

Sommaire

À la suite d'une erreur systématique faite dans les calculs des nombres des larves des harengs par mètre carrée, capturées par un seul pays, il fallait évaluer de nouveau les résultats des études sur les larves de harengs entreprises à la Mer du Nord, en 1975/76. Ces données, et celles des années 1976/77 sont décrites dans ce communiqué.

Celles-ci suggèrent que, la production larvaire en 1975, dans toutes les régions sauf dans la région de Buchan était beaucoup moins importante en comparaison avec des années précédentes. En 1976 on avait calculé une certaine augmentation dans l'abondance larvaire aux îles de Shetland, néanmoins dans la région de Buchan, il est resté à un niveau très bas. Dans les secteurs au centre et au sud de la Mer du Nord, la production larvaire resta au niveau assez bas de l'année 1975.

Les chiffres portant sur l'abondance des stocks des géniteurs, dans le secteur nord-ouest de la Mer du Nord et dans la région de Whithy-Dogger, estimés selon une diminution de l'abondance larvaire contre des stocks des géniteurs, sont 89 000 tonnes pour l'année 1975 et 107 000 tonnes pour l'année 1976, pour ces deux régions prises ensemble. Ces estimations sont assez proches à celles estimées par le Herring Assessment Working Group, pour la région au sud de 62°N, qu'ont été préparées d'après les données des pecheries.

Ce communiqué décrit quelques facteurs portant sur l'organisation des futures campagnes et sur la mise en valeur de ces données en ce qui concerne l'estimation de l'abondance des stocks.

This paper not to be cited without prior reference to the authors

International Council for the
Exploration of the Sea

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REPORT ON THE INTERNATIONAL SURVEYS OF HERRING LARVAE IN THE NORTH SEA AND
ADJACENT WATERS IN 1975/76 and 1976/77

by

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Summary

Because of systematic error in calculating the numbers of herring larvae per square metre, caught by one country, the results of the North Sea herring larval surveys in 1975/76 have had to be re-appraised. These data, and those collected in 1976/77, are presented in this paper.

They suggest that larval production in 1975, in all areas except Buchan, was considerably less than in preceding years. In 1976 there was some increase in estimated abundance in the Shetland area, but in the Buchan area it was again at a very low level. In the Central and Southern North Sea larval production in 1976 remained at the low level encountered in these areas in 1975.

Spawning stock sizes in the north-western North Sea, and in the Whitby-Dogger area, as estimated from a regression of larval abundance on spawning stock size, are 89 000 tons in 1975 and 107 000 tons in 1976 for these areas combined. These estimates are close to those produced by the Herring Assessment Working Group for the area south of 62°N from fisheries data.

Some factors which have a bearing on the planning of future surveys on the utilisation of these data to estimate stock size are discussed.

Introduction

This report presents the results of the tenth international survey of herring larvae carried out in the North Sea and adjacent waters in 1976-77. It also includes a re-appraisal of the data from the ninth survey, previously reported by Jacobsen & Hansen (1976). These surveys were started in 1967 in order to monitor changes in the North Sea herring spawning stocks independently of fishery data.

Results of the previous surveys have been reported by Saville (1970), Boëtius & McKay (1970), Wood (1971), Zijlstra (1972), Schnack (1973), Saville & McKay (1974), Wood (1975) and Pommeranz (1977).

Materials and Methods

In 1975-76 five countries participated in these surveys. In 1976-77 seven countries took part; Norway, Poland and the German Democratic Republic participating for the first time in the I.C.E.S. coordinated sampling programme. On all ships sampling was carried out using a modified Gulf III plankton sampler towed in a double oblique haul. The water column was sampled from surface down to 5 metres or less above the bottom. The sampling technique has

been described in detail by Saville (1970) and Anon (1977).

Following a recommendation by the Working Group on North Sea Herring Larval Surveys (Anon, 1971) the area to be sampled is divided into four sub-areas. The timing of the surveys, with details of the countries and research vessels involved, within these sub-areas are given in Tables 1 and 2 for 1975/76 and 1976/77. In these periods a total of 938 and 920 stations were sampled respectively. Although the input of effort was fairly similar in both years the allocation of this effort to sub-areas was rather different. In 1975 the effort was fairly evenly distributed with three surveys being carried out in both the Whitby/Dogger and S Bight/Channel areas, four in the Shetland/Orkney area and two in the Buchan area. In 1976 there was considerable concentration of effort on the Whitby/Dogger area with six surveys, representing 58% of the total sampling effort, being carried out there. In the Shetland/Orkney, Buchan and Southern Bight/English Channel areas the number of surveys carried out was two, three and one respectively. Although no area was over-sampled the Shetland/Orkney area was very inadequately sampled and if the effort devoted to these surveys cannot be increased it should be allocated more appropriately.

For all areas except the Southern Bight/English Channel the larvae have been grouped into three size ranges, <10 mm, 10-15 mm, and >15 mm long. For the Downs larvae, which hatch at a greater length, the size groups are <11 mm, 11-16 mm, and >16 mm long. Abundance estimates were calculated in a similar manner to that of Schnack (1973) and Wood (1975); the abundance per square metre at each station being multiplied by the area appropriate to that station. In cases where a station was sampled more than once during a survey period, the greatest number of larvae caught was used in the calculations.

Results

1975/76 surveys - Distribution

The results of the 1975/76 surveys have been reported by Jacobsen and Hansen (1976) but it was subsequently discovered that, due to an error in the computation of the stations sampled by Dana, the data given for these positions are under-estimated by a factor of 4. It has therefore been necessary to re-analyse these data to ensure that the results are comparable with those of other years. The results from the various surveys in 1975/76 are shown in Figs. 1 - 17. These have been contoured at levels of 1, 25 and 100 larvae/m² surface to illustrate centres of abundance.

Shetland/Orkney

A total of four surveys was carried out in this area, but as the Scottish and English ones overlapped in time and sampled rather different areas the data have been combined to give a more complete coverage (Figs. 1 and 2). On the first survey, from 3 - 19 September, the major concentrations of recently hatched larvae (<10 mm long) were found to the north of the Orkney Islands. Larvae in the 10 - 15 mm length range were widely distributed over the surveyed area but at lower densities than the small larvae. On the second survey, 10 - 24 September, the main concentration of small larvae was located in the area west of Orkney (Fig. 3). Larger larvae (10 - 15 mm long) were also most abundant in that area, although there was a wider spread of this age group to the north and east of the islands, (Fig. 4). On the third survey, 20 - 25 September recently hatched larvae (<10 mm long) were largely confined to a small area off Clythness (Fig. 5). Larvae in the 10 - 15 mm length range were generally distributed around the Orkney Islands with the major

concentrations being to the west of the islands (Fig. 6). Larvae >15 mm long, which had not been taken on the preceding surveys, were widely distributed over most of the surveyed area (Fig. 7), but generally at low densities.

The timing of the surveys in this area overlapped quite considerably but even so there were variations in the distributions of the newly hatched larvae on these three surveys. It would appear that there was a gradual progression of spawning from north to south, even in the short time period covered by the surveys.

Buchan

One complete and one partial survey of the Buchan area were carried out during September and early October 1975. During the first survey, 5 - 11 Sept, the whole survey area was covered. Newly hatched larvae were found over a fairly wide area to the north-east of Aberdeen (Fig. 8). Older larvae were found at low densities in a similar area (Fig. 9). On the partial survey, 30 September - 2 October, very few larvae in the <10 mm and 10 - 15 mm length groups were caught but larvae >15 mm long were rather more abundant although densities were less than 5 per m² surface.

Whitby/Dogger

Three surveys of this area were carried out during September and October 1975. On the first survey, 15 - 23 September newly hatched larvae (<10 mm long) were found in two patches, the major one stretching along the coast from the Tees north to the Farne Islands with a smaller patch being located off Whitby (Fig. 10). Larvae in the 10 - 15 mm length range had a similar distribution except that for this size group the patch off Whitby was the larger one (Fig. 11). No larvae >15 mm long were caught. On the second survey, 8 - 14 October, newly hatched larvae (<10 mm long) were largely confined to a patch off Flamborough Head (Fig. 12). Larger larvae (10 - 15 mm and >15 mm long) were widely distributed along the coast from the Humber north to the Farne Islands (Figs. 13 and 14) with the highest densities being recorded off Flamborough Head. On the third survey newly hatched larvae were taken only in a small patch south east of Flamborough Head (Fig. 15). Older larvae (10 - 15 mm and >15 mm long) were chiefly confined to a more widespread patch north and east of Flamborough Head (Figs. 16 and 17).

Southern Bight/English Channel

This area was surveyed three times during December 1975 and January 1976. On the first survey, 8 - 19 December, larvae in the <11 mm and 11 - 16 mm length groups were found at low densities (<10/m² surface) at a few stations in the north-eastern part of the Bay of the Seine and off Dieppe. Larvae >16 mm long were located at very low densities (<1/m² surface) at only two stations in the northern part of the survey area. The second and third surveys covered overlapping time periods and have been treated as a single survey. Newly hatched larvae (<11 mm long) were recorded from a small, low density (<5/m² surface) patch west of Dieppe. Larvae in the 11 - 16 mm length range were located over a rather larger area north of Dieppe, but at low densities (<10/m² surface). Larvae >16 mm long were encountered at a few scattered stations in the Bay of the Seine and north of Dieppe.

1976/77 surveys - Distribution

The results from all the surveys carried out during 1976/77 are shown in Figs. 18 - 48. These have been contoured at 1, 25 and 100 larvae/m² to show the centres of abundance.

Shetland/Orkney

During 1976/77 the Shetland/Orkney area was surveyed twice. On the first survey (4 - 11 September) recently hatched larvae (<10 mm long) were found over a wide area from Fair Isle north and west to Foula, at densities up to 397/m² surface (Fig. 18). Larvae in the 10 - 15 mm length range were more generally distributed over much of the surveyed area. The maximum density of 32 larvae/m² was observed north west of Westray (Fig. 19). Larvae >15 mm long were found at a few widely dispersed stations at densities <5/m² (Fig. 20). On the second survey (13 - 23 September) small larvae (<10 mm long) were found to the north east of the Orkney Islands (Fig. 21). The highest concentration in that area was 49 larvae/m². Larvae in the 10 - 15 mm length range were generally distributed around the Orkney Islands at rather low densities (Fig. 22). Larvae >15 mm long were sporadically distributed at densities less than 5 per m² (Fig. 23).

Buchan

The Buchan area was surveyed three times during September 1976. On the first survey (6-17/9/1976) larvae were present only in small numbers, mostly in the size groups >10 mm long (Fig. 24 - 26). The majority of the larvae were found east of Aberdeen. On the second survey (24-28/9/1976) larvae were again only found in very low numbers (Fig. 27 - 29), with the majority being in the 10 - 15 mm length range. The major concentrations were again found east of Aberdeen. The third survey in the Buchan area (Fig. 30) was a wide ranging offshore one in which larvae, mostly >15 mm long, were taken at low densities (<2 per m² surface).

Whitby/Dogger

This area was the most adequately surveyed with 6 surveys being carried out during September and October 1976. Two of these surveys however overlapped considerably in time (Table 2). On the first of these surveys (3-14/9/1977) newly hatched larvae (<10 mm long) were located over a fairly extensive area from Whitby north to the Farne Islands, with a maximum density of 90/m² being found off Blyth (Fig. 31). Larvae in the 10 - 15 mm length range were located off Middlesbrough and Whitby but at generally very low densities (Fig. 32).

On the second survey (16-24 September) newly hatched larvae were found in two large patches, one covering an area very similar to that of the previous survey and the other off Flamborough Head (Fig. 33). The maximum density of larvae found on this survey was 61/m² surface, in the area off Flamborough Head. Older larvae (>10 mm long) were found over a wide area from the Tyne south to the Humber, with the major concentration (130/m² surface) being again found off Flamborough Head (Fig. 34 and 35).

On the third survey (28 Sept - 10 Oct) newly hatched larvae (<10 mm long) were very scarce, and at only one station, off Flamborough Head, were densities as high as 5/m² surface observed (Fig. 36). Larvae >10 mm long were again found over a wide area from the Tyne south to the Humber with the maximum density, 74/m² surface, off Flamborough Head (Fig. 37 and 38). The fourth survey was a wide ranging offshore one covering the period 8 - 22 October.

On this survey very few larvae were caught, almost all of which were greater than 15 mm long (Fig. 39).

The last two surveys covered much the same time period, 19 - 25 October. Although the surveys located larvae in much the same area, off Scarborough, (Fig. 40 - 45) the densities found were rather different. That carried out by the Netherlands indicated that larvae were almost twice as numerous as the Norwegian data would suggest. This question is more fully discussed later.

Southern Bight/English Channel

This area was only sampled once, in January 1977 (Figs. 46 - 48). On this survey larvae were very scarce with small numbers <11 mm long, being found in the Sandettie area. Older larvae were found at the eastern end of the Channel and in the Bay of the Seine.

Quantitative estimates

The major aim of these surveys is to monitor changes in larval production as a measure of spawning stock size. In Tables 3 and 4 the estimated abundances for the three size groups of herring larvae in each survey period are given for 1975/76 and 1976/77 respectively.

The results as in previous years since these surveys began, suggest that in 1975 and in 1976 the larval production in the Shetland/Orkney area formed the major part of that for the North Sea population as a whole. Saville & McKay (1974) pointed out the problems in estimating total larval production from data of the type produced by these surveys and suggested that the best approach might be to obtain relative measures of spawning stock size by comparing estimates of larval abundance obtained from surveys carried out at similar times in each year. It should be noted however that even to do this demands that there is little year to year variation in the timing of larval production within an area. From this type of comparison it would appear that the spawning stocks, in all areas except Buchan, in 1975 were considerably below the levels of the previous year.

The 1976 surveys produced a different picture with production in the Shetland/Orkney area showing some apparent recovery, at least in the earlier survey. In the Buchan area larval abundances were much lower than in 1975 and had indeed reverted to the very low levels observed in the late 1960's.

In the Whitby/Dogger area larval abundances were appreciably higher on the second survey in 1976 than on the comparable one in time in 1975 but on subsequent ones were very much lower. In the Southern Bight/Channel area larval abundances were maintained at the very low level of recent years. In the Report of the Working Group On North Sea Herring Larval Surveys (Anon, 1977a) regressions are given relating larval abundance in the north western North Sea, and in the central North Sea, to estimates derived from VPA's of the spawning stocks in these areas. From the larval abundances in Tables 3 and 4, and using these regression equations the spawning stocks in these areas in 1975 and 1976 have been calculated as shown in the text table below:

	North-Western	Whitby/Dogger
1975	66 000 tons	23 000 tons
1976	84 000 tons	23 000 tons

These estimates for the north-western area are somewhat greater than those estimated from larval data in the Report of the Herring Assessment Working Group for the Area South of 62°N (Anon, 1977b), because of the re-estimation of larval abundance for 1975 mentioned in the Introduction and because at the time the Assessment Working Group met only part of the 1976 data for this area was available. The summation of these new estimates from the larval data in 1976 are much closer to the Assessment Working Group's estimate of spawning stock from VPA for the total North Sea, although they would still suggest that the latter estimate may be somewhat too high. It would seem inconceivable that the Downs spawning stock was of the order of 50 000 tons in 1976, as would be required to bring the two estimates into agreement.

Discussion

To use the data from these larval surveys to estimate either absolute or relative stock sizes in a more precise way it will be necessary to estimate either total production or total standing stock from a seasonal curve of larval abundance. The inability to do this with the present data is largely due to the extent of the problem being tackled. Because herring in the North Sea spawn over a wide area and an extended time period, to do so involves the expenditure of a large amount of research vessel effort. To help optimise the use of this effort the North Sea has been divided into four sub-areas and each area is surveyed as often as possible during the hatching period.

It has however been the case that surveys have attempted to cover the whole of one area eg Shetland/Orkney and so have taken a long time to complete. Spawning within these large areas is not, however, a single event but a series of isolated events on individual spawning grounds. It might therefore be a better approach to concentrate the available effort on restricted and more frequently repeated surveys of known spawning sites over the period which is critical to them. The production on the individual sites can be summed to produce a total for the sub-area and the season.

At present not enough is known of the shape and timing of these hatching curves for individual spawning sites. The 1975 surveys of the Orkney/Shetland area, which covered only the period 3 - 25 September indicated at least three major spawning sites, each of which was only apparent on one survey. To obtain measures of either relative changes in spawning stock size or more absolute estimates of stock size using the regressions would seem to demand some assumptions about the shape of the curve of larval production during a season, and about the constancy of its timing between seasons, irrespective of variations in amplitude. This question has been discussed by Saville and McKay (1974) and by Wood (1975). In particular the latter author produced some data which suggested that within each of the discrete spawning areas in the Central North Sea the larval production within a season might be defined by a normal curve and that, within each spawning area, the timing of the modes of these curves did not differ very radically.

As this is a question of considerable importance in the interpretation of the data from these surveys it has been re-examined, using the additional data which has become available for the central North Sea spawning grounds since Wood's analysis.

In none of the other areas sampled are there sufficient observations, even in any one year, to make such an approach possible.

25 000 tons	25 000 tons	1975
25 000 tons	6. 25 000 tons	1976

The data available, in substantial agreement with Wood's findings, suggest:

- (a) that in the distinct spawning areas (Longstone, Whitby and Dousing) in the central North Sea the larval production curve can as a reasonable first approximation be fitted to a normal curve.
- (b) that at least in most years the timing of the modes of these production curves differs appreciably; with Longstone normally being earliest and Whitby and Dousing some weeks later.
- (c) within a spawning area there can also be considerable variation in the timing of the mode from year to year.

The latter point is the one on which there is some discrepancy between these results and those reported by Wood (1975). In this investigation the estimates of abundance for larvae less than 10 mm long, for each survey, in each of the years 1972 - 76 were fitted to a normal curve by a computer program which also produced the basic parameters of the fitted curves. The timing of peak production for the distinct spawning areas, as estimated by this computer program, are given in the text table below:

Year	Longstone	Whitby	Dousing
1972	10 September (8.1)	5 October (5.0)	
1973	4 September (14.4)	6 October (12.8)	26 September (5.7)
1974	25 September (6.5)	25 September (5.8)	26 September (5.7)
1975	23 September (6.5)	1 October (8.1)	15 October (11.2)
1976	28 August (13.0)		18 September (7.0)

These suggest a considerable variation in the timing of peak hatching, of about a month, in the case of Longstone and Dousing and a rather smaller one of about 12 days in the case of Whitby. The same computer program also gives estimates of the standard deviation of the normal curves fitted to the data, which is a measure of the distribution of larval production about these modes. These are also given in the text table above. Apart from some markedly higher values, which are probably the result of the inadequacies of the input data in those years, they would suggest that the standard deviation lies in the range 5 - 8 days. This would mean that practically all of the larval production within any one spawning site takes place within a period of 30 - 48 days and 90% of it within a period of 17 - 26 days. This type of data, if more firmly based, could have major repercussions on the planning of sampling in these surveys and on the precision with which spawning stock size can be estimated from the data produced by the larval surveys.

Inherent in the fitting of normal curves to these data is the assumption that all estimates are equally valid ones of standing stocks of larvae at the time the sampling was carried out. A number of factors are likely to make this a dubious assumption: (a) in some cases there are considerable variations in the intensity of, and distribution of, sampling within a spawning site between surveys;

(b) the surveys have been done by a number of countries whose sampling efficiency may differ; etc.

The latter point has previously been discussed in relation to these herring larval surveys, by McKay (1974) and Wood (1975) and their results pointed to differences between England, Netherlands and Scotland in the estimates of standing stocks of larvae when sampling in approximately the same area and time period. This problem is likely to have been increased in 1976 when three additional countries participated in the surveys. Unfortunately the data available for that year are totally inadequate to estimate any differences in "sampling efficiency" between the new participants, and those of longer standing. The sampling by the German Democratic Republic in the Shetland area and by Poland in the Buchan and Central North Sea areas had no overlap in time with sampling in these areas by other participants. Norwegian and Dutch vessels surveyed the Whitby/Dogger area in 1976 in the period 19 - 25 October and the estimates of total larval standing stock from these two surveys differed by a factor of three.

This however does not necessarily mean that one of these countries was catching three times as many larvae as the other, under identical conditions, since the distribution of sampling in time and space between the surveys differed very significantly. As a result the data are not suitable to do any precise test of whether these two countries were catching significantly different numbers of larvae when sampling under the same conditions. A rough test of this, by taking catches per square metre, over all statistical squares sampled by the two vessels within a maximum interval of four days and applying a χ^2 test to the goodness of fit with the catches grouped into categories of 0, <1 and >2 suggested that the differences were not significant. However because of the variability of herring larval abundance over small area and time differences: this is a very rough test and too much reliance should not be placed on the result quoted above. In the light of previously reported differences between countries and the number of new countries which have recently joined these co-ordinated surveys there is a pressing need for a planned programme to measure the variability between participating countries in the "efficiency" with which they sample herring larvae.

In view of the major role which the North Sea herring larval surveys are likely to play in assessment in the immediate future, when regulation of the fisheries will make direct catch data unavailable or difficult to evaluate, it would seem necessary to look more critically at the current sampling strategy, and the utilisation for assessment, of the data collected. Key elements in this will be:

(a) a more critical examination of the data available on inter-ship differences in catching larvae under comparable conditions, (b) to use past data to try and establish key areas, and periods within these areas, in which sampling effort should be concentrated, (c) to look at methods of obtaining more accurate and precise estimates of larval production and hence of spawning stock size. It is hoped that the 1977 surveys will provide greater overlap in sampling between vessels from different countries to allow (a) to be done; if not it may be advisable to mount experiments specifically for this purpose in 1978. The planned programme for the surveys in 1977 should also result in a greater sampling intensity in each of the major spawning areas which will allow better estimates of the variations with time in larval production within discrete spawning areas. However if these data are to be used for redesigning the survey strategy for 1978 it will be essential that all countries analyse the material collected in 1977 quickly, so that the results are available by early spring.

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Table 1 Surveys carried out in 1975/76

Area	Period	Country	Vessel	Number of stations	
				per survey	total
Shetland/ Orkney	3-19 Sept 1975	Scotland	Clupea	87	347
	6-13 Sept 1975	England	Corella	68	
	10-24 Sept 1975	Denmark	Dana	102	
	20-25 Sept 1975	Fed German Rep	Anton-Dohrn	90	
Buchan	1 Sept 1975	Scotland	Clupea	46	61
	30 Sept-2 Oct 1975	Scotland	Clupea	15	
Whitby/ Dogger	15-23 Sept 1975	Netherlands	Tridens	104	299
	8-14 Oct 1975	England	Corella	105	
	21-29 Oct 1975	Netherlands	Tridens	90	
S Bight/ English Channel	8-19 Dec 1975	Netherlands	Tridens	121	231
	7-29 Jan 1975	Netherlands	Willem- Beuklaz	49	
	16-19 Jan 1976	England	Clione	61	

Table 2 Surveys carried out 1976/77

Area	Period	Country	Vessel	Number of stations	
				per survey	total
Shetland/ Orkney	4-11 Sept 1976	Fed German Rep	Anton-Dohrn	91	179
	13-23 Sept 1976	German Dem. Rep	Eisbar	88	
Buchan	6-17 Sept 1976	Scotland	Clupea	73	138
	24-28 Sept 1976	German Dem. Rep	Eisbar	50	
	27-29 Sept 1976	Poland	Birkut	15	
Whitby/ Dogger	3-14 Sept 1976	England	Corella	130	538
	16-24 Sept 1976	Netherlands	Tridens	68	
	28 Sept-10 Oct 1976	England	Corella	132	
	8-22 Oct 1976	Poland	Birkut	41	
	18-23 Oct 1976	Netherlands	Tridens	98	
	19-25 Oct 1976	Norway	Havdrøn	69	
S Bight/ English Channel	3-7 Jan 1977	Netherlands	Tridens	65	65

Table 3 Estimated abundances of herring larvae on the various surveys of the North Sea and adjacent water in 1975/76.

Area	Period	Abundance of herring larvae x 10 ⁻⁹			
		<10 mm	10-15 mm	>15 mm	Total
Shetland/Orkney	3-19/9/1975	455	391	6	852
" "	10-24/9/1975	116	352	8	476
" "	20-25/9/1975	66	605	170	841
Buchan	5-11/9/75	231	12	0	243
" "	30/9-2/10/1975	1	1	8	10
Whitby/Dogger	15-23/9/1975	91	84	0	175
" "	8-14/10/1975	79	708	35	822
" "	21-29/10/1975	8	206	62	276
		<11 mm	11-16 mm	>16 mm	
S Bight/Channel	8-19/12/1975	3	3	1	7
" "	7-29/1/1976	4	9	2	15

Table 4 Estimated abundances of herring larvae on the various surveys of the North Sea and adjacent waters in 1976/77.

