

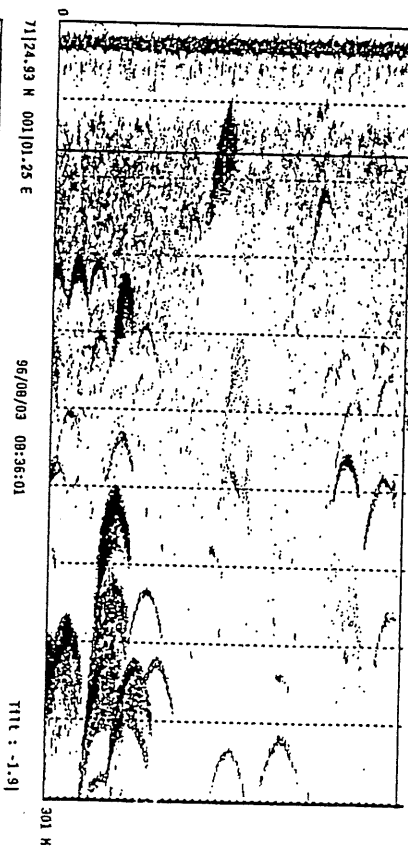
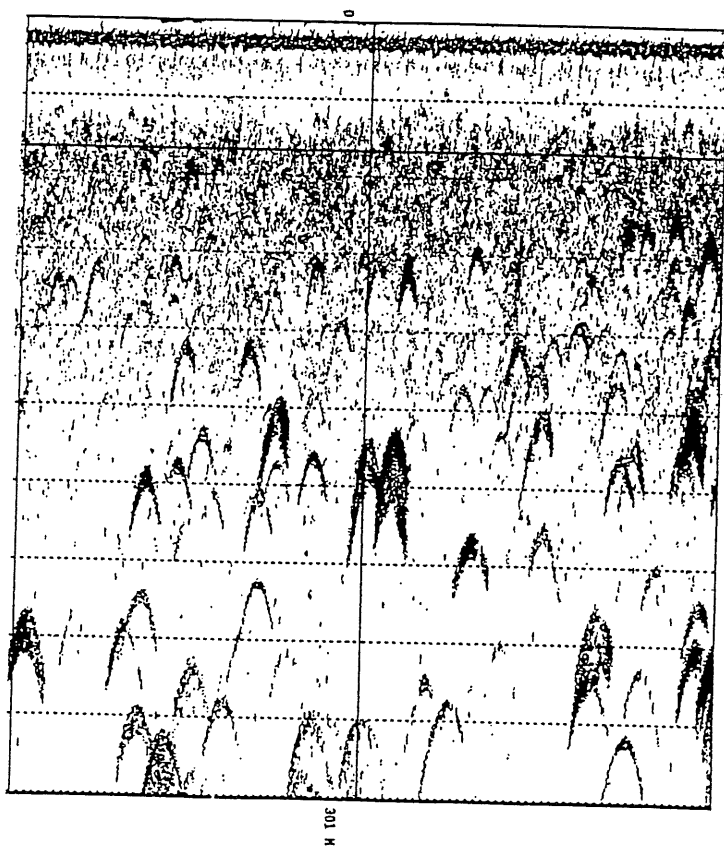
# CRUISE REPORT

Cruise no. 1996010

R.V. "G.O.Sars",

19/7 - 15/8 1996.

NORWEGIAN SEA



## INTRODUCTION

As part of IMR's Norwegian Sea programme, Mare Cognitum, and also as part of the international surveys for investigation on herring in the Norwegian Sea, the purpose of the survey was to map the distributions of pelagic fish species, with special emphasis on herring. Furthermore environmental data including plankton samples were collected, as well as a number of fish stomachs for studies of the feeding ecology. The results of these two main targets overlap each other for mutual benefits, and a balanced strategy for an overall optimal run of the survey was found.

The international programme on the Norwegian Spring Spawning Herring has been agreed upon by Russia, Norway, Iceland and Faroe Islands, and a planning meeting for 1996 was held at Torshavn 13-14 Feb.-96. The herring concentrations was to be surveyed by use of both echo sounder and sonar, with biological sampling for analysis of the stock composition and, if possible, also perform abundance estimates.

The present survey was the last one of seven Norwegian surveys participating in this programme from February 15 to August 15. The area from the Norwegian coast westwards to 3°W between 62° and 72°N was surveyed. In addition to the Norwegian zone that means surveying in the EU-zone north of Shetland, in the northern part of the Faroe zone, the eastern part of the Jan Mayen zone and the international zone north to 72°N (Figures 1 and 2).

## PARTICIPANTS

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

(19/7-15/8):	(19/7-8/8):	(8/8-15/8):
Jaime Alvarez,	Magnus Johannessen	Rolf Sundt
Otte Bjelland,	Berit Endresen	
Bjørnar Ellertsen,		
Jens Chr. Holst,		
Terje Monstad (cruise leader),		
Tore Mørk,		
Jan A. Vågenes		

In addition participated Morten Ims (19/7-8/8) from NINA, Stavanger and Lars Petter Hansen (8/8-15/8) from NINA, Trondheim.

## MATERIAL AND METHODS

The integrator system BEI (Bergen Echo System) was connected to a Simrad EK-500/ES-38B-BM echo sounder for registration of fish and plankton echo traces. The following settings were used:

Mode	Active	SV Transducer gain	25.3 dB
Transducer depth	5m	TS Transducer gain	25.3 dB
Absorbtion coeff.	10 dB/km	3dB Beam width	7.0 dg
Pulse length	medium	Alongship offset	-0.09 dg
Max power	4000w	Anthw.ship offset	0.10 dg
Angle sensitivity	21.9		
2-way beam angle	-21.0		

The integrated echo values ( $S_A$ ) were allocated to species or group of species. In addition schools were recorded throughout the survey by use of the sonar (Simrad SA 950 multibeam) set in a fixed position at 90° to the ships course, tilted 1.5°-2.0° down. The schools were counted and logged for each 5 n. mile.

For identification of the echo recordings and collection of biological samples pelagic trawls (Åkra and Harstad) were used both at depth and with big floats to the wings when used for sea surface trawling. The Åkra trawl, 30 m vertical opening had an inner-net in cod end of 22mm mesh size, while the Harstad trawl, 20m vertical opening had an inner net of 11mm mesh size in cod end. In addition to echo recordings of fish and plankton the pelagic species like herring, mackerel, salmon, lumpsucker and 0-group fish, were also recorded by counting their numbers in the sea surface trawl catches.

A net of hydrographic stations, including the Svinøy and the Gimsøy standard sections, was worked by use of CTD-sonde. Water bottle samples were from 0, 10, 20, 30, 50, 100, 150, 200, 300, 400, 500 and 700m depths on nearly all CTD stations, and also at 1000m on the two standard sections. Nutrient salt were sampled from all depths except 0m, and chlorophyll samples were taken on the stations in 0,10,20,30,50 and 100m. Samples for phytoplankton counts were taken on the sections. All analysis will be conducted at the IMR, Bergen.

For zooplankton a standard WP-2 net with 180µm mesh was haled vertically in 200-0 m on all stations with CTD on the Svinøy and the Gimsøy sections. A 1m<sup>2</sup> MOCNESS, equipped with eight nets (180 µm mesh size) was used regularly throughout the area investigated. A total of 45 MOCNESS hauls were performed, i.e. 29 from 700m to the surface covering the intervals 700-500, 500-400, 400-300, 300-200, 200-100, 100-50, 50-25 and 25-0m depths, and 16 hauls covering the upper 200m in four intervals. In connection with the Mocness hauls additional sea surface trawling by the Harstad trawl were worked. At some of the deeper MOCNESS hauls also additional two stepwise trawl hauls from 600m to surface were worked.

The plankton samples were divided for formaldehyde preservation and biomass estimation

purposes. the size of the subsamples were usually 1/2, occasionally large samples were divided into 1/8. The biomass samples were filtered through 2000, 1000 and 180µm mesh sieves, to obtain three size fractions of zoo-plankton, and the fractions were transferred to preweighed aluminium trays. Krill, shrimps, fish and large amphipods were removed from the 2000 µm fraction and placed in separate trays. Dominating species or taxonomic groups from each size category were noted. The samples were placed in an oven and dried for 24 hours at 70° C for dry wight determination at IMR. About 600 individual specimens of the copepod *Calanus finmarchius* cop.st. IV and V and the euphausiid *Thysanoessa longicaudata* were sampled for later biochemical analyses. These specimens were length measured and individually transferred to cryo tubes in -80° C.

## RESULTS

### Herring

As mentioned above the recordings of herring (Norwegian spring-spawning herring) were made both by echo sounder and sonar (Figure 3). Furthermore also by the catches from the surface trawling (Figure 4). The herring appeared either in the very upper sea surface layer where it was detected by the sonar only, or at a depth of ca. 20m where it was recorded by the echo sounder as a thin and "knotted" layer. The recordings by the sonar were also of small schools or flocks of herring only.

The main concentrations occurred north of about 67°N and east of about 2°W and in an area off Vesterålen. There was a rather strong size/age gradient running offshore from Vesterålen, with the largest and oldest herring (mainly the 1983 yearclass) occurring in the north-westernmost areas and smaller and younger herring (mainly the 1991 and 1992 yearclass) occurring closer to the Norwegian coast (Figures 5 and 6). Comparing this situation with the one observed during the same period in 1995 it appears that the older herring stayed in much the same area these two years. The young herring was observed further offshore and north in 1996 as compared to 1995. Separate length frequencies and mean weights from each trawl catch are given in Table 1.

### Blue whiting

Recordings of blue whiting were made throughout the whole area surveyed. The integrator values ( $S_A$ ) averaged per rectangle, are given on Figure 7 to illustrate the distribution and relative abundance. The concentrations were highest in the continental shelf area, with the distribution rather even further into the Norwegian Sea. Zero-line was observed only in the coastal areas.

Using the length dependent density coefficient

$$C_F = 1.488 \times 10^6 \times L^{-2.18}$$

where L is fish length, the biomass was estimated to 1.7 mill tonnes (Table 2). This is the same as estimated during summer both in 1993 and in 1995 over approximately the same area. However, the abundance was much higher this year, being  $27.9 \times 10^9$  compared to  $15.6 \times 10^9$  last year. This was due to the high number of one year olds, and the survey hence confirmed earlier observations that the 1995 is a very rich yearclass.

Age and length distributions are shown on Figures 8 and 9 for five different areas and for

the total respectively. It clearly demonstrates the young fish being near the Norwegian coast and the bigger and older ones being more over deep water areas. The 1995 yearclass dominated with a contribution of 84% in numbers. Separate length frequencies and mean weights from each trawl catch are given in Table 1.

#### Mackerel

Mackerel was caught in a western area up to 72° north and in an eastern area up to about 69° north (Fig. 10). The two areas were separated by an area of no catches, stretching from about 65° N, 2° E, in north-easterly direction. The largest concentrations of mackerel occurred south of about 67° north. Like in 1991, 1993 and 1995 the mean length of mackerel increased northwards. Separate length frequencies and mean weights from each trawl catch are given in Table 1.

#### Lumpsucker

Lumpsucker was caught in most surface hauls and in some mesopelagic hauls (Fig. 11). The highest abundance of lumpsucker appeared in the northernmost parts of the sampled area. These large northerly catches consisted mainly of immature individuals, which is in accordance with the observations made in 1991, 1993 and 1995.

#### Salmon

A total of 13 Atlantic salmon (1 grilse, 12 postsmolts) were caught in the surface trawl hauls (Fig. 12). Most of the salmon were caught in the northern part of the surveyed area, north of 70° north. The catches of salmon increased after buoys were fitted to the headline of the trawl, and due to this change in the applied trawl method, we are reluctant to draw conclusions about the geographic distribution of postsmolt salmon in the Norwegian Sea in 1996.

Two individuals, the grilse and one postsmolt were adipose fin-clipped and had a hatchery origin according to the scale reading. Furthermore, at least 2 additional postsmolts were of hatchery origin as judged from damaged fins and typical signs of a hatchery origin in the freshwater part of the scales.

#### 0-group fish

Relatively large catches of 0-group of haddock were made throughout the sampled area. The largest concentrations occurred off Vesterålen, where up to 840 individuals were caught in one half hour haul (Fig. 13). The large extension of the area where haddock was caught indicates that the 1996 yearclass of haddock is very strong at this stage.

Only minor catches were made of 0-group of other species like cod, herring, capelin and whiting.

#### Mesopelagic fish

Recordings of mesopelagic fish were made over most part of the area surveyed, with the highest values in the south and near the shelf area (Figure 14). Mainly lanternfish and *Notolepis risso* occurred in the trawl catches and remarkably lesser pearlside than observed last year. Biological samples from a number of stations were preserved for later analysis.

#### Whales and seals

Occasional observations of whales and seals were done from the bridge. These observations were reported to the Marine mammals at HI, and is not further referred here due to their unsystematic nature.

### Plankton

Also recordings of plankton were made by the echo sounder, using the same threshold level as for fish recordings while allocating the  $S_A$ -values to species, i.e. -92 dB (Figure 15).

The general pattern of the MOCNESS zooplankton distribution is a rather low abundance in the eastern part of the investigated area, especially in areas close to the Norwegian coast. In the central Norwegian Sea the biomass increased, and in the NW-part the abundances were quite high. In this area, where we also observed concentrations of herring, the production of a new generation of *Calanus finmarchius* was about to take place, and the surface layers were densely populated with cop.st.IV and V of this copepod. A preliminary count was performed at one station giving 5-6000 individuals per m<sup>3</sup> water.

A pattern of low concentrations in the eastern part, increasing westwards, is consistent with the observations done in previous years, and is mainly caused by the dynamics of *Calanus finmarchius*. This copepod spawn and form its first new generation in the spring along the Norwegian coast. Further west the spawning is delayed, and in the western area it is influenced by cold arctic water masses, and therefore may take place in August or even later.

The large carnivorous copepod *Euchaeta norvegica* was common at depths below 100m and was occasionally dominating in the 2000 µm size fraction. Its close and even larger relative *Euchaeta glacialis* was observed in cold water masses in the NW-part of the area investigated. *Metrida longa* was common in the samples, so were the smaller copepods *Pseudocalanus sp.* and *Oithona sp.*

The euphausiids *Meganyctiphanes norvegica* and *Thysanoessa longicaudata* were common in the MOCNESS samples. Young individuals of the usually large *M. norvegica* was regularly observed along the Norwegian coast, and these may belong to the generation produced this year. The large (40-50mm) and very mobile *M. norvegica* tend to avoid plankton gears and is not caught representatively in the MOCNESS. It is often observed in shoals on echo registrations, and its presence was verified in trawl catches, especially when a Harstad trawl with a 11mm mesh size inner net was used. Individuals carrying eggs were observed in the southern part of the investigated area.

