International Commission for the Northwest Atlantic Fisheries

Serial No. 3341
(D.c.3)

ICNAF Res.Doc. 74/105

ANNUAL MEETING - JUNE 1974

Summery Report of the 1973 ICNAF Joint Larval Herring Survey in Georges Bank - Gulf of Maine areas.

by
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The ICNAF larval herring survey program was continued in fall 1973 by France, Poland, USSR, Fed. Rep. Germany, USA, and Canada. The proposed time schedule as given in Red Book 1973 Part 1 page 97 was generally adhered to, except that the USA was not able to carry out the cruise planned for beginning of September. Time coverage during the period end of September through December was fairly well in the off shore area. The coastal Gulf of Maine area was not sampled in 1973. Results from sampling in the Bay of Fundy carried out by Canada were not available prior to this annual meeting.

Table 1: Cruises carried out during 1973 ICNAF Larval Herring Survey

Vessel	Country	Period	No of Stat. sampled	Reports
R.V. "Cryos"	France	16 Sep-28 Sep	76 *	Res.Doc. 74/57
R.V. "Wieczno"	Poland	29 Sep-20 Oct	137	Res.Doc 74/18
R.V. "Belogorsk"	USSR	15 Oct- 1 Nov	119	Res.Doc. 74/14
R.V. "W. Herwig"	Germany F.R.	28 Oct- 8 Nov	126	Res.Doc. 74/16
R.V. "Albatross IV"	USA	4 Dec-20 Dec	115 **	Res.Doc. 74/17

* no sampling in the inner Gulf of Maine
** no sampling in the area southwest off Nova Scotia

Table 1 specifies the cruises taken into account in this summery. In addition to the respective cruise reports, indicated in the table, original results are reported in a standard format ("ICNAF Larval Herring Survey-Basic Data Summery") and are available from ICNAF secretariat on request.

Methods

Standard Methods to be used in the Joint Survey program were recommended in the appendix of the Res. Doc. 73/115. Some further proposals concerning additional stations for enlarging the area covered, surface sampling with Neuston net, and additional horizontal hauls for studying the vertical distribution of larvae were made prior to the survey.

The standard cruise track and the proposed additional stations are given in Fig. 1. Generally, the research vessel adhered to the standard station grid. Additional stations were also sampled by R/V "Wieczno" and R/V "Albatross IV". Major deviations from standard are given for the first and last cruise in this fall survey: R/V "Cryos" worked up a reduced station grid in Nantucket Shoals area and did not sample the inner Gulf of Maine;"Albatross IV"left out the area southwest off Nova Scotia. For minor changes see the respective cruise reports.

Results from additional sampling with Neuston net and for vertical distribution of larvae are not included in this report.

Hydrographic measurements have been made in different extension Charts of temperature and salinity distribution at least at the surface and near the bottom are attached in the single cruise reports.

Sorting of the Bongo samples has been concentrated on the 0.505 mm mesh net in most cases. The results have therefore generally been used for this report. Missing data have been substituted by results from 0.333 mm mesh net.

Length of larvae was recommended to be reported as standard length measured to the mm below. The "Basic Data Summery" sheets contain in no case an indication that a different method was used. However, according to Res. Doc. 74/14 and 74/57 "total length" of larvae caught by R/V Cryos was measured "to the nearest mm" and for larvae caught by R/V Belogorsk also "total length" was measures "to within 1 mm".

Results

Distribution of larvae

Descriptions of larval distribution during individual cruises are given in the Res.Doc.'s indicated in table 1. Charts containing the numbers of larvae per 10 m^2 for size categories seperately are attached as an appendix in this report. The results are summerized in Fig. 2-4.

Nothing can be said about the distribution of larvae in the coastal Gulf of Maine area as the offshore stations encounter only a very small percentage of the coastal larval herring population (Res. Doc. 73/115, Table 2). Results from stations in the inner Gulf of Maine confirm, however, that drift of larvae from coastal to off shore areas is negligible.

In the area southwest off Nova Scotia the main distribution of larval herring appears similar to that of previous years. However, small larvae (< 10 mm) were somewhat wider spread out than in 1972 whereas large larvae (> 25 mm) were found only on two stations. This significant difference to 1972, when large larvae had a much wider distribution in that area, is presumably due to a more vigorous drift of these larvae into the Bay of Fundy in 1973.

On Georges Bank and Nantucket Shoals area a much wider distribution of larvae is obvious from Fig. 2 compared to the previous years (see Res. Doc. 74/15, Fig. 3,4). In the east and south of the Georges Bank even small larvae were encountered beyond the 200 m isobath. The standard station grid did not cover the whole area of distribution this time. Moreover, a significantly enlarged spawning area is indicated in this region by the wide-spread newly hatched larvae (< 10 mm). Different from the situation in 1971 and 1972 no clearly distinct spawning areas, west and east of the Great South Channel, appear in Fig. 2. But when the main distribution of small larvae is looked at for individual cruises (Fig. 3), two general spawning areas remain obviously separate during the season. Starting from the usual center in Nantucket Shoals area, spawning largely extended northeast and southwest in the course of time. On Georges Bank spawning also started as usual on Northern Edge/ Northeastern Peak and than proceeded in southerly and westerly directions.

From the general distribution of larger larvae (> 10 mm) it is obvious that the two originally distinct larval herring populations become mixed in the course of time. Fig. 4 shows, that larvae > 25 mm are almost entirely aggreated on Georges Bank. Only some single large larvae were caught west of the Great South Channel. The reduced westerly extension of the distribution of successive size groups (Fig. 2,4) indicate that a general drift of larvae in easterly directions predominated during the season in 1973. During fall 1972 a westerly drift was stated (Res. Doc. 74/15). A more comprehensive analysis comparing larval disribution and drift with hydrographic data over a series of years would be desirable especially with regard to the amount of larvae which might be drifted into oceanic waters and by that presumably being lost.

Results from all three years (71-73) indicate a mixing of larger larvae originated from Nantucket Shoals and Georges Bank spawning places. It is thus unlikely that herring, spawning in these two areas, belong to distinct stocks. The separation of the three main larval herring populations (Georges Bank incl. Nant. Shoals, coastal Gulf of Maine, Nova Scotia), on the other hand, is again confirmed by the 1973 results.

Quantitative estimates

The number of larvae per m^2 were calculated according to the recommendations in the appendix of Res. Doc. 73/115. As in that calculation the number per m^2 refers only to the sampled depth range, the actual number on a station is slightly underestimated. For the summery of the 1972 results, (Res. Doc. 73/115) numbers of larvae were slightly overestimated as total depth of station of less than 100 m had to be used. It was already stated that these differences are negligible in view of the feasable precision of these estimates. The abundance of larvae in a specific area was calculated by taking the number per m^2 on each respective station representative for an area of $1.13 \cdot 10^9$ m^2 as was done for the 1972 estimates. Length frequency curves for specific areas were derived from the total number of larvae of each mm length group calculated for the area.

Abundance estimates are summerized in table 2, for size categories, time periods, and areas separately. In Nantucket Shoals area and on Georges Bank time coverage appears to be fairly well, with relatively low numbers of larvae caught during the first and the last cruise compared to the peak numbers in about the middle of the whole sampling period. In the area southwest off Nova Scotia, on the other hand, most larvae were caught during the first cruise at the end of September. Sampling was obviously started somewhere beyond the peak of hatching. The largest larvae caught during the first cruise belongs to the 23 mm length group. According to the monthly increase in larval length of 4,1-7,4 mm, as reported by Bojar et al.* hatching started before mid of July in this area.

Comparisons between years in the abundance of larvae are given in Fig. 10-13:
For the area off Nova Scotia some slight indication is given that small larvae (< 10 mm) as well as larger ones were somewhat more abundand in 1973 than in the previous years. However, the incomplete sampling prevents any reasonable comparison. The number of

*Bojar, H.C., Marak, R.R., Perkins, F.E., Clifford, R.A. 1973: "Seasonal distribution and growth of larval herring in the Georges Bank - Gulf of Maine area from 1962 to 1970". J. Cons. int. Expl. Mer, 35 (1): 36-51

Table 2: Estimates of abundance of larval herring based on sampling with 0,505 (0,333) mm mesh size (Numbers rounded to two significant digits)

Area	Period	Vessel	Number of larvae x 10^{-9} <10 mm	10-15 mm	15-20 mm	>20 mm	total
Nantucket Shoals (Stat. 1-30)	16 Sep	Cryos	0	0	0	0	0
	30 Sep - 7 Oct	Wieczno	440	9,7	0,43	0	450
	15 Oct - 19 Oct	Belogorsk	3600	890	120	16	4600
	28 Oct - 31 Oct	W. Herwig	1200	250	150	10	410
	4 Dec - 8 Dec	Albatross IV	39	76	99	79	250
Georges Bank (Stat. 50-64, 70-85, 88-99)	20 Sep - 25 Sep	Cryos	130 (150)	5,2(2,3)	0	0	140 (150)
	7 Oct - 17 Oct	Wieczno	2300	530	95	5	2900
	23 Oct - 29 Oct	Belogorsk	2800	580	710	55	4100
	2 Nov - 6 Nov	W. Herwig	2000	970	540	97	3600
	11 Dec - 18 Dec	Albatross IV	58	56	360	190	660
Nova Scotia (Stat.102-109, 112-124)	25 Sep - 27 Sep	Cryos	110	130	30	2	270
	17 Oct - 20 Oct	Wieczno	6,8	120	110	14	250
	30 Oct - 1 Nov	Belogorsk	2,5	16	170	25	210
	7 Nov - 8 Nov	W. Herwig	2,2	7,3	14,3	2,4	26

larger larvae caught in this area is moreover depending on the intensity of drift into the Bay of Fundy. Thus abundance of larvae in this Bay had to be taken into account at the same time. In order to get an index of larval production in the area off Nova Scotia by the number of newly hatched larvae, a much earlier start of the survey and presumably a more inshore sampling is required.

In Nantucket Shoals area and on the Georges Bank sampling covers the hatching season much more completely. In these areas a significantly higher abundance of larvae is demonstrated for 1973 compared to the previous years by Fig. 11. Not only an unusually higher number of newly hatched larvae (< 10 mm) was encountered during October through November but also larger larvae were obviously more abundand than before during the season (Fig. 12, 13).

Taking the number of small larvae (< 10 mm) times the number of days they were encountered in the area (this product is given by the area under the curves in Fig. 12 and 13) as an index of production of larvae during the sampling period, then in 1973 this production was about one order of magnitude higher than in 71 and 72. For differences between the tow areas in the three years see table 3.

Table 3
Indices of production of larval herring during the sampling period (Number of larvae . 10^{-11} x days)

Area	1971	1972	1973
Nantucket Shoals	13	180	850
Georges Bank	150	49	1200
Nantucket Shoals and Georges Bank	160	230	2100

The difference in abundance of larger larvae (>10 mm) between 1973 and the previous years is not as pronounced in Nantucket Shoals area as on Georges Bank. This is suggested to be due mainly to the drift of larvae out of Nantucket Shoals into Georges Bank area as stated above.

Discussion on growth and mortality

The mixing of originally separated larval herring populations in Georges Bank - Nantucket Shoals area appears as a problem when trying to follow growth and mortality of larvae of distinct

hatching groups. The hope that information on growth and mortality might be derived by this method is expressed in Res. Doc. 74/15, based on the polymodal structure of the length frequency curves of larvae caught during the 1972 season. The modes in length distributions of 1973 are generally not as pronounced (Fig. 5-7). Nevertheless, it seems possible to combine respective modes (indicated by letters) and get reasonable growth figures. A monthly increase of 7 to 8 mm in length of larvae is indicated in both areas in 1973. For 1972 somewhat lower values were derived by this method: 6-7 mm per month in Nantucket Shoals area and 3-4 mm on Georges Bank. The length increase of largest larvae during the season went also not as rapidly in 1972 (6-7 mm per month) as in 1973 (> 8 mm). However, some reservations about the reliability of these values seem necessary for the moment.

To get mortality data, is even more problematic in view of the drift of larvae. The decrease in numbers of larvae of respective hatching groups is most likely much to fast in Nantucket Shoals area, as the older larvae were drifting out of the area. On Georges Bank, on the other hand, the numbers of larvae may even increase or stay at about the same level as it is not possible to separate the incoming larvae from those originated in the area. Mortality data for this early larval phase may be derived only in years where larvae remain in their area or when hatching waves appear occasionally more or less simultaneously in both areas. As this information depends on occasionally favourable conditions it will not generally be available for comparisons between years.