Area	Period	Abundance of herring larvae x 10 ⁻⁹			
		<10 mm	10-15 mm	>15 mm	Total
Shetland/Orkney	4-11/9/1976	1732	162	8	1902
" "	13-23/9/1976	63	149	9	221
Buchan	6-17/9/1976	1	12	4	17
" "	24-28/9/1976	1	9	2	12
Whitby/Dogger	3-14/9/1976	86	19	-	105
" "	16-24/9/1976	137	270	8	415
" "	28/9-10/10/1976	4	107	14	125
" "	18-23/10/1976	12	10	17	39
" "	19-25/10/1976	5	2	6	13
		<11 mm	11-16 mm	>16 mm	
S Bight/Channel	3-7/1/1977	2	5	+	7

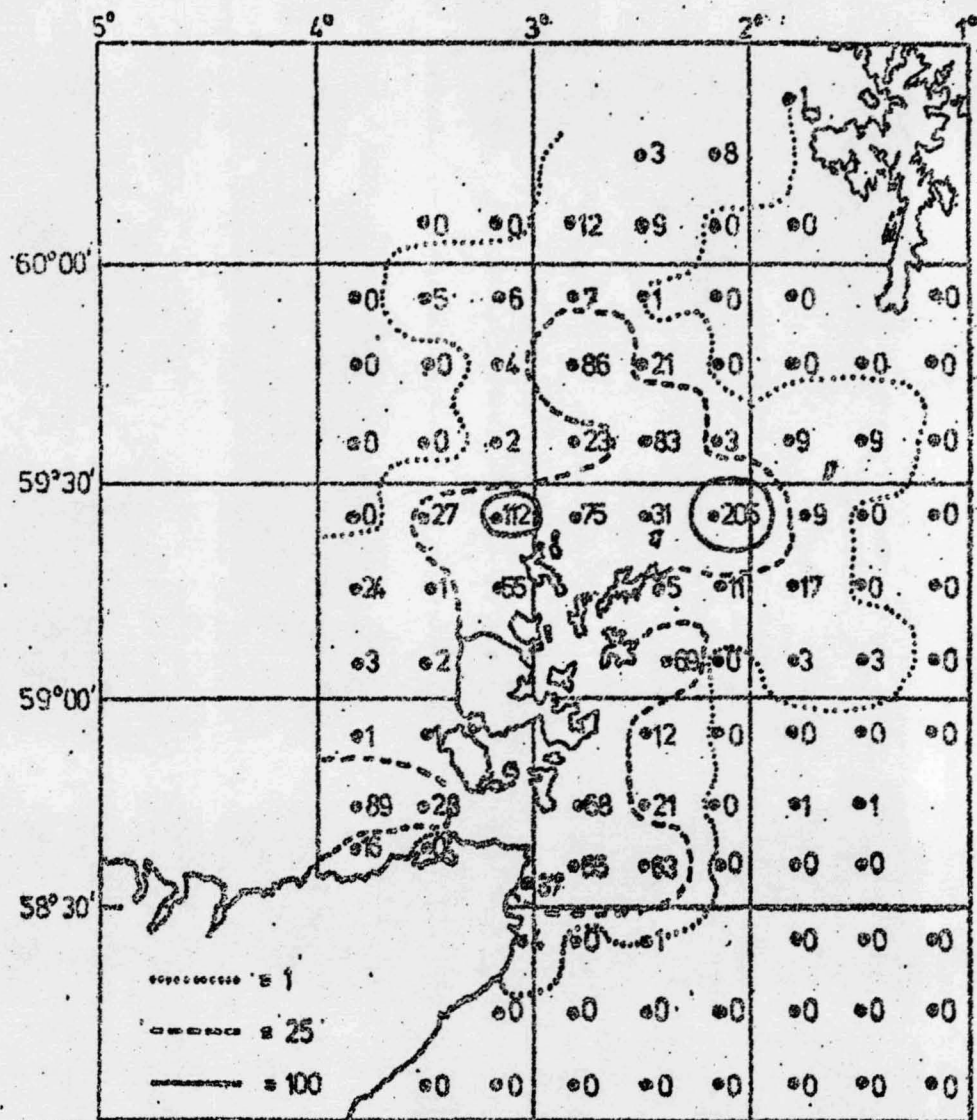


Fig. 1 - Numbers of larvae <10 mm long below 1 m²
 Shetland/Orkney area 3-19/9/1975
 Scottish and English surveys combined.

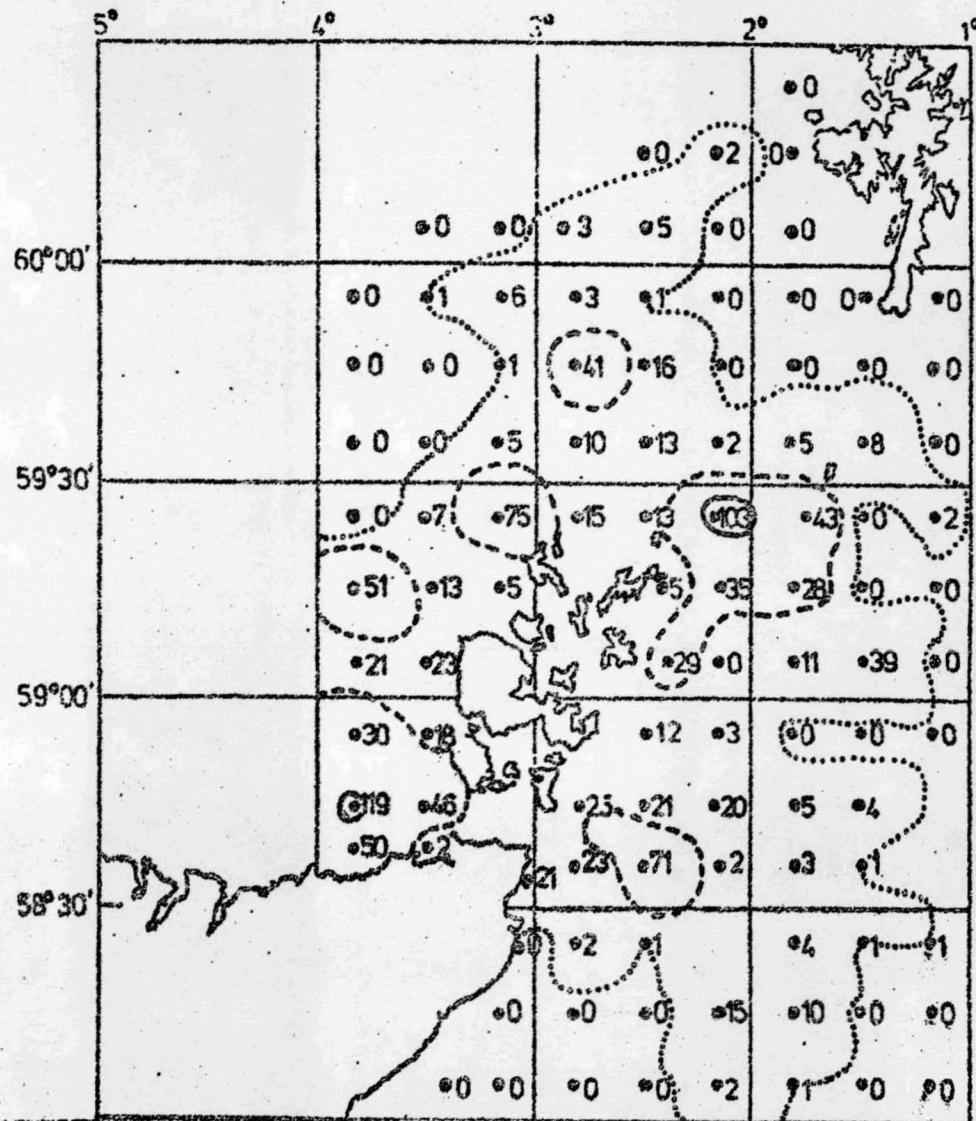


Fig. 2 - Numbers of larvae 10-15 mm long below 1 m²
 Shetland/Orkney area 3-19/9/1975
 Scottish and English surveys combined.

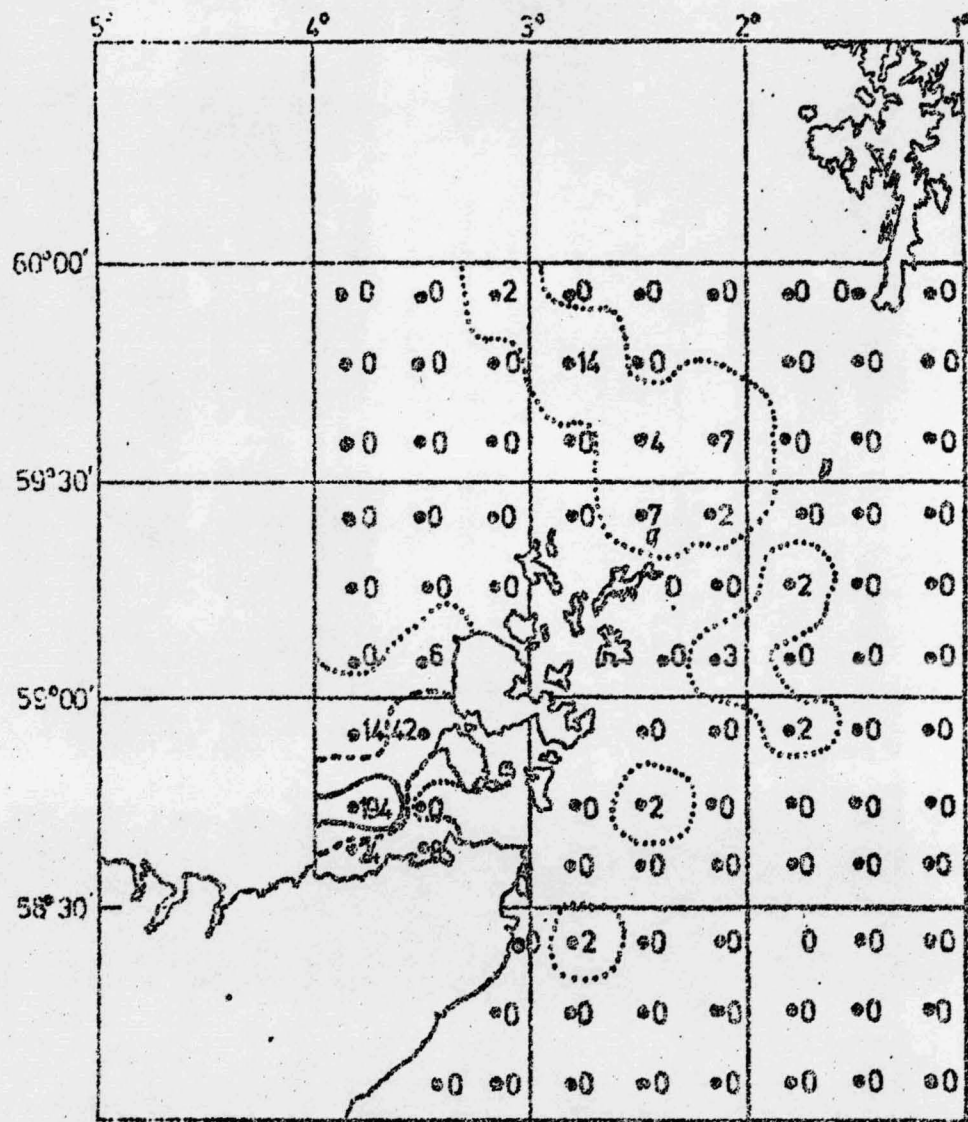


Fig. 3 - Numbers of larvae <10 mm long below 1 m²
Shetland/Orkney area 10-24/9/1975
Danish survey.

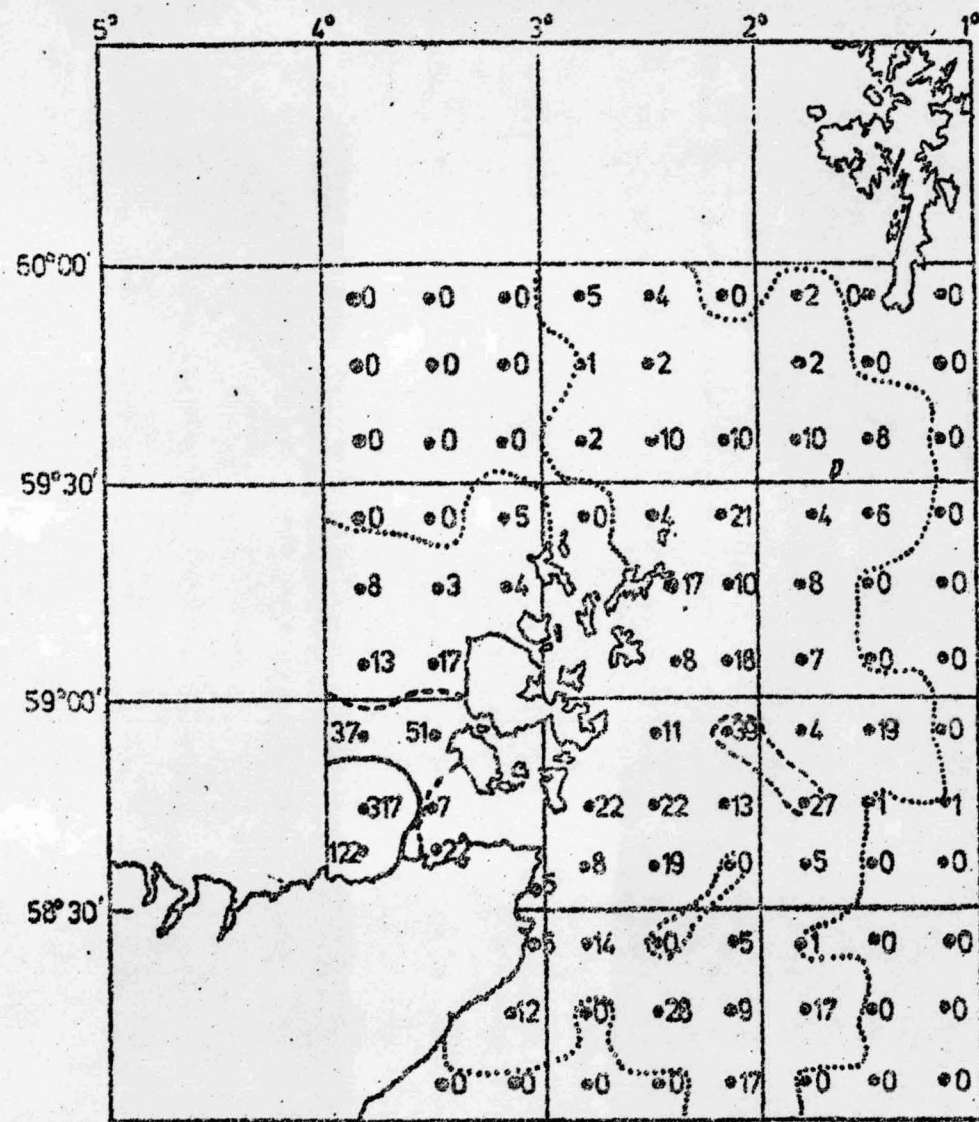


Fig. 4 - Numbers of larvae 10-15 mm long below 1 m²
Shetland/Orkney area 10-24/9/1975
Danish survey.

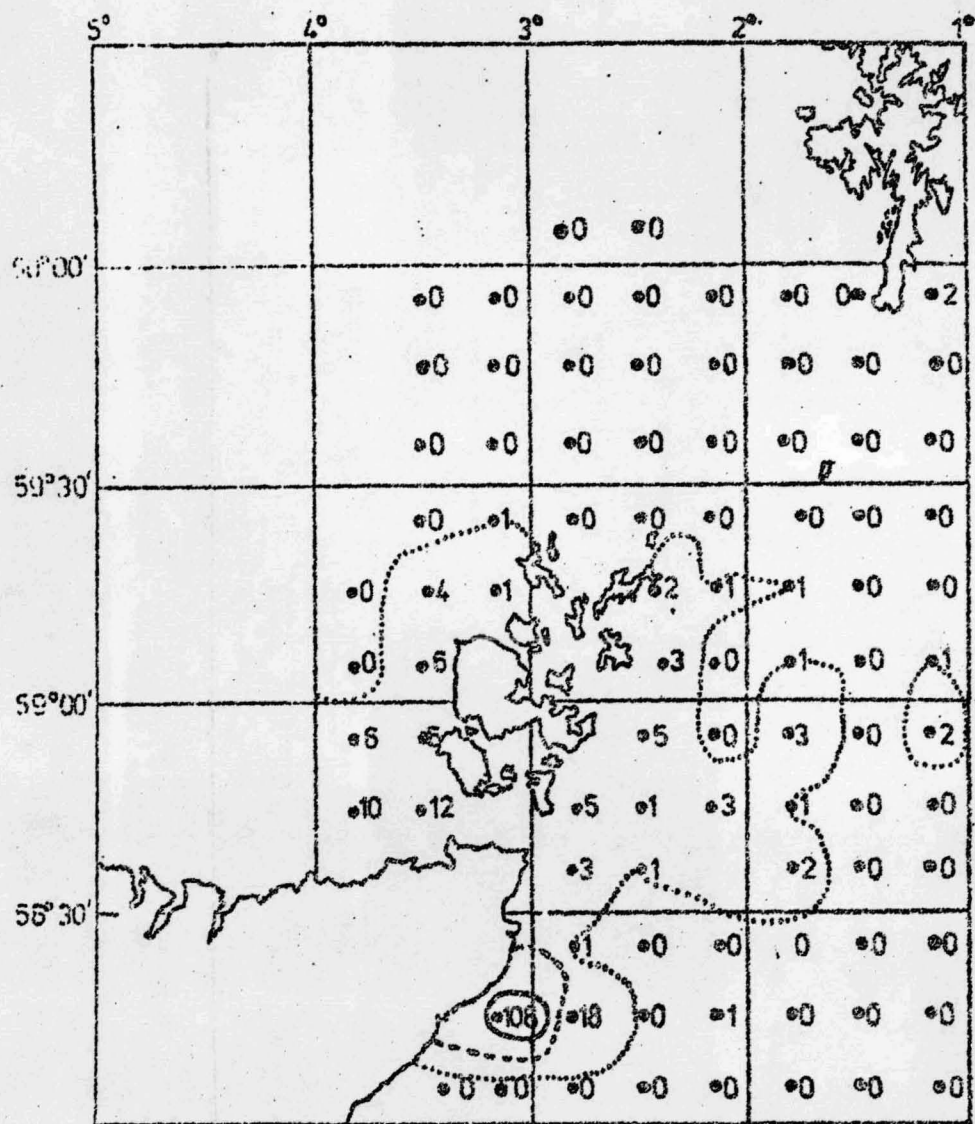


Fig. 5 - Numbers of larvae <10 mm long below 1 m²
 Shetland/Orkney area 20-25/9/1975
 West German survey.

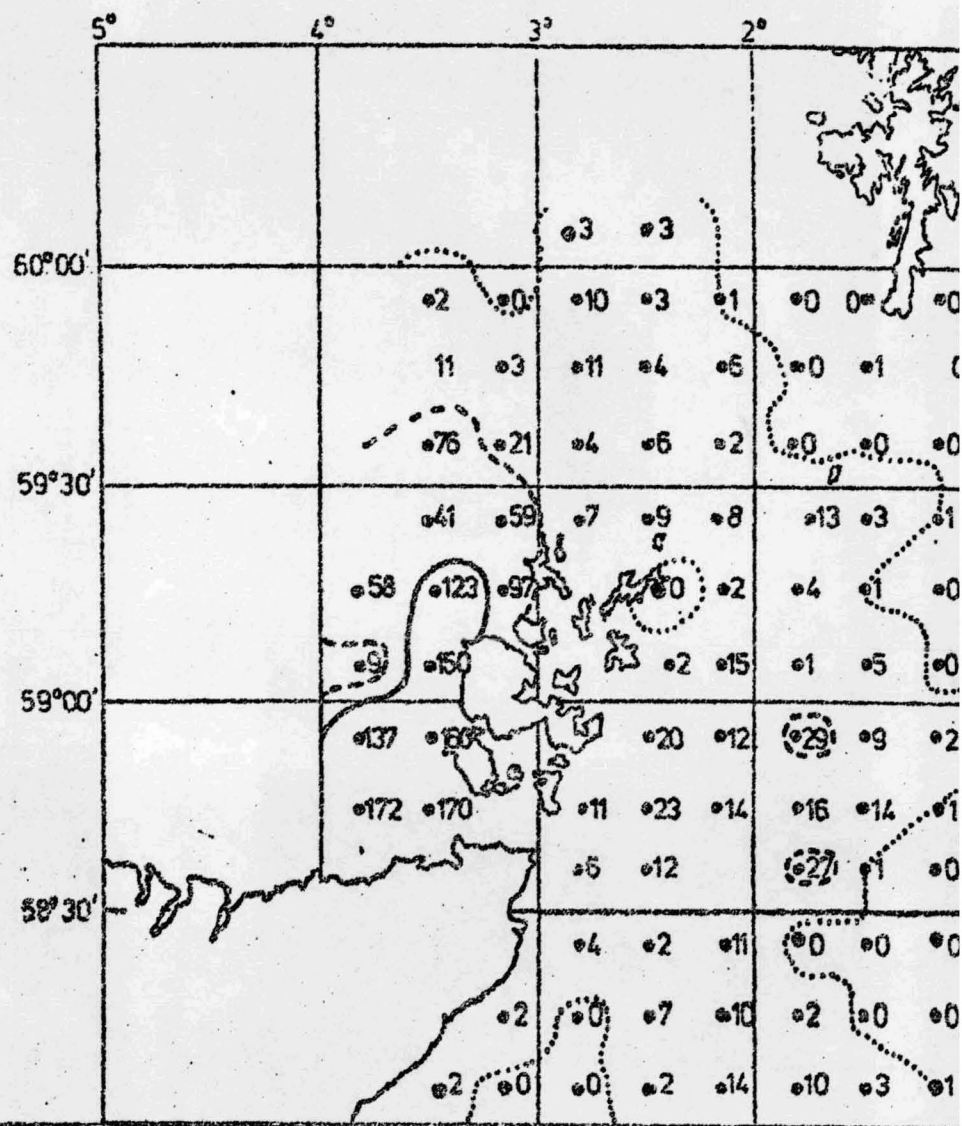


Fig. 6 - Numbers of larvae 10-15 mm long below 1 m²
 Shetland/Orkney area 20-25/9/1975
 West German survey.

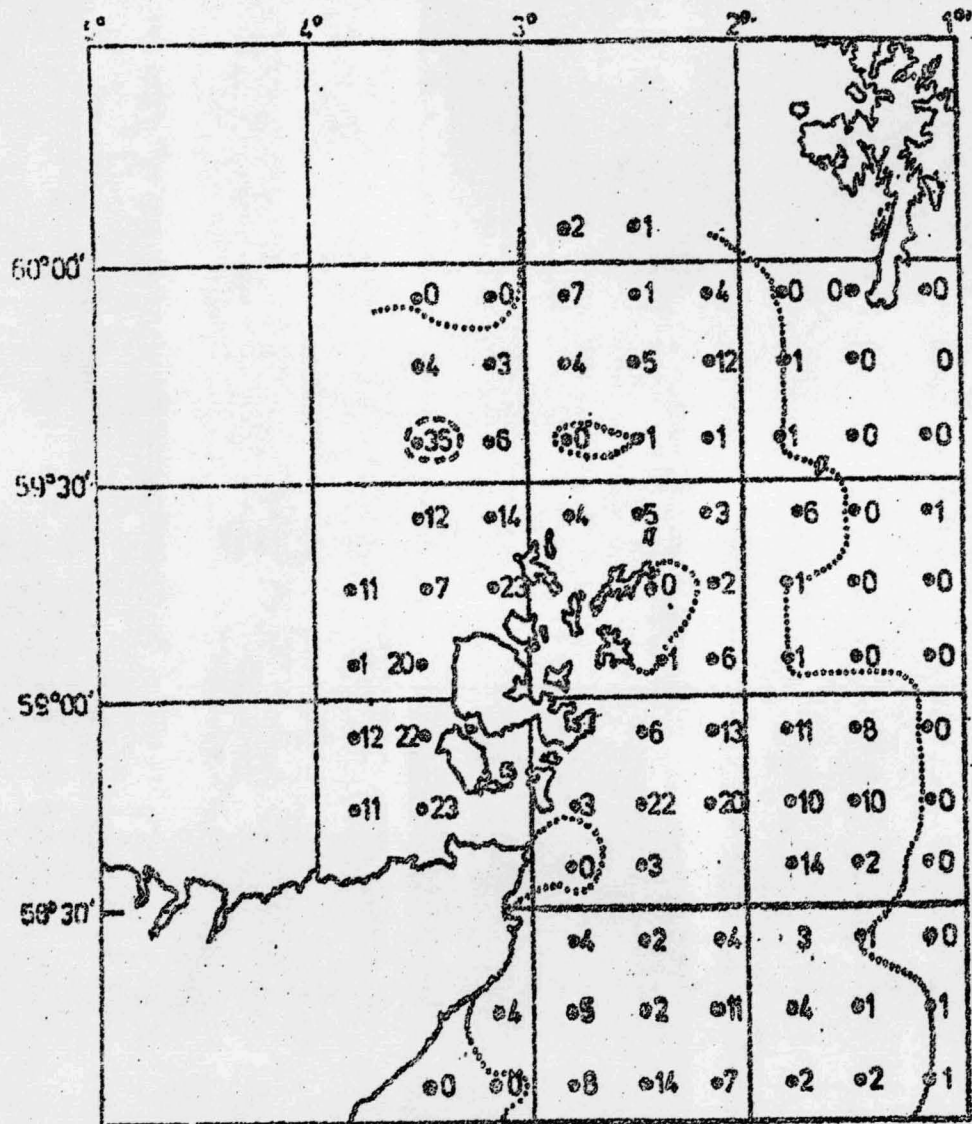


Fig. 7 - Numbers of larvae >15 mm long below 1 m²
Shetland/Orkney area 20-25/9/1971
West German survey.

