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## **NORWEGIAN INVESTIGATIONS IN 1984-1985 ON JUVENILE HERRING**

by

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### **SUMMARY**

This paper describes the Norwegian investigations on juvenile herring (0-, I- and II-group) of the Norwegian spring spawning stock. The investigations were carried out in Norwegian coastal areas and in the Barents Sea in the period June 1984 - May 1985. Emphasis is made on the distribution of the strong 1983 year class, and the distribution and migration of this year class is compared with an earlier strong year class, that of 1959.

### **INTRODUCTION**

The Norwegian spring spawning herring had a stock collapse in the late 1960s. (Dragesund et al. 1980). Since then the stock has been in a rebuilding period. Until 1983, the year classes during this rebuilding period were poor compared to the average year class strength of this stock prior to the collapse. However, in 1983 considerable concentrations of 0-group herring were recorded over large areas, indicating a strong year class. (Anon. 1983, Røttingen 1984). The aim of this paper is to give a summary of the Norwegian investigations on juvenile herring (i.e. year classes 1983 and 1984), which were carried out in the period June 1984-May 1985. The distribution and migration pattern of the 1983 year class is compared with an earlier strong yearclass, that of 1959.

### **METHODS**

The data on distribution of the juvenile herring are collected during acoustic surveys in the Barents Sea and on the Norwegian coast. The Norwegian research vessels are equipped with a 38 kHz echo sounder and a digital echo integrator. A commercial capelin trawl (Harstad trawl), with small meshes in the codend has been applied to identify

the recordings and to collect the biological samples.

#### DISTRIBUTION

Fig. 1 shows a map which includes the geographical names which are mentioned in this report.

#### BARENTS SEA

June 1984: Fig. 2 gives the geographical distribution of I-group herring (1983 year class) in June 1984. (Toreisen, 1984) There was two main distribution areas. In the eastern part of the Barents Sea the I-group herring was distributed from north of the Rybachy peninsular (approx.  $70^{\circ}30'N, 32^{\circ}00'E$ ) to the Goose Bank area (approx.  $73^{\circ}00'N, 48^{\circ}00'E$ ). There were more or less continuous recordings as a scattering layer in 100-150m depth over a distance of 250 nautical miles. The other distribution area was off the Finnmark coast, to about 50 nautical miles offshore. In this area some of the I-group herring formed schools near the surface, and there was some mixing with adult capelin.

January 1985: Fig. 3 gives an indication of the distribution of the 1983 year class in the eastern part of the Barents Sea in January 1985. The acoustic surveys in January are designed to cover the distribution of cod. Some areas where capelin are distributed are therefore not surveyed in January. This refers in particular to the northern borders of the capelin distribution. In general, the distribution seems to be similar to the distribution in June 1984. But the behavior had changed, in January the herring mostly occurred in schools in contrast to the scattering layers in June 1984. The sonar and echo recordings of capelin and herring in this area were difficult to separate, and this caused considerable difficulties in carrying out the Norwegian capelin winter fishery in January 1985. The area where the capelin fishery took place is included in Fig. 3 (hatched area). A maximum bycatch of 10% herring was enforced in the Norwegian fishery. Preliminary bycatch statistics show that approximately 2500 tonnes of II-group herring were caught in the Norwegian winter capelin fishery in 1985.

May 1985: Fig. 4 gives the distribution of the 1983 year class in May 1985 (Hamre and Dommarnes 1985). The eastern border is now approximately at  $40^{\circ}E$ . The herring was recorded both as small schools and as scattering layers from 50m to 100m depth. In some parts of the distribution area, the herring was mixed with capelin, the capelin layer usually deeper than the herring recordings.

