | 963   | 978   | 1134  | 640   | 825   | 1829  | 1772  | 1464  | 934   |  |
| 13               | 578             | 435   | 609   | 424   | 588   | 434   | 553   | 886   | 1863  | 1232  | 552   |  |
| 14               | 306             | 252   | 331   | 174   | 363   | 141   | 203   | 213   | 706   | 502   | 347   |  |
| 15               | 143             | 176   | 195   | 37    | 92    | 37    | 59    | 31    | 217   | 365   | 137   |  |
| 16+              | 116             | 159   | 132   | 47    | 20    | 47    | 34    | 5     | 248   | 142   | 57    |  |
| TOTAL            | 13896           | 8103  | 13034 | 13368 | 13781 | 13111 | 13339 | 21197 | 18798 | 26914 | 15903 |  |
| A) SOP           | 31249           | 19192 | 32452 | 30551 | 34240 | 32053 | 32979 | 47490 | 51122 | 61366 | 38318 |  |
| B)NOMIN.         | 31252           | 19239 | 32441 | 30888 | 34024 | 32075 | 32984 | 46622 | 51118 | 61398 | 38486 |  |
| (B/A) %          | 100             | 100   | 100   | 101   | 99    | 100   | 100   | 98    | 100   | 100   | 100   |  |

Table 3.7 VPA.

Greenland Halibut in the Iceland and Faroes Grounds and East Greenland (Fishing Areas V and XIV)

| MEAN WEIGHT AT AGE OF THE STOCK | UNIT: kilogram |       |       |       |       |       |       |       |       |       |       |  |
|---------------------------------|----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--|
|                                 | 1980           | 1981  | 1982  | 1983  | 1984  | 1985  | 1986  | 1987  | 1988  | 1989  | 1990  |  |
| 5                               | 1.125          | 1.071 | 1.010 | .984  | .942  | .995  | 1.030 | 1.030 | 1.129 | .842  | 1.029 |  |
| 6                               | 1.283          | 1.257 | 1.368 | 1.338 | 1.275 | 1.230 | 1.238 | 1.218 | 1.304 | 1.047 | 1.210 |  |
| 7                               | 1.487          | 1.440 | 1.618 | 1.577 | 1.592 | 1.630 | 1.499 | 1.533 | 1.541 | 1.425 | 1.571 |  |
| 8                               | 1.756          | 1.660 | 1.905 | 1.848 | 1.817 | 1.951 | 1.937 | 1.824 | 1.770 | 1.727 | 1.789 |  |
| 9                               | 2.053          | 1.967 | 2.187 | 2.159 | 2.240 | 2.367 | 2.363 | 2.187 | 2.236 | 2.125 | 2.125 |  |
| 10                              | 2.279          | 2.258 | 2.516 | 2.434 | 2.461 | 2.637 | 2.631 | 2.666 | 2.683 | 2.637 | 2.536 |  |
| 11                              | 2.498          | 2.515 | 2.761 | 2.603 | 2.835 | 2.829 | 2.848 | 2.996 | 3.082 | 3.220 | 3.216 |  |
| 12                              | 3.059          | 2.950 | 3.129 | 3.034 | 3.262 | 3.353 | 3.335 | 3.595 | 3.624 | 3.733 | 3.695 |  |
| 13                              | 3.783          | 3.450 | 3.785 | 3.784 | 3.962 | 4.006 | 4.039 | 4.431 | 4.312 | 4.135 | 4.447 |  |
| 14                              | 4.507          | 4.033 | 4.475 | 4.446 | 4.936 | 4.792 | 4.925 | 5.140 | 5.098 | 5.380 | 5.198 |  |
| 15                              | 5.139          | 4.652 | 4.985 | 4.751 | 5.230 | 5.231 | 5.466 | 5.764 | 5.213 | 6.569 | 5.893 |  |
| 16+                             | 5.633          | 4.714 | 5.610 | 6.209 | 6.968 | 6.323 | 5.764 | 5.764 | 5.764 | 6.497 | 6.054 |  |



Table 3.9

DISAGGREGATED Qs

LOG TRANSFORMATION

NO explanatory variate (Mean used)

Fleet 1, Greenland halibut, 1, has terminal q estimated as the mean

FLEETS COMBINED BY \*\* VARIANCE \*\*

Regression weights

, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000,

Oldest age F = 1.000\*average of 5 younger ages. Fleets combined by variance of predictions

Fishing mortalities

| Age, | 80,   | 81,   | 82,    | 83,   | 84,    | 85,   | 86,    | 87,   | 88,    | 89,    | 90,   |
|------|-------|-------|--------|-------|--------|-------|--------|-------|--------|--------|-------|
| 5,   | .001, | .001, | .000,  | .000, | .003,  | .003, | .006,  | .005, | .005,  | .025,  | .003, |
| 6,   | .019, | .005, | .010,  | .009, | .013,  | .021, | .019,  | .093, | .024,  | .079,  | .025, |
| 7,   | .087, | .026, | .043,  | .065, | .042,  | .060, | .058,  | .193, | .078,  | .184,  | .090, |
| 8,   | .209, | .084, | .138,  | .126, | .110,  | .140, | .146,  | .190, | .166,  | .318,  | .198, |
| 9,   | .339, | .159, | .262,  | .241, | .235,  | .253, | .252,  | .224, | .356,  | .510,  | .351, |
| 10,  | .429, | .307, | .418,  | .387, | .341,  | .278, | .348,  | .486, | .516,  | .699,  | .528, |
| 11,  | .589, | .428, | .555,  | .537, | .526,  | .290, | .253,  | .338, | .492,  | .546,  | .570, |
| 12,  | .578, | .441, | .613,  | .630, | .801,  | .332, | .244,  | .448, | .592,  | .864,  | .676, |
| 13,  | .556, | .627, | .885,  | .568, | .944,  | .790, | .503,  | .421, | 1.090, | 1.047, | .919, |
| 14,  | .437, | .474, | 1.443, | .642, | 1.398, | .579, | 1.055, | .347, | .661,  | .964,  | .932, |
| 15,  | .518, | .455, | .783,  | .553, | .802,  | .454, | .481,  | .408, | .670,  | .824,  | .725, |

Log catchability estimates

Age 5

| Fleet, | 80,     | 81,     | 82,     | 83,     | 84,     | 85,     | 86,     | 87,     | 88,     | 89,     | 90     |
|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------|
| 1,     | -16.37, | -16.82, | -18.19, | -17.40, | -15.35, | -15.37, | -14.99, | -15.57, | -15.89, | -14.16, | -16.01 |

SUMMARY STATISTICS

| Fleet | Pred. q | SE(q)       | Partial F   | Raised F       | SLOPE          | SE Slope | INTRCPT | SE Intrcpt |
|-------|---------|-------------|-------------|----------------|----------------|----------|---------|------------|
| 1     | -16.01  | 1.190       | .0030       | .0030          | .000E+00       | .000E+00 | -16.012 | .344       |
|       | Fbar    | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |         |            |
|       | .003    | 1.19        | 0.000       | 1.19           | 0.000          |          |         |            |

Age 6

| Fleet, | 80,     | 81,     | 82,     | 83,     | 84,     | 85,     | 86,     | 87,     | 88,     | 89,     | 90     |
|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------|
| 1,     | -13.68, | -14.92, | -14.57, | -14.27, | -13.95, | -13.54, | -13.85, | -12.64, | -14.35, | -13.00, | -13.88 |

SUMMARY STATISTICS

| Fleet | Pred. q | SE(q)       | Partial F   | Raised F       | SLOPE          | SE Slope | INTRCPT | SE Intrcpt |
|-------|---------|-------------|-------------|----------------|----------------|----------|---------|------------|
| 1     | -13.88  | .695        | .0255       | .0255          | .000E+00       | .000E+00 | -13.877 | .200       |
|       | Fbar    | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |         |            |
|       | .025    | .695        | 0.000       | .695           | 0.000          |          |         |            |

Age 7

| Fleet, | 80,     | 81,     | 82,     | 83,     | 84,     | 85,     | 86,     | 87,     | 88,     | 89,     | 90     |
|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------|
| 1,     | -12.14, | -13.28, | -13.13, | -12.33, | -12.81, | -12.49, | -12.72, | -11.91, | -13.16, | -12.15, | -12.61 |

SUMMARY STATISTICS

| Fleet | Pred. q | SE(q)       | Partial F   | Raised F       | SLOPE          | SE Slope | INTRCPT | SE Intrcpt |
|-------|---------|-------------|-------------|----------------|----------------|----------|---------|------------|
| 1     | -12.61  | .477        | .0902       | .0902          | .000E+00       | .000E+00 | -12.612 | .138       |
|       | Fbar    | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |         |            |
|       | .090    | .477        | 0.000       | .477           | 0.000          |          |         |            |

Age 8

| Fleet, | 80,     | 81,     | 82,     | 83,     | 84,     | 85,     | 86,     | 87,     | 88,     | 89,     | 90     |
|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------|
| 1,     | -11.27, | -12.11, | -11.96, | -11.68, | -11.84, | -11.64, | -11.81, | -11.92, | -12.41, | -11.60, | -11.82 |

SUMMARY STATISTICS

| Fleet | Pred. q | SE(q)       | Partial F   | Raised F       | SLOPE          | SE Slope | INTRCPT | SE Intrcpt |
|-------|---------|-------------|-------------|----------------|----------------|----------|---------|------------|
| 1     | -11.82  | .306        | .1981       | .1981          | .000E+00       | .000E+00 | -11.825 | .088       |
|       | Fbar    | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |         |            |
|       | .198    | .306        | 0.000       | .306           | 0.000          |          |         |            |

Age 9

| Fleet, | 80,     | 81,     | 82,     | 83,     | 84,     | 85,     | 86,     | 87,     | 88,     | 89,     | 90     |
|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------|
| 1,     | -10.79, | -11.46, | -11.32, | -11.03, | -11.09, | -11.05, | -11.26, | -11.76, | -11.65, | -11.13, | -11.25 |

SUMMARY STATISTICS

| Fleet | Pred. q | SE(q)       | Partial F   | Raised F       | SLOPE          | SE Slope | INTRCPT | SE Intrcpt |
|-------|---------|-------------|-------------|----------------|----------------|----------|---------|------------|
| 1     | -11.25  | .306        | .1981       | .1981          | .000E+00       | .000E+00 | -11.25  | .088       |
|       | Fbar    | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |         |            |
|       | .198    | .306        | 0.000       | .306           | 0.000          |          |         |            |

Table 3.9 cont'd.

| Age 10             |             |             |                |                |          |          |           |           |        |        |        |
|--------------------|-------------|-------------|----------------|----------------|----------|----------|-----------|-----------|--------|--------|--------|
| Fleet,             | 80,         | 81,         | 82,            | 83,            | 84,      | 85,      | 86,       | 87,       | 88,    | 89,    | 90     |
| 1                  | -10.55      | -10.80      | -10.85         | -10.56         | -10.71   | -10.96   | -10.94    | -10.99    | -11.28 | -10.81 | -10.84 |
| SUMMARY STATISTICS |             |             |                |                |          |          |           |           |        |        |        |
| Fleet              | Pred.       | SE(q)       | Partial        | Raised         | SLOPE    | SE       | INTRCPT   | SE        |        |        |        |
| , q                | , F         | , F         | , F            | , F            | , Slope  | , Slope  | , Intrcpt | , Intrcpt |        |        |        |
| 1                  | -10.84      | .213        | .5280          | .5280          | .000E+00 | .000E+00 | -10.845   | .062      |        |        |        |
| Fbar               | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |          |           |           |        |        |        |
| .528               | .213        | 0.000       | .213           | 0.000          |          |          |           |           |        |        |        |
| Age 11             |             |             |                |                |          |          |           |           |        |        |        |
| Fleet,             | 80,         | 81,         | 82,            | 83,            | 84,      | 85,      | 86,       | 87,       | 88,    | 89,    | 90     |
| 1                  | -10.24      | -10.47      | -10.57         | -10.23         | -10.28   | -10.92   | -11.26    | -11.35    | -11.33 | -11.06 | -10.77 |
| SUMMARY STATISTICS |             |             |                |                |          |          |           |           |        |        |        |
| Fleet              | Pred.       | SE(q)       | Partial        | Raised         | SLOPE    | SE       | INTRCPT   | SE        |        |        |        |
| , q                | , F         | , F         | , F            | , F            | , Slope  | , Slope  | , Intrcpt | , Intrcpt |        |        |        |
| 1                  | -10.77      | .459        | .5696          | .5696          | .000E+00 | .000E+00 | -10.769   | .133      |        |        |        |
| Fbar               | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |          |           |           |        |        |        |
| .570               | .459        | 0.000       | .459           | 0.000          |          |          |           |           |        |        |        |
| Age 12             |             |             |                |                |          |          |           |           |        |        |        |
| Fleet,             | 80,         | 81,         | 82,            | 83,            | 84,      | 85,      | 86,       | 87,       | 88,    | 89,    | 90     |
| 1                  | -10.25      | -10.44      | -10.47         | -10.07         | -9.86    | -10.78   | -11.29    | -11.07    | -11.14 | -10.60 | -10.60 |
| SUMMARY STATISTICS |             |             |                |                |          |          |           |           |        |        |        |
| Fleet              | Pred.       | SE(q)       | Partial        | Raised         | SLOPE    | SE       | INTRCPT   | SE        |        |        |        |
| , q                | , F         | , F         | , F            | , F            | , Slope  | , Slope  | , Intrcpt | , Intrcpt |        |        |        |
| 1                  | -10.60      | .469        | .6764          | .6764          | .000E+00 | .000E+00 | -10.597   | .135      |        |        |        |
| Fbar               | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |          |           |           |        |        |        |
| .676               | .469        | 0.000       | .469           | 0.000          |          |          |           |           |        |        |        |
| Age 13             |             |             |                |                |          |          |           |           |        |        |        |
| Fleet,             | 80,         | 81,         | 82,            | 83,            | 84,      | 85,      | 86,       | 87,       | 88,    | 89,    | 90     |
| 1                  | -10.29      | -10.09      | -10.10         | -10.17         | -9.69    | -9.91    | -10.57    | -11.13    | -10.53 | -10.41 | -10.29 |
| SUMMARY STATISTICS |             |             |                |                |          |          |           |           |        |        |        |
| Fleet              | Pred.       | SE(q)       | Partial        | Raised         | SLOPE    | SE       | INTRCPT   | SE        |        |        |        |
| , q                | , F         | , F         | , F            | , F            | , Slope  | , Slope  | , Intrcpt | , Intrcpt |        |        |        |
| 1                  | -10.29      | .396        | .9194          | .9194          | .000E+00 | .000E+00 | -10.290   | .114      |        |        |        |
| Fbar               | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |          |           |           |        |        |        |
| .919               | .396        | 0.000       | .396           | 0.000          |          |          |           |           |        |        |        |
| Age 14             |             |             |                |                |          |          |           |           |        |        |        |
| Fleet,             | 80,         | 81,         | 82,            | 83,            | 84,      | 85,      | 86,       | 87,       | 88,    | 89,    | 90     |
| 1                  | -10.53      | -10.37      | -9.61          | -10.05         | -9.30    | -10.22   | -9.83     | -11.32    | -11.03 | -10.49 | -10.28 |
| SUMMARY STATISTICS |             |             |                |                |          |          |           |           |        |        |        |
| Fleet              | Pred.       | SE(q)       | Partial        | Raised         | SLOPE    | SE       | INTRCPT   | SE        |        |        |        |
| , q                | , F         | , F         | , F            | , F            | , Slope  | , Slope  | , Intrcpt | , Intrcpt |        |        |        |
| 1                  | -10.28      | .612        | .9319          | .9319          | .000E+00 | .000E+00 | -10.277   | .177      |        |        |        |
| Fbar               | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |          |           |           |        |        |        |
| .932               | .612        | 0.000       | .612           | 0.000          |          |          |           |           |        |        |        |



Table 3.10 VPA from tuning.

Greenland Halibut in the Iceland and Faroes Grounds and East Greenland (Fishing Areas V and XIV)

FISHING MORTALITY COEFFICIENT UNIT: Year-1 NATURAL MORTALITY COEFFICIENT = .15

|         | 1980 | 1981 | 1982  | 1983 | 1984  | 1985 | 1986  | 1987 | 1988  | 1989  | 1990 |
|---------|------|------|-------|------|-------|------|-------|------|-------|-------|------|
| 5       | .001 | .001 | .000  | .000 | .003  | .003 | .006  | .005 | .005  | .025  | .003 |
| 6       | .019 | .005 | .010  | .009 | .013  | .021 | .019  | .093 | .024  | .079  | .025 |
| 7       | .087 | .026 | .043  | .065 | .042  | .060 | .058  | .193 | .078  | .184  | .090 |
| 8       | .209 | .084 | .138  | .126 | .110  | .140 | .146  | .190 | .166  | .318  | .198 |
| 9       | .339 | .159 | .262  | .241 | .235  | .253 | .252  | .224 | .356  | .510  | .351 |
| 10      | .429 | .307 | .418  | .387 | .341  | .278 | .348  | .486 | .516  | .699  | .528 |
| 11      | .589 | .428 | .555  | .537 | .526  | .290 | .253  | .338 | .492  | .546  | .570 |
| 12      | .578 | .441 | .613  | .630 | .801  | .332 | .244  | .448 | .592  | .864  | .676 |
| 13      | .556 | .627 | .885  | .568 | .944  | .790 | .503  | .421 | 1.090 | 1.047 | .919 |
| 14      | .437 | .474 | 1.443 | .642 | 1.398 | .579 | 1.055 | .347 | .661  | .964  | .932 |
| 15      | .518 | .455 | .783  | .553 | .802  | .454 | .481  | .408 | .670  | .824  | .725 |
| 16+     | .518 | .455 | .783  | .553 | .802  | .454 | .481  | .408 | .670  | .824  | .725 |
| (8-13)U | .450 | .341 | .479  | .415 | .493  | .347 | .291  | .351 | .535  | .664  | .540 |

F<sub>11</sub> = 0.540

Table 3.11 VPA from tuning.

Greenland Halibut in the Iceland and Faroes Grounds and East Greenland (Fishing Areas V and XIV)

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

|           | 1980   | 1981   | 1982   | 1983   | 1984   | 1985   | 1986   | 1987   | 1988   | 1989   | 1990   | 1991  |
|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| 5         | 39731  | 37320  | 31913  | 26154  | 27280  | 41102  | 44184  | 39798  | 27312  | 23041  | 66864  | 0     |
| 6         | 28899  | 34154  | 32098  | 27460  | 22502  | 23402  | 35258  | 37801  | 34086  | 23387  | 19359  | 57378 |
| 7         | 19737  | 24408  | 29250  | 27349  | 23413  | 19111  | 19725  | 29776  | 29644  | 28646  | 18609  | 16251 |
| 8         | 14999  | 15565  | 20471  | 24119  | 22047  | 19326  | 15486  | 16015  | 21132  | 23588  | 20512  | 14638 |
| 9         | 11659  | 10479  | 12323  | 15352  | 18307  | 16996  | 14460  | 11521  | 11393  | 15410  | 14774  | 14483 |
| 10        | 7137   | 7150   | 7696   | 8162   | 10385  | 12459  | 11363  | 9673   | 7924   | 6866   | 7967   | 8952  |
| 11        | 4177   | 4000   | 4525   | 4360   | 4772   | 6355   | 8120   | 6905   | 5123   | 4072   | 2936   | 4045  |
| 12        | 2067   | 1995   | 2245   | 2235   | 2194   | 2427   | 4093   | 5425   | 4239   | 2696   | 2030   | 1429  |
| 13        | 1449   | 998    | 1105   | 1047   | 1024   | 847    | 1498   | 2761   | 2983   | 2018   | 978    | 889   |
| 14        | 927    | 715    | 459    | 393    | 511    | 343    | 331    | 780    | 1559   | 864    | 609    | 336   |
| 15        | 378    | 516    | 383    | 93     | 178    | 109    | 165    | 99     | 475    | 693    | 284    | 207   |
| 16+       | 307    | 466    | 259    | 118    | 39     | 138    | 95     | 16     | 542    | 270    | 118    | 167   |
| TOTAL NO  | 131466 | 137764 | 142727 | 136841 | 132651 | 142614 | 154779 | 160570 | 146412 | 131550 | 155041 |       |
| SPS NO    | 33223  | 32534  | 33836  | 32325  | 35009  | 32543  | 39146  | 40696  | 39592  | 36215  | 31830  |       |
| TOT. BIOM | 207749 | 207505 | 237896 | 228202 | 226747 | 244214 | 258698 | 269971 | 262667 | 218767 | 236603 |       |
| SPS BIOM  | 77396  | 72078  | 78293  | 70681  | 80355  | 78015  | 95350  | 102986 | 103658 | 88564  | 72895  |       |

Table 3.12

List of input variables for the ICES prediction program.

Prediction for Greenland Halibut in Areas V and XIV

The reference F is the mean F (non-weighted) for the age group range from 8 to 13

The number of recruits per year is as follows:

| Year | Recruitment |
|------|-------------|
| 1991 | 32614.0     |
| 1992 | 32614.0     |
| 1993 | 32614.0     |
| 1994 | 32614.0     |

Data are printed in the following units:

Number of fish: thousands  
 Weight by age group in the catch: kilogram  
 Weight by age group in the stock: kilogram  
 Stock biomass: tonnes  
 Catch weight: tonnes

| age | stock size | fishing pattern | natural mortality | maturity ogive | weight in the catch | weight in the stock |
|-----|------------|-----------------|-------------------|----------------|---------------------|---------------------|
| 5   | 32614.0    | .01             | .15               | .04            | 1.000               | 1.000               |
| 6   | 27394.0    | .04             | .15               | .07            | 1.187               | 1.187               |
| 7   | 22214.0    | .11             | .15               | .19            | 1.512               | 1.512               |
| 8   | 14607.0    | .21             | .15               | .31            | 1.762               | 1.762               |
| 9   | 14474.0    | .38             | .15               | .43            | 2.162               | 2.162               |
| 10  | 8958.0     | .54             | .15               | .65            | 2.619               | 2.619               |
| 11  | 4044.0     | .50             | .15               | .83            | 3.173               | 3.173               |
| 12  | 1430.0     | .66             | .15               | .96            | 3.684               | 3.684               |
| 13  | 888.0      | .95             | .15               | 1.00           | 4.298               | 4.298               |
| 14  | 336.0      | .79             | .15               | 1.00           | 5.225               | 5.225               |
| 15  | 207.0      | .69             | .15               | 1.00           | 5.892               | 5.892               |
| 16+ | 167.0      | .69             | .15               | 1.00           | 6.105               | 6.105               |

Table 3.13

Effects of different levels of fishing mortality on catch, stock biomass and spawning stock biomass.

Prediction for Greenland Halibut in Areas V and XIV

| Year 1991   |           |                  |                     |       | Year 1992   |           |                  |                     |       | Year 1993        |                     |
|-------------|-----------|------------------|---------------------|-------|-------------|-----------|------------------|---------------------|-------|------------------|---------------------|
| fac-<br>tor | ref.<br>F | stock<br>biomass | sp.stock<br>biomass | catch | fac-<br>tor | ref.<br>F | stock<br>biomass | sp.stock<br>biomass | catch | stock<br>biomass | sp.stock<br>biomass |
| .9          | .48       | 203              | 70                  | 35    | .2          | .13       | 204              | 71                  | 11    | 232              | 90                  |
|             |           |                  |                     |       | .7          | .36       |                  |                     | 28    | 214              | 77                  |
|             |           |                  |                     |       | .8          | .43       |                  |                     | 32    | 209              | 73                  |
|             |           |                  |                     |       | 1.0         | .54       |                  |                     | 38    | 202              | 68                  |
|             |           |                  |                     |       | 1.2         | .65       |                  |                     | 44    | 196              | 64                  |

The data unit of the biomass and the catch is 1000 tonnes.

The spawning stock biomass is given for 1 January.

The reference F is the mean F (non-weighted) for the age group range from 8 to 13

**Table 4.1** Nominal catch (tonnes) of SAITHE in Division Va, 1978-1990, as reported to ICES.

| Country                      | 1978          | 1979          | 1980          | 1981          | 1982          | 1983          | 1984          |
|------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Belgium                      | 1,092         | 980           | 980           | 532           | 203           | 224           | 269           |
| Faroe Islands                | 4,250         | 5,457         | 4,930         | 3,545         | 3,582         | 2,138         | 2,044         |
| France                       | -             | -             | -             | -             | 23            | -             | -             |
| Iceland                      | 44,327        | 57,066        | 52,436        | 54,921        | 65,124        | 55,904        | 60,406        |
| Norway                       | 3             | 1             | 1             | 3             | 1             | +             | -             |
| UK (Engl.& Wales)            | -             | -             | -             | -             | -             | -             | -             |
| <b>Total</b>                 | <b>49,672</b> | <b>63,504</b> | <b>58,347</b> | <b>59,001</b> | <b>68,933</b> | <b>58,266</b> | <b>62,719</b> |
| Total used in the assessment |               |               |               |               |               |               | 62,719        |

| Country                      | 1985          | 1986                | 1987          | 1988          | 1989          | 1990                |
|------------------------------|---------------|---------------------|---------------|---------------|---------------|---------------------|
| Belgium                      | 158           | 218                 | 217           | 268           | 369           | 190 <sup>1</sup>    |
| Faroe Islands                | 1,778         | 783                 | 2,139         | 2,596         | 2,246         | 2,905               |
| France                       | -             | -                   | -             | -             | -             | -                   |
| Iceland                      | 55,135        | 63,867              | 78,175        | 74,383        | 79,796        | 94,200 <sup>1</sup> |
| Norway                       | 1             | -                   | -             | -             | -             | -                   |
| UK (Engl.& Wales)            | 29            | -                   | -             | -             | -             | -                   |
| <b>Total</b>                 | <b>57,101</b> | <b>64,868</b>       | <b>80,531</b> | <b>77,247</b> | <b>82,411</b> | <b>97,295</b>       |
| Total used in the assessment | 57,101        | 66,376 <sup>2</sup> | 80,531        | 77,247        | 82,411        | 97,902              |

<sup>1</sup> Preliminary.

<sup>2</sup> Additional catch by Faroe Islands of 1,508 tonnes included.

**Table 4.2** Icelandic SAITHE. CPUE and effort data during 1978-1990 in Division Va.

| Year              | CPUE<br>(t/hr trawling) | Total landings | Total effort<br>(hrs) |
|-------------------|-------------------------|----------------|-----------------------|
| 1978              | 1.05                    | 49,672         | 47,672                |
| 1979              | 1.16                    | 63,504         | 54,934                |
| 1980              | 1.40                    | 58,347         | 41,558                |
| 1981              | 1.57                    | 59,001         | 37,652                |
| 1982              | 1.34                    | 68,933         | 51,328                |
| 1983              | 1.23                    | 58,266         | 47,371                |
| 1984              | 1.07                    | 62,719         | 58,836                |
| 1985              | 1.24                    | 57,101         | 46,012                |
| 1986              | 1.23                    | 66,376         | 54,052                |
| 1987              | 1.36                    | 80,531         | 59,388                |
| 1988              | 1.28                    | 77,247         | 60,256                |
| 1989              | 1.17                    | 82,411         | 70,197                |
| 1990 <sup>1</sup> | 1.26                    | 97,902         | 77,700                |

<sup>1</sup> Preliminary.

Table 4.3 VPA.

Saithe in the Iceland Grounds (Fishing Area Va)

|       | CATCH IN NUMBERS |       |       |       |       |       |       |       |       |       |       |
|-------|------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|       | UNIT: thousands  |       |       |       |       |       |       |       |       |       |       |
|       | 1980             | 1981  | 1982  | 1983  | 1984  | 1985  | 1986  | 1987  | 1988  | 1989  | 1990  |
| 3     | 135              | 257   | 486   | 40    | 135   | 197   | 3060  | 924   | 861   | 366   | 123   |
| 4     | 2303             | 1550  | 1221  | 1469  | 492   | 2929  | 1394  | 4983  | 6044  | 3599  | 1462  |
| 5     | 4634             | 4310  | 2526  | 1343  | 826   | 3432  | 3722  | 4327  | 7719  | 7016  | 4523  |
| 6     | 2551             | 5464  | 4817  | 2410  | 1537  | 1818  | 2382  | 5348  | 3767  | 5750  | 9191  |
| 7     | 2419             | 1504  | 4361  | 4364  | 2456  | 1719  | 1386  | 2987  | 2484  | 2152  | 6128  |
| 8     | 1612             | 1470  | 1375  | 2406  | 3367  | 1530  | 1170  | 1412  | 1650  | 2220  | 2032  |
| 9     | 482              | 589   | 1119  | 460   | 982   | 1604  | 695   | 679   | 720   | 1034  | 1227  |
| 10    | 245              | 192   | 343   | 346   | 318   | 627   | 1809  | 494   | 205   | 364   | 435   |
| 11    | 132              | 67    | 65    | 71    | 249   | 185   | 266   | 507   | 227   | 302   | 189   |
| 12    | 102              | 175   | 37    | 36    | 227   | 100   | 69    | 58    | 101   | 207   | 75    |
| 13    | 59               | 130   | 38    | 11    | 137   | 96    | 44    | 26    | 19    | 171   | 113   |
| 14+   | 52               | 208   | 112   | 66    | 339   | 317   | 156   | 65    | 4     | 31    | 130   |
| TOTAL | 14726            | 15916 | 16500 | 13022 | 11065 | 14554 | 16153 | 21810 | 23801 | 23212 | 25628 |

Table 4.4 VPA.

Saithe in the Iceland Grounds (Fishing Area Va)

|     | MEAN WEIGHT AT AGE OF THE STOCK |        |        |        |        |        |        |        |        |        |        |
|-----|---------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
|     | UNIT: kilogram                  |        |        |        |        |        |        |        |        |        |        |
|     | 1980                            | 1981   | 1982   | 1983   | 1984   | 1985   | 1986   | 1987   | 1988   | 1989   | 1990   |
| 3   | 1.445                           | 1.477  | 1.540  | 1.865  | 1.540  | 1.526  | 1.381  | 1.516  | 1.403  | 1.307  | 1.635  |
| 4   | 1.893                           | 2.004  | 2.148  | 2.229  | 2.367  | 2.087  | 2.132  | 1.717  | 2.050  | 1.921  | 1.971  |
| 5   | 2.682                           | 2.574  | 2.951  | 3.151  | 3.319  | 2.880  | 2.953  | 2.670  | 2.433  | 2.126  | 2.570  |
| 6   | 3.871                           | 3.457  | 3.044  | 4.199  | 4.450  | 3.722  | 4.350  | 3.832  | 3.374  | 3.135  | 3.072  |
| 7   | 5.324                           | 4.431  | 5.013  | 4.115  | 5.460  | 4.719  | 5.482  | 5.080  | 4.815  | 4.662  | 4.205  |
| 8   | 6.143                           | 6.156  | 6.031  | 5.930  | 5.194  | 6.162  | 6.431  | 6.179  | 5.937  | 5.941  | 5.790  |
| 9   | 6.848                           | 6.820  | 7.249  | 7.509  | 7.526  | 5.650  | 7.614  | 7.310  | 7.538  | 7.253  | 7.037  |
| 10  | 8.227                           | 8.047  | 8.070  | 8.815  | 8.580  | 8.314  | 6.477  | 8.023  | 8.598  | 8.988  | 7.557  |
| 11  | 9.062                           | 9.409  | 8.920  | 9.357  | 9.315  | 9.640  | 9.625  | 7.945  | 8.714  | 10.689 | 8.983  |
| 12  | 9.299                           | 9.205  | 10.581 | 9.557  | 10.123 | 10.401 | 10.487 | 9.609  | 9.580  | 10.635 | 10.771 |
| 13  | 10.502                          | 9.439  | 10.144 | 10.235 | 10.875 | 11.055 | 11.781 | 12.250 | 11.145 | 13.334 | 11.793 |
| 14+ | 11.373                          | 10.146 | 11.093 | 9.578  | 11.223 | 11.443 | 12.088 | 12.562 | 14.098 | 12.134 | 11.694 |



Table 4.6 Icelandic saithe - tuning analysis.

DISAGGREGATED Qs  
 LOG TRANSFORMATION  
 NO explanatory variate (Mean used)  
 Fleet 1, only one fleet for s, has terminal q estimated as the mean  
 FLEETS COMBINED BY \*\* VARIANCE \*\*

Regression weights  
 , 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000,  
 Oldest age F = 1.000\*average of 5 younger ages. Fleets combined by variance of predictions  
 Fishing mortalities

| Age, | 80,   | 81,   | 82,   | 83,   | 84,   | 85,   | 86,   | 87,   | 88,   | 89,   | 90,   |
|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 3,   | .005, | .014, | .025, | .001, | .004, | .006, | .050, | .014, | .024, | .022, | .016, |
| 4,   | .052, | .070, | .083, | .099, | .022, | .098, | .058, | .107, | .116, | .133, | .113, |
| 5,   | .185, | .131, | .156, | .123, | .074, | .207, | .173, | .255, | .239, | .191, | .247, |
| 6,   | .335, | .346, | .212, | .219, | .202, | .231, | .217, | .401, | .369, | .281, | .409, |
| 7,   | .381, | .338, | .514, | .303, | .362, | .364, | .277, | .462, | .328, | .374, | .546, |
| 8,   | .503, | .422, | .591, | .602, | .405, | .403, | .453, | .503, | .503, | .549, | .732, |
| 9,   | .359, | .346, | .665, | .401, | .532, | .343, | .322, | .521, | .522, | .692, | .680, |
| 10,  | .774, | .237, | .348, | .443, | .538, | .787, | .820, | .400, | .292, | .550, | .717, |
| 11,  | .308, | .498, | .117, | .112, | .669, | .703, | .965, | .573, | .324, | .924, | .624, |
| 12,  | .218, | .866, | .571, | .088, | .612, | .630, | .627, | .571, | .210, | .553, | .622, |
| 13,  | .432, | .474, | .458, | .329, | .551, | .573, | .637, | .514, | .370, | .653, | .675, |

0.455

Log catchability estimates

| Age 3<br>Fleet, | 80,     | 81,     | 82,     | 83,     | 84,     | 85,     | 86,     | 87,     | 88,     | 89,     | 90     |
|-----------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------|
| 1,              | -15.97, | -14.83, | -14.53, | -17.31, | -16.64, | -15.77, | -13.90, | -15.29, | -14.73, | -14.99, | -15.40 |

| SUMMARY STATISTICS |             |             |                |                |           |          |         |      |
|--------------------|-------------|-------------|----------------|----------------|-----------|----------|---------|------|
| Fleet              | Pred.       | SE(q)       | Partial        | Raised         | SLOPE     | SE       |         |      |
| , q                | , F         | , F         | , F            | , Slope        | , InTRCPT | SE       |         |      |
|                    |             |             |                |                |           | Intrcpt  |         |      |
| 1                  | -15.40      | 1.024       | .0160          | .0160          | .000E+00  | .000E+00 | -15.395 | .295 |
| Fbar               | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |           |          |         |      |
| .016               | 1.02        | 0.000       | 1.02           | 0.000          |           |          |         |      |

| Age 4<br>Fleet, | 80,     | 81,     | 82,     | 83,     | 84,     | 85,     | 86,     | 87,     | 88,     | 89,     | 90     |
|-----------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------|
| 1,              | -13.58, | -13.19, | -13.34, | -13.08, | -14.81, | -13.06, | -13.75, | -13.23, | -13.16, | -13.17, | -13.44 |

| SUMMARY STATISTICS |             |             |                |                |           |          |         |      |
|--------------------|-------------|-------------|----------------|----------------|-----------|----------|---------|------|
| Fleet              | Pred.       | SE(q)       | Partial        | Raised         | SLOPE     | SE       |         |      |
| , q                | , F         | , F         | , F            | , Slope        | , InTRCPT | SE       |         |      |
|                    |             |             |                |                |           | Intrcpt  |         |      |
| 1                  | -13.44      | .525        | .1134          | .1134          | .000E+00  | .000E+00 | -13.438 | .151 |
| Fbar               | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |           |          |         |      |
| .113               | .525        | 0.000       | .525           | 0.000          |           |          |         |      |

| Age 5<br>Fleet, | 80,     | 81,     | 82,     | 83,     | 84,     | 85,     | 86,     | 87,     | 88,     | 89,     | 90     |
|-----------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------|
| 1,              | -12.32, | -12.57, | -12.70, | -12.86, | -13.59, | -12.31, | -12.65, | -12.36, | -12.44, | -12.81, | -12.66 |

| SUMMARY STATISTICS |             |             |                |                |           |          |         |      |
|--------------------|-------------|-------------|----------------|----------------|-----------|----------|---------|------|
| Fleet              | Pred.       | SE(q)       | Partial        | Raised         | SLOPE     | SE       |         |      |
| , q                | , F         | , F         | , F            | , Slope        | , InTRCPT | SE       |         |      |
|                    |             |             |                |                |           | Intrcpt  |         |      |
| 1                  | -12.66      | .378        | .2465          | .2465          | .000E+00  | .000E+00 | -12.661 | .109 |
| Fbar               | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |           |          |         |      |
| .247               | .378        | 0.000       | .378           | 0.000          |           |          |         |      |

| Age 6<br>Fleet, | 80,     | 81,     | 82,     | 83,     | 84,     | 85,     | 86,     | 87,     | 88,     | 89,     | 90     |
|-----------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------|
| 1,              | -11.73, | -11.60, | -12.40, | -12.29, | -12.58, | -12.20, | -12.43, | -11.91, | -12.00, | -12.43, | -12.16 |

| SUMMARY STATISTICS |             |             |                |                |           |          |         |      |
|--------------------|-------------|-------------|----------------|----------------|-----------|----------|---------|------|
| Fleet              | Pred.       | SE(q)       | Partial        | Raised         | SLOPE     | SE       |         |      |
| , q                | , F         | , F         | , F            | , Slope        | , InTRCPT | SE       |         |      |
|                    |             |             |                |                |           | Intrcpt  |         |      |
| 1                  | -12.16      | .328        | .4087          | .4091          | .000E+00  | .000E+00 | -12.155 | .095 |
| Fbar               | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |           |          |         |      |
| .409               | .328        | 0.000       | .328           | 0.000          |           |          |         |      |

Table 4.6 cont'd.

