JOINT SURVEY REPORT

VESSELS: R/V "PROF. MARTY" and R/V "G.O. SARS"

DURATION: 1. - 28. June 1993

AREA: Southern Barents Sea

OBJECTIVES: Estimate the abundance of Atlanto-Scandian herring in Barents Sea. Map the hydrographical regime. Plankton sampling. Study feeding habits of herring. Estimate abundance index of capelin larvae.

INTRODUCTION

Since 1984, when the 1983 year-class of the Norwegian spring-spawning herring was distributed in the eastern part of the Barents Sea, a young herring survey has been conducted every year in May/June to estimate the abundance of the year-class components spending the adolescense in the open Barents Sea. Since 1989, every yearclass of the Norwegian spring-spawners has been distributed in the southern parts of the sea at this time of the year, well distributed for acoustic abundance estimation. In the years 1984 - 1991 these investigations were conducted by a Norwegian vessel. Many years, however, the distribution of young herring were close to the Russian coast and the Norwegian vessel was unable to cover the full area of distribution due to restrictions in entering the "fishery" zone. Therefore, and also to get a better coverage in the main distribution area in the open sea, Russian and Norwegian scientists agreed on using one vessel from each country to cooperate during the survey in 1992. On the March 1993 Murmansk meeting it was agreed to conduct this survey also this year. This is the joint report following this survey agreed upon by the participating scientists.

MATERIAL AND METHODS

During this time of the year the herring is expected to be distributed in the southern part of the Barents Sea, close to the Norwegian and the Russian coasts, mainly to the south of 73°00'N. It is also expected to find herring mainly younger than four years old.

The research vessel "Prof. Marty" started the coverage from along the Murman coast on the 1. of June, and R/V "G.O. Sars" started on the same day to cover tha area from the west going north along the longitude 20°00'E (Fig. 1). It was agreed to cover the area by north-south transects one degree longitude apart (about 20 NM). In the area with highest concentrations of herring, transects were run just 10 NM apart. This was the area between longitudes 31°00' and 37°00'E. The Russian vessel should cover the area close to the Russian

coast and then cover the area with presumeably the highest concentrations of herring (between 30°00'E and 35°00'E), by going north-south transects between the Norwegian vessel's courses.

Hydrographical stations (CTD) were performed every 20 NM. Altogether 271 stations were taken, 181 by "G.O. Sars", and 90 by "Prof Marty".

Plankton sampling

On "G.O. Sars", various nets were used to collect plankton. Figure 2 shows how the plankton stations were distributed in the survey area.

The GULF-III (375 my) was used mainly to collect capelin larvae, and hauled slowly from 60 m to the surface at 5 knots. A total of 178 Gulf-III stations were carried out to get data for the capelin larvae index estimation.

The WP-2 net (180 my) was used at 58 stations to sample plankton, hauled from bottom to surface and from 100 m to the surface. Half of the samples were fixed in Formalin and the other half fractioned in 2000-, 1000- and 180 my and dried. These samples will later be used for biomass estimates of zooplankton.

On 17 stations, the MOCNESS plankton sampler was applied to sample plankton in up to 8 depths depending on the bottom depth and the depth of the main concentrations of plankton on the actual position. The nets in this gear are all 200 my. The samples were treated in the same way as the samples from the WP-2 net.

At the stations where either the WP-2 net or the MOCNESS were run, samples for determination of chlorophyll, nutrition salts, suspended organic materials like POC/PON-POP-PSi were taken at standard depths.

Fluorescence measurements were undertaken at all CTD stations for measurement of phytoplankton activity.

Sampling of pelagic fish

On both vessels, trawling was done on registrations, both pelagic and close to bottom. On "G.O. Sars" 39 trawl stations were performed, 38 pelagic and 1 on the bottom. The pelagic trawl used for herring sampling on R/V "G.O. Sars" was the "Åkra" trawl, with an opening of 25x30 m. On R/V "Prof Marty" 29 trawl stations were performed, all pelagic. The opening of the pelagic trawl on this vessel was 40x40 m.

When herring were caught by "G.O. Sars", a GULF-III station was performed in the same position. Stomachs of herring were sampled to study the predation on capelin larvae by young herring. A total of 700 stomachs were examined during the survey, and the same amount is preserved on Ethanol to be analysed later in the onshore laboratory.

Sampling by acoustics

The echo recordings were processed applying the standard echo integration method. The registrations were daily scrutinized and the S_A-values for herring were used to calculate the abundance. The new SIMRAD SA 950 sonar was used continuously sending signals 90° to one side of the sailing direction to help verify herring concentrations and recordings. The following TS function was applied to convert the S_A-values to fish densities:

$$TS = 20 \log L - 71.9 \text{ dB}$$

which gives a C_F of:

$$C_F = 1.23 \times 10^6 \times L^{-2}$$

where L is the total length of the fish. The two vessels had radio contact every day to exchange sailing diary, S_A-values and trawl data. An intercalibration was performed between the two participating vessels on the night 21 - 22 June. A separate report on this calibration was written on the 22 June on board "G.O.Sars". This report (Annex I) which includes the settings of the instruments of the two vessels, concludes that the acoustic performance of the two vessels is 1:1.

