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ICHTHYOPLANKTON DISTRIBUTION AND ABUNDANCE IN THE EASTERN BALTIC SEA IN 1994

by

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ABSTRACT

Abundance indices of four fish species eggs (sprat, cod, flounder, four-break rockling) are estimated on the basis of ichthyoplankton surveys, performed in April-May of 1994. In spring of 1994 sprat eggs abundance slightly decreased and cod and rockling eggs abundance increased as compared to 1992 and 1993.

INTRODUCTION

Reproduction of major commercial fishes of the Baltic Sea starts in spring and often approches its peak in the southern area during May.(Grauman, 1980). As is shown by Kändler (1949) based on data on ichthyoplankton distribution in the Baltic Sea during the first half of the 20th centure, abundance variability of any fish species eggs in ichthyoplankton allows to assume variations in the spawning stock state. From that point of veiw the results of ichthyoplankton researches, carried out by AtlantNIRO laboratory from 1992 and continued during 1994, are of interest.

MATERIALS AND METHODS

In 1994 two ichthyoplankton surveys were carried out in the open Baltic Sea - from 3 April to 21 April and from 24 May to 7 June. Total of 40 and 56 ichthyoplankton samples were collected during the surveys respectively. Sampling was performed with net IKS-80 with gause No. 2 . Sampling was carried out by vertical hauls in the layer from surface to bottom, and at depths over 120 m - in the layer from 120 m to bottom. Average number of eggs in indiv.$\cdot m^{-2}$, calculated by months and areas, was used as quantitative indices. As an index of survival in early onthogenesis stage, the percent ratio of average number for sprat larvae and eggs was calculated during April-May. The area scheme by Grauman (1980) was used to provide comparison with averagelong-term data for 1968-77.

RESULTS

Six species of eggs and larvae were found in ichthyoplankton, including eggs of sprat, cod, four-beard rockling, flounder, dab and larvae of sprat, four-beard, flounder, liparis. Sprat was prediminating species and constituted in Gdansk Deep 89.7% in April, 75.1% in May and in Gotland Deep 90.6% and 95.5% in April and May respectively. Spatial distribution of sprat eggs in April was characterized by two centres of reproduction in deep areas of Gdansk and Gotland Deep.

In Gdansk Deep 68% of sprat eggs concentrated in the most deep area over the depths of 100-110 m (Table 1). In Gotland Deep in April the major eggs aggregations were found over the depths of

120-150 m (range of 78-220 m, table 2). The highest sprat spawning rate in April was in Gdansk Deep (Table 3) with maximum sprat eggs density of 542 indiv.$\cdot m^{-2}$. In Gotland Deep sprat eggs abundance was low (maximum 120 indiv.$\cdot m^{-2}$).

In May some changes were observed in spatial distribution of sprat. In Gdansk Deep the process of gradual spread of spawning to shallower depths had started (Table 1). Peak of egg abundance was observed at depth from 90 to 100 m. In Gotland Deep eggs abundance increased in the shallower area (from 60 to 120 m), however, significant proportion of eggs was caught over the depth of 210-240 m (Table 2).

Though sprat spawning rate increased in May as compared to April, in Gdansk Deep that increase was insignificant: average eggs abundance in the area increased by 1.2 times from April to May, while in the southern Gotland Deep it increased by 5.8 times, and in the middle area by 8.7 times. In general the most high average abundance of eggs in May was found in the northern part of investigation area . However, maximum density of eggs in Gdansk Deep was rather high, and even exceeded that in Gotland Deep (630 and 500 indiv.$\cdot m^{-2}$, respectively).

In April the maximum abundance of sprat eggs occured in Gdansk Deep, and in May high aggregations of larvae was found both in the southern and in northern parts of survey area (Table 3). Modal length of sprat larvae (4-5 mm) showed that they were caught close to their spawning area. Maximum density of sprat larvae in May amounted to 526 and 449 indiv.$\cdot m^{-2}$ in Gdansk and Gotland Deeps respectively. Percent ratio of sprat larvae and eggs was high in all three areas (Table 3).