General Conclusions

This larval herring survey program in its present form has or may provide information about discreteness of spawning areas, relative size of spawning stocks, larval drift, and ecology of larval herring. In a long run this may also lead to possibilities for predicting relative year class strength, supposing that factors correlating with survival rate of larvae can be found. From experience in other areas this seems difficult but might be possible in the Georges Bank - Gulf of Maine area in relation with hydrographic factors for instance. This has to be looked at in more detail.

Another, perhaps more favourable way to enable prediction of relative year class strength seems to be the extension (or perhaps later the general shift) of the larval herring survey into the winter period and the combination of effort in research vessel time with juvenil herring surveys. Growth and mortality of larvae from

December, when hatching has finished, during winter through spring may provide valuable information about year to year differences in the initial success of a year class. This way, however, is depending on whether larger larvae and just metamorphosed stages can be sampled quantitatively with Bongo or any other simple gear. First experiences have been made in beginning of 1973 and 74 and some preliminary results are available for discussion.

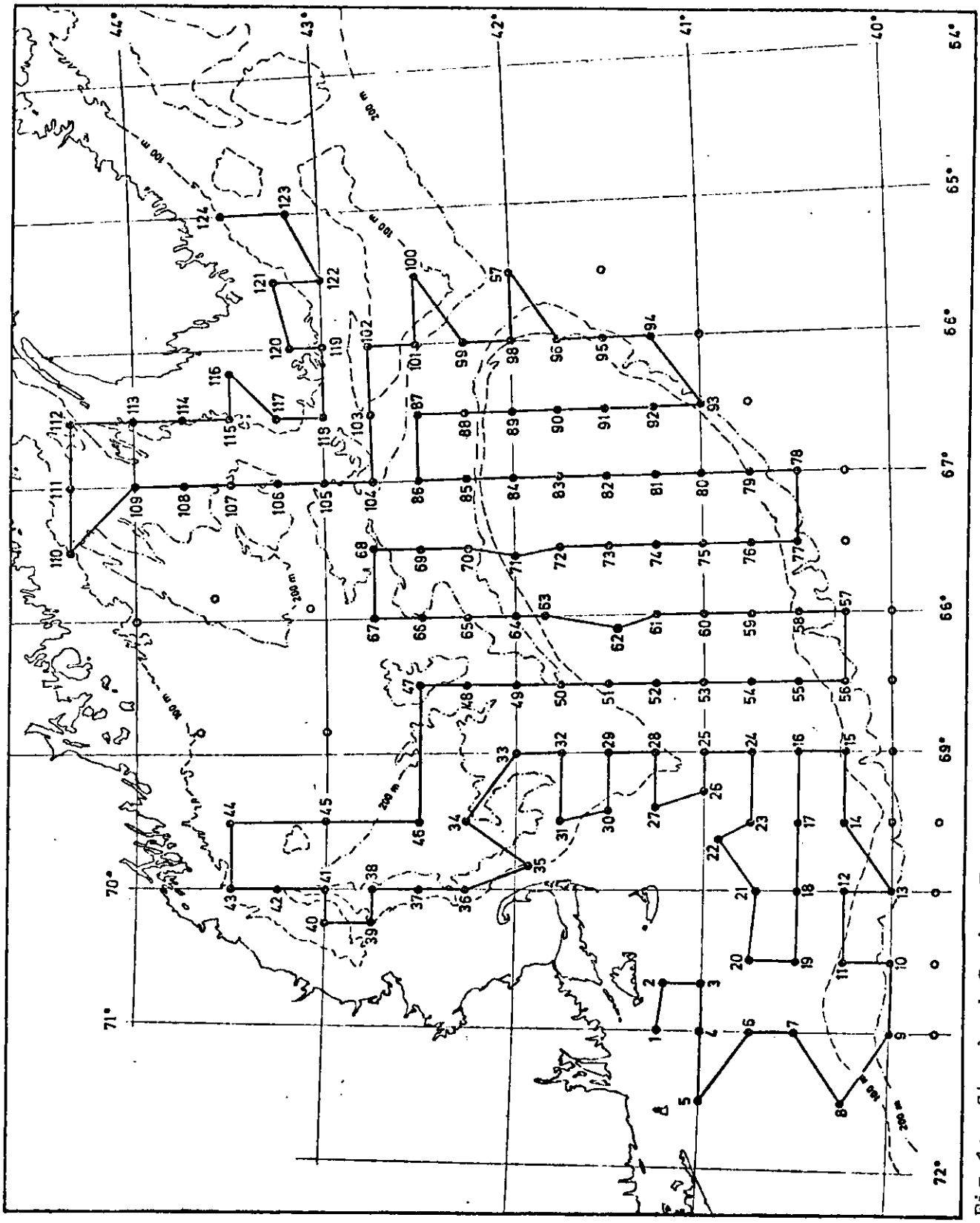


Fig.1: Standard Cruise Track of ICNAF Larval Herring Survey
O = proposed additional stations

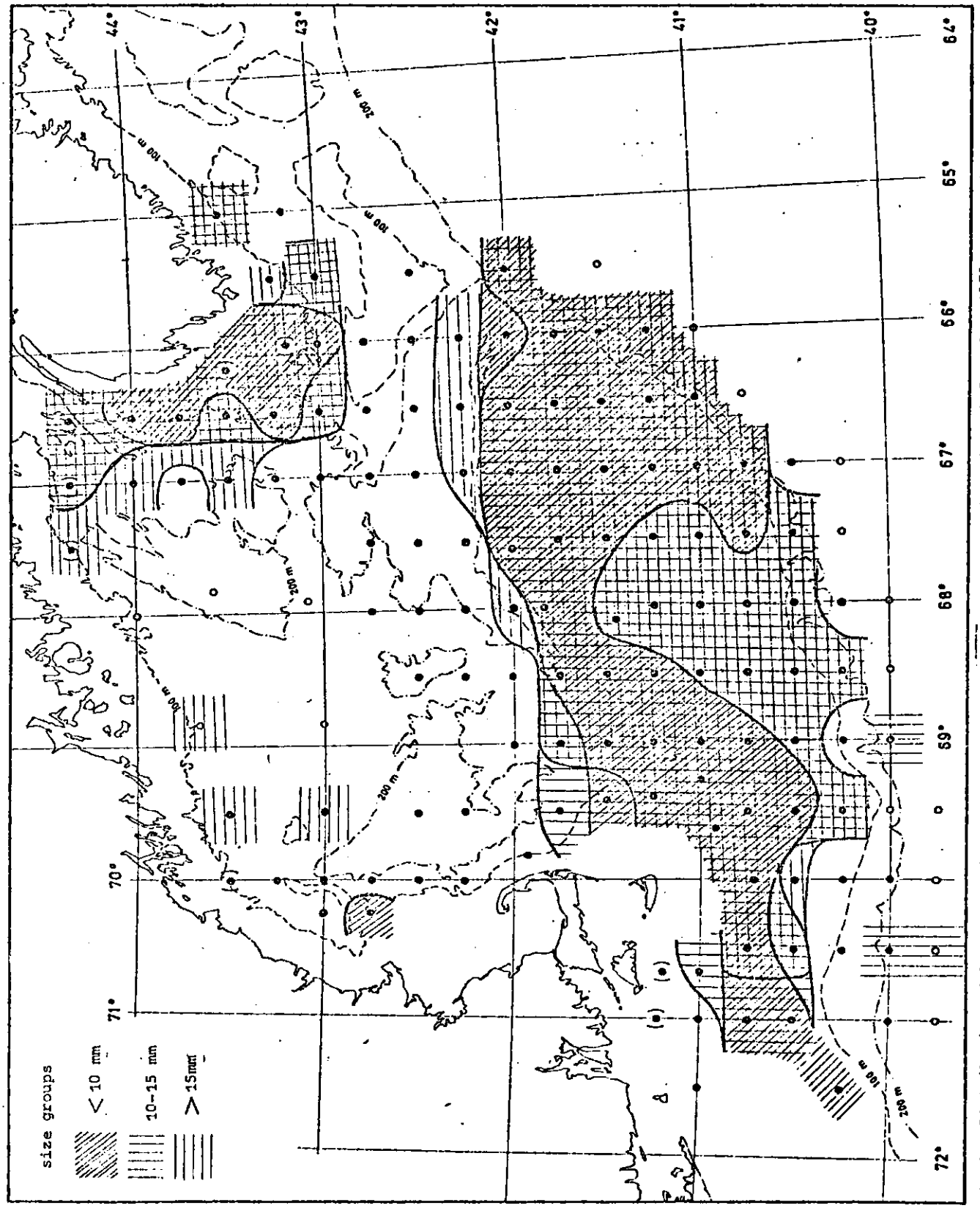
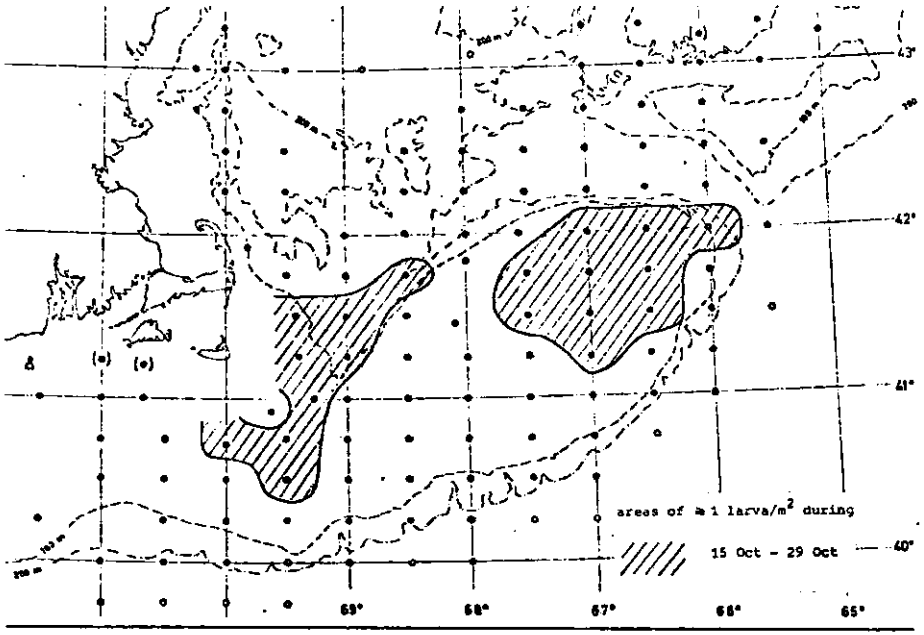
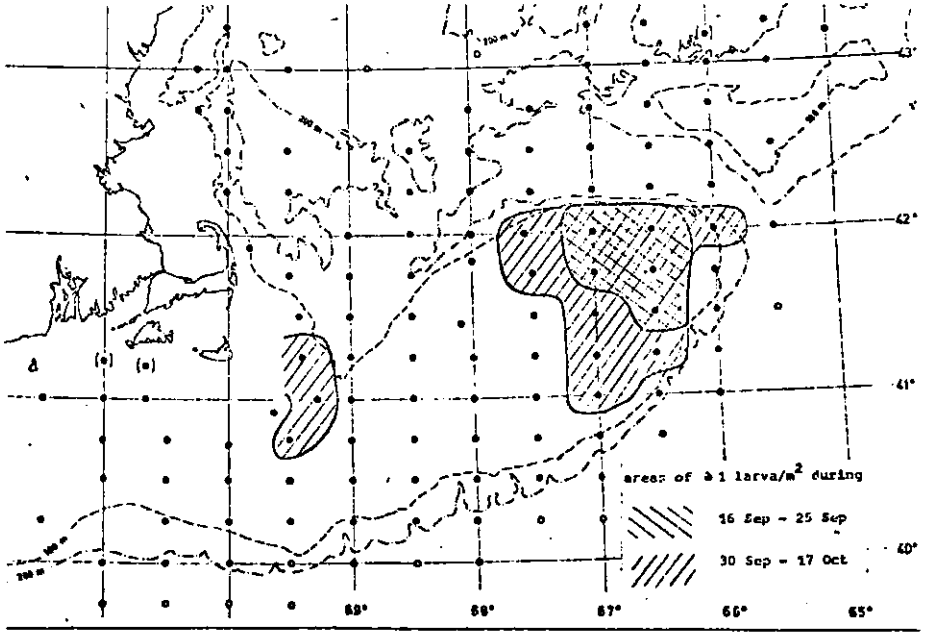
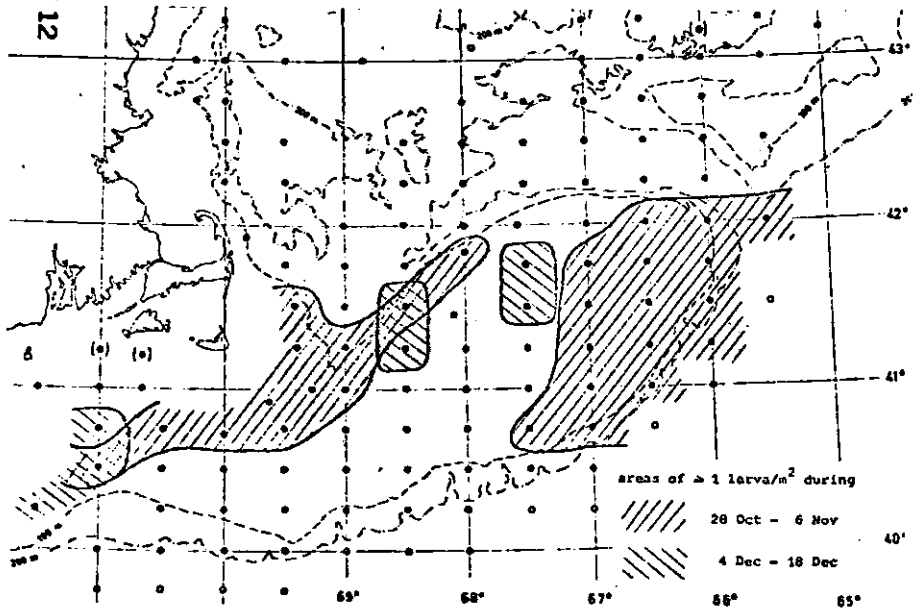


Fig.2: Distribution of larvae of different size categories during September through December 1973.
(Based on stations with at least 1 larvae of the respective size per m^2)







F 12

Fig.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.

