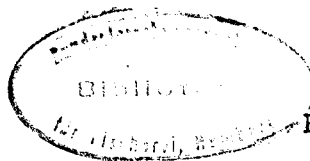


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International Council for
the Exploration of the Sea



C.M. 1975/H:30

Pelagic Fish (Northern) Committee
Ref.: Demersal Fish (Northern)
and Plankton Cttees

A methodological study of catching 0-group fish (larvae) and small fish in the North
Sea area by using Isaacs-Kidd Midwater Trawl

by

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ABSTRACT

During the North Sea Young Herring Survey in February, 1975, Isaacs-Kidd Midwater Trawl was used for collecting 0-group fish (larvae) in the Kattegat, Skagerrak and North Sea. 20 species of fish, mainly 0-group fish (larvae) were caught and large amounts of krill. The most important species were herring, sprat, transparent goby, sand goby, elver and two species of sand eel. Other species were pearl-side, Nilsson's pipefish, whiting, spotted dragonet, painted goby, crystal goby, armed bullhead, three-spined stickleback, dab, long rough dab, witch, lemon sole and plaice. The total size range of the specimens in the samples was 20-165 mm. The 0-group fish (larvae) were 20-80 mm. The results of oblique and horizontal tows were statistically treated. Some species had such a distribution that more specimens were taken in oblique tows at night. Others were more abundant in horizontal surface tows at night. Statistical treatment of the samples showed, however, that for some groups of samples there were not any differences between horizontal surface tows and oblique tows from surface to bottom, although the mean values were quite different.

INTRODUCTION

The results from a three year study for collecting herring larvae with an Isaacs-Kidd Midwater Trawl (I.K.M.W.T.) were presented at the ICES' meeting in 1974 (Ackefors, 1974). With horizontal hauls at surface during night time it was possible to collect a large number of herring larvae in the size range 30-50 mm just before metamorphosis. At the end of the ICES' meeting the following statement was made: "Interest was expressed in the results achieved in sampling late herring larvae in the Skagerak area using I.K.M.W.T. hauls at night. It was agreed that similar studies should be made in conjunction with the North Sea Young Herring Surveys by participating countries to investigate whether in that way an earlier estimate of recruitment could be made".

It was proposed that during the North Sea Young Herring Survey in February, 1975, the participating vessels should make I.K.M.W.T. hauls at night to catch 0-group herring in conjunction with the trawling for 1-group herring in the day-time. During this first joint attempt to catch 0-group herring, it was decided that each country should apply their own methods for using the I.K.M.W.T. The authors of this paper considered it important that both horizontal and oblique hauls should be carried out in order to test the most suitable hauls for future studies. The present paper deals with such methodological studies made in February, 1975 in the areas Kattegat, Skagerrak and North Sea.

MATERIAL AND METHODS

The investigation was carried out in February 5-22, 1975 in the Kattegat, Skagerrak and North Sea (fig. 1). The area sampled in the Skagerrak comprised both shallow areas inside the 100 m depth curve and deep areas (cf. figs. 1 and 2). The station net in the North Sea was mainly inside the 60 m depth curve. At certain stations the depth was not more than 20 m. In the Kattegat the depth fluctuated from 20 to 46 m. In fig. 1 only the first sample at each station is reproduced with a number.

An Isaacs-Kidd Midwater Trawl (I.K.M.W.T.) was used with an opening of 4 x 2.5 m. The trawl was 10 m long with a mesh-size of 1 cm except in the cod-end (3 m long) which had a mesh-size of 0.5 cm. An extra inner cod-end (1 m long) with a mesh-size of 0.15 cm was inserted in the cod-end. A net-sond was attached to the upper frame of the I.K.M.W.T. It was therefore possible to check each oblique tow, while the trawl was operating from surface to a depth of 3-4 m above bottom and then up to surface again. In deep areas the tows were made down to 50 m depth. At each station one oblique and one horizontal tow were made after each other. With a few exceptions this scheme was

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followed during the whole cruise. The duration of each tow was 20 min. All operations were performed from 1900-0500 hrs local time, i.e. from two hours after sunset until two hours before dawn. In total 65 successful tows were made, 34 oblique and 31 horizontal ones (fig. 1). The towing speed was 3.5 knots. The horizontal tows sampled the water column from surface down to 4 m depth.

The larvae were preserved in 4 % formalin. The results of all tows were raised to 30 min tows to get comparable results with previous investigations.

RESULTS

Hydrographical notes

The salinity and temperature were quite different in the various parts of the sampled area (fig. 3). The Kattegat (Area C) is strongly influenced by the Baltic water current coming from the south. In February the salinity fluctuated from 11 to 22 ‰. Gradually the salinity increased to about 26 ‰ at 20 m level. There was a halocline between 20 and 30 m. Below the halocline the salinity was more than 30 ‰. The temperature was about 4°C at surface and increased gradually to 6-7°C at the deepest stations.

In the inner Skagerrak (Area A) the salinity fluctuated from less than 22 ‰ to 33 ‰ at surface (fig. 3). The isohaline for 30 ‰ was at 20 m level close to the coast. The isohaline became closer to the surface further out from the coast. At 10°32'E it was just below the surface. At the border line between the inner Skagerrak (Area A) and the outer Skagerrak (Area B) the salinity increased from 33.5 ‰ at surface to 34.8 ‰ at 50 m level. The surface temperature increased from less than 2°C close to the coast to more than 4°C in the western part of the area B. The isotherm for 5°C was at 20-30 m level close to the coast and at 10 m level further out from the coast.

In the outer Skagerrak and in the North Sea (Area B) the salinity was more than 33 ‰ at surface and about 35 ‰ at 50 m level. The temperature was between 5 and 6°C from surface to bottom. In deep areas the temperatures were up to 7.5°C in some parts of the water column.

Biological observations

20 different species, mainly 0-group fish (larvae), occurred in the samples from the three subareas (table 1, figs. 4-12). Large amounts of krill were also present in the samples (fig. 13). The most frequent species were herring

(Clupea harengus)(fig. 4), sprat (Sprattus sprattus)(fig. 5), elver (Anguilla anguilla)(fig. 6), two species of sand eel (Ammodytes marinus and A. tobianus)(fig. 7), sand goby (Pomatoschistus minutus)(fig. 8), crystal goby (Crystallogobius nilssoni)(fig. 9), transparent goby (Aphia minuta)(fig. 10), three-spinad stickleback (Gasterosteus aculeatus)(fig. 11). A lot of species occurred sparsely in the samples, viz. pearl-side (Maurolicus milleri), Nilsson's pipefish (Syngnathus rostellatus), armed bullhead (Agonus cataphractus), spotted dragonet (Callionymus maculatus), painted goby (Pomatoschistus pictus), whiting (Merlangius merlangus), dab (Limanda limanda), long rough dab (Hippoglossoides platessoides), witch (Glyptocephalus cynoglossus), lemon sole (Microstomus kitt), and plaice (Pleuronectes platessa)(fig. 12). The largest amounts of krill occurred in the Skagerrak and in the North Sea (fig. 13).

Detailed information about the number of individuals caught in the three sub-areas (cf. fig. 1) is given in table 1. 8 760 specimens, mainly 0-group fish, were caught in the 65 hauls. 82.4 % of the total amount of fish consisted of sprat, 5.9 % of herring, 3.1 % of transparent goby, 2.6 % of sand goby, 1.9 % of elver and 1.9 % of sand eel. The rest of the species made 2.2 %.

The number of individuals per 30 min tow was in the order of 200 for horizontal tows in area A, and for oblique tows in both area A and B (table 1). In area C the number of specimens in the samples was less as well as the number of specimens in the samples from horizontal tows in area B. Leaving the sprats out of account the number caught with the I.K.M.W.T. in all three areas was in the range from 14 to 36 per 30 min tow.

The size range of the sampled organisms in the I.K.M.W.T. was from 20 mm to 165 mm. The majority of the specimens were from 30 to 60 mm. For species appearing both in samples from horizontal tows at surface and oblique tows from surface to bottom no real difference in size could be demonstrated.

From preliminary results it appeared that a possible difference could be shown for oblique and horizontal tows in areas A and B. From figs. 4 and 5 it is obvious that more sprats and herring were caught in horizontal surface tows in area A than B. On the other hand more specimens were taken in oblique tows in area B than in area A. For this reason the number of specimens of five species, herring, sprat, elver, sand goby and transparent goby in oblique and horizontal tows were compared statistically treated (table 3). The mean number and standard deviation were calculated for each group of samples. The figures were then analysed with the Student's t-test. A difference of the number of herring specimens in samples from horizontal tows compared with oblique tows in area A and B was indicated with 95 % confidence limits. The same is true with 99 % confidence limits for sand goby in area B. The other groups of samples were not statistically different from each other. The variance within each group was

great. From the present investigation, it is therefore doubtful if horizontal surface tows are more suitable than oblique tows at night for catching 0-group fish (larvae) or vice versa. Possibly the results indicate that more herring larvae can be taken in horizontal surface tows at night in the inner Skagerrak in comparison with oblique tows (cf. fig. 3). For the outer Skagerrak and the North Sea the oblique tows seem to sample more herring larvae than the horizontal tows.

