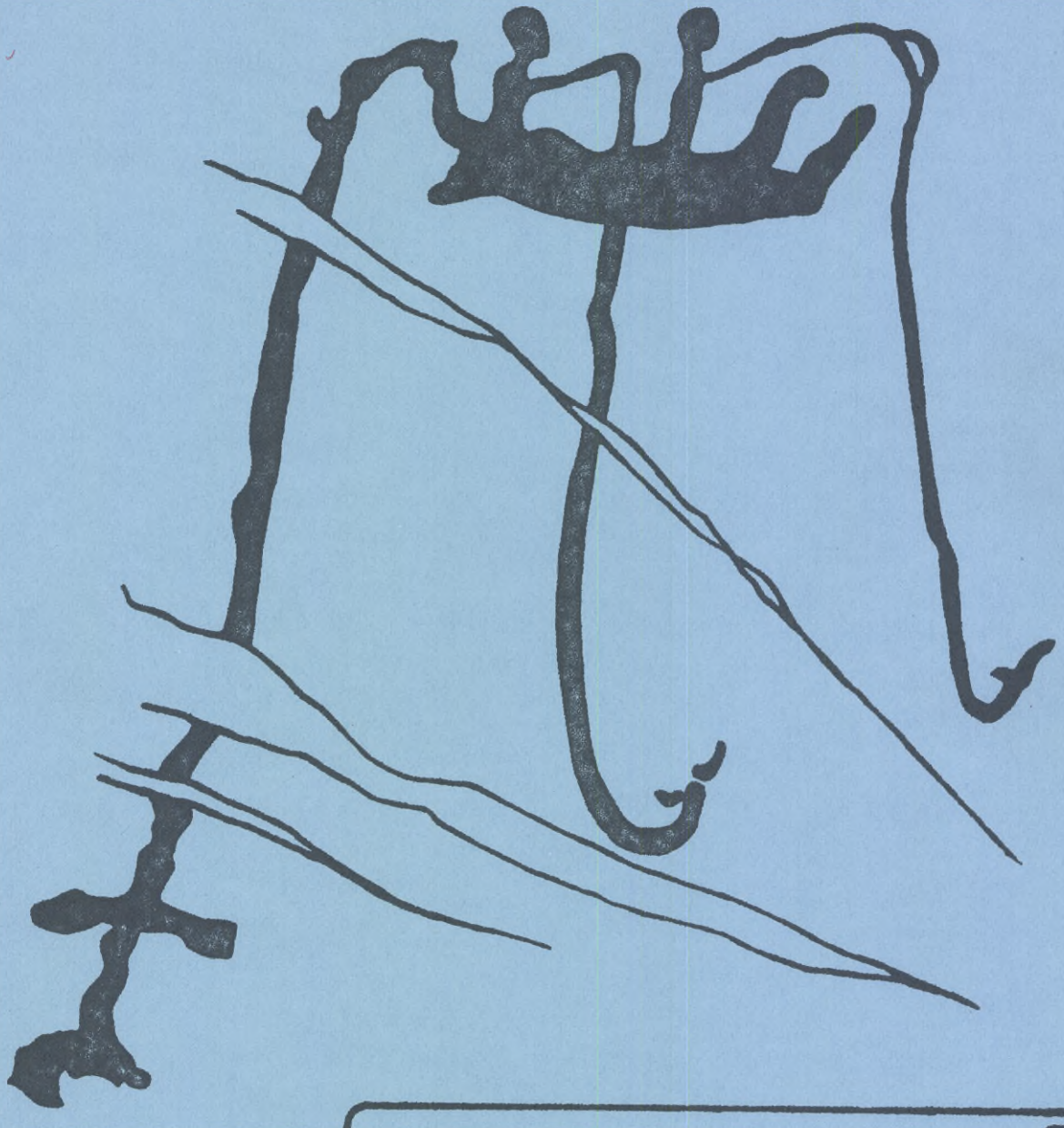
Ödemål, Kville sn, Bohuslän

Hällristning
Fiskare från
bronsåldern

Rock carving
Bronze age
fishermen



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OBSERVATIONS ON GLASS EELS IN THE SKAGERAK AND KATTEGAT

by

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Observations on
Glass Eels in the Skagerak and Kattegat

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Abstract

Elvers are found in the plankton of the Skagerak and Kattegat from January to April, with a peak in February-March. Thereafter they enter the fresh water. The pathways of immigration have been studied since the end of the 1960's. Immigration takes place as a drift with the Jutland current. By its speed the current acts as a "jet stream", carrying elvers (and other plankton organisms) with it from the North Sea. During the night elvers rise to the surface; during daytime they are supposed to be close to the bottom. Fluctuations in the abundance have been considerable from cruise to cruise.

1. Introduction

The landings of eel in the Skagerak, the Kattegat, and the Baltic are considerable. According to the preliminary statistics of ICES in 1974, they amounted to 4 056 ton. To this figure must be added the eel caught in fresh waters.

Variations in the catches of eel have been great, and to ascertain the causes it was considered of value to have an assessment of the quantities of immigrating glass eel or elvers. There was no work in this field before in the region. This question gave rise to the present work.

All our eels originate from larvae drifting from north of Scotland into the North Sea and Skagerak, from where they drift farther into the Baltic. Little information is available on how this drift occurs: occasionally glass eels have been found from February to April, 6-9 cm in length.

Along the Danish North Sea and Skagerak coasts A.C. JOHANSEN caught elvers during March and April. "Während dieser Monate leben sie nachts pelagisch an der Oberfläche, am Tage näher zum Boden" (NORDQVIST 1924). ÖSTERGREN found elvers in the Gullmarfjord from the middle of February to the beginning of June. Until April they are typical elvers (NORDQVIST, op.cit., p. 14).

In the Sound, elvers have been found either hidden amongst Zostera or in the harbour of Landskrona (NORDQVIST, op. cit., p. 13 and 19). LÖNNBERG (1903) found elvers in June. VALLIN (1975) reports about the contents of the intestine of elvers from the Kattegat and the Sound in 1922 and 1923.

These old finds, which were made during plankton studies with entirely different objectives, give little information about the occurrence of elvers in time and space.

