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JAKOB MAGNÚSSON, JUTTA MAGNÚSSON
and INGVAR HALLGRÍMSSON:

THE "ÆGIR" REDFISH LARVAE EXPEDITION TO THE IRMINGER SEA IN MAY 1961

Cruise Report and Biological Observations

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THE UNIVERSITY RESEARCH INSTITUTE — DEPARTMENT OF FISHERIES

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CONTENTS

I. INTRODUCTION

In 1961, from late April to the beginning of June, a joint German-Icelandic redfish larvae research programme was carried out in the Central North Atlantic. The area investigated extended from 50° N to 67° N, including the Irminger Sea, the western boundary being 42° W. The eastern boundary was from southeast Iceland to position 60° N, 16° W, then to 50° N, 30° W.

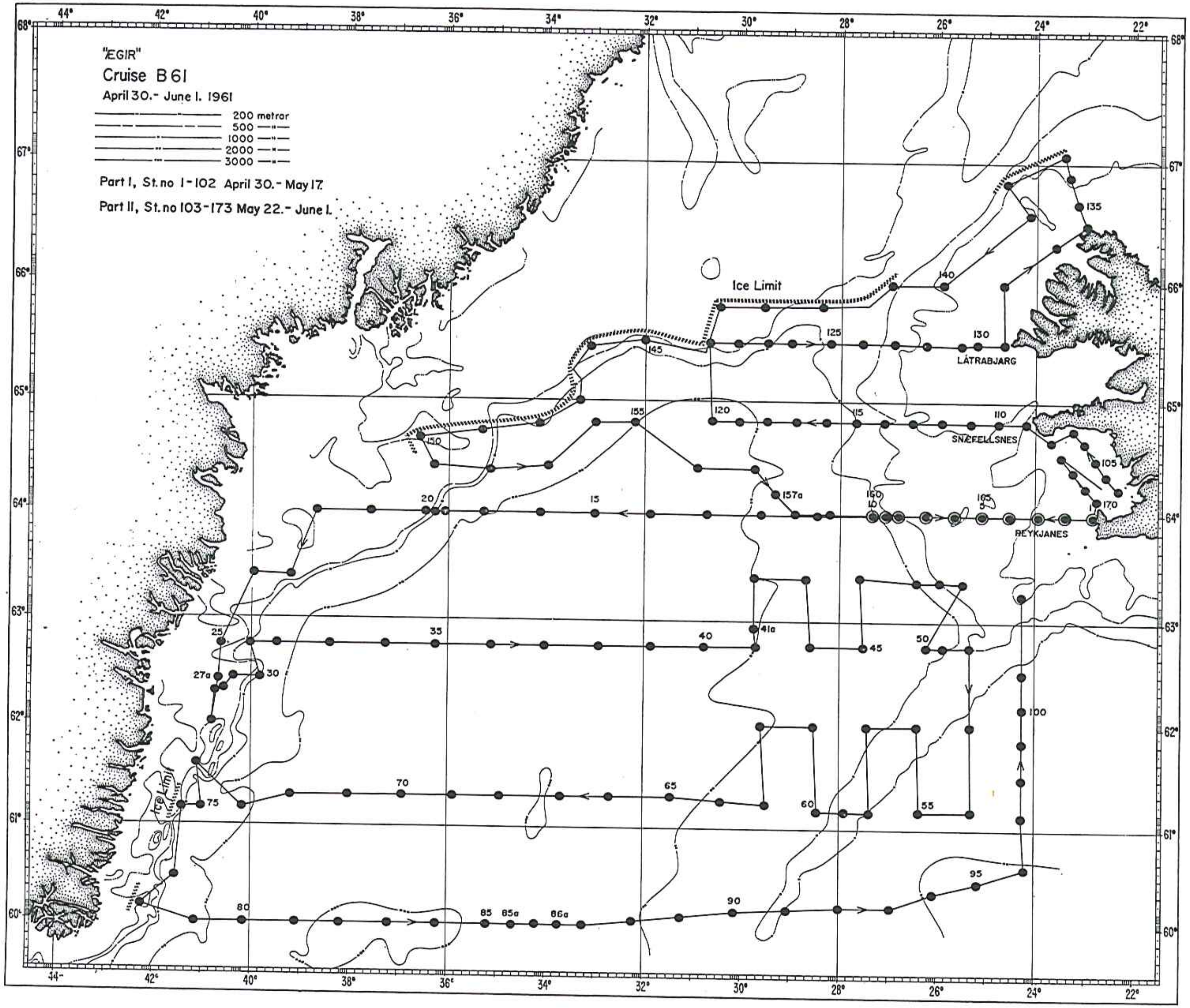
The southern and eastern part of this region was investigated by the German research vessel "Anton Dohrn". The German redfish larvae investigations have been discussed by KOTTHAUS (1961). The German and Icelandic hydrographical observations of this cruise have been discussed by DIETRICH and STEFÁNSSON (1963).

The northern part of the area investigated, from 60° N and 24° W, was covered by the Icelandic research vessel "Ægir". Because the hydrographic data from this cruise have already been published by STEFÁNSSON (1963) and discussed by DIETRICH and STEFÁNSSON (1963, see above), this paper will deal with the cruise report and the zooplankton material which will be discussed in four chapters:

Redfish larvae, by JAKOB MAGNÚSSON,
Other fish larvae, by JUTTA MAGNÚSSON,
Fish eggs, by JUTTA MAGNÚSSON,
Other zooplankton, by INGVAR HALLGRÍMSSON.

A preliminary review of the redfish larvae from this cruise has already been presented by MAGNÚSSON (1962) and of other fish larvae by Mrs. MAGNÚSSON (1962). Further, the relationship between the distribution of *Sebastes* larvae, zooplankton and temperature has been discussed by MAGNÚSSON and HALLGRÍMSSON (1964).

The authors are greatly indebted to the Icelandic Government for financial support for this cruise and to the Icelandic Coast Guard for placing a vessel at the Fishery Research Institute's disposal. Further, the authors wish to express their thanks to Miss SIGRÚN STURLAUGSDÓTTIR, Mr. SIGTRYGGUR GUÐMUNDSSON and Mr. GUÐMUNDUR SV. JÓNSSON for their help in working up the material. Last, but not least, the authors are indebted to Dr. G. T. D. HENDERSON, Oceanographic Laboratory, Edinburgh, for valuable suggestions, criticism and correction of the English text.


"ÆGIR"
Cruise B 61
April 30.- June 1. 1961
200 metrar
500
1000
2000
3000
Part I, St.no 1-102 April 30.- May 17.
Part II, St.no 103-173 May 22.- June 1.
Ice Limit
LÁTRABJARG
SNÆFELLSNES
REYKJANES

II. CRUISE REPORT

The Icelandic cruise was divided into two parts: Part I, from April 30th to May 17th, and part II, from May 22nd to June 1st.

Part I consisted of four main sections following different latitudes between 60°N and 64°N, with some additional stations in the Reykjanes Ridge area and on the East Greenland shelf. It started off Reykjanes in a westerly direction. For further route, see Fig. 1.

The stations in the open ocean were normally 30 miles apart, but over the Shelf and Slope areas this distance reduced to 15 miles or less.

106 stations were taken (102 according to plan, and four additional ones: 27A, 41A, 85A, 86A).

On part II, north of 64° N, 71 stations (Nos. 103—173) and one additional station (No. 157A) were taken. The first stations (only hydrographical ones) were taken in the Faxa Bay, the next ones on the sections off Snæfellsnes, Látrabjarg and Kögur (see also Fig. 1).

The positions of the stations taken on the East Greenland shelf depended to a great extent on the local ice conditions. Finally, a part of the Reykjanes section was worked up again. The distance between the stations was on the whole the same as during part I.

The weather conditions during part I of the survey were favourable on the whole. However, on some stations the heavy wind excluded the use of some of the gears. The ice conditions did not influence the programme on this part of the cruise. Off Prince Christian's Sund, a Faroe fishing vessel with machine damage needed help and was towed to Iceland. Therefore, the hydrographic work had to be limited to some extent on the southernmost section on the way back to Iceland.

During part II, the weather conditions were not as favourable as on part I and caused some delay. Therefore, on a number of stations the use of the gears was limited. As expected at this time of the year, the ice conditions influenced the programme considerably. The ice limit followed roughly the edge of the East Greenland continental slope.

During the whole survey, investigations were carried out on: Hydrography, phytoplankton, zooplankton and ichthyoplankton. Echo sounders were used for the detection of fish shoals and for recording the scattering layers. Further, an asdic was used for detection of fish shoals, especially herring. Also, some sets with the Isaacs-Kidd midwater trawl were made.

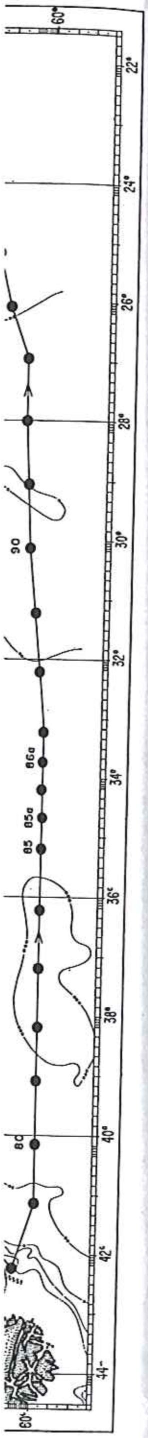


FIG. 1. *The route of the Icelandic redfish larvae cruise in the Irminger Sea in May 1961. Encircled stations on the Reykjanes section were worked twice, i.e. in the beginning of the cruise (sts. 1 to 10) and at the end of the cruise (sts. 160 to 169).*

III. GEAR AND METHODS

Hydrography: West of Iceland, in the Reykjanes Ridge area and at East Greenland, hydrographical serial observations were made. On the other stations, only the B.T. was used. The hydrographical serial observations were made in the following standard depths: 0 — 10 — 20 — 30 — 50 — 75 — 100 — 150 — 200 — 300 — 400 — 500 and, on some sections additionally, 600 — 800 and 1000 meters (see also STEFÁNSSON 1963). *Phytoplankton:* During the whole survey, transparency measurements were made by means of a Secchi-disc. West of Iceland, primary productivity studies were made with the C^{14} technique. Samples were taken at standard depths: 0 — 10 — 20 — 30 m. A temperature regulated incubator with artificial light was used. Samples of phytoplankton for taxonomic and quantitative studies were collected at the same depths. *Zooplankton:* Both vertical and horizontal zooplankton samples were taken at the stations whenever possible. The Helgoland larvae net was hauled from 50—0 meters, and for horizontal sampling Icelandic High Speed Samplers (IHSS) were towed on the same wire at the following depths: 3, 15 to 18 and 25 to 30 meters. The towing speed was 8 knots and the distance towed 1.5 n.m., which gives a filtration of about 20 m^3 for each sampler. The zooplankton was measured by the wet displacement method and fixed in 4% formaldehyde. The redfish larvae were as far as possible sorted out of the samples and directly counted, and the zooplankton samples were also worked up at sea by a short-cut method described by HALLGRÍMSSON (1958). Other fish larvae were sorted out of the samples, counted and measured in the laboratory.

The *echo sounder* for the detection of scattering layers and fish shoals was of the usual SIMRAD type (model 510/3). The 200 m depth-range scale was used. The asdic — a Kelvin Hughes 2000 yards range — was fixed at an angle of 45° to one side of the ship and kept in this position during most of the time. On part II of the cruise 4 sets were made with the Isaacs-Kidd midwater trawl in different depths, each haul was of 30 to 60 minutes duration at a speed of 4 to 4.5 knots.

IV. RESULTS

1. Redfish Larvae.

The number of redfish larvae collected and measured on this cruise is given in the following table: *)

As a whole, the redfish larvae caught were in good condition. However, the larvae caught with the Helgoland larvae net were generally in better

*) The term "redfish larvae" means *Sebastes* larvae, except *S. viviparus.*

TABLE I
Number of redfish larvae
(Given by Gear and Cruise Parts)
Cruise B61, May 1961

Gear	Part I *No. of larvae*	%	Part II *No. of larvae*	%	Total *No. of larvae*	%
Helgoland Larvae Net	2337	41.7	328	14.0	2665	33.5
I.H.S.S. I	587	10.5	332	14.2	919	11.6
I.H.S.S. II	1766	31.5	1127	48.1	2893	36.4
I.H.S.S. III	914	16.3	556	23.7	1470	18.5
Total	5604	100.0	2343	100.0	7947	100.0

condition than those caught with the IHSS, which seemed sometimes to cause damage, especially to larvae of small size.

A. *Distribution and Abundance.*

Redfish larvae were found in most of the oceanic region of the area surveyed. There was a great difference in the abundance between the oceanic and shelf area as well as within the oceanic area itself. For this study, the area surveyed has been divided into different regions (see Fig. 6). The main divisions are these described by EINARSSON (1960) but his regions A and B have been subdivided into smaller areas for the purpose of separating the East Greenland shelf from the oceanic region. Thus, the investigated area is arranged as follows:

Shelf areas: A B C D (Greenland)
N W S (Iceland)
Oceanic areas: E F G H I

The abundance of redfish larvae according to this division is given in Table II.

As expected, the number of positive stations and larvae caught in the coastal area was considerably lower than in the oceanic area. All stations in the oceanic area were positive with exception of area E where 6 of 30 stations were negative, i.e., 20% of the total number of stations in this area.

The number of stations taken in the coastal region varied greatly, e.g., in area C only 2 stations both positive were taken. On the other hand, area W was fairly well covered by stations (32), but only 10 stations were positive. The difference between the shelf and oceanic regions was even more pronounced in the number of larvae caught. The average number of larvae per positive station in the shelf areas ranged from 1.0 (area N) up to 17.0 (area D), with an average of 8.1 for all shelf areas. In the oceanic areas

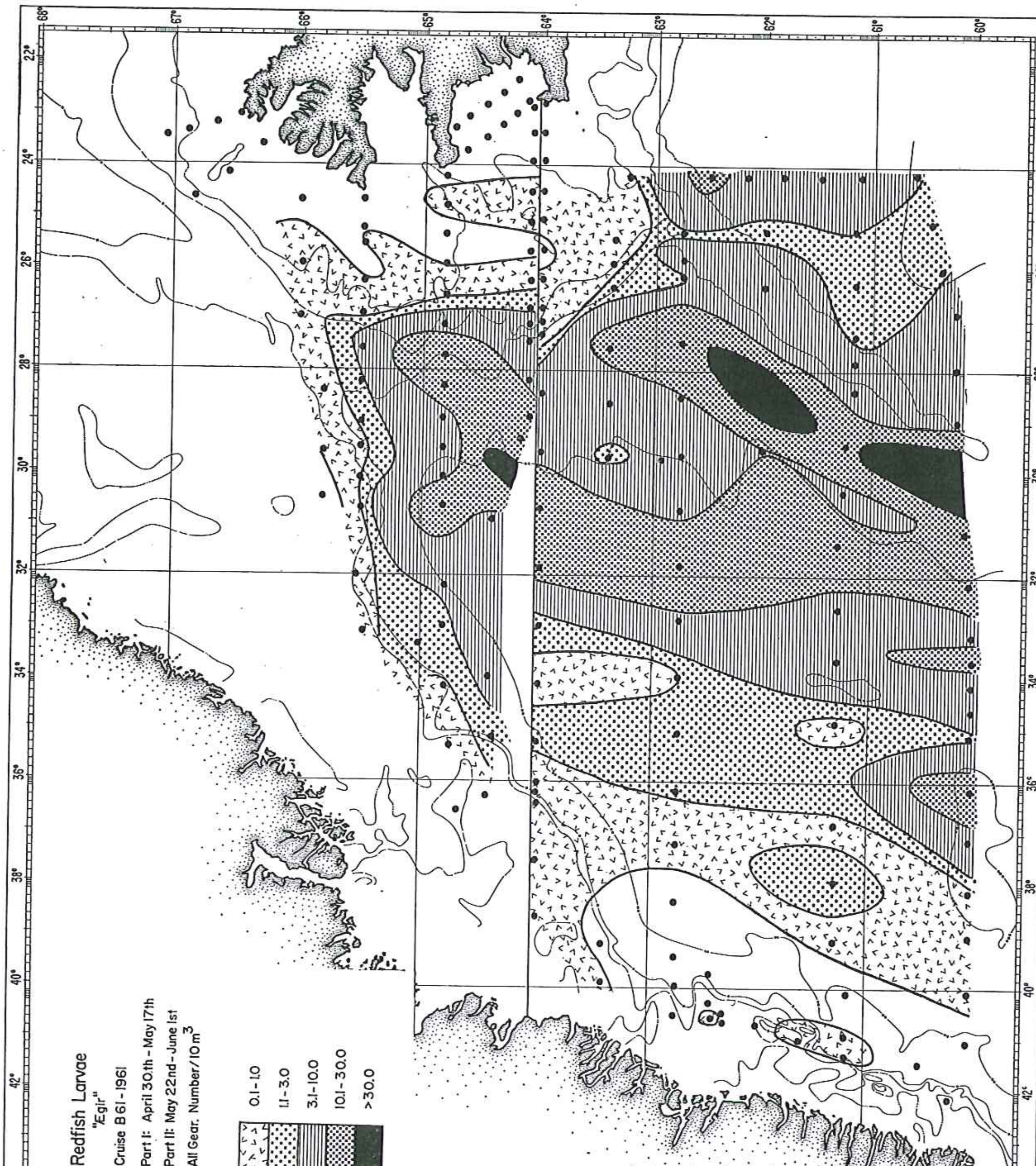

Redfish Larvae
"Ægir"
Cruise B 61 - 1961
Part I: April 30th - May 17th
Part II: May 22nd - June 1st
All Gear. Number/10 m³
0.1-1.0
1.1-3.0
3.1-10.0
10.1-30.0
>30.0

TABLE II
Abundance of redfish larvae according to areas
Cruise B61, May 1961

Area		*Stations* No. of Stat.	*Stations* No. of Pos. Stat.	*Redfish Larvae* No. of Larvae	*Redfish Larvae* Av. No. per Station	Av. No. per Pos. Station
Coastal:						
A) Iceland	S	12	7	41	3.4	5.9
	W	26	12	55	2.1	4.6
	N	6	1	1	+	+
	A) Total	44	20	97	2.2	5.1
B) Greenland	A	12	4	5	0.4	1.3
	B	8	5	16	2.0	3.2
	C	2	2	7	3.5	3.5
	D	9	8	136	15.1	17.0
	B) Total	31	19	164	5.3	8.6
	Total	*75*	*39*	*261*	*3.5*	*6.8*
Oceanic:						
	E	28	23	1072	38.3	46.6
	F	11	11	249	22.6	22.6
	G	19	19	2535	133.4	133.4
	H	23	23	2796	121.6	121.6
	I	16	16	1035	64.7	64.7
	Total	97	92	7687	79.3	83.6
Coastal and Oceanic	Total	172	131	7948	46.2	61.1

the average number of larvae per positive station ranged from 22.6 in area F up to 132.1 in area G, with an average of 81.6 for the whole oceanic area.

As mentioned before, there was also a difference in the abundance of redfish larvae within the oceanic area. The number of larvae caught was much greater in the eastern part of the oceanic region (i.e., area I, G, H) than in the western part (E, F). This is shown more clearly in Fig. 2 which illustrates the distribution and relative abundance of redfish larvae.

This figure is based on the relative number of larvae per 10 m^3 (all gear included), the density shown by graduated shading. The figure shows that the larvae were most abundant in the eastern part of the area surveyed, and in this part negative stations were only found to be on the Icelandic shelf. The main concentrations were found west of the Reykjanes Ridge as pre-

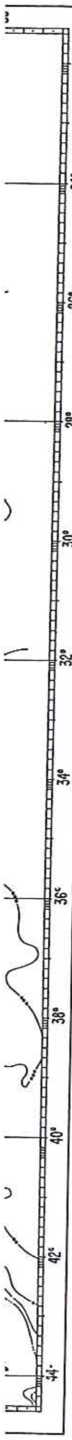
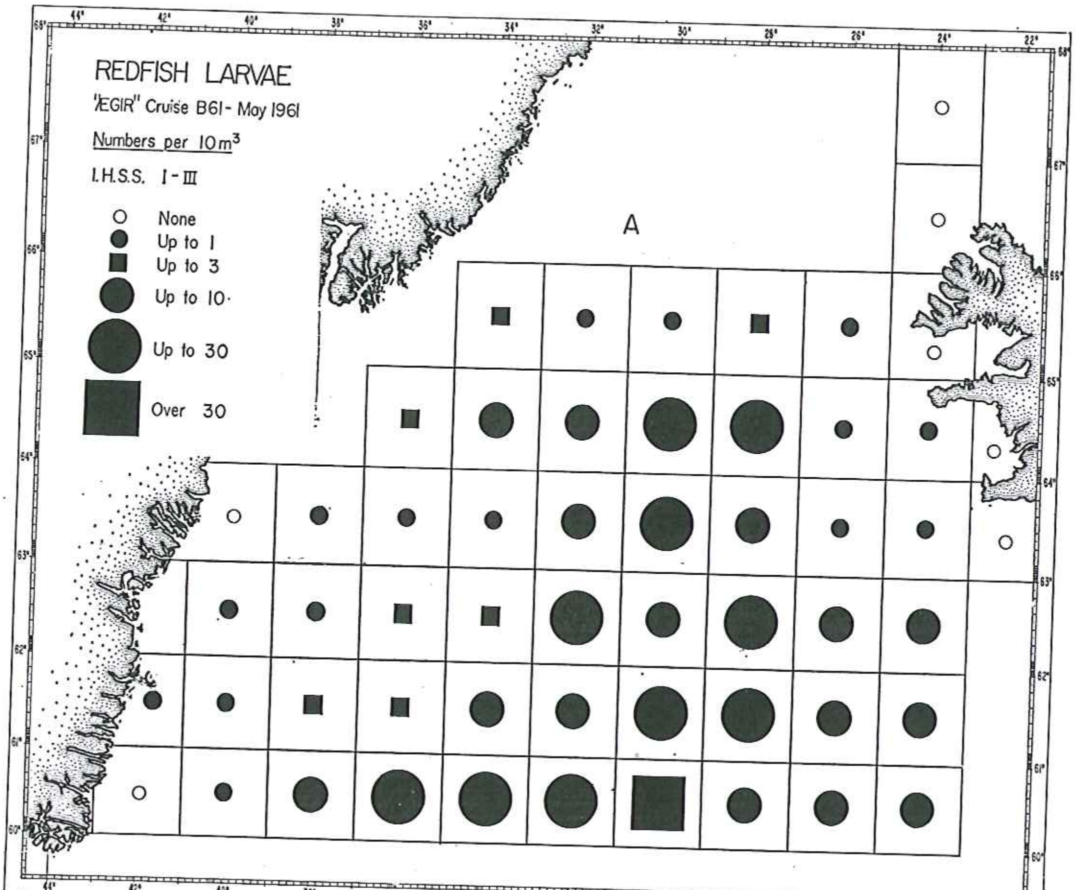
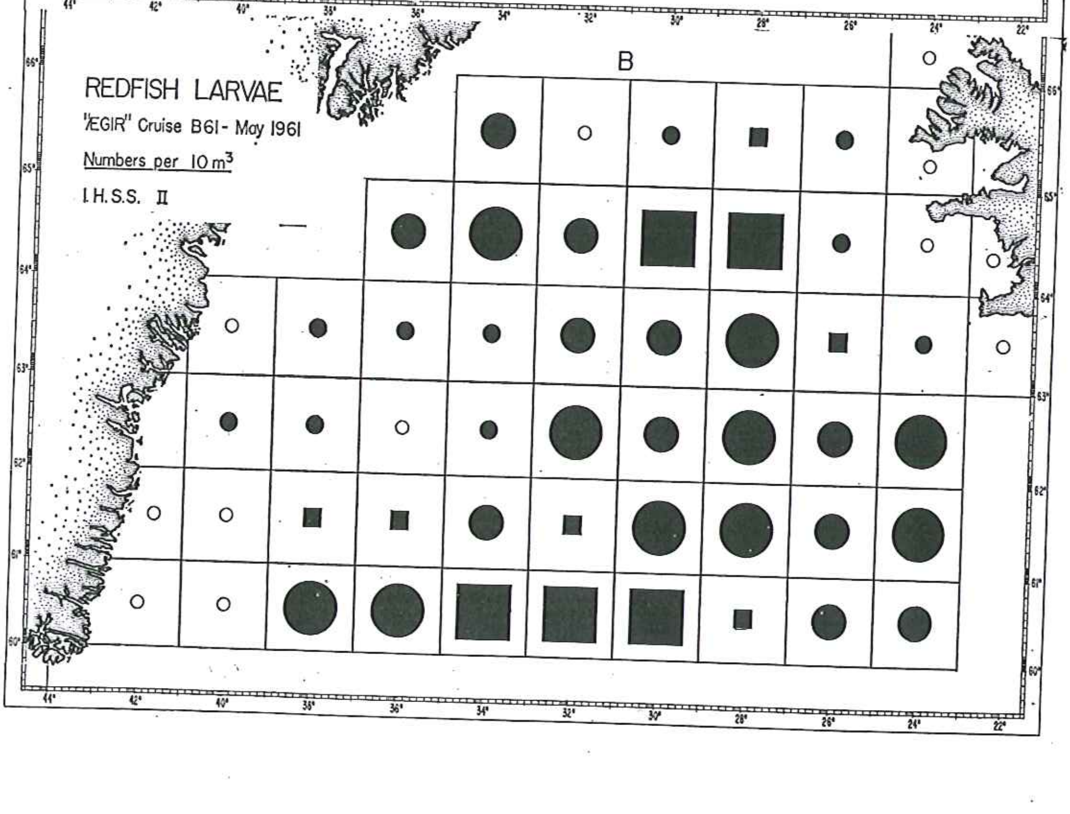


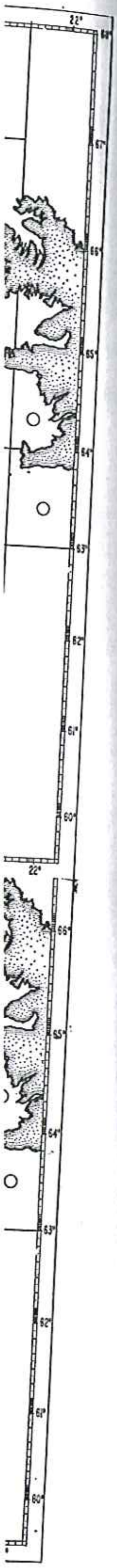
FIG. 2. *Distribution and relative abundance of redfish larvae. B61, May 1961.*



REDFISH LARVAE
"ÆGIR" Cruise B61 - May 1961
Numbers per 10 m³
I.H.S.S. I - III
None
Up to 1
Up to 3
Up to 10
Up to 30
Over 30
A



REDFISH LARVAE
"ÆGIR" Cruise B61 - May 1961
Numbers per 10 m³
I.H.S.S. II
B

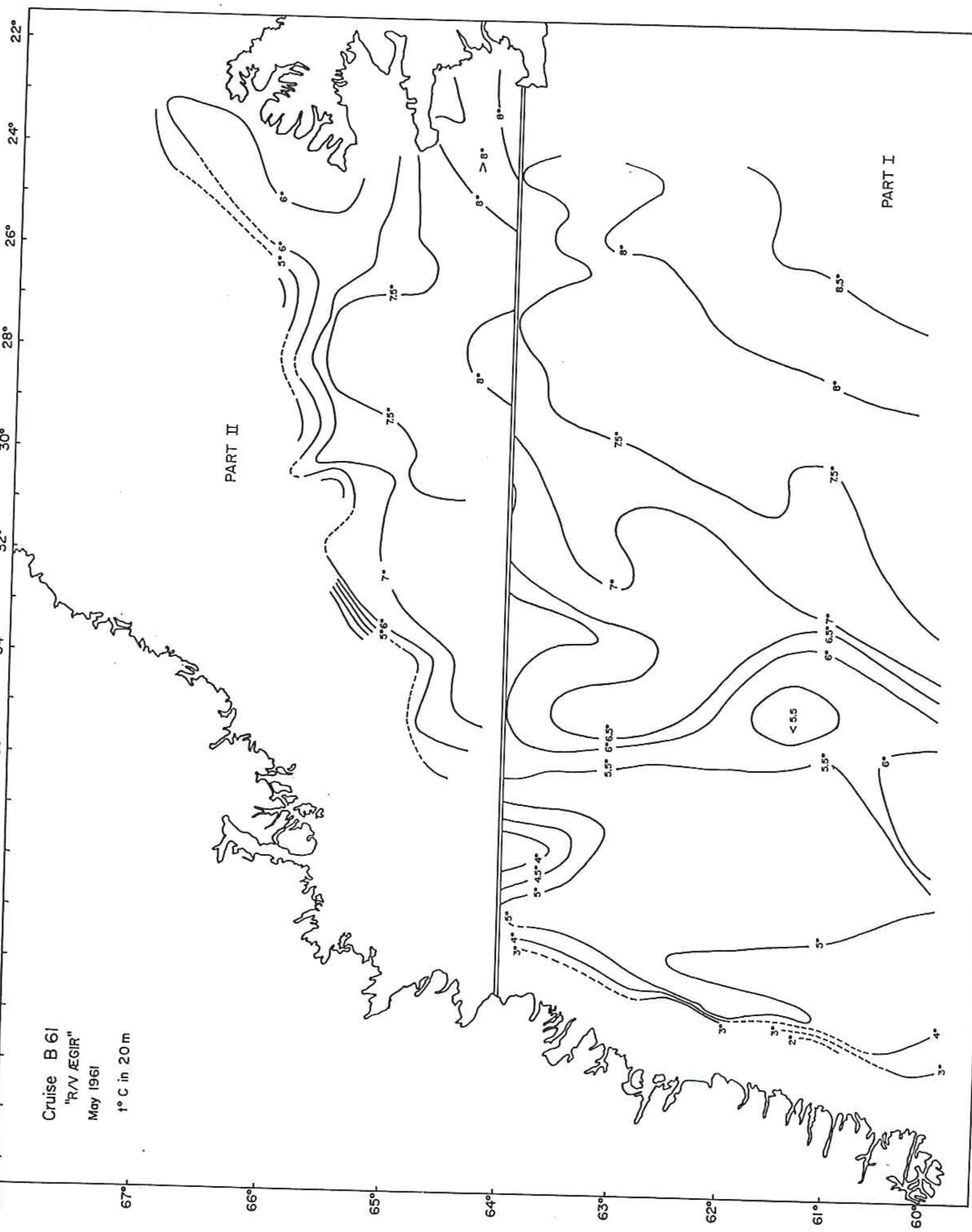


viously indicated by HENDERSON (1962) and also found in 1962 by RAITT (RAITT 1964) and by our own observations in that year. DIETRICH, AURICH and KOTTHAUS (1961) obtained in May–June 1955 the highest frequency of redfish larvae in the area of the Reykjanes Ridge. These concentrations appeared in two distinct zones, one running along the western slope of the ridge between the 1000 and 2000 m contours, the other mainly outside the 2000 m contour. It is worth noticing that these concentrations seemed to have penetrated further north during May, since they were also observed in part II of the cruise (Fig. 2). Further, on both sides of the main concentrations tongues of high larval density penetrated northwards and westwards into the area observed. This is also in accordance with simultaneous German observations carried out farther south and east (KOTTHAUS 1961). Since HENDERSON has been working on redfish larvae from the continuous plankton recorders for several years and has expressed the results as the mean numbers per 10 m^3 in statistical rectangles, it was thought to be useful to present our material in the same way for the purpose of comparison. In our calculations only the material of the IHSS was used as this gear is also a horizontally operating sampler. As the continuous plankton recorder is towed in 10 m depth but the IHSS are towed in three levels (ca. 3, 15 to 18, 25 to 30 m) simultaneously, our calculations are based on the mean number of the catches of the 3 IHSS together. In Fig. 3, the IHSS material from this cruise is presented by this method: A) for the 3 samplers together, B) for one sampler only in the depth of 15 to 18 m. A comparison of these figures and the result of HENDERSON's material from the same month and year in this area (HENDERSON 1962) shows a good agreement. Therefore, the results based upon material from continuous plankton recorders and the IHSS are well comparable. Thus, our observations strongly support HENDERSON's conclusion that in 1961 "the numbers caught in the Irminger Sea area in May were generally higher than had been noted previously" (HENDERSON 1962). This can also be confirmed for the region north of the area covered by the continuous plankton recorders as our results seem to give a higher abundance of redfish larvae in this region than had been observed before (according to text Fig. 6, p. 183, HENDERSON 1961).

