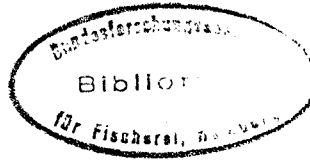


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International Council for the
Exploration of the Sea

G.M. 1975/H: 25
Pelagic Fish (Northern)
Committee



Investigations on abundance and distribution of herring
larvae in the northern North Sea and adjacent waters in
1974

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1. Summary

The abundance of herring larvae was investigated at 94 stations east and north-west of the Orkneys and in the Aberdeen Bank region from 14th - 27 th September 1974. The greatest larvae abundances in the areas investigated were, as for several years now, observed west and north-west of the Orkneys. The number of larvae found during our 1974 investigations was the lowest since 1969. As a result of this deterioration, the abundance must be regarded as below average.

2. Introduction

The investigations performed since 1962 on herring larvae were continued in 1974 during a voyage of the fisheries research vessel "Eisbär".

A research program agreed upon with the Soviet Union and the People's Republic of Poland on the investigation of herring larvae abundance in the most important spawning grounds along the eastern coasts of Scotland and England began in 1963 and has been carried out up to the present with slight modifications and only one interruption.

The results of our work have been published by Hyronimus (1971), Schultz and Hahlbeck (1970), Hahlbeck (1973) and Hahlbeck (1975). These publications and the present paper contain exclusively the results of our contribution towards the joint program.

The investigations on the abundance are intended to produce knowledge regarding the state of the spawning stocks which can be derived from investigation of the larvae and to contribute towards the estimation of herring recruitment. Such knowledge is at present particularly important since, for example, commercial herring catches are, due to fishing restrictions and prohibition, scarcely available for estimating the state of the spawning stocks. This paper will report on the abundance and distribution of herring larvae in 1974.

3. Material and methods

Ichthyoplankton stations were sampled using the "Hai" plankton sampler during the period from the 14th to the 27th of September, 1974 in the course of a voyage in the north-western North Sea and west of the Orkneys and Shetlands (ICES areas IVa and partly VIa).

Table 1 shows the number of stations visited according to sub-areas.

Table 1 Period of the investigations and number of stations

Time	Area	Number of stations	Mean number of herring larvae per sq.m. and station
16 - 22/9/74	East Orkneys (south of Fair Isle)	33	4
24 - 27/9/74	North-west Orkneys	40	4
14 - 16/9/74	Aberdeen Bank (south of 57° 45'N)	21	-

The equipment and, in principle, the methods used were the same as those which have been used since 1970.

The "Hai" stations were sampled by day and by night (Gulf III plankton sampler, built by Messrs. Hydrobios, Kiel, Monodur net, mesh size between yarn centres: 315 μ y, yarn thickness 120 μ y). The inclined hauls which are usual for herring larvae investigations were performed with the "Hai".

The speed of the ship was 5.0 - 5.5 m/s. The "Hai" was towed by means of a wire rope with a diameter of 20 mm and the lowering and hauling speeds were 0.59 - 0.66 m/s.

The depth of the "Hai" was monitored at all stations. The Japanese cable-less depth gauge (FURUNO) was used for measuring the depth. The speed of the ship and the duration of the haul were used as a basis for determining the volume of fished water because the current meter (200 mm diameter) in the inlet opening of the "Hai" had failed. The area of the "Hai" opening, and thus the cross-section of the fished water, is 0.027 m². On the assumption that no water accumulates before the opening of the net, 50 m³ of water are filtered over a distance of 1 nautical mile.

The areas were planimetered for the abundances 1 - 9, 10 - 19, 20 - 29, 30 - 39 larvae/m². In the figures, the numbers of larvae have been united to the abundances 1 - 9 and 10 - 39 for reasons of clarity. The total number of larvae was calculated by multiplying the planimetered area by the mean number for the abundances concerned. The numbers of larvae have been calculated and drawn separately for the three size groups <10 mm, 10 - 15 mm and >15 mm and have been summarised to form the total number of all fished larvae.

4. Results

The positions of the stations in the whole of the area investigated and the total number of larvae per square metre are shown in figure 2a.