Our task was first to find a method for catching elvers in a quantitative way as satisfactory as possible and then to study fluctuations from year to year.

2. Methodological investigations

Since the end of the 1960's we have tried to catch elvers with different nets in the open sea. In the Gullmarfjord experiments were carried out for the first time in 1969 to attract them with light. From these and later experiments some information was gained about the occurrence of elvers along the coast, Tab. 1 and Fig. 1. - Most of the elvers were observed during the darkest hours of the night.

The work with underwater light was time consuming. As will be seen from Fig. 1 and Tab. 1 only one station could be visited during the night. The experiments did not give any information about the vertical distribution of the elvers. During work with underwater television, which followed then, elvers were observed only in the surface layer. Horizontal and vertical hauls with plankton nets during daylight at the same stations as the night work gave no catches of elvers. We tried, therefore, to find some means of straining large quantities of water. Numerous trials were made with a high speed plankton sampler, type Gulf III, but no glass eels were caught.

We then decided to try another gear, made to catch larger species of plankton, the Isaacs-Kidd Midwater Trawl (IKMWT). This is described in Fig. 2. The mesh size in the cone was 0.5 cm bar, and when the net was stretched the meshes were almost completely closed. The trawl was used at different depths[1] according to the depth of and just above the thermocline. Since nothing was known with certainty about the vertical distribution of elvers, this was considered to be a good approach particularly as the trials were made at station after station continuously day and night. The results were totally negative, for no elvers were obtained, March 1972.

Later in 1972, in April, tows with the IKMWT at the surface during the darkest hours (2100-0300) were for the first time successful and gave an indication on the immigration routes of elvers, Fig. 3.

When using the word "surface" here, it should be borne in mind, that this, according to the construction of the IKMWT means about the top three meters.

Since 1972 the investigations have been carried out with an IKMWT, fishing at the surface during the night, avoiding twilight and dawn.

The number of elvers caught was mostly between 0 and 15 per half-hour haul with a speed of the vessel of about 2-3 knots. Elvers do not swim very rapidly, as can be observed around a lamp at the surface or in an aquarium. The towing speed is therefore quite sufficient.

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1) The depths were determined by means of wire length and angle or at a depth of > 25 m by a wireless netsonde.

This method has recently been tested in connection with 0-group surveys by Ackefors and Hagström (1975). The authors found - in general - that fish larvae in the Skagerak are closer to the surface than in the North Sea. Horizontal hauls are, in comparison to oblique hauls, somewhat easier to perform and therefore permit visits to a greater number of stations, which is of importance in our investigations.

3. Results

The results from experiments with underwater lights in April 1970 were given in Fig. 1. Later results, obtained with IKMWT, from 1972 onwards, are given in Fig. 3-8.

The fishing experiments show that elvers occur along the north coast of Denmark and in the waters between Denmark and Sweden and along the Swedish coast.

The maps must be interpreted by the permanent current system of the area: the Jutland and the Baltic currents (cf. LINDQUIST 1963). The Jutland current flows eastward from the surface to the bottom and has a velocity of at least one knot (Swedish pilots' manuals). The Baltic current follows the coast of Sweden and flows always to the north (SVANSSON 1975).

The immigration of elvers apparently takes place by drift with the Jutland current. As this current is a permanent one, the situation can be used for the calculation of the number of immigrants. This is exemplified in Fig. 3 where an area of 20 x 20 nautical miles is inserted into the map at a point where the current, so to say, is going to loose its natural boundary to the south. A distance of 20 nautical miles to the north from Denmark is considered to cover the main section of the Jutland current. A current velocity of 1-2 knots implies that in 24 hours the elvers can drift away from the 20 x 20 n.m. square and be replaced by others from the west.

For all investigated years calculations along this principle give the following results:

April	1972	$2.6\ 10^6$ elvers/day
March	1973	$0.03\ 10^6$
April	1974	$0.03\ 10^6$
February	1975	$0.3\ 10^6$
April	1975	$0.1\ 10^6$
February	1976	$0.5\ 10^6$

These figures are, of course, very uncertain and are only presented to show which order of magnitude the fluctuations do have. The figure are, after all, minimum figures, for some elvers no doubt pass through the meshes in the front part of the IKMWT.

During daytime elvers are not very active. Observations from aquaria have been confirmed by observations from the North Sea (DEELDER 1960).

These experiences indicate immigration takes place during night only, that means with a speed of 1-2 knots 6 to 12 nautical miles a night, which corresponds to 11-22 km/night. It is therefore possible, that only 1/4 to 1/2 of the a.m. number of elvers actually immigrate. There is, at the moment no way to prove this.

In any event, the immigration to the North Sea is considered to be in the order of 8 km/24 hours (TESCH 1973). This means that the Jutland current is much faster and virtually acts as a "jet stream" for elvers (and possibly many other plankton forms).

Regarding the time of immigration there are some other observations. In the Brofjord (HALLBÄCK 1974) elvers were fished from February to March/ April with the a.m., method but using a smaller IKMWT. The trout (Salmo trutta) in the same fjord consume a great deal of elvers (unpigmented), and trout stomachs are filled with glass eels during March and April (WINSTRÖM 1974) Fig. 9. The migration into fresh water starts during April/May. In a trawl haul at the end of January 1974 in the southern Kattegat ("Lysegrund") with the Swedish research vessel Thetis, a small glass eel was found in the catch; presumably it originated from a vomiting fish. NYBELIN reported a finding of glass eel in the stomach of Raja clavata (February 1921, trawl station "Soten", in NORDQVIST, op. cit., p. 14).

The yearly fluctuations in the abundance of elvers are certainly dependant on many factors. Fluctuations tend also to be greater when the number of individuals is small. JENSEN (1961) and TESCH (1973) give details on the fluctuations in the occurrence of elvers along the European coasts. JENSEN compared differences in barometric pressure between Fanø and Skagen (as an expression of west wind frequency) with the eel fishery 1912-1959. He found a positive relation between increased west wind and a greater number of immigrating elvers. There is a time difference of 7 years between elvers and eel fishery.

Summary

1. Glass eels drift with the Jutland current into the Skagerak. As the current is a rather strong one this results in a greater mean speed for elver immigration into this area than into the North Sea proper.