The depth distribution of *M. norvegica* seems to be related to the size (Figure 16), and at several stations the largest individuals (average 31-34mm) were observed at depths between 700 and 500m. The size decreased with decreasing depth and at the average size at 25-0m depth level varied from 10 to 12mm between stations. The size of the smaller *T. longicaudata* seems, however, not to be related to depth. *Aglantha digitale* (3-15mm) was a common hydromedusa at several stations. *Beroë sp.* the most common ctenophore. Scyphozoans, especially *Cyanea sp.*, were caught in large quantities all over the area, especially in the surface trawl hauls. The pteropods *Limacina retroversa* and *L. helicina*

were at some stations dominating the plankton in the surface layer, especially in the NW part of the area (St. 539)

#### Hydrography

The horizontal temperature distributions at sea surface, 20, 50, 100, 200 and 400m depths are shown on Figures 17-22. The vertical temperature distribution in the Svinøy-NW and in the Gimsøy-NW sections are further shown on Figures 23 and 24.

In water layers near the sea surface the temperature varied from 11° to 13° C off the Norwegian coast, decreasing to 8.5° C in the western part of the area investigated. At 200m depth it had decreased to 8° C near the coast in the south and to 6° in the north. A frontal area could be observed in the southern part, being even more pronounced at 400m. An overall comparison to the last years conditions suggests an average of approximately 0.5° C warmer water this year. That might indicate an stronger influx of Atlantic water to the area.

Bergen, 29 July 1996

Terje Monstad  
Bjørnar Ellertsen  
Jens Chr. Holst

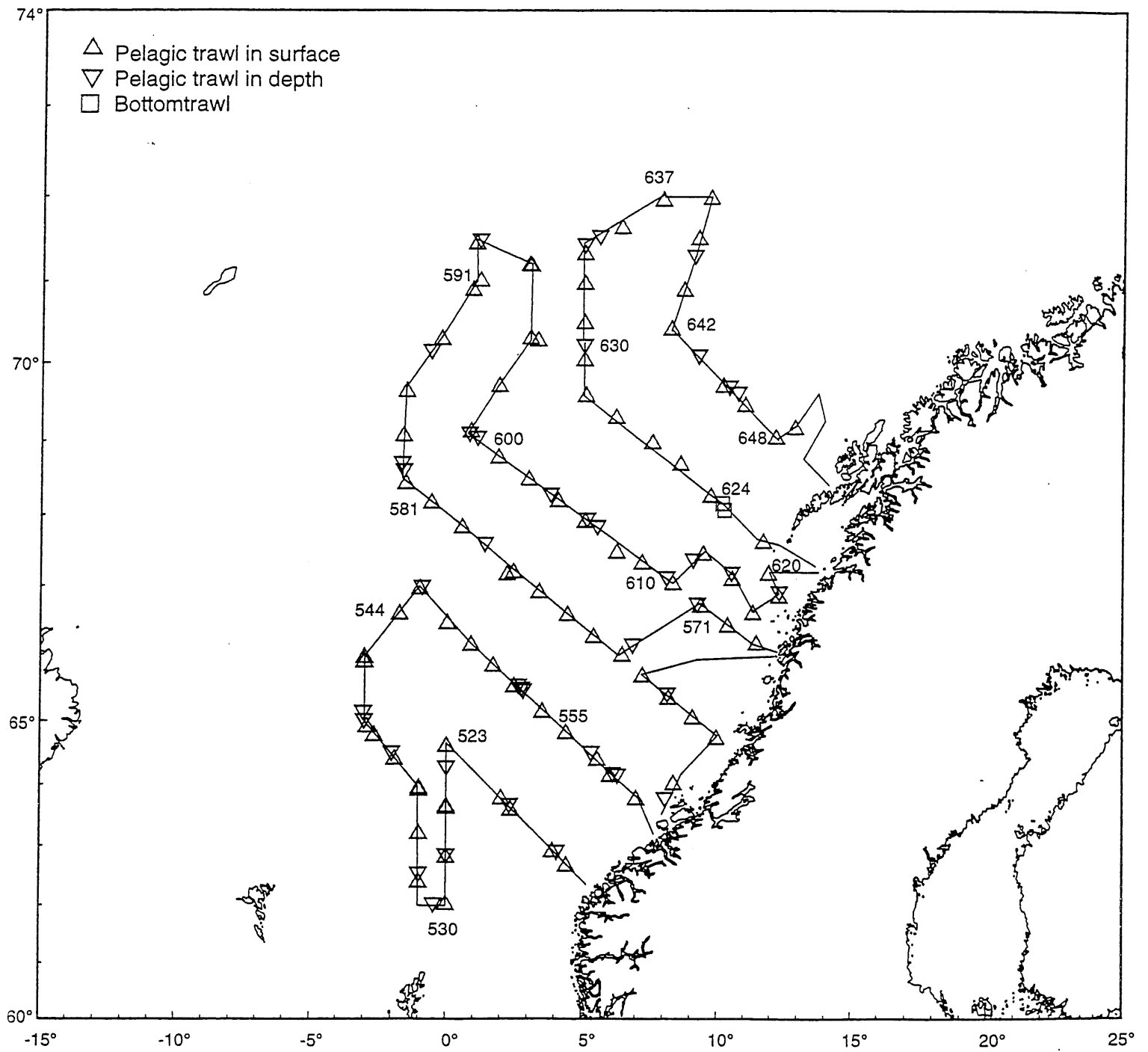


Figure 1. Cruise track with fishing stations, R.V. "G.O.Sars" 19/7-15/8 1996.



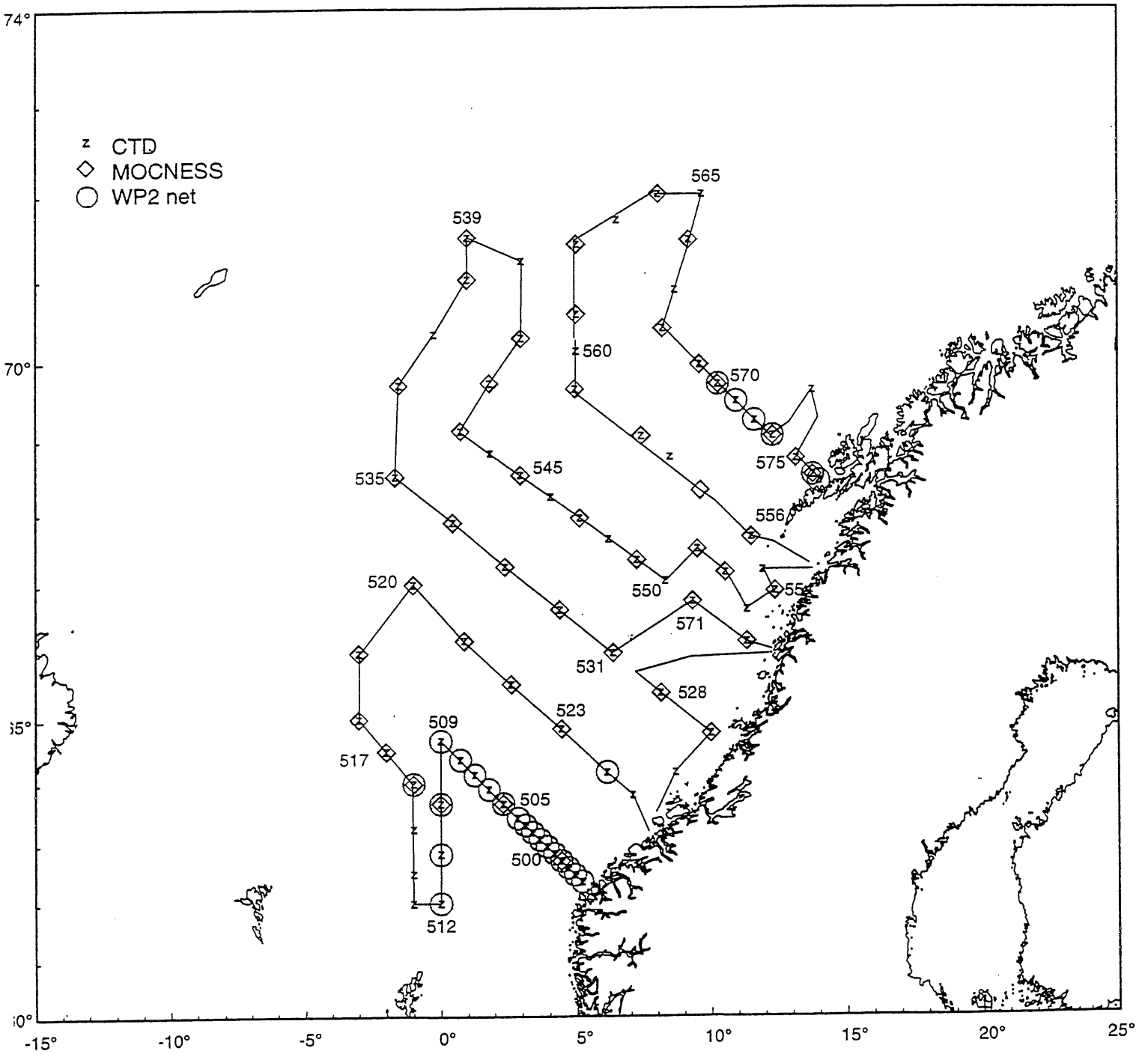


Figure 2. Cruise track with hydrography and plankton stations, R.V. "G.O.Sars" 19/7-15/8 1996.

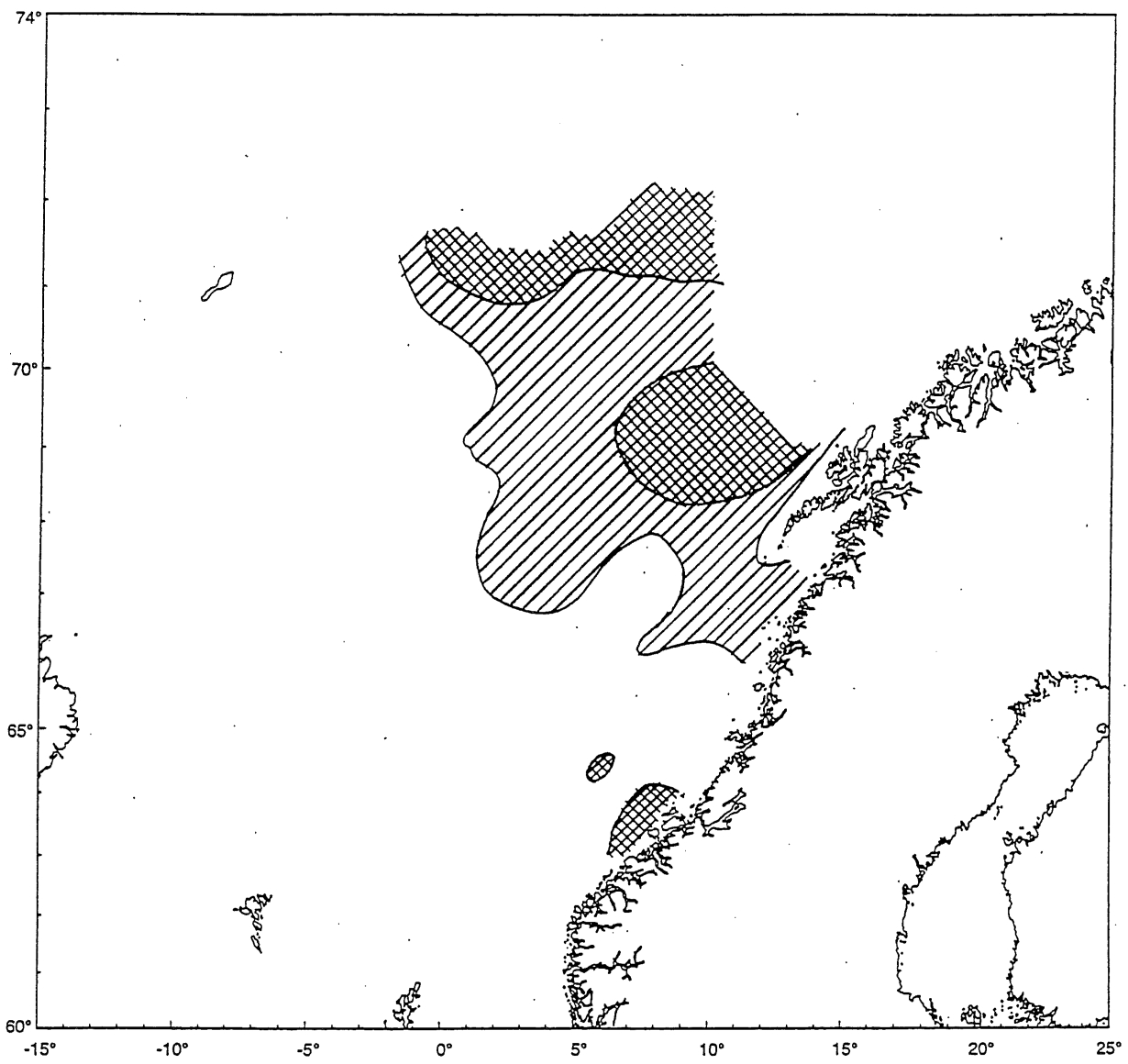


Figure 3. Distribution of herring; combined recordings of echo sounder and sonar.