Age 7  
 Fleet, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90  
 1, -11.60, -11.62, -11.51, -11.96, -12.00, -11.75, -12.18, -11.77, -12.12, -12.14, -11.87

SUMMARY STATISTICS

| Fleet | Pred.       | SE(q)       | Partial        | Raised         | SLOPE    | SE        | INTRCPT   | SE   |
|-------|-------------|-------------|----------------|----------------|----------|-----------|-----------|------|
| , q   | , F         | , F         | , F            | , Slope        | , Slope  | , Intrcpt | , Intrcpt |      |
| 1     | -11.87      | .245        | .5463          | .5463          | .000E+00 | .000E+00  | -11.865   | .071 |
| Fbar  | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |           |           |      |
| .546  | .245        | 0.000       | .245           | 0.000          |          |           |           |      |

Age 8  
 Fleet, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90  
 1, -11.32, -11.40, -11.37, -11.27, -11.89, -11.65, -11.69, -11.68, -11.69, -11.76, -11.57

SUMMARY STATISTICS

| Fleet | Pred.       | SE(q)       | Partial        | Raised         | SLOPE    | SE        | INTRCPT   | SE   |
|-------|-------------|-------------|----------------|----------------|----------|-----------|-----------|------|
| , q   | , F         | , F         | , F            | , Slope        | , Slope  | , Intrcpt | , Intrcpt |      |
| 1     | -11.57      | .209        | .7325          | .7325          | .000E+00 | .000E+00  | -11.572   | .060 |
| Fbar  | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |           |           |      |
| .732  | .209        | 0.000       | .209           | 0.000          |          |           |           |      |

Age 9  
 Fleet, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90  
 1, -11.66, -11.60, -11.25, -11.68, -11.61, -11.81, -12.03, -11.64, -11.66, -11.53, -11.65

SUMMARY STATISTICS

| Fleet | Pred.       | SE(q)       | Partial        | Raised         | SLOPE    | SE        | INTRCPT   | SE   |
|-------|-------------|-------------|----------------|----------------|----------|-----------|-----------|------|
| , q   | , F         | , F         | , F            | , Slope        | , Slope  | , Intrcpt | , Intrcpt |      |
| 1     | -11.65      | .194        | .6796          | .6796          | .000E+00 | .000E+00  | -11.647   | .056 |
| Fbar  | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |           |           |      |
| .680  | .194        | 0.000       | .194           | 0.000          |          |           |           |      |

Age 10  
 Fleet, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90  
 1, -10.89, -11.98, -11.90, -11.58, -11.60, -10.98, -11.10, -11.91, -12.24, -11.76, -11.59

SUMMARY STATISTICS

| Fleet | Pred.       | SE(q)       | Partial        | Raised         | SLOPE    | SE        | INTRCPT   | SE   |
|-------|-------------|-------------|----------------|----------------|----------|-----------|-----------|------|
| , q   | , F         | , F         | , F            | , Slope        | , Slope  | , Intrcpt | , Intrcpt |      |
| 1     | -11.59      | .456        | .7173          | .7174          | .000E+00 | .000E+00  | -11.593   | .132 |
| Fbar  | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |           |           |      |
| .717  | .456        | 0.000       | .456           | 0.000          |          |           |           |      |

Age 11  
 Fleet, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90  
 1, -11.81, -11.23, -12.99, -12.96, -11.38, -11.09, -10.93, -11.55, -12.13, -11.24, -11.73

SUMMARY STATISTICS

| Fleet | Pred.       | SE(q)       | Partial        | Raised         | SLOPE    | SE        | INTRCPT   | SE   |
|-------|-------------|-------------|----------------|----------------|----------|-----------|-----------|------|
| , q   | , F         | , F         | , F            | , Slope        | , Slope  | , Intrcpt | , Intrcpt |      |
| 1     | -11.73      | .735        | .6241          | .6241          | .000E+00 | .000E+00  | -11.732   | .212 |
| Fbar  | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |           |           |      |
| .624  | .735        | 0.000       | .735           | 0.000          |          |           |           |      |

Age 12  
 Fleet, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90  
 1, -12.16, -10.68, -11.41, -13.20, -11.47, -11.20, -11.37, -11.55, -12.57, -11.75, -11.74

SUMMARY STATISTICS

| Fleet | Pred.       | SE(q)       | Partial        | Raised         | SLOPE    | SE        | INTRCPT   | SE   |
|-------|-------------|-------------|----------------|----------------|----------|-----------|-----------|------|
| , q   | , F         | , F         | , F            | , Slope        | , Slope  | , Intrcpt | , Intrcpt |      |
| 1     | -11.74      | .720        | .6221          | .6221          | .000E+00 | .000E+00  | -11.735   | .208 |
| Fbar  | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |           |           |      |
| .622  | .720        | 0.000       | .720           | 0.000          |          |           |           |      |

**Table 4.7**

Title : Saithe in the Iceland Grounds (Fishing Area Va)  
 At 13.11.33 03 MAY 1991  
 from 80 to 90 on ages 3 to 13  
 with Terminal F of .425 on age 6 and Terminal S of 1.000

Initial sum of squared residuals was 109.646 and  
 final sum of squared residuals is 26.796 after 81 iterations

Matrix of Residuals

| Years | 80/81 | 81/82 | 82/83 | 83/84  | 84/85  | 85/86 | 86/87 | 87/88 | 88/89  | 89/90 | WTS  |       |
|-------|-------|-------|-------|--------|--------|-------|-------|-------|--------|-------|------|-------|
| Ages  |       |       |       |        |        |       |       |       |        |       |      |       |
| 3/ 4  | -.747 | .223  | .292  | -.582  | -1.051 | -.209 | 1.417 | -.342 | .473   | .526  | .000 | .304  |
| 4/ 5  | -.231 | -.005 | .015  | 1.221  | -1.216 | .198  | -.547 | -.219 | .438   | .347  | .000 | .345  |
| 5/ 6  | -.138 | .004  | -.199 | .161   | -.430  | .421  | -.169 | -.034 | .491   | -.107 | .000 | .779  |
| 6/ 7  | .262  | .049  | -.431 | .005   | -.043  | .021  | -.348 | .275  | .444   | -.235 | .000 | .790  |
| 7/ 8  | .140  | -.178 | -.014 | .211   | .450   | .029  | -.257 | -.014 | -.117  | -.251 | .000 | 1.000 |
| 8/ 9  | .247  | -.393 | .081  | .464   | .330   | .026  | -.099 | -.358 | -.167  | -.131 | .000 | .779  |
| 9/10  | .225  | -.062 | .222  | -.006  | .099   | -.816 | -.233 | .239  | .117   | .216  | .000 | .682  |
| 10/11 | .436  | .317  | .449  | -.217  | .032   | .005  | .549  | -.337 | -1.103 | -.132 | .000 | .450  |
| 11/12 | -.974 | -.006 | -.372 | -1.558 | .565   | .312  | .983  | .689  | -.442  | .803  | .000 | .267  |
| 12/13 | -.812 | 1.049 | .370  | -1.618 | .633   | .273  | .564  | .324  | -.933  | .151  | .000 | .265  |
|       | .000  | .000  | .000  | .000   | .000   | .000  | .000  | .000  | .000   | .000  |      | -.001 |
| WTS   | 1.000 | 1.000 | 1.000 | 1.000  | 1.000  | 1.000 | 1.000 | 1.000 | 1.000  | 1.000 |      |       |

Fishing Mortalities (F)

| F-values | 80    | 81    | 82    | 83    | 84    | 85    | 86    | 87    | 88    | 89    | 90 |
|----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|
| F-values | .2643 |       |       |       |       |       |       |       |       |       |    |
| F-values | .2520 | .2626 | .1845 | .2210 | .2952 | .2991 | .3574 | .2932 | .3497 | .4250 |    |

Selection-at-age (S)

| S-values | 3     | 4     | 5      | 6      | 7      | 8      | 9      | 10     | 11     | 12     | 13 |
|----------|-------|-------|--------|--------|--------|--------|--------|--------|--------|--------|----|
| S-values | .0400 |       |        |        |        |        |        |        |        |        |    |
| S-values | .2902 | .6190 | 1.0000 | 1.3197 | 1.7460 | 1.6211 | 1.5658 | 1.2239 | 1.0567 | 1.0000 |    |

**Table 4.8 VPA.**

Saithe in the Iceland Grounds (Fishing Area Va)

FISHING MORTALITY COEFFICIENT      UNIT: Year-1      NATURAL MORTALITY COEFFICIENT = .20

|          | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
|----------|------|------|------|------|------|------|------|------|------|------|------|
| 3        | .005 | .013 | .025 | .001 | .004 | .007 | .048 | .014 | .021 | .019 | .017 |
| 4        | .052 | .070 | .082 | .099 | .022 | .099 | .059 | .102 | .117 | .112 | .097 |
| 5        | .178 | .129 | .156 | .121 | .074 | .208 | .176 | .259 | .228 | .193 | .201 |
| 6        | .317 | .327 | .207 | .218 | .198 | .232 | .218 | .411 | .377 | .265 | .416 |
| 7        | .348 | .313 | .473 | .293 | .361 | .355 | .279 | .464 | .341 | .385 | .499 |
| 8        | .473 | .370 | .525 | .522 | .387 | .401 | .437 | .509 | .507 | .582 | .774 |
| 9        | .394 | .315 | .536 | .333 | .419 | .322 | .320 | .492 | .533 | .702 | .758 |
| 10       | .573 | .268 | .306 | .313 | .405 | .520 | .733 | .397 | .268 | .569 | .739 |
| 11       | .220 | .300 | .136 | .095 | .390 | .438 | .436 | .465 | .320 | .796 | .665 |
| 12       | .177 | .506 | .269 | .104 | .490 | .267 | .289 | .158 | .156 | .542 | .464 |
| 13       | .264 | .356 | .193 | .119 | .704 | .396 | .180 | .168 | .071 | .428 | .651 |
| 14+      | .264 | .356 | .193 | .119 | .704 | .396 | .180 | .168 | .071 | .428 | .651 |
| ( 4- 9)U | .293 | .254 | .330 | .265 | .244 | .270 | .248 | .373 | .350 | .373 | .457 |



Table 4.9 VPA.

Saithe in the Iceland Grounds (Fishing Area Va)

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

|           | 1980   | 1981   | 1982   | 1983   | 1984   | 1985   | 1986   | 1987   | 1988   | 1989   | 1990   | 1991  |
|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| 3         | 31000  | 21240  | 21429  | 30719  | 41891  | 33131  | 72205  | 74584  | 46623  | 21691  | 8052   | 0     |
| 4         | 50568  | 25258  | 17158  | 17106  | 25114  | 34175  | 26948  | 56354  | 60230  | 37394  | 17429  | 6481  |
| 5         | 31333  | 39323  | 19281  | 12946  | 12680  | 20118  | 25339  | 20805  | 41646  | 43863  | 27371  | 12951 |
| 6         | 10307  | 21480  | 28310  | 13510  | 9389   | 9637   | 13381  | 17393  | 13142  | 27150  | 29594  | 18337 |
| 7         | 9022   | 6147   | 12677  | 18842  | 8892   | 6303   | 6254   | 8812   | 9442   | 7378   | 17057  | 15984 |
| 8         | 4686   | 5214   | 3681   | 6470   | 11503  | 5075   | 3617   | 3874   | 4537   | 5499   | 4109   | 8475  |
| 9         | 1623   | 2392   | 2949   | 1782   | 3143   | 6396   | 2782   | 1912   | 1907   | 2236   | 2516   | 1552  |
| 10        | 614    | 896    | 1429   | 1413   | 1046   | 1692   | 3795   | 1653   | 957    | 917    | 908    | 965   |
| 11        | 734    | 284    | 561    | 862    | 846    | 571    | 824    | 1493   | 910    | 599    | 425    | 355   |
| 12        | 693    | 482    | 172    | 401    | 641    | 469    | 302    | 436    | 768    | 541    | 221    | 179   |
| 13        | 279    | 476    | 238    | 108    | 296    | 322    | 294    | 185    | 305    | 538    | 258    | 114   |
| 14+       | 246    | 761    | 702    | 646    | 731    | 1063   | 1042   | 462    | 64     | 97     | 297    | 237   |
| TOTAL NO  | 141106 | 123952 | 108587 | 104804 | 116172 | 118951 | 156783 | 187964 | 180530 | 147904 | 108236 |       |
| SPS NO    | 34031  | 40991  | 46421  | 48228  | 44132  | 40121  | 40767  | 45582  | 33098  | 32799  | 46496  |       |
| TOT. BIOM | 376273 | 359634 | 348612 | 353859 | 374543 | 353008 | 420665 | 452095 | 449136 | 390590 | 341563 |       |
| SPS BIOM  | 155398 | 173181 | 206025 | 215569 | 214020 | 177883 | 196723 | 189767 | 146788 | 147014 | 183776 |       |

Table 4.10

List of input variables for the ICES prediction program.

## ICELANDIC SAITHE

The reference F is the mean F (non-weighted) for the age group range from 4 to 9

The number of recruits per year is as follows:

| Year | Recruitment |
|------|-------------|
| 1991 | 40000.0     |
| 1992 | 40000.0     |
| 1993 | 40000.0     |
| 1994 | 40000.0     |

Data are printed in the following units:

Number of fish: thousands  
 Weight by age group in the catch: kilogram  
 Weight by age group in the stock: kilogram  
 Stock biomass: tonnes  
 Catch weight: tonnes

| age | stock size | fishing pattern | natural mortality | maturity ogive | weight in the catch | weight in the stock |
|-----|------------|-----------------|-------------------|----------------|---------------------|---------------------|
| 3   | 40000.0    | .02             | .20               | .02            | 1.448               | 1.448               |
| 4   | 32133.0    | .12             | .20               | .18            | 1.981               | 1.981               |
| 5   | 12951.0    | .26             | .20               | .36            | 2.376               | 2.376               |
| 6   | 18337.0    | .42             | .20               | .65            | 3.194               | 3.194               |
| 7   | 15984.0    | .55             | .20               | .81            | 4.561               | 4.561               |
| 8   | 8475.0     | .73             | .20               | .89            | 5.889               | 5.889               |
| 9   | 1552.0     | .67             | .20               | .88            | 7.276               | 7.276               |
| 10  | 965.0      | .65             | .20               | .96            | 8.381               | 8.381               |
| 11  | 355.0      | .51             | .20               | .99            | 9.462               | 9.462               |
| 12  | 179.0      | .44             | .20               | 1.00           | 10.329              | 10.329              |
| 13  | 114.0      | .42             | .20               | 1.00           | 12.091              | 12.091              |
| 14+ | 237.0      | .42             | .20               | 1.00           | 12.642              | 12.642              |

Table 4.11 Icelandic saithe.

Effects of different levels of fishing mortality on catch, stock biomass.

| Year 1991   |           |                  |                     |       | Year 1992   |           |                  |                     |       | Year 1993        |                     |
|-------------|-----------|------------------|---------------------|-------|-------------|-----------|------------------|---------------------|-------|------------------|---------------------|
| fac-<br>tor | ref.<br>F | stock<br>biomass | sp.stock<br>biomass | catch | fac-<br>tor | ref.<br>F | stock<br>biomass | sp.stock<br>biomass | catch | stock<br>biomass | sp.stock<br>biomass |
| .9          | .42       | 363              | 192                 | 90    | .4          | .16       | 338              | 167                 | 35    | 373              | 190                 |
|             |           |                  |                     |       | .8          | .37       |                  |                     | 71    | 332              | 157                 |
|             |           |                  |                     |       | .8          | .35       |                  |                     | 68    | 335              | 160                 |
|             |           |                  |                     |       | 1.0         | .46       |                  |                     | 85    | 317              | 145                 |
|             |           |                  |                     |       | 1.2         | .55       |                  |                     | 97    | 303              | 121                 |

The data unit of the biomass and the catch is 1000 tonnes.

The spawning stock biomass is given for 1 January.

The reference F is the mean F (non-weighted) for the age group range from 4 to 9

Table 5.1 Catches of SAITHE, COD, and HADDOCK in Division Vb (Faroes area) in 1981-1990 by fleet category.

| Category                  | 1981          |               |               | 1982          |               |               | 1983          |               |               | 1984          |               |               | 1985          |               |               |
|---------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
|                           | Saithe        | Cod           | Haddock       | Saithe        | Cod           | Haddock       | Saithe        | Cod           | Haddock       | Saithe        | Cod           | Haddock       | Saithe        | Cod           | Haddock       |
| Open boats                | 62            | 3,092         | 511           | 88            | 1,864         | 313           | 8             | 99            | 233           | 75            | 75            | 235           | 94            | 5,960         | 944           |
| Longliners (< 100 GRT)    | 105           | 8,247         | 5,127         | 24            | 6,016         | 2,946         | 19            | 3,975         | 3,319         | 27            | 6,884         | 3,579         | 22            | 8,351         | 4,771         |
| Longliners (>100 GRT)     | 42            | 3,078         | 1,272         | 20            | 1,440         | 902           | 28            | 2,987         | 1,250         | 19            | 2,825         | 1,406         | 44            | 2,562         | 1,547         |
| Trawlers (4-1000 HP)      | 7,373         | 3,023         | 1,836         | 3,760         | 3,807         | 1,729         | 6,981         | 7,967         | 1,272         | 9,820         | 4,908         | 906           | 3,186         | 2,838         | 678           |
| Trawlers (>1000 HP)       | 11,750        | 2,353         | 1,323         | 8,850         | 2,027         | 1,068         | 11,870        | 4,791         | 748           | 17,759        | 4,392         | 886           | 13,963        | 4,300         | 904           |
| Pair trawlers (4-1000 HP) | 4,346         | 837           | 626           | 5,527         | 1,405         | 1,149         | 6,435         | 5,358         | 2,662         | 8,556         | 4,454         | 1,917         | 11,203        | 4,754         | 1,927         |
| Pair trawlers (>1000 HP)  | 4,435         | 522           | 295           | 4,961         | 989           | 774           | 8,450         | 3,550         | 1,198         | 11,259        | 2,131         | 637           | 11,015        | 1,994         | 686           |
| Others                    | 2,567         | 1,464         | 1,004         | 7,578         | 3,839         | 2,991         | 5,172         | 9,189         | 2,183         | 6,829         | 11,085        | 2,777         | 4,664         | 10,250        | 4,359         |
| <b>Total</b>              | <b>29,682</b> | <b>22,616</b> | <b>11,994</b> | <b>30,808</b> | <b>21,387</b> | <b>11,872</b> | <b>38,963</b> | <b>37,916</b> | <b>12,865</b> | <b>54,344</b> | <b>36,914</b> | <b>12,343</b> | <b>44,191</b> | <b>41,009</b> | <b>15,816</b> |

| Category                  | 1986          |               |               | 1987          |               |               | 1988          |               |               | 1989          |               |               | 1990          |               |               |
|---------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
|                           | Saithe        | Cod           | Haddock       | Saithe        | Cod           | Haddock       | Saithe        | Cod           | Haddock       | Saithe        | Cod           | Haddock       | Saithe        | Cod           | Haddock       |
| Open boats                | 110           | 3,203         | 93            | 235           | 2,345         | 1,665         | 29            | 2,745         | 74            | 533           | 1,903         | 898           | 333           | 456           | 186           |
| Longliners (< 100 GRT)    | 62            | 5,113         | 6,170         | 46            | 3,434         | 5,932         | -             | 2,745         | 4,598         | 38            | 6,047         | 7,696         | 122           | 4,735         | 6,644         |
| Longliners (>100 GRT)     | 14            | 1,778         | 1,667         | 31            | 2,359         | 1,611         | -             | 3,080         | 2,018         | 52            | 3,887         | 2,301         | 102           | 2,571         | 1,877         |
| Trawlers (4-1000 HP)      | 1,211         | 2,150         | 350           | 1,536         | 1,580         | 627           | 2,958         | 1,764         | 466           | 2,392         | 1,277         | 436           | 2,248         | 448           | 306           |
| Trawlers (>1000 HP)       | 10,717        | 2,798         | 526           | 7,763         | 1,879         | 284           | 9,118         | 1,558         | 268           | 7,737         | 1,218         | 208           | 11,784        | 516           | 168           |
| Pair trawlers (4-1000 HP) | 11,112        | 9,634         | 2,428         | 9,371         | 6,359         | 2,243         | 9,680         | 6,475         | 1,259         | 10,021        | 2,285         | 837           | 14,538        | 910           | 568           |
| Pair trawlers (>1000 HP)  | 13,791        | 4,595         | 1,264         | 16,689        | 3,334         | 1,264         | 18,172        | 3,674         | 983           | 18,298        | 1,901         | 821           | 26,004        | 1,368         | 875           |
| Others                    | 3,396         | 5,255         | 2,808         | 1,723         | 3,052         | 1,756         | 4,765         | 5,545         | 2,486         | 5,406         | 4,471         | 1,104         | 5,699         | 2,825         | 2,398         |
| <b>Total</b>              | <b>40,413</b> | <b>34,526</b> | <b>15,306</b> | <b>37,394</b> | <b>24,342</b> | <b>15,382</b> | <b>44,722</b> | <b>25,075</b> | <b>12,152</b> | <b>44,477</b> | <b>22,989</b> | <b>14,301</b> | <b>60,830</b> | <b>13,829</b> | <b>13,022</b> |

Table 6.1 Nominal catch (t) of SAITHE in Division Vb, 1979-1990, as reported to ICES.

| Country              | 1979   | 1980   | 1981   | 1982   | 1983   | 1984   |
|----------------------|--------|--------|--------|--------|--------|--------|
| Denmark              | -      | -      | -      | -      | -      | -      |
| Faroe Islands        | 22,003 | 23,810 | 29,682 | 30,808 | 38,963 | 54,344 |
| France               | 2,974  | 1,110  | 258    | 130    | 180    | 243    |
| German Dem.Rep.      | -      | -      | -      | -      | -      | -      |
| Germany, Fed.Rep.    | 581    | 197    | 20     | 19     | 28     | 73     |
| Norway               | 1,137  | 62     | 134    | 15     | 5      | 5      |
| UK (England & Wales) | 190    | 13     | -      | -      | -      | -      |
| UK (Scotland)        | 361    | 38     | 9      | 1      | -      | -      |
| Total                | 27,246 | 25,230 | 30,103 | 30,973 | 39,176 | 54,665 |

| Country              | 1985   | 1986   | 1987   | 1988                | 1989   | 1990 <sup>1</sup> |
|----------------------|--------|--------|--------|---------------------|--------|-------------------|
| Denmark              | -      | 21     | 255    | 94                  | -      | 2                 |
| Faroe Islands        | 42,874 | 40,139 | 39,301 | 44,402 <sup>1</sup> | 43,624 | 59,721            |
| France               | 839    | 87     | 153    | 313                 | -      | -                 |
| German Dem.Rep.      | 31     | -      | -      | -                   | 9      | -                 |
| Germany, Fed.Rep.    | 227    | 105    | 49     | 74                  | 20     | 111               |
| Norway               | -      | 24     | 14     | 52                  | 51     | 46                |
| UK (England & Wales) | 4      | -      | 108    | -                   | -      | -                 |
| UK (Scotland)        | 630    | 1,340  | 140    | 92                  | 9      | 28                |
| Total                | 44,605 | 41,716 | 40,020 | 45,027              | 43,713 | 59,906            |

|                                       |  |  |  |        |                     |                     |
|---------------------------------------|--|--|--|--------|---------------------|---------------------|
| Total used in assessment <sup>2</sup> |  |  |  | 45,347 | 45,039 <sup>3</sup> | 61,642 <sup>3</sup> |
|---------------------------------------|--|--|--|--------|---------------------|---------------------|

<sup>1</sup> Preliminary.

<sup>2</sup> Includes catches from Division IIa in Faroese waters.

<sup>3</sup> Includes France catches from Division Vb.

Table 6.2 SUM OF PRODUCTS CHECK

Saithe in the Faroes Grounds (Fishing Area Vb)  
CATEGORY: TOTAL

| CATCH IN NUMBERS | UNIT: thousands |      |       |       |       |       |       |       |       |       |
|------------------|-----------------|------|-------|-------|-------|-------|-------|-------|-------|-------|
|                  | 1981            | 1982 | 1983  | 1984  | 1985  | 1986  | 1987  | 1988  | 1989  | 1990  |
| 3                | 411             | 387  | 2483  | 368   | 1224  | 1167  | 1581  | 867   | 458   | 294   |
| 4                | 1804            | 4076 | 1103  | 11067 | 3990  | 1997  | 5793  | 2954  | 6068  | 3838  |
| 5                | 769             | 994  | 5052  | 2359  | 5583  | 4473  | 3827  | 9568  | 5377  | 10133 |
| 6                | 932             | 1114 | 1343  | 4093  | 1182  | 3730  | 2785  | 2788  | 7240  | 9231  |
| 7                | 908             | 380  | 575   | 875   | 1898  | 953   | 990   | 1302  | 804   | 5077  |
| 8                | 734             | 417  | 339   | 273   | 273   | 1077  | 532   | 622   | 554   | 478   |
| 9                | 343             | 296  | 273   | 161   | 103   | 245   | 333   | 363   | 187   | 123   |
| 10               | 192             | 105  | 98    | 52    | 38    | 104   | 81    | 159   | 84    | 61    |
| 11               | 92              | 88   | 98    | 65    | 26    | 67    | 43    | 27    | 56    | 60    |
| 12               | 128             | 56   | 99    | 59    | 72    | 33    | 5     | 43    | 10    | 18    |
| 13               | 176             | 49   | 25    | 18    | 41    | 56    | 11    | 15    | 2     | 19    |
| 14               | 310             | 110  | 127   | 25    | 8     | 7     | 15    | 0     | 11    | 9     |
| 15+              | 407             | 687  | 289   | 151   | 154   | 62    | 66    | 0     | 16    | 33    |
| TOTAL            | 7206            | 8759 | 11904 | 19566 | 14592 | 13971 | 16062 | 18708 | 20867 | 29374 |

Table 6.3 SUM OF PRODUCTS CHECK

Saithe in the Faroes Grounds (Fishing Area Vb)  
CATEGORY: TOTAL

| MEAN WEIGHT AT AGE IN THE CATCH | UNIT: kilogram |        |        |        |        |        |        |       |        |       |
|---------------------------------|----------------|--------|--------|--------|--------|--------|--------|-------|--------|-------|
|                                 | 1981           | 1982   | 1983   | 1984   | 1985   | 1986   | 1987   | 1988  | 1989   | 1990  |
| 3                               | 1.310          | 1.337  | 1.208  | 1.431  | 1.401  | 1.718  | 1.609  | 1.500 | 1.309  | 1.223 |
| 4                               | 2.130          | 1.851  | 2.029  | 1.953  | 2.032  | 1.986  | 1.935  | 1.975 | 1.735  | 1.633 |
| 5                               | 3.000          | 2.951  | 2.965  | 2.470  | 2.965  | 2.618  | 2.395  | 1.978 | 1.907  | 1.830 |
| 6                               | 3.810          | 3.577  | 4.143  | 3.850  | 3.596  | 3.277  | 3.182  | 2.937 | 2.373  | 2.052 |
| 7                               | 4.750          | 4.927  | 4.724  | 5.177  | 5.336  | 4.186  | 4.067  | 3.798 | 3.810  | 2.866 |
| 8                               | 5.250          | 6.243  | 5.901  | 6.347  | 7.202  | 5.289  | 5.149  | 4.419 | 4.567  | 4.474 |
| 9                               | 5.950          | 7.232  | 6.811  | 7.825  | 6.966  | 6.050  | 5.501  | 5.115 | 5.509  | 5.424 |
| 10                              | 6.430          | 7.239  | 7.051  | 6.746  | 9.862  | 6.150  | 6.626  | 6.712 | 5.972  | 6.469 |
| 11                              | 7.000          | 8.346  | 7.248  | 8.636  | 10.670 | 9.536  | 6.343  | 8.040 | 6.939  | 6.343 |
| 12                              | 7.470          | 8.345  | 8.292  | 8.467  | 10.461 | 9.823  | 10.245 | 9.364 | 8.543  | 8.418 |
| 13                              | 8.140          | 8.956  | 9.478  | 8.556  | 10.202 | 7.303  | 8.491  | 9.142 | 9.514  | 7.383 |
| 14                              | 8.550          | 9.584  | 10.893 | 11.127 | 9.644  | 11.869 | 11.634 | .000  | 11.730 | 5.822 |
| 15+                             | 10.100         | 10.330 | 10.340 | 10.748 | 13.232 | 12.875 | 10.220 | .000  | 9.627  | 9.408 |

**Table 6.4** Effort (days fishing) and catch-at-age in numbers ('000) for eight Faroese pair trawlers in the category >1000 HP in Division Vb.

| Age/Gear                  | 1982  | 1983  | 1984  | 1985  | 1986  | 1987  | 1988  | 1989  | 1990  |
|---------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1                         | -     | -     | -     | -     | -     | -     | -     | -     | -     |
| 2                         | -     | -     | -     | 6     | 3     | 2     | -     | -     | -     |
| 3                         | -     | 225   | 77    | 93    | 170   | 239   | 129   | 96    | 44    |
| 4                         | 984   | 231   | 1,780 | 518   | 324   | 943   | 539   | 1,096 | 477   |
| 5                         | 275   | 1,052 | 328   | 1,196 | 891   | 798   | 1,706 | 931   | 1,442 |
| 6                         | 516   | 312   | 762   | 249   | 638   | 633   | 599   | 1,178 | 1,395 |
| 7                         | 107   | 116   | 182   | 313   | 177   | 237   | 244   | 133   | 768   |
| 8                         | 47    | 85    | 49    | 41    | 188   | 125   | 102   | 79    | 71    |
| 9                         | 37    | 73    | 19    | 16    | 45    | 65    | 67    | 26    | 19    |
| 10                        | 34    | 15    | 3     | 3     | 17    | 15    | 16    | 15    | 8     |
| 11                        | 14    | 31    | 8     | 6     | 9     | 10    | 2     | 10    | 8     |
| 12                        | 12    | 32    | 17    | 12    | 6     | 1     | 2     | 2     | 3     |
| 13                        | 9     | 2     | 2     | 4     | 16    | 3     | 4     | 0     | 2     |
| 14                        | 17    | 36    | 5     | 1     | 1     | 4     | -     | 2     | 1     |
| 15+                       | 119   | 41    | 23    | 32    | 7     | 11    | -     | 3     | 6     |
| Effort <sup>1</sup>       | 1,805 | 1,792 | 1,714 | 1,224 | 1,341 | 1,762 | 1,705 | 1,473 | 1,820 |
| Catch <sup>1</sup><br>(t) | 6,194 | 6,530 | 8,814 | 6,865 | 6,846 | 7,397 | 7,549 | 6,864 | 8,148 |

<sup>1</sup> Gutted weight.

Table 6.5

DISAGGREGATED Qs  
 LOG TRANSFORMATION  
 NO explanatory variate (Mean used)  
 Fleet 1,CUBATRAWLERS , has terminal q estimated as the mean  
 FLEETS COMBINED BY \*\* VARIANCE \*\*  
 Terminal populations from weighted Separable populations  
 Regression weights  
 , .026, .148, .348, .569, .759, .893, .967, .996, 1.000,  
 Oldest age F = 1.000\*average of 5 younger ages. Fleets combined by variance of predictions  
 Fishing mortalities

| Age, | 82,   | 83,   | 84,   | 85,   | 86,   | 87,   | 88,    | 89,    | 90,   |
|------|-------|-------|-------|-------|-------|-------|--------|--------|-------|
| 3,   | .030, | .072, | .017, | .070, | .022, | .040, | .022,  | .023,  | .033, |
| 4,   | .186, | .112, | .513, | .255, | .155, | .143, | .098,  | .205,  | .269, |
| 5,   | .199, | .370, | .370, | .533, | .505, | .495, | .369,  | .259,  | .619, |
| 6,   | .481, | .451, | .582, | .320, | .847, | .690, | .835,  | .529,  | .953, |
| 7,   | .333, | .494, | .602, | .592, | .463, | .569, | .834,  | .619,  | .902, |
| 8,   | .522, | .561, | .463, | .379, | .816, | .512, | .881,  | 1.120, | .964, |
| 9,   | .410, | .788, | .574, | .317, | .699, | .650, | .809,  | .734,  | .826, |
| 10,  | .202, | .230, | .330, | .254, | .613, | .527, | .761,  | .438,  | .567, |
| 11,  | .357, | .293, | .236, | .273, | .959, | .558, | .333,  | .676,  | .649, |
| 12,  | .574, | .878, | .288, | .443, | .661, | .161, | 2.204, | .197,  | .478, |
| 13,  | .413, | .550, | .378, | .333, | .749, | .481, | .998,  | .633,  | .697, |

F<sub>4-8</sub> = 0.741

Log catchability estimates

| Age 3 | Fleet, | 82,     | 83,     | 84,     | 85,     | 86,     | 87,     | 88,     | 89,     | 90     |
|-------|--------|---------|---------|---------|---------|---------|---------|---------|---------|--------|
| 1,    |        | -18.57, | -12.53, | -13.09, | -12.35, | -12.96, | -12.58, | -13.18, | -12.63, | -12.82 |

| SUMMARY STATISTICS |             |             |                |                |          |          |           |           |  |
|--------------------|-------------|-------------|----------------|----------------|----------|----------|-----------|-----------|--|
| Fleet              | Pred.       | SE(q)       | Partial        | Raised         | SLOPE    | SE       | INTRCPT   | SE        |  |
| , q                | , F         | , F         | , F            | , F            | , Slope  | , Slope  | , Intrcpt | , Intrcpt |  |
| 1                  | -12.82      | .431        | .0049          | .0330          | .000E+00 | .000E+00 | -12.818   | .166      |  |
| Fbar               | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |          |           |           |  |
| .033               | .431        | 0.000       | .431           | 0.000          |          |          |           |           |  |

| Age 4 | Fleet, | 82,     | 83,     | 84,    | 85,     | 86,     | 87,     | 88,     | 89,     | 90     |
|-------|--------|---------|---------|--------|---------|---------|---------|---------|---------|--------|
| 1,    |        | -10.60, | -11.24, | -9.94, | -10.52, | -10.88, | -11.24, | -11.46, | -10.59, | -10.90 |

| SUMMARY STATISTICS |             |             |                |                |          |          |           |           |  |
|--------------------|-------------|-------------|----------------|----------------|----------|----------|-----------|-----------|--|
| Fleet              | Pred.       | SE(q)       | Partial        | Raised         | SLOPE    | SE       | INTRCPT   | SE        |  |
| , q                | , F         | , F         | , F            | , F            | , Slope  | , Slope  | , Intrcpt | , Intrcpt |  |
| 1                  | -10.90      | .369        | .0335          | .2694          | .000E+00 | .000E+00 | -10.903   | .143      |  |
| Fbar               | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |          |           |           |  |
| .269               | .369        | 0.000       | .369           | 0.000          |          |          |           |           |  |

| Age 5 | Fleet, | 82,     | 83,     | 84,     | 85,    | 86,    | 87,    | 88,     | 89,     | 90    |
|-------|--------|---------|---------|---------|--------|--------|--------|---------|---------|-------|
| 1,    |        | -10.40, | -10.06, | -10.42, | -9.28, | -9.50, | -9.75, | -10.16, | -10.40, | -9.94 |

| SUMMARY STATISTICS |             |             |                |                |          |          |           |           |  |
|--------------------|-------------|-------------|----------------|----------------|----------|----------|-----------|-----------|--|
| Fleet              | Pred.       | SE(q)       | Partial        | Raised         | SLOPE    | SE       | INTRCPT   | SE        |  |
| , q                | , F         | , F         | , F            | , F            | , Slope  | , Slope  | , Intrcpt | , Intrcpt |  |
| 1                  | -9.94       | .337        | .0881          | .6189          | .000E+00 | .000E+00 | -9.936    | .130      |  |
| Fbar               | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |          |           |           |  |
| .619               | .337        | 0.000       | .337           | 0.000          |          |          |           |           |  |

| Age 6 | Fleet, | 82,    | 83,    | 84,    | 85,    | 86,    | 87,    | 88,    | 89,    | 90    |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| 1,    |        | -9.00, | -9.75, | -9.67, | -9.81, | -9.13, | -9.33, | -9.16, | -9.75, | -9.44 |

| SUMMARY STATISTICS |             |             |                |                |          |          |           |           |  |
|--------------------|-------------|-------------|----------------|----------------|----------|----------|-----------|-----------|--|
| Fleet              | Pred.       | SE(q)       | Partial        | Raised         | SLOPE    | SE       | INTRCPT   | SE        |  |
| , q                | , F         | , F         | , F            | , F            | , Slope  | , Slope  | , Intrcpt | , Intrcpt |  |
| 1                  | -9.44       | .232        | .1439          | .9525          | .000E+00 | .000E+00 | -9.445    | .090      |  |
| Fbar               | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |          |           |           |  |
| .953               | .232        | 0.000       | .232           | 0.000          |          |          |           |           |  |

| Age 7 | Fleet, | 82,   | 83,    | 84,    | 85,    | 86,    | 87,    | 88,   | 89,    | 90   |
|-------|--------|-------|--------|--------|--------|--------|--------|-------|--------|------|
| 1,    |        | 9.86, | -9.80, | -9.52, | -9.44, | -9.66, | -9.47, | 9.30, | -9.57, | 9.50 |

| SUMMARY STATISTICS |             |             |                |                |          |          |           |           |  |
|--------------------|-------------|-------------|----------------|----------------|----------|----------|-----------|-----------|--|
| Fleet              | Pred.       | SE(q)       | Partial        | Raised         | SLOPE    | SE       | INTRCPT   | SE        |  |
| , q                | , F         | , F         | , F            | , F            | , Slope  | , Slope  | , Intrcpt | , Intrcpt |  |
| 1                  | -9.50       | .111        | .1364          | .9019          | .000E+00 | .000E+00 | 9.499     | .043      |  |
| Fbar               | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |          |           |           |  |
| .902               | .111        | 0.000       | .111           | 0.000          |          |          |           |           |  |

cont'd.