The estimate of herring divided in age groups is based on the length and age distribution as shown in Figure 7. The calculations were done by rectangles (1 latitude degree x 2 longitude degrees). The mean S_A-values from both vessels combined were calculated within each rectangle and biological samples in terms of age/length keys were allocated to the nearest area or to regions with similar type of recordings. The calculations were done applying standard computer programs developed at IMR, Bergen.

RESULTS

Hydrography

The overall hydrographic regime in the surveyed area is shown in Figures 4 a-d. In the area there is an inflow of Norwegian coastal water close to the coast and inflow of Atlantic water in the central and northern parts of the area. In the water were herring was recorded, i.e. close to surface in the whole area of distribution, the temperature varied between 4.0 and 5.5°C. The overall temperature regime in the surface is higher this year than last year, but from 50 m and below the environment this year is colder than last year.

Plankton

The plankton samples from this survey will be analysed at IMR later. However, in the western part of the survey area, high concentrations of plankton was recorded on the echo sounder, giving mean S_A-values pr 5 NM of 2-300. This plankton consisted mainly of Calanus sp., Oicopleura sp., krill and phytoplankton. In the central and eastern parts of the survey

area, considerably fewer concentrations of planktonic organisms were recorded.

Capelin larvae

The overall geographical distribution of capelin larvae is shown on Fig 6. A separate report will be written about the distribution by size and abundance of capelin larvae.

Herring

The herring were distributed off the Norwegian and Russian coasts between the longitudes 23°00'E and 38°30'E (Fig. 5) and extending in offshore direction to about 90 NM off the coast. The highest concentrations were recorded in a belt (30 x 180 NM) along the coast of Norway from about 29°30'E and eastwards along the Russian coast to about 38°30'E. A high density area was also recorded around 70°30'N and 34°00'E extending some 30 NM in each direction. Some very dense schools were recorded to the east of Vardø and north of Murmansk.

The herring in the western part of the survey area (north of Norway) consisted mainly of 2-year olds while the concentrations in the eastern part were dominated by 1-year olds. In major parts of the distribution area, the herring were found close to surface at about 10 - 30 m depth. This caused severe methodical problems as many schools in large areas avoided the vessel when within a certain range. This could easily be detected by the sonar by which many herring schools were recorded while none or very few in the same area were recorded by the echosounder. An example of this feature is shown in Fig. 8 where the echo recording paper and the sonar recording paper of 4 miles are compared. In this example several herring schools are clearly seen on the recording paper from the sonar while just one small school appear on the echo recording paper. Trawl stations were performed to verify that the schools detected by the sonar were herring. The problem occurred all over the distribution area. Of course this leads to an underestimation of herring.

Length and age distributions for herring to the west and to the east of 30°00'E are shown in Figure 7 a and b.

An estimate of the total abundance in terms of number and weight divided into age/length groups is shown in Table 1. Comparison with last year's estimate is shown in Table 2 presented in the text below.

This year, no 4-year olds were found and a very limited number of 3-year olds were calculated in the westernmost parts of the survey area. Only 1.5 billion individuals are estimated indicating that this yearclass has migrated out of the Barents Sea. Last year 14 billion two year olds were estimated. The estimate of the 2-year olds this year of 26 billion is a confirmation of the strength of this yearclass (1991) and in relation to last years estimate of 33 billion this number is reasonable.

The estimated number of the 1-year olds of 102 billion is the highest number on record of herring at this age in this area. The acoustic estimate of this yearclass as 0-group last autumn also indicated that this yearclass could be of considerable size. The number was calculated

to more than 300 billion. The problems concerning the position of the herring in the water column has probably been significant for this agegroup on the present survey, hence the estimated number is probably too low.

Table 2. Estimated number (N x 10^{-9}) of small herring divided by age group for the last two years in the Barents Sea.

	AGE			
Year	1	2	3	4
1992	32.6	14.0	5.8	0.1
1993	102.7	25.8	1.5	-

CONCLUDING REMARKS

- The estimate of the 3-year olds is not reflecting the yearclass-strength as this age group has probably migrated out of the Barents Sea.
- The sources of error due to avoidance reactions is probably significant, especially for the 1-year olds.
- The sources of error due too mixing with capelin is insignificant.
- The overall coverage of the stock in the area is good. It is not likely to believe that herring is distributed to the north or to the east of the surveyed area.

At sea, 27. June 1993

Alexander Kryssov
(sign.)

Reidar Toresen
(sign.)

