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Report on the international surveys of herring larvae in the  
North Sea and adjacent waters



by  
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## 1. Introduction

This report gives the results of the eighth international survey of herring larvae in the North Sea and adjacent waters. These surveys were started in 1967 and they are intended to provide measures of changes in the North Sea herring spawning stocks, which are independent of catch per unit effort data. This report is similar to the previous ones since it was found appropriate to use the form of presentation which had developed up until now.

Results of the previous surveys are published in SAVILLE (1970), BOËTIUS and MCKAY (1970), WOOD (1971), ZIJLSTRA (1972), SCHNACK (1973), SAVILLE and MCKAY (1973), and WOOD (1974).

## 2. Material and Methods

During the autumn and winter of 1974/75 five countries participated in the surveys with the following research vessels: Denmark: RV "Dana"; England: RV "Cirolana", RV "Clione", and RV "Scotia"; Federal Republic of Germany: RV "Anton Dohrn II" and RV "Walther Herwig II"; Netherlands: RV "Tridens" and RV "Willem Beukelsz"; and Scotland: RV "Clupea" and RV "Explorer". On all ships sampling was carried out using a modified Gulf plankton sampler towed in a double oblique haul, sampling the whole water column down to 5 metres above the bottom. The sampling technique is described in detail by SAVILLE (1970).

The timing of the surveys carried out in each area is given in Table 1. From August 1974 until January 1975 a total of 1199 stations was sampled. The results, recorded as numbers per  $m^2$  at each station, are shown in Figures 1-40 for each size group of larvae and survey period. Charts of surveys on which no or very few larvae of a size group were caught have been omitted from this report.

The total area is broken down into subareas as proposed by the Working Group on North Sea Herring Larval Surveys (ANON., 1971):

- 1.) Shetland-Orkney (north of  $58^{\circ}00'N$ )
- 2.) Buchan ( $56^{\circ}$ - $58^{\circ}N$ )
- 3.) Whitby-Dogger ( $53^{\circ}$ - $56^{\circ}N$ )
- 4.) Southern Bight-English Channel (south of  $53^{\circ}N$ ).

Additionally the area Cape Wrath-Hebrides (west of  $4^{\circ}W$ ) is included in this report. No results from the Kattegat are reported.

For all areas except the Southern Bight-English Channel, the size groups (total length) of herring larvae are  $<10$  mm, 10-15 mm,  $>15$  mm. For the Downs larvae, which hatch at a greater length, the size groups are  $<11$  mm, 11-16 mm, and  $>16$  mm.

Abundance estimates were calculated in a similar manner to that of SCHNACK (1973) and WOOD (1974). 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.

### 3. Results

#### 3.1. Distributions

##### 3.1.1. Cape Wrath-Hebrides

In 1974 (11-18 September) the survey of the area west of  $4^{\circ}W$  was extended to the Little Minch and the Sea of the Hebrides. Recently hatched larvae of  $<10$  mm in length were mostly found in the Cape Wrath-Butt of Lewis area but also in the southern part of the surveyed area substantial numbers ( $331/m^2$ ) were revealed (Fig.1). Larvae in the 10-15 mm category were widely distributed, with a maximum density of  $226/m^2$  off Butt of Lewis (Fig.2). They were found on all stations in the Sea of the Hebrides. Larvae  $>15$  mm in length were scarce in the total area with the exception for one patch of  $34/m^2$  north of Lewis (Fig.3).

The second survey, which partially took place during the same time (15-18 September) revealed substantial numbers ( $482/m^2$ ) of small larvae  $<10$  mm in length under the Scottish coast (Fig.4) and confirmed the wide distribution of 10-15 mm long larvae (Fig.5) as well as the small abundance of large larvae (Fig.6) in the Cape Wrath area, which was established during the survey mentioned above. There is however some discrepancy between the results of the two surveys regarding the abundance of small and medium sized larvae east of Cape Wrath.

### 3.1.2. Shetland-Orkney

The Shetland-Orkney area was sampled during three periods (I-III), 7-19 September, 23 September-2 October and 8-17 October. During the first period the area was covered effectively by three surveys overlapping in time.

During the first survey of period I (7-15 September) newly hatched larvae  $<10$  mm in length were found nearly all around Orkney with a wide distribution north of Orkney. The highest concentration there was  $142/m^2$  (Fig.7). Larvae of the 10-15 mm size group were taken at the majority of stations with a maximum density of  $84/m^2$  (fig.8). Small numbers of larvae  $>15$  mm long were recorded fairly regular at the stations south east of Orkney but the maximum of  $15/m^2$  was found further north (Fig.9).

During the second survey (11-15 September) of period I only the area west and north of Orkney was covered. The number of larvae  $<10$  mm and of 10-15 mm Larvae in the northern part of the area had increased (Fig.4,5). The maximum density of the small larvae was  $352/m^2$  and of the medium size group it was  $100/m^2$  west of Orkney. Larvae  $>15$  mm were recorded with the highest concentration of  $22/m^2$  (Fig.6) north of Orkney.

At the time of the last survey of the first period (14-19 September) the main distribution of small larvae might have shifted slightly to the east (Fig.10). Larvae of the 10-15 mm category were again taken at the majority of stations (Fig.11). Their maximum density of  $203/m^2$  was found east of Orkney. Larvae  $>15$  mm long were recorded fairly regular all around Orkney, with a maximum of  $53/m^2$  in the east (Fig.12).

During period II almost the whole of the ICES grid of stations was covered by one survey (23 September-2 October). At that time the small larvae  $<10$  mm mostly occurred east of Orkney (Fig.13). The maximum of  $339/m^2$  was found in the northern part of the Moray Firth. High numbers with a maximum of  $107/m^2$  of larvae 10-15 mm long were regularly recorded east of Orkney (Fig.14). Larvae  $>15$  mm were widely distributed over most of the surveyed area (Fig.15). The highest density of  $48/m^2$  occurred also east of Orkney.

On the final survey (period III) of the Shetland-Orkney area (8-17 October) only very few recently hatched larvae were taken east and north east of Orkney (Fig.16). The larvae 10-15 mm long were regularly found in the eastern part of the surveyed area with two maxima of  $20/m^2$  there (Fig.17). There was another maximum of  $68/m^2$  southwest of Orkney. The larger larvae were again widely distributed with a maximum density of  $27/m^2$  east of Orkney (Fig.18).

### 3.1.3. Buchan

The Buchan area was surveyed seven times during four periods. Some of the surveys covered only small but important parts of the area. They are useful supplements to the surveys of larger extent. The first survey lasted from 1-10 September. During this period another survey was carried out and a second one was started (see Table 1).

The first survey revealed only one patch of recently hatched larvae off Newburgh, with a maximum density of  $59/m^2$  (Fig.19). Only very few larvae of the 10-15 mm size group were caught off Buchan Ness and Girdle Ness (Fig.20), and larvae  $>15$  mm long were not taken at all.

The second survey (4-7 September) confirmed the patch of small larvae  $<10$  mm off Newburgh (Fig.7), and little more larvae of the 10-15 mm size group were found (Fig.8). Only few larvae  $>15$  mm in length were taken (Fig.9). During the third survey (9-12 September) the number of  $<10$  mm and of 10-15 mm long larvae had increased with a maximum of  $61/m^2$  (Fig.22) and  $60/m^2$  respectively (Fig.23). Only few larvae of the size group  $>15$  mm were taken along the coastline (Fig.24).

During the second period two surveys were made. The first one of these (16-17 September) was of limited extent. Recently hatched larvae were abundant ( $235/m^2$ ) off Buchan Ness (Fig.25), and the larger size groups were scarcely found (Fig.26,27). During the next survey (17-19 September) the maximum density of small larvae  $<10$  mm long was revealed again off Buchan Ness with a remarkable value of  $1492/m^2$  (Fig.28). Larvae 10-15 mm of length were dispersed over most of the surveyed area with a maximum density of  $75/m^2$  (Fig.29), and larvae  $>15$  mm were slightly more abundant than during the previous survey (Fig.30).

During the survey period of 7-8 October only a few stations were sampled in the Buchan area, which showed, that there were larvae 10-15 mm (Fig.17) and  $>15$  mm (Fig.18) in length near the southern limit of the Shetland-Orkney area and larvae of all size groups off Todhead Point (Fig.16,17,18). On two of five stations of 17 October 15 respectively 3 larvae  $>15$  mm in length were obtained north of Kinnairds Head (no figure).

#### 3.1.4. Whitby-Dogger

The Whitby-Dogger area was surveyed twice. The first survey (27 August-1 September) revealed three separated patches of recently hatched larvae at low densities, one in the Longstone area, one off Whitby and one off the Humber (Fig.19). Few larvae of the middle size group were caught along the middle part of the coastline (Fig.20) and no larvae  $>15$  mm in length in the whole area at all.

The area was surveyed again during the period 2-9 October. Two separated patches of recently hatched larvae were located, one in the Longstone area and another one with high densities up to  $775/m^2$  off Flamborough Head (Fig.31). Larvae of the 10-15 mm category were found all over the area with a maximum density of  $120/m^2$  (Fig.32). Larvae  $>15$  mm in length were widely spread in small numbers (Fig.33).

#### 3.1.5. Southern Bight-English Channel

These areas were surveyed during three periods. During the first one (9-16 December) only a few small  $<11$  mm larvae were found in

the eastern Channel (Fig.34). There also occurred low numbers of larvae 11-16 mm in length (Fig.35). No large larvae were located at all.

Two surveys took place during the second period. During the first of them (7-12 January) recently hatched larvae were caught in the Bay of the Seine, in the eastern Channel, and in the Sandettie area (Fig.37). The numbers of larger larvae (Fig.38,39) were extremely low. The other survey (8-16 January) of that period has poorer coverage. It revealed a patch of recently hatched larvae off Boulogne (Fig.40), with a maximum density of  $10/m^2$ . Larger larvae were totally missing.

During the third survey period (24-27 January) the coverage was incomplete due to bad weather. The abundance of herring larvae in the English Channel was very poor. Only one single larva<sup>/m<sup>2</sup></sup> of the middle size group was taken in the Bay of the Seine and two larvae<sup>/m<sup>2</sup></sup> >16 mm in length were caught off Dieppe.

### 3.2. Quantitative Estimates

The major aim of these surveys is to monitor changes in larval production as a measure of spawning stock sizes. In Table 2 the estimates of larval abundance in 1974/75 for the three size groups of herring larvae in each area and survey period are given.

The results demonstrate again clearly the dominance of the spawning stock in the Shetland-Orkney area in the total herring population of the North Sea. The total abundance estimate of  $2146 \cdot 10^9$  for the period 7-19 September can be compared with the total of  $2558 \cdot 10^9$  for the period 7-14 September of the previous year. The production in 1974 appears to be slightly lower. This is confirmed by lower abundance figures at the end of September 1974. In 1974 the abundance of newly hatched larvae was smaller than in 1973. However, larger larvae were considerably more abundant than in the previous year. This indicates earlier spawning and presumably higher overall larval production in 1974 in spite of the apparent overall larval abundance ( $2146 \cdot 10^9$  in 1974 versus  $2558 \cdot 10^9$  in 1973).

In the Cape Wrath-Hebrides area the substantial total abundance

of  $1956 \cdot 10^9$  was estimated. The importance of the larval production in this area has been discussed by SAVILLE (1975), SCHNACK (1973), WOOD (1971, 1973), and ZIJLSTRA (1972). There are indications that substantial numbers of herring larvae are transported into the North Sea from the spawning grounds to the west of  $4^{\circ}\text{W}$  (WOOD, 1974). Although the surveyed area was considerably extended to the south in 1974, the larval abundance was smaller than in the previous year.

For the Buchan area the results given in Table 2 indicate much higher larval production in 1974 when compared with the maximum value of  $16 \cdot 10^9$  herring larvae for the period 26-27 September 1973. In the Whitby-Dogger area the total abundance of early October 1974 reached  $1700 \cdot 10^9$ . The comparable figure for 27 September-6 October 1973 was  $1672 \cdot 10^9$ . Also the size composition was very similar for those two years. In the Southern Bight-English Channel area spawning was negligible in 1974/75, while in 1973/74 still a few larvae had been found.

#### 4. References

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Table 1 Surveys carried out in 1974/75				
Country	Area	Period	No of Stations Sampled	
Netherlands	Cape Wrath-Hebrides	11-18/9/74	81	116
England	Cape Wrath	15-18/9/74	35	
Scotland	Shetland-Orkney	7-15/9/74	103	428
England	" "	11-15/9/74	68	
Germany	" "	14-19/9/74	73	
Scotland	" "	23/9-2/10/74	96	
Scotland	" "	8-17/10/74	88	
Denmark	Buchan	1-10/9/74	71	256
Scotland	"	4-7/9/74	66	
Scotland	"	9-12/9/74	55	
Scotland	"	16-17/9/74	21	
Scotland	"	17-19/9/74	26	
Scotland	"	7-8/10/74	12	
Scotland	"	17/10/74	5	
Denmark	Whitby-Dogger	27/8-1/9/74	74	160
England	" "	2-9/10/74	86	
Netherlands	S.Bight-Engl.Channel	9-16/12/74	83	239
Germany	" "	7-12/1/75	87	
Netherlands	" "	8-16/1/75	39	
England	" "	24-27/1/75	30	



Table 2 Estimates of herring larval abundance

Area	Period	Abundance of herring larvae · 10 <sup>-9</sup>			
		< 10 mm	10-15 mm	>15 mm	Total
Cape Wrath - Hebrides	11-18/9/74	1115	808	34	1957
Shetland - Orkney	7-19/9/74	1164	794	189	2147
" "	23/9-2/10/74	225	545	226	996
" "	8-17/10/74	8	103	176	287
Buchan	1-12/9/74	97	91	6	194
" *	16-19/9/74	448	84	26	558
" *	7-8/10/74	3	19	18	40
" *	17/10/74	0	0	6	6
Whitby - Dogger	27/8-1/9/74	16	2	0	18
" "	2-9/10/74	1271	398	30	1699
		< 11 mm	11-16 mm	>16 mm	Total
S.Bight-Engl.Channel	9-16/12/74	1	10	0	11
" "	7-16/1/75	15	4	3	22
" " *	24-27/1/75	0	02	04	06

\* Survey incomplete

Fig. 1  
Number of Larvae <10 mm below 1 m<sup>2</sup>  
Dutch Survey  
Cape Wrath-Hebrides Area: 11-18/9/74

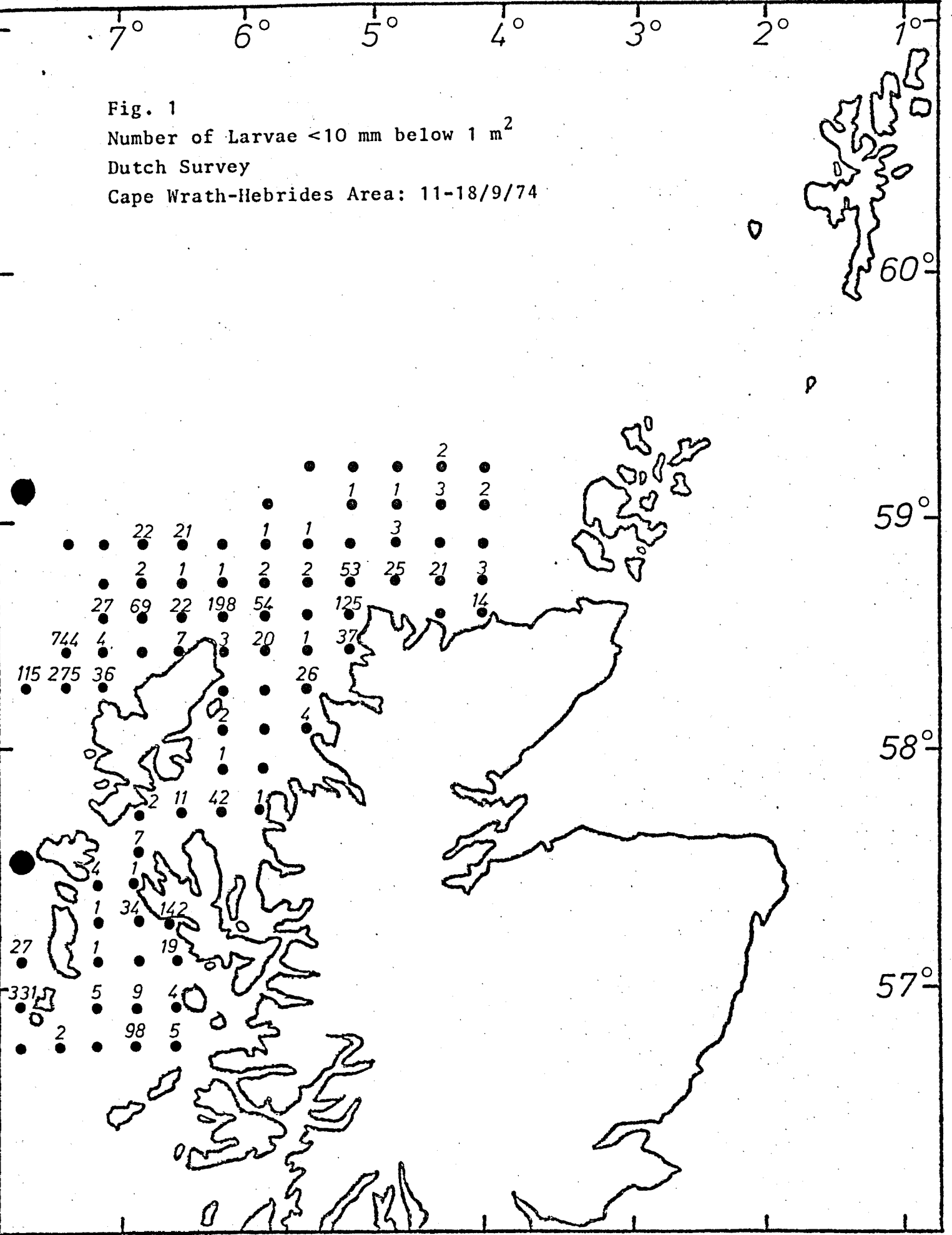


Fig. 2

Number of Larvae 10-15 mm below 1 m<sup>2</sup>

Dutch Survey

Cape Wrath-Hebrides Area: 11-18/9/74

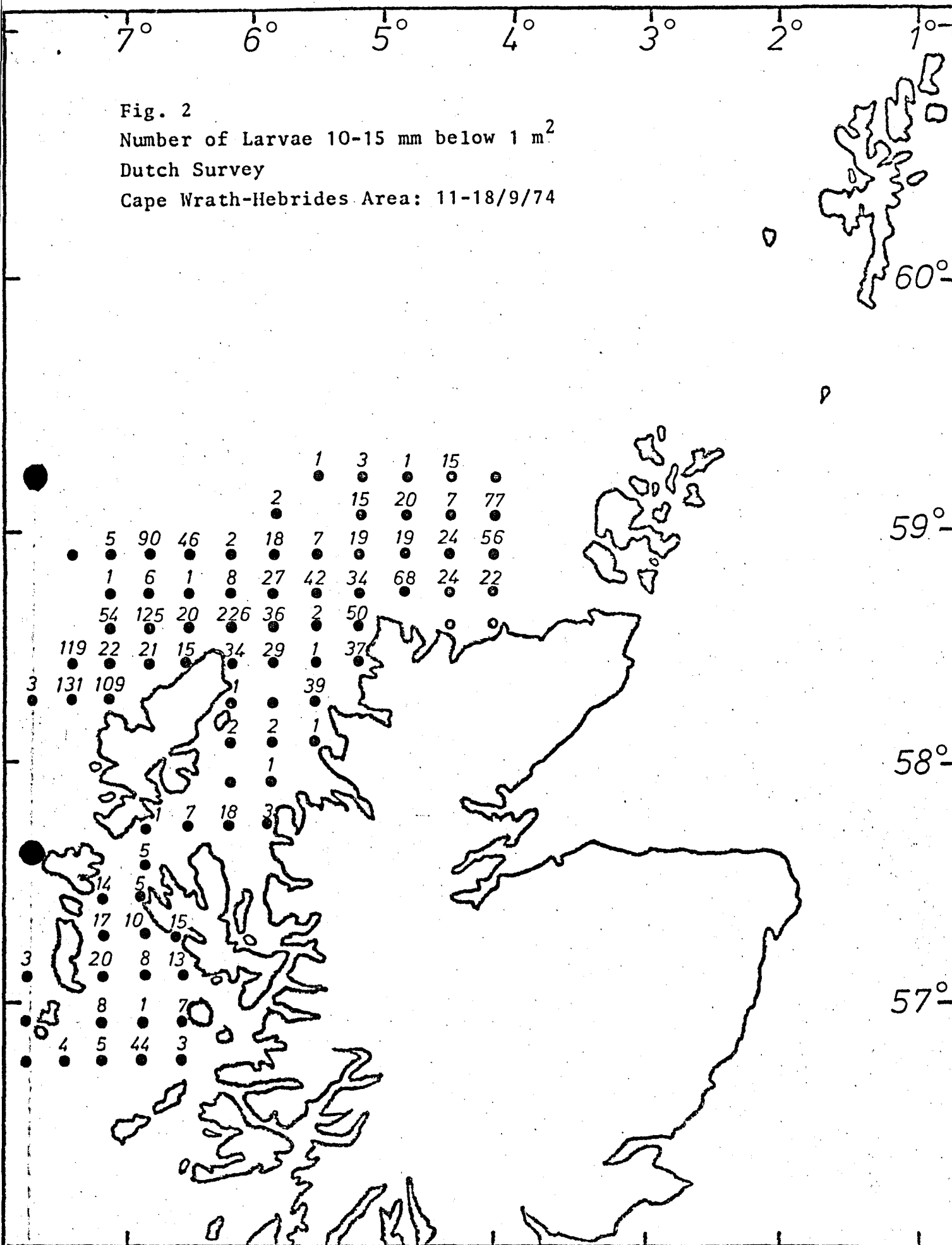
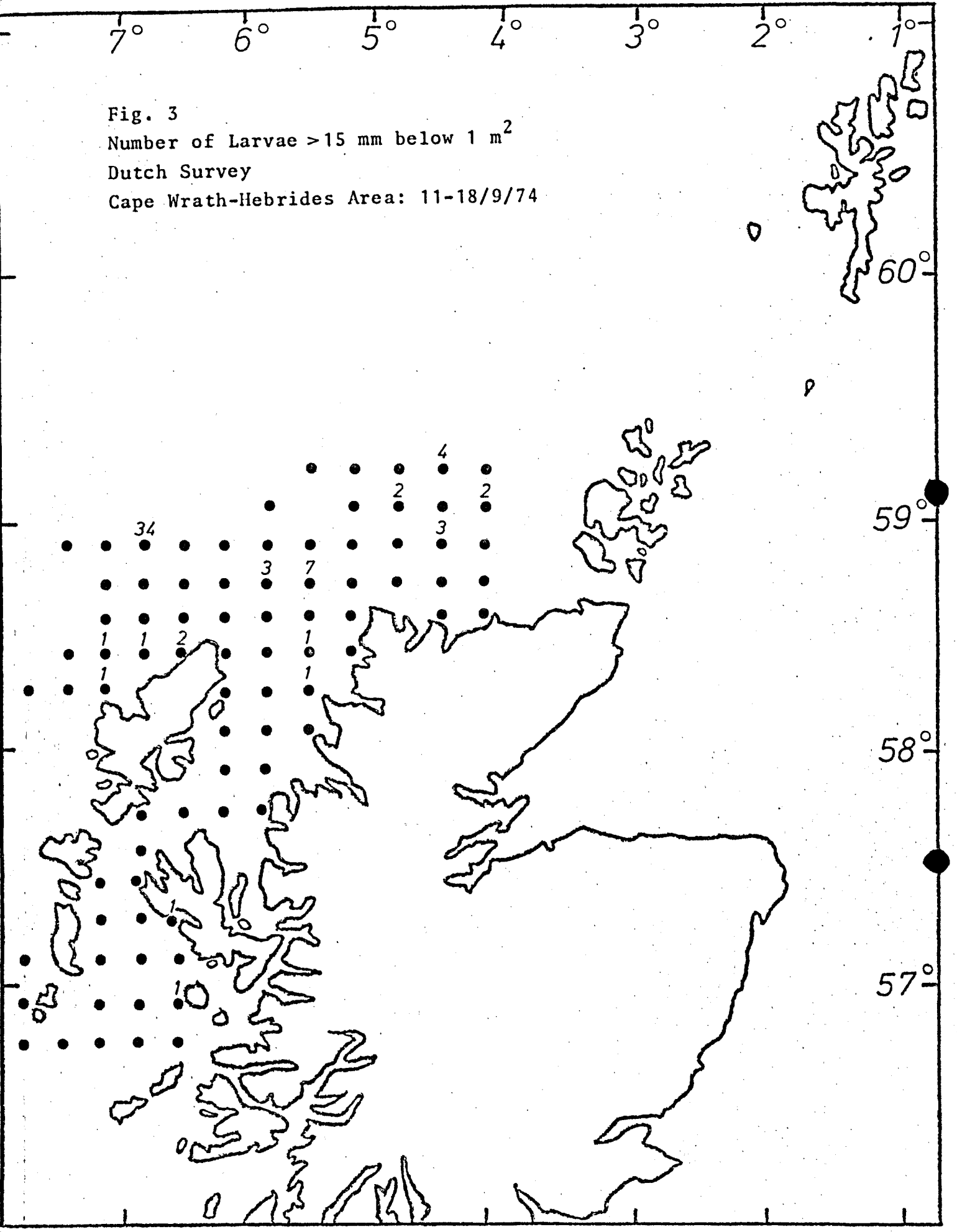