As for several years, the greatest abundances of larvae in the area investigated were found in the region west and north-west of the Orkneys. A relatively greater abundance than in previous years was observed south-east of the Orkneys this year.

The greatest concentration was observed west of the Orkneys where it forms a continuous pattern with a single region of concentration. As in 1973, this area was further west than in 1970 and 1971. A considerable abundance to the north of the Orkneys was observed in 1974, as in 1973, but the concentration here was only slightly lower than the main concentration (in 1973 it was about 50 % lower than the greatest concentration).

Level with the Moray Firth, more herring fry, relative to the concentrations west and north-west of the Orkneys, were caught than in 1973. As in 1973, the larvae in this area were more than 15 mm long.

During 1973 no larvae were caught on the Aberdeen Bank (south of $57^{\circ}45'N$) and only one herring larva was found in 1974.

Figure 1 summarises the distribution of the length of the herring larvae. The arithmetic means of the length differ only slightly in the sub-areas south of Fair Isle and north-west of the Orkneys. In the region with the highest concentrations (northwest of the Orkneys), the majority of the larvae achieved a length of 10 - 17 mm, as in the area south of the Fair Isle with a lower concentration.

This result differs somewhat from that of previous years, the larvae having, for example, a length of 11 - 13 mm in 1973. The mean length for our whole area is greater than in 1973; it was 13.5 mm in 1974. In contrast to previous years, the length distribution of the herring larvae in 1974 (see fig. 1) resulted in a curve with two peaks. Larvae of all size classes (fig. 2b - d) were found in the area West Orkneys/Shetlands (up to 5 larvae/m² < 10 mm; up to 29 larvae/m² in the size class 10 - 15 mm and up to 6 larvae/m² > 15 mm).

Small larvae were observed primarily south-east of the Orkney Isles (fig. 2 b). The majority of the larvae belonged to the medium class which was found distributed throughout the whole investigated area as the predominating size class except in the Moray Firth region (fig. 2 c).

The distribution pattern of these larvae corresponds to that of 1973. Large larvae were observed in noteworthy numbers in the Moray Firth (fig. 2 d).

A relatively higher number of larvae were caught in the area south of Fair Isle than in 1971 and 1973. The suspected drift from the region west of the Orkneys-Shetlands into the North Sea appears to be noticeable in figures 2 a - d.

5. Discussion

Table 2 contains the estimates of the herring larvae abundance according to the three size classes and sub-areas for 1974 and, for comparison, the estimates from 1969 - 1973. The values for 1969 - 1973 have been revised to take the following into consideration: during

the original determination of the values for 1969 - 1973, the quantity of water fished was based only on the hauling process, whereas in the revised values both the lowering and the hauling distances of the "Hai" have been considered. This accounts for the differences in comparison to the previously published values.

Table 2

Total number ($\times 10^9$) of herring larvae in the area investigated in the North Sea and adjacent waters from 1969 to 1974.

	Period	Number of stations	<10 mm	10-15 mm	>15 mm	Total
<u>Total 1969</u>	27. 9.- 8.10.69	64	28	199	137	364
East Orkneys/ Shetlands	27. 9.- 3.10.69	22	5	74	84	163
NW Orkneys/ Shetlands	3.10.- 8.10.69	42	23	125	53	201
<u>Total 1970</u>	22.10. - 27.10.70	56	5	64	167	236
East Orkneys	22.10. -25.10.70	37	5	24	93	122
East Shetlands/ NW Orkneys	26.10.- 27.10.70	19	-	40	74	114
<u>Total 1971</u>	16. 9.- 28. 9.71	102	124	339	94	557
East Orkneys	16. 9.- 23. 9.71	44	28	62	42	132
NW Orkneys	25. 9.- 28. 9.71	40	88	245	43	376
Buchan/Aber- deen Bank	21. 9.- 23. 9.71	18	8	32	9	49
<u>Total 1973</u>	13. 9.- 24. 9.73	97	138	774	101	1013
East Orkneys	18. 9.- 20. 9.73	39	5	79	30	114
Aberdeen Bank	13. 9.- 17. 9.73	24	-	-	-	-
NW Orkneys	21. 9.- 24. 9.73	34	133	695	71	899
<u>Total 1974</u>	14. 9.- 27. 9.74	94	57	170	101	328
East Orkn.	17. 9.- 22. 9.74	33	36	78	51	165
Aberd. Bank	14. 9.- 17. 9.74	21	-	-	-	-
NW Orkneys	24. 9.- 27. 9.74	40	21	92	47	160

Compared with 1971 and 1973 (we were unable to investigate the herring larvae abundance in 1972), the low abundance in the West Orkneys in particular reflects a remarkable deterioration in the abundance of the larvae over the whole area investigated. The greatest difference between our investigations in 1974 and those of previous years is to be found in this region.

