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Summary of the ICNAF Joint Larval Herring Survey in Georges Bank-Gulf of Maine areas, September - December 1974.

by

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Within the scope of the ICNAF larval herring survey program in fall 1974 cruises were carried out by France, Poland, USSR, Fed.Rep.Germany, and USA. A tentative time schedule was given in the Report of the Working Group on Coordinated Surveys (Red Book 1974, page 122) and in the Circular Letter 74/29. Except for the German cruise, where a breakdown of the engine of R.V. "Anton Dohrn" caused some longer time delay, no significant changes are given in the schedule. Temporal coverage during the period September through December was fairly well and very much comparable to that in 1973. Spatial coverage varied between cruises. No adequate sampling was to be achieved in the area southwest off Nova Scotia, which was worked up only twice. Stations in the inner Gulf of Maine were sampled on three cruises, during one of which also the additionally proposed stations have been worked up. Sampling in the coastal Gulf of Maine area was discontinued in 1973 but has been taken up again in fall 1974 with two cruises carried out by USA.

Sampling results have become available shortly before this Annual Meeting. Thus a cursory summary can be given only. In table 1 the

cruises taken into account are listed. For offshore cruises original results are given in standard format ("ICNAF Larval Herring Survey-Basic Data Summary") and may be requested from ICNAF secretariat. Additional cruise reports are indicated in the table.

Table 1:

Vessel	Country	sampling period	No of Stat. sampled	Reports
1) offshore cruises				
Cryos	France	6 Sep-24 Sep	115	Res.Doc.75/71
Wieczno	Poland	27 Sep-18 Oct	144	Data Summary
Prognoz	USSR	18 Oct-30 Oct	90	Res.Doc.75/66
A.Dohrn	Germany Fed.Rep.	16 Nov-23 Nov	75	Res.Doc.75/67
AlbatrossIV	USA	4 Dec-19 Dec	108	Res.Doc.75/49
2) along shore cruises				
Duchess II	USA	7 Sep-14 Sep	20	Res.Doc.75/49
Delaware II	USA	8 Oct-16 Oct	55	Res.Doc.75/49

Methods

During the 1974 Annual Meeting the standard methods as summarized in appendix of Res.Doc. 73/115 were again discussed in the light of the experiences of the previous years. In order to further improve the uniformity of methods used in this joint program a more comprehensive outline of basic sampling procedures with suggestions for supplementary sampling was set up and distributed by the Circular Letter 74/29.

The standard cruise track and proposed additional stations are given in Fig.1. A major deviation from standard is given for the last three cruises during which the area southwest off Nova Scotia had to be neglected due to lack of time. The most complete coverage including additional stations in the inner Gulf of Maine

was completed by R.V. "Wieczno" in beginning of October. The actual cruise tracks are not given here but may be looked at in the respective reports. Station grids may be seen also in the appendix of this report. In general, the main idea of the standard cruise track was adhered to, saying that both, time periods for surveying single spawning areas and the elapsed time between spawning areas, should be kept at a minimum. A deviation from this concept during the first cruise in September, where differences in sampling time of up to about one week may be noticed between neighbouring stations on Georges Bank, is of no importance, as during that cruise no larvae were encountered in that area at all.

As sampling gear the recommended paired 61 cm Bongo was generally used. During some cruises additional sampling with Neuston net was made, and during the cruise of Delaware II small Bongos were towed simultaneously to study the vertical distribution of larvae. Results of additional sampling will be given in separate Reports. A first report on vertical distribution is given in Res.Doc. 75/50. Informations about composition and distribution of the plankton in the considered area are given in Res.Doc.s 75/66 and 75/71.

Hydrographic measurements have been made on most stations; however as final results have not been completely available prior to the meeting, they are not taken into account in the report. The hydrographic situations during the cruises of R.V. "Cryos" and R.V. "Prognoz" are described in some detail in Res.Doc.s 75/66 and 75/71.

Sorting of Bongo samples was mostly restricted to the 0.505 mm mesh nets as in the previous years and only these results have been considered here. Length of larvae was recommended to be measured "to the mm below" from "tip of snout to base of caudal fin" which is referred to as "standard length" in the "Basic Data Summary" sheets. In these data sheets no hint is given that any other method has been used. Nevertheless, this point seems to be still problematic, as according to Res.Doc. 75/66 and 71 "total length" was measured for larvae caught by R.V. "Prognoz" and

larvae caught by R.V. "Cryos" were measured" from the snout to the base of the tail to the nearest mm".

Results

Distribution of larvae

No attempt is made to discuss the distribution of larvae during individual cruises in detail. For this purpose see the respective Res.Doc.s indicated in table 1. For information, however, charts are attached for each cruise in an appendix containing numbers of larvae per 10 m^2 for size categories separately. The results of larval distribution in fall 1974 are summarized in figures 2-4: Areas in which at least one larva per m^2 was encountered during the whole sampling period (September-December) are indicated in figure 2 for three size categories separately. The picture is somewhat incomplete for the inner Gulf of Maine and the coastal areas, as sampling was restricted there to September and October. Moreover, for the area along the west coast of the Gulf of Maine no data were yet at hand for the larger two size groups. In that area only the distribution of recently hatched larvae derived from the two alongshore cruises has been included in figure 2. Three main spawning places are indicated along the coast. The sites generally correspond with earlier findings although in a more complete time coverage of this area in 1972 (see Res.Doc.s 73/12 and 74/15) the middle sector extended further south and included two other centres of newly hatched larvae: one south of Portland the other near the base of Jeffreys Ledge, the latter one being distinct from that on Stellwagen Bank. For larger larvae populations overlap in their distribution. In 1972 larvae $> 10 \text{ mm}$ extended throughout the coastal sampling area. In 1974 as may be seen from Res.Doc. 75/49 the southern population of larvae seem to keep discrete. This, however, may be due to lack of sampling in the later part of the season.

Results from offshore stations confirm some drift of larvae out of the coastal area beyond the 100 m depth contour. However, as in the previous year, this drift appears negligible in quantity.

In the area southwest off Nova Scotia the distribution of larvae was very similar to that in 1973. Results from the most northern stations again seem to indicate an overlap in the distribution of larger larvae (> 10 mm) originated from the areas off Nova Scotia and off the coast of Maine. However, referring to Res.Doc. 73/93 it is obvious that a discussion of larval drift and mixing of populations in this area requires sampling on a narrow station grid including the Bay of Fundy.