2. Elvers have been caught from February to April. The peak of immigration is probably during February/March.

3. During the night elvers ascend to the surface and can be successfully fished with an Isaacs-Kidd-Midwater Trawl.

4. Preliminary calculations about the number of elvers show great fluctuations from one cruise to another.

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Tab. 1. Number of glass eels which has been observed at the surface round an underwater lamp. The lamp had an effect of 500 W and hang abt. a half metre below the surface. The observer's eyes were abt. 2 m above the surface. For stations see Fig. 1. Information regarding 1969 and 1970 from ASK, BERNTSSON & LINDQUIST 1971.

Station No.	1. Kosterfjord		2. Brofjord			3. Fiskebäckskilsbukt			4. Askerö fjord	5. Marstrands-fjord	6.	7.	8.
Date	21.-22.4.69	2.4.70	16.4.69	15.4.70	6.4.72	15.4.69	6.4.70	4.4.72	7.4.70	8.4.70	14.4.70	9.4.70	13.4.70
Kl													
1930-2030		-		-	-		3	1	-	-	-	1	1
2030-2130		-		-	1		51	54	-	2	3	-	3
2130-2230		15		-	19		116	36	-	14	3	-	8
2230-2330		11		-			121	53	1	5	2	-	13
2330-0030		12	ca 25	1		ca 28	106	86	1	1	1	-	2
0030-0130	ca 60	10		1			52	71	-	4	2	-	2
0130-0230	?	3	?	-	?	?	2	13	-	4	2	-	-
0230-0330		-		-			-	-	-	7	1	-	2
0330-0430		-		-			2	-	-	1	1	-	3
Total	>60	51	>25	2	>20	>28	453	314	2	38	15	1	34

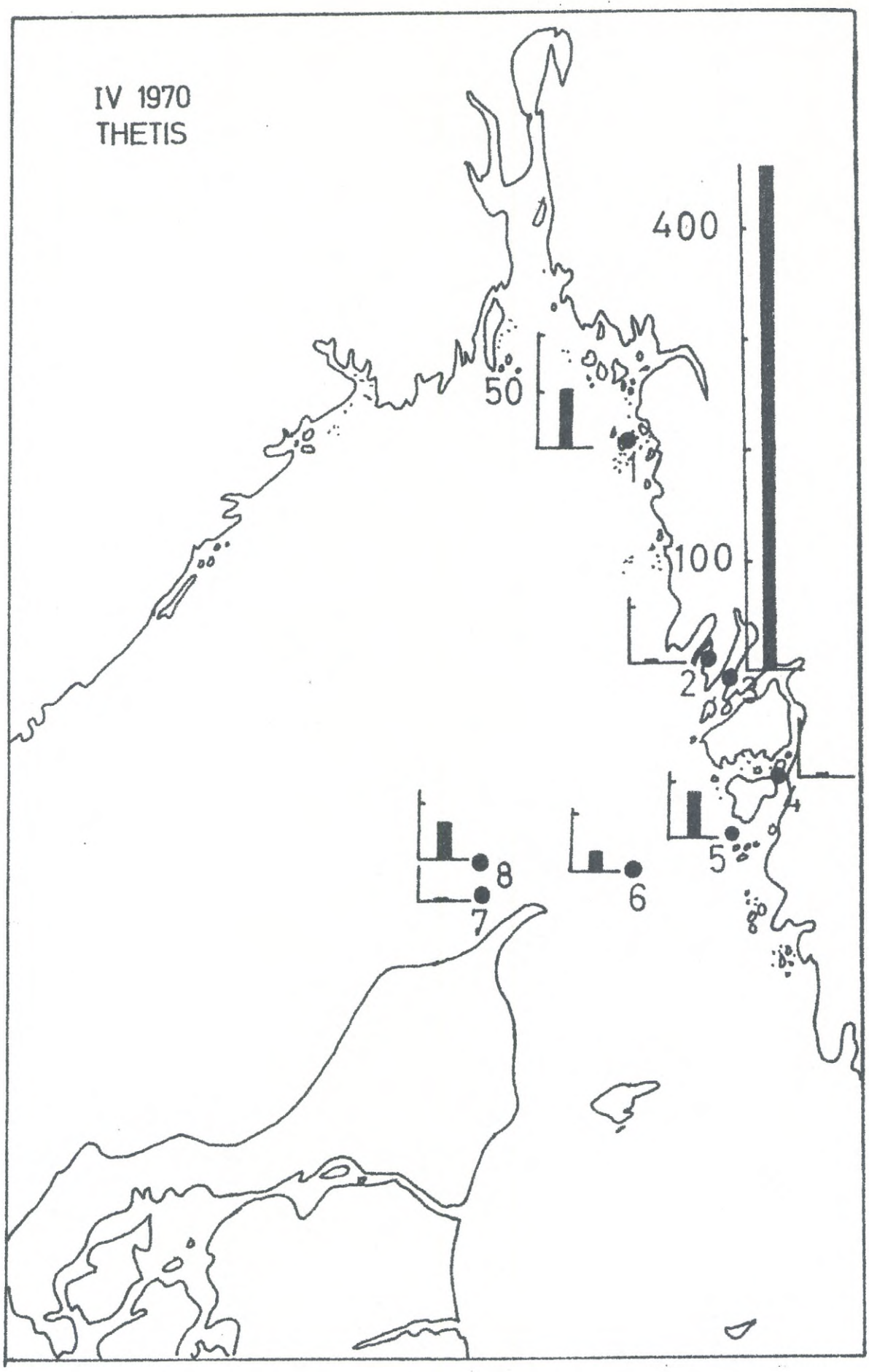

Fig. 1. Number of elvers observed at the water surface, cf. Tab. 1. From LINDQUIST 1972.