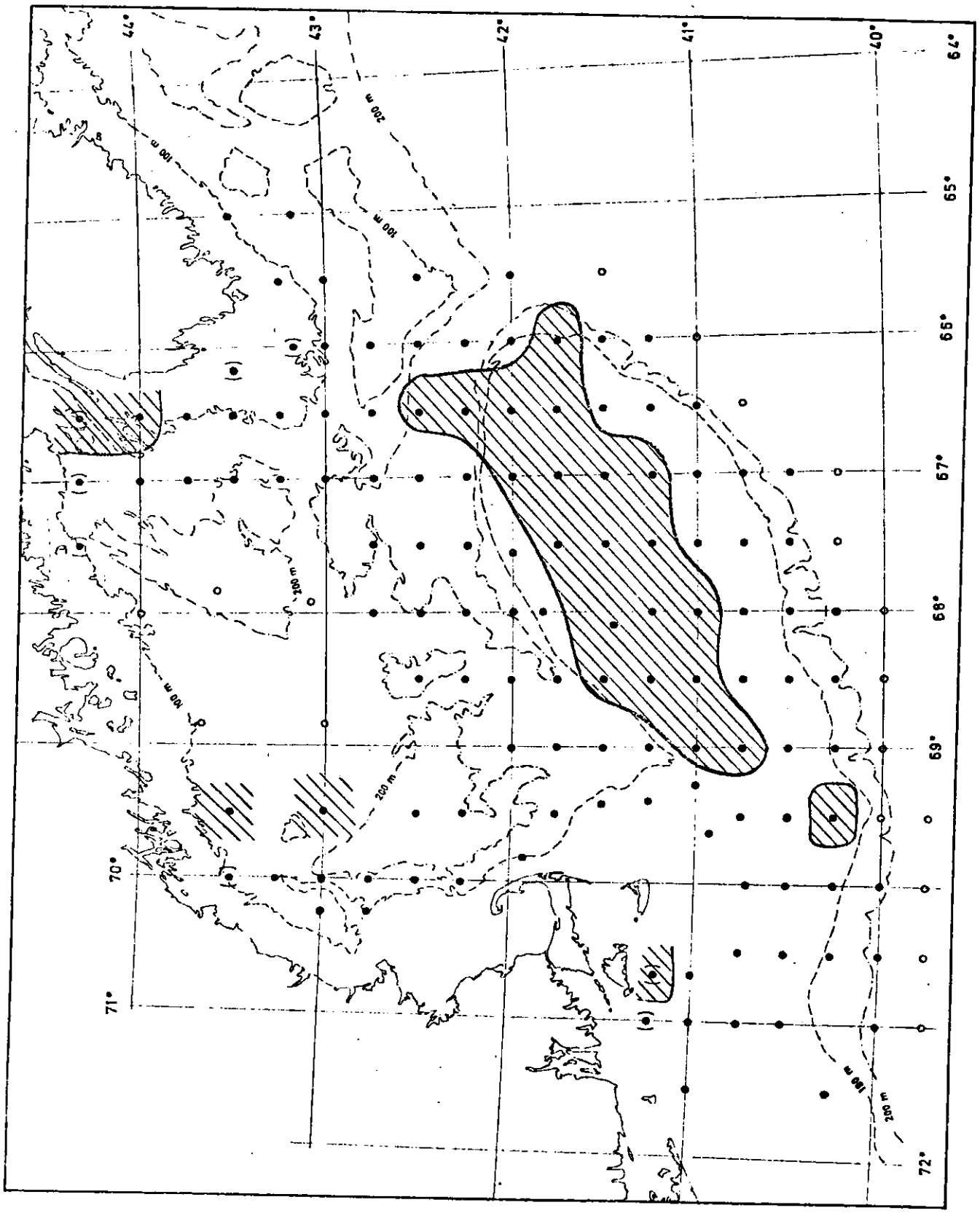


Fig.4: Distribution of larvae > 25 mm

Nantucket Shoals 1973

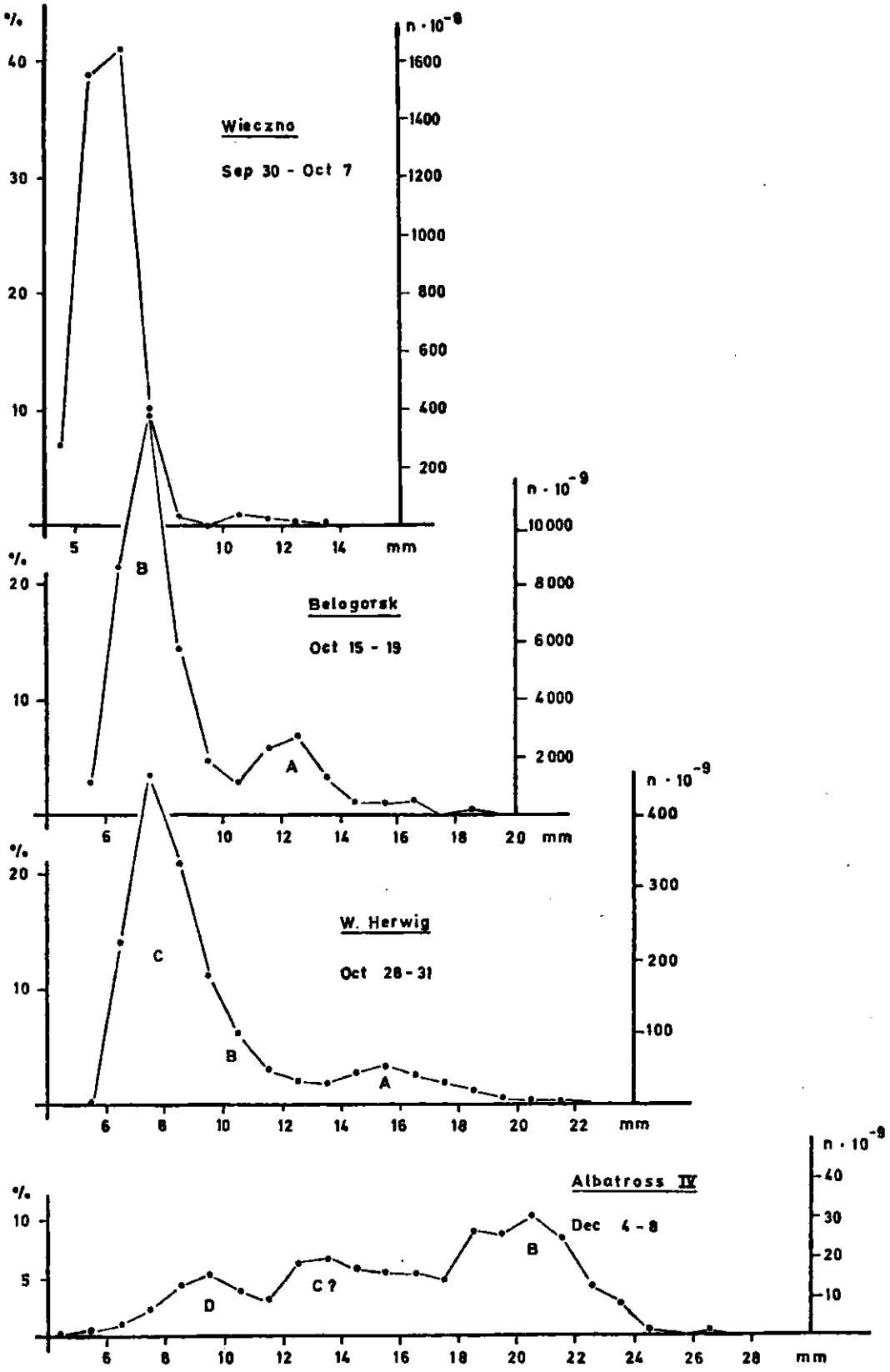


Fig. 5: Length frequency distribution in Nantucket Shoals area (Stat. 1 - 30)

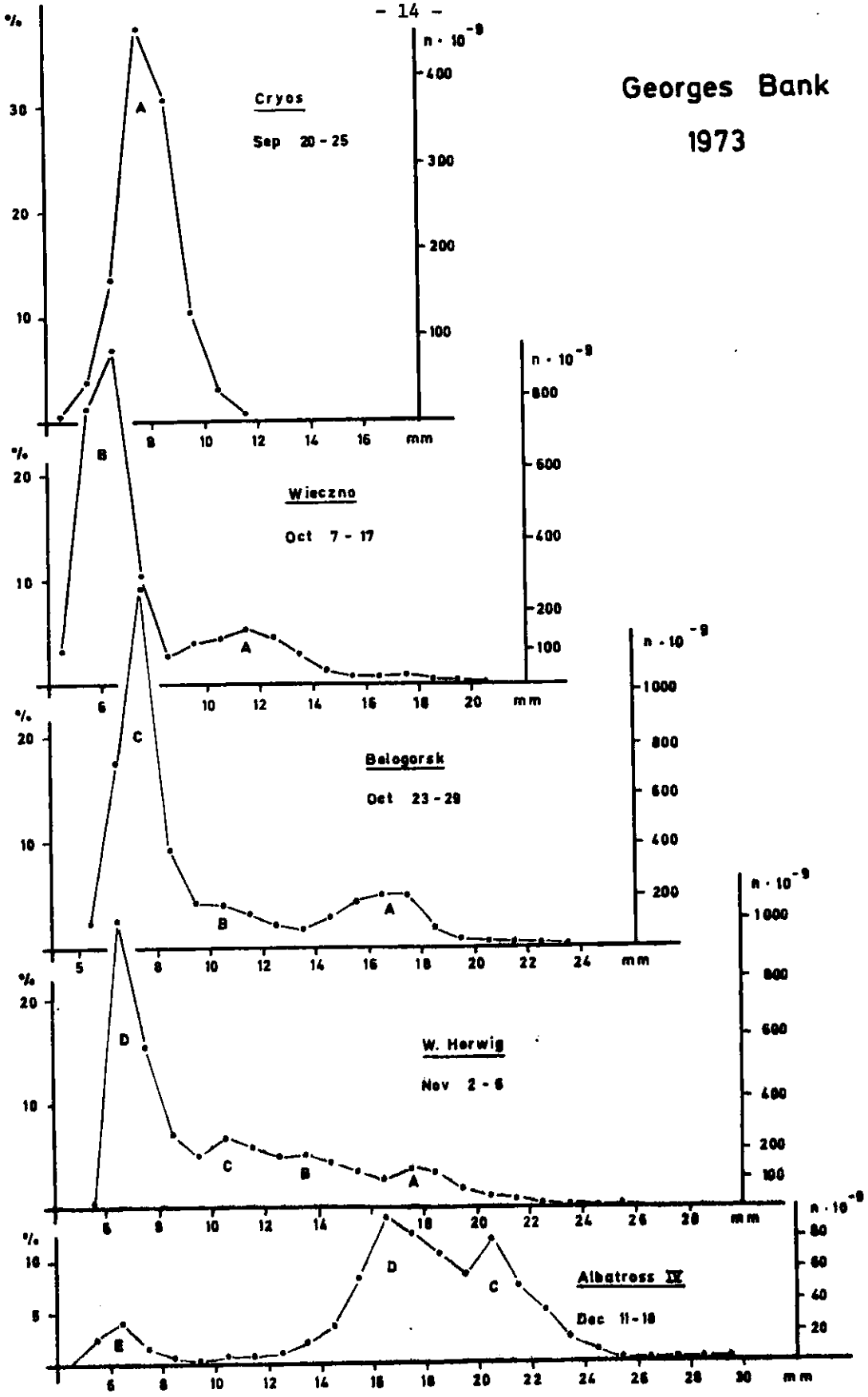


Fig. 6: Length frequency distribution on Georges Bank (Stat. 50 - 64, 70 - 85, 88 - 98)