B. *Relation to Temperature.*

Since the hydrographic data have already been published, we will only present the temperature distribution at 20 m (Fig. 4) for discussion of the temperature and redfish larvae relationship.

FIG. 3. *Redfish larvae distribution, arranged in statistical rectangles as by* HENDERSON. *B61, May 1961.*
A) Number/10 m^3 *in IHSS I to III*
B) Number/10 m^3 *in IHSS II*


Cruise B 61
"R/V ÆGIR"
May 1961
t° C in 20 m
PART I
PART II

As to the tongue of warm water running along the Icelandic shelf, the 8° C isotherm runs approximately along the western side of the Reykjanes Ridge up to 63° N during part I, but during part II, this same isotherm extends as far north as 64°30′ N. The 7.5° C isotherm had likewise moved from 64° N to 65°30′ N during the interval between parts I and II. At 65°30′ N, this warm water tongue splits into two branches, one running north-eastwards, the other westwards. During part II, warm water of more than 6° C was thus found from 23° to 36° W. North of the 6° C isotherm the temperature decreases very rapidly.

The comparison between the larval abundance (Fig. 2) and the temperature at 20 m (Fig. 4) shows that the main concentrations of larvae were generally found in water of 7° to 8° C. However, larvae were also abundant in waters of higher and lower temperatures, but no great quantities were found below 6° C. Only very few larvae were collected when the temperature was less than 5.5° C. But they were abundant at 9° C which was the highest temperature recorded in 20 m depth during the cruise (east of Reykjanes Ridge). This corresponds fairly well with HENDERSON's comparison of abundance of redfish larvae and the surface temperature (HENDERSON 1964).

Closer comparison of the two figures indicates clearly the connection between larval abundance and certain isotherms. Thus, the highest density was found between 7.5 and 8° C west of the Reykjanes Ridge in part I of the cruise. This high density was observed farther north a couple of weeks later (in part II of the cruise) within the same temperature limits. Further, the above mentioned division of the warm water west of Iceland effects the larval density zone since this also splits at approximately 65° N. The penetration of warm and cold water tongues highly effects the density of larvae. Thus, in the cold water tongue at 64° N, 34° W and the cold water core at 61° N, 35° W, larval minima were found. Contrarily, a larval maximum was observed in the inflowing warm water at 60° N, 36° W.

C. *Relation to Depth and Day Time.*

The use of 3 high speed samplers at different depths simultaneously made it possible to study the vertical abundance to some extent. Fig. 5 shows the abundance of redfish larvae for each gear separately. A comparison of the 3 IHSS shows that redfish larvae were most abundant in the hauls of sampler II, that means a depth of 15 to 18 meters. It is somewhat less abundant in the level of sampler III (25 to 30 m), but most scarce in sampler I (about 3 m). KELLY and BARKER (1961) found the greatest abundance of young redfish in the Gulf of Maine in July–August in 20 m (1957) and 10 to 30 m (1958) depths, which corresponds to our findings in the Irminger Sea in May 1961.

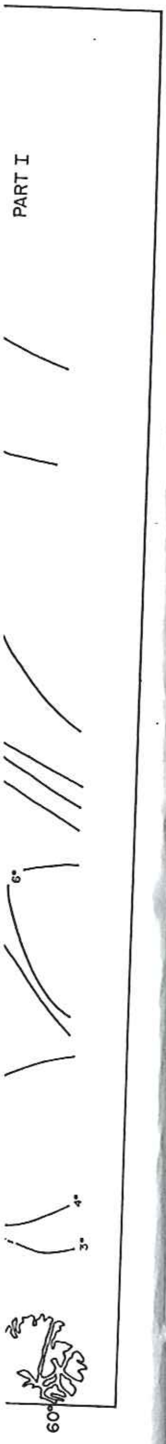


FIG. 4. *Temperature distribution at 20 m depth. B61, May 1961.*

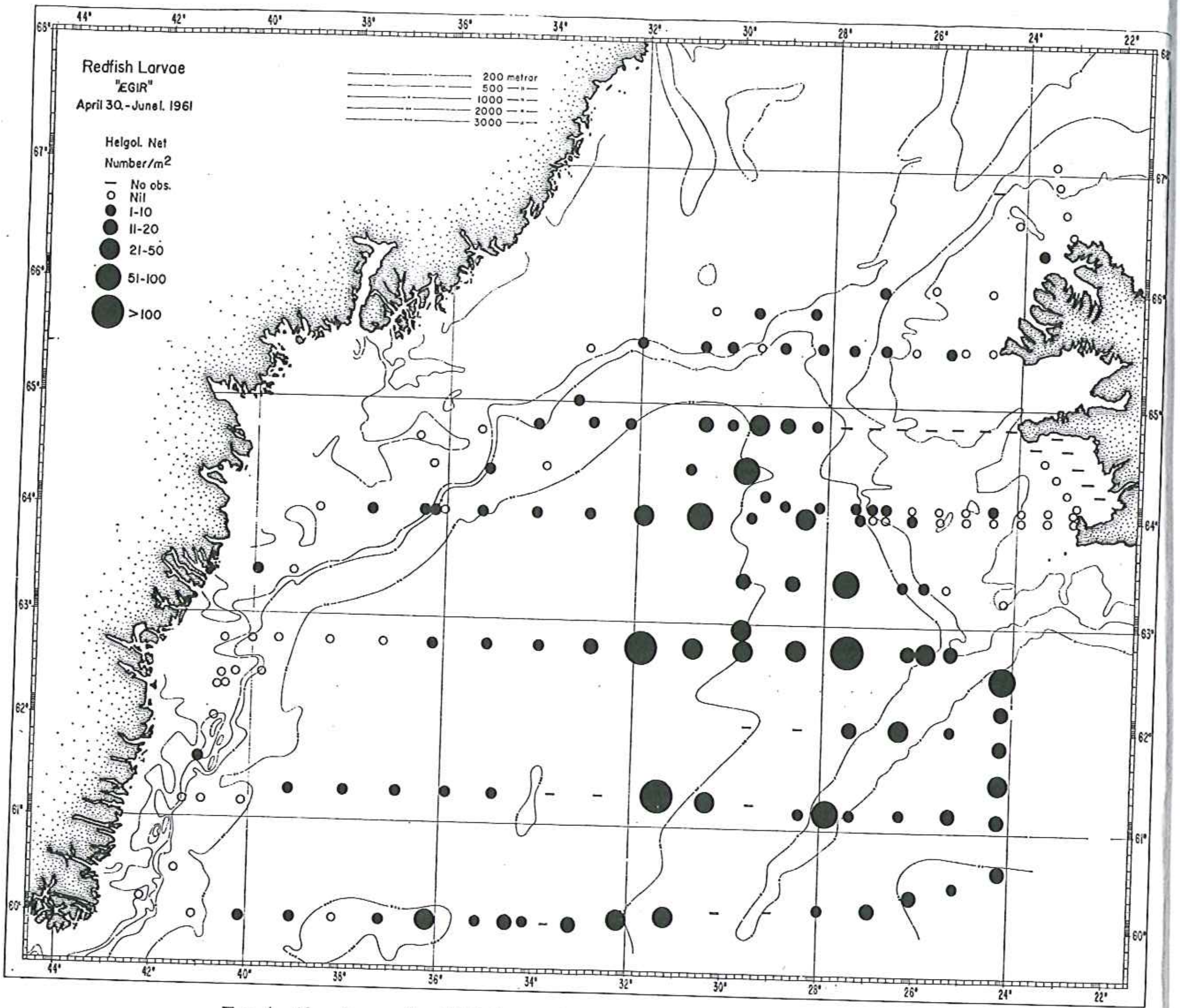


FIG. 5. *Abundance of redfish larvae for each gear separately. B 61, May 1961. A. Helgoland Net, number per m².*

During the cruise, it often was observed by means of the samplers and echograms that redfish larvae can occur in great densities within a thin layer, e.g., on station 88 where we got following number of specimens: IHSS I: 0, IHSS II: 131, IHSS III: 14.

When studying the night–day variations it should be mentioned that in this region the difference in light intensity between day and night is not very pronounced at this time of the year. The samples were divided into:

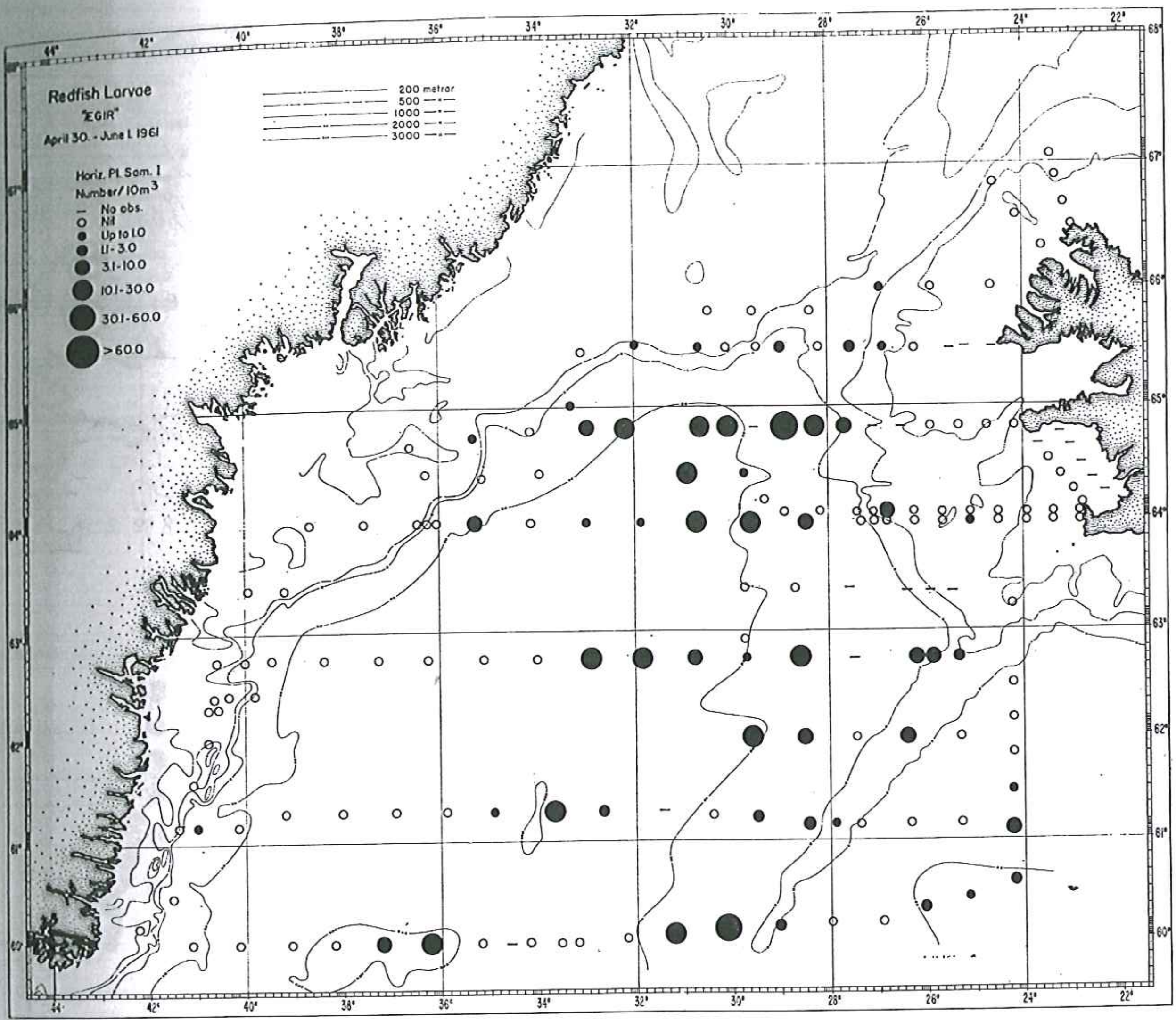


Fig. 5. *B. IHSS I, number per 10 m³.*

Day catches from 0600 h to 2200 h, and night catches from 2201 h to 0559 h. According to this division, the number of night stations is only about one third of the total number of stations.

In Table III the night and day catches of redfish larvae are given for the three sampling levels.

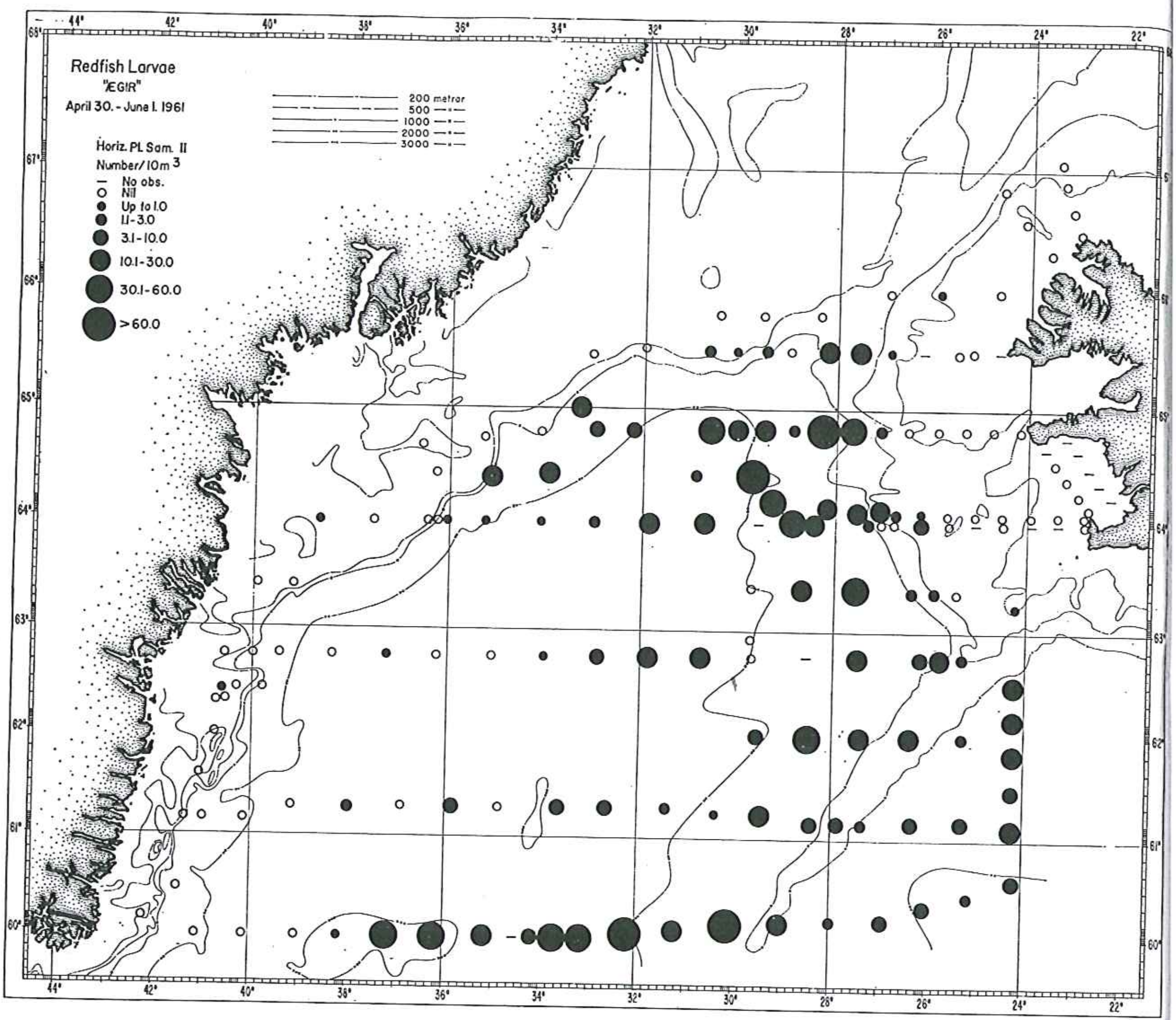


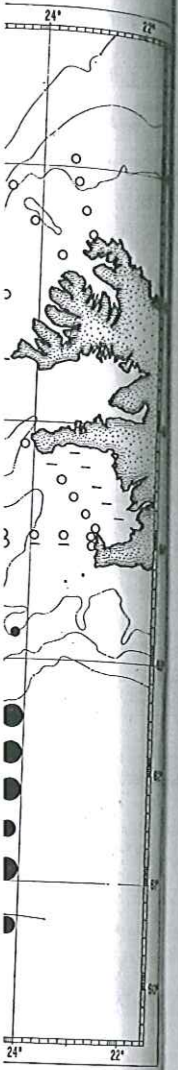
FIG. 5. *C. IHSS II, number per 10 m³.*

TABLE III

Redfish larvae. Night–day catches for the 3 sampling levels.

B 61, May 1961

Level	*Mean Number per 10 m³* Day	Night	*Night/Day Ratio*
I	5.9	11.0	1.86
II	15.6	15.9	1.02
III	8.0	5.4	0.68
Mean	6.9	8.6	1.25



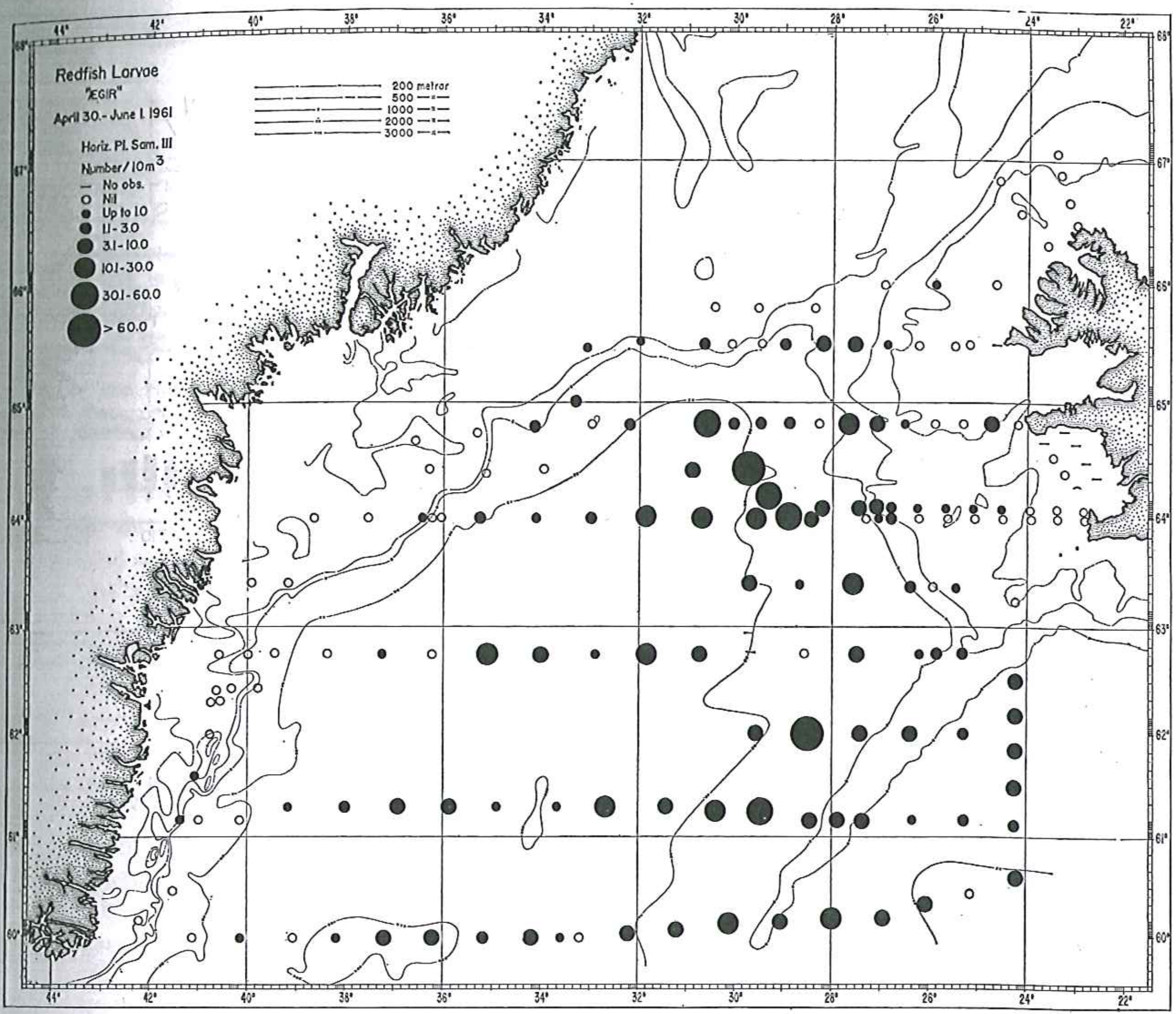


FIG. 5 D. *IHSS III, number per 10 m*^{3}.

On the whole, the night catches were somewhat higher than the day catches which is in accordance with the findings of HANSEN and ANDERSEN (1961) and KELLY & BARKER (1961) for young redfish in the Gulf of Maine. Further, level II gave the highest yields both during day and night with approximately the same values. The second highest yields for night were obtained in level I, but for day in level III. It should be noted that during day time level I was relatively seldom positive for redfish larvae. Thus, the night–day ratio was greatest for level I. For discussion of these results in relation with zooplankton volume, see chapter V.

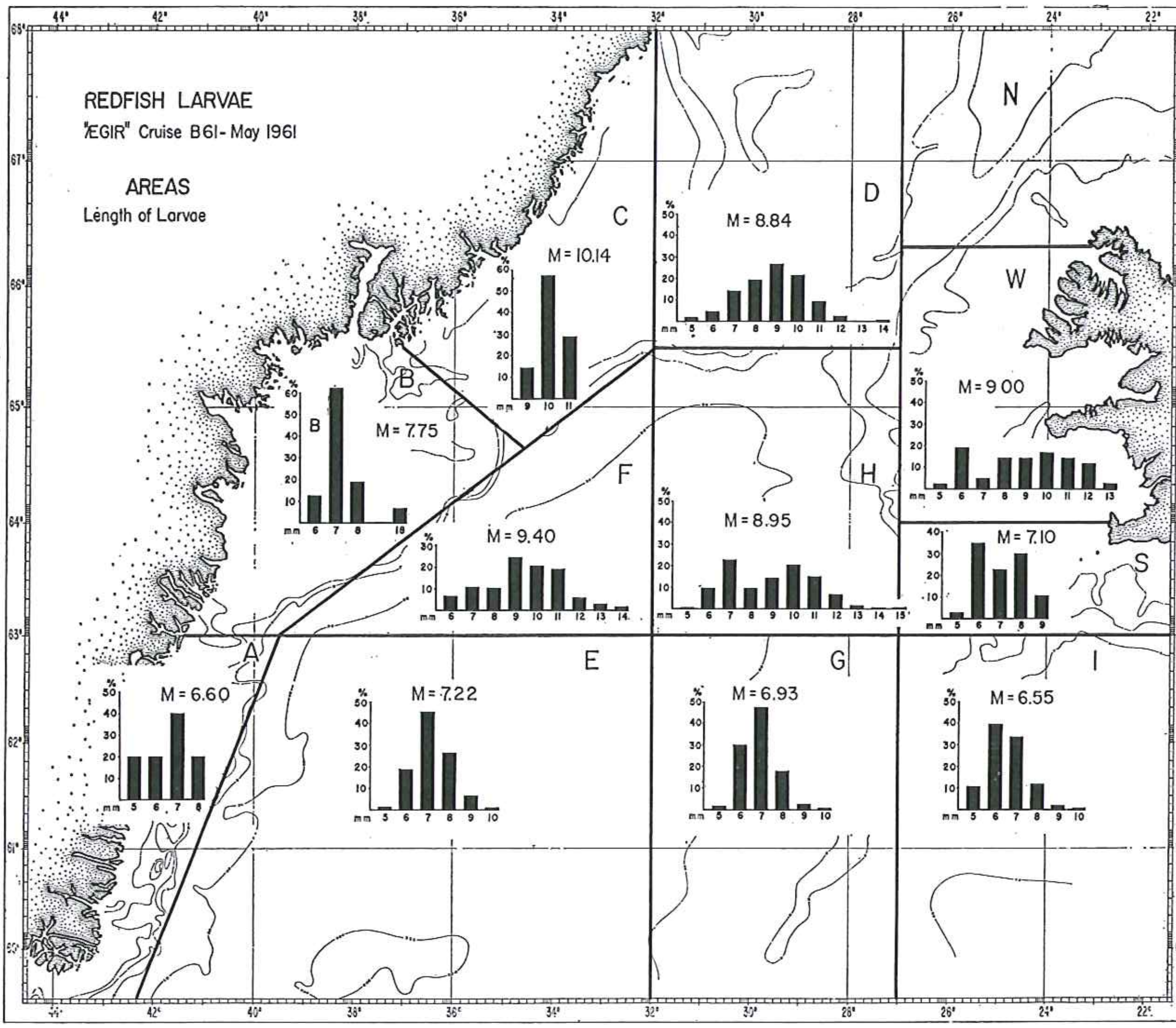


FIG. 6. *Length distribution and mean length of redfish larvae for different geographical areas. B61, May 1961.*

D. *Length Distribution.*

As expected at this time of the year, most of the redfish larvae were of a small size, the range being from 5 to 10 mm in part I with a mean length of 6.89 mm. In part II of the cruise the range was somewhat greater, i.e., from 5 to 15 mm. Only one larva was of 18 mm size. The mean length on part II was 9.88 mm (see also Table IV).

