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ANNUAL MEETING - JUNE 1978

The studies on the feeding habits of larval herring (*Clupea harengus*) in the Georges Bank area, 1965-1975

by

A. S. Noskov, V. I. Vinogradov and L. G. Ptitsina
AtlantNIRO, Kaliningrad, USSR

Table 2. Proportion of feeding larval herring.

Larvae length, mm:	Years	1965	1966	1968	1969	1970	1971	1972	1973	1974	1975
5.0-7.9	Total number, sp.	521	307	72	101	200	42	28	162	226	164
	Food containing, sp.	77	4	0	22	3	5	14	13	46	20
	Proportion of feeding sp., %%	15	1	0	22	2	12	60	8	20	12
8.0-12.9	Total number, sp.	77	60	154	66	93	136	68	116	336	297
	Food containing, sp.	23	6	35	18	25	48	50	50	80	58
	Proportion of feeding sp., %%	30	10	23	27	27	35	74	43	24	20
13.0-17.9	Total number, sp.	15	-	31	65	17	211	32	219	112	57
	Food containing, sp.	4	-	6	27	5	59	21	85	42	2
	Proportion of feeding sp., %%	27	-	19	42	29	28	66	39	38	4
5.0-17.9	Total number, sp.	613	367	257	232	310	389	128	497	674	518
	Food containing, sp.	104	10	41	67	33	112	85	148	168	80
	Proportion of feeding sp., %%	17	3	16	29	11	29	66	30	25	15

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I. Introduction

A herring stock inhabiting the Georges Bank area and contiguous regions is one of the most numerous in the Northwest Atlantic. The abundance of Georges Bank herring stocks is subjected to sharp fluctuations depending on the strength of the year class recruitment, hence, marked variations of the yields. When regular fishing commenced in 1967 the herring yields amounted to 68 thous. tons, in 1968 they increased to about 373 thous. tons and in 1976 reduced to 43 thous. tons. So, the study of the factors telling upon the strength of the herring year classes was necessiated. To date feeding conditions at the earlier development stages are considered to be the primary factor determining the strength of the majority of fish species. Beginning from 1965, the annual studies on distribution, abundance, composition and feeding intensity of larval herring were initiated in the Georges Bank area, as well as the studies on composition and abundance of the food zooplankton. The surveys were conducted in October after the overall hatching of the larva on the main spawning grounds of Georges Bank. During the 1965 to 1970 period the surveys were carried out by the Soviet scientists (from AtlantNIRO). From 1971 to 1975 the research activities were fulfilled under the International Program for the studies of the Georges Bank herring breeding undertaken by the ICNAF.

II. Material and Methods

Ichthyoplankton surveys on abundance and distribution of larval herring were conducted in the middle or by the end of October after the overall hatching of larval herring occurred on the main spawning grounds. The surveys covered the Georges Bank area and adjacent regions of the Gulf of Maine. Prior to 1971 the surveys were made according to the pattern of standard stations adopted in the AtlantNIRO (fig.1). Beginning from 1971 the international pattern of standard stations under the ICNAF Program was adopted (fig.2). There are no principal differences between the two patterns The survey was usually completely made at all the stations exept for 1970, when the ichthyoplankton was collected on the spawning ground of the northern part of Georges Bank. In the period of 1965-1970 the hauls were made by the ichthyoplankton conical net (IKS-80) with the opening diameter of 800 cm and 0.570 mm mesh size. Vertical hauls in the horizon of 0-50 m and near the surface were made during the circulation of the vessel for about 10-15 minutes. From 1971 the plankton sampler BONGO with the opening diameter of 61 cm and 0.333 and 0.505 mm mesh size is used for hauling by depth level (each haul of 15 minute duration at the vessel speed of 3.5 knots) from the depths of 100 m or 10 m off the bottom in the shallow water. The samples are fixed in 4% formalin. The collected and processed data are given in table 1 by year.

The analysis of the diurnal feeding habits indicated that the larva do not feed at night, therefore, in the laboratory the larva from the hauls taken during the day were selected for the feeding studies (fig.3).