Nova Scotia 1973

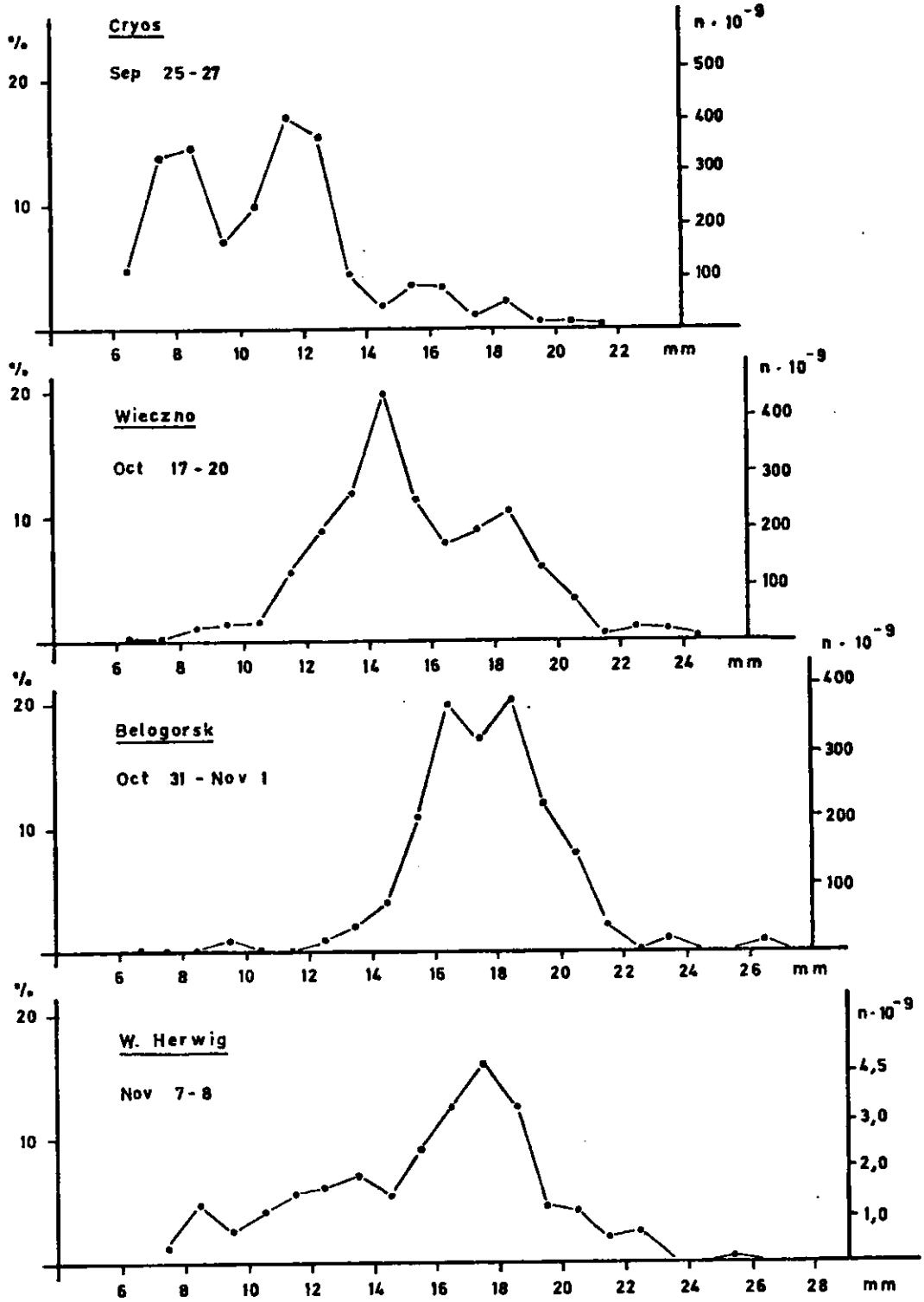


Fig. 7: Length frequency distribution in the area southwest off Nova Scotia (Stat. 102 - 109, 112 - 124)

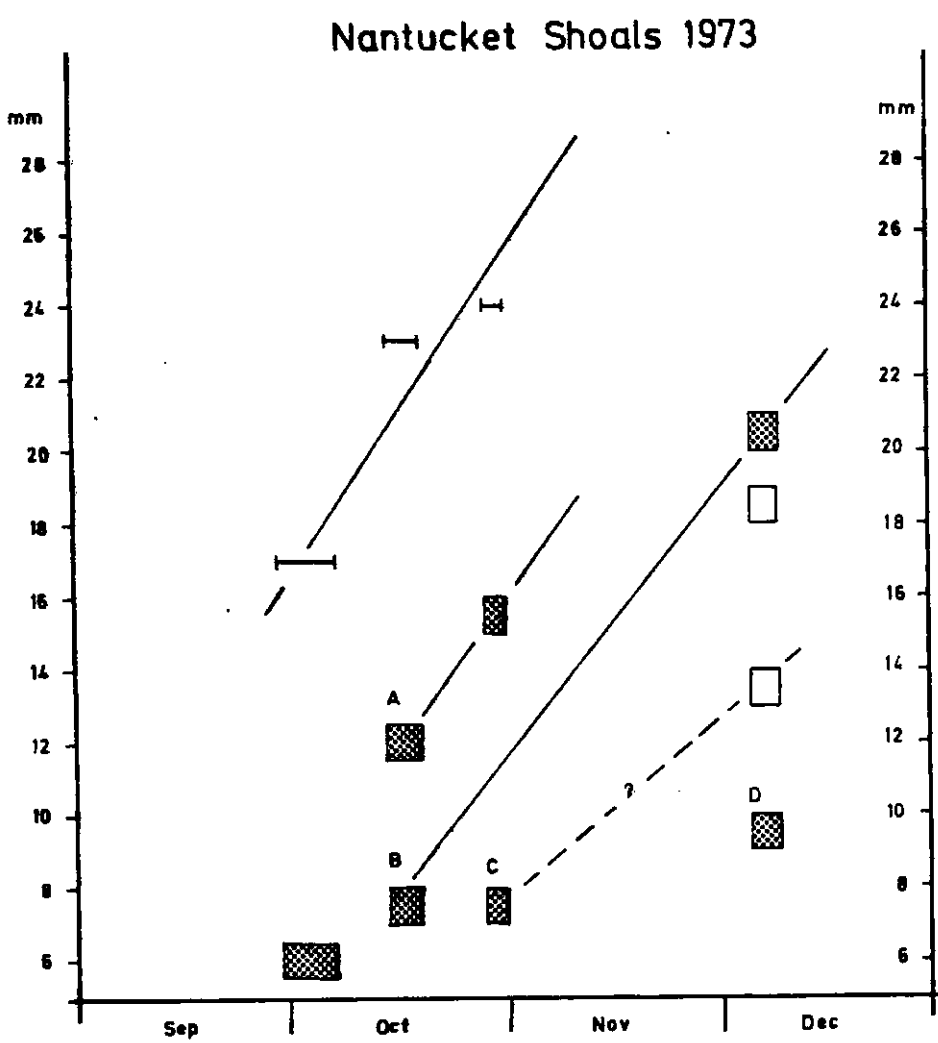


Fig. 8

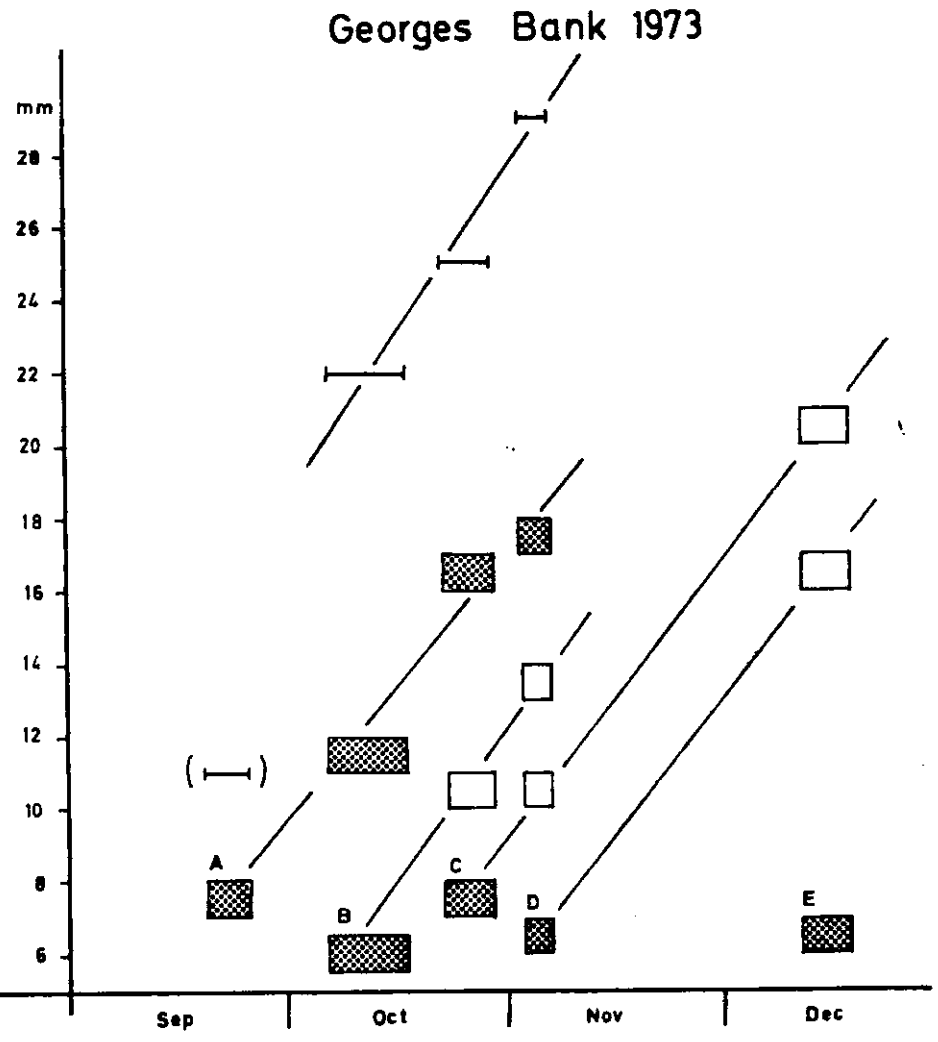


Fig. 9

Fig.8,9: Attempt of following the increase in length of hatching groups of larvae compared with increase in length of largest larvae during September through December.
▓▓ significant modes of length frequency curve, ▭ unsignificant modes, ⊢—⊣ largest larvae. Letters correspond to those in Fig.4-5