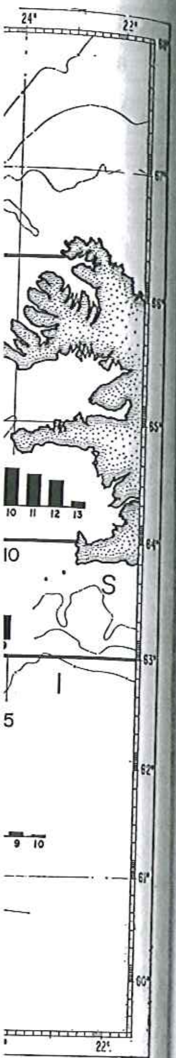


Table IV
Length distribution of redfish larvae.
Number and percentages
B 61, May 1961

mm		*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*18*	*Total*	*Mean (mm)*
Part	No.	129	1243	1894	707	119	28							4120	6.89
I	%	3.13	30.17	45.97	17.16	2.89	0.68							100.0	
Part	No.	4	19	71	166	368	467	352	148	38	7	4	1	1645	9.88
II	%	0.24	1.16	4.32	10.09	22.37	28.39	21.40	8.99	2.31	0.43	0.24	0.06	100.0	
Total	No.	133	1262	1965	873	487	495	352	148	38	7	4	1	5765	7.74
	%	2.31	21.89	34.08	15.14	8.45	8.59	6.10	2.57	0.66	0.12	0.07	0.02	100.0	

The length distribution for each geographical area and the mean length is shown in Table V and Fig. 6.*) Further, the mean length for the shelf and oceanic areas has been calculated. In the Icelandic shelf area (S and W), the mean length was 8.07 mm, in the Greenland shelf area (A to D) 8.72 mm, but for the oceanic areas (E to I) the mean length was 7.72 mm. From Table V and Fig. 6 we see that the majority of the larvae caught in the southernmost section of the area surveyed are newly extruded. But in the areas north of 63° N, the difference of time is clearly reflected in the size distribution. Therefore it was thought desirable to study the distribution and abundance of small redfish larvae separately for the purpose of localizing the extrusion regions for redfish. All larvae of 7 mm size and smaller are supposed to be just extruded. This size limit is based upon measurements of intraovarial larvae from several specimens where the size range was found to be from 5.2 to 7 mm. The development of the intraovarial larvae was of the same stage within each specimen, but differed from one specimen to another. The most developed larvae, which seemed to be just before extrusion, were of 6 to 7 mm size.

In part I of the cruise, almost 80% of the larvae were within this size range, but in part II of the cruise the size composition was reversed since only 5.3% of the larvae caught were of 7 mm and smaller (see also Table IV).

In Fig. 7, which shows the distribution and abundance of small larvae, we see that newly extruded larvae were found in almost the whole oceanic area surveyed. As to the survey area of part I, there is a good correspondance between the general abundance of redfish larvae on the whole and that of the small larvae. This could also be expected since they were 80% of the total number of larvae caught in part I. This correlation could not be established for part II. However, the quantity of small larvae at certain

*) a single larva caught in area N omitted.

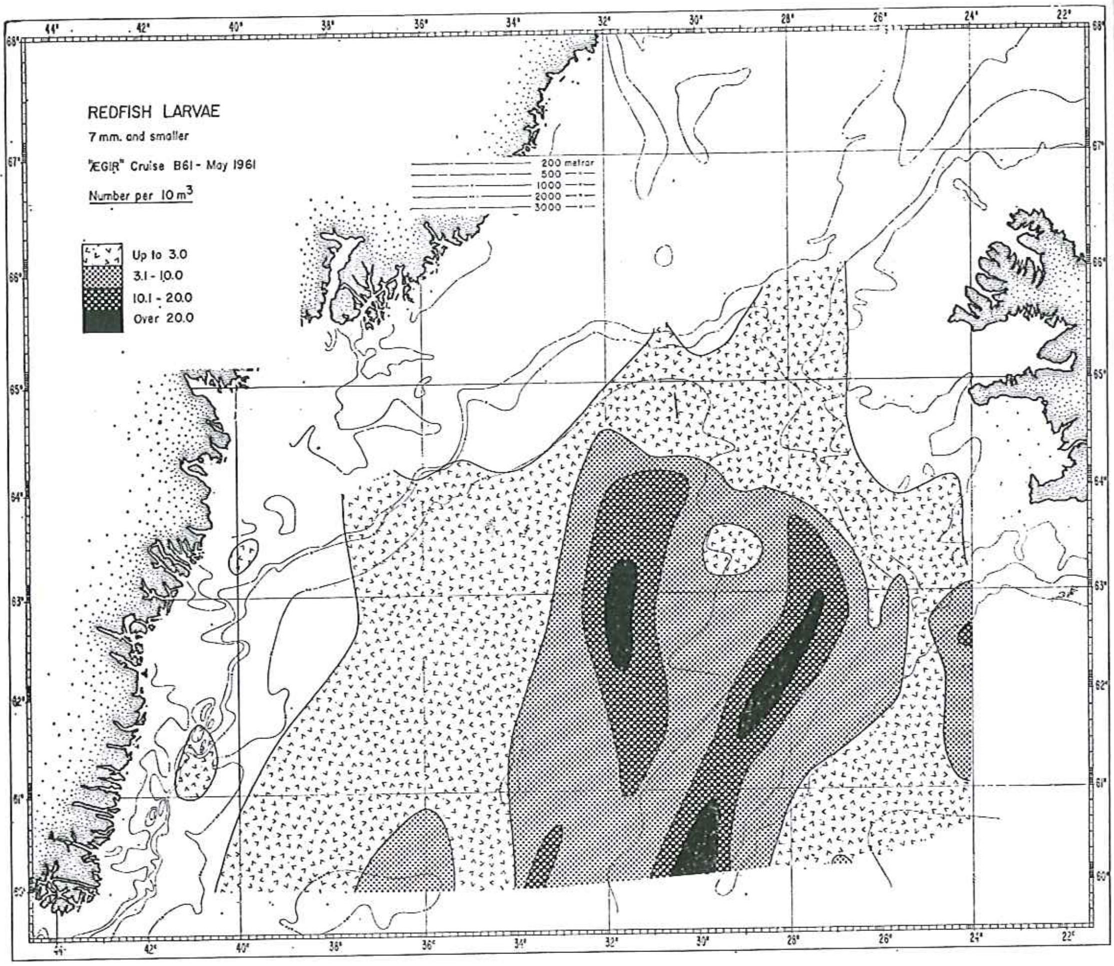


FIG. 7. *Distribution and abundance of small redfish larvae. B61, May 1961.*

stations in the eastern part of this northerly region indicated that an extrusion of redfish larvae was still going on at this time.

According to TÅNING (1949), the breeding places of redfish extend over the entire oceanic area of the Irminger Sea. Our observations show also that extrusion was taking place in almost the entire oceanic region of it and was not limited to definite areas. However, there were distinct areas of outstanding intensive extrusion. These areas were found to be south of 64° N and east of 34° W (see also Fig. 7). In the area west of 34° W (at 36° W, 60° N) we found a patch of newly hatched larvae coinciding with a branch of warm water of above 6° C (see also Fig. 7). A comparison of temperature in 20 m (Fig. 4) and the abundance of small larvae (Fig. 7) shows that

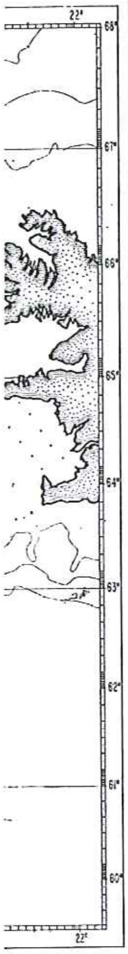


Table V

Length of redfish larvae in geographical areas

B 61, May 1961

A) *Shelf Areas*

Areas / *Length mm*	*Greenland* A No.	%	B No.	%	C No.	%	D No.	%	*Total* No.	%	*Iceland* S No.	%	W No.	%	*Total* No.	%	*Grand Total* No.	%
5	1	20.0					2	1.6	3	1.9	1	2.5	1	2.4	2	2.4	5	2.1
6	1	20.0	2	12.5			6	4.6	9	5.8	14	35.0	8	19.0	22	26.8	31	12.9
7	2	40.0	10	62.5			18	13.9	30	19.0	9	22.5	2	4.8	11	13.4	41	17.1
8	1	20.0	3	18.8			25	19.2	29	18.3	12	30.0	6	14.3	18	22.1	47	19.6
9					1	14.3	35	26.9	36	22.8	4	10.0	6	14.3	10	12.2	46	19.2
10					4	57.1	28	21.5	32	20.2			7	16.6	7	8.5	39	16.3
11					2	28.6	12	9.2	14	8.9			6	14.3	6	7.3	20	8.3
12							3	2.3	3	1.9			5	11.9	5	6.1	8	3.3
13													1	2.4	1	1.2	1	0.4
14							1	0.8	1	0.6							1	0.4
18			1	6.2					1	0.6							1	0.4
Total ...	5	100.0	16	100.0	7	100.0	130	100.0	158	100.0	40	100.0	42	100.0	82	100.0	240	100.0
ML	6.60		7.75		10.14		8.84		8.72		7.10		9.00		8.07		8.50	

B) *Oceanic Areas*

Areas / *mm*	I No.	%	G No.	%	E No.	%	H No.	%	F No.	%	*Total* No.	%
5	92	10.1	23	1.4	11	1.3	2	0.1			128	2.3
6	385	42.2	483	30.1	166	18.9	181	9.6	16	6.6	1231	22.3
7	307	33.6	760	47.4	399	45.5	432	22.9	26	10.7	1924	34.8
8	105	11.5	288	18.0	233	26.6	175	9.3	25	10.2	826	14.9
9	16	1.8	39	2.4	59	6.7	268	14.2	59	24.2	441	8.0
10	8	0.8	11	0.7	9	1.0	379	20.1	49	20.1	456	8.3
11							285	15.1	46	18.8	331	6.0
12							126	6.7	14	5.7	140	2.5
13							31	1.6	6	2.5	37	0.7
14							3	0.2	3	1.2	6	0.1
15							4	0.2			4	0.1
Total	913	100.0	1604	100.0	877	100.0	1886	100.0	244	100.0	5524	100.0
ML	6.55		6.92		7.22		8.97		9.40		7.72	

the main area of extrusion was found in temperatures between 6.5° and 9° C. Considering the depth contours in the Figures 2 and 7, we see that the main extrusion areas lie outside the 1000 m contour (see also EINARSSON 1960), except over the Reykjanes Ridge itself. Further, the above mentioned density zones (see also Fig. 2) between 1000 and 2000 m contours and outside the 2000 m contour were also found for the small larvae. These zones represent the areas with heaviest extrusion in the Irminger Sea in this year.

Later observations have shown that these zones of heaviest extrusion are not strictly bound to the same localities but seem to move somewhat from one year to another, most probably due to hydrographical conditions.

E. *Caudal Pigment.*

During working up the material, attention was paid to the presence of subcaudal melanophores as described by TEMPLEMAN and SANDEMAN 1959. No redfish larvae were found to be with subcaudal melanophores except those of *Sebastes viviparus* Kröyer which have been found in small numbers in the Icelandic shelf area.

F. *Effectivity of Sampling Gears.*

Preliminary calculations have been made to estimate the relative sampling efficiency between the Helgoland net and the IHSS. These calculations are based upon the mean number of larvae per m^3 for a number of stations. During part I of the cruise, when the larvae were still of a small size, the efficiency of the gears expressed in number per m^3 was practically the same or slightly higher for the IHSS since we got the relation $\frac{\text{IHSS}}{\text{Helgol. larv. net}} = 1.07$ (mean). In part II where the larvae were of a bigger size, this ratio had changed considerably and the IHSS showed much greater sampling efficiency, the ratio being 8.75 (mean). Thus it appears that the larger and presumably more active redfish larvae taken during part II were more successful in avoiding capture by the Helgoland net than by the IHSS.

G. *Scattering Layers.*

During the cruise, a Simrad echo-sounder was run for the purpose of recording the scattering layers (see above).

In Fig. 8, the estimated intensity of the scattering layer is given by gradual shading along the route. The depth was mainly 5 to 30 m. The figure shows that there are two main areas with dense scattering layers, i.e. one mainly within the 200 m depth contour on the Icelandic shelf and the other one in the eastern part of the Irminger Sea mainly outside the 1000 m depth contour and above the Reykjanes Ridge. As to the latter zone, it coincides well with the area of high density of redfish larvae.

At station 157 (see Figs. 1, 2 and 8), very dense echo-traces were ob-

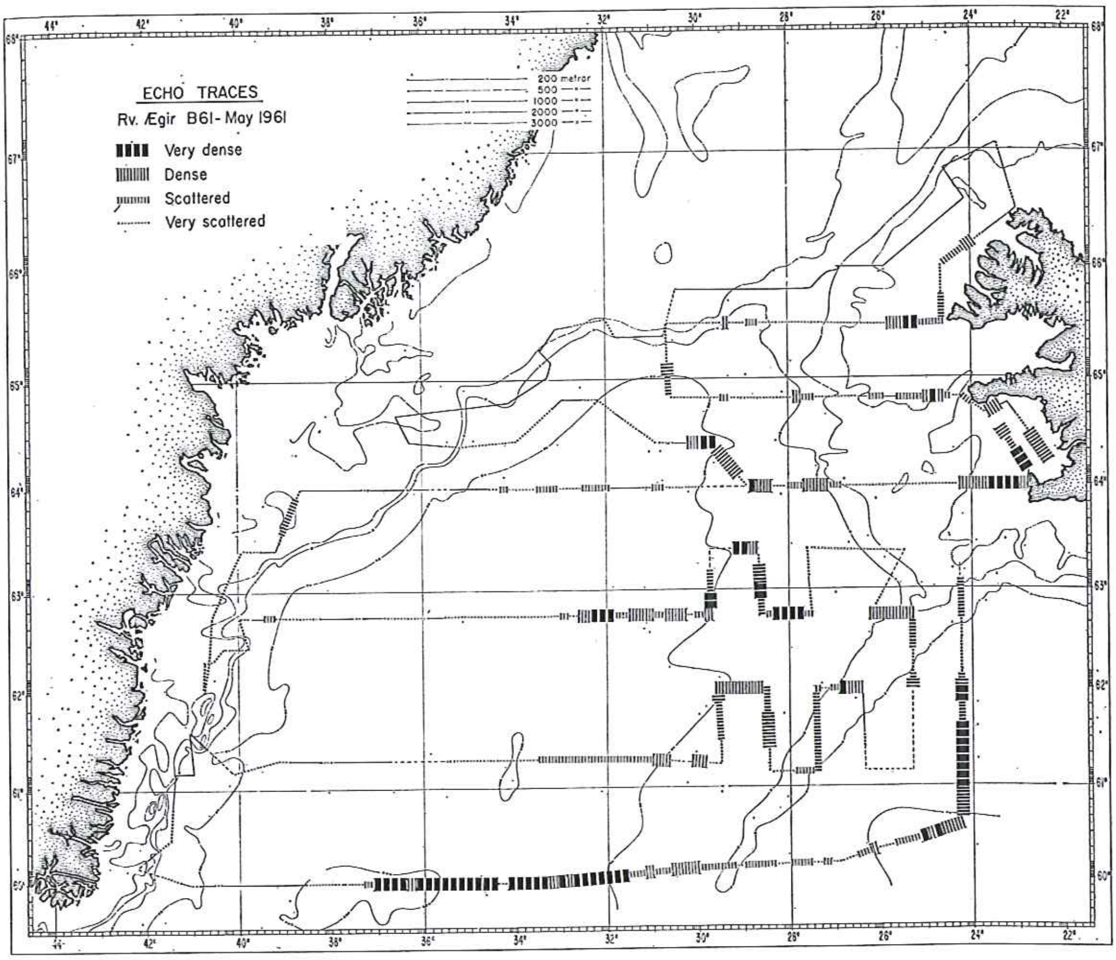


FIG. 8. *Echo-traces in 5 to 30 m depth. B61, May 1961.*

served and an Isaacs-Kidd midwater trawl was shot additionally to the plankton samplers in order to obtain a sample from this layer. A great number of redfish larvae was caught in the plankton samplers, but enormous quantities of redfish larvae were found in the net. Most of these larvae stuck to the meshes. It was also observed that the water at the ship's side seemed to be coloured greyish by the immense crowd of redfish larvae escaping.

2. Other Fish Larvae.

A. *Introduction.*

In discussing the fish larvae of the cruise other than redfish larvae, it must be kept in mind that the main purpose of the cruise was a redfish larval survey. However, larvae of many species other than redfish were obtained, mainly in the Icelandic shelf area, some of them in considerable quantities. Therefore it was thought desirable to discuss this material separately.

The larvae were separated from the plankton samples in the laboratory, identified, counted and measured. The composition of species of fish larvae except redfish is shown in Table VI. As to be seen from this table, the

TABLE VI

The composition of species of fish larvae, redfish excepted, in the Irminger Sea in May 1961 (all gear)

B 61, May 1961

Species	*Part I* Number of *pos.st.*	*larvae*	*Part II* Number of *pos.st.*	*larvae*	*Total* Number of *pos.st.*	*larvae*	*%*
Gadus morhua	10	3607	24	2266	34	5873	12.10
Melanogrammus æglefinus	3	207	18	928	21	1135	2.34
Pollachius virens	3	118	19	92	22	210	0.43
Gadus merlangus	2	21	9	105	11	126	0.26
Trisopterus esmarkii	4	1605	14	1319	18	2924	6.02
Micromesistius poutassou	16	89	3	4	19	93	0.19
Hippoglossoides limandoides	3	72	21	669	24	741	1.53
Platessa platessa / *Limanda limanda*	2	107	12	1099	14	1206	2.48
Glyptocephalus cynoglossus	1	9	8	29	9	38	0.08
Mallotus villosus	8	19471	26	15982	34	35453	73.03
Ammodytes sp.	1	22	22	154	23	176	0.36
Clupea harengus	3	58	7	23	10	81	0.17
Onos cimbrius	5	6	7	80	12	86	0.18
Onos mustela	1	2	11	238	12	240	0.50
Brosmius brosme			2	3	2	3	0.01
Molva byrkelange	8	10	1	1	9	11	0.02
Gadiculus thori	2	2	1	1	3	3	0.01
Myctophum glaciale	12	41	1	2	13	43	0.09
Scopelidae sp.	7	29			7	29	0.06
Argentina sp.	3	4	3	3	6	7	0.01
Cottus sp.	2	2	5	13	7	15	0.03
Triglops pingeli	1	1	7	10	8	11	0.02
Agonus cataphractus			1	1	1	1	+
Lumpenus lampretiformis	1	2	3	8	4	10	0.02
Chirolophis galerita			1	1	1	1	+
Centronotus gunnellus	1	4	1	1	2	5	0.01
Lebetus orca	1	1	3	8	4	9	0.02
Liparis montagui			4	6	4	6	0.01
Lepidorhombus whiff	1	1			1	1	+
Indeterminate	7	9			7	9	0.02
Total	108	25500	234	23046	342	48546	100.00

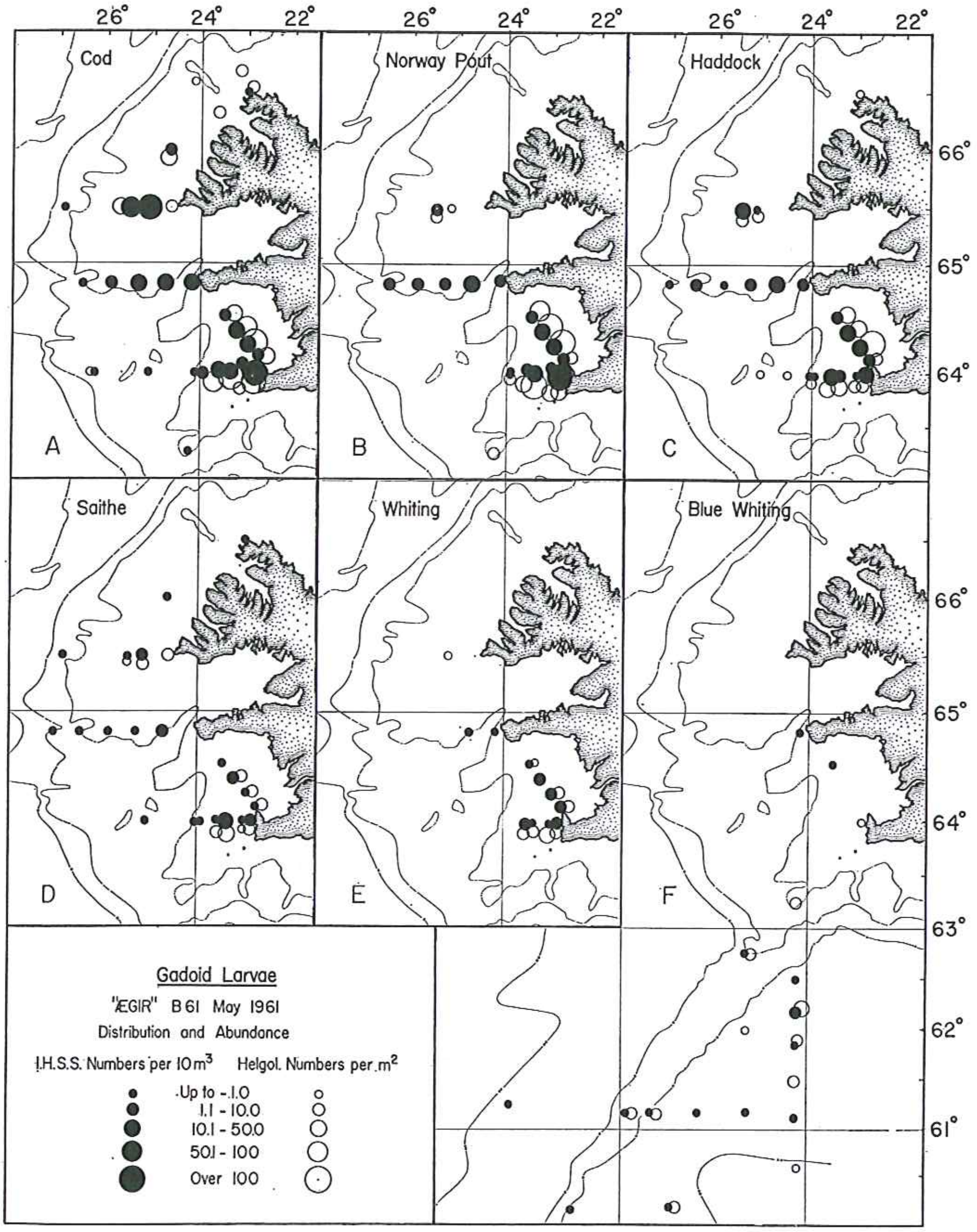


FIG. 9. *Distribution and abundance of six species of Gadoid larvae. B61, May 1961.*

number of species was rather great, but the total number of each species caught varied considerably. Beside the capelin (*Mallotus villosus* O.F.Müll.), which dominated in number with 73% of the total number of larvae caught, the gadoid group was best represented. Within this group the cod (*Gadus morhua* L.) larvae were dominant, making about 12% of the total catch. A fairly good number of Pleuronectidae larvae were also caught.

In spite of the largeness of the area surveyed and the number of species caught, the distribution of the larvae (except redfish larvae) was almost exclusively limited to the Icelandic shelf. Few larvae were caught outside the shelf region (e.g., cod (*Gadus morhua* L.) off the East Greenland shelf and blue whiting (*Micromesistius poutassou* Risso) in the oceanic region SW of Iceland). The main larval concentrations were found within limited areas of the shelf region. Thus, only small numbers of larvae were found outside the 200 m depth contour. But, in general, the gadoid larvae show now a wider offshore distribution than observed by SCHMIDT in 1903 (SCHMIDT 1904). The greatest density of larvae and number of species was found off Reykjanes and in Faxa Bay, and for some species those concentrations continued as far north as Látrabjarg. As expected at this time of the year, most of the larvae were of a small size, i.e., newly hatched.

In this paper the main emphasis will be laid on gadoid larvae, but some other species will also be discussed.

B. *Gadoidae.*

The following gadoids are discussed: Cod (*Gadus (morhua) callarias* L.), haddock (*Gadus (Melanogrammus) æglefinus* L.), saithe (*Gadus (Pollachius) virens* L.), whiting (*Gadus merlangus* L.), Norway pout (*Gadus (Trisopterus esmarkii) esmarki* Nilss.), and blue whiting (*Gadus (Micromesistius) poutassou* Risso).

Cod (*Gadus (morhua) callarias* L.): The distribution of cod larvae was strictly limited to the shelf region, extending from 63°15′N to 66°40′N off Kögur. Most of the larvae were found within the 200 m depth contour and no larvae outside the 500 m depth contour in Icelandic waters.

The main concentration was found to be in a zone extending from Reykjanes and Faxa Bay to Látrabjarg, close to the coast in the south but withdrawing from it somewhat towards the north, see Fig. 9 A. The greatest quantitiy of cod larvae was found near the coast of Reykjanes and in Faxa Bay. Here, larvae were obtained up to 231 per m^2 and 475 per 10 m^3 (see Table VII).

TABLE VII

Number of cod (*Gadus morhua* L.) larvae per station and gear

Cruise B 61, May 1961

— No Sample

Station No.	*Helgoland Larvae Net*		*High-Speed Samplers* I		II		III		I–III		*All Gear*
	No. of Larvae	*No. per m²*	*No. of Larvae*	*No. per 10 m³*	*No. of Larvae*	*No. per 10 m³*	*No. of Larvae*	*No. per 10 m³*	*No. of Larvae*	*No. per 10 m³*	*No. of Larvae*
1	370	231.3	450	228.4	1400	710.7	1000	507.6	2850	475.0	3220
2	218	136.3	55	27.9	–	–	95	48.2	150	37.5	368
3	0	0	8	4.1	–	–	0	0	8	2.0	8
26	1	0.6	0	0	0	0	0	0	0	0	1
27A	3	1.9	0	0	0	0	0	0	0	0	3
74	2	1.3	0	0	0	0	0	0	0	0	2
75	0	0	0	0	0	0	1	0.5	1	0.2	1
76	0	0	0	0	0	0	1	0.5	1	0.2	1
78	0	0	2	1.0	0	0	0	0	2	0.3	2
102	0	0	1	0.5	0	0	0	0	1	0.2	1
109	–	–	10	5.1	70	35.5	2	1.0	82	13.7	82
110	–	–	22	11.2	60	30.5	104	52.8	186	31.0	186
111	–	–	42	21.3	16	8.1	17	8.6	75	12.5	75
112	–	–	32	16.2	6	3.0	14	7.1	52	8.7	52
113	–	–	–	–	2	1.0	2	1.0	4	1.0	4
127	0	0	0	0	1	0.5	0	0	1	0.2	1
129	45	28.1	–	–	180	91.4	143	72.6	323	80.8	368
130	0	0	–	–	48	24.4	397	201.5	445	111.3	445
131	10	6.3	–	–	–	–	–	–	–	–	10
132	26	16.3	0	0	3	1.5	10	5.1	13	2.2	39
133	2	1.3	0	0	0	0	0	0	0	0	2
134	7	4.4	0	0	0	0	3	1.5	3	0.5	10
135	2	1.3	0	0	0	0	0	0	0	0	2
139	1	0.6	0	0	0	0	0	0	0	0	1
151	1	0.6	0	0	0	0	0	0	0	0	1
163	1	0.6	3	1.5	0	0	0	0	3	0.5	4
165	0	0	0	0	1	0.5	0	0	1	0.2	1
167	0	0	0	0	2	1.0	2	1.0	4	0.7	4
168	100	62.5	24	12.2	57	28.9	9	4.6	90	15.0	190
169	15	9.4	0	0	14	7.1	4	2.0	18	3.0	33
170	17	10.6	1	0.5	11	5.6	7	3.6	19	3.2	36
171	172	107.5	5	2.5	94	47.7	30	15.2	129	21.5	301
172	100	62.5	48	24.4	140	71.1	45	22.8	233	38.8	333
173	45	28.1	21	10.7	10	5.1	10	5.1	41	6.8	86
Total	1138		724		2115		1896		4735		5873

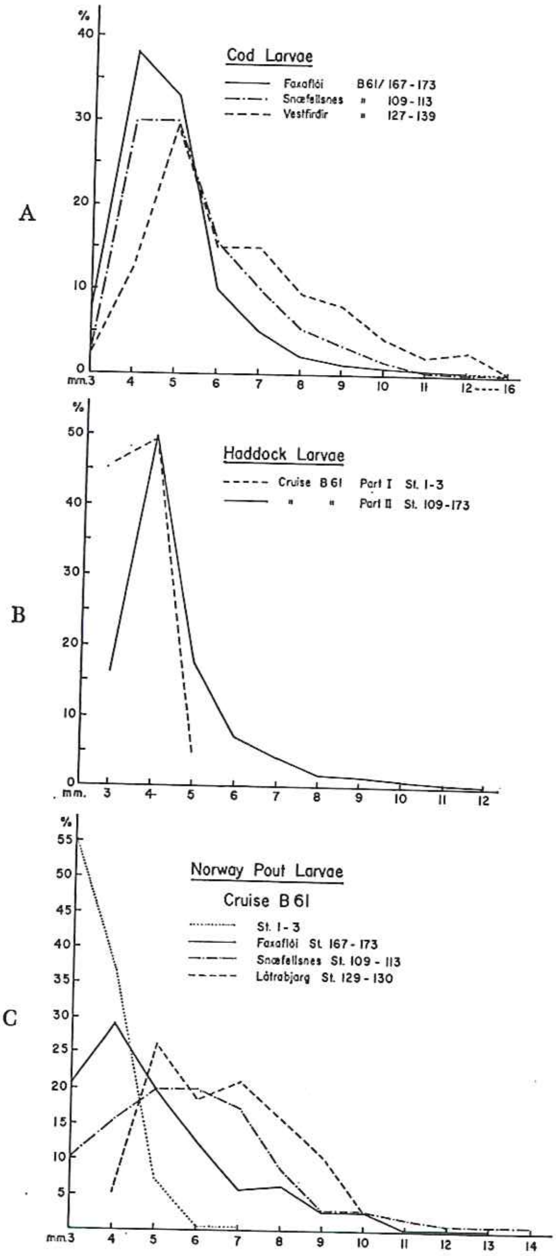


FIG. 10. *Size frequency for cod* (Gadus morhua L.), *haddock* (Melanogrammus æglefinus L.) *and Norway pout* (Trisopterus esmarkii) *larvae. B61, May 1961.*

In East Greenland waters, cod larvae were obtained at 7 stations and only in small numbers (see Fig. 1: Stat. nos. 26, 27A, 74, 75, 76, 78, 151). But in this area, considerable numbers of eggs were obtained in different places (see below).