In the Georges Bank - Nantucket Shoals area the picture of larval distribution varied from year to year. Since 1971 the most obvious separation between Georges Bank and Nantucket Shoals populations was to be noticed in 1972, when only larvae larger than 15 mm showed some overlap in their distribution (see Res.Doc. 74/15). In 1973 the largest extension in the general distribution of larvae was encountered, not entirely covered by the station grid, and the populations of both areas appeared contiguous in their distribution for all size categories, when summarizing results over the whole sampling period (Res.Doc. 74/105). The situation in 1974 was somewhat inbetween. The station grid covered the area of distribution fairly well, although it is obvious that the additionally proposed stations are necessary for proper delimitation. As shown in figure 2, the main spawning areas, indicated by the distribution of newly hatched larvae (< 10 mm) on Georges Bank and Nantucket Shoals remained separated. The small discrete area inbetween was previously integrated to the one or the other of the both main areas depending on their actual extension. When following the changes in the main distribution of newly hatched larvae during the season (fig. 3) a slight shift in the spawning activity in southerly and westerly directions is indicated similar to the previous year.

From the distribution of larger larvae (> 10 mm) a mixing of populations originated from Nantucket Shoals and Georges Bank

is again confirmed, while they keep separated from the coastal Gulf of Maine and the Nova Scotia stocks. Fig. 4 shows that till first half of December larvae > 25 mm have mainly aggregated on the central part of Georges Bank. The area of distribution of these large larvae is obviously less extended than in 1973. A detailed comparison of distribution and drift of larvae with hydrographic data might be worthwhile for the existing time series already, as obviously different conditions have been encountered during these years.

Quantitative estimates and length distributions

Numbers of larvae per m² sea surface were calculated for each station and from these data a rough estimate of total abundance of larvae in specific areas obtained by the methods described previously (see Res.Doc.s 73/115 and 74/105). Length frequency curves for the specific areas were derived from the total number of larvae of each mm length group calculated for the area.

Length frequency distributions encountered during each cruise are given in figures 5-7 for Georges Bank, Nantucket Shoals and Nova Scotia separately. It may be tried to get information about growth and mortality by following hatching groups of larvae as mentioned in Res.Doc. 74/15 and further discussed in Res.Doc. 74/105. However, as in 1973 and in contrast to 1972, modes in the length frequency curves are generally not very pronounced for larger larvae. This is possibly due to the mixing of originally separated larval herring populations in Georges Bank - Nantucket Shoals area which was obviously more pronounced in the last two years compared to 1972 as mentioned above. In the area off Nova Scotia data may be affected by the drift of larvae into the Bay of Fundy and perhaps by influx of larvae from more inshore areas. Two cruises were carried out in the area off Nova Scotia, about one month apart. The increase in length of about 6 mm for the bulk of the larvae (from about 6 to about 12 mm) would agree with expected values; however, the much higher number of larvae during

Table 2: Estimates of abundance of larval herring based on sampling with 0.505 mm mesh size
(Two significant digits given)

Area	Period	Vessel	Number of larvae x 10 ⁻⁹				total
			10 mm	10- 15 mm	15- 20 mm	20 mm	
Nantucket Shoals (Stat. 1-30)	14 Sep - 23 Sep ^{*)}	Cryos	0	0	0	0	0
	28 Sep - 1 Oct	Wieczno	110	4.0	0	0	110
	25 Oct - 28 Oct	Prognoz	210	27	21	1.4	260
	16 Nov - 18 Nov	A. Dohrn	770	230	150	19	1200
	4 Dec - 8 Dec	Albatross IV	9.2	200	97	32	340
Georges Bank (Stat. 50-64, 70-85, 88-99)	13 Sep - 24 Sep	Cryos	0	0	0	0	0
	3 Oct - 10 Oct	Wieczno	1400	1.7	0.90	0	1400
	18 Oct - 24 Oct	Prognoz	4300	780	30	0.61	5100
	18 Nov - 23 Nov	A. Dohrn	600	410	270	22	1300
	8 Dec - 19 Dec	Albatross IV	6.7	320	440	210	970
Nova Scotia (Stat. 102-109 112-124)	8 Sep - 10 Sep	Cryos	200	14	1.7	0.52	220
	11 Oct - 14 Oct	Wieczno	200	1200	160	16	1600

*) Stat. 1-11, 18-22 not sampled

the second cruise show that most of the larvae had come into the area after the first survey. Similar difficulties arise for the other areas. Thus for the present only one attempt to follow a hatching group is made for Georges Bank (fig. 8). From this a monthly increase in length of about 6 mm is derived, which is somewhat lower than estimated for 1973 (7-8 mm) and inbetween the values for Georges Bank (3-4 mm) and Nantucket Shoals (6-7 mm) in 1972. A more intensive analysis of the given data with respect to growth and mortality might be worthwhile. Abundance estimates of larvae are summarized in table 2 for size categories, time periods, and areas separately. The period of hatching was delimited by the sampling in Nantucket Shoals area and on Georges Bank as indicated by the low values of small larvae derived for the first and last cruise compared to the peak numbers inbetween. In the area off Nova Scotia the hatching period starts much earlier and has not been covered in any year by the standard sampling program. Abundance estimates for comparable time periods since 1971 in this area are summarized in table 3:

Table 3: Between year comparison in abundance estimates for larvae < 10 mm (of all sizes) in the area southwest off Nova Scotia

	1971	1972	1973	1974
1-15 Sep	38 (47)	0 (0.1)		200 (220)
15-30 Sep	74 (160)		110 (270)	
1-15 Oct	0.1 (0.8)			200 (1600)
15-30 Oct		9.2 (140)	6.8 (250)	

The highest numbers were derived for 1974. This, however, may not necessarily be attributed to a respectively high production of larvae but may be due to changes in drift of larvae.

Between years comparisons in abundance of larvae in Nantucket Shoals area and on Georges Bank are given in figures 9 and 10. In these areas hatching started somewhat later in 1974 compared to previous years. No larvae were caught at all during the first cruise in the second half of September and only very few larvae > 10 mm were encountered at the end of September, beginning of October.

In Nantucket Shoals area peak abundances were encountered relatively late, in mid November, compared to mid October in 1973 and 1972. Production of larvae as indicated by the abundance of newly hatched larvae (<10 mm) appears lower than in 1973 and similar to that in 1972.

On Georges Bank, on the other hand, production cycle and abundance of newly hatched larvae were similar to the previous year. Table 4 summarizes production indices for both areas separately and combined.