The methods for processing the data on feeding were adopted from "The Manual of the Studies of the Fish Feeding Habits in Natural Conditions" (E.N.Bokova, 1961). The larva were measured from the top of the snout to the chord end to within 1 mm. For determination of the mean weight indices the larva of the same body length were grouped by 10 specimens or less, dried on the filtering paper for about a minute and weighted on the analytical balance.

Then the abdominal cavity was dissected. Food organisms were collected from the intestines, and their genera determined. Heavily digested organisms were determined to within the order. Smaller organisms were combined into a single group; for instance, the Copepoda nauplii. All food organisms were measured, simultaneously, their digestion degree was recorded according to the following scale:

1 - whole fresh organisms

2 - party digested organisms

3 - digested organisms except for carapace

4 - completely digested organisms (some non-assimilated parts of the body).

Based on the measurement of whole organisms and from the tables of dependance of organisms weight on the body length the weight of food organisms was re-established (V.G.Bogorov and E.N. Preobrazhenskaya, 1934, I.P.Kanaeva, 1962, A.A.Shmeleva, 1963). The weight of heavily digested organisms was equalled to mean weight of the given group of organisms. All the results were combined into three groups of larva as follows:

1. 5.0-7.9 mm - larva having yolk-sacs, but already consuming food organisms;

2. 8.0-12.9 mm - larva feeding mainly on small organisms (the Copepoda nauplii and copepodites);

3. 13.0-17.9 mm - larva feeding mainly on copepodites.

Feeding intensity was estimated with regard for the proportion of food containing larva and consumption index is the ratio of the mean weight of food organisms to the weight of food containing larva of the given length group.

To determine the fat condition of the larva the weight of the larva of the same length by year was compared to mean weights calculated for a series of observations (Noskov, 1956).

In addition to ichthyoplankton samples, the zooplankton was also collected by a Judey plankton net (1965-1970) and a plankton sampler BONGO with smaller mesh size.

III. Results and Discussion

The observation period in the Georges Bank area was characterised by low number of feeding larval herring and on the average it amounted to 3 specimens in 1966 to about 66 specimens in 1972, which made up some 20% (table 2). Smaller larva of 5 to 8 mm in length were feeding less intensively than average-sized larva of 8 to 13mm. The proportion of larger food containing larva of 13 to 18 mm in length was lower compared to average-sized ones, but higher than that of smaller specimens. The fact that the number of smaller feeding larva was lower than that of the average-sized specimens can be attributed to lower feeding intensity during the yolk-sac resorption. The higher number of average-sized food containing larva is evidently due to more intensive consumption of food organisms. The lower number of larger food containing larva may be related to the fact that larger food organisms are less frequent in the plankton than the smaller forms. Generally, only the insignificant part of larval herring contains food in the intestines with the exception of the larva from the spawning grounds in the gulfs or bays, where the food zooplankton is abundant. According to M.Lebour (1921), Bhattacharyya (1957) and Schnack D. (1972), the proportions of food containing larval herring from the North Sea were respectively 30%, 45% and 50%. K.Sherman and K.Honey (1968) stated that 43% of the examined intestines of larval herring from the Gulf of Maine contained the food. According to I.S.Pokrovskaya (1955) the food was found in 44% of the intestines of the Pacific larval herring. D.Schnack found the food in all the larva from the western part of the Baltic (Schley Fiord), except for a small number of the younger specimens.

As indicated by E.Z.Samyshev and L.G.Ptitsina (1976), the transition of larval herring on Georges Bank to active feeding begins on attaining the length of 5 mm. The basic food components at first are small organisms: eggs and nauplii of Copepoda and also the larva of the molluscs (table 3). In the average-sized larva the food is mainly represented by the copepodite stages of Copepoda, Oithona spp. and Centropages spp. (table 4). Larger larva feed mainly on older copepodite

stages of Copepoda: Calanus finmarchicus, Paracalanus spp., Pseudocalanus spp. (table 5). Although the food of larval herring was represented by 28 taxonomic groups, only 9 groups were predominant (tables 3-5), the smaller the larva, the smaller the consumed food forms.