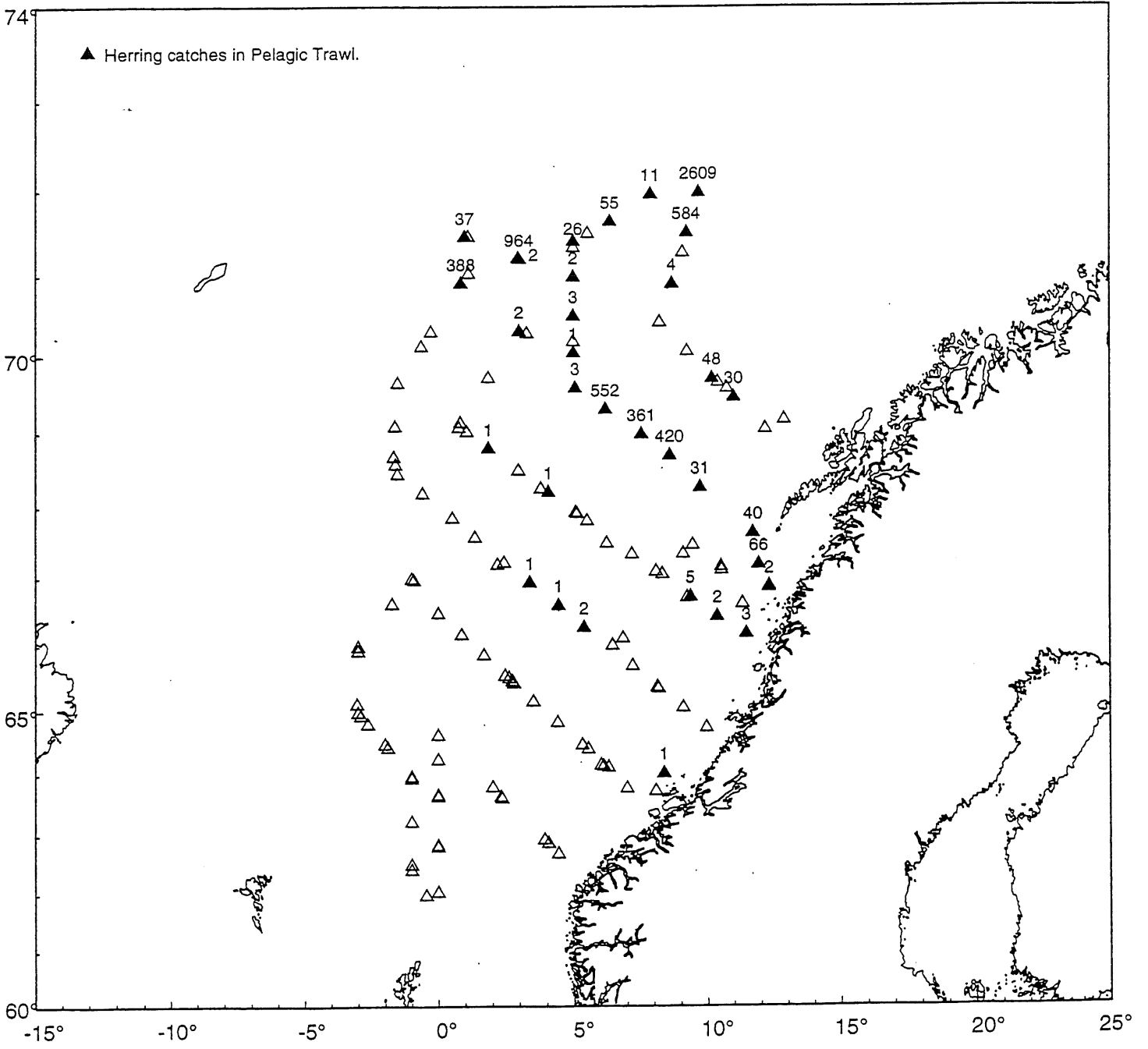


Figure 4. Catch of herring in numbers per trawl station (1/2 hour duration).

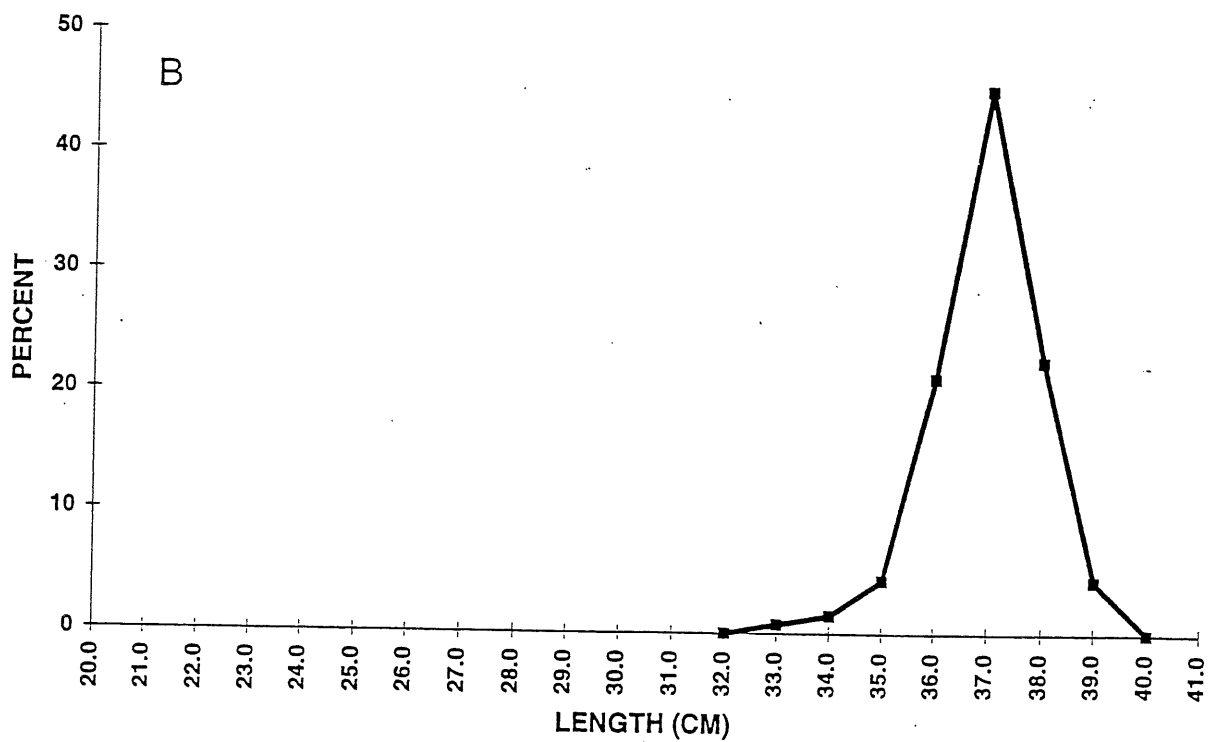
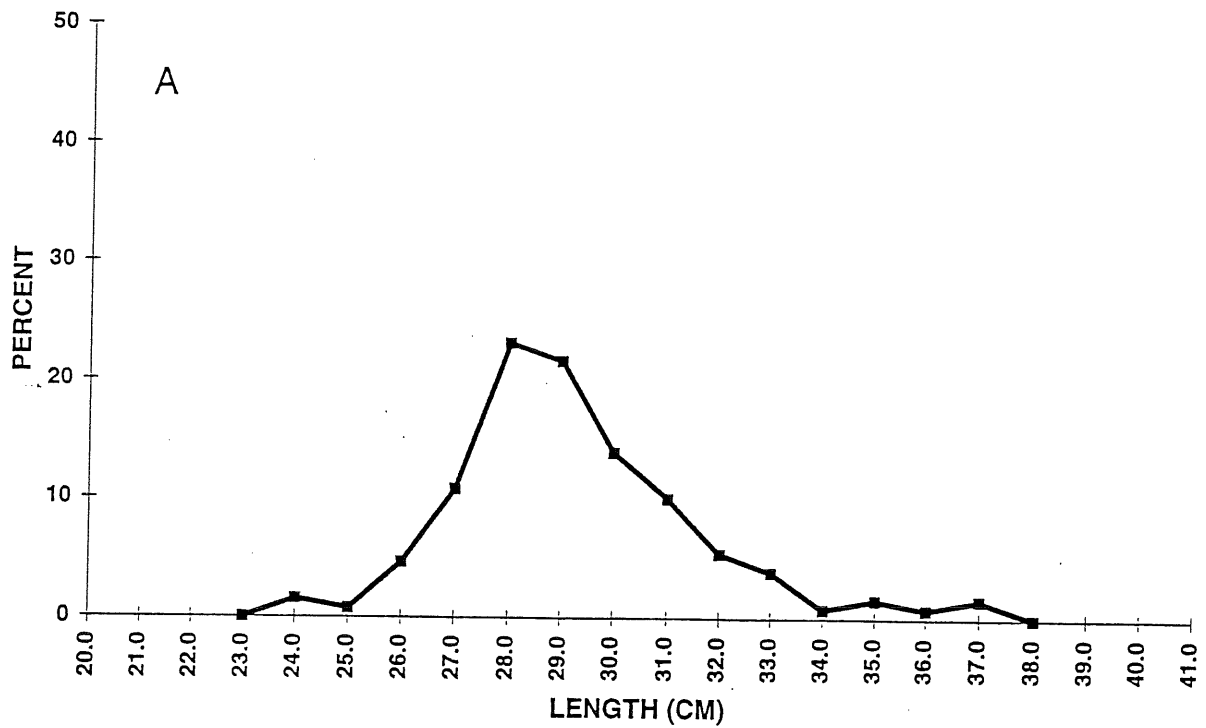


Figure 5. Length distribution of herring. A) The eastern area, off Lofoten, B) the north-western area. N=300.

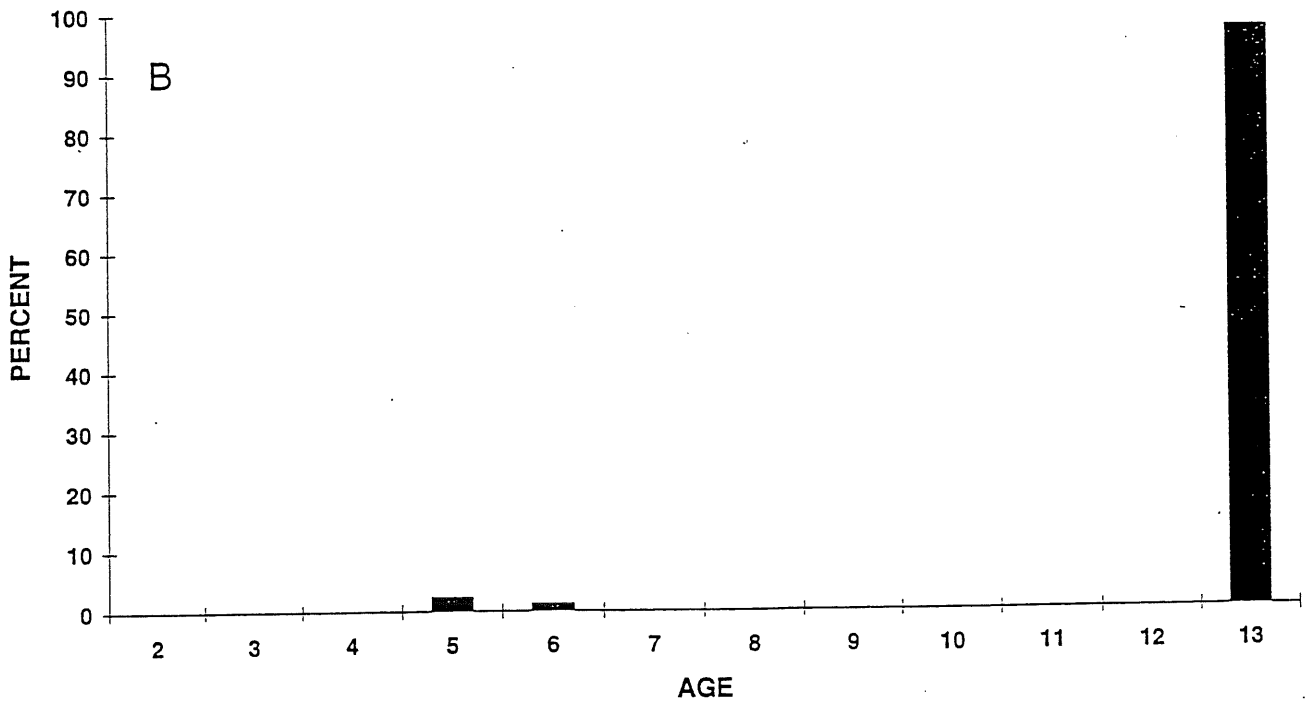
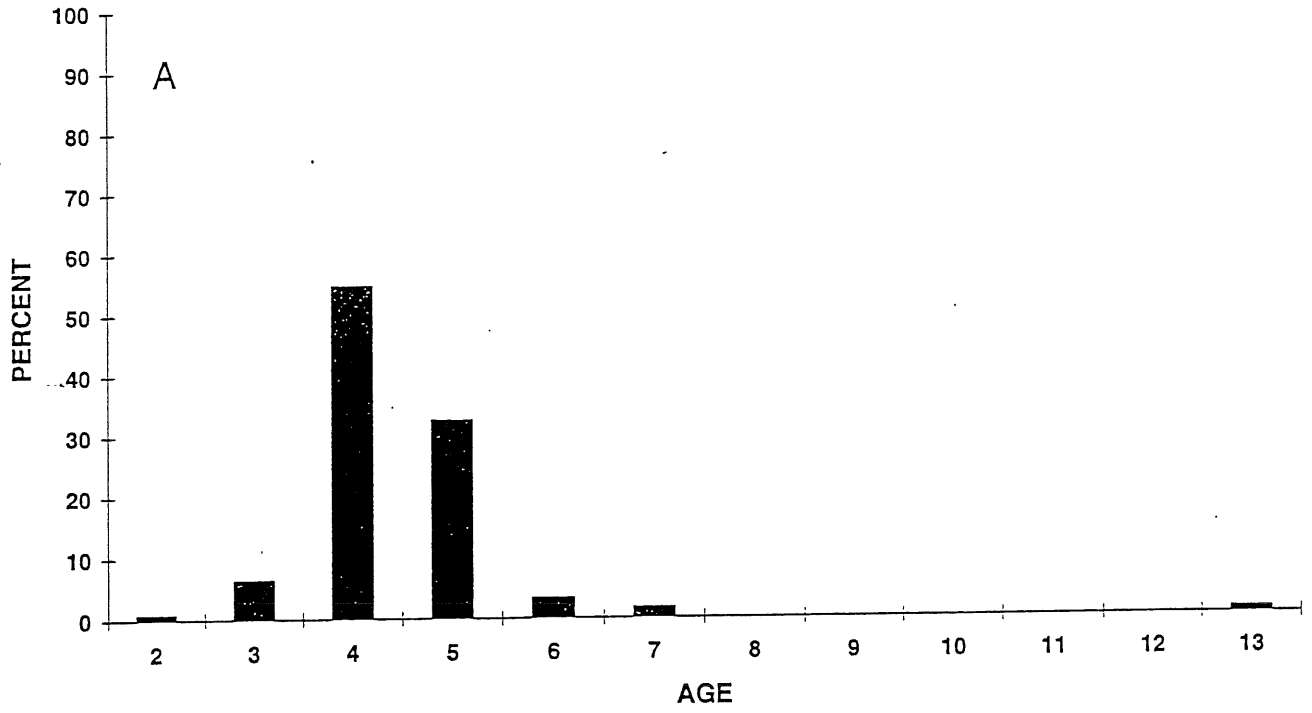


Figure 6. Age distribution of herring. A) The eastern area, off Lofoten, B) the north-western area. N=300.