Table 6.5 cont'd.

| Age 8  |         |        |        |        |        |        |        |        |       |
|--------|---------|--------|--------|--------|--------|--------|--------|--------|-------|
| Fleet, | 82,     | 83,    | 84,    | 85,    | 86,    | 87,    | 88,    | 89,    | 90    |
| 1,     | -10.33, | -9.45, | -9.93, | -9.98, | -9.15, | -9.59, | -9.38, | -9.13, | -9.45 |

| SUMMARY STATISTICS |             |             |                |                |          |          |           |           |
|--------------------|-------------|-------------|----------------|----------------|----------|----------|-----------|-----------|
| Fleet              | Pred.       | SE(q)       | Partial        | Raised         | SLOPE    | SE       | INTRCPT   | SE        |
| , q                | , F         | , F         | , F            | , F            | , Slope  | , Slope  | , Intrcpt | , Intrcpt |
| 1                  | -9.45       | .258        | .1432          | .9642          | .000E+00 | .000E+00 | -9.450    | .100      |
| Fbar               | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |          |           |           |
| .964               | .258        | 0.000       | .258           | 0.000          |          |          |           |           |

| Age 9  |         |        |         |         |        |        |        |        |       |
|--------|---------|--------|---------|---------|--------|--------|--------|--------|-------|
| Fleet, | 82,     | 83,    | 84,     | 85,     | 86,    | 87,    | 88,    | 89,    | 90    |
| 1,     | -10.47, | -9.05, | -10.14, | -10.12, | -9.25, | -9.54, | -9.34, | -9.58, | -9.57 |

| SUMMARY STATISTICS |             |             |                |                |          |          |           |           |
|--------------------|-------------|-------------|----------------|----------------|----------|----------|-----------|-----------|
| Fleet              | Pred.       | SE(q)       | Partial        | Raised         | SLOPE    | SE       | INTRCPT   | SE        |
| , q                | , F         | , F         | , F            | , F            | , Slope  | , Slope  | , Intrcpt | , Intrcpt |
| 1                  | -9.57       | .264        | .1276          | .8262          | .000E+00 | .000E+00 | -9.565    | .102      |
| Fbar               | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |          |           |           |
| .826               | .264        | 0.000       | .264           | 0.000          |          |          |           |           |

| Age 10 |         |         |         |         |        |        |         |        |        |
|--------|---------|---------|---------|---------|--------|--------|---------|--------|--------|
| Fleet, | 82,     | 83,     | 84,     | 85,     | 86,    | 87,    | 88,     | 89,    | 90     |
| 1,     | -10.23, | -10.84, | -11.41, | -11.02, | -9.50, | -9.80, | -10.01, | -9.84, | -10.11 |

| SUMMARY STATISTICS |             |             |                |                |          |          |           |           |
|--------------------|-------------|-------------|----------------|----------------|----------|----------|-----------|-----------|
| Fleet              | Pred.       | SE(q)       | Partial        | Raised         | SLOPE    | SE       | INTRCPT   | SE        |
| , q                | , F         | , F         | , F            | , F            | , Slope  | , Slope  | , Intrcpt | , Intrcpt |
| 1                  | -10.11      | .482        | .0743          | .5665          | .000E+00 | .000E+00 | -10.106   | .186      |
| Fbar               | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |          |           |           |
| .567               | .482        | 0.000       | .482           | 0.000          |          |          |           |           |

| Age 11 |         |        |         |        |        |        |         |        |       |
|--------|---------|--------|---------|--------|--------|--------|---------|--------|-------|
| Fleet, | 82,     | 83,    | 84,     | 85,    | 86,    | 87,    | 88,     | 89,    | 90    |
| 1,     | -10.37, | -9.87, | -10.99, | -9.87, | -9.25, | -9.52, | -11.14, | -9.41, | -9.95 |

| SUMMARY STATISTICS |             |             |                |                |          |          |           |           |
|--------------------|-------------|-------------|----------------|----------------|----------|----------|-----------|-----------|
| Fleet              | Pred.       | SE(q)       | Partial        | Raised         | SLOPE    | SE       | INTRCPT   | SE        |
| , q                | , F         | , F         | , F            | , F            | , Slope  | , Slope  | , Intrcpt | , Intrcpt |
| 1                  | -9.95       | .617        | .0865          | .6491          | .000E+00 | .000E+00 | -9.954    | .238      |
| Fbar               | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |          |           |           |
| .649               | .617        | 0.000       | .617           | 0.000          |          |          |           |           |

| Age 12 |        |        |        |        |        |         |        |        |        |
|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|
| Fleet, | 82,    | 83,    | 84,    | 85,    | 86,    | 87,     | 88,    | 89,    | 90     |
| 1,     | -9.59, | -8.75, | -9.93, | -9.72, | -9.32, | -10.91, | -9.72, | 10.53, | -10.04 |

| SUMMARY STATISTICS |             |             |                |                |          |          |           |           |
|--------------------|-------------|-------------|----------------|----------------|----------|----------|-----------|-----------|
| Fleet              | Pred.       | SE(q)       | Partial        | Raised         | SLOPE    | SE       | INTRCPT   | SE        |
| , q                | , F         | , F         | , F            | , F            | , Slope  | , Slope  | , Intrcpt | , Intrcpt |
| 1                  | -10.04      | .503        | .0797          | .4782          | .000E+00 | .000E+00 | -10.036   | .194      |
| Fbar               | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |          |           |           |
| .478               | .503        | 0.000       | .503           | 0.000          |          |          |           |           |



Table 6.6

Title : Saithe in the Faroes Grounds (Fishing Area Vb)  
 At 15.39.09 07 MAY 1991  
 from 81 to 90 on ages 3 to 13  
 with Terminal F of .545 on age 5 and Terminal S of 1.000

Initial sum of squared residuals was 95.612 and  
 final sum of squared residuals is 31.280 after 61 iterations

Matrix of Residuals

| Years | 81/82  | 82/83 | 83/84 | 84/85  | 85/86 | 86/87 | 87/88  | 88/89 | 89/90  |        | WTS   |
|-------|--------|-------|-------|--------|-------|-------|--------|-------|--------|--------|-------|
| Ages  |        |       |       |        |       |       |        |       |        |        |       |
| 3/ 4  | -1.148 | .432  | -.213 | -1.325 | 1.212 | -.542 | .834   | -.917 | -.585  | .000   | .226  |
| 4/ 5  | .916   | .428  | -.330 | .909   | .721  | -.468 | .070   | -.452 | .126   | .000   | .361  |
| 5/ 6  | -.648  | -.259 | .016  | .303   | .610  | -.011 | .226   | -.249 | -.576  | .000   | .491  |
| 6/ 7  | .046   | .145  | -.346 | -.205  | -.135 | .226  | .083   | .093  | -.267  | .000   | 1.000 |
| 7/ 8  | .121   | -.217 | .158  | .386   | .392  | -.326 | -.034  | -.104 | .072   | .000   | .817  |
| 8/ 9  | -.023  | -.172 | -.116 | -.083  | -.326 | -.025 | -.388  | -.048 | .787   | .000   | .599  |
| 9/10  | .216   | .477  | .772  | .353   | -.463 | -.103 | -.040  | .204  | .400   | .000   | .556  |
| 10/11 | .132   | -.249 | -.155 | -.072  | -.715 | .012  | .641   | .127  | -.065  | .000   | .562  |
| 11/12 | -.509  | -.780 | -.405 | -1.225 | -.714 | 1.373 | -.790  | -.276 | .409   | .000   | .260  |
| 12/13 | .297   | .479  | 1.142 | -.409  | .113  | .249  | -1.532 | 2.177 | -1.009 | .000   | .184  |
|       | .000   | .000  | .000  | .000   | .000  | .000  | .000   | .000  | .000   | -1.162 |       |
| WTS   | .001   | .001  | .001  | .001   | 1.000 | 1.000 | 1.000  | 1.000 | 1.000  |        |       |

Fishing Mortalities (F)

| F-values | 81    | 82    | 83    | 84    | 85    | 86    | 87    | 88    | 89    | 90    |
|----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|          | .3276 | .2881 | .3580 | .3668 | .2968 | .4710 | .3906 | .4909 | .3955 | .5450 |

Selection-at-age (S)

| S-values | 3     | 4     | 5      | 6      | 7      | 8      | 9      | 10     | 11     | 12     | 13     |
|----------|-------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
|          | .0902 | .4243 | 1.0000 | 1.5382 | 1.4543 | 1.6954 | 1.5389 | 1.2620 | 1.3747 | 1.0215 | 1.0000 |

Table 6.7 From separable VPA

Saithe in the Faroes Grounds (Fishing Area Vb)

| FISHING MORTALITY COEFFICIENT | UNIT: Year-1 |      |      |      |      |      |      |       |      |       | NATURAL MORTALITY COEFFICIENT = .20 |
|-------------------------------|--------------|------|------|------|------|------|------|-------|------|-------|-------------------------------------|
|                               | 1981         | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988  | 1989 | 1990  |                                     |
| 3                             | .014         | .030 | .072 | .017 | .069 | .022 | .041 | .021  | .024 | .049  |                                     |
| 4                             | .239         | .186 | .113 | .512 | .251 | .153 | .144 | .101  | .202 | .289  |                                     |
| 5                             | .193         | .201 | .368 | .374 | .531 | .494 | .486 | .374  | .270 | .606  |                                     |
| 6                             | .446         | .470 | .455 | .579 | .326 | .842 | .662 | .806  | .542 | 1.028 |                                     |
| 7                             | .540         | .329 | .476 | .612 | .586 | .475 | .562 | .767  | .576 | .948  |                                     |
| 8                             | .476         | .515 | .549 | .436 | .390 | .801 | .535 | .860  | .911 | .829  |                                     |
| 9                             | .383         | .358 | .767 | .553 | .291 | .733 | .625 | .882  | .696 | .521  |                                     |
| 10                            | .385         | .192 | .192 | .315 | .241 | .536 | .577 | .704  | .516 | .514  |                                     |
| 11                            | .373         | .305 | .276 | .188 | .257 | .867 | .445 | .384  | .581 | .879  |                                     |
| 12                            | .386         | .410 | .669 | .267 | .327 | .601 | .136 | 1.130 | .238 | .371  |                                     |
| 13                            | .327         | .250 | .324 | .240 | .300 | .456 | .411 | .753  | .129 | .960  |                                     |
| 14+                           | .327         | .250 | .324 | .240 | .300 | .456 | .411 | .753  | .129 | .960  |                                     |
| ( 4 - 8)U                     | .379         | .340 | .392 | .503 | .417 | .553 | .478 | .582  | .500 | .740  |                                     |

Table 6.8 VIRTUAL POPULATION ANALYSIS

Saithe in the Faroes Grounds (Fishing Area Vb)

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

|           | 1981   | 1982   | 1983   | 1984   | 1985   | 1986   | 1987   | 1988   | 1989   | 1990   | 1991  |
|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| 3         | 32747  | 14272  | 39628  | 24496  | 20279  | 59195  | 42949  | 45448  | 21038  | 6756   | 0     |
| 4         | 9316   | 26439  | 11335  | 30204  | 19723  | 15498  | 47411  | 33737  | 36426  | 16811  | 5266  |
| 5         | 4816   | 6004   | 17976  | 8286   | 14816  | 12559  | 10890  | 33597  | 24957  | 24360  | 10313 |
| 6         | 2838   | 3250   | 4021   | 10182  | 4666   | 7131   | 6275   | 5486   | 18917  | 15598  | 10882 |
| 7         | 2378   | 1488   | 1663   | 2088   | 4674   | 2758   | 2515   | 2649   | 2006   | 9006   | 4570  |
| 8         | 2122   | 1134   | 877    | 846    | 927    | 2129   | 1404   | 1173   | 1007   | 923    | 2858  |
| 9         | 1182   | 1079   | 555    | 415    | 448    | 514    | 783    | 673    | 407    | 332    | 330   |
| 10        | 659    | 660    | 618    | 211    | 195    | 274    | 202    | 343    | 228    | 166    | 161   |
| 11        | 324    | 367    | 446    | 418    | 126    | 126    | 131    | 93     | 139    | 112    | 81    |
| 12        | 438    | 182    | 221    | 277    | 283    | 80     | 43     | 69     | 52     | 64     | 38    |
| 13        | 693    | 244    | 99     | 93     | 174    | 167    | 36     | 31     | 18     | 33     | 36    |
| 14+       | 2822   | 3964   | 1649   | 907    | 686    | 206    | 264    | 0      | 246    | 74     | 34    |
| TOTAL NO  | 60333  | 59084  | 79087  | 78421  | 66997  | 100638 | 112903 | 123298 | 105442 | 74235  |       |
| SPS NO    | 18271  | 18373  | 28124  | 23722  | 26995  | 25944  | 22542  | 44114  | 47978  | 50668  |       |
| TOT. BIOM | 157009 | 169119 | 185960 | 191393 | 178550 | 221978 | 229902 | 240036 | 203534 | 147037 |       |
| SPS BIOM  | 94269  | 101098 | 115091 | 97351  | 110062 | 89501  | 73797  | 105234 | 112795 | 111322 |       |

Table 6.9

List of input variables for the ICES prediction program.

FAROE SAI THE

The reference F is the mean F (non-weighted) for the age group range from 4 to 8

The number of recruits per year is as follows:

| Year | Recruitment |
|------|-------------|
| 1991 | 22000.0     |
| 1992 | 22000.0     |
| 1993 | 22000.0     |
| 1994 | 22000.0     |

Data are printed in the following units:

Number of fish: thousands  
 Weight by age group in the catch: kilogram  
 Weight by age group in the stock: kilogram  
 Stock biomass: tonnes  
 Catch weight: tonnes

| age | stock size | fishing pattern | natural mortality | maturity ogive | weight in the catch | weight in the stock |
|-----|------------|-----------------|-------------------|----------------|---------------------|---------------------|
| 3   | 22000.0    | .05             | .20               | .00            | 1.344               | 1.344               |
| 4   | 17150.0    | .26             | .20               | .00            | 1.781               | 1.781               |
| 5   | 10313.0    | .61             | .20               | 1.00           | 1.905               | 1.905               |
| 6   | 10882.0    | .93             | .20               | 1.00           | 2.454               | 2.454               |
| 7   | 4570.0     | .88             | .20               | 1.00           | 3.491               | 3.491               |
| 8   | 2858.0     | 1.03            | .20               | 1.00           | 4.487               | 4.487               |
| 9   | 330.0      | .93             | .20               | 1.00           | 5.349               | 5.349               |
| 10  | 161.0      | .76             | .20               | 1.00           | 6.384               | 6.384               |
| 11  | 81.0       | .83             | .20               | 1.00           | 7.107               | 7.107               |
| 12  | 38.0       | .62             | .20               | 1.00           | 8.775               | 8.775               |
| 13  | 36.0       | .61             | .20               | 1.00           | 8.680               | 8.680               |
| 14+ | 34.0       | .61             | .20               | 1.00           | 8.776               | 8.776               |

Table 6.10

Effects of different levels of fishing mortality on catch, stock biomass and spawning stock biomass.

## FAROE SAITHE

| Year 1991   |           |                  |                     |       | Year 1992   |           |                  |                     |       | Year 1993        |                     |  |
|-------------|-----------|------------------|---------------------|-------|-------------|-----------|------------------|---------------------|-------|------------------|---------------------|--|
| fac-<br>tor | ref.<br>F | stock<br>biomass | sp.stock<br>biomass | catch | fac-<br>tor | ref.<br>F | stock<br>biomass | sp.stock<br>biomass | catch | stock<br>biomass | sp.stock<br>biomass |  |
| 1.0         | .74       | 140              | 79                  | 49    | 1.2         | .89       | 117              | 58                  | 11    | 136              | 75                  |  |
|             |           |                  |                     |       | .8          | .59       |                  |                     | 31    | 114              | 54                  |  |
|             |           |                  |                     |       | 1.0         | .74       |                  |                     | 37    | 108              | 48                  |  |
|             |           |                  |                     |       | 1.2         | .89       |                  |                     | 42    | 103              | 43                  |  |

The data unit of the biomass and the catch is 1000 tonnes.

The spawning stock biomass is given for 1 January.

The reference F is the mean F (non-weighted) for the age group range from 4 to 8

**Table 7.1** Faroe Plateau COD in Division Vb1.

Nominal catches (t) by countries, 1980-1990, as officially reported to ICES.

| Year              | Faroe Islands | France          | Germany, Fed.Rep. | Norway            | Poland | UK England | UK Scotland    | Denmark         | Others | Total  |
|-------------------|---------------|-----------------|-------------------|-------------------|--------|------------|----------------|-----------------|--------|--------|
| 1980              | 19,966        | 40 <sup>1</sup> | - <sup>3</sup>    | 127               | -      | 13         | 367            | -               | -      | 20,513 |
| 1981              | 22,616        | 47              | - <sup>3</sup>    | 240               | -      | -          | 60             | -               | -      | 22,963 |
| 1982              | 21,387        | 10              | -                 | 90                | -      | -          | 2              | -               | -      | 21,489 |
| 1983              | 37,916        | 13              | 128               | 76                | -      | -          | - <sup>4</sup> | -               | -      | 38,133 |
| 1984              | 36,914        | 34              | 9                 | 22                | -      | -          | - <sup>4</sup> | -               | -      | 36,979 |
| 1985              | 39,422        | 29              | 5                 | 28                | -      | -          | - <sup>4</sup> | -               | -      | 39,484 |
| 1986              | 34,492        | 4               | 8                 | 83                | -      | -          | - <sup>4</sup> | 8               | -      | 34,595 |
| 1987              | 21,303        | 17              | 12                | 21                | -      | 8          | - <sup>4</sup> | 30              | -      | 21,391 |
| 1988              | 22,272        | 17              | 5                 | 163               | -      | -          | - <sup>4</sup> | 10 <sup>1</sup> | -      | 22,467 |
| 1989 <sup>2</sup> | 20,535        | -               | 7                 | 285 <sup>12</sup> | -      | -          | -              | -               | -      | 20,827 |
| 1990 <sup>2</sup> | 10,735        | -               | 23                | 196               | -      | -          | - <sup>4</sup> | -               | -      | 10,954 |

Total used in the assessment<sup>5</sup>:

|      |                     |
|------|---------------------|
| 1988 | 23,182              |
| 1989 | 23,293 <sup>6</sup> |
| 1990 | 14,065 <sup>6</sup> |

<sup>1</sup> Sub-division Vb2 included.<sup>2</sup> Preliminary.<sup>3</sup> Working Group Data.<sup>4</sup> Included in Sub-division Vb2.<sup>5</sup> Includes catches from Division IIa in Faroese waters.<sup>6</sup> Includes French catches from Division Vb.**Table 7.2** Faroe Bank COD in Division Vb2.

Nominal catches (t) by countries, 1980-1990, as reported to ICES.

| Year              | Faroe Islands | France         | Germany, Fed.Rep. | Norway         | UK England | UK Scotland     | Denmark | Others | Total |
|-------------------|---------------|----------------|-------------------|----------------|------------|-----------------|---------|--------|-------|
| 1980              | 724           | - <sup>1</sup> | -                 | 54             | 85         | 340             | -       | -      | 1,203 |
| 1981              | 975           | -              | -                 | 120            | -          | 134             | -       | -      | 1,229 |
| 1982              | 2,184         | -              | -                 | 16             | -          | 152             | -       | -      | 2,352 |
| 1983              | 2,284         | -              | -                 | 17             | -          | 66 <sup>3</sup> | -       | -      | 2,367 |
| 1984              | 2,189         | -              | -                 | 11             | -          | 16 <sup>3</sup> | -       | -      | 2,216 |
| 1985              | 2,913         | -              | -                 | 23             | -          | 25 <sup>3</sup> | -       | -      | 2,961 |
| 1986              | 1,836         | -              | -                 | 6              | -          | 63 <sup>3</sup> | -       | -      | 1,905 |
| 1987              | 3,409         | -              | -                 | 23             | -          | 47 <sup>3</sup> | -       | -      | 3,479 |
| 1988              | 2,966         | -              | -                 | 94             | -          | 37 <sup>3</sup> | -       | -      | 3,097 |
| 1989 <sup>2</sup> | 1,270         | -              | -                 | 128            | -          | 14 <sup>3</sup> | -       | -      | 1,412 |
| 1990 <sup>2</sup> | 498           | -              | -                 | - <sup>1</sup> | -          | 175             | -       | -      | 673   |

<sup>1</sup> Catches included in Sub-division Vb1.<sup>2</sup> Preliminary.<sup>3</sup> Catches including Sub-division Vb1.

Table 7.3 VPA.

Cod in the Faroe Plateau (Fishing Area Vb1)

| CATCH IN NUMBERS | UNIT: thousands |       |       |       |       |       |       |       |       |       |
|------------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                  | 1981            | 1982  | 1983  | 1984  | 1985  | 1986  | 1987  | 1988  | 1989  | 1990  |
| 1                | 16              | 5     | 80    | 37    | 0     | 0     | 11    | 0     | 0     | 0     |
| 2                | 646             | 1139  | 2149  | 4396  | 998   | 210   | 257   | 509   | 2361  | 253   |
| 3                | 4137            | 1965  | 5771  | 5234  | 9484  | 3586  | 1362  | 2122  | 2270  | 2971  |
| 4                | 1981            | 3073  | 2760  | 3487  | 3795  | 8462  | 2611  | 1945  | 2308  | 1544  |
| 5                | 947             | 1286  | 2746  | 1461  | 1669  | 2373  | 3083  | 1484  | 1183  | 888   |
| 6                | 582             | 471   | 1204  | 912   | 770   | 907   | 812   | 2178  | 1083  | 421   |
| 7                | 487             | 314   | 510   | 314   | 872   | 236   | 224   | 492   | 1052  | 307   |
| 8                | 527             | 169   | 157   | 82    | 309   | 147   | 68    | 168   | 232   | 303   |
| 9                | 123             | 254   | 104   | 34    | 65    | 47    | 69    | 33    | 64    | 52    |
| 10+              | 55              | 122   | 102   | 66    | 80    | 38    | 26    | 25    | 10    | 27    |
| TOTAL            | 9501            | 8798  | 15583 | 16023 | 18042 | 16006 | 8523  | 8956  | 10563 | 6766  |
| A) SOP           | 22075           | 21485 | 39389 | 38209 | 41603 | 35990 | 22190 | 23040 | 23832 | 14205 |
| B)NOMIN.         | 22963           | 21489 | 38133 | 36979 | 39484 | 34595 | 21391 | 23182 | 23293 | 14065 |
| (B/A) %          | 104             | 100   | 97    | 97    | 95    | 96    | 96    | 101   | 98    | 99    |

Table 7.4 VPA.

Cod in the Faroe Plateau (Fishing Area Vb1)

| MEAN WEIGHT AT AGE OF THE STOCK | UNIT: kilogram |       |       |        |        |       |       |       |       |       |
|---------------------------------|----------------|-------|-------|--------|--------|-------|-------|-------|-------|-------|
|                                 | 1981           | 1982  | 1983  | 1984   | 1985   | 1986  | 1987  | 1988  | 1989  | 1990  |
| 1                               | .750           | .715  | .690  | .743   | .743   | .743  | .489  | .000  | .000  | .000  |
| 2                               | 1.080          | 1.280 | 1.338 | 1.195  | .905   | 1.099 | 1.093 | 1.061 | 1.010 | .945  |
| 3                               | 1.470          | 1.413 | 1.950 | 1.888  | 1.658  | 1.459 | 1.517 | 1.749 | 1.597 | 1.300 |
| 4                               | 2.180          | 2.138 | 2.403 | 2.980  | 2.626  | 2.046 | 2.160 | 2.300 | 2.201 | 1.959 |
| 5                               | 3.210          | 3.107 | 3.107 | 3.679  | 3.400  | 2.936 | 2.766 | 2.914 | 2.934 | 2.531 |
| 6                               | 3.700          | 4.012 | 4.110 | 4.470  | 3.752  | 3.786 | 3.908 | 3.109 | 3.468 | 3.273 |
| 7                               | 4.240          | 5.442 | 5.020 | 5.488  | 4.220  | 4.899 | 5.461 | 3.976 | 3.750 | 4.652 |
| 8                               | 4.430          | 5.563 | 5.601 | 6.466  | 4.739  | 5.893 | 6.341 | 4.896 | 4.682 | 4.758 |
| 9                               | 6.690          | 5.216 | 8.013 | 6.628  | 6.511  | 9.699 | 8.509 | 7.087 | 6.140 | 6.704 |
| 10+                             | 10.000         | 6.707 | 8.031 | 10.981 | 10.981 | 8.815 | 9.811 | 8.287 | 9.156 | 8.689 |

**Table 7.5** Stratified mean catch by age in number per trawl hour of COD in the Faroese groundfish surveys, 1982-1991.

| Age | 1982 | 1983 | 1984 | 1985  | 1986  | 1987  | 1988 | 1989 | 1990 | 1991 |
|-----|------|------|------|-------|-------|-------|------|------|------|------|
| 1   | -    | 0.9  | 0.9  | -     | -     | -     | 0.1  | 0.0  | 0.0  | 0.0  |
| 2   | 5.9  | 12.6 | 24.5 | 9.7   | 3.1   | 2.9   | 5.5  | 13.5 | 0.0  | 7.0  |
| 3   | 10.5 | 71.6 | 46.4 | 108.4 | 72.3  | 44.7  | 63.5 | 14.3 | 27.6 | 10.9 |
| 4   | 55.2 | 48.2 | 33.9 | 46.5  | 262.8 | 89.3  | 82.3 | 28.2 | 41.3 | 49.2 |
| 5   | 42.2 | 45.3 | 12.3 | 17.1  | 69.2  | 132.7 | 60.0 | 26.0 | 37.4 | 13.7 |
| 6   | 17.6 | 15.5 | 8.1  | 3.6   | 25.1  | 22.8  | 61.5 | 14.4 | 12.9 | 7.8  |
| 7   | 6.5  | 4.2  | 3.4  | 3.9   | 12.1  | 2.9   | 11.8 | 22.7 | 18.3 | 2.1  |
| 8   | 7.6  | 1.3  | 0.3  | 1.6   | 5.5   | 2.4   | 1.8  | 3.3  | 12.9 | 0.2  |
| 9   | 2.8  | 0.6  | -    | 0.2   | 0.8   | 0.4   | 0.7  | 0.2  | 1.3  | 1.9  |
| 10  | -    | 1.8  | 0.4  | 0.2   | -     | 0.5   | 0.6  | 0.3  | 0.2  | 0.2  |

**Table 7.6.A** Catch and effort data by age of Cod in Sub-division Vb1 1985-1990 from longliners <100 GRT for the spring season. Numbers measured in 1000 and effort in million hooks.

| Age    | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
|--------|------|------|------|------|------|------|
| 2      | 12   | 0    | 0    | 0    | 6    | 0    |
| 3      | 358  | 59   | 20   | 62   | 91   | 107  |
| 4      | 78   | 198  | 73   | 34   | 97   | 74   |
| 5      | 34   | 74   | 106  | 26   | 44   | 55   |
| 6      | 16   | 37   | 29   | 49   | 29   | 11   |
| 7      | 25   | 9    | 6    | 11   | 29   | 11   |
| 8      | 10   | 6    | 2    | 3    | 6    | 13   |
| 9      | 2    | 1    | 2    | 0    | 1    | 3    |
| Effort | 6.3  | 7.0  | 6.7  | 5.6  | 6.0  | 5.6  |

**Table 7.6.B** Catch and effort data by age of Cod in Subdivision Vb1 1985-1990 from longliners <100 GRT in the autumn season. Numbers measured in 1000 and effort in million hooks.

| Age    | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
|--------|------|------|------|------|------|------|
| 2      | 109  | 26   | 54   | 93   | 213  | 36   |
| 3      | 269  | 97   | 37   | 90   | 104  | 106  |
| 4      | 94   | 67   | 26   | 30   | 50   | 19   |
| 5      | 43   | 16   | 22   | 20   | 23   | 5    |
| 6      | 16   | 4    | 6    | 24   | 22   | 6    |
| 7      | 20   | 1    | 1    | 6    | 16   | 3    |
| 8      | 3    | 0    | 0    | 3    | 1    | 2    |
| 9      | 1    | 0    | 0    | 1    | 0    | -    |
| Effort | 6.9  | 4.8  | 6.3  | 5.9  | 8.2  | 5.1  |

Table 7.7

DISAGGREGATED Qs  
 LOG TRANSFORMATION  
 NU explanatory variate (mean used)  
 Fleet 1 ,Magnus Heinasson , has terminal q estimated as the mean  
 Fleet 2 ,LONGLINERS, SPRING , has terminal q estimated as the mean  
 Fleet 3 ,LONGLINERS, AUTUM , has terminal q estimated as the mean  
 FLEETS COMBINED BY \*\* VARIANCE \*\*

Regression weights  
 , 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000,  
 Oldest age F = 1.000 average of 5 younger ages. Fleets combined by variance of predictions.  
 Fishing mortalities

| Age, | 82,   | 83,    | 84,   | 85,    | 86,   | 87,   | 88,   | 89,   | 90,    |
|------|-------|--------|-------|--------|-------|-------|-------|-------|--------|
| 2,   | .059, | .098,  | .103, | .061,  | .022, | .020, | .042, | .117, | 2.120, |
| 3,   | .223, | .463,  | .364, | .335,  | .322, | .195, | .229, | .264, | .212,  |
| 4,   | .360, | .556,  | .569, | .491,  | .565, | .412, | .468, | .417, | .289,  |
| 5,   | .389, | .635,  | .654, | .594,  | .659, | .414, | .436, | .583, | .279,  |
| 6,   | .405, | .779,  | .448, | .896,  | .769, | .496, | .902, | .865, | .423,  |
| 7,   | .690, | 1.062, | .474, | 1.059, | .784, | .432, | .642, | .626, | .399,  |
| 8,   | .548, | .928,  | .470, | 1.270, | .496, | .545, | .660, | .730, | .367,  |
| 9,   | .479, | .792,  | .523, | .862,  | .655, | .460, | .562, | .604, | .351,  |

F<sub>3-7</sub> = 0.32

Log catchability estimates

| Age 2  |         |         |         |         |         |         |         |        |        |
|--------|---------|---------|---------|---------|---------|---------|---------|--------|--------|
| Fleet, | 82,     | 83,     | 84,     | 85,     | 86,     | 87,     | 88,     | 89,    | 90     |
| 1,     | -12.71, | -12.07, | -12.07, | -12.03, | 12.63,  | 12.99,  | -12.31, | 11.91, | -12.61 |
| 2,     | ,       | ,       | ,       | -9.06,  | -12.71, | -12.96, | 12.74,  | -9.91, | -8.11  |
| 3,     | ,       | ,       | ,       | -6.94,  | -7.47,  | 7.30,   | -6.65,  | -6.65, | 2.83   |

SUMMARY STATISTICS

| Fleet | Pred.       | SE(q)       | Partial        | Raised         | SLOPE    | SE       | INTRCPT | SC      |
|-------|-------------|-------------|----------------|----------------|----------|----------|---------|---------|
| ,     | q           | ,           | F              | F              | ,        | Slope    | ,       | Intrcpt |
| 1     | -12.37      | .397        | .0004          | 2.6865         | .000E+00 | .000E+00 | -12.369 | .126    |
| 2     | -10.92      | 2.320       | .0001          | .1288          | .000E+00 | .000E+00 | -10.915 | .877    |
| 3     | -6.31       | 1.876       | .0093          | .0654          | .000E+00 | .000E+00 | -6.306  | .709    |
| Fbar  | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |          |         |         |
| 2.118 | .383        | .621        | .621           | 2.627          |          |          |         |         |

| Age 3  |         |        |         |         |        |        |        |         |        |
|--------|---------|--------|---------|---------|--------|--------|--------|---------|--------|
| Fleet, | 82,     | 83,    | 84,     | 85,     | 86,    | 87,    | 88,    | 89,     | 90     |
| 1,     | -11.34, | -9.76, | -10.34, | -10.17, | -9.64, | -9.66, | -9.59, | -11.00, | -10.83 |
| 2,     | ,       | ,      | ,       | -6.21,  | -7.19, | -7.76, | -6.73, | -6.34,  | -6.60  |
| 3,     | ,       | ,      | ,       | -6.59,  | -6.31, | -7.08, | -6.41, | -6.52,  | -6.51  |