Table 1. Abundance estimate of Atlanto-Scandian herring in the Barents Sea, 1. - 28. June 1993.

ATLANTO-SCANDIAN HERRING BARENTS SEA JUNE 1993

Number :N x 10 Exp-7 Mean length : Cm Weight . : Ton x 10 Exp-3
Av.weight :Gram Condition : 1000 x Weight/Length Exp+3

$$C : 1.230 * 10^{6} * L^{-2.00}$$

Length	1	2	3	4	5	6	7	8	Tot	Weight	Av.w.
9.5- 9.9	43								43	2.4	5.5
10.0-10.4	1134								1134	68.1	6.0
10.5-10.9	2681								2681	182.3	6.8
11.0-11.4	2634								2634	210.7	8.0
11.5-11.9	2082	42							2124	197.8	9.3
12.0-12.4	1001								1001	106.1	10.6
12.5-12.9	281	100							381	45.1	11.8
13.0-13.4	283	124							407	54.4	13.4
13.5-13.9	87	187							274	41.9	15.3
14.0-14.4	41	283							324	51.4	15.9
14.5-14.9		248							248	43.4	17.5
15.0-15.4		234							234	46.7	20.0
15.5-15.9		245							245	53.8	21.9
16.0-16.4		337							337	79.4	23.6
16.5-16.9		262							262	71.3	27.2
17.0-17.4		199							199	59.0	29.6
17.5-17.9		173							173	53.9	31.2
18.0-18.4		87							87	29.4	33.8
18.5-18.9		39							39	15.2	38.9
19.0-19.4		13							13	5.4	41.3
19.5-19.9		6							6	2.5	41.3
20.0-20.4			6						6	3.0	50.0
20.5-20.9			10						10	5.6	55.5
21.0-21.4			9						9	5.2	57.5
21.5-21.9			17						17	10.5	61.5
22.0-22.4			20						20	13.9	69.5
22.5-22.9			39						39	28.4	72.8
23.0-23.4			17						17	13.4	79.0
23.5-23.9			17						17	11.1	65.0
24.0-24.4			9						9	5.8	65.0
24.5-24.9			3						3	1.9	65.0
Number:	10267	2579	147						12993		
Av.len:	11.33	15.57	22.54						12.30		
Weight:	854.0	566.2	98.8						1519.0		
Av.wei:	8.3	22.0	67.2						11.7		
Cond.:	5.6	5.6	5.9						5.6		

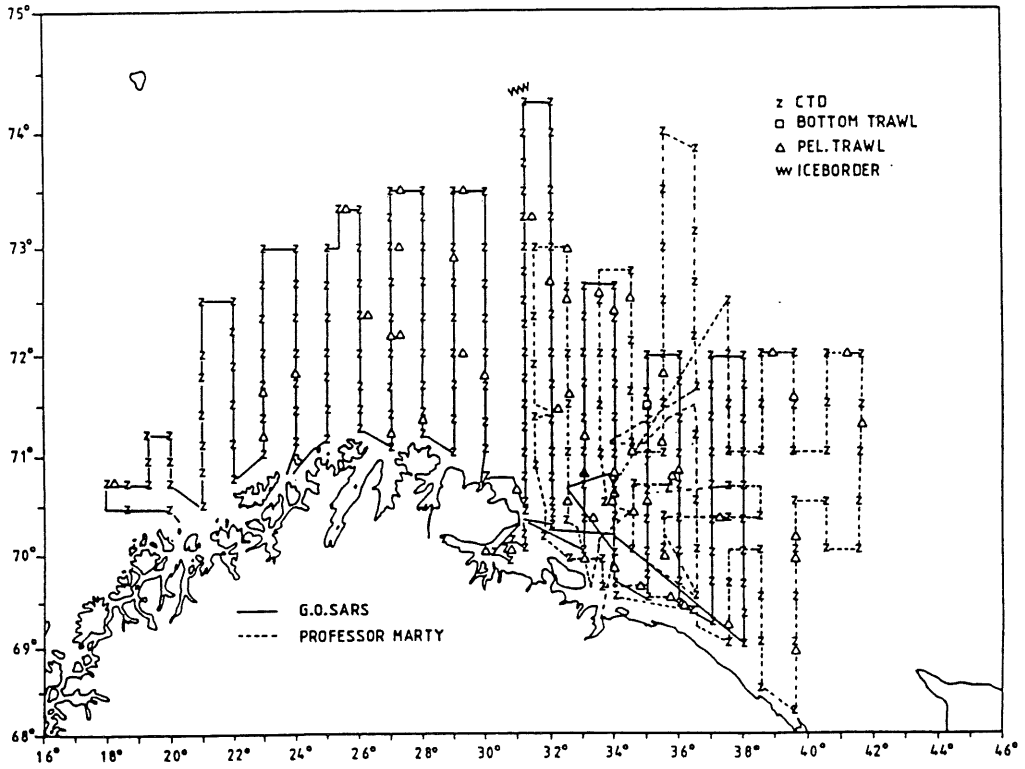


Figure 1. Survey grid, hydrographic and trawl stations for R/V "G.O. Sars" and R/V "Professor Marty" 1. - 28. June 1993.