Nova Scotia

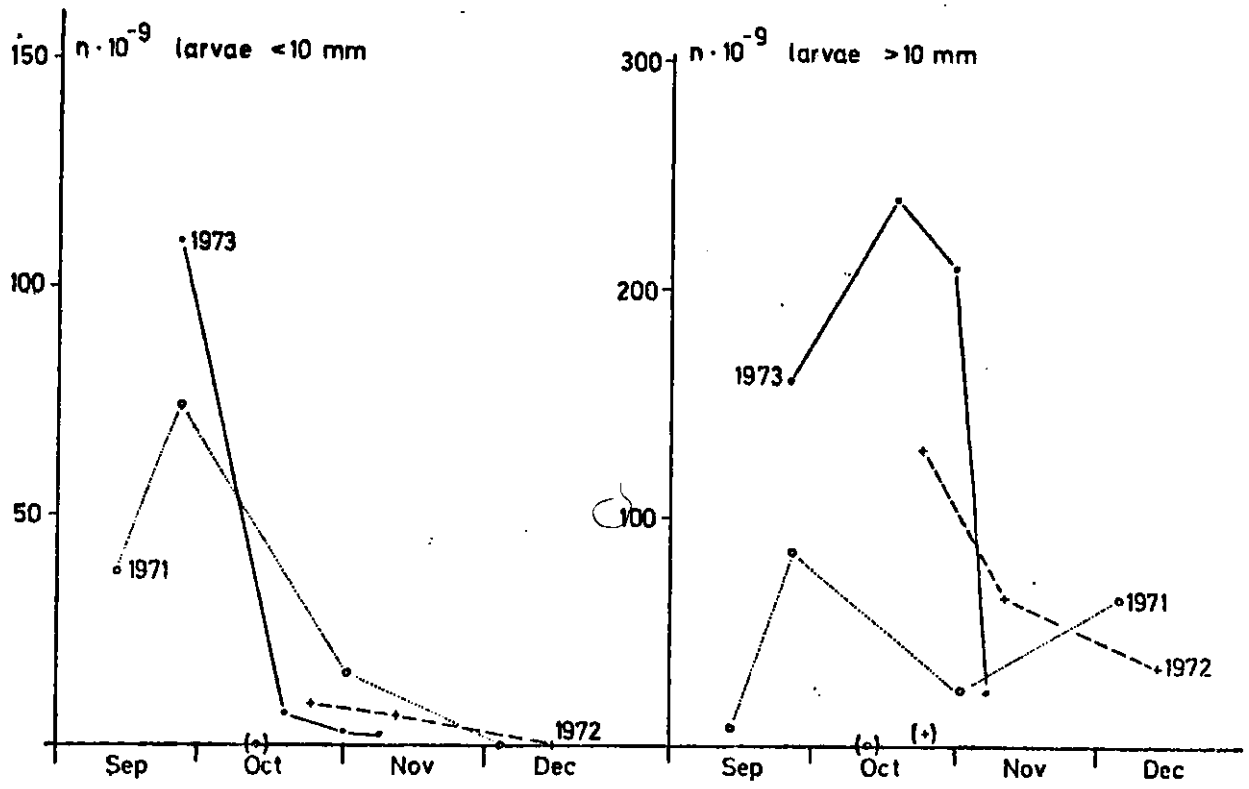


Fig. 10

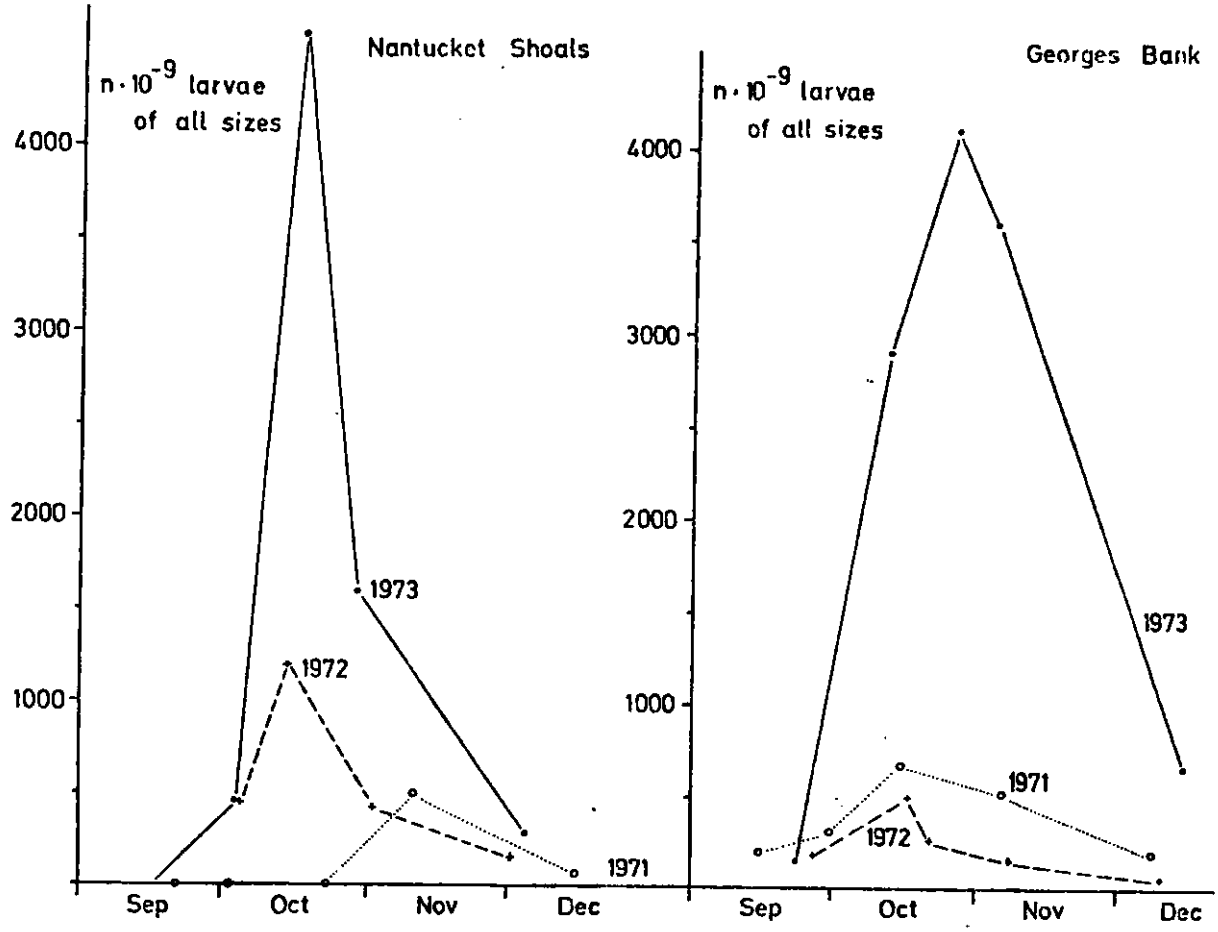


Fig. 11

Fig.10-13: Between years comparison of abundance estimates of larvae, separately for areas and size categories.