Length measurements showed that over three quarters of the cod larvae appeared to be of very recent hatching, as the length composition of the first three stations of part I shows:

mm	*Number of larvae*	%
7	2	0.6
6	3	0.8
5	40	11.1
4	202	56.1
3	113	31.4
Total	360	100.0

On these stations about 87% of the cod larvae were newly hatched (i.e., 3 to 4 mm size).

In Fig. 10A the size frequency is given for Faxa Bay, Snæfellsnes Section and Vestfirdir area, separately. We see from this figure that the small larvae are most abundant in Faxa Bay although these larvae were obtained at the end of the cruise. The number of bigger larvae increases towards north and the size range is much wider as can be seen for the Vestfirdir area. However, the diagram shows us that there was a considerable hatching in all 3 areas, but the influx of drifted larvae affected the size distribution increasingly towards the north. Another characteristic in the size distribution was that the average size of cod larvae increased with increasing distance from the shore (e.g., Snæfellsnes section, average size for stations 109 to 113: 4.82 — 5.41 — 5.27 — 6.78 — 7.50 mm). This indicates also a drift of the larvae from the coastal region out over the shelf. The few larvae caught in the Greenland waters were all of 3 to 4 mm size except one specimen at 5 mm.

Haddock (*Gadus (Melanogrammus) æglefinus* L.): Haddock larvae were only found in the area between Reykjanes and Látrabjarg and thus limited to a smaller region than the cod larvae (see Fig. 9C). The main concentration was found in Faxa Bay as for cod, with a maximum density of 120 per m^2 (st. 171, see also Table VIII). Most of the larvae were of 3 to 4 mm size, i.e., newly hatched (Fig. 10B). At the beginning of May (stat. nos. 1 to 3) the 3 to 4 mm size group amounted to 96.1% of all those caught. None were above 5 mm in size. In late May (part II of the cruise), the size ranged from 3 to 12 mm, but the most were still below 5 mm. The length

TABLE VIII

Number of haddock (*Melanogrammus æglefinus* L.) larvae per station and gear

Cruise B 61, May 1961

— No Sample

Station No.	Helgoland Larvae Net No. of Larvae	Helgoland Larvae Net No. per m²	High-Speed Samplers I No. of Larvae	I No. per 10 m³	II No. of Larvae	II No. per 10 m³	III No. of Larvae	III No. per 10 m³	I–III No. of Larvae	I–III No. per 10 m³	All Gear No. of Larvae
1	16	10.0	0	0	80	40.6	76	38.6	156	26.0	172
2	24	15.0	2	1.0	–	–	8	4.1	10	2.5	34
3	0	0	1	0.5	–	–	0	0	1	0.3	1
109	–	–	0	0	27	13.7	8	4.1	35	5.8	35
110	–	–	5	2.5	22	11.2	74	37.6	101	16.8	101
111	–	–	2	1.0	3	1.5	2	1.0	7	1.2	7
112	–	–	2	1.0	3	1.5	1	0.5	6	1.0	6
113	–	–	–	–	2	1.0	8	4.1	10	2.5	10
114	–	–	–	–	0	0	1	0.5	1	0.3	1
129	7	4.4	–	–	40	20.0	40	20.0	80	20.0	87
130	7	4.4	–	–	0	0	3	1.5	3	0.8	10
134	1	0.6	0	0	0	0	0	0	0	0	1
165	1	0.6	0	0	0	0	0	0	0	0	1
166	1	0.6	0	0	0	0	0	0	0	0	1
167	2	1.3	0	0	0	0	2	1.0	2	0.3	4
168	47	29.4	0	0	85	43.1	6	3.0	91	15.2	138
169	6	3.8	0	0	1	0.5	1	0.5	2	0.3	8
170	8	5.0	1	0.5	3	1.5	3	1.5	7	1.2	15
171	192	120.0	1	0.5	74	37.6	12	6.1	87	14.5	279
172	46	28.8	8	4.1	86	43.7	16	8.1	110	18.3	156
173	61	38.1	1	0.5	2	1.0	4	2.0	7	1.2	68
Total	419		23		428		265		716		1135

distribution was more or less uniform from one area to another. However, the relative number of the 5 to 6 mm group was a little higher in the northernmost part of the Icelandic waters.

Saithe (*Gadus (Pollachius) virens* L.): The distribution of saithe larvae corresponded on the whole with that of cod larvae (Fig. 9D). But the number of larvae caught was considerably smaller, with a maximum of 70 specimens at stat. no. 2 (see also Table IX). The saithe larvae showed a greater range in the size distribution than cod and haddock. The size frequencies differed, however, from part I to part II, as shown in Table X.

Table IX

Number of saithe (*Pollachius virens* L.) larvae per station and gear

Cruise B 61, May 1961

— No Sample

Station No.	Helgoland Larvae Net		High-Speed Samplers I		II		III		I–III		All Gear
	No. of Larvae	*No. per m²*	*No. of Larvae*	*No. per 10 m³*	*No. of Larvae*	*No. per 10 m³*	*No. of Larvae*	*No. per 10 m³*	*No. of Larvae*	*No. per 10 m³*	*No. of Larvae*
1	7	4.4	0	0	24	12.2	16	8.1	40	6.7	47
2	20	12.5	22	11.2	–	–	28	14.2	50	12.5	70
3	0	0	1	0.5	–	–	0	0	1	0.3	1
110	–	–	0	0	2	1.0	5	2.5	7	1.2	7
111	–	–	0	0	0	0	2	1.0	2	0.3	2
112	–	–	0	0	0	0	4	2.0	4	0.7	4
113	–	–	–	–	0	0	1	0.5	1	0.3	1
114	–	–	–	–	1	0.5	1	0.5	2	0.5	2
127	0	0	0	0	1	0.5	0	0	1	0.2	1
129	1	0.6	–	–	0	0	4	2.0	4	1.0	5
130	2	1.3	–	–	0	0	6	3.0	6	1.5	8
131	7	4.4	–	–	–	–	–	–	–	–	7
132	0	0	0	0	0	0	1	0.5	1	0.2	1
134	0	0	0	0	0	0	2	1.0	2	0.3	2
165	0	0	0	0	0	0	1	0.5	1	0.2	1
167	0	0	0	0	1	0.5	1	0.5	2	0.3	2
168	13	8.1	0	0	3	1.5	0	0	3	0.5	16
169	1	0.6	0	0	0	0	1	0.5	1	0.2	2
170	2	1.3	1	0.5	1	0.5	0	0	2	0.3	4
171	4	2.5	0	0	4	2.0	1	0.5	5	0.8	9
172	4	2.5	4	2.0	2	1.0	5	2.5	11	1.8	15
173	0	0	2	1.0	1	0.5	0	0	3	0.5	3
Total	61		30		40		79		149		210

Whiting (*Gadus merlangus* L.): The distribution of whiting larvae showed that they were more bound to the Icelandic coastal waters than the other gadoid larvae (see Fig. 9E). Thus, whiting larvae were only found within 20 miles off the shore and in Faxa Bay from Reykjanes to Látrabjarg. The number of whiting larvae was rather small and, as for cod and haddock, the greatest number was taken off Reykjanes and in the southern part of Faxa Bay, where 69% of the total number of larvae caught were obtained at four stations (Nos. 168 to 171, Table XI). No larvae were bigger than 8 mm. About 55% of the larvae were of 3 to 4 mm in size.

TABLE X

Size composition of saithe (*Pollachius virens* L.) larvae

Cruise B 61, May 1961

Size mm	*Part I No. larvae*	*Part II No. larvae*
20—25		3
16—19		3
11—15		14
6—10	20	40
3—5	66	29
Total	86	89

TABLE XI

Number of whiting (*Gadus merlangus* L.) larvae per station and gear

Cruise B 61, May 1961

— No Sample

Station No.	*Helgoland Larvae Net*		*High-Speed Samplers*								*All Gear*
			I		II		III		I–III		
	No. of Larvae	*No. per m²*	*No. of Larvae*	*No. per 10 m³*	*No. of Larvae*	*No. per 10 m³*	*No. of Larvae*	*No. per 10 m³*	*No. of Larvae*	*No. per 10 m³*	*No. of Larvae*
1	2	1.3	0	0	0	0	8	4.1	8	1.3	10
2	10	6.3	1	0.5	–	–	0	0	1	0.3	11
109	–	–	0	0	1	0.5	0	0	1	0.2	1
110	–	–	0	0	0	0	3	1.5	3	0.5	3
130	1	0.6	–	–	0	0	0	0	0	0	1
168	14	8.8	3	1.5	7	3.6	1	0.5	11	1.8	25
169	18	11.3	0	0	2	1.0	2	1.0	4	0.7	22
170	9	5.6	0	0	12	6.1	4	2.0	16	2.7	25
171	4	2.5	0	0	10	5.1	0	0	10	1.7	14
172	0	0	3	1.5	6	3.0	0	0	9	1.5	9
173	1	0.6	1	0.5	3	1.5	0	0	4	0.7	5
Total	59		8		41		18		67		126

Norway pout (*Gadus (Trisopterus esmarkii) esmarki* Nilss.): The general distribution of Norway pout larvae corresponded on the whole to that of cod and haddock, but was somewhat more limited in offshore direction and did not extend north of the Látrabjarg section. But the main concentration of these larvae in Faxa Bay and off Reykjanes was still more pronounced than that of cod and haddock (see Fig. 9 B and Table XII). Here we obtained a maximum of 244 per m² surface water (st. no. 2).

Table XII

Number of Norway pout (*Trisopterus esmarkii* Nilss.) larvae per station and gear

Cruise B 61, May 1961

— No Sample

Station No.	*Helgoland Larvae Net* No. of Larvae	*Helgoland Larvae Net* No. per m²	*High-Speed Samplers* I No. of Larvae	I No. per 10 m³	II No. of Larvae	II No. per 10 m³	III No. of Larvae	III No. per 10 m³	I–III No. of Larvae	I–III No. per 10 m³	*All Gear* No. of Larvae
1	80	50.0	15	7.6	600	304.6	360	182.7	975	162.5	1055
2	391	244.4	50	25.4	–	–	103	52.3	153	38.3	544
3	0	0	1	0.5	–	–	0	0	1	0.3	1
102	4	2.5	1	0.5	0	0	0	0	1	0.2	5
109	–	–	0	0	12	6.1	24	12.2	36	6.0	36
110	–	–	0	0	2	1.0	61	31.0	63	10.5	63
111	–	–	0	0	2	1.0	7	3.6	9	1.5	9
112	–	–	9	4.6	0	0	4	2.0	13	2.2	13
113	–	–	–	–	2	1.0	5	2.5	7	1.8	7
129	13	8.1	–	–	5	2.5	24	12.2	29	7.3	42
130	1	0.6	–	–	0	0	0	0	0	0	1
167	2	1.3	0	0	0	0	4	2.0	4	0.7	6
168	40	25.0	0	0	26	13.2	14	7.1	40	6.7	80
169	26	16.3	0	0	15	7.6	7	3.6	22	3.7	48
170	7	4.4	0	0	6	3.0	19	9.6	25	4.2	32
171	360	225.0	3	1.5	47	23.9	34	17.3	84	14.0	444
172	240	150.0	7	3.6	90	45.7	62	31.5	159	26.5	399
173	103	64.4	7	3.6	22	11.2	7	3.6	36	6.0	139
Total	1267		93		829		735		1656		2924

As regards the length composition, there is a clear difference between part I and part II (Fig. 10C). In part I 91% of the larvae measured were 3 to 4 mm in length, of recent hatching, and all were within a size range of 3 to 7 mm. In part II, however, not only had the size range increased but the relative numbers of bigger larvae had also increased, especially at the stations on the Látrabjarg section, where the smallest larvae taken, at 4 mm, now represented only 5% of the total. It seems probably, therefore, that hatching of the eggs has been largely completed in the southern part of the area before there has been sufficient time for large numbers of eggs to drift north and hatch there.

Blue whiting *(Gadus (Micromesistius) poutassou* Risso): As known, the blue whiting belongs to the species which spawn in oceanic areas. Therefore, the distribution of blue whiting larvae is quite different from the other gadoid larvae discussed before. As shown in Fig. 9F, most of the larvae were found above the Reykjanes Ridge and east of it, but some were also found

TABLE XIII

Number of blue whiting (*Micromesistius poutassou* Risso) larvae per station and gear

Cruise B 61, May 1961

— No Sample

Station No.	Helgoland Larvae Net		High-Speed Samplers								All Gear
			I		II		III		I–III		
	No. of Larvae	*No. per m²*	*No. of Larvae*	*No. per 10 m³*	*No. of Larvae*	*No. per 10 m³*	*No. of Larvae*	*No. per 10 m³*	*No. of Larvae*	*No. per 10 m³*	*No. of Larvae*
52	5	3.1	1	0.5	0	0	0	0	1	0.2	6
53	1	0.6	0	0	0	0	0	0	0	0	1
54	0	0	0	0	2	1.0	0	0	2	0.3	2
55	0	0	0	0	1	0.5	0	0	1	0.2	1
58	6	3.8	0	0	2	1.0	3	1.5	5	0.8	11
59	4	2.5	0	0	0	0	3	1.5	3	0.5	7
64	0	0	0	0	1	0.5	0	0	1	0.2	1
91	–	–	0	0	1	0.5	0	0	1	0.2	1
93	9	5.6	0	0	1	0.5	0	0	1	0.2	10
96	1	0.6	0	0	0	0	0	0	0	0	1
97	0	0	0	0	3	1.5	0	0	3	0.5	3
98	3	1.9	0	0	0	0	0	0	0	0	3
99	2	1.3	0	0	2	1.0	0	0	2	0.3	4
100	21	13.1	1	0.5	10	5.1	0	0	11	1.8	32
101	0	0	0	0	3	1.5	1	0.5	4	0.7	4
102	2	1.3	0	0	0	0	0	0	0	0	2
109	–	–	0	0	1	0.5	0	0	1	0.2	1
169	1	0.6	0	0	0	0	0	0	0	0	1
173	0	0	0	0	2	1.0	0	0	2	0.3	2
Total	55		2		29		7		38		93

west of the Reykjanes Ridge and in the coastal region, i.e., Faxa Bay and off Snæfellsnes. Thus, the distribution of blue whiting larvae on this cruise extended from 60° N to the Snæfellsnes section in the north and the larvae were therefore spread over a relatively wide area. But the total number of larvae caught was not very high (93), the greatest density (32 specimens) being at one station (No. 100), see also Table XIII.

The length range of all larvae was from 3 to 7 mm, the 3 mm group being best represented with about 45% of the total.

South of Iceland, considerable numbers of blue whiting larvae have been observed (SCHMIDT 1904). Thus our findings of small blue whiting larvae in the Reykjanes Ridge area (Fig. 9) indicate that the Reykjanes Ridge most probably forms the western limit of the blue whiting spawning area south of Iceland.

C. *Abundance in Relation to Depth.*

Since on both parts of the cruise three high-speed samplers were used at different depths, an attempt was made to study the abundance of larvae in relation to depth. The samplers were towed at the following depths: 3 to 5 m (IHSS I), 15 to 18 m (IHSS II), and 25 to 30 m (IHSS III). It should be mentioned here that this kind of gear samples both during set-

TABLE XIV

Number of larvae per 10 m³ and percentages per station and depth levels for cod, haddock and Norway pout separately

Cruise B 61, May 1961

A) *Cod* (Gadus morhua L.)

Stat. No.	*Day:* 1		111		132		168		169	
Level	*No. per 10 m³*	*%*	*No. per 10 m³*	*%*	*No. per 10 m³*	*%*	*No. per 10 m³*	*%*	*No. per 10 m³*	*%*
I	228.4	15.8	21.3	56.0	0	0	12.2	26.7	0	0
II	710.7	49.1	8.1	21.3	1.5	23.1	28.9	63.3	7.1	77.8
III	507.6	35.1	8.6	22.7	5.1	76.9	4.6	10.0	2.0	22.2
Mean	475.0		12.5		2.2		15.0		3.0	

Stat. No.	*Day, cont.:* 170		171		172		173		*Mean Day*	
Level	*No. per 10 m³*	*%*	*No. per 10 m³*	*%*	*No. per 10 m³*	*%*	*No. per 10 m³*	*%*	*No. per 10 m³*	*%*
I	0.5	5.3	2.5	3.9	24.4	20.6	10.7	51.2	32.8	17.0
II	5.6	57.9	47.7	72.9	71.1	60.1	5.1	24.4	96.9	50.3
III	3.6	36.8	15.2	23.2	22.8	19.3	5.1	24.4	62.9	32.7
Mean	3.2		21.5		38.8		6.8		64.2	

Stat. No.	*Night:* 109		110		112		*Mean Night*	
Level	*No. per 10 m³*	*%*	*No. per 10 m³*	*%*	*No. per 10 m³*	*%*	*No. per 10 m³*	*%*
I	5.1	12.2	11.2	11.8	16.2	61.5	10.7	20.0
II	35.5	85.4	30.5	32.3	3.0	11.6	22.7	42.5
III	1.0	2.4	52.8	55.9	7.1	26.9	20.0	37.5
Mean	13.7		31.0		8.7		17.8	

B) *Haddock* (Melanogrammus æglefinus L.)

Stat. No. / *Level*	*Day:* 1 *No. per 10 m³*	%	168 *No. per 10 m³*	%	171 *No. per 10 m³*	%	172 *No. per 10 m³*	%	*Mean Day* *No. per 10 m³*	%
I	0	0	0	0	0.5	1.1	4.1	7.3	1.1	2.0
II	40.6	51.3	43.1	93.4	37.6	85.1	43.7	78.2	40.6	73.1
III	38.6	48.7	3.0	6.6	6.1	13.8	8.1	14.5	13.8	24.9
Mean	26.0		15.2		14.5		18.3		18.5	

Stat. No. / *Level*	*Night:* 109 *No. per 10 m³*	%	110 *No. per 10 m³*	%	*Mean Night* *No. per 10 m³*	%
I	0	0	2.5	4.9	1.3	3.8
II	13.7	77.1	11.2	21.8	12.3	36.1
III	4.1	22.9	37.6	73.3	20.5	60.1
Mean	5.8		16.8		11.7	

C) *Norway Pout* (Trisopterus esmarkii Nilss.)

Stat. No. / *Level*	*Day:* 1 *No. per 10 m³*	%	168 *No. per 10 m³*	%	169 *No. per 10 m³*	%	170 *No. per 10 m³*	%	171 *No. per 10 m³*	%
I	7.6	1.5	0	0	0	0	0	0	1.5	3.6
II	304.6	61.6	13.2	65.0	7.6	68.2	3.0	24.0	23.9	55.9
III	182.7	36.9	7.1	35.0	3.6	31.8	9.6	76.0	17.3	40.5
Mean	162.5		6.7		3.7		4.2		14.0	

Stat. No. / *Level*	*Day, cont.:* 172 *No. per 10 m³*	%	173 *No. per 10 m³*	%	*Mean Day* *No. per 10 m³*	%
I	3.6	4.4	3.6	19.4	2.3	2.4
II	45.7	56.6	11.2	61.1	57.6	60.1
III	31.5	39.0	3.6	19.5	35.9	37.5
Mean	26.5		6.0		31.9	

Table XIV C, cont.

Stat. No. / *Level*	*Night:* 109 *No. per 10 m³*	%	110 *No. per 10 m³*	%	112 *No. per 10 m³*	%	*Mean Night* *No. per 10 m³*	%
I	0	0	0	0	4.6	69.2	1.5	8.1
II	6.1	33.3	1.0	3.2	0	0	2.3	12.4
III	12.2	66.7	31.0	96.8	2.0	30.8	14.8	79.5
Mean	6.0		10.5		2.2		6.2	

ting out and hauling in because these gears are not equipped with a closing mechanism. This is of course of greatest influence on sampler III, much less in samplers II and I. But, since the filtration during setting out and hauling in is small compared with that during the towing time, a study on the depth relation based upon material from these 3 samplers can, however, be carried out. Even though it is most reliable for samplers I and II, sampler III also gives important information in this respect.

For this study, the larvae taken in the vertical net are excluded. Only the material of cod, haddock and Norway pout larvae was used. Further, only stations where all three samplers were operated and where the total number of each species was higher than ten were used (Table XIV). Sampler II gave the highest total number of larve caught for all three species and sampler I the lowest, though the number of larvae caught at each depth varied considerably from one station to another. Sampler II gave also the highest mean percentage for cod (48.3%) and haddock (67.8%), but sampler III for the Norway pout larvae (47.3%).

D. *Day and Night Relationship.*

A study of variations in day and night catches showed some notable differences. As to day and night time, the same division is used as for redfish larvae. As regards cod larvae, we can see from the means in day and night catches (Table XIV) that the yield during day time was considerably higher than during the night. However, it should be taken into consideration that there are three times more day stations than night stations and that the mean for the day stations is highly affected by one station (st. 1). Further, it can be said that the yields for level II (15 to 18 m) are highest both for day and night and the yields for level I (3 to 5 m) are the lowest ones. Thus, the differences between the levels are much more pronounced during the day than during the night.

Haddock larvae show on the whole a tendency similar to the cod larvae during day time. The mean for the night time is highest for level III, but since it is based upon two stations only with quite different numbers of larvae per depth, this mean should be taken with reservation, especially

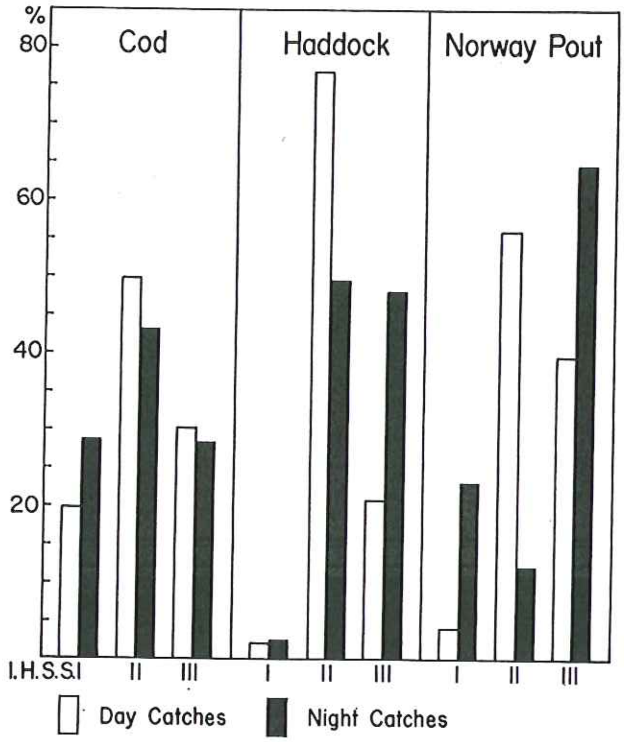


FIG. 11. *Variation in day and night catches at different levels for cod, haddock and Norway pout larvae, based on average percentages. B 61, May 1961.*

since the average percentage for level II is slightly higher than for level III for these two stations.

Considering the means for day and night catches for the Norway pout larvae, we see that the mean features are very similar to those for haddock, but as for cod, the yields of Norway pout larvae during the day time were considerably higher than at night.

Considering Table XIV as a whole, we notice considerable differences from one station to another, both in the depth relation and the total yields. MILLER, COLTON and MARAK (1963) have pointed out in a special study that there are great local variations in the diurnal migration of larval haddock on Georges Bank, where probably other factors than light are the determining ones. Although our material is not suitable for such studies since there are no continuous repetitions of sampling at the very same locality, some of our observations seem to indicate similar facts, since in some cases we got very different depth distributions of larvae within a couple of hours, but at different localities (e.g., st. 109 and 110, Table XIV). However, if we look upon the material as a whole, we see from the table that the depth

TABLE XV

Number of long rough dab (*Hippoglossoides limandoides* Fabr.) larvae per station and gear

Cruise B 61, May 1961

— No Sample

Station No.	*Helgoland Larvae Net* *No. of Larvae*	*No. per m²*	I *No. of Larvae*	*No. per 10 m³*	II *No. of Larvae*	*No. per 10 m³*	III *No. of Larvae*	*No. per 10 m³*	I–III *No. of Larvae*	*No. per 10 m³*	*All Gear* *No. of Larvae*
1	4	2.5	0	0	32	16.0	16	8.1	48	8.0	52
2	17	10.6	2	1.0	–	–	0	0	2	0.5	19
3	0	0	1	0.5	–	–	0	0	1	0.3	1
109	–	–	3	1.5	3	1.5	0	0	6	1.0	6
110	–	–	2	1.0	4	2.0	12	6.1	18	3.0	18
111	–	–	3	1.5	1	0.5	3	1.5	7	1.2	7
112	–	–	6	3.0	3	1.5	6	3.0	15	2.5	15
113	–	–	–	–	3	1.5	4	2.0	7	1.8	7
121	0	0	0	0	0	0	1	0.5	1	0.2	1
129	18	11.3	–	–	83	42.1	91	46.2	174	43.5	192
130	37	23.1	–	–	0	0	38	19.3	38	9.5	75
132	3	1.9	0	0	0	0	5	2.5	5	0.8	8
135	1	0.6	0	0	0	0	0	0	0	0	1
139	3	1.9	0	0	0	0	0	0	0	0	3
148	0	0	1	0.5	0	0	0	0	1	0.2	1
162	0	0	1	0.5	0	0	0	0	1	0.2	1
165	0	0	0	0	1	0.5	0	0	1	0.2	1
167	5	3.1	0	0	2	1.0	0	0	2	0.3	7
168	56	35.0	1	0.5	28	14.2	0	0	29	4.8	85
169	15	9.4	0	0	5	2.5	0	0	5	0.8	20
170	6	3.8	0	0	0	0	0	0	0	0	6
171	64	40.0	0	0	16	8.1	5	2.5	21	3.5	85
172	60	37.5	2	1.0	29	14.7	0	0	31	5.2	91
173	32	20.0	0	0	6	3.0	1	0.5	7	1.2	39
Total	321		22		216		182		420		741

relation seems to be much more stabilized for each of the three species at day time than at night.

In spite of the incompleteness of the material for day–night and depth relation studies, an attempt was made to demonstrate the conditions graphically, based upon average percentages (see Fig. 11). According to this diagram, there are no distinct differences between day and night catches for cod. On the other hand, for haddock and Norway pout, there are marked differences in the levels II and III. But all three species showed the highest average percentage catch in level II during day time.

E. *Pleuronectidae.*

Long rough dab (*Drepanopsetta platessoides* — *Hippoglossoides limandoides* Fabr.): The long rough dab was distributed over the continental shelf of Iceland, from Reykjanes to the Kögur section (stat. no. 135), and thus had the widest distribution of the Pleuronectidae. Further, they were found at two stations at East Greenland (stat. no. 121, 148). The greatest density of larvae, 192 sp., was found off Látrabjarg at a single station (no. 129, see also Table XV), though the larvae were most abundant in the Faxa Bay area (see Fig. 12 A).

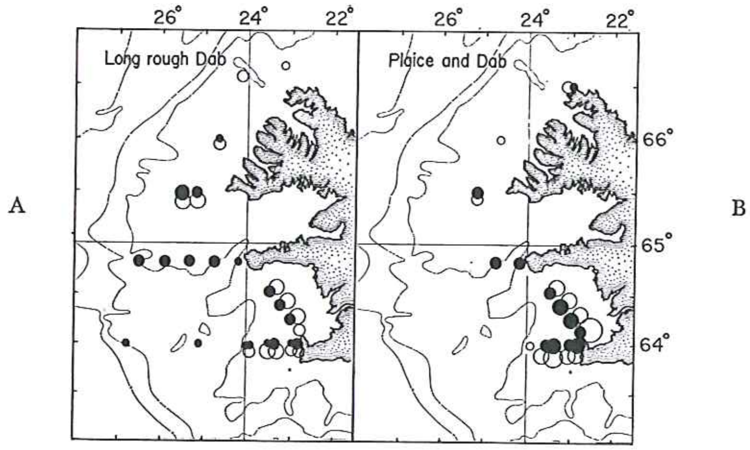


FIG. 12. *Distribution and abundance of A) Long rough dab (Hippoglossoides limandoides* Fabr.), *B) Plaice (Platessa platessa* L.) *and dab (Limanda limanda* L.) *larvae. B 61, May 1961.*

The length ranged from 3 to 13 mm, with the majority being of 4 to 7 mm size. Although the small larvae of 3 to 4 mm were found at most of the stations, the mean length increased somewhat from south to north: Off Reykjanes and in Faxa Bay 5.23 mm, off Snæfellsnes 6.31 mm, off Látrabjarg 6.47 mm and off Vestfirdir (stat. no. 132, 8 specimens) 7.50 mm.

