

**INSTITUTE OF MARINE RESEARCH  
BERGEN, NORWAY**

**CRUISE REPORT  
R/V "JOHAN HJORT"  
30.6 - 29.7 1998**

**NORWEGIAN SEA**

**CRUISE NO. 1998209**

## PARTICIPANTS

From the Institute of Marine Research, Bergen, the following persons participated:

### 30/6-30/7:

Bård Bjordal  
Ole Gullaksen  
Terje Monstad (Cruise leader)  
Øyvind Torgersen

### 30/6-15/7:

Valantine Anthonypillai  
Otte Bjelland  
Bjørnar Ellertsen  
Julio Erices  
Bjørn E. Gjerde

### 15/7-30/7:

Are Dommasnes  
Åse Husebø  
Kåre Lauvås  
Webjørn Melle  
Øyvind Tangen

### Guest:

Yataka Kurita, Tohoku National Fisheries Research Institute, Japan

## INTRODUCTION

The present survey is part of the Norwegian Sea Programme, Mare Cognitum, which is run by the Institute of Marine Research, Bergen, to study distribution, feeding and abundance of pelagic fish species in relation to the physical and biological environment. The programme includes studies of herring, blue whiting, mackerel, horse mackerel, salmon, lumpsucker, squid (*Gonatus*) and mesopelagic fish species. A large number of fish stomachs and plankton samples have been collected and analysed. Hydrographic observations are part of the programme.

The survey is also included in the ICES-co-ordinated investigations on pelagic fish in the Norwegian Sea, with special emphasis on the Norwegian spring spawning herring. Plans for the investigations in 1998 were described by the Planning Group, which met in Reykjavik 22 August 1997 (Anon., 1998: Report of the ICES Planning Group on Surveys on the Pelagic Fish in the Norwegian Sea (PGSPEN), Reykjavik, Iceland, 22 August 1997. ICES, Copenhagen).

During the period 30 June to 29 July 1998 the Norwegian Sea was surveyed from Faroe /Shetland waters in the south to the Bear Island in the north, between the shelf edge off the Norwegian coast to the Jan Mayen area (Figures 1 and 2). Included were the standard hydrological section Svinøy- NW and a transverse hydrological section along the latitude 69°30' N from 11°00' W to the Norwegian coast, with stations at each whole degree longitude.

The present cruise had a number of tasks, some of them in addition to those described by the ICES Planning Group:

- Investigate distribution and quantity of blue whiting, herring, mackerel, postsmolt salmon, lumpsucker, and other species.
- Deep sea trawl hauls to 1100 m depth for the squid *Gonatus*.
- A hydrography/plankton section Svinøy - NW, with multiple gears.

- A hydrography/plankton section along 69° 30' N, with multiple gears. This section is a co-operation between IMR and the Polar Research Institute (PINRO) in Murmansk.
- A grid of hydrographic stations with CTD sonde with water bottles, plankton stations with WP-2 net, and MOCNESS over the area covered.

In order to cover the area planned, and carry out sampling with the different gears and procedures desired within the allocated ship time, compromises were necessary both with regard to the density of cruise tracks and the number of sampling stations.

A standard summary of information is given in an APPENDIX.

## MATERIAL AND METHODS

The echo sounder used was a Simrad EK-500/ES-38B-SK which was connected to a BEI (Bergen Echo System) integrator system. The transducer was mounted on an extensible keel, which could be lowered 2 m below the bottom of the ship in order to reduce interference from air bubbles in bad weather. The following settings were used for the echo sounder system:

Transducer depth:	5-7m	2-way beam angle	-21.0 dB
Absorption coeff.:	10 dB/km	SV Transducer gain	22.70 dB
Pulse length:	medium	TS Transducer gain	27.55 dB
Band width	wide	3 dB beam width alongship	7.0 dg.
Max power	2000 W	3 dB beam width athw. ship	6.8 dg.
Angle sensitivity alongship	21.9 dB	Alongship offset	-0.09 dg.
Angle sensitivity athw. ship	21.9 dB	Athw.ship offset	-0.03 dg.

In addition, a Simrad SR 240 sonar was used to record schools. The sonar has a vertical angle of 12°, and was set in a fixed position at 90° to port, tilted 5-7° down. The schools in a zone 50 - 300 m from the ship were recorded on paper, and then counted and logged for each 5 nautical miles.

The distribution of zooplankton was recorded acoustically with a ES120-7 echo sounder as well as with the ES-38B connected to the BEI system.

For identification of echo recordings and collection of biological samples, a pelagic trawl ("Åkra trawl") with 30 m vertical opening and inner-net in the cod end of 22 mm was used. When used for surface trawling 2 big floats were attached to each trawl wing and a smaller one at the middle of the headline. In addition to echo recording herring was also observed by such surface trawling, and it was the main method for observations of mackerel, horse mackerel, salmon and lumpsucker as well as for 0-group fish.

For zooplankton sampling a standard WP-2 net with 180µm mesh was used for vertical hauls 200-0 m. On all stations on the section along 69°30' N a Juday-36 net was used in addition for vertical hauls 200-100m, 100-50m, and 50-0m. A 1m<sup>2</sup>

MOCNESS plankton sampler was also used, covering the depth range 700-0m, at selected stations.

A CTD sonde was used to record temperature and salinity (conductivity) down to 500 m depth on "standard" stations, and to 1000m on MOCNESS stations. On the section Svinøy-NW the stations were taken to the bottom, and water samples were taken from 12 depths, depending on the bottom depth of the stations, for analysis of nutrient salts (all 12 depths) and chlorophyll (0-100 m).

## RESULTS

### Surface schools

Recordings of schools near the surface were made by sonar through most of the survey (Figure 3). The highest number of schools were found in the northern part of the area covered, and north of 69°N the distribution of schools coincides well with the integrator values for herring. In this area most of the sonar recordings are probably herring schools. In the southern part there were fewer sonar recordings, which may have come from herring, mackerel, horse mackerel, or even from lumpsuckers.

### Herring

Mean integrator values ( $S_A$ ) allocated to herring are shown, by rectangle, in Figure 4. Recordings of herring were mostly in the upper 50 m, as narrow scattering layers in 20 - 50 m depth, or as small schools. The schools were often close to the surface; above the upper limit for integration - and probably even above the transducer. The integrator values can therefore not be considered as a reliable indicator of the density of herring. The strongest recordings were found north of 69°N. Areas with particularly high  $S_A$ -values were found north of 71°N.

Figure 5 gives the catches of herring in surface hauls. These were mostly "blind" hauls, at positions selected in advance. The catches indicate that, in addition to the area north of 71°N, there may also have been concentrations of herring outside Vesterålen-Lofoten (68° - 70°N and from 11°E to the Norwegian coast), and in the area 69 - 70°N and 9° - 11°W.

Length- and age distributions of the herring in four sub-areas marked in Figure 4, are given in Figures 6 and for all the sub-areas in Figure 7. The youngest fish were found in sub-area I, i.e. off Lofoten Isles where the 1994 and -95 year-classes made up the majority of the rather weak recordings. In the north-western part of the area surveyed (sub-area III) where the highest abundance was recorded, the 1991 and -92 yearclasses dominated, as they did also in sub-area further to the east (IV). In both sub-area I and III remnants of the 1993 yearclass were observed. The overall age distribution show that the 1991 and -92 year-classes dominated the recorded concentrations and together contributed with 75 % in number. Separate length frequencies and mean lengths and weights for each trawl station are given in Table 1.

### Blue whiting

Observations of blue whiting were made over a vast area in the Norwegian Sea, with echo recordings obtained more or less throughout the whole survey. The concen-



trations which varied in density, were mostly observed at depths from 200 - 400 m during daytime. At night it dispersed and in some areas ascended towards the upper surface layer.

The mean integrator values ( $S_A$ ) allocated to blue whiting, are shown by rectangles on Figure 8. To the west the limit of the distribution was found in the polar-front area, i. e. at position  $68^{\circ}\text{N } 07^{\circ}\text{W}$  and further north and north-eastwards to around position  $73^{\circ}45'\text{N } 06^{\circ}00'\text{E}$ , while to the east it was only found in the area off the southern part of the Lofoten Isles. Highest concentrations were found in the mid part of the southern Norwegian Sea, i.e. from  $63^{\circ}$  to  $65^{\circ}\text{N}$  around the  $0^{\circ}$  meridian and from  $66^{\circ}$  to  $68^{\circ}\text{N}$  between  $0^{\circ}$  and  $6^{\circ}\text{E}$ . Rather high values were also recorded in the north, and at position  $73^{\circ}30'\text{N } 13^{\circ}00'\text{E}$  some dense schools of blue whiting were observed at 300m depth, as well as good recordings were made near the coast at position  $70^{\circ}30'\text{N } 17^{\circ}00'\text{E}$ . The distribution of blue whiting continued eastwards into the Barents Sea.

The biomass was estimated at 6.6 mill tonnes with a corresponding abundance of  $89.6 \times 10^9$  individuals (Table 2). The same density coefficient as used earlier for blue whiting estimates was used, i. e. corresponding to  $C_F = 1.488 \times 10^6 \times L^{-2.18}$ , where  $L$  is the fish length. The  $S_A$ -values by rectangle shown in Figure 8 were used, with interpolated values for "empty" rectangles not covered within the distribution area.

The result of 6.6 mill tonnes is almost the double of the 1997 result when 3.9 mill tonnes was measured, which again was significant higher than the results of 1996 and 1995. It is the highest value obtained for the blue whiting in the Norwegian Sea since 1980 when Norway measured the stock at 9.1 mill. tonnes. The difference in numbers of individuals was  $30.1 \times 10^9$  from the result in 1997, and both the overall mean length and mean weight were higher than in 1997.

Separate length frequencies with mean lengths and mean weights for each trawl station are given in Table 1. The age and length distributions for the six sub-areas marked in Figure 8 are given in Figure 9, and for the total recordings in Figure 10. Young fish dominated the concentrations, and the 2 year olds (1996 year-class) constituted with more than half of the measured abundance. The relationship between the 3 major yearclasses, 1995-97, was rather similar for all the sub-areas except for the south-eastern part. There, in sub-area I, the one year olds (1997 year-class) were the most numerous one.

### **Mackerel and horse mackerel**

Mackerel was caught in larger parts of the area surveyed, from the Faroe/Shetland waters to  $72^{\circ}\text{N}$  (Figure 11). As observed in 1997 the highest concentrations were found in the south, but more frequently in the north. The best catch was taken at position  $65^{\circ}20'\text{N } 04^{\circ}00'\text{E}$  and a rather good catch also taken in the middle of the Norwegian sea at position  $68^{\circ}\text{N } 0^{\circ}\text{E/W}$ . In Figure 12 the length distributions of mackerel are given for 3 sub-areas, i.e. south of  $65^{\circ}\text{N}$ , from  $65^{\circ}$  -  $69^{\circ}\text{N}$  and north of  $69^{\circ}\text{N}$ . The size of the mackerel increased towards north, with mean lengths of 31.2, 32.5 and 36.3 cm for the three mentioned sub-areas respectively.

Only 4 individuals of horse mackerel were caught at 3 surface trawl stations (Figure 13), which is a notable difference from the rather good 1997 result, and more at the same level as the results of 1996 and 1995. Separate length frequencies with mean lengths and weights for each trawl station are given in Table 1.

### **Lumpsucker**

Except for a few surface trawl hauls individuals of lumpsucker were caught over the whole area surveyed. The highest abundance was observed in the north, with the best catch of 806 individuals at position 73° 30' N 03° 30' E (Figure 14). As observed in earlier year most of the specimens were young fish, but a notable part was, however, of adults. The total length distributions is shown in Figure 15.

### **Salmon**

A total of 68 salmon (64 smolt and 4 grilse and adults) were caught in surface trawl hauls (Figure 16). This is at the same level as in 1995 when 66 salmon were caught during a corresponding survey. In 1996 a number of 13 salmon were caught, but in 1997 only 2 were taken during the corresponding survey. Length distributions from each trawl station are given in Table 1.

### **Gonatus**

The squid, *Gonatus fabricii*, was caught at 40 of the 117 trawl stations worked. Highest frequency was observed in the north, i.e. north of 68° N, where it was found distributed from the Norwegian coast westwards to the Jan Mayen area (Figure 17).

The species is known as a very significant summer prey of sperm whale (Bjørke, pers com.) and hence would maybe appears in concentrations of commercial interest. During earlier surveys in the Norwegian Sea small gonatus has been caught in surface trawl hauls at varying numbers. Adults have, however, been caught at greater depths especially along the continental slope off Vesterålen and Lofoten Isles, but never in any significant number.

As part of the ongoing study of gonatus in the Norwegian Sea, a number of 7 deep trawl haul were worked. Of these one was taken at the outer station on the Svinøy-section, three hauls along the polar front east of Jan Mayen, one off Vesterålen and two hauls in the north at 73° 40' N and 42° 24' N respectively. The target of these hauls was to find concentrations of adult gonatus and the depths were from 700 to 1050m with duration of 60 minutes for each haul. These trawl stations are marked with a circle on Figure 17.

No significant catch of adult gonatus was obtained. The number caught varied from 12 to 88, but most of the individuals were of small sizes and only 13 % was larger than 10 cm. The largest individual was 25 cm caught south-east of Jan Mayen. The catches of gonatus from the surface trawl hauls were also of small sized individuals only.

In Figure 18 is shown the common length distribution of gonatus from the 7 deep trawl stations. The separate length frequencies with mean lengths from each of the trawl stations are given in Table 3.

### **0-group fish**

As during the corresponding survey in 1997, haddock was the most frequently caught 0-group fish (Figure 19). It was observed from 62° N to almost 74° N with highest abundance found in the north-eastern part of the area, at the “entrance” the Barents Sea.

0-group cod was observed more near coastal areas, the highest catches being off Stad and off Vesterålen (Figure 20).

Herring was mostly found in the north, i.e. north of 68° N, and only at one station in the south (Figure 21). Highest number was caught in the north-eastern part, i.e. in the same area as for 0-group haddock.

Only minor catches were made of other 0-group fish species such as saithe and whiting.

### **Mesopelagic fish**

Scattered observations of mesopelagic fish were made throughout the survey. Due to extraordinary low echo recordings of the group, no BEI-map was produced. However, minor catches were taken in the pelagic trawl, especially the deep hauls, and presented on Figure 22. The barracudina *Notolepis rissoi* and northern lanternfish comprised most of these small catches.

### **Zooplankton**

Throughout the whole survey plankton was recorded by echo sounder, both in the upper water layers, in mixture with fish species like blue whiting and mesopelagic fish and at greater depths. The integrator values ( $S_A$ ) allocated to plankton and averaged by rectangle are shown on Figure 23. The registrations of plankton were low in the western and northern regions, and moderate to high in the south-eastern region. The highest registrations off Lofoten were probably due to the gastropod *Limacina* sp. (see below).

A total of 32 MOCNESS (700-0 m), 81 Juday-36 (200-100, 100-50, 50-0 m), and 87 WP-2 (200-0 m) were taken (Fig. 1). Zooplankton samples from MOCNESS and WP-2 were divided in two halves to make subsamples for preservation in formaldehyde and for biomass determination. The biomass part was filtered through 2000, 1000, and 180µm nylon sieves to separate plankton into three size groups. Euphausiids, shrimps and fish were sorted from the >2000 µm fraction for separate length measurements and weighing. The fractions were dried at sea and weighed at the institute in Bergen shortly after the cruise.

Total zooplankton biomass varied between ~2 and 12 g m<sup>-2</sup> (Fig. 24). Highest biomasses were found in the southern, central Norwegian Sea, in the cold water east of Jan Mayen, and at the entrance of the Barents Sea, between the Norwegian coast and Bear Island. These biomass maxima coincided with maximum biomass of the 2000-1000 fraction in the central Norwegian Sea (Fig. 25), and with maximum biomass of the 1000-180 fraction in the southernmost, western and north-eastern regions of the sampling area (Fig. 26). Maximum biomass of the smallest size fraction (1000-180) generally coincided with the production of a new generation of the copepod *Calanus finmarchicus*. Still, *C. finmarchicus*, which usually constitute the major part of the zooplankton biomass in the Norwegian Sea, occurred in rather small quantities, partly due to the timing of the cruise in relation to the dynamic of the species.

The zooplankton biomasses in July 1998 (Fig. 24) seemed to be somewhat lower than the values observed during the years 1995-1997, and much below the high values of 1994. Exact indices of zooplankton biomasses will be calculated later.

Along the transect at 69°20'N (Fig. 1), the *Calanus* stock in the westernmost Arctic influenced water masses constituted mainly by the copepodite stages IV, V and adult females in the deeper and middle part of the water column sampled. In the surface we observed the new generation consisting of nauplii and copepodite stages II-V. At 4°W, where Arctic water is found below about 200 m, the frequency of the new generation was reduced. In the central to the eastern part (5-11°E), i.e. in the Atlantic water masses the *Calanus* observed belonged to copepodite stage V and adult females. In the easternmost area, at 14°E, where the Norwegian coastal current is overlaying the deeper Atlantic and Arctic water masses, nauplii and copepodites in stage II were observed in the surface waters, and copepodites in stages IV-V and adults in the deeper waters. To evaluate whether the new generations are the first, second or possibly even the third generation of the year, more detailed zooplankton analyses are needed.

Large amounts of crustacean skeletons (excuviae) were observed at great depths all over the area, indicating that heavy production of crustaceans had previously taken place. The excuviae were usually found together with the detritus feeding copepod *Oncea* sp.

The large carnivorous copepod *Euchaeta norvegica* was common at depths below 100 m in the MOCNESS samples, though not dominating the >2000 µm fraction as observed in previous years. Its close and even larger relative, *E. glacialis*, was observed in the cold deep water masses at the westernmost parts of the 69°20' transect. At stations where the influence of the Arctic water reached the surface, *E. glacialis* was also observed in the upper 200 m.

Dominating the largest size fraction at greater depths were Chaetognaths, all over the area. The amphipod *Themisto* sp. was observed at most stations, mainly as newly released juveniles both in the eastern and western areas of the Norwegian Sea, while very few large individuals were found.

The gastropod, *Limacina* spp., was abundantly present in the Atlantic water masses, reaching maximum abundances in the core of the Norwegian Atlantic current flowing northwards just off the break of the Norwegian shelf. The occurrence of *Limacina* in the plankton nets coincided with high acoustic registrations in the upper 50 m (both 120 and 38 kHz) (Fig. 23). This observation fits well with recent findings showing that the target strength of *Limacina* is very high due to the hard shell covering it.

In central and eastern parts the small euphausiid *Thyssanoessa longicaudata* was quite abundant, especially at about 100-200 m depth. Large numbers of calyptopis and furcilia stages were occasionally observed. Individuals above 10 mm were measured, and the size seemed somewhat to increase with depth. So was the size of the larger *Meganyctiphanes norvegica*. This species was occasionally, if not commonly, found in the MOCNESS samples up to a size of about 34 mm. The larger (40-50 mm) individuals are very mobile and tend to avoid the plankton gears and is not caught representatively in the MOCNESS. It is often observed in shoals on echo registrations, and its presence was significant in trawl hauls, using a 11 mm mesh size in the cod end.

Small medusae with a bell diameter of about 4.5 mm, were very abundant in the upper MOCNESS samples (25-0 m). These medusae got easily torn apart, and were to some extent clogging the net.

In some regions we observed rather high rates of phytoplankton sedimentation. For example empty *Ceratium tripos* shells were caught in the MOCNESS net at 700-500 m depth. There may have been an association between high rates of sedimentation and low zooplankton biomasses in the surface layers. This we will follow up in some more detail in subsequent analyses.

## Hydrography

The horizontal temperature distribution of at sea surface, 20, 50, 100, 200 and 400m depths are shown on Figures 27 - 32.

Off the Norwegian coast at Møre and northwards along the shelf to Lofoten Isles the temperature at surface was around 13° C, which is 1 -2 ° lower than in 1997 and more like the situation in 1996. In the Jan Mayen area the surface temperature was 5-6° C at surface, but dropped to 0° C at 50 m depth. At 200 m the temperature along the Norwegian shelf was 8-9° in the south and 6-7° C in the north, while it was 5° in the Mid-Norwegian sea, dropping to 0° C east of Jan Mayen.

The vertical temperature distribution along the standard Svinøy section (Figure 33) shows negative water temperature along the shelf below 1000m, while in 1997 it was below 700m. At the outermost station (Pos. 64° 40' N 00° 00' E/W) negative water temperature was found below 550m, i.e. the same conditions as in 1997.

On Figure 34 are shown the temperatures down to 1000m across the Norwegian Sea from south of Jan Mayen to the Norwegian coast, i.e. along the latitude 69° 20' N from 11° W to 14° E.

## **Whale observations**

All observations of whale from the bridge were noted to be reported to the Marine Mammals Section of IMR, Bergen (Table 4). The observations were strongly influenced by the weather conditions. For several periods the weather did not permit any reliable observations to be made, either due to fog or to wind. No personnel especial dedicated for whale observations participated, but the navigation personnel, however, revealed good knowledge of whale identification due to long time experience of observations.