The number of organisms per feeding larvae is generally insignificant (table 6) and in the period of 1965-1975 it averaged to 1.6(1.0 - 2.6) in smaller larva, to 2.4(1.5 - 4.0) in averaged-sized larva, and to 2.0(1.2 - 2.8) in larger specimens (table 6). The consumption index in smaller, average-sized and larger larva made up respectively 300 (94-834), 207(101-440) and 72‰ (15-117). Thus, a trend towards a decrease of the feeding intensity with growth is evident. The highest feeding intensity of smaller larva falls on 1965, 1969 and 1973, of average-sized larva on 1968, 1969 and 1973 and of larger larva on 1969, 1970 and 1973. Judging by the number of food organisms per feeding larvae, larval herring feed more intensively on Georges Bank than in the North Sea, where, according to Schnack, a feeding larvae gets 4 organisms. In Schley Fjord the larva of 14 and 19 mm get respectively 4.5 and 8.2 organisms each.

The estimation of the food zooplankton for larval herring showed that its total abundance in October on Georges Bank changed by year on the average from 3.75 in 1965 to 15.64 thous. sp./m^3 in 1969 (table 7). Oithona spp., Centropages spp., Nauplii Copepoda predominated in the food zooplankton.

The highest abundance of the food zooplankton recorded in 1969 and 1970 was attributed to a sharp increase of the Oithona spp. numbers. So, 1969 and 1970 were evidently charactherized by better feeding conditions in October, than other years. The 1970 year class appeared to be relatively strong, which is likely to result from a correlation between the high abundance of the food zooplankton and better survival of the larva. According to Lisivnenko L.N. (1960, 1961) in the Riga Bay there exists a positive correlation between the zooplankton larvae abundance and

the strength of the herring year classes. As estimated by D. Schnack (1972), the optimum abundance of food organisms for the feeding of larval herring should be 200 specimens per liter. On Georges Bank the average abundance per liter is much less, fluctuating from 4 to 16 specimens.

Condition factor of larval herring may be taken as a summed index of feeding conditions, the availability and quality of the food being its main components. In table 8 mean weights of the larva are given and their divergence from the long-term mean value. As is evident from the table, the highest condition factor of the larva was observed in 1970 and 1971. In these years the weight of the larva of 10 mm was 28% higher than the mean weight in the 1966 to 1975 period. Lower condition factor was observed in 1968, 1969 and 1975. The only numerous year class was that of 1970, therefore, it may be suggested that good condition factor of larval herring in October 1970 promoted higher survival.

IV. Conclusion

The herring stocks are subjected to considerable fluctuations on Georges Bank depending on the strength of the recruitment. The availability of the food at the earlier development stages is suggested to be one of the most important factors affecting the year class strength.

In order to study the feeding habits of larval herring and the availability of the food, the ichthyo-and zooplankton samples were collected annually in October on Georges Bank during the 1965 to 1975 period. Both the species composition and feeding intensity of larval herring of 5 to 18 mm in length were studied on the main spawning grounds of Georges Bank after overall hatching. The results show that the number of feeding larva averaged to 20%. Smaller and larger larva feed less intensively than the average-sized ones. The food of smaller larva of 5.0 to 8.0 mm included the eggs and nauplii of Copepoda and sometimes larval molluscs. The bulk of the average-sized larvae (8.0-13.0 mm) diet was represented by copepodite stages of Copepoda. Larger larva fed on older copepodite stages of Copepoda.

The mean number of organisms found in the intestines of smaller, average-sized and larger feeding larva was respectively 1.0 to 3.6; 1.5 to 4.0; 1.2 to 2.8. Mean consumption indices for smaller, average-sized and larger larva were 300, 207 and 27‰ respectively. In the years of studies the feeding of larval herring on Georges Bank was less intensive on the average than in other regions, especially if compared with the larva in Schley Fjord in the western part of the Baltic. The highest condition factor was recorded in 1970 and 1971. The 1970 year classes were relatively strong, therefore, in that year the feeding conditions were evidently more favourable, which promoted better survival of the larva. In conclusion it should be noted that the strength of the larva cannot be determined immediately after hatching, but during the whole winter period right up to the spring zooplankton development.