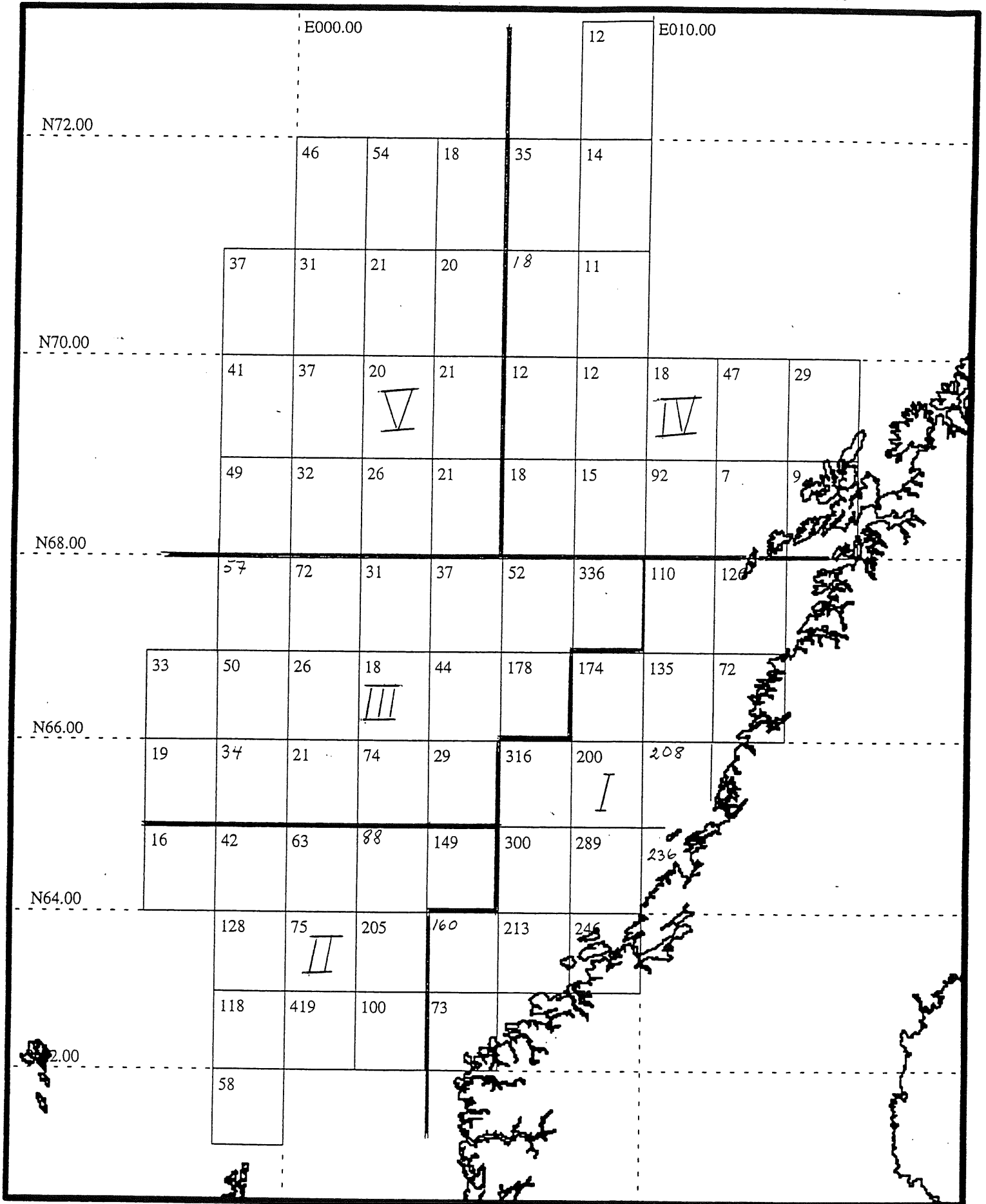


Figure 7. Distribution of blue whiting, BEI-map of  $S_A$ -values. I - V are subareas represented by the length and age compositions on Figure 8.

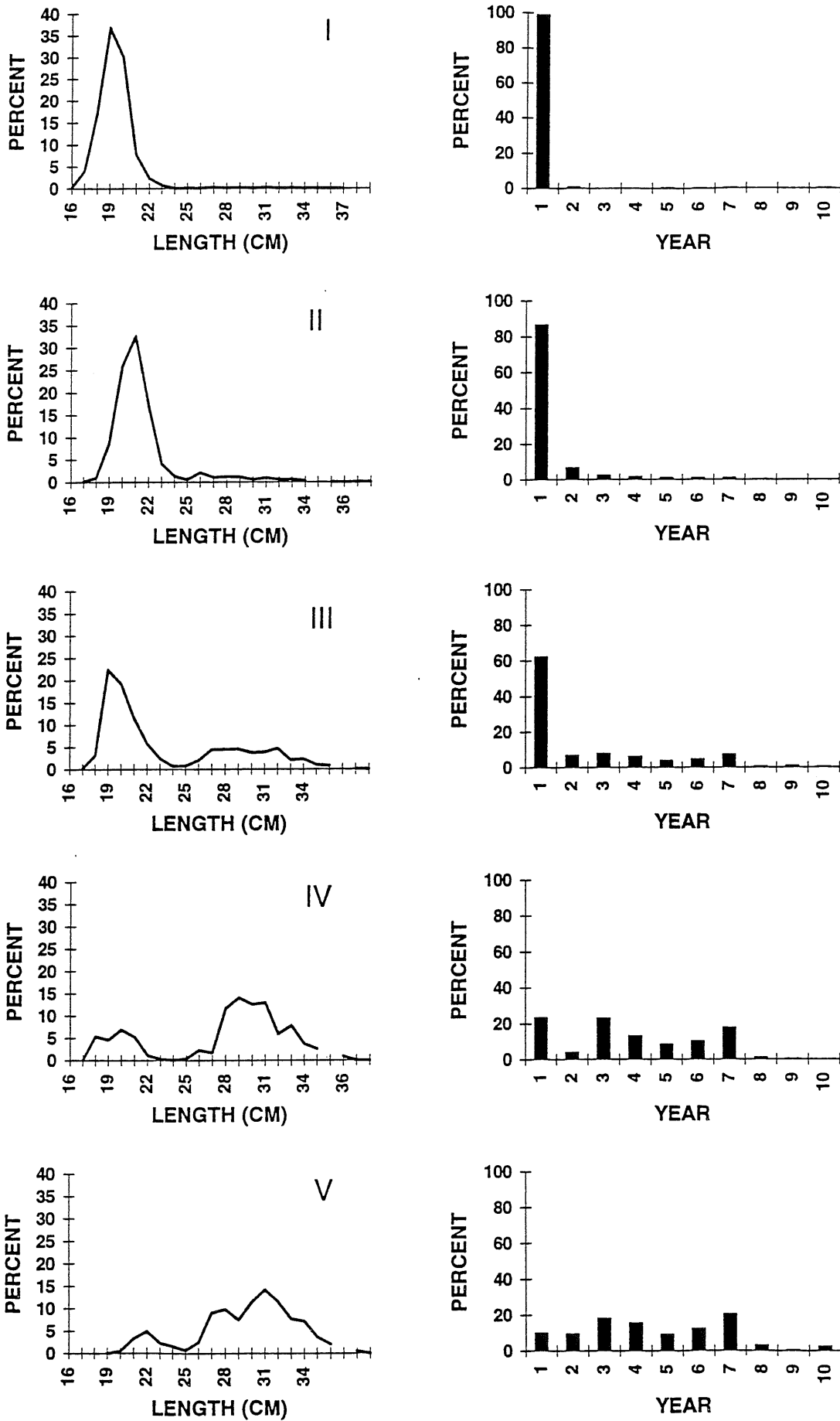


Figure 8. Length and age compositions of blue whiting in the various subareas marked on Figure 7.

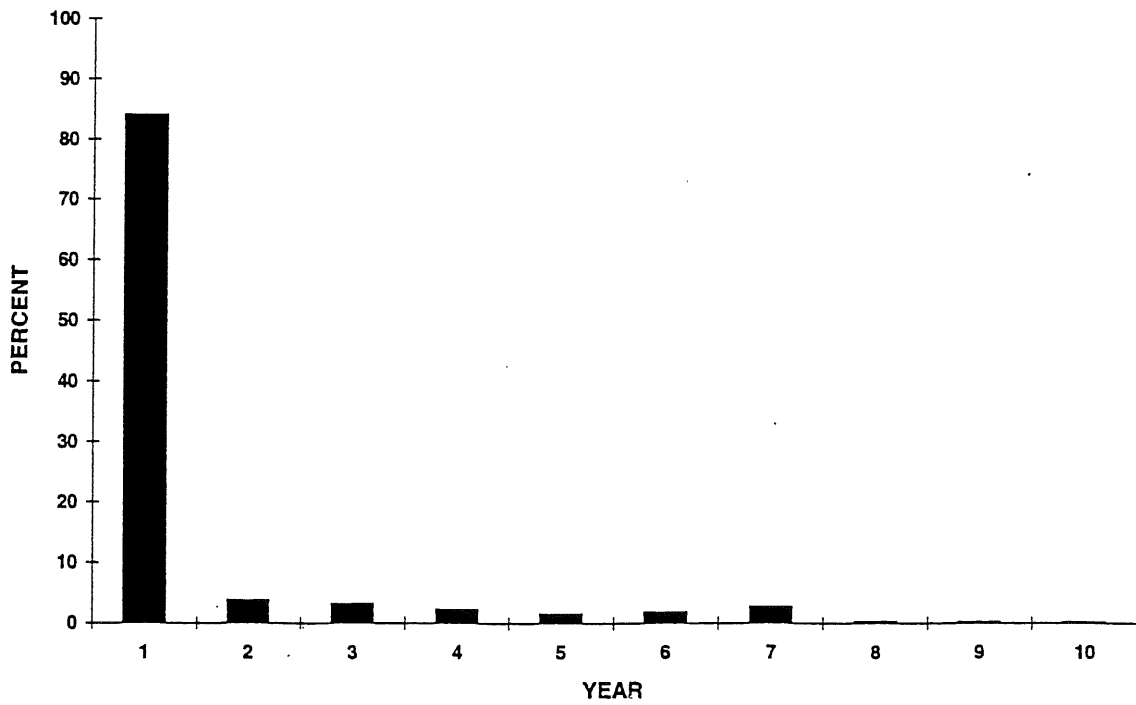
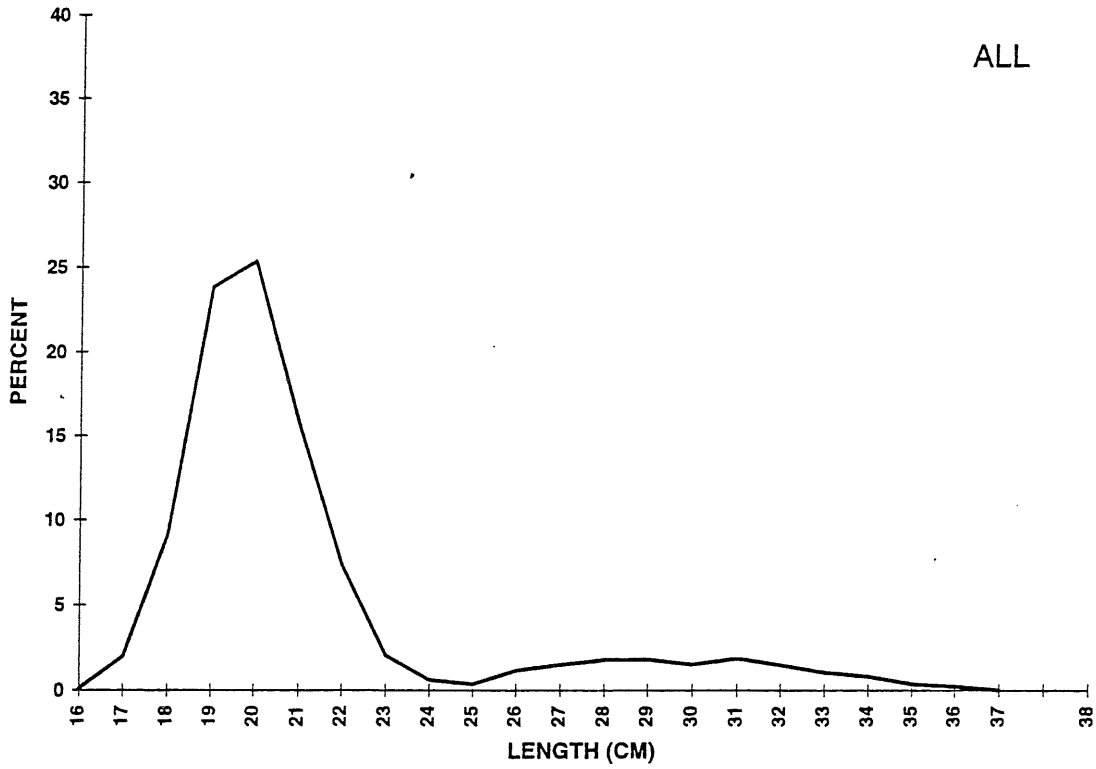


Figure 9. Total length and age compositions of blue whiting in all areas, weighted by abundance.  $N = 27.9 \times 10^9$ .





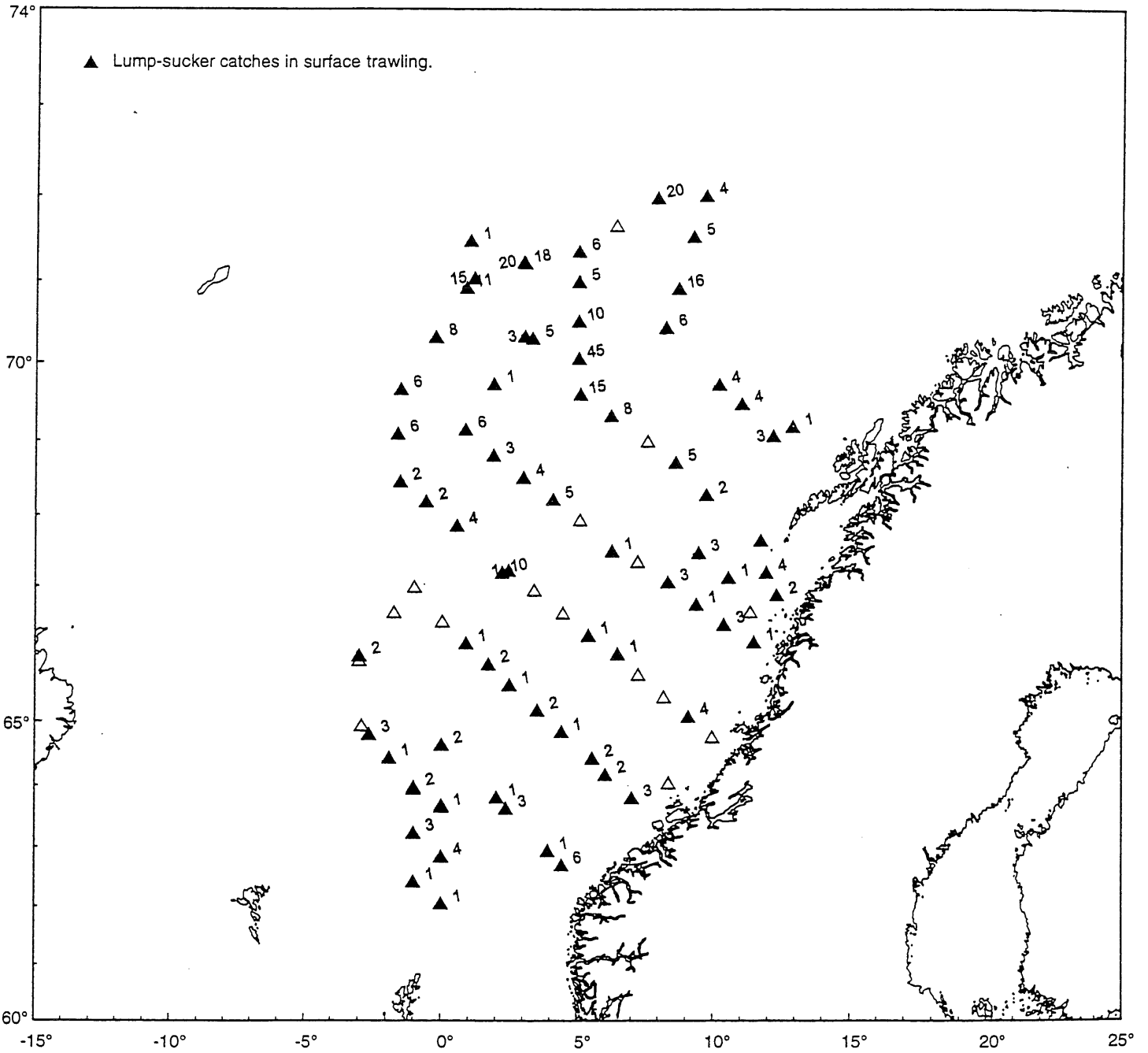


Figure 11. Catch of lumpsucker in numbers per trawl station (1/2 hour duration).