Georges Bank

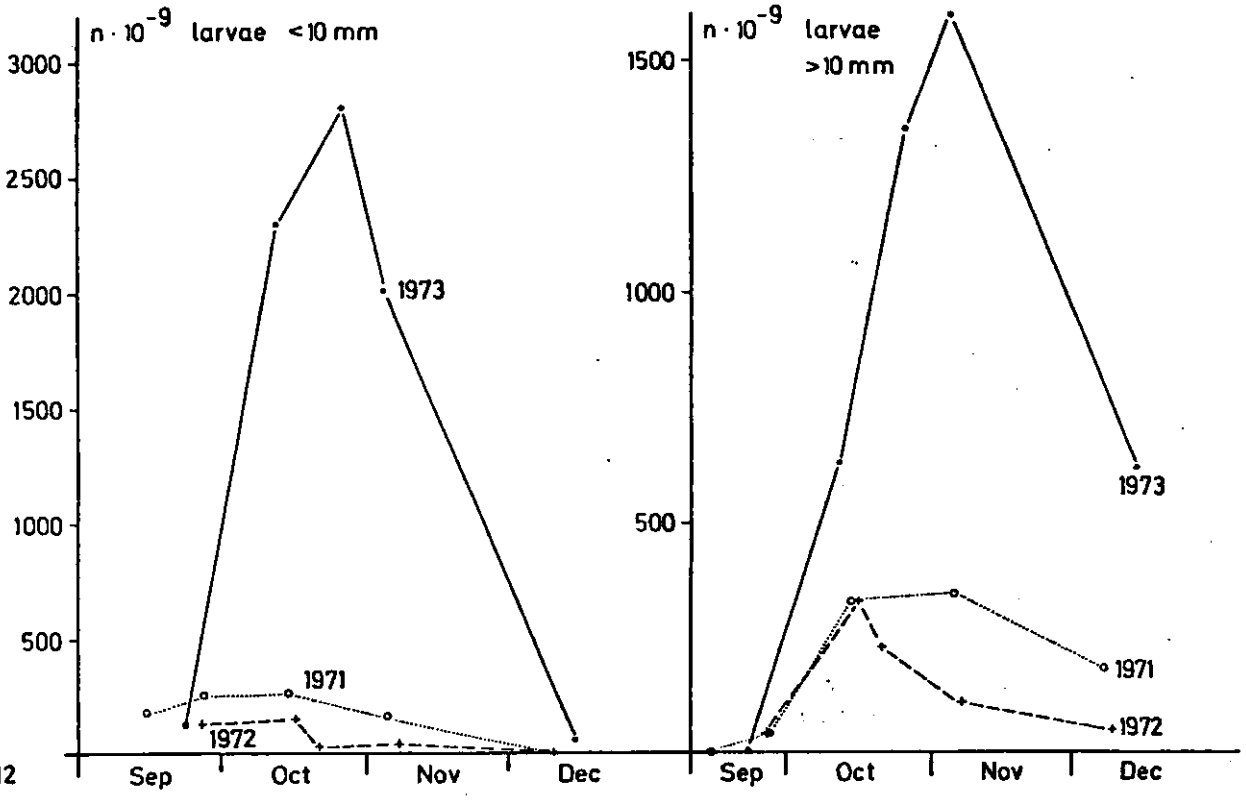


Fig. 12

Nantucket Shoals

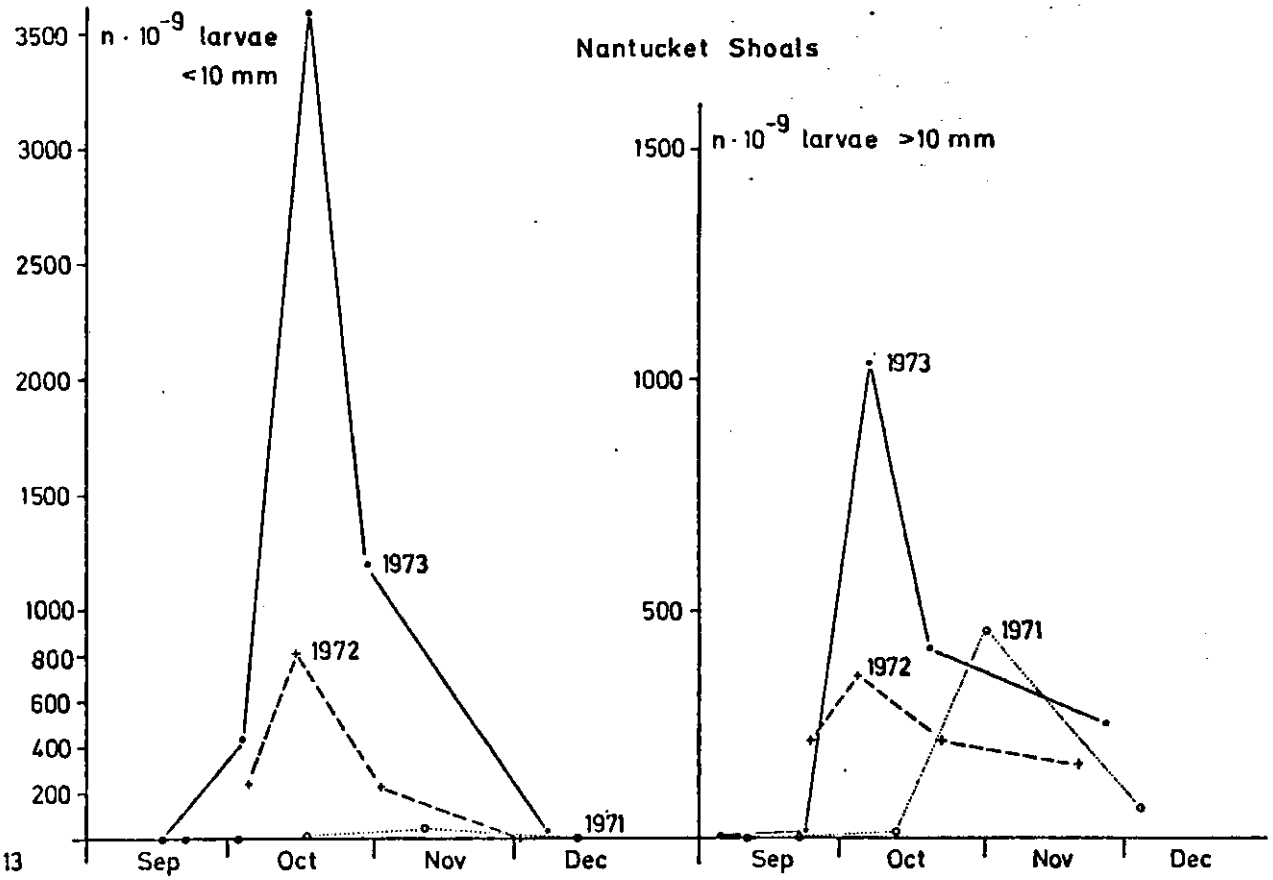
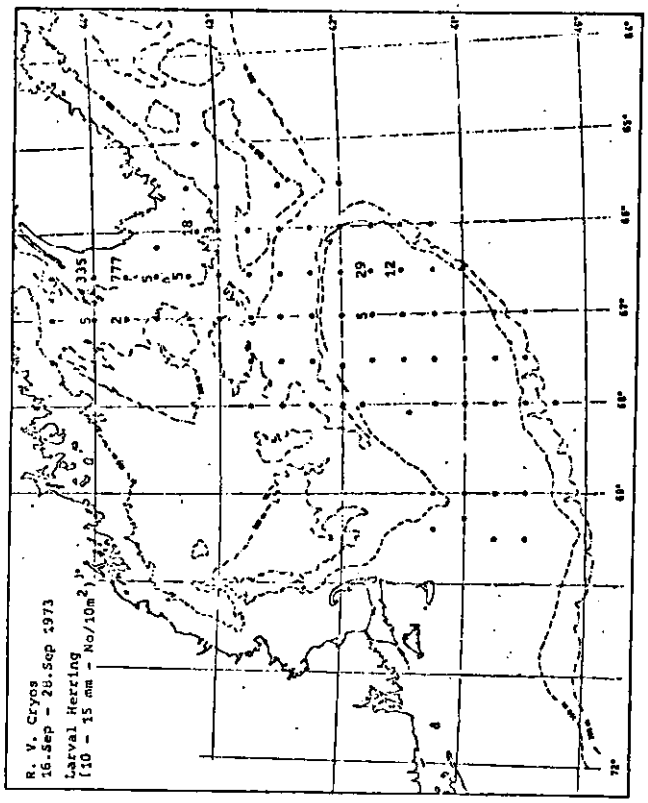
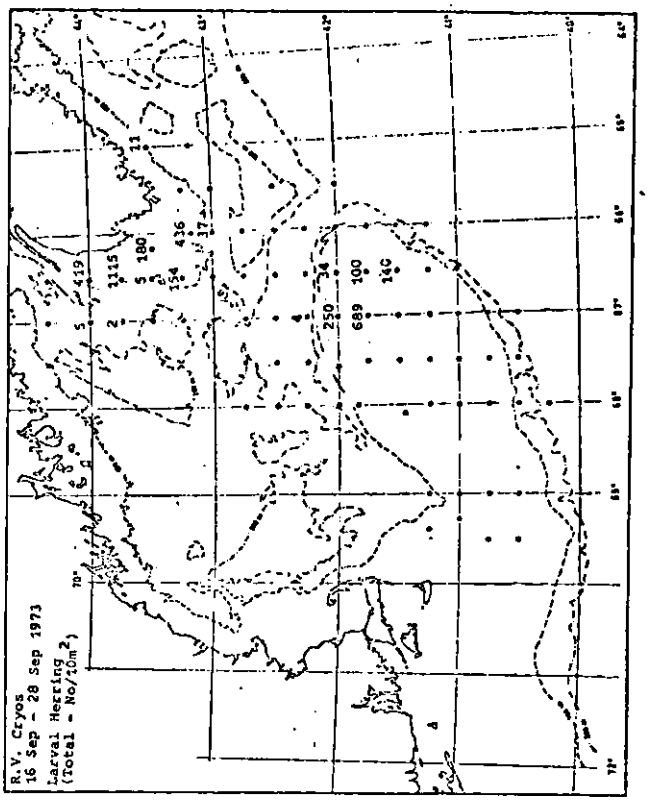
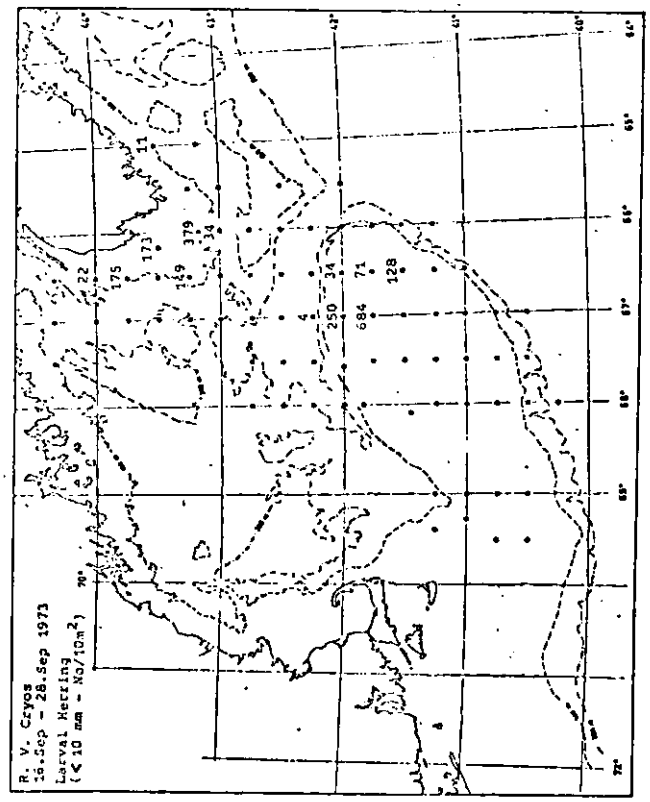


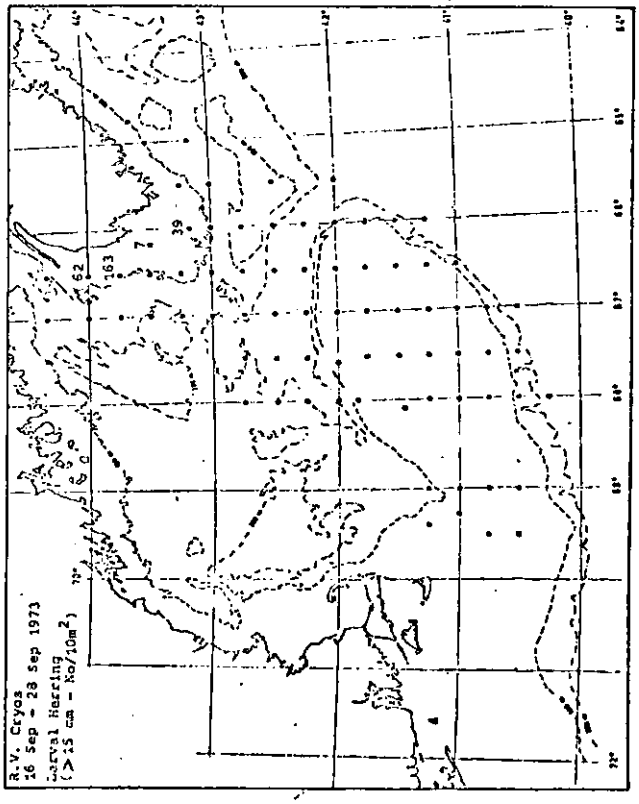
Fig. 13

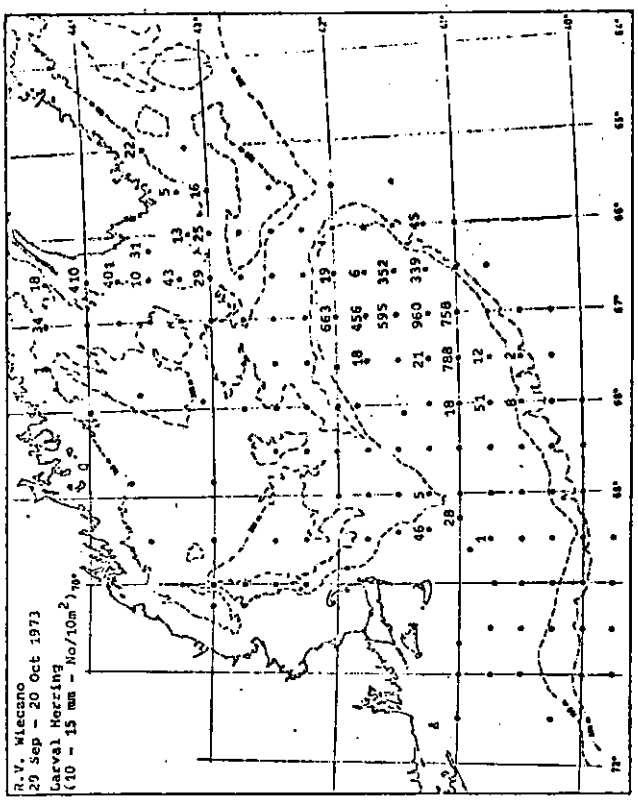
Fig.10-13: Between years comparison of abundance estimates of larvae, separately for areas and size categories.

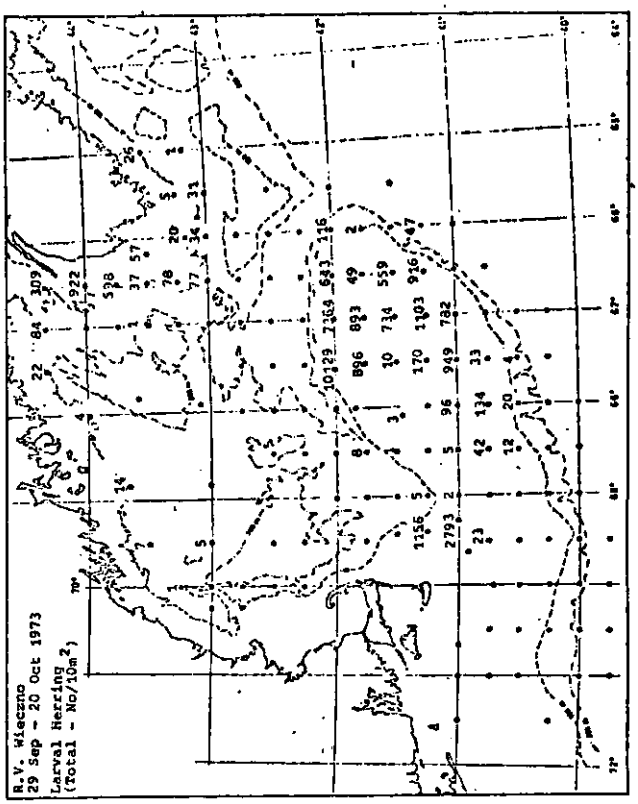

R. V. Cryos
16.Sep - 28.Sep 1973
Larval Herring
(10 - 15 mm - No/10m²)

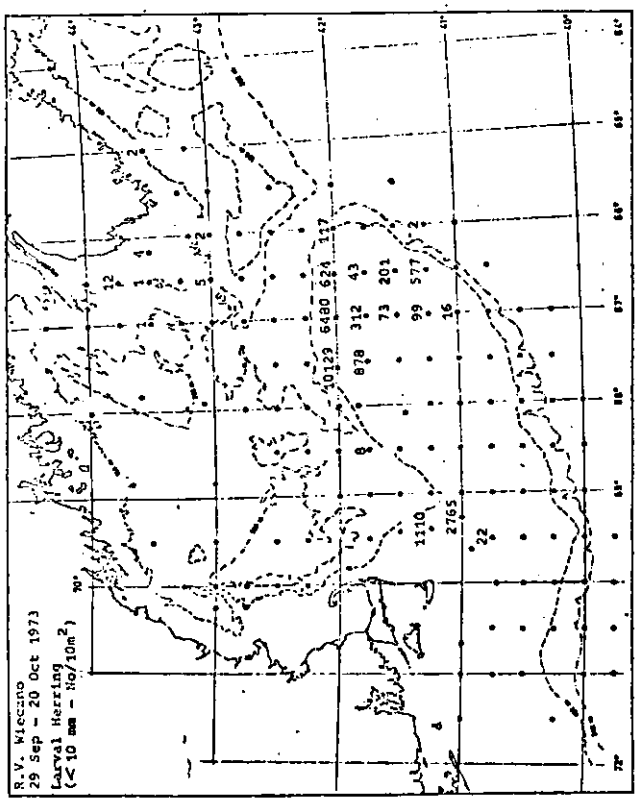

R.V. Cryos
16 Sep - 28 Sep 1973
Larval Herring
(Total - No/10m²)