Plaice and dab (*Pleuronectes (Platessa) platessa* L. and *Pleuronectes (Limanda) limanda* L.): Due to injuries by the gears, the plaice and dab larvae could not be distinguished with certainty from each other and, therefore, both species are discussed together. However, it is supposed that the larvae are mainly of the *Limanda* species since 85% of the larvae caught were smaller than the size known for newly hatched *Platessa* larvae.

The distribution of plaice and dab larvae was more limited to the coastal regions than that of the long rough dab, but was also found from Reykjanes to the Kögur section (stat. no. 134). They were most abundant in Faxa

TABLE XVI

Number of plaice (*Platessa platessa* L.) and dab (*Limanda limanda* L.) larvae per station and gear

Cruise B 61, May 1961

— No Sample

Station No.	Helgoland Larvae Net No. of Larvae	Helgoland Larvae Net No. per m²	High-Speed Samplers I No. of Larvae	I No. per 10 m³	II No. of Larvae	II No. per 10 m³	III No. of Larvae	III No. per 10 m³	I–III No. of Larvae	I–III No. per 10 m³	All Gear No. of Larvae
1	50	31.3	20	10.2	8	4.1	4	2.0	32	5.3	82
2	18	11.3	7	3.6	–	–	0	0	7	1.8	25
109	–	–	16	8.1	12	6.1	3	1.5	31	5.2	31
110	–	–	0	0	0	0	7	3.6	7	1.2	7
130	3	1.9	–	–	1	0.5	6	3.1	7	1.8	10
132	1	0.6	0	0	0	0	0	0	0	0	1
134	3	1.9	0	0	0	0	1	0.5	1	0.2	4
167	1	0.6	0	0	0	0	0	0	0	0	1
168	130	81.3	4	2.0	106	53.8	24	12.2	134	22.3	264
169	75	46.9	0	0	60	30.5	4	2.0	64	10.7	139
170	190	118.8	0	0	47	23.9	12	6.1	59	9.8	249
171	64	40.0	8	4.1	80	40.6	10	5.1	98	16.3	162
172	44	27.5	12	6.1	80	40.6	23	11.7	115	19.2	159
173	34	21.3	14	7.1	20	10.2	4	2.0	38	6.3	72
Total	613		81		414		98		593		1206

Bay and off Reykjanes (see Table XVI and Fig. 12B). Length measurements gave a range of 2 to 11 mm, with the peak at 4 mm for the whole material.

Witch (*Pleuronectes (Glyptocephalus) cynoglossus* L.): Very few specimens were obtained and most of them in Faxa Bay. Single specimens were also caught off Vestfirdir and at East Greenland. The length was 4 to 8 mm, two specimens from East Greenland were 15 and 18 mm, respectively.

F. *Capelin and Notes on Some Other Species.*

Capelin (*Mallotus villosus* O.F.Müll.): Capelin larvae were by far the most numerous in the larval material (see also Table V), amounting to more than 70% of all the larvae, redfish excluded. It was found to be spread over the whole shelf area between 63°15′N and 66°40′N (Kögur section). Though they were very abundant on all sections, the maximal density was found in Faxa Bay and the Faxa Bay area (16110 specimens at one station, see also Fig. 13 and Table XVII).

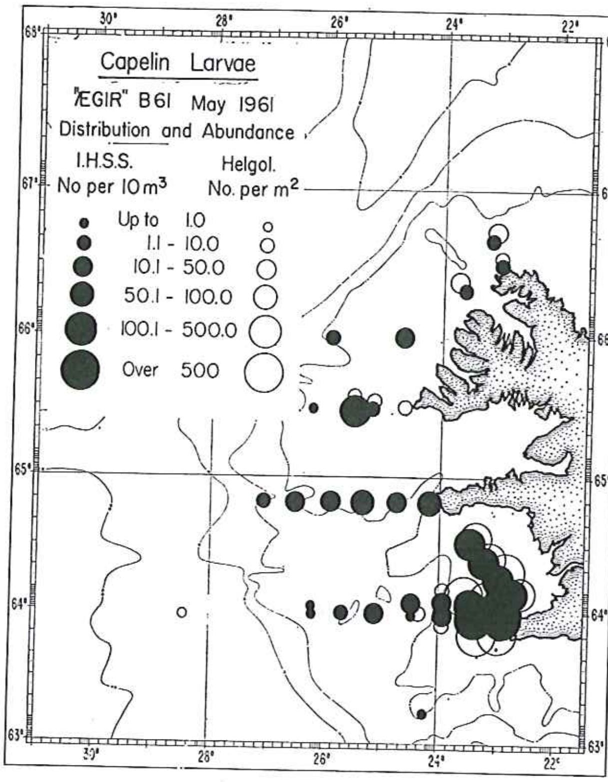


FIG. 13. *Distribution and abundance of capelin (Mallotus villosus O.F.Müll.) larvae.*

The length range was rather great, 4 to 28 mm, with the majority between 6 and 12 mm. In the length distribution some characteristic features were noticed. The smallest larvae up to 8 mm were almost exclusively obtained in the Faxa Bay and off Reykjanes. The size increased considerably with increasing distance from the coast. This is demonstrated in Fig. 14 which is based on the mean length of larvae at each station on the following sections:

I	Reykjanes	stat. nos.	1—3
II	Snæfellsnes	— —	109—114
III	Látrabjarg	— —	130—128
IV	Reykjanes	— —	169—163
V	Faxa Bay	— —	170—173

Table XVII

Number of capelin (*Mallotus villosus* O.F.Müll.) larvae per station and gear

Cruise B 61, May 1961

— No Sample

Station No.	*Helgoland Larvae Net* *No. of Larvae*	*No. per m²*	*I* *No. of Larvae*	*No. per 10 m³*	*II* *No. of Larvae*	*No. per 10 m³*	*III* *No. of Larvae*	*No. per 10 m³*	*I–III* *No. of Larvae*	*No. per 10 m³*	*All Gear* *No. of Larvae*
			High-Speed Samplers								
1	1670	1043.8	6400	3248.7	6000	3045.7	2040	1035.5	14440	2406.7	16110
2	916	572.5	2030	1030.5	–	–	320	162.4	2350	587.5	3266
3	11	6.9	75	38.1	–	–	0	0	75	18.8	86
4	2	1.3	0	0	2	1.0	0	0	2	0.3	4
7	0	0	1	0.5	0	0	0	0	1	0.2	1
11	1	0.6	0	0	0	0	0	0	0	0	1
74	1	0.6	0	0	0	0	0	0	0	0	1
102	0	0	1	0.5	1	0.5	0	0	2	0.3	2
109	–	–	27	13.7	220	111.7	69	35.0	316	52.7	316
110	–	–	13	6.6	21	10.7	216	109.6	250	41.7	250
111	–	–	202	102.5	102	51.8	70	35.5	374	62.3	374
112	–	–	159	80.7	38	19.3	44	22.3	241	40.2	241
113	–	–	–	–	41	20.8	4	2.0	45	11.3	45
114	–	–	–	–	8	4.1	0	0	8	2.0	8
128	0	0	1	0.5	0	0	3	1.5	4	0.7	4
129	16	10.0	–	–	314	159.4	109	55.3	423	105.8	439
130	5	3.1	–	–	2	1.0	24	12.2	26	6.5	31
131	3	1.9	–	–	–	–	–	–	–	–	3
132	0	0	0	0	3	1.5	59	29.9	62	10.3	62
133	70	43.8	0	0	1	0.5	24	12.2	25	4.2	95
134	3	1.9	0	0	0	0	7	3.6	7	1.2	10
135	32	20.0	0	0	0	0	9	4.6	9	1.5	41
140	0	0	0	0	4	2.0	5	2.5	9	1.5	9
163	0	0	1	0.5	1	0.5	1	0.5	3	0.5	3
164	0	0	0	0	28	14.2	16	8.1	44	7.3	44
165	0	0	0	0	13	6.6	100	50.8	113	18.8	113
166	0	0	0	0	19	10.0	49	24.9	68	11.3	68
167	4	2.5	1	0.5	5	2.5	73	37.1	79	13.2	83
168	1020	637.5	150	76.1	310	157.4	210	106.6	670	111.7	1690
169	440	275.0	5	2.5	875	444.2	270	137.1	1150	191.7	1590
170	250	156.3	36	18.3	500	253.8	485	246.2	1021	170.2	1271
171	1560	975.0	44	22.3	520	264.0	500	253.8	1064	177.3	2624
172	730	456.3	360	182.7	1260	639.6	920	467.0	2540	423.3	3270
173	651	406.9	2367	1201.5	110	55.8	170	86.3	2647	441.2	3298
Total	7385		11873		10398		5797		28068		35453

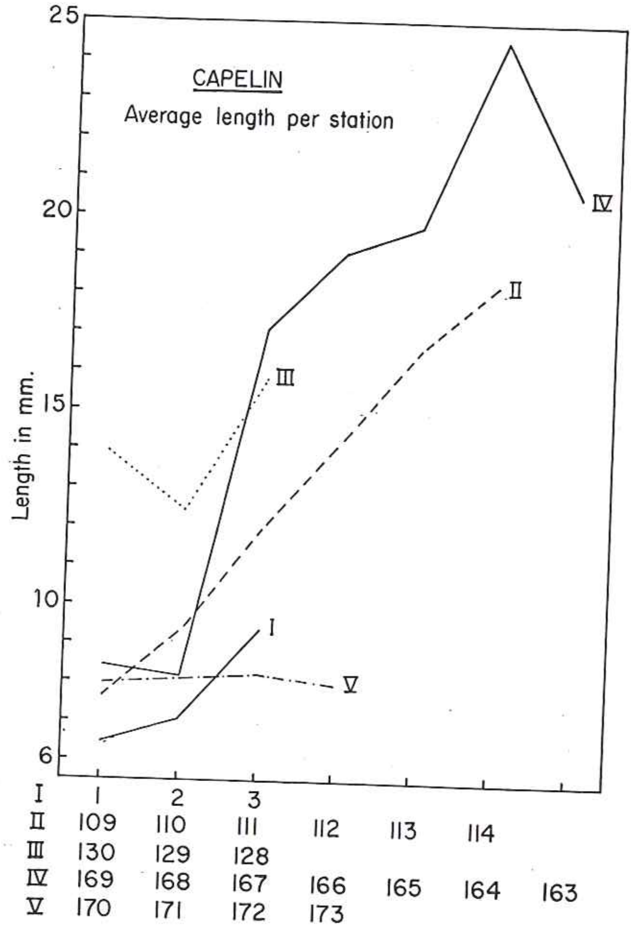


FIG. 14. *Average length of capelin larvae per station (arabic numerals) on five sections (roman numerals) west of Iceland. Stations arranged in offshore direction. B 61, May 1961.*

We can also see from this figure that the size increased towards north (sections I–III). As to section IV, there is a great jump in the size between the stations 168 and 167, from 8.19 up to 17.02 mm mean length. The Faxa Bay section, however, showed a striking difference in the length distribution compared with the other four sections. As mentioned before, the smallest larvae up to 8 mm were almost exclusively found in Faxa Bay and off Reykjanes. Fig. 14 shows too that on all sections, except II, the smallest larvae with a mean length of about 8 mm were caught on the stations closest to the coast, and the Faxa Bay section entirely coincides with this category. The increasing size from the coast out over the shelf region could be explained with

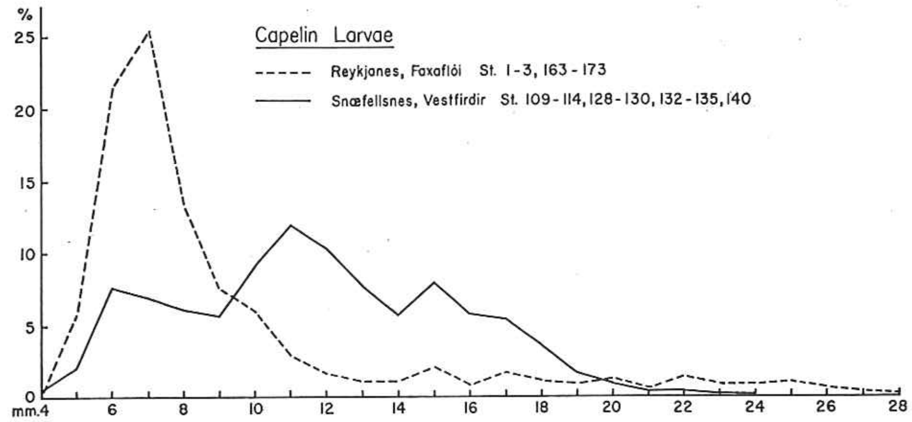


FIG. 15. *Size frequency for capelin larvae west of Iceland. B 61, May 1961.*

a spawning taking place successively from east to west along the south coast and northwards along the west coast, further, that there is a break in the continuity of spawning and hatching along the west coast at Látrabjarg since we find again newly hatched larvae at stations 133—135. The jump in the mean length in section IV also indicates a break in the mentioned continuity of spawning and hatching.

The above mentioned difference in size between Faxa Bay and the northerly area and, further, the lack of newly hatched larvae in the northerly region, are demonstrated in Fig. 15 which is based upon all larval material

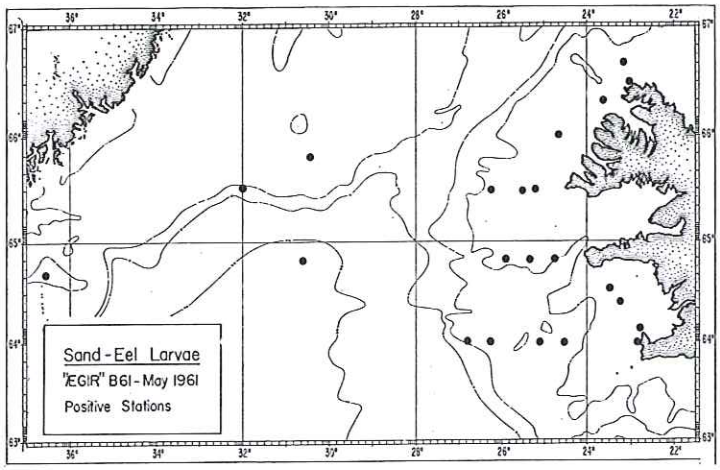


FIG. 16. *Distribution of Ammodytes spp. larvae. Positive stations. B 61, May 1961.*

from Faxa Bay and the Reykjanes section (sections I, IV and V) and from the Látrabjarg and Snæfellsnes sections (sections II and III).

Ammodytes spp.: The sand-eel larvae occurred in the catches from Reykjanes to Kögur section and also at some few stations in the northerly region of East-Greenland (see Fig. 16). Even when the sand-eel larvae were obtained at a considerable number of stations, the total number of the larvae was small (see Table XVIII). 57 specimens, i.e., 32% of the total number were obtained at one station (no. 132).

TABLE XVIII

Number of Ammodytes spp. larvae per station and gear

Cruise B 61, May 1961

— No Sample

Station No.	*Helgoland Larvae Net*		*High-Speed Samplers* I		II		III		I–III		*All Gear*
	No. of Larvae	*No. per m²*	*No. of Larvae*	*No. per 10 m³*	*No. of Larvae*	*No. per 10 m³*	*No. of Larvae*	*No. per 10 m³*	*No. of Larvae*	*No. per 10 m³*	*No. of Larvae*
1	4	2.5	10	5.1	8	4.1	0	0	18	3.0	22
110	–	–	2	1.0	2	1.0	3	1.5	7	1.2	7
111	–	–	5	2.5	1	0.5	1	0.5	7	1.2	7
112	–	–	1	0.5	22	11.1	0	0	23	3.8	23
120	0	0	1	0.5	0	0	0	0	1	0.2	1
128	0	0	1	0.5	0	0	0	0	1	0.2	1
129	1	0.6	–	–	8	4.1	2	1.0	10	2.5	11
130	3	1.9	–	–	2	1.0	3	1.5	5	1.3	8
132	5	3.1	0	0	12	6.1	40	20.3	52	8.7	57
133	0	0	0	0	0	0	1	0.5	1	0.2	1
134	1	0.6	0	0	0	0	3	1.5	3	0.5	4
135	2	1.3	0	0	0	0	3	1.5	3	0.5	5
144	0	0	0	0	3	1.5	0	0	3	0.5	3
145	0	0	0	0	0	0	1	0.5	1	0.2	1
150	0	0	0	0	0	0	1	0.5	1	0.2	1
162	1	0.6	1	0.5	0	0	0	0	1	0.2	2
163	2	1.3	1	0.5	0	0	0	0	1	0.2	3
165	0	0	0	0	1	0.5	0	0	1	0.2	1
166	0	0	0	0	1	0.5	0	0	1	0.2	1
169	0	0	0	0	1	0.5	1	0.5	2	0.3	2
170	0	0	4	2.0	1	0.5	0	0	5	0.8	5
172	0	0	8	4.1	0	0	1	0.5	9	1.5	9
173	0	0	1	0.5	0	0	0	0	1	0.2	1
Total	19		35		62		60		157		176

The length ranged from 4 to 33 mm, the bulk being in the group of 10 to 20 mm. The smallest larvae were obtained off Reykjanes and in Faxa Bay, the biggest ones on the offshore stations off Reykjanes.

Herring (*Clupea harengus* L.): The distribution of herring larvae was restricted to the area off Reykjanes and Faxa Bay (see Fig. 17). The total number of larvae caught was 81, and about 72% were obtained on stations nos. 1, 2 and 102. The length range was 8 to 22 mm, 75% being in the 8 to 14 mm groups. The majority of the small larvae was obtained during part I, the biggest larvae towards the end of part II.

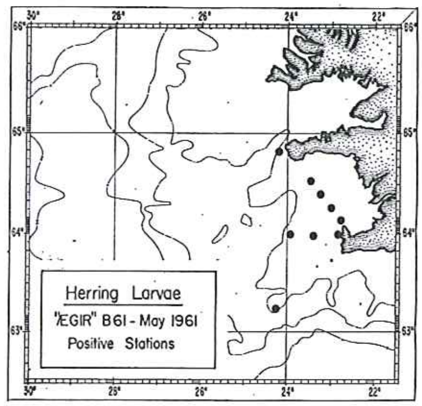


FIG. 17. *Distribution of herring (Clupea harengus L.) larvae. Positive stations. B 61, May 1961.*

Onos spp.: Onos larvae were obtained in considerable numbers in Faxa Bay, some few were also found on the Snæfellsnes section above the continental shelf and at the oceanic stations south of Reykjanes Ridge (see Fig. 18). The length ranged from 2 to 8 mm, with only very few specimens of 4 mm and bigger.

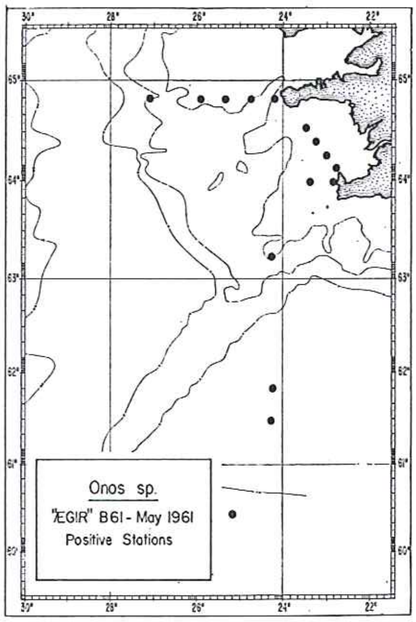


FIG. 18. *Distribution of Onos spp. larvae. Positive stations. B 61, May 1961.*

All larvae discussed above were mainly bound to the Icelandic shelf region (except *Gadus poutassou* to a great extent). However, some species were obtained which were almost exclusively found in the oceanic regions, viz.:

1) *Myctophum glaciale* Reinh., 43 specimens, found in the Reykjanes Ridge area.
2) *Scopelidae sp.*, 29 specimens, found in the Reykjanes Ridge area, too.
3) *Argentina sp.*, 6 specimens, found at few stations both in the northern and southern oceanic part of the area investigated.

4) *Molva byrkelange* Coll., 11 specimens, also found in the Reykjanes Ridge area.

3. Fish Eggs.

Fish eggs were obtained in great quantities during the cruise. As to the distribution of eggs, the area surveyed can geographically be divided into three main regions, i.e., East Greenland shelf, the Icelandic shelf and the Reykjanes Ridge area. These areas differed also in the composition of the fish egg material: On the East Greenland shelf area we found almost exclusively cod eggs. It should, however, be mentioned here that spawning haddock has been observed at East Greenland (Jónsson 1958). But in the trawl catches from East Greenland, haddock occurs only occasionally as single specimens. Therefore, we can consider the presence of haddock eggs in this material as negligible as we have neither got haddock eggs of stages IV to V nor haddock larvae at East Greenland in our material. On the Icelandic shelf area, the egg material was very heterogeneous. Here we obtained also the greatest quantities. In the Reykjanes Ridge area, the eggs from *Brosmius brosme* Asc. and *Scopelidae sp.* dominated.

In working up the material, the main emphasis was laid on the East Greenland shelf material and the material from the Reykjanes Ridge, as these areas are of a general interest, especially East Greenland, because of lack of serial observations from this area. As to the Icelandic shelf region, the working up of the material has not yet been completed and will not be discussed here further.

A. *East Greenland Region.*

a. *Distribution of Cod Eggs.*

Cod eggs were found off East Greenland on almost all stations on the East Greenland shelf. The occurrence of cod eggs was strictly limited to the shelf and the slopes, with few exceptions in the southernmost part (see Fig. 19 and Table XIX). The greatest density was found to be between 61°N and 63°N latitudes where cod eggs were obtained in considerable numbers at several stations. The number of eggs decreased considerably towards north with only few eggs per station. Spawning cod has been observed more or less continuously along the East Greenland shelf (Jónsson 1958). Further, in April 1959 and later years concentrations of spawning cod have been observed on the Fylkir Bank (Magnússon, personal communication). Both these facts are in good correspondance with the distribution and abundance of cod eggs at East Greenland.

The difference in the number of eggs between stations which were taken across to the current direction was striking, even between stations close to each other on the shelf. In Table XX, those differences are illustrated.

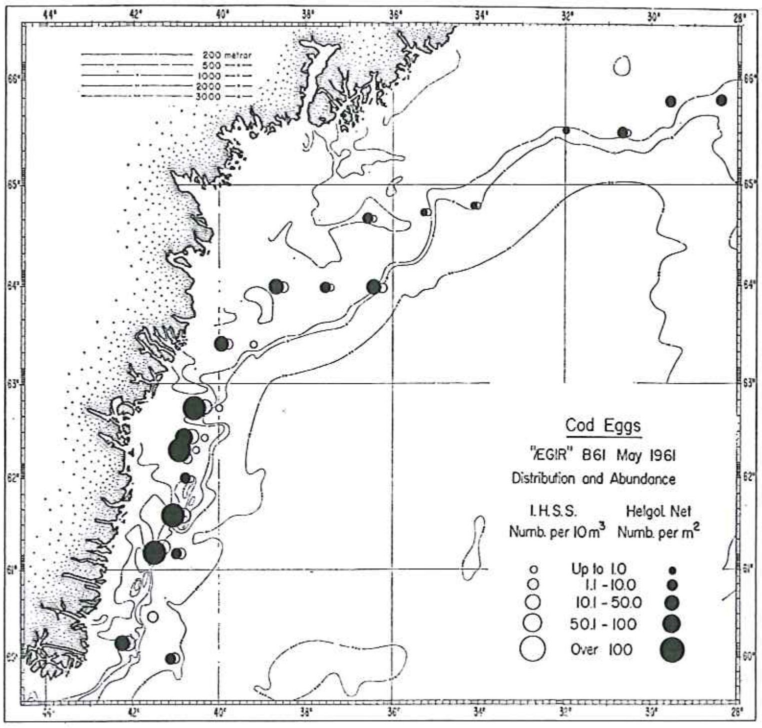


FIG. 19. *Distribution and abundance of cod eggs off East Greenland. B 61, May 1961.*

b. *Relation to Temperature.*

A comparison of this table and the temperature conditions at these stations (see Fig. 20) shows clearly how the temperature influences the density and distribution of cod eggs in this area. The greatest quantities of eggs were obtained in temperatures of 1 to 4° C, which is in good agreement with observations on temperature on the banks, where spawning cod has been observed (JÓNSSON 1958). Thus we see that the majority of the cod eggs at East Greenland was found to be within the area of the East Greenland current.

As mentioned before, the number of cod eggs in the northerly region was much less than in the above mentioned area. Further, the differences in the number of eggs per station which were taken on sections in west-

Table XIX

Number of cod eggs per station (East Greenland) and gear

Cruise B 61, May 1961

Station No.	*Helgoland Larvae Net*		*High-Speed Samplers* I		II		III		I–III		*All Gear*
	No. of Egg	*No. per m^2*	*No. of Egg*	*No. per 10 m^3*	*No. of Egg*	*No. per 10 m^3*	*No. of Egg*	*No. per 10 m^3*	*No. of Egg*	*No. per 10 m^3*	*No. of Egg*
20	17	10.6	3	1.5	7	3.5	3	1.5	13	2.2	30
21	4	2.5	1	0.5	0	0	0	0	1	0.2	5
22	35	21.9	5	2.5	14	7.0	4	2.0	23	3.8	58
23	0	0	0	0	2	1.0	0	0	2	0.3	2
24	39	24.4	12	6.0	17	8.5	3	1.5	32	5.3	71
25	210	131.3	73	36.5	55	27.5	34	17.0	162	27.0	372
26	118	73.8	32	16.0	21	10.5	14	7.0	67	11.2	185
27	4	2.5	0	0	0	0	1	0.5	1	0.2	5
27A	366	228.8	14	7.0	16	8.0	0	0	30	5.0	396
28	0	0	0	0	3	1.5	1	0.5	4	0.7	4
29	0	0	0	0	0	0	4	2.0	4	0.7	4
31	0	0	0	0	0	0	1	0.5	1	0.2	1
74	209	130.6	91	45.5	71	35.5	7	3.5	169	28.2	378
75	5	3.1	1	0.5	2	1.0	22	11.0	25	4.2	30
76	312	195.0	80	40.0	89	44.5	8	4.0	177	29.5	489
77	0	0	23	11.5	10	5.0	10	5.0	43	7.2	43
78	77	48.1	56	28.0	40	20.0	25	12.5	121	20.2	198
79	4	2.5	3	1.5	2	1.0	4	2.0	9	1.5	13
121	4	2.5	0	0	1	0.5	0	0	1	0.2	5
142	2	1.3	0	0	0	0	0	0	0	0	2
143	3	1.9	0	0	0	0	0	0	0	0	3
145	1	0.6	0	0	0	0	0	0	0	0	1
148	1	0.6	0	0	1	0.5	0	0	1	0.2	2
149	1	0.6	0	0	1	0.5	0	0	1	0.2	2
150	4	2.5	0	0	0	0	3	1.5	3	0.5	7
Total	1416		394		352		144		890		2306

Table XX

No. of eggs at stations across the East Greenland current

Stat. no.	*No. of eggs*	*Stat. no.*	*No. of eggs*
25	372	31	1
26	185	29	4
27A	396	28	4
76	489	75	30
24	71	23	2
78	198	79	13

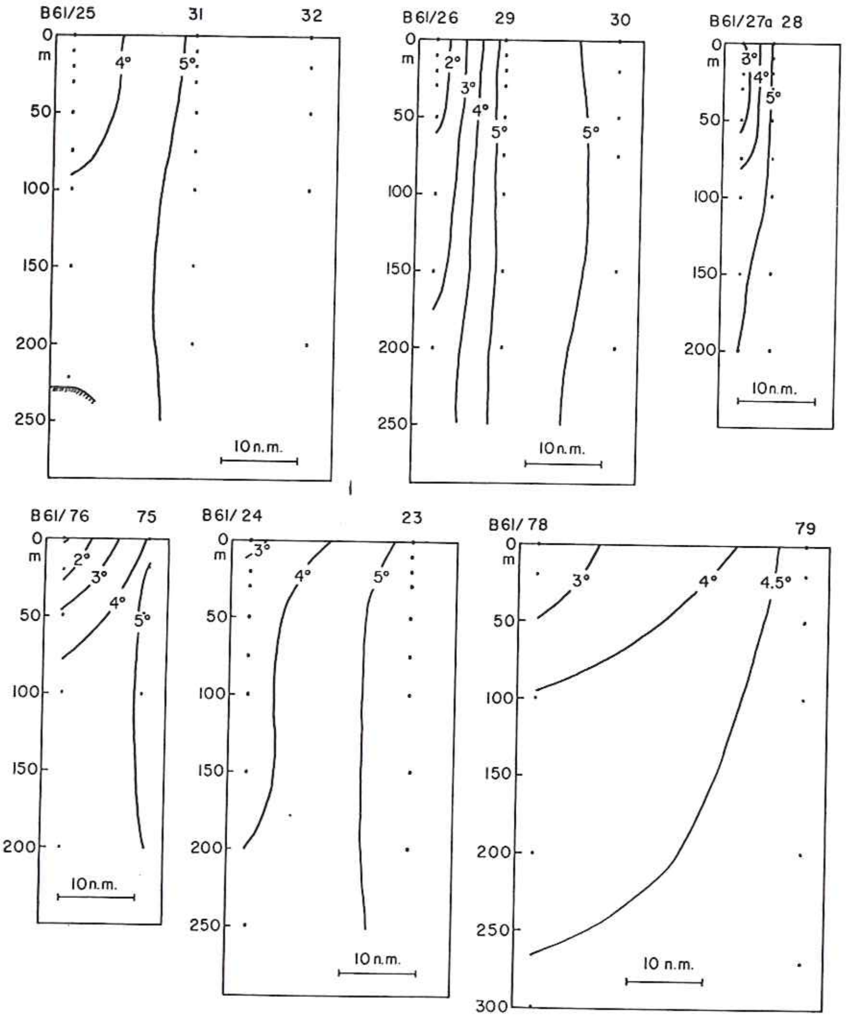


Fig. 20. *Temperature sections on the East Greenland slope, south of 64°N. B 61, May 1961.*

easterly directions were not so pronounced. Temperature measurements showed that we had not reached the East Greenland current. These conditions are illustrated as follows (see also Fig. 21):

Stat. no.	*No. egg*	*Stat. no.*	*No. egg*	*Stat. no.*	*No. egg*
22	58	21	5	20	30
150	7	149	2	148	2

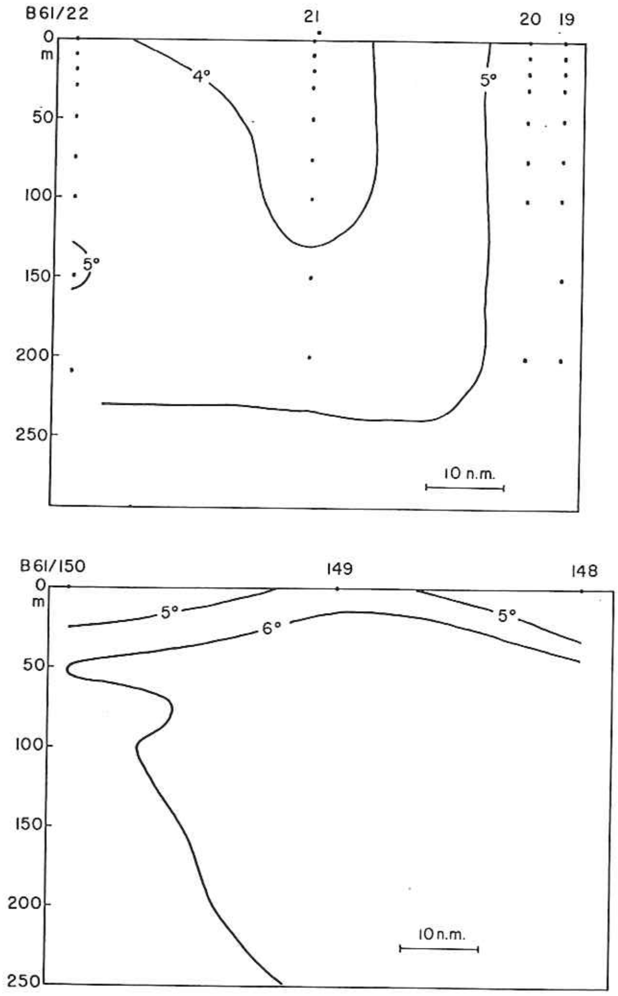


FIG. 21. *Temperature sections on the East Greenland slope, between 64°N and 65°N. B 61, May 1961.*

c. *Relation of Developmental Stages to Drift.*

The very few cod larvae found at East Greenland indicate an early development stage of the eggs. Table XXI gives the stages of cod eggs for each station off East Greenland arranged from north to south. As can be seen from this table, the bulk of the eggs (94%) is on the developmental stages I to III. Thus, we can see that spawning has newly taken place in May on the whole area surveyed off East Greenland. Further, that the spawning was much more intensive in the southern part than in the northern part of East Greenland.