#### COASTAL AREAS

The fjord and coastal areas of Norway are important nursery grounds for the Norwegian spring spawning herring (Dragesund 1970). In autumn 1983 considerable concentrations of 0-group herring were recorded in the fjords of northern Norway, especially north of  $69^{\circ}N$ . (Røttingen 1984). In November-December 1984 these concentrations, now as I-group, were recorded over somewhat smaller areas, but there still remained considerable amounts of I-group herring in the fjord areas. Fig. 5 shows a typical fjord recording of I-group herring in December 1985.

## GROWTH

Fig. 6 gives mean length for the 1983 year class in the period January 1984 to May 1985 for the different areas referred to in Fig. 1. A and B are fjord areas. In area C both fjord and offshore areas are included. In this area the growth data from autumn are mostly based on samples from fjord and coastal areas, in May and June the main part of the samples are taken offshore. It is observed a decrease in mean length in area C, this may indicate a westward migration of smaller herring from more eastern parts of the Barents Sea. Area D represents the herring in the open eastern Barents Sea. There are considerable differences in mean length in May 1985, approximately 9 cm difference from the Møre area compared to the eastern Barents Sea. This indicates that the 1983 year class will recruit to the spawning stock over a number of years.

## ABUNDANCE

Abundance estimates of herring of the 1983 year class have been obtained by applying the capelin "conversion constant" to convert integrator values to number of herring. The following target strength-length relationship has been applied (Dommasnes and Røttingen 1985):

$$TS = 19.1 \log L - 74.0$$

L = Length of herring

The results are given in the text table below:

Abundance of the 1983 year class ( $N \times 10^{-9}$ )

	Norwegian coast	Barents Sea	
		West of 32° E	East of 32° E
Nov-Dec 1983	13.7	n.a.	35.7
June 1984	n.a.	4.6	38.1
Nov-Dec 1984	3.6	n.a.	n.a.
May 1985	n.a.	10.1	29.7

n.a. = not available

The survey in the Barents Sea in Nov-Dec 1983 was severely hampered by bad weather. The total distribution area was not covered, the Barents Sea component for this time interval is therefore underestimated. There are also some difficulties in conducting the acoustic survey in May-June. This is due to mixing of capelin and herring recordings. (Hamre and Dommasnes 1985). The sampling is done by pelagic trawl, but the capelin and herring may have different selective properties with regard to the trawls which have been applied.

## MIGRATION

From Figs. 2 and 3 it seems that the 1983 year class is distributed in the same areas, and have not undertaken any substantial migration in the period June 1984 to January 1985. Fig. 8 gives isotherms in 100m (mean depth of the herring recordings) in June 1984, and it seems that the distribution borders in the north and east follow approximately the 1°-isotherm.

During winter and spring 1985 it seems that these open sea

concentrations gradually have migrated southwestwards (Fig. 3). Fig. 9 gives the isotherms in 100m in May 1985, and it can be observed that the 10°-isotherm has been moved southwestwards. The change in distribution area for the open sea concentrations of the 1983 year class may therefore have its cause in environmental changes, and not as a result of a general migration pattern (Hamre and Dommasnes 1985).

Some of the members of the 1983 year class which in November-December 1983 were distributed in the fjords of northern Norway, may have migrated from the coast in the period Nov-Dec 1983 to Nov-Dec 1984. The text table on page 4 shows a considerable reduction in the number of herring from 0- to I-group in the fjord and coastal regions. However, an eventual migration for the 1983 year class is at present difficult to quantify, and no conclusion can be drawn from the distribution maps on Figs. 2 and 4.

#### 1984 YEAR CLASS

The 0-group abundance index for the open sea concentrations of the 1984 year class of herring, calculated on basis of the international 0-group survey in the Barents Sea was 66.9 compared to 751.8 for the 1983 year class as 0-group (Anon. 1985). Acoustic estimates for the 1984 year class in the fjord areas was  $1.4 \times 10$  individuals, compared to  $13.7 \times 10$  for the 1983 year class. The 1984 year class has mixed with the 1983 year class in some fjords in northern Norway (Fig. 9), and in the south-eastern part of the Barents Sea.

