

SOMMAIRE

Ce communiqué décrit les résultats des études portant sur les larves de harengs entreprises à l'ouest de l'Ecosse, à l'automne de 1976. Celles-ci ont donné des abondances larvaires considérablement inférieures à celles de ces dernières années, et ont indiqué que la réduction de la production larvaire n'était pas uniforme pendant toute l'époque du frai. Le communiqué considère les problèmes que pose la conversion des données relatives à l'abondance larvaire en estimations de l'importance de la population de poissons produite.

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THE DISTRIBUTION AND ABUNDANCE OF HERRING LARVAE
TO THE WEST OF SCOTLAND IN 1976

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Summary

This paper describes the results of the herring larval surveys carried out to the west of Scotland in the autumn of 1976. These gave larval abundances considerably lower than in recent years and indicated that the decline in larval production was not uniform throughout the spawning season. The problems of converting the larval abundance data into spawning stock size estimates are discussed.

Introduction

This report gives the results of the seventh in a series of annual surveys of herring larvae to the west of Scotland. An initial survey in 1965 was followed by a regular series from 1971, resulting from a recommendation by the ICES Herring Assessment Working Group (Anon 1971). These surveys are intended to provide measures of the relative changes in herring spawning stock size which are independent of those estimated from commercial fishery data. The results of previous surveys have been reported by Wood (1971, 1973), Saville & McKay (1974) and McKay (1975, 1976, 1977).

Materials and Methods

During the autumn of 1976 two complete and one partial survey of the spawning area of herring in Division VIa were carried out. The timing of each survey is given in Table 1. Sampling was carried out using a modified Gulf III sampler towed in a double oblique haul fishing the whole water column to within 5 metres of the sea bed. A more detailed description of the gear and sampling techniques is given by Saville (1970) and Anon (1976). During September and October a total of 376 stations were sampled.

Abundance estimates were calculated in a similar manner to that of Schnack (1973), viz. each station value was multiplied by a sea surface area in square metres appropriate to that station, and the individual numbers were then summed for each survey and size group of larvae. This method of calculating abundance estimates gives results which are very similar to those obtained by the method of density - contouring used for previous surveys. Pommeranz (1975) using this method estimated that the abundance of all sizes of herring larvae to the west of Scotland in the period 11-18/9/1974 was 1.957×10^9 whereas McKay (1977) from the same basic data but using the contouring methods estimated the abundance as 1.906×10^9 . This

represents a difference of 2.6%. The main advantage of using the method of Schnack (1973) is that there is a considerable saving in the time needed to produce the estimates.

Results

The results from the various surveys in 1976 are given in Figs 1-8. These have been contoured at the 1, 25 and 100 larvae/m² surface levels to pinpoint the location and extent of larval concentrations. On the first complete survey (from 8 to 24 September) <10 mm long larvae were largely confined to three small patches with maximum densities between 170 and 270 larvae/m² surface. These patches of <10 mm long larvae were found west of Handa Is., density up to 262 larvae/m² surface, west of South Uist, density up to 203 larvae/m² surface and north of Malin Head, density up to 177 larvae/m² surface. The total number of larvae <10 mm long was estimated to be 269 x 10⁹ (Table 2). Larvae in the 10-15 mm length range were found at low densities (<30/m² surface) over much of the North Minch and off the north coast of Scotland. Other patches of 10-15 mm long larvae were located to the west of the Outer Hebrides and off the north west coast of Ireland. The total number of larvae in the 10-15 mm length range was estimated to be 114 x 10⁹ (Table 2). Larvae >15 mm long were confined to a small patch off the north coast of Scotland. The total abundance of >15 mm long larvae was estimated to be 14 x 10⁹.

The second survey (25 and 26 September) was very restricted with sampling being confined to the area west of the Outer Hebrides from Barra Head north to Harris (Figs 4 and 5). Larvae <10 mm long were found in two distinct patches, west of Barra with a maximum density of 340 larvae/m² surface and west of North Uist with a maximum density of 149 larvae/m² surface. The total number of larvae <10 mm long in the surveyed area was estimated to be 231 x 10⁹. Larvae in the 10-15 mm length range were found at low densities over much of the surveyed area with the peak density of 63 larvae/m² surface being located west of Benbecula. The total abundance of larvae in the 10-15 mm length range was estimated at 51 x 10⁹. Larvae >15 mm long were recorded at very low densities (<5 larvae/m² surface) at only two of the stations sampled.

On the third survey the whole of the known spawning area of herring was sampled for a second time (Figs 6-8). Larvae <10 mm long were found over a wide area at rather low densities. In the northern part of the surveyed area the major concentrations were located in the North Minch with a maximum density of 103 larvae/m² surface and west of Harris at a maximum density of 63 larvae/m² surface. In the southern part of the surveyed area the major concentration of larvae was located in Donegal Bay, maximum density 145 larvae/m² surface with minor concentrations, maximum densities 46 and 37 larvae/m² surface respectively, being found north of Malin Head and Tory Island. The total abundance of larvae <10 mm long was estimated to be 261 x 10⁹ (Table 2). Larvae in the 10-15 mm length range had a distribution pattern that was very similar to that of the younger larvae. The estimated total abundance of larvae in the 10-15 mm length range was 607 x 10⁹ (Table 2). Larvae >15 mm long were sporadically distributed over the whole survey area at rather low densities, but were more abundant in the north than in the south. The estimated number of larvae >15 mm long was 60 x 10⁹ (Table 2).

Discussion

The main aim of these surveys is to produce a series of data which can be used to give an estimate of annual variations in spawning stock size. Before such comparisons between years can have validity it is necessary to group the estimates into comparable time periods and surveyed areas. As discussed by Saville & McKay (1974) it is desirable to split Division VIa into two areas, north and south of

56° 30'N. The larval abundance data for the past and the present surveys of VIa on this basis are given in Tables 3 and 4.