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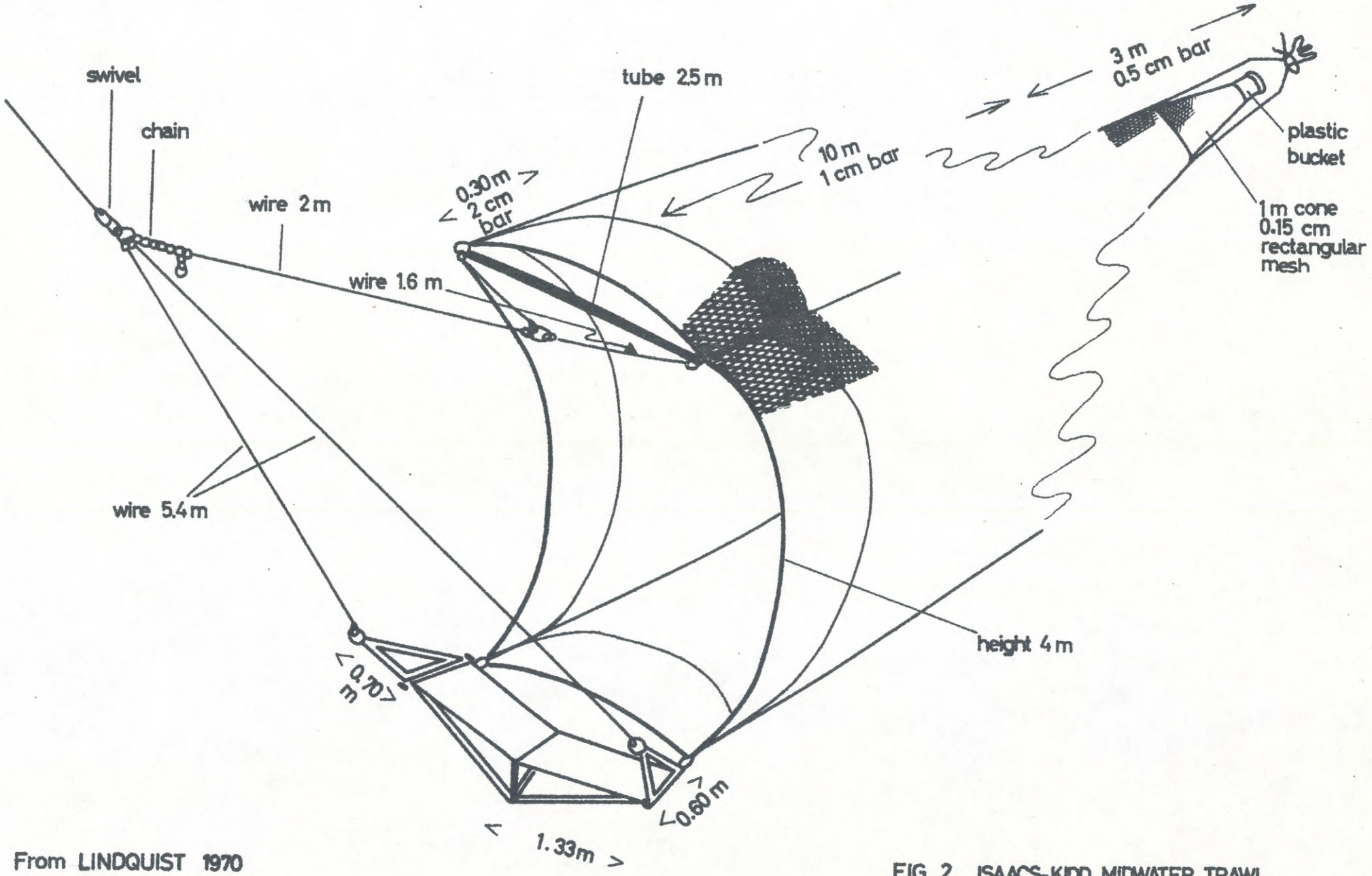