Fig. 3  
 Number of Larvae >15 mm below 1 m<sup>2</sup>  
 Dutch Survey  
 Cape Wrath-Hebrides Area: 11-18/9/74



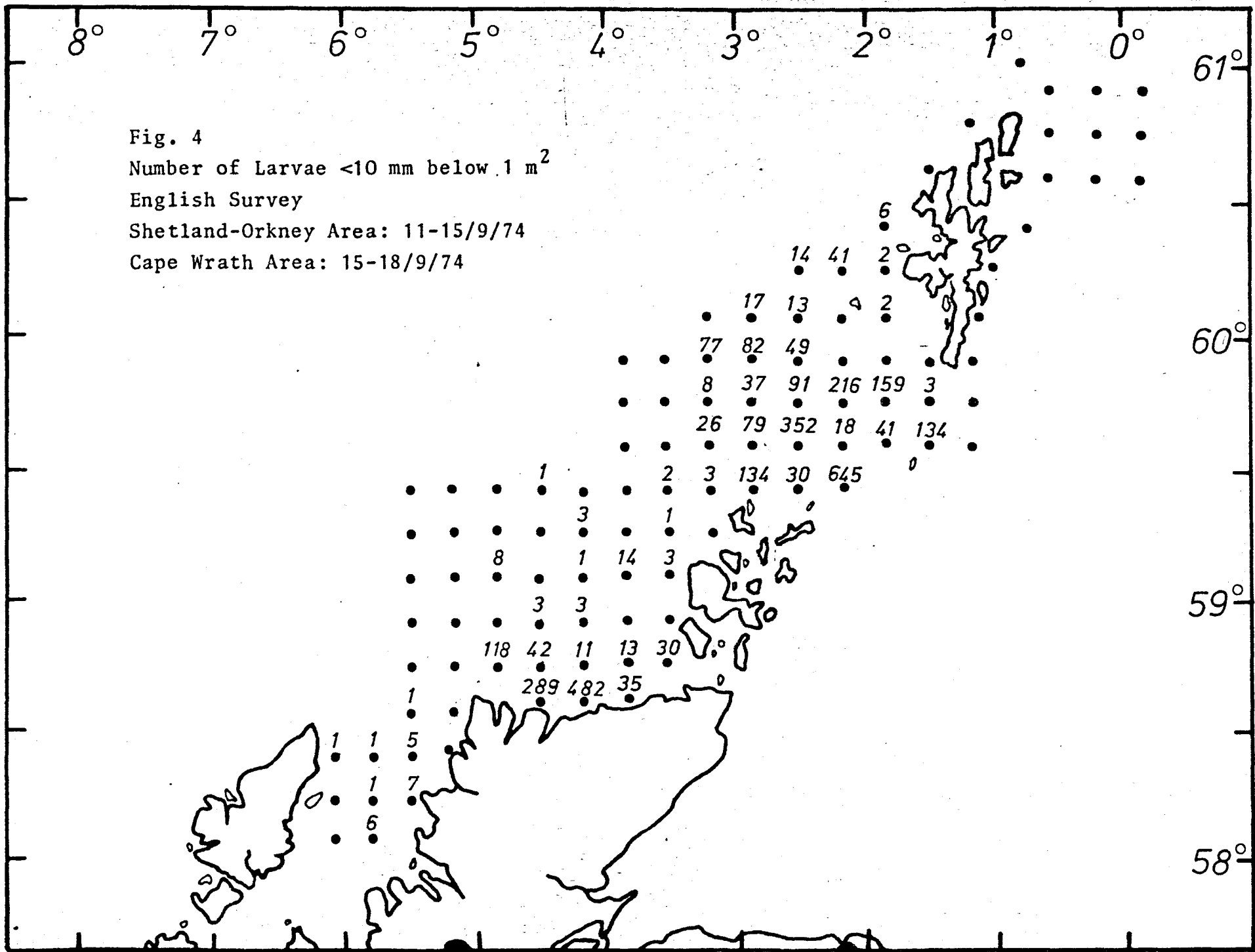


Fig. 5  
 Number of Larvae 10-15 mm below 1 m<sup>2</sup>  
 English Survey  
 Shetland-Orkney Area: 11-15/9/74  
 Cape Wrath Area: 15-18/9/74

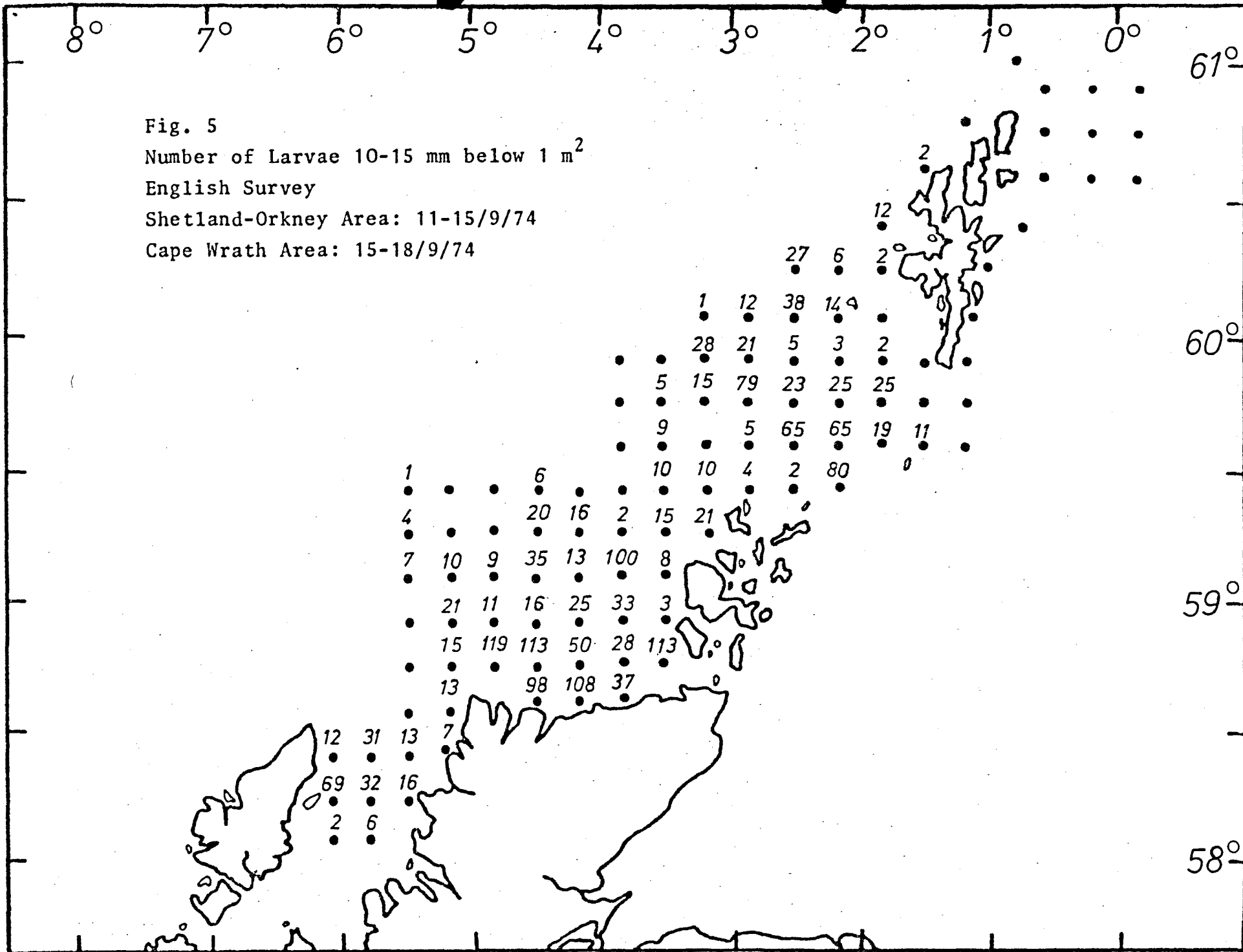
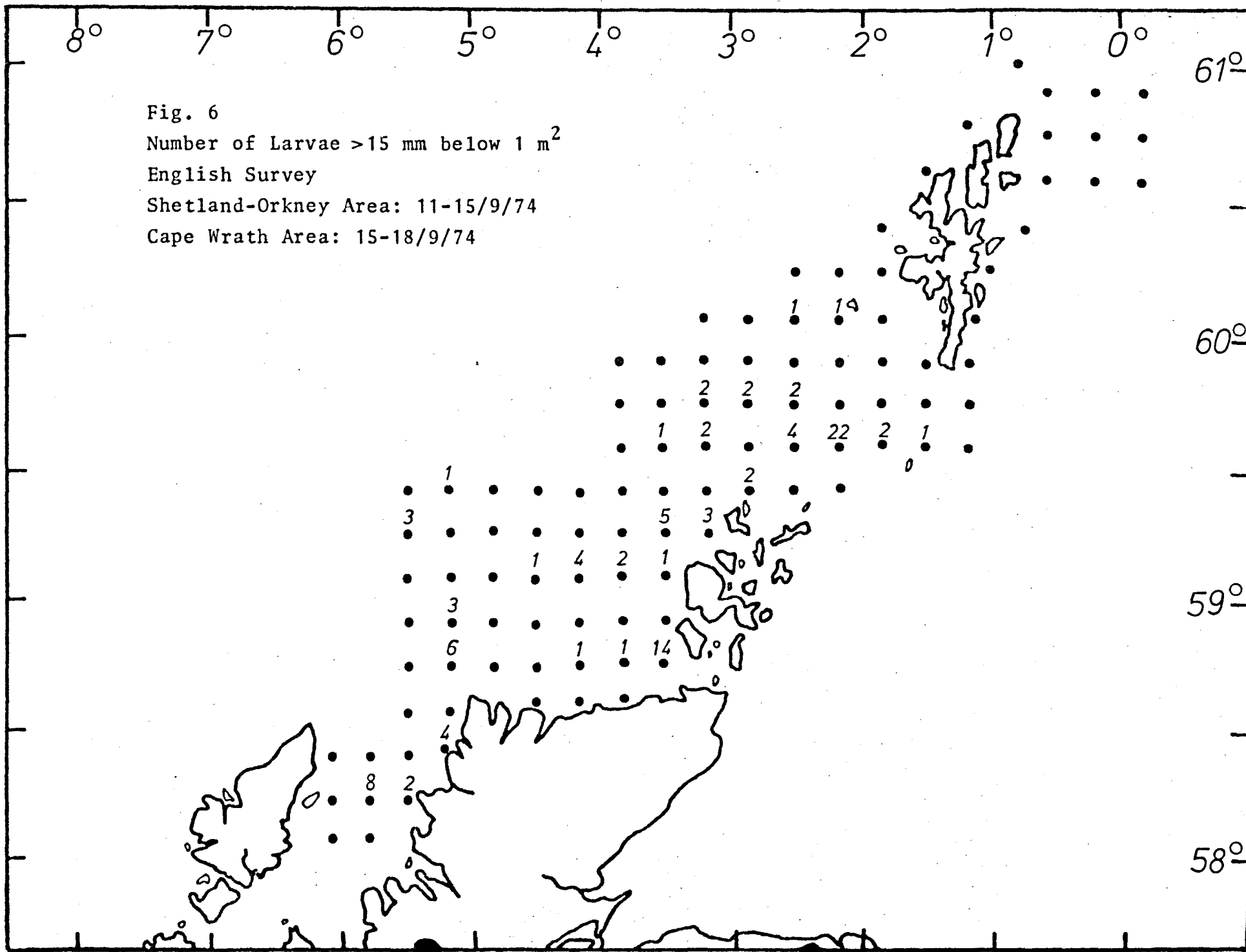


Fig. 6  
Number of Larvae >15 mm below 1 m<sup>2</sup>  
English Survey  
Shetland-Orkney Area: 11-15/9/74  
Cape Wrath Area: 15-18/9/74