#### DISCUSSION

It is expected that the spawning stock of the Norwegian spring spawning herring will increase substantially when the 1983 year class recruits (Anon. 1985). But where will the future migration routes and spawning areas for this year class be?

Dragesund (1970) has given a detailed description of the migration and distribution of the year classes 1959-1965 of herring as 0-group and juveniles. Special emphasis was put on the 1959 year class which was strong. This year class went through an interesting development as juvenile and adolescent herring. One part of this year class, the fastest growing, migrated as adolescents to the traditional feeding areas in the Jan Mayen/Iceland area and appeared as recruit spawners at the spawning grounds at Møre. The other part of the year class assembled as adolescents on wintering grounds at Torsvåg and Ingøydjupet and spawned in the years 1963-1966 at the Røstbanken area. This stock component had their summer feeding grounds in the eastern part of the Norwegian Sea (Devold 1968).

Will the 1983 year class follow the 1959 "year class model"? Dragesund (1970) states that the 1959 year class began a south- and westward migration from the central parts of the Barents Sea in 1960 (as I-group). This migration was along the front between colder and warmer water masses. This migration continued in 1961, and in late summer that year the main part of the open sea concentrations were located off the Finnmark coast (between 25° E and 30° E). The 1983 year class did not undertake any substantial migration as I-group. In June 1985, as II-group, the main part of the 1983 year class in the Barents Sea is located between 30° E and 40° E. The II-group open sea concentrations of the 1983 year class have therefore a more eastern distribution than the same age group of the 1959 year class.

The fjord distributed part of the 1959 year class migrated from the fjords in the period March to May 1960. Dragesund (1970) takes the I-group herring in the Ullsfjord region as an example, and there the main concentrations of I-group herring had migrated by May 1960, very little I-group remained in the fjord areas during summer and autumn. Fig. 5 shows that considerable concentrations of I-group herring were still in that region in December 1984.

A preliminary comparison of the distribution and migration of the year classes 1959 and 1983 shows:

- 1) As II-group, the open sea concentrations of the 1983 year class have a more easterly distribution than the year class 1959.
- 2) Of the fjord distributed (in northern Norway) part of these two year classes, the 1959 year class migrated from the fjord areas at an earlier stage than the 1983 year class.

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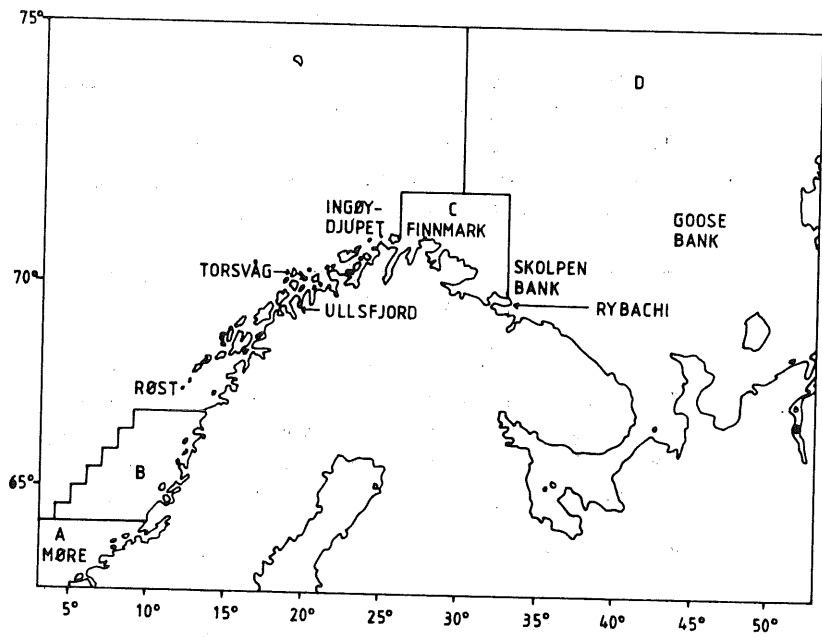


Fig.1 Names of areas mentioned in the text.