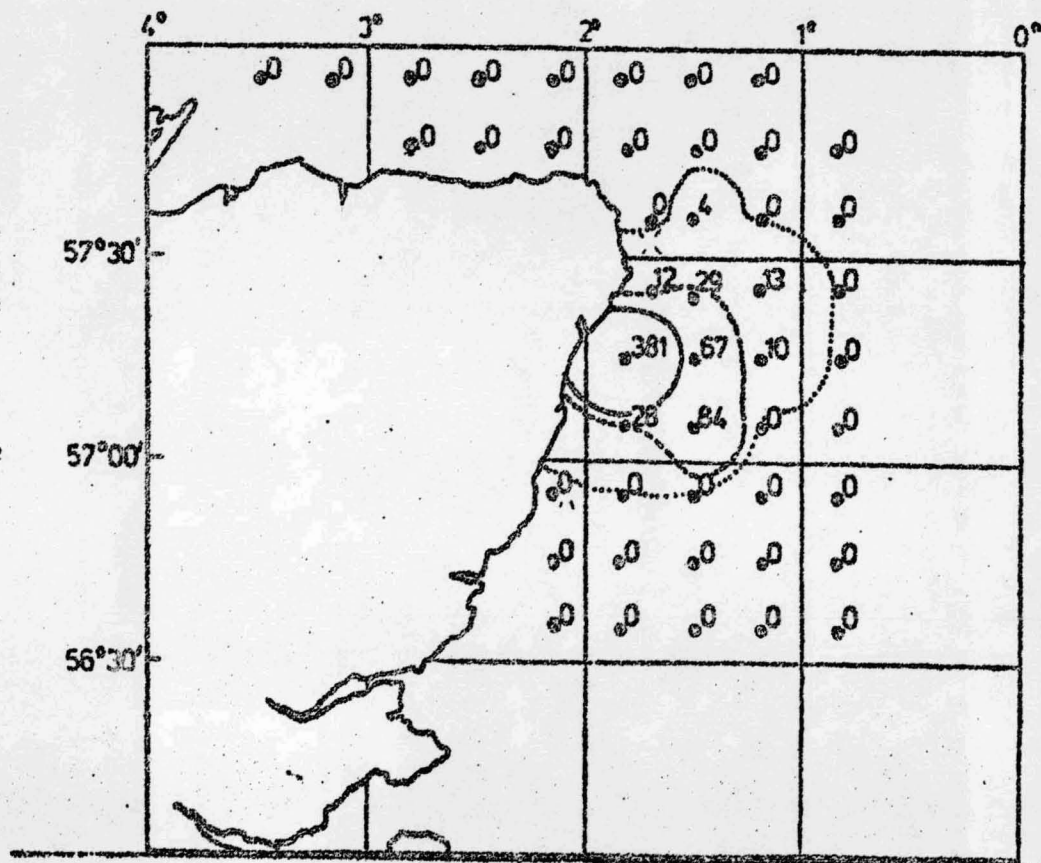


Fig. 8 - Numbers of larvae <10 mm long below 1 m²
Buchan area 5-11/9/1975
Scottish survey.

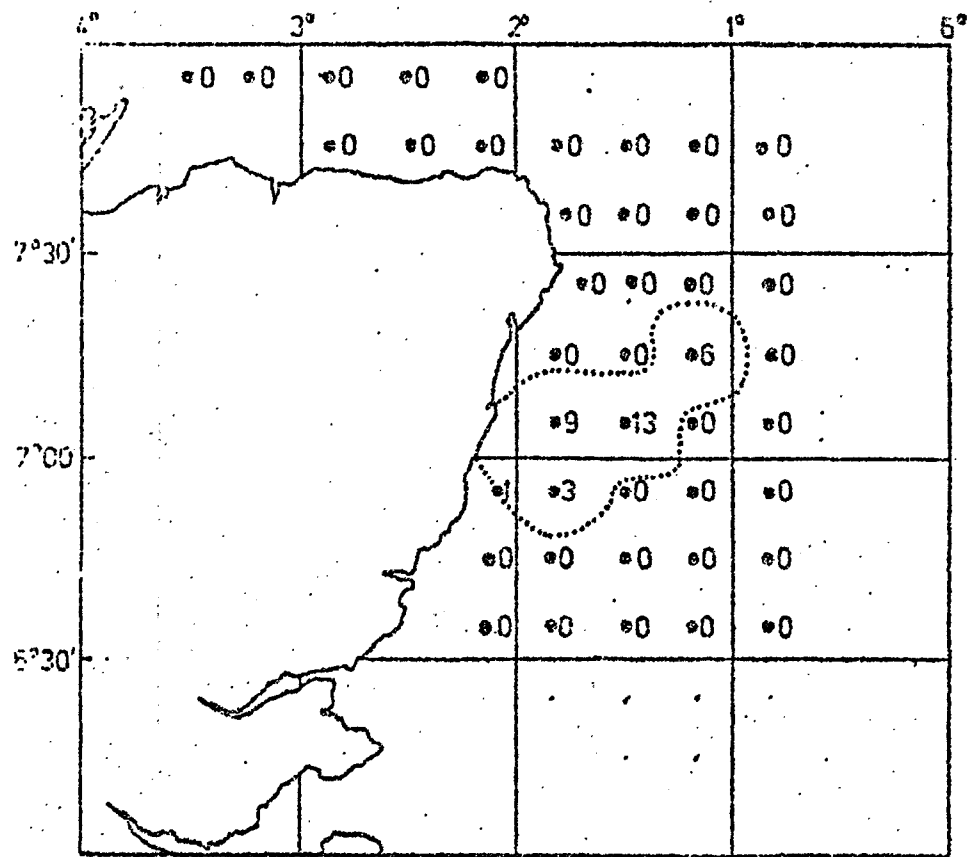


Fig. 9 - Numbers of larvae 10-15 mm long below 1 m²
 Buchan area 5-11/9/1975
 Scottish survey.

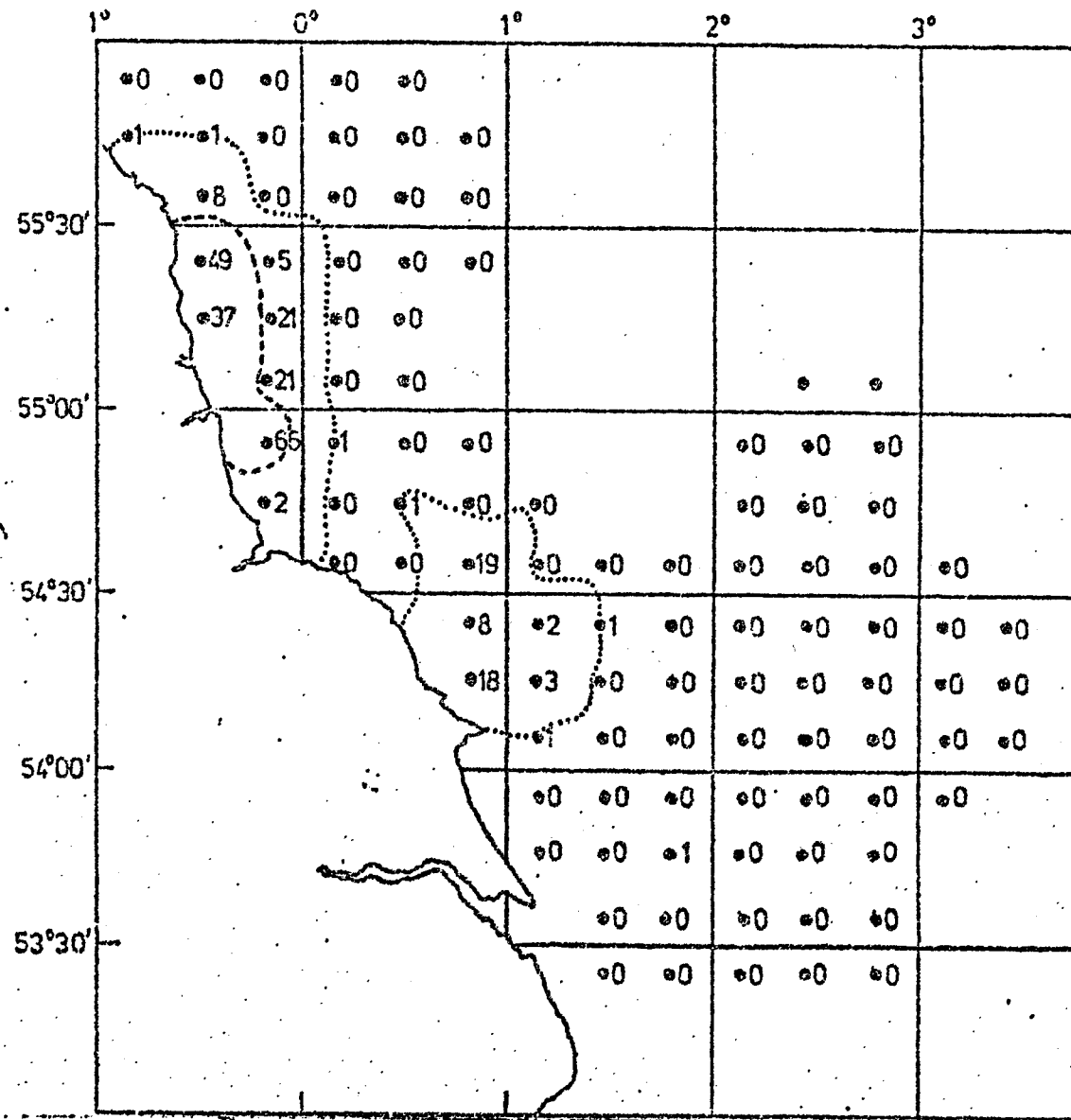


Fig. 10 - Numbers of larvae <10 mm long below 1 m²
 Whitby Dogger-area 15-23/9/1975
 Dutch survey.

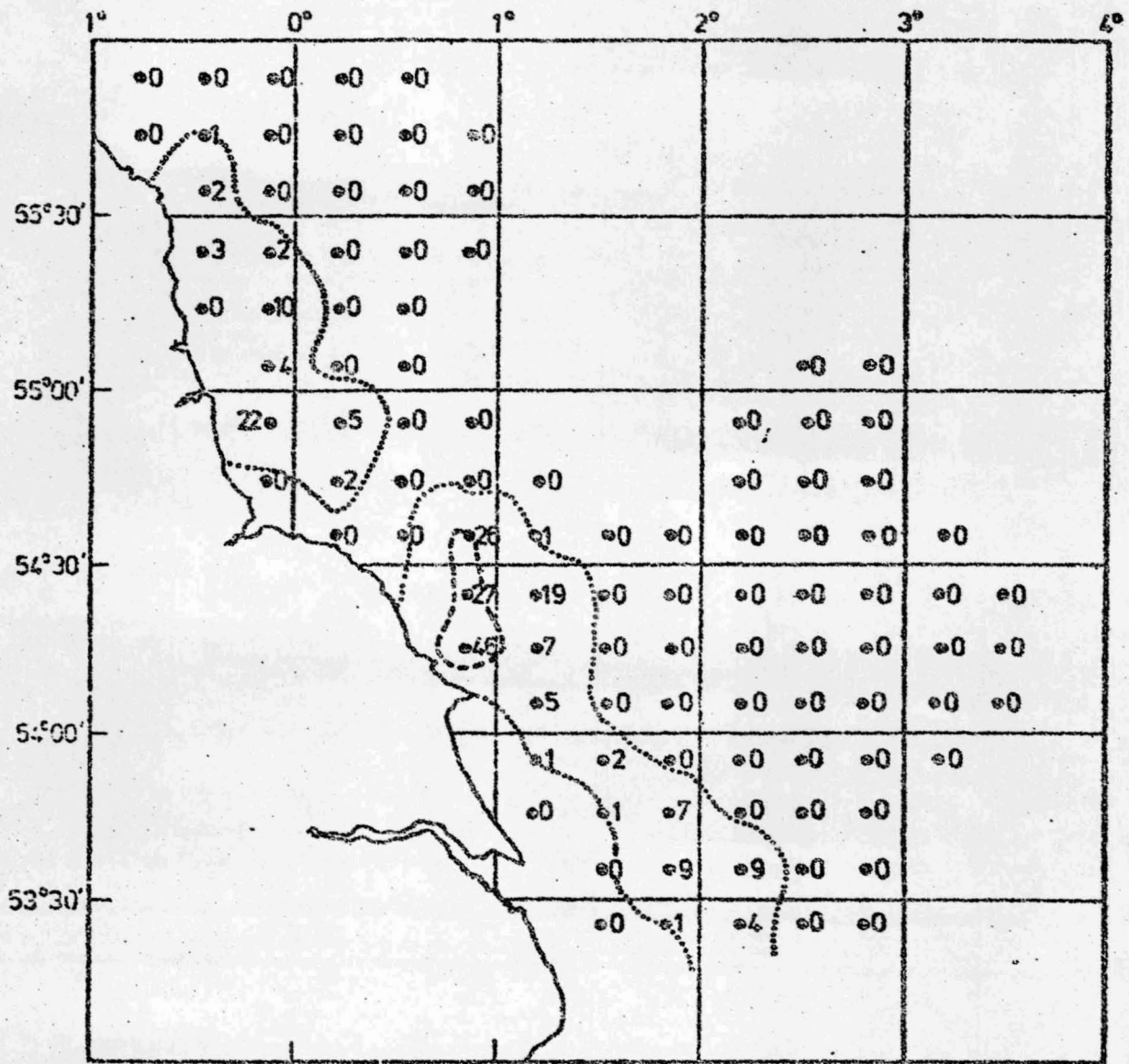


Fig. 11 - Numbers of larvae 10-15 mm long below 1 m²
 Whitby/Dogger area 15-23/9/1975
 Dutch survey.

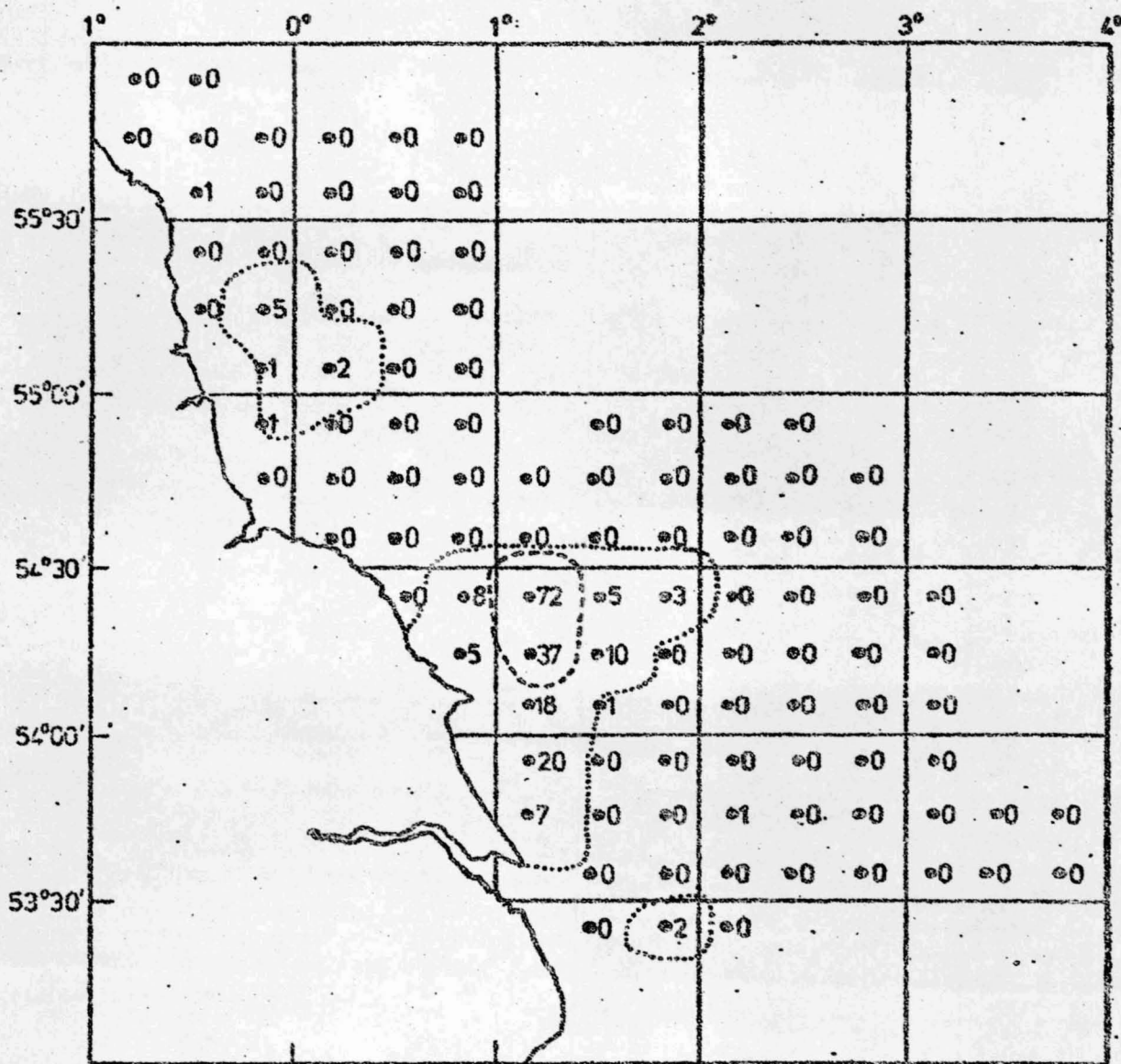


Fig. 12 - Numbers of larvae <10 mm long below 1 m²
 Whitby/Dogger area 8-14/10/1975
 English survey.

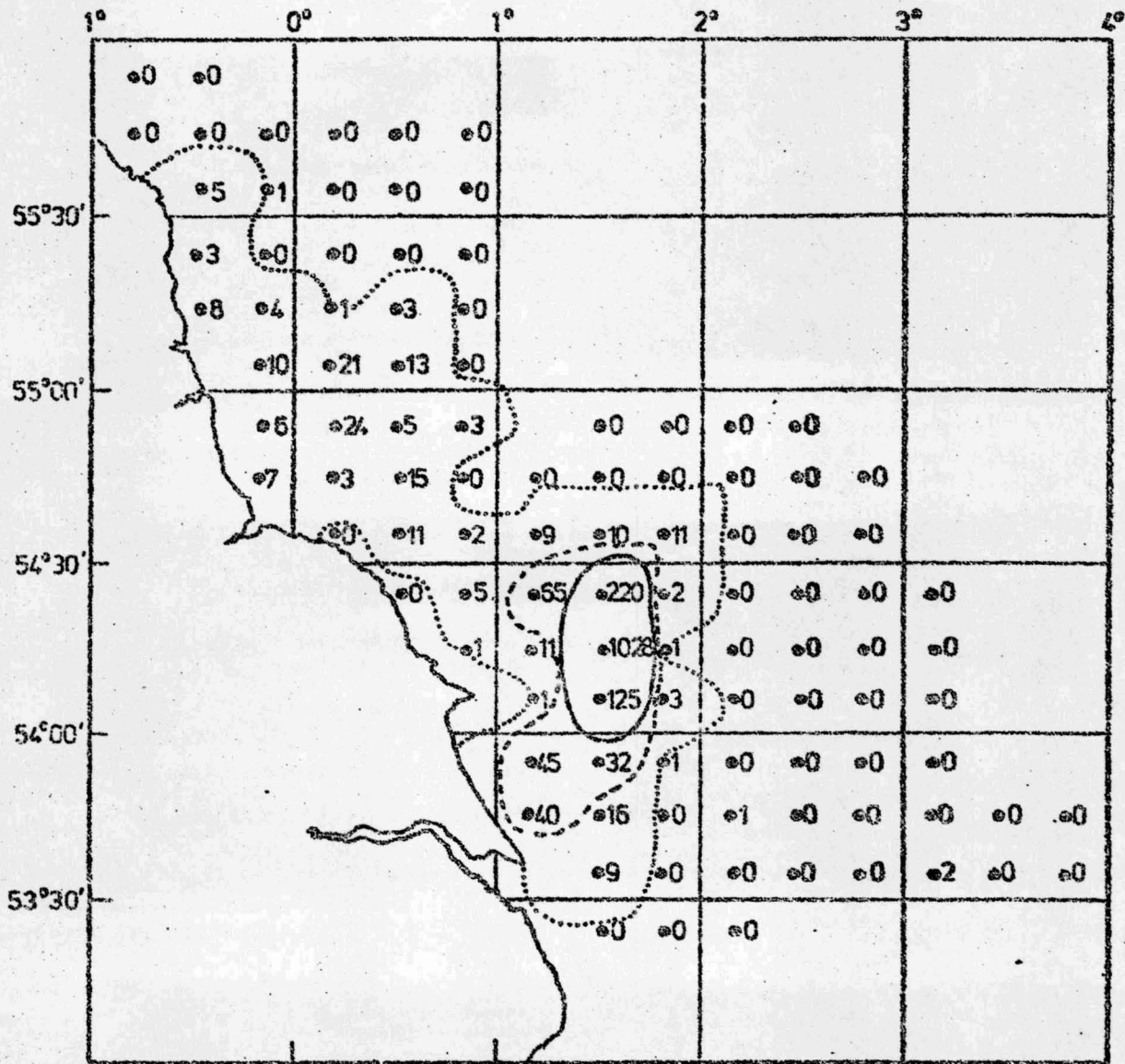


Fig. 13 - Numbers of larvae 10-15 mm long below 1 m²
 Whitby/Dogger area 8-14/10/1975
 English survey.

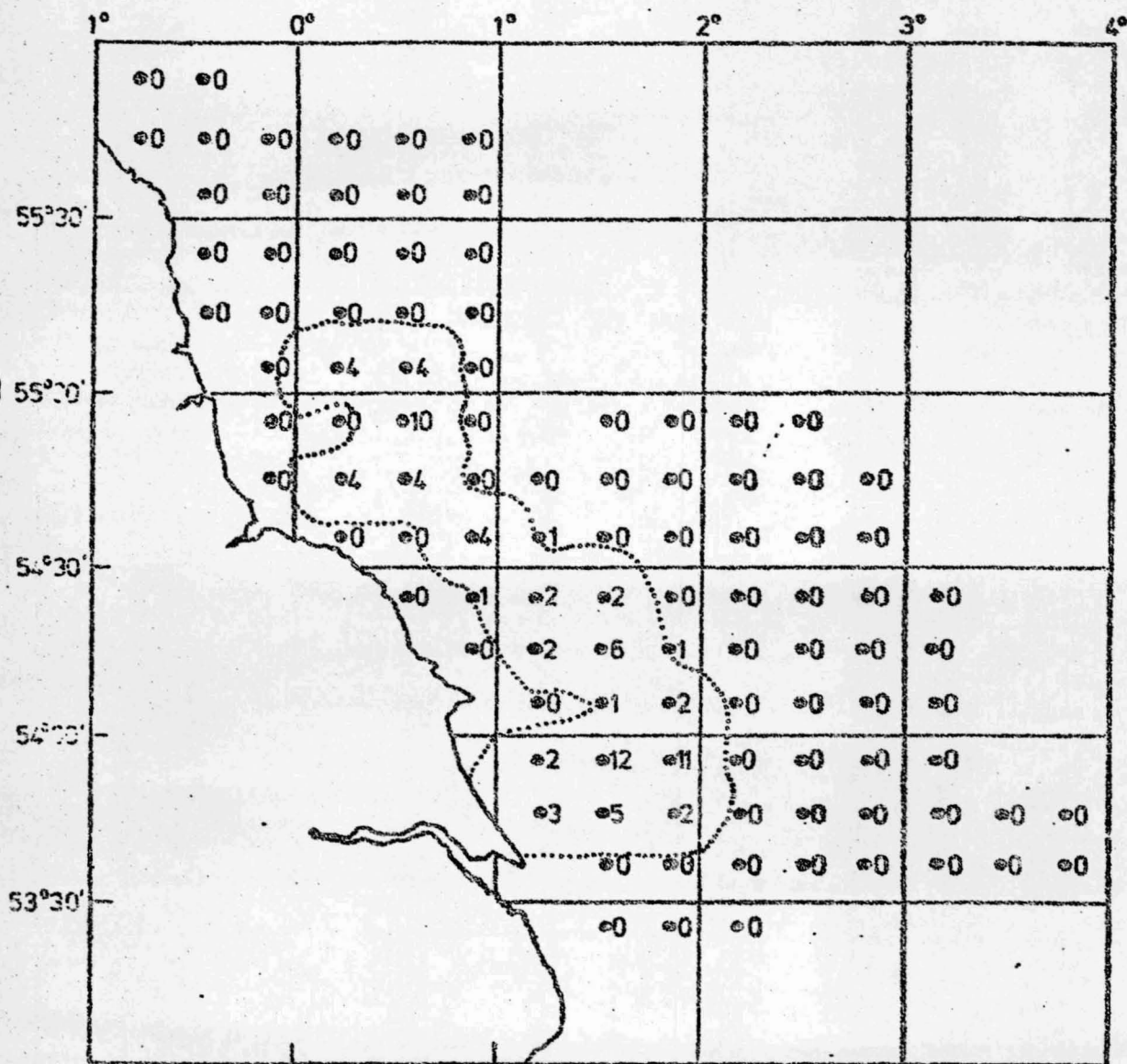


Fig. 14 - Numbers of larvae >15 mm long below 1 m²
 Whitby/Dogger area 8-14/10/1975
 English survey.