The species in the samples

The greatest density of herring larvae was found in the Skagerrak and North Sea (fig. 4). The mean values of length for each statistical rectangle were in the range 22-38 mm (cf. Ackefors, 1975). A few 1-group herrings were also caught. The total size range for herring specimens in the samples was 21-165 mm (table 2). The main part of the sprats was 0-group sprat from 26-81 mm long (fig. 5). 1 402 specimens were measured ($\bar{m} = 47.71$ mm; $s^2 = 95.69$; $s = 9.78$). 1-group sprat in the range 89-115 mm was also caught with I.K.M.W.T. Single specimens of pearl-side (29-35 mm) were caught in the Skagerrak (fig. 12). The elvers were caught in all three areas (fig. 6). The specimens were in the size range 61-80 mm. Nilsson's pipefish occurred sparsely in the samples from the Skagerrak and the North Sea (fig. 12). 1-group whiting occurred in a few samples from the Kattegat and Skagerrak (97-164 mm)(fig. 12). According to Reay (1970) two species of sand eel (Ammodytes tobianus, A. marinus) occur in the North Sea area. Specimens from four different tows were analysed concerning total vertebral number, dorsal fin ray number, anal fin ray number and pectoral fin ray number. In two of the samples both species occurred and in the other two samples just A. marinus. The latter species was in the size range 57-107 mm and A. tobianus 42-58 mm. The size range for all samples was 37-157 mm (table 2). Spotted dragonet (93 mm) was only found in the North Sea (fig. 12). Sand goby occurred in all three areas (fig. 8). The main part of the specimens was caught in oblique tows (cf. table 3). The size of the specimens was 27-56 mm. Painted goby (25-30 mm) was caught in the Kattegat (fig. 12). Crystal goby (19-41 mm) occurred in the Skagerrak and North Sea mainly in the oblique tows (fig. 9). Transparent goby (16-43 mm) occurred in all three areas mainly in the oblique tows (fig. 10). A single specimen of armed bullhead (71 mm) occurred in one sample from the North Sea (fig. 12). Three-spined stickleback (39-74 mm) occurred mainly in the surface samples in all three areas (fig. 11). Five species of flat fishes occurred in the samples, viz. dab (20-161 mm), long rough dab (56-58 mm), witch (40 mm), lemon sole (25-33 mm) and plaice (33 mm)(fig. 12). Large amounts of krill occurred in the Skagerrak and in the North Sea (fig. 13). The largest concentrations of krill occurred in areas deeper than 100 m (cf. fig. 2). The border line between small (moderate) and large amounts of krill coincides with the 100 m depth curve. The main part of the krill was Meganyctiphanes norvegica.

DISCUSSION

The present investigation indicates that it is possible to collect with I.K.M. W.T. a large number of 0-group fish (larvae) in the size range 20-50 mm. The differences of the catches between oblique tows from surface to bottom and horizontal tows at surface during night is obvious concerning a few species. Pearl-side, crystal goby, painted goby, transparent goby and dab were mainly caught in oblique tows while three-spined stickleback was mainly found in horizontal surface tows. The statistical treatment of some samples might indicate that herring larvae were differently distributed in the two areas compared. In the inner Skagerrak the main part of the larvae occurred in the surface water at night. In the outer Skagerrak and the North Sea the main part of the larvae occurred below the surface water.

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Table 1. The number of 0-group fish (and older) caught per 30 min tow with Isaacs-Kidd Midwater Trawl (I.K.M.W.T.) in February, 1975, in the Skagerrak east of 10° E (Area A), in the Skagerrak west of 10° E including the North Sea (Area B) and in the Kattegat (Area C).

	Area A		Area B		Area C		Total
	HOR	OBL	HOR	OBL	HOR	OBL	
Herring, <u>Clupea harengus</u>	119	27	85	282	0	3	516
Sprat, <u>Sprattus sprattus</u>	1826	1526	501	3136	14	219	7222
Pearl-side, <u>Maurolicus milleri</u>	0	3	0	2	0	0	5
Elver, <u>Anguilla anguilla</u>	33	39	36	29	12	15	164
Nilsson's pipefish, <u>Syngnathus rostellatus</u>	0	5	3	9	0	2	19
Whiting, <u>Merlangius merlangus</u>	2	2	0	0	6	3	13
Sand eel, <u>Ammodytes</u> spp.	3	4	78	73	3	1	162
Spotted dragonet, <u>Callionymus maculatus</u>	0	0	0	2	0	0	2
Sand goby, <u>Pomatoschistus minutus</u>	5	90	6	47	24	52	224
Painted goby, <u>Pomatoschistus pictus</u>	0	0	0	0	6	0	6
Crystal goby, <u>Crystallogobius nilssoni</u>	0	18	4	37	0	0	59
Transparent goby, <u>Aphia minuta</u>	6	128	3	57	18	61	273
Armed bullhead, <u>Agonus cataphractus</u>	0	0	2	0	0	0	2
Three-spined stickleback, <u>Gasterosteus aculeatus</u>	12	0	32	5	3	0	52
Long rough dab, <u>Hippoglossoides platessoides</u>	1	0	0	3	0	0	4
Dab, <u>Limanda limanda</u>	0	0	2	18	0	0	20
Plaice, <u>Pleuronectes platessa</u>	0	2	0	0	0	0	2
Lemon sole, <u>Microstomus kitt</u>	0	3	5	5	0	0	13
Witch, <u>Glyptocephalus cynoglossus</u>	0	2	0	0	0	0	2
Total	2007	1849	757	3705	86	356	8760
Number of tows	9	9	18	18	4	7	
Ind. per tow	223	205	42	206	22	51	
Ind. per tow except sprat	20	36	14	32	18	20	

Table 2. The size range of the various species in mm caught with I.K.M.W.T. in February, 1975, in horizontal hauls (HOR) at surface and oblique hauls (OBL) from surface to bottom in the Skagerrak east of 10°E (Area A), in the Skagerrak west of 10°E including the North Sea (Area B) and in the Kattegat (Area C).

	Area A		Area B		Area C	
	HOR	OBL	HOR	OBL	HOR	OBL
Herring, <u>Clupea harengus</u>	22-165	21-41	22-41	22-42	-	35
Sprat, <u>Sprattus sprattus</u>	30-136	29-115	34-103	26-98	-	43-105
Pearl-side, <u>Maurollicus mülleri</u>	-	35	-	29	-	-
Elver, <u>Anguilla anguilla</u>	61-78	63-77	65-80	66-81	69-72	64-73
Nilsson's pipefish, <u>Syngnathus rostellatus</u>	-	59-72	65-117	65-93	-	-
Whiting, <u>Merlangius merlangus</u>	97	160	-	-	128-164	157
Sand eel, <u>Ammodytes</u> spp.	37-59	46-82	39-147	41-157	44	-
Spotted dragonet, <u>Callionymus maculatus</u>	-	-	-	93	-	-
Sand goby, <u>Pomatoschistus minutus</u>	35-45	34-56	37-45	27-48	28-42	29-52
Painted goby, <u>Pomatoschistus pictus</u>	-	-	-	-	23-30	-
Crystal goby, <u>Crystallogobius nilsoni</u>	-	25-40	31-36	19-41	-	-
Transparent goby, <u>Aphia minuta</u>	-	32-35	29-36	16-41	34-45	35-48
Armed bullhead, <u>Agonus cataphractus</u>	-	-	71	-	-	-
Three-spined stickleback, <u>Gasterosteus aculeatus</u>	39-69	-	46-74	61-69	61	-
Long rough dab, <u>Hippoglossoides platessoides</u>	-	58	-	56-58	-	-
Dab, <u>Limanda limanda</u>	-	-	45	20-161	-	-
Plaice, <u>Pleuronectes platessa</u>	-	33	-	-	-	-
Lemon sole, <u>Microstomus kitt</u>	-	25-33	25-31	29-32	-	-
Witch, <u>Glyptocephalus cynoglossus</u>	-	40	-	-	-	-

Table 3. Comparisons of the results from oblique (OBL) and horizontal (HOR) hauls in the Skagerrak east of 10° E (Area A) and west of 10° E including the area in the North Sea (Area B). The mean numbers (\bar{m}) of herring, sprat, elvers, sand goby and transparent goby are compared. Standard deviation (s) and number of hauls (n) for each area and species are given. The values are analysed with the Student's t-test. The t-value are given for each group of values. The 95 % confidence interval(*) and the 99 % confidence interval (**) are reproduced. ($t_{.05} = 2.120$, $t_{.01} = 2.921$ for 16 degrees of freedom; $t_{.05} = 2.042$, $t_{.01} = 2.750$ for 30 degrees of freedom.)