The species observed during the survey included killer whale, mostly in flocks of varying sizes, sperm whale, minke whale, fin whale and humpback whale. Sperm and minke whales were the most frequent observed species, and one specimen of the latter appeared between the trawl wires while a surface trawl haul was operated.

## Aknowledgements

A great thanks to all the participants listed on page 2 and to the officers and crew on board R.V. "Johan Hjort" for a good job carried out throughout the survey.

Bergen, 8. August 1998

Terje Monstad, Are Dommasnes, Bjørnar Ellertsen and Webjørn Melle

## APPENDIX - Cruise Report Content

Name of ship	R.V. "Johan Hjort"
Call sign:	LDGJ
Cruise number:	1998209
Responsible laboratory:	Institute of Marine Research, Bergen
Cruise leader:	Terje Monstad
Cruise period:	30/6 - 29/7, 1998
Echo sounder equipment:	Simrad EK - 500, 38 kHz, ES - 38B - SK
Echo integrator equipment:	Bergen Echo Integrator (BEI)
Instrument calibration date:	30 April 1998
Sampling equipm. (trawl):	Åkra Pelagic Trawl, 152 X 3200, 486m circumf.
Sampling equipm. (plankt):	MOCNESS 1m <sup>2</sup> , WP2
Type of CTD sonde:	SEABIRD model 11+
Number of trawl stations:	117 pelagic
Number of CTD stations:	110
Cruise lines and stations:	Figure and worksheet
Echo integrator values :	Figures and worksheet
Sonar recordings:	Worksheet database
Length distributions:	Table and worksheet
Age distribution of pel. fish:	Figures for herring and blue whiting
Temperature:	Figures and worksheet
Plankton:	Figures and worksheet

Table 1. Length distributions with mean weights of herring, mackerel, horse mackerel, salmon and blue whiting. "Johan Hjort", Norwegian Sea, 30.6 - 29.7 1998 (cont.).

Date	980705		980706		980707		980707		980707		980707		980708		980708		980709		980709		980710		980710		980710		980710						
St.no.	219		223		225		225		226		227		228		229		231		232		235		235		236		237		237				
Species	BLUE WH		BLUE WH		HERRING		MACK		BLUE WH		MACK		HERRING		HERRING		HERRING		HERRING		MACK		HERRING		BLUE WH		MACK		HERRING				
cm	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)			
15															1	24																	
16															1	34																	
17																																	
18	2	34																															
19	1	40																															
20	8	45	1	65																													
21	9	52	1	68																					1	71							
22	14	61	17	74																				3	64								
23	23	70	31	80																				6	78								
24	31	77	30	87																				15	89								
25	14	82	17	95																				6	96								
26	4	86	3	96					1	116														3	113								
27																								1	125								
28									1	159																							
29																																	
30					1	290			3	167								1	243														
31													1	280			3	283	3	275			1	245				2	333	2	283		
32																	20	309	21	284								2	360		2	293	
33									1	203							31	335	46	301													
34					1	400											22	367	15	318										1	295		
35									1	217							9	387	7	349													
36																	7	413	2	378			1	315			1	450					
37											1	525					6	440	2	391													
38																	2	475	3	412													
39																																	
40																																	
41																																	
42																							1	665									
43																																	
44																																	
45									1	735																							
46																																	
Sum	106		100		2		1		7		1		1		2		100		100		1		2		35		5		5		5		
Mean W.		69		84		345		735		171		525		280		29		354		309		665		290		89		367		289		289	
Mean L.	23,5		24,0		32,0		45,0		30,5		37,0		31,5		15,7		34,2		33,8		42,0		33,7		24,5		32,8		32,2		32,2		



Table 1. (cont.)

Date	980711		980711		980711		980711		980711		980711		980711		980712		980712		980712		980712		980712		980712		980712							
St.no.	238		238		239		239		240		241		241		241		242		243		243		243		244		244		245					
Species	MACK		HERRING		MACK		HERRING		BLUE WH		SALMON		MACK		HERRING		BLUE WH		MACK		HERRING		SALMON		MACK		HERRING		BLUE WH					
cm	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)				
15																																		
16																																		
17																																		
18																																		
19																																		
20																2	46									1	58	6	43					
21																10	50												8	52				
22																13	57												22	58				
23							1	105								16	69							1	120					23	68			
24																23	78													22	78			
25																21	88													13	89			
26												1	170			9	106													5	102			
27																6	110																	
28												1	210			4	129														1	120		
29																																		
30																																		
31																																		
32																																		
33																																		
34																																		
35																																		
36																																		
37																																		
38																																		
39																																		
40																																		
41																																		
42																																		
43																																		
44																																		
45																																		
46																																		
Sum	1		100		2		3		9		2		1		1		106		6		14		1		21		14		100					
Mean W.		485		329		465		248		91		190		710		215		81		559		236		120		457		222		70				
Mean L.	37,0		33,3		38,0		29,0		24,0		27,0		41,0		32,0		24,6		38,5		32,0		23,5		36,0		31,4		23,6					

Table 1. (cont.)

Date	980713		980713		980713		980713		980713		980713		980713		980713		980714		980714		980714		980714		980715		980716								
St.no.	246		246		246		247		248		248		249		249		250		251		251		252		252		253		254						
Species	MACK		HERRING		HERRING		BLUE WH		HERRING		MACK		HERRING		MACK		BLUE WH		MACK		HERRING		MACK		HERRING		HERRING		MACK						
cm	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)			
15																					1	34													
16																																			
17																																			
18			1	42									1	61							1	53													
19															2	35					2	66			1	75	4	65							
20							13	41	1	59			10	80	9	43					4	87					1	73							
21							11	50					3	87	31	50					2	90					5	88							
22							13	55					4	99	31	57					1	114					1	93							
23							12	67					2	106	18	66					1	123													
24							13	74							7	73					1	134													
25							13	84							1	79																			
26					1	157	3	109							1	104									1	195									
27							1	129	1	235																									
28							2	135	12	224																									
29			1	179			1	145	18	251	1	220									1	289													
30			3	242					29	276																									
31	1	288					1	127	24	302			2	262	1	278			1	303									1	305					
32			10	261			1	204	4	310					2	349			1	333	2	298													
33			5	305					6	388			1	365	1	349			1	358															
34									5	389																									
35	2	426							1	398					1	404			2	397															
36	1	417							1	413					1	476			1	437															
37	1	582												3	482			3	517																
38	2	548																					1	530											
39	1	685										1	565			1	638																		
40																																			
41																																			
42												1	685																						
43																																			
44																																			
45																																			
46																																			
Sum	8		20		1		84		102		3		23		10		100		9		16		1		2		11		1						
Mean W.		490		254		157		70		285		490		114		429		57		420		125		530		135		79					305		
Mean L.	36,6		31,6		26,5		23,6		30,7		37,2		22,6		35,4		22,4		35,3		22,6		38,0		23,0		20,9						31,0		

Table 1. (cont.)

Date	980716		980716		980716		980716		980716		980717		980717		980717		980717		980717		980717		980718		980718						
St.no.	255		256		256		257		257		258		258		259		259		260		261		261		262		263		264		
Species	BLUE WH		HERRING		MACK		HERRING		MACK		HERRING		MACK		HERRING		MACK		BLUE WH		HERRING		MACK		MACK		MACK		BLUE WH		
cm	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	
15																															
16																															
17																															
18																															
19																				1	36										
20	7	49					1	60				1	90							5	41										
21	15	46																		18	48										
22	14	57																		20	54							5	61		
23	22	65																		17	66							17	74		
24	28	73																		17	70							36	82		
25	11	84																		13	76							32	88		
26	2	89																		7	77							7	105		
27	1	110										1	190							1	115							3	101		
28																				1	107										
29															8	262							2	228							
30			2	276			1	306	2	298	1	260	2	278			39	279				17	275	1	273	1	285				
31									1	316			4	309	1	242	28	309				1	305	21	295						
32													5	300	2	324	12	329				2	301	22	333						
33			1	350	1	297							2	378			10	368				2	364	20	352						
34									2	340			2	318			3	415				1	297	8	392						
35									1	410			1	348									4	374							
36												1	458										4	413							
37																							1	346							
38																															
39																															
40																							1	551							
41																															
42																															
43																															
44																															
45																															
46																															
Sum	100		3		1		2		6		3		17		3		100		100		6		100		1		1		100		
Mean W.		65		301		297		183		334		180		323		296		305		63		322		329		273		285		84	
Mean L.	23,4		31,5		33,0		25,5		32,8		25,8		32,8		32,2		31,4		23,5		33,1		32,7		30,0		30,0		24,8		

Table 1. (cont.)

Date	980718		980718		980718		980719		980719		980719		980719		980719		980719		980719		980719		980720		980720					
St.no.	265		266		266		267		267		268		270		271		271		272		272		272		274		275			
Species	MACK		SALMON		MACK		HERRING		SALMON		MACK		BLUE WH		BLUE WH		MACK		HERRING		MACK		HERRING		SALMON		HERRING		MACK	
cm	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)
15																														
16																														
17																														
18																														
19																														
20																														
21																														
22																														
23																														
24																														
25																														
26																														
27																														
28																														
29																														
30																														
31																														
32																														
33																														
34																														
35																														
36																														
37																														
38																														
39																														
40																														
41																														
42																														
43																														
44																														
45																														
46																														
Sum	1		1		1		1		100		100		100		4		1		10		1		1		36		8			
Mean W.		471		230		470		211		121		358		81		72		404		200		396		357		120		92		456
Mean L.	36,0		30,0		36,0		31,5		23,0		31,9		24,4		23,5		33,5		30,0		34,1		33,0		24,2		21,7		34,9	

Table 1. (cont.)

Date	980720		980721		980721		980721		980721		980721		980722		980722		980722		980722		980722		980722		980723		980723			
St.no.	275		276		276		277		277		278		279		281		282		282		283		284		284		285		286	
Species	HERRING		SALMON		HERRING		HERRING		SALMON		BLUE WH		HERRING		HERRING		SALMON		HERRING		HERRING		SALMON		HERRING		HERRING		HERRING	
cm	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)
15																														
16																														
17																														
18																														
19																														
20					1	53					2	58														1	59			
21											6	61																		
22	4	102									10	72																		
23	3	104									24	78																		
24	2	132									37	89																		
25											19	101				1	156													
26											1	130																		
27	2	190								3	198	1	133																	
28					1	164				1	235																			
29	6	253																												
30	11	279																1	245											
31	15	291			5	297			1	274				1	180	5	233				23	290					1	252	1	267
32	6	311			34	310								1	241	5	272				55	313	1	324	1	311		14	313	
33	8	373			7	335										6	282			1	347	15	327		1	307		31	330	
34	5	369			5	338									1	231						2	349		2	315		23	349	
35	2	440													3	334						2	375					8	370	
36	1	414																				1	374					10	423	
37					1	469								1	424													8	436	
38								1	414													2	434			1	380		5	451
39																														
40																														
41																														
42																														
43																														
44																														
45																														
46			1(56)	1567																					1(54)	1615				
Sum	65		1		69		2		4		100		3		20		1		2		100		2		5		2		100	
Mean W.		282		1567		304		344		208		86		282		272		156		296		315		970		325		156		358
Mean L.	30,6			56,0		30,9		34,7		27,6		24,1		33,5		33,0		25,0		32,0		32,7		43,0		34,5		25,5		34,6

Table 1. (cont.)

Date	980723		980723		980724		980724		980724		980724		980724		980724		980725		980725		980725		980725		980725				
St.no.	289		289		291		292		292		293		294		294		295		296		296		297		298		298		
Species	HERRING		MACK		HERRING		MACK		HERRING		BLUE WH		HERRING		SALMON		HERRING		SALMON		HERRING		SALMON		HERRING		BLUE WH		
cm	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	
15																													
16																													
17																													
18																													
19																													
20																													
21																													
22																													
23																												3	82
24												4	95						1	195							5	96	
25												18	108														28	106	
26												28	120						3	180							37	126	
27												26	131						3	195							56	138	
28												10	140						4	219			1	230			28	154	
29								1	164		4	166							1	260							14	174	
30														3	274				2	215	3	245	1	158			4	202	
31	3	289						7	273	3	175	11	285					3	251	4	269						2	217	
32	15	306			2	257			22	293	1	172	40	305				2	233			2	234			3	300	1	167
33	32	322							39	313	3	211	31	322				1	215			1	286			1	288	4	225
34	15	354							11	337	2	216	9	343								1	315						
35	10	386							8	377			4	376								1	232					4	270
36	11	410							10	383	1	262																2	296
37	10	424	1	488					10	392			1	440															
38	4	478						4	488	2	408			1	373			1	405										
39								1	485																				
40			1	643																									
41			1	642				1	607																				
42			2	601				2	623																				
43								1	670																				
44			1	721																									
45																													
46																													
Sum	100		6		2		9		110		100		100		1		9		19		6		2		4		188		
Mean W.		356		516		257		551		327		132		316		2740		252		225		243		820		297		142	
Mean L.	34,6		41,0		32,3		40,4		34,1		27,5		33,0		64,0		32,6		28,8		33,3		39,0		32,8		27,7		

Table 1. (cont.)

Date	980725		980726		980726		980726		980727		980727		980727		980727		980727		980728		980728		980728							
St.no.	299		300		301		302		304		304		305		306		306		307		308		309		310		310			
Species	HERRING		HERRING		HERRING		HERRING		SALMON		HERRING		HERRING		BLUE WH		HERRING		HERRING		HERRING		BLUE WH		HERRING		SALMON			
cm	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)		
15																														
16																														
17																														
18																			2	53										
19																		7	62			2	36							
20																		4	78	1	70	7	47							
21																		6	89			21	55							
22																		2	104			23	61							
23																		5	103			11	70							
24												1	123	2	89			4	127			14	80							
25														3	106			7	146			7	96							
26													1	164	21	121			5	160			5	102						
27					1	207					1	187			18	140			2	162			4	120			1	210		
28											3	215	2	218	19	153			1	182			1	155			1	230		
29			1	209							5	231	1	230	10	166	1	203	1	193			1	139			1	245		
30	3	260	1	170							10	262	12	246	5	183	3	243	6	228										
31	24	285	2	230	11	280	6	279			32	285	13	274	2	223	2	251	17	246					2	230				
32	47	303	6	289	16	296	49	301			32	304	33	297	2	231	8	262	23	279			1	178	2	266				
33	19	329	3	300	9	318	24	317			13	327	21	324	3	226	2	325	7	298					1	228				
34	5	341	4	348	6	342	12	360			2	349	13	353	4	265					1	212								
35			7	356	3	364	7	376			1	293	2	374	3	245	1	356	1	372										
36			2	386	4	373	1	393					1	363	4	317							1	252						
37	1	388	2	406	2	394									3	360			2	419			1	296						
38	1	438					1	448			1	301			1	389														
39																														
40																														
41																														
42																														
43																														
44																														
45																														
46											1(47)	1030																		
Sum	100		28		52		100		1		100		100		100		17		100		3		100		5		3			
Mean W.		306		319		314		318		1030		290		298		172		267		203		59		77		244		228		
Mean L.	32,5		34,0		33,0		33,2		47,0		31,9		32,5		29,4		32,1		28,4		19,0		23,8		32,0		28,0			

Table 1. (cont.)

Date	980728		980728		980728		980729		980729		980729		980729	
St.no.	311		311		312		313		313		314		315	
Species	HERRING		SALMON		BLUE WH		MACK		HERRING		BLUE WH		HERRING	
cm	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)	n	w (g)
15														
16														
17														
18														
19														
20					3	49					5	44	1	75
21					5	62					10	49		
22					8	68			1	100	11	60		
23					7	81			1	128	11	69		
24					28	88					4	80		
25					21	100					6	89		
26	1	164			12	110					2	107		
27			2	190	9	127								
28			2	203	6	138								
29	6	240	3	220					1	161				
30	9	248	5	254					11	216				
31	17	242							17	238				
32	18	269			1	168			19	245				
33	15	286	1	375					14	302				
34	2	297							1	277				
35	2	319							1	275				
36	1	426							1	372				
37	1	453							3	434				
38							1	658						
39														
40							1	689						
41														
42														
43														
44														
45														
46														
Sum	72		13		100		2		70		49		1	
Mean W.		267		238		96		674		256		65		75
Mean L.	31,6		29,2		25,0		39,0		32,2		22,5		20,0	



Table 2. Blue whiting acoustic assessment, "Johan Hjort", Norwegian Sea, 30.6 - 29.7 1998.

Antall i omr.: N x 10 Exp-6

Middel-lengde: Cm

Vekt i omr.: Tonn x 10 Exp-3

-7

2.18

Gj.vekt : Gram

Kondisjon : 1000 x Vekt/Lengde Exp+3

\_: 6.72 \* 10 \* L

Område : Alle

Lengde	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	Tot	Vekt	Gj.v
18.0-19.0		222															222	6.6	29.9
19.0-20.0		701															701	26.2	37.4
20.0-21.0		4618	340														4958	227.6	45.9
21.0-22.0		10927	1951	51													12929	654.9	50.7
22.0-23.0		6252	7563	54													13869	848.1	61.2
23.0-24.0		1062	16814	1798													19674	1412.9	71.8
24.0-25.0		462	13685	5068													19215	1531.2	79.7
25.0-26.0			6318	4473	129												10920	971.4	89.0
26.0-27.0			893	2805	76												3774	382.0	101.2
27.0-28.0			163	1347	11												1521	189.9	124.8
28.0-29.0			73	439	113	9											634	91.2	143.8
29.0-30.0			15	171	44	133											363	54.3	149.6
30.0-31.0				46	117	27	21										211	32.5	153.9
31.0-32.0				30	38					83							151	27.7	183.6
32.0-33.0					9	24	20	9		6							68	13.5	198.9
33.0-34.0						9	36	12	7	14							78	17.1	219.4
34.0-35.0					19	10	23	29		41							122	27.2	223.0
35.0-36.0								13	3	30	4						50	11.9	238.6
36.0-37.0								1		61							62	18.2	293.6
37.0-38.0										20	13	13					46	15.5	337.2
38.0-39.0											10						10	3.9	389.0
Antall:	0	24244	47815	16282	556	212	100	64	10	255	27	13	0	0	0	0	89578		
Gj.lgd:	0.00	21.66	23.88	25.42	28.34	30.15	32.85	34.31	33.85	34.38	37.75	37.75	0.00	0.00	0.00	0.00	23.66		
Vekt:	0.01284	3.3571	8.1495	9.74	74.0	31.8	18.3	13.9	2.3	58.9	8.8	3.7	0.0	0.0	0.0	0.0	6563.9		
Gj.vkt:	0.0	53.0	74.7	91.9	133.2	150.1	183.3	217.6	233.3	231.1	326.0	288.0	0.0	0.0	0.0	0.0	73.3		
Kond.:	0.0	5.2	5.4	5.5	5.6	5.4	5.2	5.4	6.0	5.5	6.0	5.4	0.0	0.0	0.0	0.0	5.4		

Table 3. Length distributions of the squid *Gonatus fabricii*, in the Norwegian Sea.  
 "Johan Hjort", Norwegian Sea, 30.6 - 29.7 1998 (cont).

Date	980701	980704	980708	980708	980708	980709	980709	980709	980710	980711	980711	980712	980712	980712	980713	980717	980718	980719	980719	980720
Station	202	209	228	229	230	232	233	234	235	239	241	242	244	245	247	262	263	267	271	275
Position	N6224 E0514	N6437 W0003	N6702 W0530	N6823 W0926	N6838 W0955	N6921 W0859	N6920 W0648	N6920 W0557	N6920 W0345	N6920 E0402	N6921 E0702	N6919 E0709	N6920 E1204	N6919 E1230	N6920 E1441	N6630 E0118	N6702 W0005	N6801 W0001	N6800 E0448	N7001 E1232
Depth (m)	0	1050	0	0	800	0	800	0	0	0	0	320	0	310	705	0	0	0	0	0
Duration (min)	29	59	29	30	60	30	59	30	30	31	31	60	31	68	66	31	30	32	29	30
Total catch (N)	1	12	13	30	44	51	29	132	71	7	1	1	4	5	29	2	7	4	2	3
cm	1				1											1				
2			3	2	5			7	8						1		6	2	2	
3			5	6	8	8		14	6			1	2	1	5	1		2		
4			5	6	8	23	1	9	13				1	1	5		1			3
5				10	5	13		4	3				1	2	11					
6				6	3	5		1			1				4					
7						1	2							1	1					
8		1			2	1	3													
9					5		2													
10	1				1		1													
11		2					1													
12					2		3								1					
13							1													
14		6					1								1					
15																				
16		1			1															
17							1													
18					1															
19		1																		
20					1															
21					1															
22		1																		
23																				
24																				
25							1													
n measured	1	12	13	30	44	51	17	35	30	7	1	1	4	5	29	2	7	4	2	3
M.length	10,00	14,25	3,48	4,70	6,70	4,80	11,40	3,37	3,70		6,00	3,70	4,20	5,20	5,70	2,45	2,54	2,88	2,25	4,30

Table 3. (cont.)