From LINDQUIST 1970

FIG. 2. ISAACS-KIDD MIDWATER TRAWL AS USED IN EEL INVESTIGATIONS

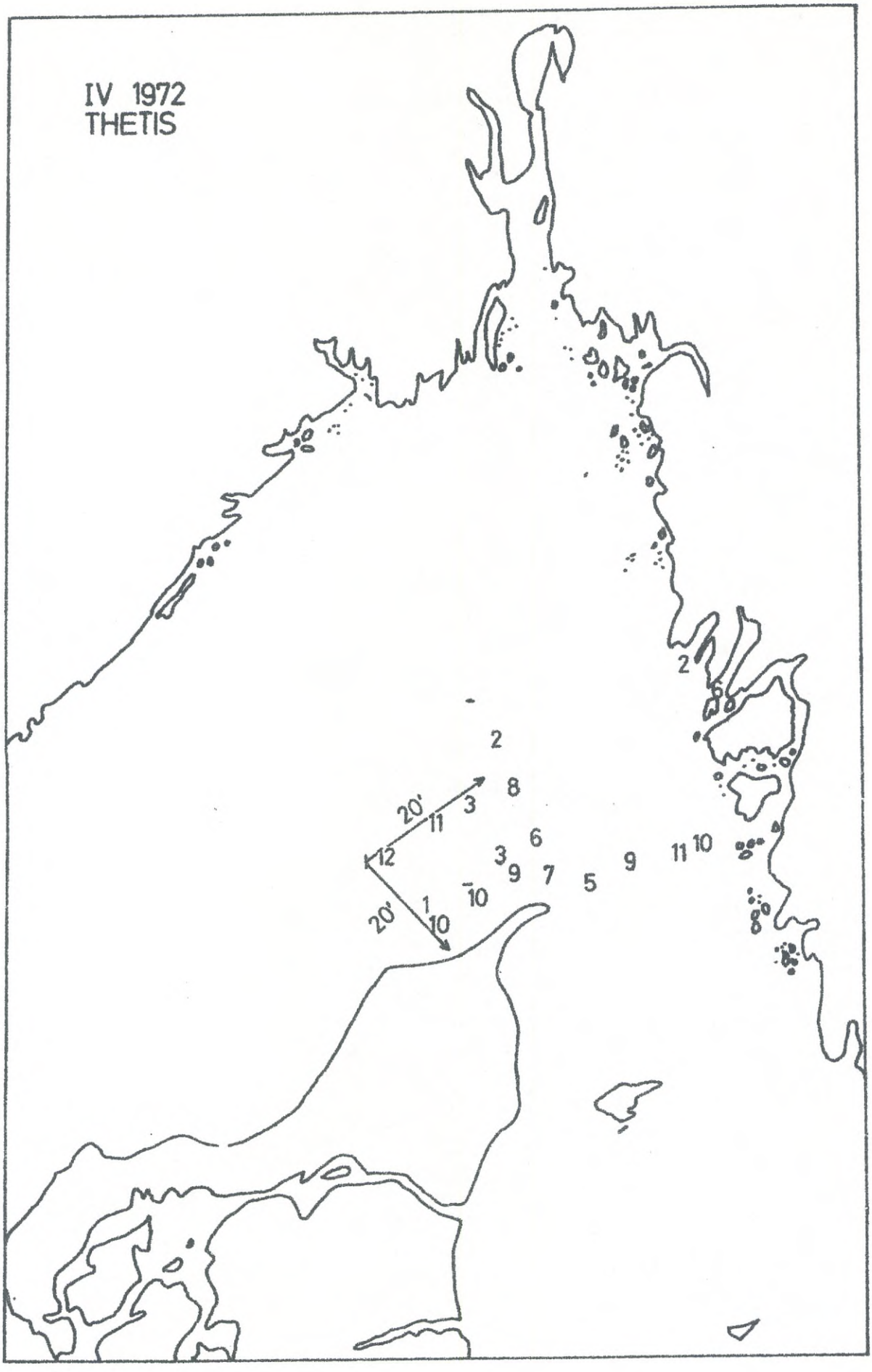

Fig. 3. Number of elvers fished during 1/2 hour surface hauls with the IKMWT. Modified from LINDQUIST 1972.