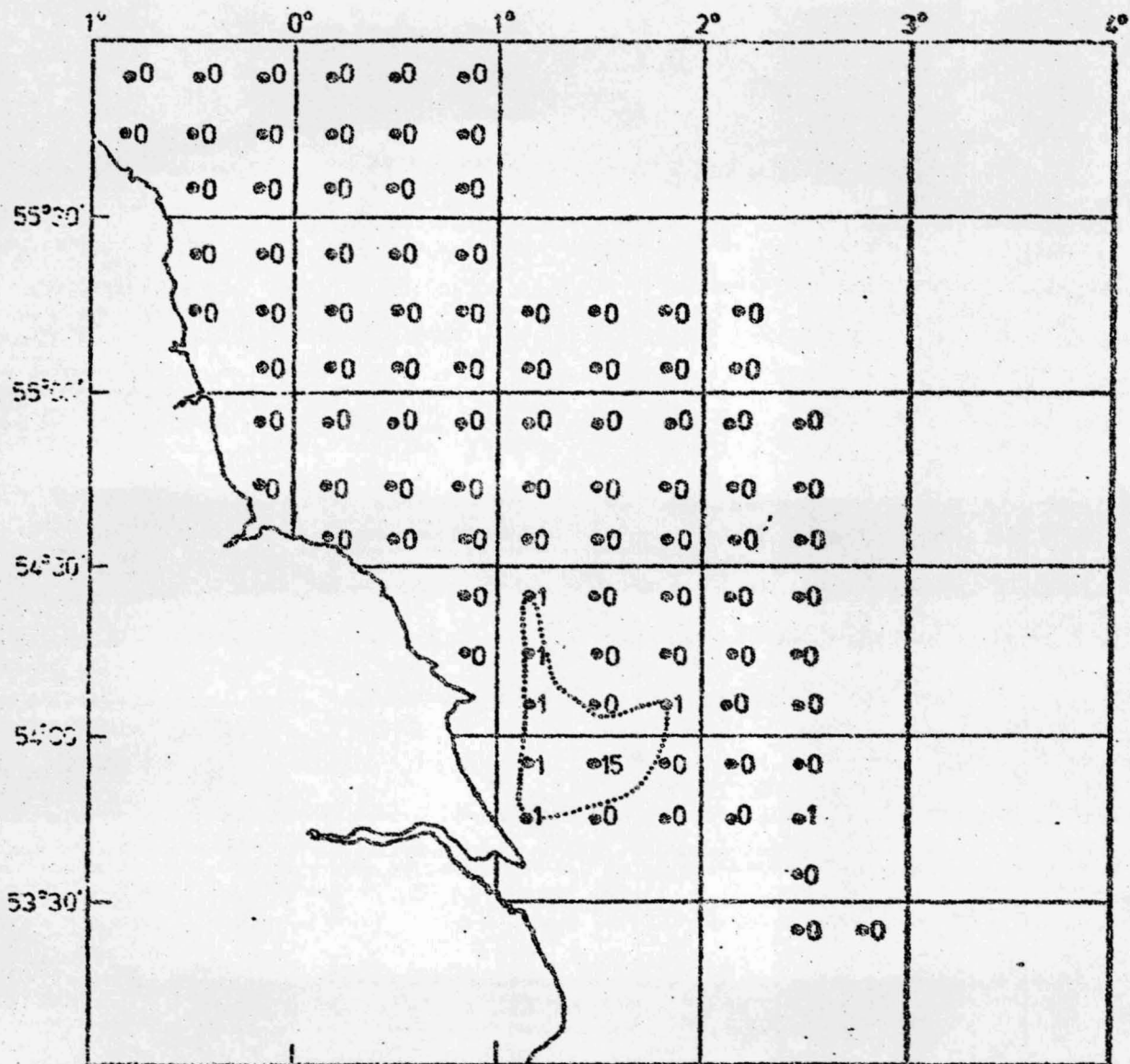


Fig. 15 - Numbers of larvae <10 mm long below 1 m²
 Whitby/Dogger area 21-29/10/1975
 Dutch survey.

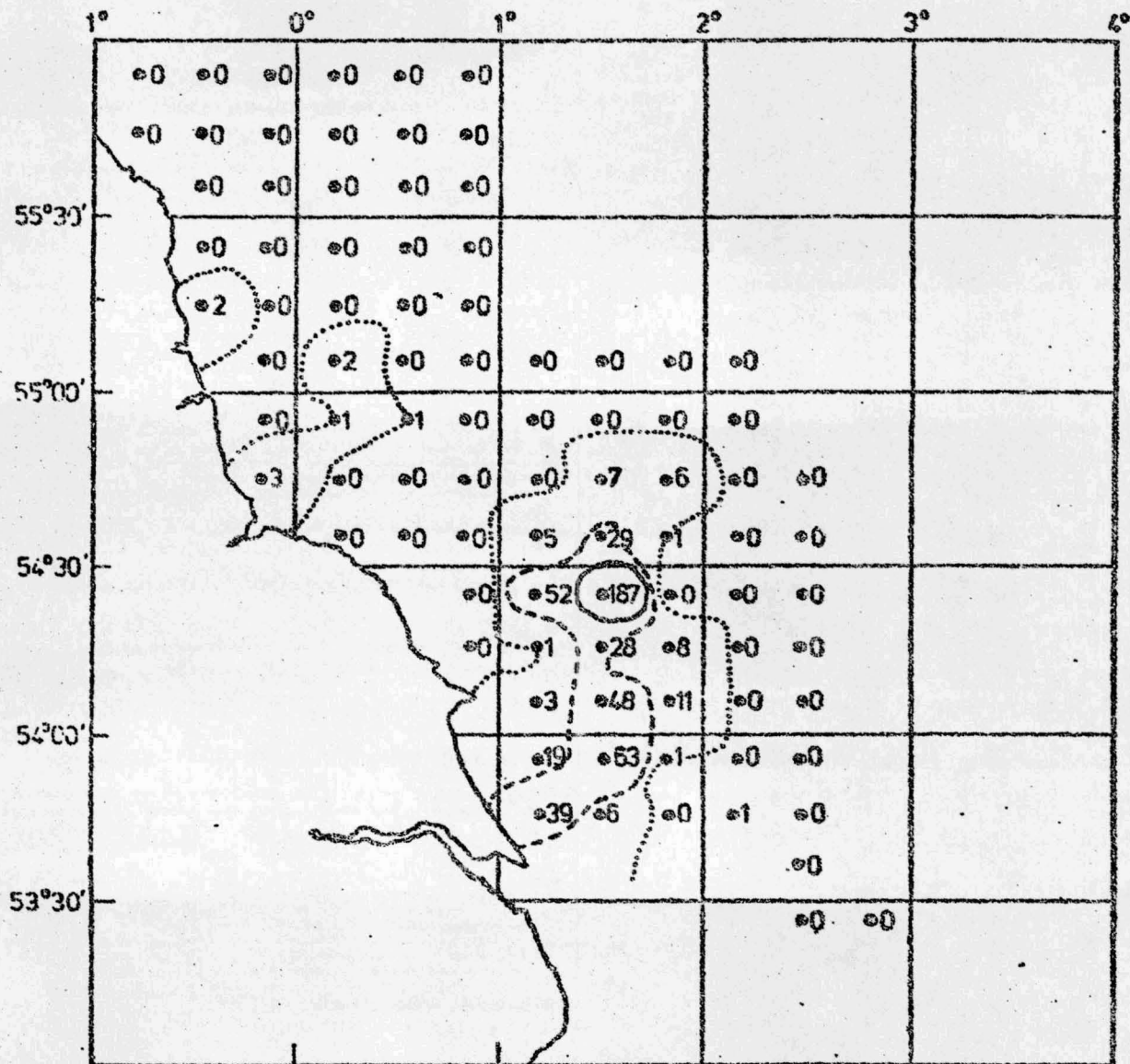


Fig. 16 - Numbers of larvae 10-15 mm long below 1 m²
 Whitby/Dogger area 21-29/10/1975
 Dutch survey.

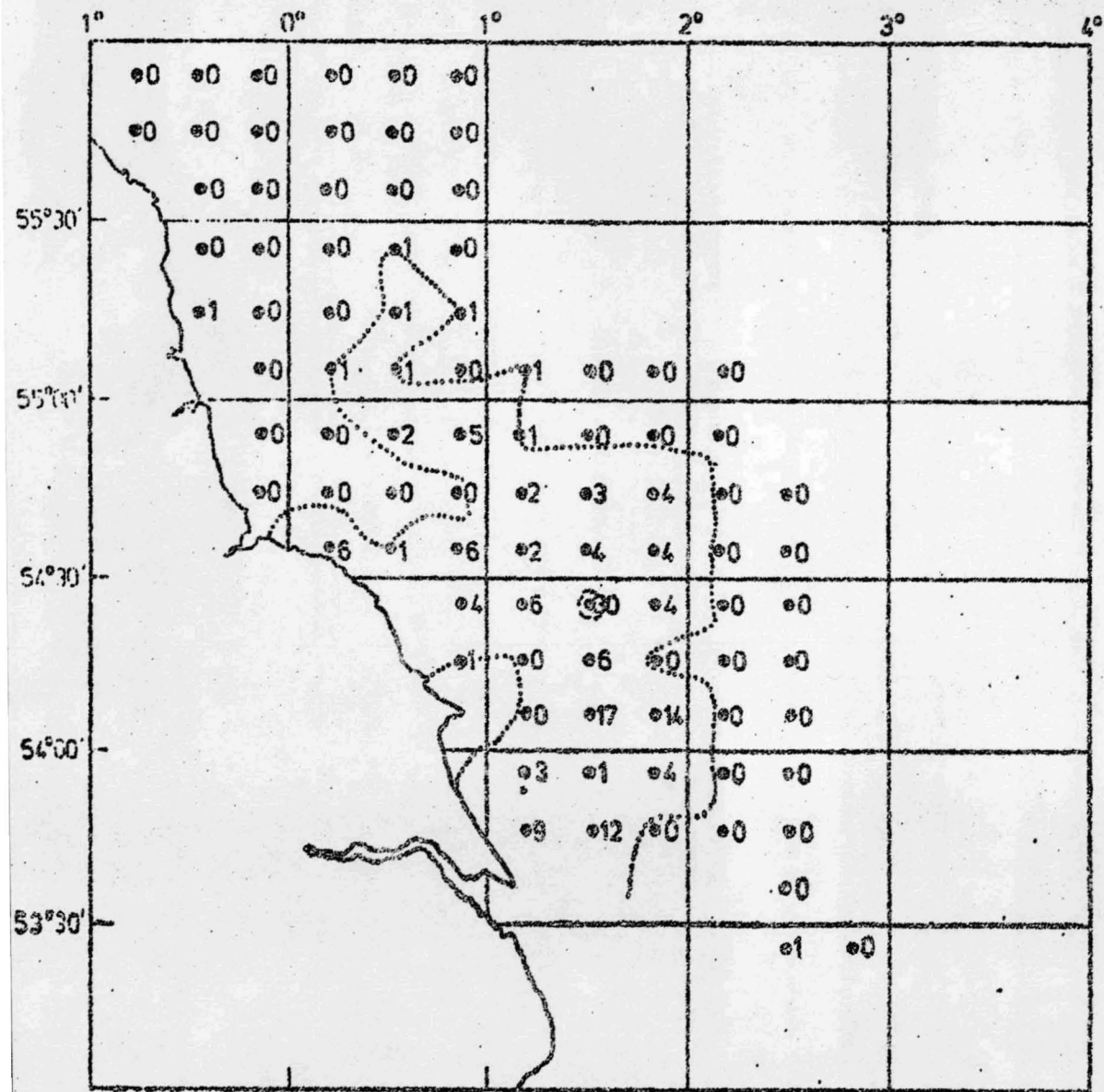


Fig. 17 - Numbers of larvae >15 mm long below 1 m²
Whitby/Dogger area 21-29/10/1975
Dutch survey.

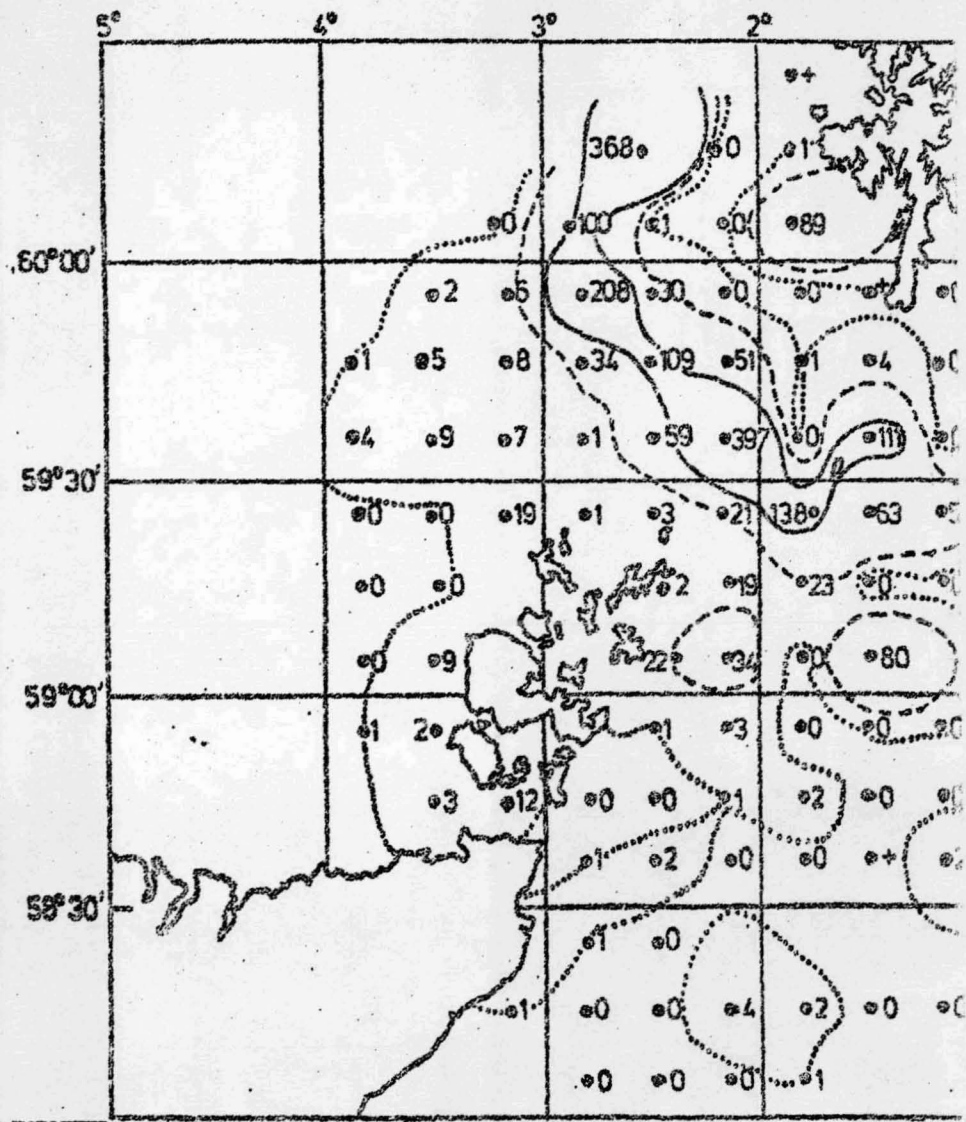


Fig. 18 - Numbers of larvae <10 mm long below 1 m²
Shetland/Orkney area 4-11/9/1976
Federal German Republic.

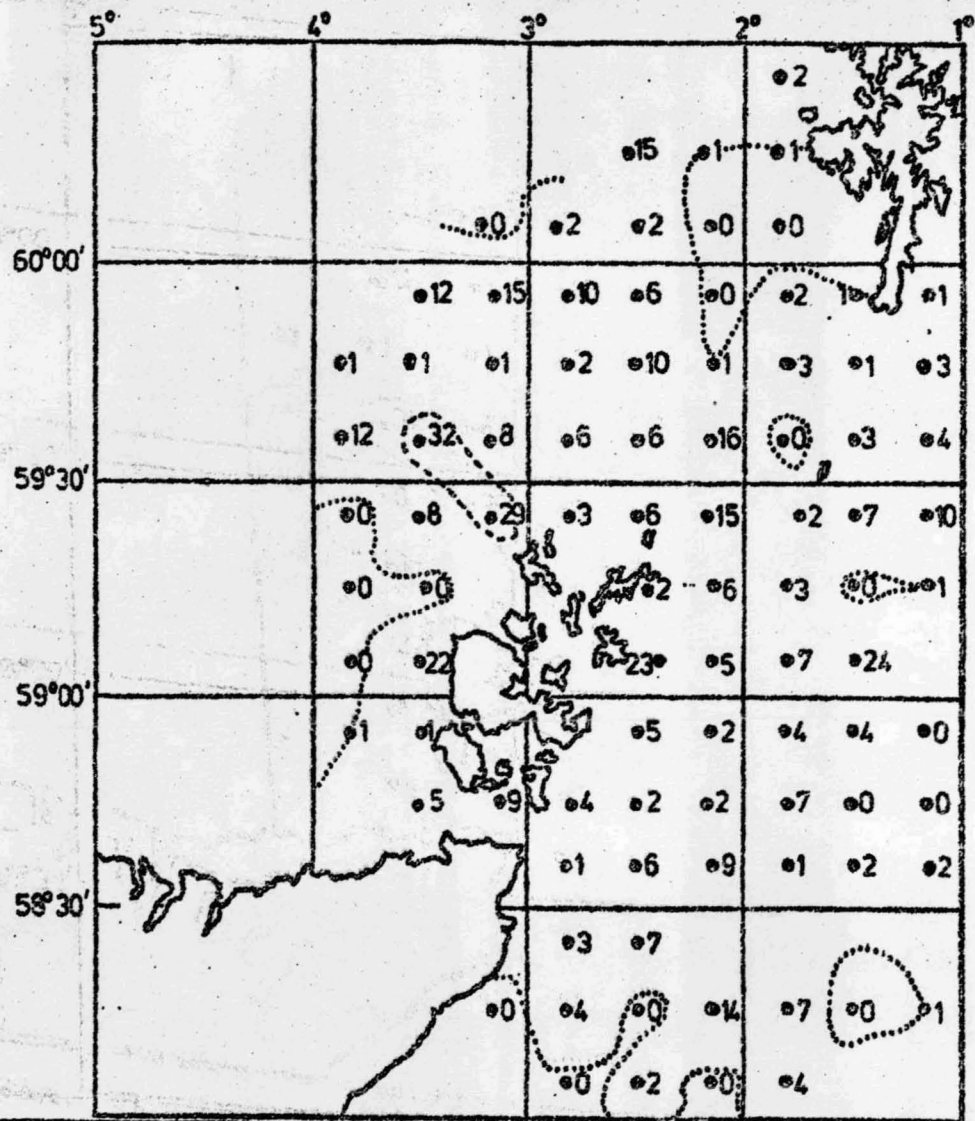


Fig. 19 - Numbers of larvae 10-15 mm long below 1 m²
Shetland/Orkney area 4-11/9/1976
Federal German Republic.

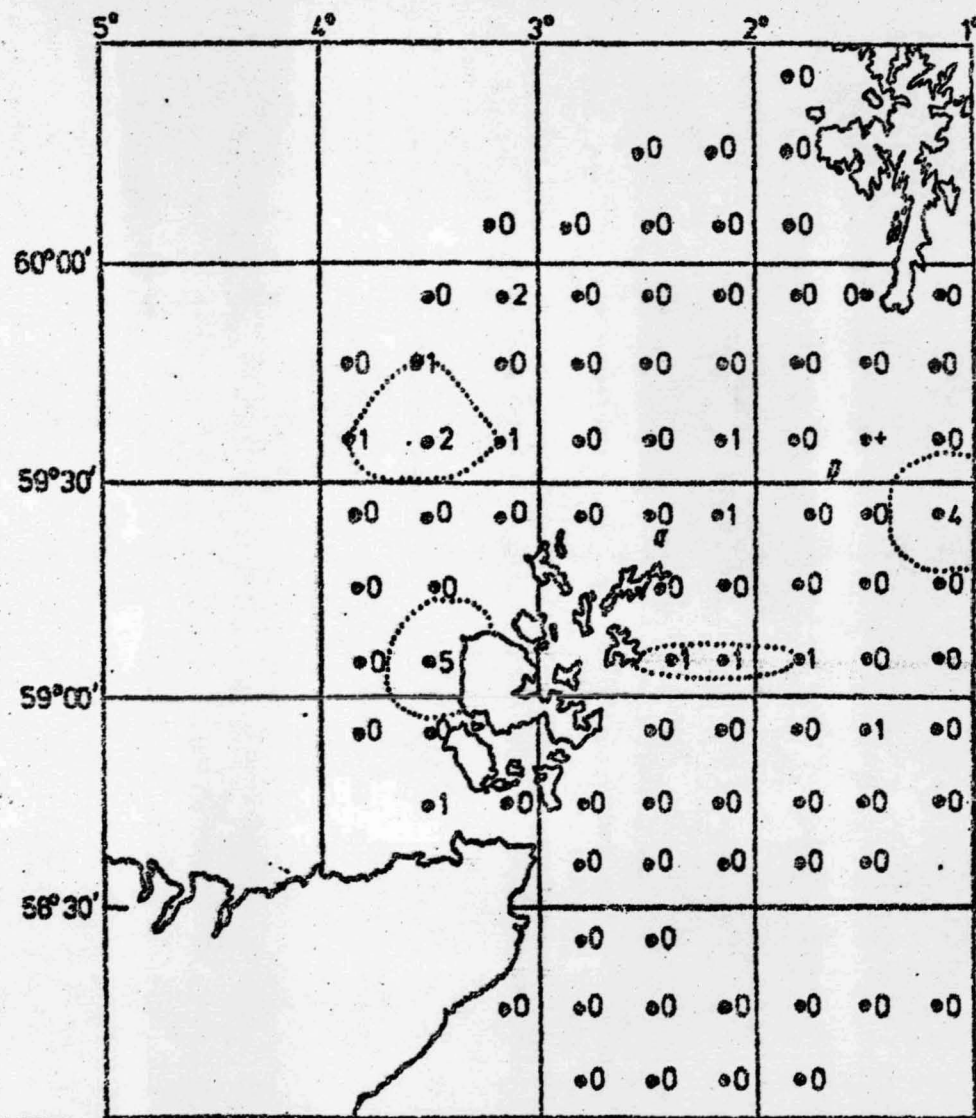


Fig. 20 - Numbers of larvae >15 mm long below 1 m²
Shetland/Orkney area 4-11/9/1976
Federal German Republic.