Date	980723	980723	980724	980724	980724	980724	980725	980725	980725	980725	980726	980726	980726	980726	980727	980727	980728	980728	980728	980729
Station	287	288	290	291	293	295	296	297	298	299	300	301	302	303	304	308	309	312	313	315
Position	N7047 W0457	N7109 W0412	N7155 W0243	N7155 E0003	N7155 E0257	N7155 E0533	N7155 E0753	N7159 E0954	N7233 E0907	N7236 E0856	N7317 E0803	N7320 E0526	N7326 E0328	N7340 E0412	N7359 E1021	N7230 E1655	N7230 E1613	N7224 E1205	N7139 E1247	N7140 E1600
Depth (m)	768	0	0	25	300	0	0	0	280	0	0	0	0	760	0	0	250	830	0	0
Duration (min)	60	30	32	31	60	30	30	30	57	30	32	30	31	60	30	30	52	60	30	30
Total catch (N)	72	80	54	5	4	127	173	12	3	1	139	42	28	88	2	928	3	83	10	1
cm	1																			
	2		1		1	11	5	1			10	1								
	3	3	6	5	2	1	16	18	10			29	10	5	3		2		1	3
	4	13	23	30	3		3	5	1		1	20	13	14	24	1	1		16	1
	5	21	1	16		1		2				5	16	9	14	1	11		23	4
	6	6		2		1						1	2		24		12		19	1
	7	1							2						11		4	3	12	
	8	1							1						2		1		5	1
	9	2													5				3	
	10																		1	
	11	1													2				1	
	12	1													1				1	
	13																			
	14																			
	15																			
	16														1					
	17																		1	
	18	1													1					
	19																			
	20																			
	21																			
	22																			
	23																			
	24																			
	25																			
n measured	50	30	54	5	4	30	30	12	3	1	65	42	28	88	2	31	3	83	10	1
M.length	6,00	4,24	4,70	3,94	4,60	3,20	3,52	3,44	7,90	4,80	3,78	4,61	4,42	6,40	5,20	5,95	7,40	6,32	5,03	3,30

Table 4. Whale observations. "Johan Hjort", Norwegian Sea, 30.6 - 29.7 1998.

Date	Position	Species	Number	Remarks
July 3	N 63° 40' E 02° 21'	Fin whale	1	
July 4	N 64° 19' E 00° 55'	Minke whale	2	
July 5	N 62° 15' W 03° 55'	Sperm whale	1	
July 7	N 66° 22' W 04° 13'	Sperm whale	1	
July 7	N 66° 43' W 05° 15'	Sperm whale	1	
July 7	N 66° 30' W 04° 33'	Fin whale	2	
July 9	N 69° 20' W 08° 14'	Humpback whale	1	
July 10	N 69° 20' W 06° 00'	Minke whale	1	
July 10	N 69° 20' W 00° 30'	Killer whale	20	
July 11	N 69° 20' E 04° 28'	Sperm whale	6	Calm sea
July 11	N 69° 20' E 04° 54'	Sperm whale	1	
July 11	N 69° 20' E 05° 00'	Sperm whale	3	
July 11	N 69° 20' E 05° 07'	Sperm whale	4	
July 11	N 69° 20' E 05° 35'	Sperm whale	1	
July 11	N 69° 20' E 06° 10'	Fin whale	3	
July 12	N 69° 20' E 07° 00'	Sei whale	1	
July 12	N 69° 20' E 07° 05'	Humpback whale	2	
July 13	N 69° 20' E 13° 00'	Sperm whale	1	
July 13	N 69° 20' E 13° 14'	Sperm whale	1	
July 13	N 69° 20' E 14° 00'	Sperm whale	2	
July 13	N 69° 02' E 13° 30'	Minke whale	1	
July 13	N 69° 01' E 13° 02'	Sperm whale	5	
July 13	N 69° 01' E 12° 45'	Sperm whale	3	
July 14	N 67° 58' E 12° 27'	Minke whale	1	
July 14	N 66° 40' E 06° 45'	Killer whale	8	
July 18	N 67° 11' E 00° 09'	Sperm whale	1	
July 18	N 67° 52' W 02° 09'	Killer whale	20	
July 18	N 67° 59' W 01° 26'	Killer whale	6	
July 19	N 68° 00' E 01° 50'	Fin whale	2	
July 19	N 68° 00' E 02° 10'	Sperm whale	4	
July 19	N 68° 00' E 02° 33'	Sperm whale	2	
July 19	N 68° 00' E 02° 44'	Killer whale	10	
July 22	N 70° 45' E 03° 54'	Humpback whale	3	Rolling in surface
July 22	N 70° 45' E 00° 20'	Sperm whale	1	
July 24	N 71° 55' E 02° 23'	Minke whale	2	
July 24	N 71° 55' E 02° 35'	Killer whale	10	
July 24	N 71° 55' E 04° 35'	Minke whale	2	
July 24	N 71° 55' E 04° 55'	Minke whale	4	
July 24	N 71° 55' E 05° 00'	Minke whale	2	
July 24	N 71° 55' E 05° 46'	Minke whale	2	Slowly moving
July 26	N 73° 40' E 04° 10'	Minke whale	1	
July 27	N 73° 57' E 10° 21'	Minke whale	1	Between the trawl wires
July 27	N 73° 24' E 13° 33'	Minke whale	1	

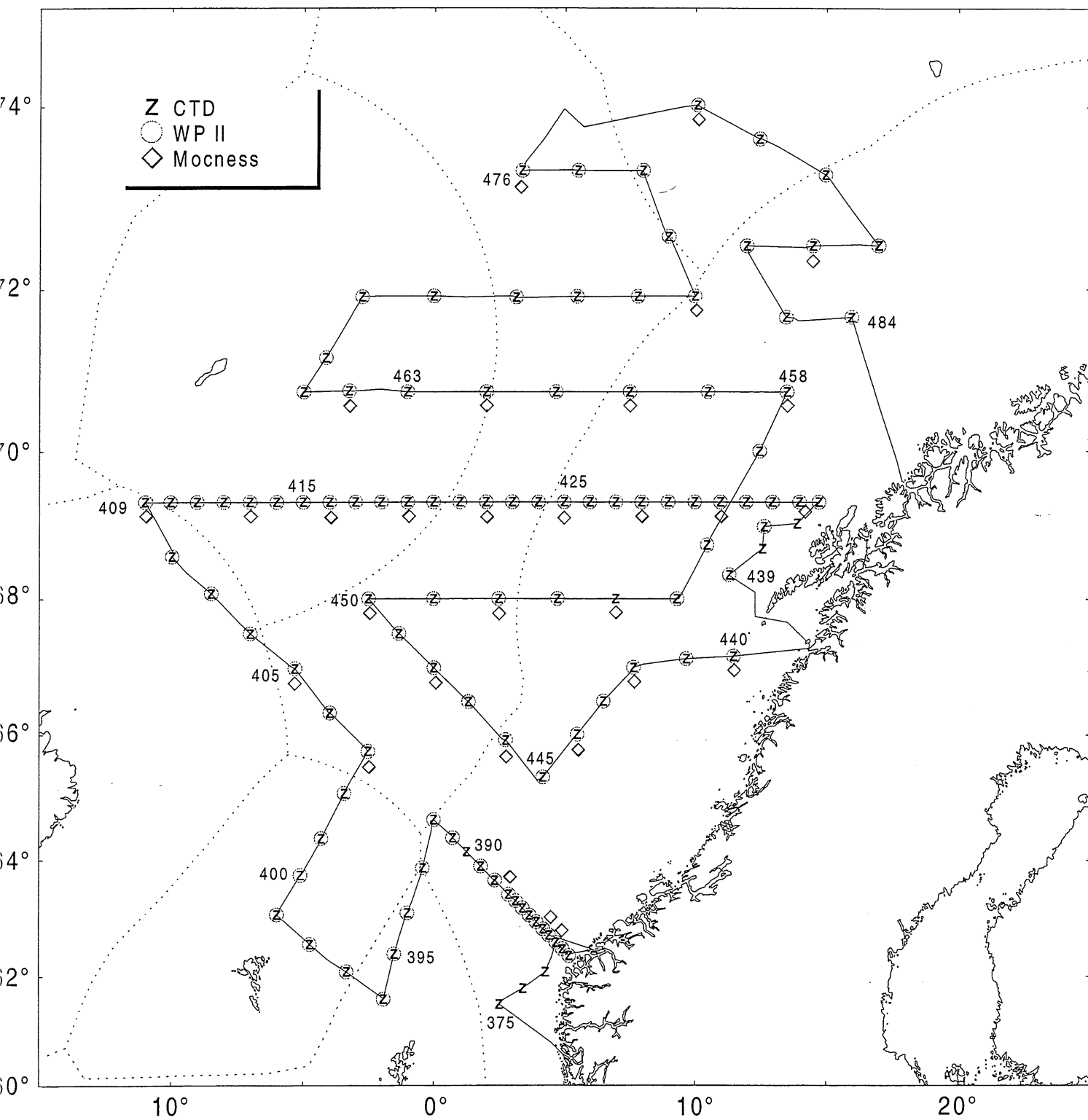


Figure 1. Cruise tracks with hydrography- and plankton stations.  
"Johan Hjort", Norwegian Sea, 30.6 - 29.7 1998.

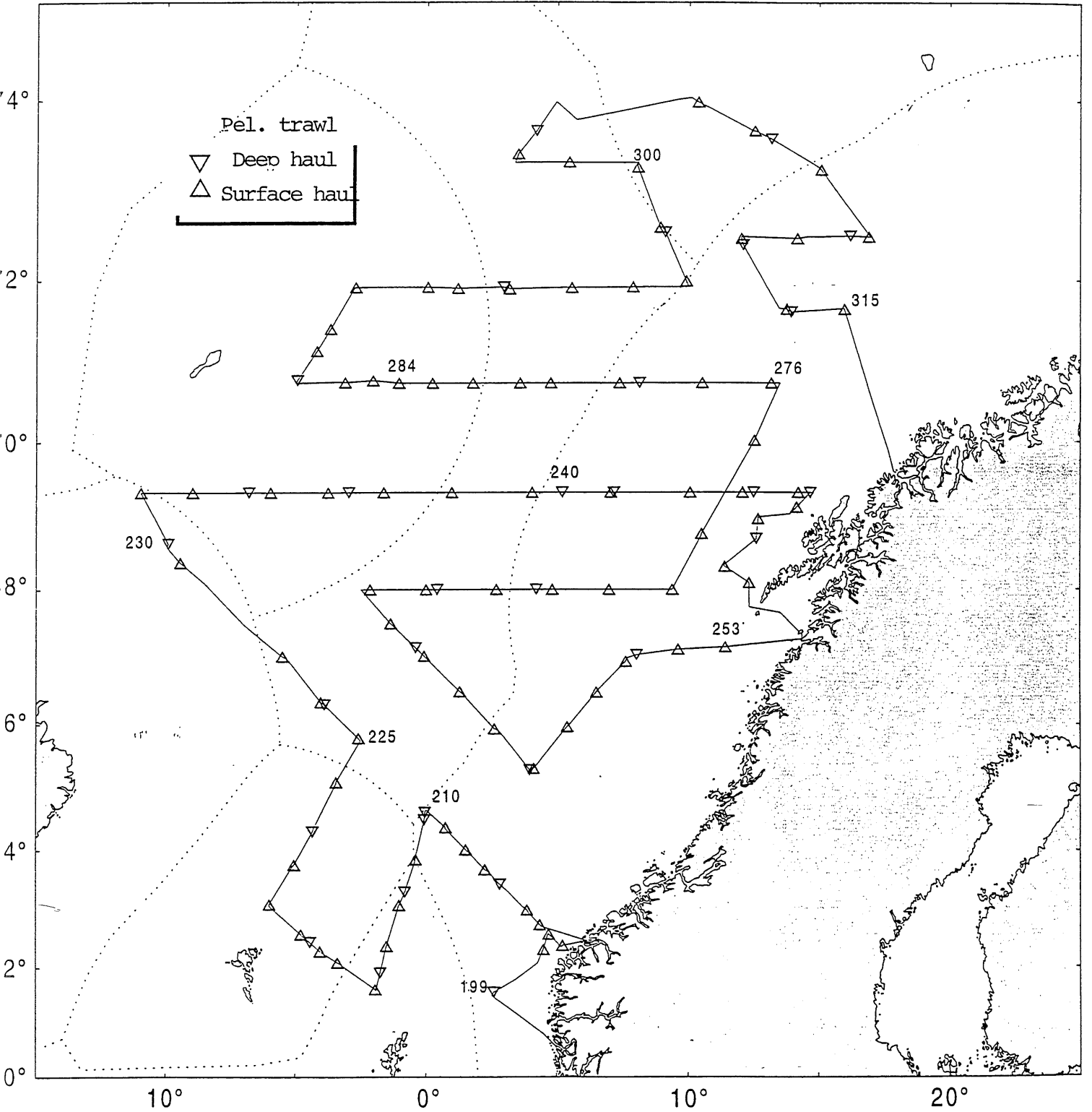


Figure 2. Cruise tracks with fishing stations. "Johan Hjort", 30.6 - 29.7 1998.

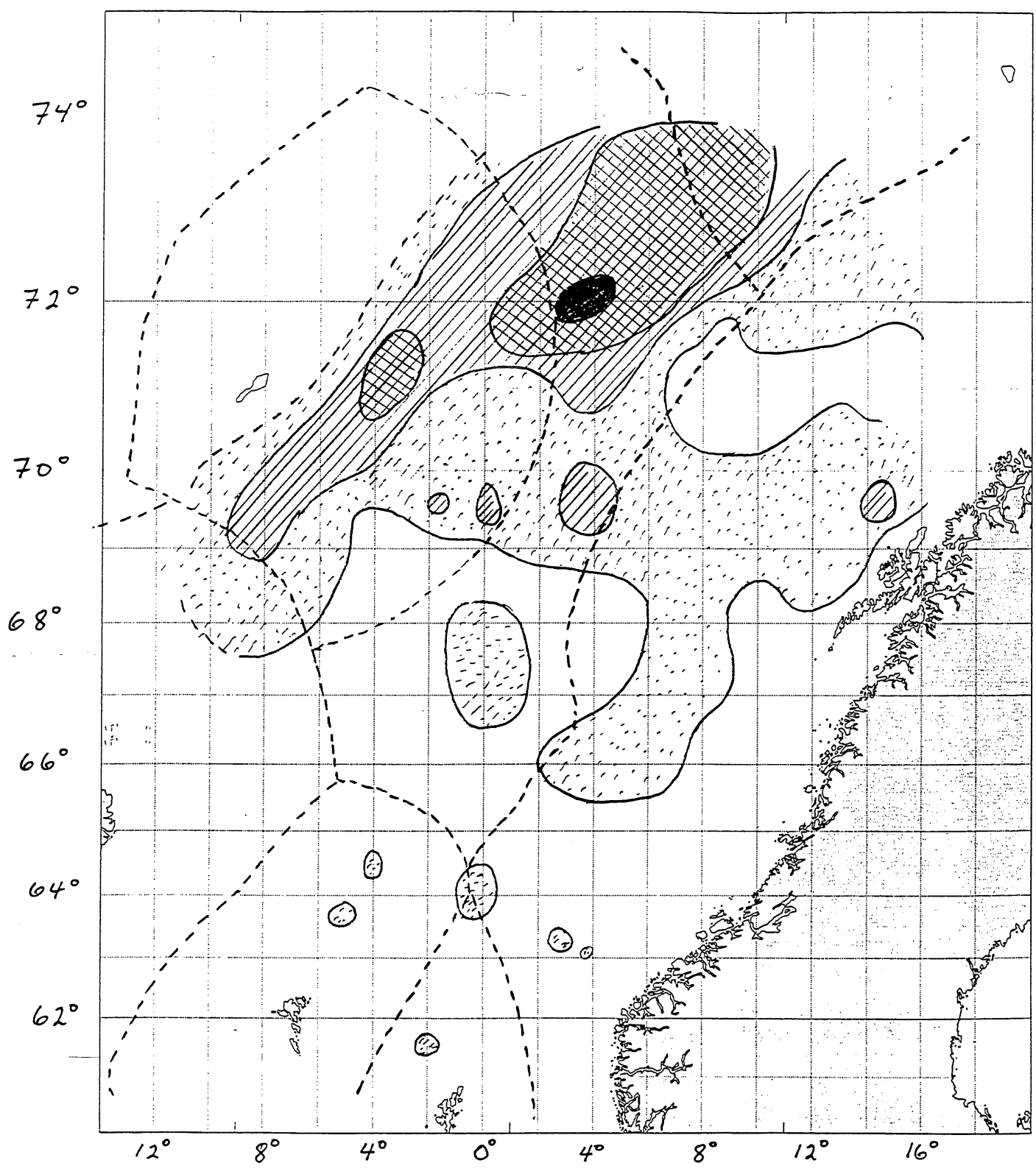


Figure 3. Sonar recordings of surface schools, July 1998.

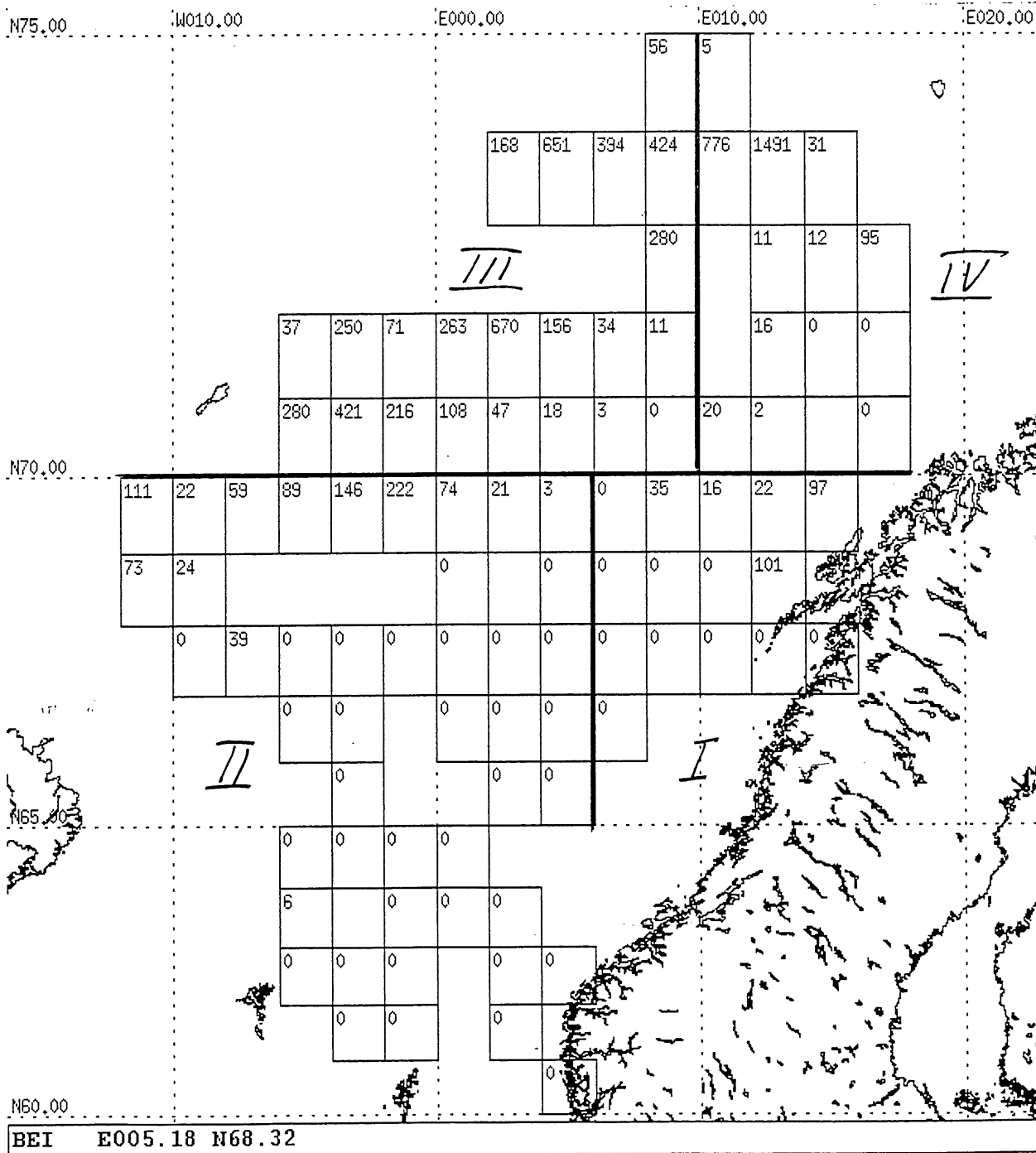


Figure 4. S<sub>A</sub>-values for herring, July 1998.