		<u>AREA A</u>									
		Herring		Sprat		Elver		Sand goby		Transparent goby	
		OBL	HOR	OBL	HOR	OBL	HOR	OBL	HOR	OBL	HOR
\bar{m}		2.988	13.666	169.611	202.833	4.333	3.667	9.978	0.667	14.222	0.667
s		4.747	11.467	113.059	258.371	6.514	4.316	20.362	1.090	40.247	2.000
n		9	9	9	9	9	9	9	9	9	9
t		2.5811		0.3533		0.2556		1.3698		1.0091	
* or **		*		-		-		-		-	
		<u>AREA B</u>									
\bar{m}		16.225	5.300	189.350	31.163	1.500	2.250	2.688	0.375	3.350	0.188
s		14.965	9.345	549.804	91.400	2.121	3.286	2.874	1.162	7.105	0.750
n		16	16	16	16	16	16	16	16	16	16
t		2.4768		1.1352		0.7670		2.9844		1.7703	
* or **		*		-		-		**		-	

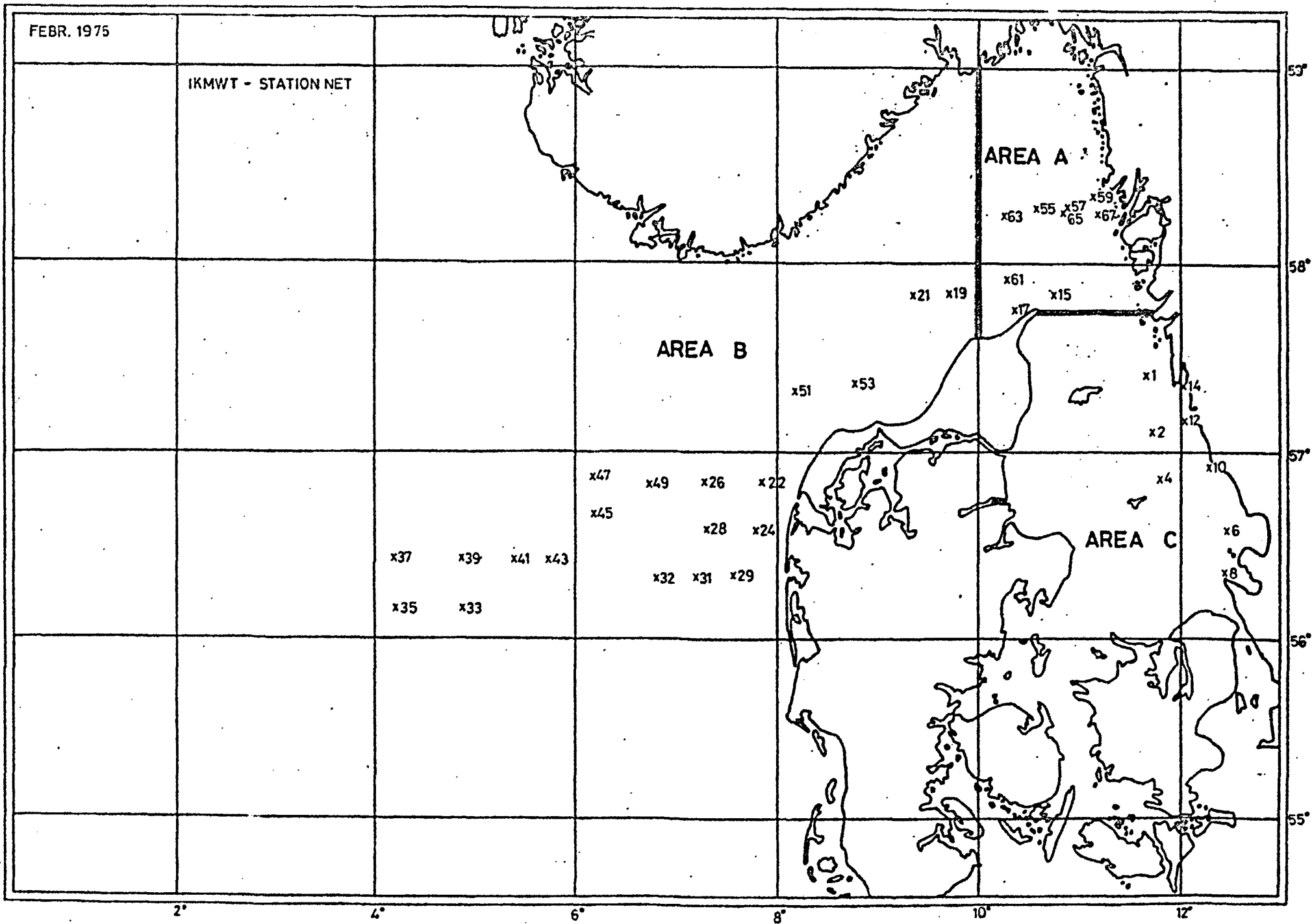


Fig. 1

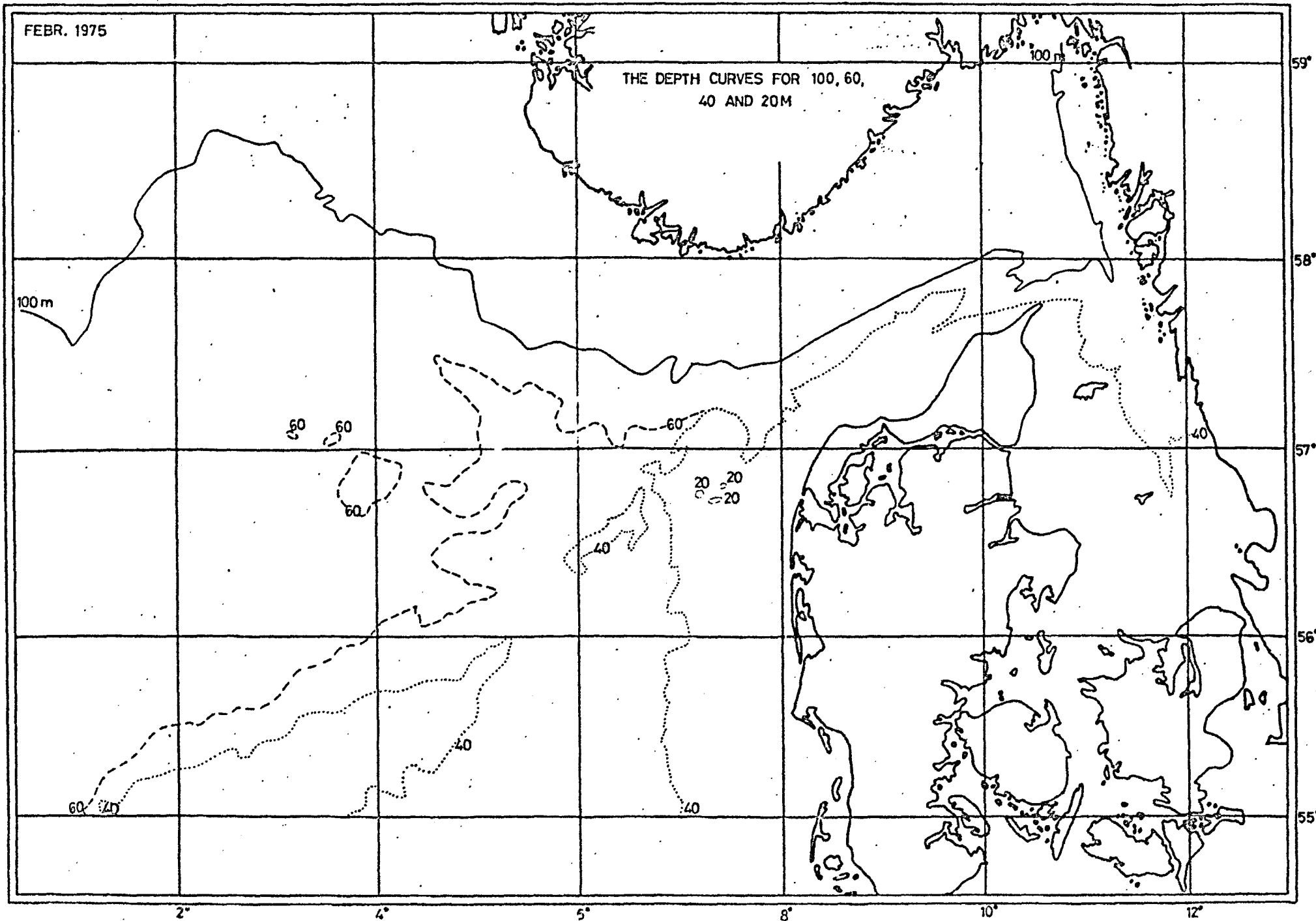


Fig. 2