Eggs of other commercial fishes (cod, flounder) occured in significant amount only in Gdansk Deep (Table 4). Maximum density of cod aggs in above area amounted to 16 indiv.$\cdot m^{-2}$ in April and 36 indiv.$\cdot m^{-2}$ in May.

Since cod spawning intensity increased from April to May, and that of flounder decreased, in April flounder eggs abundance was higher than that of cod, while in May cod eggs abundance was the highest one.

Both species have lower eggs abundance as compared to that of four-beard rockling. In May density of the latter eggs aggregations at individual stations in Gdansk Deep was comparative to that of sprat and even exceeded it. Maximum density of four-beard rockling eggs approached 263 indiv.$\cdot m^{-2}$, while the average value was 46 indiv.$\cdot m^{-2}$.

In Gotland Deep eggs abundance of four-beard rockling was low, however the latter exceeded abundance of cod and flounder eggs.

DISCUSSION

During spawning season of 1994 distribution of fish eggs and larvae differred but had some similar features as in two previous years (1992 and 1993). Such similar features as sprat eggs predomination in ichthyoplankton and association of spawning in April with deep areas while that in May was rising to shallower depths. Both in 1992 and 1994 sprat spawning increased from April to May. However, some significant features of ichthyoplankton distribution in 1994 differred from that in the previous years.

Thus, ichthyoplankton survey data for 1992 showed considerably more intensive sprat spawning in Gdansk Deep than in Gotland Deep from March to late May while in May 1994 sprat eggs abundance was higher in Gotland Deep than in Gdansk Deep. Taking in account significant increase of depths over which the highest sprat eggs concentrations occured in Gotland Deep, it may be assumed that in May 1994 adult sprat migrated northwards and therefore the most intense spawning of the latter shifted into the middle part of Gotland Deep. Sprat larvae abundance in Gotland Deep in May was lower than that in Gdansk Deep, evidencing that the most number of sprat eggs was spawned in the southern area of sea during the previous period.

Comaprison with published data (Grauman, 1980) on spatial distribution of sprat eggs showed that while in April 1994 it was similar to long-term average, in May the distribution pattern differed (Table 4) in occurence of significant eggs aggregations in Gotland Deep. Sprat eggs abundance in that area considerably exceeded the long-term average while in Gdansk Deep it was lower than the latter.

Sprat larvae abundance in 1994 was higher both the level of 1992-1993 and long-term average. In April that excess was observed in Gdansk and Southern Gotland areas, and in May - within all three areas. Percent ratio of sprat larvae and eggs evidenced the existence of favourable conditions for youth survival in 1994. That index exceeded both values in 1992-1993 and long-term average.

Some variations of other species abundance were observed in Gdansk Deep during 1994.

Thus, cod eggs abundance in April and May 1994 was appreciably higher than in 1992-1993, though it still remained below the level of 1968-1977. However, the latter period was characterized by relatively low abundance of cod stock. Flounder eggs abundance in Gdansk Deep increased as compared to 1992 and 1993 but never exceeded the long-term average.

The most outstanding feature of spring 1994 was outburst of four-beard rockling reproduction in Gdansk Deep. Abundance of the latter exceeded that in 1992-1993 and 1968-1977, and even the level of cod eggs abundance in 1968-1977.

Taking in account, that all 4 species researched are spawning in spring in water column below 60-70 m, increase of eggs abundance of cod, flounder, four-bread rockling and high abundance of sprat larvae evidence the improvement of reproduction conditions in deep waters of Eastern Baltic Sea. As showed the hydrological researches carried out in the Laboratory for Baltic Sea (Feldman et al., 1995), in May 1994 increased salinity of near-bottom water was recorded and the area, occupied by water with salinity over 10‰, extended considerably.

In spring 1992 no salinite North Sea water inflow occured in the Eastern Baltic Sea, while in 1993 advection of the North Sea water was recorded in Gdansk Deep and in Gotland Deep to the less extend.

In May 1994 saline North Sea water reached Gotland Deep which seemed to associate with considerable increase of sprat spawning in the central area.