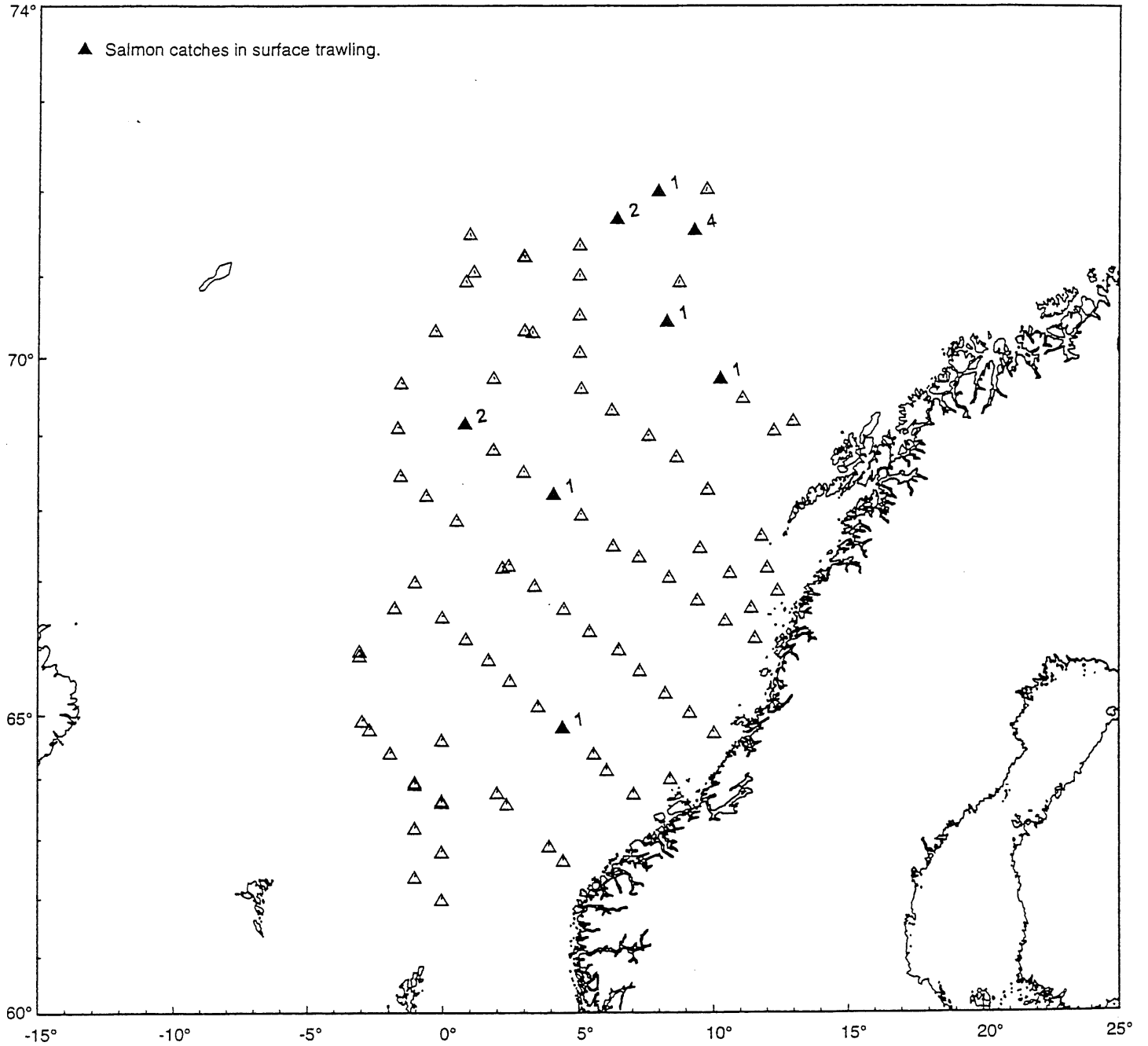


Figure 12. Catch of salmon in numbers per trawl station (1/2 hour duration).

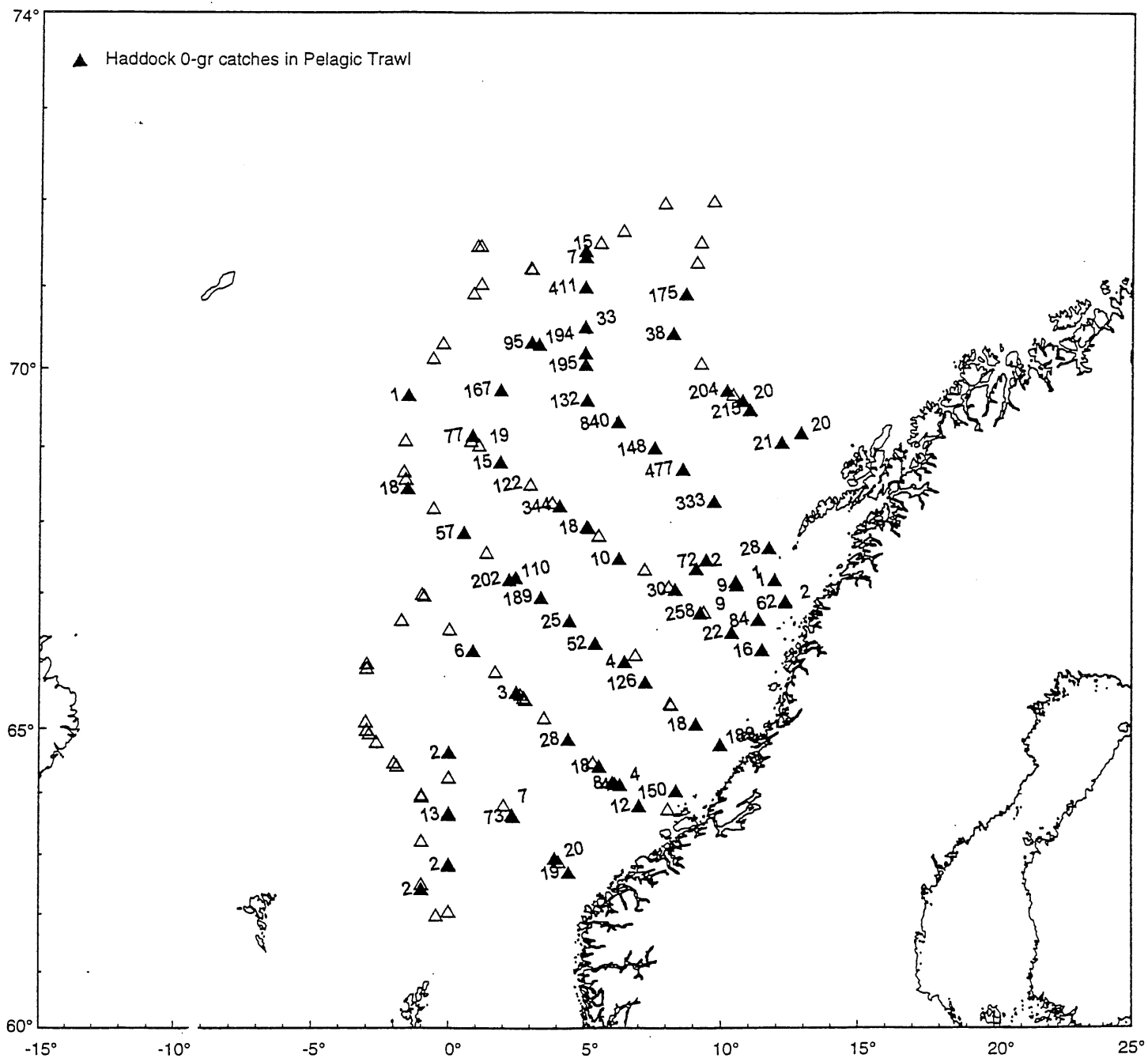
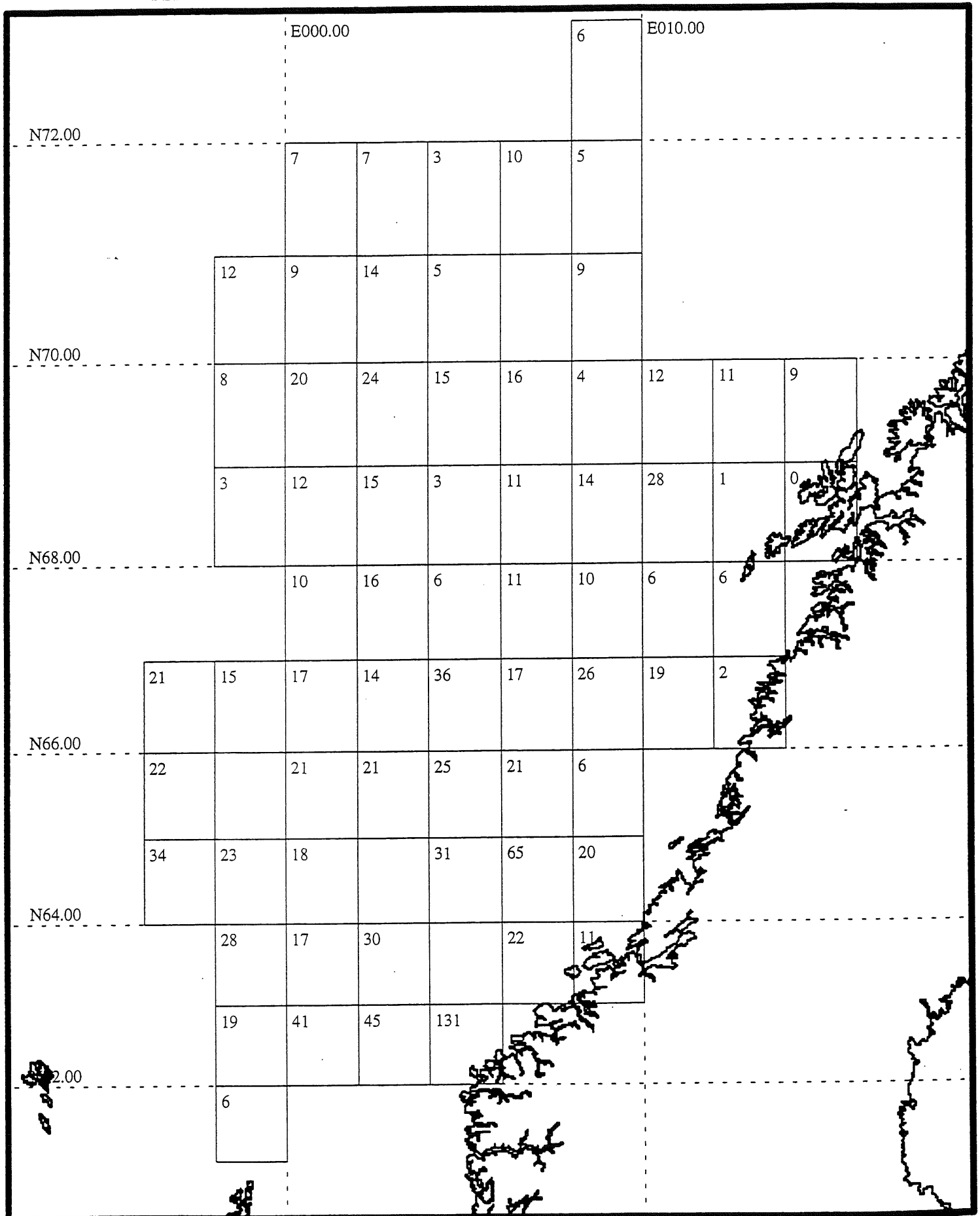


Figure 13. Catch of 0-group haddock in numbers per trawl station (1/2 hour duration).

BEI FISH DENSITY MAP

N058-S015-S1996010-F037879-T01-MESOP

Figure 14. Distribution of mesopelagic fish, BEI-map of  $S_A$ -values.