The abundance found west and north-west of the Orkneys in 1974 is about 1/5th of the abundance observed in 1973, whereas the abundance east of Fair Isle in 1974 is rather higher than that for 1973.

The numerical abundance values (see table 2) differ considerably for the whole of the investigated area from those for 1971 and 1973 (altogether about 1/3 of the 1973 numerical abundance values in 1974).

Our investigations for 1974 showed, taking into consideration the comparable periods involved, the lowest larvae abundances since 1969 - since the commencement of our work to the west and north-west of the Orkneys. The fact that we were unable to undertake investigations in 1972 has been taken into consideration. The results of the ICES Herring Larvae Program of 1972 (Saville, A. and McKay, D.W., 1973) indicate the above-average numbers of larvae for 1972, so that, in comparison to the international results, it can be said that the lowest number of larvae since 1969 was found in 1974.

Wood (1974) stresses the importance of the herring larvae production in the region west of 4°W and its importance for interpreting the results of all herring larvae investigations in the North Sea.

According to our investigations which, as in 1971 and 1973, extended beyond 4°W in this year too, the problem

of distinguishing between the larval abundance in ICES area VI a from that of the north-western North Sea (area IV a) cannot be answered. As in 1973, the larvae showed a pronounced concentration west of the Orkneys in 1974. In 1973 and 1974 it was further west than in 1970 and 1971 and merged in 1973 and 1974 at the eastern boundary with the distribution area north of the Orkneys. The three size classes of the herring larvae occurred in the same ratios in both sub-areas.

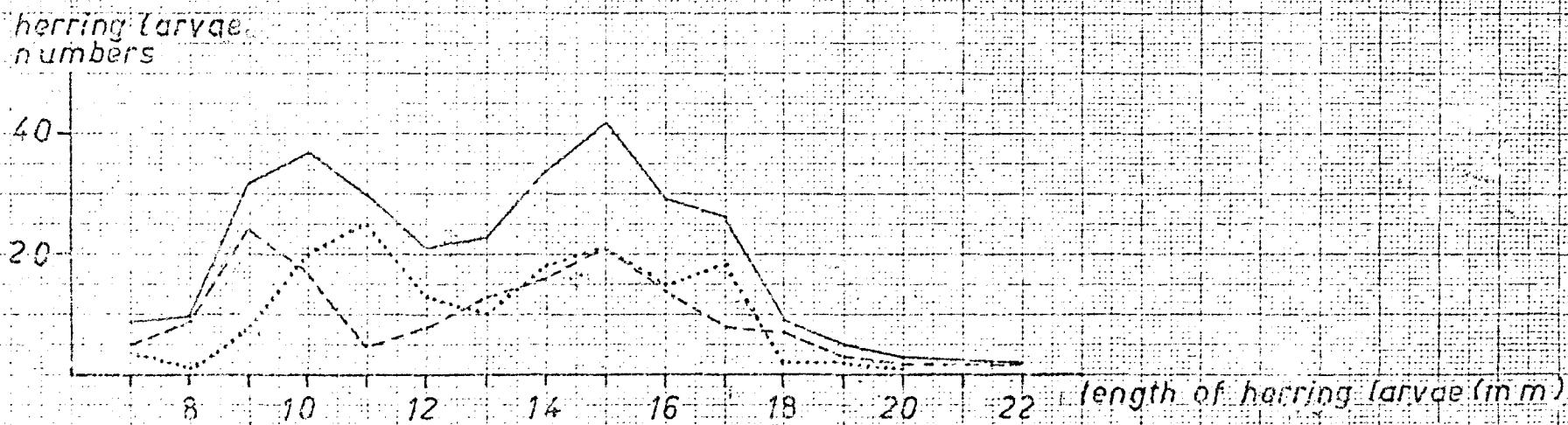
In the ICES area VIa, the larvae stocks of different origins can merge.