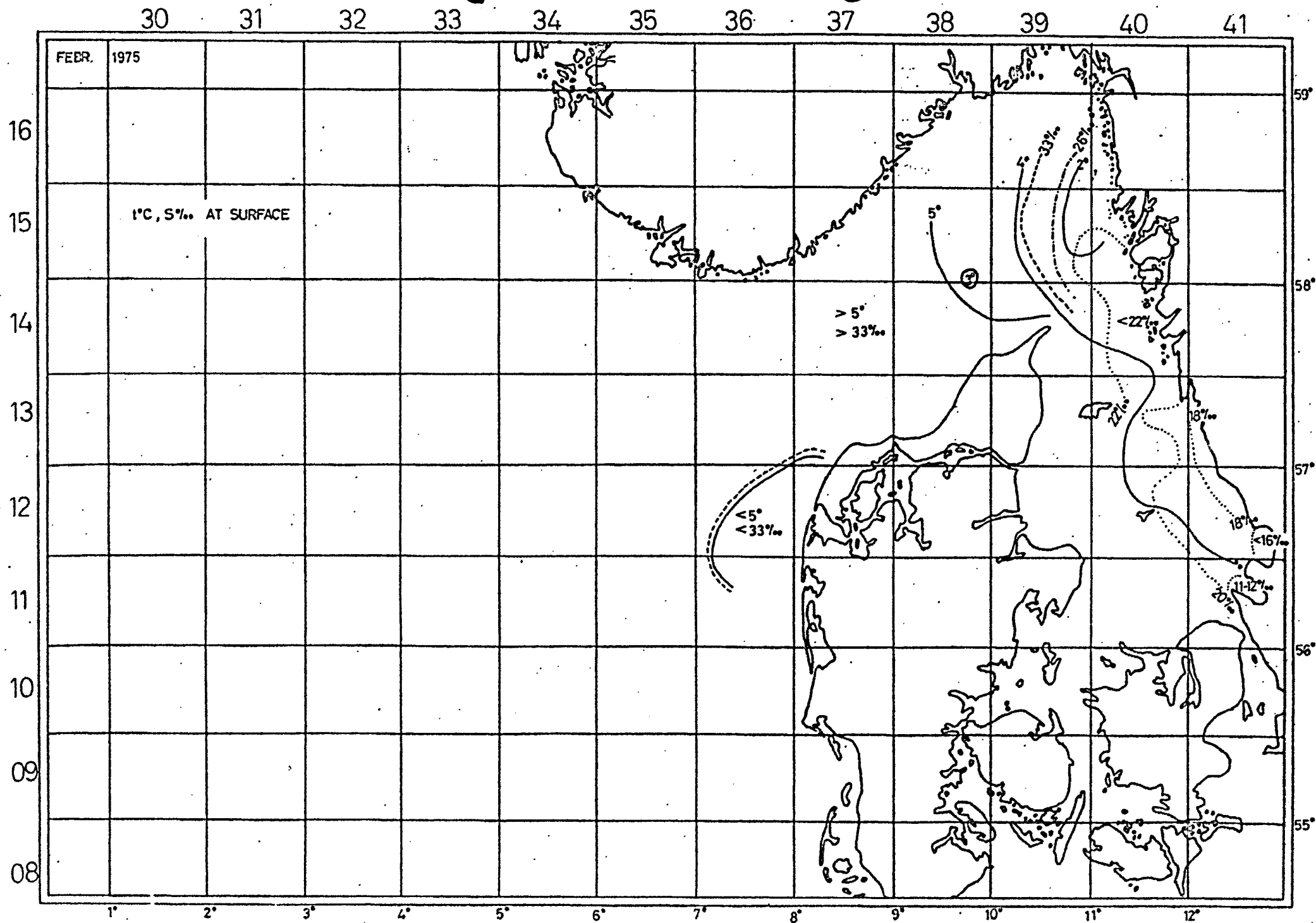


Fig. 3

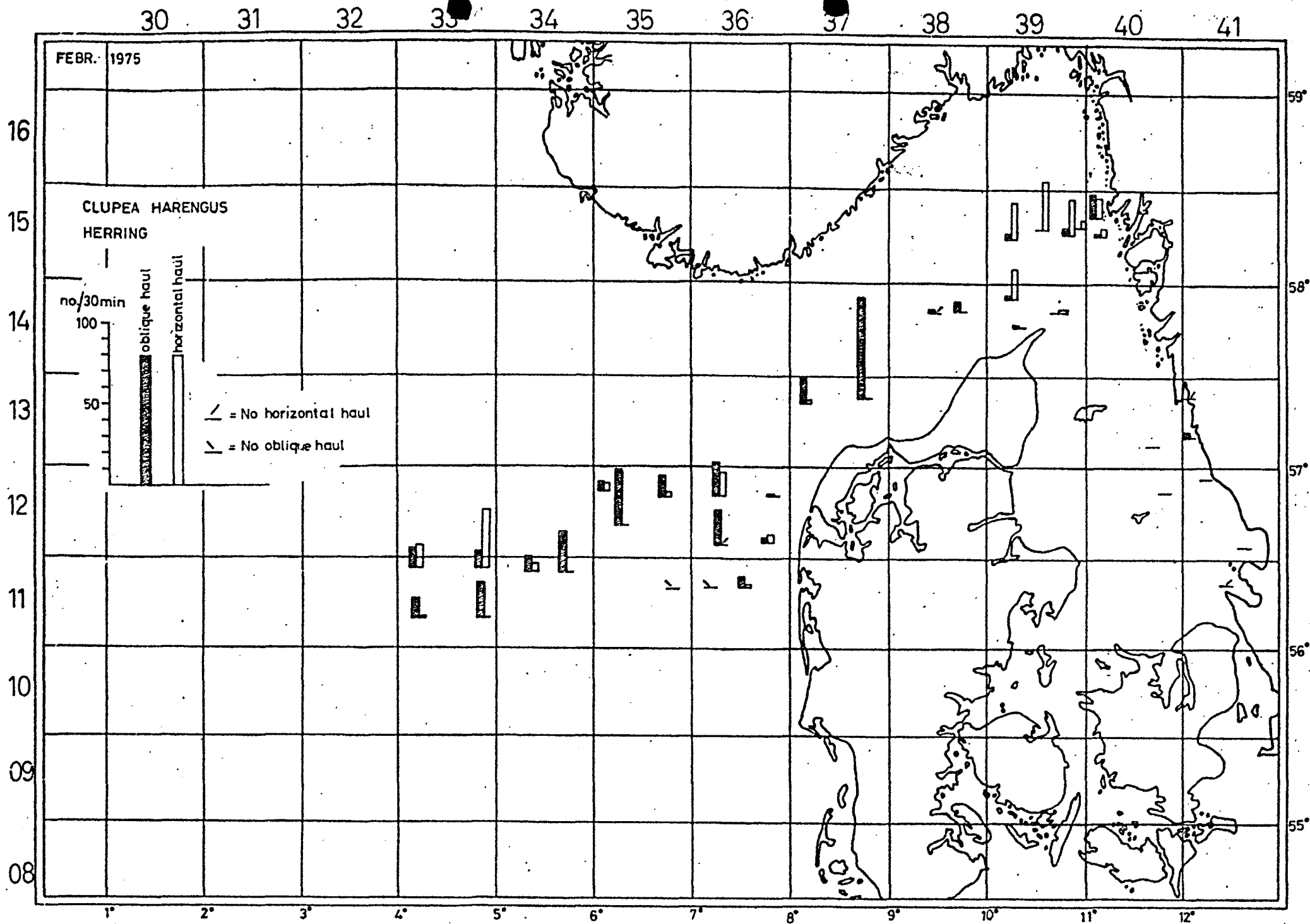


FIG. 4

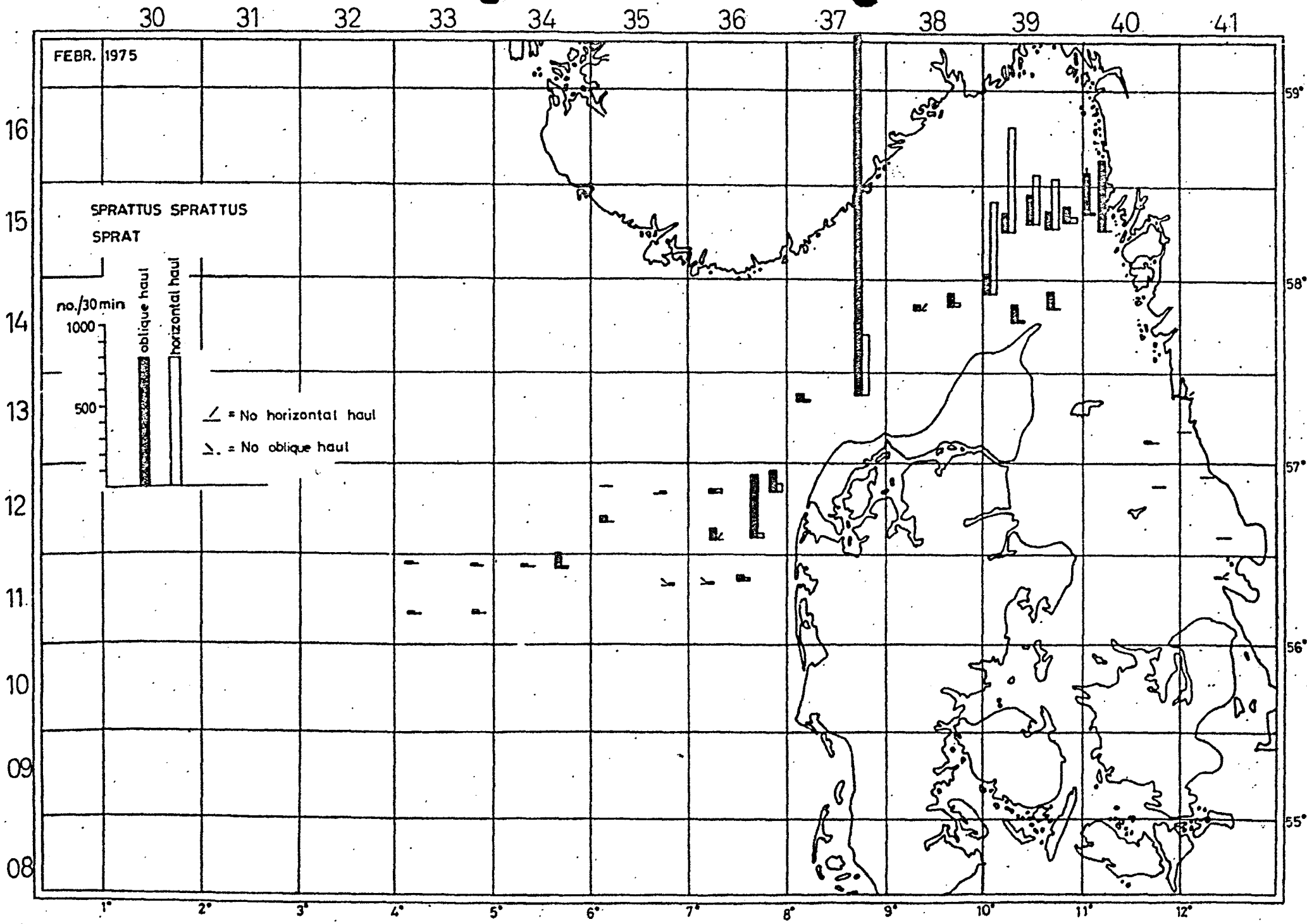


Fig. 5

30 31 32 33 34 35 36 37 38 39 40 41

FEBR. 1975

ANGUILLA ANGUILLA
ELVER

no./30 min

50
40
30
20
10

oblique haul

horizontal haul

∟ = No horizontal haul

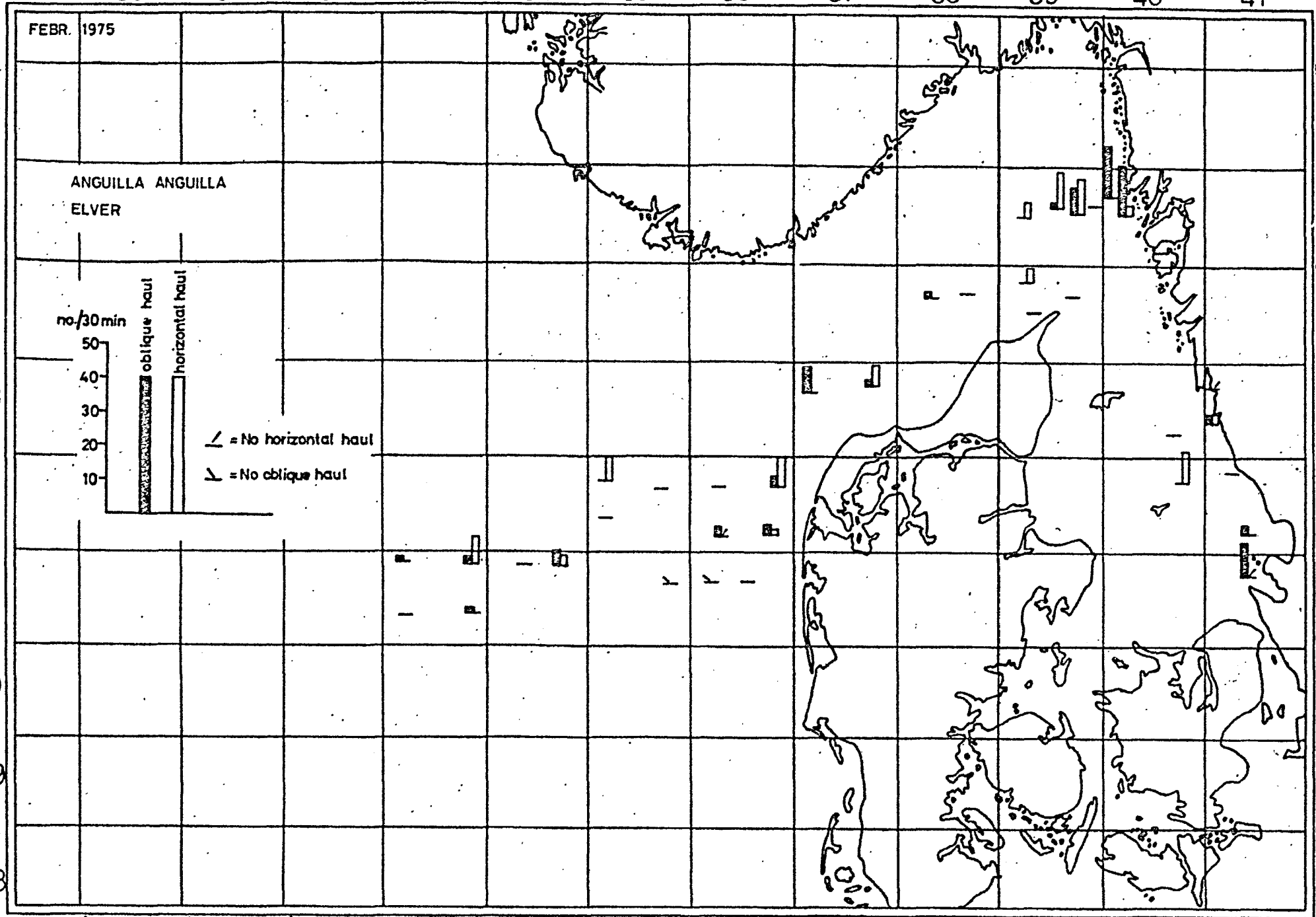
∟ = No oblique haul