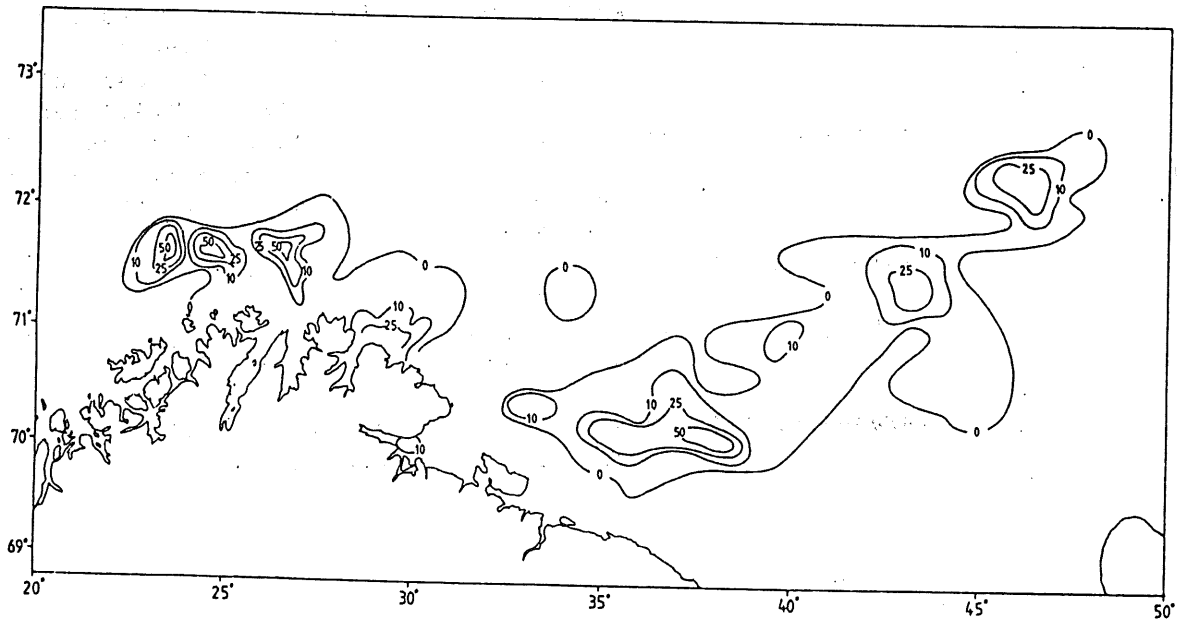


Fig.2 Distribution of the 1983 year class in June 1984.  
(Tonnes per square nautical mile)