Table 4: Indices of production of larval herring during the sampling period (Number of larvae $\cdot 10^{-11}$ x days, two significant digits given).

Area	1971	1972	1973	1974
Nantucket Shoals	13	180	850	230
Georges Bank	150	49	1200	1300
Total	160	230	2100	1600

The number of larvae produced in 1974 in the total area appears to be somewhat lower but in the same order of magnitude compared to 1973 and was obviously higher than in the years before. Thus the spawning stock size possibly was about one order of magnitude larger in 1974 and 1973 compared to 1971 and 1972.

It might be of interest to note that the abundance of larger larvae in beginning of December was highest in 1974 and similar to 1973

whereas obviously lower in the first two years. This is demonstrated for the groups of larvae >10 mm in figures 9 and 10 and for larvae >15 mm in table 5.

Table 5: Number $\cdot 10^{-9}$ of larvae >15 mm in the first half of December.

Area	1971	1972	1973	1974
Nantucket Shoals	50	36	180	130
Georges Bank	180	47	550	650
Total	230	80	730	780

The number of larger larvae at the beginning of the winter period may be of some importance for the success of the year class. However, the environmental conditions during winter may be as important. Thus, the decrease in abundance during winter through spring will possibly be more related to the initial success of a year class.

References

Res.Doc.

- 73/12 - Graham, J.J., Davis, C.W., and Bickford, B.C.: Annual distribution, abundance and dispersion of larval herring along the western coast of the Gulf of Maine in 1972.
- 73/93 - Stobo, W.T. and Iles, T.D.: Larval herring distribution in the Bay of Fundy.
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- 75/67 - Schnack, D. and Joakimsson, G.: Report of the ICNAF larval herring cruise, Anton Dohrn, November 1974, in Georges Bank-Gulf of Maine area.
- 75/71 - Paulmier, G. and Briand, D.: Environment and distribution of herring larvae on Georges Bank and the Nova Scotia Shelf in September 1974.