TABLE XXI

Developmental stages of cod eggs (East Greenland)

Cruise B 61, May 1961

Station Number	I–II	III	IV	V	*Total*
142	2				2
143	3				3
121	5				5
145		1			1
148		2			2
149	1	1			2
150		6	1		7
20	23	7			30
21	2	3			5
22	36	14	7	1	58
23	1	1			2
24	53	16	2		71
31	1				1
25	303	62	6	1	372
29	4				4
26	160	24	1		185
28	2	1	1		4
27A	212	142	41	1	396
27	2	3			5
74	172	167	28	11	378
75	25	3	1	1	30
76	262	208	12	7	489
77	35	7	1		43
79	10	2	1		13
78	81	102	13	2	198
Total	1395	772	115	24	2306
%	60.49	33.48	4.99	1.04	100.00

SEREBRYAKOV (1964) and POSTOLAKY (1964) have recently shown that cod eggs in the Labrador current are carried over long distances during the incubation time which is estimated to be 40 to 50 days in this region. In the East Greenland area, we have some comparable features, since the bulk of the eggs was found within the boundary of the East Greenland current. But the temperature off East Greenland was higher (1 to 4° C) than in the

Labrador current (—1.0 to 0.0° C, SEREBRYAKOV 1964). Thus, we can assume that the incubation time will be about 20 to 30 days at East Greenland, (see APSTEIN 1909).

According to DIETRICH's current chart (DIETRICH 1957), the velocity of the East Greenland current in the area in question is from 1.1 to 20 cm/sec, or 4.7 to 9.3 n.m. per day. Thus, eggs drifting in the East Greenland current, can be transported up to 280 n.m. during the incubation time. As can be seen from Table XX, eggs which had reached the developmental stages IV and V were mainly found south of 63° N latitude. They must thus originate from spawning places much farther north, most probably from the areas off Angmagsalik, and hatching might have taken place for the bulk of these eggs before they reached Cape Farewell. But the majority of the eggs south of 63° N latitude (stages I to III) must have been drifted round Cape Farewell before hatching could have taken place.

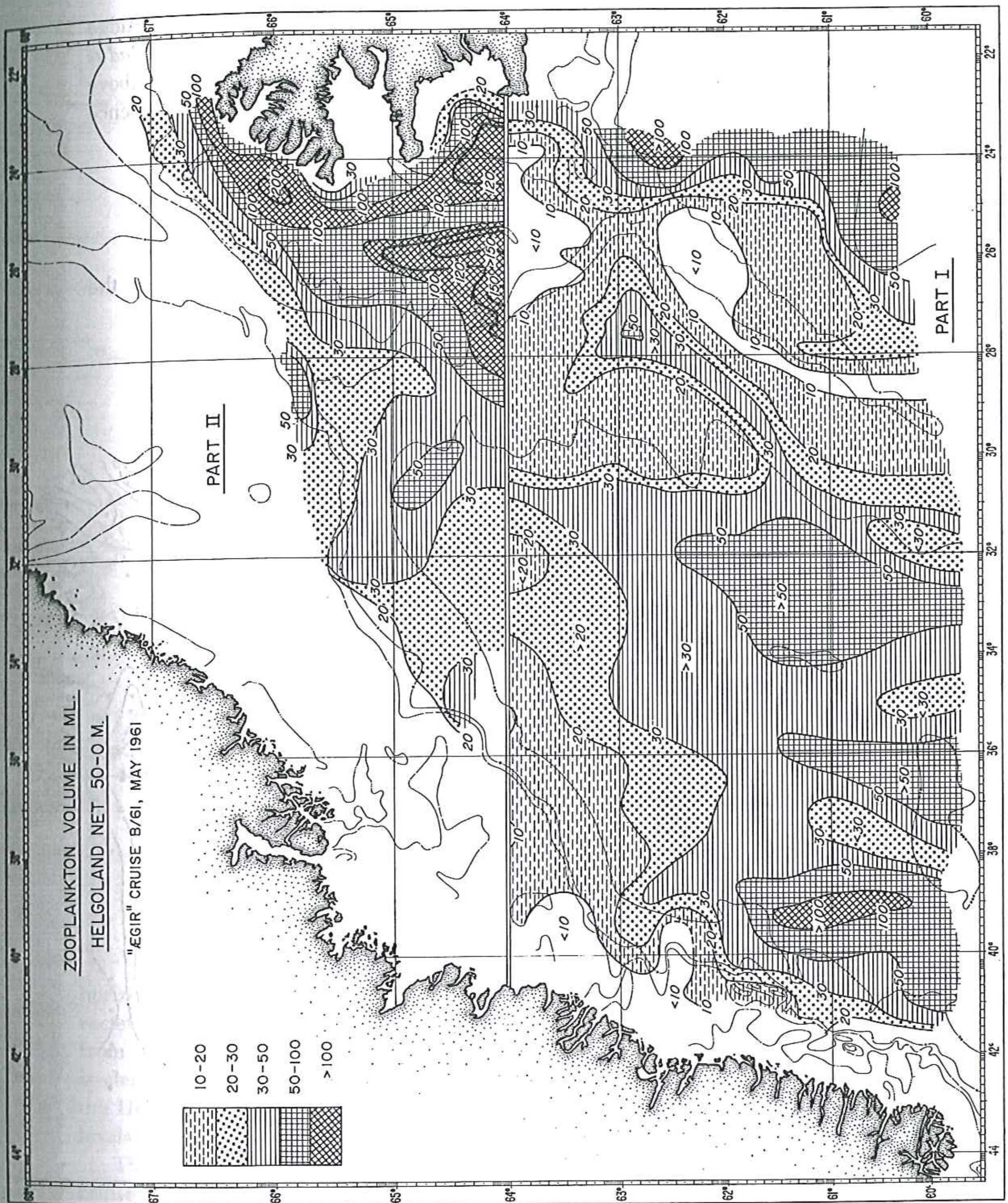
These considerations lead to the assumption that no remarkable concentrations of cod larvae can be expected on the East Greenland banks, except when there has been heavy spawning in the northernmost region or there has been a strong drift from the spawning grounds off Iceland.

The size of the cod eggs at East Greenland varied within the range of 1.19 to 1.56 mm in diameter, the majority being within the range 1.31 to 1.44 mm (91%). POSTOLAKY (1964) gives the corresponding size range of cod eggs for the Labrador area: 1.1 to 1.8 mm and 1.4 to 1.6 mm. Preliminary measurements of cod eggs in Faxa Bay from this cruise show a size range of 1.12 to 1.44 mm, 93% being within 1.25 to 1.38 mm. Thus, the bulk of the cod eggs at East Greenland seems to be slightly bigger than cod eggs in Faxa Bay and distinctly smaller than cod eggs off Labrador.

B. *Reykjanes Ridge Region.*

The Reykjanes Ridge area was distinguished from the other oceanic areas by occurrence of fish eggs. They were found on a relatively great number of stations though the total number of eggs in this area was rather small. The eggs proved to be only from *Brosmius brosme* Asc. (total no. 39) and *Scopelidae spp.* (tot. no. 23). In this connection it is interesting to mention stat. no. 102 which belongs to the Icelandic shelf area, but lies close to the area here in mind. On this single station we got eggs from 6 species, with *Brosmius, Molva molva* L. and *Onos spp.* eggs dominating, and larvae from 10 species.

FIG. 22. *Total zooplankton volume in ml in Helgoland net, 50 to 0 m. B 61, May 1961.*


ZOOPLANKTON VOLUME IN ML.
HELGOLAND NET 50-0 M.
"ÆGIR" CRUISE B/61, MAY 1961
10-20
20-30
30-50
50-100
>100
PART I
PART II

During this cruise and later cruises we got above the Reykjanes Ridge and southeast of it beside the common species as *Sebastes marinus* and *Gadus poutassou,* fish larvae of several less common species. Therefore, the above mentioned area is thought to be of rather great interest as to the occurrence of larvae of less common fish species.

4. Other Zooplankton.

A. *Quantitative Distribution.*

It has previously been indicated (HALLGRÍMSSON 1957, 1960) that the

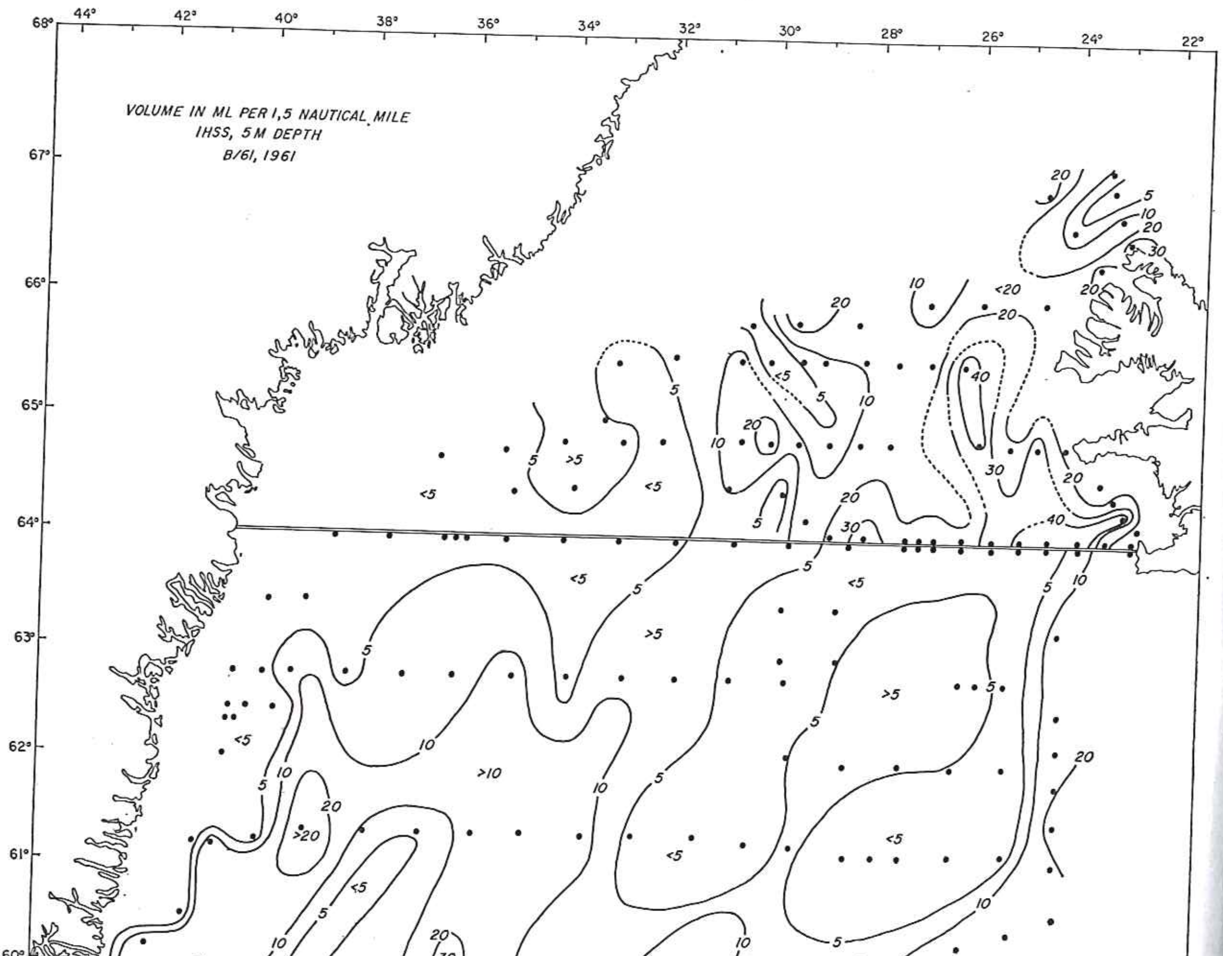


FIG. 23. *Total zooplankton volume in ml in IHSS I. B 61, May 1961.*

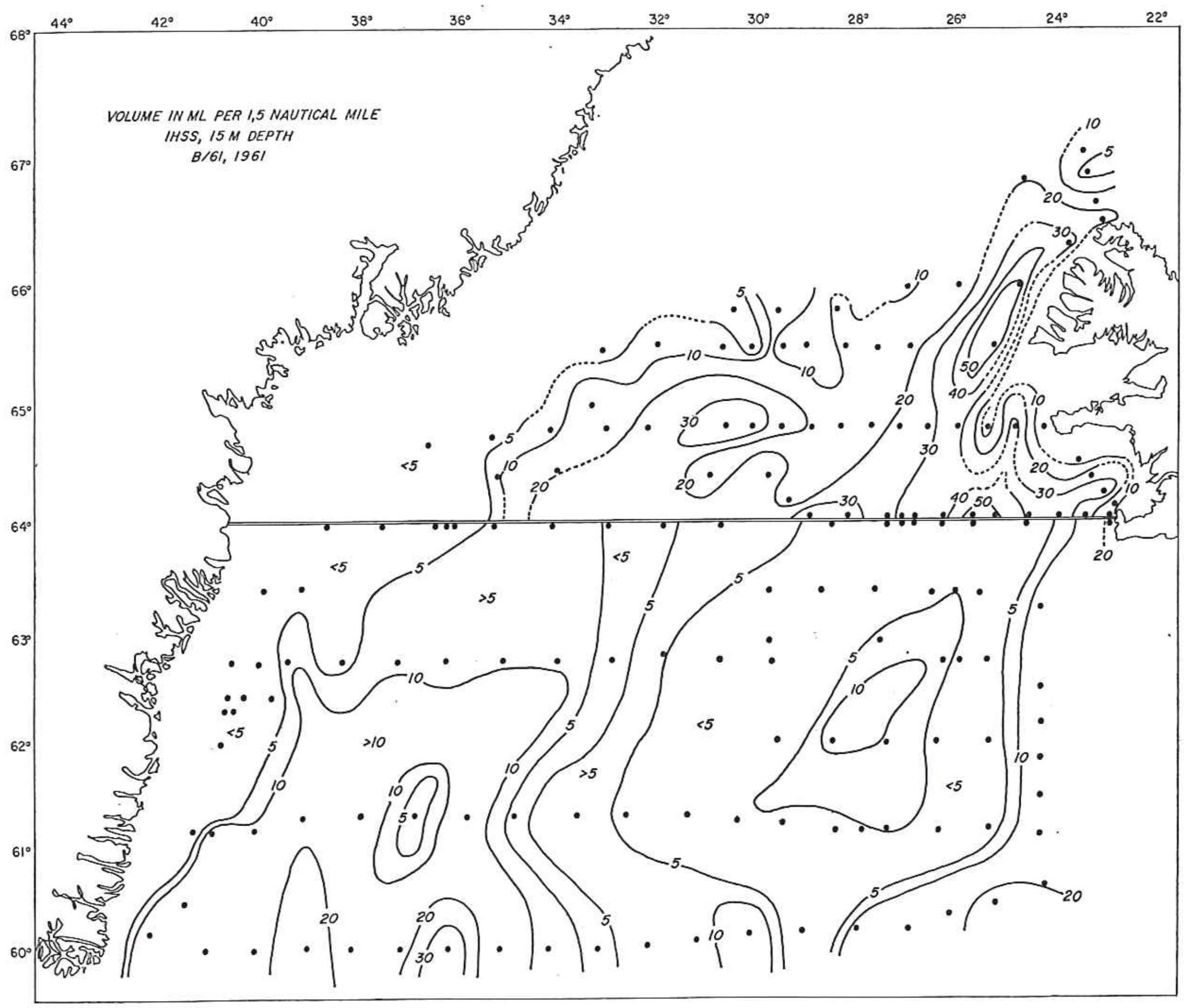


Fig. 24. *Total zooplankton volume in ml in IHSS II. B 61, May 1961.*

horizontal distribution of zooplankton in the Irminger Sea in spring is characterized by tongues of high zooplankton density extending into this area from south and east. The horizontal distribution is thus very uneven, and this is clearly indicated in Figs. 22 to 25. Fig. 22 shows the distribution based on the Helgoland net yield, Figs. 23, 24 and 25 show the distribution in different levels according to the IHHS's yields.

The mean total zooplankton volume per IHSS tow in both parts of this cruise was 10.4 ml, but the mean for part I was 6.5 ml.

As to the zooplankton density in the Irminger Sea proper in spring, in-

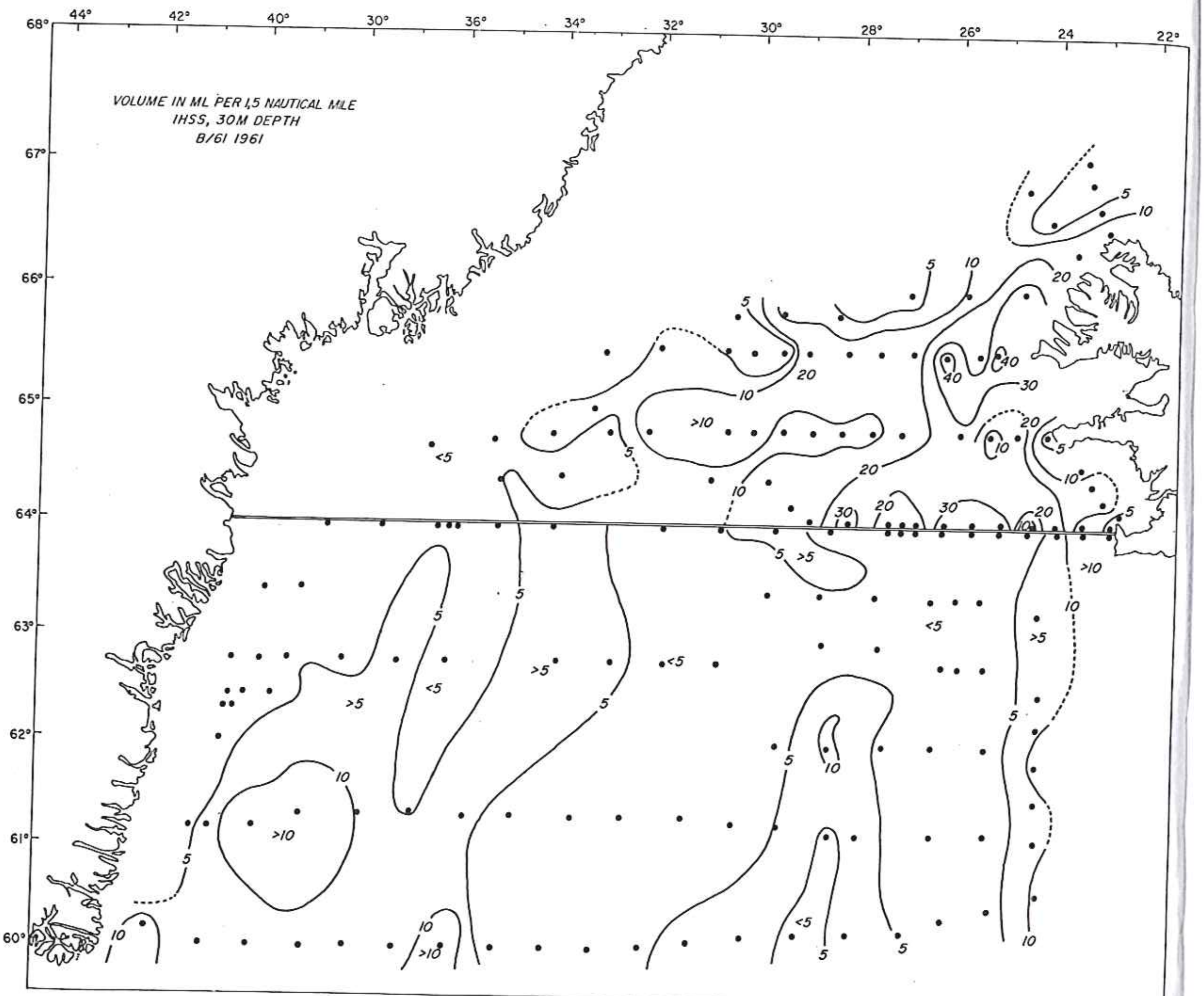


FIG. 25. *Total zooplankton volume in ml in IHSS III. B 61, May 1961.*

sufficient material is available from previous years, whereas samples from May 1962 and 1963 are at hand.

In chapter V these collections are compared and discussed.

Although the zooplankton density in Icelandic waters was generally below the mean in the spring of 1961, the density of the shelf area itself off the west coast was above the average as indicated in Fig. 22.

It can be seen from Figs. 22 to 25 that the eastern part of the area surveyed during part I was on the whole poorer in zooplankton, with the exception of a few zones of high density penetrating into the area from the east, and a marked density tongue running along the western side of the Reykjanes Ridge, between the 1000 and 2000 m contours. The western part of the area, south of 63° N, was also characterized by marked density zones penetrating from the south.

In part II of the cruise the Icelandic shelf area was characterized by tongues of high zooplankton density, whereas the area west of 28° W was relatively poor.

It is interesting to compare the horizontal distribution based on the Helgoland net yields (Fig. 22) and on the IHSSs' samplings (Figs. 23, 24 and 25). Although the Helgoland net illustrates more density variations than the IHSSs, all these devices show similar general features of the horizontal distribution.

B. *Relation to Temperature.*

Although the zooplankton density does not indicate as good a correlation with temperature as the larvae, some characteristic features can be pointed out.

Comparison with temperature distribution at 20 metres (Fig. 4) shows a high zooplankton density east of the Reykjanes Ridge where temperatures exceed 8.5° C. Above the ridge itself, the density is lower, but west of the ridge a maximum was observed in waters between 7.5° and 8° C.

In the southern part of the area, approximately along and west of the 7° isotherm, a new maximum extends northward. In the warm water tongue at approximately 60° N, 36° W a maximum was found, and also along the 5° isotherm extending northward along the 40° W meridian.

Figs. 22 to 25 illustrate also that the zooplankton density in the East Greenland current was relatively low.

Although we are not able to show a detailed correspondance between zooplankton abundance and the isotherms at 20 meters, it is evident that the isolines for the zooplankton volume mainly follow the same general direction as the isotherms.

However, it is presumed that the marked tongues of high zooplankton density which extend into the area from south and east must be explained by the complexity of the current system in the Irminger Sea as illustrated by Dietrich (1957) and Hermann and Thomsen (1946).

Fig. 22 indicates clearly a splitting in the zooplankton density at about 65° N (part II of the cruise) resembling that for the temperature and redfish larvae density.

This splitting in the density is not so marked on Figs. 23 and 24, but can, however, clearly be observed in the 30 m level (Fig. 25). This plankton distribution corresponds with the division of the Irminger Current into two branches in this region as indicated by Hermann and Thomsen (1946).

C. *Day and Night Catches.*

The relation between night and day yield was studied, the samples divided into day and night catches as for the larvae. Table XXII shows the mean volume in ml per m³ day and night and the relation between night and day catches.

TABLE XXII

Mean volume in ml per m³

B 61, May 1961.

	Total Sampling	*Day Sampling*	*Night Sampling*	*Night/Day Ratio*
Helgoland net 50—0 m	0.50	0.50	0.52	1.04
IHSS I 3 m level	0.56	0.54	0.62	1.15
IHSS II 15—18 m level	0.63	0.59	0.71	1.20
IHSS III 25—30 m level	0.38	0.34	0.46	1.35

It can be seen from the table that the highest mean zooplankton density is found in the 15 to 18 m level. On the other hand, the greatest night/day variations are observed in the 25 to 30 m level, whereas the vertical 50 to 0 m hauls show practically no night/day variations, which indicates a diurnal migration within this layer.

As mentioned above, the horizontal distribution of zooplankton and redfish larvae is characterized by zones or tongues of high density, which more or less marked minima between. This relationship is discussed in Chapter V.

D. *Composition of the Zooplankton.*

Calanus finmarchicus was the most dominant species in the whole oceanic area, its percentage frequency in the samples varying from 72 to 99. This frequency is illustrated in Fig. 26. The figure illustrates that tongues of relatively low *C. finmarchicus* density penetrate into the area from south to southeast, with corresponding maxima between. In these zones of *C. finmarchicus* maxima, females of stage VI were generally dominating as shown in Fig. 27.