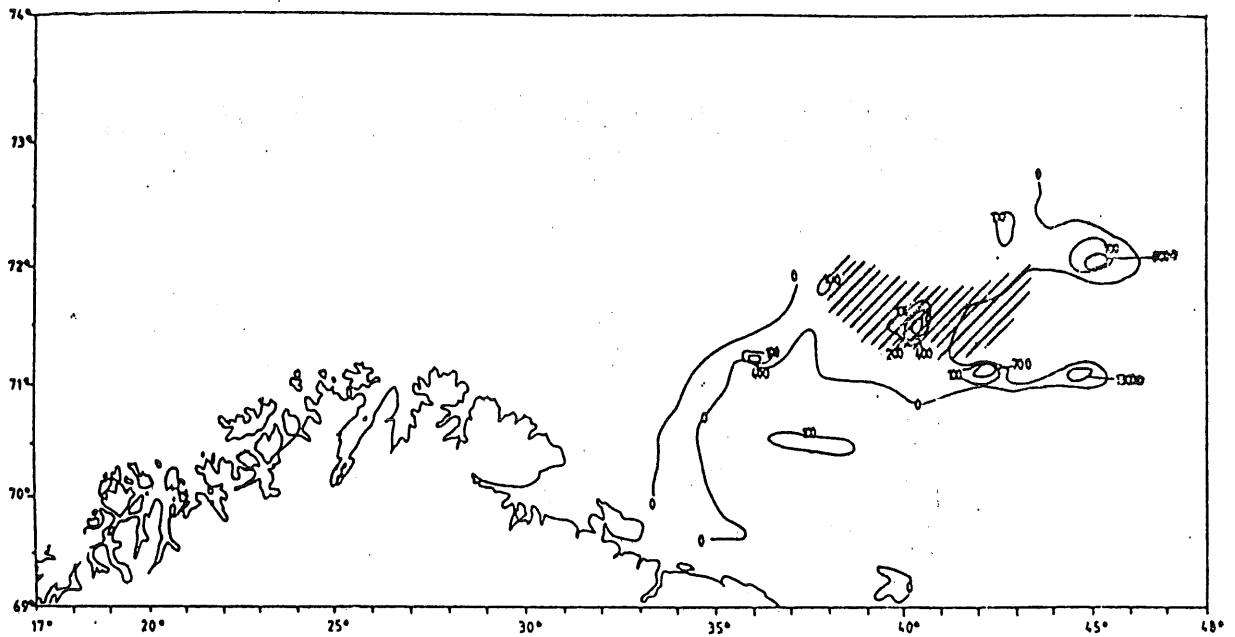


Fig.3 Distribution of the 1983 year class in January 1985. (Integrator values). The area for the Norwegian winter capelin fishery in January is hatched.

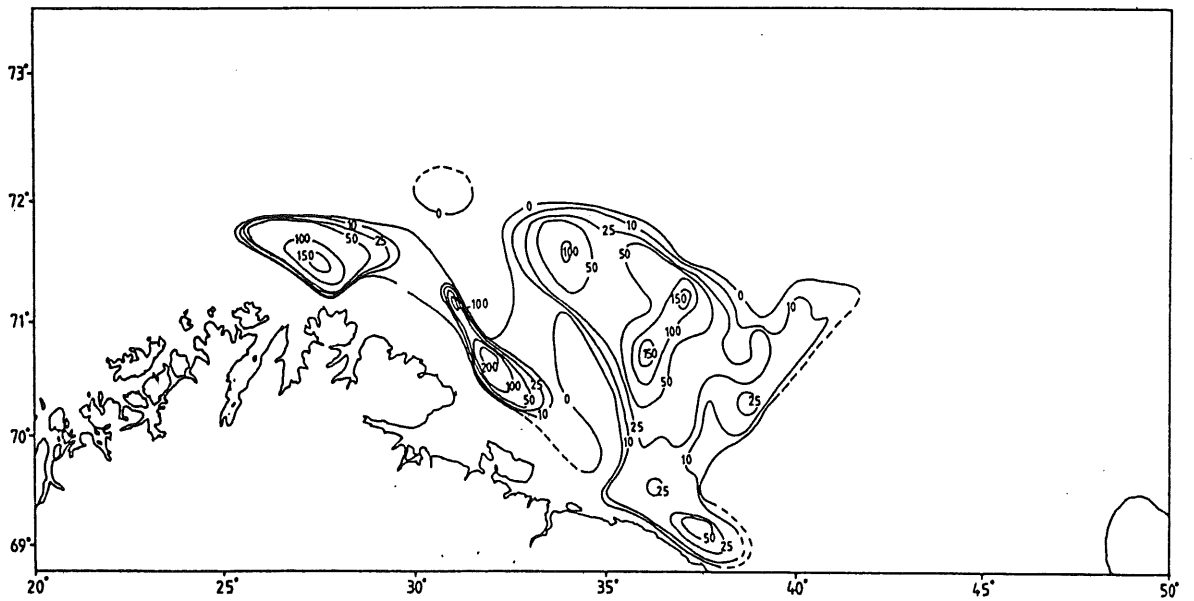


Fig.4 Distribution of the 1983 year class in May 1985. (Tonnes per square nautical mile)