Those data indicate that there has been a marked decline in the larval production to the west of Scotland in 1976. Although larval production has been greatly reduced the reduction has not been constant over the area or time periods covered by the surveys. The most marked decline was observed in the area north of 56°30'N and during the survey carried out in the period 10-25 September, where the results indicate that the abundance of all size groups of larvae had declined by an order of magnitude from the levels observed in previous years. For most of the other surveys the larval abundances have been reduced to about half the levels observed in previous years. The only survey in 1976 during which the larval abundance was not obviously very much lower than in preceding years was that carried out on the 25 and 26 September 1976. Because that survey covered only a restricted area the figures given in Table 3 apparently show a similar decline to those of other periods. When comparisons are made, however, between the larval densities observed on that survey and those of other years (McKay 1975, 1976, 1977) it is apparent that larval production in this area in 1976 was at much the same level as in 1973-1975.

This pattern of differential decline in larval production from area to area is not a new phenomenon in Division VIa. It was first observed off Cape Wrath where peak larval density in early September declined from 5.523 larvae/m² surface in 1972 to 25 in 1975 when the densities in other hatching areas were showing a much more gradual decline. Similarly larval production to the NW of Ireland increased between 1972 and 1974 whereas larval production to the north of 56°30'N showed a general decline over the same period.

Two attempts have been made to relate larval production in Division VIa with the herring spawning stock size. Saville & McKay (1974) and McKay (1975, 1977) compared the mean larval abundances in Division VIa with those of other stocks, notably those in the Central/Northern North Sea, for which both larval abundance and stock size data were available. McKay (1976) however pointed out that this approach was not altogether valid as the sampling of Division VIa had not been carried out in a strictly comparable manner in all the years used. That author suggested that if one assumes that the seasonal progression of hatching does not vary from year to year, it should be possible to use the abundance of small larvae during a standard time period for comparison with the estimated spawning stock size from virtual population analysis (Anon 1977). Examination of the larval abundance data given in Tables 3 and 4 indicates that the longest series of comparable data available is from the surveys carried out in late October. For those years for which no data are available for this period the ratio of abundance of larvae in early and late October surveys, in the years when two valid surveys are available, has been used to weight the abundances of larvae on the early October surveys. The relevant data are given in Table 5 and Figure 9. From these it can be seen that there appears to be a fairly good relationship between the estimated spawning stock size and the larval abundance in late October.

It should however be pointed out that the basic assumption of a similar seasonal progression of hatching in each year may not be justified in view of the differential decline of production of larvae on the various spawning areas in 1976. It would therefore appear that in Division VIa, the data at present available allow no more than a rather rough index of variation in spawning stock size to be deduced from larval abundances. It would seem quite clear however that, in 1976, production of herring larvae in Division VIa was at a low level in comparison with the early 1970's.

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Table 1 Surveys carried out in 1976

Country	Area	Period	No of stations sampled
Scotland	54°25'N - 59°15'N	8 - 24 September	181
Scotland	56°55'N - 58°05'N	25 - 26 September	21
Scotland	54°25'N - 59°15'N	8 - 25 October	174

Table 2 Estimated abundances of herring larvae on the various surveys of VIa in 1976 (Totals for N and S of 56°30'N given separately. Estimates obtained by method of Schnack (1973))

Date	Survey area	Larval abundances x 10 ⁹			
		<10 mm	10-15 mm	>15 mm	Total
8 - 24 Sept	N of 56°30'N	198	96	11	305
	S of 56°30'N	71	18	3	92
	Complete survey	269	114	14	397
25 - 26 Sept	56°55'N - 56°05'N	231	51	2	284
8 - 25 Oct	N of 56°30'N	145	367	50	562
	S of 56°30'W	117	241	14	372
	Complete survey	262	608	64	934

Table 3

Estimated abundances of herring larvae in division VIa, North of 56°30'N, in 1965, 1971, 1972, 1973, 1974, 1975 and 1976 in standard time periods (After Wood (1971, 1973), Saville & McKay (1974) and McKay (1975, 1976, 1977))

Size group of larvae	Time period	Estimated abundance x 10 ⁻⁹						
		1965	1971	1972	1973	1974	1975	1976
< 10 mm	1-10/9	NS	ND	7 691 ¹⁾	NS	364 ¹⁾	515	NS
	11-25/9	NS	NS	1 334	2 016	1 051 ¹⁾	1 132 ¹⁾	198
	26/9-10/10	NS	NS	2 388	1 665	1 376	663	231 ¹⁾
	10-25/10	415	319	NS	NS	788	421 ¹⁾	145
10-15 mm	1-10/9	NS	ND	669 ¹⁾	NS	205 ¹⁾	83	NS
	11-25/9	NS	NS	1 350	2 553	832 ¹⁾	976 ¹⁾	96
	26/9-10/10	NS	NS	2 122	1 779	1 234	949	51 ¹⁾
	10-25/10	ND	ND	NS	NS	1 321	334 ¹⁾	367
Total	1-10/9	NS	3 267 ²⁾	8 360 ¹⁾	NS	569 ¹⁾	598	NS
	11-25/9	NS	NS	2 773	4 569	1 906 ¹⁾	2 108 ¹⁾	305
	26/9-10/10	NS	NS	4 585	3 586	2 832	1 661	284
	10-25/10	1 330	1 037	NS	NS	2 366	795 ¹⁾	562

NS - No survey

1) Incomplete survey

ND - No data given

2) Including yolk sac larvae

Table 4 Estimated abundances of herring larvae in division VIa, south of 56°30'N, in 1965, 1971, 1972, 1973, 1974, 1975, 1976 in standard time periods. (After Wood (1971, 1973), Saville & McKay (1974) McKay (1975, 1976, 1977))

Size group of larvae	Time period	Estimated abundance x 10 ⁻⁹						
		1965	1971	1972	1973	1974	1975	1976
< 10 mm	11-25/9	NS	NS	21	194	NS	153	71
	26/9-10/10	NS	NS	31	524	1 013	810	NS
	10-25/10	504	677	NS	NS	727	NS	117
10-15 mm	11-25/9	NS	NS	29	47	NS	5	18
	26/9-10/10	NS	NS	21	231	149	151	NS
	10-25/10	ND	ND	NS	NS	740	NS	240
Total	11-25/9	NS	NS	51	241	NS	158	92
	26/9-10/10	NS	NS	57	758	1 172	972	NS
	10-25/10	807	940	NS	NS	1 561	NS	371

NS - No survey

ND - No data given

Table 5 Estimated larval abundance in late October and spawning stock size from VPA during the period 1965 - 1976

Year	Abundance of larvae <10mm long during late October x 10 ⁻⁹	Spawning stock size (tonnes x 10 ⁻³)
1965	919	181
1971	996	293
1972	1 526*	450
1973	1 381*	382
1974	1 515	205
1975	929	131
1976	262	132

* Estimates for early October surveys weighted by the ratio of early to late October surveys in other years.