BEI FISH DENSITY MAP

N058-S015-S1996010-F037879-T01-PLANK

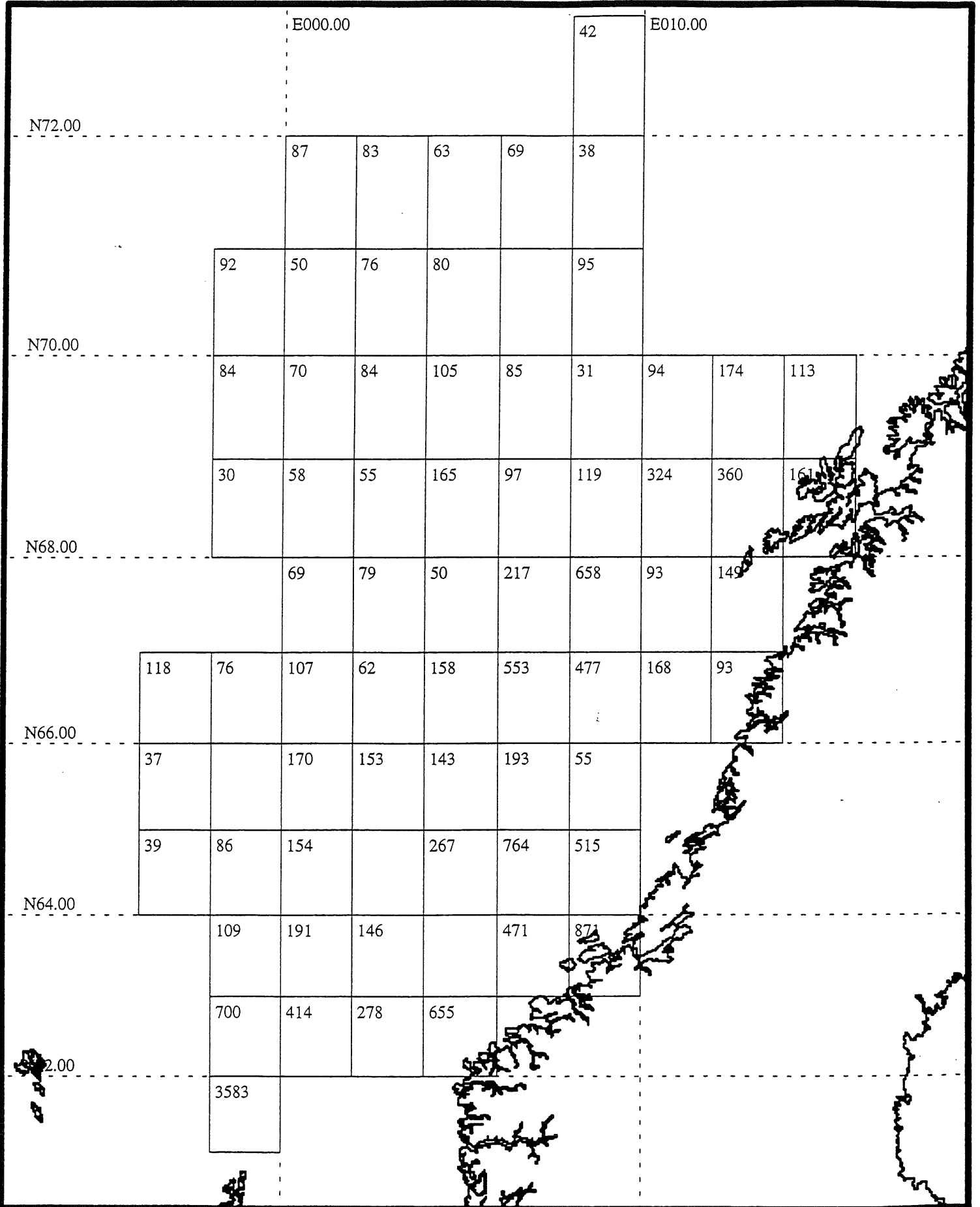


Figure 15. Distribution of blue whiting, BEI-map of  $S_A$ -values.

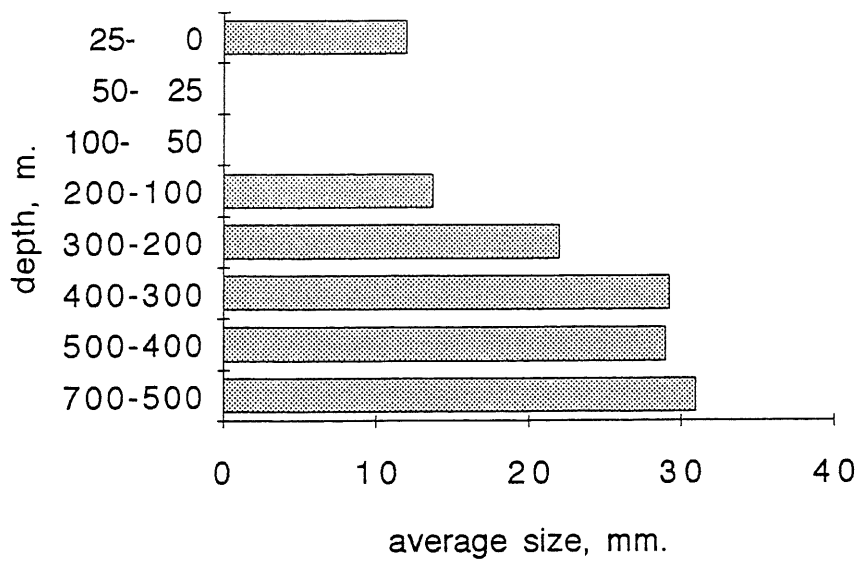


Figure 16. Size distribution by depth of *Meganyctiphanes norvegica*, station 505.

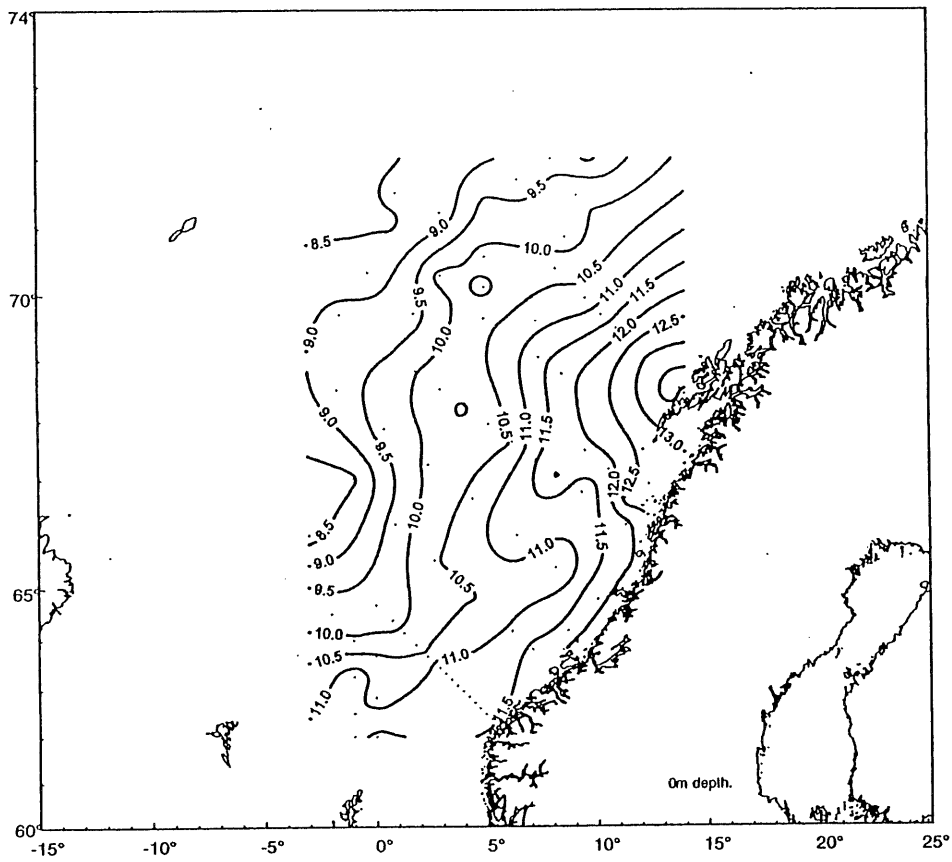


Figure 17. Temperature, t° C in the sea surface layer.

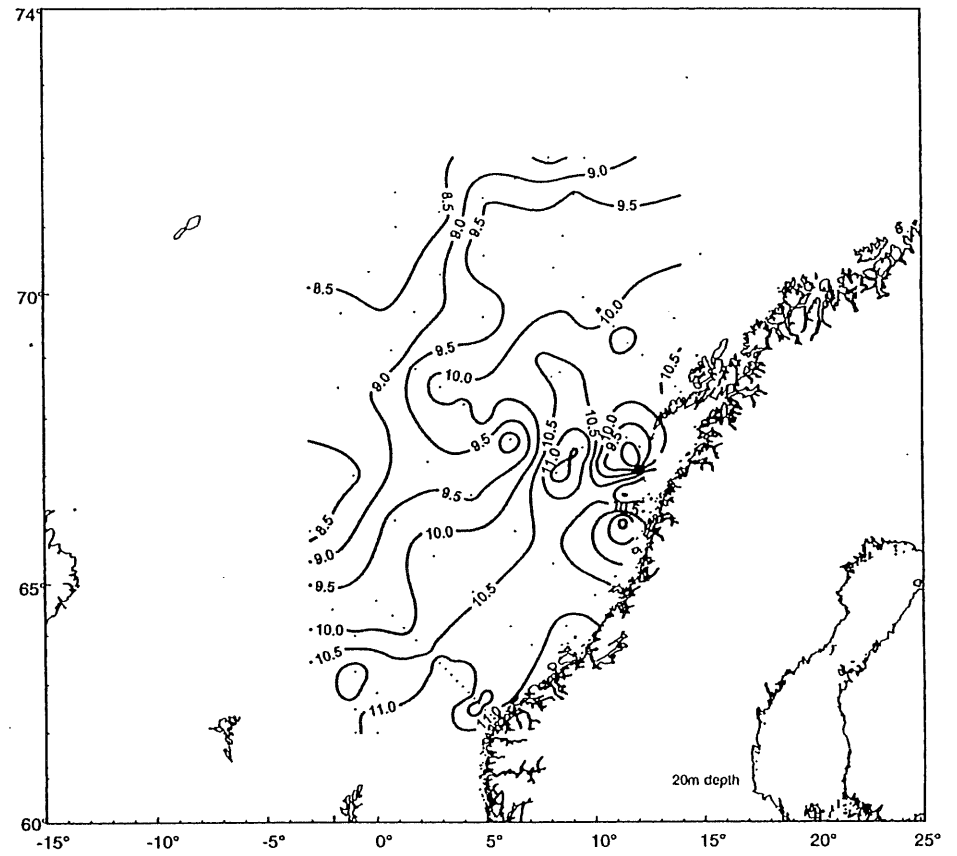


Figure 18. Temperature, t° C in 20m depth.



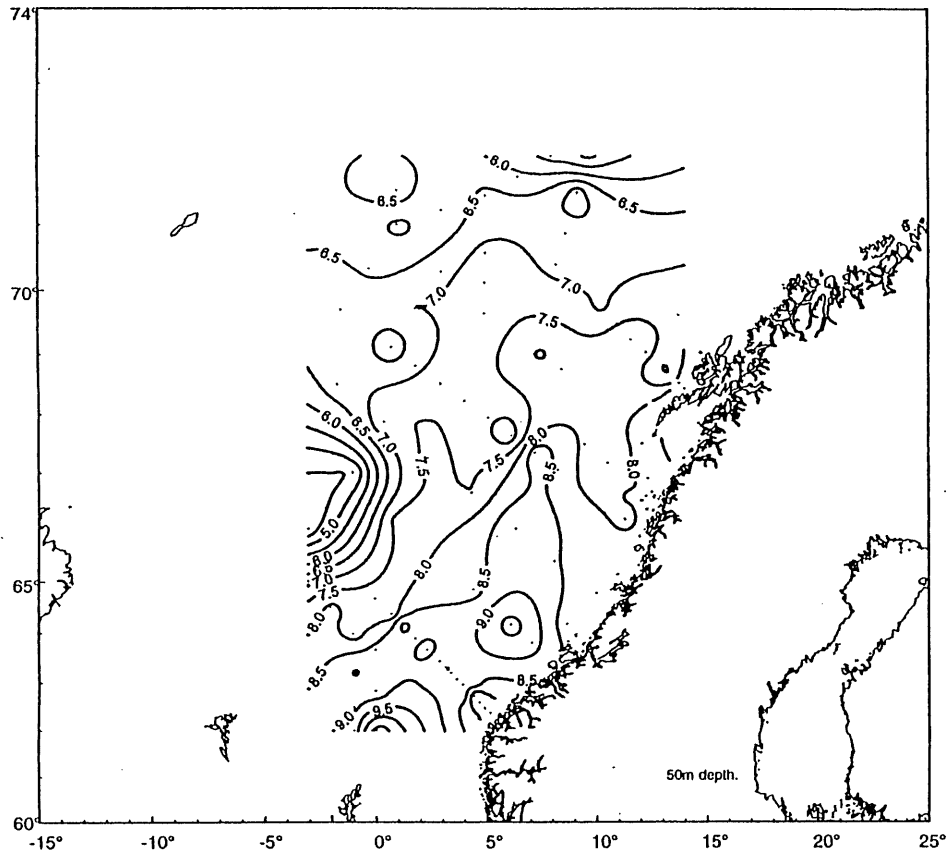


Figure 19.. Temperature, t° C in 50m depth.

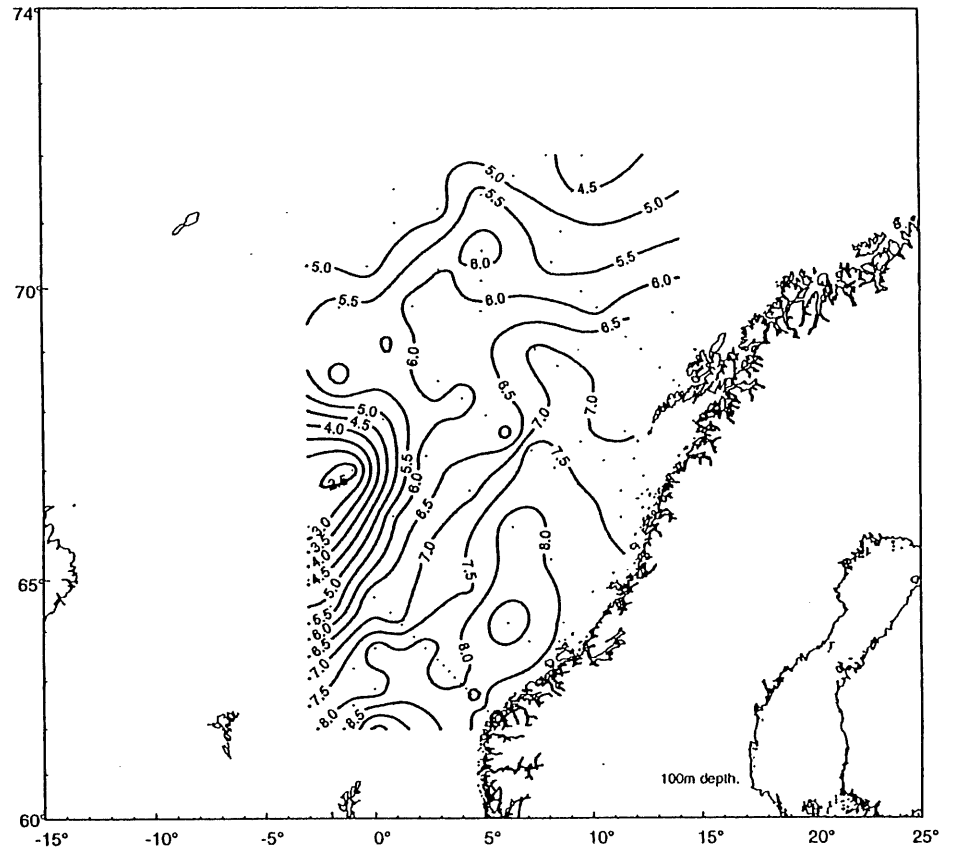


Figure 20. Temperature, t° C in 100m depth.