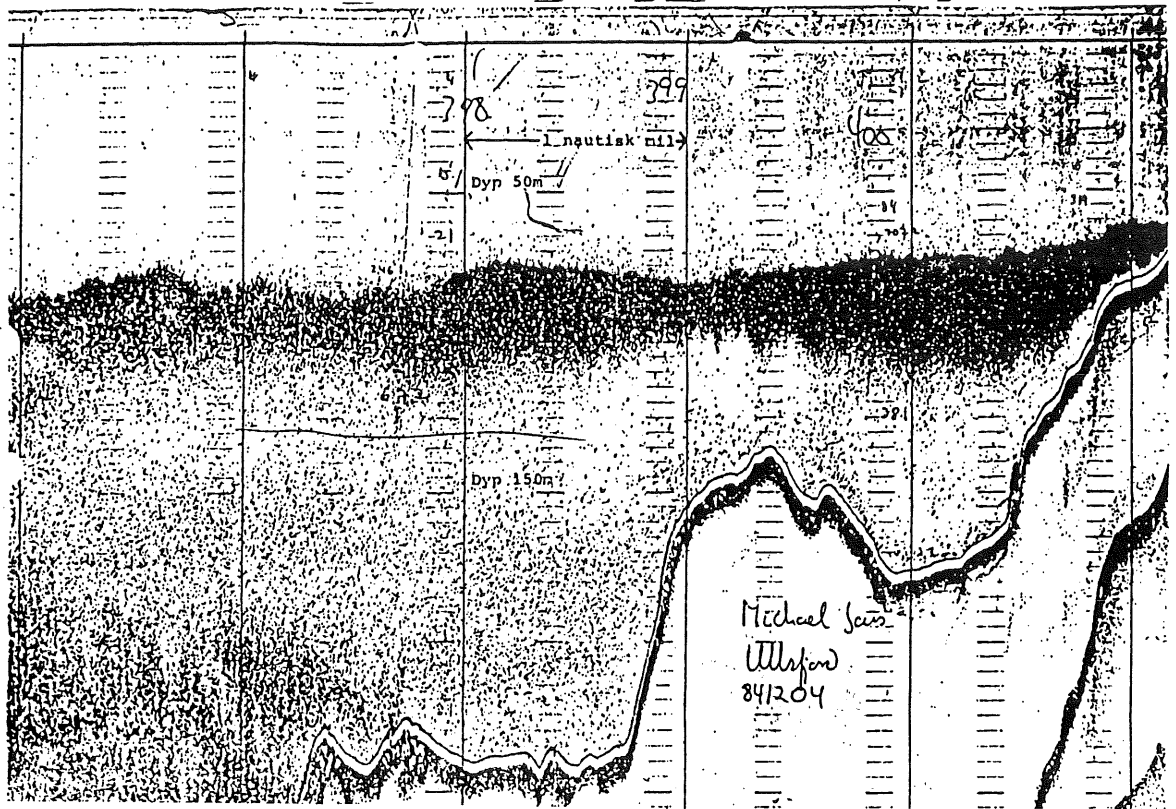


Fig. 5. Echogram recording of the 1983 year class in Ullsfjord in December 1984

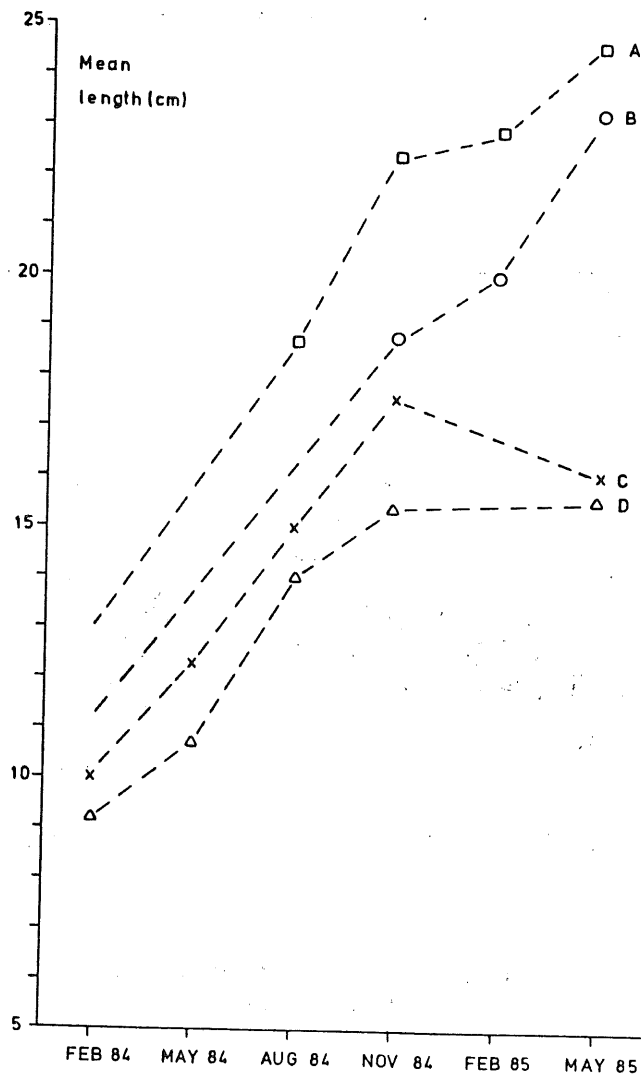