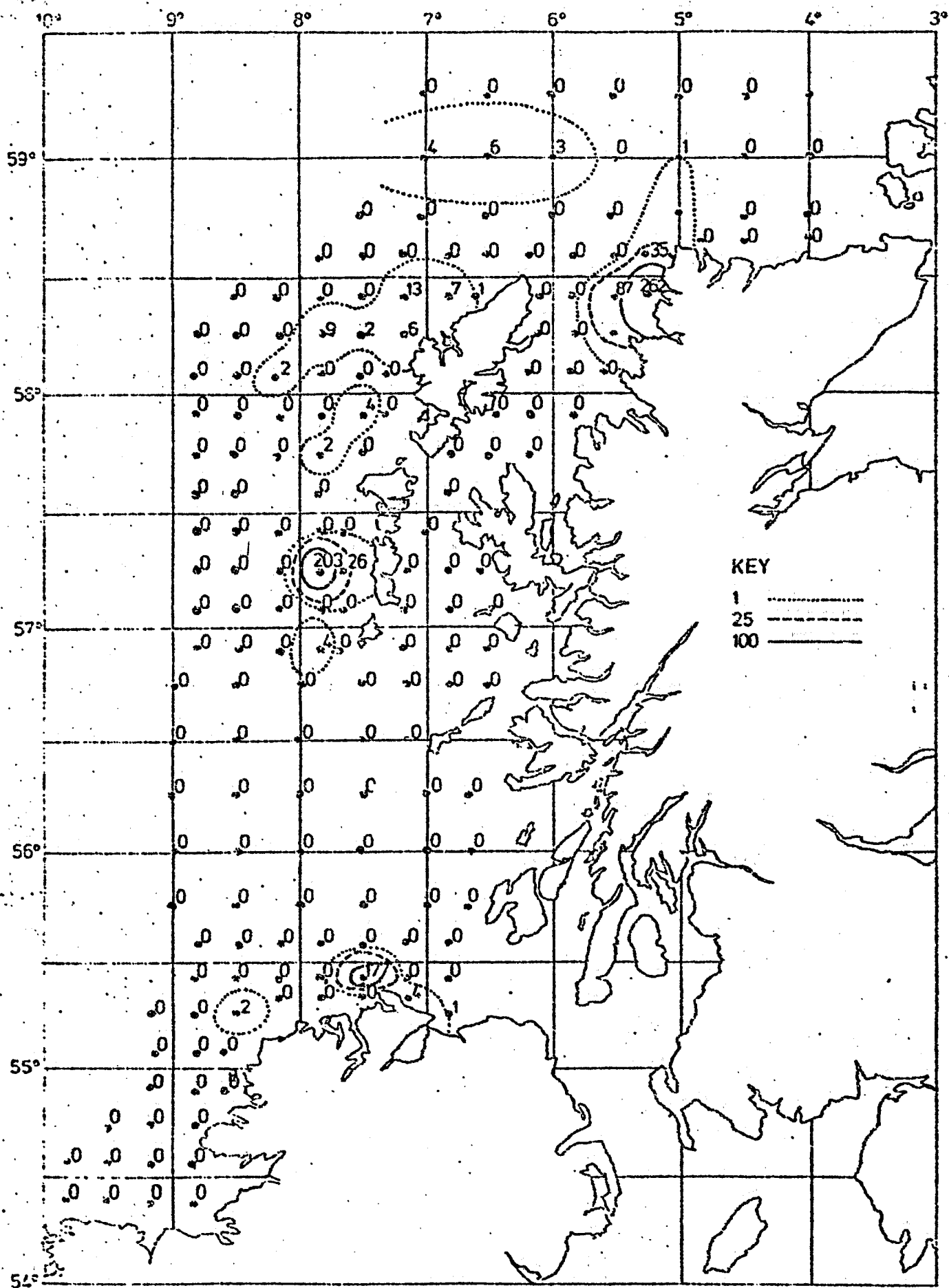


Fig. 1. Number of larvae <10 mm long below 1 sq metre W. of Scotland 8-24 September 1976