References

BOKOVA E.N., 1961. The methods of the study of the larval fish feeding. Coll. The Manual of the Studies of the Fish Feeding Habits in Natural Conditions. Coll. of Acad. of Sciences USSR.M.pp. 125-136.

BOGOROV V.G. and PREOBRAZHENSKAYA E.N., 1934. The weight charcteristic of plankters in the Barents Sea. II Copepoda. Bulletin No. 2 VNIRO, pp. I-21.

KANAEVA N.P., 1962. Mean weight of Copepoda in the Central and North Atlantic, the Norway and Greenland Seas. Trudy VNIRO, vol. 66, coll.1, pp.253-265.

SHMELEVA A.A., 1963. Weight characteristics of the mass forms of Zooplankton in the Adriatic Sea. Comm.II. Transactions of the Sebastopol Biological Station, vol. 16, pp. 153-158.

NOSKOV A.S., 1956. On determination of contition factor in the fishes, Trudy BaltNIRO, iss. 2, pp.90-94.

POKROVSKAYA I.S., 1955. The feeding of larval herring off the south-west coast of Sakhalin. TINRO Proceedings, vol. 43, pp. 202-204.

SAMYSHEV E.Z., PTITSINA L.G., 1976. The feeding of larval herring, silver and red hakes in the Georges Bank area. Trudy AtlantNIRO, iss. 60, pp. 138-142.

LISIVNENKO L.N., 1960. The influence of environmental factors on the Baltic herring survival. Trudy VNIRO, vol. 42, pp. 152-166.

LISIVNENKO L.N., 1961. The plankton and feeding of larval Baltic herring in the Riga Bay. Trydy NIIHKH SNKH, Latvian SSR, III, Acad. of Sciences of Latvian SSR, Riga, pp. 105-138.

LEBOUR M.V., 1921. The food of young clupeoids. J. mar.biol.Ass. U.K. 12, 458-467.

BHATTACHARYYA 1957. The food and feeding habits of larval and postlarval herring in the northern North Sea. Mar. Res. 3, 1-14.

SCHNACK D., 1972. Nahrunsökologische Untersuchungen an Heringslarven. Berichte der Deutschen Wissenschaftlichen Kommission für Meresforschung. Neue Folge, Band 22, Heft 3, Hamburg, 92 pp.

SCHERMAN K., HONEY K.A., 1968. Seasonal variations in the food of larval herring in coastal waters of central Maine. Rapp.-v.Reun.Cons.perm.int.Explor.Mer. 160, 121-124.

Table 1. The data on the feeding of larval herring in October 1965-1975.

Year	Date	Gear	Hauling depth, m	Number of larva examined
1965	8-11/X	IKS-80	50-0	483
			surface	130
1966	7-14/X	IKS-80	50-0	217
			surface	150
1968	6-9/X	IKS-80	50-0	195
			surface	62
1969	11-16/X	IKS-80	50-0	122
			surface	110
1970	14-28/X	IKS-80	50-0	258
			surface	52
1971	9-25/X	Bongo-61	100-0	389
1972	13-28/X	Bongo-61	100-0	128
1973	15/X-1/XI	Bongo-61	100-0	497
1974	18-30/X	Bongo-61	100-0	674
1975	17-30/X	Bongo-61	100-0	518

NOTE: Table 2 not received with document - to be issued later as an addendum to this paper.

Table 3. **Food composition (weight,%) and occurrence frequency of food organisms in larval herring of 5.0-7.9 mm**

Groups	Length, mm		Years 1965	1966	1969	1970	1971	1972	1973	1974	1975
Copepoda eggs	0.10-0.13	Occur. frequency	1	-	9	50	-	-	15	22	25
		Weight	+	-	2	50	-	-	3	12	11
Copepoda nauplii	0.18-0.32	Occur. frequency	65	100	14	-	100	100	62	70	85
		Weight	21	100	2	-	100	100	35	41	54
Mollusk larva	0.10-0.20	Occur. frequency	48	-	45	-	-	-	8	2	5
		Weight	69	-	86	-	-	-	48	12	54
Calanus finmarchicus	1.40	Occur. frequency	1	-	-	-	-	-	-	-	-
		Weight	8	-	-	-	-	-	-	-	-
Paracalanus spp.		Occur. frequency	-	-	-	-	-	-	-	-	-
		Weight	-	-	-	-	-	-	-	-	-
Pseudocalanus spp.		Occur. frequency	-	-	-	-	-	-	-	-	-
		Weight	-	-	-	-	-	-	-	-	-
Centropages spp.	0.4	Occur. frequency	-	-	-	-	-	-	-	4	-
		Weight	-	-	-	-	-	-	-	6	-
Oithona spp.	5.50-0.65	Occur. frequency	8	-	14	-	-	-	15	4	-
		Weight	2	-	4	-	-	-	6	4	-
Other Copepoda and digested food	0.40-0.75	Occur. frequency	9	-	41	50	-	-	8	4	10
		Weight	+	-	6	50	-	-	8	25	11