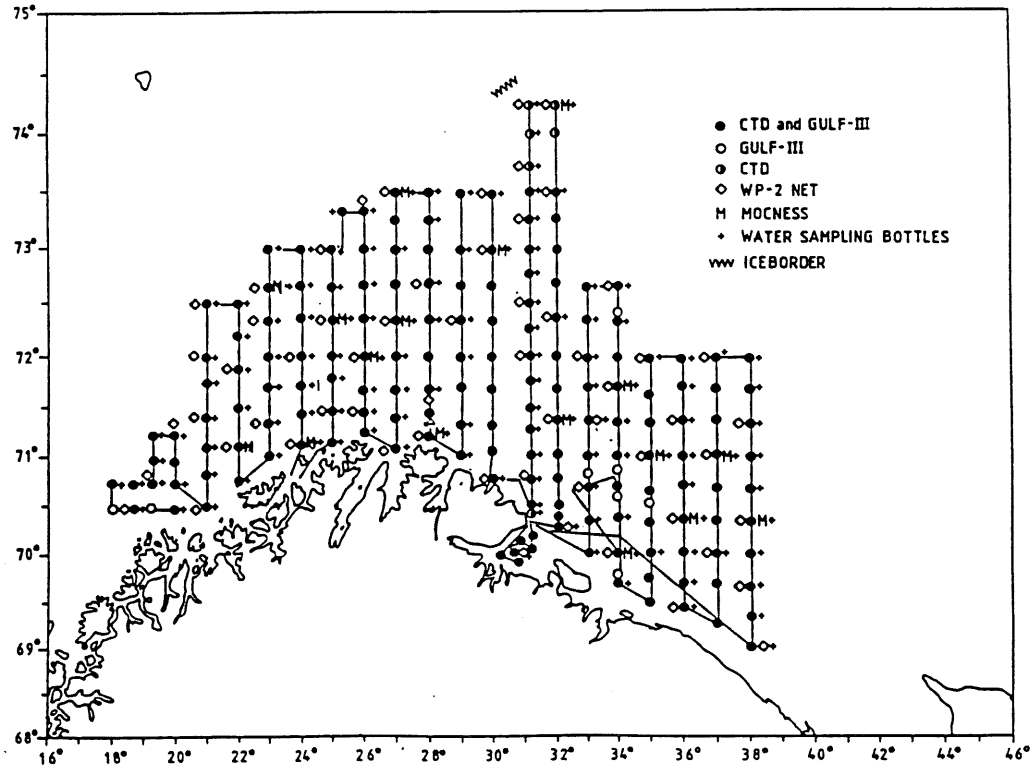


Figure 2. Plankton sampling stations for R/V "G.O.Sars" 1. - 28. June 1993.