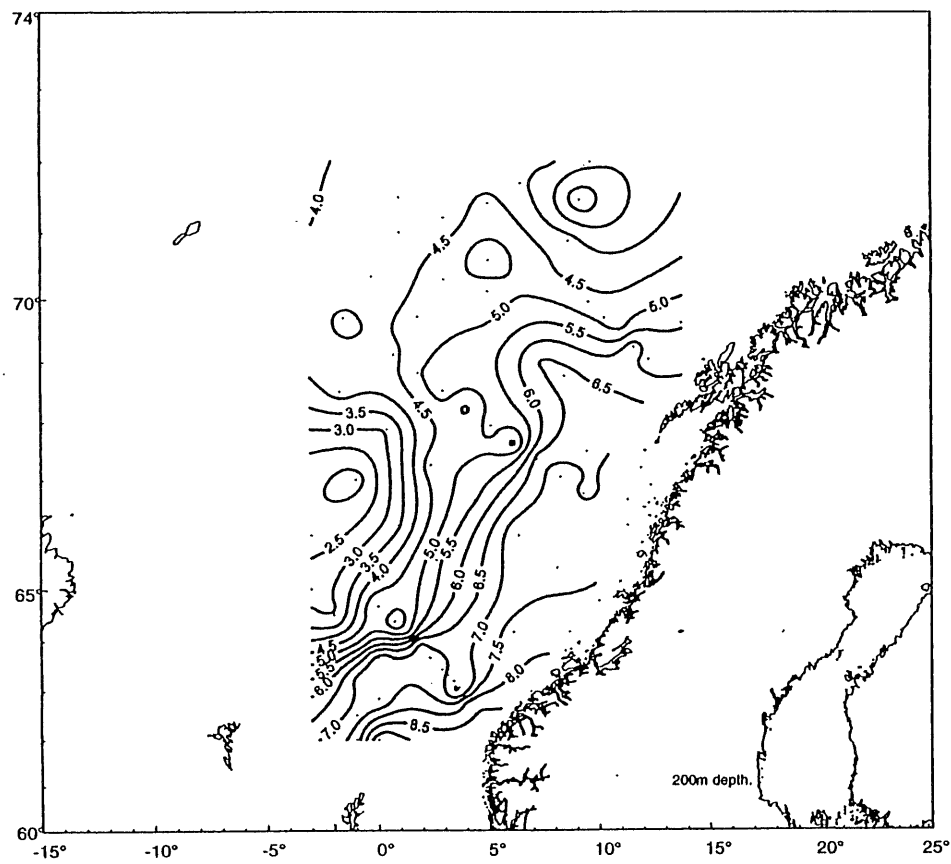


Figure 21. Temperature,  $t^{\circ}$  C in 200m depth.

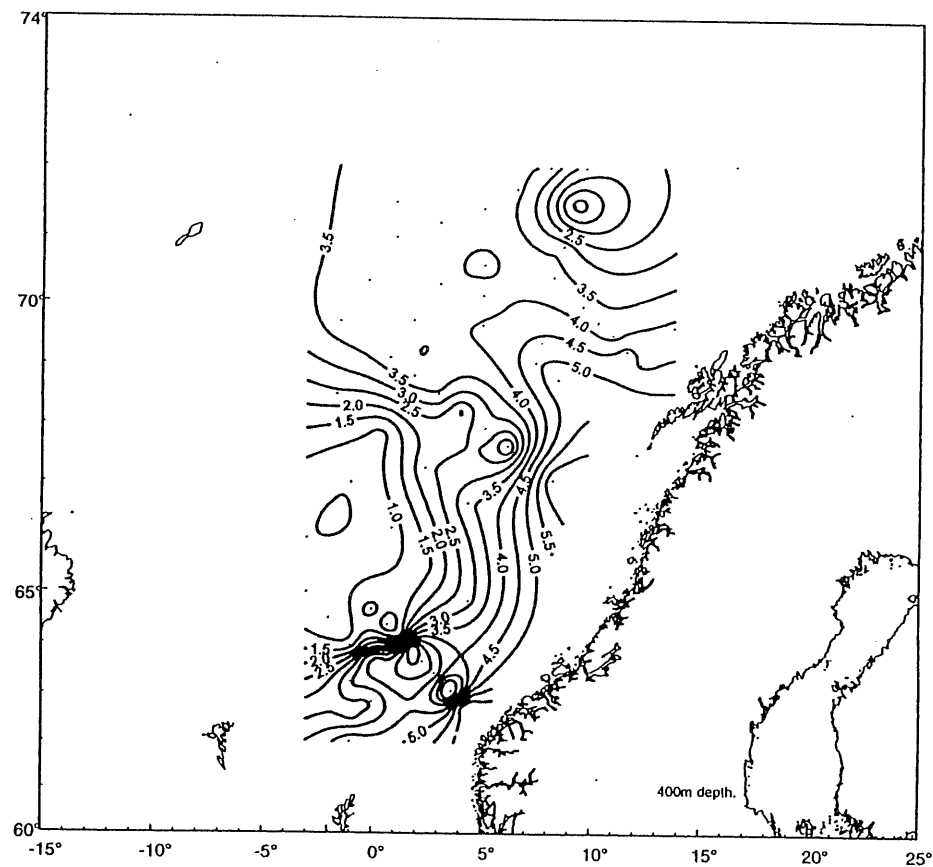


Figure 22. Temperature,  $t^{\circ}$  C in 400m depth.

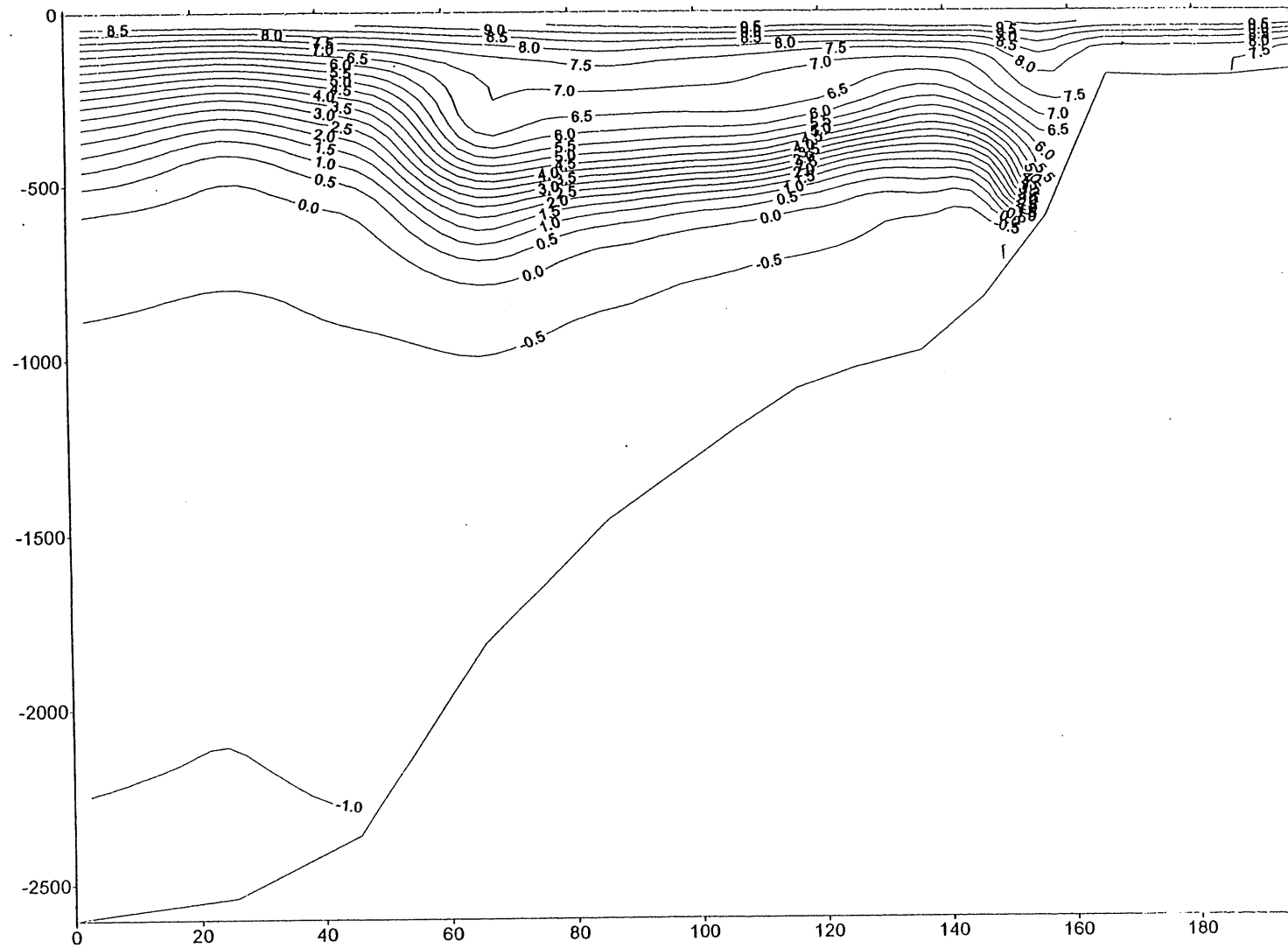


Figure 23. Temperature, t° C in the Svinøy-NW section, 50-2500m.

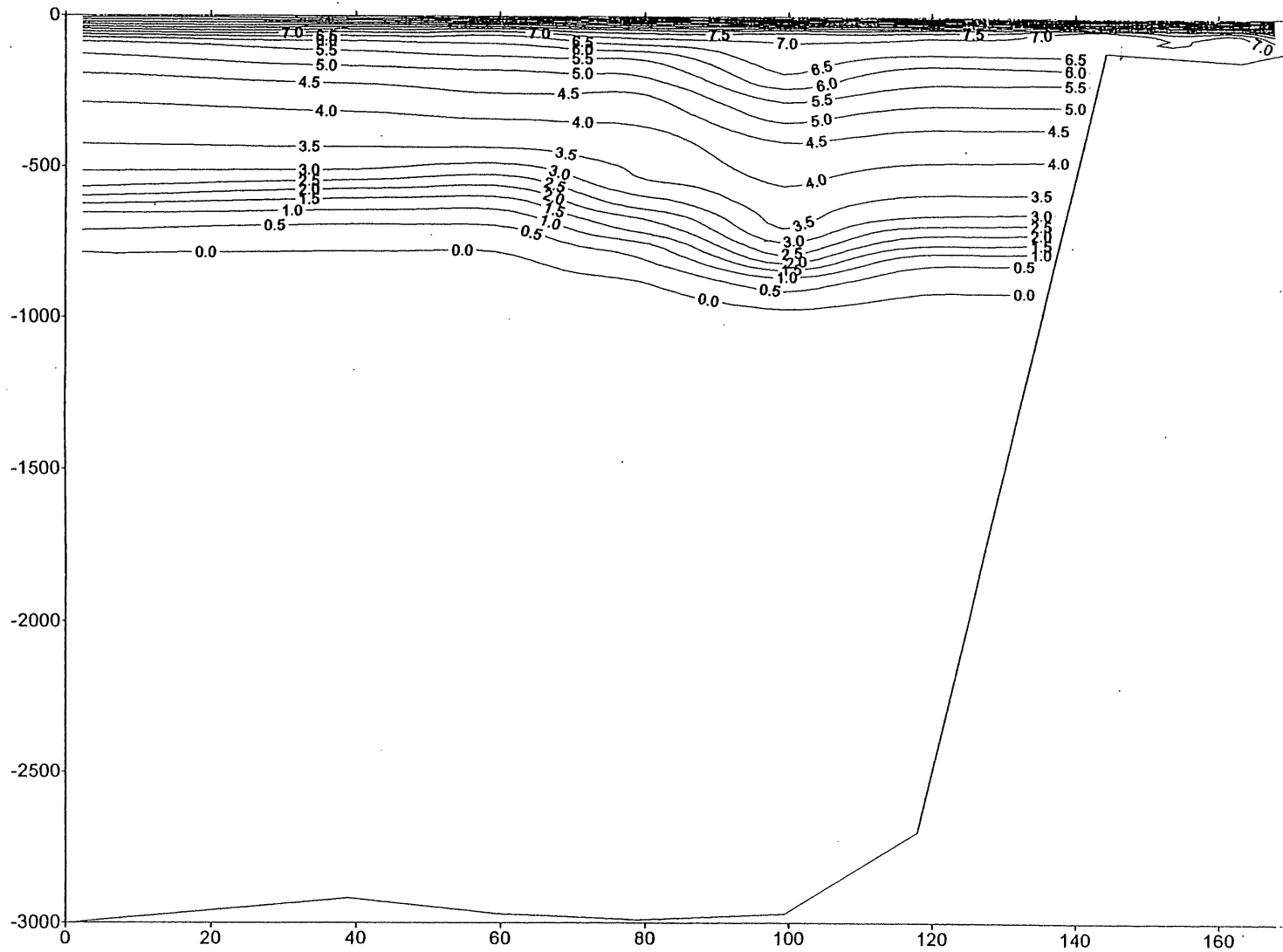


Figure 24. Temperature, t° C in the Gimsøy-NW section, 0-1000m.

Table 1. Length distributions with mean weights of herring, mackerel and blue whiting.