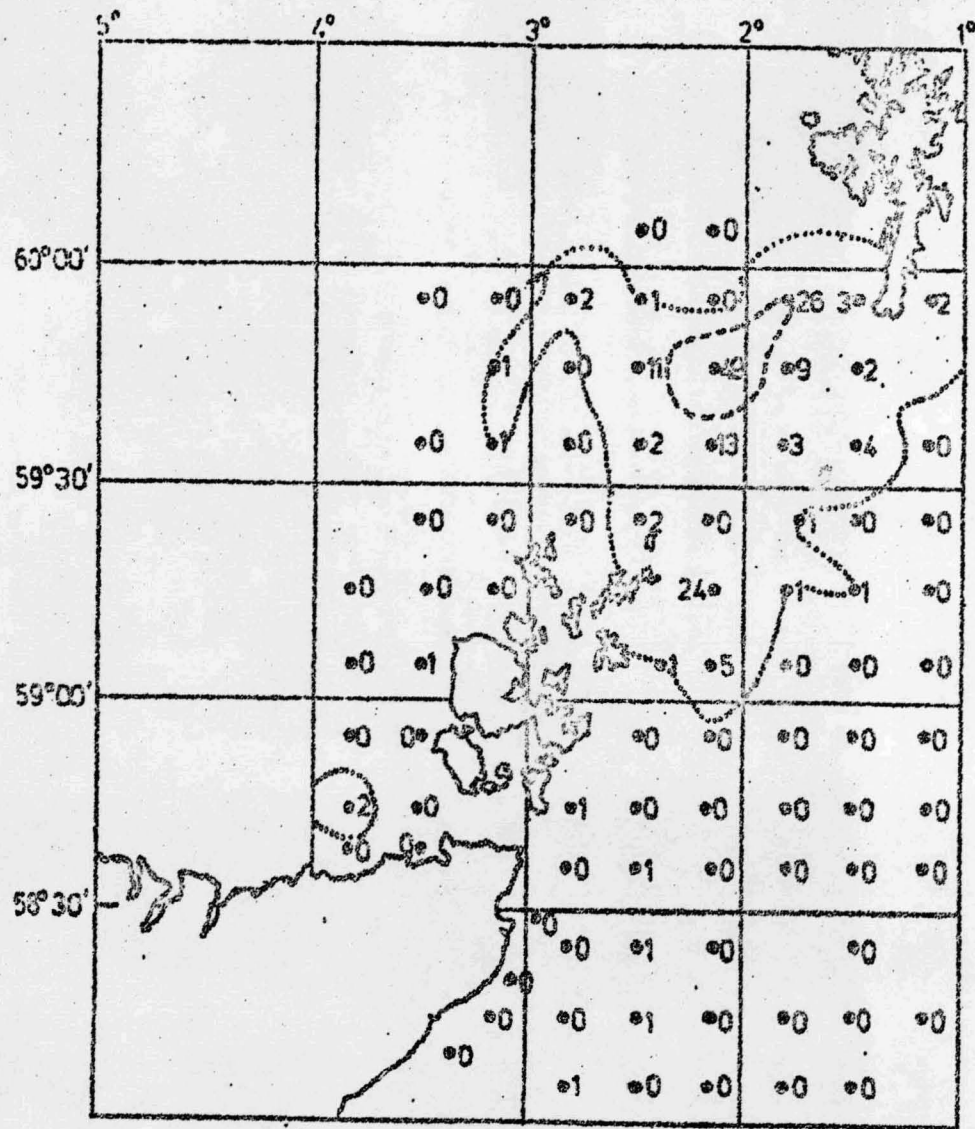


Fig. 21 - Numbers of larvae <10 mm long below 1 m²
 Shetland/Orkney area 13-23/9/1976
 East German survey.

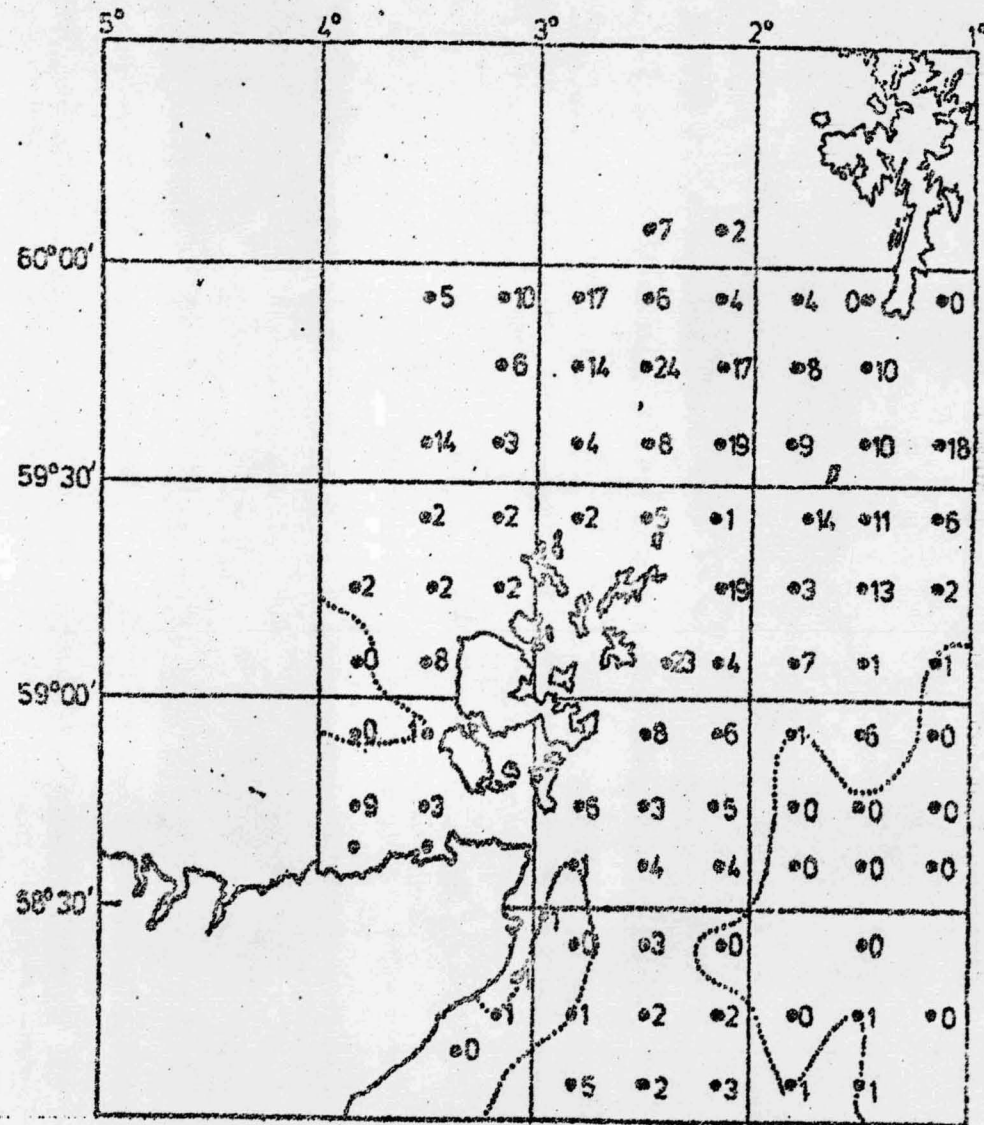


Fig. 22 - Numbers of larvae 10-15 mm long below 1 m²
 Shetland/Orkney area 13-23/9/1976
 East German survey.

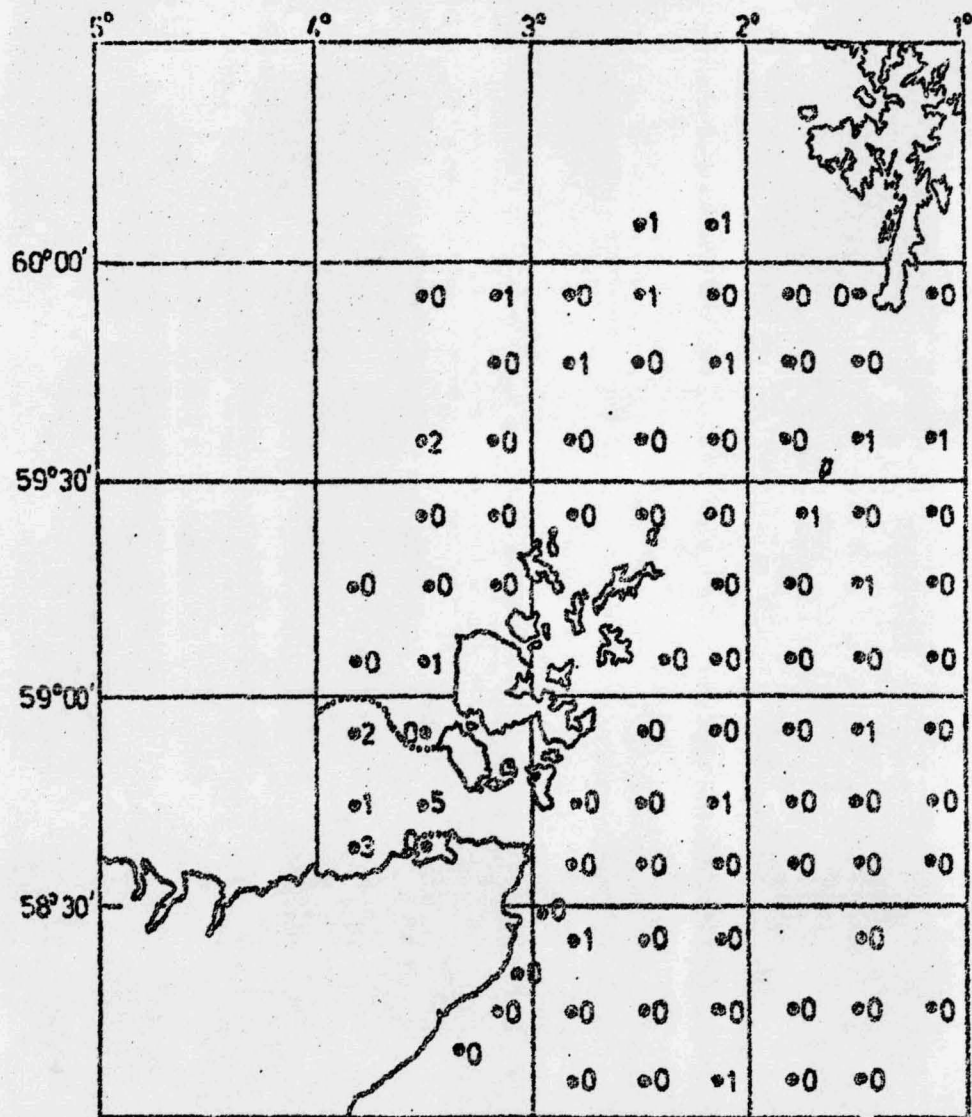


Fig. 23.- Numbers of larvae >15 mm long below 1 m²
Shetland/Orkney area 13-23/9/1976
East German survey.

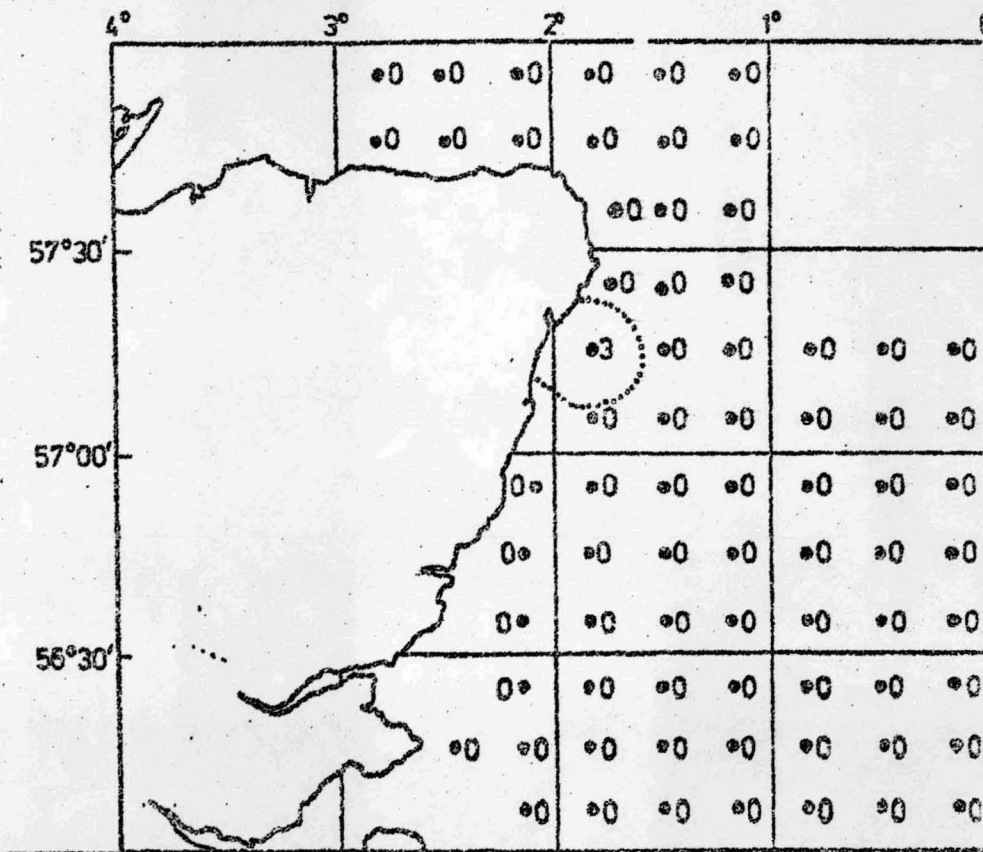


Fig. 24 - Numbers of larvae <10 mm long below 1 m²
Buchan area
6-17/9/1976
Scottish survey.

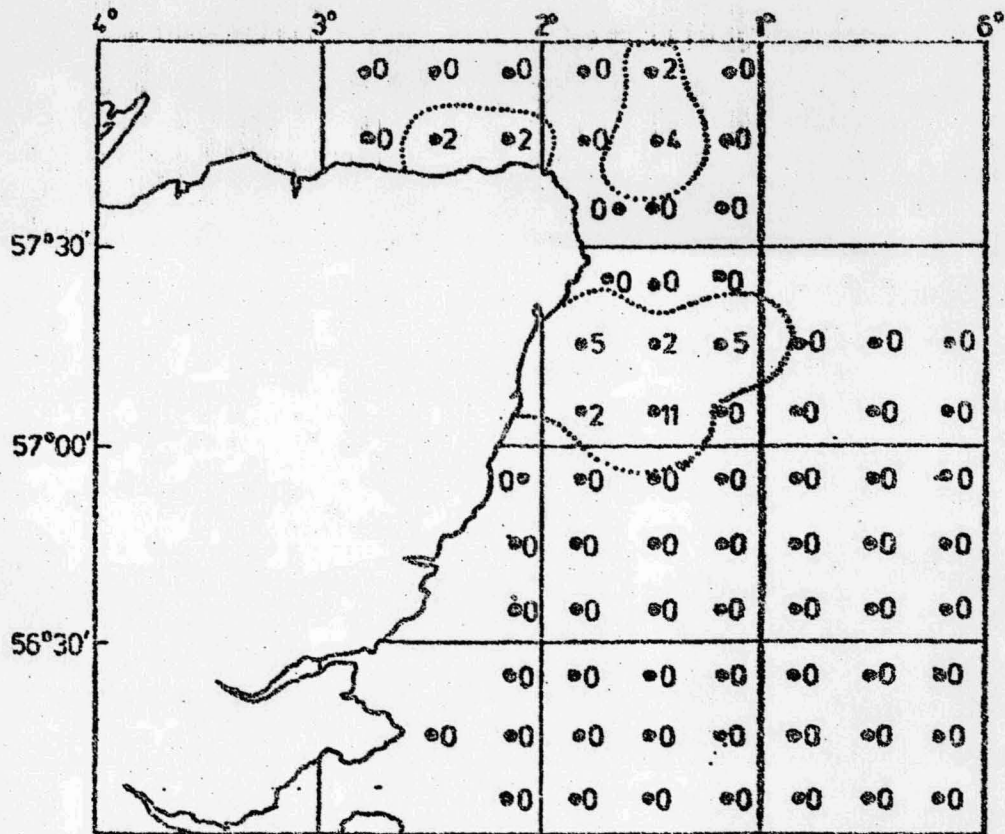


Fig. 25 - Numbers of larvae 10-15 mm long below 1 m²
 Buchan area 6-17/9/1976
 Scottish survey.

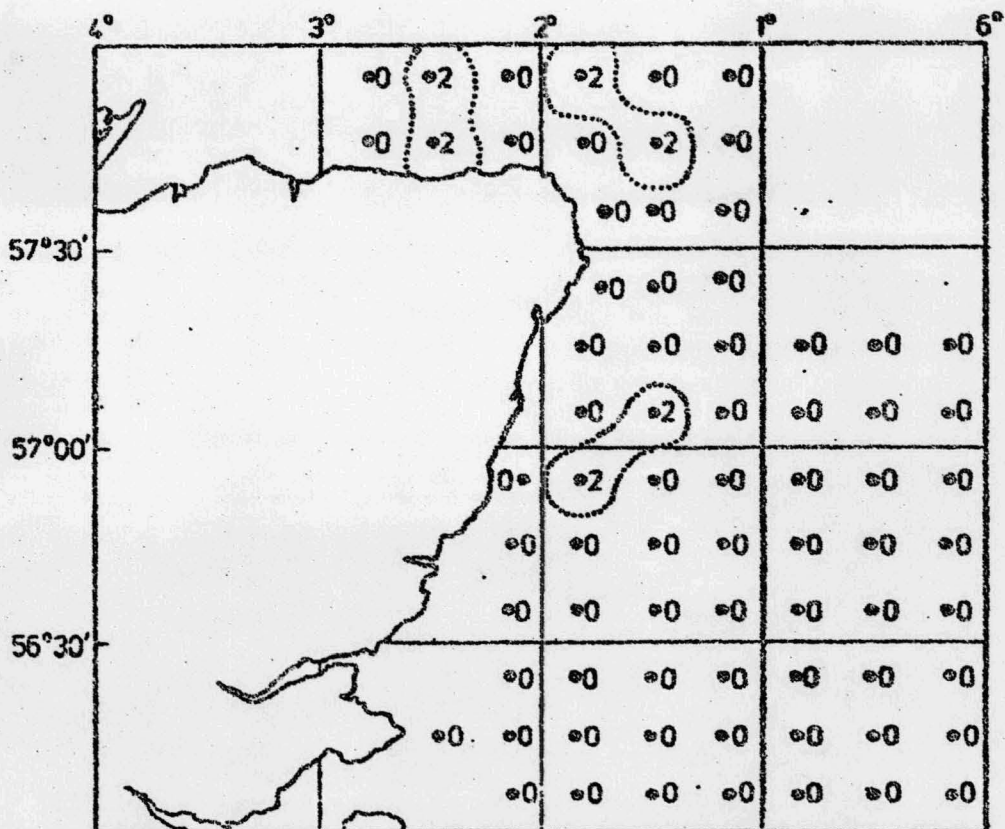


Fig. 26 - Numbers of larvae >15 mm long below 1 m²
 Buchan area 6-17/9/1976
 Scottish survey.

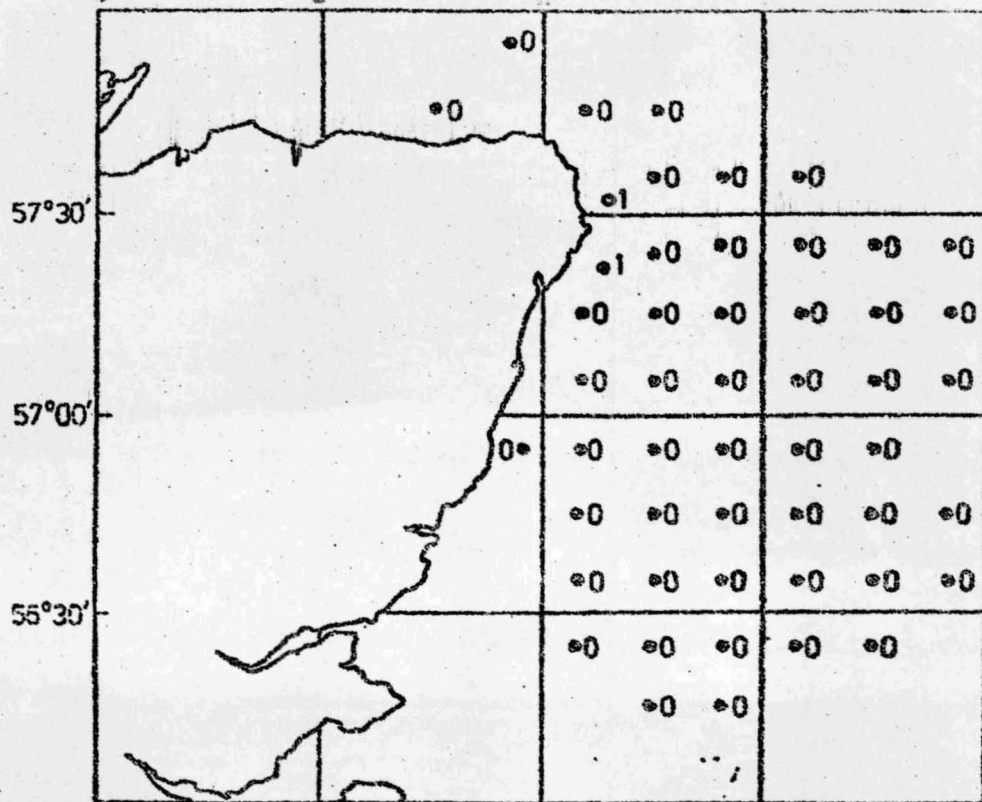


Fig. 27 - Numbers of larvae <10 mm long below 1 m²
 Buchan area 24-28/9/1976
 East German survey.

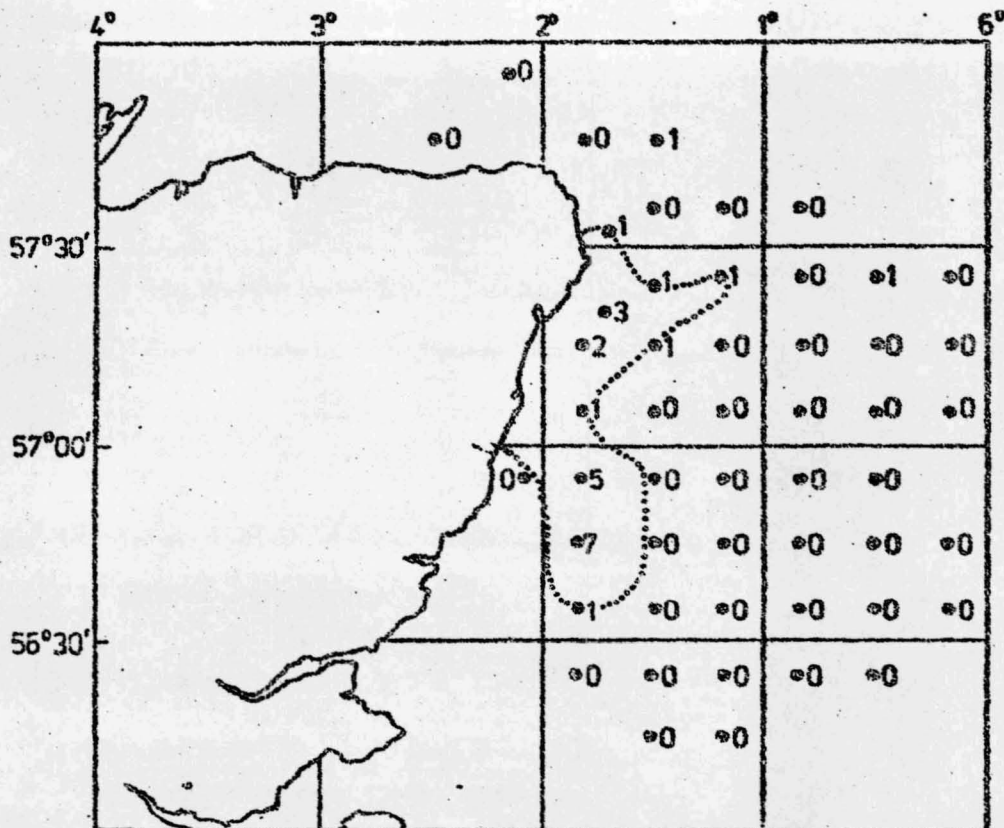


Fig. 28 - Numbers of larvae 10-15 mm long below 1 m²
 Buchan area 24-28/9/1976
 East German survey.