Table 4. **Food composition (weight, %) and occurrence frequency of food organisms in larval herring of 8.0-12.9 mm**

Groups	Length,mm		Years 1965	1966	1968	1969	1970	1971	1972	1973	1974	1975
Copepoda eggs	0.15-0.25	Occur. frequency	4	-	-	-	-	-	-	-	14	3
		Weight	2	-	-	-	-	-	-	-	1	1
Copepoda nauplii	0.20-0.33	Occur. frequency	83	67	-	17	25	48	80	30	48	43
		Weight	43	37	-	1	5	16	42	5	10	17
Mollusc larva	0.15-0.22	Occur. frequency	6	-	43	33	8	4	-	2	1	-
		Weight	28	-	46	45	29	7	-	2	2	-
Calanus finmarchicus	1.00	Occur. frequency	26	-	-	-	-	-	-	-	-	-
		Weight	20	-	-	-	-	-	-	-	-	-
Paracalanus spp.	0.70-0.90	Occur. frequency	-	-	3	-	-	4	-	40	1	3
		Weight	-	-	6	-	-	13	-	6	4	7
Pseudocalanus spp.	0.80-1.00	Occur. frequency	-	-	-	-	-	8	-	2	1	-
		Weight	-	-	-	-	-	9	-	4	6	-
Centropages spp.	0.40-0.70	Occur. frequency	-	-	11	-	-	10	26	12	2	2
		Weight	-	-	11	-	-	10	30	14	2	2
Oithona spp.	0.50-0.70	Occur. frequency	22	-	3	11	25	12	8	34	20	50
		Weight	6	-	2	5	13	7	6	15	9	29
Other Copepoda and digested food	0.48-1.10	Occur. frequency	9	67	54	89	75	64	38	46	41	33
		Weight	1	63	35	50	53	38	22	54	66	44

Table 5. **Food composition (weight,%) and occurrence frequency of food organisms in larval herring of 13.0-17.9 mm**

Groups	Length, mm		Years								
			1965	1968	1969	1970	1971	1972	1973	1974	1975
Copepoda eggs	0.10-0.20	Occur. frequency	-	-	-	-	-	5	2	2	-
		Weight	-	-	-	-	-	+	+	+	-
Copepoda nauplii	0.21-0.40	Occur. frequency	25	-	7	-	17	28	1	17	-
		Weight	22	-	1	-	2	3	+	2	-
Mollusc larva	0.21	Occur. frequency	-	-	15	-	-	-	-	-	-
		Weight	-	-	8	-	-	-	-	-	-
Calanus finmarchicus	1.00-1.50	Occur. frequency	75	-	-	-	-	5	-	-	-
		Weight	78	-	-	-	-	42	-	-	-
Paracalanus spp.	0.84-0.92	Occur. frequency	-	-	26	50	41	10	41	19	-
		Weight	-	-	43	50	46	4	39	38	-
Pseudocalanus spp.	0.95-1.25	Occur. frequency	-	-	-	-	12	14	14	-	-
		Weight	-	-	-	-	14	10	25	-	-
Centropages spp.	0.57-0.70	Occur. frequency	-	17	-	-	3	10	13	-	-
		Weight	-	5	-	-	1	4	9	-	-
Oithona spp.	0.60-0.78	Occur. frequency	-	-	4	-	3	33	18	36	100
		Weight	-	-	+	-	+	5	3	15	100
Other Copepoda and digested food	0.66-1.15	Occur. frequency	-	117	74	50	59	57	36	45	-
		Weight	-	95	48	50	36	32	24	45	-