Our investigations have produced no direct proof for a large scale drift of herring larvae from 4°W into the North Sea which, however, occurs in some years.

6. References

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Fig.1: Length distribution of herring larvae, 1974



— total n=312
- - - south of Fair Isle n=154
..... northwest of Orkneys n=158

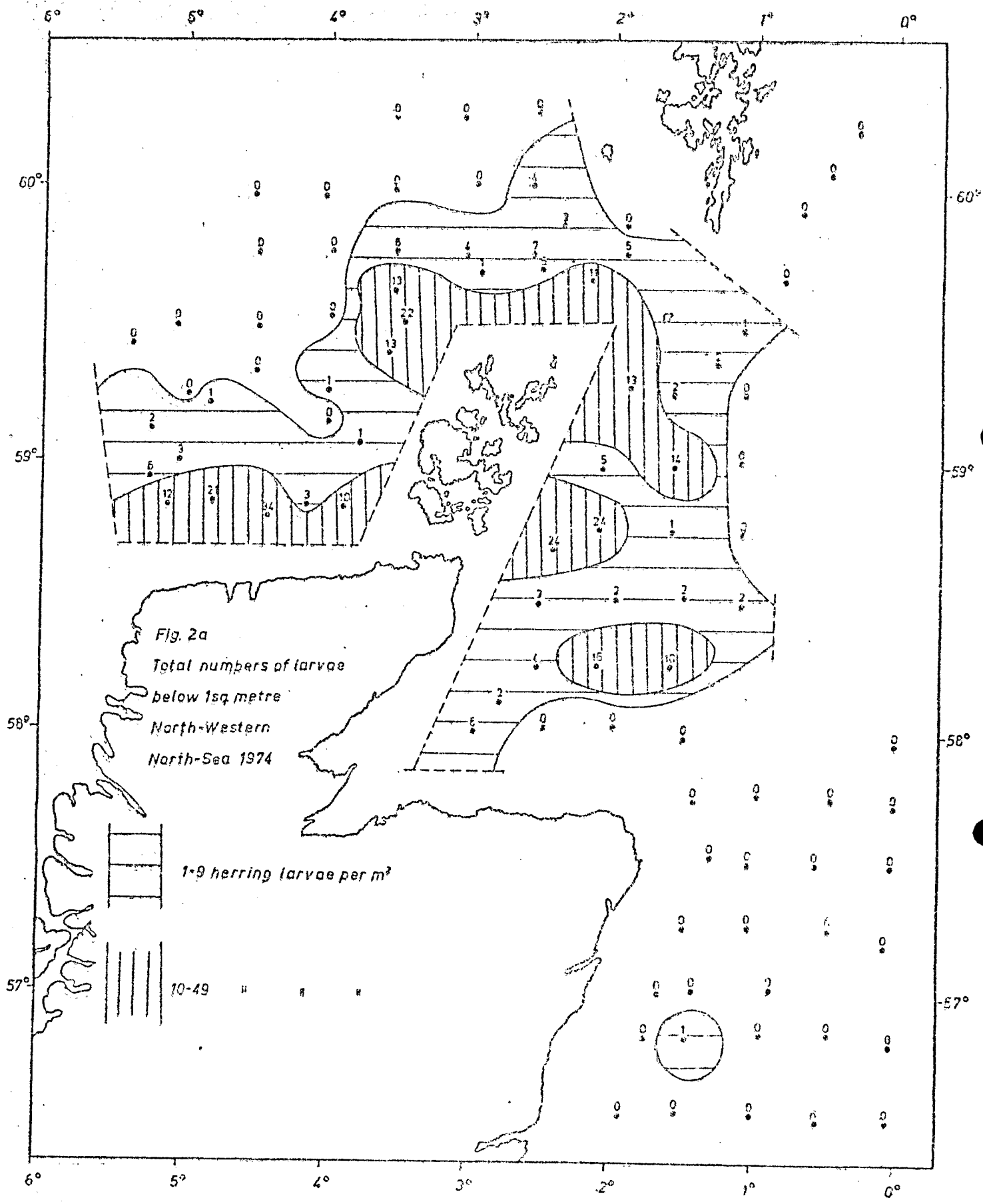


Fig. 2a
 Total numbers of larvae
 below 1sq metre
 North-Western
 North-Sea 1974

[Horizontal lines] 1-9 herring larvae per m²
 [Vertical lines] 10-49 " " "