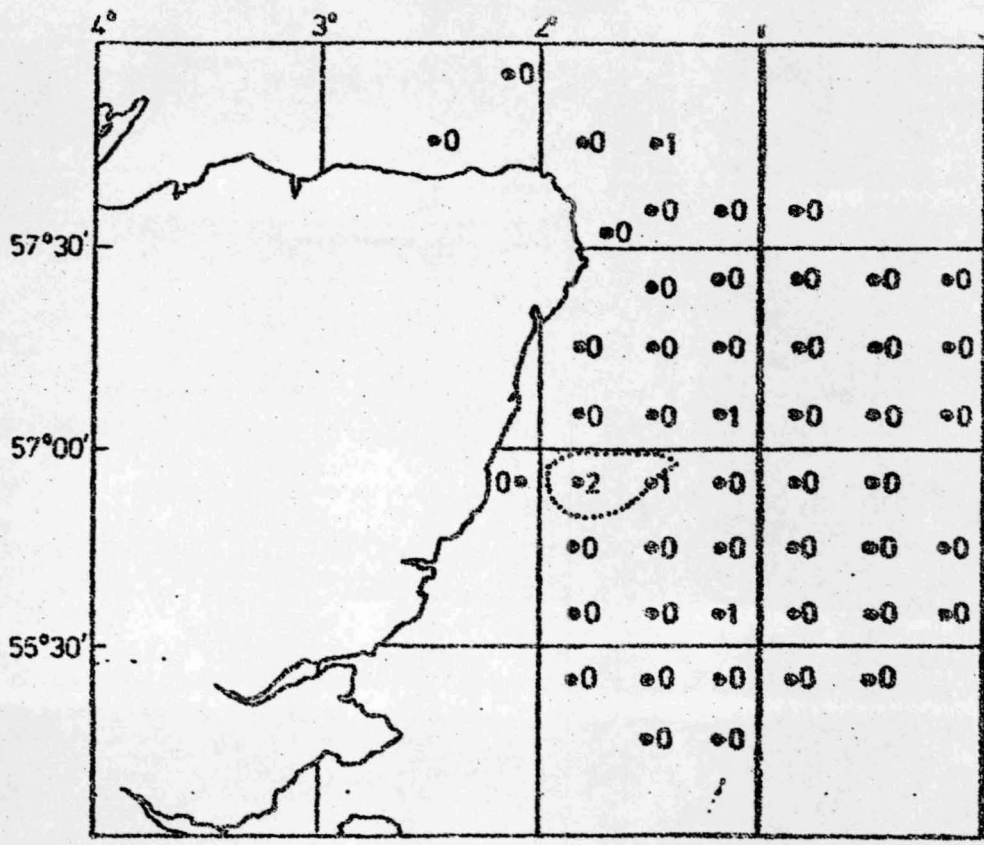


Fig. 29 - Numbers of larvae >15 mm long below 1 m²
 Buchan area 24-28/9/1976
 East German survey.

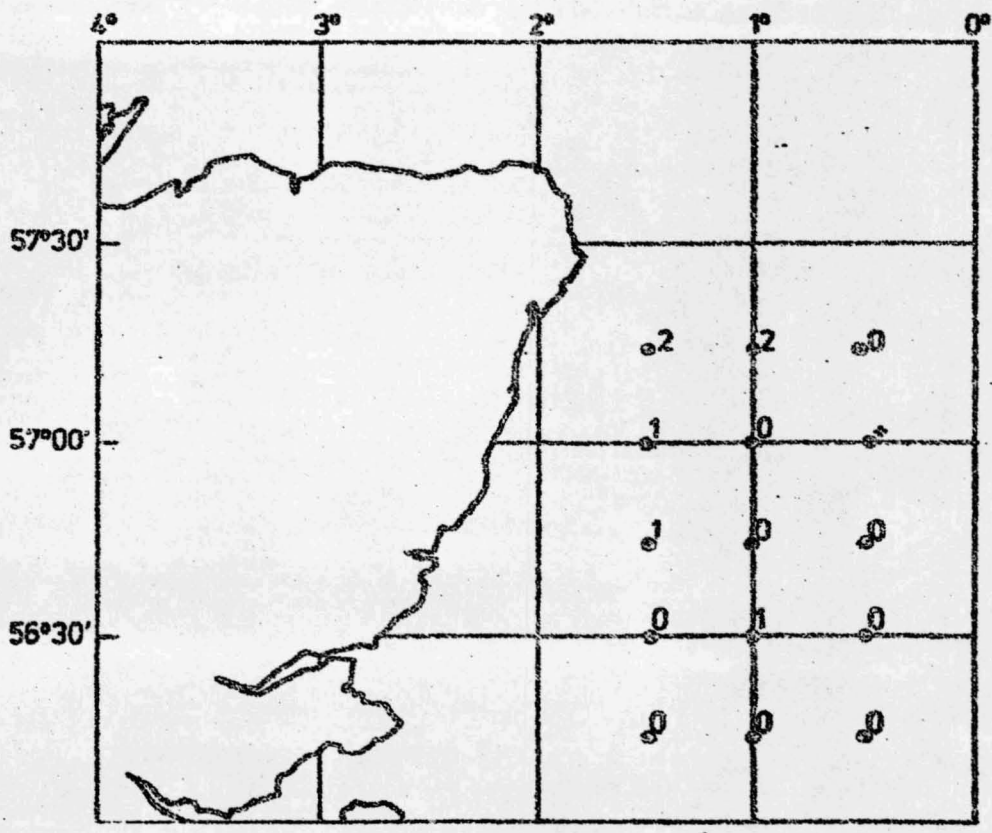


Fig. 30 - Numbers of larvae >15 mm long below 1 m²
 Buchan area 27-29/9/1976
 Polish survey.

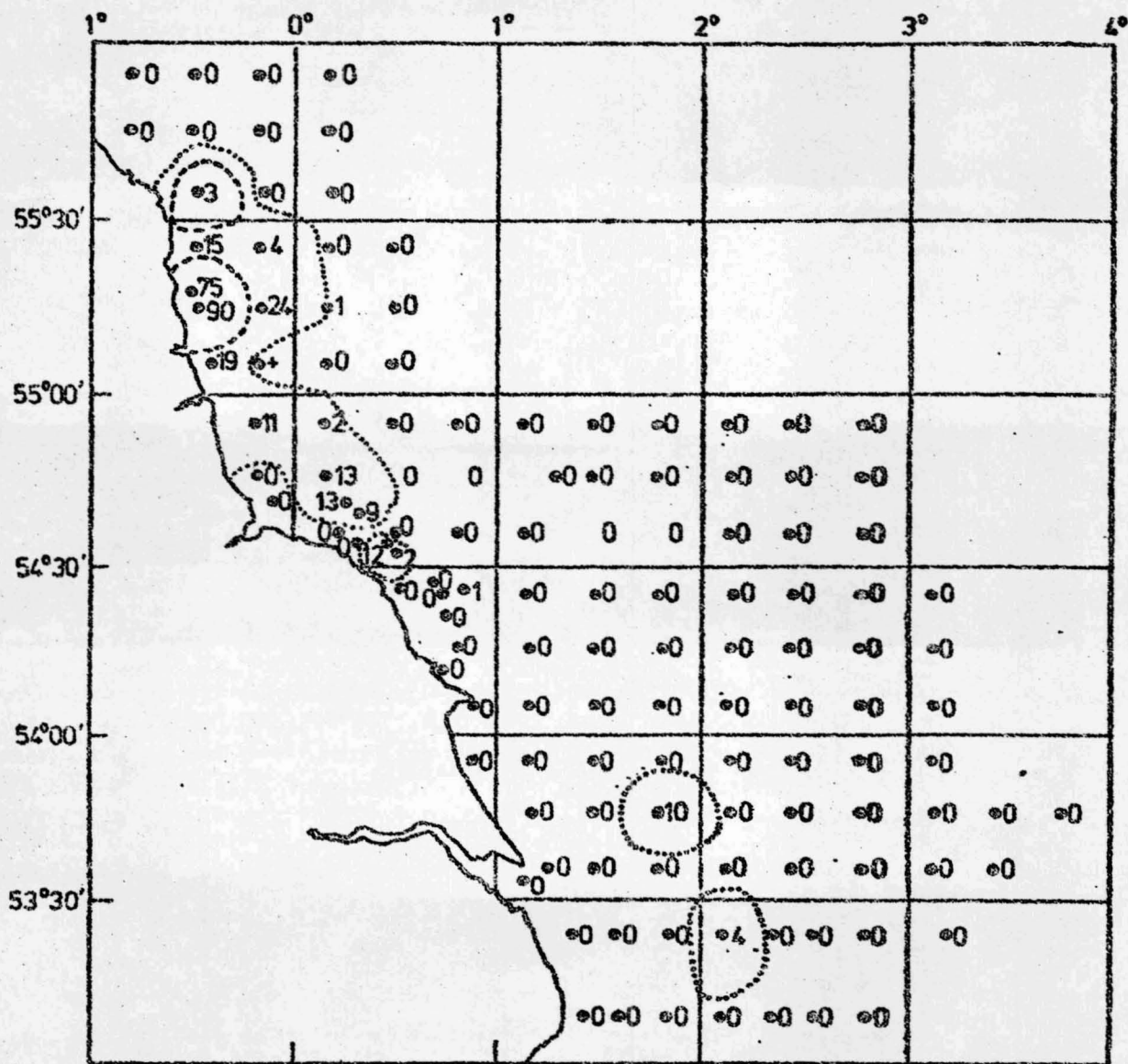


Fig. 31 - Number of larvae <10 mm long below 1 m²
 Whitby/Dogger area 3-14/9/1976
 English survey.

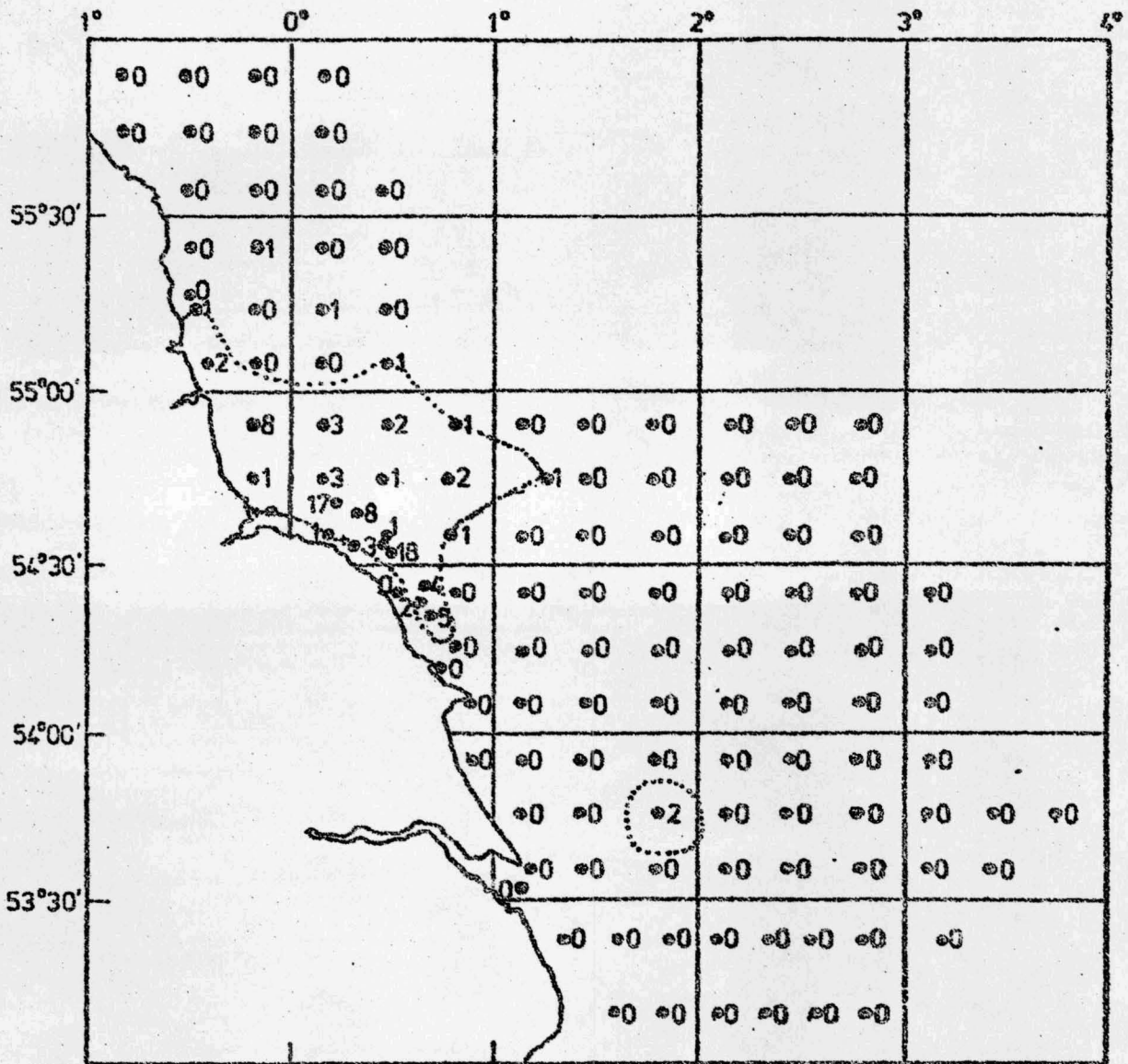


Fig. 32 - Numbers of larvae 10-15 mm long below 1 m²
 Whitby/Dogger area 3-14/9/1976
 English survey.

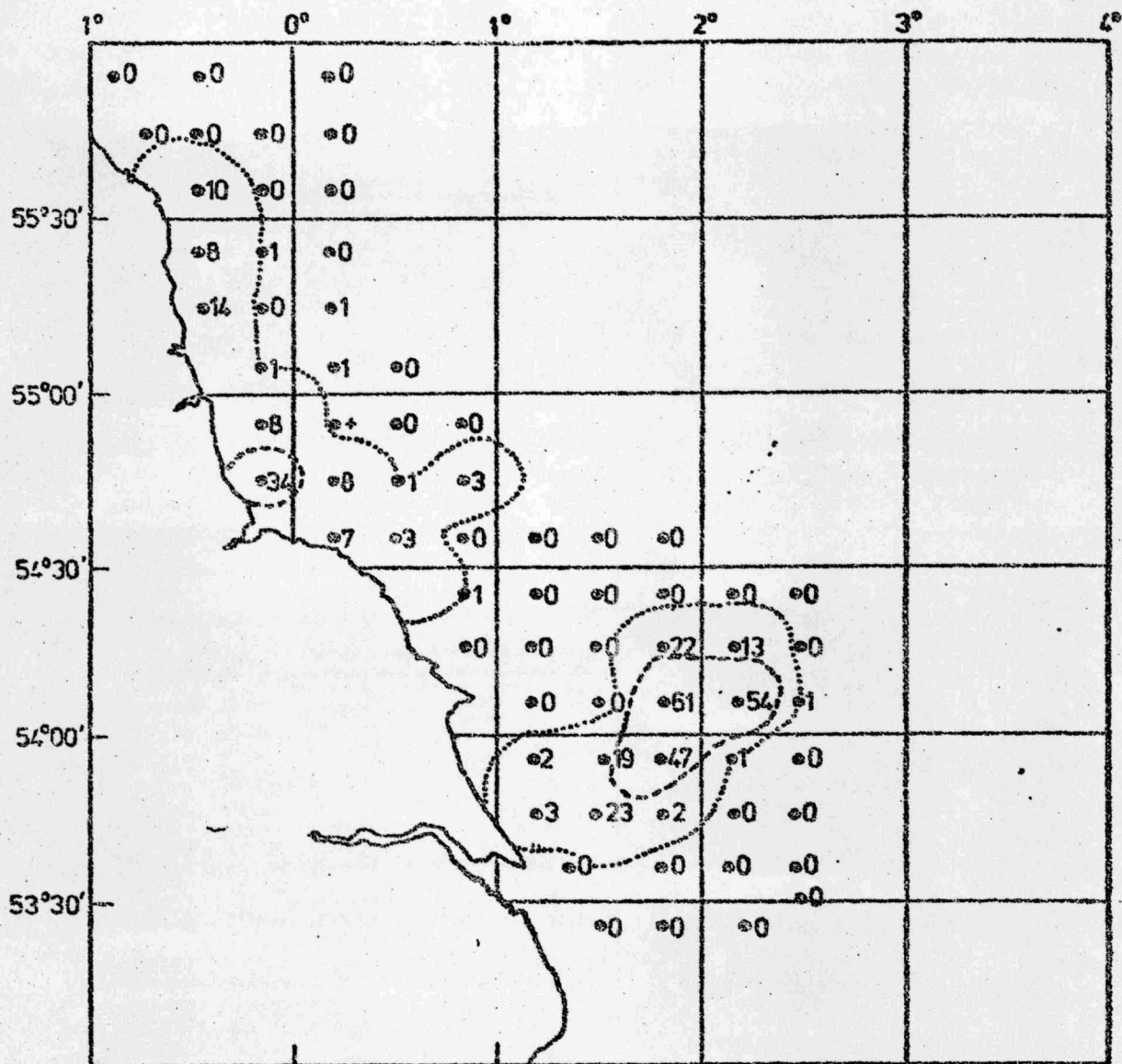


Fig. 33 - Numbers of larvae <10 mm long below 1 m²
 Whitby/Dogger area 16-24/9/1976
 Dutch survey.

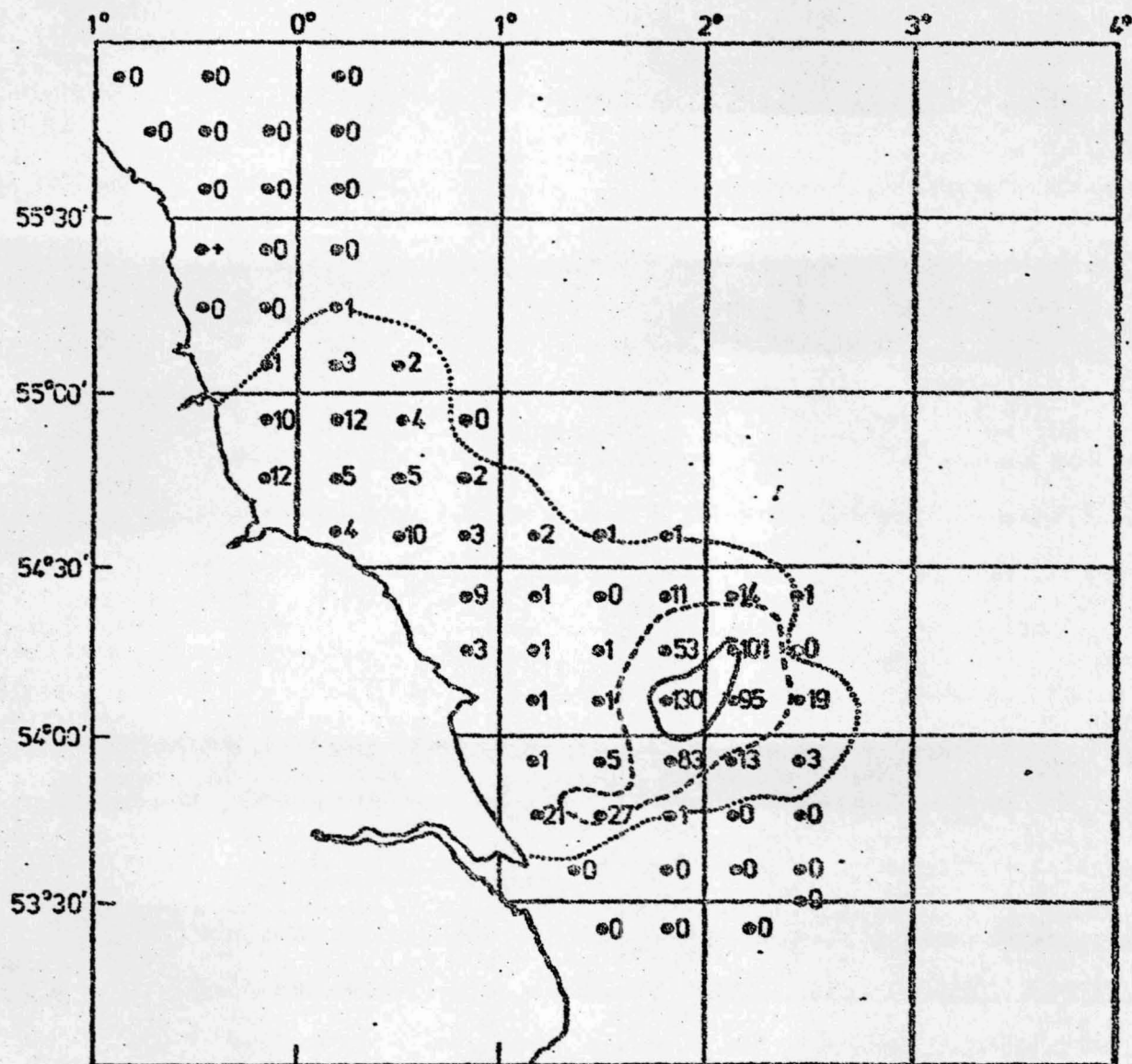


Fig. 34 - Numbers of larvae 10-15 mm long below 1 m²
 Whitby/Dogger area 16-24/9/1976
 Dutch survey.

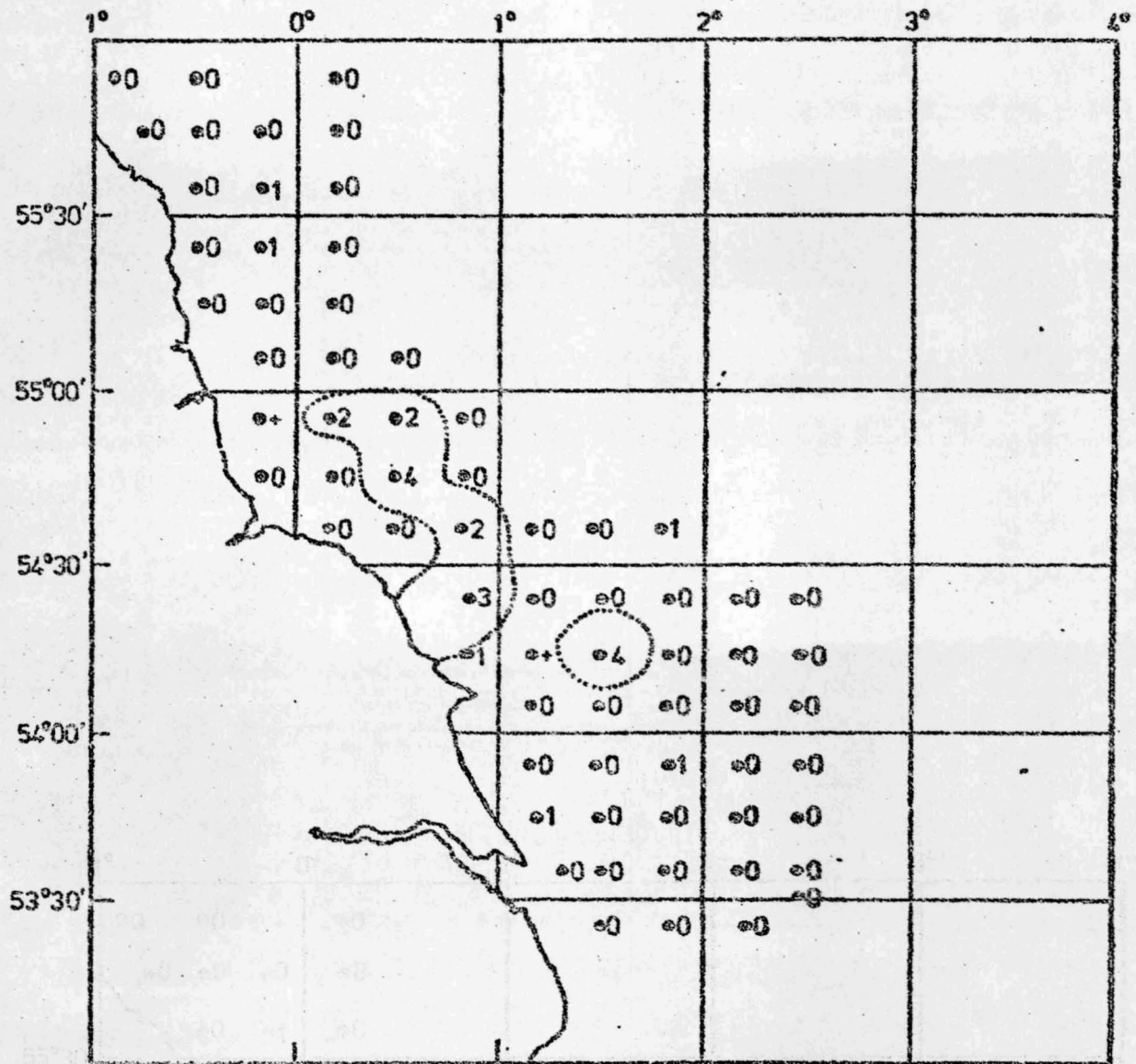


Fig. 35 - Numbers of larvae >15 mm long below 1 m²
 Whithy/Dogger area 16-24/9/1976
 Dutch survey.