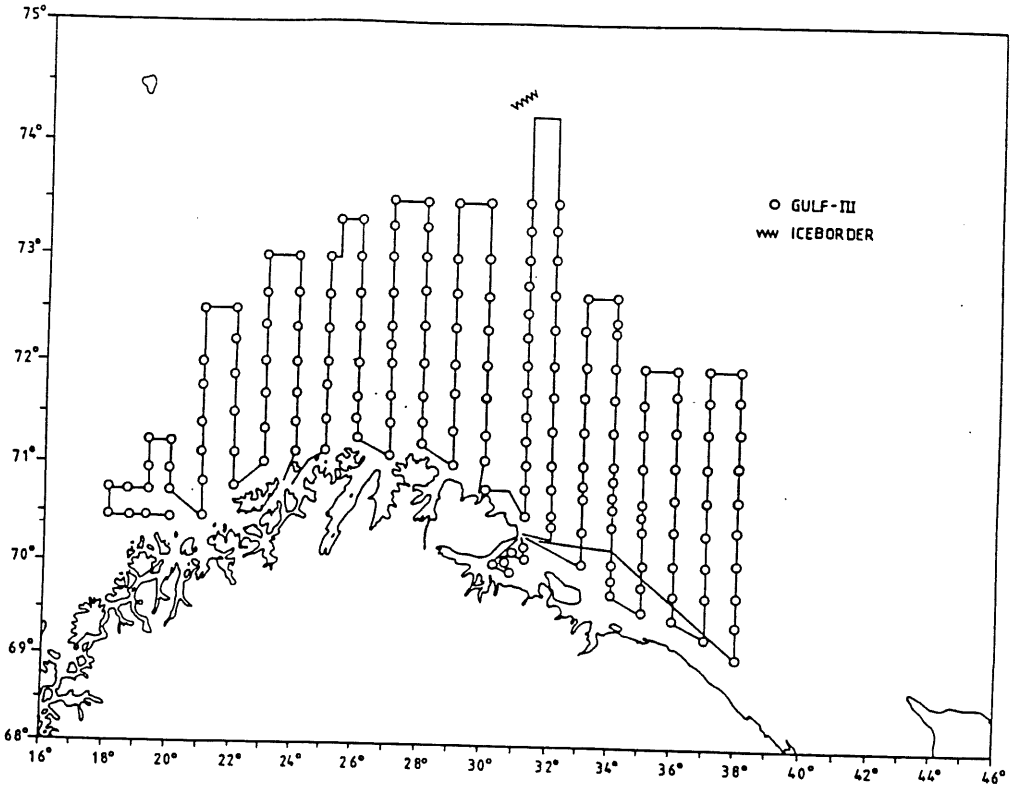


Figure 3. GULF-III stations for R/V "G.O. Sars" 1. - 28. June 1993.

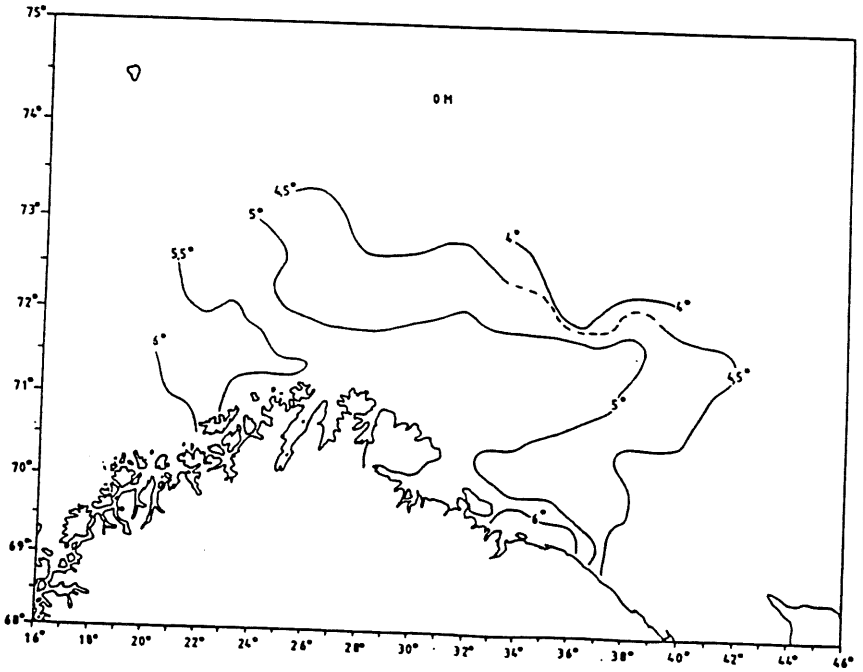


Figure 4. Isotherms at 0, 50, 100 and 200 m. for R/V "G.O.Sars" and R/V "Professor Marty" 1. - 28. June 1993.