Table 6. **Feeding intensity (‰) and the number of consumed organisms per feeding larval herring**

Length of larva, mm		Years										
		1965	1966	1968	1969	1970	1971	1972	1973	1974	1975	1965-1
5.0-7.9	Organisms number	2.0	1.0	0	1.5	1.3	2.4	1.3	2.6	1.4	2.2	1.6
	Average consumption index	834	120	0	380	94	136	116	567	178	279	300
8.0-12.9	Organisms number	2.6	4.0	1.7	2.0	2.0	2.8	3.3	2.0	1.5	1.9	2.4
	Average consumption index	162	101	440	367	153	145	166	222	172	138	207
13.0-17.9	Organisms number	1.2	-	1.8	2.6	1.5	2.4	2.8	2.4	1.4	1.5	2.0
	Average consumption index	15	-	93	117	107	67	73	88	57	31	72

Table 7. Number of organisms (thous. sp./m^3)

Food organisms	Length, mm	Years							
		1965	1966	1968	1969	1970	1972	1973	1975
Centropages spp.	0.2-1.4	0.20	0.38	1.00	0.61	1.44	2.50	2.35	0.86
Paracalanus spp.	0.2-1.2	0.01	0.02	0.06	0.17	0.28	0.21	0.33	1.34
Pseudocalanus spp.	0.2-1.5	0.24	0.08	0.44	0.49	0.33	0.23	0.73	0.22
Oithona spp.	0.2-1.2	2.61	5.12	2.94	13.12	9.37	2.83	6.21	1.39
Ova, Nauplii Copepoda	0.1-0.5	0.69	0.74	0.28	1.29	1.75	0.05	0.28	4.7
TOTAL		3.75	6.34	4.72	15.68	13.17	5.82	9.90	8.51

Table 8. Length (mm) and weight (mg) and divergence from the mean weight values (%%) for larval herring in 1966 - 1975

Year / Length, mm	1966		1968		1969		1970		1971		1972		1973		1974		1975		Mean weight for 1966-1975 period	
	mg	%	mg	%	mg	%	mg	%	mg	%	mg	%	mg	%	mg	%	mg	%	mg	%
5	0.10	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.10	100
6	0.13	72	0.17	94	-	-	0.27	150	-	-	-	-	0.16	89	0.18	100	0.16	89	0.18	100
7	0.17	63	0.24	89	0.31	115	0.35	130	0.34	126	0.29	107	0.25	93	0.26	96	0.22	82	0.27	100
8	-	-	0.32	78	0.40	98	0.48	117	0.54	132	0.42	102	0.40	98	0.38	93	0.32	78	0.41	100
9	-	-	0.41	70	0.55	93	0.68	115	0.80	136	0.63	107	0.60	102	0.55	93	0.51	86	0.59	100
10	-	-	0.52	63	0.71	87	1.05	128	1.05	128	0.90	110	0.81	98	0.75	91	0.80	98	0.82	100
11	-	-	0.64	60	0.90	85	-	-	1.41	133	1.18	111	120	113	1.00	94	1.06	100	1.06	100
12	-	-	0.76	49	-	-	-	-	2.05	133	2.000	129	1.80	117	1.20	78	1.40	91	1.54	100
13	-	-	-	-	-	-	-	-	2.50	115	2.50	115	2.20	101	1.80	83	1.85	85	2.17	100
14	-	-	-	-	-	-	-	-	3.30	115	3.10	108	2.90	101	2.60	90	2.50	87	2.88	100
15	-	-	-	-	-	-	-	-	4.50	118	3.80	100	3.90	103	3.60	95	3.20	84	3.80	100
16	-	-	-	-	-	-	-	-	6.50	126	5.00	97	5.10	98	5.00	97	4.30	83	5.18	100
17	-	-	-	-	-	-	-	-	9.50	128	6.70	90	6.70	90	6.75	91	-	-	7.41	100
18	-	-	-	-	-	-	-	-	11.00	94	9.10	85	11.00	103	-	-	-	-	10.66	100
19	-	-	-	-	-	-	-	-	13.00	100	12.00	92	14.00	108	-	-	-	-	13.00	100
20	-	-	-	-	-	-	-	-	19.00	110	15.50	89	17.50	101	-	-	-	-	17.33	100