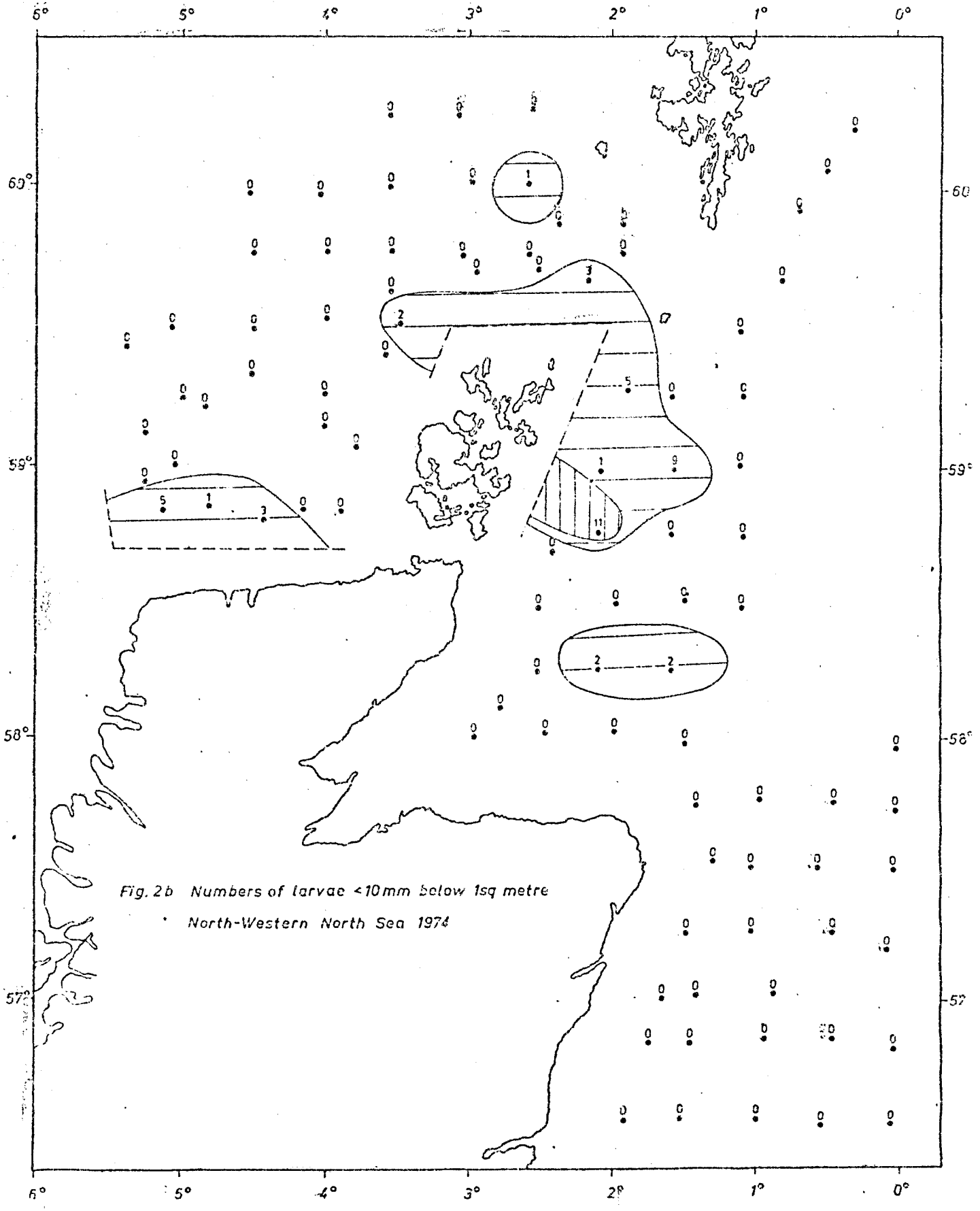


Fig. 2b Numbers of larvae <10mm below 1sq metre
 North-Western North Sea 1974