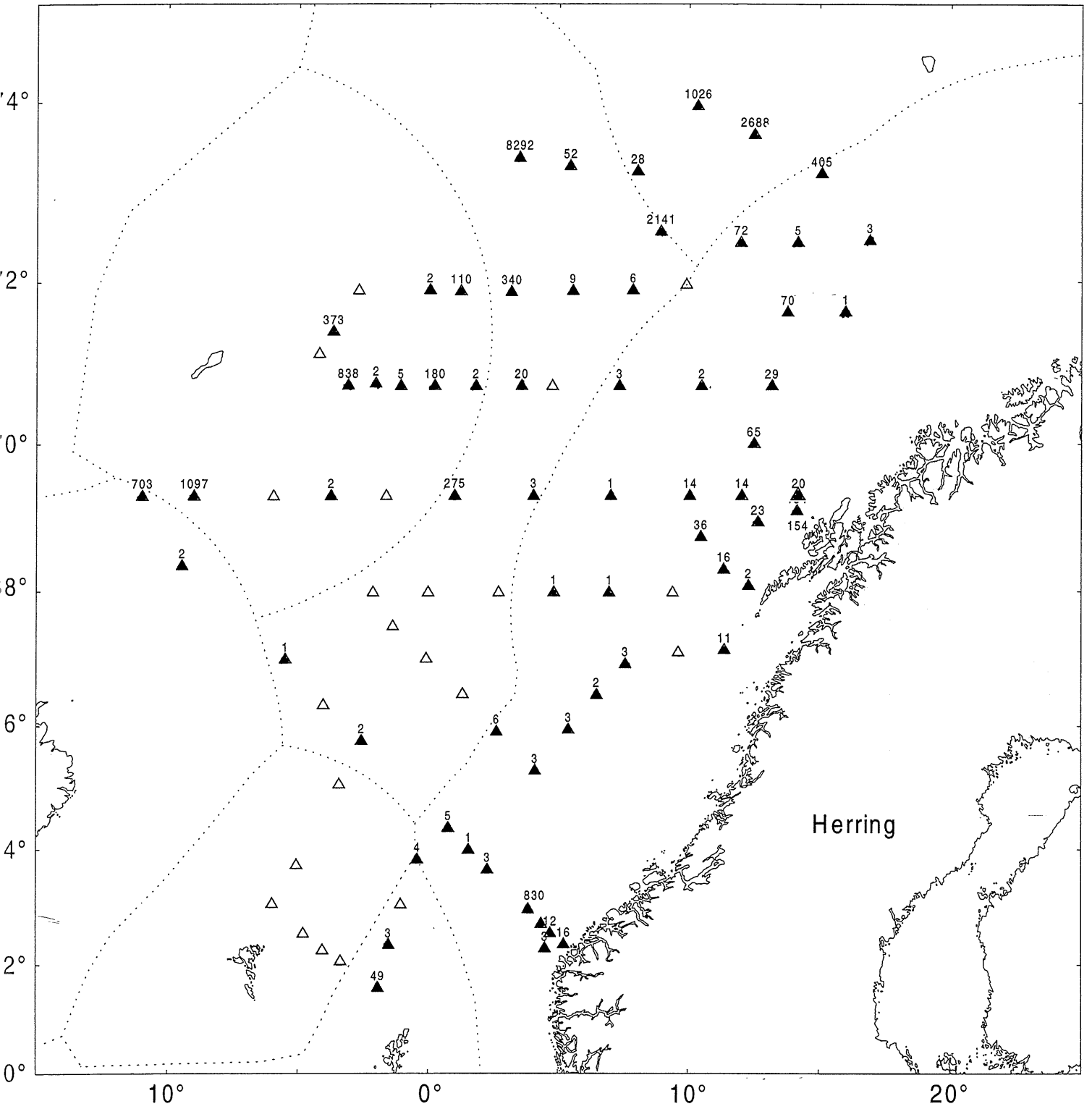
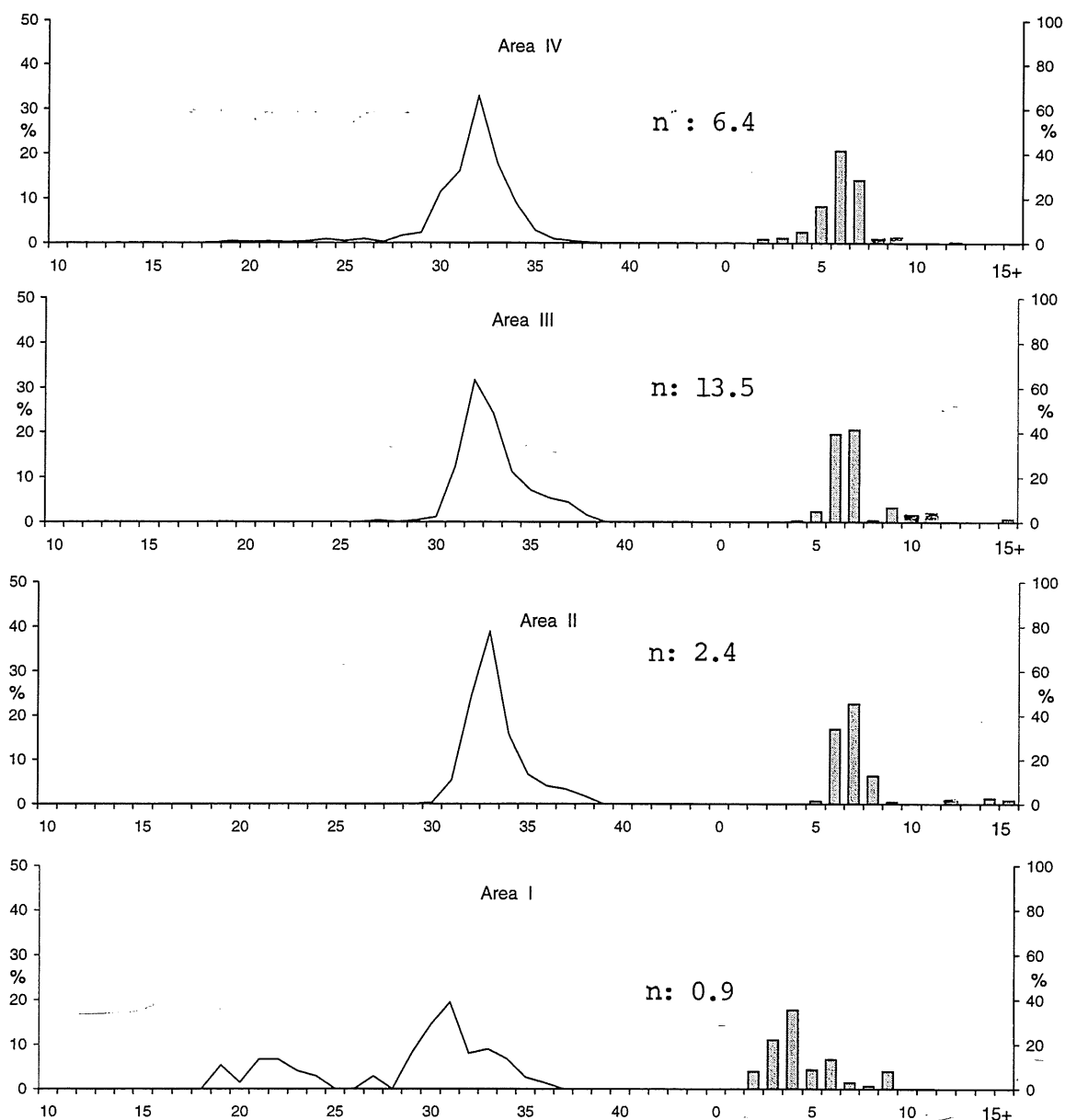
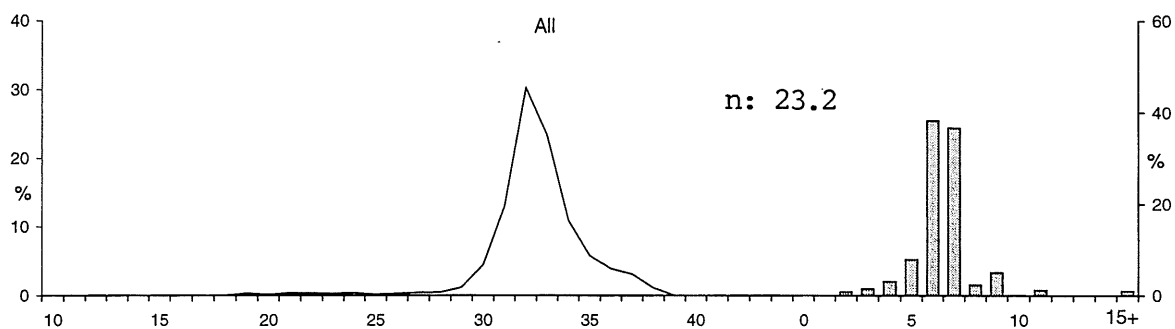


Figure 5. Catches of herring in surface hauls, July 1998. Nos. per 1/2 hour trawling.



Figures 6. Length- and age-distributions of herring in 4 sub-areas marked on Figure 4, July 1998. Weighed by abundance,  $n = 10^9$  individuals.



Figures 7. Total length- and age-distributions of herring in the Norwegian Sea, July 1998. Weighed by abundance,  $n = 10^9$  individuals.

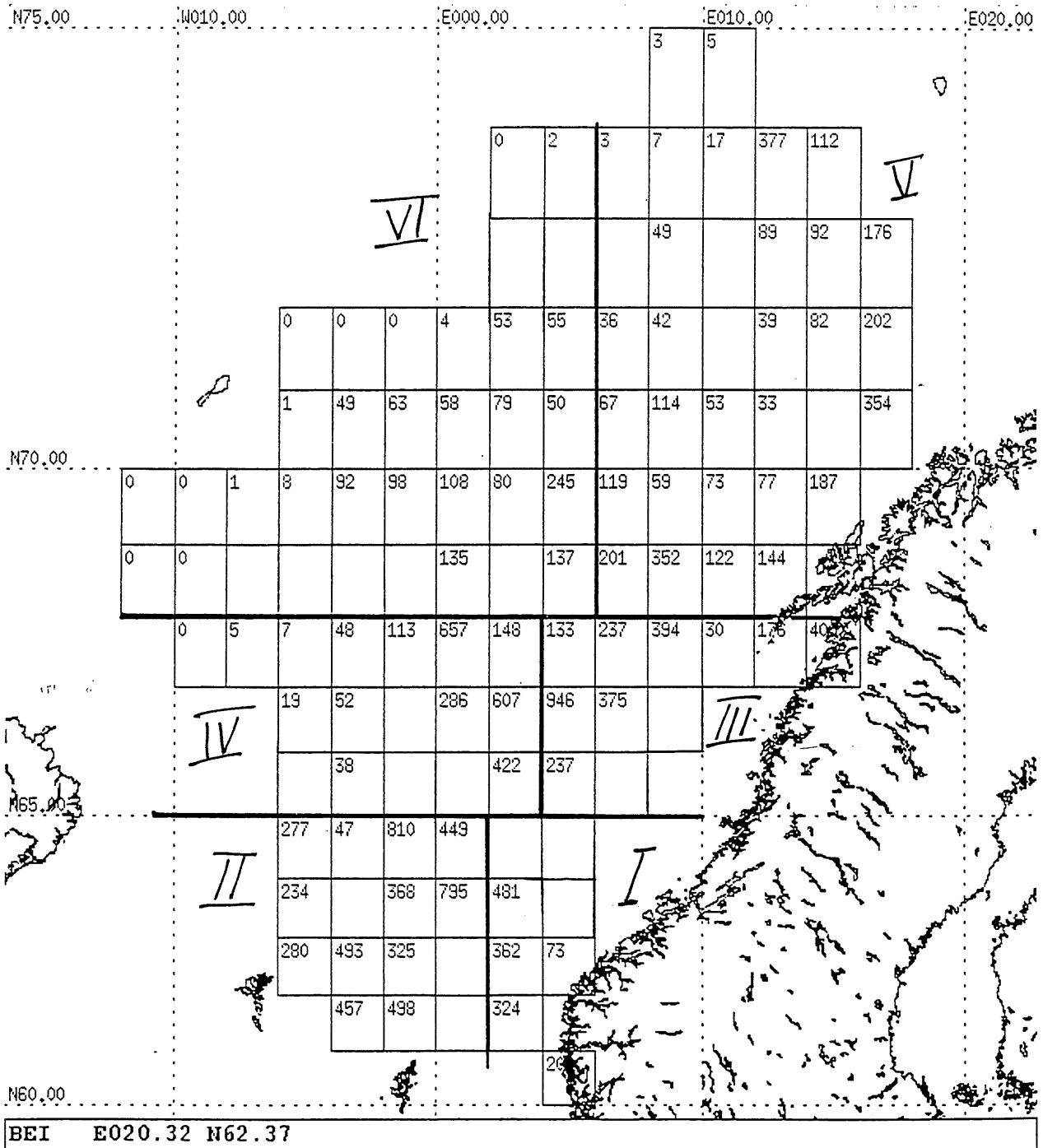


Figure 8. S<sub>A</sub>-values for blue whiting, July 1998.

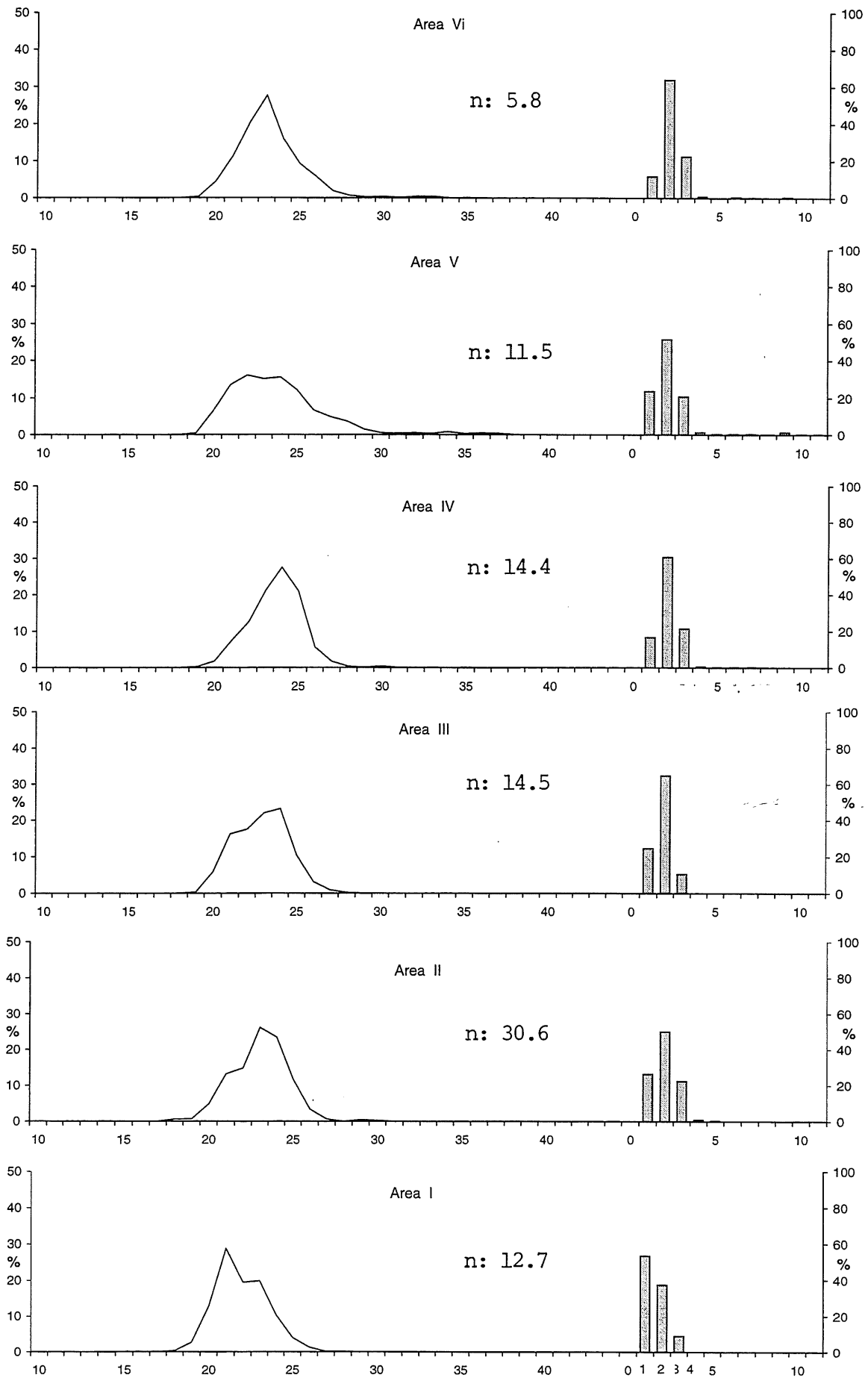
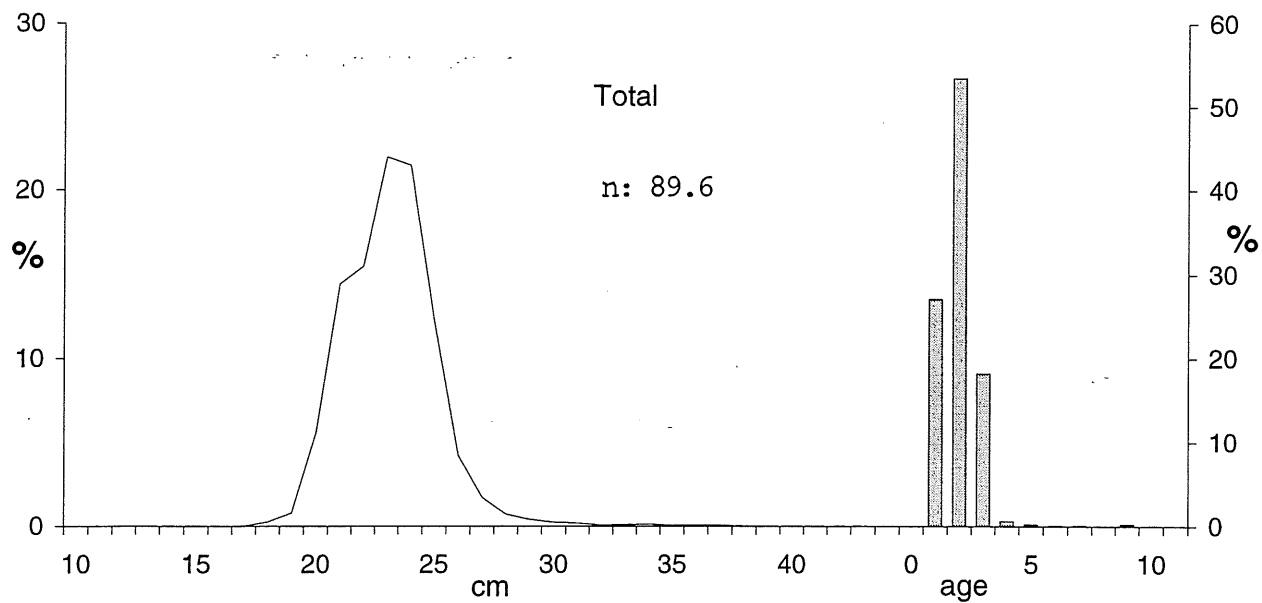


Figure 9.  $S_A$ -values for blue whiting in 6 sub-areas marked on Figure 8, July 1998. Weighed by abundance,  $n = 10^9$  individuals.



Figures 10. Total length- and age-distributions of blue whiting in the Norwegian Sea, July 1998. Weighed by abundance,  $n = 10^9$  individuals.