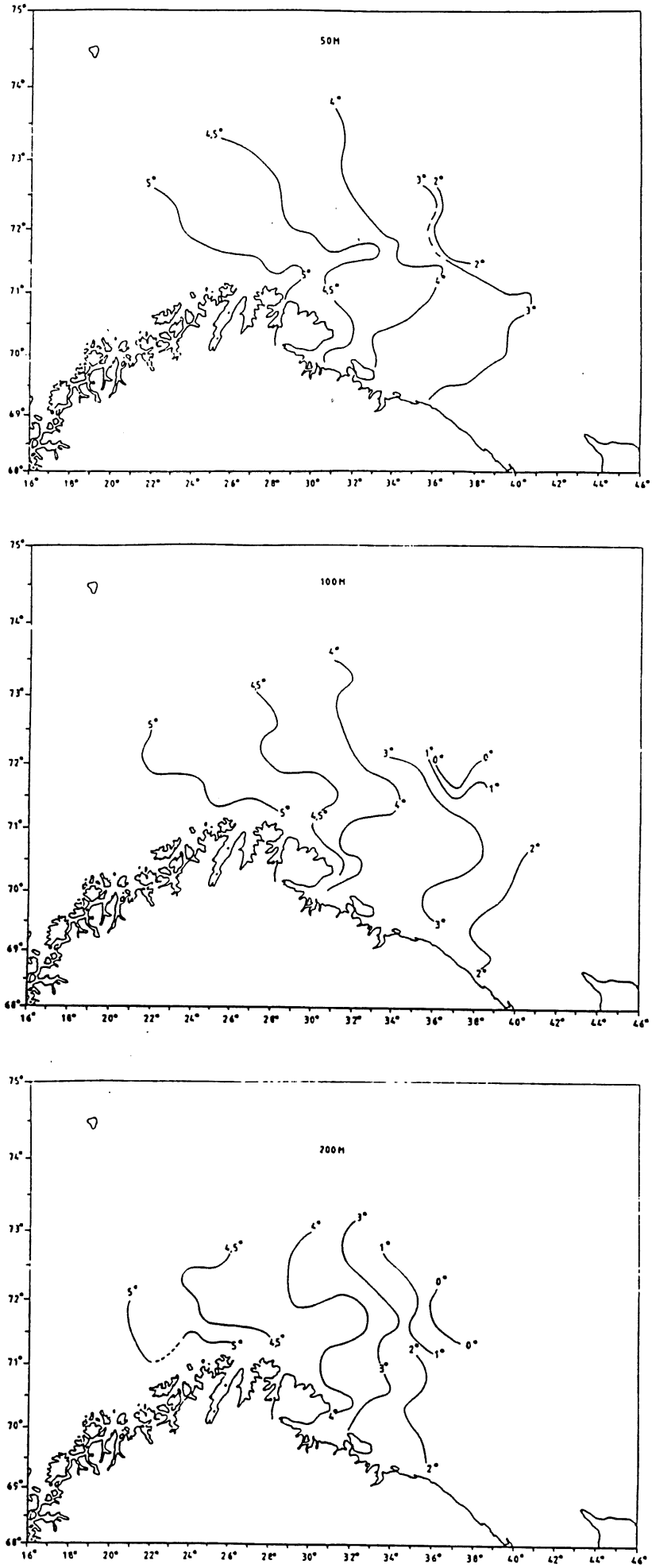


Figure 4. (Cont.)

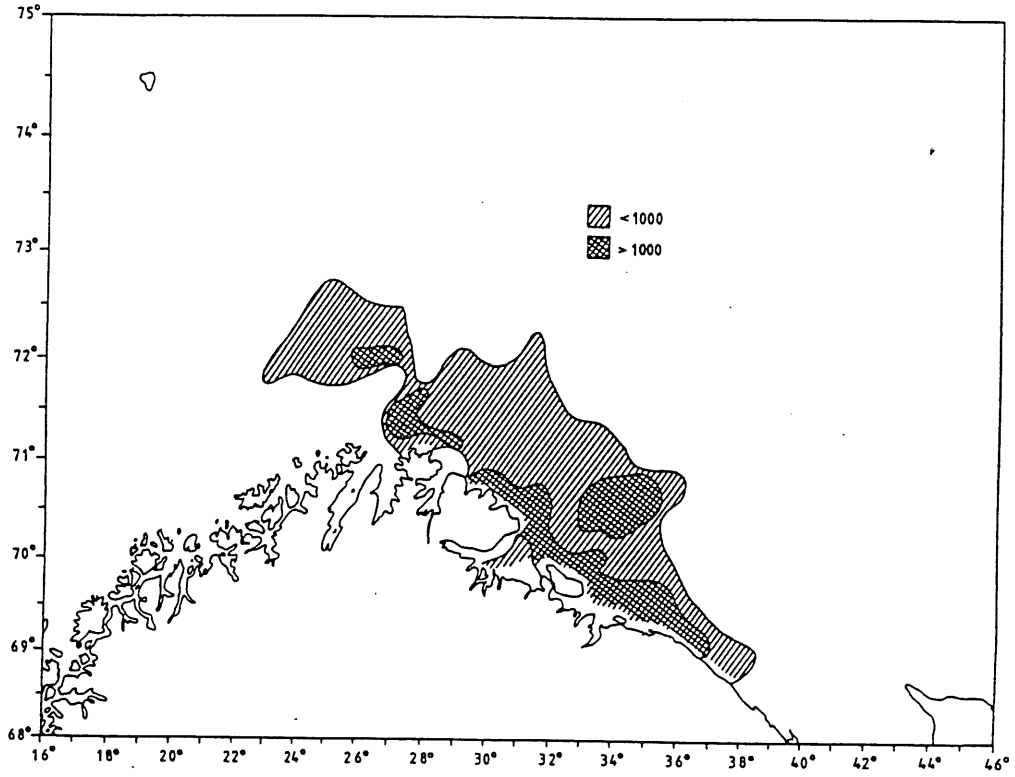


Figure 5. Distribution of immature herring 1. - 28. June 1993. Double hatched area indicate highest density.