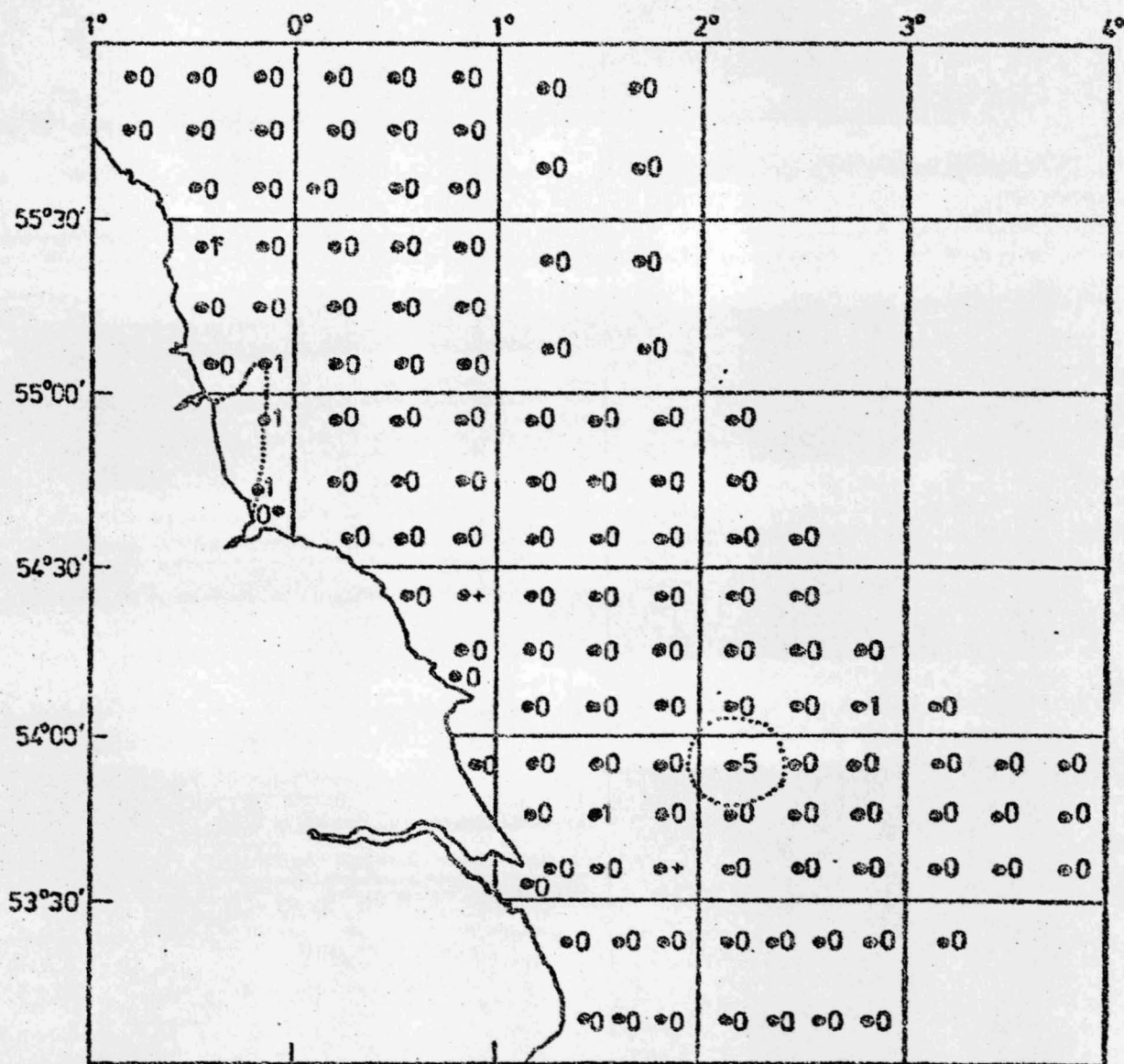


Fig. 36 - Numbers of larvae <10 mm long below 1 m²
 Whitby/Dogger area 28/9-10/10/1976
 English survey.

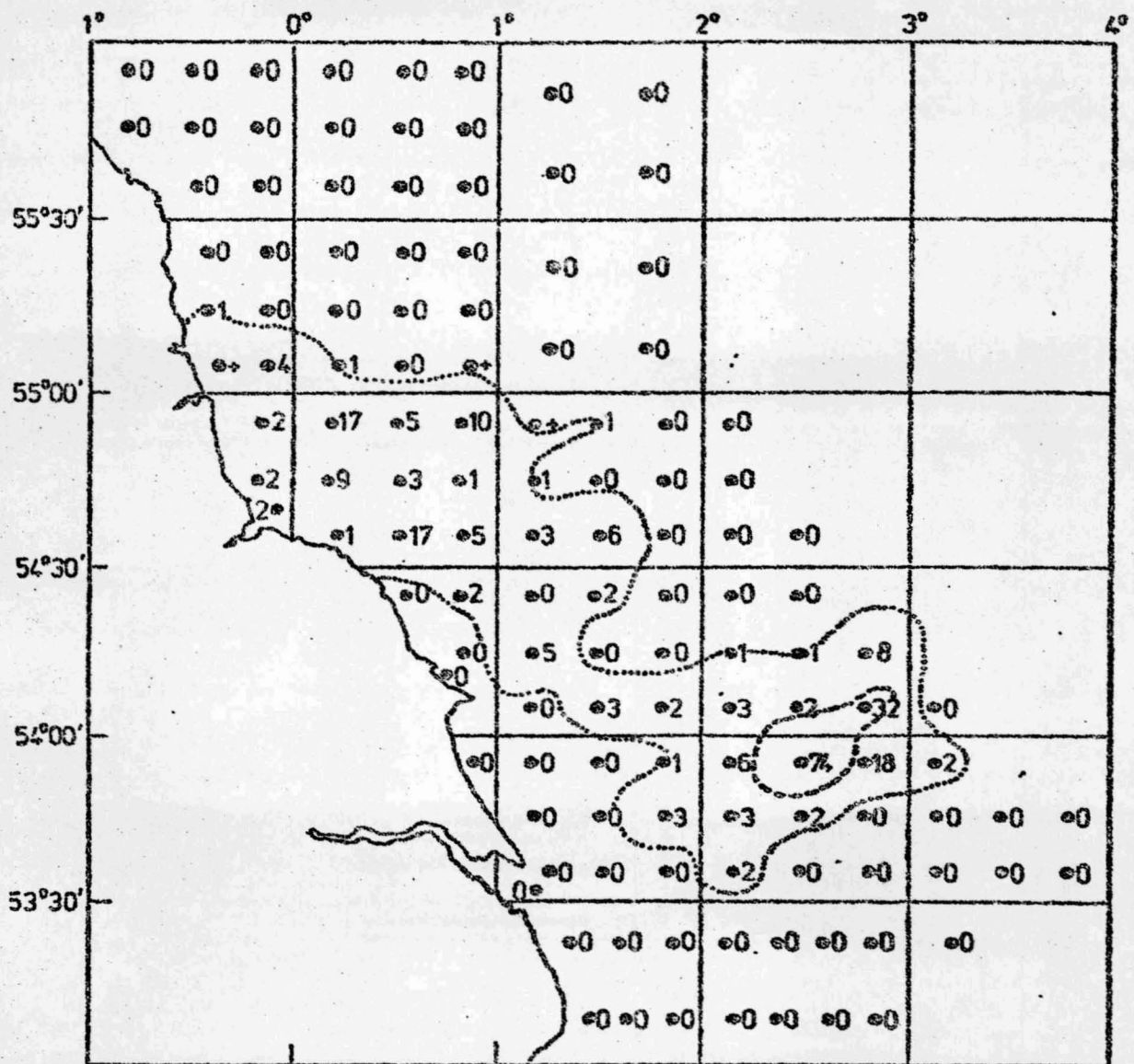


Fig. 37 - Numbers of larvae 10-15 mm long below 1 m²
 Whitby/Dogger area 28/9-10/10/1976
 English survey.

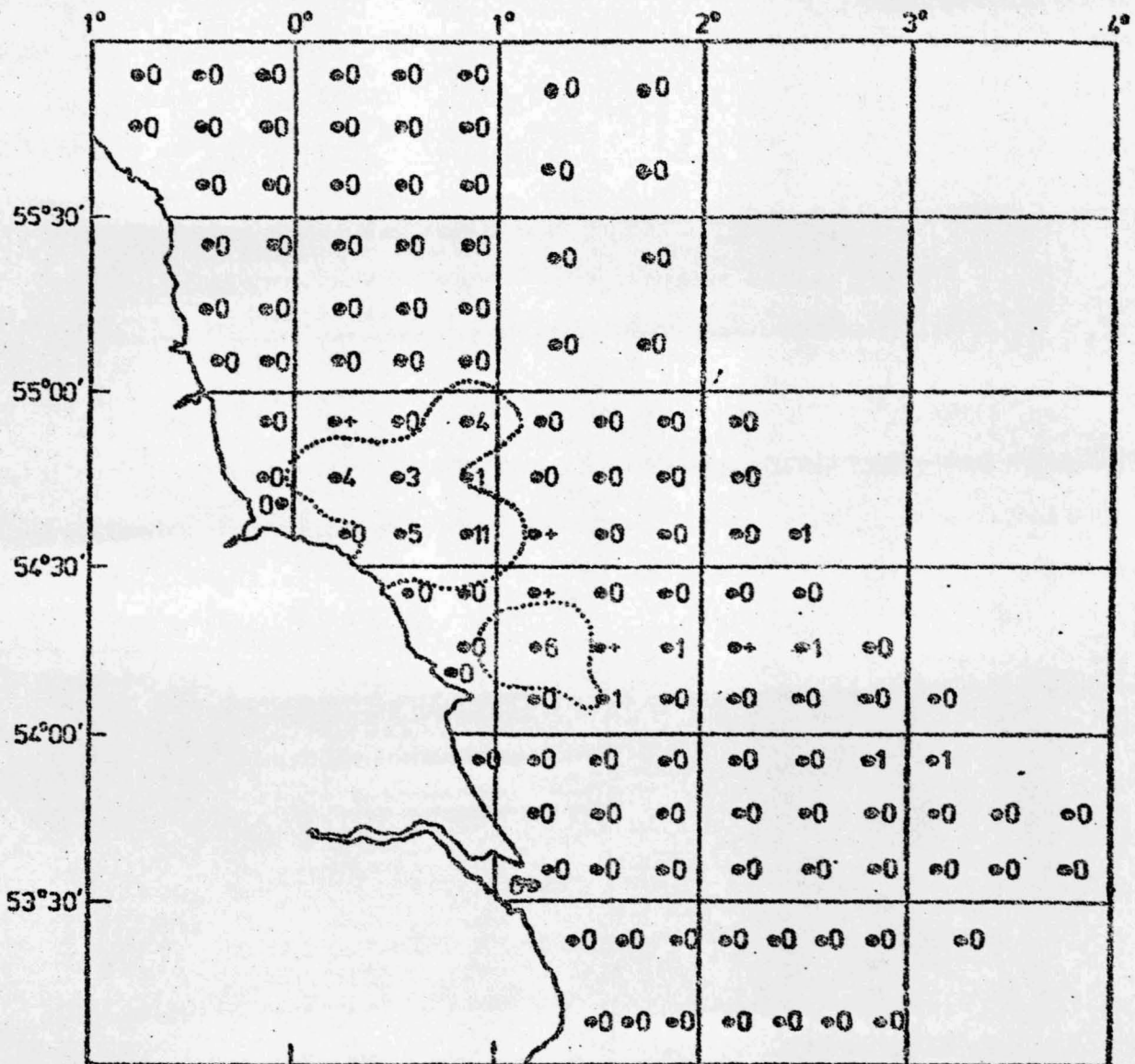


Fig. 38 - Numbers of larvae >15 mm long below 1 m²
 Whitby/Dogger area 28/9-10/10/1976
 English survey.

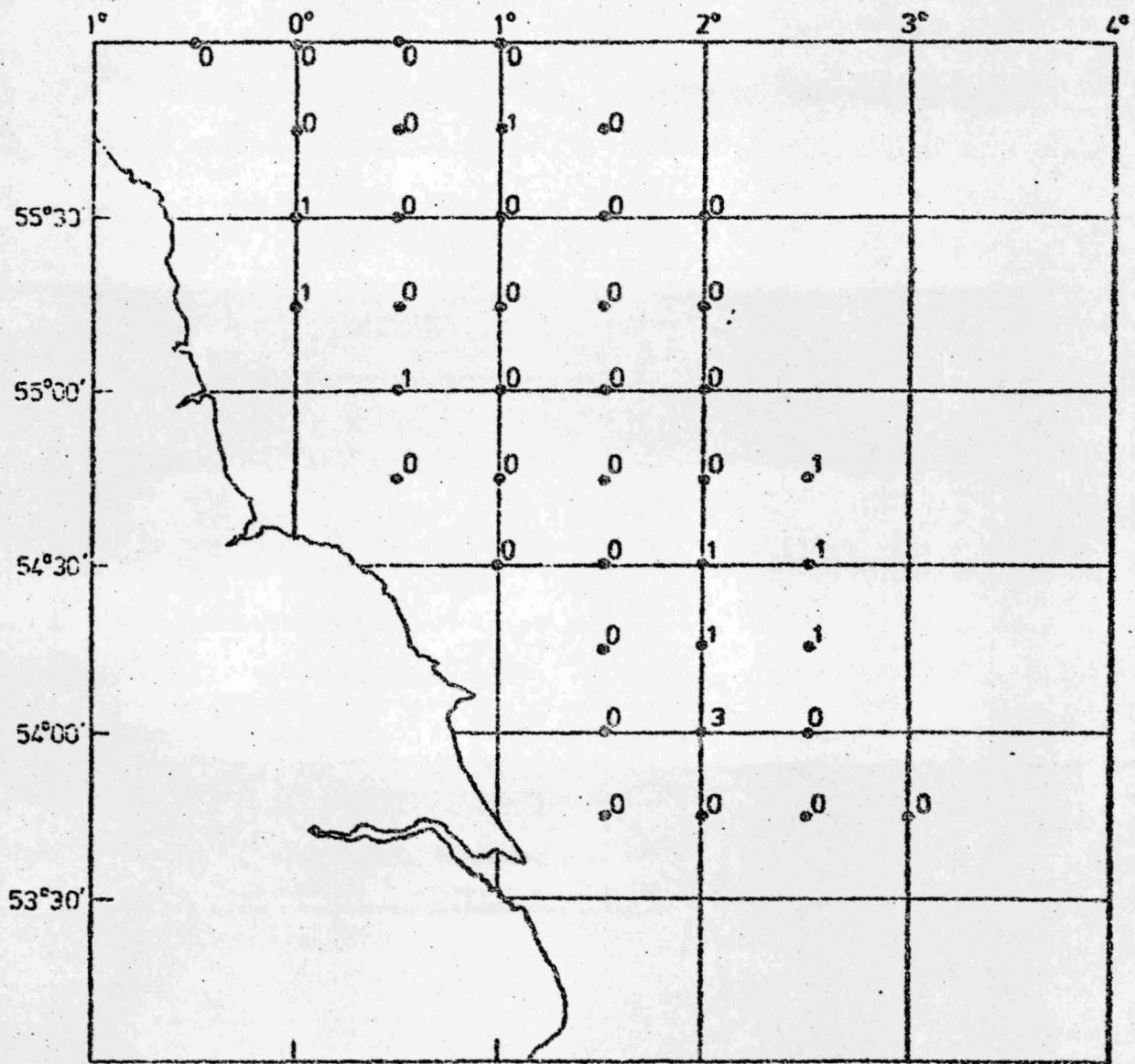


Fig. 39 - Numbers of larvae >15 mm long below 1 m²
 Whitby/Dogger area 8-22/10/1976
 Polish survey.

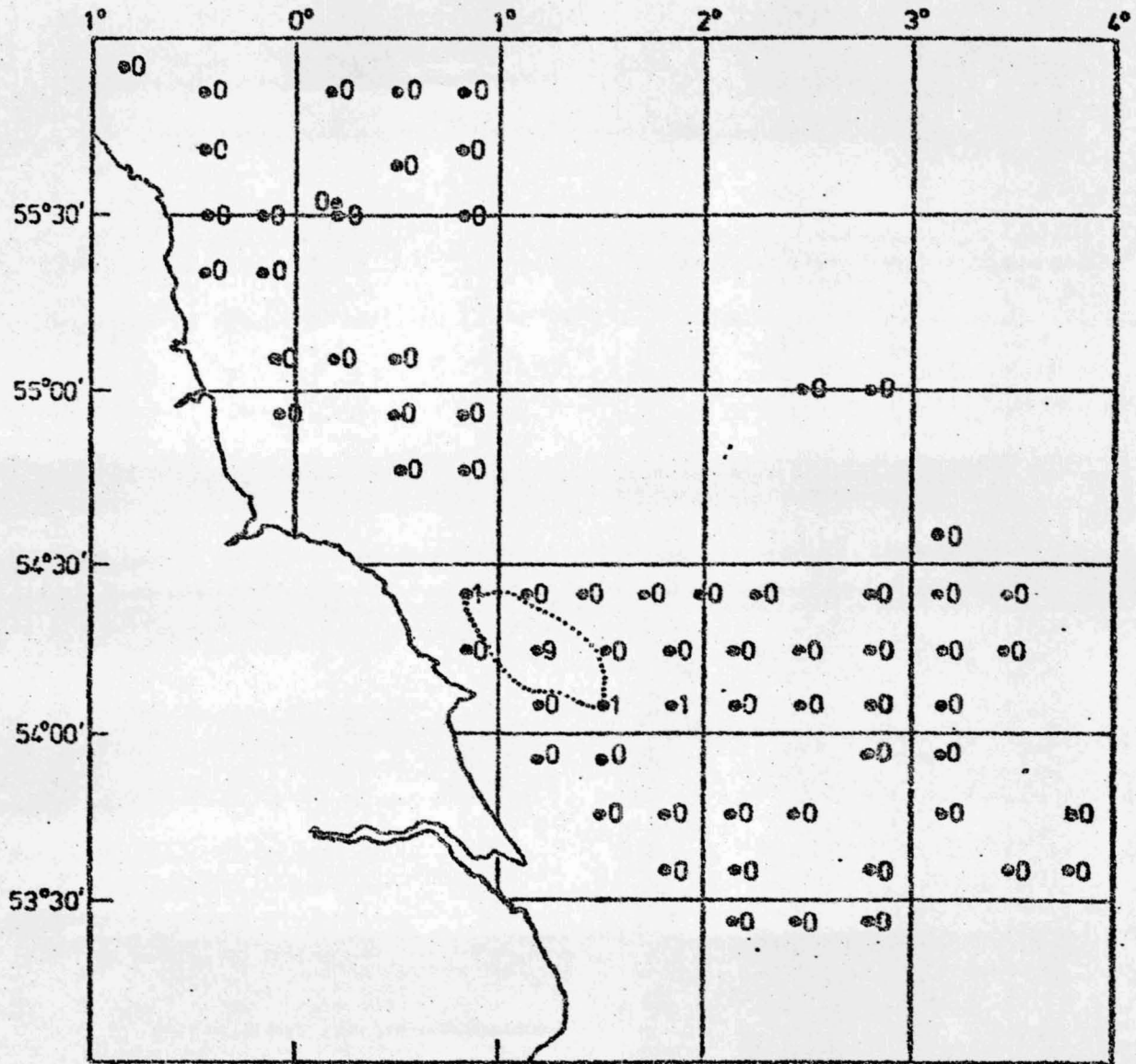


Fig. 40 - Numbers of larvae <10 mm long below 1 m²
 Whitby/Dogger area 19-25/10/1976
 Norwegian survey.

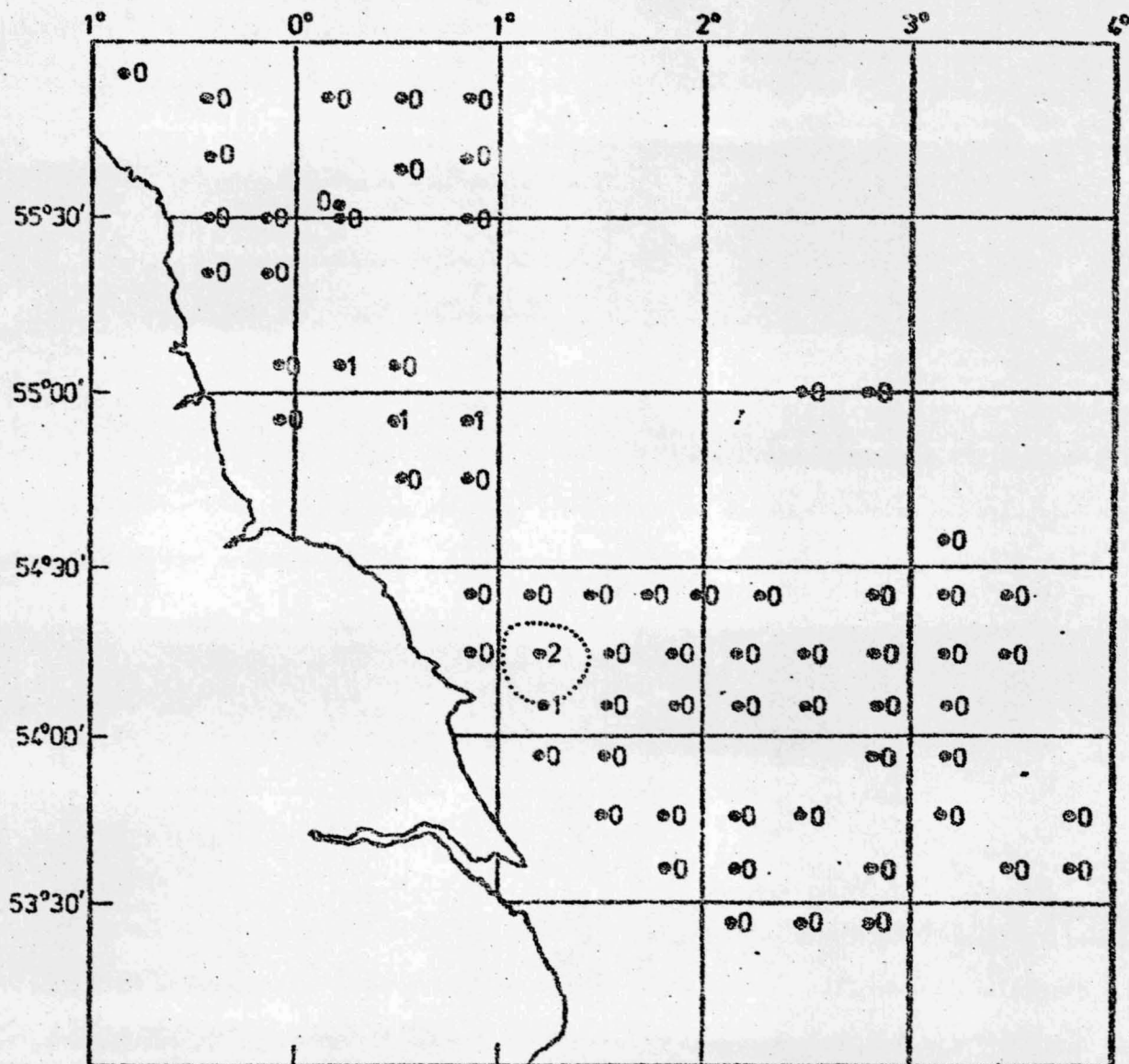


Fig. 41 - Numbers of larvae 10-15 mm long below 1 m²
 Whitby/Dogger area 19-25/10/1976
 Norwegian survey.

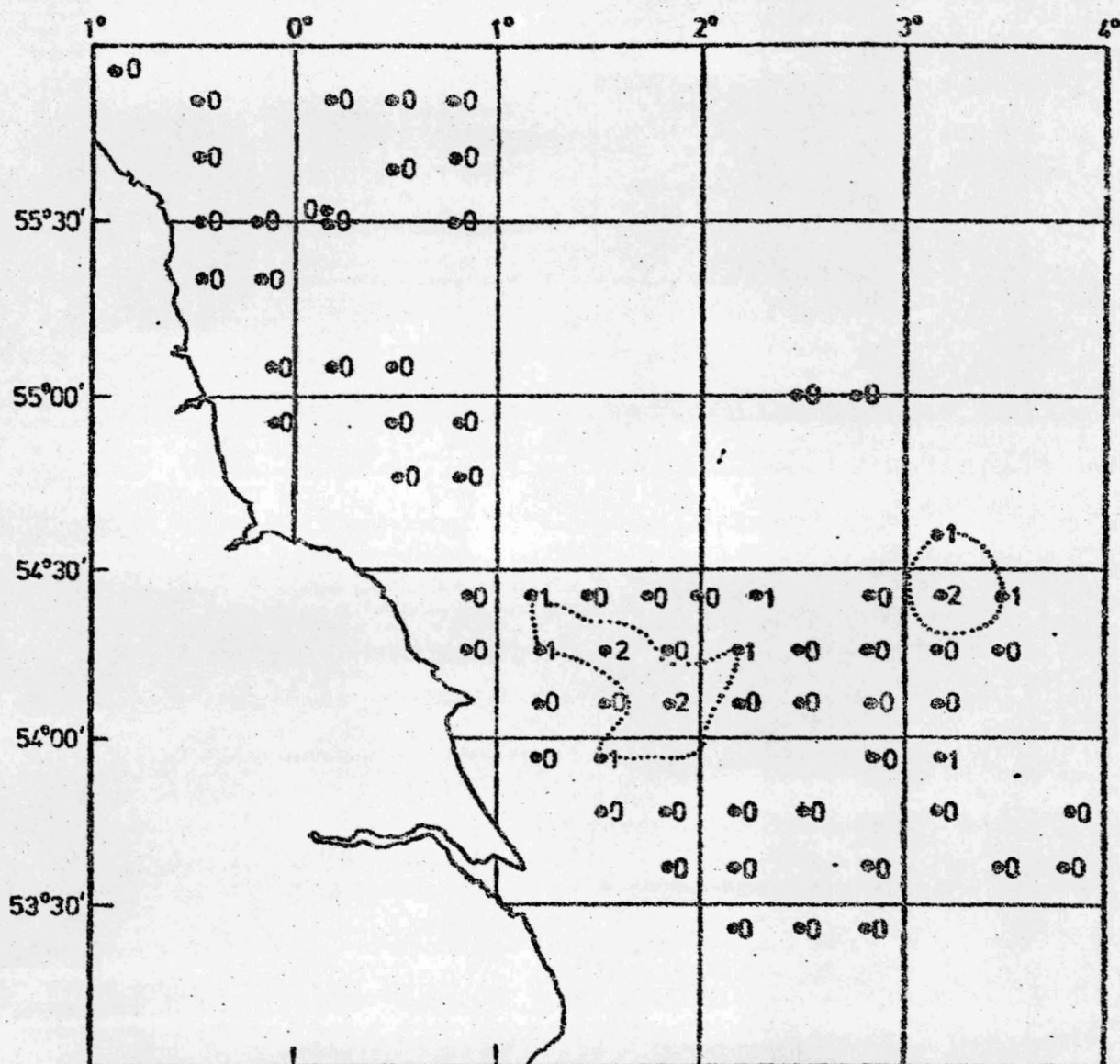


Fig. 42 - Numbers of larvae >15 mm long below 1 m²
 Whitby/Dogger area 19-25/10/1976
 Norwegian survey.