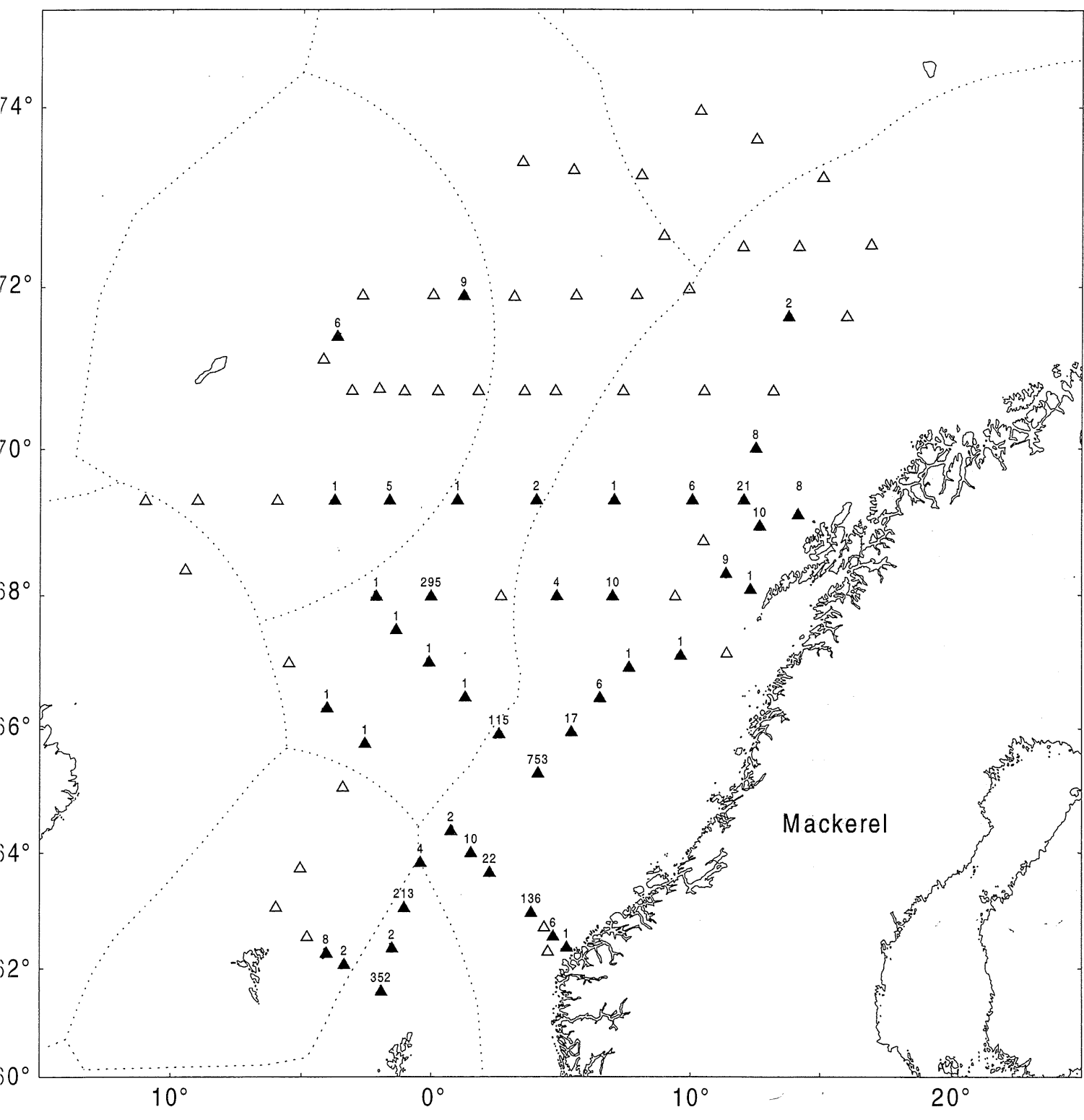


Figure 11. Catch of mackerel in surface hauls, July 1998. Nos. per 1/2 hour trawling.

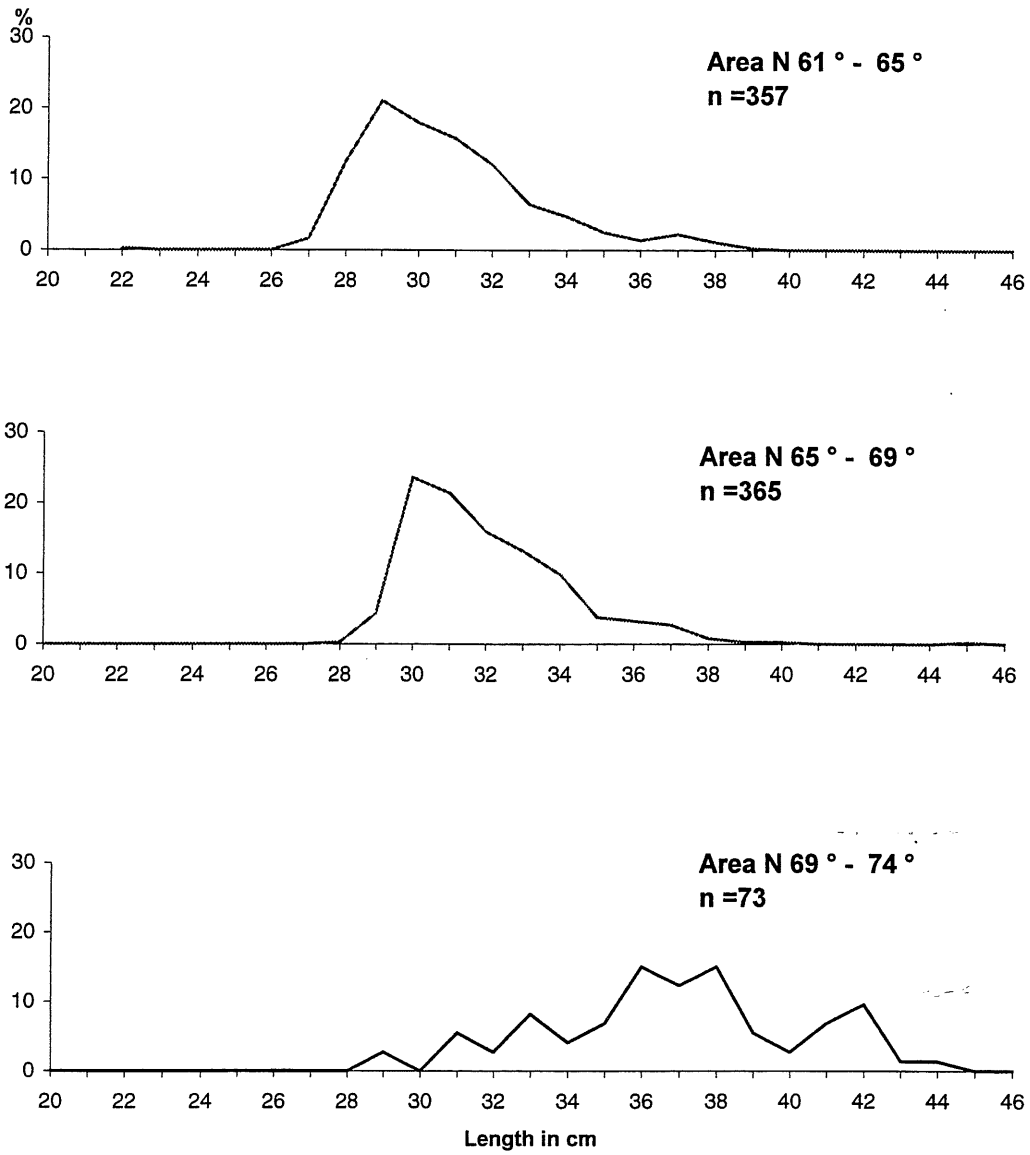


Figure 12. Length distribution of mackerel. Norwegian Sea, July 1998.

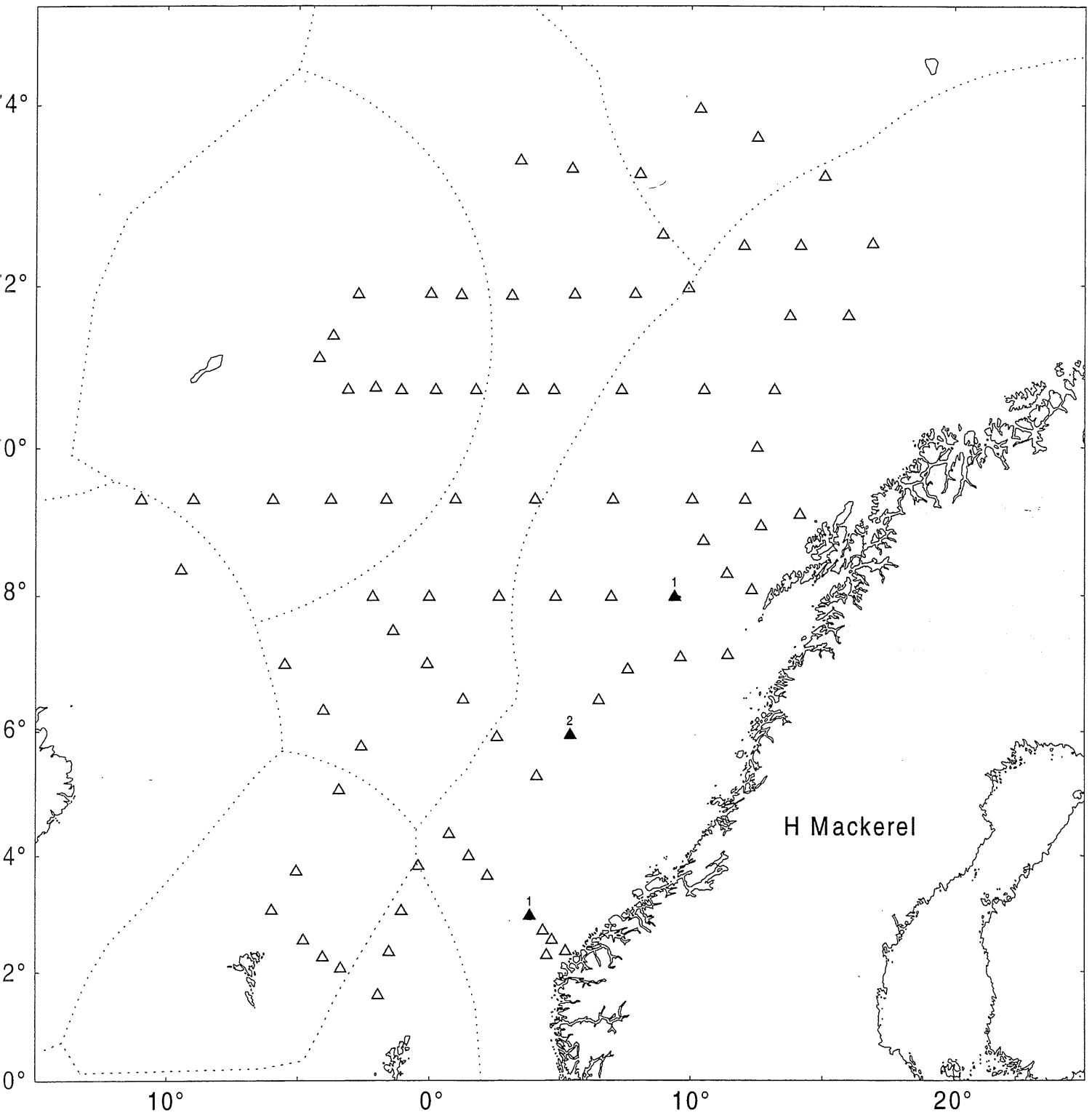


Figure 13. Catch of horse mackerel in surface hauls. Nos. per 1/2 hour trawling.  
July 1998.



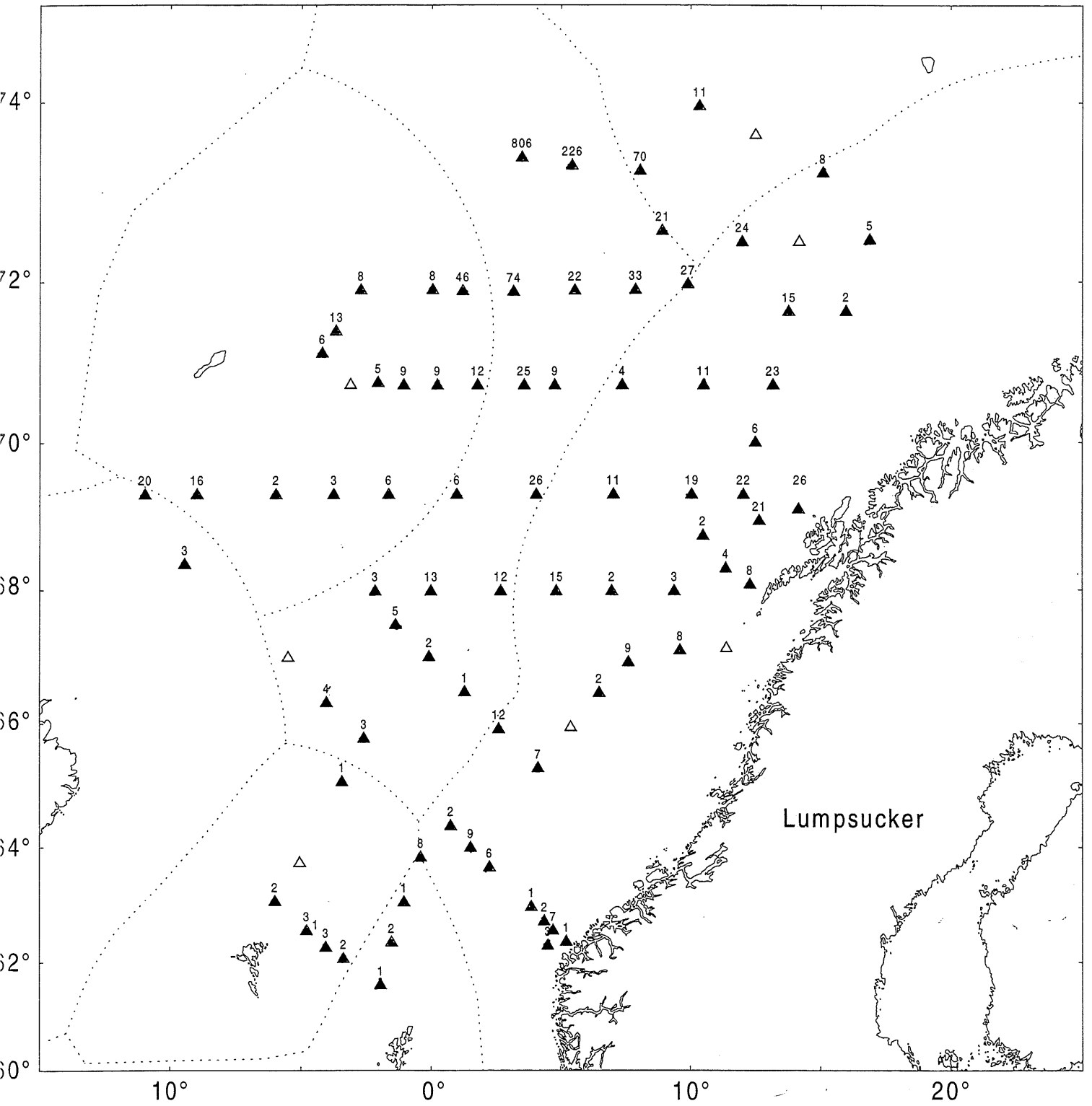


Figure 14. Catch of lump sucker in surface hauls, July 1998. Nos. per 1/2 hour trawling.

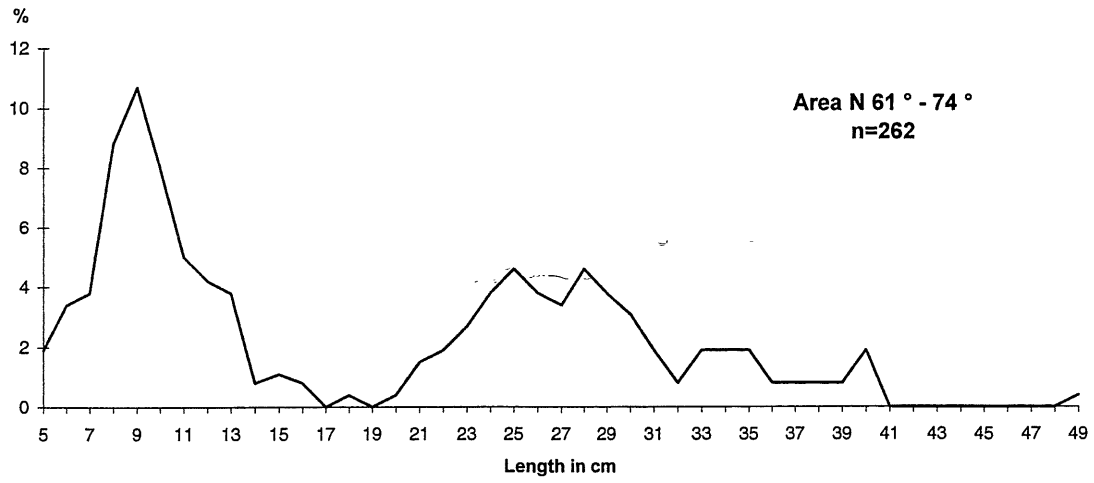


Figure 15. Total length distribution of lumpsucker in the Norwegian Sea, July 1998.

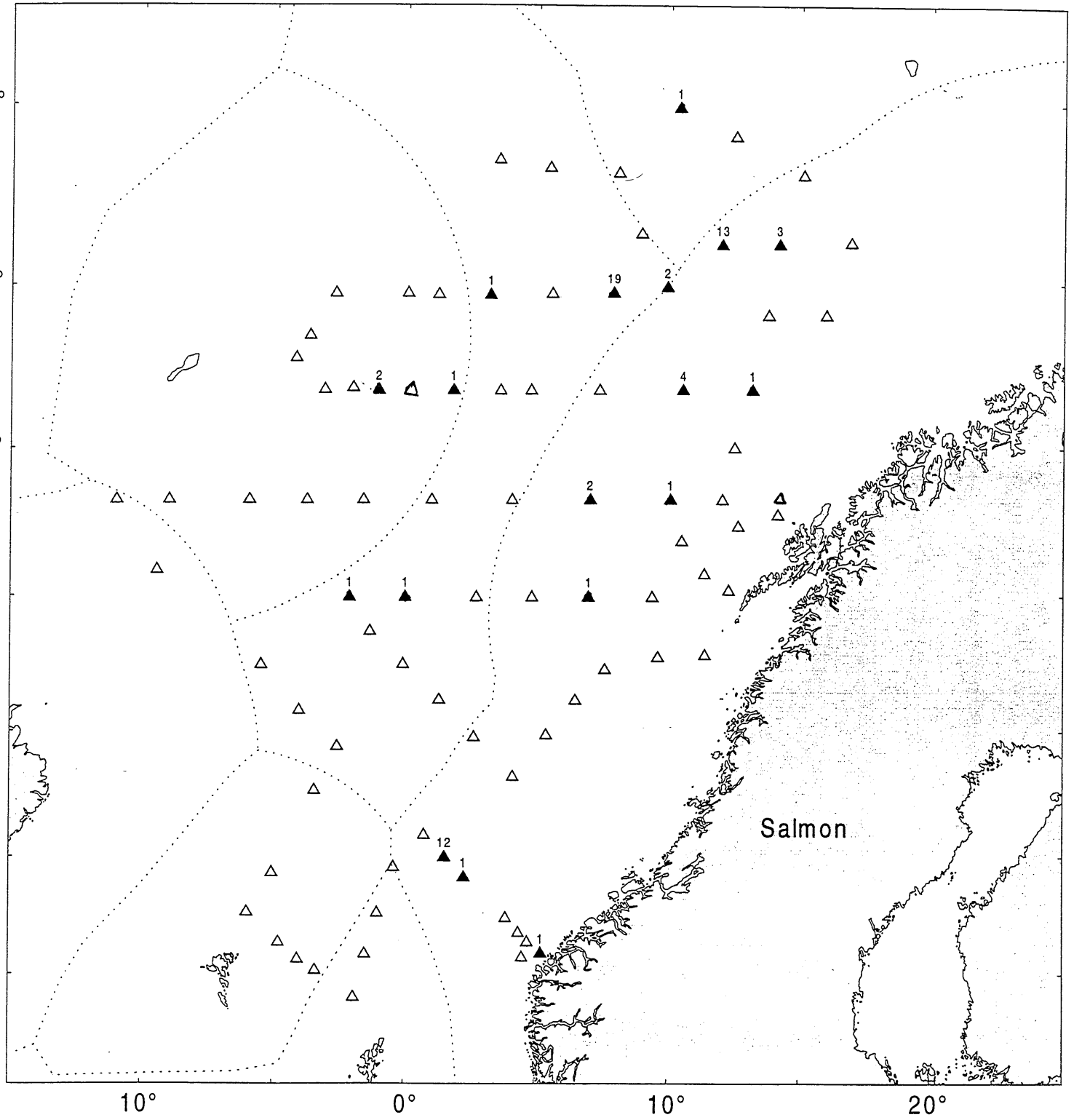


Figure 16. Catch of salmon (smolt) in surface hauls, July 1998. Nos. per 1/2 hour trawling.