DATE	960720		960721		960721		960721		960721		960721		960721		960722		960722		960723		960723		960722		960723		960723					
ST.NO.	516		517		518		518		520		521		522		523		524		528		532		526		527		529					
SPECIES	MACK		BLUE WH		MACK		BLUE WH		BLUE WH		BLUE WH		BLUE WH		MACK		BLUE WH		BLUE WH		BLUE WH		MACK		MACK		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)				
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17.0																																
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26.0											1	108					12	108	2	97	1	110										
27.0	1	155									1	109					6	116			2	122					1	176				
28.0	5	225	1	115													7	124			3	131	5	202	4	186	12	216				
29.0	8	224									2	133					8	128			1	129	21	216	13	206	29	211				
30.0	13	241			1	250					1	148					3	156			1	124	35	232	6	234	22	227				
31.0	27	270			4	242					1	162					5	145			1	128	20	255	1	253	17	256				
32.0	21	292			6	307					1	165			1	305					2	172	13	295	3	312	11	294				
33.0	13	326			2	341											4	181					2	303			3	302				
34.0	7	347													2	358	3	187					2	316			3	319				
35.0	3	388																					1	350			2	350				
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MEAN L.	32		22		33		21		21		22		20		34		26		22		23		31		31		31					

(Table 1 continue)

DATE	960723		960724		960724		960724		960724		960724		960724		960725		960725		960725		960725		960725		960726		960726		
ST.NO.	529		533		533		535		537		538		540		541		542		543		544		546		547		551		
SPECIES	HMACK		MACK		HMACK		MACK		BLUE WH		MACK		BLUE WH		BLUE WH		BLUE WH		MACK		MACK		BLUE WH		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)	
15.0																													
16.0																													
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18.0																													
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21.0																													
22.0																													
23.0																													
24.0																													
25.0																													
26.0																													
27.0															2	127		5	123						1	129			
28.0															2														
29.0															2	134													
30.0																													
31.0																													
32.0																													
33.0																													
34.0																													
35.0																													
36.0																													
37.0																													
38.0																													
39.0																													
40.0																													
41.0																													
42.0																													
43.0																													
44.0																													
45.0																													
SUM	17		100		8		58		18		91		2		46		100		100		48		35		8		3		
MEAN W.		341		280		436		313		182		414			156		165		519		510		188		499				
MEAN L.	35		32		38		34		32		36		27		31		31		38		38		32		38		27		

(Table 1 continue)

DATE	960726		960726		960727		960727		960727		960727		960727		960727		960728		960728		960729		960729		960730		960731		
ST.NO.	552		553		554		556		557		559		560		561		562		563		565		567		569		570		
SPECIES	BLUE WH		BLUE WH		MACK		BLUE WH		MACK		BLUE WH		BLUE WH		MACK		BLUE WH		MACK		MACK		BLUE WH		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)	
15.0																													
16.0																													
17.0											1	28					4	26					4	24					
18.0							1	36			6	34	1	34			26	30					19	30					
19.0	1						5	41			35	37	4	39			38	35					42	36					
20.0							7	43			44	42	2	43			31	40					30	40					
21.0	1										13	47					1	45					3	45					
22.0			1	65																			2	53					
23.0	1																												
24.0	1																												
25.0																													
26.0							1	116																					
27.0	2		1	111							1	109																	
28.0	3		1	142																									
29.0			1	149																						2	222		
30.0			1	151																									
31.0	1		1	183	6	303	2	191	12	307																			
32.0	3				11	332			28	333					1	355					1	350							
33.0	1				32	353	1	179	28	355					3	362					10	363				1	341		
34.0					21	382			18	386					4	378					6	361	24	384					
35.0					18	413			6	406					3	402						26	408				2	440	
36.0			1	234	3	449			5	434					2	413					2	445	18	450			5	449	
37.0					5	429			1	487					1	490					1	416	8	467					
38.0					3	476			1	460					1	490					1	489	7	513			1	559	
39.0					3	546																1	565			1	374		
40.0					1	580																4	574				2	669	
41.0									1	520												1	681				3	646	
42.0																													
43.0																													
44.0																													
45.0																													
SUM	14		7		103		17		100		50		7		15		100		10		100		100		100		3		14
MEAN W.				148		382		71		360		41		39		397		35		396		428		36		272		522	
MEAN L.	28		30		35		23		34		20		20		35		20		36		36		20		33		38		

(Table 1 continue)

DATE	960731		960731		960731		960731		960731		960731		960731		960801		960801		960801		9600802		960802		960802		960803		
ST.NO.	570		571		572		573		575		576		576		577		580		583		584		585		588		590		
SPECIES	HERRING		HERRING		BLUE WH		BLUE WH		HERRING		BLUE WH		HERRING		HERRING		BLUE WH		BLUE WH		BLUE WH		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)	n	w(g)	n	w(g)	n	w(g)	n	w(g)	n	w(g)	n	w(g)	n	w(g)	
15.0																													
16.0																													
17.0					1	26	1	28																					
18.0					16	33	4	33																					
19.0					40	37	30	38																					
20.0					29	42	27	42																					
21.0					10	49	16	48																					
22.0					1	49	12	54			1	60					1	83							3	65			
23.0					1	61	5	64					1	76			3	82							4	80			
24.0			2	110			1	65									2	93							1	93			
25.0			1	120													2	105							1	92			
26.0									1	140							8	115			1	125							
27.0							1	106			1	130					20	123			1	134	1	135	4	137			
28.0							1	105	1	196	1	137					8	132	1	149	1	132			4	146			
29.0			2	164			2	88			2	134			1	126	8	143							2	151			
30.0	1	253									1	155					12	158	1	166	2	155			1	165			
31.0																	11	170			3	182			1	167			
32.0											1	198					6	176	3	197	4	193			2	182			
33.0	1	288															7	202			1	205			2	192			
34.0																	9	205	1	167	3	218					1	380	
35.0																	2	252			1	222			1	210	5	373	
36.0																													
37.0																												16	413
38.0					1	280															1	257					48	428	
39.0																											24	456	
40.0																											6	488	
41.0																													
42.0																													
43.0																													
44.0																													
45.0																													
SUM	2		5		99		100		2		7		1		1		100		6		18		1		26		100		
MEAN W.		271		133		42		46		168		135		76		126		151		179		186		135		132		433	
MEAN L.	32		27		20		21		27		29		23		30		30		32		32		28		28		38		



(Table 1 continue)

DATE	960803		960803		960803		960803		960803		960804		960804		960805		960805		960805		960805		960805									
ST.NO.	592		593		595		595		596		600		601		602		602		602		603		604		607		608					
SPECIES	HERRING		BLUE WH		HERRING		MACK		HERRING		BLUE WH		BLUE WH		BLUE WH		HERRING		MACK		BLUE WH		BLUE WH		BLUE WH		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)				
15.0																																
16.0																																
17.0																																
18.0																																
19.0																																
20.0																																
21.0																																
22.0																																
23.0			1	70																												
24.0																																
25.0																																
26.0													1	119	1	123							1	102			1	95				
27.0													1	127									1	103				1	92			
28.0																												2	127			
29.0			1	150																								2	138			
30.0			1	157									2	149												2	148	1	149	3	151	
31.0			2	174	2	258						1	156	1	158									3	155	2	158	3	149			
32.0					4	257						4	178	4	171							1	160	1	180	6	164	3	170			
33.0			1	192	17	295						3	194	2	174											2	156	1	172	5	190	
34.0	1	346	1	203	13	315						1	191	1	182											2	201			1	206	
35.0	1	368	2	224	6	346						3	208	1	219										1	249	1	209	2	209		
36.0	13	397			4	405						2	221	1	160													1	245	1	204	
37.0	14	422			14	418						3	221																			
38.0	7	450			25	440			2	408										1	310											
39.0					15	465																										
40.0																																
41.0																																
42.0																																
43.0																																
44.0																																
45.0																																
SUM	37		9		100			2		2		17		14		1		1		2		1		13		13		13		24		
MEAN W.		414		174		382		575		408		198		164		123		310		615		160		162		166		166		163		
MEAN L.	37		31		36		40		37		34		31		26		37		41		31		31		31		31		31		31	

(Table 1 continue)

DATE	960806		960806		960806		960806		960806		960806		960806		960807		960807		960807		960807		960807		960808		960808			
ST.NO.	609		609		610		611		612		613		615		616		617		618		619		620		621		621			
SPECIES	BLUE WH		MACK		MACK		BLUE WH		MACK		BLUE WH		BLUE WH		MACK		MACK		HERRING		BLUE WH		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)	n	w(g)	n	w(g)	n	w(g)	n	w(g)	n	w(g)	n	w(g)	n	w(g)		
15.0																														
16.0													3	20												1	22			
17.0													20	25												6	24			
18.0							3	35			5	33	40	29							6	26			25	30		5	33	
19.0							23	37			31	37	30	33											38	34		2	37	
20.0							16	42			33	43	7	38																
21.0							10	48			18	50														14	41			
22.0							3	58			7	58														10	45			
23.0											3	63													5	55	2	93		
24.0																														
25.0							1	87																						
26.0							1	101			1	115																		
27.0							1	123			1	114																		
28.0	2	137					2	130																						
29.0	2	135					3	149																						
30.0							1	168			1	155																		
31.0	1	164																												
32.0	1	172					1	186	1																					
33.0	1	197							3																					
34.0									1																					
35.0			1	407					1																					
36.0			1	421																										
37.0			1	454					2																					
38.0																														
39.0			1	558	1	398																								
40.0			3	598																										
41.0																														
42.0			1	745																										
43.0																														
44.0			2	810																										
45.0																														
SUM	7		10		1		65		8		100		100		7		6		2		100		66		14		40			
MEAN W.		154		600		398		56				46		30		456		531		163		37		168		30		40	273	
MEAN L.	31		40		40		22		35		21		19		37		38		26		20		27		18		33			

(Table 1 continue)

DATE	960809		960809		960809		960809		960810		960810		960810		960811		960810		960811		960811		960811		960811						
ST.NO.	622		624		625		626		627		628		629		629		630		632		633		634		635		636				
SPECIES	BLUE WH		HERRING		HERRING		HERRING		HERRING		HERRING		HERRING		HERRING		BLUE WH		BLUE WH		HERRING		BLUE WH		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)	n	w(g)	n	w(g)	n	w(g)	n	w(g)	n	w(g)	n	w(g)	n	w(g)			
15.0																															
16.0																															
17.0																															
18.0	5	31																													
19.0	3	35																													
20.0	5	44																													
21.0	4	46																													
22.0																															
23.0							1	100									2	83							2	75					
24.0							2	119									2	90							1	86					
25.0			1	144	1	128	5	130									1	117													
26.0			1	143	5	157	14	152									2	121									1	147			
27.0			2	176	23	169	10	168									10	135					1	130	2	127	1	177			
28.0			1	198	17	185	14	193	1	193			1	195			12	143					4	128			7	199			
29.0			2	178	24	206	19	210	3	229	1	260	1	208			3	160			3	206	1	148	5	153	6	213			
30.0			4	231	15	233	17	233	23	240			1	195			7	156	1	161	10	235	7	180			10	247			
31.0			5	245	7	253	11	270	30	260							7	183	1	185	6	269	10	182	3	202	9	265			
32.0			2	271	3	240	3	288	27	283	1	330			1	273	3	193			4	281	3	184	2	221	4	273			
33.0					1	314	3	305	7	312							2	204					1	326	5	206	1	224	5	309	
34.0					2	286			2	328												1	343	1	228			3	351		
35.0			2	350	1	292			3	361											1	293	2	230			4	359			
36.0			4	389					2	404					1	321				1	302			1	239			1	462		
37.0			5	430					1	417	1	500																2	427		
38.0			2	421	1	397	1	506	1	451																		2	430		
39.0																															
40.0																															
41.0																															
42.0																															
43.0																															
44.0																															
45.0																															
SUM	17		31		100		100		100		3		3		2		100		3		26		35		16		55				
MEAN W.		39		295		204		207		274		363		199		297		133		216		256		182		158		275			
MEAN L.	20		33		29		29		32		33		30		35		28		33		31		32		29		32				

(Table 1 continue)

DATE	960811		960811		960812		960812		960812		960812		960813		960813		960813		960813		960813		
ST.NO.	637		638		639		640		641		643		644		645		647		649		649		
SPECIES	HERRING		HERRING		HERRING		BLUE WH		HERRING		BLUE WH		HERRING		BLUE WH		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)	
15.0																							
16.0																							
17.0																							
18.0																							
19.0							1	35															
20.0																							
21.0							1	65															
22.0							1	64															
23.0																				1	94		
24.0													2	90					2	105			
25.0					1	142						8	133	1	78	1	128	9	132				
26.0			1	146	7	157					1	118	14	151			5	159	12	150			
27.0	1	155	3	180	10	169	4	122					9	158			11	176	26	168			
28.0	1	194	25	191	20	191	8	133	1	144	5	128	6	177			5	186	19	182			
29.0	1	212	27	205	29	209	12	160					6	128	3	191			1	203	10	212	
30.0	2	195	15	232	17	236	11	160					5	152	1	212			3	233	7	224	
31.0	1	278	12	255	7	263	16	172	2	221	4	169	1	196			1	260	1	255			
32.0	1	282	7	300	4	287	13	176					1	193									
33.0	1	346	5	313	1	317	11	200					3	184	1	323					2	319	
34.0			1	369	1	366	7	229					1	212	1	269					1	363	
35.0	1	260	2	385	1	354	1	199					1	196									
36.0	1	399	1	394	1	347	5	242														1 520	
37.0			1	460	1	448			1	314							1	333	1	418			
38.0	1	482																				1 485	
39.0																							
40.0																							
41.0																						1 770	
42.0																							
43.0																							
44.0																							
45.0																							
SUM	11		100		100		91		4		27		48		1		30		100		3		
MEAN W.		273		232		216		172		225		152		159		78		184		175		592	
MEAN L.	32		30		30		31		32		31		27		25		28		28		39		

Table 2. Acoustic abundance estimate of blue whiting, Norwegian Sea July/August 1996.

c:\kolm-s96\xxx  
 Printed 13:28 26 Aug 96

IMengd2 Ver 0692 Mengdeberegninger Kolmule													Kolmule Norskehavet, sommer 1996			Side 80		
0Antall i omr. : N x 10 Exp-6													Middel-lengde : Cm			Vekt i omr. : Tonn x 10 Exp-3		
Gj.vekt : Gram													Kondisjon : 1000 x Vekt/ Lengde Exp+3			Dato : 26/ 8-1996		
0													6			-2.18		
Område	Alle												C : 1.490 * 10		* L			
Lengde	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	Tot	Vekt	Gj.v
16.0-16.9	30															30	.6	20.0
17.0-17.9	548															548	14.3	26.1
18.0-18.9	2566															2566	80.3	31.3
19.0-19.9	6658															6658	245.3	36.8
20.0-20.9	6985	98														7083	319.5	45.1
21.0-21.9	4341	19														4360	244.6	56.1
22.0-22.9	1904	141														2045	130.6	63.9
23.0-23.9	352	217														569	39.8	69.9
24.0-24.9	80	82	9													171	14.1	82.4
25.0-25.9		98	5													103	9.6	92.8
26.0-26.9		135	157	29												321	35.7	111.1
27.0-27.9		138	193	42	40	2										415	50.5	121.8
28.0-28.9		106	236	138	17											497	66.5	133.8
29.0-29.9		21	232	177	48	17	8									503	71.4	141.9
30.0-30.9		2	24	121	118	93	64									422	66.8	158.2
31.0-31.9			43	97	94	118	154	13								519	88.1	169.7
32.0-32.9				41	57	118	186	9								411	74.9	182.3
33.0-33.9				4	39	90	128	10	8	12						291	56.9	195.4
34.0-34.9					16	40	133	4	15	20						228	47.7	209.1
35.0-35.9					7	26	44	23	1	2						103	22.7	219.9
36.0-36.9						1	38	10	12							61	14.1	230.5
37.0-37.9									5	2						7	1.6	234.3
38.0-38.9										14						14	3.9	280.0
0 Antall:	23464	1057	899	649	436	505	755	69	41	50	0	0	0	0	0	27925		
Gj.lgd:	20.33	24.85	28.33	29.72	31.01	32.28	32.99	34.15	35.28	35.54	.00	.00	.00	.00	.00	21.78		
Vekt:	1051.3	94.7	119.4	95.9	71.1	89.7	142.4	14.8	8.5	11.4	.0	.0	.0	.0	.0	1699.2		
Gj.vkt:	44.8	89.6	132.8	147.8	163.1	177.6	188.6	213.8	208.0	228.0	.0	.0	.0	.0	.0	60.8		
Kond.:	5.2	5.6	5.8	5.6	5.4	5.3	5.2	5.3	4.8	5.1	.0	.0	.0	.0	.0	5.3		