According to EINARSSON (1960), the redfish larvae in the Irminger Sea in May 1955 fed mainly on juvenile gastropods (*Spiratella* sp.) and copepod eggs. No copepod eggs were caught in our nets due to wide mesh openings

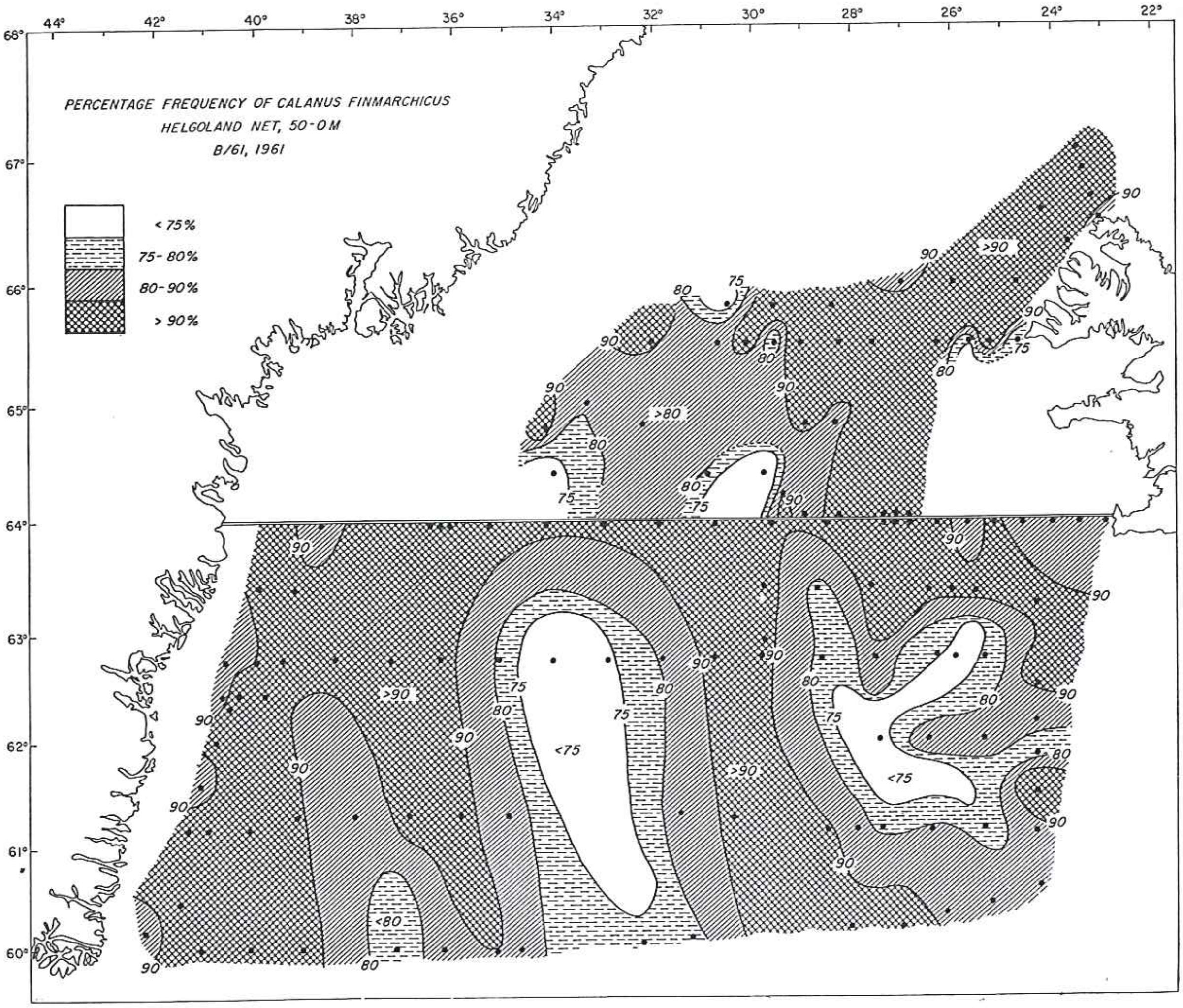


Fig. 26. *Percentage frequency of C. finmarchicus, Helgoland net 50 to 0 m. B 61, May 1961.*

(0.3 mm). Therefore, special attention was paid to the distribution and percentage frequency of *Spiratella retroversa* which is illustrated in Fig. 28. Comparison between this figure and Fig. 26, illustrating the *C. finmarchicus* percentage frequency, shows that the minima in the percentage frequency of *C. finmarchicus* west of the 31° meridian generally coincide with the maxima in *S. retroversa.* In the *S. retroversa* zone, as illustrated in Fig. 28, the percentage frequency of *C. finmarchicus* and *S. retroversa* varies from 84 to 100, the mean being 96. Thus it is obvious that the low percentage values of *C. finmarchicus* in this zone are due to the occurrence of *S. retroversa,* since the presence of other species is negligible. Outside the *Spiratella* zone in Fig. 28,

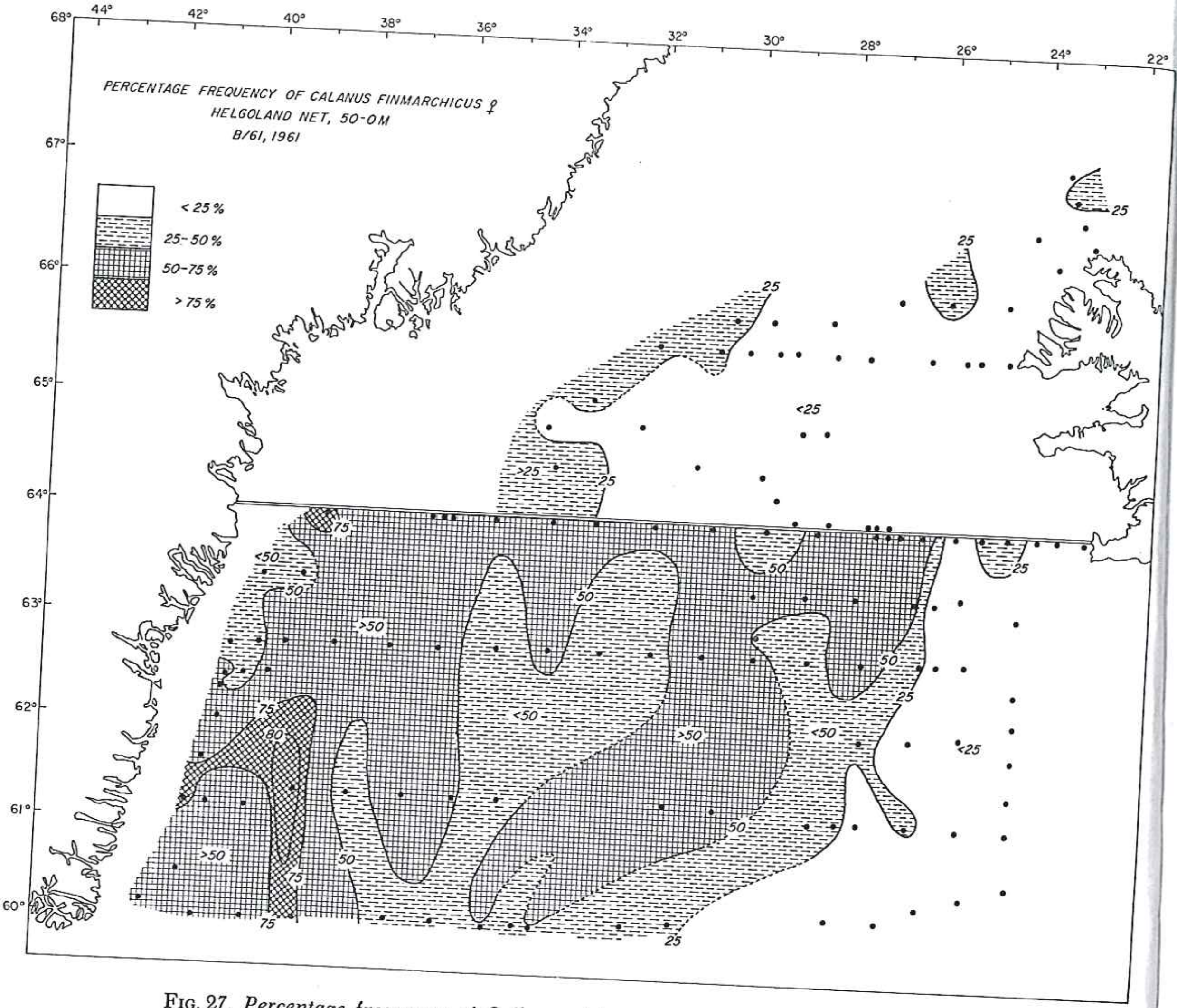
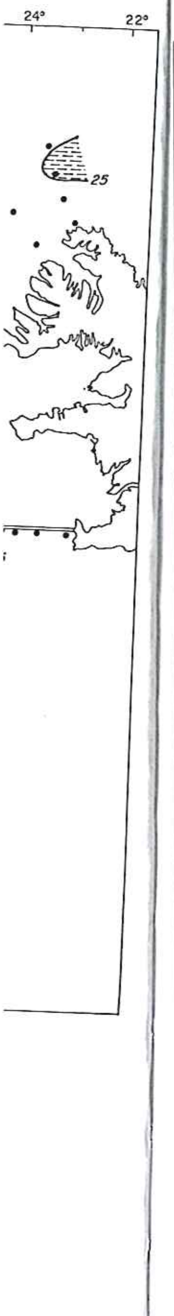


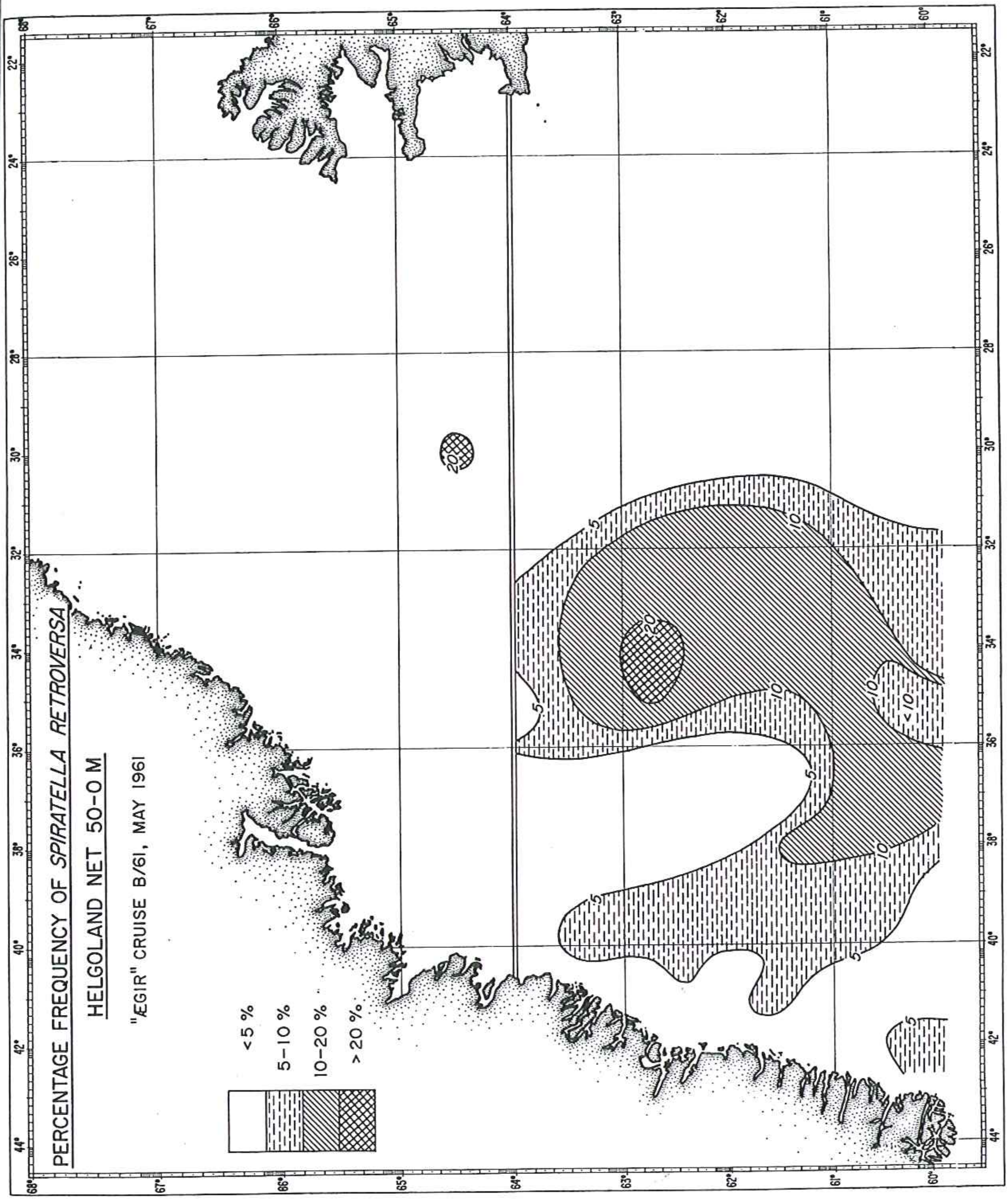
FIG. 27. *Percentage frequency of C. finmarchicus, females, Helgoland net 50 to 0 m. B 61, May 1961.*

its percentage frequency was very low — with one exception — although it was present at a number of stations.

As mentioned before, the relatively low percentage frequency of *C. finmarchicus* west of the 32° meridian in part I of the cruise is mainly due to the presence of *S. retroversa,* whereas the relatively low frequency of *C. finmarchicus* east of the 28° meridian is mostly due to presence of other cope-

FIG. 28. *Percentage frequency of S. retroversa, Helgoland net 50 to 0 m. B 61, May 1961.*


24°
22°
25


PERCENTAGE FREQUENCY OF SPIRATELLA RETROVERSA
HELGOLAND NET 50-0 M
"ÆGIR" CRUISE B/61, MAY 1961
<5 %
5-10 %
10-20 %
>20 %

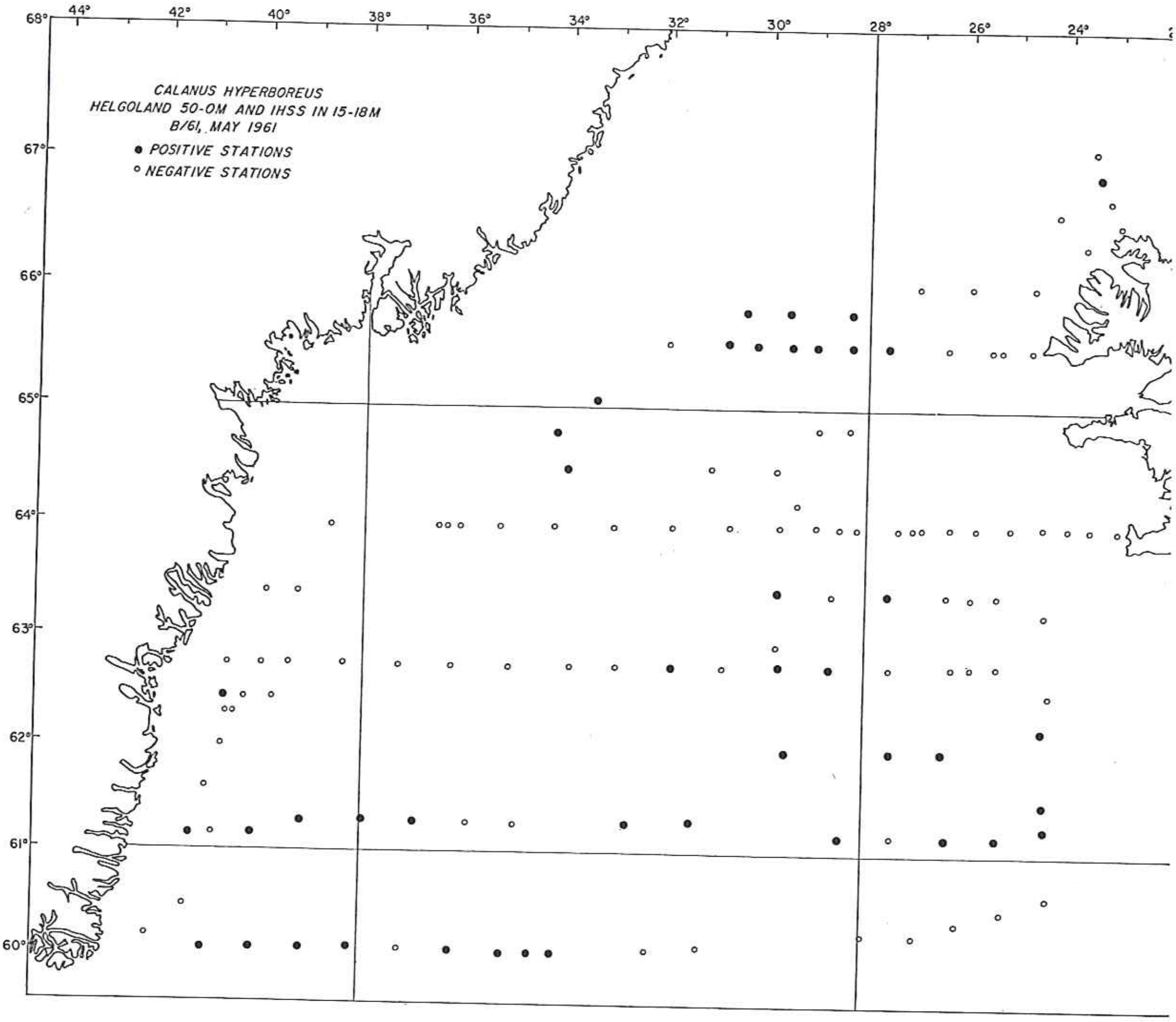


Fig. 29. *Distribution of C. hyperboreus, Helgoland net 50 to 0 m and IHSS II. B 61, May 1961.*

pods, i.e. *Oithona spinirostris, Pareuchæta norvegica,* and in some instances, Euphausiids.

As to the Euphausiids, two species dominated, i.e. *Meganyctiphanes norvegica* and *Thysanoessa longicaudata.* They were mostly found in two areas, i.e. in the SE-part of the survey area, east of the Reykjanes Ridge, and west of Faxa Bay (between 63° and 65° N) between the 1000 and 2000 m contours.

Their percentage frequency in the samples was low. *M. norvegica* never exceeded 15% and was seldom observed west of the 32° meridian. *Th. longicaudata* was more evenly distributed, and its highest percentage frequency was 16.

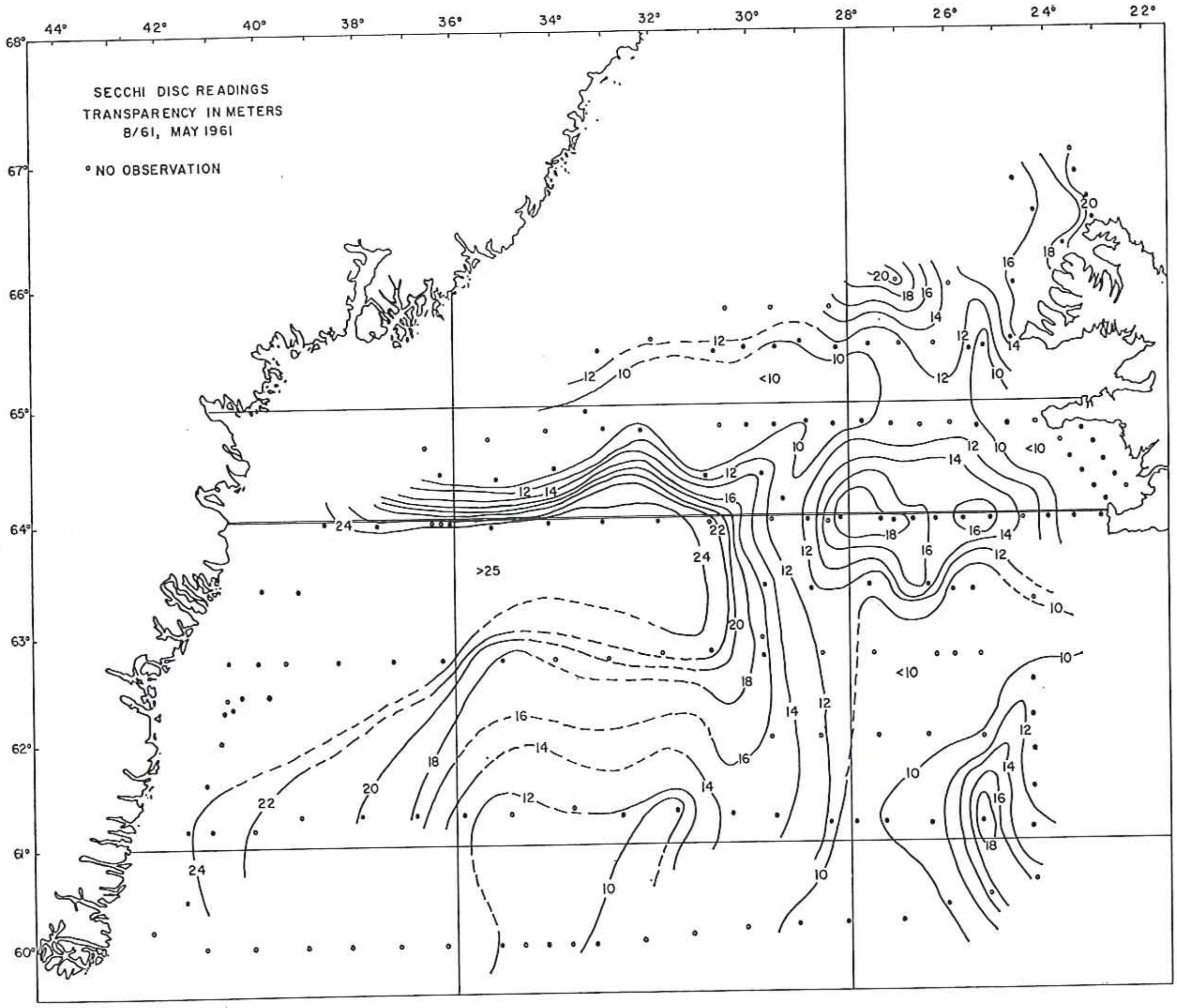


FIG. 30. *Transparency in meters according to Secchi disc readings. B 61, May 1961.*

This low frequency of the Euphausiids is noteworthy, as they have been considered a dominating part of the macroplankton in the Irminger Sea (EINARSSON 1960).

BAINBRIDGE has given a survey of the composition of the plankton as well as the food of young redfish from the Irminger Sea during May 1961, based on the Continuous Plankton Recorder Survey (BAINBRIDGE 1964).

Generally, the zooplankton composition according to the Plankton Recorders is in good agreement with our material. In the Plankton Recorder material *C. finmarchicus* was predominant. BAINBRIDGE found the mean number

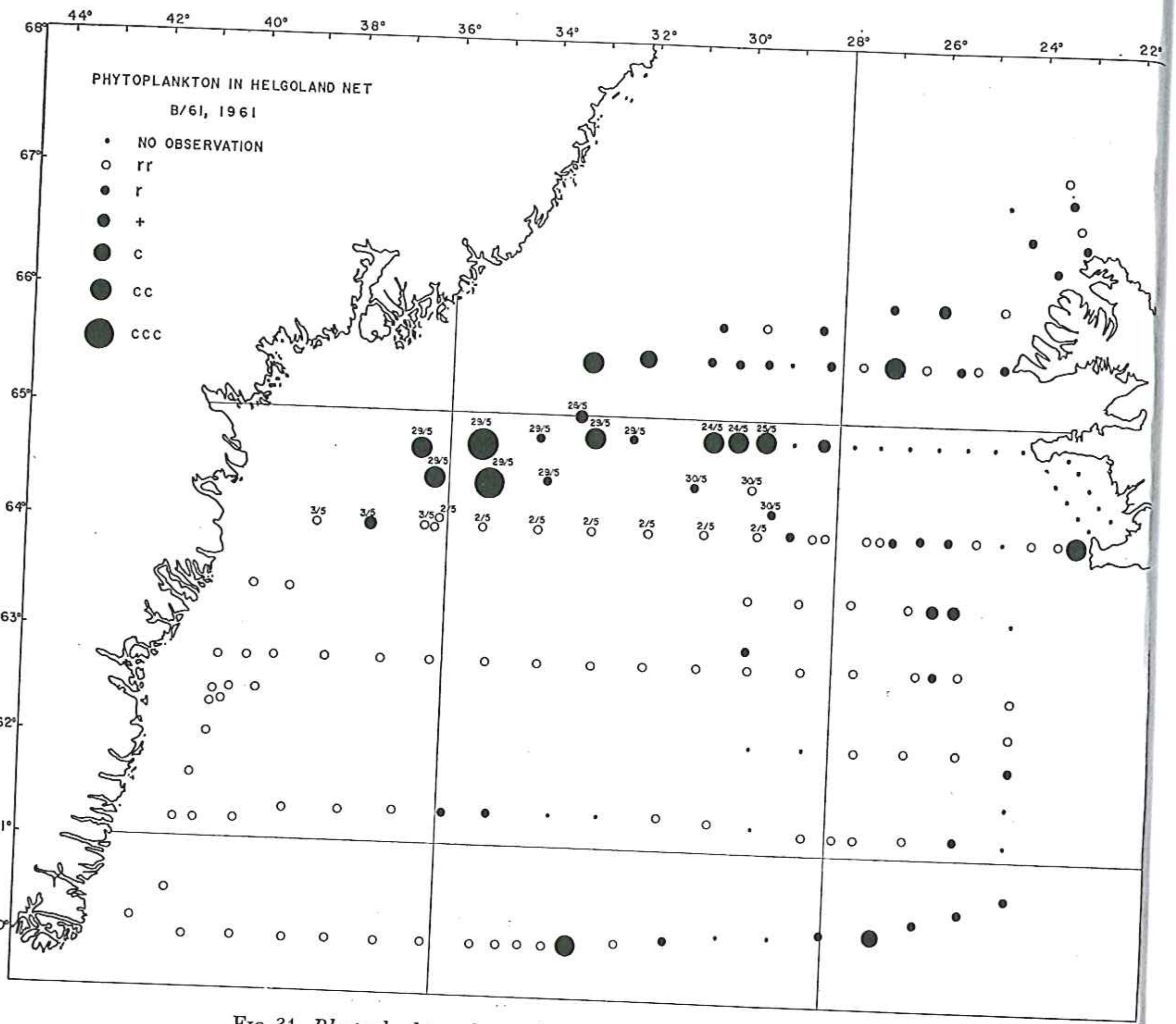


FIG. 31. *Phytoplankton observations in the Helgoland net 50 to 0 m. B 61, May 1961.*

of *C. finmarchicus* per 3 m³, at a depth of 10 m, to be 127 (84.1%), the mean number of other copepods 4 (2.6%), the mean number of *Spiratella spp.* 8 (5.2%), the mean number of *Euphausiids* 5 (3.4%), and of larvacea 7 (4.6%).

As to the food of young redfish, BAINBRIDGE found it to be restricted to *Calanus* eggs and *Spiratella* larvae. Of the 65 stomachs examined, he found 48% containing *Calanus* eggs only, 6% containing *Spiratella* larvae only and 14% containing both these eggs and larvae (BAINBRIDGE 1964). Thus, a clear relationship between *Calanus* eggs and young redfish was found for this period.

In the northern part of the area surveyed (part II) there was a relative minimum in the percentage frequency of *C. finmarchicus* west of the 29° meridian.

Other species most frequent in this part were *Oithona spinirostris, Th. longicaudata* together with Ostracods, Amphipods and *Calanus hyperboreus*.

Regarding the last-named species, it was just as often recorded in the warm water of the southern and eastern parts of the area, as indicated in Fig. 29. It was, for example, found at 13 of 27 stations in the area south of 63° N and east of 32° W, i.e. in typical Atlantic water. Thus, the distribution of *C. hyperboreus* was neither confined to the cold East Greenland current nor directly related to temperature as previously observed by EINARSSON (1960).

E. *Secchi Disc Readings and Phytoplankton Observations.*

As mentioned before, Secchi Disc readings were carried out in daytime and phytoplankton was observed in the Helgoland net. Figs. 30 and 31 illustrate this, respectively. The phytoplankton was estimated according to EINARSSON (1956). It is obvious that the phytoplankton caught in the Helgoland net does not illustrate any true picture of the phytoplankton, because of the big meshes used in the net (0.3 mm). Nevertheless, these two pictures correspond fairly well.

As to the transparency (Fig. 30), it was very high in May in part I of the cruise, indicating no phytoplankton blooming. In part II (north of 64° N) the transparency was much lower. In this connection it is interesting to note the western part of the section along the 64° latitude. As shown in Fig. 31, this part of the section was worked in the first days of May and the transparency was very high and no phytoplankton observed in the net. On the other hand, the stations immediately north of this section were worked in the last days of May. Then the transparency has become low and much phytoplankton was observed in the net.

V. GENERAL DISCUSSION

As known, there is a clear difference in the distribution of redfish larvae and most of the other larvae here discussed. Thus, the bulk of the redfish larvae was found in the oceanic region of the survey area, where their distribution was characterized by zones or tongues of high density with more or less marked minima between, whereas the majority of the other fish larvae was found on the Icelandic shelf within the 200 m depth contour, the greatest density being in the Faxa Bay. A comparison of Figs. 2 and 9 illustrates clearly how the distribution of redfish and other larvae is separated, since they show very little overlapping, except for blue whiting which occurred together with redfish larvae in the samples taken south east of the Reykjanes Ridge. Beside blue whiting, only few species, e.g. sand-eel and Onos larvae, were found to be distributed in the Atlantic part of the Irminger Sea.

In correspondance with the redfish larvae abundance, the zones and tongues of high density were also typical for the zooplankton in general (see also Figs. 2 and 22).*) Thus, the density zones of redfish larvae and zooplankton east of the Reykjanes Ridge, west of the Ridge between the 1000 m and 2000 m contours, west of the 2000 m contour and along the 36° meridian correspond fairly well. Between these density zones corresponding minima also appear. However, off the East Greenland shelf (part I), a high density zone of zooplankton does not correspond with any great concentration of redfish larvae, and the southern part of the redfish larval density zone west of the Reykjanes Ridge does not coincide with high zooplankton density. In the northern part of the area, west of the 27° meridian, the zooplankton and redfish larval densities correspond fairly well, both splitting in two branches at about 65° N due to currents. But, east of the 27° W meridian, i.e. on the Icelandic shelf in a zone of high zooplankton density, the redfish larvae were scarce, but within this area the greatest concentrations of other fish larvae were observed.

Since there have also been carried out Icelandic investigations in the Irminger Sea in May 1962 and 1963, it was thought desirable to compare the zooplankton volume and the main number of redfish larvae from these years. However, the 1962 expedition only covered a part of the area investigated in the years 1961 and 1963, i.e. between 62° N to 64° N and 22° W to 37° W. Therefore, the sampling within this area during May 1961 to 1963 has been used for comparison (area A in Table XXIII).

TABLE XXIII

Mean total zooplankton volume in ml and mean number of redfish larvae per IHSS's tow in May 1961 to 1963.