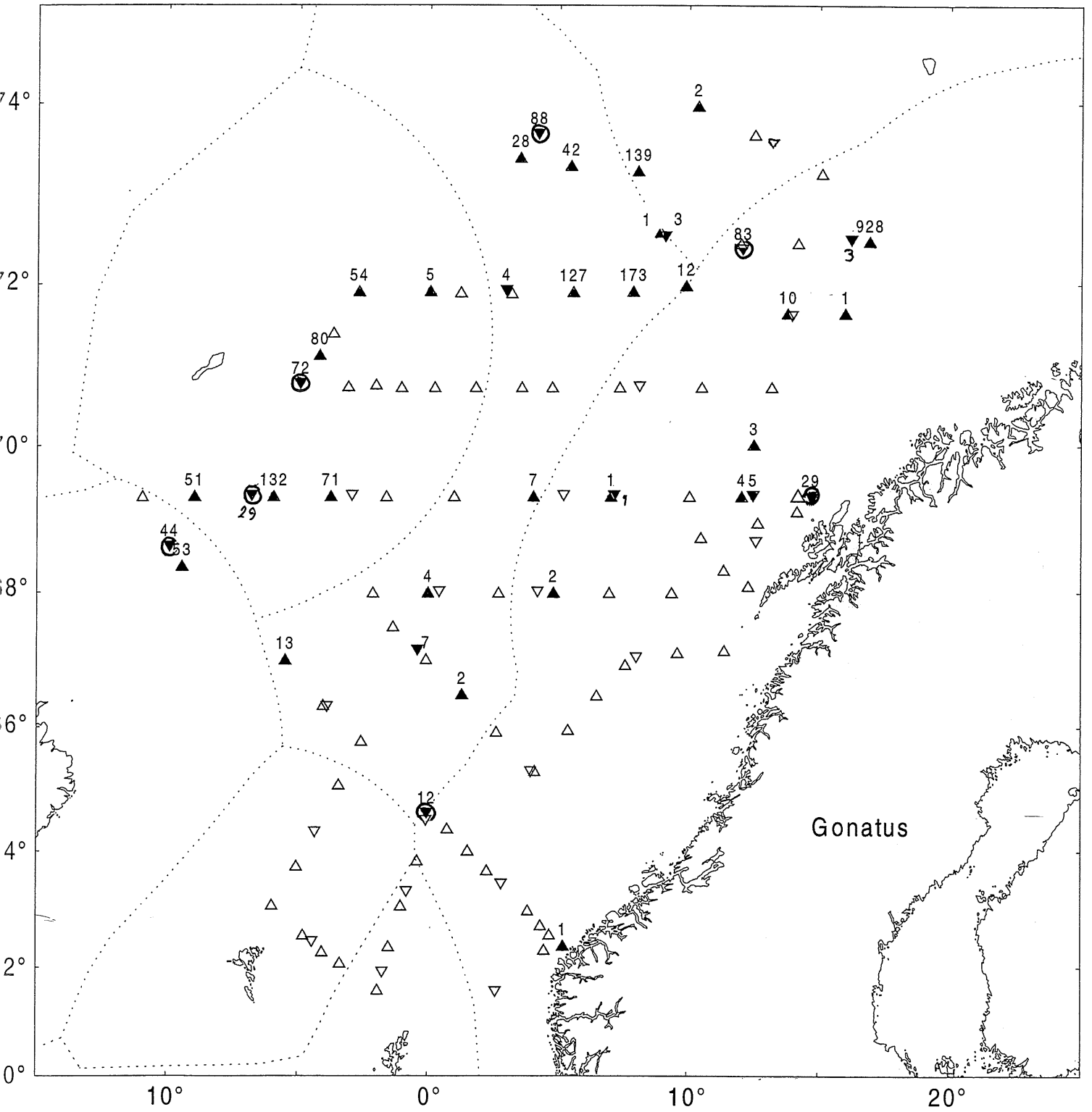


Figure 17. Catch of the squid *Gonatus* in pelagic trawl hauls, July 1998.

Symbols: Triangle pointing up: surface haul, triangle pointing down: deep hauls (200-400m), both nos. individuals per ½ hour trawling. Encircled triangle: special deep haul for *Gonatus* (750-1050m), with nos. per 1 hour.

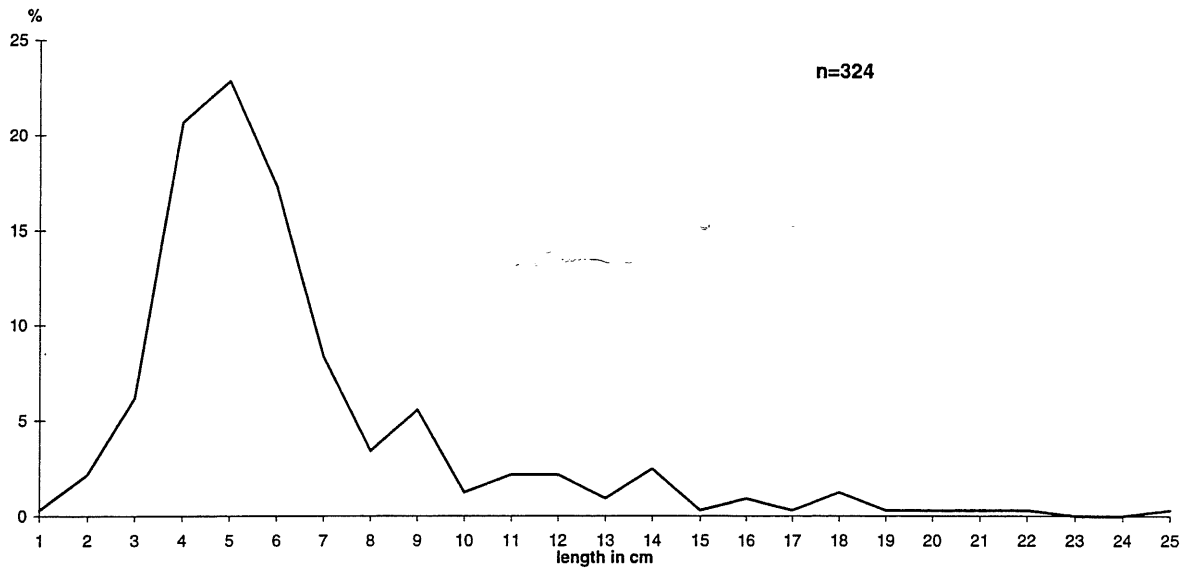


Figure 18. Common length distribution of *Gonatus* from the 7 special deep trawl stations no. 209, 230, 233, 247, 287, 303 and 312.

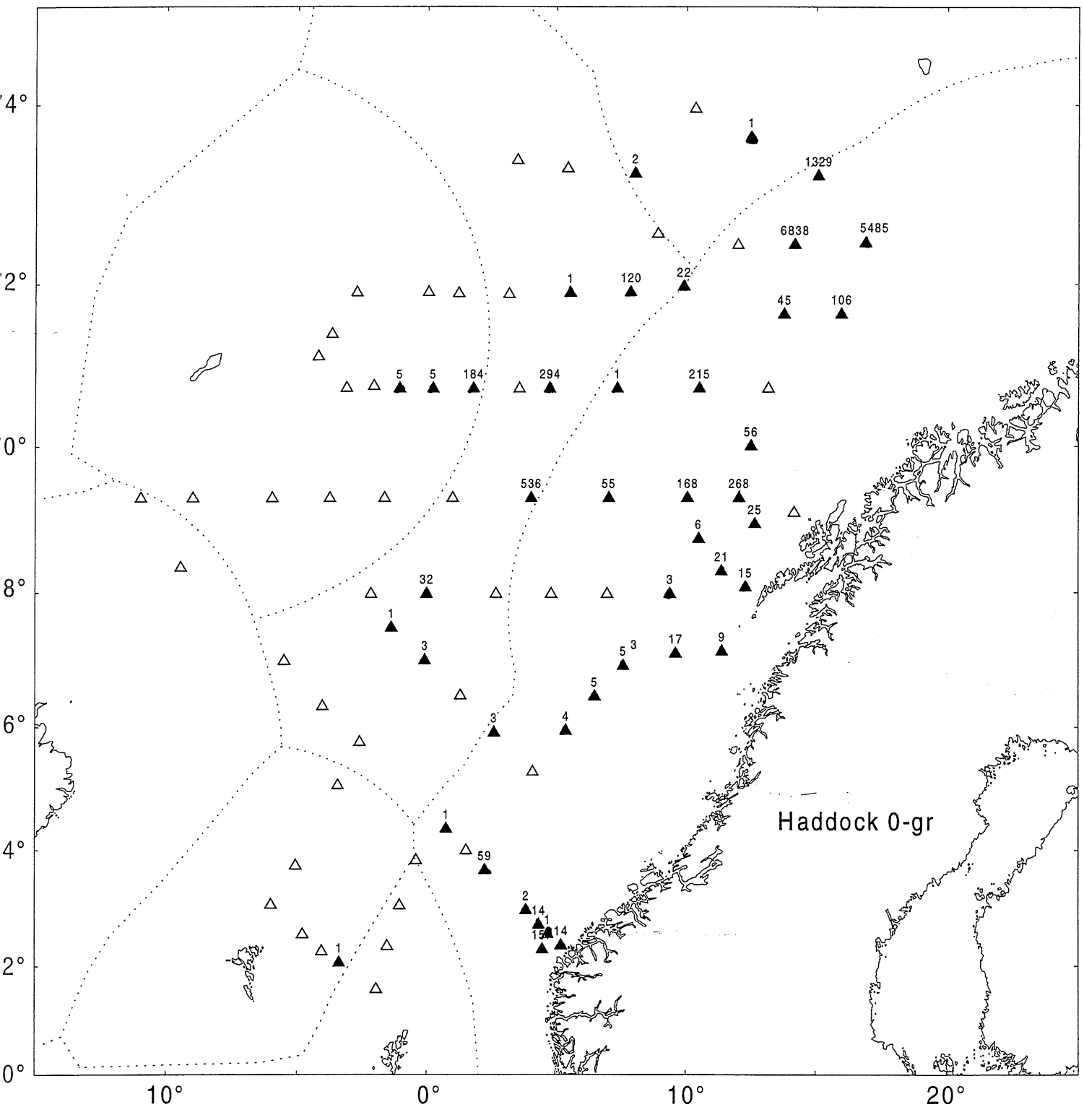


Figure 19. Catch of 0-group haddock in surface hauls July 1998. Nos. per 1/2 hour.

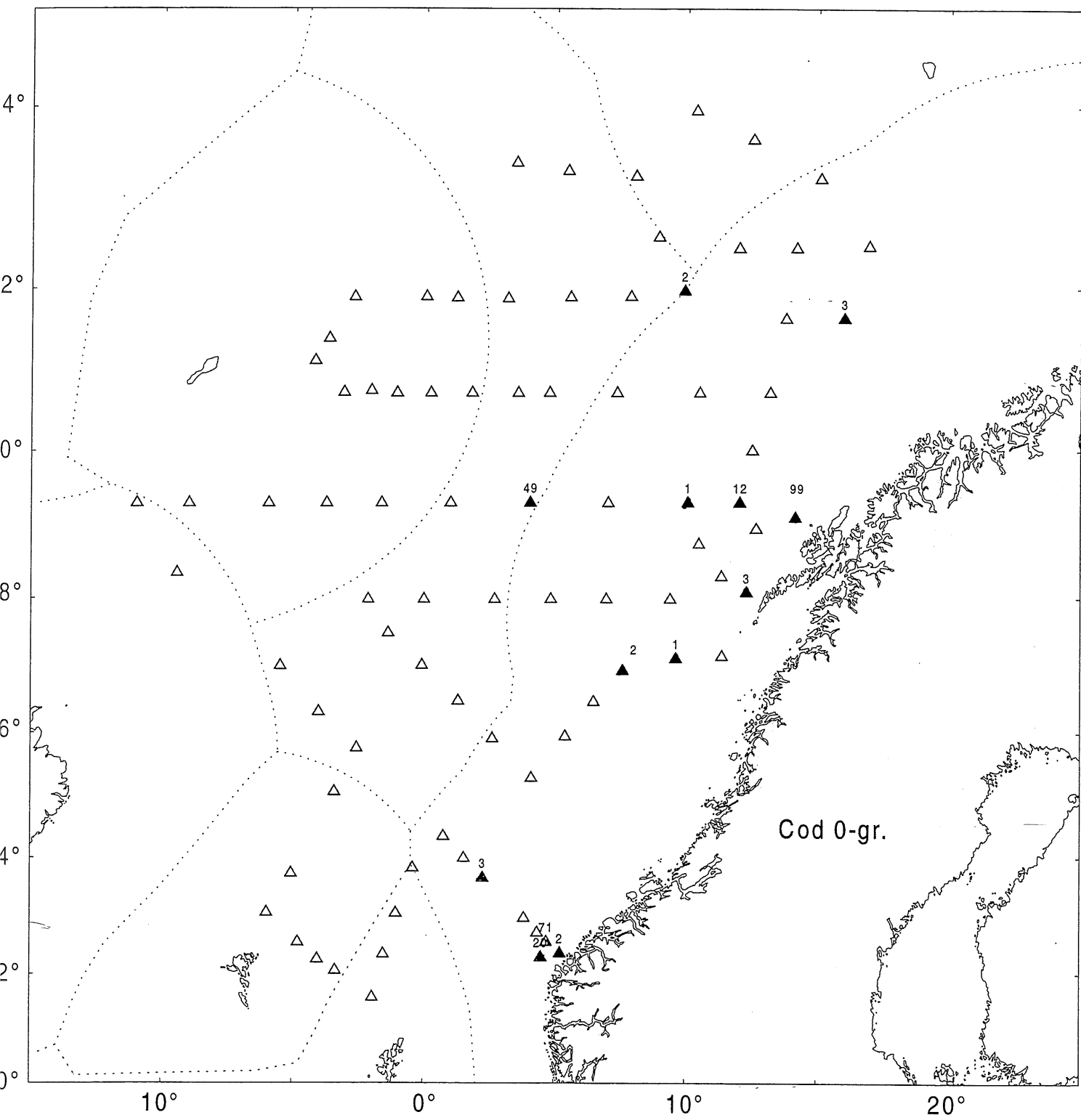


Figure 20. Catch of 0-group cod in surface hauls, July 1998. Nos. per 1/2 hour.

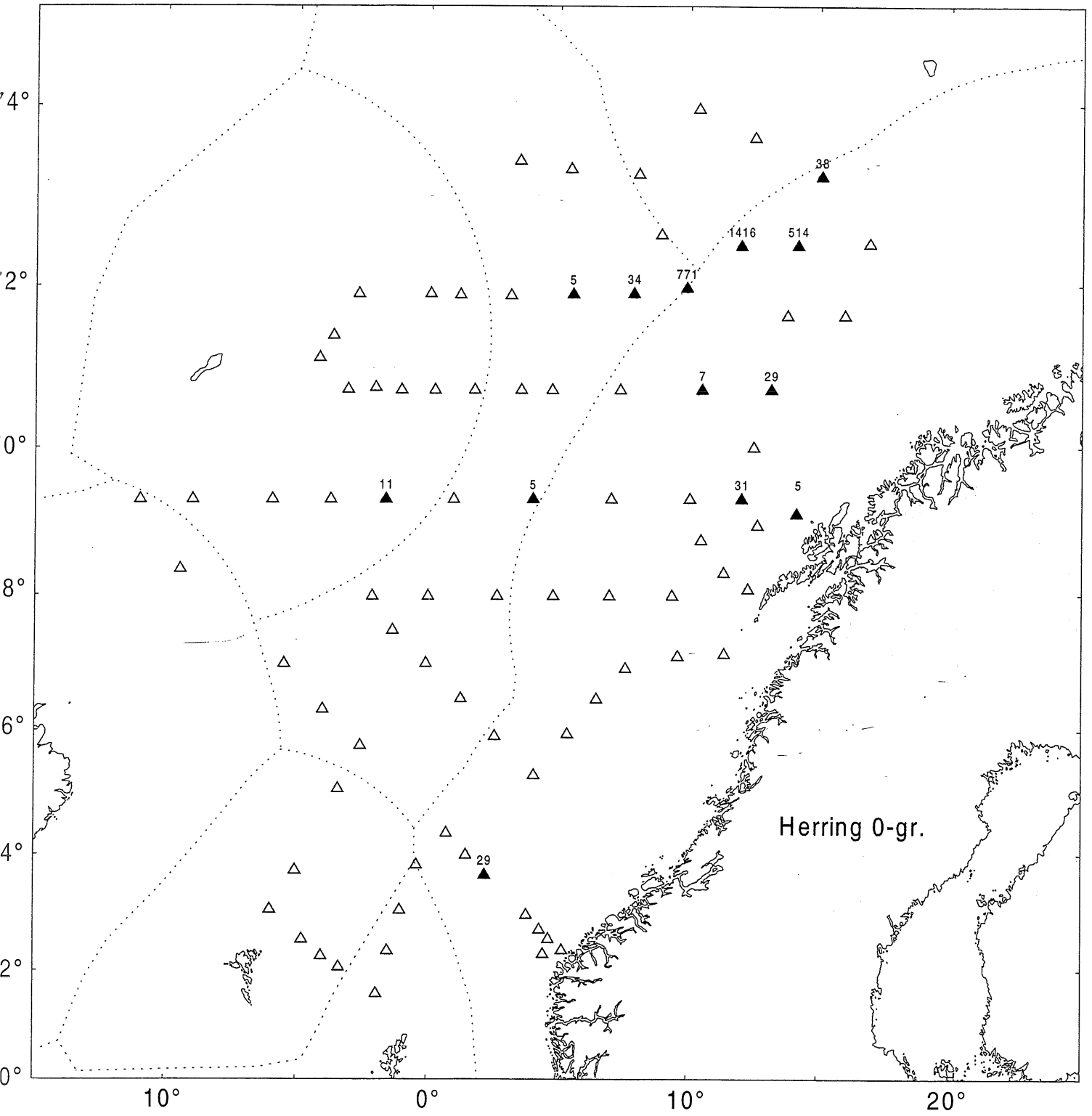


Figure 21. Catch of 0-group herring in surface hauls, July 1998. Nos. per 1/2 hour.



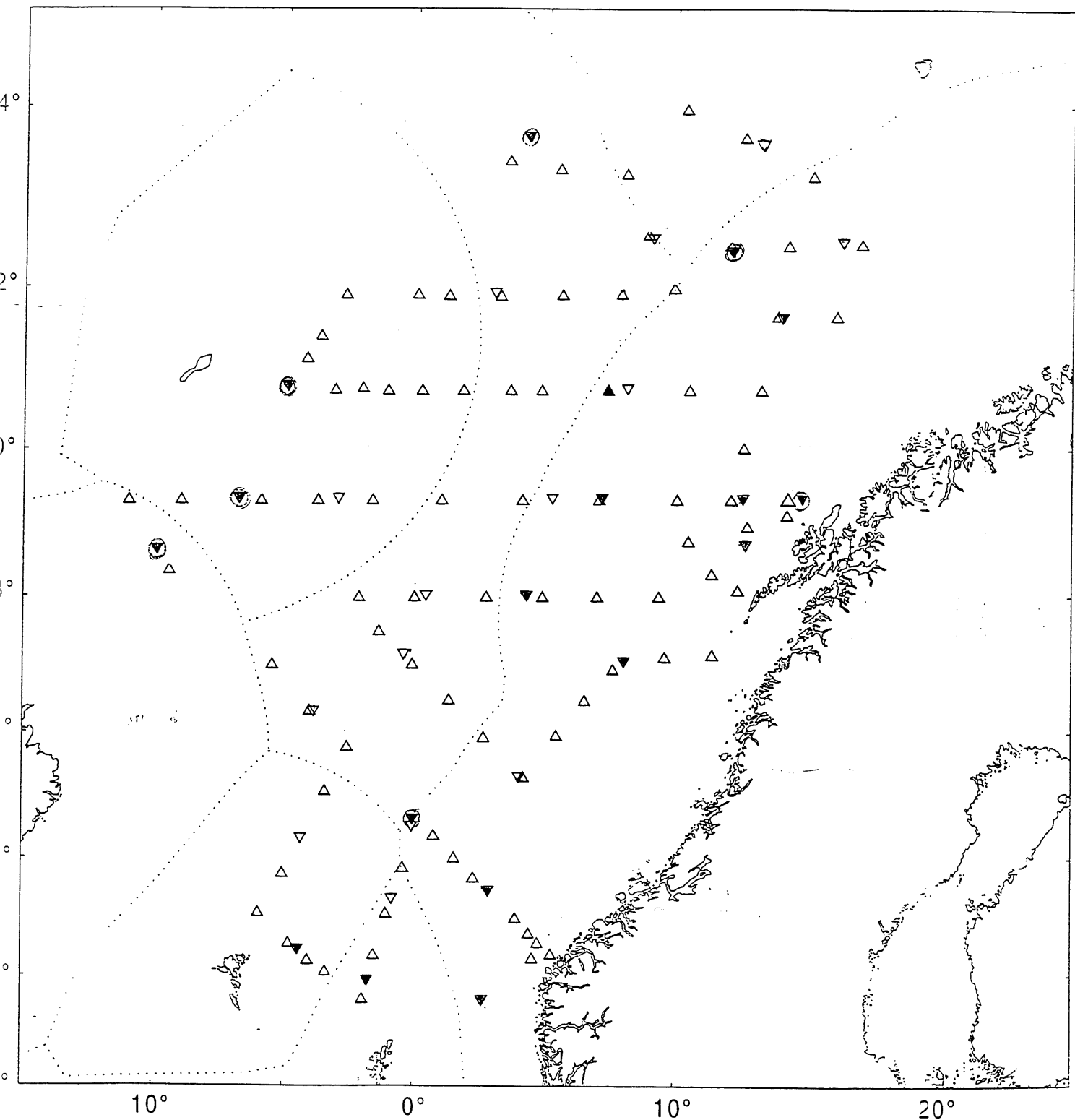


Figure 22 Catch of mesopelagic fish (filled triangles) in pelagic trawl hauls, July July 1998. Symbols as in Figure 17.