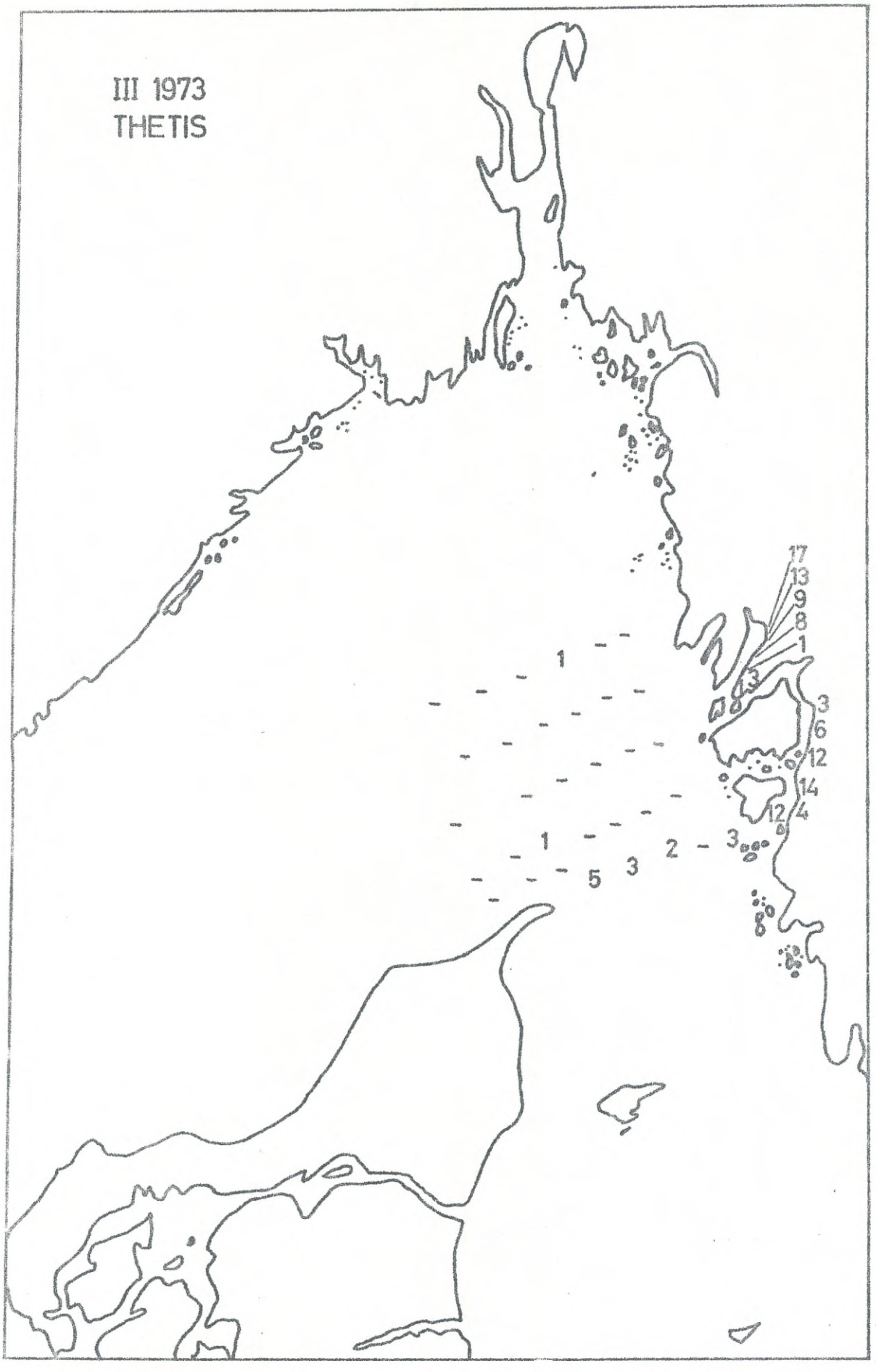

Fig. 4. Number of elvers fished during 1/2 hour surface hauls with the IKMWT

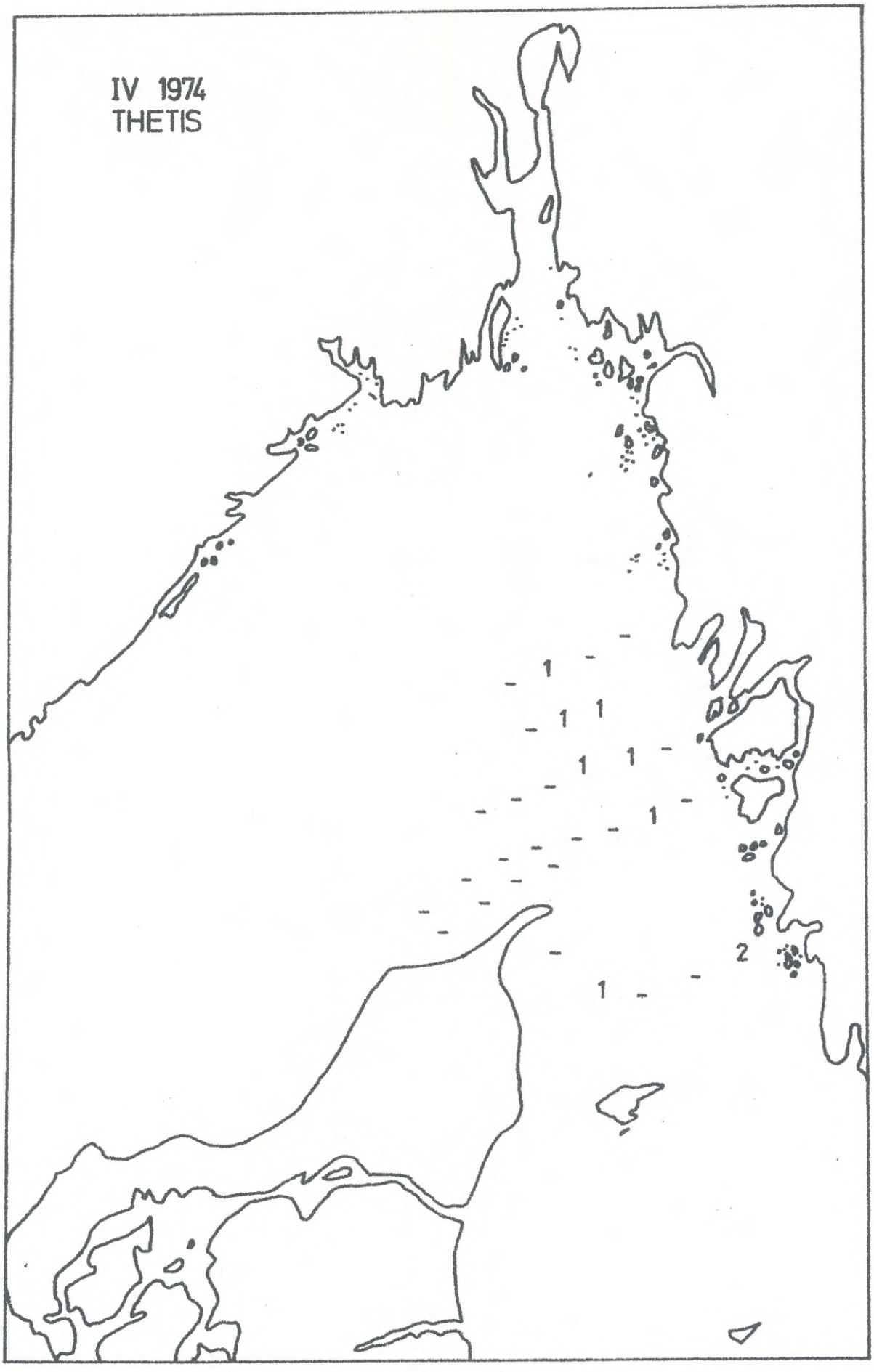

Fig. 5. Number of elvers fished during 1/2 hour surface hauls with the IKMWT.