16
15
14
13
12
11
10
09
08

59°
58°
57°
56°
55°

1° 2° 3° 4° 5° 6° 7° 8° 9° 10° 11° 12°

Fig. 6



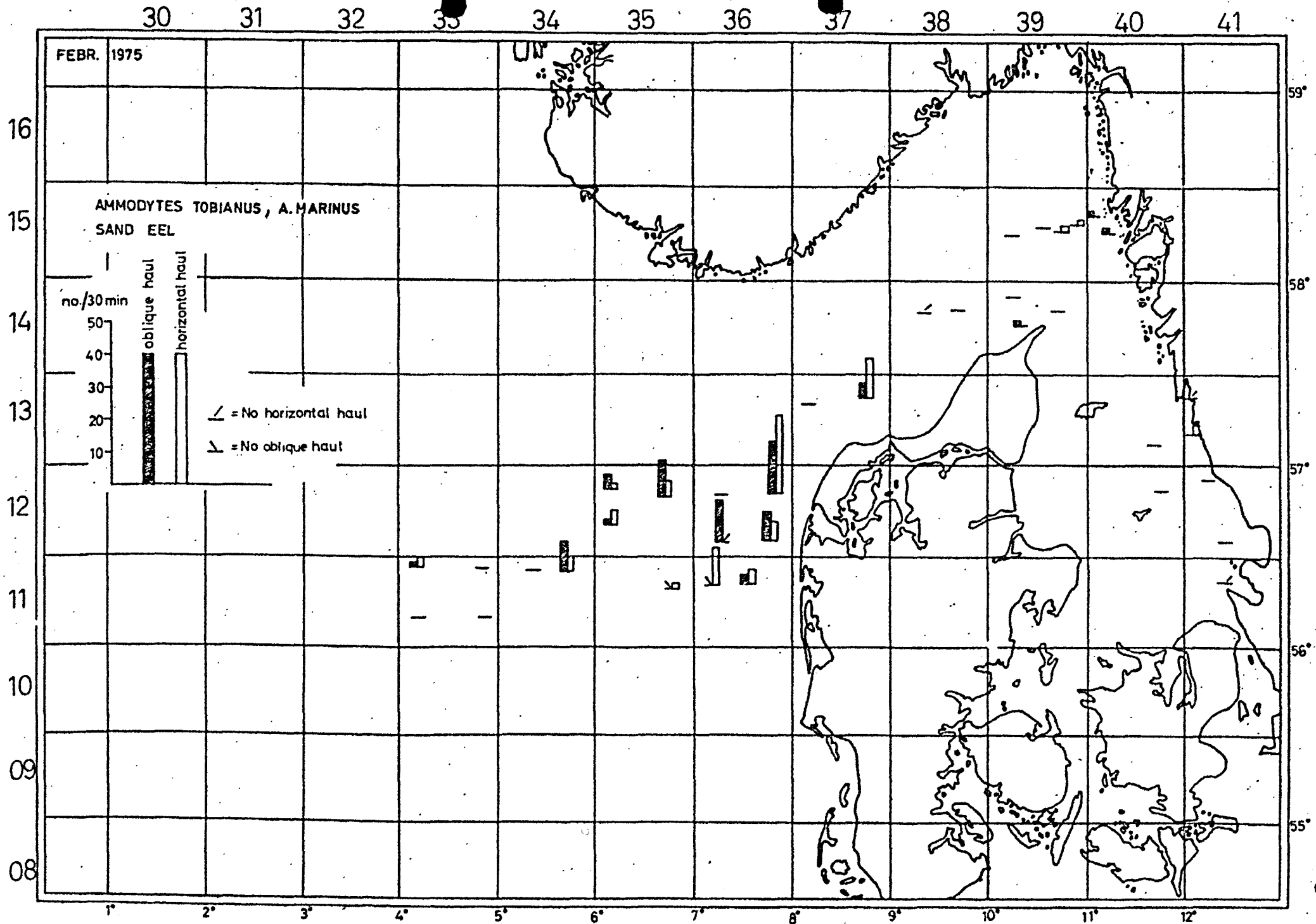


Fig. 7

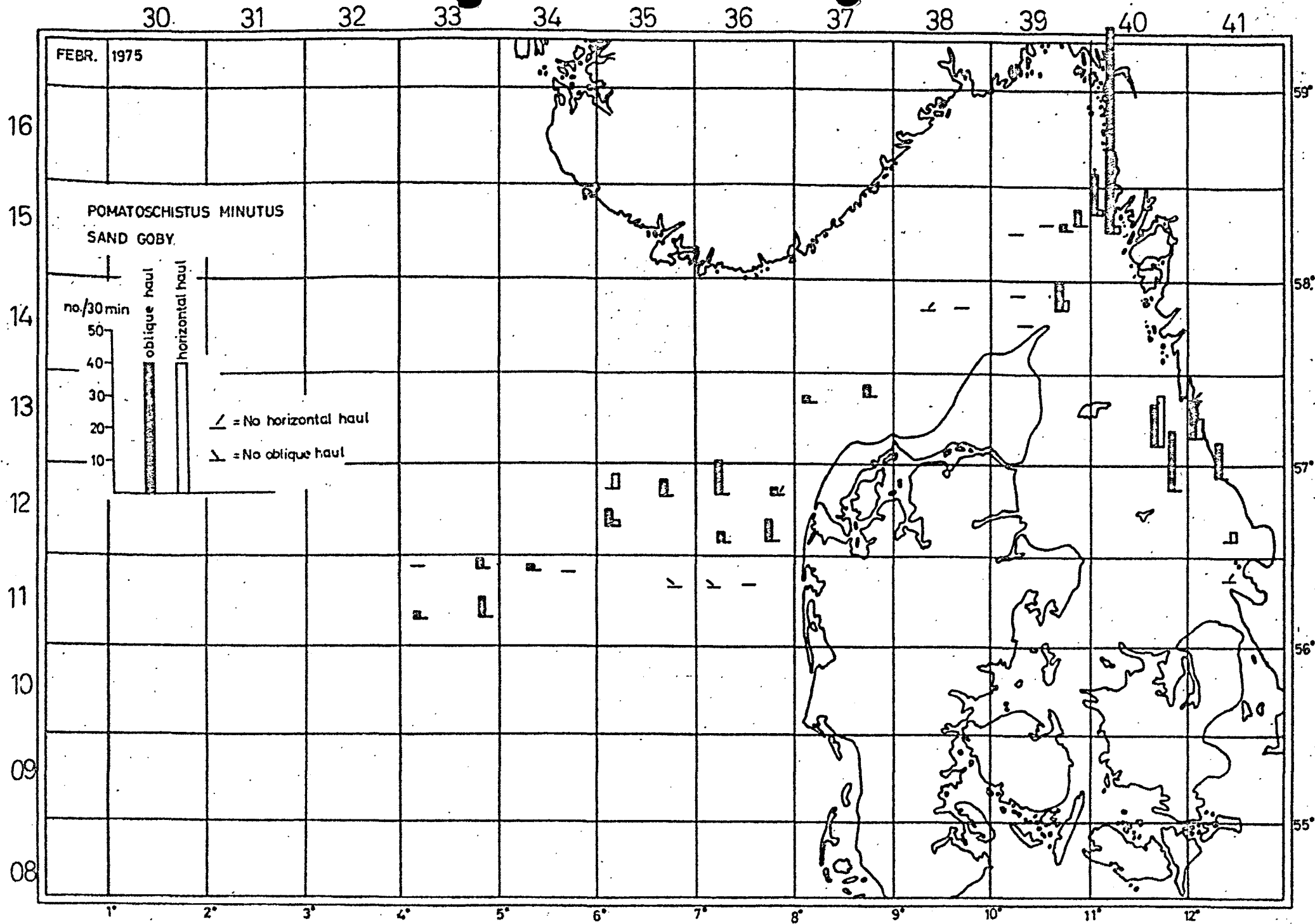


Fig. 8

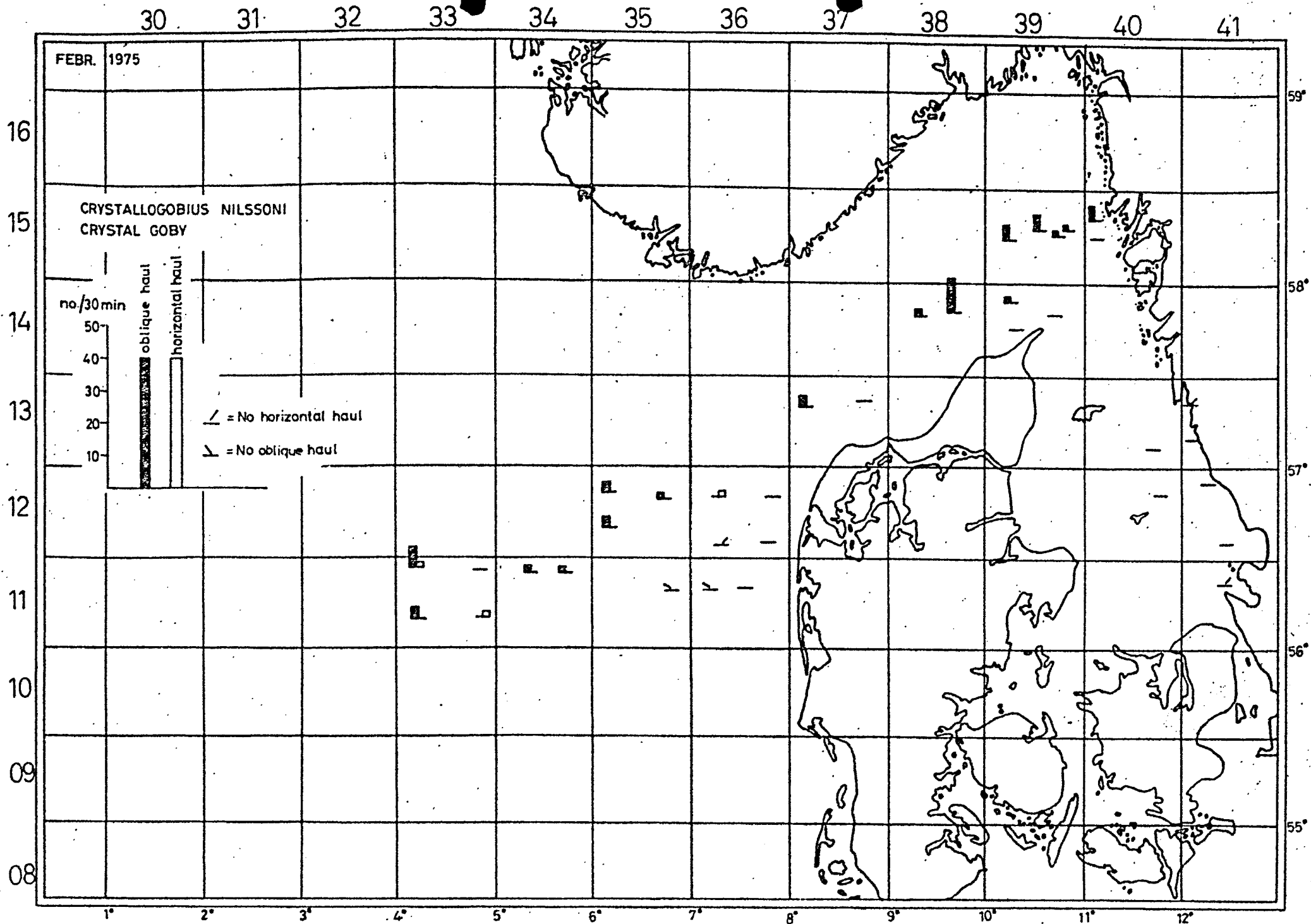


Fig. 9

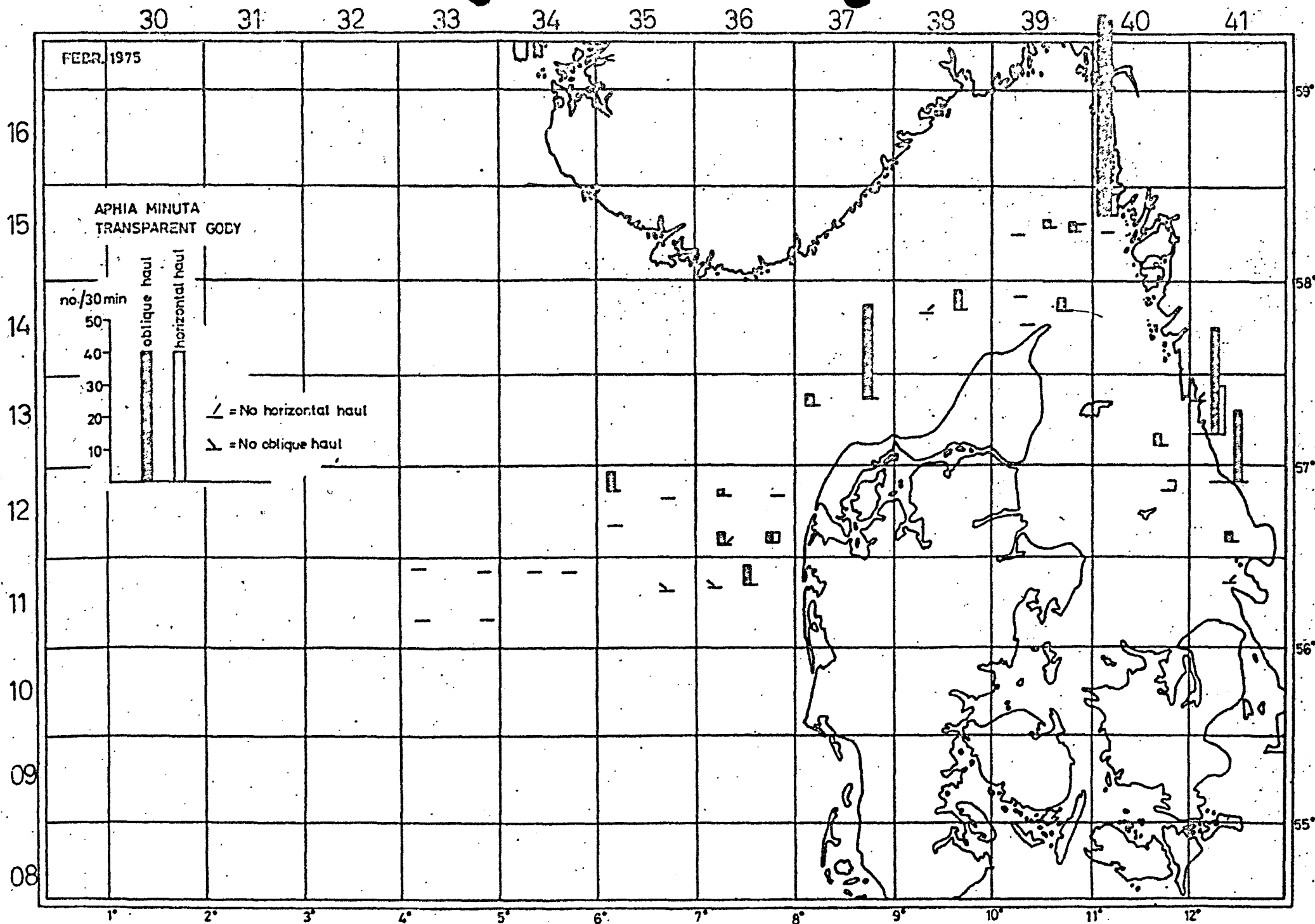


Fig. 10

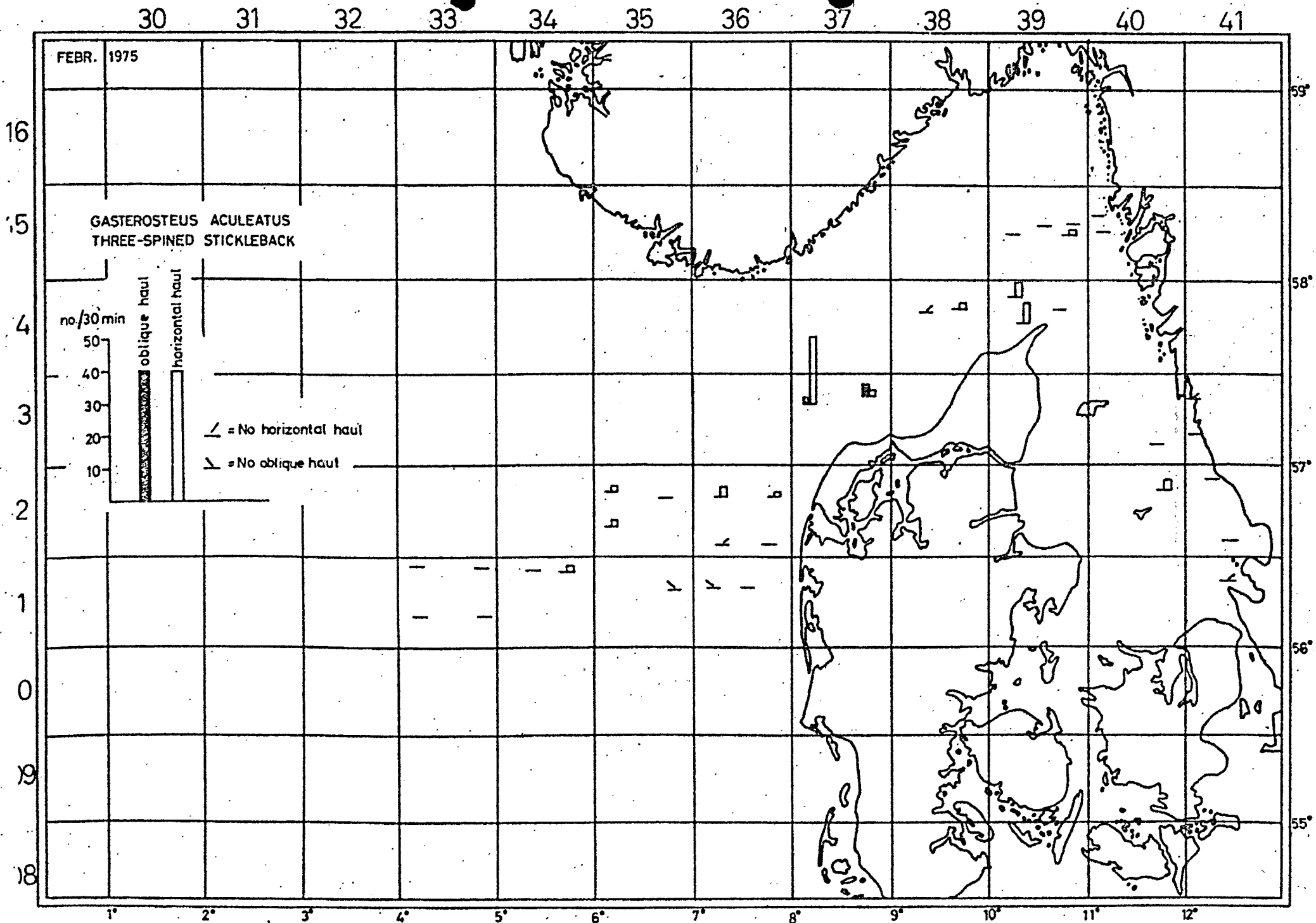


Fig.11

FEBR. 1975

MAUROLICUS MÜLLERI	PEARLSIDE
SYNGNATUS ROSTELLATUS	NILSSON'S PIPEFISH
AGONUS CATAPHRACTUS	ARMED BULLHEAD
CALLIONYMUS MACULATUS	SPOTTED DRAGONET
POMATOSCHISTUS PICTUS	PAINTED GOBY
MERLANGIUS MERLANGUS	WHITING
LIMANDA LIMANDA	DAB
HIPPOGLOSSOIDES PLATESSOIDES	LONG ROUGH DAB
GLYPTOCEPHALUS CYNOGLOSSIUS	WITCH
MICROSTOMUS KITT	LEMON SOLE
PLEURONECTES PLATESSA	PLAICE