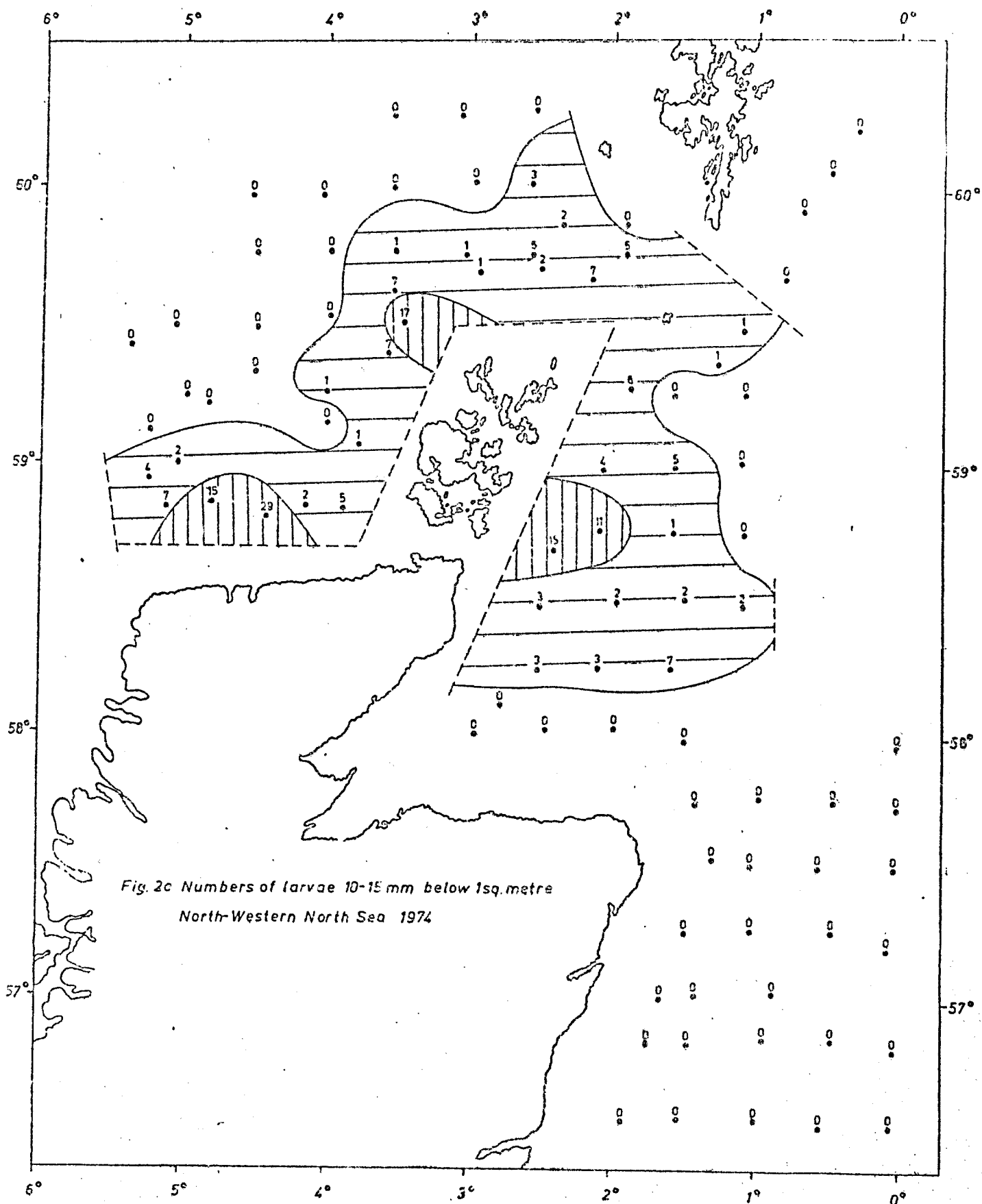


Fig. 2c Numbers of larvae 10-15 mm below 1sq. metre
North-Western North Sea 1974