SUMMARY STATISTICS

| Fleet | Pred.       | SE(q)       | Partial        | Raised         | SLOPE    | SE       | INTRCPT | SC      |
|-------|-------------|-------------|----------------|----------------|----------|----------|---------|---------|
| ,     | q           | ,           | F              | F              | ,        | Slope    | ,       | Intrcpt |
| 1     | -10.26      | .697        | .0035          | .3768          | .000E+00 | .000E+00 | -10.260 | .220    |
| 2     | -6.80       | .625        | .0062          | .1726          | .000E+00 | .000E+00 | -6.804  | .236    |
| 3     | -6.57       | .290        | .0071          | .2003          | .000E+00 | .000E+00 | -6.570  | .110    |
| Fbar  | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |          |         |         |
| .212  | .246        | .158        | .246           | .414           |          |          |         |         |

| Age 4  |        |        |        |        |        |        |        |        |       |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| Fleet, | 82,    | 83,    | 84,    | 85,    | 86,    | 87,    | 88,    | 89,    | 90    |
| 1,     | -9.65, | -9.24, | -9.80, | -9.72, | -8.65, | -8.87, | -8.53, | -9.89, | -9.47 |
| 2,     | ,      | ,      | ,      | -6.44, | -6.27, | -6.37, | -6.53, | -5.84, | -6.00 |
| 3,     | ,      | ,      | ,      | -6.34, | -6.98, | -7.34, | -6.71, | -6.81, | -7.27 |

SUMMARY STATISTICS

| Fleet | Pred.       | SE(q)       | Partial        | Raised         | SLOPE    | SE       | INTRCPT | SC      |
|-------|-------------|-------------|----------------|----------------|----------|----------|---------|---------|
| ,     | q           | ,           | F              | F              | ,        | Slope    | ,       | Intrcpt |
| 1     | -9.31       | .544        | .0090          | .3370          | .000E+00 | .000E+00 | 9.312   | .172    |
| 2     | 6.24        | .290        | .0109          | .2277          | .000E+00 | .000E+00 | 6.240   | .109    |
| 3     | -6.91       | .401        | .0051          | .4147          | .000E+00 | .000E+00 | 6.907   | .152    |
| Fbar  | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) | Variance ratio |          |          |         |         |
| .288  | .216        | .191        | .216           | .785           |          |          |         |         |

Table 7.7 cont'd.

| Age 5<br>Fleet, | 82,    | 83,    | 84,    | 85,    | 86,    | 87,   | 88,    | 89,    | 90    |
|-----------------|--------|--------|--------|--------|--------|-------|--------|--------|-------|
| 1,              | -8.97, | -9.16, | -9.81, | -9.71, | -8.56, | 6.63, | -8.64, | -8.96, | -9.05 |
| 2,              | ,      | ,      | ,      | 6.26,  | 5.63,  | 8.15, | 6.60,  | 5.62,  | 5.78  |
| 3,              | ,      | ,      | ,      | 6.11,  | -6.90, | 7.67, | 6.91,  | 6.50,  | 8.00  |

| SUMMARY STATISTICS |       |             |         |             |          |                |         |                |  |
|--------------------|-------|-------------|---------|-------------|----------|----------------|---------|----------------|--|
| Fleet              | Pred. | SE(q)       | Partial | Raised      | SLOPE    | SE             | INTRCPT | SE             |  |
| ,                  | q     | ,           | F       | F           | ,        | Slope          | ,       | Intrcpt        |  |
| 1,                 | 9.05  | .474        | .0117   | .2776       | .000E+00 | .000E+00       | 9.054   | .150           |  |
| 2,                 | 6.04  | .391        | .0133   | .2153       | .000E+00 | .000E+00       | 6.040   | .148           |  |
| 3,                 | 7.06  | .775        | .0044   | .7803       | .000E+00 | .000E+00       | 7.057   | .290           |  |
| Fbar               |       | SIGMA(int.) |         | SIGMA(ext.) |          | SIGMA(overall) |         | Variance ratio |  |
| .279               |       | .261        |         | .295        |          | .295           |         | 1.101          |  |

| Age 6<br>Fleet, | 82,    | 83,    | 84,     | 85,     | 86,    | 87,    | 88,    | 89,    | 90    |
|-----------------|--------|--------|---------|---------|--------|--------|--------|--------|-------|
| 1,              | -8.79, | -9.21, | -10.13, | -10.08, | -8.46, | 8.88,  | -8.71, | -9.33, | -8.95 |
| 2,              | ,      | ,      | ,       | -5.82,  | -5.41, | 5.94,  | 6.86,  | -5.82, | -5.85 |
| 3,              | ,      | ,      | ,       | -5.92,  | -7.26, | -7.45, | -6.83, | -6.41, | -6.74 |

| SUMMARY STATISTICS |       |             |         |             |          |                |         |                |  |
|--------------------|-------|-------------|---------|-------------|----------|----------------|---------|----------------|--|
| Fleet              | Pred. | SE(q)       | Partial | Raised      | SLOPE    | SE             | INTRCPT | SE             |  |
| ,                  | q     | ,           | F       | F           | ,        | Slope          | ,       | Intrcpt        |  |
| 1,                 | 9.17  | .621        | .0104   | .3391       | .000E+00 | .000E+00       | 9.172   | .196           |  |
| 2,                 | -5.82 | .237        | .0167   | .4368       | .000E+00 | .000E+00       | 5.816   | .090           |  |
| 3,                 | 6.77  | .604        | .0059   | .4125       | .000E+00 | .000E+00       | 6.766   | .228           |  |
| Fbar               |       | SIGMA(int.) |         | SIGMA(ext.) |          | SIGMA(overall) |         | Variance ratio |  |
| .423               |       | .208        |         | .574E-01    |          | .208           |         | .076           |  |

| Age 7<br>Fleet, | 82,    | 83,    | 84,    | 85,    | 86,    | 87,    | 88,    | 89,    | 90    |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| 1,              | -8.85, | -9.34, | -9.88, | -9.96, | -7.82, | -9.79, | 8.78,  | -8.91, | 8.34  |
| 2,              | ,      | ,      | ,      | -5.34, | -5.46, | -6.36, | -5.97, | -5.85, | 5.97  |
| 3,              | ,      | ,      | ,      | -5.65, | -7.28, | -8.09, | -6.62, | -6.76, | -7.18 |

| SUMMARY STATISTICS |       |             |         |             |          |                |         |                |  |
|--------------------|-------|-------------|---------|-------------|----------|----------------|---------|----------------|--|
| Fleet              | Pred. | SE(q)       | Partial | Raised      | SLOPE    | SE             | INTRCPT | SE             |  |
| ,                  | q     | ,           | F       | F           | ,        | Slope          | ,       | Intrcpt        |  |
| 1,                 | -9.08 | .771        | .0114   | .1920       | .000E+00 | .000E+00       | -9.075  | .244           |  |
| 2,                 | -5.82 | .406        | .0166   | .4622       | .000E+00 | .000E+00       | -5.824  | .153           |  |
| 3,                 | -6.93 | .876        | .0050   | .5107       | .000E+00 | .000E+00       | -6.929  | .331           |  |
| Fbar               |       | SIGMA(int.) |         | SIGMA(ext.) |          | SIGMA(overall) |         | Variance ratio |  |
| .398               |       | .332        |         | .247        |          | .332           |         | .555           |  |

| Age 8<br>Fleet, | 82,    | 83,    | 84,     | 85,    | 86,    | 87,    | 88,    | 89,    | 90    |
|-----------------|--------|--------|---------|--------|--------|--------|--------|--------|-------|
| 1,              | -8.31, | -9.47, | -10.97, | -9.63, | -8.59, | -8.50, | 9.53,  | -9.17, | 8.76  |
| 2,              | ,      | ,      | ,       | -5.03, | -5.85, | -6.03, | -6.13, | -5.76, | -5.87 |
| 3,              | ,      | ,      | ,       | -6.33, | -8.87, | -8.26, | -6.19, | -7.87, | -7.65 |

| SUMMARY STATISTICS |       |             |         |             |          |                |         |                |  |
|--------------------|-------|-------------|---------|-------------|----------|----------------|---------|----------------|--|
| Fleet              | Pred. | SE(q)       | Partial | Raised      | SLOPE    | SE             | INTRCPT | SE             |  |
| ,                  | q     | ,           | F       | F           | ,        | Slope          | ,       | Intrcpt        |  |
| 1,                 | -9.22 | .855        | .0099   | .2323       | .000E+00 | .000E+00       | -9.221  | .271           |  |
| 2,                 | -5.78 | .422        | .0173   | .4030       | .000E+00 | .000E+00       | -5.780  | .159           |  |
| 3,                 | 7.53  | 1.156       | .0027   | .4150       | .000E+00 | .000E+00       | -7.529  | .437           |  |
| Fbar               |       | SIGMA(int.) |         | SIGMA(ext.) |          | SIGMA(overall) |         | Variance ratio |  |
| .367               |       | .360        |         | .150        |          | .360           |         | .173           |  |



Table 7.8

Title : Cod in the Faroe Plateau (Fishing Area Vb1)  
 At 13.59.14 06 MAY 1991  
 from 81 to 90 on ages 2 to 9  
 with Terminal F of .290 on age 4 and Terminal S of 1.000

Initial sum of squared residuals was 47.489 and  
 final sum of squared residuals is 6.174 after 83 iterations

## Matrix of Residuals

| Years | 81/82 | 82/83 | 83/84 | 84/85 | 85/86 | 86/87 | 87/88 | 88/89 | 89/90 |      | WTS   |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|
| Ages  |       |       |       |       |       |       |       |       |       |      |       |
| 2/ 3  | .116  | .176  | .052  | .657  | -.131 | -.878 | -.548 | -.044 | .600  | .000 | .252  |
| 3/ 4  | .154  | .055  | -.005 | .339  | .155  | -.065 | -.145 | -.020 | -.158 | .000 | .753  |
| 4/ 5  | -.171 | .042  | -.391 | .276  | -.290 | .161  | .335  | .096  | -.057 | .000 | .498  |
| 5/ 6  | .051  | -.065 | .006  | .121  | -.210 | .179  | .077  | -.137 | -.022 | .000 | 1.000 |
| 6/ 7  | -.147 | -.334 | .102  | -.603 | .231  | .387  | .122  | .155  | .086  | .000 | .403  |
| 7/ 8  | .081  | .247  | .361  | -.837 | .613  | .012  | -.295 | -.027 | -.154 | .000 | .297  |
| 8/ 9  | -.247 | .061  | .099  | -.601 | .737  | -.476 | .134  | .197  | .095  | .000 | .311  |
|       | .000  | .000  | .000  | .000  | .000  | .000  | .000  | .000  | .000  | .000 |       |
| WTS   | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |      |       |

Fishing Mortalities (F)

| F-values | 81    | 82    | 83    | 84    | 85    | 86    | 87    | 88    | 89    | 90    |
|----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|          | .4230 | .3828 | .6619 | .4681 | .5417 | .4671 | .3296 | .4189 | .4881 | .2900 |

Selection-at-age (S)

| S-values | 2     | 3     | 4      | 5      | 6      | 7      | 8      | 9      |
|----------|-------|-------|--------|--------|--------|--------|--------|--------|
|          | .1175 | .6221 | 1.0000 | 1.1327 | 1.3032 | 1.4164 | 1.2403 | 1.0000 |

Table 7.9 VPA.

Cod in the Faroe Plateau (Fishing Area Vb1)

| FISHING MORTALITY COEFFICIENT | UNIT: Year <sup>-1</sup> |      |       |      |       |      |      |      |      |      | NATURAL MORTALITY COEFFICIENT = .20 |
|-------------------------------|--------------------------|------|-------|------|-------|------|------|------|------|------|-------------------------------------|
|                               | 1981                     | 1982 | 1983  | 1984 | 1985  | 1986 | 1987 | 1988 | 1989 | 1990 |                                     |
| 2                             | .052                     | .058 | .097  | .102 | .061  | .022 | .022 | .044 | .087 | .034 |                                     |
| 3                             | .287                     | .220 | .457  | .358 | .331  | .319 | .192 | .259 | .281 | .150 |                                     |
| 4                             | .337                     | .358 | .544  | .556 | .479  | .556 | .406 | .460 | .495 | .314 |                                     |
| 5                             | .432                     | .382 | .632  | .629 | .570  | .630 | .404 | .428 | .567 | .359 |                                     |
| 6                             | .545                     | .398 | .751  | .444 | .824  | .711 | .459 | .559 | .642 | .404 |                                     |
| 7                             | .642                     | .648 | 1.020 | .444 | 1.038 | .655 | .377 | .563 | .582 | .376 |                                     |
| 8                             | .460                     | .482 | .812  | .433 | 1.093 | .476 | .396 | .543 | .572 | .327 |                                     |
| 9                             | .421                     | .421 | .624  | .405 | .739  | .465 | .431 | .340 | .410 | .239 |                                     |
| 10+                           | .421                     | .421 | .624  | .405 | .739  | .465 | .431 | .340 | .410 | .239 |                                     |
| ( 3- 7)U                      | .448                     | .401 | .681  | .486 | .649  | .574 | .368 | .454 | .514 | .321 |                                     |

Table 7.10 VPA.

## Cod in the Faroe Plateau (Fishing Area Vb1)

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

|           | 1981  | 1982   | 1983   | 1984   | 1985   | 1986   | 1987  | 1988  | 1989  | 1990  | 1991  |
|-----------|-------|--------|--------|--------|--------|--------|-------|-------|-------|-------|-------|
| 2         | 14082 | 22310  | 25672  | 49891  | 18690  | 10681  | 12781 | 12992 | 31285 | 8326  | 0     |
| 3         | 18212 | 10947  | 17238  | 19080  | 36883  | 14402  | 8555  | 10232 | 10177 | 23484 | 6588  |
| 4         | 7601  | 11192  | 7194   | 8940   | 10922  | 21677  | 8569  | 5778  | 6469  | 6291  | 16550 |
| 5         | 2959  | 4444   | 6403   | 3419   | 4198   | 5541   | 10174 | 4673  | 2987  | 3228  | 3763  |
| 6         | 1514  | 1573   | 2484   | 2788   | 1493   | 1943   | 2415  | 5563  | 2495  | 1387  | 1846  |
| 7         | 1123  | 718    | 865    | 959    | 1465   | 536    | 781   | 1249  | 2605  | 1074  | 758   |
| 8         | 1565  | 484    | 307    | 255    | 504    | 425    | 228   | 439   | 582   | 1192  | 604   |
| 9         | 392   | 809    | 245    | 112    | 136    | 138    | 216   | 126   | 209   | 269   | 771   |
| 10+       | 175   | 389    | 240    | 217    | 167    | 112    | 81    | 95    | 33    | 140   | 204   |
| TOTAL NO  | 47623 | 52865  | 60649  | 85661  | 74457  | 55455  | 43800 | 41146 | 56842 | 45392 |       |
| SPS NO    | 15329 | 19609  | 17739  | 16690  | 18883  | 30372  | 22464 | 17923 | 15380 | 13582 |       |
| TOT. BIOM | 89719 | 101499 | 125309 | 157363 | 137905 | 108183 | 91383 | 84676 | 93581 | 77122 |       |
| SPS BIOM  | 47739 | 57475  | 57346  | 61720  | 59838  | 75432  | 64435 | 52996 | 45730 | 38724 |       |

Table 7.11

Analysis by RCRTINX2 of data from file RECR-COD  
 FAROE COD RECRUITMENT INDICES 1980 -1989

Data for 2 surveys over 10 years  
 REGRESSION TYPE = C  
 TAPERED TIME WEIGHTING APPLIED  
 POWER = 3 OVER 20 YEARS  
 PRIOR WEIGHTING NOT APPLIED  
 FINAL ESTIMATES SHRUNK TOWARDS MEAN  
 ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN INCLUDED  
 MINIMUM S.E. FOR ANY SURVEY TAKEN AS .20  
 MINIMUM OF 5 POINTS USED FOR REGRESSION

Yearclass = 1985

| Survey/<br>Series | Index<br>Value | Slope | Inter-<br>cept | Rsquare | No.<br>Pts | Predicted<br>Value | Sigma  | Standard<br>Error | Weight |
|-------------------|----------------|-------|----------------|---------|------------|--------------------|--------|-------------------|--------|
| OGROUP            | 3.5553         | .000  | .000           | .0000   | 0          | .0000              | .00000 | .00000            | .00000 |
| SURVEY            | 1.3610         | .861  | 8.026          | .8785   | 5          | 9.1984             | .24050 | .31157            | .76306 |
| MEAN              |                |       |                |         |            | 10.0184            | .55913 | .55913            | .23694 |

Yearclass = 1986

| Survey/<br>Series | Index<br>Value | Slope | Inter-<br>cept | Rsquare | No.<br>Pts | Predicted<br>Value | Sigma  | Standard<br>Error | Weight |
|-------------------|----------------|-------|----------------|---------|------------|--------------------|--------|-------------------|--------|
| OGROUP            | 2.8904         | .685  | 6.808          | .8711   | 5          | 8.7880             | .26854 | .37236            | .25499 |
| SURVEY            | 1.8718         | .797  | 8.207          | .8906   | 6          | 9.6991             | .21658 | .23712            | .62879 |
| MEAN              |                |       |                |         |            | 9.9222             | .55154 | .55154            | .11622 |

Yearclass = 1987

| Survey/<br>Series | Index<br>Value | Slope | Inter-<br>cept | Rsquare | No.<br>Pts | Predicted<br>Value | Sigma  | Standard<br>Error | Weight |
|-------------------|----------------|-------|----------------|---------|------------|--------------------|--------|-------------------|--------|
| OGROUP            | 5.4424         | .597  | 7.295          | .7838   | 6          | 10.5440            | .33213 | .39930            | .63968 |
| SURVEY            |                |       |                |         |            |                    |        |                   |        |
| MEAN              |                |       |                |         |            | 9.8538             | .53203 | .53203            | .36032 |

Yearclass = 1988

| Survey/<br>Series | Index<br>Value | Slope | Inter-<br>cept | Rsquare | No.<br>Pts | Predicted<br>Value | Sigma  | Standard<br>Error | Weight |
|-------------------|----------------|-------|----------------|---------|------------|--------------------|--------|-------------------|--------|
| OGROUP            | 5.0370         | .567  | 7.399          | .8140   | 7          | 10.2555            | .29159 | .32088            | .46831 |
| SURVEY            |                |       |                |         |            |                    |        |                   |        |
| MEAN              |                |       |                |         |            | 9.9140             | .52405 | .52405            | .17558 |

Yearclass = 1989

| Survey/<br>Series | Index<br>Value | Slope | Inter-<br>cept | Rsquare | No.<br>Pts | Predicted<br>Value | Sigma  | Standard<br>Error | Weight |
|-------------------|----------------|-------|----------------|---------|------------|--------------------|--------|-------------------|--------|
| OGROUP            | 1.3863         | .565  | 7.409          | .8144   | 7          | 8.1924             | .29239 | .45991            | .18595 |
| SURVEY            | 2.0794         | .840  | 8.081          | .8730   | 7          | 9.8272             | .22533 | .24197            | .67176 |
| MEAN              |                |       |                |         |            | 9.9098             | .52576 | .52576            | .14229 |

| Yearclass | Weighted<br>Average<br>Prediction | Internal<br>Standard<br>Error | External<br>Standard<br>Error | Virtual<br>Population<br>Analysis | Ext.SE/<br>Int.SE |      |
|-----------|-----------------------------------|-------------------------------|-------------------------------|-----------------------------------|-------------------|------|
| 1985      | 9.39                              | 12000.64                      | .27                           | .35                               | 9.4612782.00      | 1.28 |
| 1986      | 9.49                              | 13262.29                      | .19                           | .30                               | 9.4712993.00      | 1.57 |
| 1987      | 10.30                             | 29593.41                      | .32                           | .33                               | 10.3531285.98     | 1.04 |
| 1988      | 9.45                              | 12705.61                      | .22                           | .68                               |                   | 3.11 |
| 1989      | 9.53                              | 13834.86                      | .20                           | .45                               |                   | 2.29 |

Table 7.12

List of input variables for the ICES prediction program.

PREDICTION OF FAROE COD VERSION 1

The reference F is the mean F (non-weighted) for the age group range from 3 to 7

The number of recruits per year is as follows:

| Year | Recruitment |
|------|-------------|
| 1991 | 14000.0     |
| 1992 | 19000.0     |
| 1993 | 19000.0     |
| 1994 | 19000.0     |

Data are printed in the following units:

Number of fish: thousands  
 Weight by age group in the catch: kilogram  
 Weight by age group in the stock: kilogram  
 Stock biomass: tonnes  
 Catch weight: tonnes

| age | stock size | fishing pattern | natural mortality | maturity ogive | weight in the catch | weight in the stock |
|-----|------------|-----------------|-------------------|----------------|---------------------|---------------------|
| 2   | 14000.0    | .03             | .20               | .00            | 1.005               | 1.005               |
| 3   | 10054.0    | .18             | .20               | .00            | 1.549               | 1.549               |
| 4   | 16550.0    | .29             | .20               | 1.00           | 2.153               | 2.153               |
| 5   | 3763.0     | .33             | .20               | 1.00           | 2.793               | 2.793               |
| 6   | 1846.0     | .38             | .20               | 1.00           | 3.283               | 3.283               |
| 7   | 758.0      | .42             | .20               | 1.00           | 4.126               | 4.126               |
| 8   | 604.0      | .37             | .20               | 1.00           | 4.779               | 4.779               |
| 9   | 704.0      | .29             | .20               | 1.00           | 6.644               | 6.644               |
| 10+ | 264.0      | .29             | .20               | 1.00           | 8.711               | 8.711               |

Table 7.13

Effects of different levels of fishing mortality on catch, stock biomass and spawning stock biomass.

PREDICTION OF FAROE COD VERSION 1

| Year 1991   |           |                  |                     |       | Year 1992   |           |                  |                     |       | Year 1993        |                     |
|-------------|-----------|------------------|---------------------|-------|-------------|-----------|------------------|---------------------|-------|------------------|---------------------|
| fac-<br>tor | ref.<br>F | stock<br>biomass | sp.stock<br>biomass | catch | fac-<br>tor | ref.<br>F | stock<br>biomass | sp.stock<br>biomass | catch | stock<br>biomass | sp.stock<br>biomass |
| 1.0         | .32       | 95               | 65                  | 19    | .5          | .17       | 100              | 64                  | 11    | 113              | 71                  |
|             |           |                  |                     |       | .8          | .26       |                  |                     | 16    | 108              | 65                  |
|             |           |                  |                     |       | 1.0         | .32       |                  |                     | 20    | 104              | 62                  |
|             |           |                  |                     |       | 1.2         | .39       |                  |                     | 23    | 100              | 58                  |
|             |           |                  |                     |       | 1.3         | .41       |                  |                     | 24    | 99               | 57                  |

The data unit of the biomass and the catch is 1000 tonnes.

The spawning stock biomass is given for 1 January.

The reference F is the mean F (non-weighted) for the age group range from 3 to 7

**Table 8.1** Faroe Plateau HADDOCK in Sub-division Vb1.  
Nominal catches (t) by countries, 1980-1990, as reported to ICES.

| Year              | Faroe Islands         | France          | Germany, Fed.Rep. | Norway           | Poland | UK England     | UK Scotland    | Denmark | Others | Total  |
|-------------------|-----------------------|-----------------|-------------------|------------------|--------|----------------|----------------|---------|--------|--------|
| 1980              | 13,633                | 31 <sup>1</sup> | 4                 | 9                | -      | 6              | 434            | -       | 6      | 14,123 |
| 1981              | 10,891                | 113             | +                 | 20               | -      | -              | 85             | -       | -      | 11,109 |
| 1982              | 10,319                | 2               | 1                 | 12               | -      | -              | 1 <sup>3</sup> | -       | -      | 10,335 |
| 1983              | 11,898                | 2               | +                 | 12               | -      | -              | - <sup>3</sup> | -       | -      | 11,912 |
| 1984              | 11,418                | 20              | +                 | 10               | -      | -              | - <sup>3</sup> | -       | -      | 11,448 |
| 1985              | 13,597                | 23              | +                 | 21               | -      | -              | - <sup>3</sup> | -       | -      | 13,641 |
| 1986              | 13,359                | 8               | 1                 | 22               | -      | -              | - <sup>3</sup> | 1       | -      | 13,391 |
| 1987              | 13,954                | 22              | 1                 | 13               | -      | 2              | - <sup>3</sup> | 8       | -      | 14,000 |
| 1988              | 10,867 <sup>1,2</sup> | 14              | -                 | 54               | -      | -              | - <sup>3</sup> | 4       | -      | 10,939 |
| 1989              | 13,506 <sup>1</sup>   | -               | -                 | 111 <sup>2</sup> | -      | - <sup>3</sup> | - <sup>3</sup> | -       | -      | 13,416 |
| 1990 <sup>2</sup> | 10,529                | -               | -                 | 190 <sup>1</sup> | -      | - <sup>3</sup> | -              | -       | -      | 10,719 |

Total used in the assessment<sup>5</sup>: 1988 ..... 13,529  
 1989 ..... 13,754  
 1990 ..... 12,618<sup>6</sup>

<sup>1</sup> Catches including Sub-division Vb2.

<sup>2</sup> Preliminary.

<sup>3</sup> Catches included in Sub-division Vb2.

<sup>4</sup> Catches as reported to the Faroese Coastal Guard Service.

<sup>5</sup> Includes catches from Division IIa in Faroese waters.

<sup>6</sup> Includes French catches from Division Vb.

**Table 8.2** Faroe Bank HADDOCK in Sub-division Vb2.  
Nominal catches (t) by countries, 1980-1990, as reported to ICES.

| Year              | Faroe Islands | France         | Germany, Fed.Rep. | Norway          | UK England | UK Scotland     | Denmark | Others | Total |
|-------------------|---------------|----------------|-------------------|-----------------|------------|-----------------|---------|--------|-------|
| 1980              | 690           | - <sup>1</sup> | -                 | 8               | 152        | 43              | -       | -      | 893   |
| 1981              | 1,103         | -              | -                 | 7               | -          | 14              | -       | -      | 1,124 |
| 1982              | 1,553         | -              | -                 | 1               | -          | 48 <sup>3</sup> | -       | -      | 1,602 |
| 1983              | 967           | -              | -                 | 2               | -          | 13 <sup>3</sup> | -       | -      | 982   |
| 1984              | 925           | -              | -                 | 5               | -          | + <sup>3</sup>  | -       | -      | 930   |
| 1985              | 1,474         | -              | -                 | 3               | -          | 25 <sup>3</sup> | -       | -      | 1,502 |
| 1986              | 1,050         | -              | -                 | 10              | -          | 26 <sup>3</sup> | -       | -      | 1,086 |
| 1987              | 832           | -              | -                 | 5               | -          | 45 <sup>3</sup> | -       | -      | 882   |
| 1988              | 1,160         | -              | -                 | 43              | -          | 15 <sup>3</sup> | -       | -      | 1,218 |
| 1989              | 659           | -              | -                 | 16 <sup>2</sup> | -          | 30 <sup>3</sup> | -       | -      | 705   |
| 1990 <sup>2</sup> | 733           | -              | -                 | 1               | -          | 620             | -       | -      | 1,353 |

<sup>1</sup> Catches included in Sub-division Vb1.

<sup>2</sup> Preliminary.

<sup>3</sup> Catches including Sub-division Vb1.

Table 8.3 SOP.

Haddock in the Faroe Grounds (Fishing Area Vb)  
CATEGORY: TOTAL

| CATCH IN NUMBERS | UNIT: thousands |       |       |       |       |       |       |       |       |       |
|------------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                  | 1981            | 1982  | 1983  | 1984  | 1985  | 1986  | 1987  | 1988  | 1989  | 1990  |
| 1                | 0               | 0     | 0     | 25    | 0     | 0     | 0     | 0     | 0     | 0     |
| 2                | 74              | 539   | 441   | 1195  | 985   | 230   | 283   | 661   | 64    | 124   |
| 3                | 455             | 934   | 1969  | 1561  | 4553  | 2549  | 1718  | 448   | 1532  | 1505  |
| 4                | 202             | 784   | 383   | 2462  | 2196  | 4452  | 3565  | 2485  | 664   | 2267  |
| 5                | 2586            | 298   | 422   | 147   | 1242  | 1522  | 2972  | 3063  | 2813  | 906   |
| 6                | 1354            | 2182  | 93    | 234   | 169   | 738   | 1114  | 2159  | 2578  | 2050  |
| 7                | 1559            | 973   | 1444  | 42    | 91    | 39    | 529   | 479   | 1994  | 2253  |
| 8                | 608             | 1166  | 740   | 861   | 61    | 130   | 83    | 152   | 546   | 1044  |
| 9                | 177             | 1283  | 947   | 388   | 503   | 71    | 48    | 18    | 134   | 318   |
| 10+              | 36              | 214   | 795   | 968   | 973   | 712   | 334   | 129   | 82    | 127   |
| TOTAL            | 7051            | 8373  | 7234  | 7883  | 10773 | 10443 | 10646 | 9594  | 10407 | 10594 |
| A) SOP           | 11254           | 12922 | 12217 | 11685 | 14341 | 14275 | 14594 | 12671 | 14422 | 13571 |
| B)NOMIN.         | 11109           | 11936 | 12894 | 12378 | 15143 | 14477 | 14882 | 12286 | 14459 | 13836 |
| (B/A) %          | 99              | 92    | 106   | 106   | 106   | 101   | 102   | 97    | 100   | 102   |

Table 8.4 SOP.

Haddock in the Faroe Grounds (Fishing Area Vb)  
CATEGORY: TOTAL

| MEAN WEIGHT AT AGE IN THE CATCH | UNIT: kilogram |       |       |       |       |       |       |       |       |       |
|---------------------------------|----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                                 | 1981           | 1982  | 1983  | 1984  | 1985  | 1986  | 1987  | 1988  | 1989  | 1990  |
| 1                               | .300           | .000  | .300  | .359  | .359  | .359  | .359  | .000  | .000  | .000  |
| 2                               | .452           | .700  | .470  | .681  | .528  | .608  | .605  | .501  | .580  | .438  |
| 3                               | .725           | .896  | .740  | 1.011 | .859  | .887  | .831  | .781  | .779  | .699  |
| 4                               | .957           | 1.150 | 1.010 | 1.255 | 1.391 | 1.175 | 1.126 | .974  | .923  | .939  |
| 5                               | 1.237          | 1.444 | 1.320 | 1.812 | 1.777 | 1.631 | 1.462 | 1.363 | 1.207 | 1.204 |
| 6                               | 1.651          | 1.498 | 1.660 | 2.061 | 2.326 | 1.984 | 1.941 | 1.680 | 1.564 | 1.384 |
| 7                               | 2.053          | 1.829 | 2.050 | 2.059 | 2.440 | 2.519 | 2.173 | 1.975 | 1.746 | 1.564 |
| 8                               | 2.406          | 1.887 | 2.260 | 2.137 | 2.401 | 2.583 | 2.347 | 2.344 | 2.086 | 1.818 |
| 9                               | 2.725          | 1.961 | 2.540 | 2.368 | 2.532 | 2.570 | 3.118 | 2.248 | 2.424 | 2.168 |
| 10+                             | 3.250          | 2.856 | 3.040 | 2.686 | 2.686 | 2.922 | 2.933 | 3.295 | 2.514 | 2.335 |

**Table 8.5.A** Stratified mean catch by age in numbers per trawl hour of HADDOCK in the Faroese groundfish surveys, 1982-1991.

| Age | 1982 | 1983  | 1984  | 1985  | 1986  | 1987 | 1988  | 1989  | 1990  | 1991 |
|-----|------|-------|-------|-------|-------|------|-------|-------|-------|------|
| 1   | -    | 143.4 | 199.0 | 417.3 | 40.9  | 66.0 | 69.3  | 71.3  | 8.6   | 23.9 |
| 2   | -    | 154.7 | 180.4 | 134.8 | 223.5 | 16.7 | 166.6 | 199.1 | 88.4  | 51.5 |
| 3   | 52.9 | 60.2  | 38.7  | 72.0  | 73.9  | 41.8 | 21.4  | 156.1 | 104.9 | 51.4 |
| 4   | 16.8 | 5.3   | 19.1  | 11.0  | 34.9  | 28.4 | 39.9  | 10.9  | 35.7  | 34.6 |
| 5   | 2.9  | 4.6   | 0.7   | 3.5   | 6.2   | 16.2 | 22.1  | 32.1  | 4.1   | 14.2 |
| 6   | 54.1 | -     | 1.0   | -     | 1.5   | 2.9  | 8.3   | 52.3  | 11.7  | 6.5  |
| 7   | 18.5 | 16.1  | -     | 0.7   | -     | -    | 2.6   | 34.2  | 13.6  | 3.5  |
| 8   | 41.3 | 7.2   | 3.3   | 0.3   | 0.1   | -    | 0.2   | 3.6   | 7.2   | 1.0  |
| 9   | 12.5 | 9.9   | 1.2   | 1.6   | 0.4   | 0.1  | 0.2   | 0.0   | 1.8   | 0.8  |
| 10  | 9.1  | 3.6   | 2.9   | 0.3   | 0.7   | 0.1  | -     | 0.0   | 0.3   | 0.3  |

**Table 8.5.B** Catch and effort data by age of Haddock in Division Vb 1985-1990 from longliners <100 GRT for the spring season. Numbers measured in 1000 and effort in million hooks.

| Age                        | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
|----------------------------|------|------|------|------|------|------|
| 2                          | 5    | 0    | 0    | 0    | 0    | 0    |
| 3                          | 204  | 14   | 22   | 15   | 0    | 18   |
| 4                          | 56   | 246  | 208  | 192  | 30   | 80   |
| 5                          | 31   | 89   | 185  | 169  | 102  | 21   |
| 6                          | 3    | 65   | 63   | 83   | 126  | 68   |
| 7                          | 3    | 2    | 30   | 18   | 120  | 84   |
| 8                          | 1    | 8    | 4    | 8    | 33   | 52   |
| 9                          | 16   | 2    | 2    | 0    | 8    | 12   |
| 10+                        | 8    | 14   | 6    | 1    | 2    | 4    |
| Total effort (mill. hooks) | 6.3  | 7.0  | 6.7  | 5.6  | 6.0  | 5.6  |

**Table 8.5.C** Catch and effort data by age of Haddock in Division Vb 1985 from longliners <100 GRT for the autumn season. Numbers measured in 1000 and effort in million hooks.

| Age                        | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
|----------------------------|------|------|------|------|------|------|
| 2                          | 176  | 32   | 66   | 130  | 157  | 0    |
| 3                          | 318  | 268  | 231  | 52   | 63   | 86   |
| 4                          | 74   | 230  | 257  | 174  | 230  | 116  |
| 5                          | 17   | 44   | 108  | 144  | 139  | 12   |
| 6                          | 6    | 11   | 23   | 101  | 109  | 98   |
| 7                          | 1    | 1    | 9    | 11   | 31   | 52   |
| 8                          | 2    | 2    | 1    | 1    | 7    | 27   |
| 9                          | 13   | 2    | 1    | 0    | 0    | 18   |
| 10+                        | 9    | 3    | 0    | 0    | 0    | 5    |
| Total effort (mill. hooks) | 6.9  | 4.8  | 6.3  | 5.9  | 8.2  | 5.1  |

Table 8.6 Tuning of haddock in Division Vb.