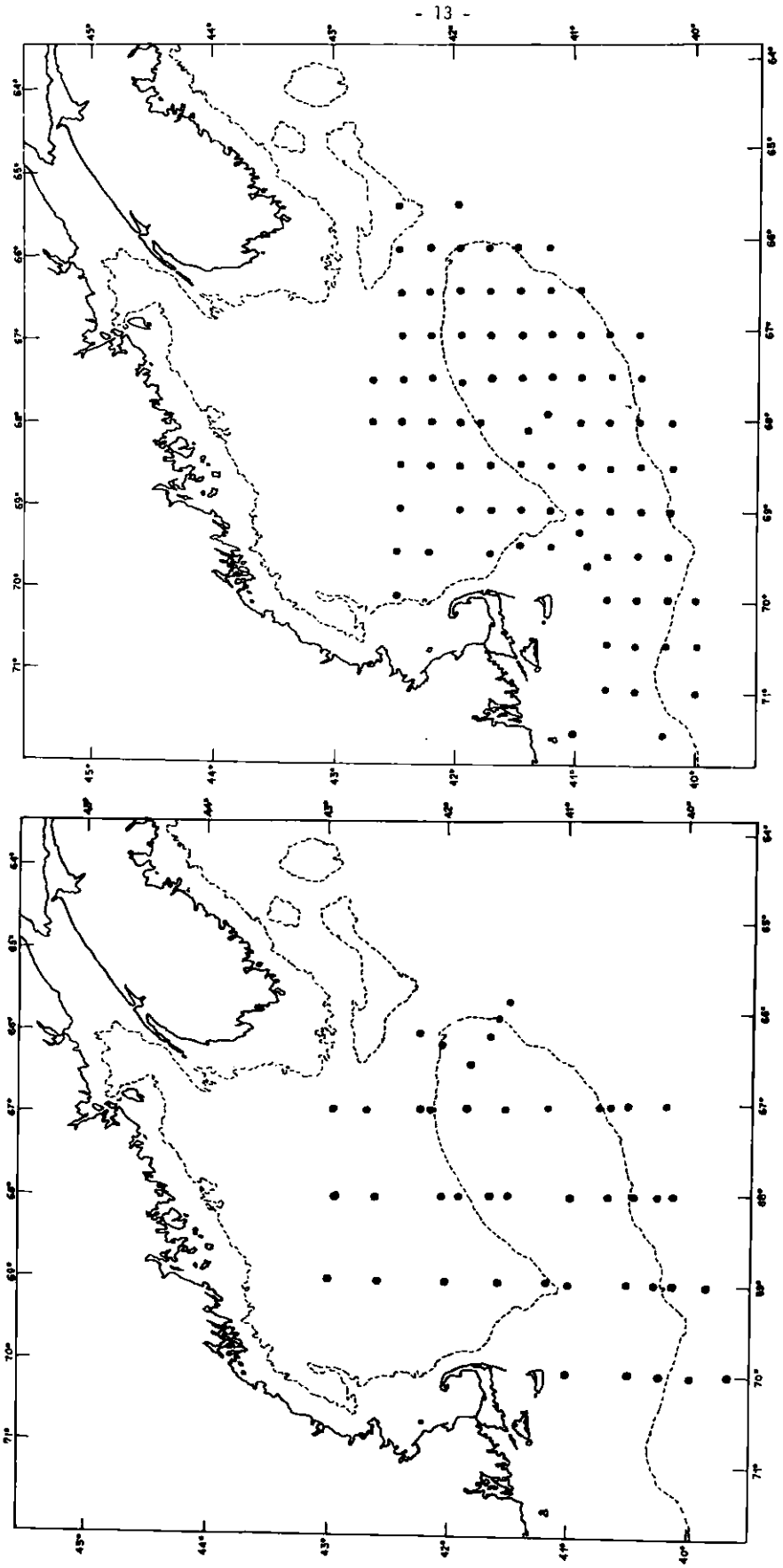

Fig. 1. Scheme of standard stations given by AtlantNIRO.