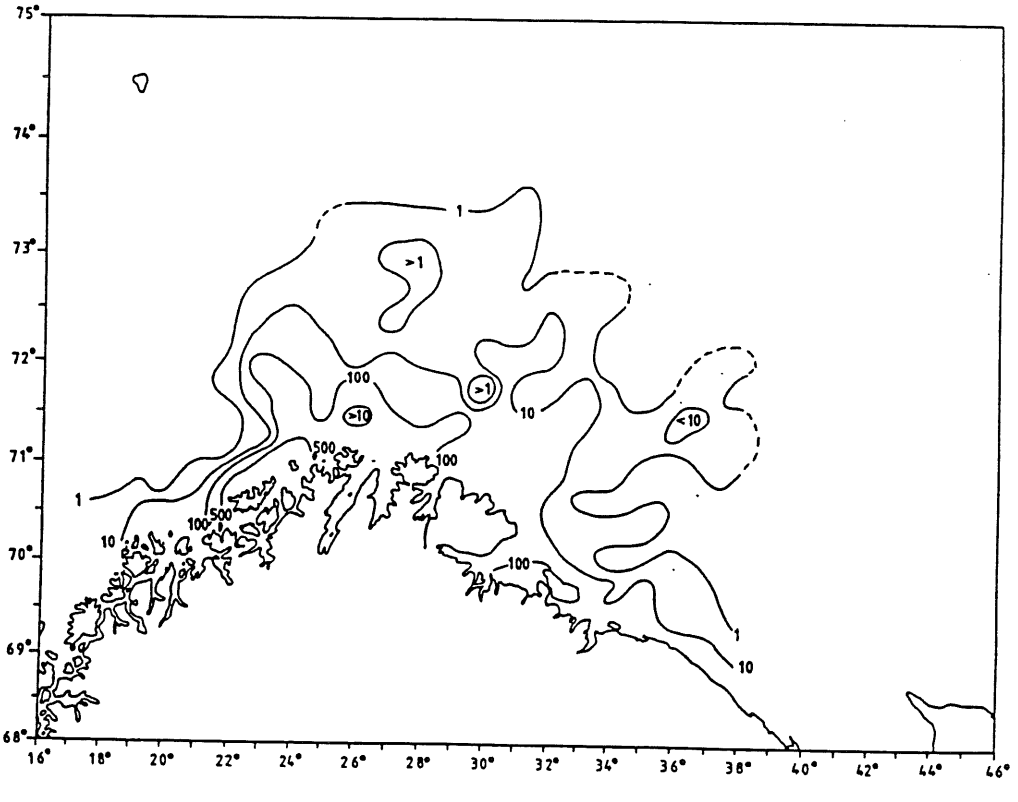
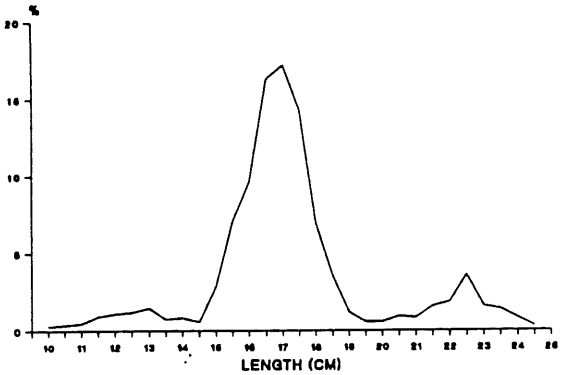


Figure 6. Distribution of capelin larvae 1. - 28. June 1993.

a)



b)

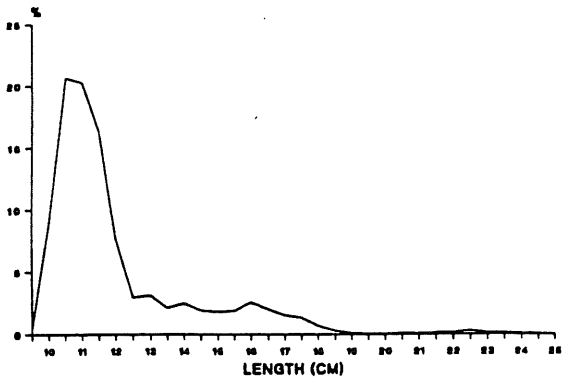
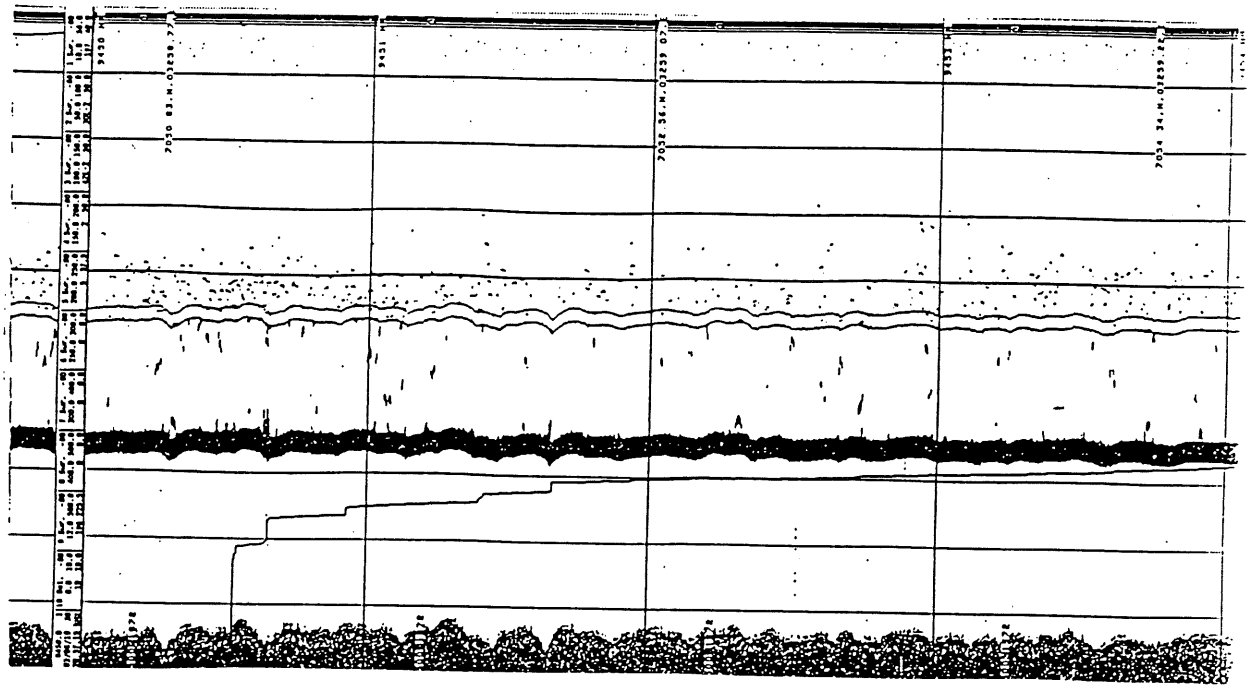