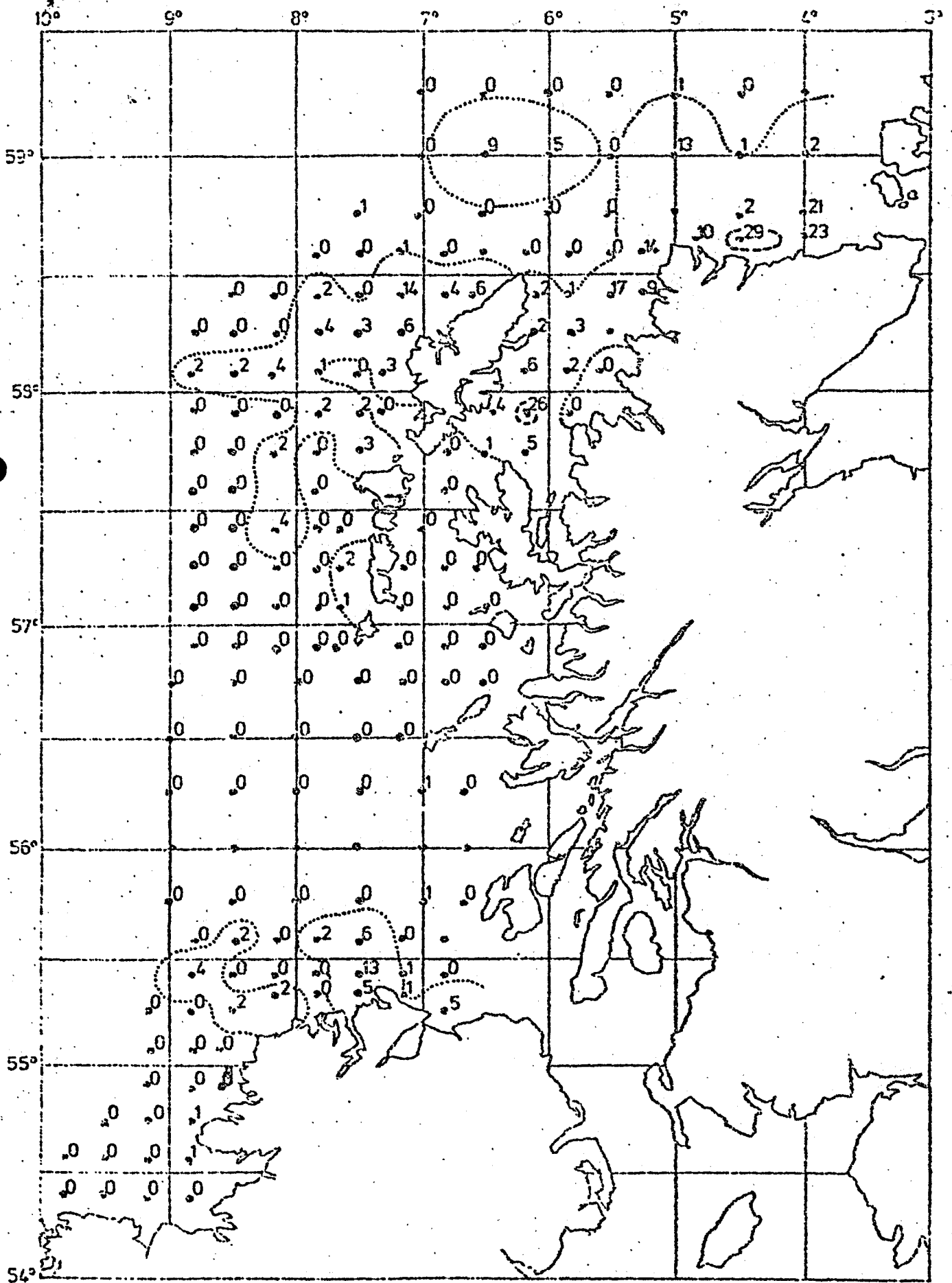


Fig. 2 Number of larvae 10-15 mm long below 1 sq metre W. of Scotland 8-24 September 1976

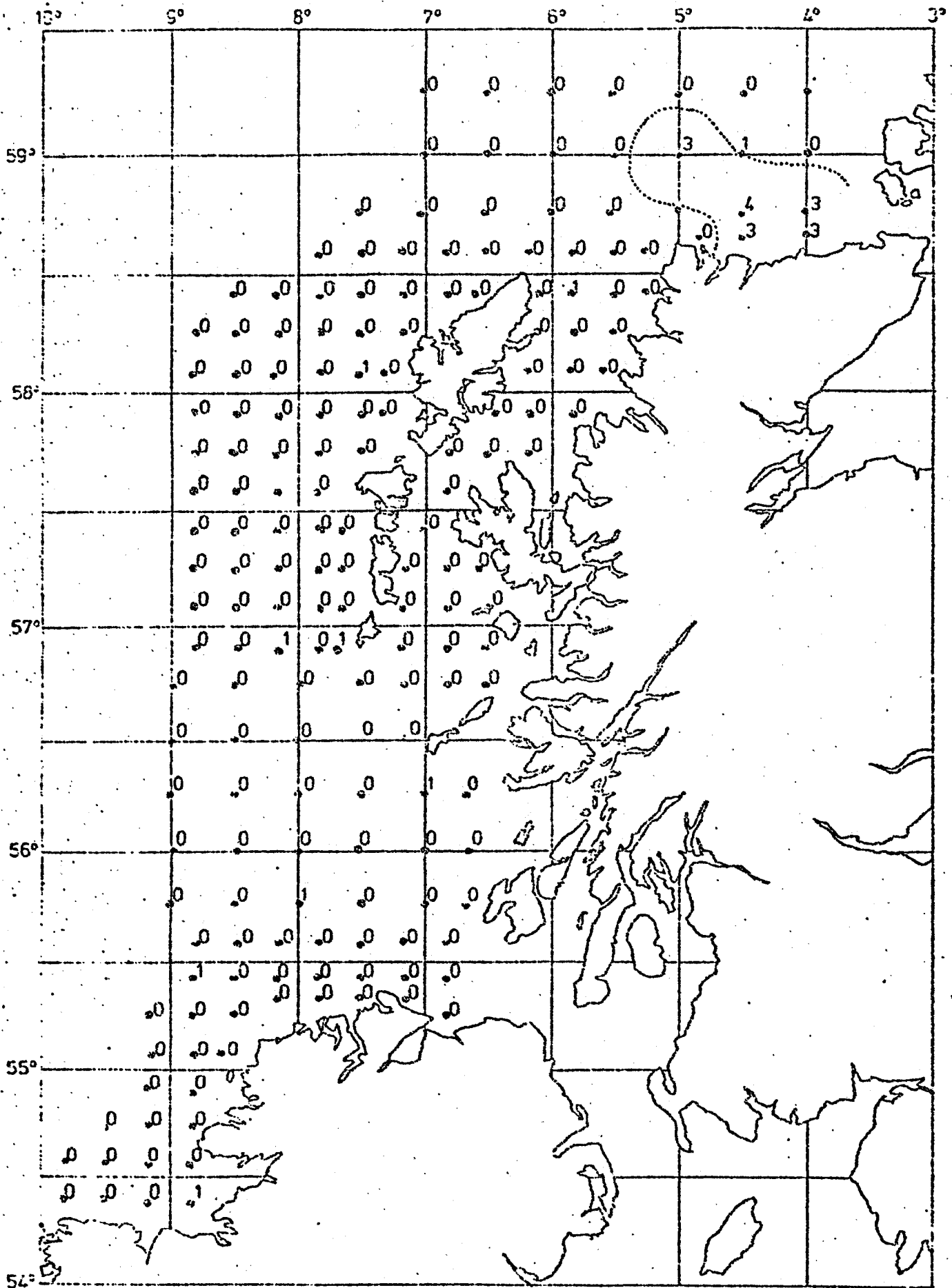


Fig. 3 Number of larvae >15 mm long below 1 sq metre W. of Scotland 8-24 September 1976