Fig. 2. Scheme of standard stations given by ICNAF.

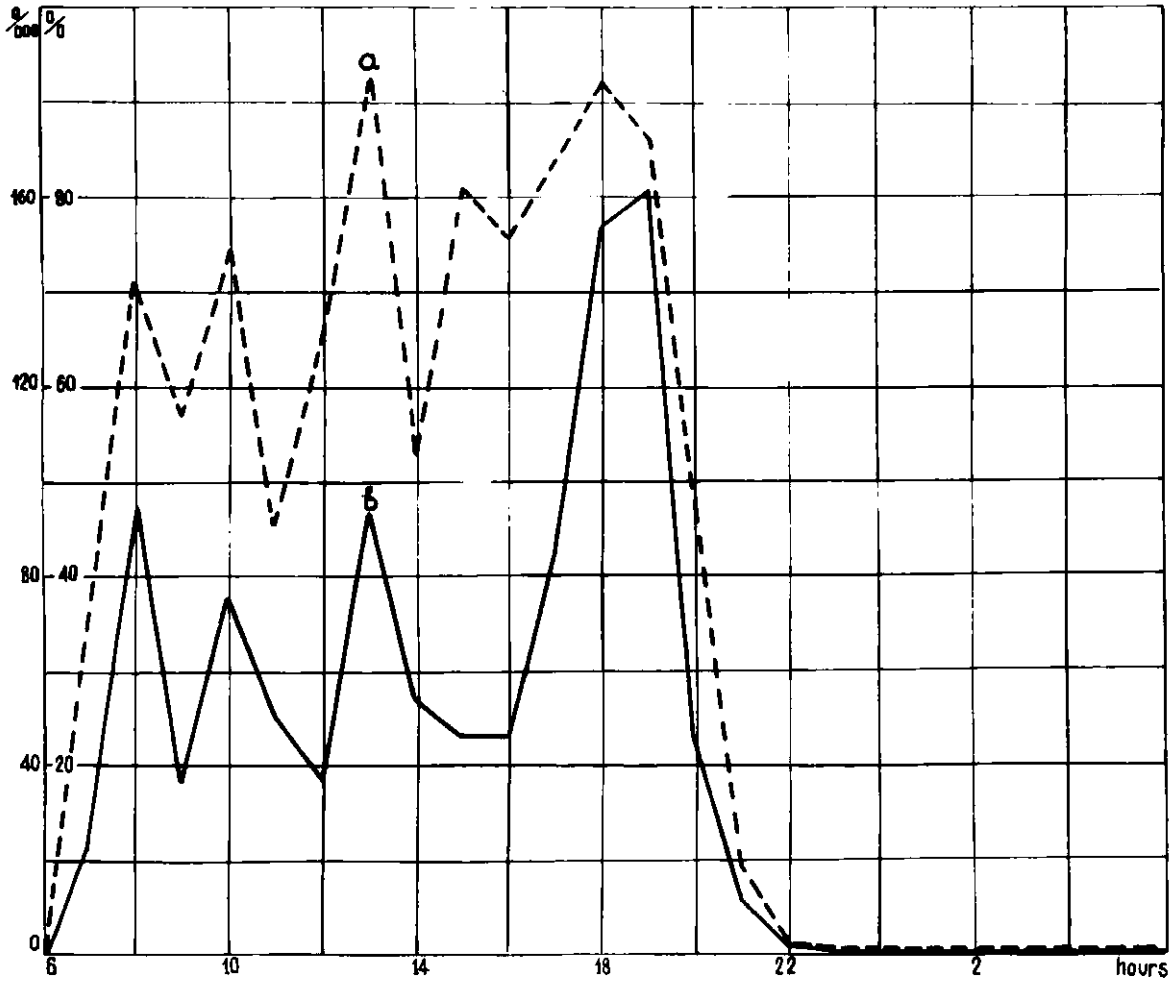

Fig. 3. Diurnal pattern of the feeding of larval herring in October 1972.
a. number of feeding larvae, %; b. consumption index, %.