Module run at 11.15.13 06 MAY 1991

DISAGGREGATED Qs  
LOG TRANSFORMATION

NO explanatory variate (mean used)

Fleet 1 ,Magnus Heinasson , has terminal q estimated as the mean  
Fleet 2 ,LONGLINERS IN SPRING, has terminal q estimated as the mean  
Fleet 3 ,LONGLINERS IN AUTUMN, has terminal q estimated as the mean  
FLEETS COMBINED BY \*\* VARIANCE \*\*

Regression weights

, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000,

Oldest age F = 1.000\*average of 4 younger ages. Fleets combined by variance of predictions

Fishing mortalities

| Age, | 85,   | 86,   | 87,   | 88,   | 89,   | 90,   |
|------|-------|-------|-------|-------|-------|-------|
| 2,   | .015, | .004, | .030, | .021, | .003, | .007, |
| 3,   | .093, | .048, | .040, | .061, | .062, | .084, |
| 4,   | .170, | .124, | .087, | .075, | .121, | .122, |
| 5,   | .255, | .171, | .114, | .101, | .113, | .240, |
| 6,   | .297, | .236, | .182, | .113, | .115, | .113, |
| 7,   | .162, | .103, | .266, | .111, | .145, | .139, |
| 8,   | .130, | .366, | .329, | .113, | .178, | .106, |
| 9,   | .211, | .219, | .223, | .110, | .138, | .150, |

0.154

Log catchability estimates

| Age 2  |         |         |         |         |         |        |
|--------|---------|---------|---------|---------|---------|--------|
| Fleet, | 85,     | 86,     | 87,     | 88,     | 89,     | 90     |
| 1,     | -10.82, | -10.09, | -10.94, | -9.85,  | -9.35,  | -9.87  |
| 2,     | -11.35, | -14.44, | -12.66, | -13.69, | -13.44, | -13.08 |
| 3,     | -7.88,  | -8.99,  | -6.80,  | -7.27,  | -11.04, | -12.98 |

SUMMARY STATISTICS

| Fleet | Pred. q | SE(q)       | Partial, F  | Raised, F      | SLOPE    | SE Slope | INTRCPT | SE Intrcpt     |
|-------|---------|-------------|-------------|----------------|----------|----------|---------|----------------|
| 1     | -10.15  | .662        | .0039       | .0055          | .000E+00 | .000E+00 | -10.151 | .250           |
| 2     | -13.11  | 1.137       | .0000       | .0070          | .000E+00 | .000E+00 | -13.109 | .430           |
| 3     | -9.16   | 2.602       | .0005       | .3326          | .000E+00 | .000E+00 | -9.160  | .983           |
| Fbar  |         | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) |          |          |         | Variance ratio |
|       | .007    | .559        | .604        | .604           |          |          |         | 1.169          |

Age 3

| Fleet, | 85,     | 86,     | 87,     | 88,     | 89,     | 90    |
|--------|---------|---------|---------|---------|---------|-------|
| 1,     | -11.12, | -11.19, | -11.54, | -10.44, | -9.67,  | -9.75 |
| 2,     | -7.32,  | -10.19, | -9.48,  | -7.92,  | -13.52, | -8.63 |
| 3,     | -6.96,  | -6.86,  | -7.07,  | -6.73,  | -7.16,  | -6.97 |

SUMMARY STATISTICS

| Fleet | Pred. q | SE(q)       | Partial, f  | Raised, f      | SLOPE    | SE Slope | INTRCPT | SE Intrcpt     |
|-------|---------|-------------|-------------|----------------|----------|----------|---------|----------------|
| 1     | -10.62  | .652        | .0044       | .0351          | .000E+00 | .000E+00 | -10.619 | .322           |
| 2     | -9.51   | 2.396       | .0004       | .0347          | .000E+00 | .000E+00 | -9.509  | .906           |
| 3     | -6.96   | .166        | .0048       | .0846          | .000E+00 | .000E+00 | -6.959  | .063           |
| Fbar  |         | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) |          |          |         | Variance ratio |
|       | .082    | .162        | .124        | .162           |          |          |         | .581           |

Age 4

| Fleet, | 85,     | 86,     | 87,     | 88,     | 89,     | 90     |
|--------|---------|---------|---------|---------|---------|--------|
| 1,     | -11.67, | -11.54, | -11.88, | -11.33, | -10.83, | -10.86 |
| 2,     | -7.28,  | -6.93,  | -7.18,  | -6.88,  | -7.00,  | -7.17  |
| 3,     | -7.09,  | -6.62,  | -6.91,  | -7.03,  | -6.57,  | -6.70  |

SUMMARY STATISTICS

| Fleet | Pred. q | SE(q)       | Partial, f  | Raised, f      | SLOPE    | SE Slope | INTRCPT | SE Intrcpt     |
|-------|---------|-------------|-------------|----------------|----------|----------|---------|----------------|
| 1     | 11.35   | .467        | .0012       | .0747          | .000E+00 | .000E+00 | -11.351 | .176           |
| 2     | -7.07   | .173        | .0047       | .1345          | .000E+00 | .000E+00 | -7.073  | .065           |
| 3     | -6.82   | .237        | .0056       | .1068          | .000E+00 | .000E+00 | -6.820  | .090           |
| Fbar  |         | SIGMA(int.) | SIGMA(ext.) | SIGMA(overall) |          |          |         | Variance ratio |
|       | .120    | .134        | .121        | .134           |          |          |         | .821           |

cont'd.



Table 8.6 cont'd.

| Age 5  |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|
| Fleet, | 85,    | 86,    | 87,    | 88,    | 89,    | 90     |
| 1      | -11.85 | -11.88 | -11.99 | -11.83 | -11.25 | -11.43 |
| 2      | -6.90  | -6.55  | -6.85  | -6.92  | -7.29  | -6.91  |
| 3      | -7.59  | -6.88  | -7.33  | -7.13  | -6.78  | -7.38  |

| SUMMARY STATISTICS |        |             |             |        |                |          |                |         |
|--------------------|--------|-------------|-------------|--------|----------------|----------|----------------|---------|
| Fleet              | Pred.  | SE(q)       | Partial     | Raised | SLOPE          | SE       | INTRCPT        | SE      |
|                    | q      |             | F           | F      |                | Slope    |                | Intrcpt |
| 1                  | -11.70 | .315        | .0008       | .1824  | .000E+00       | .000E+00 | -11.705        | .119    |
| 2                  | -6.90  | .252        | .0056       | .2428  | .000E+00       | .000E+00 | -6.903         | .095    |
| 3                  | -7.18  | .335        | .0039       | .2927  | .000E+00       | .000E+00 | -7.182         | .127    |
| Fbar               |        | SIGMA(int.) | SIGMA(ext.) |        | SIGMA(overall) |          | Variance ratio |         |
|                    | .234   | .170        | .125        |        | .170           |          | .547           |         |

| Age 6  |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|
| Fleet, | 85,    | 86,    | 87,    | 88,    | 89,    | 90     |
| 1      | -14.86 | -12.25 | -12.26 | -12.34 | -10.66 | -11.95 |
| 2      | -7.09  | -5.82  | -6.48  | -7.16  | 6.97   | -7.31  |
| 3      | -6.48  | -7.22  | -7.42  | 7.01   | 7.19   | -6.85  |

| SUMMARY STATISTICS |        |             |             |        |                |          |                |         |
|--------------------|--------|-------------|-------------|--------|----------------|----------|----------------|---------|
| Fleet              | Pred.  | SE(q)       | Partial     | Raised | SLOPE          | SE       | INTRCPT        | SE      |
|                    | q      |             | F           | F      |                | Slope    |                | Intrcpt |
| 1                  | -12.39 | 1.474       | .0004       | .0731  | .000E+00       | .000E+00 | -12.388        | .557    |
| 2                  | -6.80  | .604        | .0062       | .1874  | .000E+00       | .000E+00 | -6.803         | .226    |
| 3                  | -7.03  | .357        | .0045       | .0945  | .000E+00       | .000E+00 | -7.029         | .135    |
| Fbar               |        | SIGMA(int.) | SIGMA(ext.) |        | SIGMA(overall) |          | Variance ratio |         |
|                    | .111   | .301        | .216        |        | .301           |          | .517           |         |

| Age 7  |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|
| Fleet, | 85,    | 86,    | 87,    | 88,    | 89,    | 90     |
| 1      | -11.29 | -14.45 | -16.11 | -12.02 | -10.60 | -11.69 |
| 2      | -7.07  | -7.19  | 6.10   | -7.20  | -6.53  | -6.98  |
| 3      | -8.26  | -7.51  | -7.24  | -7.75  | -6.94  | -7.37  |

| SUMMARY STATISTICS |        |             |             |        |                |          |                |         |
|--------------------|--------|-------------|-------------|--------|----------------|----------|----------------|---------|
| Fleet              | Pred.  | SE(q)       | Partial     | Raised | SLOPE          | SE       | INTRCPT        | SE      |
|                    | q      |             | F           | F      |                | Slope    |                | Intrcpt |
| 1                  | -12.69 | 2.298       | .0003       | .0509  | .000E+00       | .000E+00 | 12.694         | .869    |
| 2                  | -6.85  | .477        | .0060       | .1598  | .000E+00       | .000E+00 | -6.846         | .180    |
| 3                  | -7.51  | .492        | .0028       | .1210  | .000E+00       | .000E+00 | -7.510         | .186    |
| Fbar               |        | SIGMA(int.) | SIGMA(ext.) |        | SIGMA(overall) |          | Variance ratio |         |
|                    | .137   | .339        | .143        |        | .339           |          | .177           |         |

| Age 8  |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|
| Fleet, | 85,    | 86,    | 87,    | 88,    | 89,    | 90     |
| 1      | -11.96 | -12.78 | -14.05 | -13.42 | -11.35 | -11.83 |
| 2      | -7.99  | -5.74  | -6.04  | -6.85  | -6.32  | 6.97   |
| 3      | -7.39  | -6.75  | -7.37  | -8.98  | -6.70  | -7.53  |

| SUMMARY STATISTICS |        |             |             |        |                |          |                |         |
|--------------------|--------|-------------|-------------|--------|----------------|----------|----------------|---------|
| Fleet              | Pred.  | SE(q)       | Partial     | Raised | SLOPE          | SE       | INTRCPT        | SE      |
|                    | q      |             | F           | F      |                | Slope    |                | Intrcpt |
| 1                  | -12.56 | 1.117       | .0003       | .0506  | .000E+00       | .000E+00 | -12.565        | .422    |
| 2                  | -6.65  | .871        | .0072       | .1451  | .000E+00       | .000E+00 | -6.653         | .329    |
| 3                  | -7.45  | .892        | .0030       | .1145  | .000E+00       | .000E+00 | -7.453         | .337    |
| Fbar               |        | SIGMA(int.) | SIGMA(ext.) |        | SIGMA(overall) |          | Variance ratio |         |
|                    | .103   | .544        | .291        |        | .544           |          | .286           |         |

Table 8.7

Title : Haddock in the Faroe Grounds (Fishing Area Vb)  
 At 09.22.38 07 MAY 1991  
 from 81 to 90 on ages 2 to 9  
 with Terminal F of .154 on age 4 and Terminal S of 1.000

Initial sum of squared residuals was 54.320 and  
 final sum of squared residuals is 13.096 after 72 iterations

## Matrix of Residuals

| Years<br>Ages           | 81/82 | 82/83 | 83/84  | 84/85  | 85/86  | 86/87 | 87/88  | 88/89  | 89/90  | WTS   |       |
|-------------------------|-------|-------|--------|--------|--------|-------|--------|--------|--------|-------|-------|
| 2/ 3                    | -.521 | -.113 | .010   | .220   | .414   | -.369 | .793   | .896   | -1.329 | .000  | .397  |
| 3/ 4                    | .096  | .685  | -.309  | -.133  | .043   | -.033 | -.454  | .012   | .094   | .000  | .863  |
| 4/ 5                    | -.205 | -.063 | .415   | .446   | -.059  | .264  | .375   | -.154  | -.267  | .000  | .911  |
| 5/ 6                    | .235  | .357  | -.074  | -.496  | -.024  | .056  | -.325  | .027   | .244   | .000  | 1.000 |
| 6/ 7                    | .195  | -.603 | -.082  | .375   | .706   | -.138 | -.019  | -.283  | -.151  | .000  | .718  |
| 7/ 8                    | .588  | -.288 | .088   | -.501  | -.673  | -.787 | .829   | -.055  | .799   | .000  | .442  |
| 8/ 9                    | -.705 | -.623 | -.046  | .152   | -.726  | .709  | .852   | -.052  | .438   | .000  | .459  |
|                         | .000  | .000  | .000   | .000   | .000   | .000  | .000   | .000   | .000   | .002  |       |
| WTS                     | 1.000 | 1.000 | 1.000  | 1.000  | 1.000  | 1.000 | 1.000  | 1.000  | 1.000  |       |       |
| Fishing Mortalities (F) |       |       |        |        |        |       |        |        |        |       |       |
| F-values                | 81    | 82    | 83     | 84     | 85     | 86    | 87     | 88     | 89     | 90    |       |
|                         | .1601 | .2651 | .1878  | .1434  | .1450  | .1202 | .1317  | .0968  | .1159  | .1540 |       |
| Selection-at-age (S)    |       |       |        |        |        |       |        |        |        |       |       |
| S-values                | 2     | 3     | 4      | 5      | 6      | 7     | 8      | 9      |        |       |       |
|                         | .0997 | .5999 | 1.0000 | 1.1064 | 1.0960 | .8625 | 1.0507 | 1.0000 |        |       |       |

Table 8.8 VPA.

Haddock in the Faroe Grounds (Fishing Area Vb)

| FISHING MORTALITY COEFFICIENT | UNIT: Year-1 |      |      |      |      |      |      |      |      |      | NATURAL MORTALITY COEFFICIENT = .20 |
|-------------------------------|--------------|------|------|------|------|------|------|------|------|------|-------------------------------------|
|                               | 1981         | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |                                     |
| 2                             | .018         | .026 | .017 | .019 | .016 | .006 | .024 | .021 | .005 | .015 |                                     |
| 3                             | .101         | .323 | .124 | .078 | .094 | .054 | .055 | .049 | .062 | .150 |                                     |
| 4                             | .128         | .253 | .212 | .224 | .149 | .125 | .099 | .106 | .095 | .124 |                                     |
| 5                             | .167         | .282 | .210 | .117 | .168 | .146 | .115 | .116 | .168 | .181 |                                     |
| 6                             | .177         | .208 | .133 | .173 | .192 | .143 | .152 | .115 | .135 | .177 |                                     |
| 7                             | .170         | .186 | .206 | .082 | .094 | .062 | .144 | .090 | .147 | .167 |                                     |
| 8                             | .111         | .185 | .211 | .183 | .164 | .188 | .181 | .056 | .141 | .107 |                                     |
| 9                             | .160         | .357 | .225 | .163 | .154 | .291 | .098 | .054 | .064 | .114 |                                     |
| 10+                           | .160         | .357 | .225 | .163 | .154 | .291 | .098 | .054 | .064 | .114 |                                     |
| ( 4- 8)U                      | .151         | .223 | .195 | .156 | .153 | .133 | .138 | .097 | .137 | .151 |                                     |



Table 9.1 Nominal catch (tonnes) of Blue Ling in Division Va, 1980-1990, as officially reported to ICES.

| BLUE LING Va  |       |       |       |       |       |       |       |       |       |       |                   |
|---------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------------------|
| Country       | 1980  | 1981  | 1982  | 1983  | 1984  | 1985  | 1986  | 1987  | 1988  | 1989  | 1990 <sup>1</sup> |
| Faroe Islands | 183   | 220   | 224   | 1,195 | 353   | 59    | 69    | 75    | 271   | 403   | 1,029             |
| Iceland       | 8,133 | 7,952 | 5,945 | 5,117 | 3,122 | 1,407 | 1,774 | 1,693 | 1,093 | 2,124 | -                 |
| Norway        | 229   | 64    | 402   | 402   | 31    | 7     | 8     | 8     | 7     | 5     | -                 |
| Total         | 8,399 | 8,401 | 6,233 | 6,714 | 3,506 | 1,473 | 1,851 | 1,776 | 1,371 | 2,532 | 1,029             |

<sup>1</sup>Preliminary.

Table 9.2 Nominal catch (tonnes) of Blue Ling in Division Vb, 1980-1990, as officially reported to ICES.

| BLUE LING Vb      |                    |       |       |                  |       |       |       |       |       |       |                   |
|-------------------|--------------------|-------|-------|------------------|-------|-------|-------|-------|-------|-------|-------------------|
| Country           | 1980               | 1981  | 1982  | 1983             | 1984  | 1985  | 1986  | 1987  | 1988  | 1989  | 1990 <sup>1</sup> |
| Faroe Islands     | 1,223              | 1,529 | 2,889 | 4,396            | 7,210 | 4,434 | 4,880 | 3,071 | 6,275 | 3,090 | 1,014             |
| France            | 2,427 <sup>2</sup> | 371   | 843   | 668              | 515   | 1,193 | 2,578 | 3,246 | 3,036 | 1,802 | -                 |
| Germany, Fed.Rep. | 5,905              | 2,867 | 2,538 | 223 <sup>2</sup> | 214   | 217   | 197   | 152   | 49    | 51    | -                 |
| Norway            | 463                | 260   | 187   | 438              | 155   | 210   | 126   | 171   | 166   | 323   | -                 |
| Total             | 10,020             | 5,027 | 6,457 | 5,725            | 8,094 | 6,054 | 7,781 | 6,640 | 9,526 | 5,266 | 1,014             |

<sup>1</sup>Preliminary.

<sup>2</sup>Includes Sub-division Vb2.

Table 9.3 Nominal catch (tonnes) of Blue Ling in Sub-area VI, 1980-1990, as officially reported to ICES.

| BLUE LING VIa      |       |       |       |       |       |       |       |       |       |       |                   |
|--------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------------------|
| Country            | 1980  | 1981  | 1982  | 1983  | 1984  | 1985  | 1986  | 1987  | 1988  | 1989  | 1990 <sup>1</sup> |
| Faroe Islands      | -     | -     | -     | -     | -     | 56    | -     | -     | 14    | 6     | -                 |
| France             | 2,124 | 3,338 | 3,430 | 5,233 | 3,653 | 5,670 | 7,628 | 9,389 | 6,335 | 7,383 | -                 |
| Germany, Fed. Rep. | 773   | 335   | 79    | 11    | 183   | 5     | 7     | 44    | 2     | 2     | -                 |
| Norway             | 10    | 11    | 16    | 118   | 45    | 75    | 50    | 51    | 29    | 142   | -                 |
| UK                 | -     | 1     | 99    | 13    | 5     | 2     | 3     | 13    | 3     | +     | -                 |
| Total              | 2,907 | 3,685 | 3,624 | 5,375 | 3,886 | 5,808 | 7,688 | 9,497 | 6,383 | 7,533 | -                 |

<sup>1</sup> Preliminary.

| BLUE LING VIb      |       |       |      |      |       |       |       |      |       |       |                   |
|--------------------|-------|-------|------|------|-------|-------|-------|------|-------|-------|-------------------|
| Country            | 1980  | 1981  | 1982 | 1983 | 1984  | 1985  | 1986  | 1987 | 1988  | 1989  | 1990 <sup>1</sup> |
| Faroe Islands      | -     | -     | -    | -    | 133   | 11    | 1,845 | -    | 2,000 | 1,292 | 360               |
| France             | 3,827 | 534   | 263  | 243  | 3,281 | 7,263 | 2,141 | 10   | 499   | 61    | -                 |
| Germany, Fed. Rep. | 5,526 | 3,944 | 554  | 38   | -     | 31    | 39    | 333  | 37    | 22    | -                 |
| Norway             | 8     | 5     | 13   | 50   | 43    | 38    | 66    | 76   | 42    | 217   | -                 |
| UK                 | +     | -     | 1    | 2    | -     | -     | 8     | 72   | 23    | 16    | -                 |
| Total              | 9,361 | 4,483 | 831  | 333  | 3,457 | 7,343 | 4,099 | 491  | 2,601 | 1,608 | 360               |

<sup>1</sup> Preliminary.

Table 9.4 Nominal catch (tonnes) of Blue Ling in Sub-area XIV, 1980-1990, as officially reported to ICES.

| BLUE LING XIVb                  |      |       |       |      |      |      |      |      |      |      |                   |
|---------------------------------|------|-------|-------|------|------|------|------|------|------|------|-------------------|
| Country                         | 1980 | 1981  | 1982  | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 <sup>1</sup> |
| Faroe Islands                   | -    | -     | -     | -    | -    | -    | -    | -    | 4    | 13   | -                 |
| Germany, Fed. Rep. <sup>2</sup> | 46   | 1,206 | 1,946 | 621  | 537  | 314  | 150  | 199  | 219  | 57   | -                 |
| Greenland <sup>2</sup>          | -    | -     | -     | -    | -    | -    | -    | -    | 3    | +    | -                 |
| Total                           | 746  | 1,206 | 1,946 | 621  | 537  | 314  | 150  | 199  | 226  | 70   | -                 |

<sup>1</sup> Preliminary.

<sup>2</sup> Includes Division XIVa.

Table 9.5 BLUE LING. Landings (tonnes) in Divisions Va, Vb, VIa, VIb and Sub-area XIV, as used by the Working Group.

| BLUE LING |      |       |      |      |      |       |
|-----------|------|-------|------|------|------|-------|
|           | Va   | Vb    | VIa  | VIb  | XIV  | Total |
| 1980      | 8399 | 10020 | 2907 | 9361 | 746  | 31433 |
| 1981      | 8401 | 5027  | 3685 | 4483 | 1206 | 22802 |
| 1982      | 6233 | 6282  | 3624 | 831  | 1946 | 18916 |
| 1983      | 6714 | 5725  | 5375 | 333  | 621  | 18768 |
| 1984      | 3506 | 8094  | 3886 | 3457 | 537  | 19480 |
| 1985      | 1473 | 6054  | 5808 | 7343 | 314  | 20992 |
| 1986      | 1851 | 7781  | 7688 | 4099 | 150  | 21569 |
| 1987      | 1776 | 6640  | 9497 | 491  | 199  | 18603 |
| 1988      | 1371 | 9556  | 6383 | 2601 | 226  | 20137 |
| 1989      | 2532 | 5135  | 7533 | 1608 | 70   | 16878 |
| 1990      | 3019 | 3432  | 4588 | 1609 | 69   | 12717 |
| Avg 80-89 | 4226 | 7031  | 5639 | 3461 | 602  | 20958 |

Table 9.6 BLUE LING in Sub-area VI and Division Vb. Total international effort and catch per unit of effort estimated from French catch and effort data for the years 1975-1985 and 1988-1990.

| Year  | France             |                        | International      |                        | CPUE                |
|-------|--------------------|------------------------|--------------------|------------------------|---------------------|
|       | Catch in<br>1000 t | Effort in<br>mill. hrs | Catch in<br>1000 t | Effort in<br>mill. hrs | Kgs per<br>1000 hrs |
| 1975  | 3.9                | 75.3                   | 7.0                | 135.2                  | 51.8                |
| 1976  | 4.1                | 89.9                   | 19.2               | 421.0                  | 45.6                |
| 1977  | 10.0               | 93.5                   | 17.8               | 166.4                  | 107.0               |
| 1978  | 6.4                | 82.4                   | 13.0               | 167.4                  | 77.7                |
| 1979  | 3.6                | 76.3                   | 10.1               | 214.1                  | 47.2                |
| 1980  | 3.2                | 68.1                   | 22.3               | 474.6                  | 47.0                |
| 1981  | 3.2                | 67.2                   | 13.2               | 277.2                  | 47.6                |
| 1982  | 3.2                | 61.9                   | 10.9               | 210.8                  | 51.7                |
| 1983  | 4.2                | 63.6                   | 11.5               | 174.1                  | 66.0                |
| 1984  | 5.6                | 64.1                   | 15.4               | 176.3                  | 87.4                |
| 1985  | 7.3                | 72.4                   | 19.2               | 190.4                  | 100.8               |
| ----- |                    |                        |                    |                        |                     |
| 1988  | 6.6                | 132.9                  | 18.3               | 368.5                  | 49.7                |
| 1989  | 9.2                | 142.1                  | 14.4               | 222.4                  | 64.2                |
| 1990  | 7.3                | 151.2                  | 9.6                | 198.8                  | 48.3                |

Table 9.7 BLUE LING in Division VIa. French age compositions and mean weight at age for the years 1988, 1989 and 1990.

| Age            | 1988 |         | 1989 |         | 1990 |         |
|----------------|------|---------|------|---------|------|---------|
|                | n    | Wt      | n    | Wt      | n    | Wt      |
| 4              |      |         |      |         | 4    | 0.300   |
| 5              |      |         |      |         | 26   | 0.672   |
| 6              |      |         | 4    |         | 94   | 1.320   |
| 7              | 34   | 2.002   | 54   | 1.777   | 83   | 1.455   |
| 8              | 140  | 2.140   | 105  | 2.201   | 67   | 1.820   |
| 9              | 301  | 2.791   | 343  | 2.673   | 111  | 2.297   |
| 10             | 356  | 2.702   | 403  | 3.046   | 114  | 2.691   |
| 11             | 153  | 3.217   | 368  | 3.581   | 129  | 3.021   |
| 12             | 194  | 3.262   | 244  | 3.931   | 84   | 3.473   |
| 13             | 136  | 3.766   | 235  | 4.554   | 141  | 3.721   |
| 14             | 160  | 3.886   | 214  | 4.717   | 136  | 4.207   |
| 15             | 67   | 4.006   | 73   | 5.078   | 99   | 4.625   |
| 16             | 87   | 3.741   | 54   | 5.885   | 77   | 4.971   |
| 17             | 93   | 4.662   | 19   | 6.839   | 59   | 5.675   |
| 18             | 68   | 5.125   | 9    | 6.327   | 44   | 5.447   |
| 19             | 42   | 5.509   | 8    | 3.279   | 36   | 4.730   |
| 20             | 31   | 7.928   | 8    | 3.731   | 10   | 5.409   |
| 21             | 6    | 6.780   | 13   | 5.497   | 5    | 4.224   |
| 22             | 21   | 4.429   |      |         | 2    | 10.570  |
| 23             | 19   | 5.303   |      |         | 10   | 5.374   |
| 24             | 4    | 4.760   |      |         |      |         |
| Mean           | 12.3 | 3.418   | 11.4 | 3.636   | 12.0 | 3.352   |
| Catch Wt.      |      | 6.605   |      | 7.383   |      | 4.487   |
| Fish. eff.     |      | 132.902 |      | 133.422 |      | 139.442 |
| CPUE (kg/hour) |      | 49.70   |      | 55.34   |      | 32.18   |

Table 9.8

Blue Ling Va and XIV

SHOT forecast spreadsheet version 3  
January 1989

running recruitment weights

older 0.25  
central 0.50  
younger 0.25

G-M = 0.00  
exp(d) 1.00  
ex exp(d/2) 1.00

| Year | Land<br>-ings | Recrt<br>Index | W'td<br>Index | Y/B<br>Ratio | Hang<br>-over | Act'l<br>Prodn | Est'd<br>Prodn | Est'd<br>SQC. | Act'l<br>Expl<br>Biom | Est'd<br>Expl<br>Biom | Est'd<br>Land<br>-ings |
|------|---------------|----------------|---------------|--------------|---------------|----------------|----------------|---------------|-----------------------|-----------------------|------------------------|
| 1978 |               | 1              |               | 0.20         | 0.80          |                |                |               | 0                     |                       |                        |
| 1979 |               | 1              | 1             | 0.20         | 0.80          | 0              |                |               | 0                     |                       |                        |
| 1980 | 9145          | 1              | 1             | 0.20         | 0.80          | 45725          |                |               | 45725                 |                       |                        |
| 1981 | 9607          | 1              | 1             | 0.20         | 0.80          | 11455          |                |               | 48035                 |                       |                        |
| 1982 | 8179          | 1              | 1             | 0.20         | 0.80          | 2467           | 19060          | 11498         | 40895                 | 57488                 | 11498                  |
| 1983 | 7335          | 1              | 1             | 0.20         | 0.80          | 3959           | 14912          | 9526          | 36675                 | 47628                 | 9526                   |
| 1984 | 4043          | 1              | 1             | 0.20         | 0.80          | -9125          | 12721          | 8412          | 20215                 | 42061                 | 8412                   |
| 1985 | 1787          | 1              | 1             | 0.20         | 0.80          | -7237          | 9080           | 5050          | 8935                  | 25252                 | 5050                   |
| 1986 | 2001          | 1              | 1             | 0.20         | 0.80          | 2857           | 6749           | 2779          | 10005                 | 13897                 | 2779                   |
| 1987 | 1975          | 1              | 1             | 0.20         | 0.80          | 1871           | 6263           | 2853          | 9875                  | 14267                 | 2853                   |
| 1988 | 1597          | 1              | 1             | 0.20         | 0.80          | 85             | 5775           | 2735          | 7985                  | 13675                 | 2735                   |
| 1989 | 2602          | 1              | 1             | 0.20         | 0.80          | 6622           | 5206           | 2319          | 13010                 | 11594                 | 2319                   |
| 1990 | 3088          | 1              | 1             | 0.20         | 0.80          | 5032           | 5334           | 3148          | 15440                 | 15742                 | 3148                   |
| 1991 |               | 1              | 1             | 0.20         | 0.80          |                | 5309           | 2642          |                       | 13209                 | 2642                   |
| 1992 |               | 1              | 1             | 0.20         | 0.80          |                | 5309           | 3175          |                       | 15877                 | 3175                   |
| 1993 |               | 1              | 1             | 0.20         | 0.80          |                | 4338           | 3408          |                       | 17039                 | 3408                   |

Table 9.9

Blue Ling VI and Vb

SHOT forecast spreadsheet version 3  
January 1989

running recruitment weights

older 0.25  
central 0.50  
younger 0.25

G-M = 0.00  
exp(d) 1.00  
ex exp(d/2) 1.00

| Year | Land<br>-ings | Recrt<br>Index | W'td<br>Index | Y/B<br>Ratio | Hang<br>-over | Act'l<br>Prodn | Est'd<br>Prodn | Est'd<br>SQC. | Act'l<br>Expl<br>Biom | Est'd<br>Expl<br>Biom | Est'd<br>Land<br>-ings |
|------|---------------|----------------|---------------|--------------|---------------|----------------|----------------|---------------|-----------------------|-----------------------|------------------------|
| 1978 |               | 1              |               | 0.20         | 0.80          |                |                |               | 0                     |                       |                        |
| 1979 |               | 1              | 1             | 0.20         | 0.80          | 0              |                |               | 0                     |                       |                        |
| 1980 | 22288         | 1              | 1             | 0.20         | 0.80          | 111440         |                |               | 111440                |                       |                        |
| 1981 | 13195         | 1              | 1             | 0.20         | 0.80          | -23177         |                |               | 65975                 |                       |                        |
| 1982 | 10737         | 1              | 1             | 0.20         | 0.80          | 905            | 29421          | 16440         | 53685                 | 82201                 | 16440                  |
| 1983 | 11433         | 1              | 1             | 0.20         | 0.80          | 14217          | 22292          | 13048         | 57165                 | 65240                 | 13048                  |
| 1984 | 15437         | 1              | 1             | 0.20         | 0.80          | 31453          | 20677          | 13282         | 77185                 | 66409                 | 13282                  |
| 1985 | 19205         | 1              | 1             | 0.20         | 0.80          | 34277          | 22473          | 16844         | 96025                 | 84221                 | 16844                  |
| 1986 | 19568         | 1              | 1             | 0.20         | 0.80          | 21020          | 24159          | 20196         | 97840                 | 100979                | 20196                  |
| 1987 | 16628         | 1              | 1             | 0.20         | 0.80          | 4868           | 23767          | 20408         | 83140                 | 102039                | 20408                  |
| 1988 | 18540         | 1              | 1             | 0.20         | 0.80          | 26188          | 21667          | 17636         | 92700                 | 88179                 | 17636                  |
| 1989 | 14276         | 1              | 1             | 0.20         | 0.80          | -2780          | 22119          | 19256         | 71380                 | 96279                 | 19256                  |
| 1990 | 9629          | 1              | 1             | 0.20         | 0.80          | -8959          | 19856          | 15392         | 48145                 | 76960                 | 15392                  |
| 1991 |               | 1              | 1             | 0.20         | 0.80          |                | 17454          | 16793         |                       | 83966                 | 16793                  |
| 1992 |               | 1              | 1             | 0.20         | 0.80          |                | 17454          | 16925         |                       | 84627                 | 16925                  |
| 1993 |               | 1              | 1             | 0.20         | 0.80          |                | 18433          | 17227         |                       | 86135                 | 17227                  |



Table 10.1 Nominal catch (tonnes) of Ling in Division Va, 1980-1990, as officially reported to ICES.

| Country       | 1980  | 1981  | 1982  | 1983  | 1984  | 1985  | 1986  | 1987  | 1988  | 1989  | 1990 <sup>1</sup> |
|---------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------------------|
| Belgium       | 445   | 196   | 116   | 128   | 103   | 59    | 88    | 157   | 134   | 95    | -                 |
| Faroe Islands | 607   | 489   | 524   | 644   | 450   | 384   | 556   | 657   | 619   | 614   | 399               |
| Iceland       | 3,149 | 3,348 | 3,733 | 4,256 | 3,304 | 2,980 | 2,946 | 4,161 | 5,098 | 4,896 | -                 |
| Norway        | 423   | 415   | 612   | 115   | 21    | 17    | 4     | 6     | 10    | 5     | -                 |
| Total         | 4,624 | 4,448 | 4,985 | 5,143 | 3,878 | 3,440 | 3,594 | 4,981 | 5,861 | 5,610 | 399               |

<sup>1</sup>Preliminary.

Table 10.2 Nominal catch (tonnes) of Ling in Division Vb, 1980-1990, as officially reported to ICES.

LING Vb

| Country            | 1980  | 1981  | 1982  | 1983  | 1984  | 1985  | 1986  | 1987  | 1988  | 1989  | 1990 <sup>1</sup> |
|--------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------------------|
| Denmark            | -     | -     | -     | -     | -     | -     | 4     | 16    | 4     | -     | -                 |
| Faroe Islands      | 1,821 | 1,400 | 2,370 | 2,505 | 2,821 | 3,190 | 2,583 | 3,958 | 2,215 | 2,826 | 1,735             |
| France             | 49    | 13    | 16    | 155   | 11    | 40    | 123   | 384   | 53    | 44    | -                 |
| Germany, Fed. Rep. | 12    | 1     | 3     | 5     | 6     | 3     | 6     | 8     | 4     | 2     | -                 |
| Norway             | 2,411 | 2,776 | 3,614 | 2,746 | 1,566 | 1,955 | 2,240 | 1,999 | 2,168 | 2,743 | -                 |
| UK                 | 212   | 28    | 94    | 48    | 4     | 2     | 1     | 2     | 6     | 3     | -                 |
| Total              | 4,510 | 4,218 | 6,097 | 5,459 | 4,408 | 5,190 | 4,957 | 6,367 | 4,450 | 4,652 | 1,735             |

<sup>1</sup>Preliminary.

**Table 10.3** Nominal catch (tonnes) of Ling in Sub-area VI, 1980-1990, as officially reported to ICES.

| LING VIa           |                 |              |               |               |               |               |               |               |               |                   |                   |
|--------------------|-----------------|--------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|-------------------|-------------------|
| Country            | 1980            | 1981         | 1982          | 1983          | 1984          | 1985          | 1986          | 1987          | 1988          | 1989 <sup>1</sup> | 1990 <sup>1</sup> |
| Belgium            | -               | -            | 4             | -             | 1             | 4             | -             | 4             | 4             | 6                 | -                 |
| Denmark            | 44 <sup>2</sup> | -            | 1             | -             | -             | -             | -             | 1             | +             | 1                 | -                 |
| Faroe Islands      | -               | -            | 20            | -             | -             | -             | -             | -             | -             | 6                 | 8                 |
| France             | 3,092           | 3,820        | 5,049         | 5,362         | 5,757         | 6,061         | 4,620         | 4,338         | 5,118         | 3,414             | -                 |
| Germany, Fed. Rep. | 1               | -            | -             | -             | 14            | 8             | 6             | 2             | 6             | 11                | -                 |
| Ireland            | 34              | 44           | 34            | 62            | 49            | 81            | 255           | 287           | 196           | 138               | -                 |
| Norway             | 2,932           | 2,150        | 4,499         | 5,943         | 4,667         | 4,779         | 5,426         | 3,842         | 3,392         | 3,755             | -                 |
| Spain              | -               | -            | 461           | 604           | 720           | 388           | 620           | 975           | 580           | -                 | -                 |
| UK                 | 292             | 502          | 389           | 314           | 442           | 640           | 435           | 1,087         | 2,002         | 1,252             | -                 |
| <b>Total</b>       | <b>6,395</b>    | <b>6,516</b> | <b>10,457</b> | <b>12,285</b> | <b>11,650</b> | <b>11,961</b> | <b>11,362</b> | <b>10,536</b> | <b>11,298</b> | <b>8,583</b>      | <b>8</b>          |

| LING VIb           |              |              |              |              |              |              |              |              |              |              |                   |
|--------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|-------------------|
| Country            | 1980         | 1981         | 1982         | 1983         | 1984         | 1985         | 1986         | 1987         | 1988         | 1989         | 1990 <sup>1</sup> |
| Faroe Islands      | 236          | 4            | 123          | 204          | 153          | 24           | 6            | -            | 196          | 17           | 3                 |
| France             | 3            | 5            | 13           | 8            | 34           | 140          | 24           | 4            | 8            | 2            | -                 |
| Germany, Fed. Rep. | -            | +            | -            | -            | -            | -            | -            | 2            | -            | -            | -                 |
| Norway             | 1,096        | 1,083        | 1,711        | 2,315        | 2,345        | 1,973        | 2,157        | 1,933        | 1,253        | 3,542        | -                 |
| Spain              | 620          | 590          | 1,911        | 1,889        | 986          | 2,381        | 2,762        | 4,036        | 2,995        | -            | -                 |
| UK                 | 235          | 192          | 84           | 30           | 57           | 202          | 236          | 315          | 317          | 125          | -                 |
| <b>Total</b>       | <b>2,190</b> | <b>1,874</b> | <b>3,842</b> | <b>4,446</b> | <b>3,575</b> | <b>4,720</b> | <b>5,185</b> | <b>6,290</b> | <b>4,769</b> | <b>3,686</b> | <b>3</b>          |

<sup>1</sup> Preliminary.