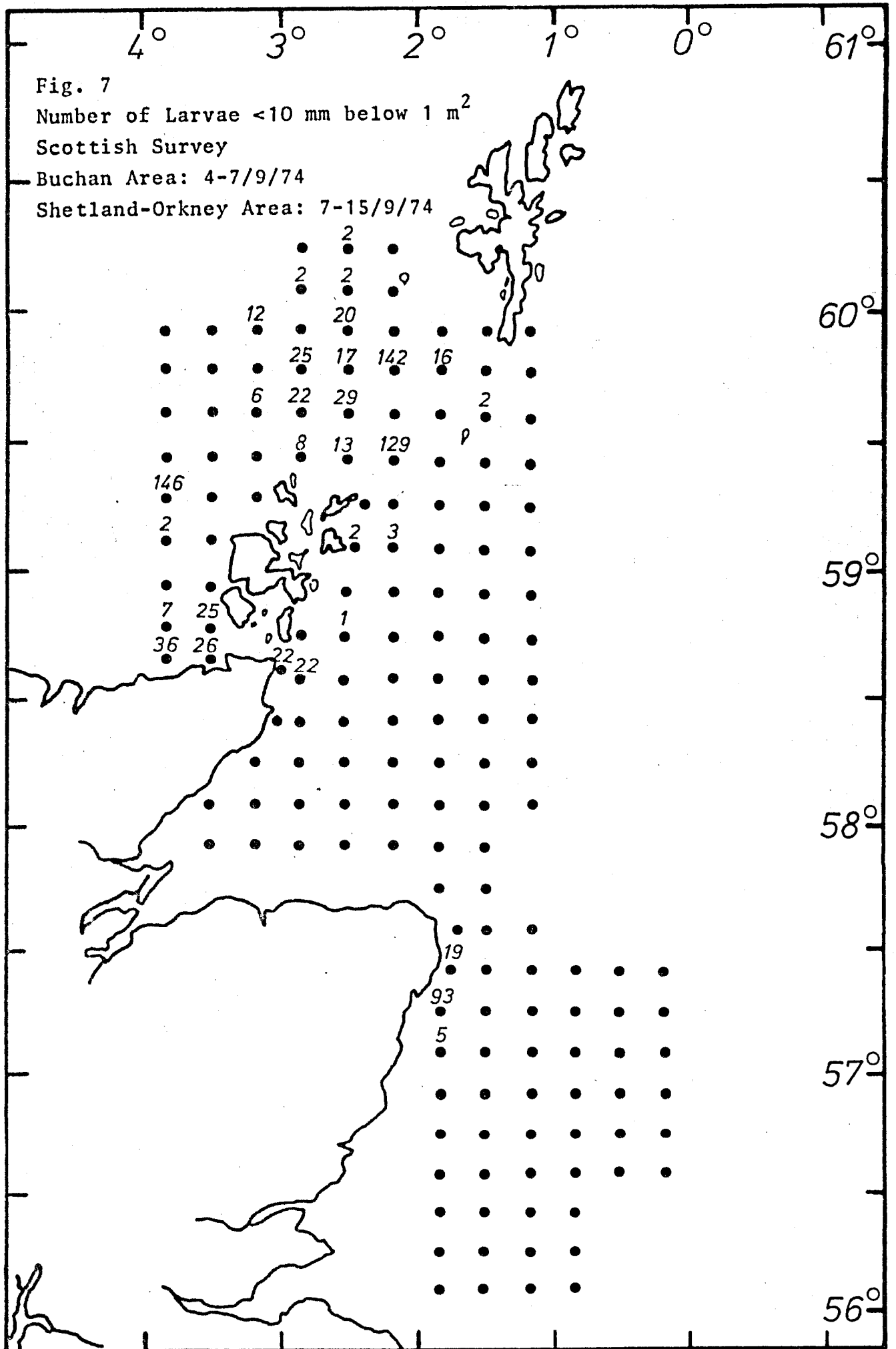




Fig. 8

Number of Larvae 10-15 mm below 1 m<sup>2</sup>

Scottish Survey

Buchan Area: 4-7/9/74

Shetland-Orkney Area: 7-15/9/74

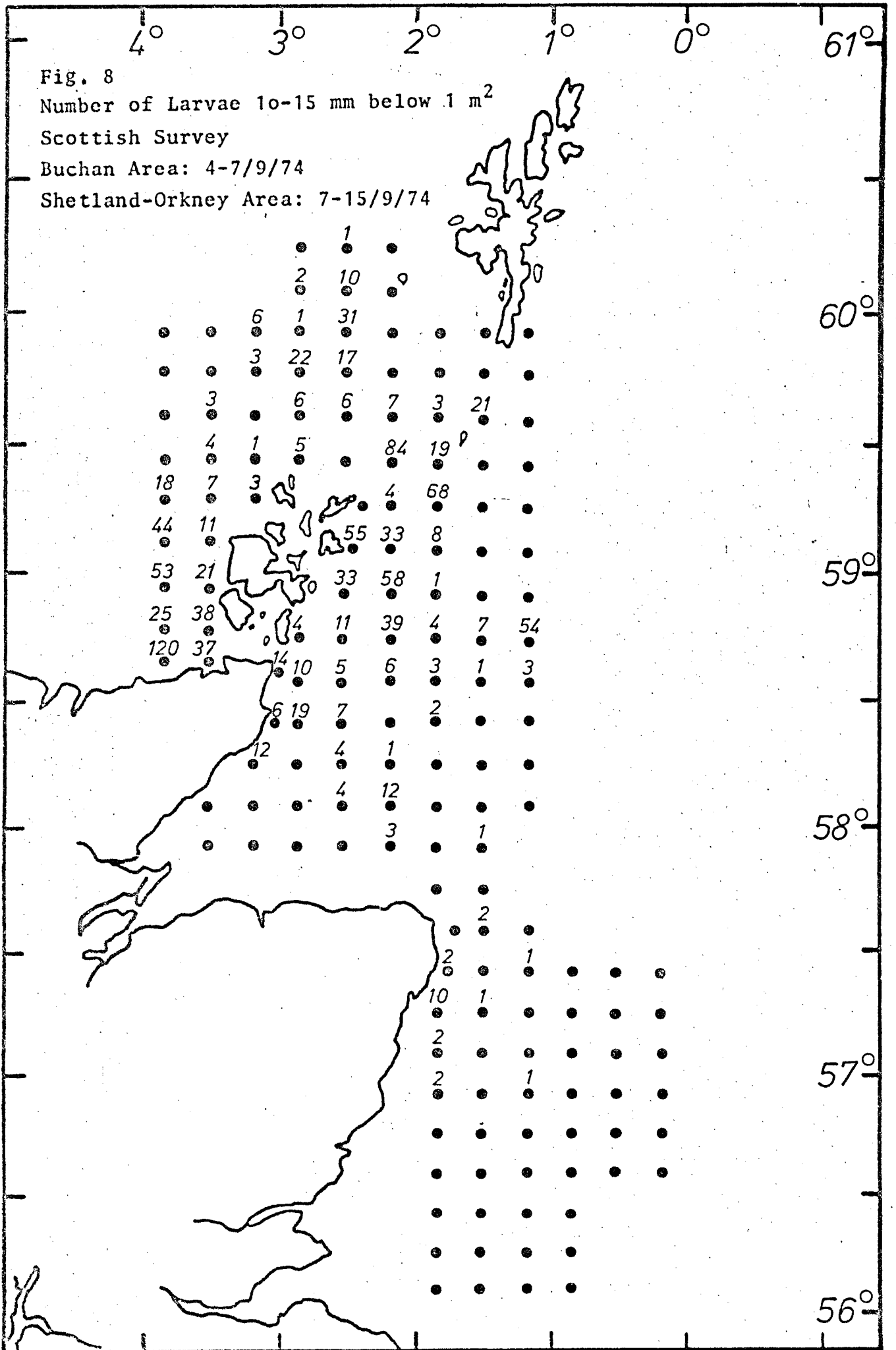


Fig. 9

Number of Larvae >15 mm below 1 m<sup>2</sup>

Scottish Survey

Buchan Area: 4-7/9/74

Shetland-Orkney Area: 7-15/9/74

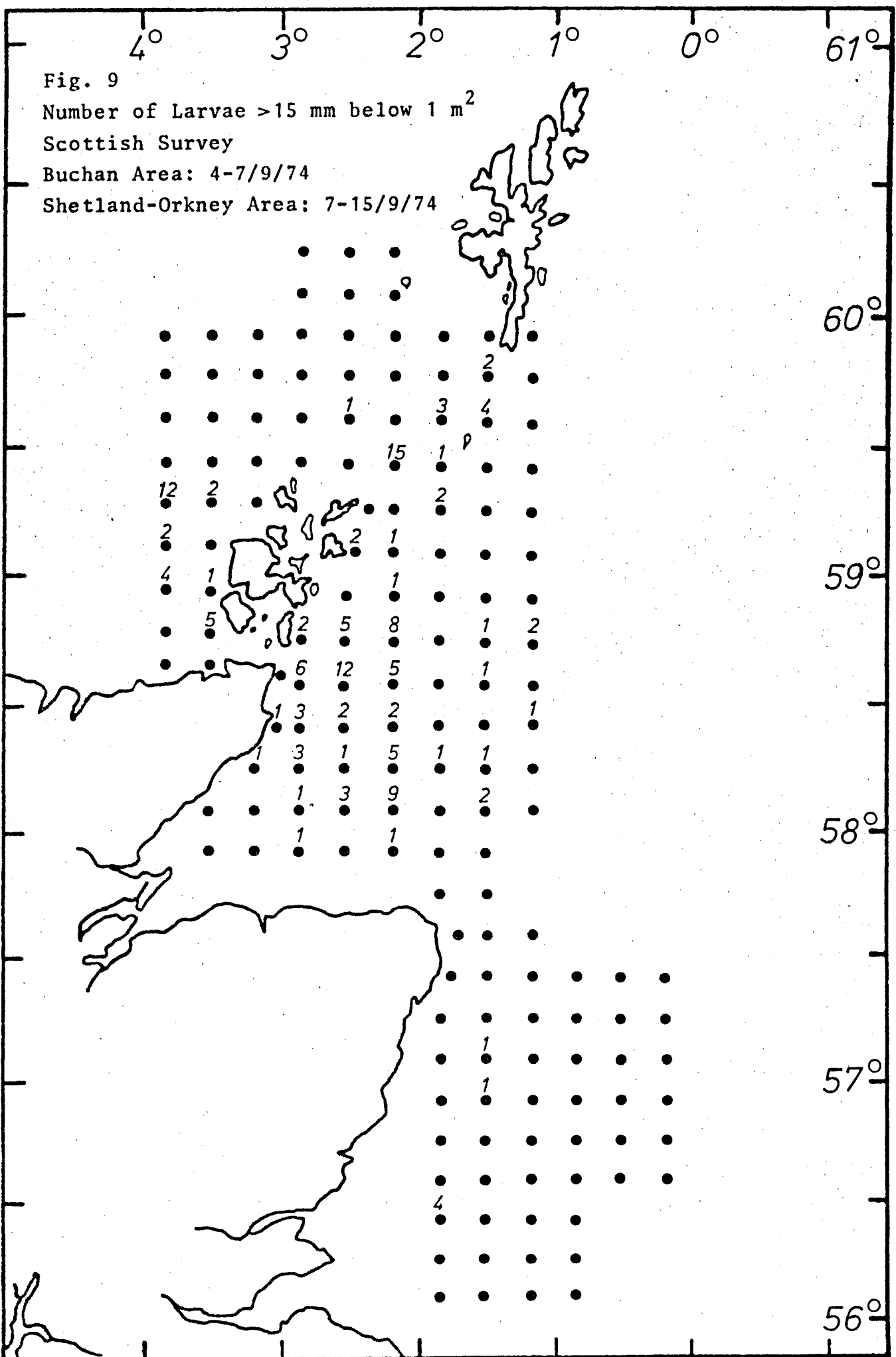


Fig. 10

Number of Larvae <10 mm below 1 m<sup>2</sup>

German Survey

Shetland-Orkney Area: 14-19/9/74

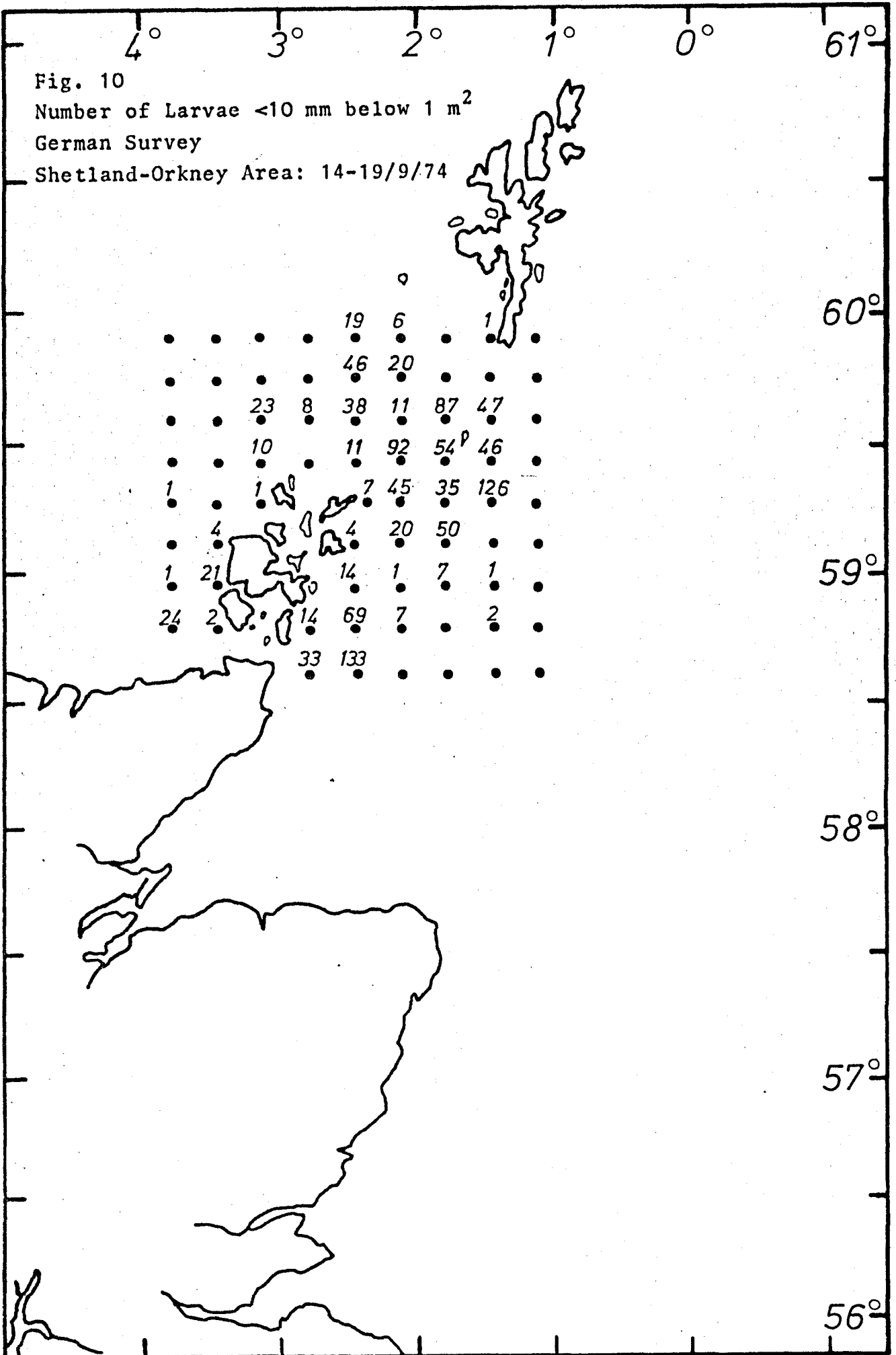


Fig. 11

Number of Larvae 10-15 mm below 1 m<sup>2</sup>

German Survey

Shetland-Orkney Area: 14-19/9/74

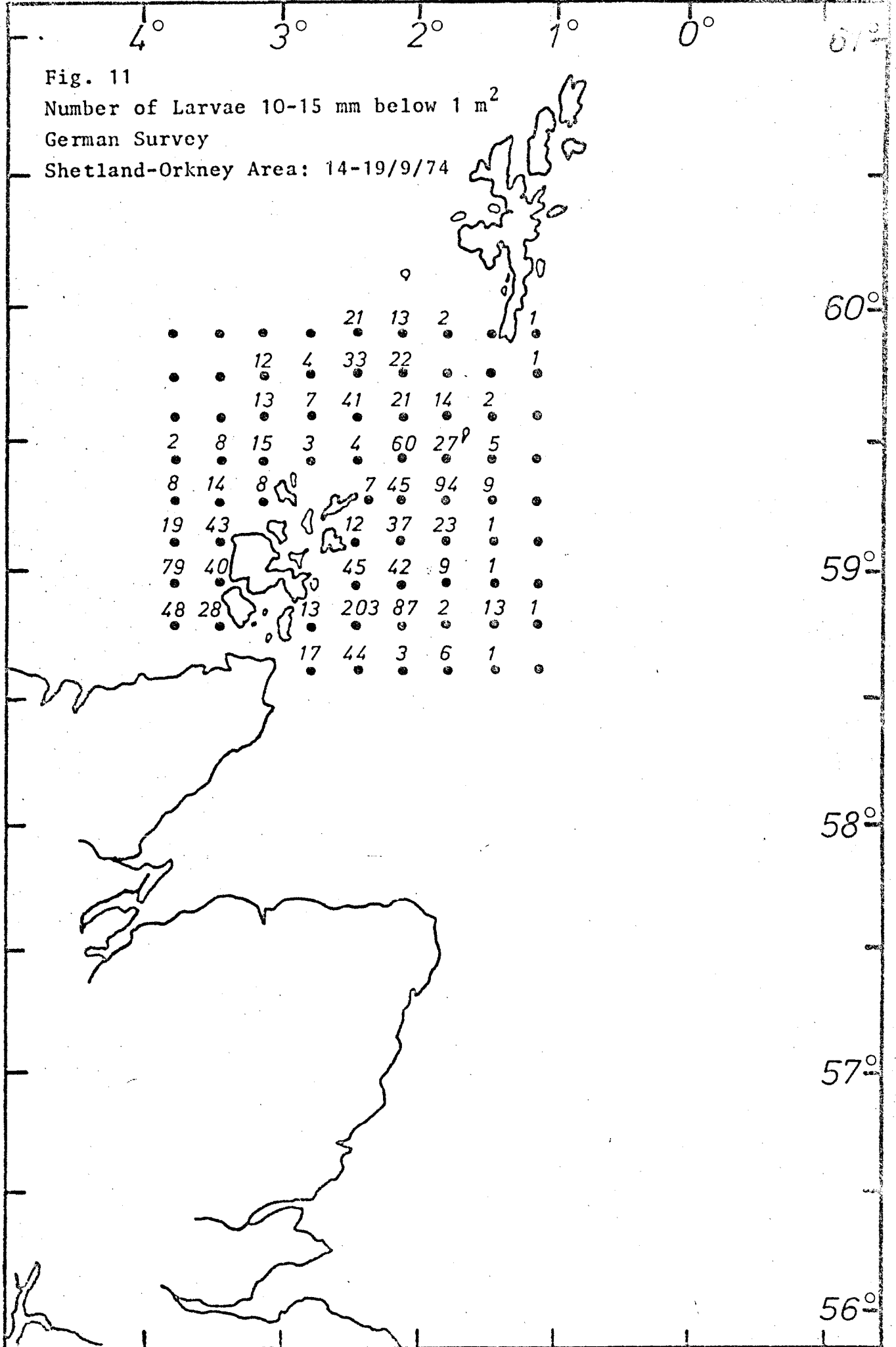
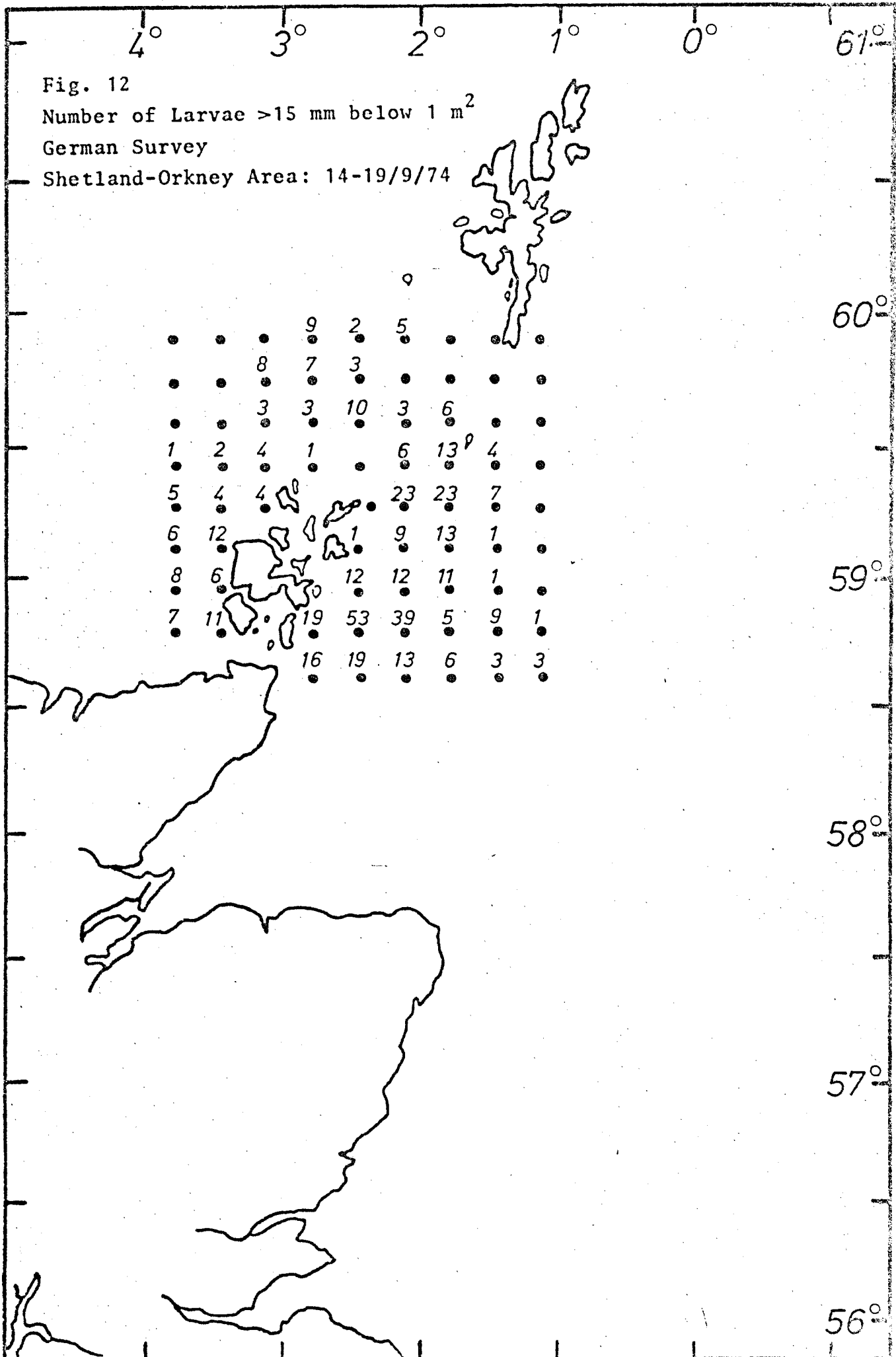


Fig. 12

Number of Larvae >15 mm below 1 m<sup>2</sup>

German Survey

Shetland-Orkney Area: 14-19/9/74



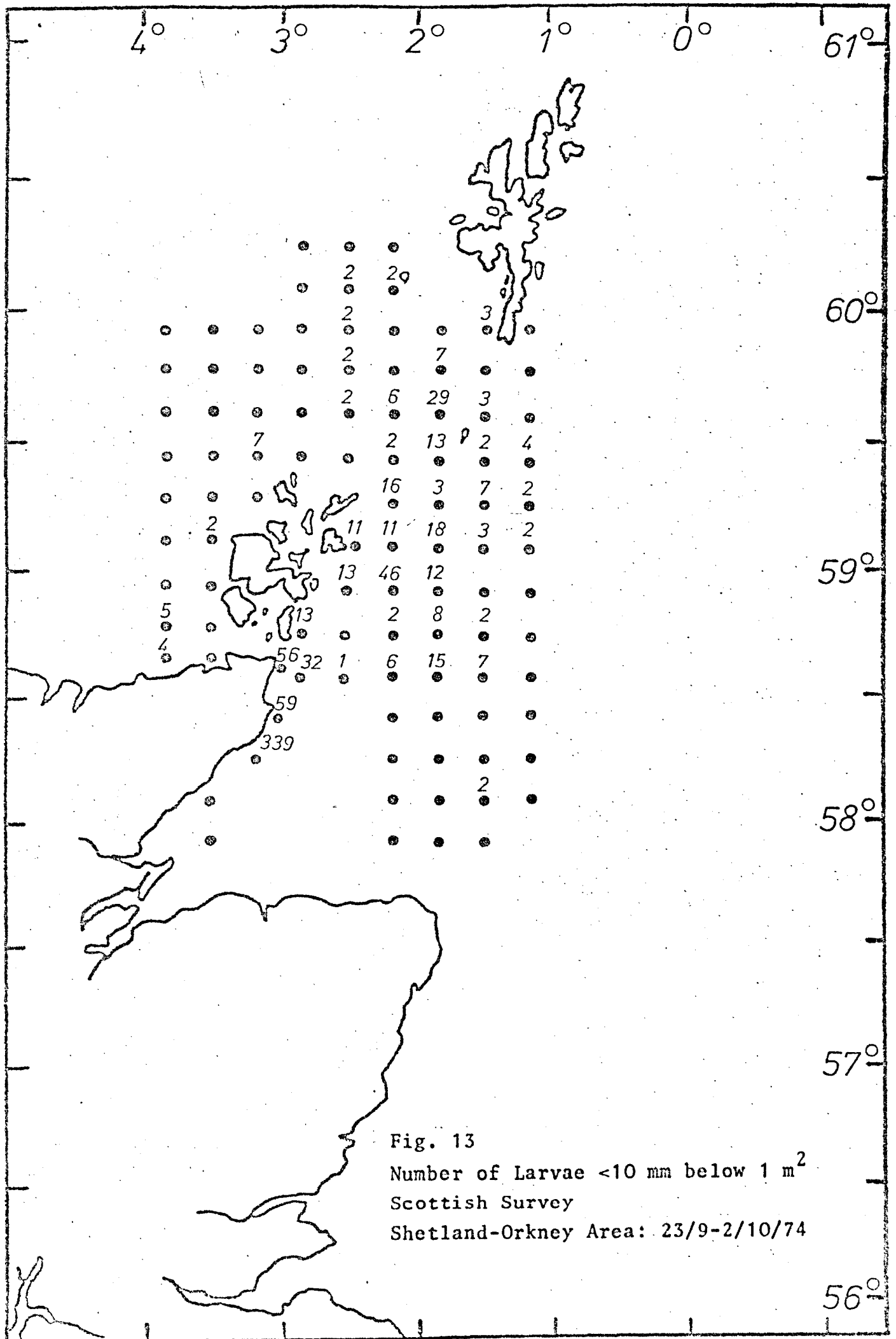


Fig. 13

Number of Larvae <10 mm below 1 m<sup>2</sup>

Scottish Survey

Shetland-Orkney Area: 23/9-2/10/74

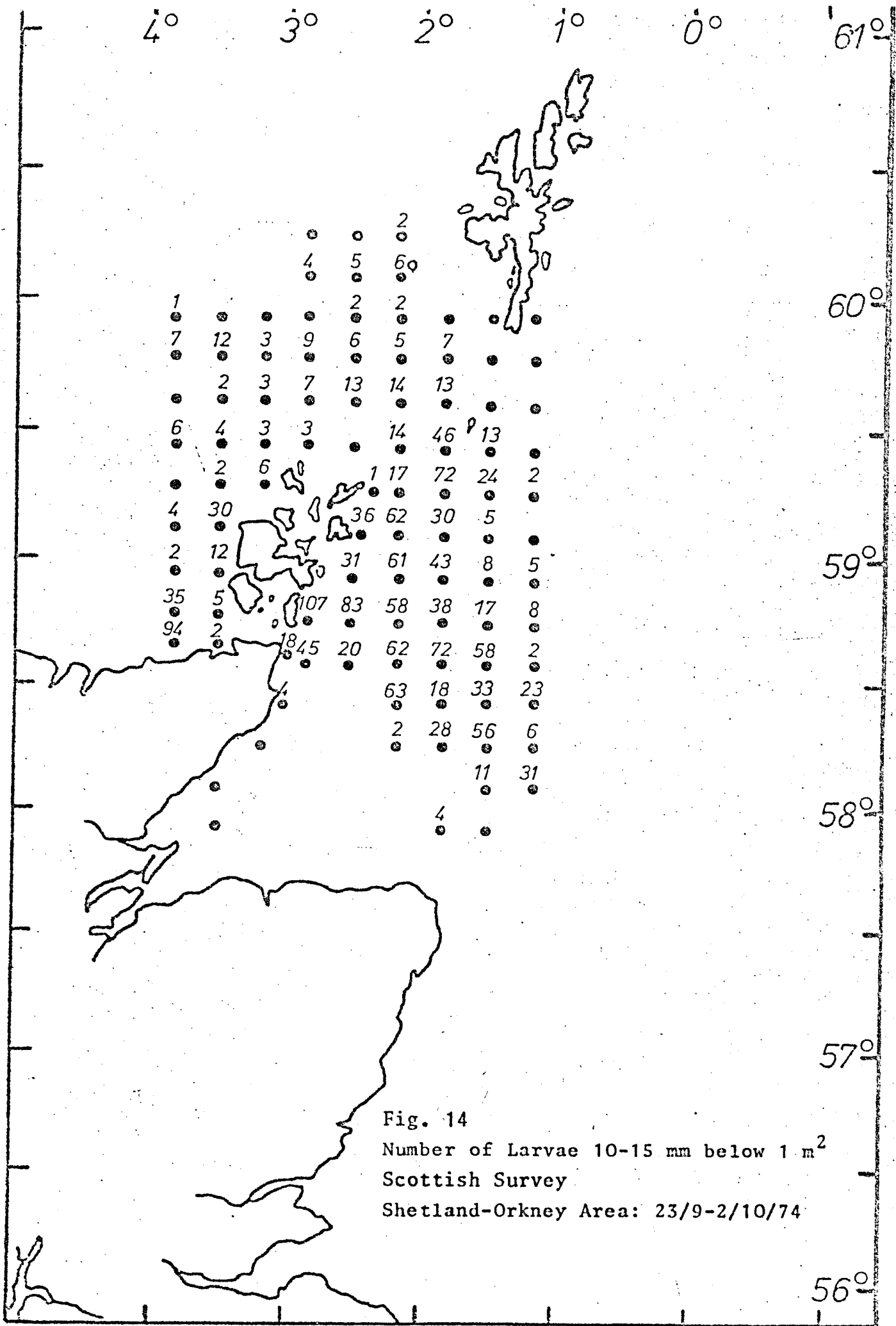


Fig. 14  
 Number of Larvae 10-15 mm below 1 m<sup>2</sup>  
 Scottish Survey  
 Shetland-Orkney Area: 23/9-2/10/74