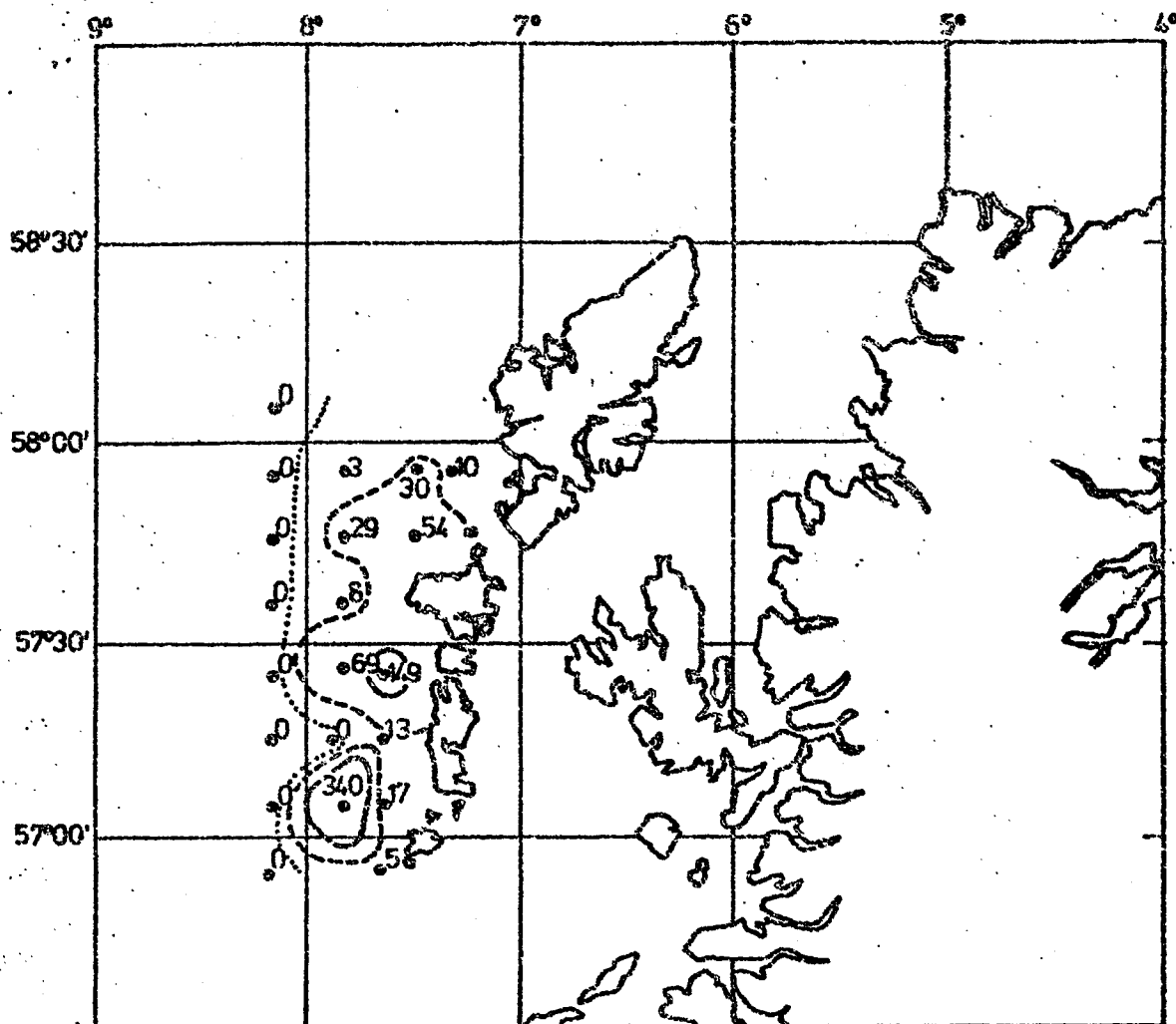


Fig. 4 Number of larvae <10 mm long below 1 sq metre W. of Scotland 25-26 September 1976