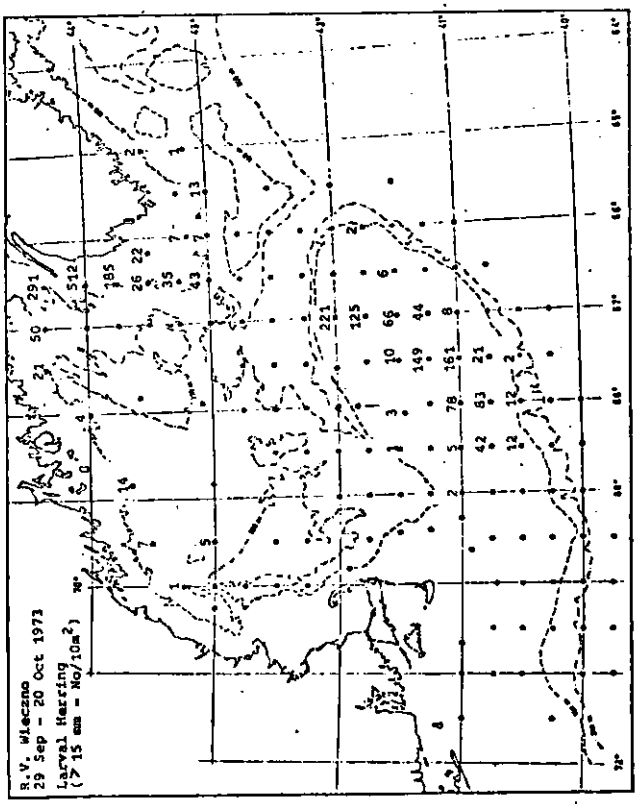

R. V. Cryos
16.Sep - 28.Sep 1973
Larval Herring
(< 10 mm - No/10m²)

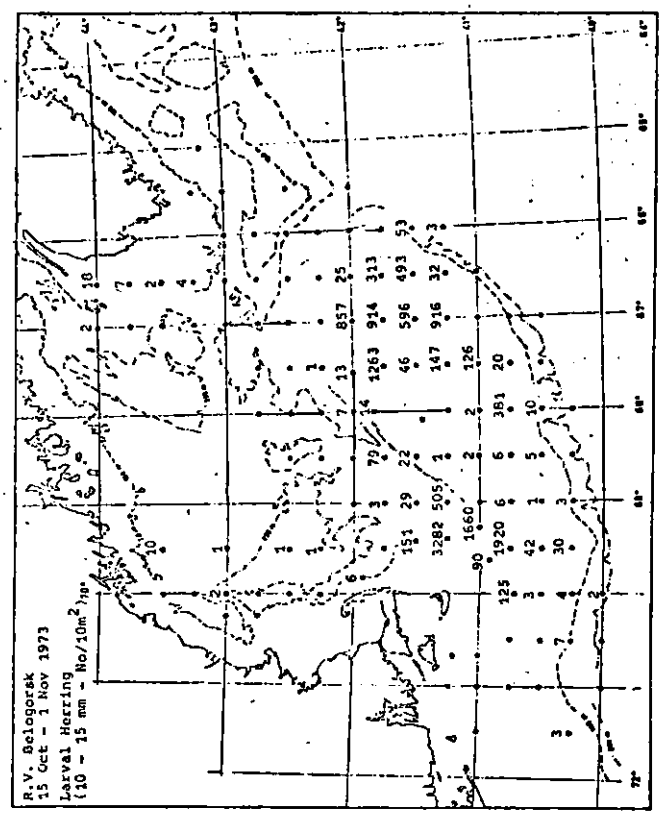

R.V. Cryos
16 Sep - 28 Sep 1973
Larval Herring
(> 15 cm - No/10m²)

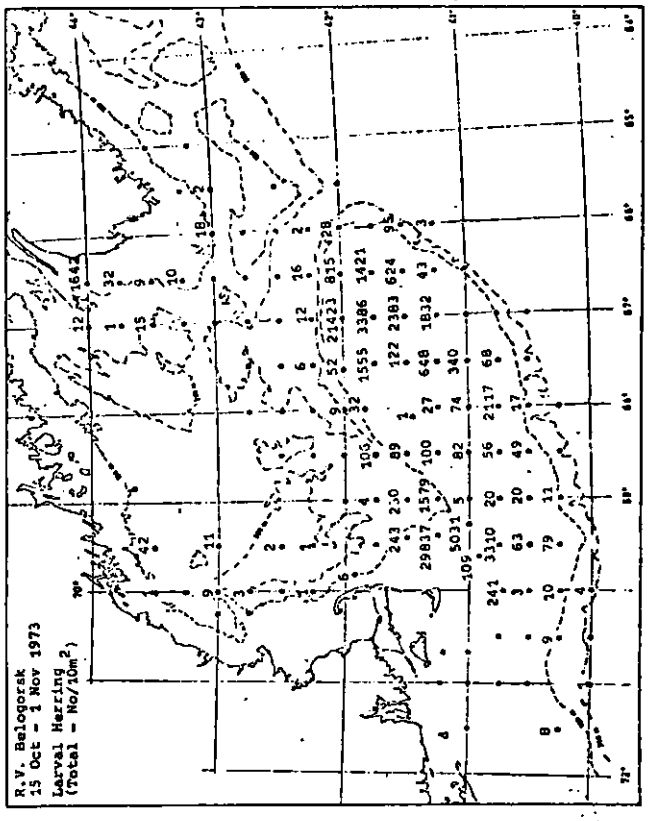

R.V. Wieczno
29 Sep - 20 Oct 1973
Larval Herring
(10 - 15 mm - No/10m²)

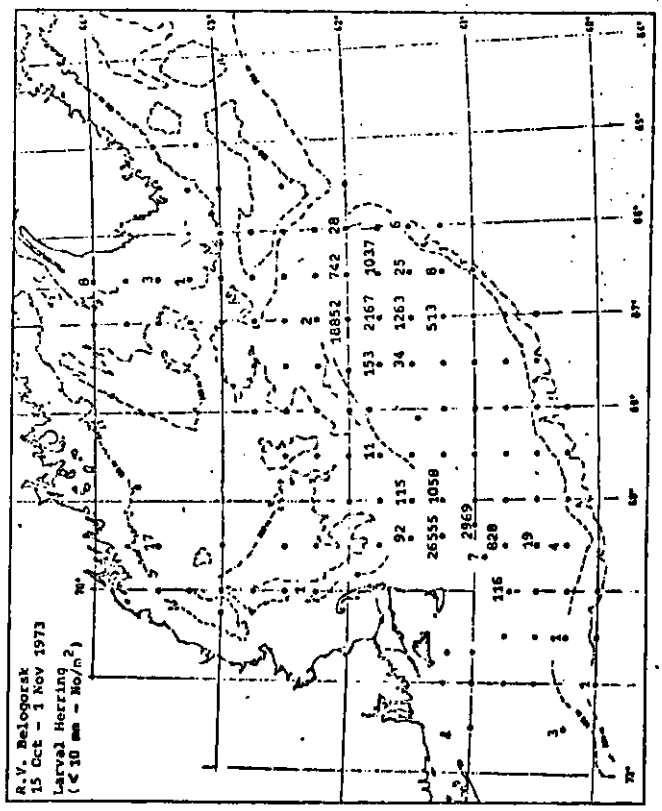

R.V. Wieczno
29 Sep - 20 Oct 1973
Larval Herring
(Total - No/10m²)

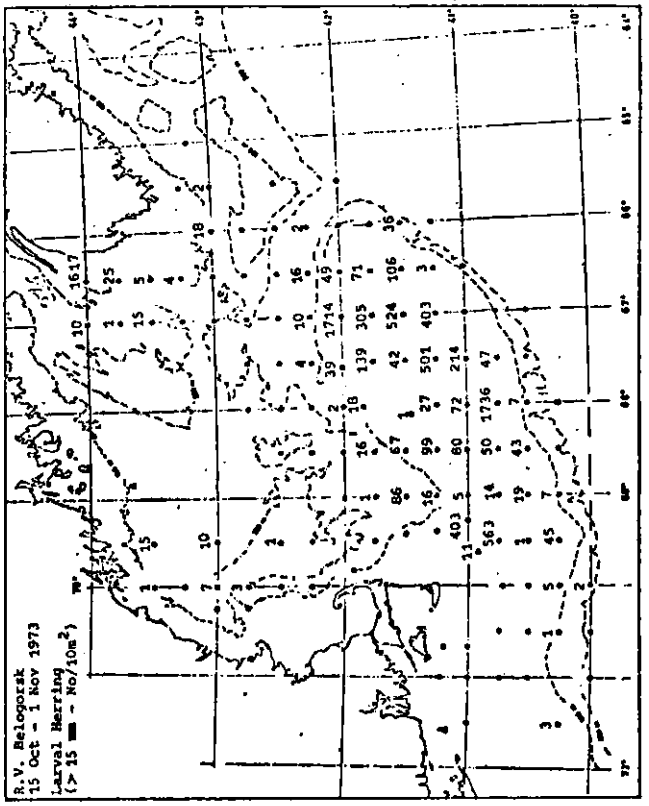

R.V. Wieczno
29 Sep - 20 Oct 1973
Larval Herring
(< 10 mm - No/10m²)

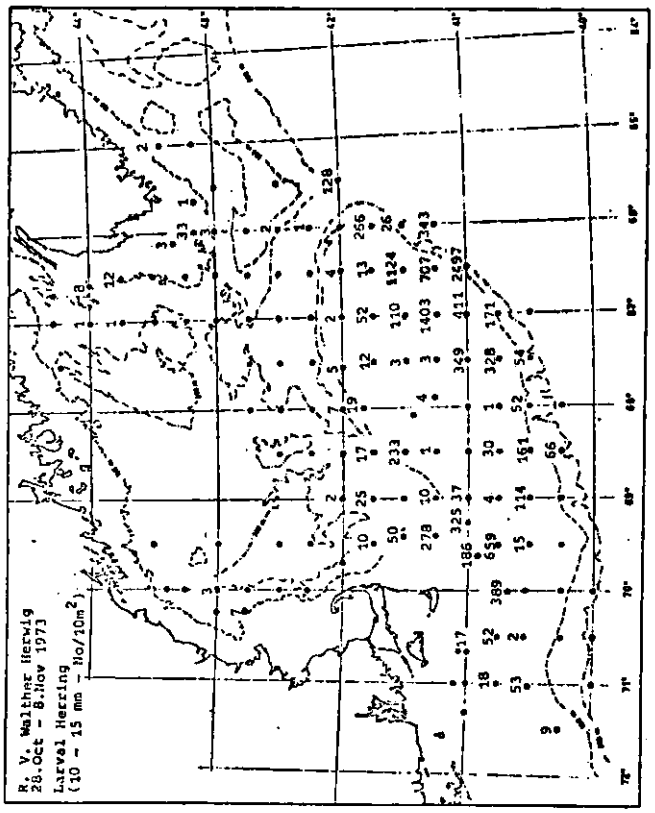

R.V. Wieczno
29 Sep - 20 Oct 1973
Larval Herring
(> 15 mm - No/10m²)

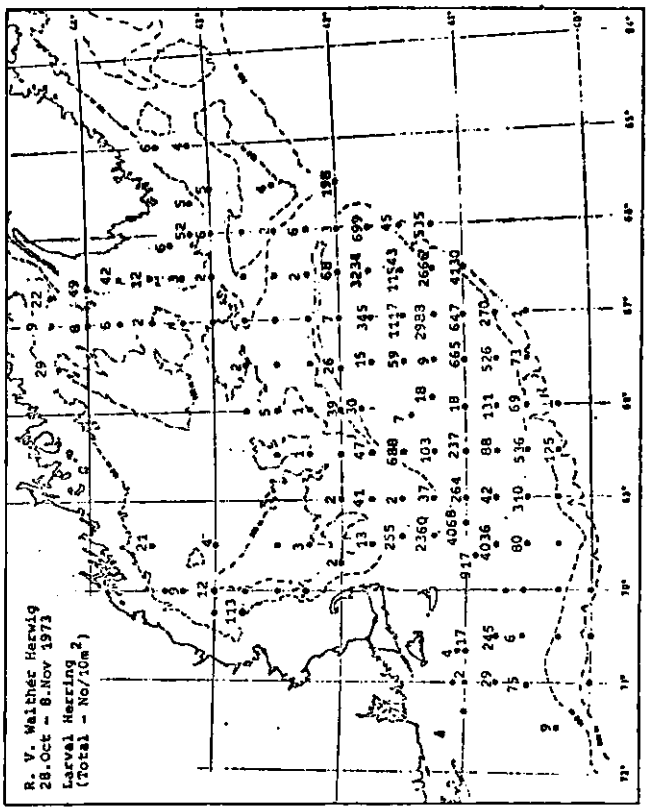

R.V. Belogorsk
15 Oct - 1 Nov 1973
Larval Herring
(10 - 15 mm - No/10m²)