□
■
○
●
△
▲
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+
x
*

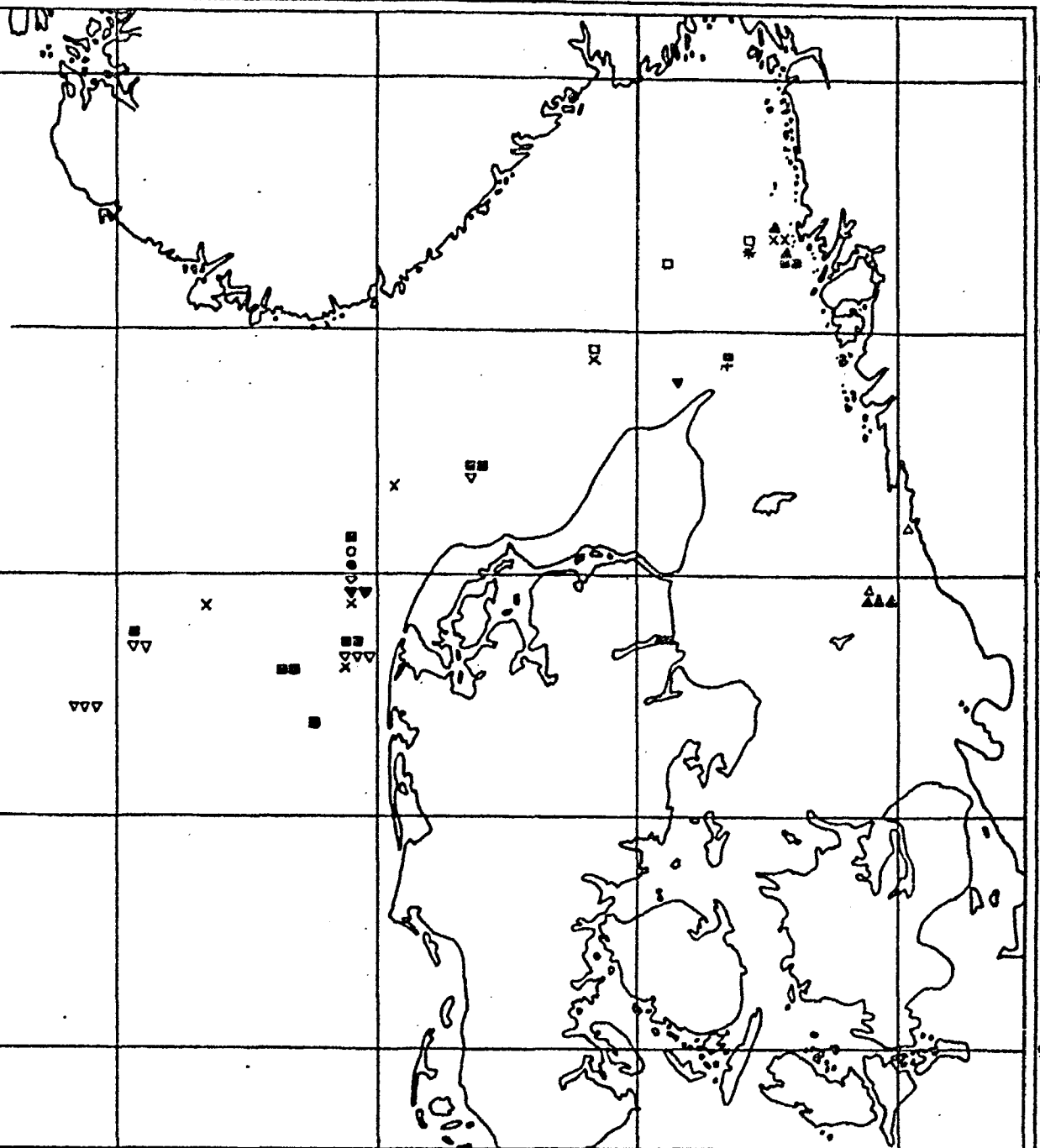


Fig. 12

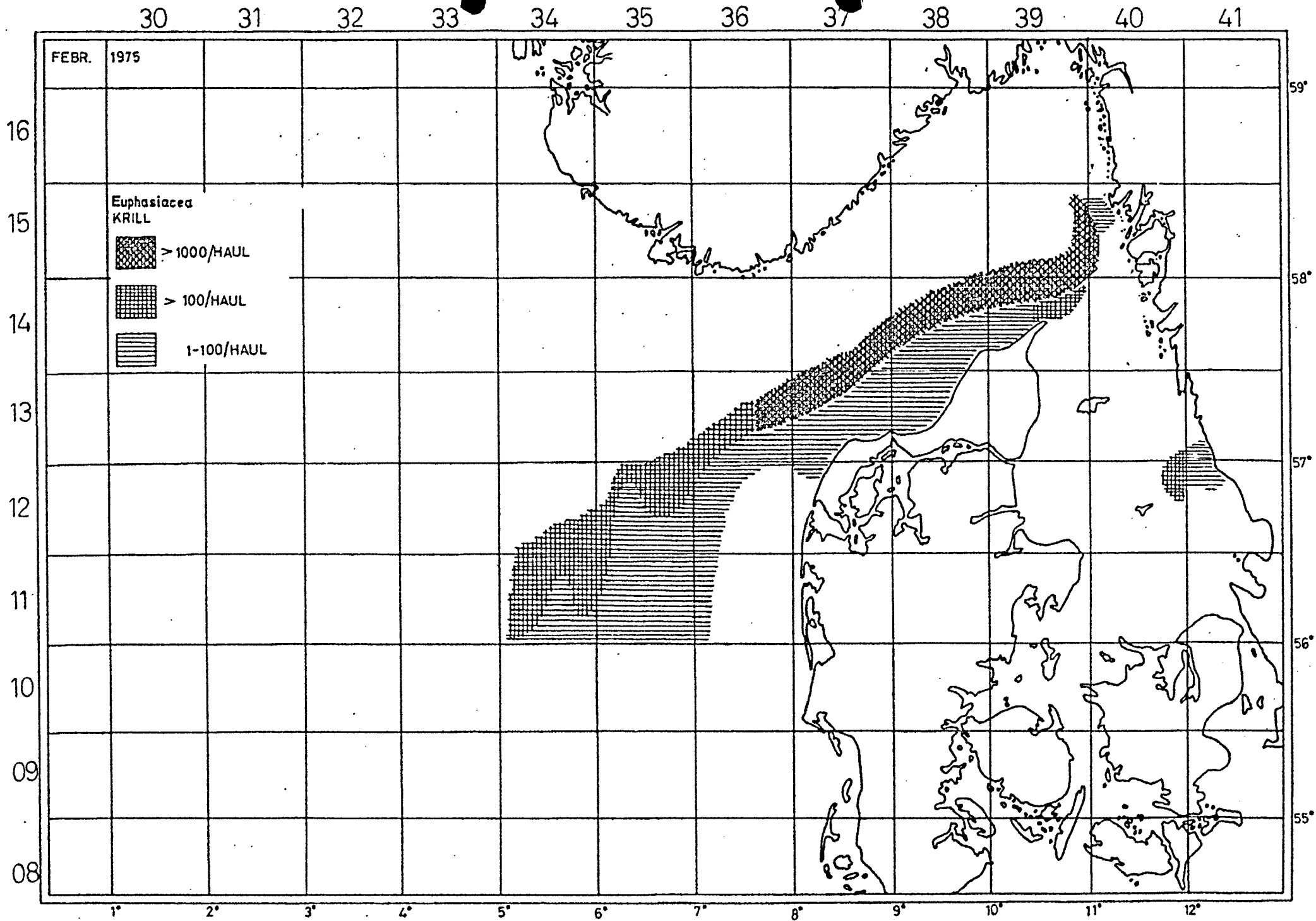


Fig. 13