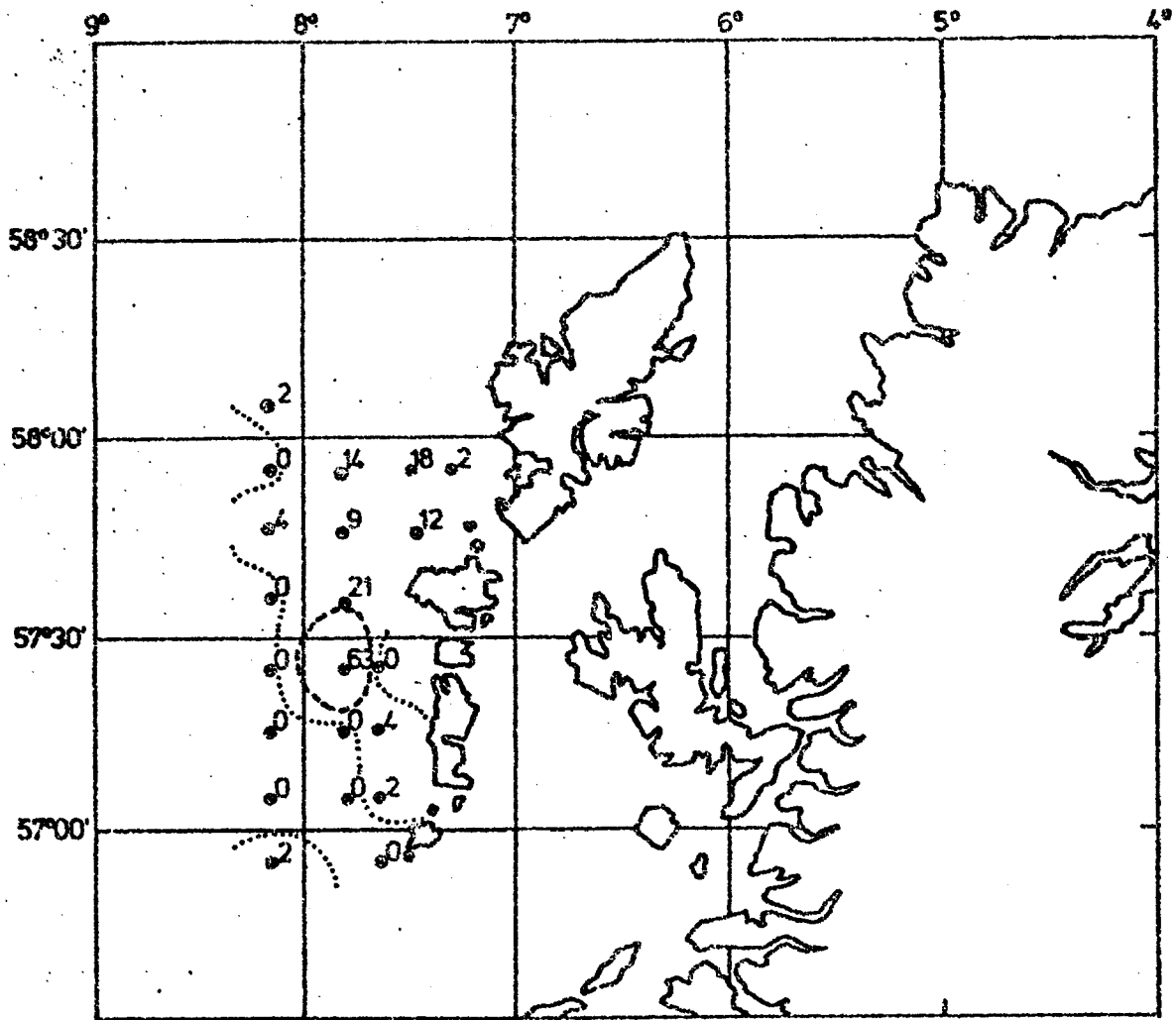


Fig. 5 Number of larvae 10-15 mm long below 1 sq metre
W. of Scotland 25-26 September 1976

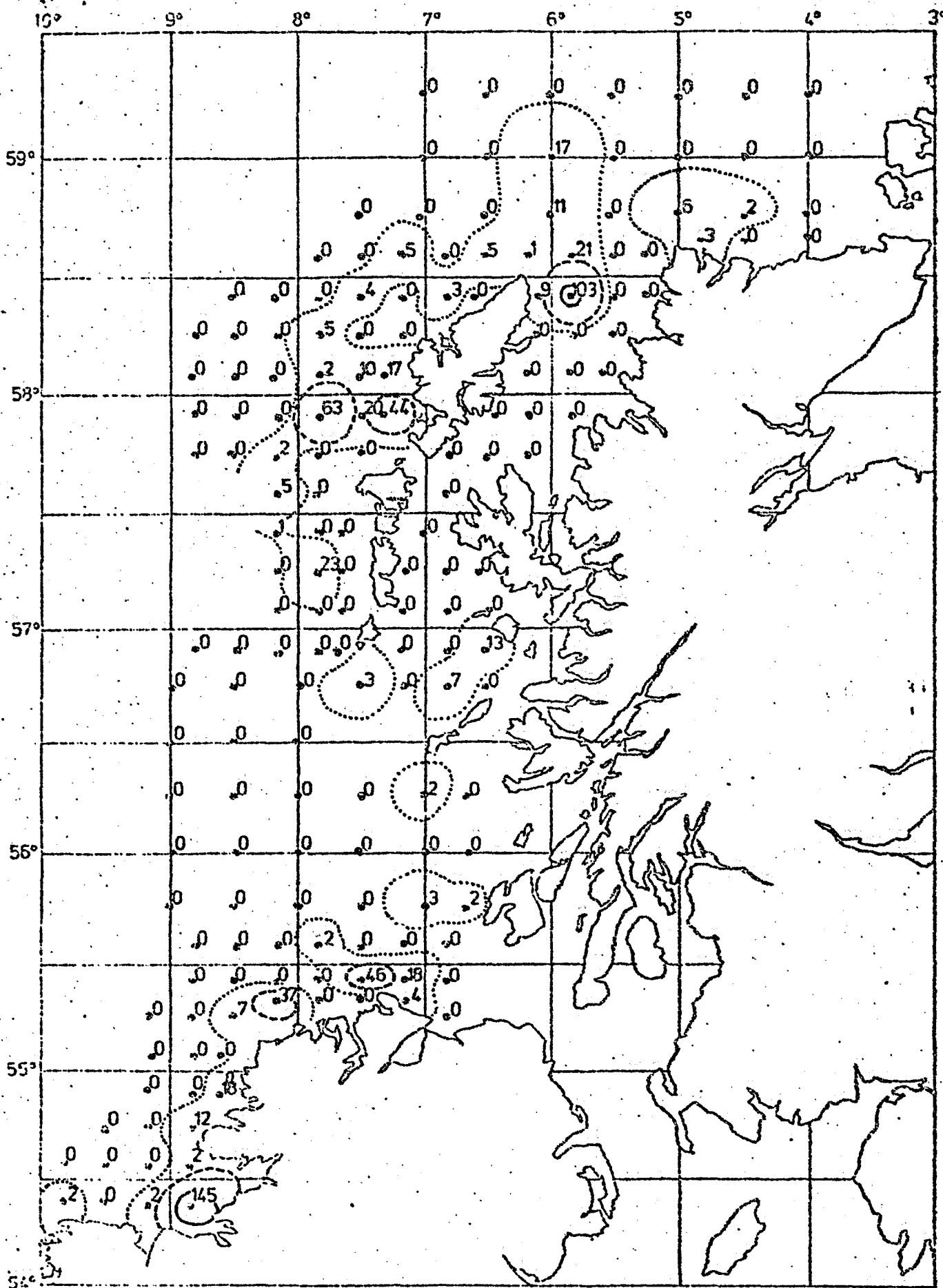


Fig. 6 Number of larvae <10 mm long below 1 sq metre W. of Scotland 8-25 October 1976