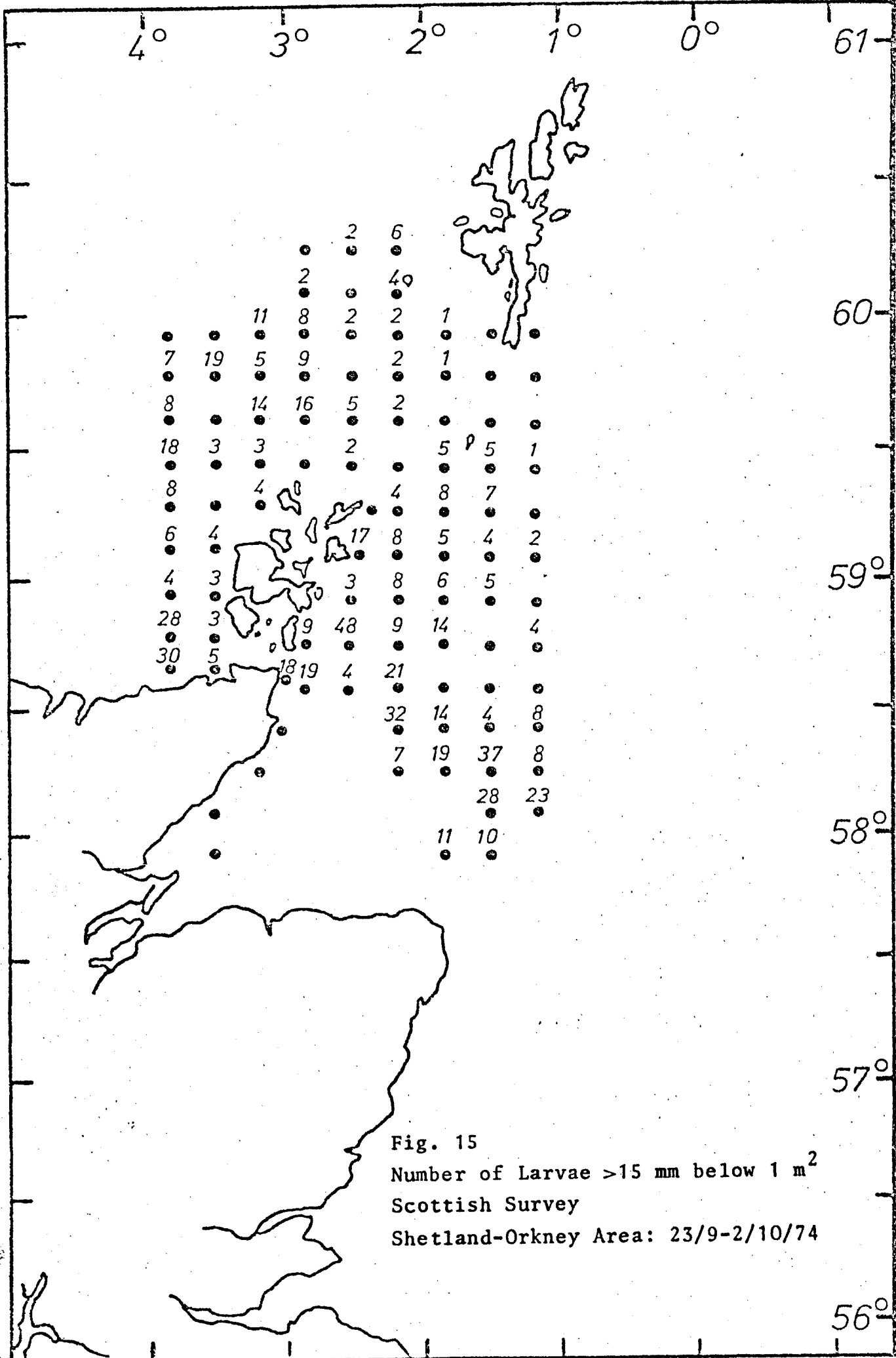


Fig. 15  
 Number of Larvae >15 mm below 1 m<sup>2</sup>  
 Scottish Survey  
 Shetland-Orkney Area: 23/9-2/10/74



Fig. 16

Number of Larvae <10 mm below 1 m<sup>2</sup>

Scottish Survey

Buchan Area: 7-8/10/74

Shetland-Orkney Area: 8-17/10/74

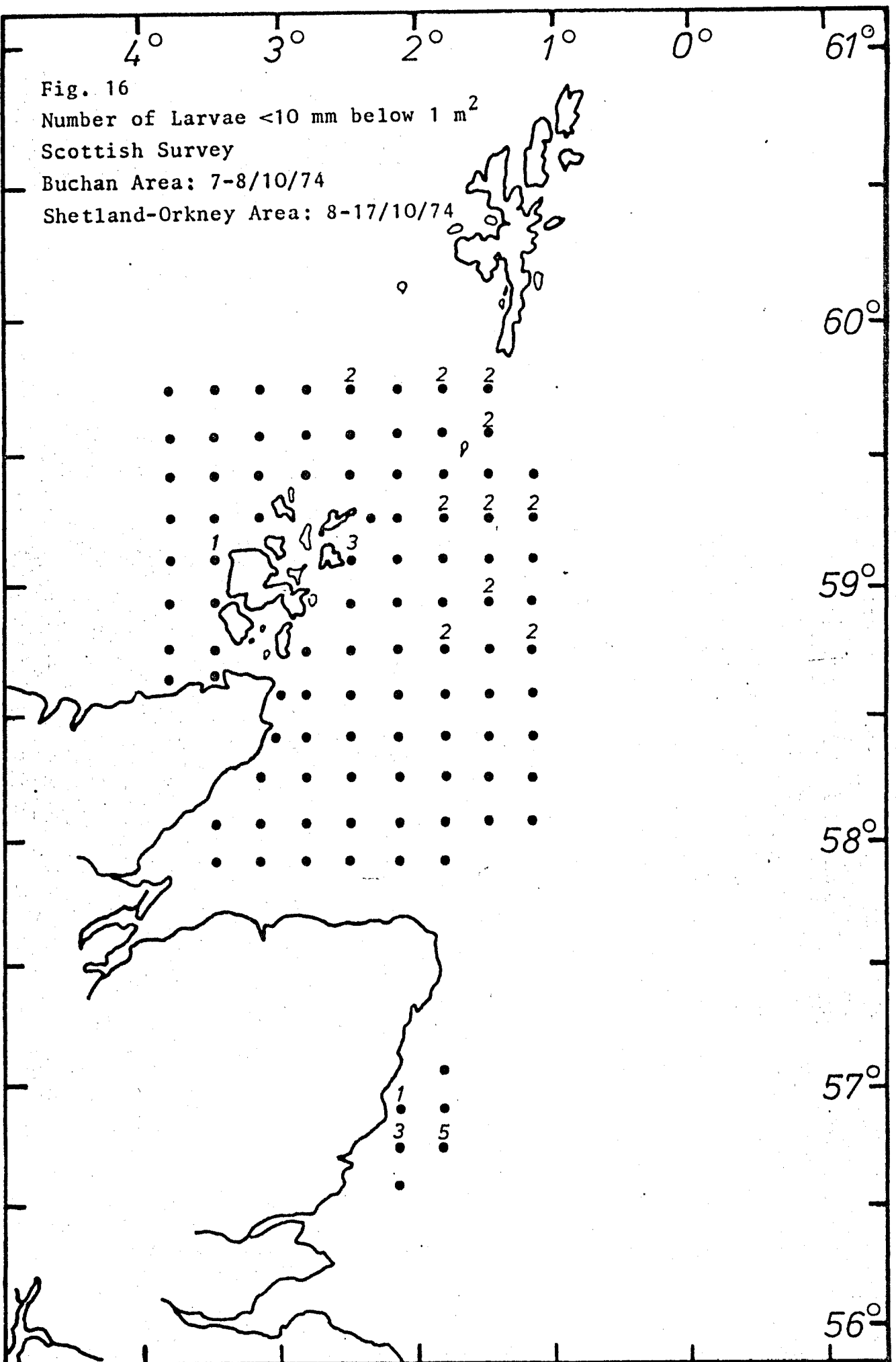


Fig. 17

Number of Larvae 10-15 mm below 1 m<sup>2</sup>

Scottish Survey

Buchan Area: 7-8/10/74

Shetland-Orkney Area: 8-17/10/74

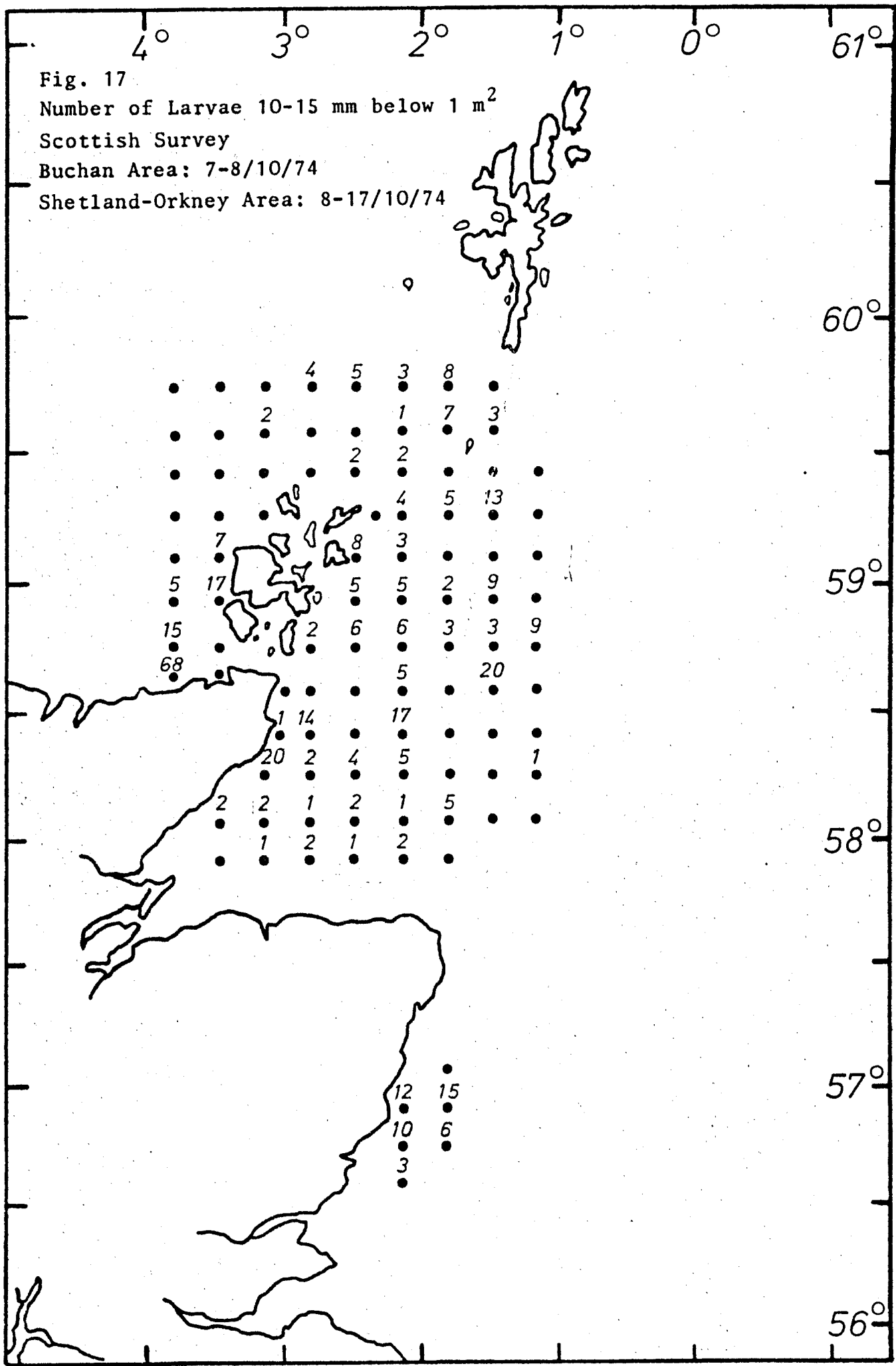


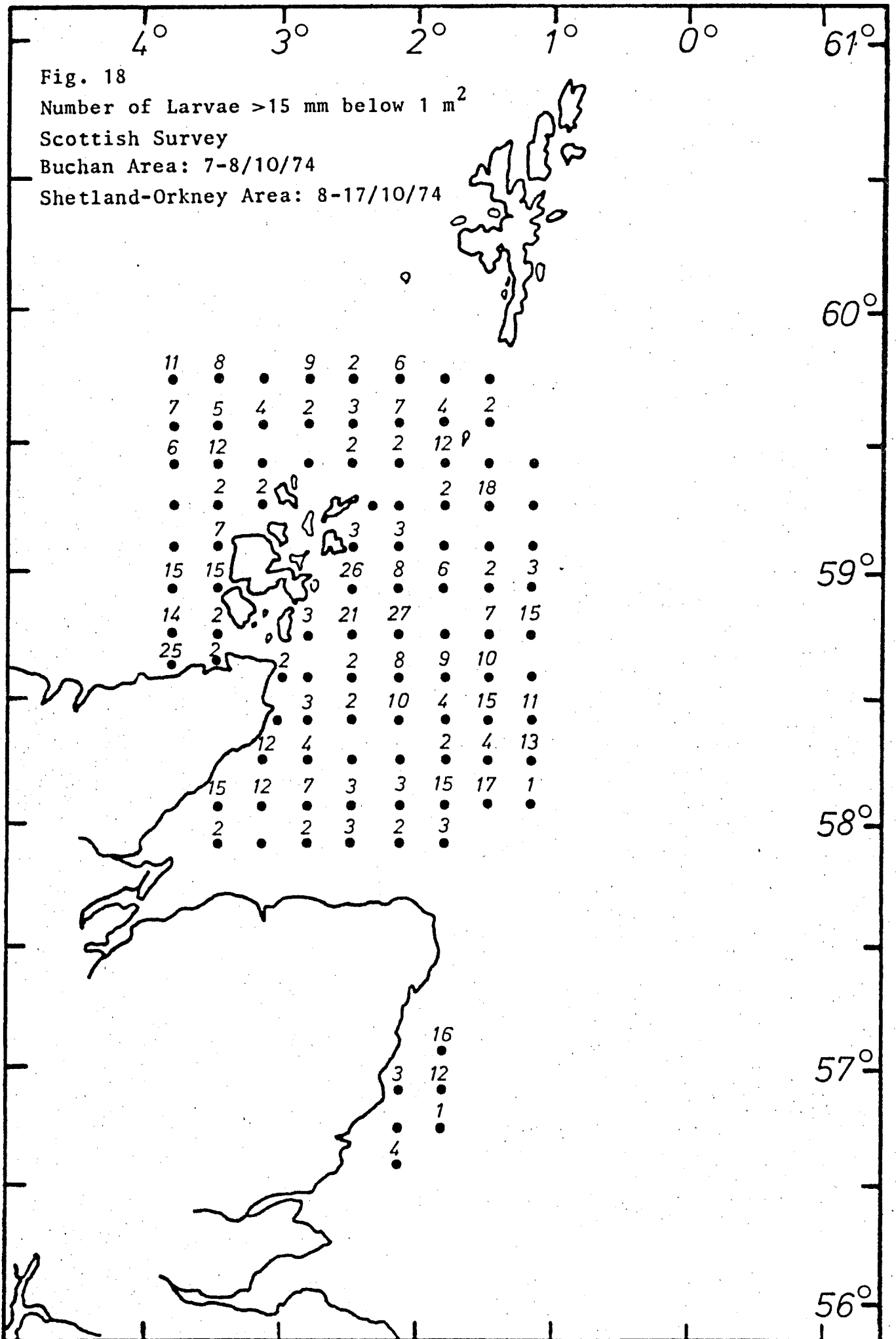
Fig. 18

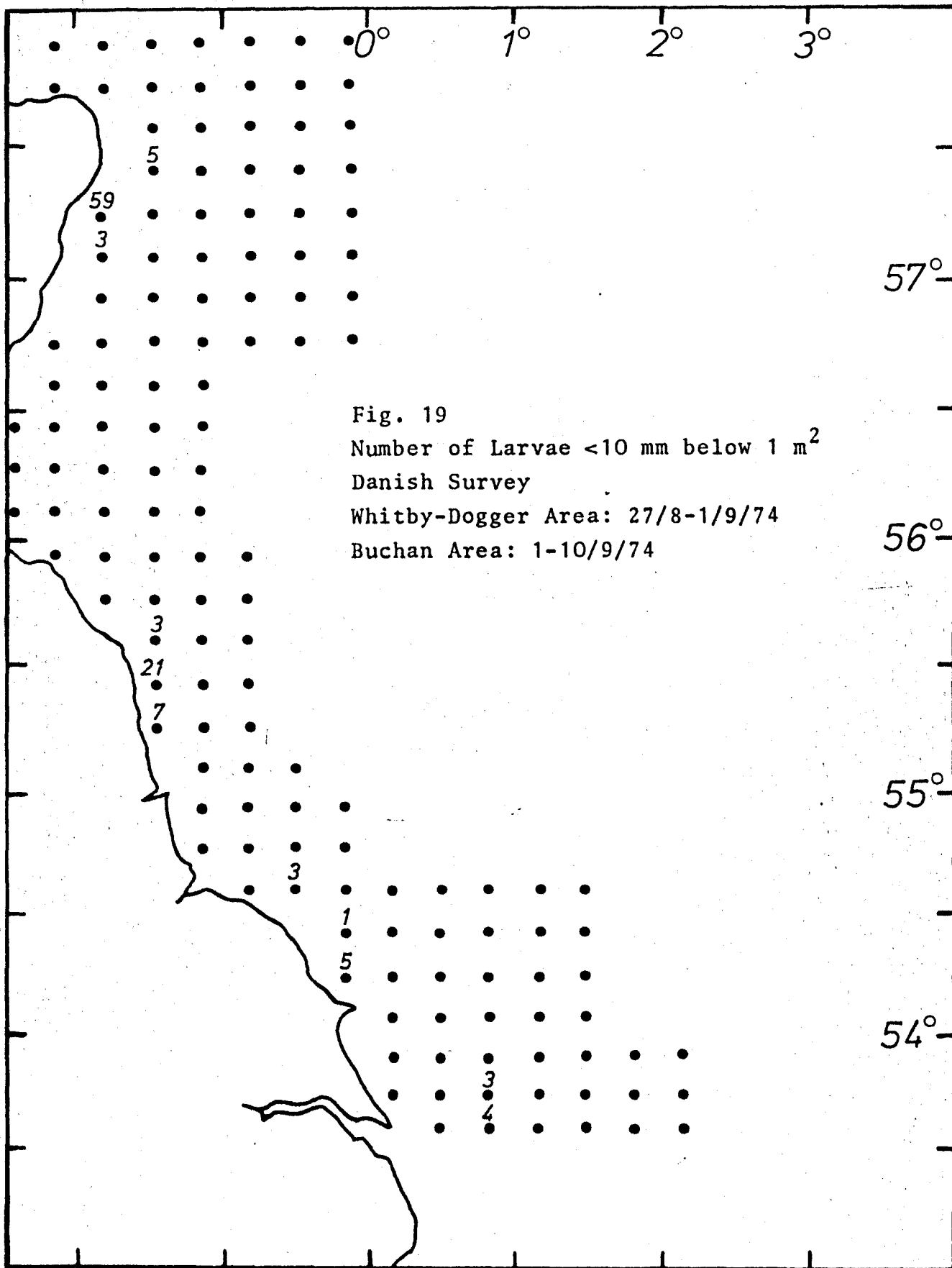
Number of Larvae >15 mm below 1 m<sup>2</sup>