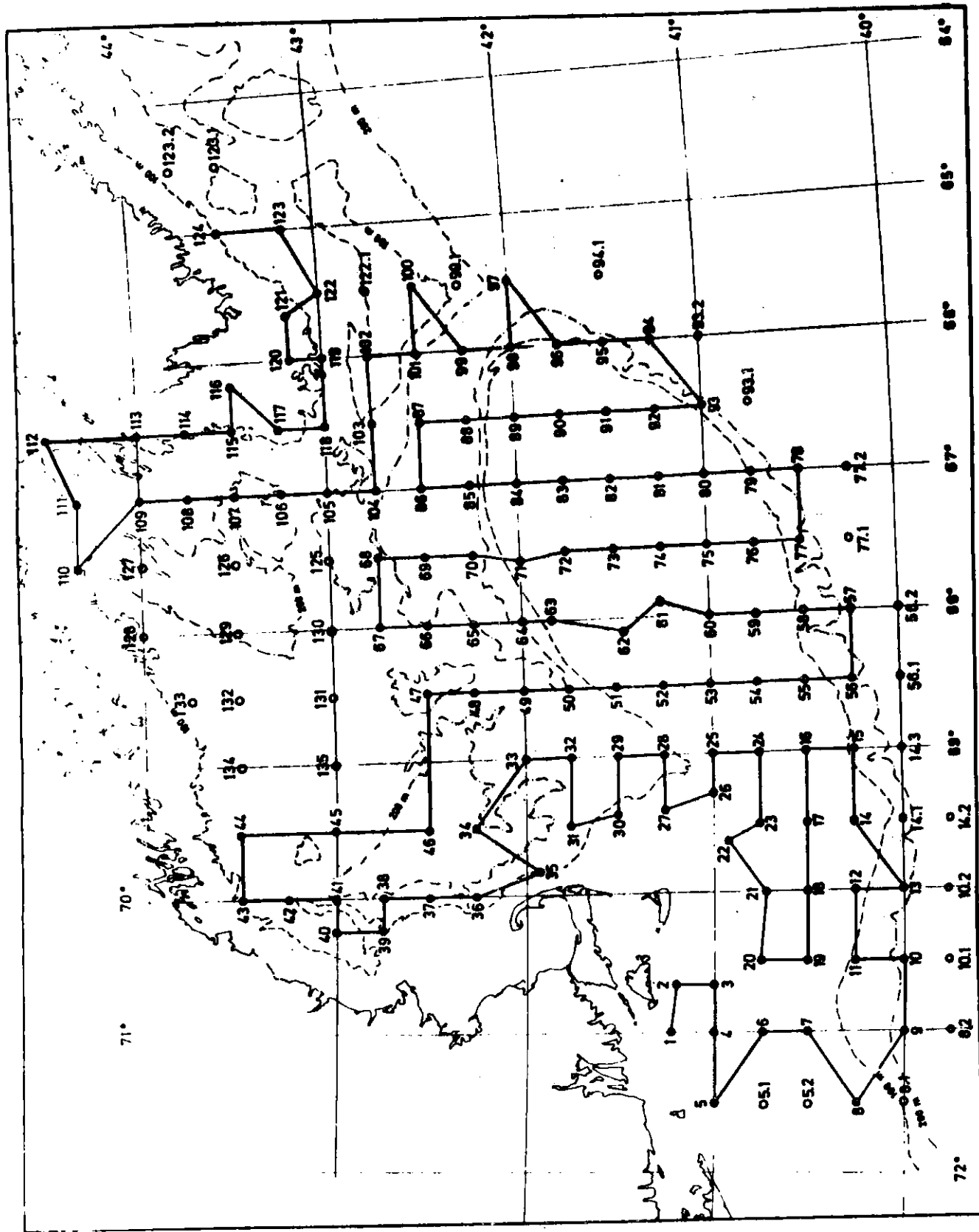


Fig.1: Standard Cruise Track of ICNAF Larval Herring Survey

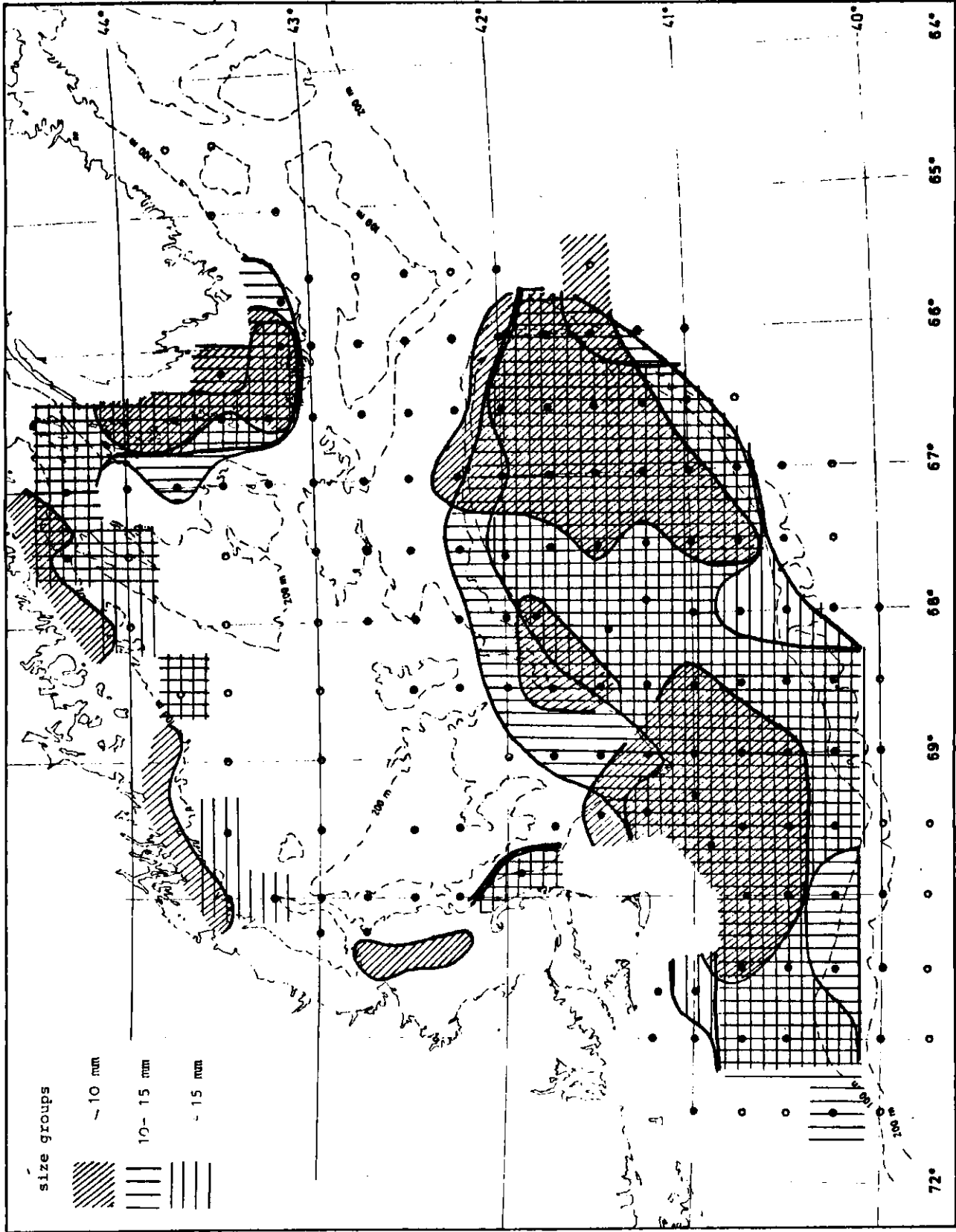
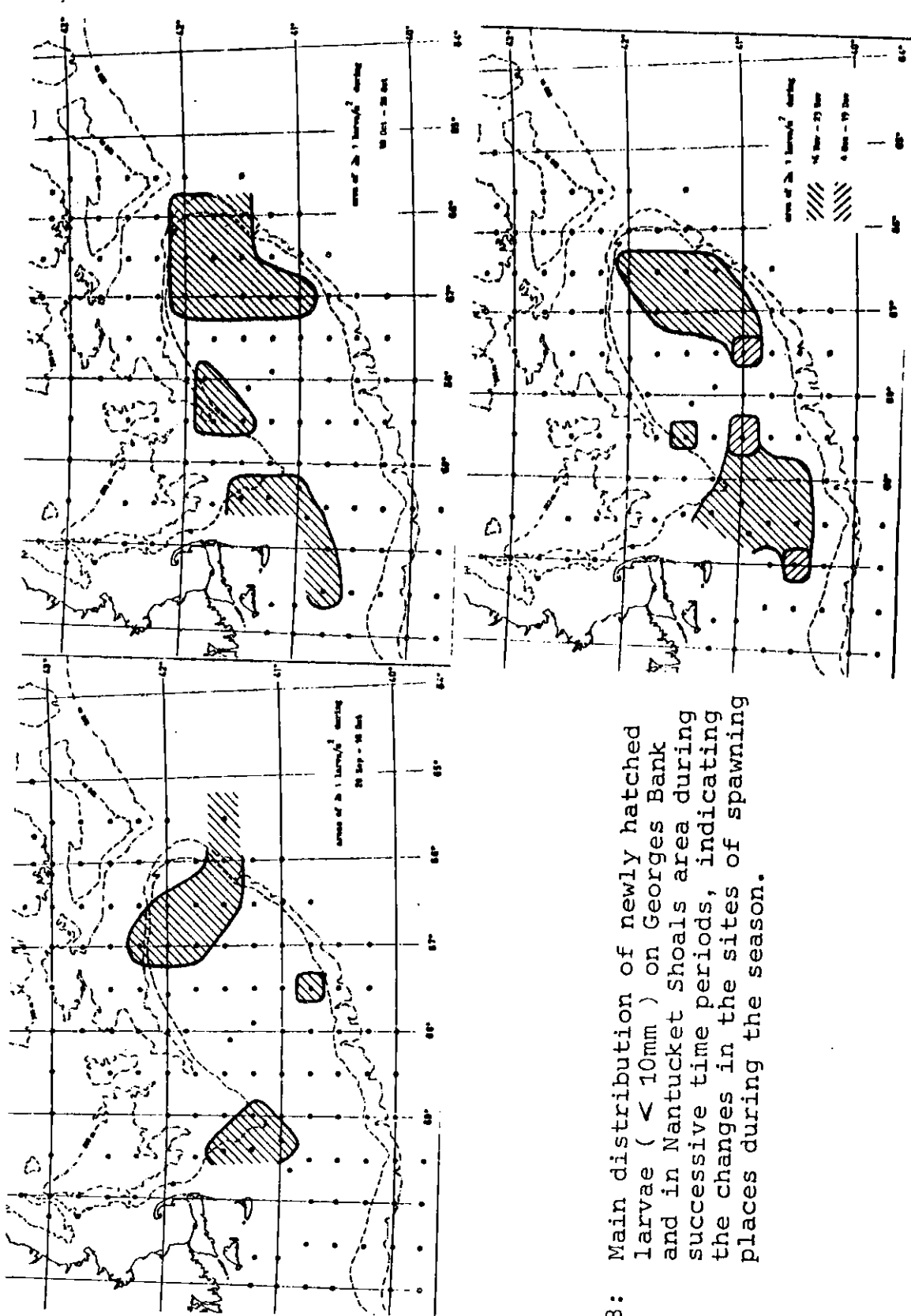