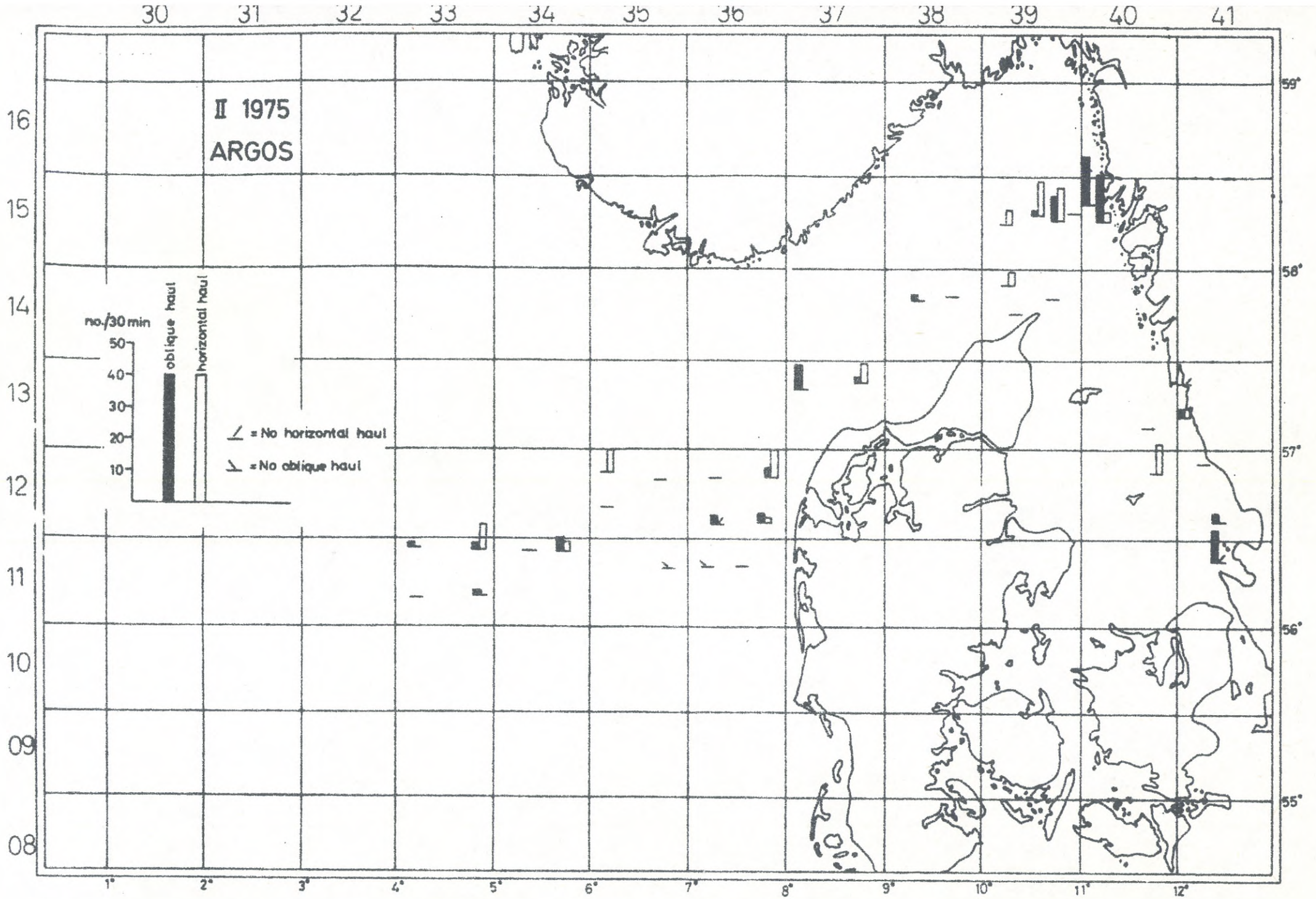

Fig. 6. Number of elvers fished during 1/2 hour surface and oblique hauls with the IKMWT. From ACKEFORS and HAGSTRÖM 1975.

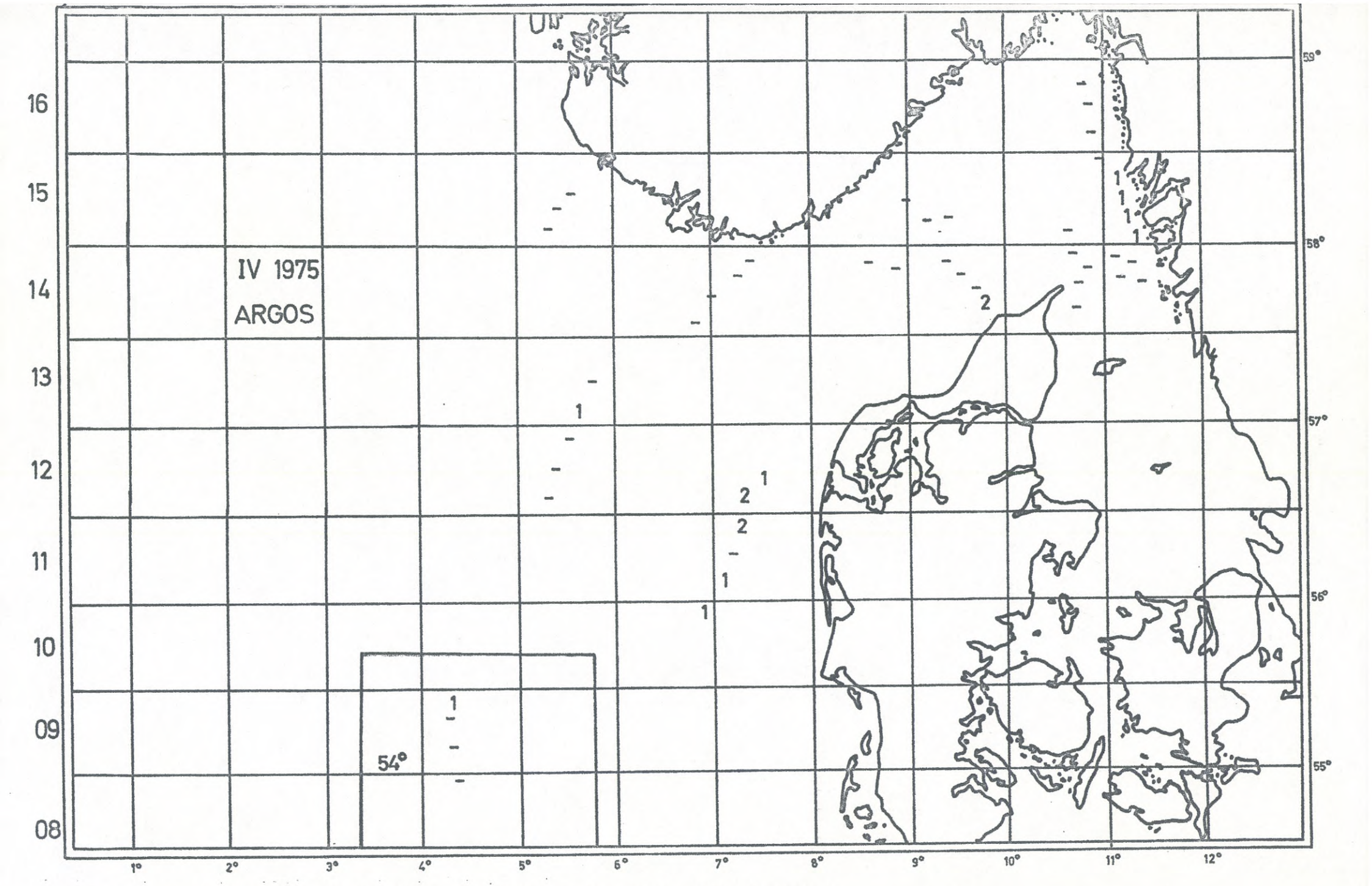

Fig. 7. Number of elvers fished during 1/2 hour surface hauls with the IKMWT.