Fig. 6 Mean length for the 1983 year class in different areas (Fig. 1) for the period January 1984-May 1985.



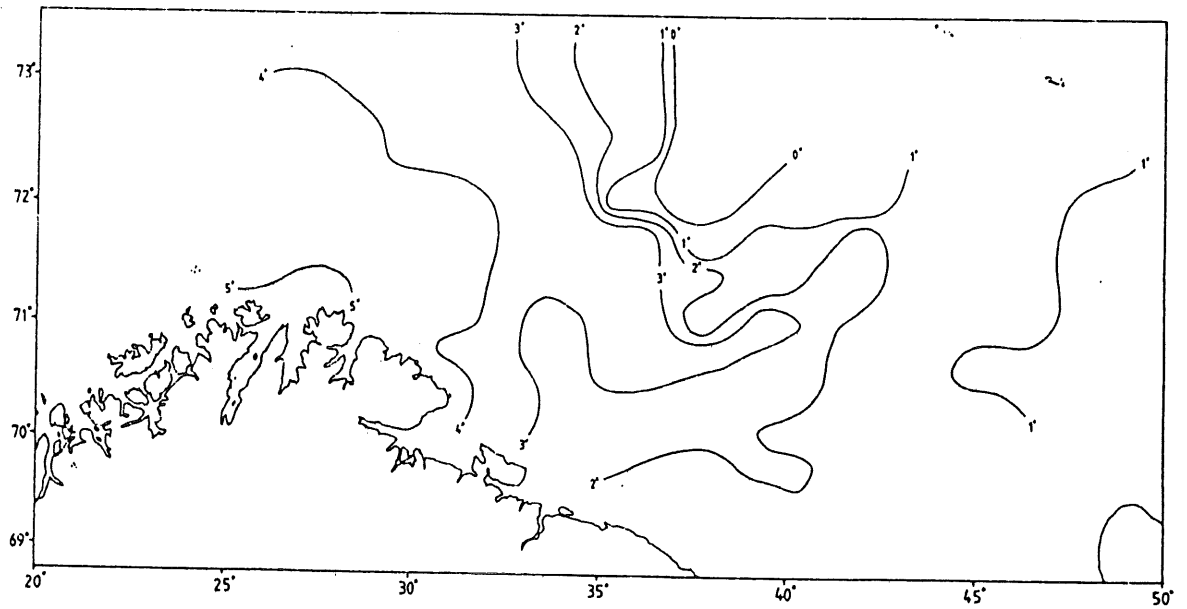


Fig.7 Temperatures in 100m in May 1984.