<sup>2</sup> Includes Division VIb.

**Table 10.4** Nominal catch (tonnes) of Ling in Sub-area XIV, 1980-1990, as officially reported to ICES.

| LING XIVb         |                  |                  |                |                |          |          |           |          |          |          |                   |
|-------------------|------------------|------------------|----------------|----------------|----------|----------|-----------|----------|----------|----------|-------------------|
| Country           | 1980             | 1981             | 1982           | 1983           | 1984     | 1985     | 1986      | 1987     | 1988     | 1989     | 1990 <sup>1</sup> |
| Faroe Islands     | -                | 13               | -              | -              | -        | -        | 17        | -        | -        | -        | -                 |
| Germany, Fed.Rep. | 208 <sup>2</sup> | 298 <sup>2</sup> | 8 <sup>2</sup> | 1 <sup>2</sup> | 6        | 1        | 2         | 1        | 3        | -        | -                 |
| <b>Total</b>      | <b>208</b>       | <b>311</b>       | <b>8</b>       | <b>1</b>       | <b>6</b> | <b>1</b> | <b>19</b> | <b>1</b> | <b>3</b> | <b>-</b> | <b>-</b>          |

<sup>1</sup> Preliminary.

<sup>2</sup> Includes Division XIVa.

**Table 10.5** LING. Landings (tonnes) in Divisions Va, Vb, VIa, VIb and Sub-area XIV, as used by the Working Group.

| LING             |             |             |              |             |           |              |
|------------------|-------------|-------------|--------------|-------------|-----------|--------------|
|                  | Va          | Vb          | VIa          | VIb         | XIV       | Total        |
| 1980             | 4624        | 4510        | 6395         | 2190        | 208       | 17927        |
| 1981             | 4448        | 4218        | 6516         | 1874        | 311       | 17367        |
| 1982             | 4685        | 6097        | 10457        | 3842        | 8         | 25089        |
| 1983             | 5143        | 5459        | 12285        | 4446        | 1         | 27334        |
| 1984             | 3878        | 4408        | 11650        | 3575        | 6         | 23517        |
| 1985             | 3440        | 5190        | 11961        | 4720        | 1         | 25312        |
| 1986             | 3594        | 4957        | 11362        | 5185        | 19        | 25117        |
| 1987             | 4981        | 6367        | 10536        | 6290        | 1         | 28175        |
| 1988             | 5861        | 4450        | 11298        | 4769        | 3         | 26381        |
| 1989             | 5610        | 4652        | 9024         | 6001        | 0         | 25287        |
| 1990             | 5586        | 3844        | 5974         | 2142        | 1         | 17547        |
| <b>Avg 80-89</b> | <b>4626</b> | <b>5031</b> | <b>10148</b> | <b>4289</b> | <b>56</b> | <b>24151</b> |

Table 10.6 LING. Estimated total international effort and catch per unit of effort derived from the Norwegian long-line fisheries in Divisions Vb, VIa and VIb in the years 1984-1990.

| Division          | Norway       |                          | Total international |                          | CPUE                            |
|-------------------|--------------|--------------------------|---------------------|--------------------------|---------------------------------|
|                   | Landings (t) | Hooks x 10 <sup>-3</sup> | Landings (t)        | Hooks x 10 <sup>-3</sup> | Kg per hooks x 10 <sup>-3</sup> |
| 1984              |              |                          |                     |                          |                                 |
| Vb                | 1,566        | 10,429                   | 4,408               | 29,356                   | 150,158                         |
| VIa               | 4,155        | 17,714                   | 11,650              | 49,667                   | 234,560                         |
| VIb               | 2,160        | 18,786                   | 3,575               | 31,093                   | 114,979                         |
| Sum               | 7,881        | 46,929                   | 19,633              | 116,909                  | 167,935                         |
| 1985              |              |                          |                     |                          |                                 |
| Vb                | 1,953        | 13,357                   | 5,190               | 35,496                   | 146,216                         |
| VIa               | 4,779        | 27,714                   | 11,961              | 69,363                   | 172,440                         |
| VIb               | 1,973        | 17,571                   | 4,720               | 42,035                   | 112,287                         |
| Sum               | 8,705        | 58,642                   | 21,871              | 147,336                  | 148,443                         |
| 1986              |              |                          |                     |                          |                                 |
| Vb                | 2,239        | 13,214                   | 4,957               | 29,255                   | 169,442                         |
| VIa               | 5,426        | 54,857                   | 11,362              | 114,870                  | 98,912                          |
| VIb               | 2,157        | 41,929                   | 5,185               | 100,789                  | 51,444                          |
| Sum               | 9,822 1      | 10,000                   | 21,504              | 240,830                  | 89,291                          |
| 1987              |              |                          |                     |                          |                                 |
| Vb                | 1,999        | 15,143                   | 6,367               | 48,232                   | 132,008                         |
| VIa               | 3,842        | 22,286                   | 10,536              | 61,115                   | 172,395                         |
| VIb               | 1,933        | 19,714                   | 6,290               | 64,150                   | 98,052                          |
| Sum               | 7,774        | 57,143                   | 23,193              | 170,480                  | 136,045                         |
| 1988              |              |                          |                     |                          |                                 |
| Vb                | 2,168        | 20,643                   | 4,450               | 42,372                   | 105,023                         |
| VIa               | 3,392        | 22,500                   | 11,298              | 74,942                   | 150,756                         |
| VIb               | 1,253        | 10,786                   | 4,769               | 42,900                   | 116,169                         |
| Sum               | 6,813        | 53,929                   | 20,517              | 162,404                  | 126,333                         |
| 1989 <sup>1</sup> |              |                          |                     |                          |                                 |
| Vb                | 2,742        | 28,698                   | 4,652               | 48,688                   | 95,547                          |
| VIa               | 3,722        | 38,567                   | 9,024               | 93,942                   | 96,507                          |
| VIb               | 3,542        | 22,653                   | 6,001               | 38,380                   | 156,359                         |
| Sum               | 10,006       | 89,918                   | 19,677              | 196,652                  | 111,279                         |
| 1990              |              |                          |                     |                          |                                 |
| Vb                | 2,073        | 21,492                   | 3,844               | 41,965                   | 96,455                          |
| VIa               | 1,968        | 28,713                   | 5,974               | 56,358                   | 68,540                          |
| VIb               | 1,315        | 21,190                   | 2,142               | 34,493                   | 62,058                          |
| Sum               | 6,326        | 71,395                   | 11,960              | 134,980                  | 88,606                          |

<sup>1</sup> Estimated total international landings.

Table 10.7

Ling Va, Vb, VI, XIV

SHOT forecast spreadsheet version 3  
January 1989

| running recruitment weights |               |                |               |              |               |                |                |               |                       |                       |                        |
|-----------------------------|---------------|----------------|---------------|--------------|---------------|----------------|----------------|---------------|-----------------------|-----------------------|------------------------|
| older                       | 0.25          |                |               |              |               |                |                |               |                       |                       |                        |
| central                     | 0.50          |                |               |              |               |                |                |               |                       |                       |                        |
| younger                     | 0.25          |                |               |              |               |                |                |               |                       |                       |                        |
|                             |               |                |               |              |               | G-M =          | 0.00           |               |                       |                       |                        |
|                             |               |                |               |              |               | exp(d)         | 1.00           |               |                       |                       |                        |
|                             |               |                |               |              |               | ex exp(d/2)    | 1.00           |               |                       |                       |                        |
| Year                        | Land<br>-ings | Recrt<br>Index | W'td<br>Index | Y/B<br>Ratio | Hang<br>-over | Act'l<br>Prodn | Est'd<br>Prodn | Est'd<br>SQC. | Act'l<br>Expl<br>Biom | Est'd<br>Expl<br>Biom | Est'd<br>Land<br>-ings |
| 1978                        |               | 1              |               | 0.30         | 0.70          |                |                |               | 0                     |                       |                        |
| 1979                        |               | 1              | 1             | 0.30         | 0.70          | 0              |                |               | 0                     |                       |                        |
| 1980                        | 17927         | 1              | 1             | 0.30         | 0.70          | 59757          |                |               | 59757                 |                       |                        |
| 1981                        | 17367         | 1              | 1             | 0.30         | 0.70          | 16060          |                |               | 57890                 |                       |                        |
| 1982                        | 25089         | 1              | 1             | 0.30         | 0.70          | 43107          | 25272          | 19739         | 83630                 | 65795                 | 19739                  |
| 1983                        | 27334         | 1              | 1             | 0.30         | 0.70          | 32572          | 29731          | 26482         | 91113                 | 88272                 | 26482                  |
| 1984                        | 23517         | 1              | 1             | 0.30         | 0.70          | 14611          | 30299          | 28224         | 78390                 | 94079                 | 28224                  |
| 1985                        | 25312         | 1              | 1             | 0.30         | 0.70          | 29500          | 27685          | 24767         | 84373                 | 82558                 | 24767                  |
| 1986                        | 25117         | 1              | 1             | 0.30         | 0.70          | 24662          | 27944          | 26102         | 83723                 | 87005                 | 26102                  |
| 1987                        | 28175         | 1              | 1             | 0.30         | 0.70          | 35310          | 27534          | 25842         | 93917                 | 86140                 | 25842                  |
| 1988                        | 26381         | 1              | 1             | 0.30         | 0.70          | 22195          | 28398          | 28242         | 87937                 | 94139                 | 28242                  |
| 1989                        | 25287         | 1              | 1             | 0.30         | 0.70          | 22734          | 27777          | 26800         | 84290                 | 89333                 | 26800                  |
| 1990                        | 17547         | 1              | 1             | 0.30         | 0.70          | -513           | 27319          | 25897         | 58490                 | 86322                 | 25897                  |
| 1991                        |               | 1              | 1             | 0.30         | 0.70          |                | 25000          | 27222         |                       | 90741                 | 27222                  |
| 1992                        |               | 1              | 1             | 0.30         | 0.70          |                | 25000          | 26556         |                       | 88519                 | 26556                  |
| 1993                        |               | 1              | 1             | 0.30         | 0.70          |                | 23148          | 25533         |                       | 85111                 | 25533                  |

**Table 11.1** Nominal catch (tonnes) of Tusk (Cusk) in Division Va, 1980-1990, as officially reported to ICES.

| TUSK Va       |              |              |              |              |              |              |              |              |              |              |                   |
|---------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|-------------------|
| Country       | 1980         | 1981         | 1982         | 1983         | 1984         | 1985         | 1986         | 1987         | 1988         | 1989         | 1990 <sup>1</sup> |
| Faroe Islands | 2,873        | 2,624        | 2,410        | 4,046        | 2,008        | 1,885        | 2,811        | 2,638        | 3,757        | 3,908        | 2,475             |
| Iceland       | 3,089        | 2,827        | 2,804        | 3,469        | 3,430        | 3,068        | 2,549        | 2,984        | 3,078        | 3,131        | -                 |
| Norway        | 928          | 1,025        | 666          | 772          | 254          | 111          | 21           | 19           | 20           | 10           | -                 |
| <b>Total</b>  | <b>6,890</b> | <b>6,476</b> | <b>5,880</b> | <b>8,287</b> | <b>5,692</b> | <b>5,064</b> | <b>5,381</b> | <b>5,641</b> | <b>6,855</b> | <b>7,049</b> | <b>2,475</b>      |

<sup>1</sup> Preliminary.

**Table 11.2** Nominal catch (tonnes) of Tusk (Cusk) in Division Vb, 1980-1990, as officially reported to ICES.

| TUSK Vb            |              |              |              |              |              |              |              |              |              |              |                   |
|--------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|-------------------|
| Country            | 1980         | 1981         | 1982         | 1983         | 1984         | 1985         | 1986         | 1987         | 1988         | 1989         | 1990 <sup>1</sup> |
| Denmark            | -            | -            | -            | -            | -            | -            | +            | 2            | +            | -            | -                 |
| Faroe Islands      | 4,717        | 2,066        | 4,148        | 3,450        | 4,389        | 5,288        | 3,625        | 4,262        | 3,372        | 1,991        | 3,009             |
| France             | 24           | 14           | 14           | 15           | 25           | 34           | 24           | 54           | 81           | 64           | -                 |
| Germany, Fed. Rep. | 23           | 7            | 12           | 11           | 16           | 10           | 15           | 13           | 8            | 20           | -                 |
| Norway             | 2,688        | 2,748        | 2,092        | 1,935        | 1,537        | 1,975        | 1,566        | 2,198        | 2,204        | 3,065        | -                 |
| UK                 | 358          | 15           | 125          | 73           | 2            | +            | +            | +            | +            | +            | -                 |
| <b>Total</b>       | <b>7,810</b> | <b>4,850</b> | <b>6,391</b> | <b>5,484</b> | <b>5,361</b> | <b>7,307</b> | <b>5,220</b> | <b>6,529</b> | <b>5,665</b> | <b>5,122</b> | <b>3,009</b>      |

<sup>1</sup> Preliminary.

**Table 11.3** Nominal catch (tonnes) of Tusk (Cusk) in Sub-area VI, 1980-1990, as officially reported to ICES.

| TUSK VIa           |            |              |              |              |              |              |              |              |              |              |                   |
|--------------------|------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|-------------------|
| Country            | 1980       | 1981         | 1982         | 1983         | 1984         | 1985         | 1986         | 1987         | 1988         | 1989         | 1990 <sup>1</sup> |
| Faroe Islands      | -          | -            | -            | -            | -            | -            | -            | -            | -            | 4            | 9                 |
| France             | 241        | 322          | 355          | 418          | 514          | 767          | 608          | 627          | 724          | 694          | -                 |
| Germany, Fed. Rep. | 4          | 1            | -            | -            | 1            | 1            | +            | +            | 1            | 3            | -                 |
| Ireland            | -          | -            | -            | -            | -            | -            | -            | 1            | -            | -            | -                 |
| Norway             | 652        | 802          | 1,052        | 1,733        | 1,305        | 1,609        | 1,873        | 1,238        | 1,310        | 1,469        | -                 |
| UK                 | 14         | 95           | 7            | 3            | 6            | 2            | 6            | 16           | 43           | 10           | -                 |
| <b>Total</b>       | <b>912</b> | <b>1,220</b> | <b>1,830</b> | <b>2,404</b> | <b>1,826</b> | <b>2,379</b> | <b>2,487</b> | <b>1,882</b> | <b>2,078</b> | <b>2,180</b> | <b>9</b>          |

<sup>1</sup> Preliminary.

| TUSK VIb      |            |            |              |              |              |              |              |              |            |                    |                   |
|---------------|------------|------------|--------------|--------------|--------------|--------------|--------------|--------------|------------|--------------------|-------------------|
| Country       | 1980       | 1981       | 1982         | 1983         | 1984         | 1985         | 1986         | 1987         | 1988       | 1989               | 1990 <sup>1</sup> |
| Faroe Islands | 196        | 1          | 159          | 188          | 53           | 48           | 106          | -            | 217        | 41                 | 6                 |
| France        | -          | 1          | 3            | 3            | 4            | 3            | 9            | 2            | 4          | 1                  | -                 |
| Norway        | 503        | 568        | 468          | 1,080        | 960          | 944          | 952          | 1,385        | 601        | 1,537 <sup>1</sup> | -                 |
| UK (Scotland) | 214        | 181        | 101          | 25           | +            | 20           | 24           | 21           | 42         | 17                 | -                 |
| <b>Total</b>  | <b>913</b> | <b>752</b> | <b>2,829</b> | <b>3,198</b> | <b>1,017</b> | <b>1,015</b> | <b>1,091</b> | <b>1,408</b> | <b>864</b> | <b>1,596</b>       | <b>6</b>          |

<sup>1</sup> Preliminary.

**Table 11.4** Nominal catch (tonnes) of Tusk (Cusk) in Sub-area XIV, 1980-1990, as officially reported to ICES.

| TUSK XIVb         |                 |                 |                 |                 |          |          |           |           |           |           |                   |
|-------------------|-----------------|-----------------|-----------------|-----------------|----------|----------|-----------|-----------|-----------|-----------|-------------------|
| Country           | 1980            | 1981            | 1982            | 1983            | 1984     | 1985     | 1986      | 1987      | 1988      | 1989      | 1990 <sup>1</sup> |
| Faroe Islands     | -               | 110             | -               | 74              | -        | -        | 33        | 13        | 19        | 13        | -                 |
| Germany, Fed.Rep. | 13 <sup>2</sup> | 10 <sup>2</sup> | 10 <sup>2</sup> | 11 <sup>2</sup> | 5        | 4        | 2         | 2         | 2         | -         | -                 |
| <b>Total</b>      | <b>13</b>       | <b>120</b>      | <b>10</b>       | <b>85</b>       | <b>5</b> | <b>4</b> | <b>35</b> | <b>15</b> | <b>21</b> | <b>13</b> | <b>-</b>          |

<sup>1</sup> Preliminary.

<sup>2</sup> Includes Division XIVa.

**Table 11.5** TUSK. Landings (tonnes) in Divisions Va, Vb, VIa, VIb and Sub-area XIV, as used by the Working Group.

|                  | Va          | Vb          | VIa         | VIb         | XIV       | Total        |
|------------------|-------------|-------------|-------------|-------------|-----------|--------------|
| 1980             | 6890        | 7810        | 912         | 913         | 13        | 16538        |
| 1981             | 6476        | 4850        | 1220        | 752         | 10        | 13308        |
| 1982             | 5880        | 6391        | 1830        | 2829        | 10        | 16940        |
| 1983             | 8287        | 5484        | 2404        | 3198        | 85        | 19458        |
| 1984             | 5692        | 5361        | 1826        | 1017        | 5         | 13901        |
| 1985             | 5064        | 7307        | 2379        | 1015        | 4         | 15769        |
| 1986             | 5381        | 5220        | 2487        | 1091        | 35        | 14214        |
| 1987             | 5641        | 6529        | 1882        | 1408        | 15        | 15475        |
| 1988             | 6855        | 5665        | 2078        | 864         | 21        | 15483        |
| 1989             | 7049        | 5122        | 2180        | 1596        | 13        | 15960        |
| 1990             | 7314        | 6146        | 2246        | 765         | 0         | 16471        |
| <b>Avg 80-89</b> | <b>6322</b> | <b>5974</b> | <b>1920</b> | <b>1468</b> | <b>21</b> | <b>15705</b> |



**Table 11.6** TUSK. Estimated total international effort and catch per unit of effort derived from the Norwegian long-line fisheries in Divisions Vb, VIa and VIB in the years 1984-1990.

| Division          | Norway      |                                       | Total international |                                       | CPUE                             |
|-------------------|-------------|---------------------------------------|---------------------|---------------------------------------|----------------------------------|
|                   | Land-ings t | Hooks <sub>3</sub> x 10 <sup>-3</sup> | Land-ings t         | Hooks <sub>3</sub> x 10 <sup>-3</sup> | Kgs per hooks x 10 <sup>-3</sup> |
| 1984              |             |                                       |                     |                                       |                                  |
| Vb                | 1,537       | 10,429                                | 5,361               | 36,376                                | 147,378                          |
| VIa               | 1,170       | 17,714                                | 1,826               | 27,646                                | 66,049                           |
| VIB               | 868         | 18,786                                | 1,017               | 22,011                                | 46,205                           |
| Sum               | 3,575       | 46,929                                | 8,817               | 115,741                               | 76,179                           |
| 1985              |             |                                       |                     |                                       |                                  |
| Vb                | 1,972       | 13,357                                | 7,307               | 49,493                                | 147,638                          |
| VIa               | 1,735       | 27,714                                | 2,379               | 38,001                                | 62,604                           |
| VIB               | 944         | 17,571                                | 1,015               | 18,893                                | 53,725                           |
| Sum               | 4,651       | 58,642                                | 10,701              | 134,923                               | 79,312                           |
| 1986              |             |                                       |                     |                                       |                                  |
| Vb                | 1,556       | 13,214                                | 5,220               | 44,329                                | 117,754                          |
| VIa               | 1,873       | 54,857                                | 2,487               | 72,841                                | 34,143                           |
| VIB               | 952         | 41,929                                | 1,091               | 22,705                                | 22,705                           |
| Sum               | 4,381       | 110,000                               | 8,798               | 222,235                               | 39,827                           |
| 1987              |             |                                       |                     |                                       |                                  |
| Vb                | 2,198       | 15,143                                | 6,529               | 44,981                                | 145,150                          |
| VIa               | 1,238       | 22,286                                | 1,882               | 33,879                                | 55,551                           |
| VIB               | 1,385       | 19,714                                | 1,408               | 20,041                                | 70,255                           |
| Sum               | 4,821       | 57,143                                | 18,150              | 115,436                               | 84,367                           |
| 1988              |             |                                       |                     |                                       |                                  |
| Vb                | 2,205       | 20,643                                | 5,665               | 53,035                                | 106,816                          |
| VIa               | 1,310       | 22,500                                | 2,078               | 35,691                                | 58,222                           |
| VIB               | 601         | 10,786                                | 864                 | 15,506                                | 55,720                           |
| Sum               | 4,116       | 53,929                                | 8,607               | 113,086                               | 76,323                           |
| 1989 <sup>1</sup> |             |                                       |                     |                                       |                                  |
| Vb                | 3,064       | 28,698                                | 5,122               | 47,974                                | 106,767                          |
| VIa               | 1,456       | 38,567                                | 2,180               | 57,744                                | 37,753                           |
| VIB               | 1,537       | 22,653                                | 1,596               | 23,522                                | 67,850                           |
| Sum               | 6,057       | 89,918                                | 8,898               | 150,487                               | 67,361                           |
| 1990              |             |                                       |                     |                                       |                                  |
| Vb                | 1,968       | 21,492                                | 3,844               | 41,979                                | 91,569                           |
| VIa               | 3,043       | 28,713                                | 5,974               | 56,369                                | 105,980                          |
| VIB               | 1,315       | 21,190                                | 2,142               | 34,516                                | 62,058                           |
| Sum               | 6,326       | 71,395                                | 11,960              | 134,980                               | 88,606                           |

<sup>1</sup> Estimated total international landings.

Table 11.7

Tusk Va, Vb, VI, XIV

SHOT forecast spreadsheet version 3

January 1989

running recruitment weights

older 0.25  
 central 0.50  
 younger 0.25

G-M = 0.00  
 exp(d) 1.00  
 ex exp(d/2) 1.00

| Year | Land<br>-ings | Recrt<br>Index | W'td<br>Index | Y/B<br>Ratio | Hang<br>-over | Act'l<br>Prodn | Est'd<br>Prodn | Est'd<br>SQC. | Act'l<br>Expl<br>Biom | Est'd<br>Expl<br>Biom | Est'd<br>Land<br>-ings |
|------|---------------|----------------|---------------|--------------|---------------|----------------|----------------|---------------|-----------------------|-----------------------|------------------------|
| 1978 |               | 1              |               | 0.30         | 0.70          |                |                |               | 0                     |                       |                        |
| 1979 |               | 1              | 1             | 0.30         | 0.70          | 0              |                |               | 0                     |                       |                        |
| 1980 | 16538         | 1              | 1             | 0.30         | 0.70          | 55127          |                |               | 55127                 |                       |                        |
| 1981 | 13308         | 1              | 1             | 0.30         | 0.70          | 5771           |                |               | 44360                 |                       |                        |
| 1982 | 16940         | 1              | 1             | 0.30         | 0.70          | 25415          | 20299          | 15405         | 56467                 | 51351                 | 15405                  |
| 1983 | 19458         | 1              | 1             | 0.30         | 0.70          | 25333          | 21578          | 18331         | 64860                 | 61105                 | 18331                  |
| 1984 | 13901         | 1              | 1             | 0.30         | 0.70          | 935            | 22329          | 20319         | 46337                 | 67731                 | 20319                  |
| 1985 | 15769         | 1              | 1             | 0.30         | 0.70          | 20128          | 18763          | 15360         | 52563                 | 51199                 | 15360                  |
| 1986 | 14214         | 1              | 1             | 0.30         | 0.70          | 10586          | 18958          | 16726         | 47380                 | 55753                 | 16726                  |
| 1987 | 15475         | 1              | 1             | 0.30         | 0.70          | 18417          | 17912          | 15323         | 51583                 | 51078                 | 15323                  |
| 1988 | 15483         | 1              | 1             | 0.30         | 0.70          | 15502          | 17968          | 16223         | 51610                 | 54076                 | 16223                  |
| 1989 | 15960         | 1              | 1             | 0.30         | 0.70          | 17073          | 17721          | 16154         | 53200                 | 53848                 | 16154                  |
| 1990 | 16471         | 1              | 1             | 0.30         | 0.70          | 17663          | 17662          | 16471         | 54903                 | 54902                 | 16471                  |
| 1991 |               | 1              | 1             | 0.30         | 0.70          |                | 17662          | 16131         |                       | 53771                 | 16131                  |
| 1992 |               | 1              | 1             | 0.30         | 0.70          |                | 17662          | 16591         |                       | 55302                 | 16591                  |
| 1993 |               | 1              | 1             | 0.30         | 0.70          |                | 14768          | 16044         |                       | 53479                 | 16044                  |

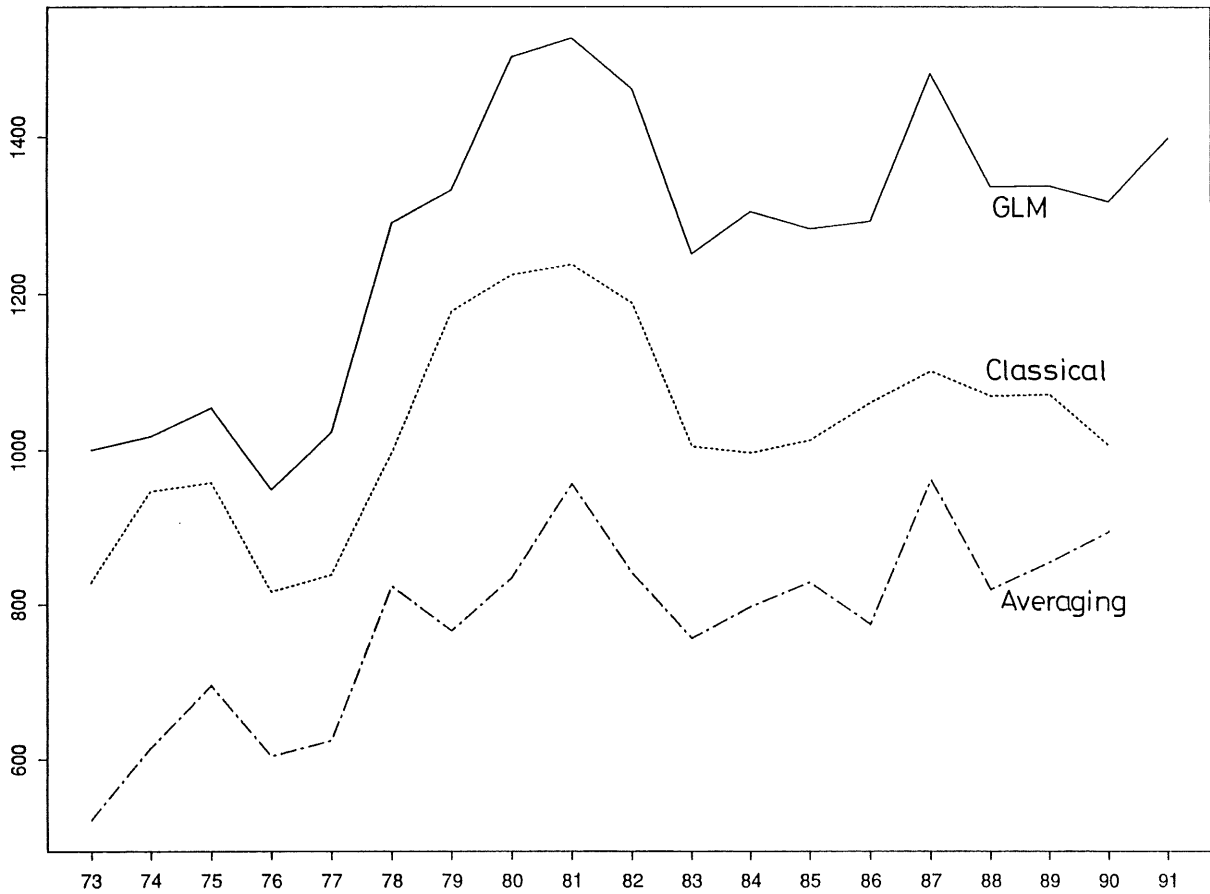


Figure 2.1 Icelandic CPUE indices for redfish in Division Va.

REDFISH TAKEN AS BY-CATCH  
IN THE SHRIMP FISHERY

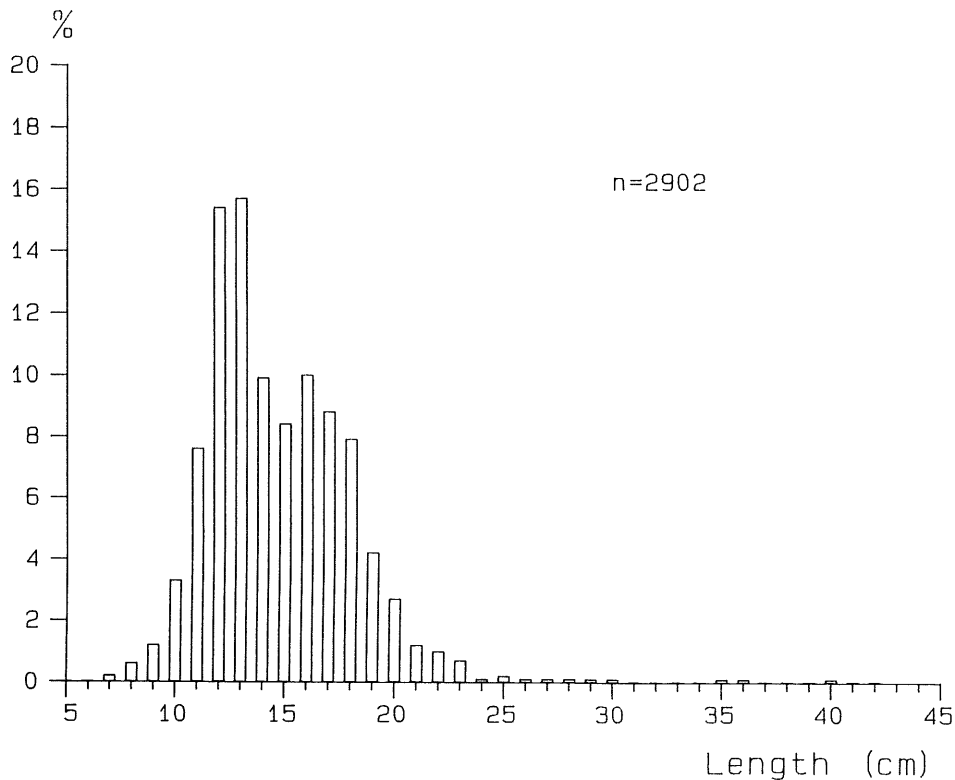


Figure 2.2 Length distribution of redfish taken as by catch in the shrimp fishery in Sub-area XIV in March/April 1991.

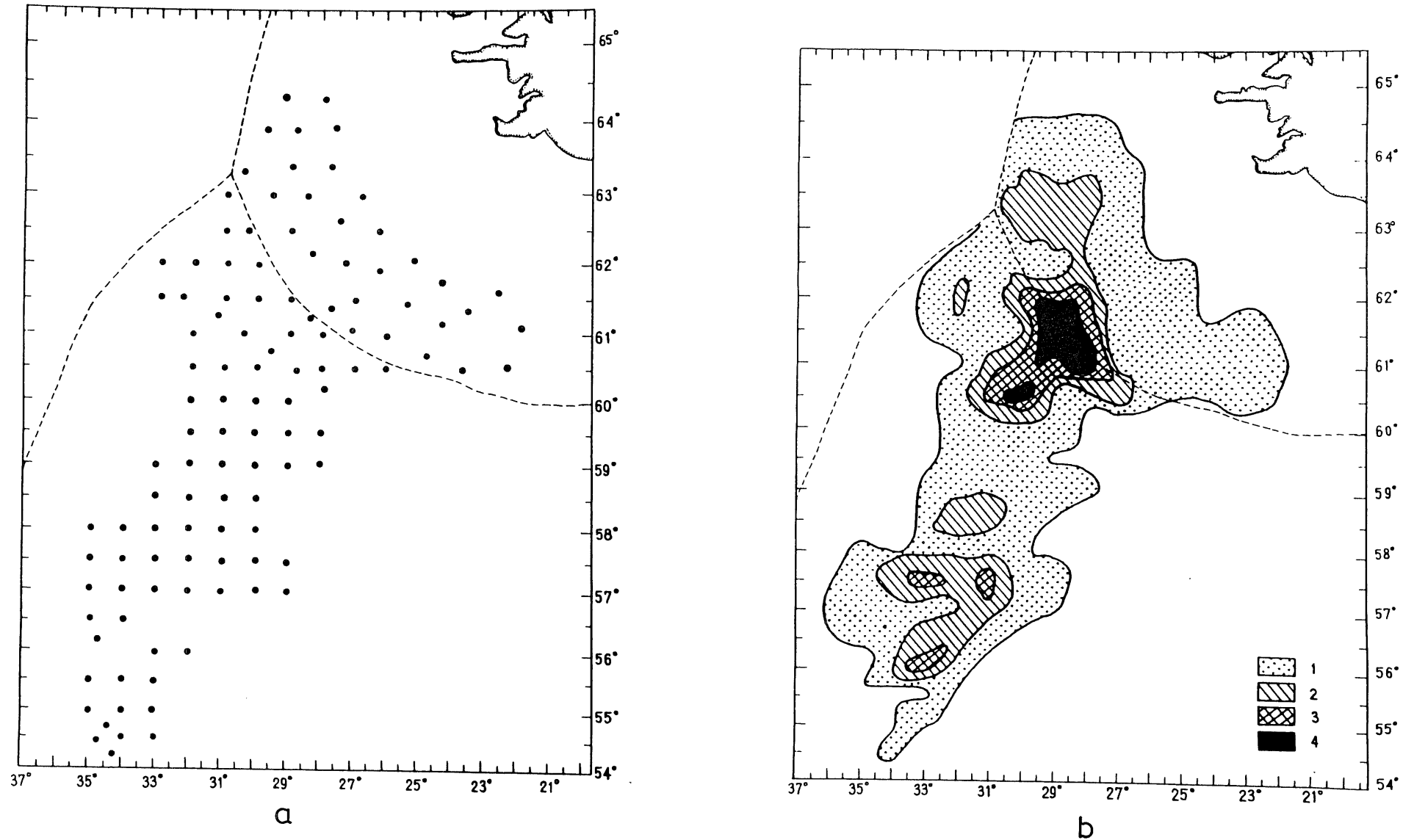


Figure 2.3 Ichthyoplankton stations conducted in the Irminger Sea from 16 April to 21 May 1990 (a), distribution of oceanic- and ordinary types of *S. mentella* (b), spec./m<sup>2</sup>: 0-0,1-10; 2-10-25; 3-25-50; 4- over 50.