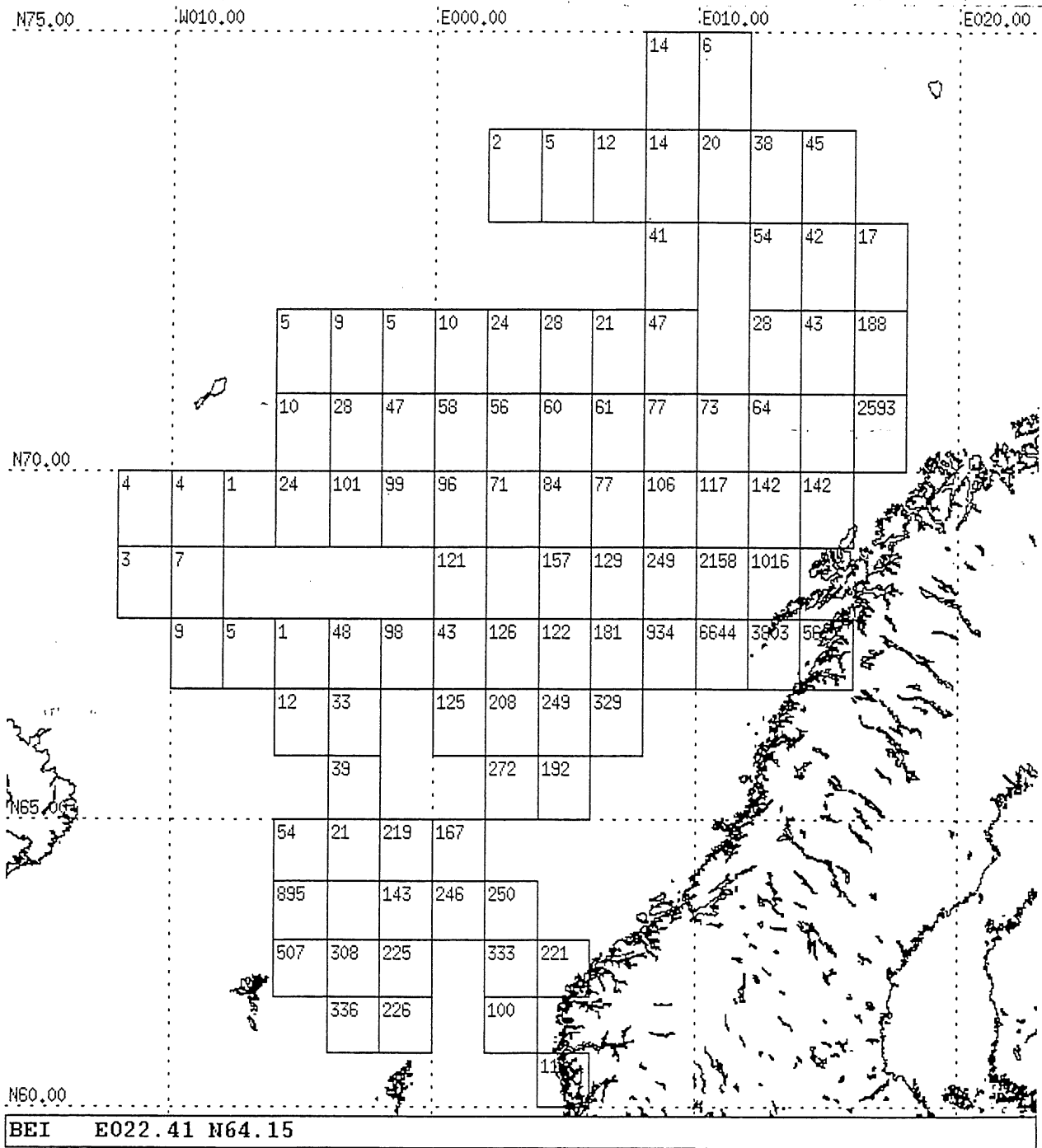


Figure 23. S<sub>A</sub>-values for plankton, July 1998.

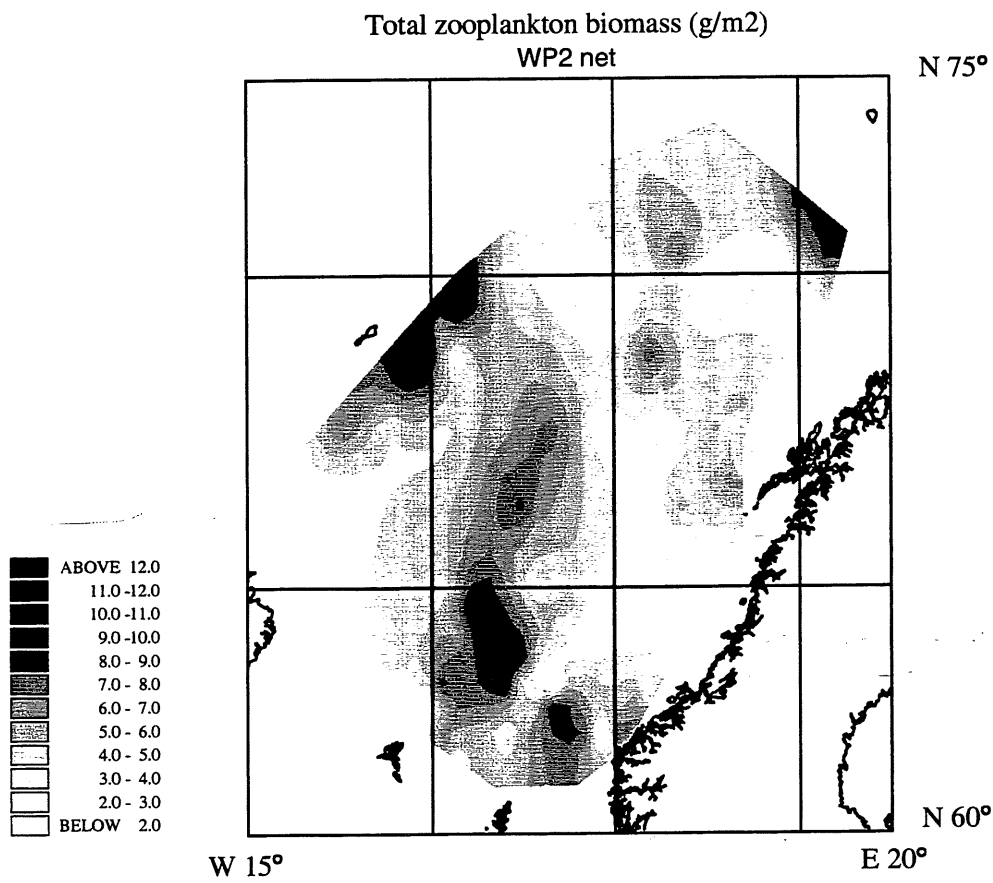


Figure 24. Total zooplankton biomass as dry weight (g m<sup>-2</sup>) in 200-0 m. Sampled with WP-2 vertical net hauls at 87 stations.

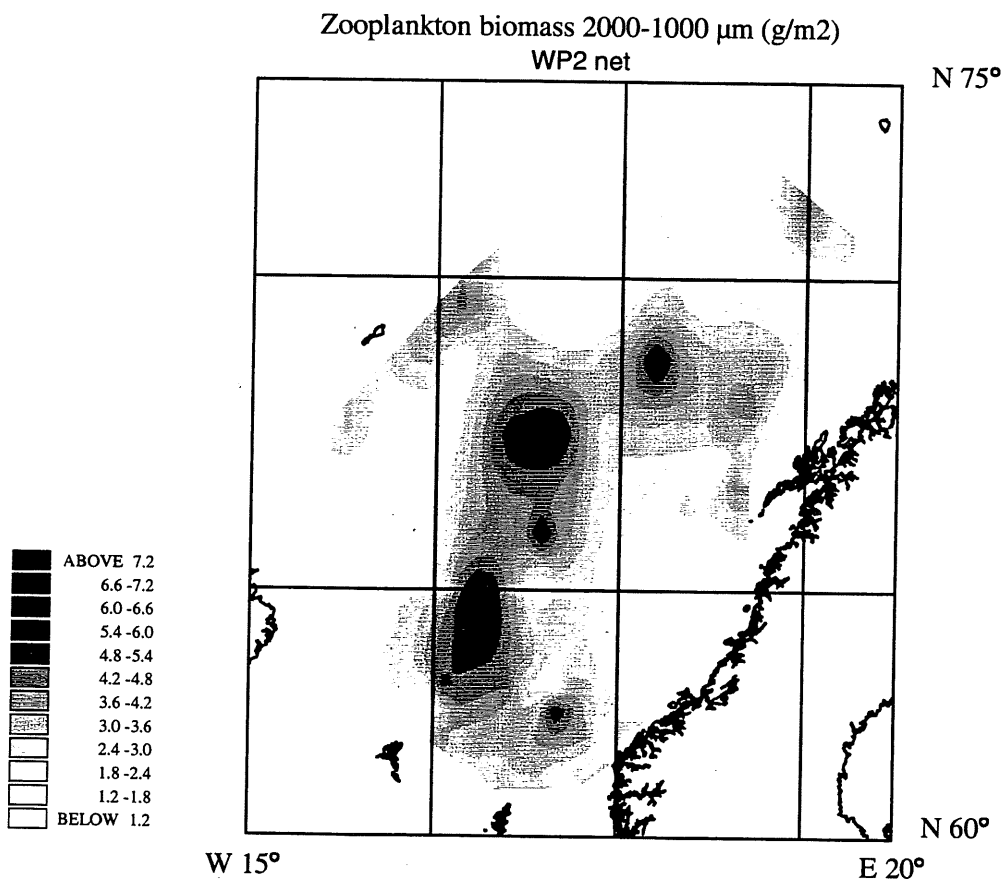


Figure 25. Zooplankton biomass in size fraction 2000-1000  $\mu\text{m}$  as dry weight ( $\text{g m}^{-2}$ ) in 200-0 m. Sampled with WP-2 vertical net hauls at 87 stations.

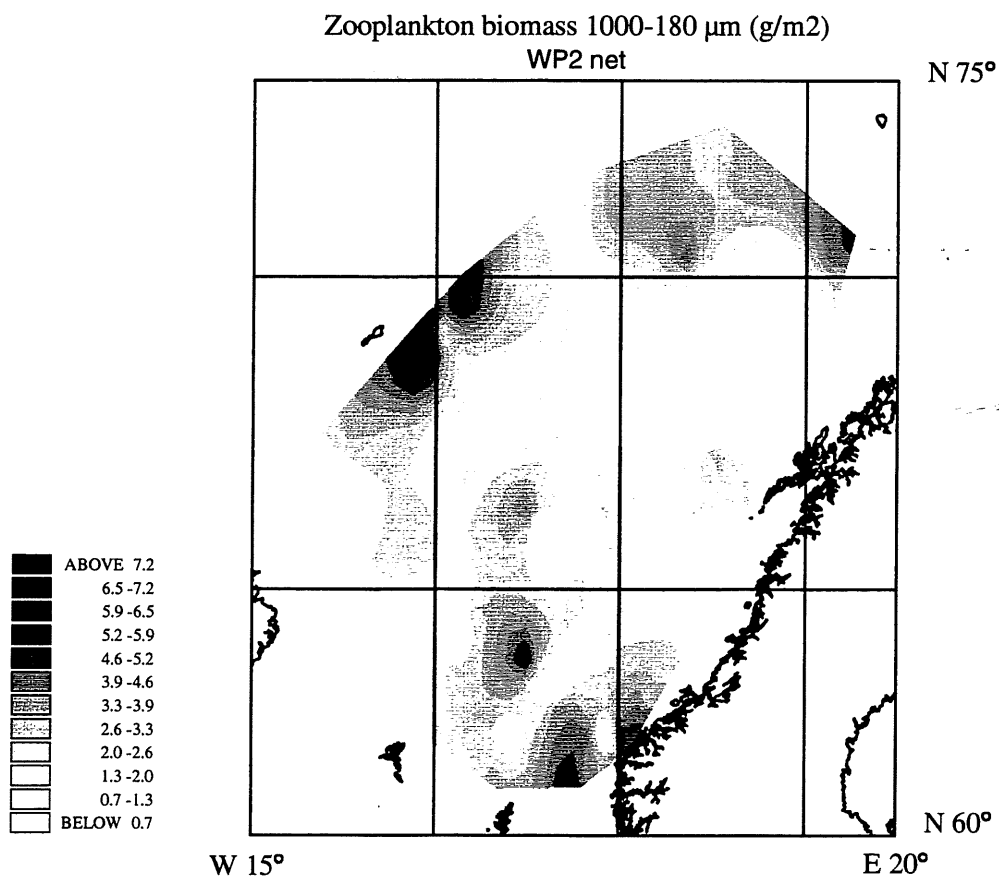


Figure 26. Zooplankton biomass in size fraction 1000-180  $\mu\text{m}$  as dry weight ( $\text{g m}^{-2}$ ) in 200-0 m. Sampled with WP-2 vertical net hauls at 87 stations.

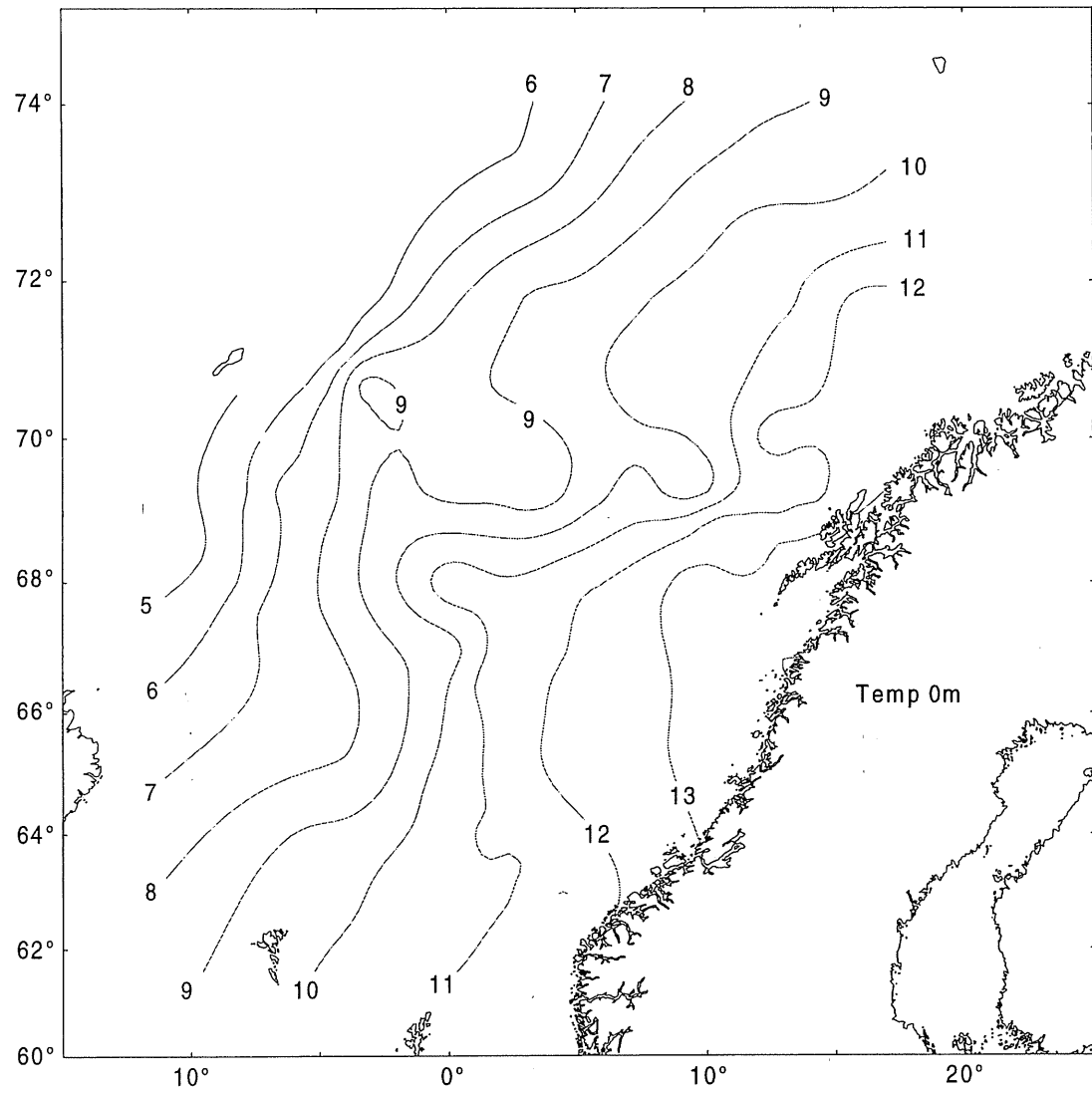


Figure 27. Temperature  $t^{\circ}\text{C}$  at the surface, July 1998.

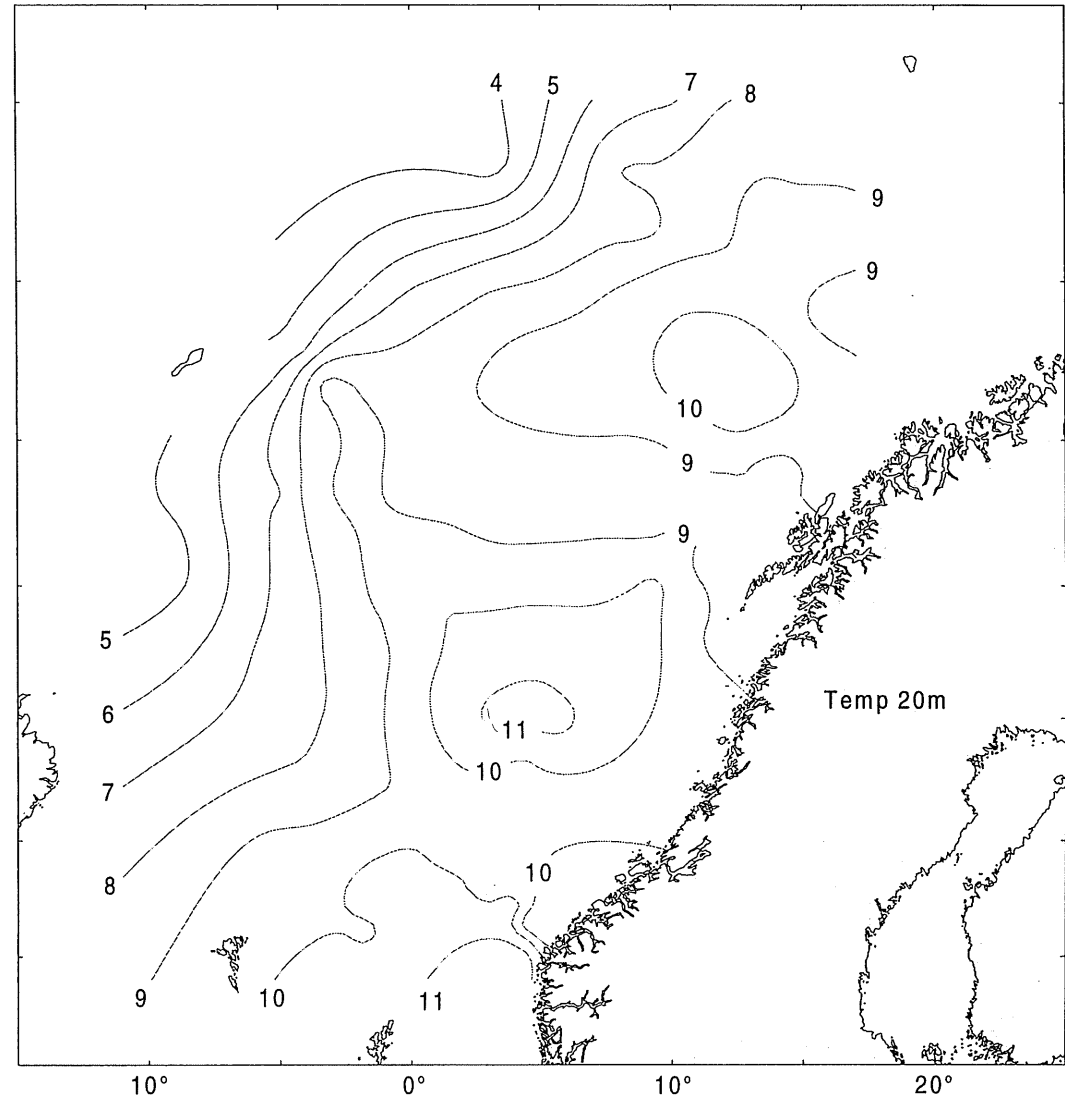


Figure 28. Temperature  $t^{\circ}\text{C}$  at 20 m depth, July 1998.