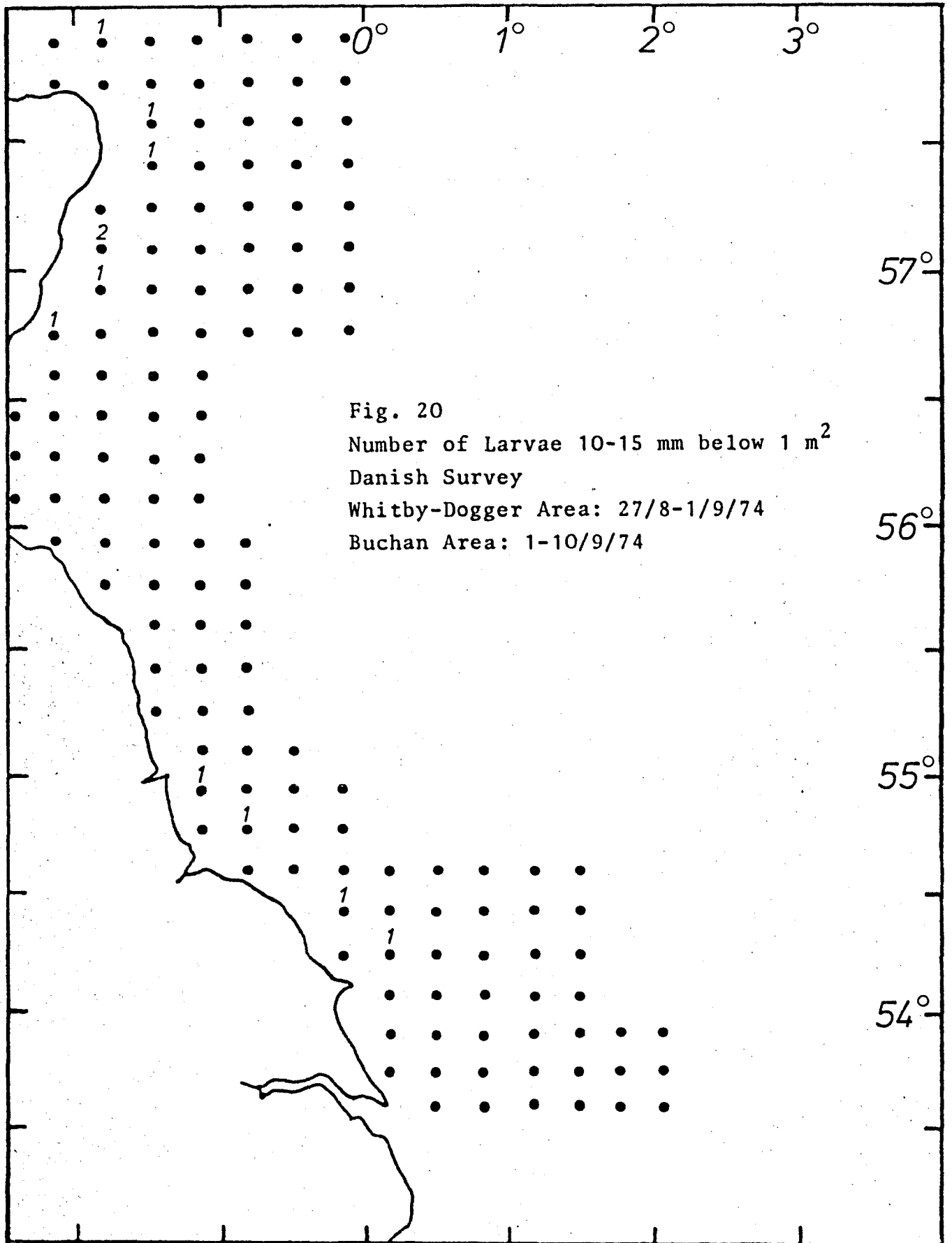
Scottish Survey

Buchan Area: 7-8/10/74

Shetland-Orkney Area: 8-17/10/74







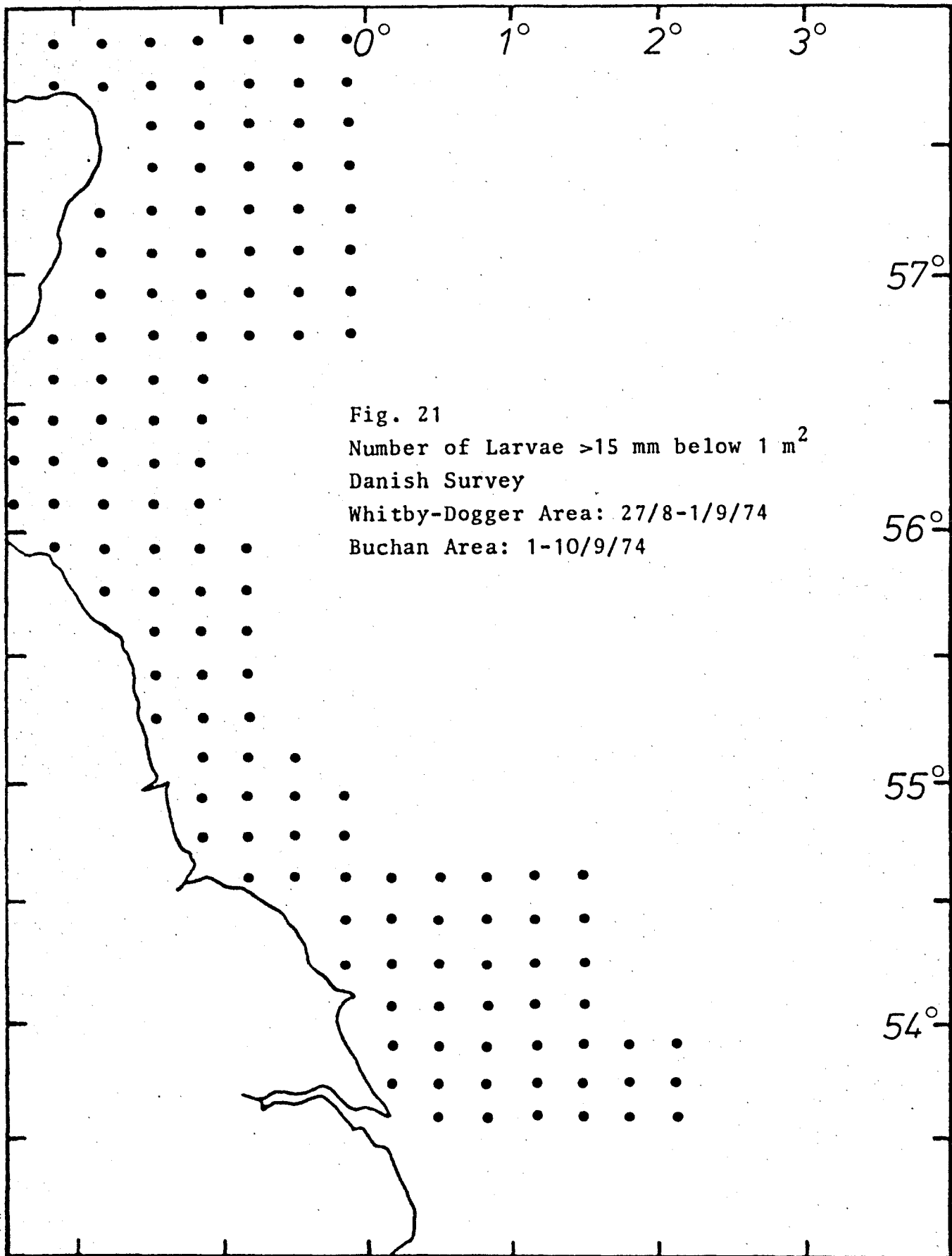


Fig. 22

Number of Larvae <10 mm below 1 m<sup>2</sup>

Scottish Survey

Buchan Area: 9-12/9/74

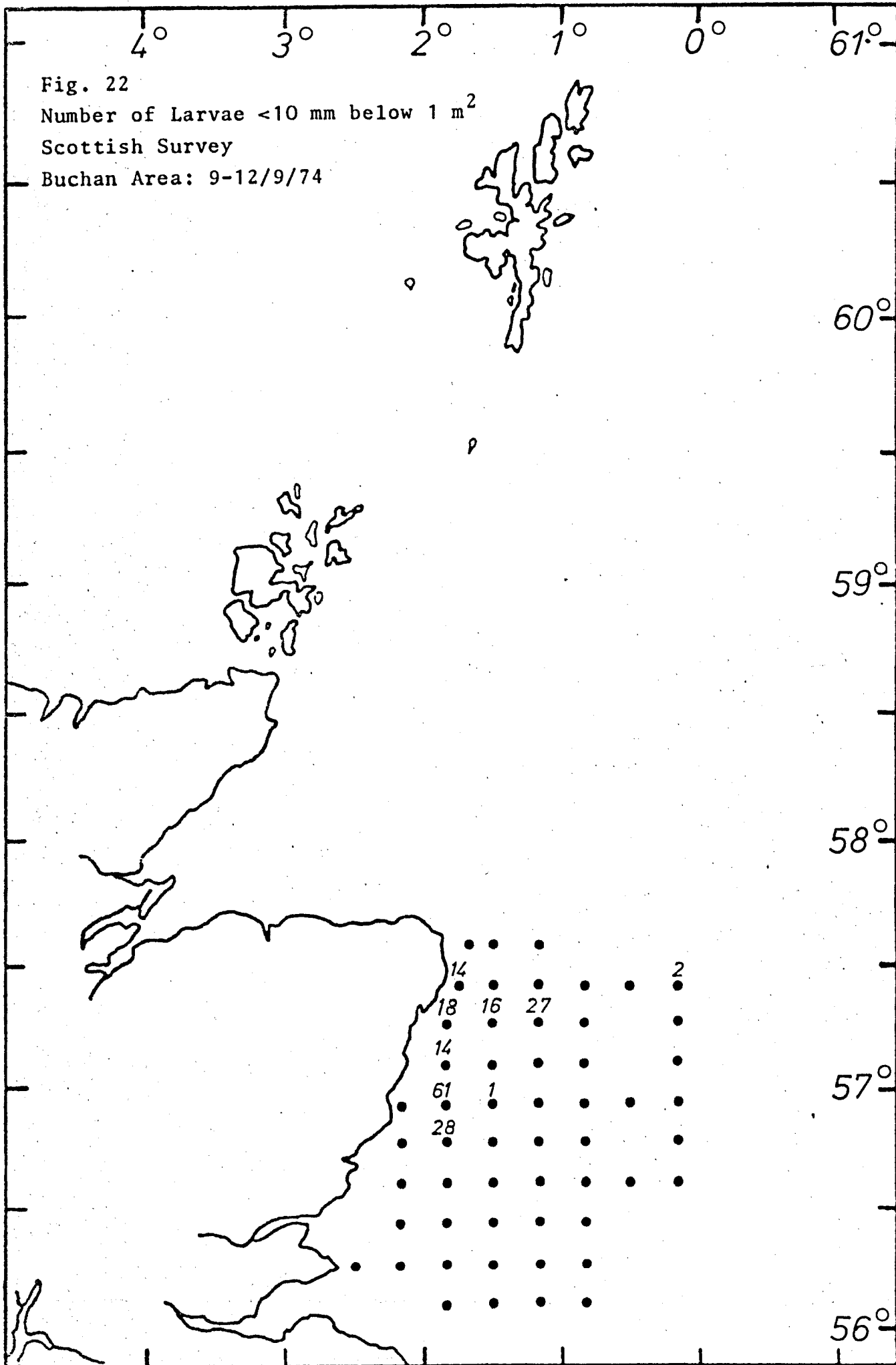


Fig. 23

Number of Larvae 10-15 mm below 1 m<sup>2</sup>

Scottish Survey

Buchan Area: 9-12/9/74

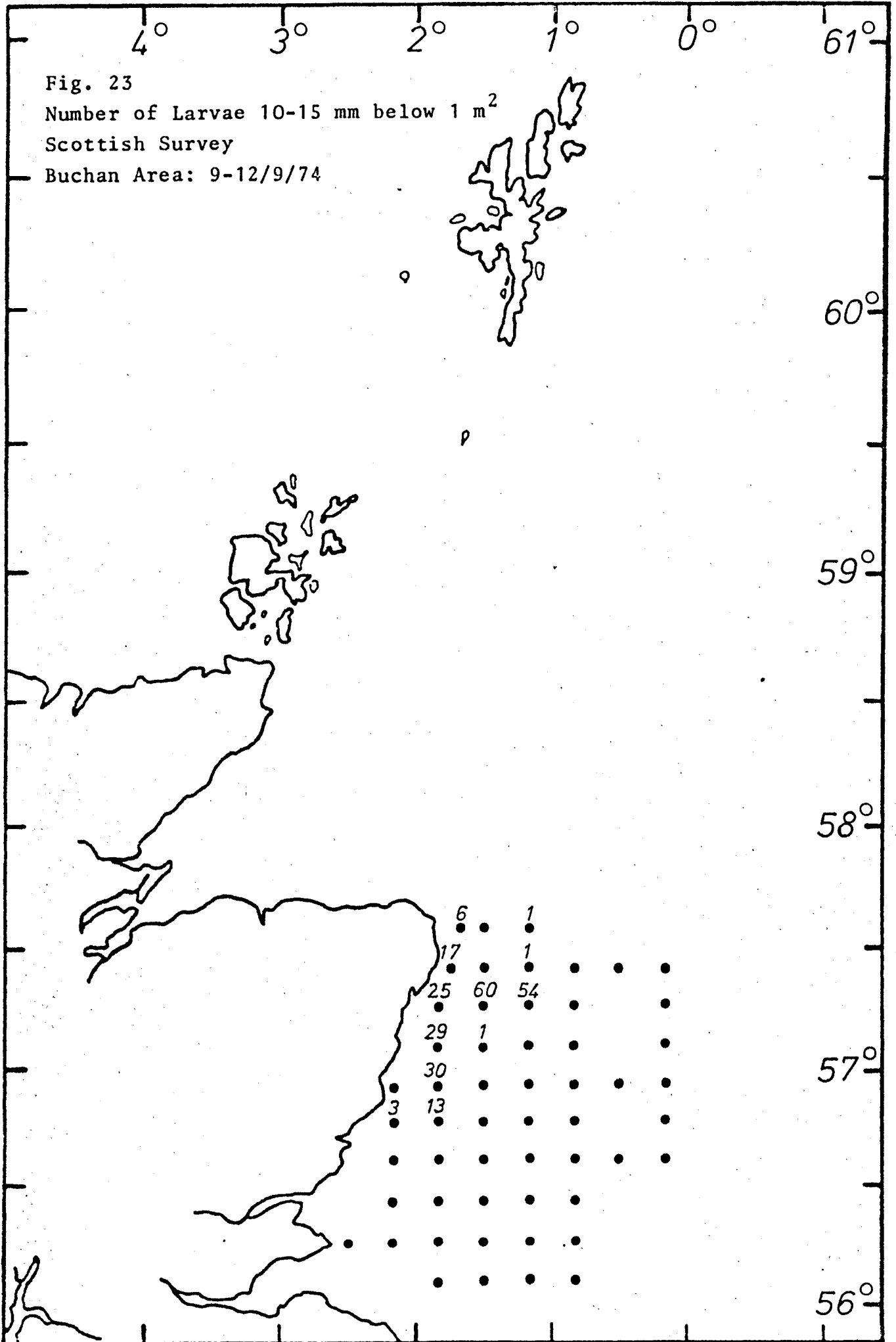




Fig. 24

Number of Larvae >15 mm below 1 m<sup>2</sup>

Scottish Survey

Buchan Area: 9-12/9/74

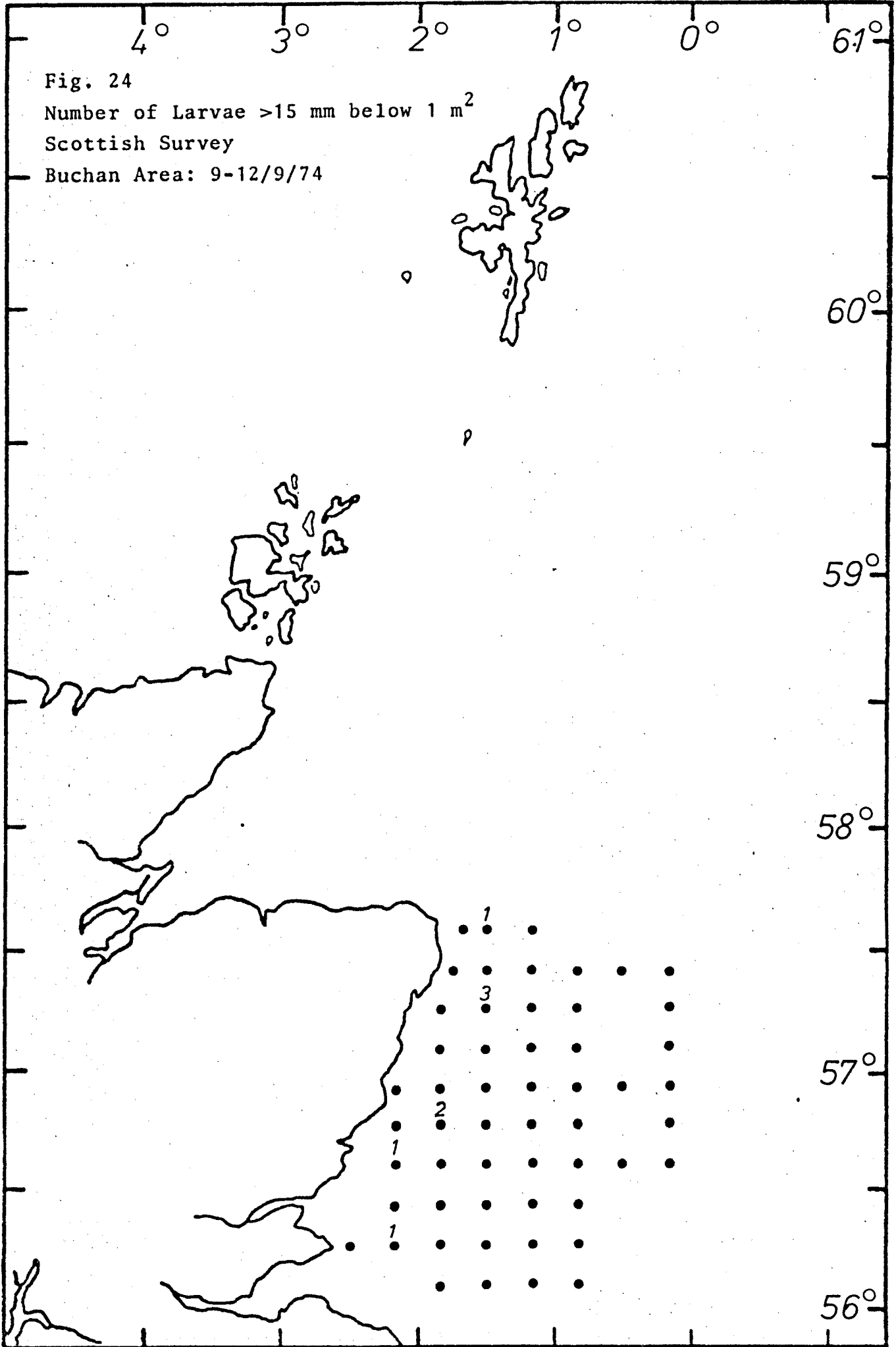
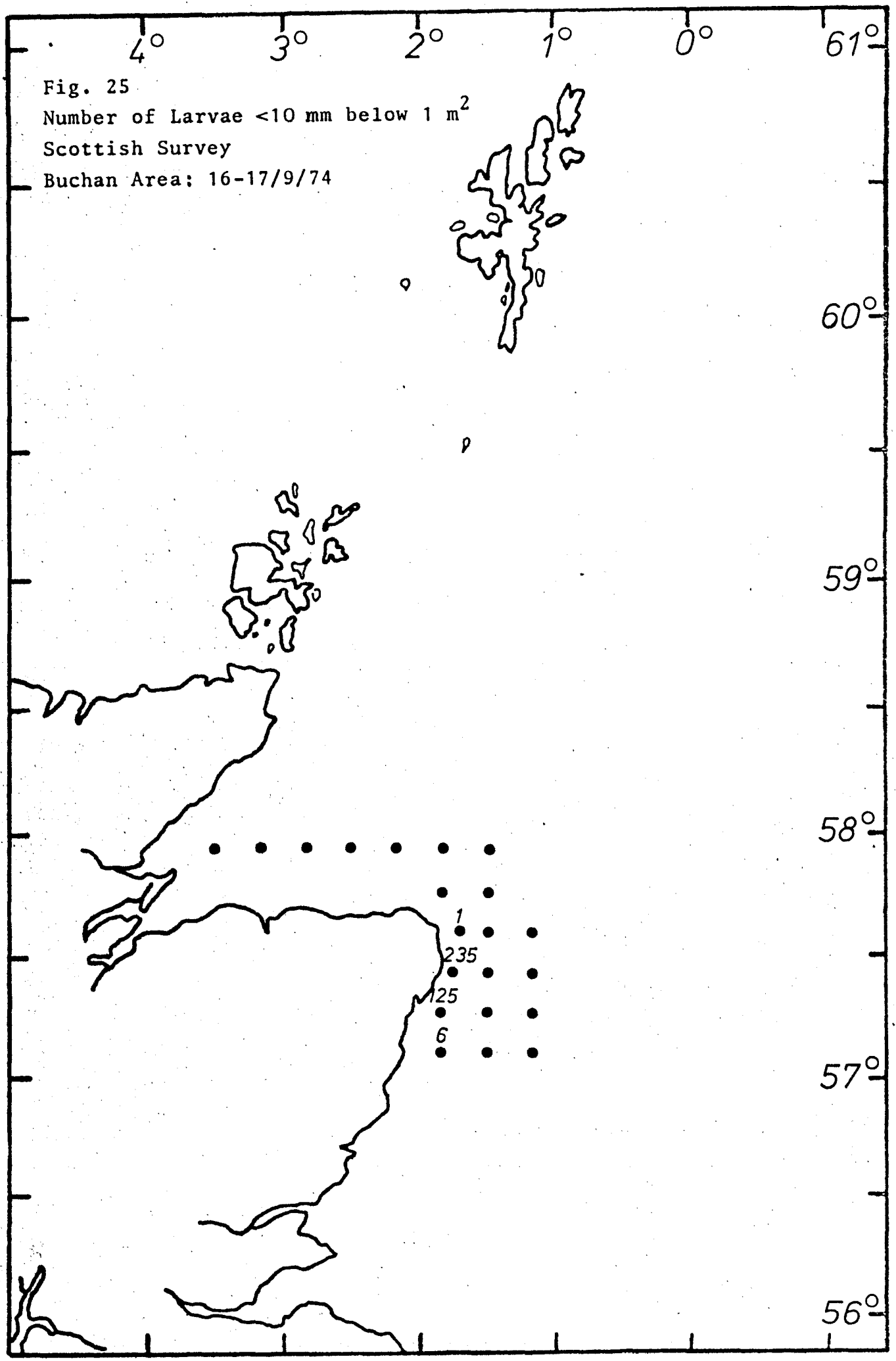