Area		*1961*	*1962*	*1963*	*Mean*
A	Total zooplankton	5.2	9.7	4.0	6.3
	Redfish larvae	11.7	11.3	8.0	10.2
B	Total zooplankton	6.6	11.2	3.9	6.5
	Redfish larvae	15.2	15.9	9.6	13.2

*) As before, the term zooplankton is here used as meaning zooplankton minus ichthyoplankton.

As can be seen from this table, the zooplankton volume in area A was by far highest in 1962 and lowest in 1963. In 1961, the mean zooplankton volume for this area was approximately half of the mean volume for the total area surveyed (see page 57), but only slightly below the average for these three years.

The difference in the mean number of redfish larvae in this area for the three years is not so pronounced. It proved to be nearly the same in 1961 and 1962. But in 1963 the mean number for the larvae was also lowest as for zooplankton, the only one below average in this period. The mean temperature at 20 m depth was 7.2°C in 1961, 6.8°C in 1962 and 6.7°C in 1963.

Area B in Table XXIII means the oceanic part of the surveyed region south of 64°N and outside the 500 m depth contour. For this area, the relationship zooplankton volume and number of redfish larvae in the IHSS for all three years is demonstrated (Table XXIII). Though the 1962 expedition took place in the latter half of May and covered only a part of the areas surveyed in 1961 and 1963, which were both carried out in approximately the same region in the first half of May, the results for 1962 are also included.

In general, the yearly variation in the total zooplankton volume, as illustrated in area A, is also reflected in area B, but more pronounced. This tendency is supported by analogous zooplankton density variations in these years in Icelandic waters and the southern part of the Norwegian Sea. (Anon. 1962).

It can be seen from the table that there was a good correlation between the standing stock of zooplankton and the number of redfish larvae, the mean volume of zooplankton and the mean number of redfish larvae being highest in 1962 but lowest in 1963. In spite of the above mentioned time difference — a fact that may have affected the zooplankton volume in 1962 — the observations present a fairly good picture of the oceanic area in question.

A correlation is found between the number of redfish larvae observed in 1961 and 1962 and Henderson's results (Henderson 1963) which show that the redfish larvae were somewhat more numerous in 1962 than in 1961 (see also page 11). Further, his investigations show that the redfish larvae in these two years were very abundant, being above the average number observed for the last 8 years period.

Thus, it can be seen that in 1961 and 1962 the great abundance of redfish larvae corresponded with a high standing stock of zooplankton. In 1963, on the other hand, there were relatively low numbers of larvae and the stock of zooplankton was low. From these results and assuming the year-class strength is determined during the larval phase, it is expected that the 1963 year-class of redfish from this area will be a relatively poor one.

Generally, the larval distribution is reflected in the echo-traces both in the coastal and oceanic area. In the coastal area dense echo-traces coincided with the abundance of fish larvae, whereas in the oceanic region these dense echo-traces most probably indicated the presence of redfish larvae. This assumption was strongly supported by the yield of the Isaacs-Kidd midwater trawl at station 157, see also page 22. This is in accordance with previous and later observations in this area (EINARSSON 1960, MAGNÚSSON 1964). According to WIBORG (1960), such echo-traces are most probably caused by fish fry and Euphausids. As mentioned before, the percentage frequency of the Euphausids in our material never exceeded 16, so that their influence could hardly be responsible for these echo-traces. As to the other crustaceans, they do not seem to be reflected. This is in good agreement with our material, as we got zones of high zooplankton density (without larvae), but almost no echo-traces, e.g. off Southeast Greenland along the 39° W meridian (see Figs. 8 and 22). Thus, from our material we can assume that the echo-traces are mostly due to fish larvae. A possible influence of fish eggs on the echo-recordings should not be excluded, since other observations indicate that some recordings might derive from fish egg concentrations.

As already pointed out above, there is a fairly good agreement between the abundance of redfish larvae and zooplankton densities. Since these densities consisted mainly of *C. finmarchicus*, there is consequently a good general agreement between the larval abundance and *C. finmarchicus* densities. The two separated larval density zones west of the Reykjanes Ridge illustrate this agreement (Fig. 2). In the southern zone (60° N, 30° W) a high percentage frequency of *C. finmarchicus* was found although the zooplankton density was relatively low, and in the northern zone (62° N 28° W) the percentage frequency of *C. finmarchicus* is relatively low, but the zooplankton density was high, so that the number of *C. finmarchicus* is high because of the high density. On the other hand, a comparison between the redfish larvae abundance (Fig. 2) and the percentage frequency of *S. retroversa* (Fig. 28) shows that the main *S. retroversa* zone is lying west of the main larval zone. Only at one station in part II of the cruise high percentage frequency of *S. retroversa* coincides with high abundance of redfish larvae.

This redfish larvae — *Calanus* — *Spiratella* relationship corresponds well with BAINBRIDGE's analysis of stomachs of redfish larvae (BAINBRIDGE 1964), as has been pointed out previously.

Concerning the depth distribution, a good agreement in the zooplankton-larvae relationship was observed. Level II gave the highest yields for zooplankton and all fish larvae. The second highest yields were in level I for zooplankton, but in level III for the fish larvae. This is in good correlation with the echo-recordings which were densest in 15 to 25 m depth.

Comparison of the diurnal migration of zooplankton and fish larvae has been carried out separately for redfish and other fish larvae according to their distinct distribution.

As to the zooplankton and redfish larvae (see Tables III and XXII), the night yields were higher than the day yields. Further, as has been established above in general for the depth distribution, the highest catches were obtained in level II both for day and night. For zooplankton the second highest yields were got in level I and the lowest ones in level III both for day and night. This applies also to the redfish larvae during night, but during day level I gave the lowest number (see also page 17). These conditions are clearly reflected in the night–day ratios which indicate more pronounced diurnal migrations in the upper layers for redfish larvae than for zooplankton.

In Table XXIV the relation zooplankton volume — other fish larvae is given. This table is based upon the same day and night stations as used for three fish larvae species before (see Table XIV), with exception of station 1 (see page 37).

TABLE XXIV

Day and night catches for zooplankton and fish larvae

B 61, May 1961.

Level	*Day Samples*		*Night Samples*		*Night/Day Ratio*	
	Zooplankton Vol/m³	*Larvae No/m³*	*Zooplankton Vol/m³*	*Larvae No/m³*	*Zooplankton*	*Larvae*
I	0.95	1.04	1.52	1.30	1.60	1.25
II	1.14	4.98	1.20	3.32	1.05	0.67
III	0.65	1.93	0.90	4.85	1.38	2.51

Both for zooplankton and fish larvae the mean volume per m^3 and the mean number per m^3 were higher at night than at day time, which is in good accordance with other investigations (see BRIDGER 1957). The day sampling showed the highest yields in sampler II for zooplankton and larvae as well, whereas during night the highest zooplankton yields were obtained in level I, but in level III for larvae. Level I and III showed also the highest night–day ratio for zooplankton and larvae, respectively. It must be emphasized that differences in light intensity between the daylight and the dark hours are very small at this time of year, and that studies of differences in distributions due to changes in light intensity were not a primary objective of the cruise. But, if these differences in the yields between various levels are due to diurnal migrations, the ratios seem to indicate that the migrations originate from two layers, the deeper one lying most probably below the deepest sampling level.

SUMMARY

This paper deals with the Icelandic results from a joint German-Icelandic redfish larvae research program in the Central North Atlantic in May 1961. A cruise report is given and sampling methods are described.

Redfish larvae were found mostly in the oceanic region of the area surveyed. The average number of larvae per positive station on the shelfs was 8.1, but in the oceanic area 81.6. In the oceanic area the greatest density of larvae was found to be in two main zones west of the Reykjanes Ridge outside the 1000 m and 2000 m depth contours. The number of redfish larvae seemed to be rather high in general in May this year which is in accordance with HENDERSON's findings.

A clear connection between redfish larval abundance and certain isotherms was found.

Redfish larvae were found to be most abundant in the 15 to 18 m level (i.e. level II of the three sampling levels). The length range was 5 to 15 mm. In part I of the cruise 80% of the larvae were of 7 mm size and smaller, but in part II only 5.3% of the larvae were within this size range. The areas of extrusion of redfish were defined by localization of the abundance of small larvae. Estimation of the scattering layers was carried out and plotted.

Fish larvae of species other than redfish are discussed, especially Gadoidae. The distribution of the larvae was on the whole limited to the Icelandic shelf area with some exceptions, e.g. blue whiting. The main concentration of the larvae was found to be in the Faxa Bay area. The majority of the larvae was newly hatched. Bigger larvae were obtained mainly at the end of the cruise. The number of bigger larvae increased towards north and with increasing distance of the shore (e.g. cod, Norway pout, capelin). An attempt was made to study the abundance of larvae of three species in relation to depth. In level II (15 to 18 m) the highest total number of larvae was obtained. A diurnal variation in the depth distribution is discussed.

The distribution and abundance of **fish eggs** is discussed. At East Greenland a clear relation between temperature and density of cod eggs was noted. The majority of cod eggs was found to be within the East Greenland current. A comparison of the velocity of the East Greenland current and the develop-

mental stages of the eggs indicated a drift of the eggs along East Greenland and round Cape Farewell from various spawning places. The size of the eggs at East Greenland was from 1.19 to 1.56 mm in diameter and seemed therefore to range between cod eggs off Labrador and in Faxa Bay.

Generally, the horizontal distribution of **other zooplankton** was characterized by marked tongues of high density penetrating into the area from south and south east. A comparison of this distribution based on different gears was made, as well as a comparison between gears. The zooplankton density in relation with temperature was studied, and a comparison made between day and night catches. Generally, the zooplankton was very homogeneous. A review of the distribution of the most common species is given, and it was established that *C. finmarchicus* was dominating, its percentage frequency ranging from 72 to 99. Comparison between the distribution of *C. finmarchicus* and *S. retroversa* showed reversed relationship.

Transparency measurements were carried out and compared with phytoplankton observations.

Finally, comparable features in the zooplankton–larval material are discussed.

Íslenzkt ágrip.

Þessi ritgerð fjallar um rannsóknir á fiskseiðum og átu úr Grænlandshafi. Gögnunum var safnað á varðskipinu „Ægi“ í maí 1961 í samvinnu við þýzkan leiðangur, sem farinn var á sama tíma.

Ritgerðin hefst á leiðangurslýsingu, og leiðin, sem sigld var, er sýnd á mynd 1. Sömuleiðis er gefið yfirlit yfir gagnasöfnun og aðferðir við úrvinnslu gagna.

Karfaseiði fundust í nær öllu úthafinu, en voru í mestu magni í tveim beltum vestan Reykjanes-hryggjar og utan 1000 og 2000 m dýptarlínu (sjá mynd 2). Í samanburði við fyrri íslenzkar og erlendar rannsóknir var mikið magn af karfaseiðum í Grænlandshafi á þessum tíma.

Greinilegt samband fannst á milli sjávarhita og magns karfaseiða. Þar sem sjávarhiti var á milli 7 og 8° C í 20 m dýpi, var mest magn karfaseiða. Hins vegar fundust mjög fá við lægri hita en 5.5° C.

Gagnasöfnun í mismunandi dýpi sýndi, að mest var af karfaseiðum í 15—18 m dýpi, og kom það skýrt fram á dýptarmælum.

Lengd karfaseiðanna var 5—15 mm, og í syðri hluta athugunarsvæðisins var meginþorri þeirra nýgotinn, þ. e. undir 7 mm að lengd. Á grundvelli fundar nýgotinna seiða hafa gotsvæði karfans í Grænlandshafi verið staðsett eins og sýnt er á mynd 7.

Seiði annarra fiska, einkum þorskfiska, eru einnig tekin til meðferðar í ritgerðinni. Útbreiðsla seiðanna var að mestu takmörkuð við íslenzka landgrunnið, með nokkrum undantekningum þó, eins og t. d. kolmunnaseiði. Aðalmagn seiðanna fannst í Faxaflóa og nærliggjandi svæðum. Útbreiðsla seiðanna er sýnd á myndum 9, 12, 13, 16, 17 og 18. Meginþorri seiðanna var nýklakinn.

Eldri seiðin fundust einkum á norðanverðu athugunarsvæðinu og fjærst landi. Eins og hjá karfaseiðum var mest um önnur fiskseiði í 15—18 m dýpi.

Í ritgerðinni er rætt um útbreiðslu **fiskeggja** SV af Íslandi og við Austur-Grænland. Á síðarnefnda svæðinu voru nær eingöngu þorskegg, og fengust þau einkum innan takmarka Austur-Grænlandsstraumsins (sjá mynd 19). Bent er á, að mikill hluti þorskeggja frá hrygningarstöðvum við A-Grænland berist með straumnum fyrir Hvarf á meðan þau eru að klekjast. Þorskegg við A-Grænland voru stærri en við Ísland, en hins vegar minni en við Labrador.

Dreifing **átunnar** einkenndist af ríkum átubeltum og tungum, er komu skýrt fram í öllum söfnunartækjum (sjá myndir 22—25). Samanburður var einnig gerður á söfnunarhæfni hinna ýmsu tækja og sömuleiðis gerður samanburður á átumagni dags og nætur. Sú athugun sýndi, að vegna hinna háttbundnu, lóðréttu hreyfinga átunnar fannst að jafnaði hærra átumagn að degi til.

Gerð er grein fyrir hinum ýmsu átutegundum og útbreiðslu þeirra. Langmest fannst af rauðátu *(Calanus finmarchicus)*, sem nam frá 72—99% allra dýra í átunni.

Loks var gerð athugun á gagnsæi sjávar og það borið saman við magn þörungagróðurs.

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APPENDIX

A) Redfish larvae. Number per station and gear

Cruise B 61, May 1961

— No Sample

Station No.	*Helgoland Larvae Net* *No. of Larvae*	*No. per m²*	*Icelandic High-Speed Samplers* I *No. of Larvae*	I *No. per 10 m³*	II *No. of Larvae*	II *No. per 10 m³*	III *No. of Larvae*	III *No. per 10 m³*	I–III *No. of Larvae*	I–III *No. per 10 m³*	*All Gear* *No. of Larvae*
5	0	0	2	1.0	–	–	0	0	2	0.5	2
7	1	0.6	0	0	8	4.0	0	0	8	1.3	9
8	0	0	0	0	0	0	3	1.5	3	0.5	3
9	0	0	0	0	0	0	1	0.5	1	0.2	1
10	1	0.6	0	0	5	2.5	0	0	5	0.8	6
11	35	21.9	13	6.5	32	16.0	16	8.0	61	10.2	96
12	11	6.9	34	17.0	–	–	36	18.0	70	11.7	81
13	139	86.9	40	20.0	40	20.0	22	11.0	102	17.0	241
14	60	37.5	2	1.0	31	15.5	60	30.0	93	15.5	153
15	6	3.8	1	0.5	3	1.5	4	2.0	8	1.3	14
16	11	6.9	0	0	1	0.5	1	0.5	2	0.3	13
17	3	1.9	9	4.5	1	0.5	3	1.5	13	2.2	16
18	0	0	0	0	1	0.5	0	0	1	0.2	1
19	2	1.3	0	0	0	0	0	0	0	0	2
20	10	6.3	0	0	0	0	1	0.5	1	0.2	11
21	2	1.3	0	0	0	0	0	0	0	0	2
22	0	0	0	0	1	0.5	0	0	1	0.2	1
24	1	0.6	0	0	0	0	0	0	0	0	1
26	0	0	0	0	1	0.5	0	0	1	0.2	1
34	0	0	0	0	1	0.5	2	1.0	3	0.5	3
35	14	8.8	0	0	0	0	0	0	0	0	14
36	4	2.5	0	0	0	0	25	12.5	25	4.2	29
37	1	0.6	0	0	2	1.0	10	5.0	12	2.0	13
38	29	18.1	30	15.0	15	7.5	2	1.0	47	7.8	76
39	252	157.5	46	23.0	28	14.0	25	12.5	99	16.5	351
40	55	34.4	8	4.0	26	13.0	12	6.0	46	7.7	101
41	45	28.1	1	0.5	0	0	–	–	1	0.3	46
41A	54	33.8	0	0	0	0	–	–	0	0	54
42	18	11.3	0	0	0	0	9	4.5	9	1.5	27
43	23	14.4	0	0	27	13.5	2	1.0	29	4.8	52
44	50	31.3	58	29.0	–	–	0	0	58	14.5	108
45	240	150.0	–	–	52	26.0	10	5.0	62	15.5	302
46	89	55.6	–	–	78	39.0	31	15.5	109	27.3	198
47	4	2.5	–	–	6	3.0	4	2.0	10	2.5	14
48	4	2.5	–	–	6	3.0	0	0	6	1.5	10
49	0	0	–	–	0	0	2	1.0	2	0.5	2
50	17	10.6	8	4.0	17	8.5	1	0.5	26	4.3	43
51	55	34.4	13	6.5	36	18.0	6	3.0	55	9.2	110
52	19	11.9	4	2.0	3	1.5	4	2.0	11	1.8	30
53	14	8.8	0	0	4	2.0	4	2.0	8	1.3	22
54	18	11.3	0	0	8	4.0	6	3.0	14	2.3	32
55	12	7.5	0	0	13	6.5	1	0.5	14	2.3	26

Station No.	Helgoland Larvae Net		Icelandic High-Speed Samplers I		II		III		I–III		All Gear
	No. of Larvae	No. per m^2	No. of Larvae	No. per 10 m^3	No. of Larvae	No. per 10 m^3	No. of Larvae	No. per 10 m^3	No. of Larvae	No. per 10 m^3	No. of Larvae
56	47	29.4	20	10.0	43	21.5	7	3.5	70	11.7	117
57	21	13.1	0	0	57	28.5	8	4.0	65	10.8	86
58	6	3.8	0	0	3	1.5	7	3.5	10	1.7	16
59	91	56.9	1	0.5	14	7.0	15	7.5	30	5.0	121
60	5	3.1	6	3.0	18	9.0	20	10.0	44	7.3	49
61	–	–	18	9.0	108	54.0	127	63.5	253	42.2	253
62	–	–	29	14.5	8	4.0	15	7.5	52	8.7	52
63	–	–	4	2.0	60	30.0	70	35.0	134	22.3	134
64	35	21.9	0	0	2	1.0	50	25.0	52	8.7	87
65	183	114.4	–	–	3	1.5	7	3.5	10	2.5	193
66	–	–	5	2.5	9	4.5	22	11.0	36	6.0	36
67	–	–	21	10.5	17	8.5	1	0.5	39	6.5	39
68	6	3.8	1	0.5	0	0	1	0.5	2	0.3	8
69	5	3.1	0	0	7	3.5	9	4.5	16	2.7	21
70	4	2.5	0	0	0	0	7	3.5	7	1.2	11
71	11	6.9	0	0	6	3.0	5	2.5	11	1.8	22
72	3	1.9	0	0	0	0	1	0.5	1	0.2	4
74	1	0.6	0	0	0	0	1	0.5	1	0.2	2
75	0	0	1	0.5	0	0	0	0	1	0.2	1
76	0	0	0	0	0	0	1	0.5	1	0.2	1
80	1	0.6	0	0	0	0	1	0.5	1	0.2	2
81	7	4.4	0	0	0	0	0	0	0	0	7
82	0	0	0	0	1	0.5	2	1.0	3	0.5	3
83	15	9.4	8	4.0	71	35.5	10	5.0	89	14.8	104
84	66	41.3	44	22.0	80	40.0	16	8.0	140	23.3	206
85	4	2.5	0	0	28	14.0	5	2.5	33	5.5	37
85A	29	18.1	–	–	–	–	–	–	–	–	29
86	3	1.9	0	0	16	8.0	19	9.5	35	5.8	38
86A	–	–	0	0	92	46.0	1	0.5	93	15.5	93
87	26	16.3	0	0	73	36.5	0	0	73	12.2	99
88	33	20.6	0	0	131	65.5	14	7.0	145	24.2	178
89	75	46.9	32	16.0	31	15.5	10	5.0	73	12.2	148
90	–	–	103	51.5	216	108.0	25	12.5	344	57.3	344
91	–	–	4	2.0	34	17.0	11	5.5	49	8.2	49
92	10	6.3	0	0	5	2.5	26	13.0	31	5.2	41
93	24	15.0	0	0	15	7.5	16	8.0	31	5.2	55
94	20	12.5	4	2.0	11	5.5	11	5.5	26	4.3	46
95	14	8.8	1	0.5	4	2.0	0	0	5	0.8	19
96	19	11.9	3	1.5	7	3.5	12	6.0	22	3.7	41
97	32	13.8	11	5.5	29	14.5	5	2.5	45	7.5	77
98	40	25.0	2	1.0	12	6.0	10	5.0	24	4.0	64
99	30	18.8	0	0	46	23.0	13	6.5	59	9.8	89
100	30	18.8	0	0	23	11.5	16	8.0	39	6.5	69
101	142	88.8	0	0	39	19.5	14	7.0	53	8.8	195
102	0	0	0	0	1	0.5	0	0	1	0.2	1
110	–	–	0	0	0	0	9	4.5	9	1.5	9

Station No.	Helgoland Larvae Net No. of Larvae	Helgoland Larvae Net No. per m²	Icelandic High-Speed Samplers I No. of Larvae	I No. per 10 m³	II No. of Larvae	II No. per 10 m³	III No. of Larvae	III No. per 10 m³	I–III No. of Larvae	I–III No. per 10 m³	All Gear No. of Larvae
113	–	–	–	–	0	0	2	1.0	2	0.5	2
114	–	–	–	–	6	3.0	8	4.0	14	3.5	14
115	–	–	19	9.5	81	40.5	29	14.5	129	21.5	129
116	7	4.4	23	11.5	174	87.0	0	0	197	32.8	204
117	27	16.9	80	40.0	4	2.0	4	2.0	88	14.7	115
118	39	24.4	–	–	41	20.5	3	1.5	44	11.0	83
119	2	1.3	44	22.0	37	18.5	3	1.5	84	14.0	86
120	26	16.3	60	30.0	97	48.5	90	45.0	247	41.2	273
121	2	1.3	2	1.0	4	2.0	5	2.5	11	1.8	13
122	12	7.5	0	0	1	0.5	0	0	1	0.2	13
123	0	0	0	0	5	2.5	0	0	5	0.8	5
124	3	1.9	10	2.0	0	0	8	1.5	18	1.2	21
125	6	3.8	0	0	22	11.0	7	3.5	29	4.8	35
126	4	2.5	5	2.5	29	14.5	9	4.5	43	7.2	47
127	3	1.9	1	0.5	1	0.5	2	1.0	4	0.7	7
129	1	0.6	–	–	0	0	0	0	0	0	1
133	1	0.6	0	0	0	0	0	0	0	0	1
140	0	0	0	0	1	0.5	1	0.5	2	0.3	2
141	2	1.3	2	1.0	0	0	0	0	2	0.3	4
142	1	0.6	0	0	0	0	0	0	0	0	1
143	1	0.6	0	0	0	0	0	0	0	0	1
145	3	1.9	1	0.5	0	0	1	0.5	2	0.3	5
146	0	0	0	0	0	0	2	1.0	2	0.3	2
147	3	1.9	2	1.0	28	14.0	4	2.0	34	5.7	37
148	5	3.1	0	0	0	0	6	3.0	6	1.0	11
149	0	0	1	0.5	0	0	0	0	1	0.2	1
152	1	0.6	0	0	26	13.0	0	0	26	4.3	27
153	0	0	0	0	53	26.5	0	0	53	8.8	53
154	4	2.5	19	9.5	9	4.5	0	0	28	4.7	32
155	2	1.3	23	11.5	15	7.5	3	1.5	41	6.8	43
156	9	5.6	32	16.0	6	3.0	11	5.5	49	8.2	58
157	121	75.6	1	0.5	151	75.5	122	61.0	274	45.7	395
157A	5	3.1	–	–	99	44.5	106	53.0	205	51.3	210
158	4	2.5	0	0	111	55.5	66	33.0	177	29.5	181
159	9	5.6	0	0	37	18.5	19	9.5	56	9.3	65
160	1	0.6	0	0	57	28.5	17	8.5	74	12.3	75
161	16	10.0	0	0	27	13.5	10	5.0	37	6.2	53
162	7	4.4	7	3.5	4	2.0	3	1.5	14	2.3	21
163	0	0	0	0	1	0.5	2	1.0	3	0.5	3
164	0	0	0	0	0	0	1	0.5	1	0.2	1
165	0	0	0	0	0	0	2	1.0	2	0.3	2
166	1	0.6	0	0	0	0	1	0.5	1	0.2	2
Total	2665	10.28	919	2.78	2893	8.46	1470	4.22	5282	5.18	7947

B) Redfish larvae. Length per station

B 61, May 1961.

Cruise Part I.

mm/St.	*5*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*24*	*26*
5									1										
6	1	2		1	1	40		6	63	11		4	1		1			1	
7	1	1	2		3	37	61	115	74	3	8	10		2	8	2			
8		5	1		1	7	20	15	3		4				2		1		1
9		1																	
Total ...	2	9	3	1	5	84	81	136	141	14	12	14	1	2	11	2	1	1	1

mm/St.	*34*	*35*	*36*	*37*	*38*	*39*	*40*	*41*	*41A*	*42*	*43*	*44*	*45*	*46*	*47*	*48*	*49*	*50*	*51*
5							1						1			1			1
6		6	9	3	11	74	51	13	26	8	13	35	37	44	4	6		19	55
7	1	5	14	9	47	66	41	25	23	14	26	18	41	54	4		1	19	47
8	2	3	2		18	2	1	5	1	2	11	45	11	2	3	3		4	4
9				1				1			1				3				1
Total ...	3	14	25	13	76	142	94	44	50	24	51	98	90	100	14	10	1	42	108

mm/St.	*52*	*53*	*54*	*55*	*56*	*57*	*58*	*59*	*60*	*61*	*62*	*63*	*64*	*65*	*66*	*67*	*68*	*69*	*70*
5	10	4	13	3	13	4		1	1		2		3	7					1
6	7	8	9	12	48	24	4	19	24	11	4	11	30	47	5	7	1	2	6
7	8	8	8	11	45	46	9	44	19	73	23	66	35	67	22	24	4	10	4
8	1	2	2		10	6		26	2	34	13	29	7	28	7	7	3	9	
9						1	1	2	1	1	2	2		10	1				
10							1							1					
Total ...	26	22	32	26	116	81	15	92	47	119	44	108	75	160	35	38	8	21	11

mm/St.	*71*	*72*	*74*	*75*	*76*	*80*	*81*	*82*	*83*	*84*	*85*	*85A*	*86*	*86A*	*87*	*88*	*89*	*90*	*91*
5			1				1				1		2			6	3		
6	5	1			1	1	5		14	17	14	4	7	17	11	20	38	16	4
7	11	3	1	1		1	1	1	33	66	14	6	16	28	54	25	77	53	21
8	4							2	29	59	4	13	12	4	26	29	13	38	20
9	1								7	23		4	1	2	3	16	1	12	2
10										6		2				1		9	
Total ...	21	4	2	1	1	2	7	3	83	171	33	29	38	51	94	97	132	128	47

mm/St.	92	93	94	95	96	97	98	99	100	101	102	mm	Total
5		1	5		3	5	18	4	7	5		5	129
6	15	26	21	6	9	26	21	50	24	44	1	6	1243
7	13	18	13	4	11	16	12	23	22	42		7	1894
8	7	8	4	7	14	19	7	6	9	8		8	707
9	3	1		1	1	6		3	2	1		9	119
10		1		1		4	1			1		10	28
Total ...	38	55	43	19	38	76	59	86	64	101	1		4120

Cruise Part II.

mm/St.	114	115	116	117	118	119	120	121	122	123	124	125	126	127	133
5			1					1							
6		2		2									6		
7	3	4	2	2	4	3	8				1		17	1	
8	2	18	8	10	11	4	15	1	4	1	7	4	8		
9	3	33	33	28	15	20	47	4	5	3	6	9	8	1	
10	6	30	23	39	25	33	68	3	3		5	10	6	1	
11		11	8	17	21	20	30	1	1		1	7	2	3	1
12			2	5	7	5	7					3		1	
13				1			1								
14												1			
15															
18															
Total	14	98	77	104	83	85	176	10	13	4	20	34	47	7	1

mm/St.	140	141	142	143	145	146	147	148	149	152	153	154	155	156	157
5			1												
6		1													
7													3	2	1
8							3	1		5	9		3	7	4
9	1	1			1		9	2		13	26	1	8	13	21
10	1			1	2	2	12	4		8	13	4	8	17	41
11		1			2		10	2			5	14	15	13	46
12		1					2	2				7	3	5	29
13							1					5			9
14												1	2		
15															
18									1						
Total	2	4	1	1	5	2	37	11	1	26	53	32	42	57	151

mm/St.	*157a*	*158*	*159*	*160*	*161*	*162*	*163*	*164*	*165*	*166*	*mm*	*Total*
5										1	5	4
6			1			7					6	19
7	1	1	6	3	8	1					7	71
8	4	8	7	7	9	5	1				8	166
9	14	7	17	10	6	3					9	368
10	35	29	11	16	6	3	1		1		10	467
11	43	39	9	19	9	1				1	11	352
12	11	24	8	12	11	1		1	1		12	148
13	2	8	5	3	2		1				13	38
14		1		2							14	7
15		3			1						15	4
18											18	1
Total	110	120	64	72	52	21	3	1	2	2		1645