Figure 7. Length and age distribution of immature herring for R/V "G.O. Sars" and R/V "Professor Marty" 1. - 28. June 1993.
a) West of 30° 00' E
b) East of 30° 00' E

a)



b)

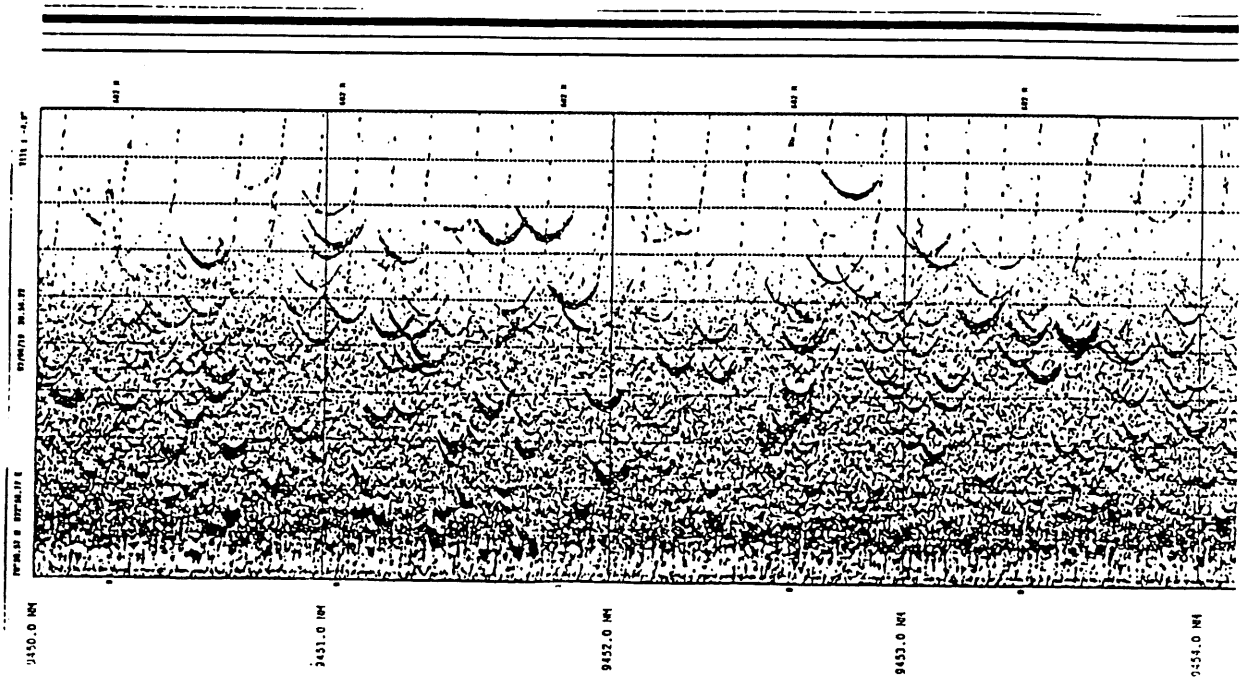


Figure 8. Recording of herring schools on a) echosounder and b) sonar over the same sailed distance. "G.O. Sars", 19. June 1993.