Fig.2: Distribution of larvae of different size categories during September through December 1974. (Based on stations with at least 1 larva of the respective size per m^2)



9.3: Main distribution of newly hatched larvae (< 10mm) on Georges Bank and in Nantucket Shoals area during successive time periods, indicating the changes in the sites of spawning places during the season.

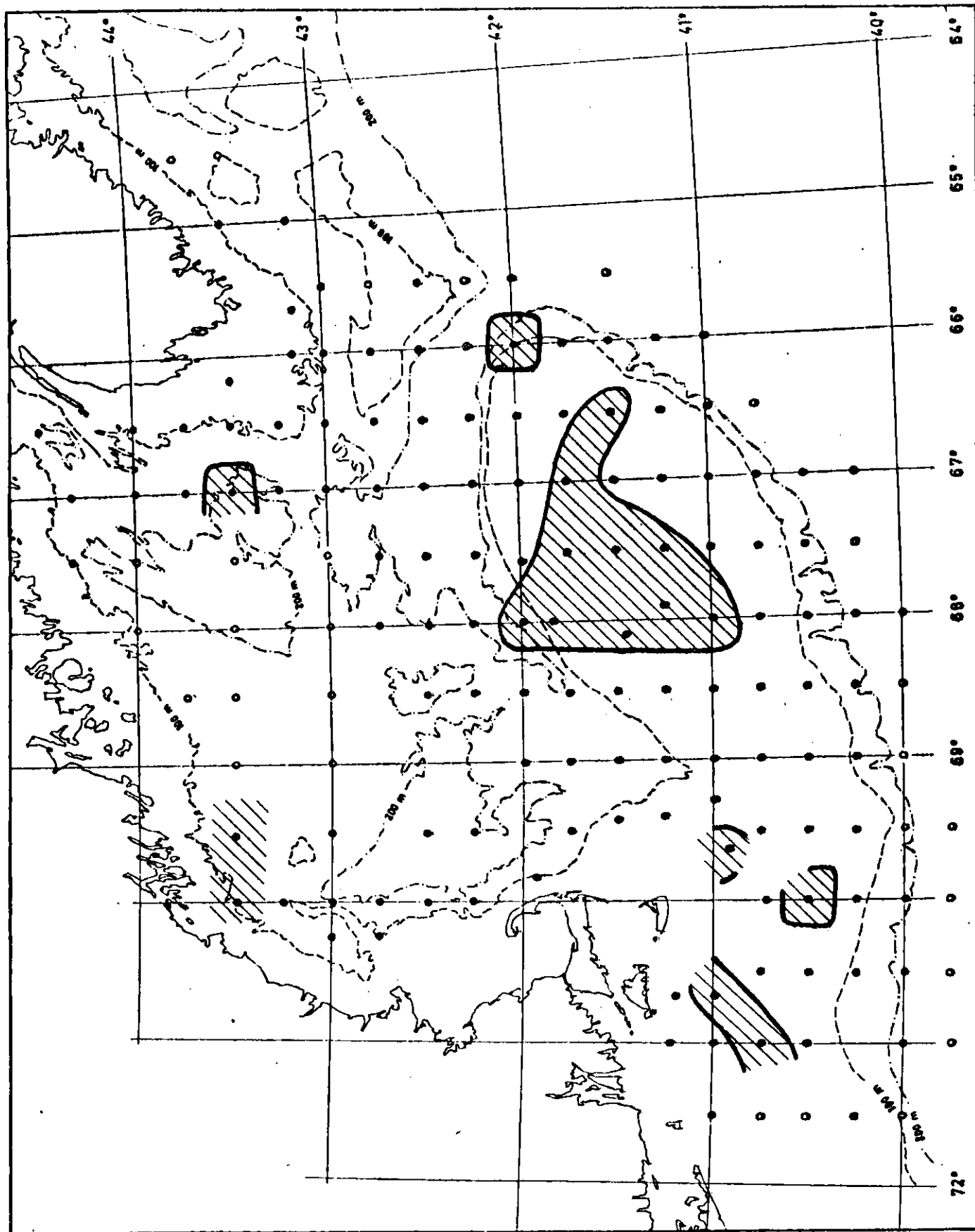


Fig. 4 : Distribution of larvae > 25 mm

Nantucket Shoals 1974

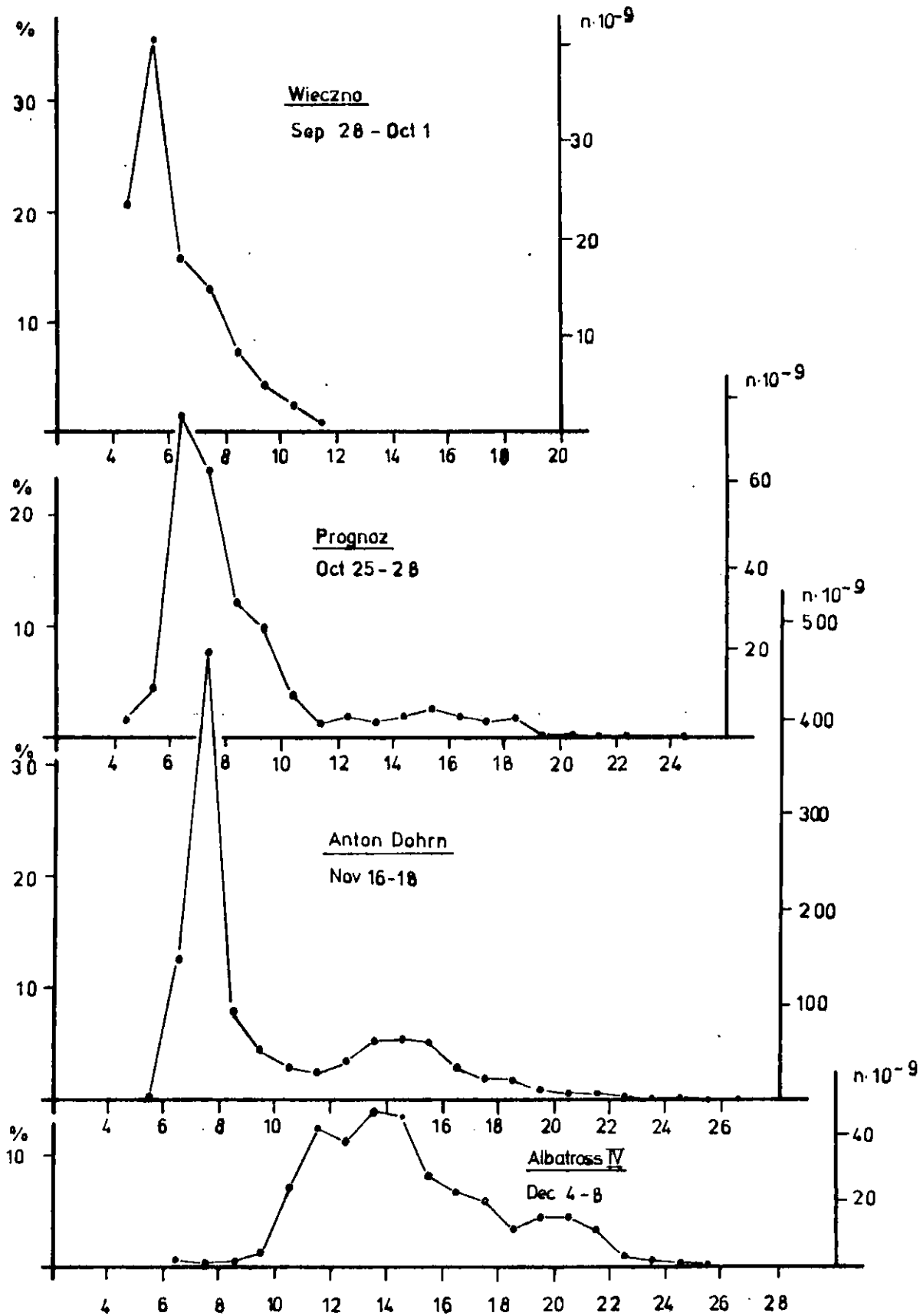


Fig. 5: Length frequency distribution in Nantucket Shoals area (Stat. 1-30)

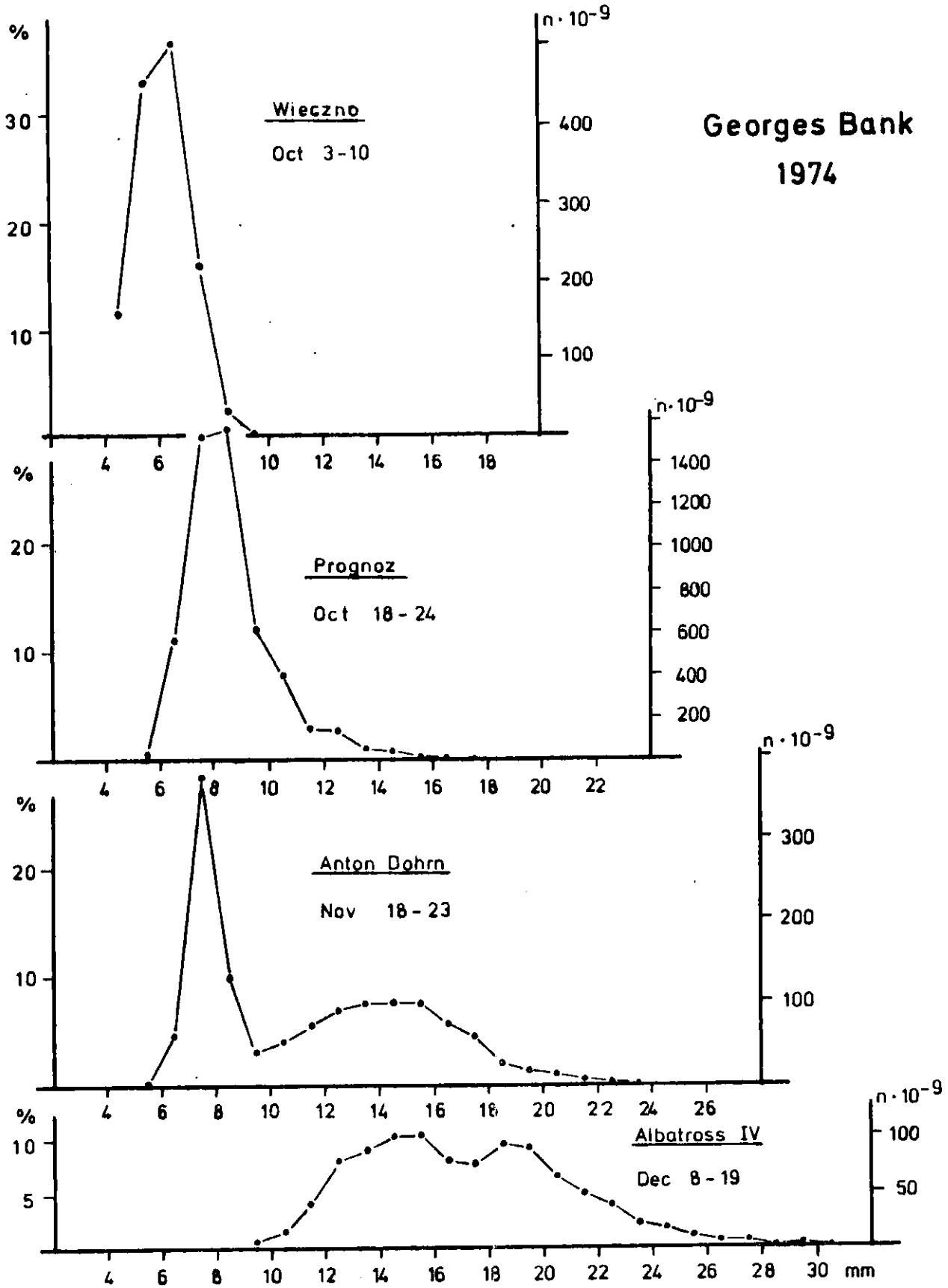


Fig. 6: Length frequency distribution on Georges Bank (Stat. 50-64, 70-85, 88-99)