Inflow of saline water favourably affected other fishes reproduction. However, low abundance of cod and flounder stocks prevent complete favourable impact upon their reproduction, though eggs abundance had increased.

Outburst of four-beard rockling reproduction seemed to be related both with favourable inflow impact and low abundance of cod stock, i.e. low pressure of cod predation upon that non-fished species.

According to Kändler (1949) till 1938 high abundance of four-beard rockling was observed in Gdansk Deep. Later it decreased, as Mankovskiy (1948) assumed, due to high cod abundance during 1940s. However, any published sources had mentioned no high abundance of that species in the Eastern Baltic Sea during subsequent 50 years. Therefore increase of the four-beard rockling eggs abundance couldnot been considered ordinary and regular event, and it seems to become one of inderect proof of critical state of cod stock in the Baltic Sea.

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Table 1

Distribution of sprat eggs (%) at various depths in Gdansk Deep during 1994

Month	Depth (m)						
	30-50	51-60	61-70	71-80	81-90	91-100	101-110
April	0	0	-	0.4	15.6	15.6	68.4
May	0.2	-	11.2	7.5	29.0	45.9	16.2

Table 2

Distribution of sprat eggs at various depths in Gotland Deep during 1994

Month	Depth (m)						
	30-60	61-90	91-120	121-150	151-180	181-210	211-240
April	0	3.6	4.3	43.5	27.5	18.1	2.9
May	0.4	17.2	22.0	26.5	-	-	34.1

Table 3

Average abundance of sprat eggs and larvae (indiv.· m^{-2}) during 1992-1994

Area	Year	Sprat eggs			Sprat larvae			Indices of young fish survival (%) for April-May
		Month			Month			
		IV	V	IV-V	IV	V	IV-V	
Gdansk Deep	1992	129	547	338	14	78	46	13.7
	1993*			334			24	7.2
	1994	141	167	154	68	172	120	77.9
	1968-77	74	206	180	10	36	23	12.8
Southern Gotland Deep	1992	36	205	121	0	21	10	8.3
	1993	15	-	-	6	-	-	-
	1994	25	144	85	14	60	37	43.5
	1968-74	50	87	68	8	11	10	14.7
Middle Gotland Deep	1992	-	118	-	-	35	-	-
	1993	66	-	-	4	-	-	-
	1994	22	192	107	3	116	60	56.1
	1968-77	39	55	47	13	14	14	29.8

* Note: Data for Gdansk Deep in 1993 have been obtained during 30.04-09.05 and reflect the April-May average

Table 4

Average abundance (indiv.$\cdot m^{-2}$) of cod, flounder and rockling eggs during 1992-1994

Area	Year	Cod			Flounder			Four-beard rockling		
		Month			Month			Month		
		IV	V	IV-V	IV	V	IV-V	IV	V	IV-V
Gdansk Deep	1992	0.5	0.6	0.6	0.2	1.8	1.0	2.6	6.2	4.4
	1993*			0.9			0.9			14.9
	1994	3.0	6.5	4.8	5.4	2.9	4.2	6.2	46.0	26.1
	1968-77	10.0	23.0	16.5	8.0	1.0	4.5	4.0	8.0	6.0
Southern Gotland Deep	1992	0.0	1.8	0.9	0.0	0.1	0.1	0.7	0.2	0.4
	1993	1.1	-	-	0.0	-	-	0.0	-	-
	1994	0.7	0.3	0.5	1.2	1.8	1.5	2.5	6.5	4.5
	1968-77	18.0	37.0	27.5	4.0	1.0	2.5	3.0	7.0	5.0
Middle Gotland Deep	1992	-	1.6	-	-	0.2	-	-	0.0	-
	1993	0.0	-	-	0.1	-	-	0.0	-	-
	1994	0.3	2.0	1.2	0.5	1.0	0.8	0.4	5.0	2.7
	1968-77	27.0	30.0	28.5	7.5	1.0	4.2	8.0	6.0	7.0

* Note: Data for Gdansk Deep in 1993 have been obtained during 30.04. - 09.05 and reflect the April-May average.