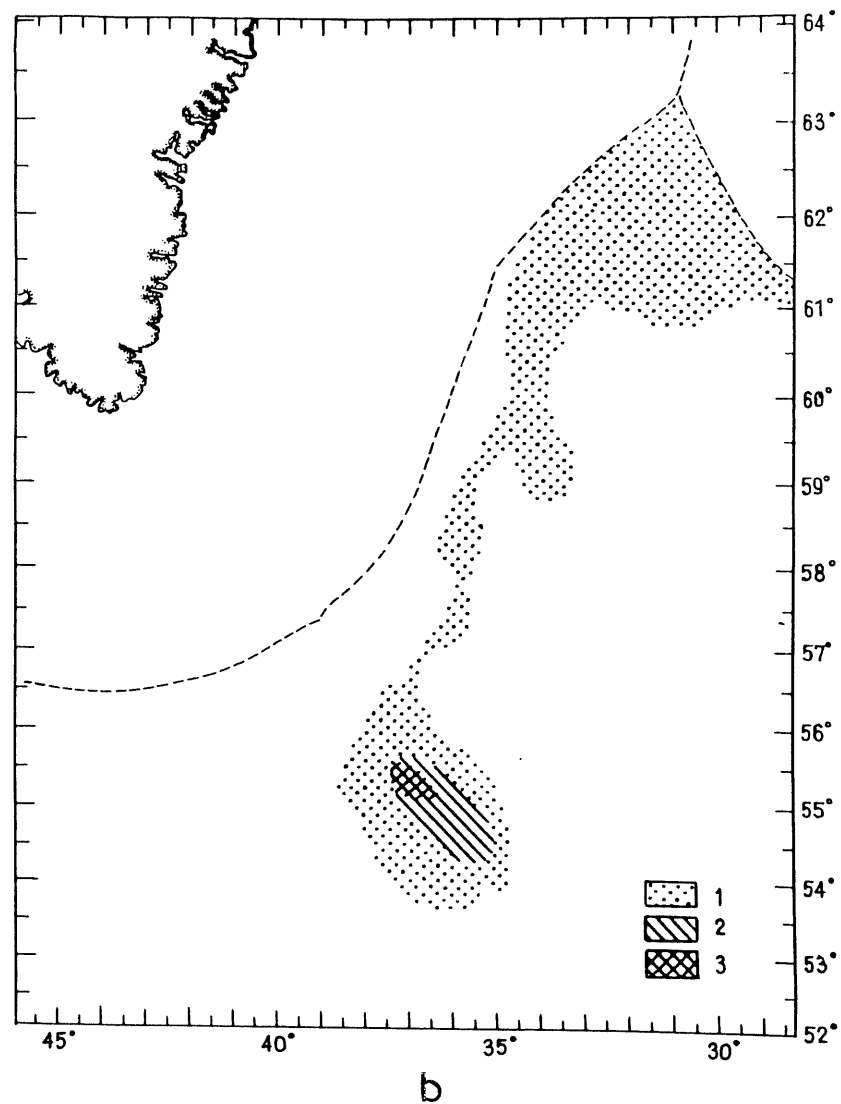
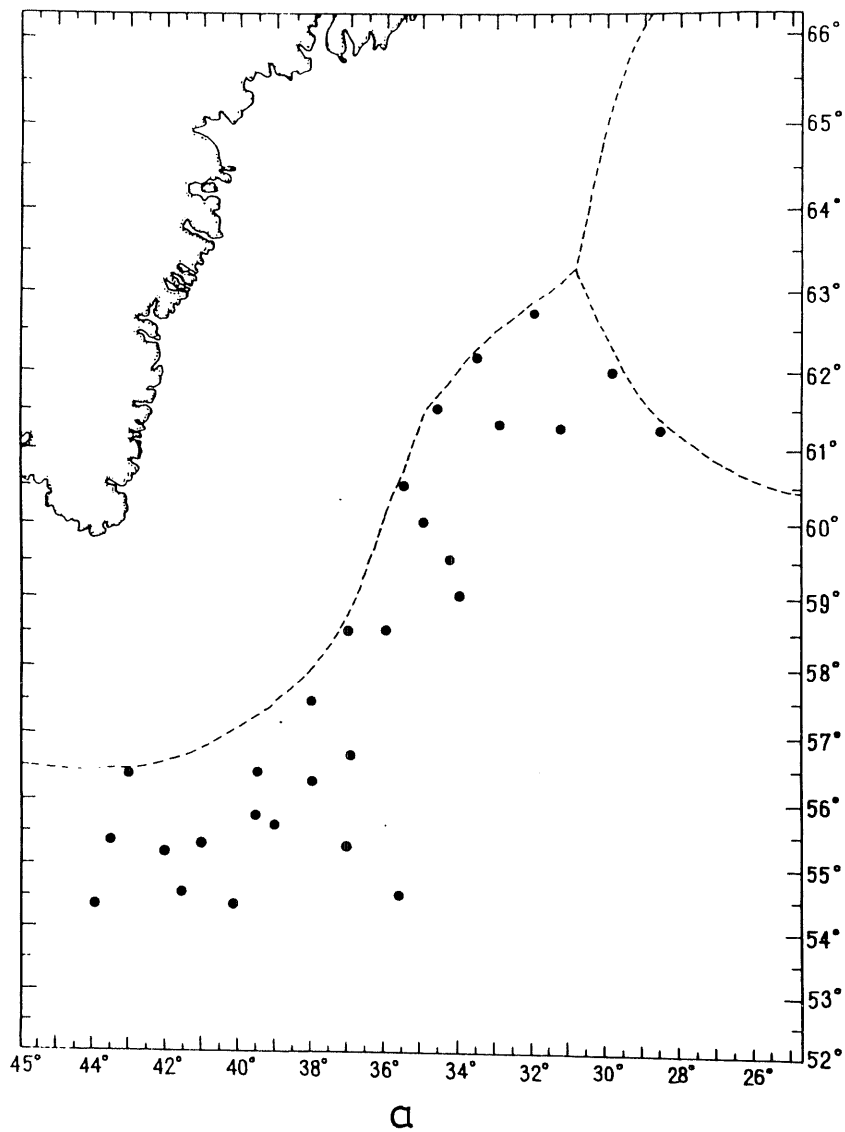


Figure 2.4 Ichthyoplankton stations (a) and density of young oceanic- and ordinary *S. mentella* types, concentrations (b), spec./m<sup>2</sup> (9 June - 5 July 1990):  
 1-0,1-10; 2-10-25; 3-25-50.

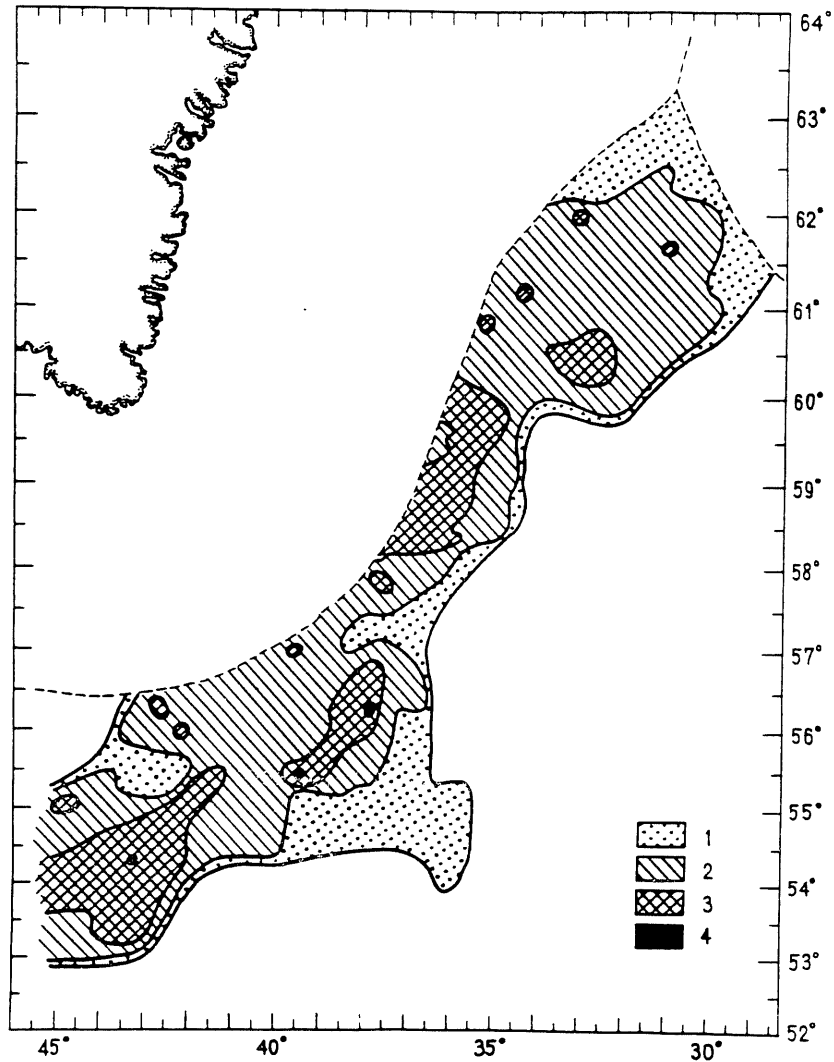


Figure 2.5 Distribution and density of oceanic-type *S. mentella* aggregations by the data from trawl-acoustic survey (9 Jun-6 Jul 1990), t/mile<sup>2</sup>: 1-1-5; 2-5-10; 3-10-30; 4- over 30.

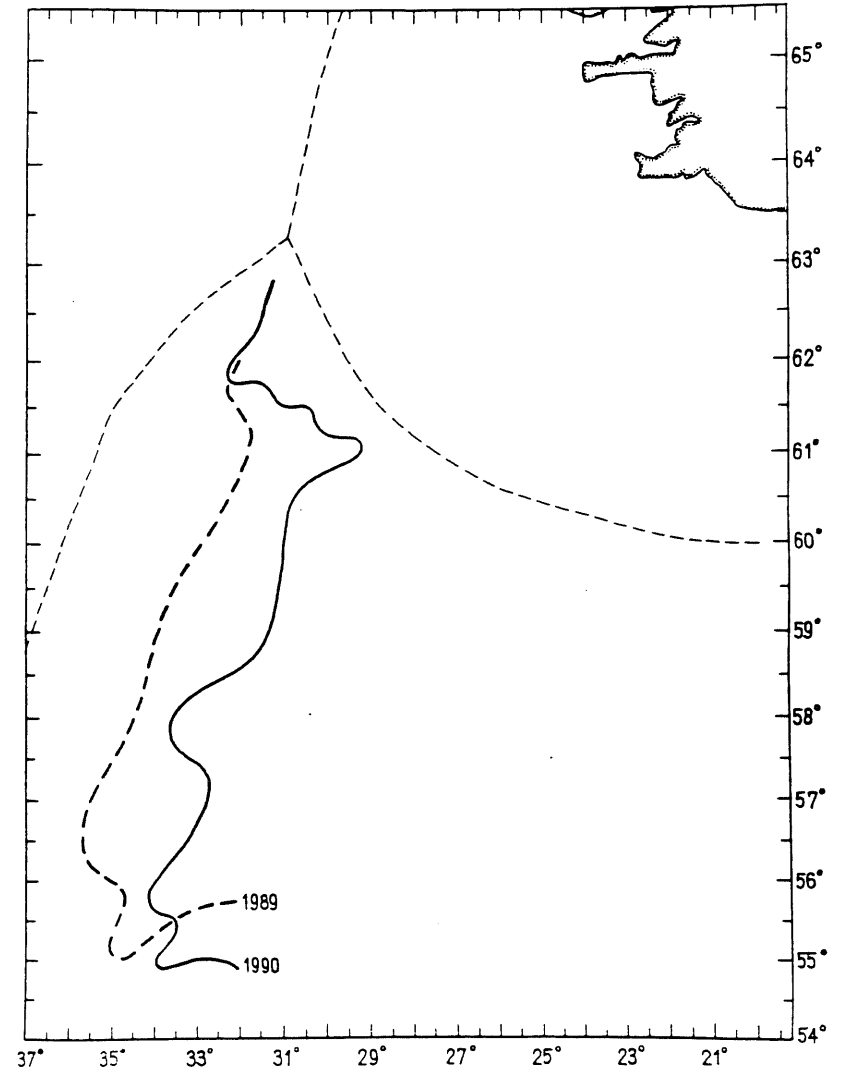


Figure 2.6 Position of the front in spring 1989 and 1990 represented by the 5,5°C isotherm at 200 m depth.

# GREENLAND HALIBUT TAKEN AS BY-CATCH IN THE SHRIMP FISHERY

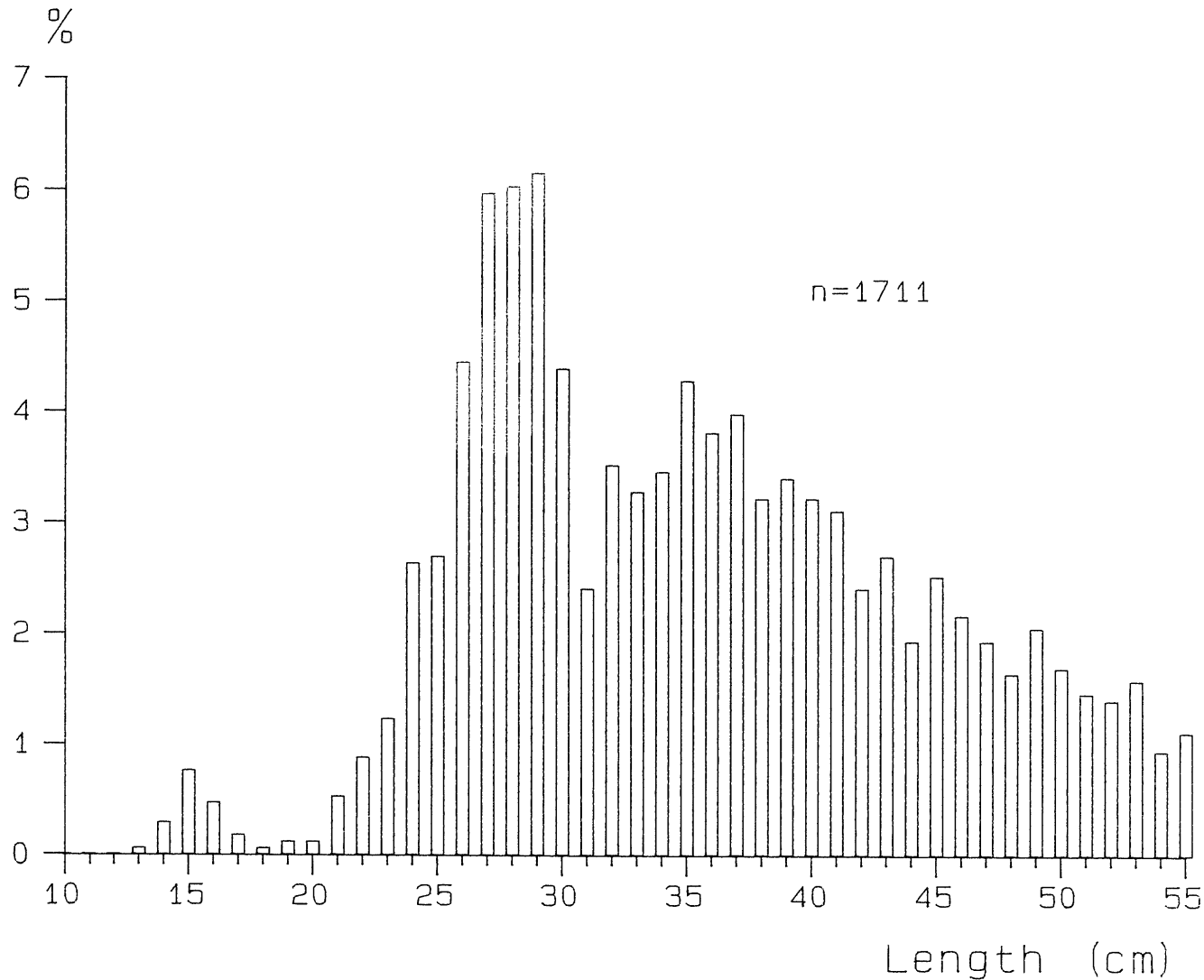
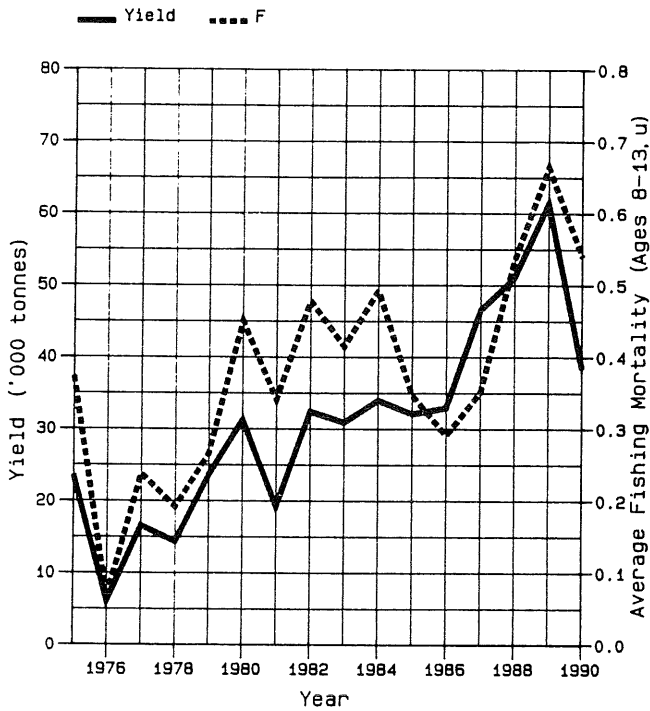


Figure 3.1 Length distribution of Greenland halibut taken as by-catch in the shrimp fishery in Sub-area XIV March/April 1991.

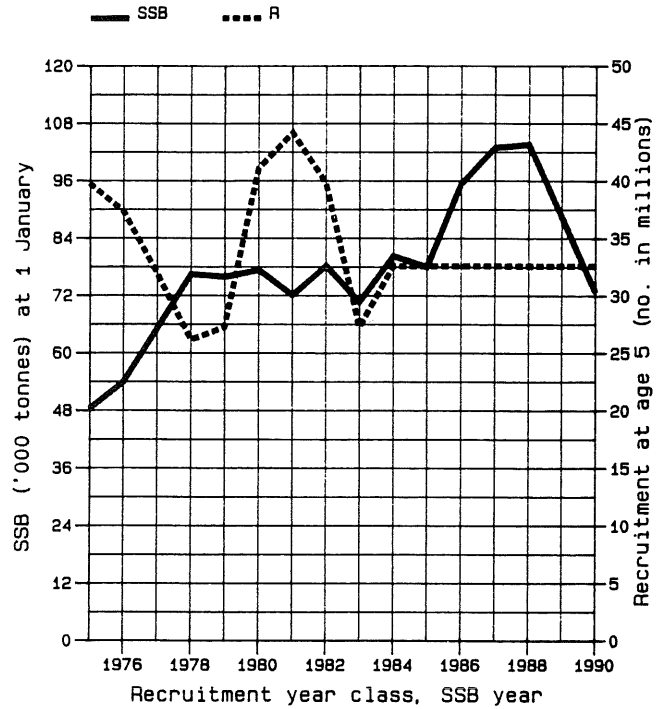
FISH STOCK SUMMARY  
Greenland Halibut in Areas V and XIV  
04-05-1991

Trends in yield and fishing mortality (F)



A

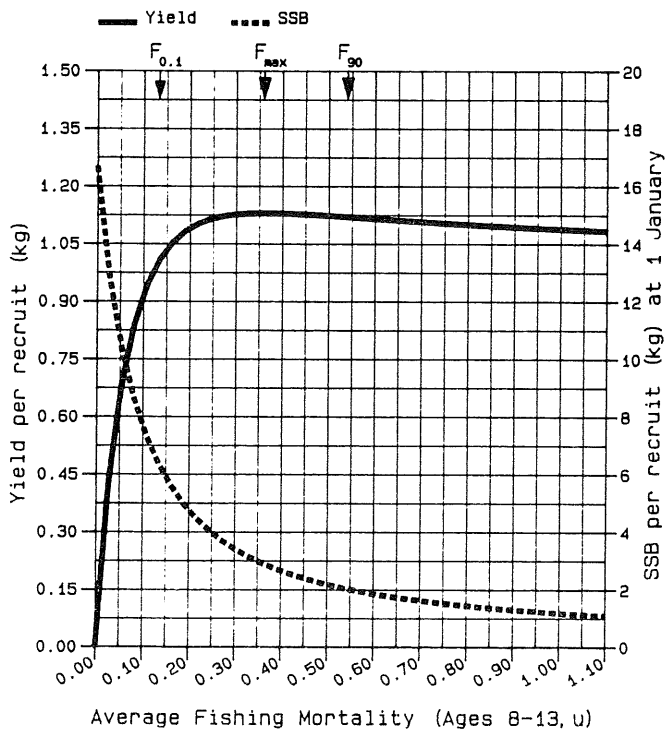
Trends in spawning stock biomass (SSB) and recruitment (R)



B

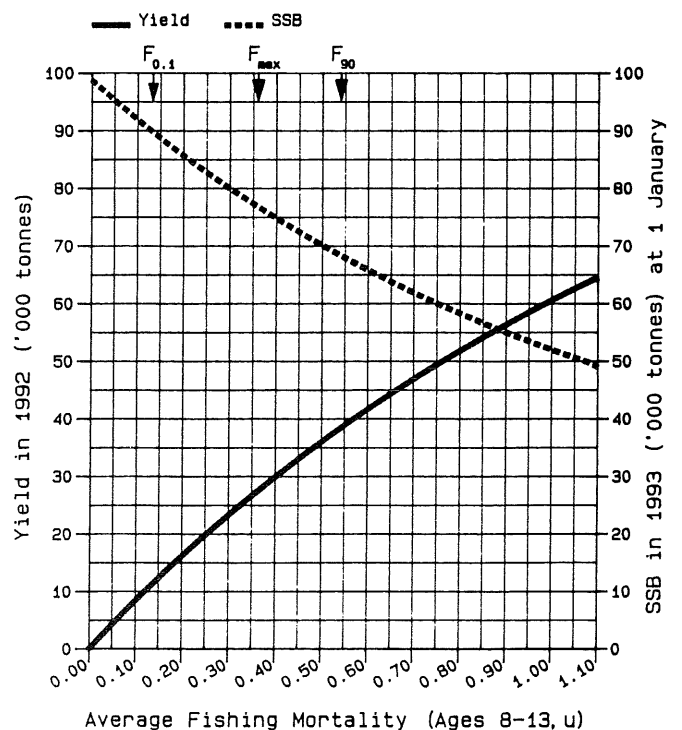
FISH STOCK SUMMARY  
STOCK: Greenland Halibut in Areas V and XIV  
05-05-1991

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



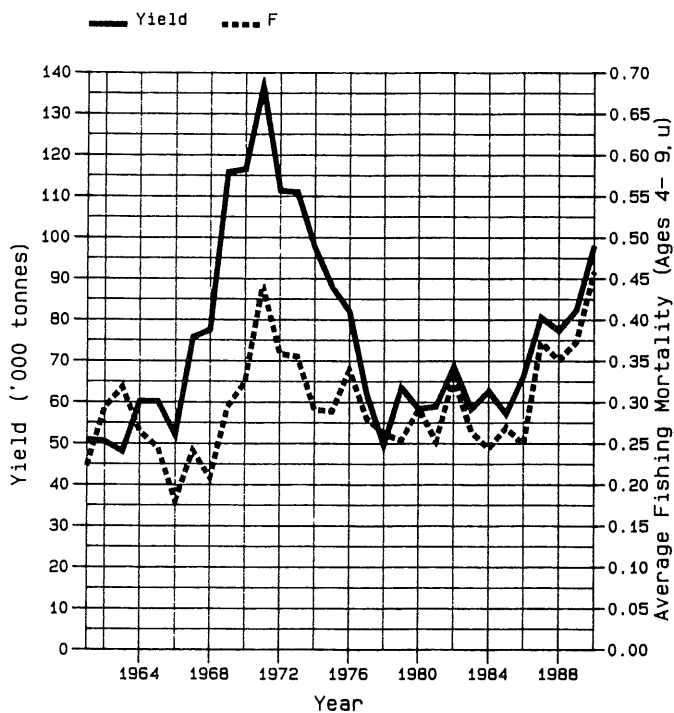
D



FISH STOCK SUMMARY

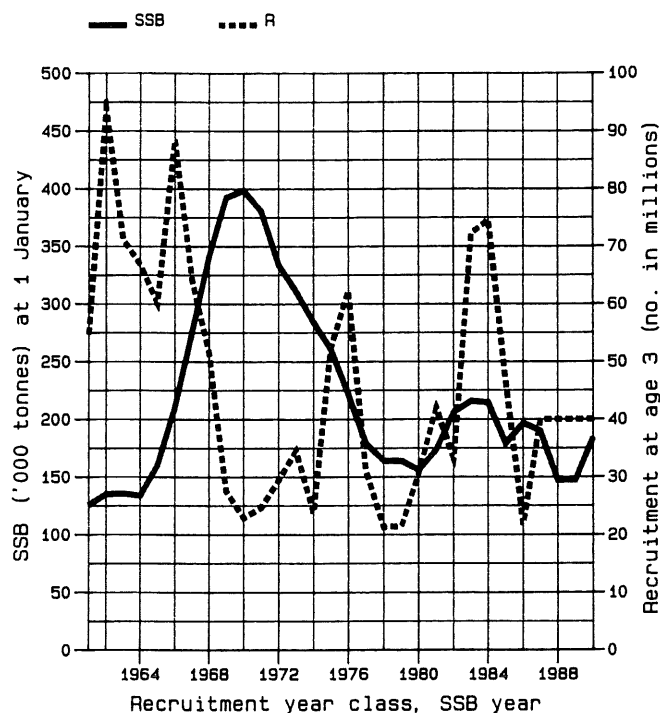
Figure 4.1 Saithe in the Iceland Grounds (Fishing Area Va)  
05-05-1991

Trends in yield and fishing mortality (F)



A

Trends in spawning stock biomass (SSB) and recruitment (R)



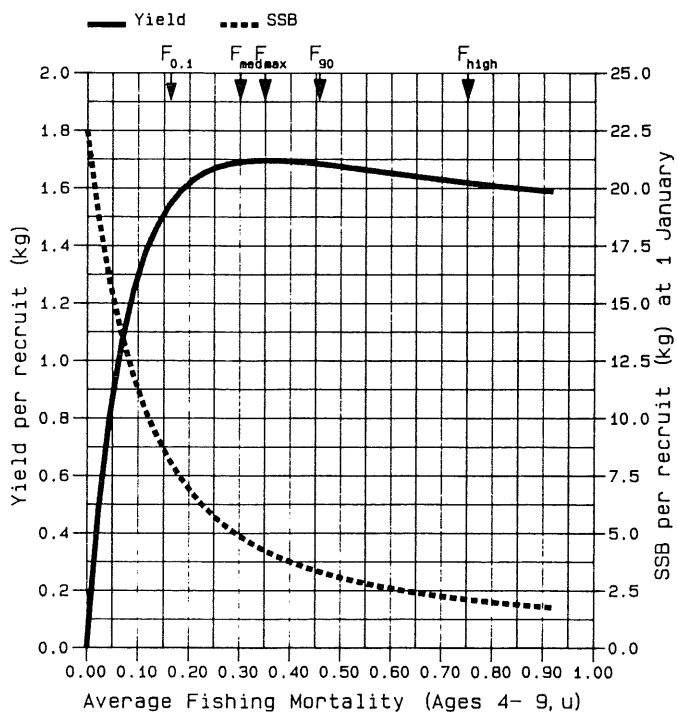
B

FISH STOCK SUMMARY

ICELANDIC SAITHE

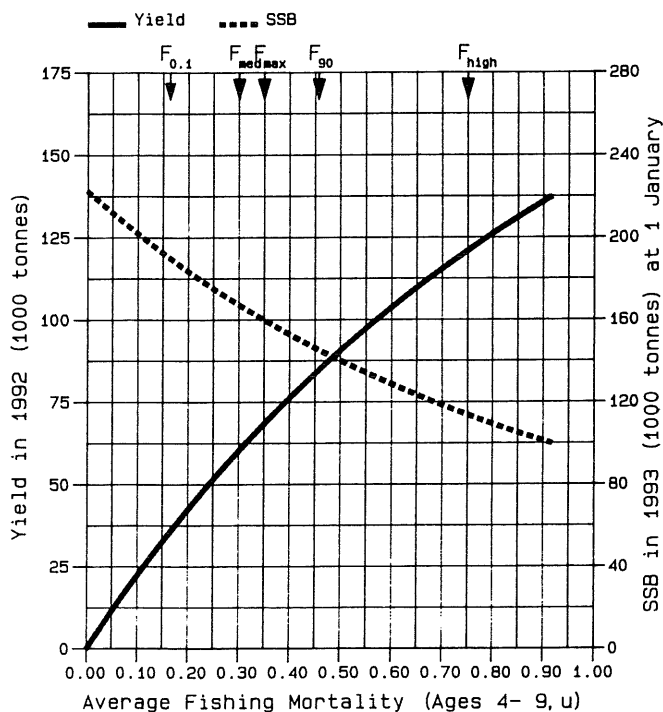
07-05-1991

Long-term yield and spawning stock biomass



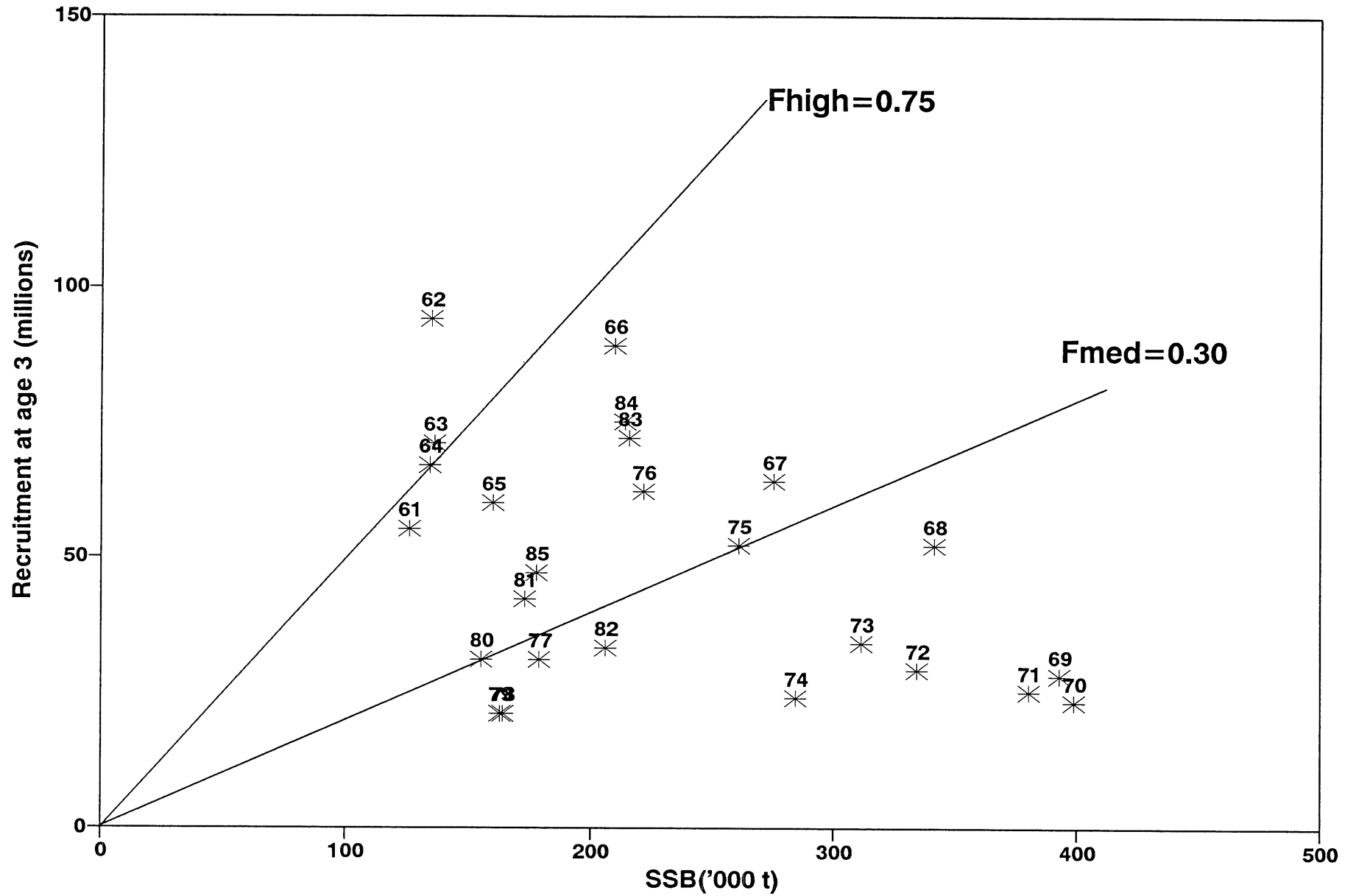
C

Short-term yield and spawning stock biomass



D

Figure 4.2 Icelandic SAITHE  
Stock-recruitment relationship



FISH STOCK SUMMARY

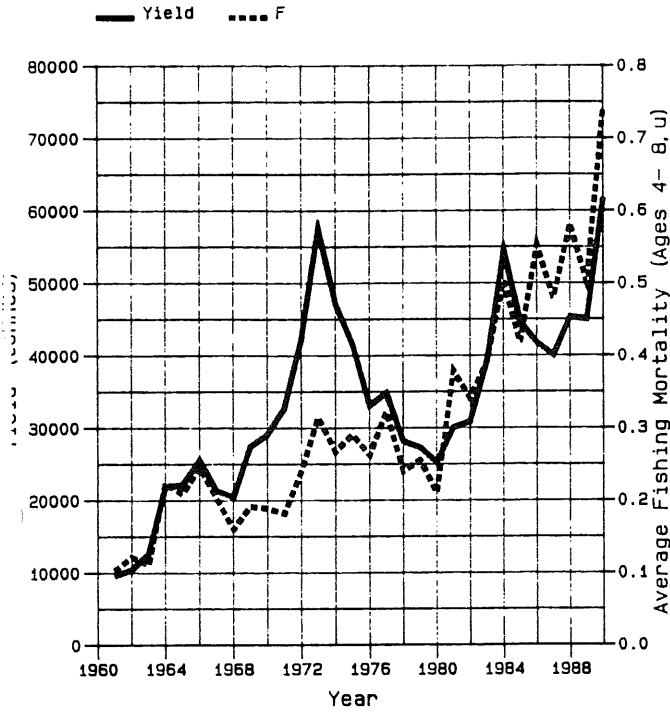
Figure 6.1 A-D

FAROE SAITHE (ICES DIVISION Vb)

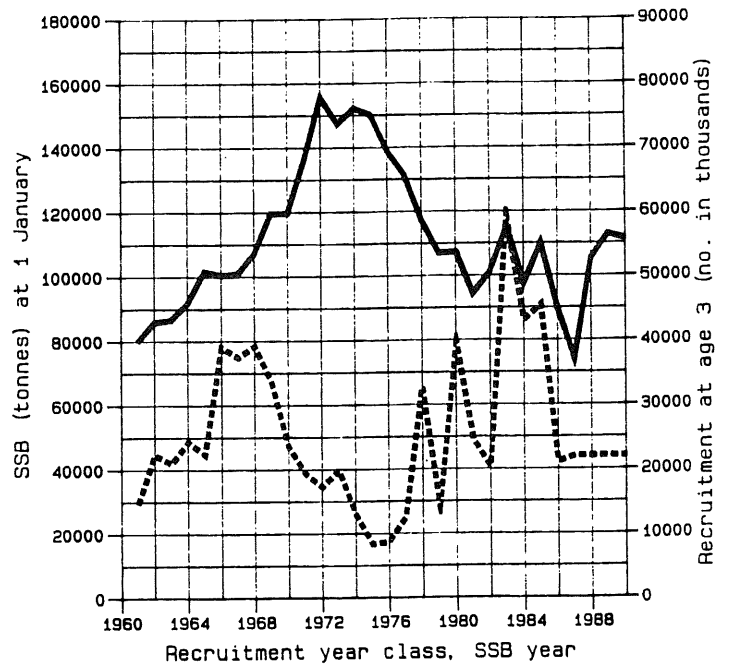
07-05-1991

Trends in yield and fishing mortality (F)

Trends in spawning stock biomass (SSB) and recruitment (R)