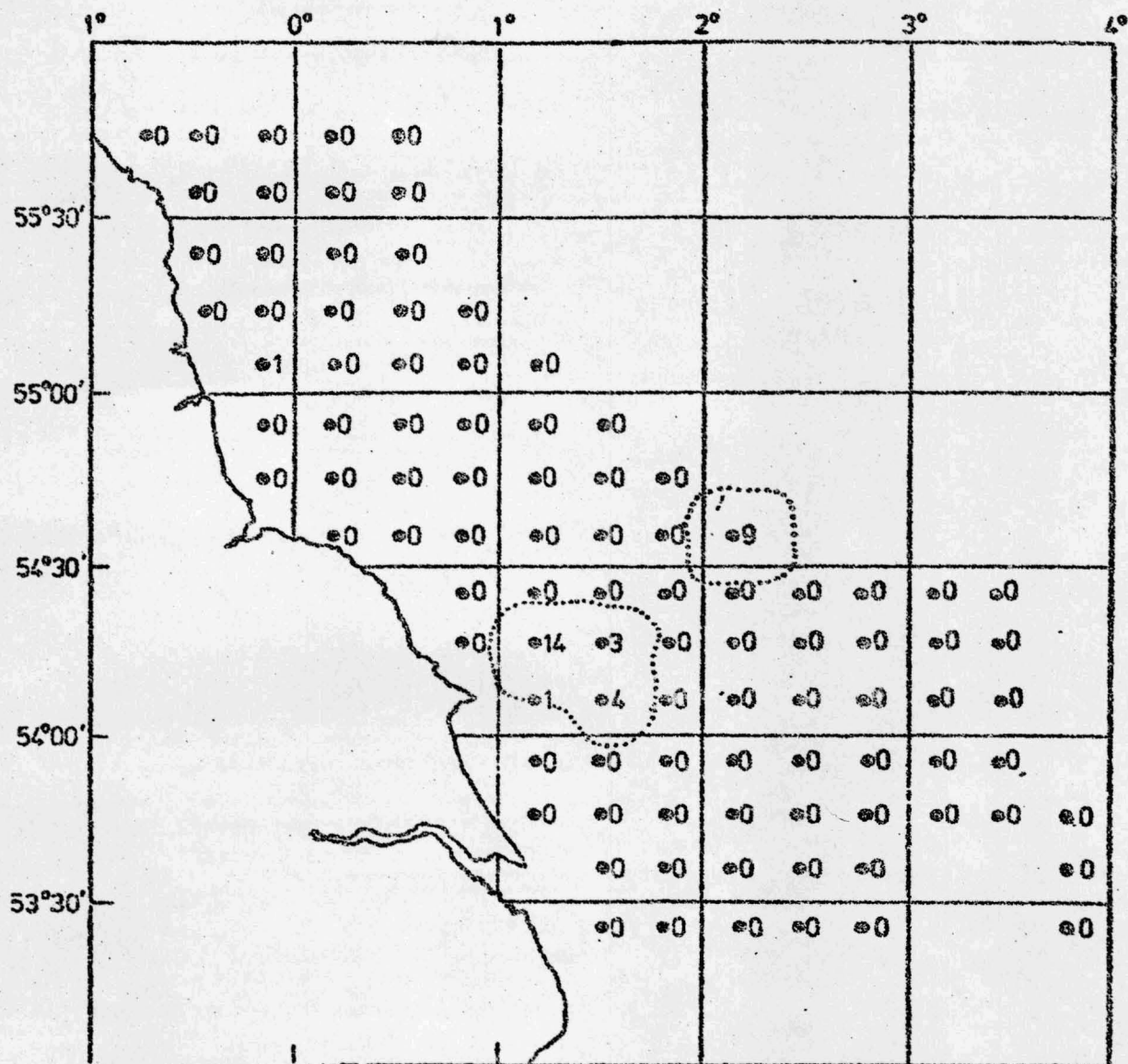


Fig. 43 - Numbers of larvae <10 mm long below 1 m²
 Whitby/Dogger area 18-23/10/1976
 Dutch survey.

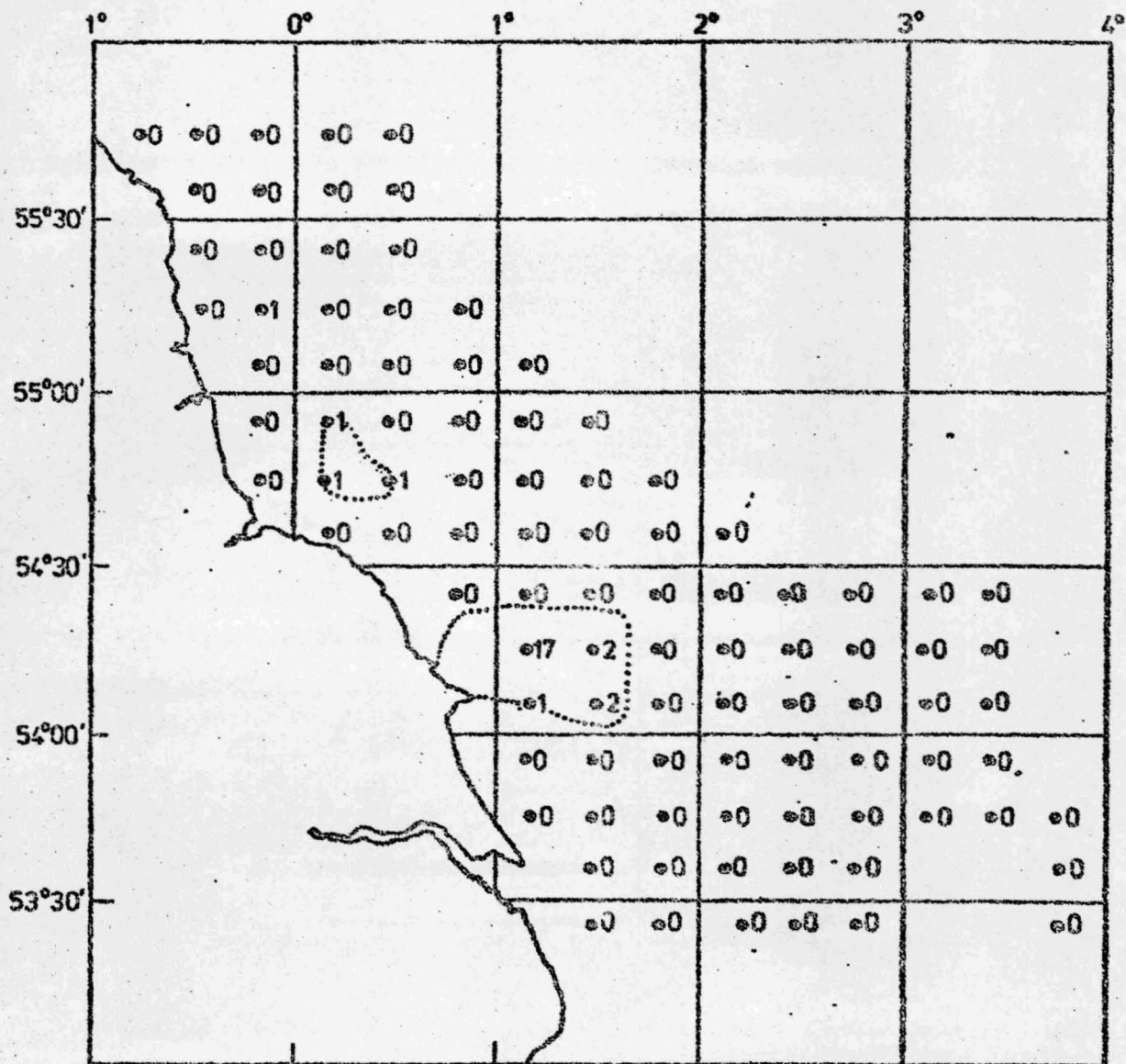


Fig. 44 - Numbers of larvae 10-15 mm long below 1 m²
 Whitby/Dogger area 18-23/10/1976
 Dutch survey.

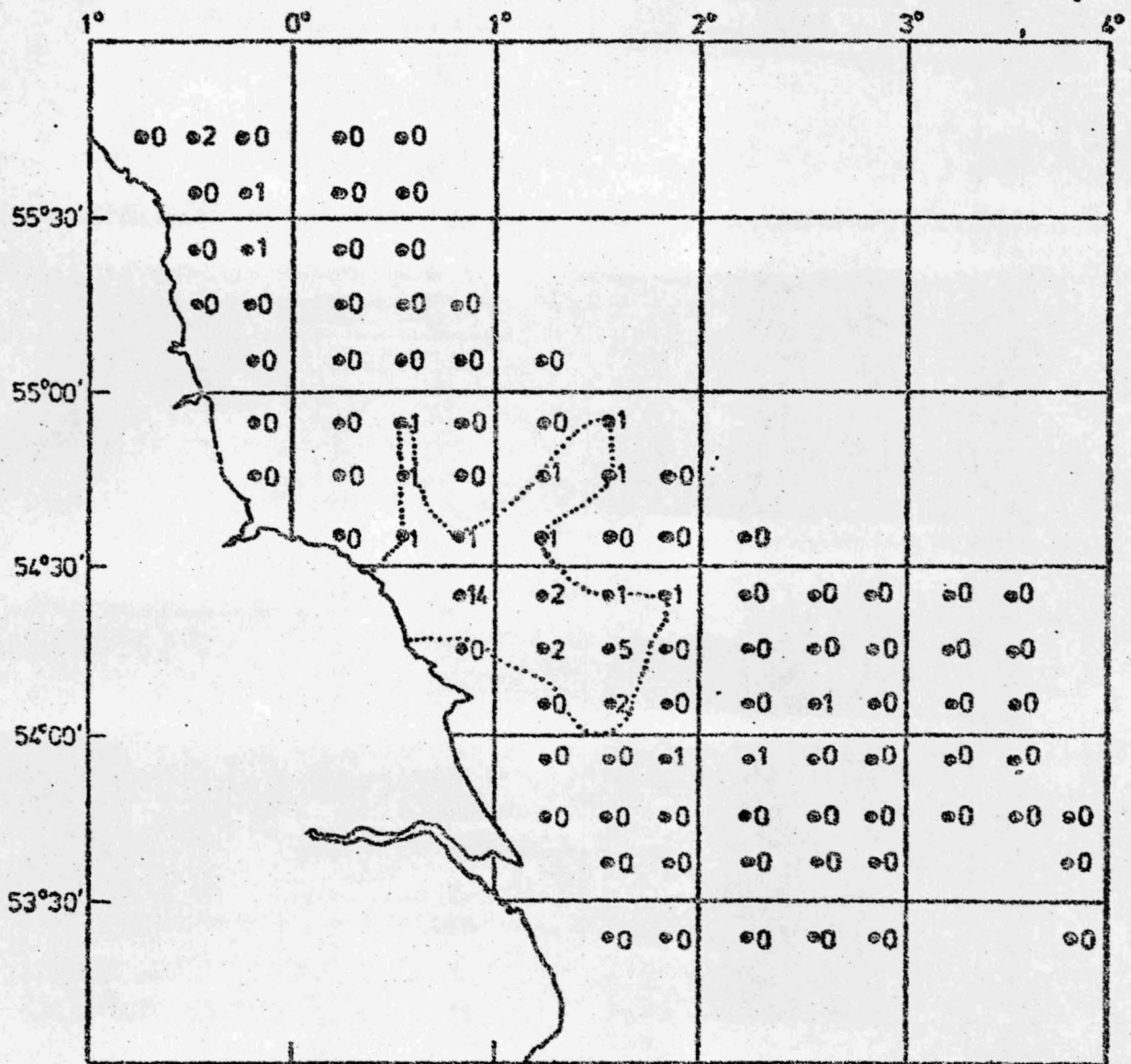


Fig. 45 - Numbers of larvae >15 mm long below 1 m²
 Whitby/Dogger area 18-23/10/1976
 Dutch survey.

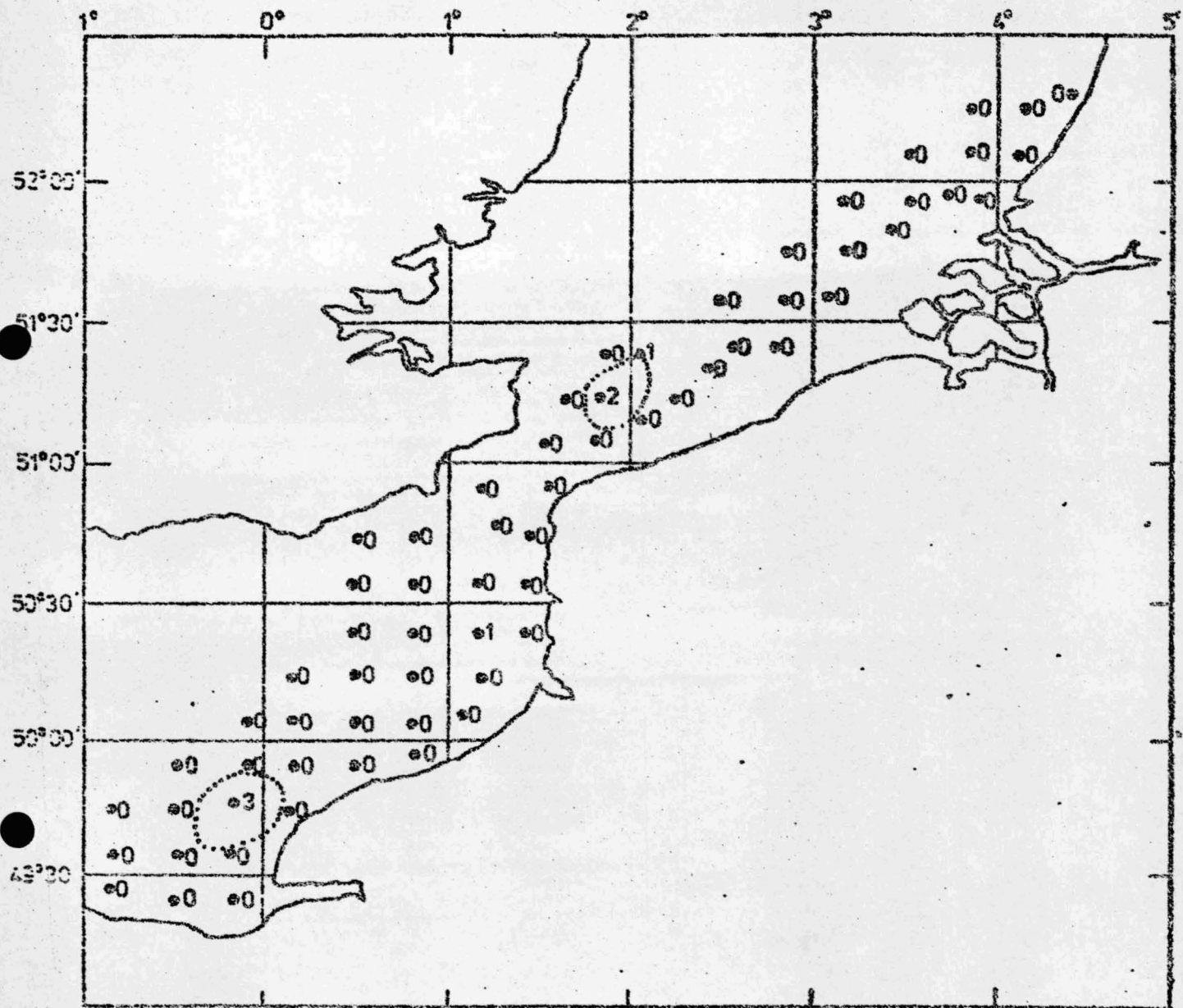


Fig. 46 -- Numbers of larvae <11 mm long below 1 m²
 Southern Bight/English Channel area 3-7/1/1977
 Dutch survey.

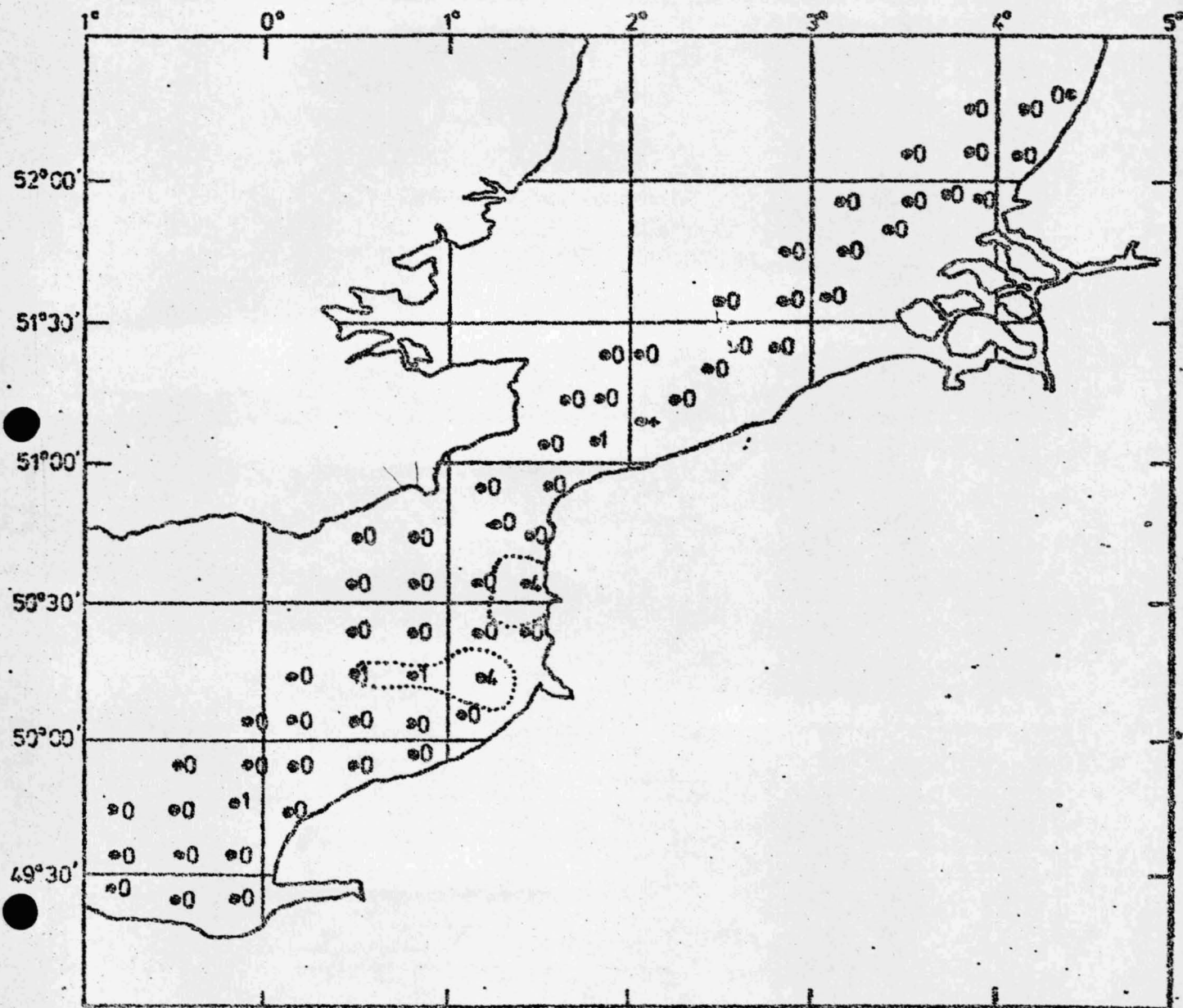


Fig. 47 - Numbers of larvae 11-16 mm long below 1 m²
 Southern Bight/English Channel 3-7/1/1977
 Dutch survey.

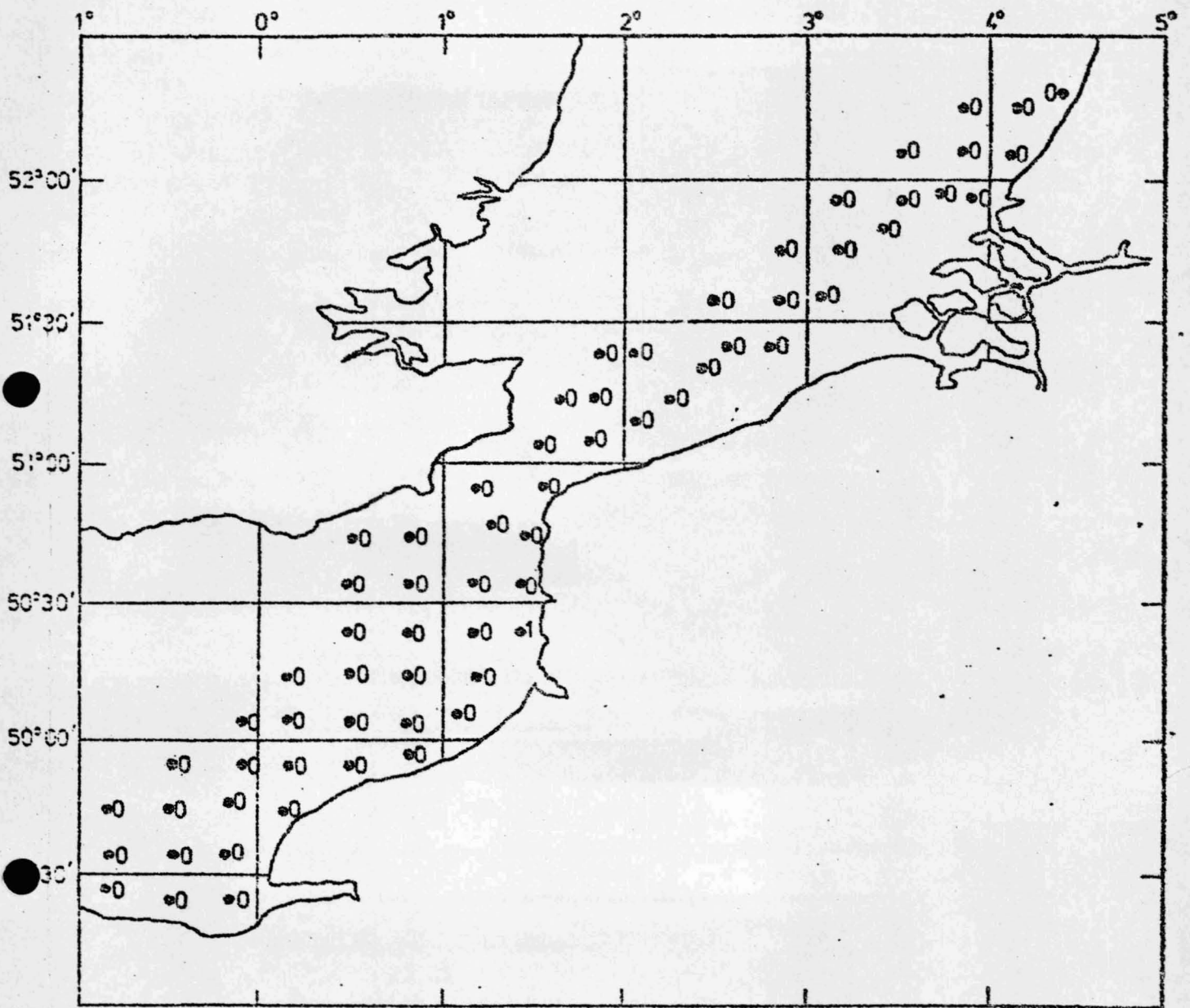


Fig. 48 - Numbers of larvae >16 mm long below 1 m²
 Southern Bight/English Channel area 3-7/1/1977
 Dutch survey.