Legends

Figure 1. Sprat eggs distribution in April 1994 (indiv.$\cdot m^{-2}$).
Figure 2. Sprat eggs distribution in May 1994 (indiv.$\cdot m^{-2}$).
Figure 3. Cod eggs distribution in May 1994 (indiv.$\cdot m^{-2}$).
Figure 4. Four-beard rockling eggs distribution in May 1994 (indiv.$\cdot m^{-2}$).

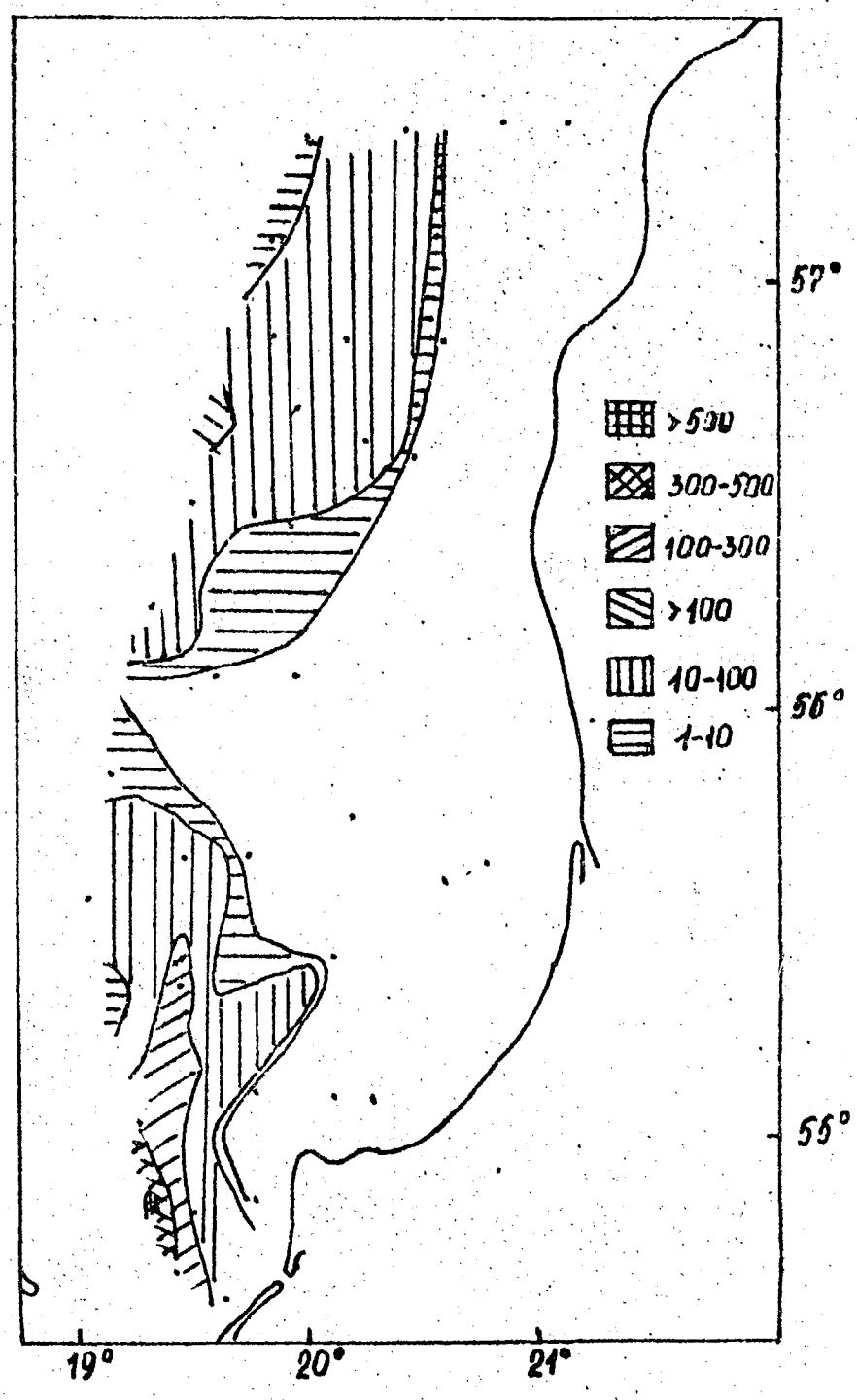

Fig. 1

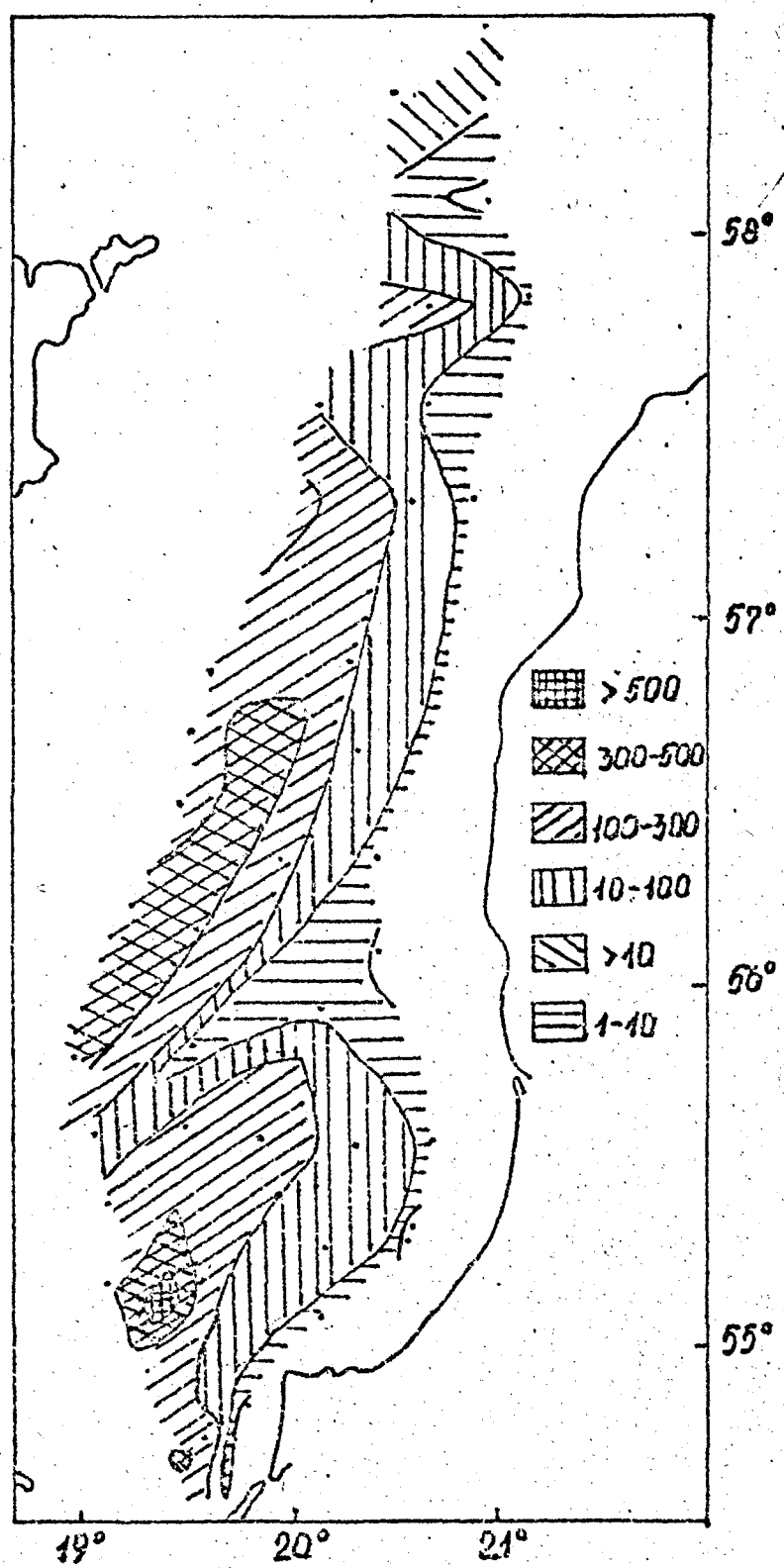