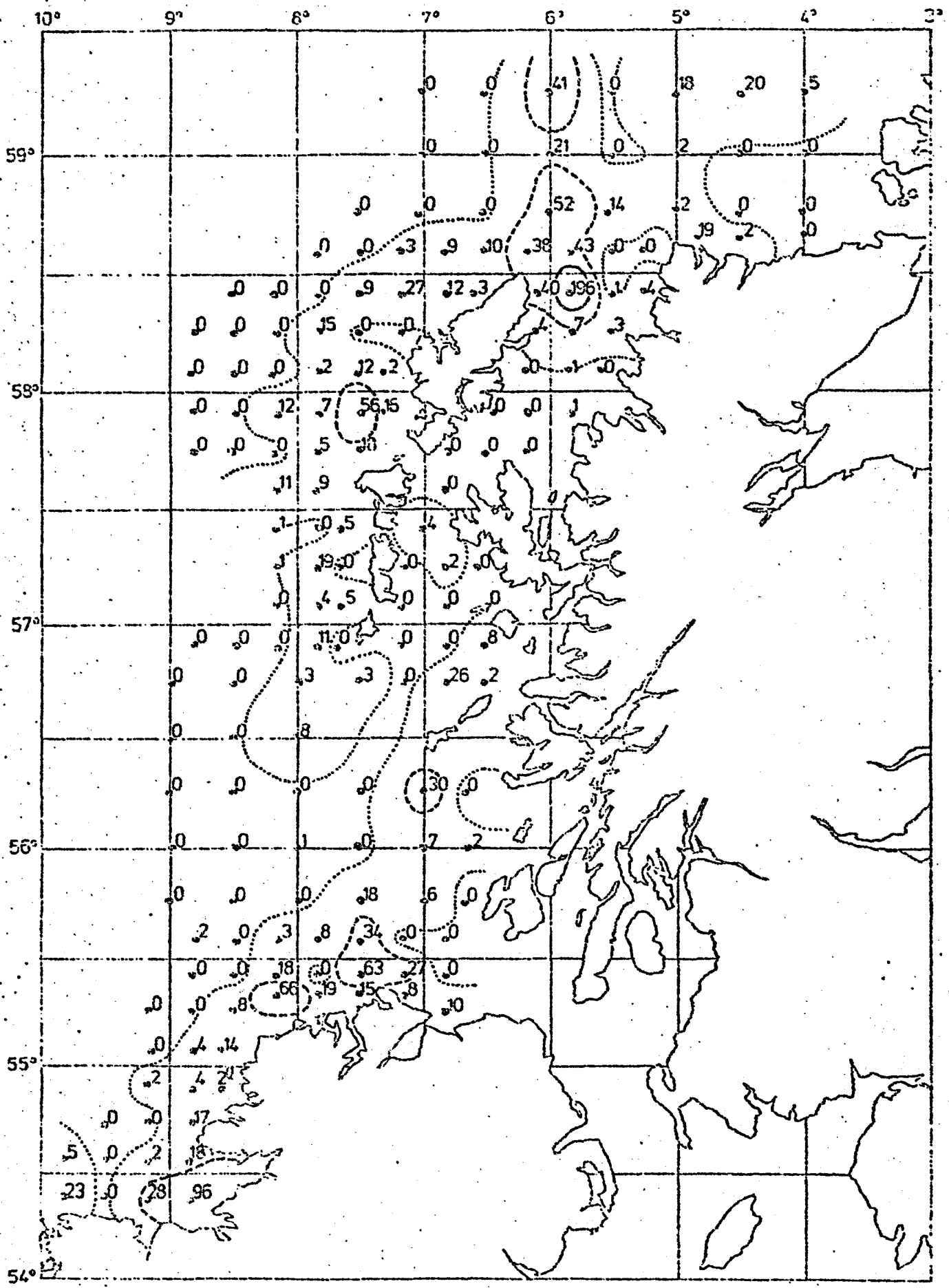


Fig. 7 Number of larvae 10-15 mm long below 1 sq metre W. of Scotland 8-25 October 1976