Fig. 25  
Number of Larvae <10 mm below 1 m<sup>2</sup>  
Scottish Survey  
Buchan Area: 16-17/9/74



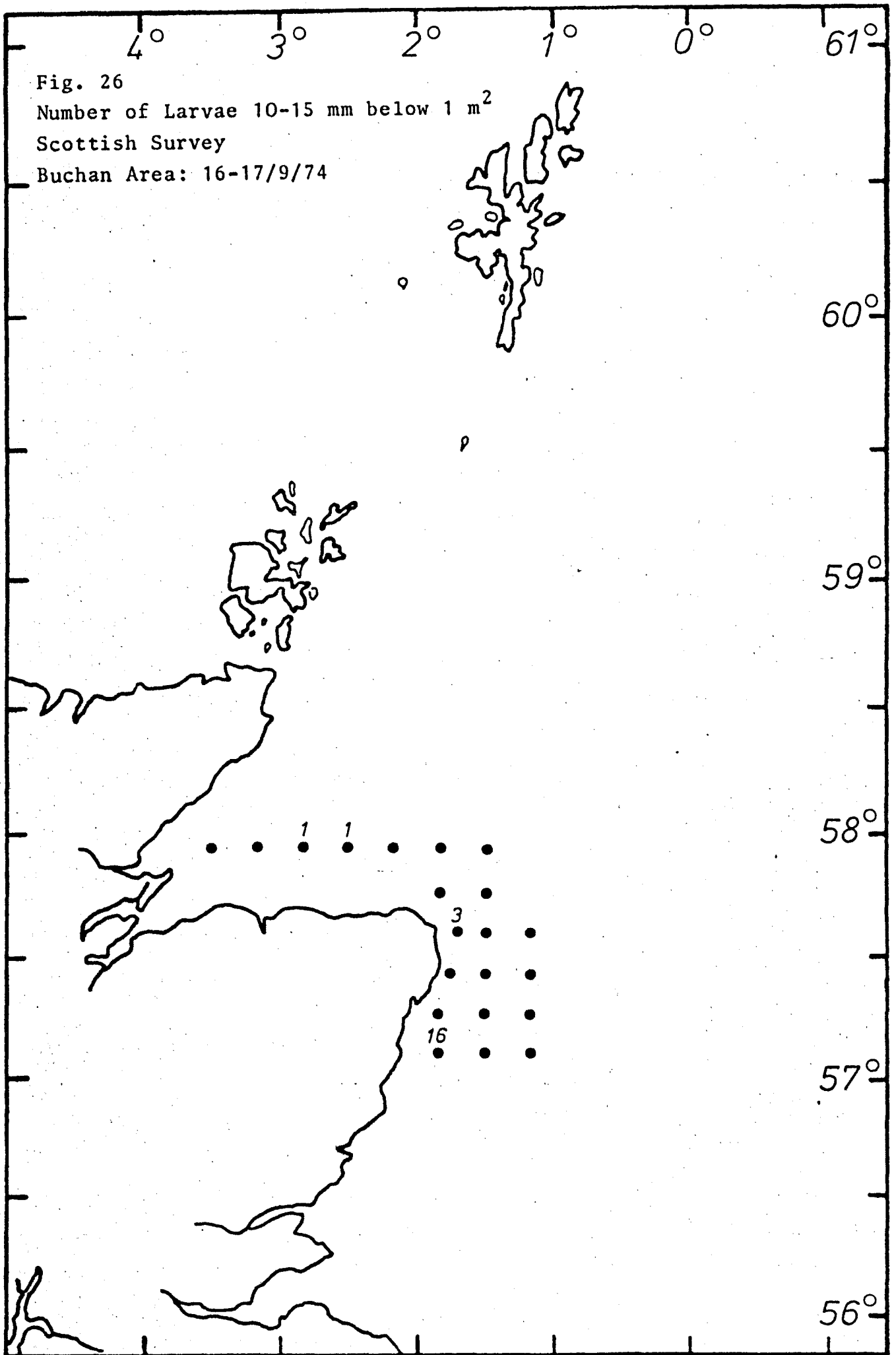


Fig. 27

Number of Larvae >15 mm below 1 m<sup>2</sup>

Scottish Survey

Buchan Area: 16-17/9/74

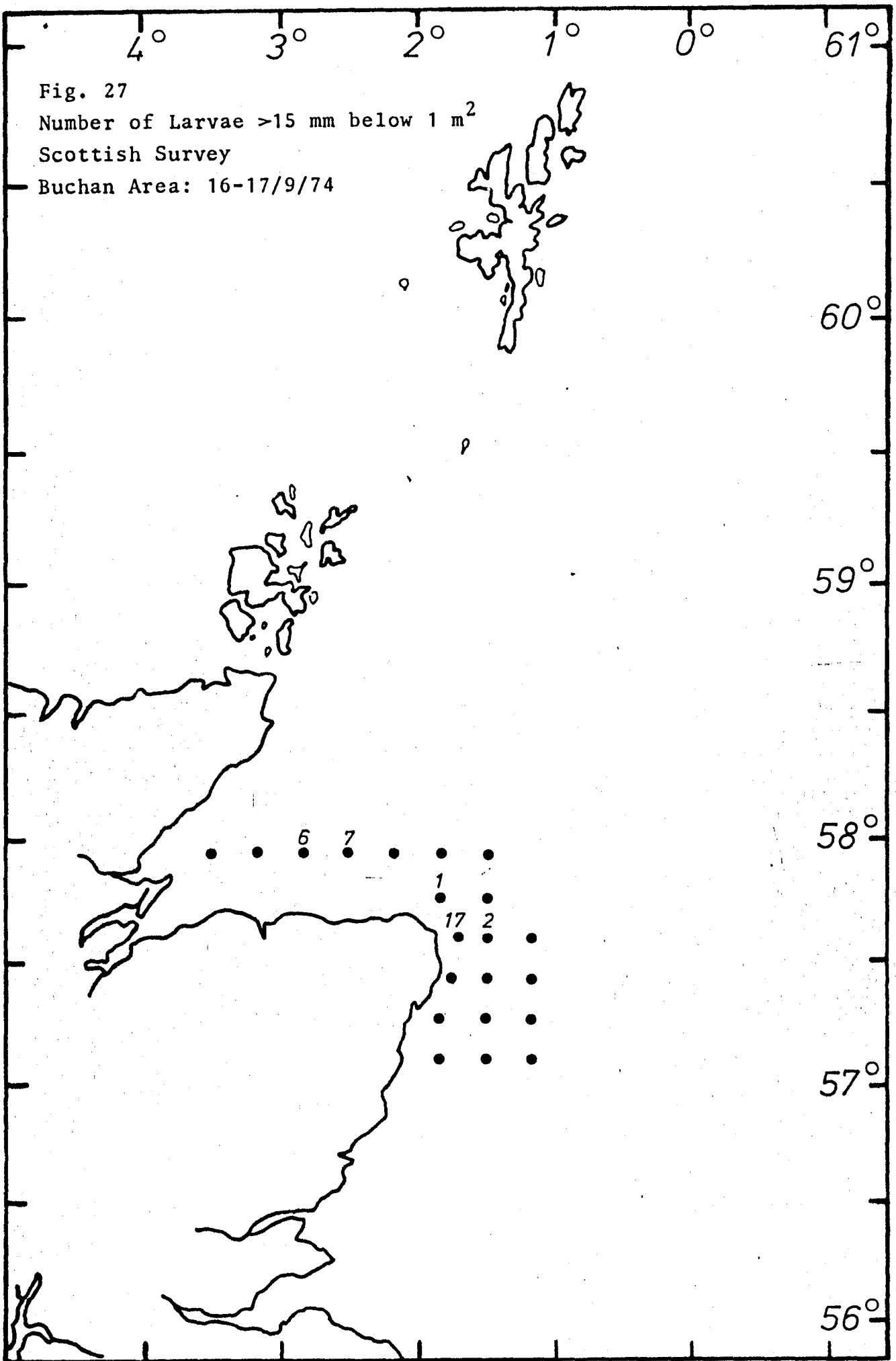


Fig. 28

Number of Larvae <10 mm below 1 m<sup>2</sup>

Scottish Survey

Buchan Area: 17-19/9/74

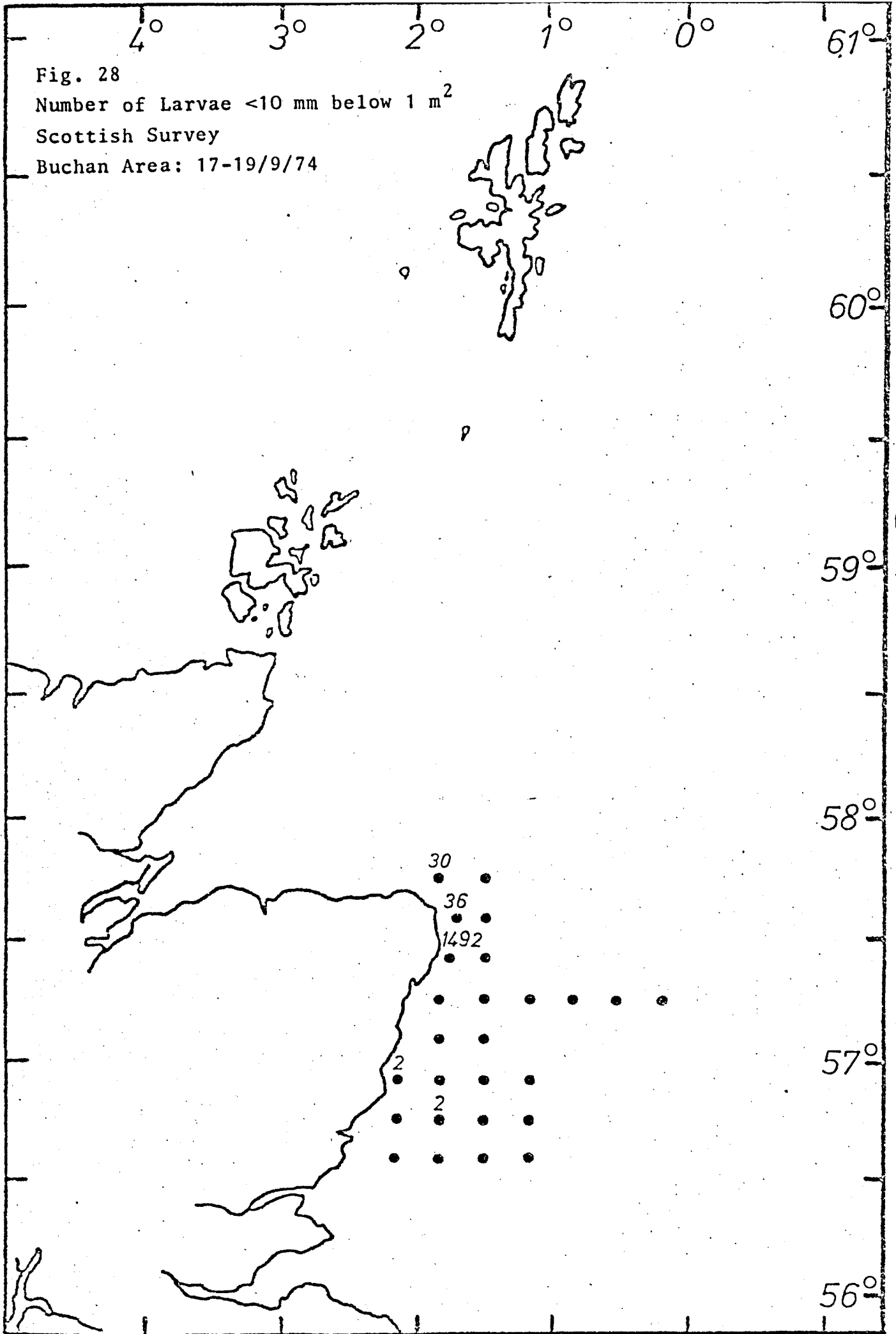


Fig. 29

Number of Larvae 10-15 mm below 1 m<sup>2</sup>

Scottish Survey

Buchan Area: 17-19/9/74

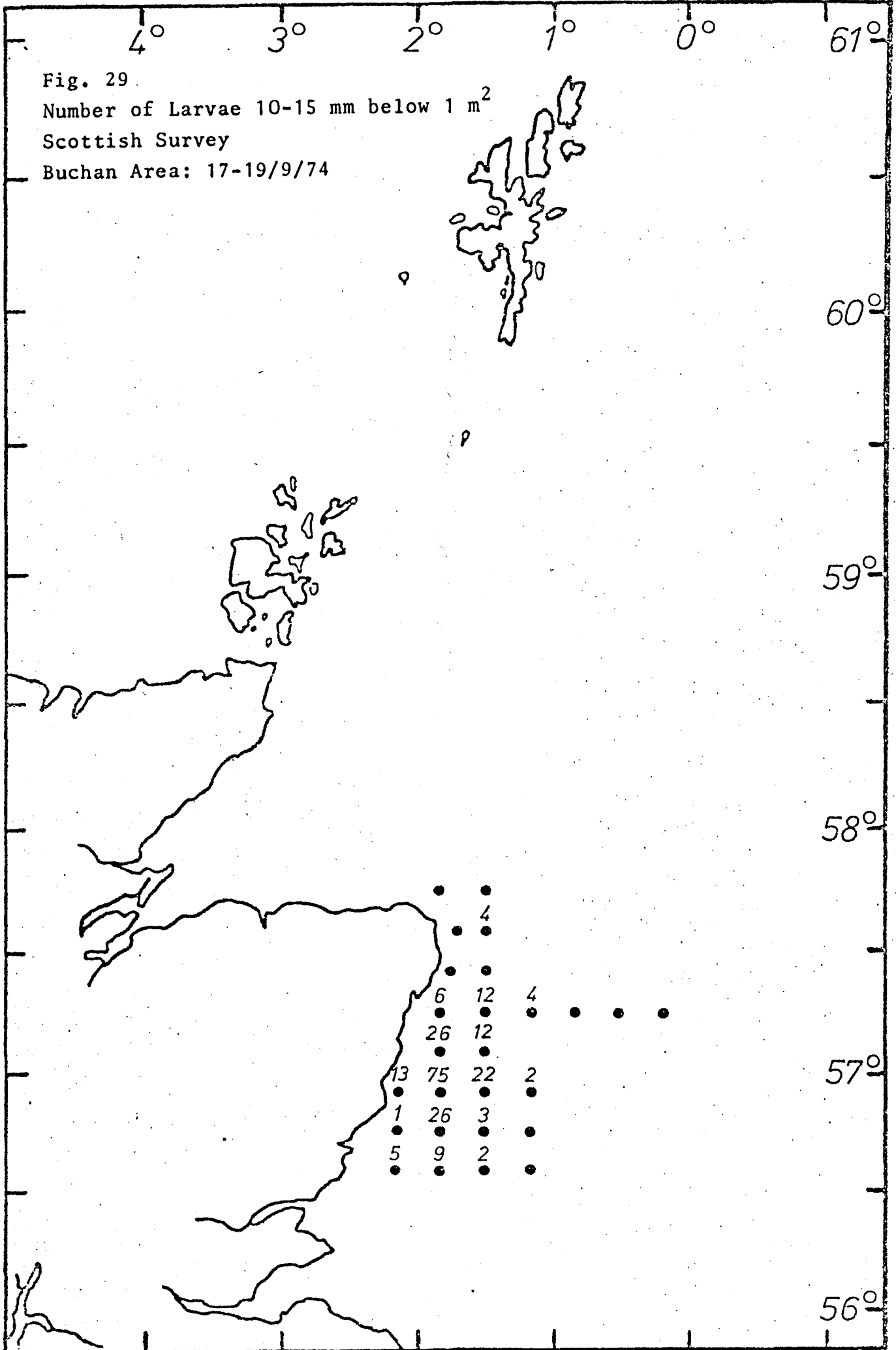
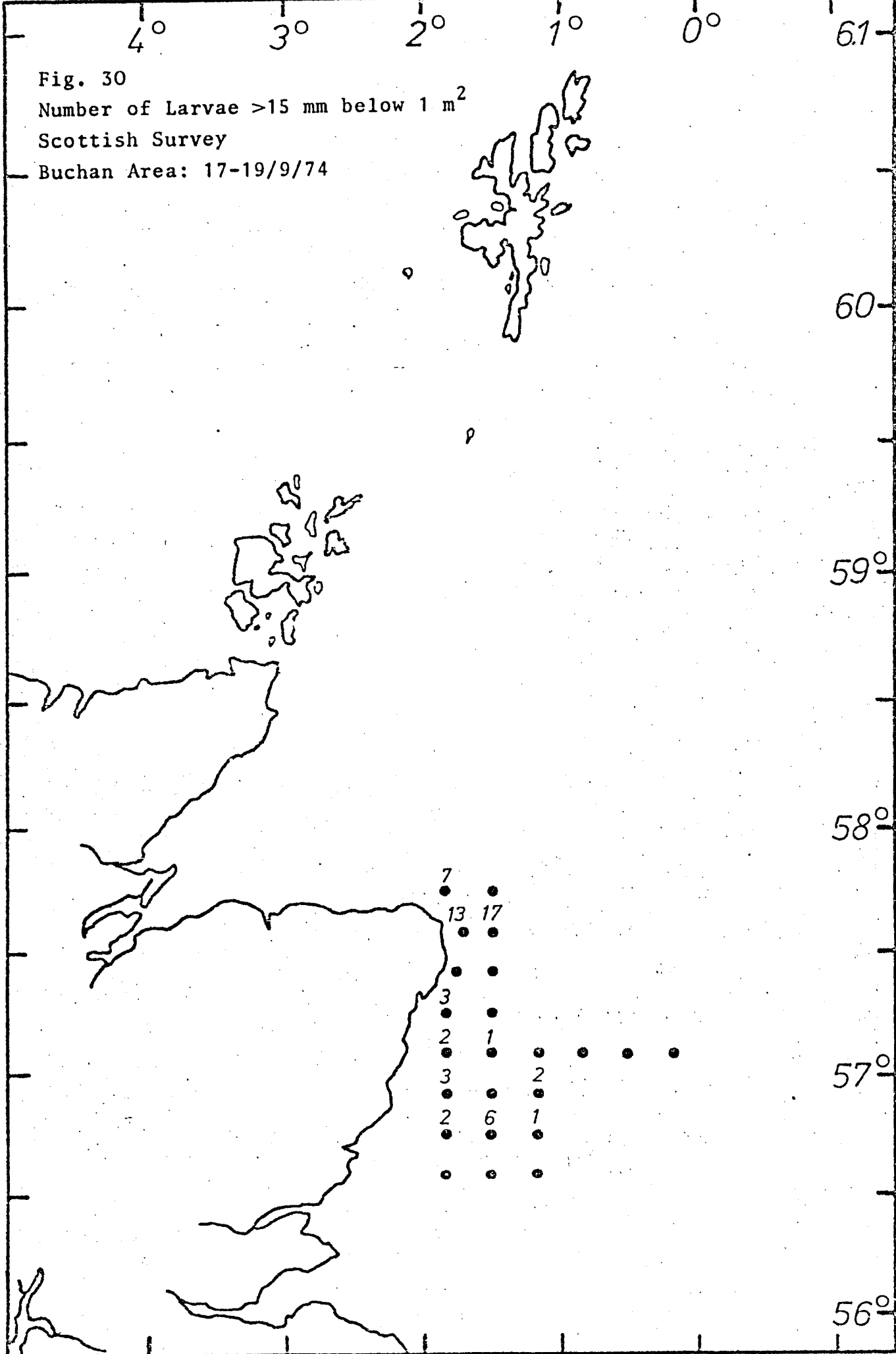