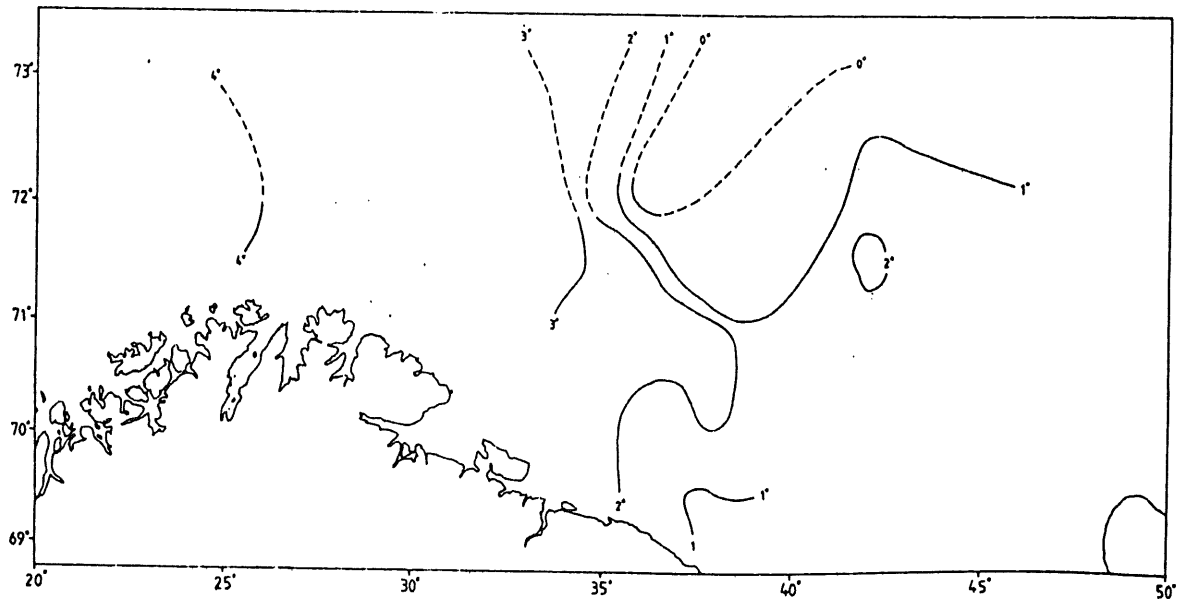


Fig.8 Temperatures in 100m in May 1985.

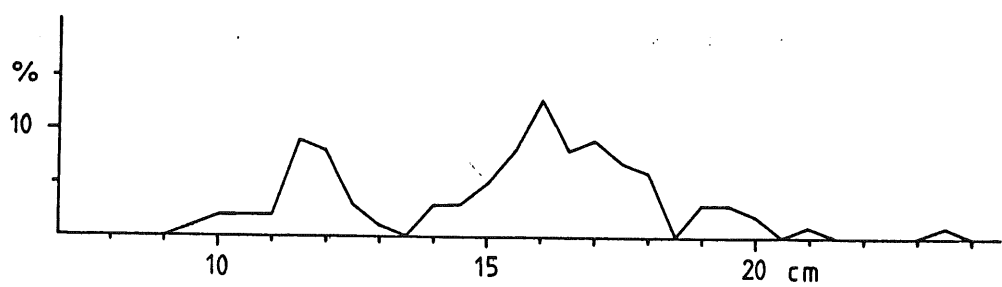


Fig.9 Typical length distribution of juvenile herring in a fjord in northern Norway, December 1984.