Nova Scotia 1974

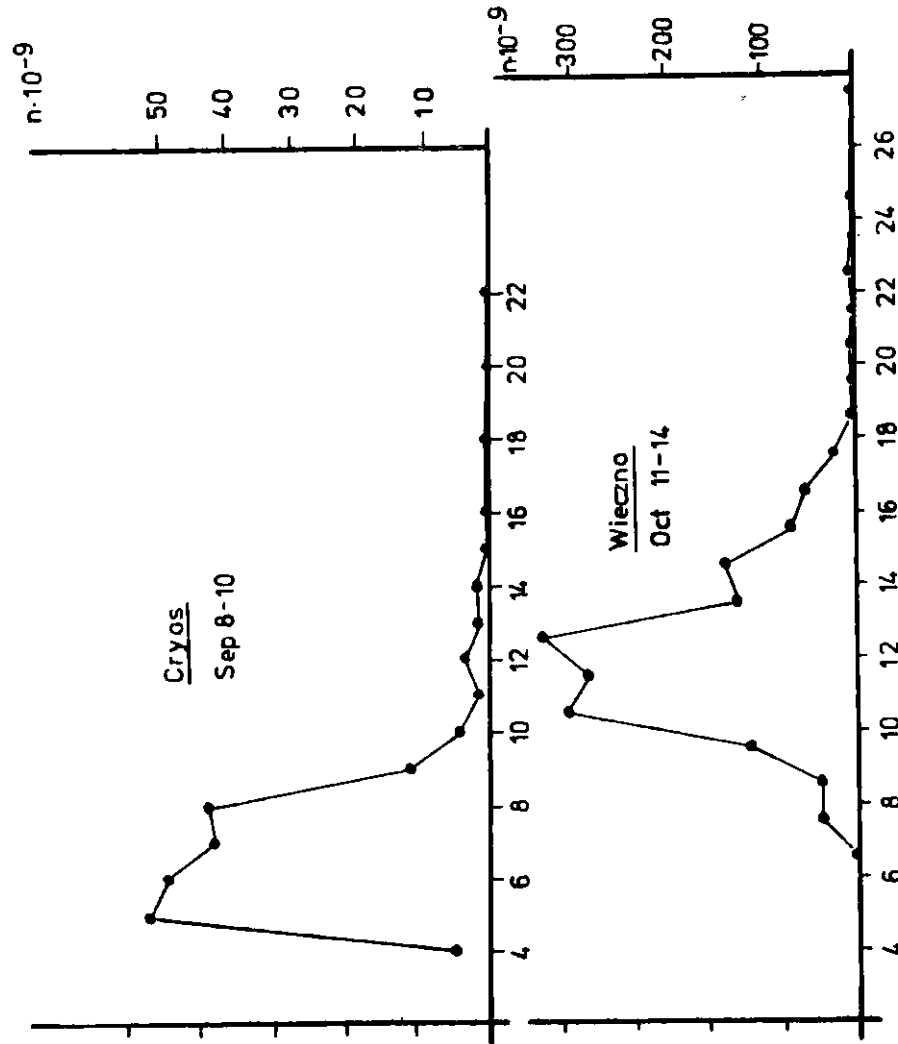


Fig. 7 : Length frequency distribution in the area southwest off Nova Scotia (Stat. 102-109, 112-124)

Georges Bank 1974

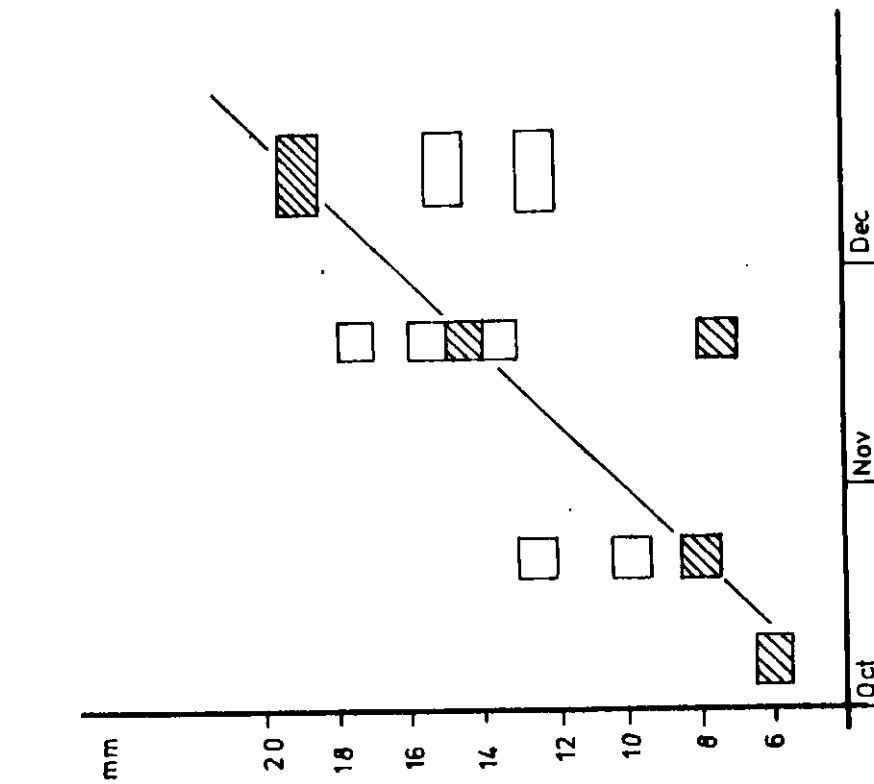


Fig. 8 : Modes of length frequency curves: significant, insignificant modes.