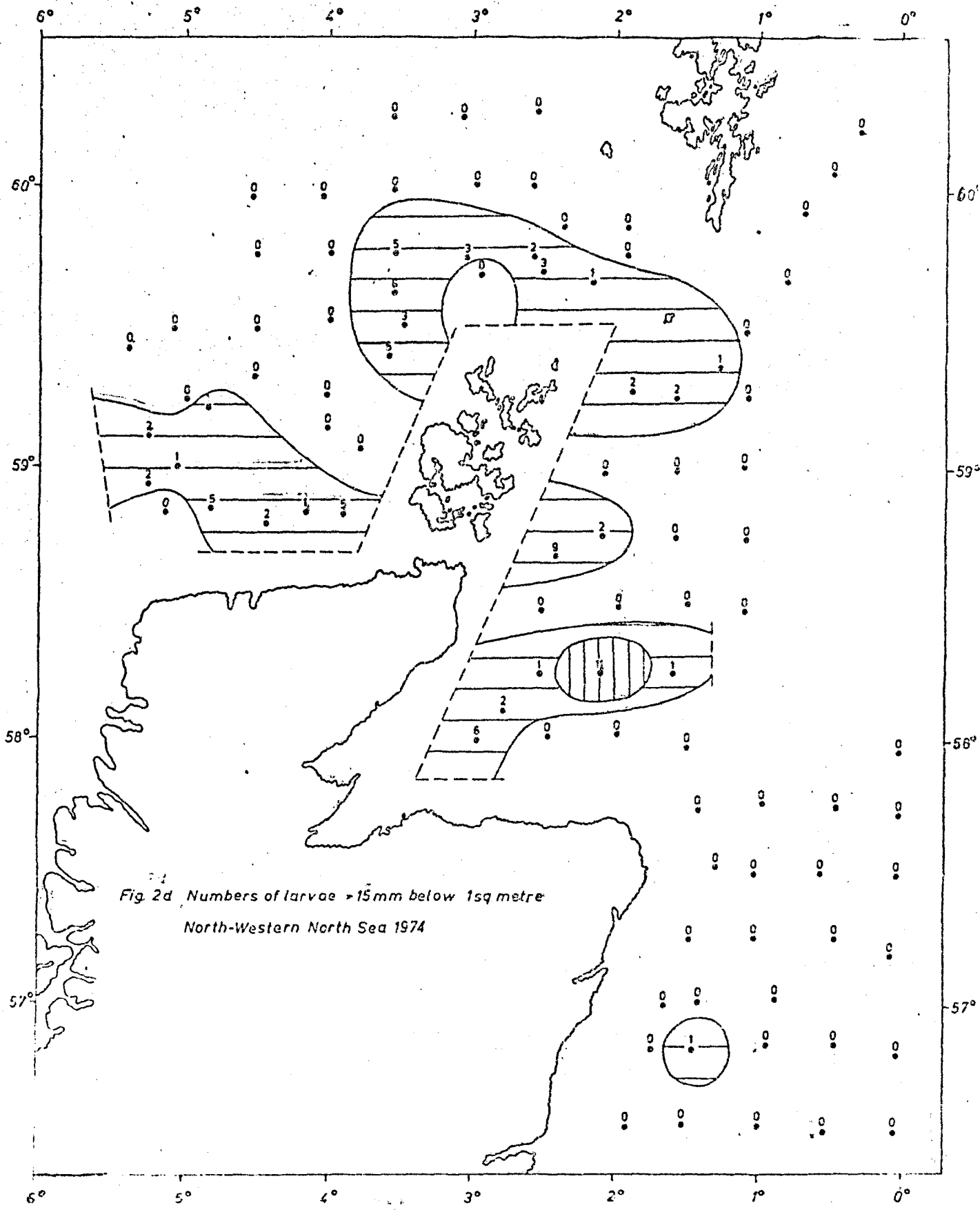


Fig 2d Numbers of larvae >15mm below 1sq metre
North-Western North Sea 1974