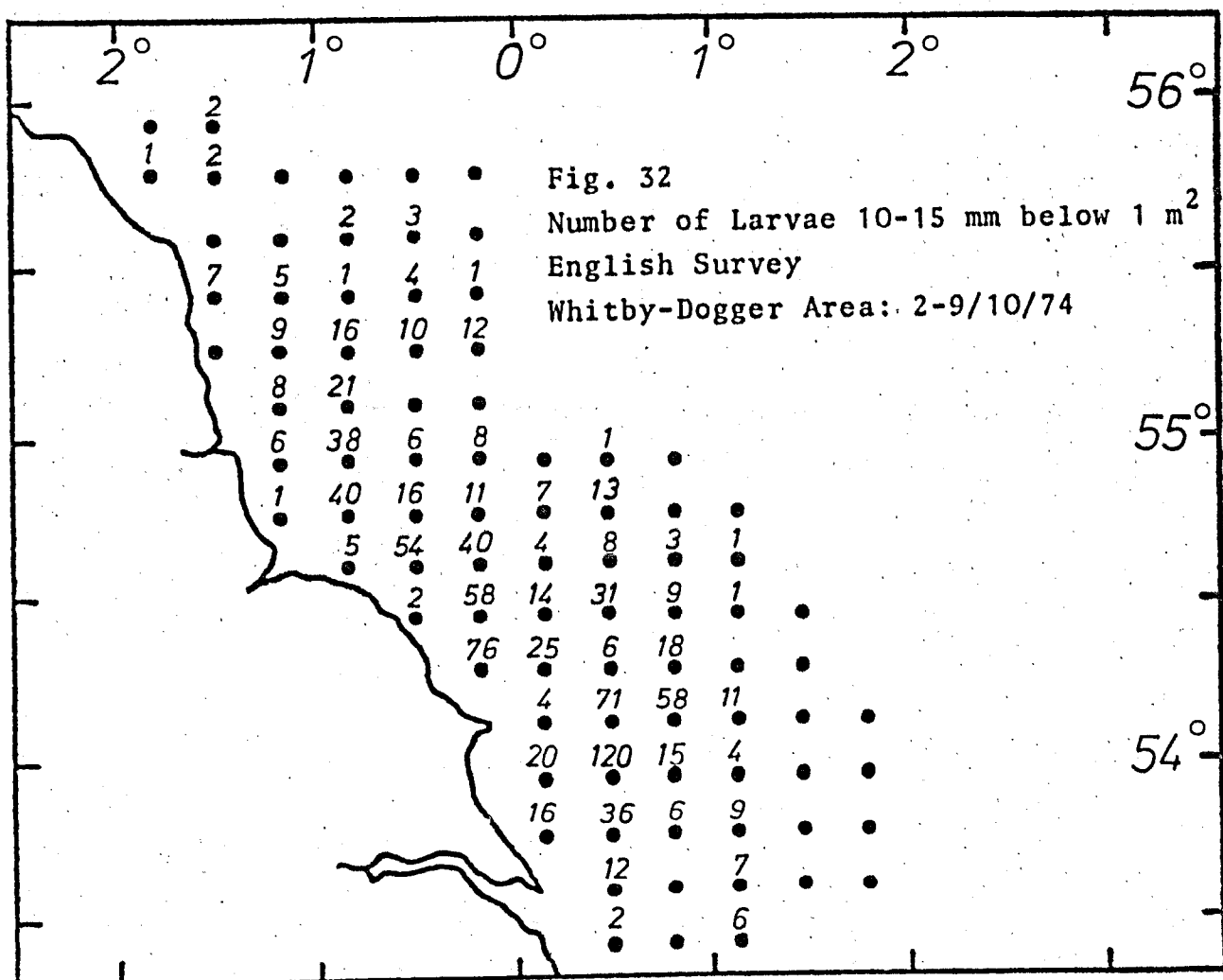
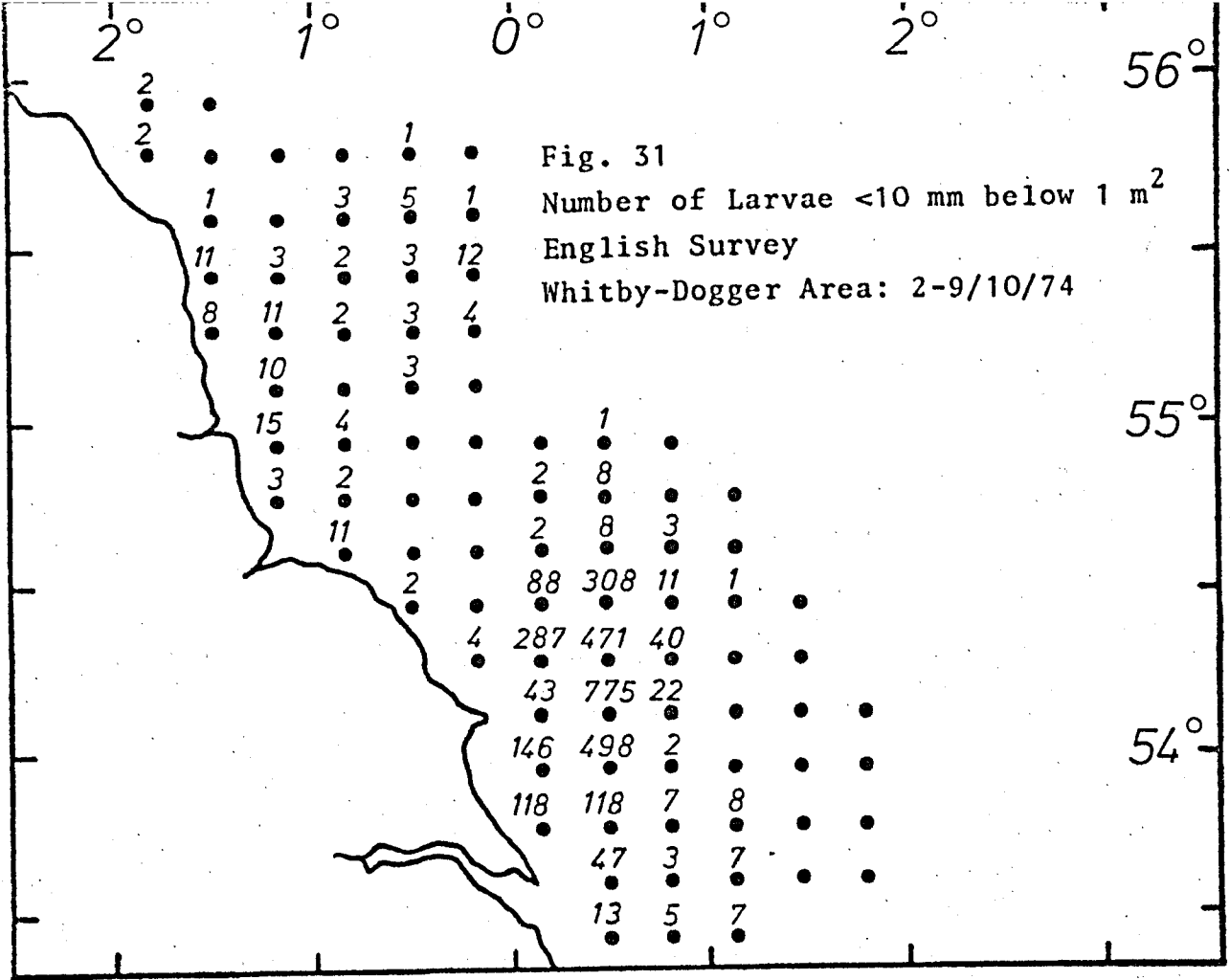
Fig. 30

Number of Larvae >15 mm below 1 m<sup>2</sup>

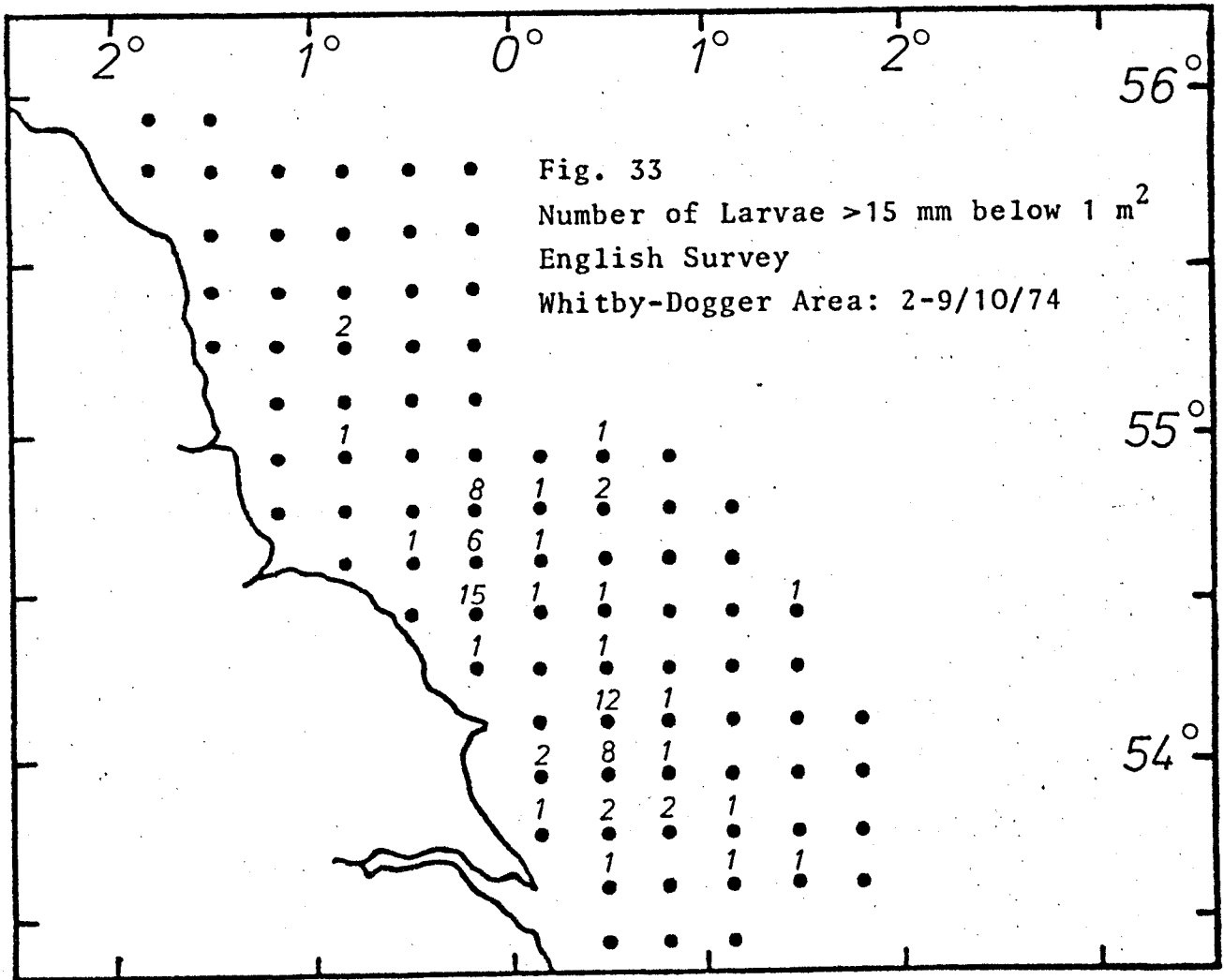
Scottish Survey

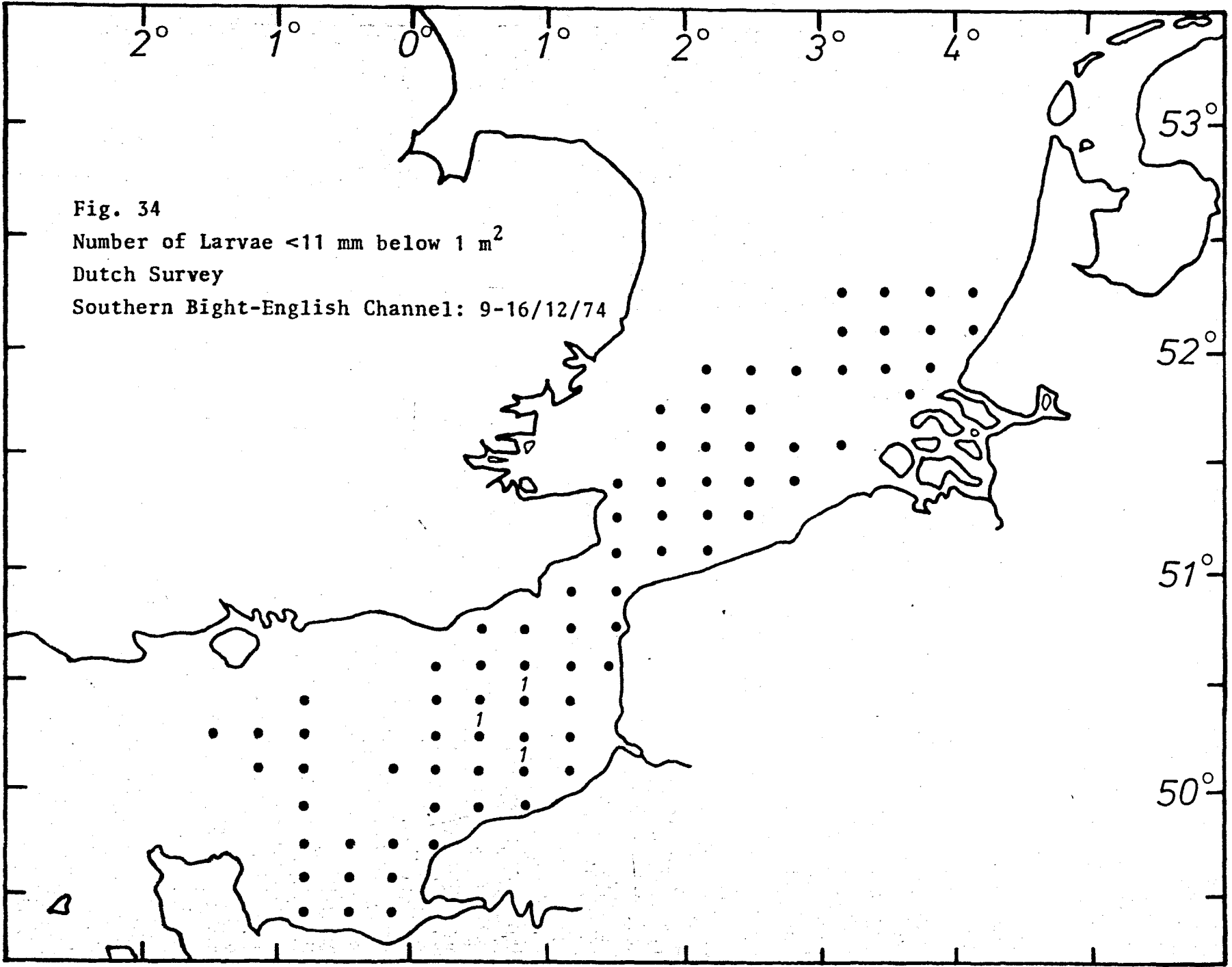
Buchan Area: 17-19/9/74

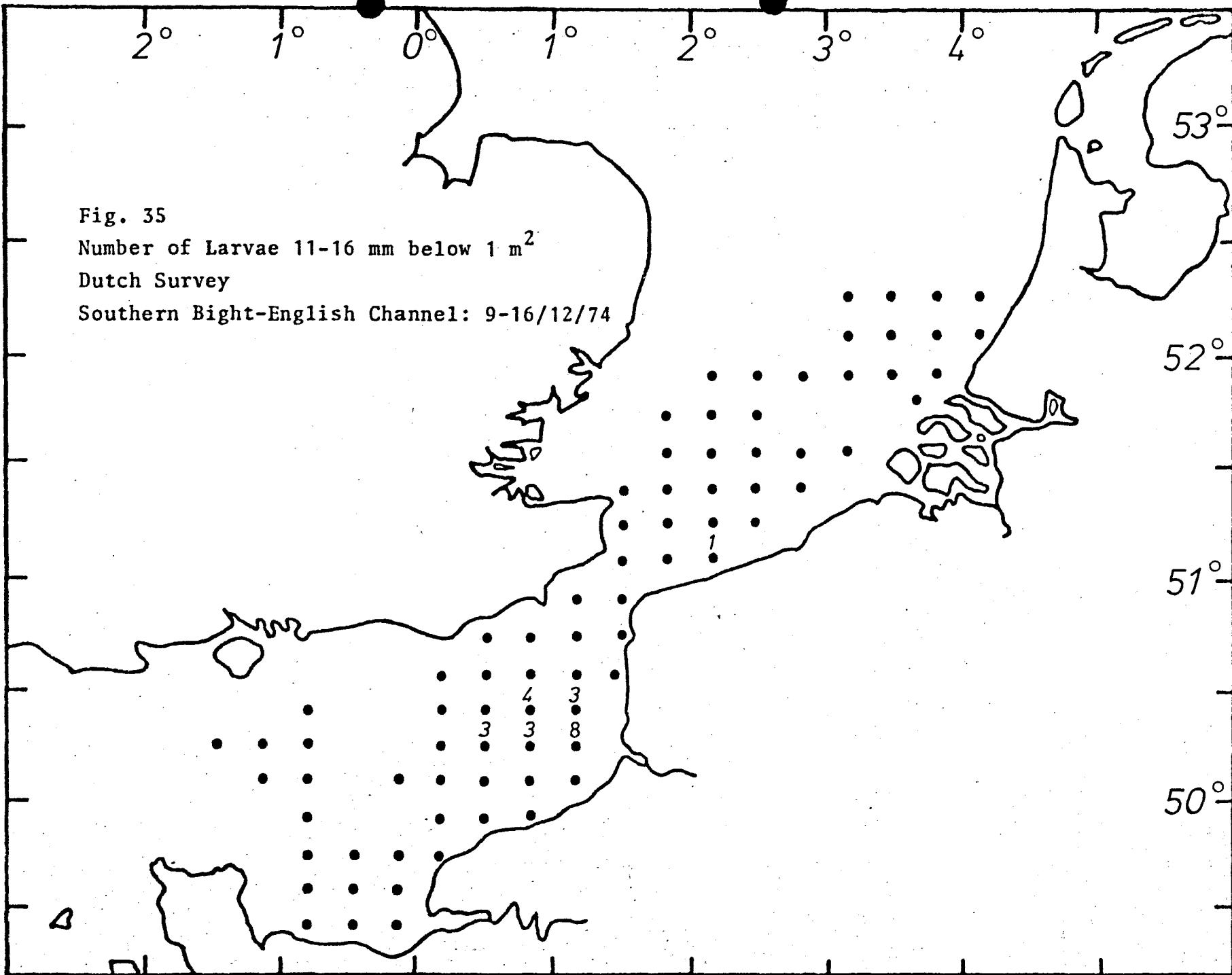












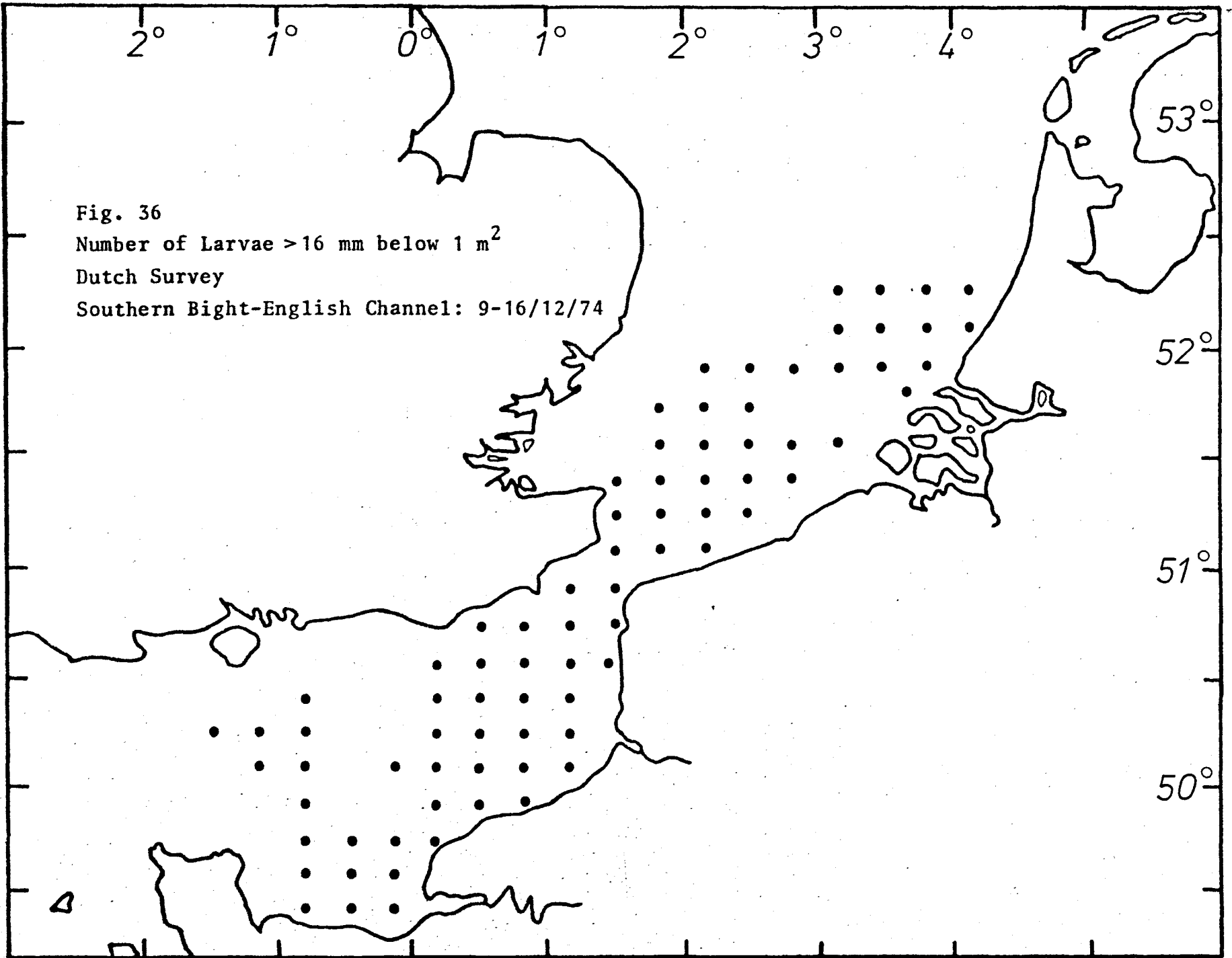
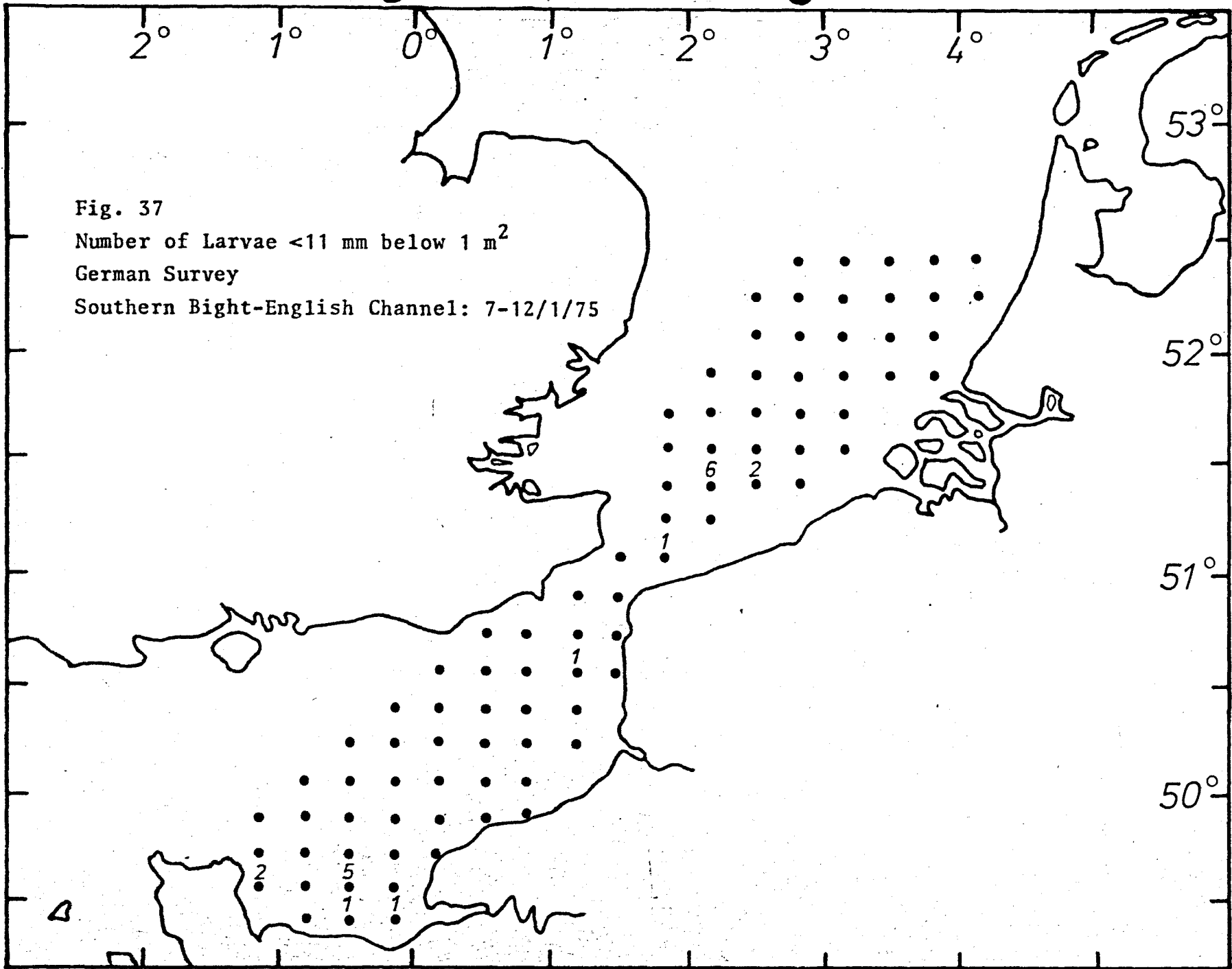