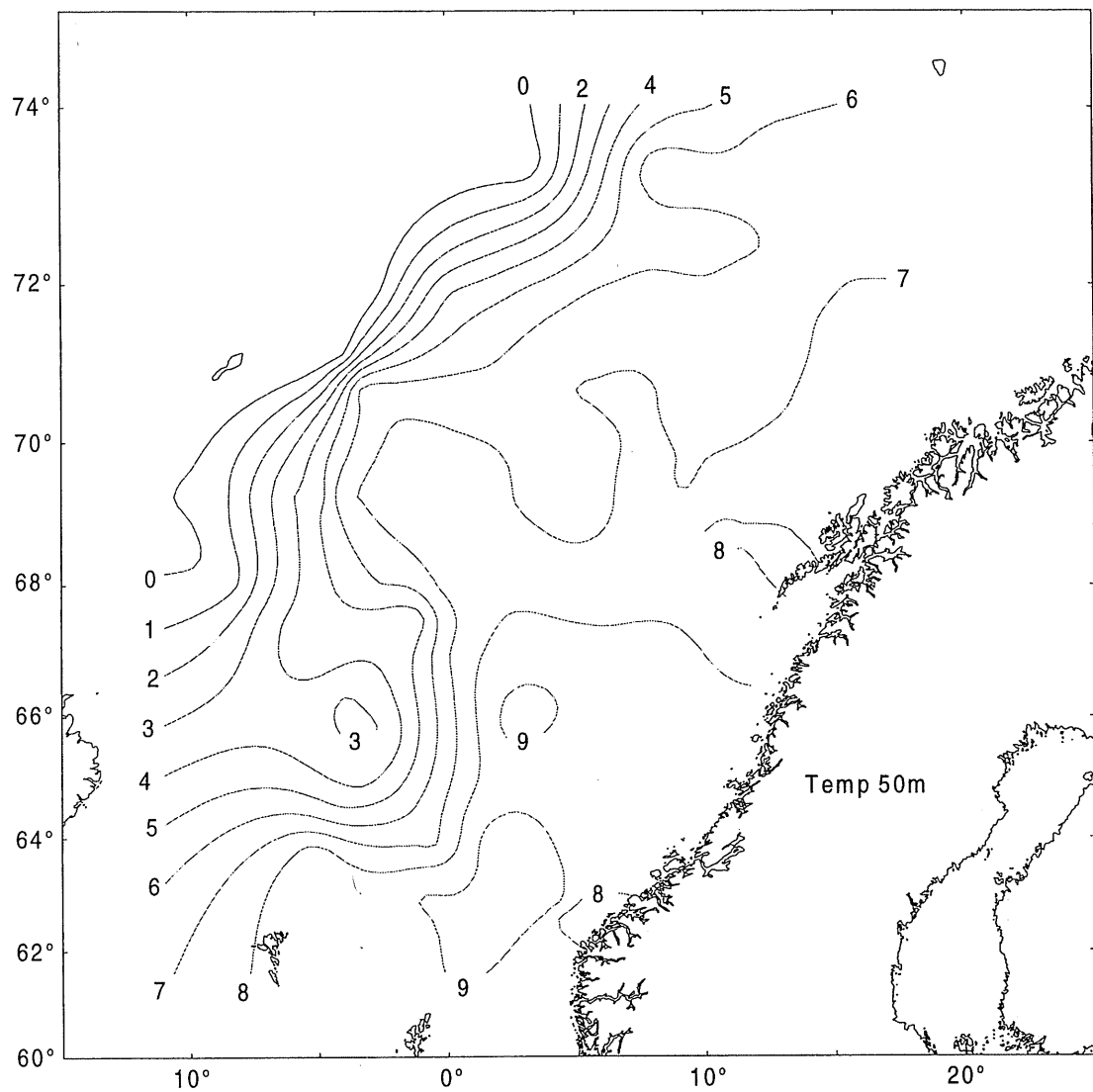


Figure 29. Temperature t° C at 50 m depth, July 1998.

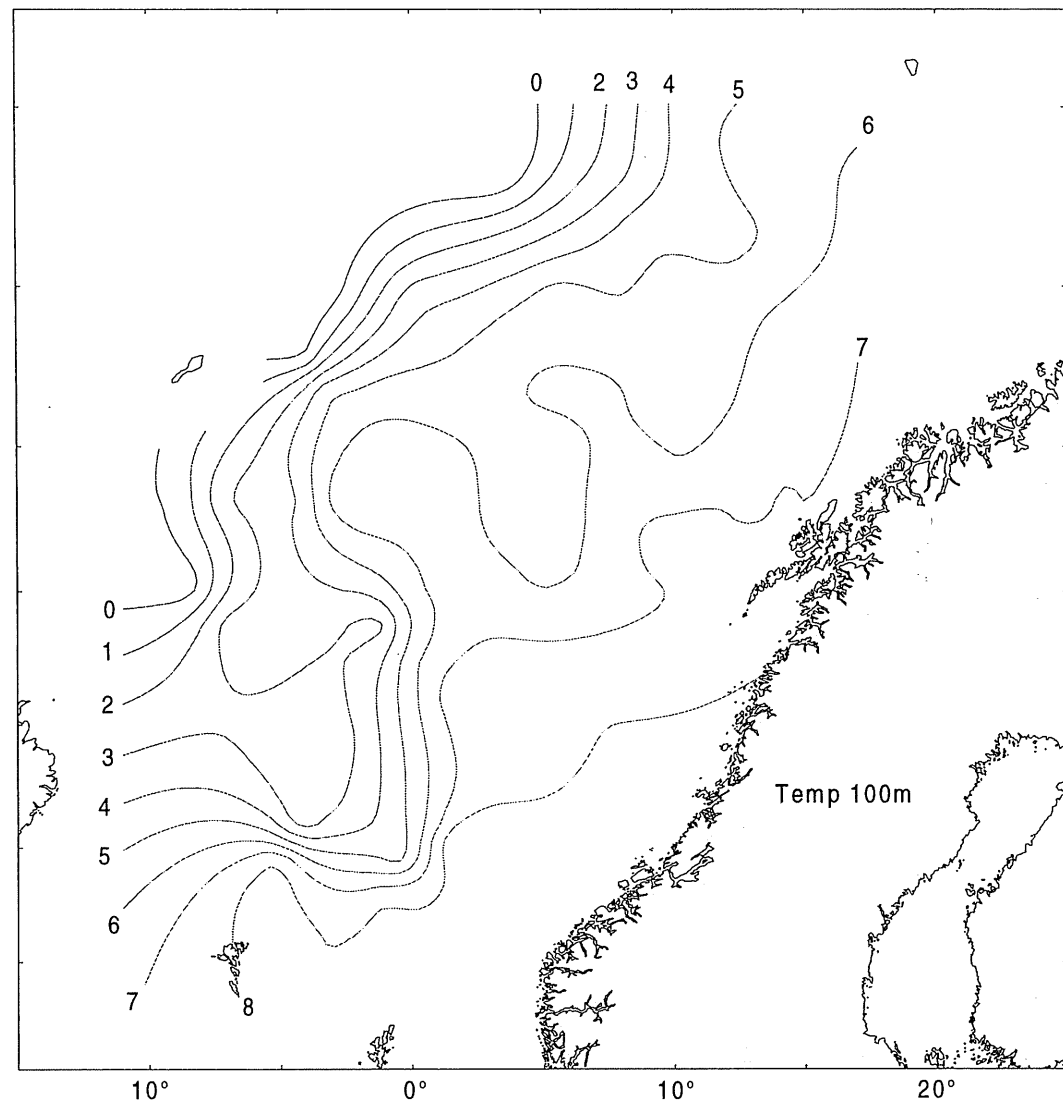


Figure 30. Temperature t° C at 100 m depth, July 1998.

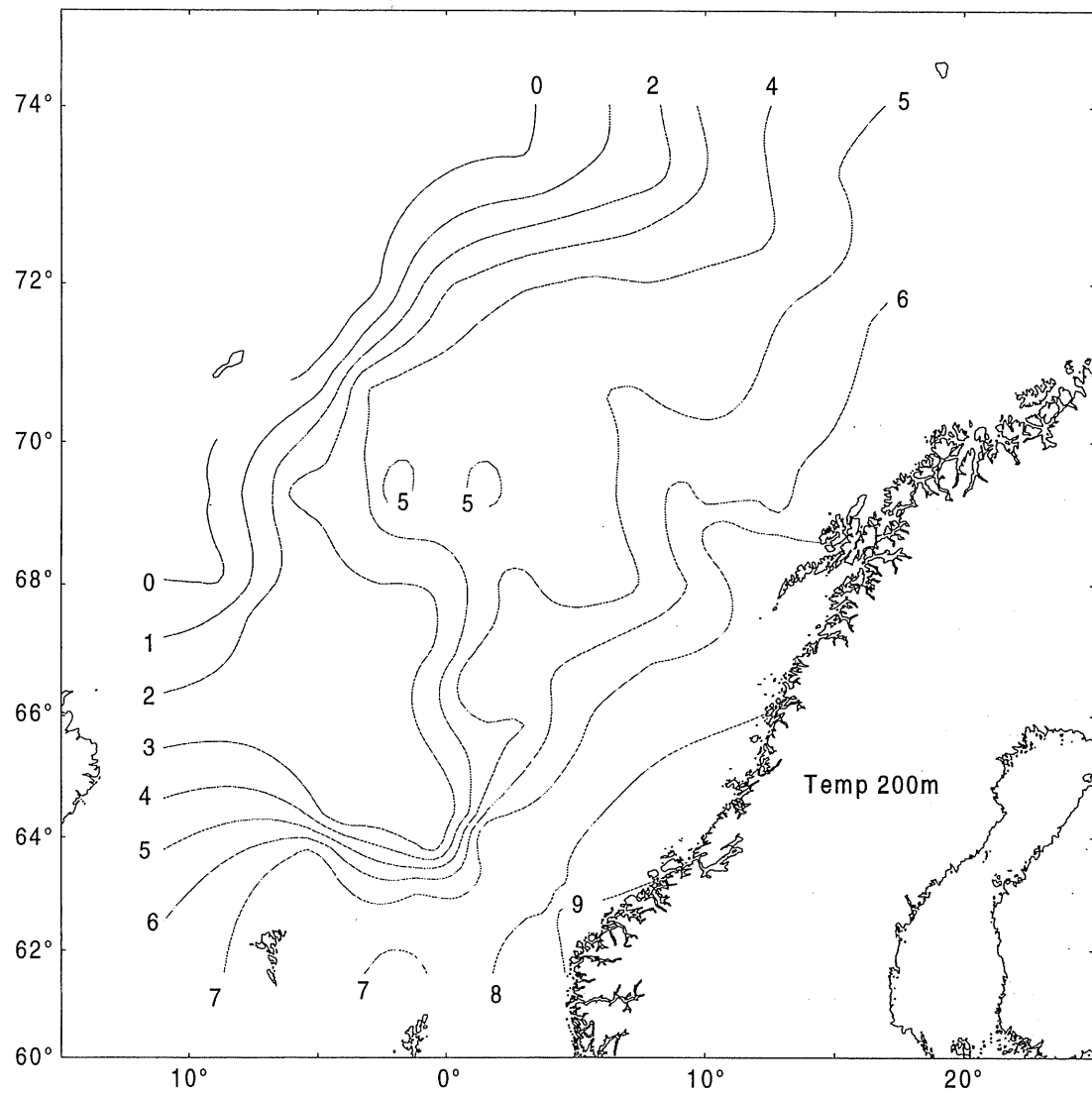


Figure 31. Temperature  $t^{\circ}\text{C}$  at 200 m depth, July 1998.

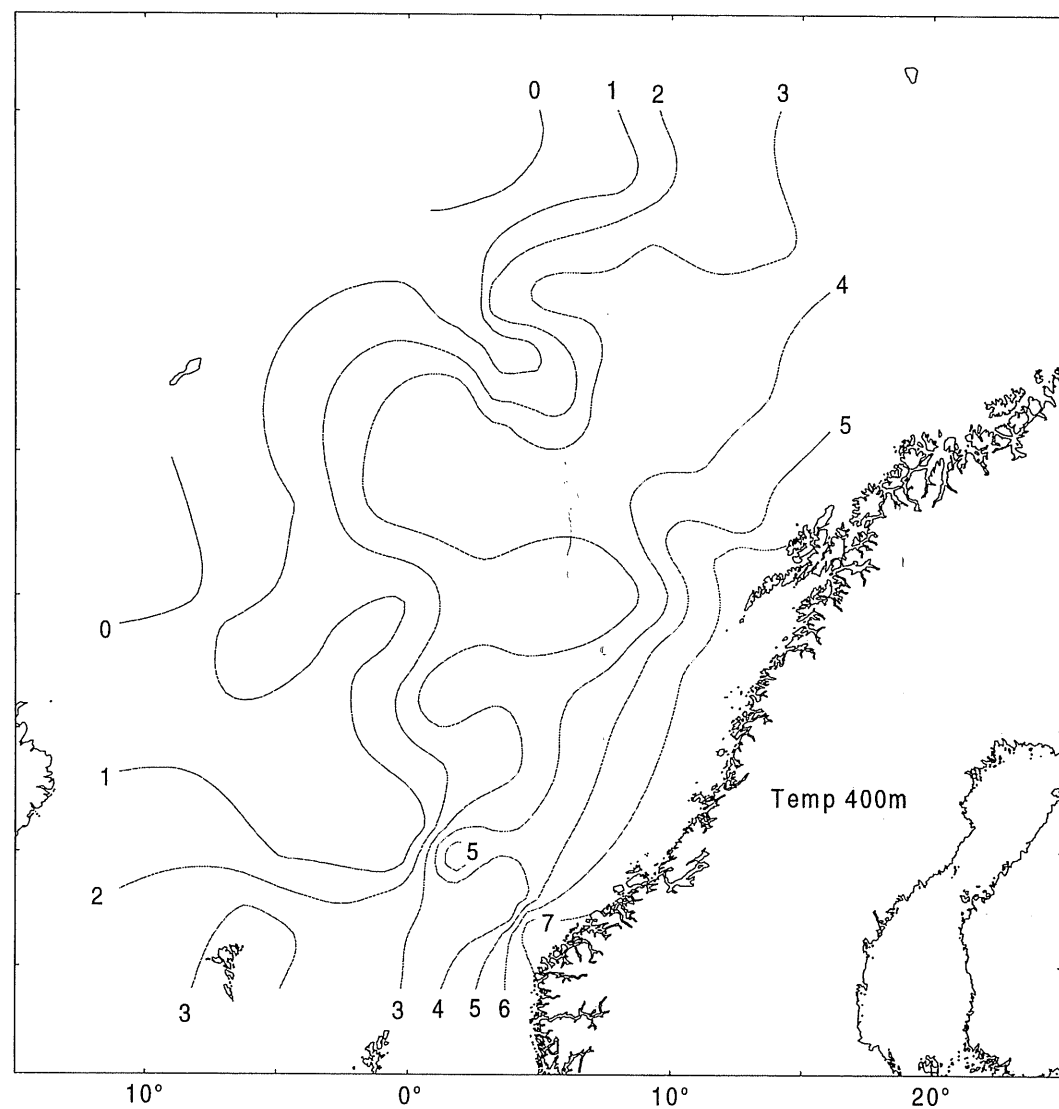


Figure 32. Temperature  $t^{\circ}\text{C}$  at 400 m depth, July 1998.



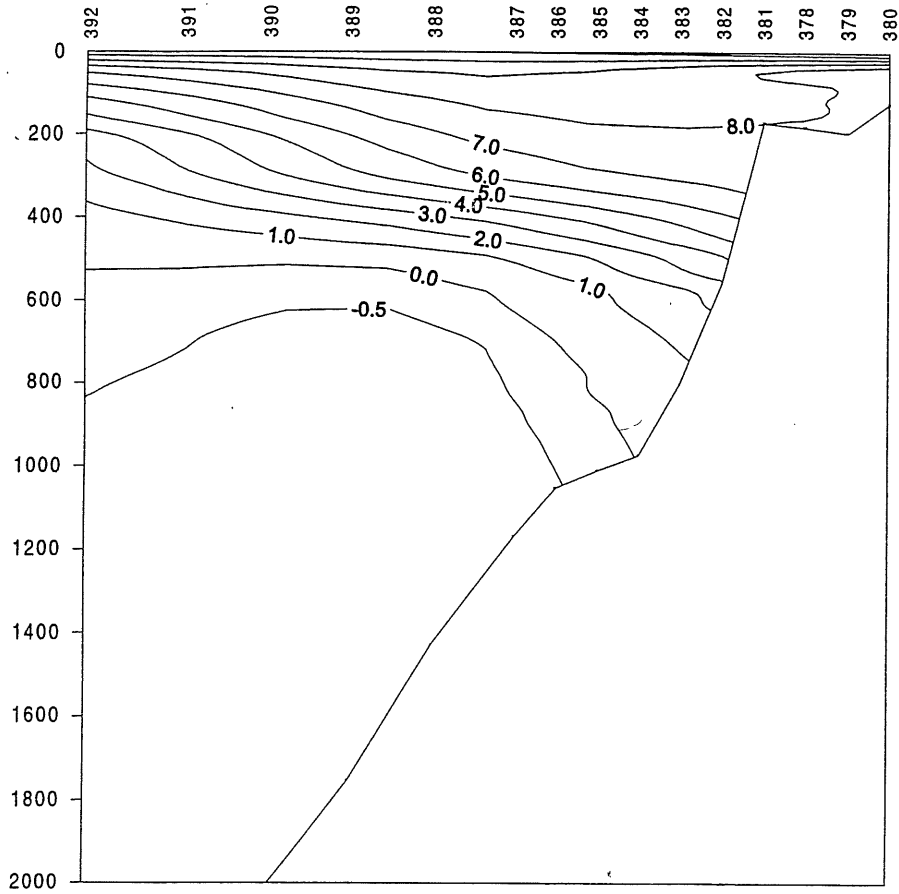


Figure 33. Vertical distribution of temperature  $t^{\circ}\text{C}$ , in the Svinøy - NW section 1-4 July 1998.

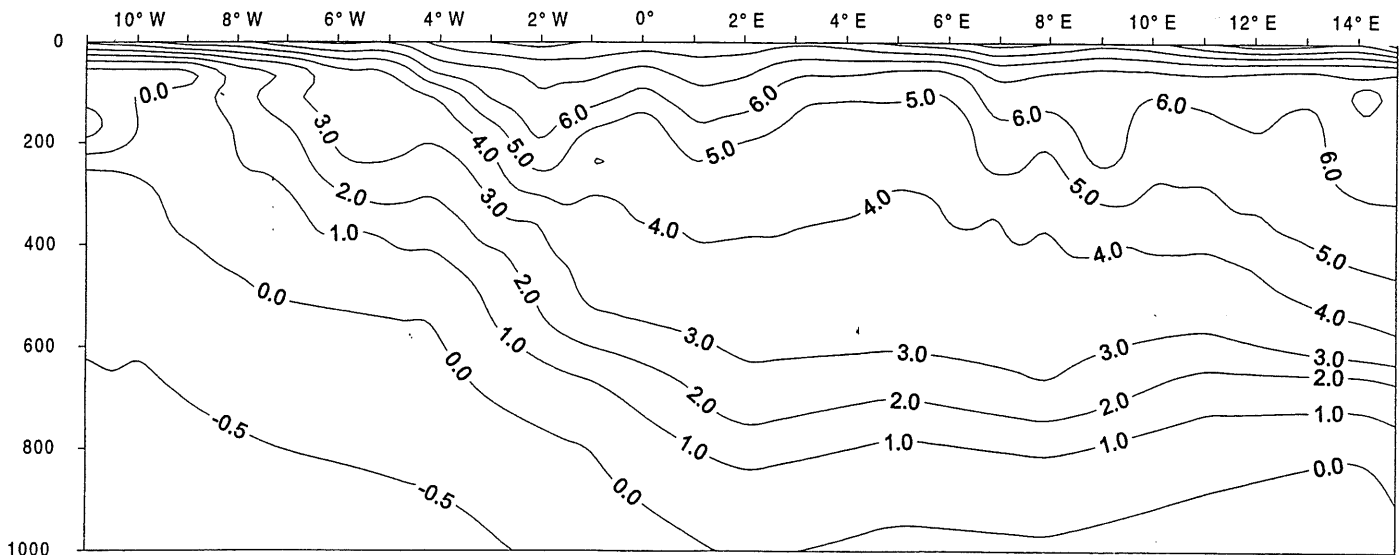


Figure 34, Vertical distribution of temperature  $t^{\circ}\text{C}$ , in a section along latitude  $69^{\circ} 20' \text{N}$  from  $11^{\circ} \text{W}$  to  $14^{\circ} \text{E}$ , 9 - 13 July 1998.