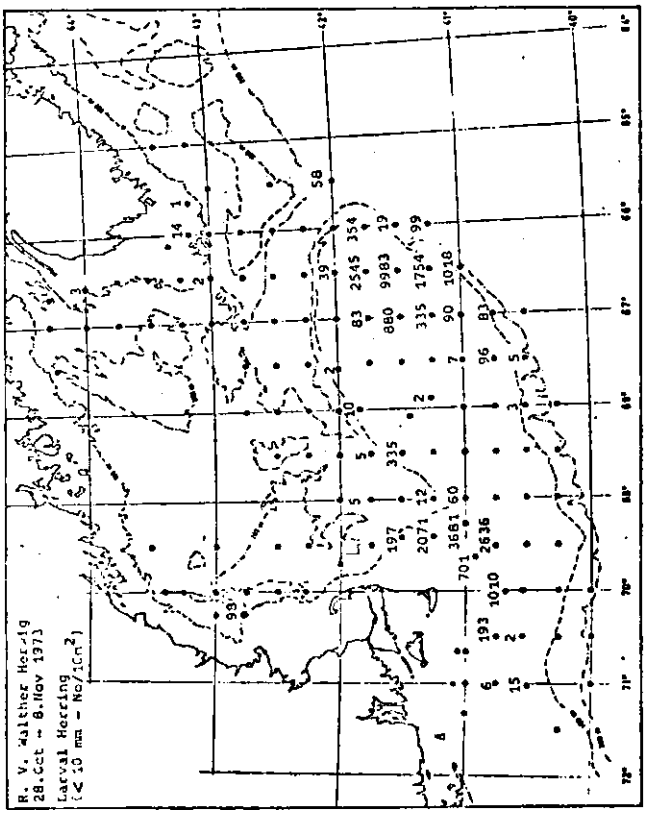

R.V. Belogorsk
15 Oct - 1 Nov 1973
Larval Herring
(Total - No/10m²)

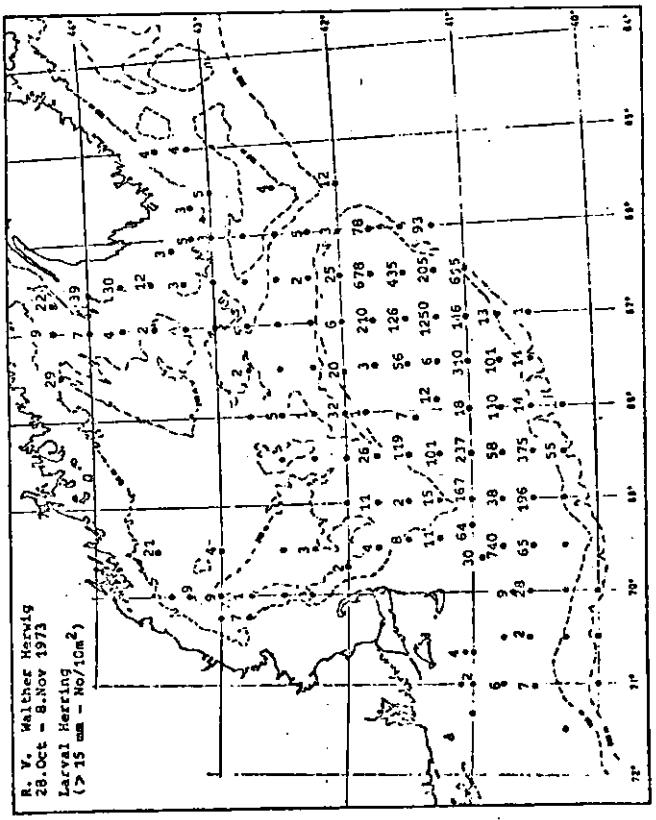

R.V. Belogorsk
15 Oct - 1 Nov 1973
Larval Herring
(< 10 mm - No/m²)

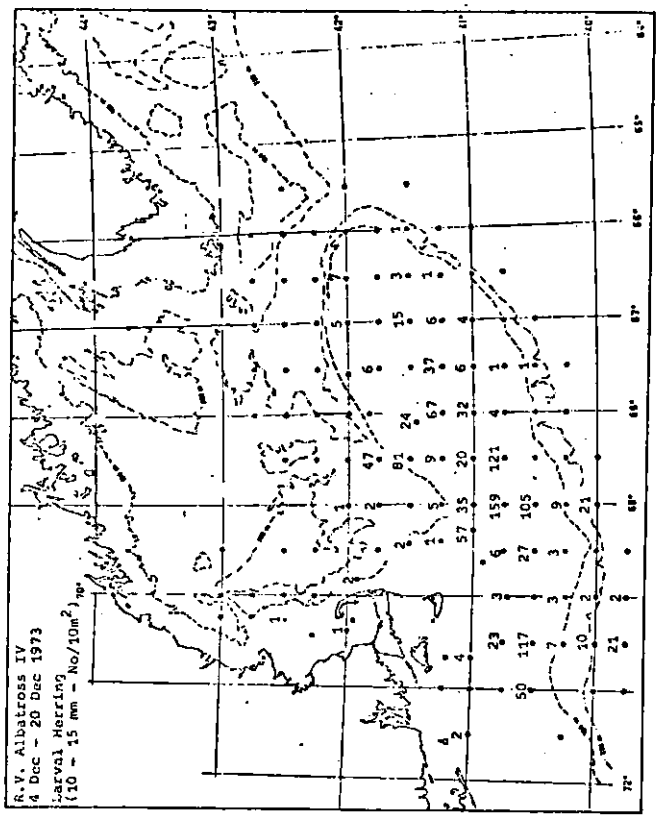

R.V. Belogorsk
15 Oct - 1 Nov 1973
Larval Herring
(> 15 mm - No/10m²)

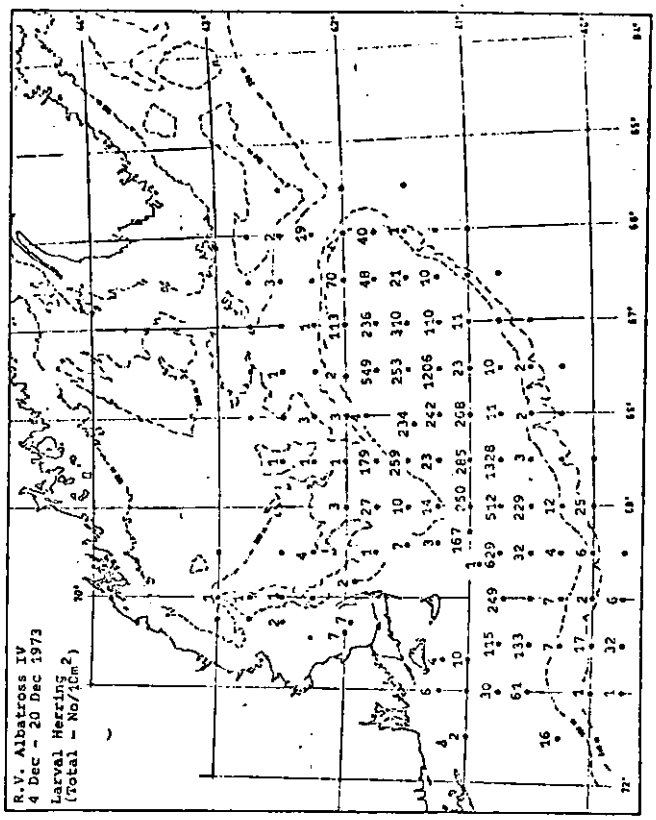

R. V. Walther Herwig
28.Oct - 8.Nov 1973
Larval Herring
(10 - 15 mm - No/10m²)

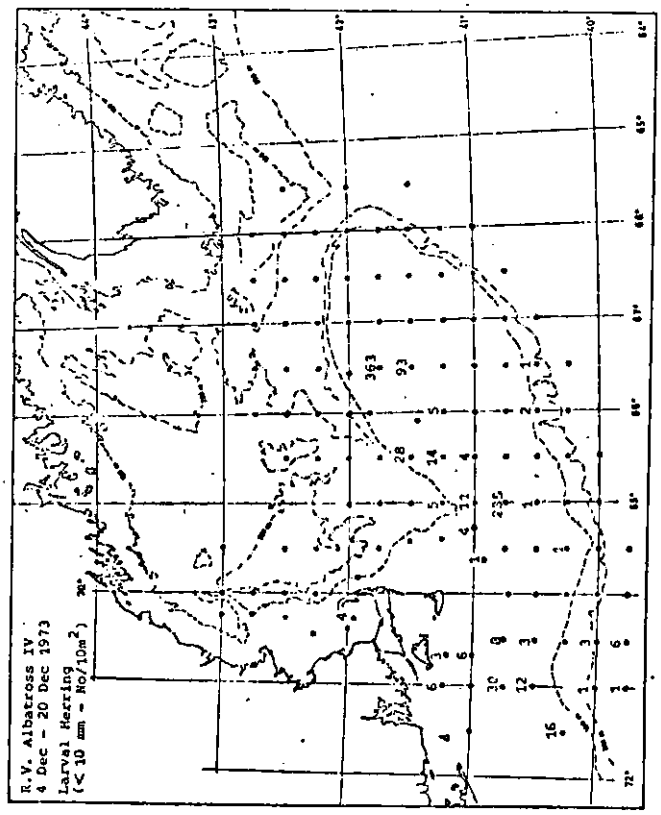

R. V. Walther Herwig
28.Oct - 8.Nov 1973
Larval Herring
(Total - No/10m²)

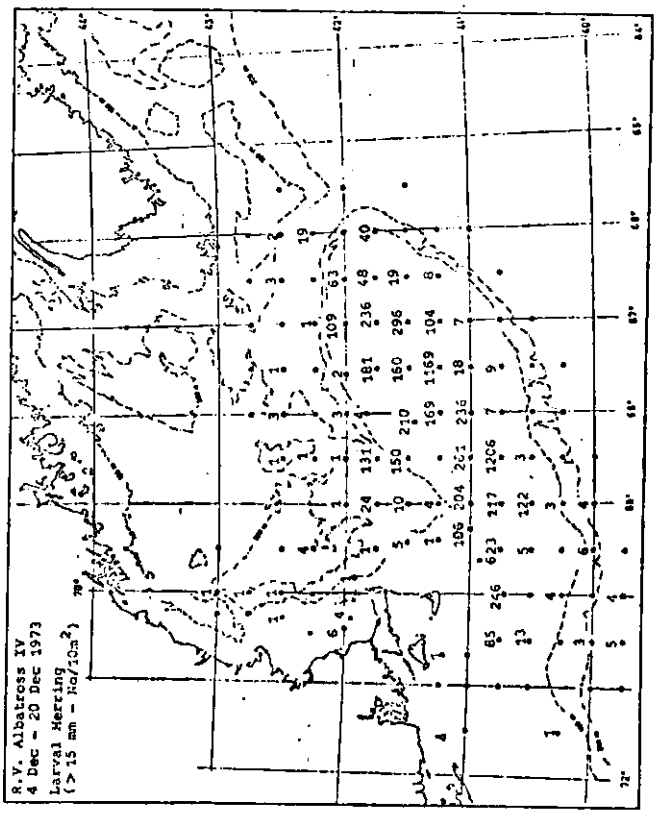

R. V. Walther Herwig
28.Oct - 8.Nov 1973
Larval Herring
(< 10 mm - No/10m²)


R. V. Walther Herwig
28.Oct - 8.Nov 1973
Larval Herring
(> 15 mm - No/10m²)


R.V. Albatross IV
4 Dec - 20 Dec 1973
Larval Herring
(10 - 15 mm - No/10m²)


R.V. Albatross IV
4 Dec - 20 Dec 1973
Larval Herring
(Total - No/10m²)


R.V. Albatross IV
4 Dec - 20 Dec 1973
Larval Herring
(< 10 mm - No/10m²)


R.V. Albatross IV
4 Dec - 20 Dec 1973
Larval Herring
(> 15 mm - No/10m²)