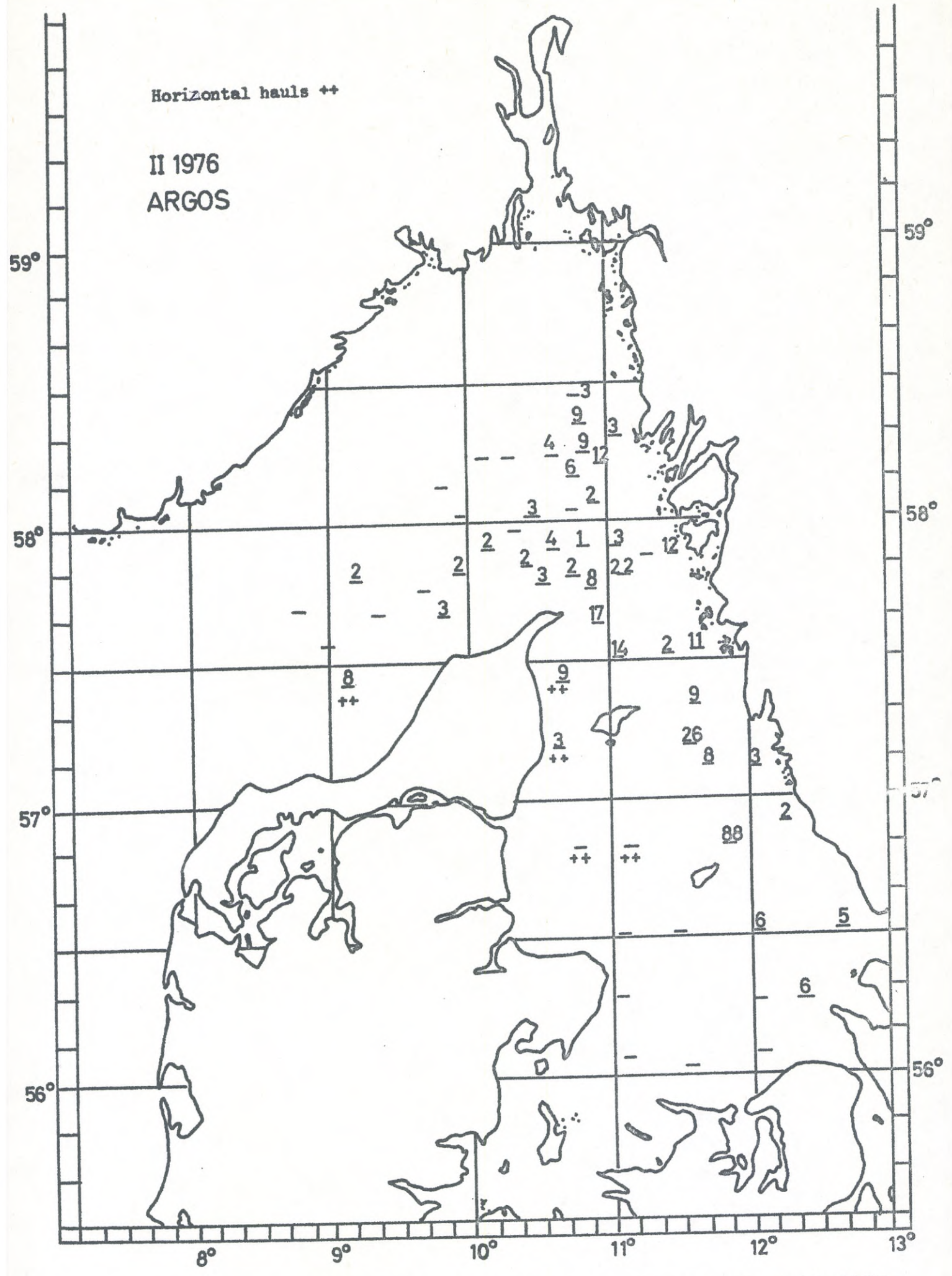

Fig. 8. Number of elvers fished during 1/2 hour oblique and surface hauls with IKMWT. With kind permission from OLLE HAGSTRÖM, unpublished.

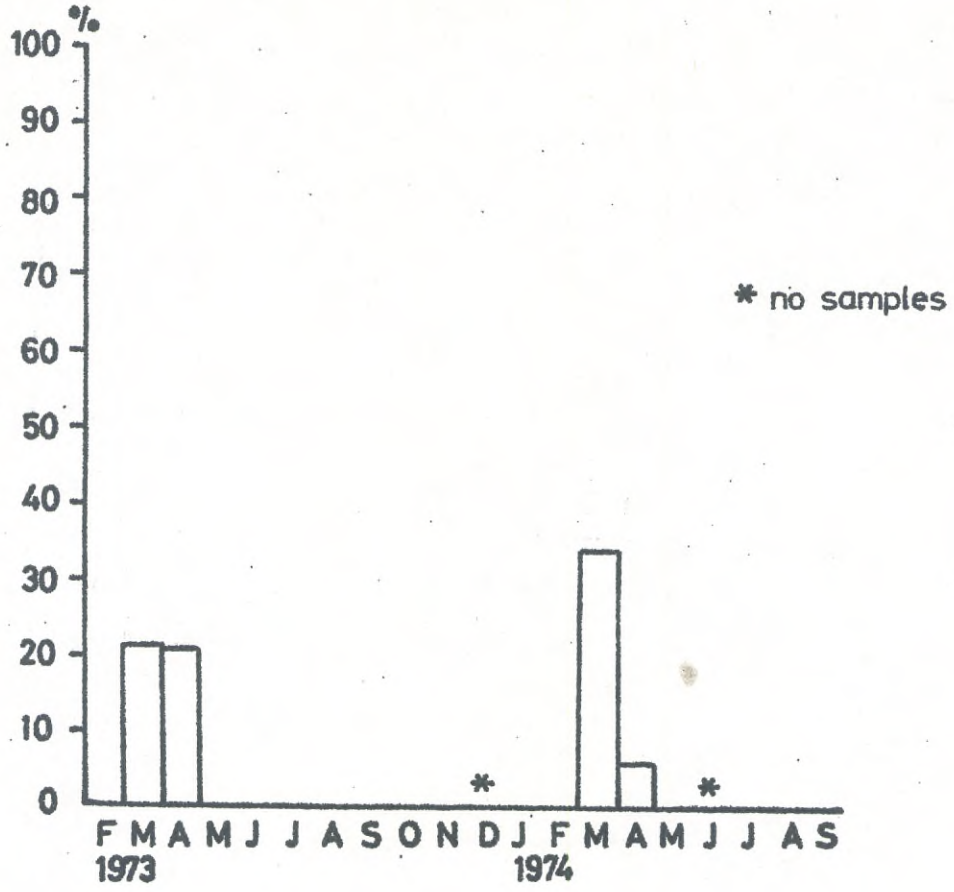

Fig. 9. Abundance of elvers in stomachs of trout in the Brofjord. From WINSTRÖM 1974.