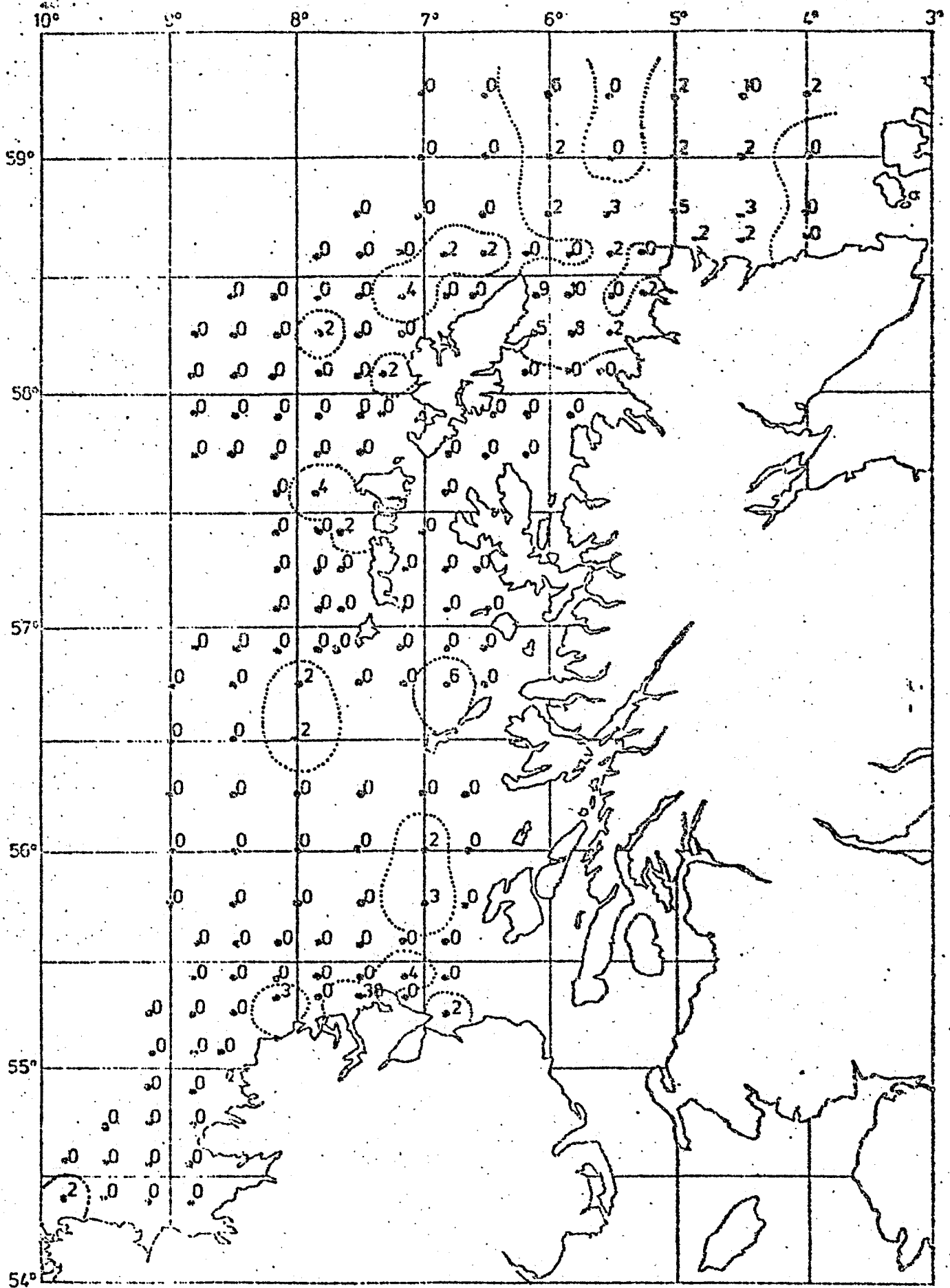


Fig. 8 Number of larvae >15 mm long below 1 sq metre N. of Scotland
8-25 October 1976.

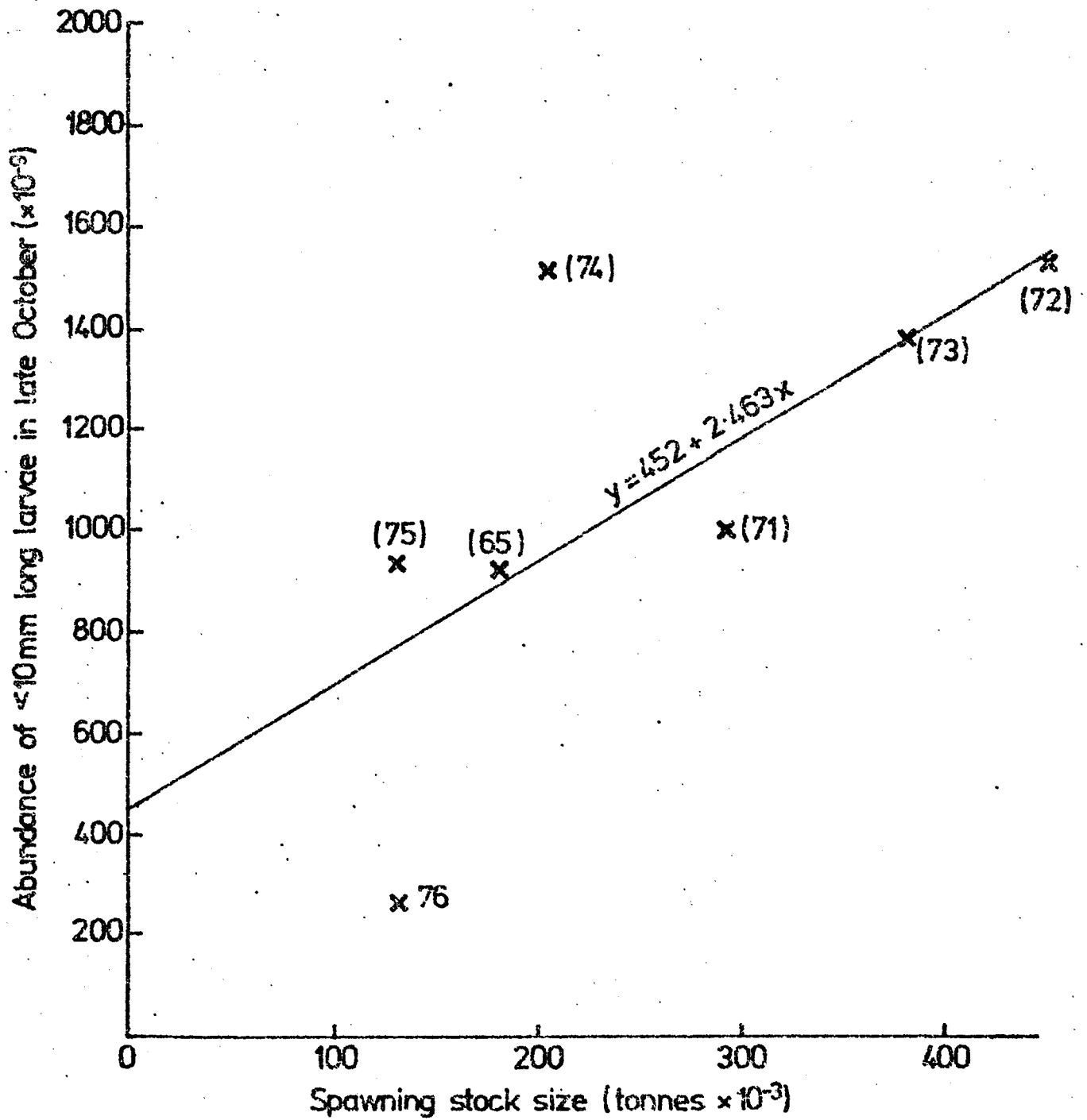


Fig. 9 Abundance of <10 mm long larvae in October plotted against estimated spawning stock size.