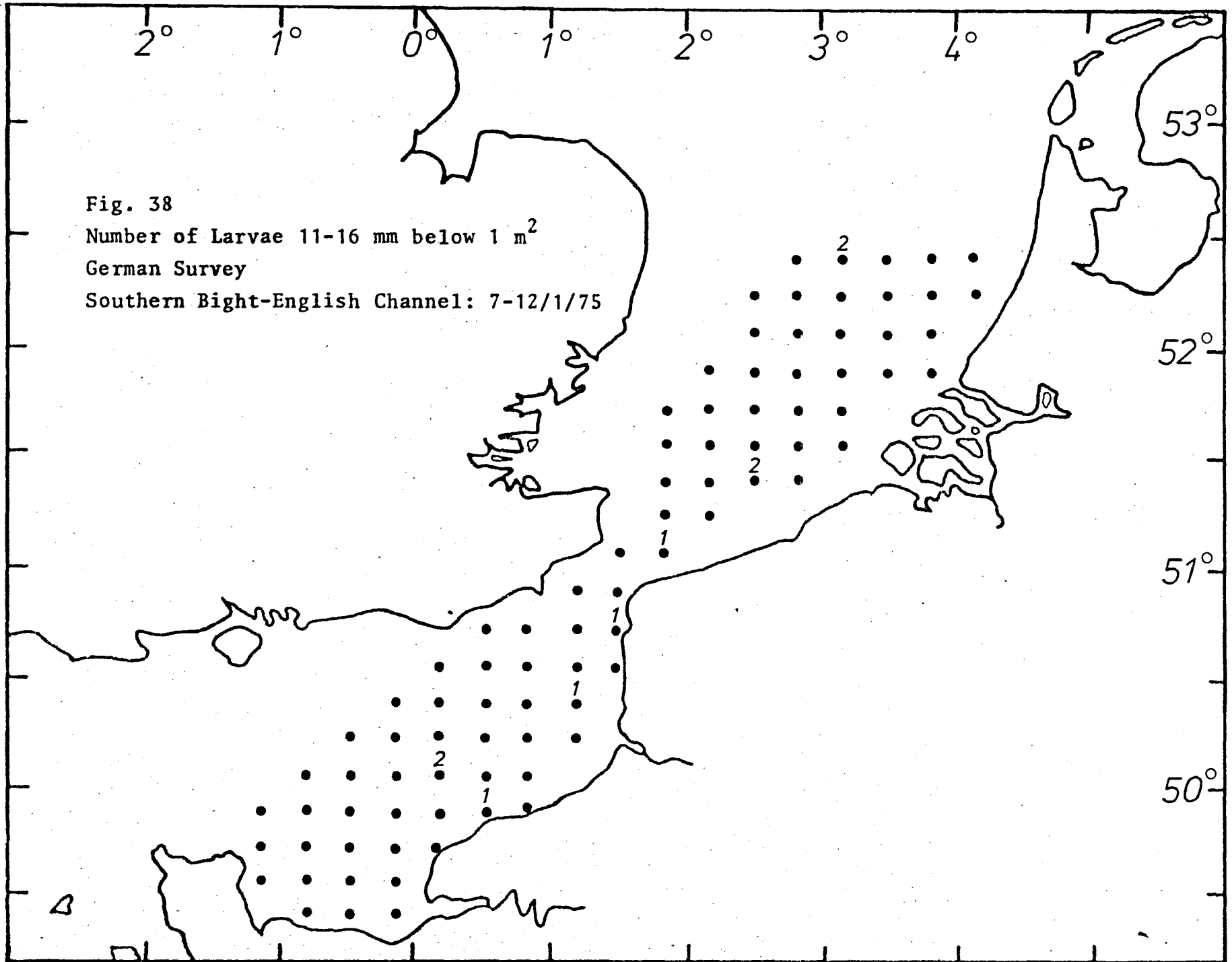
Fig. 36

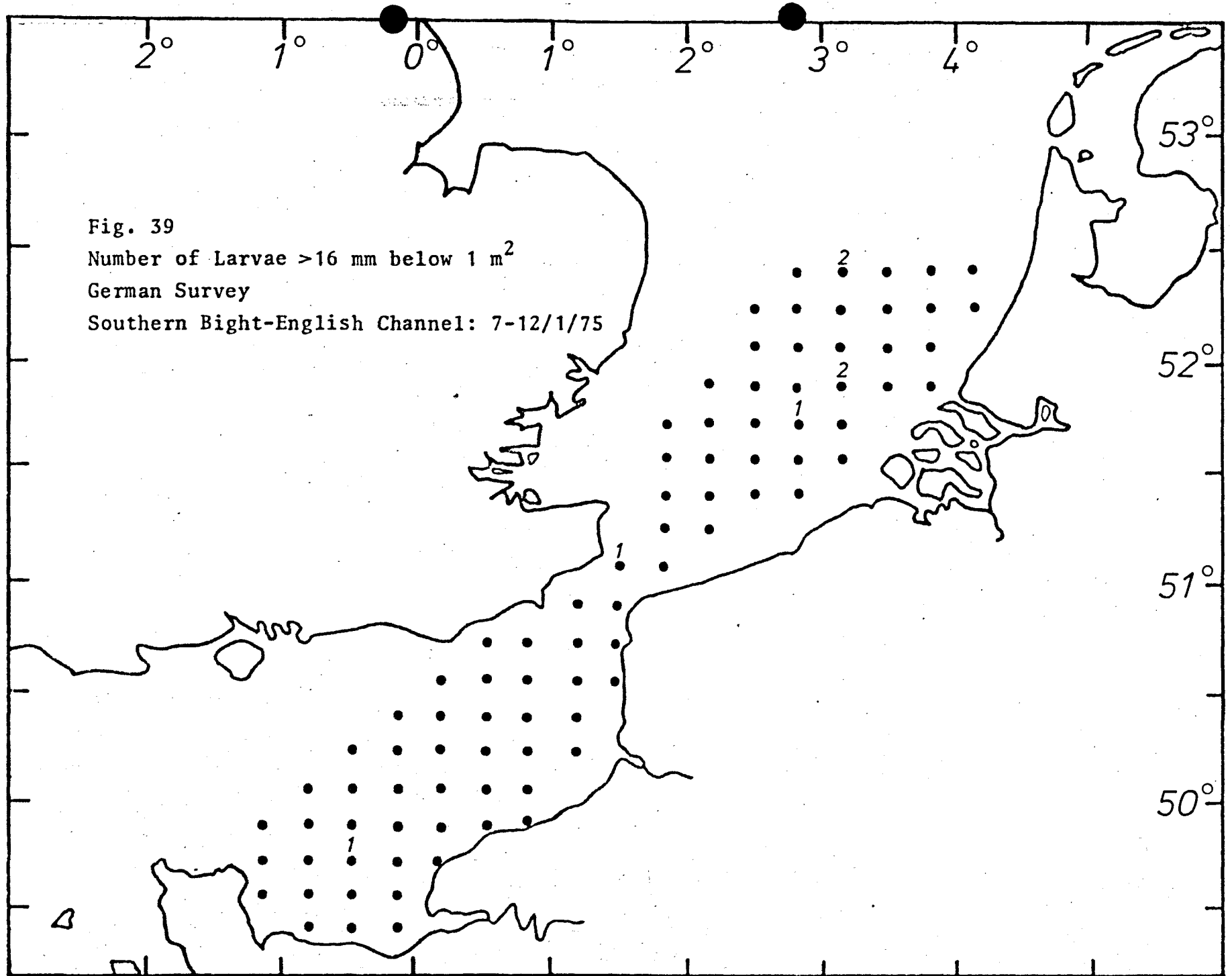
Number of Larvae >16 mm below 1 m<sup>2</sup>

Dutch Survey

Southern Bight-English Channel: 9-16/12/74







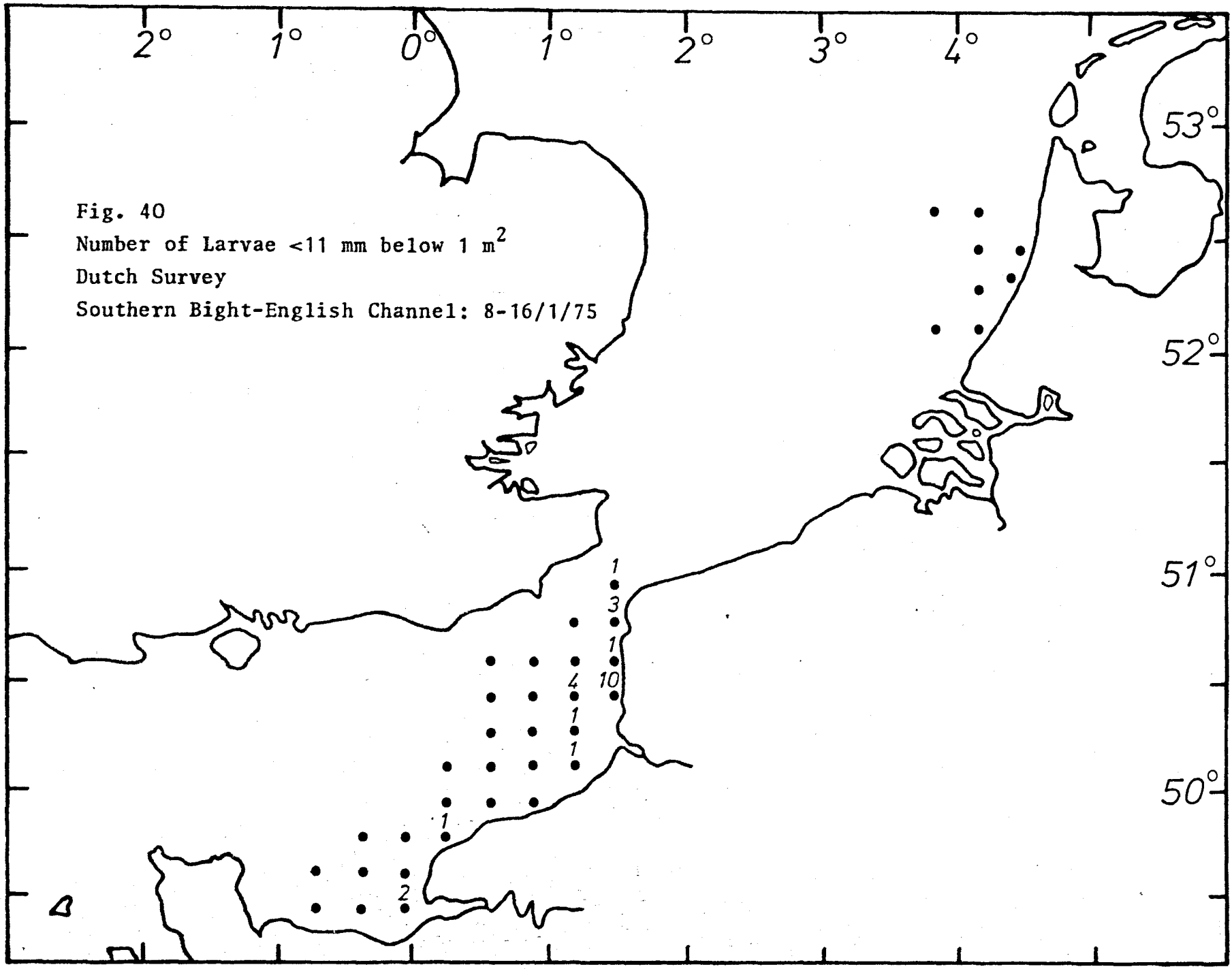


Fig. 40  
Number of Larvae <11 mm below 1 m<sup>2</sup>  
Dutch Survey  
Southern Bight-English Channel: 8-16/1/75

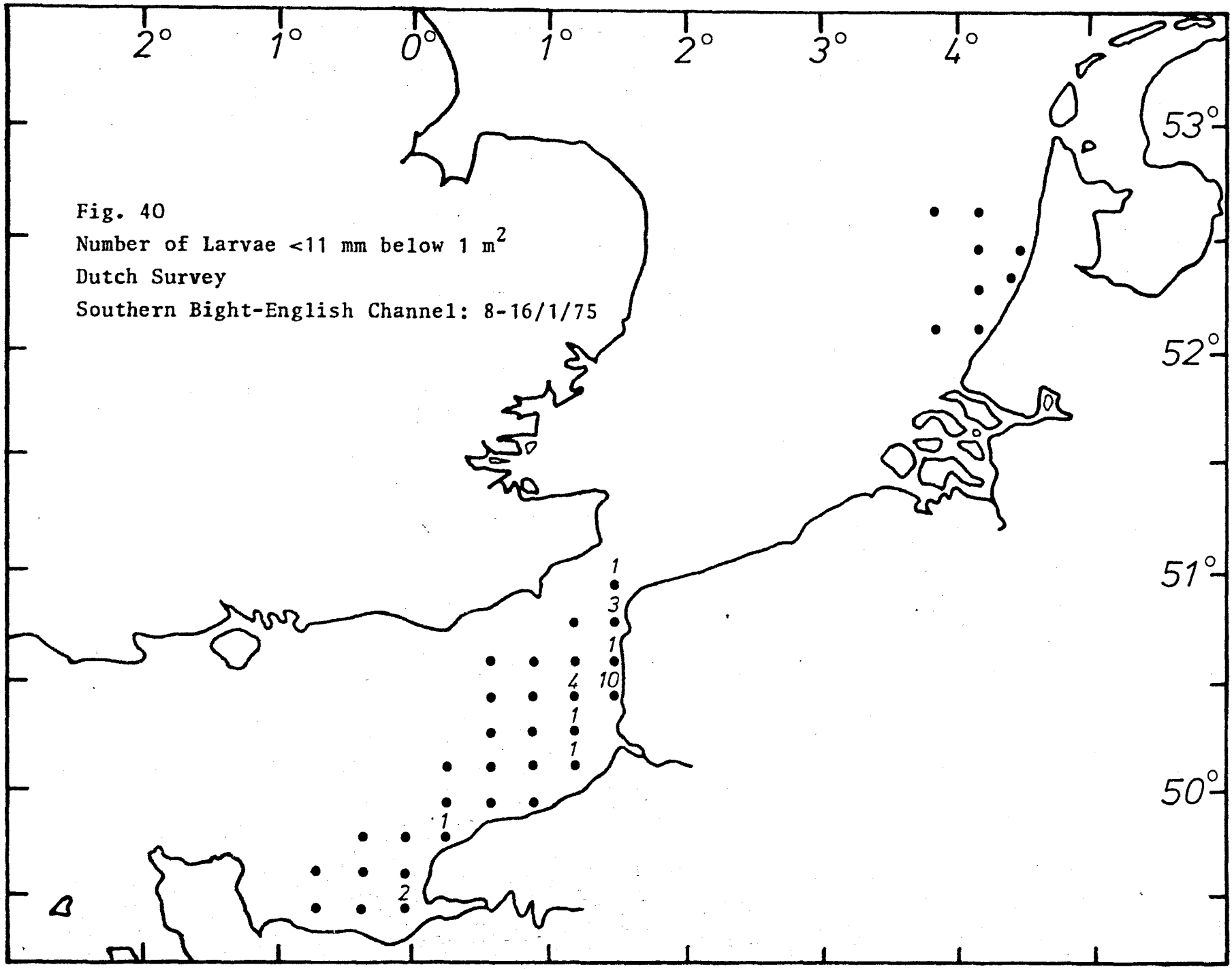


Fig. 40  
Number of Larvae <11 mm below 1 m<sup>2</sup>  
Dutch Survey  
Southern Bight-English Channel: 8-16/1/75



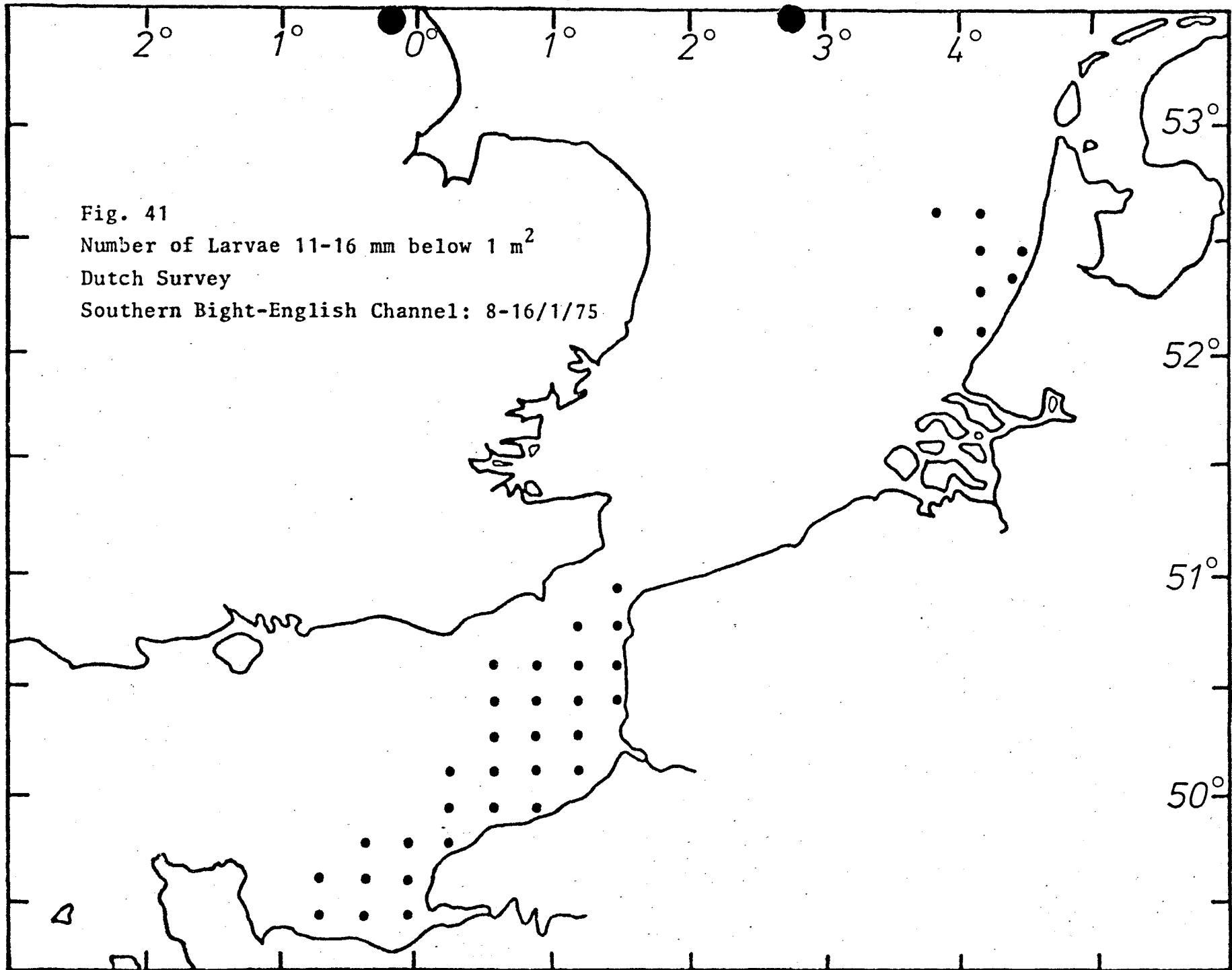


Fig. 41

Number of Larvae 11-16 mm below 1 m<sup>2</sup>

Dutch Survey

Southern Bight-English Channel: 8-16/1/75