A



B

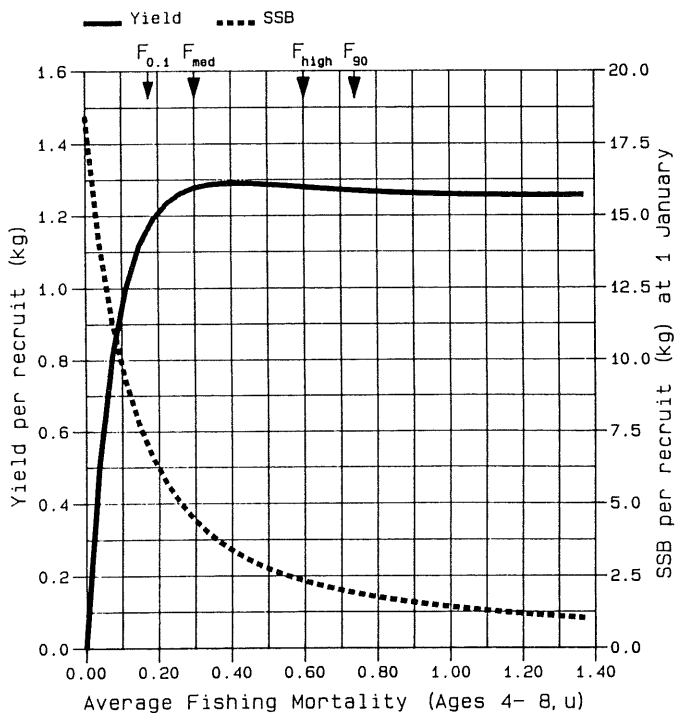
FISH STOCK SUMMARY

FAROE SAITHE (ICES DIVISION Vb)

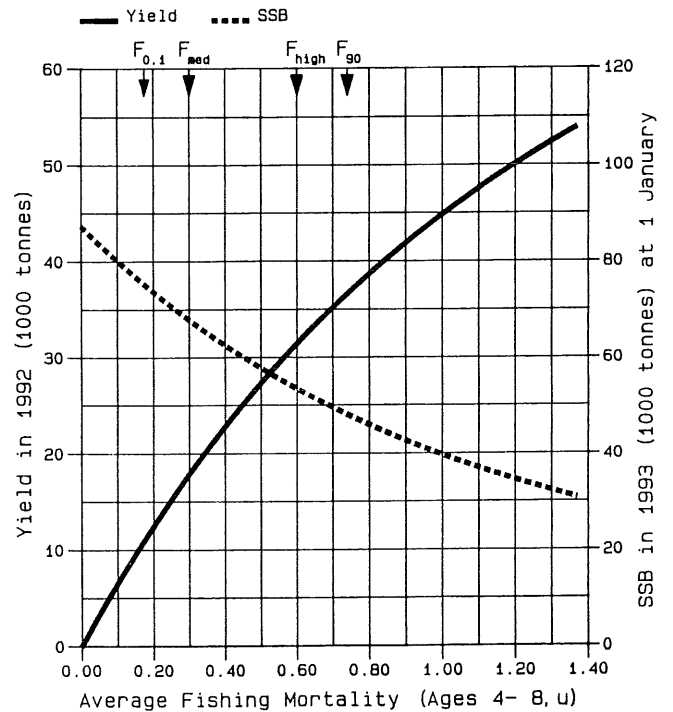
08-05-1991

Long-term yield and spawning stock biomass

Short-term yield and spawning stock biomass



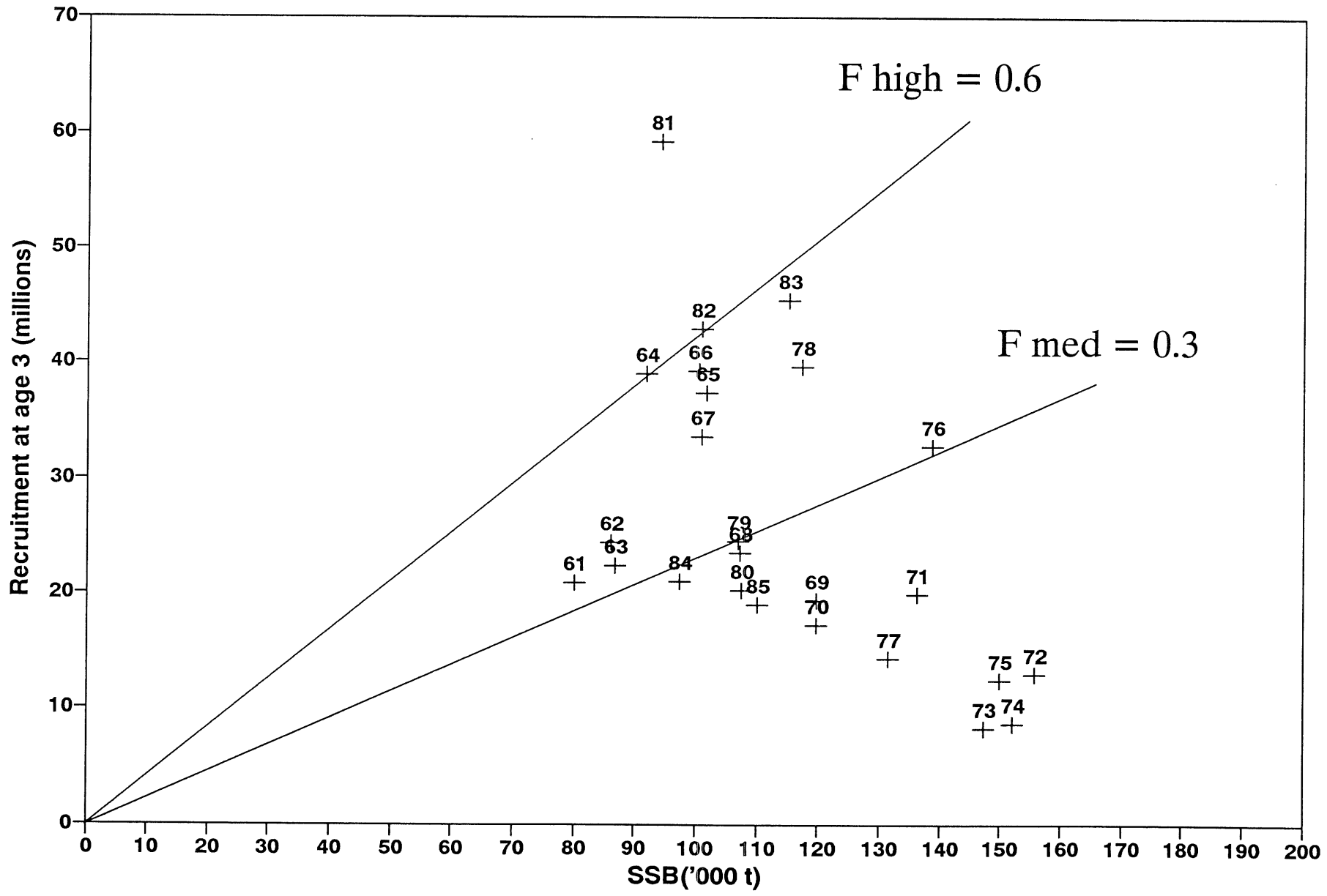
C



D

Figure 6.2

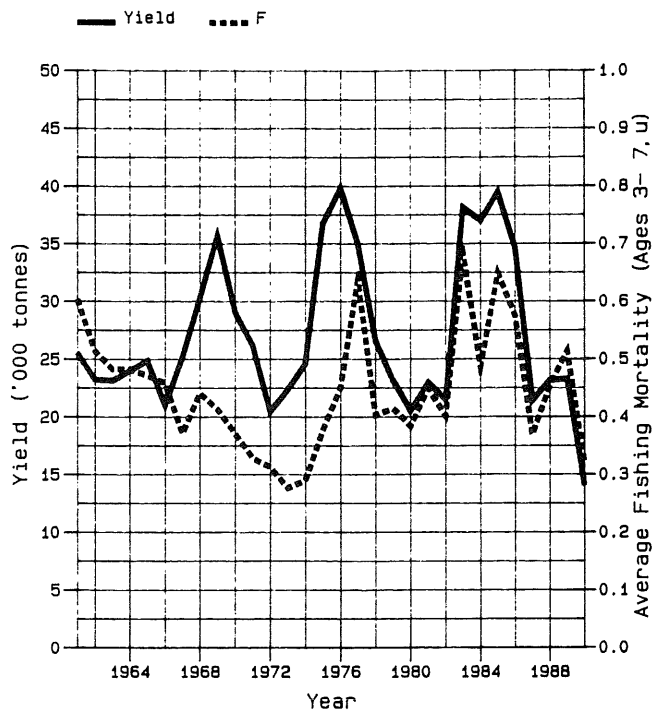
### SAITHE, Faroe Stock-recruitment relationship



FISH STOCK SUMMARY

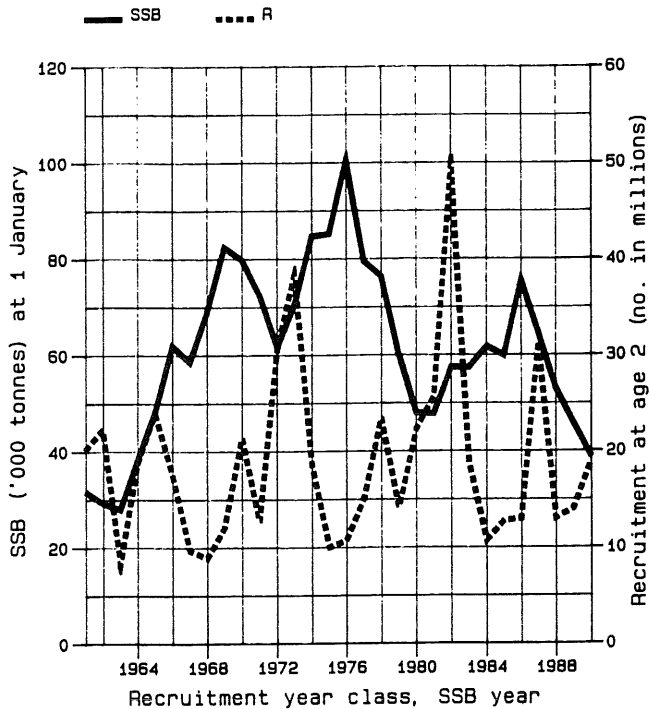
Figure 7.1 A-D Cod at the Faroe Plateau (Fishing Area Vb1)  
08-05-1991

Trends in yield and fishing mortality (F)



A

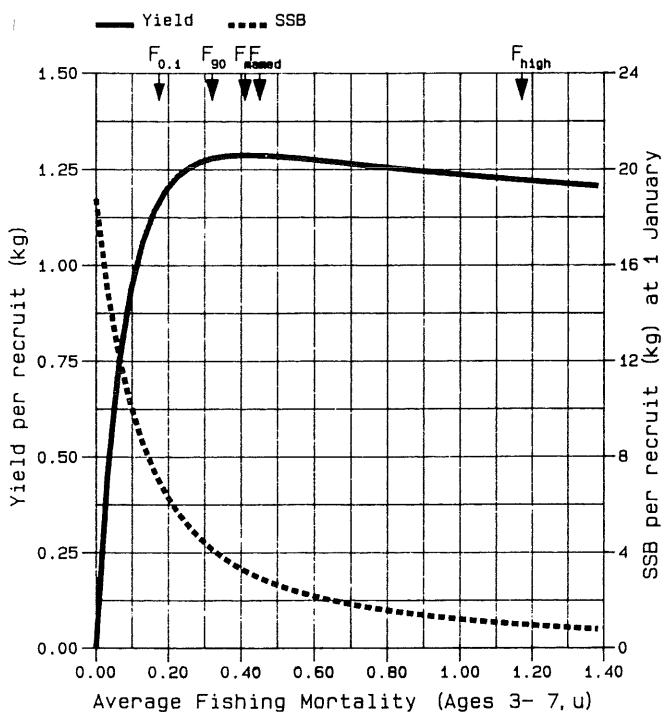
Trends in spawning stock biomass (SSB) and recruitment (R)



B

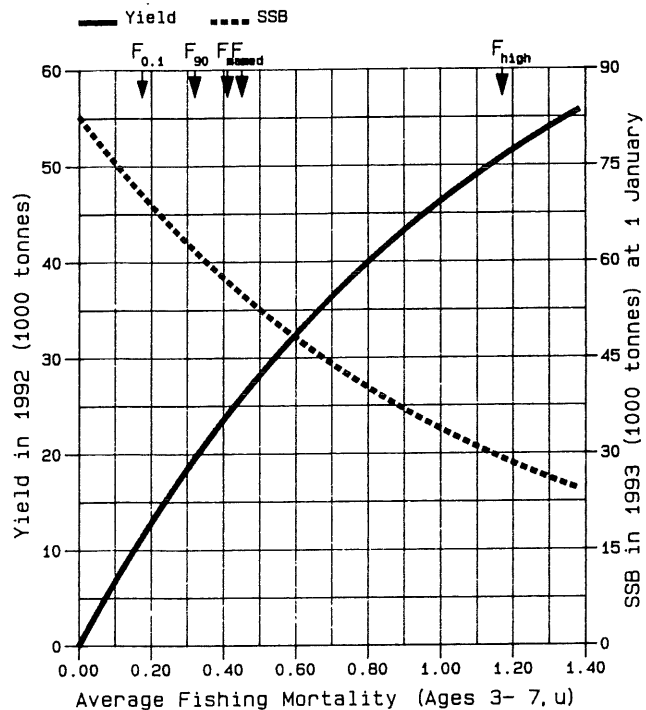
FISH STOCK SUMMARY  
Cod in the Faroe Plateau  
08-05-1991

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D

COD, Faroe Plateau  
Stock-recruitment relationship

Figure 7.2

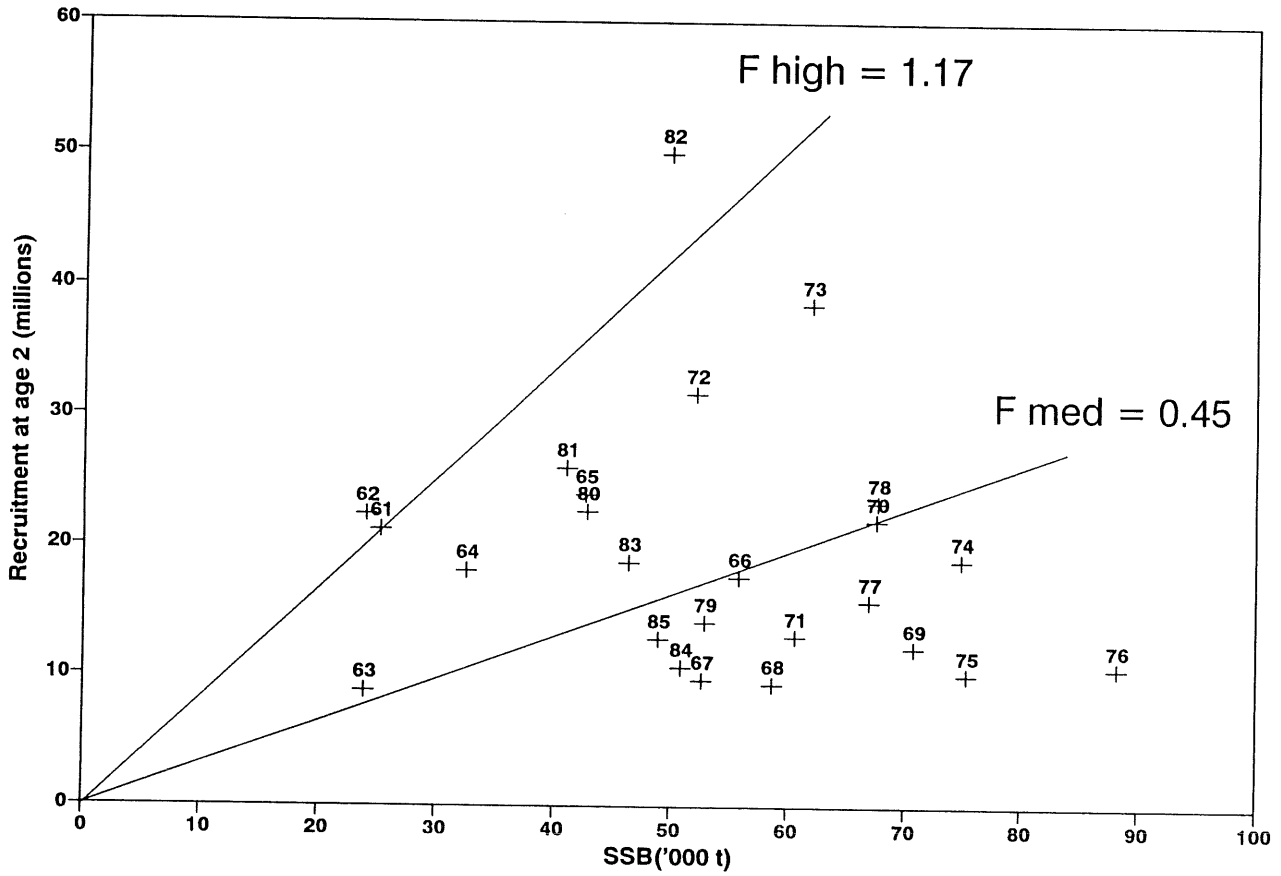
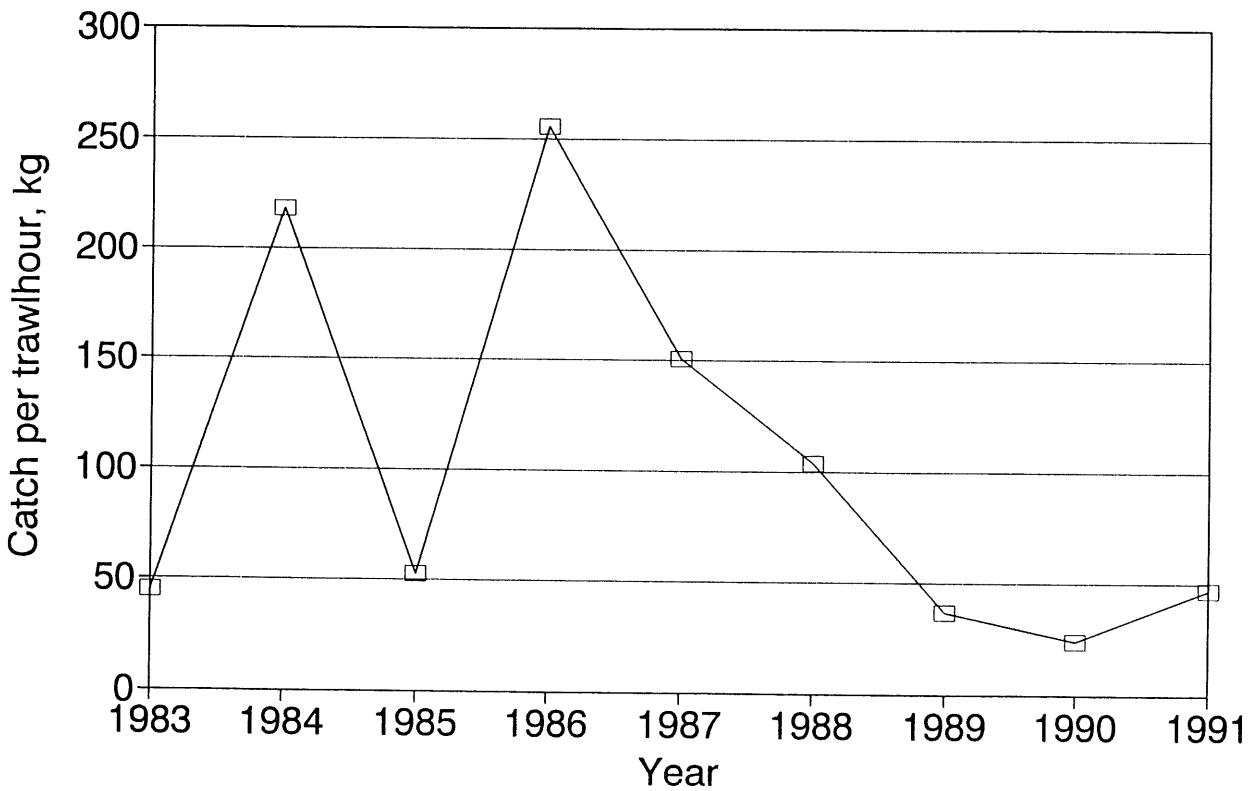


Figure 7.3

Faroese groundfish surveys 1983-1991  
on Faroe Bank



# The Faroese Groundfish Surveys 1983-91

## CPUE (kg/hour) of BLUE LING per year

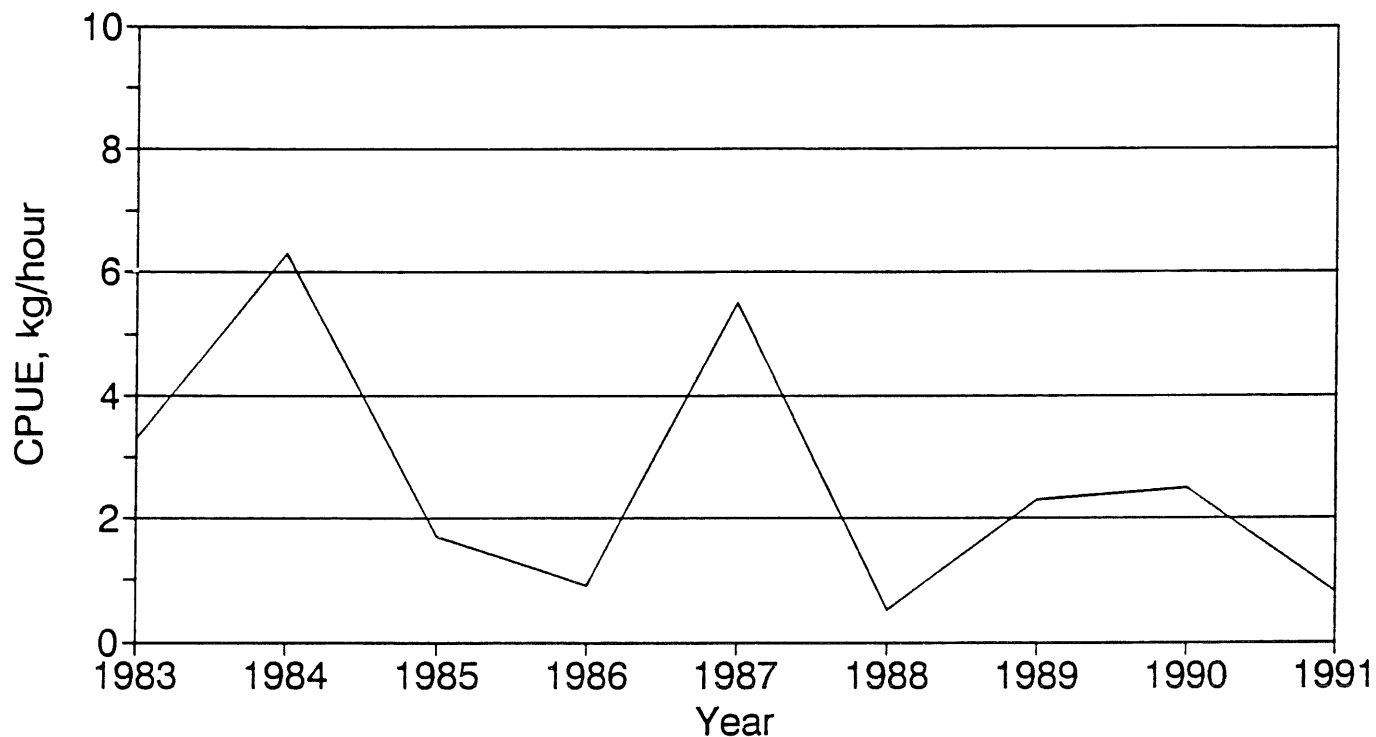


Figure 9.1

## Catchcurve Blueling, 1988-1990

### From French Trawl fisheries

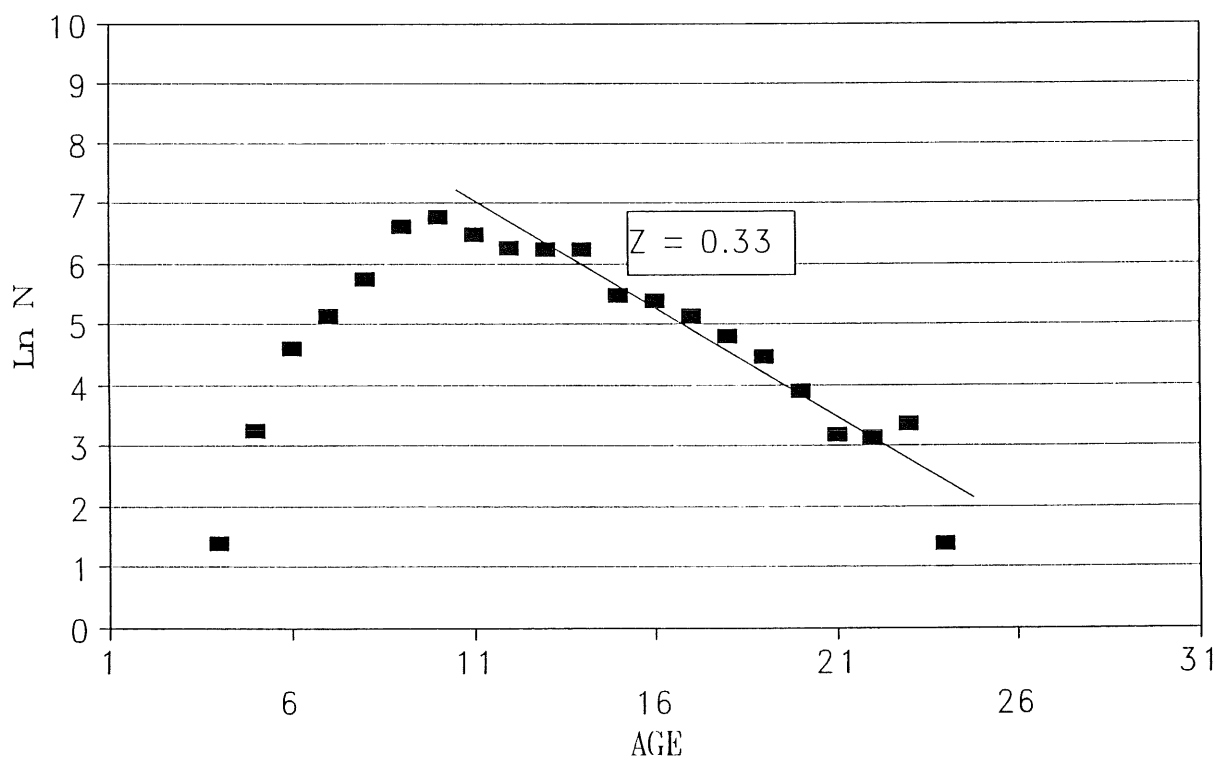


Figure 9.2

Figure 10.1

## The Faroese Groundfish Surveys 1983-91

CPUE (kg/hour) of LING per year

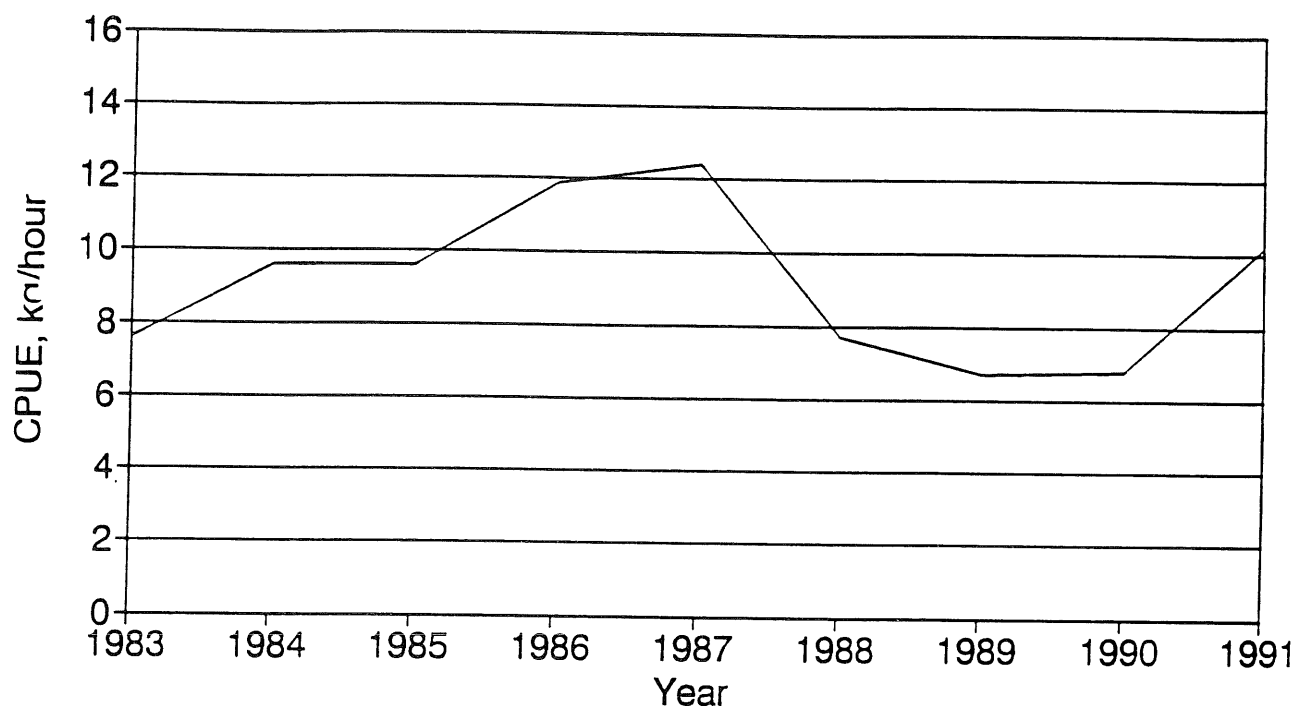
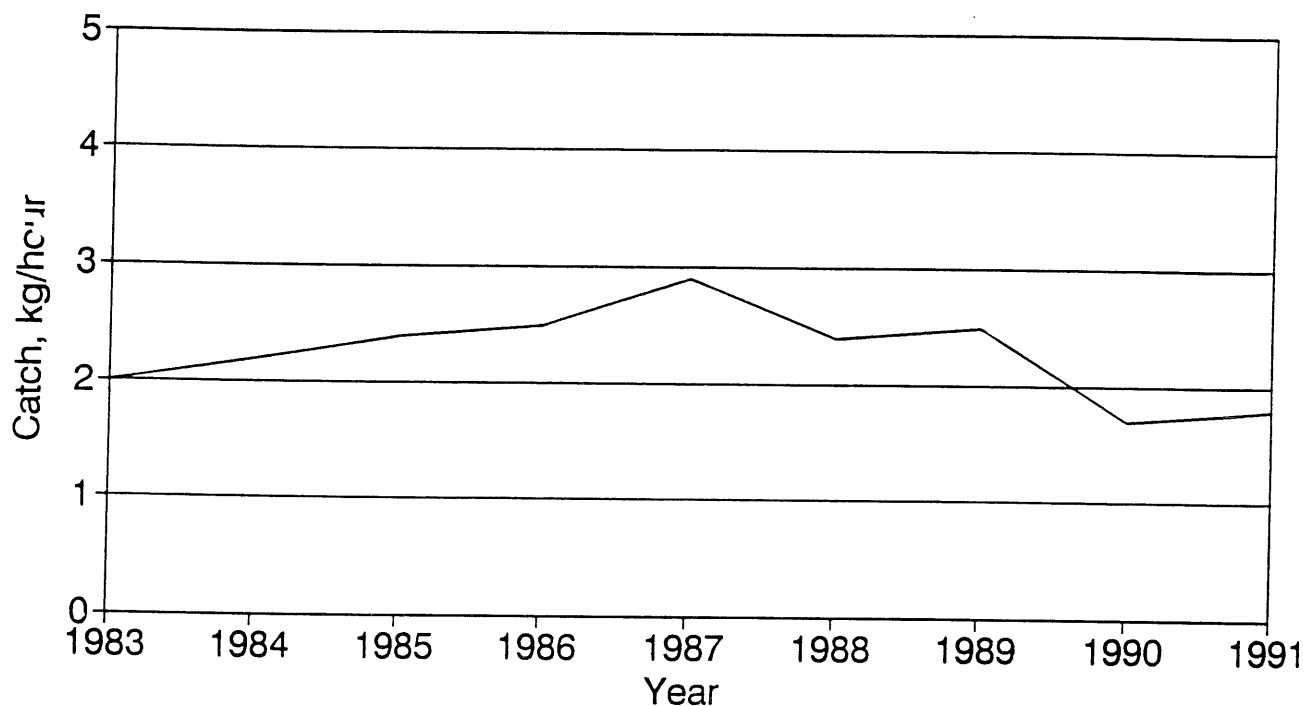


Figure 11.1

## The Faroese Groundfish Surveys 1983-91

CPUE (kg/hour) of TUSK per year





## APPENDIX 1

Report to the North Western Working Group Copenhagen 1.-8. May 1991  
Prepared by J. Magnússon

**Study Group on Redfish Stocks**  
Progress report up to 30 April 1991

According to C.Res. 1990/2:12 the Study Group on Redfish Stocks should work by correspondance in 1991 and report to North Western and Arctic Fisheries Working Groups.

The terms of reference are as follows:

- a. attempt to coordinate ongoing national research programmes on redfish in 1991;
- b. provide any new information on the stock identification, migration and spawning areas for *Sebastes mentella*, *S. marinus*, and oceanic type *S. mentella*;
- c. consider how the two redfish species could be managed on a combined basis, given that the catches and landings can contain a mixture of species;
- d. report to the 1991 meetings of the North-Western Working Group and the Arctic Fisheries Working Group.

Some action have been taken and the terms of reference addressed as follows:

- a. A letter dated 21. Dec. 1990 was sent to all members of the Study Group asking for information on cruise plans concerning research of oceanic-type *S. mentella*. The following respond was received: Germany, U.S.S.R. and Iceland have planned cruises where research on oceanic-type *S. mentella* will be the main objective or included in the research programmes. Germany planned an 8 days biological/experimental survey late March with Dr. Nagel in charge of the biological observations. Further, a commercial trawler is carrying out experimental fishing on this stock, starting in the latter half of April. During this exercise a scientist, Dr. Kosswig will take care of relevant observations and biological data sampling. In connection with these cruises and the other ones an attempt has been made to coordinate, at least to some extent the informations collected. U.S.S.R. will conduct an ichthyoplankton survey in the area (probably in April-May) and continue with an acoustic survey (probably in June-July). Dr. Shibanov in charge. Iceland is going to conduct a survey from 6.-26. June (Dr. Magnússon in charge). Besides biological sampling the main emphasize will be laid on an acoustic survey. Approaches have been made to establish a cooperation between the U.S.S.R. and Icelandic acoustic surveys in June. Hopefully the vessels can work side by side for a while to compare the results and thus, facilitate the evaluation of a combined acoustic survey.

- b. Since the last meeting of the Study Group some additional information has been pointed out to the chairman which might strengthen the theory of origin of the oceanic stock, as e.g. the confirmation of the existence of *S. mentella*-type redfish infested by *Sph. lumpi* of Baffinsland and Northern Labrador as well as between West Greenland and Baffinsland. Several points concerning this terms of reference have also been addressed by a Nordic group of scientists from Greenland, Iceland, Faroe Islands and Norway which met in Reykjavík in Nov. 1990. Among the conclusions of this meeting were the following:

To investigate the separation of the *S. marinus* stocks in the North Atlantic. For these purposes, material has been collected of *S. marinus* from different localities on the Icelandic grounds for genetic studies by electrophoresis. The analysis will be taken care of by Dr. Nedreaas, Norway. Further, material has been collected at Iceland for comparison of the concentration of radioactive isotopes (such as Cs-137, Sv-90, Pu-242 and Am-243) in *S. marinus* in different areas such as in Icelandic and in Faroes and Norwegian waters. Since there are still lots of uncertainties about such kind of study, the initial programme is considered as a pilot project which is lead by M. Reinert, Faroe Islands. This Nordic group has also initiated a collection of length measurements of *S. marinus* from different areas of the NE-Atlantic, preferably during a similar time of the year, a collection to be continued over a number of years. Simultaneously, information on c.p.u.e. data are to be provided. It is anticipated that such a programme might throw some light on migrations, but in particular on the recruitment and thus, be of value to assessment work. Dr. Stefánsson is leading this work.

- c. This terms of reference is at present under consideration.

Reykjavík, 29. 04. 1991.