Fig. 2

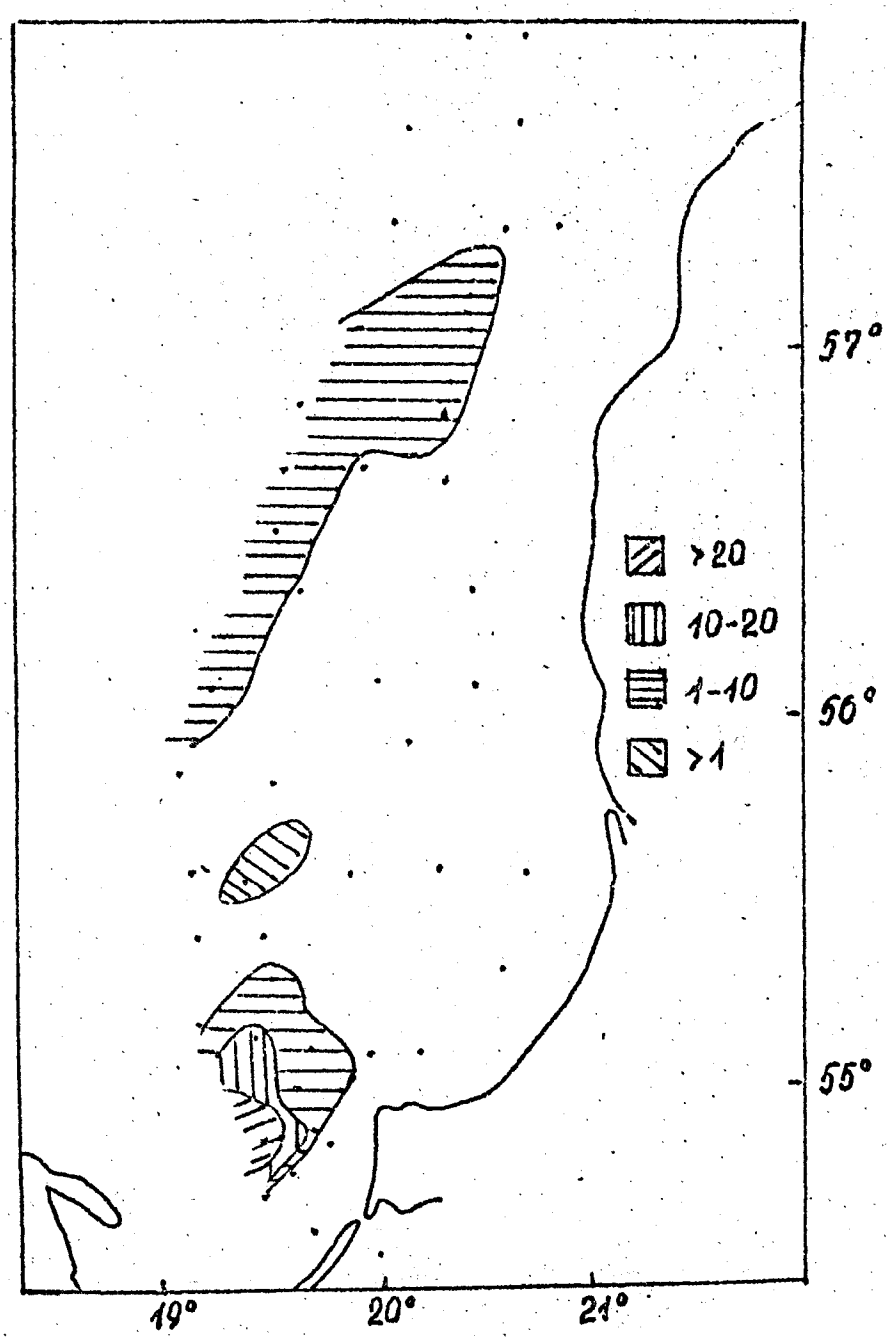

Fig. 3

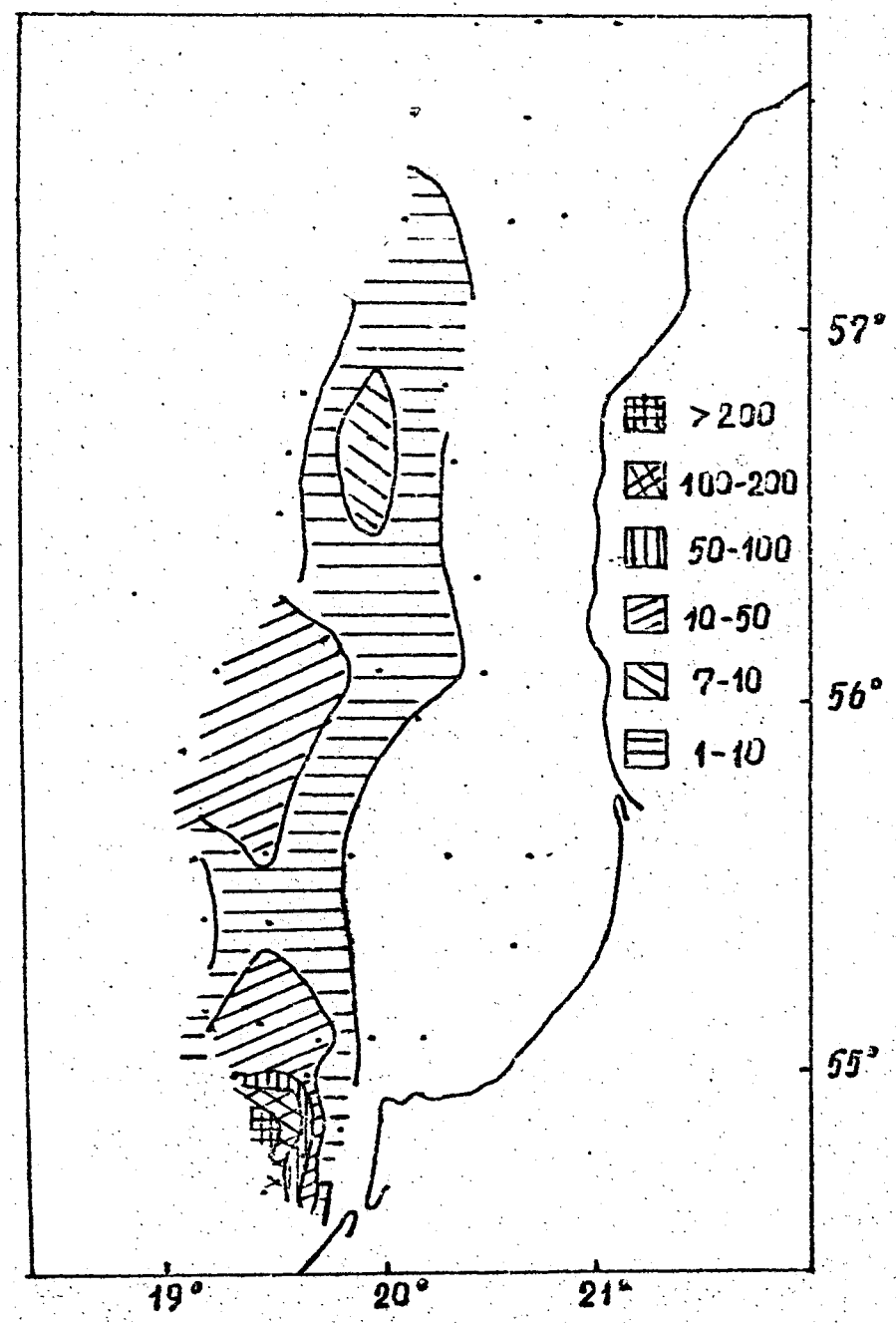

Fig. 4