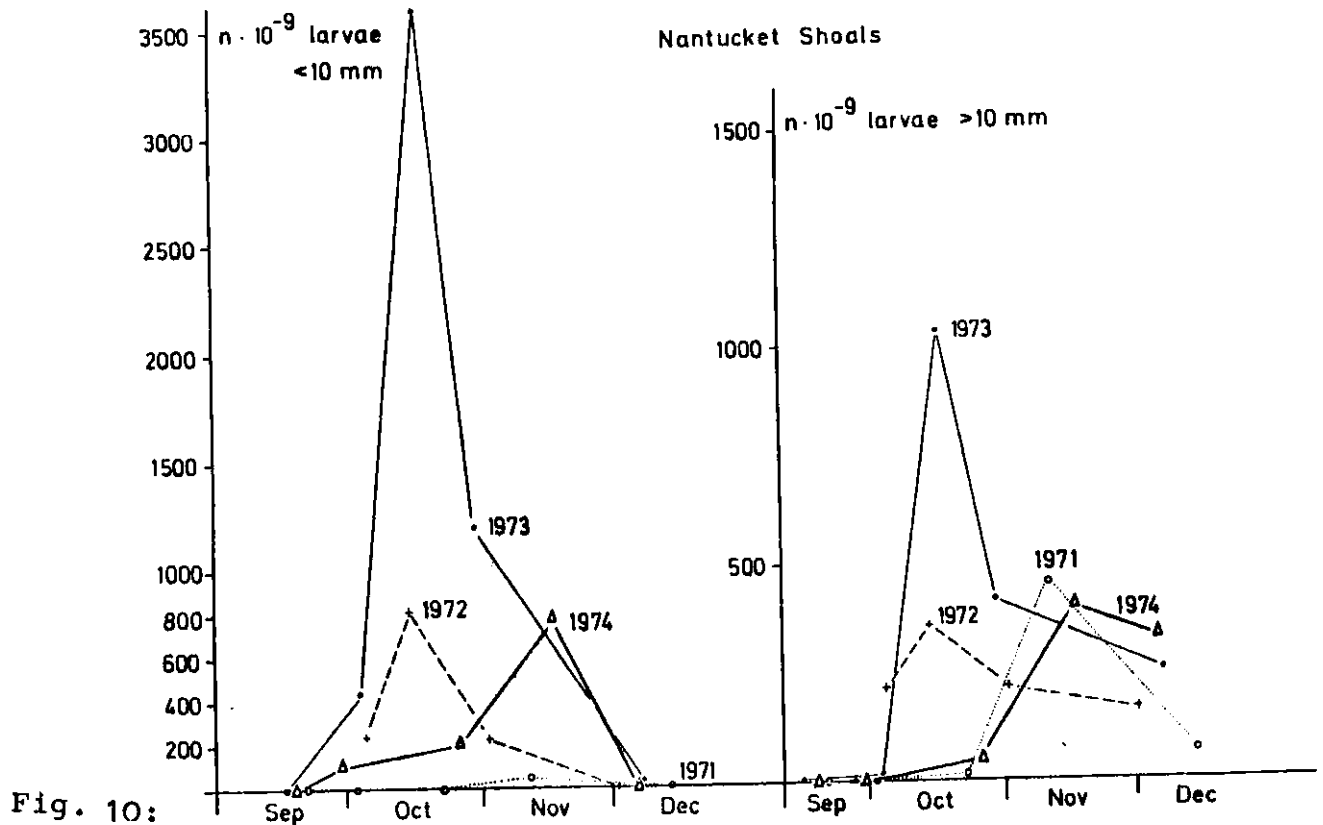
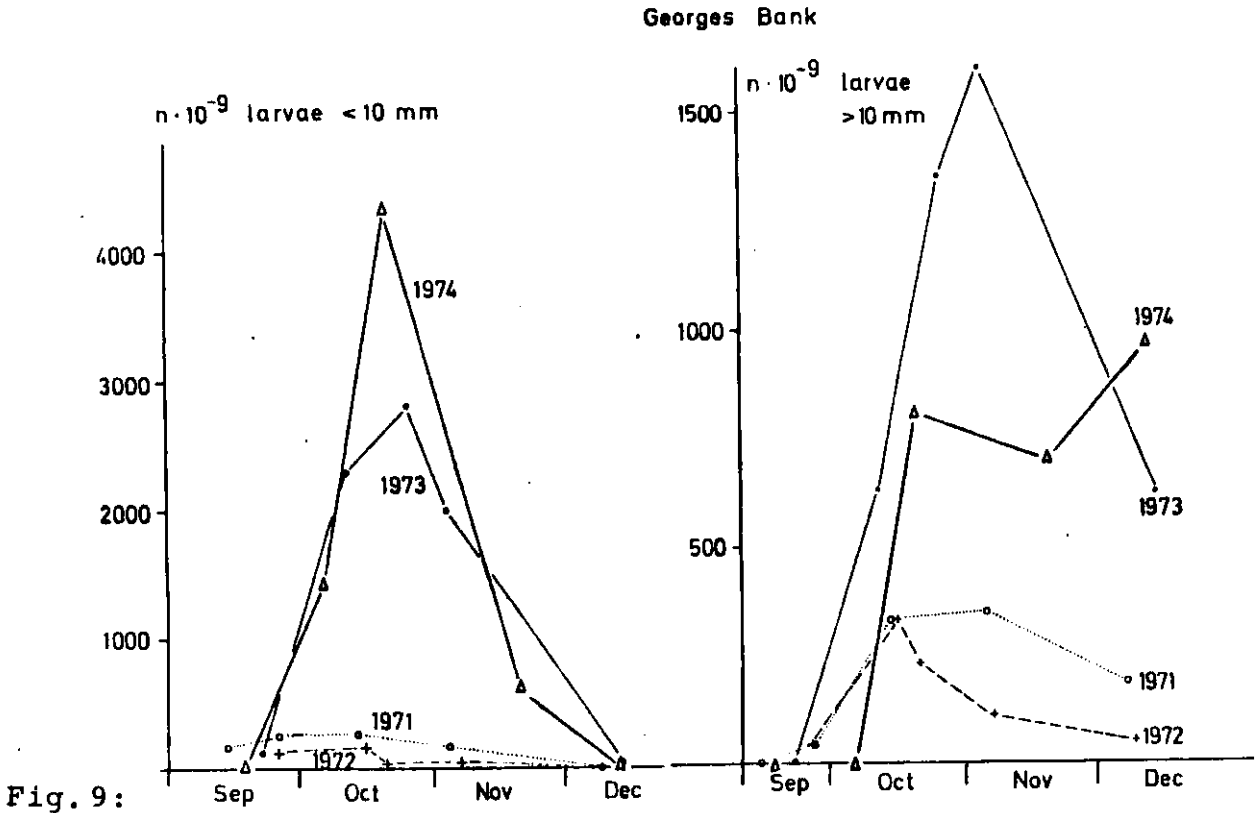


Fig. 9-10: Between years comparison of abundance estimates of larvae, separately for areas and size categories.

