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Results of a Trawl Survey carried out on the Scotian Shelf and Georges Bank in July-August 1968

by

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Abstract

This report deals with the results of surveys carried out during the cruise of the Soviet research vessel "Blesk" on the Scotian Shelf and Georges Bank in July-August 1968. The distribution and abundance of all the species of fishes and squids occurring in the catches were investigated. The data obtained show that Browns Bank (ICNAF Div.4X) is characterized by rather different distribution and abundance of species than in adjacent areas. Pure stocks of two species of flatfishes (plaice and yellowtail flounder), some rays (Raja spp.) and silver hake were also estimated during these surveys.

Introduction

The Scotian Shelf and Georges Bank are among the most important fishing areas of the world. In recent years there has been a marked decrease in the abundance of some species which have provided major fisheries. Cooling of the water could be the main reason for the decrease in abundance of one species and at the same time it could provide favourable conditions for reproduction of another species. Furthermore, there are some data, which indicate that the waters on Nova-Scotian Shelf have been warming in the last two years. This could somehow, affect the spawning intensity in the area. This situation must be investigated to obtain the prerequisites for rational exploitation of fishing resources on the Scotian Shelf within the next few years.

Materials and Methods

To obtain data on the distribution and abundance of all the fishes caught, experimental trawling surveys were carried out in July-August 1968. The operations at sea lasted for 35 days and 200 trawl hauls were made (Fig.1). Where possible standard stations were chosen as haul locations. In locations with a rough ground, bottom suitable for trawling was chosen. The gear used was a 27.1 m herring trawl without rollers. The duration of each hauling was 30 min., speed - 3.5 knots.

Catches were processed on deck according to the methods used in the joint USSR-USA surveys of ground fishes. The calculation of mean catches per haul and the compilation of length frequency distributions for each species for each of the three areas (I,II and III) investigated (Fig. 1) which coincided generally with ICNAF Div. 4W, 4X, 5Z, were carried out in the laboratory. Zones of concentrations of various density were determined by interpolation for silver hake, plaice, yellowtail flounder and rays (Raja spp.).

The area of each zone and the area covered by the trawl during each haul was then calculated. The latter was estimated using an average of 15 m for the mouth opening of the trawl (the parameters of trawl were estimated with the help of an electronic device).

Abundance indices for the above-mentioned species were then estimated. The assessment of pure stock (approximate, of course) was obtained with the help of the coefficients given by Edwards (1968)[1] with some variations. Thus, in all the cases, the area-seasonal coefficient was equal to 1, because the survey was made in one season, and on the Nova Scotian Shelf it covered the whole habitat of the silver hake, flatfishes and rays of this area. The difference in catchability between the Soviet 27.1m trawl and the Yankee trawl calculated according to the data of the joint survey in autumn 1967, was also taken into account. For the flatfishes, the coefficients of catchability and availability for the Soviet trawl were the same as for the Yankee trawl. For the rays, the catchability of the Soviet trawl was 5 times greater than that of the Yankee trawl, and for silver hake, it was 3.6 times greater. The coefficients of catchability for rays and silver hake were increased accordingly.

The density of concentrations and the contribution of each species in the catches were recorded as mean catches per haul and as a percentage of the biomass of all the species in the total catch taken from each of the areas investigated.

The results of investigations

Results of investigations of the distribution and abundance of fishes and squids occurring in the catches during the survey are described briefly in this section. Since the gear used in bottom fishing was the 27.1m herring trawl, the most reliable data were obtained for the bottom and near-bottom species, first of all for flatfishes and rays.

(a) The distribution of bottom and near-bottom species

Plaice occurred at depths of 40-200m at 2°-5°C and appeared to be the most abundant of the flatfishes on the Scotian Shelf. Yellowtail flounder was caught at 35-85m in a temperature range of 4°-11 C. The distribution of these species is shown in Fig.2-7. Witch was extremely scarce everywhere and, unlike the other flatfishes, it occurred at great depths (145-215m) in water temperatures of 3°-9°C.

The data in Tables 1 and 2 show that area 1 (ICNAF Div.4W) has the greatest abundance of plaice and yellowtail flounder when compared with all the areas investigated. The share of these species by weight was more than 10% of total catch, although in areas II and III (4X and 5Z) it was 1.3% and 3%, respectively. The abundance of these species decreases sharply on Browns Bank (4X) and increases again on Georges Bank (5Z). Witch, unlike plaice and yellowtail flounder, is more abundant in the area II than in area I. Such distribution of witch is caused by biological peculiarities, in particular, its deep habitat and, consequently, by the distinct requirements to bottom contour and to the character of bottom sediments.

The catches included several species of rays (big skate, Raja microns, Raja eglanteria, Raja radiata, Raja batis) combined into one group for convenient calculation of total biomass. The survey data are in absolute agreement with Edward's opinion (1968) on the general occurrence and rather uniform distribution of rays which seldom form dense concentrations in spite of their considerable biomass. The distribution of rays is shown in Fig.8-10. The data given in Tables 1 and 2 show an interesting similarity in abundance of rays in areas I and III (about 9% of total catch) and a sharp decrease in abundance in area II (3.5%)

[1] The analogous calculations appeared to be impossible for other species due to the lack of data on comparative catchability of the Yankee trawl and the Soviet 27.1m herring trawl.

When considering the distribution of flatfishes and rays in all areas we can suppose that the environmental conditions for some bottom species are less favourable in area II than in adjoining waters. This is probably related to the bottom countour and the character of bottom sediments. However, it can be connected with other factors, and not with temperature. According to Bigelow and Schroeder (1953) most species of rays occur in a wide temperature range (from 0° to 16°C).

For Gadidae, in areas I and III, the most abundant species is silver hake. Its abundance increases in a western direction (Tables 1 and 2). A high mean catch of silver hake from area II (higher than that from the Div.1) can be attributed, not to its numerical predominance, but to its greater mean weight. In area I the bulk of catches consists of fry 12-13cm in length. Lost abundance of silver hake in area II is also suggested by the difference between areas occupied by the concentrations (Fig. 11-13). In general, the results of the survey indicate an extremely low abundance of silver hake on the Scotian Shelf as compared to that on Georges Bank.

Such a distribution however, was not always characteristic of silver hake. Only 6-7 years before the period of cooling hake was the most abundant of the species in area I, and its stock was probably much poorer than the stock on Georges Bank in that time.

In subsequent years the commercial stock of hake in this area was recruited by poor year-classes. (Konstantinov and Noskov, 1966). However, as mentioned above, a great number of young fish of the 1967 year-class was found here in the summer of 1968. Yearlings were confined to depths of 160-200m in temperatures of 5.5°-9°C. Catches of this year-class were 1500 fish per haul, mean catch for a whole area was 61 specimens per haul (365 specimens in the area).

The abundance of young fish coincident with the warming effect (see above) suggests the beginning of a recovery of hake abundance in the area I. Probably this process did not concern area II where mean catch of the 1967 year-class was only 8 fish per haul.

For cod and haddock, a striking similarity was found in the relative abundance of these species for the areas investigated (Tables 1 and 2).

On the whole, the proportion of cod and haddock in the catches was low in all the areas investigated. However, a noticeable increase of these species was found in area II as compared with adjacent areas.

Haddock was found at 100-200m in temperatures of 3°-8°C. Cod preferred lower temperatures (2°-6°C) and was found at 50-200 meters.

Red hake, a heatloving species, was practically absent on the Scotian Shelf and only occurred occasionally in the catches in the western part.

One of the basic components of the ichthyfauna in the deep parts of the Scotian Shelf is the redfish. It also makes up a considerable part of the total catch (Tables 1 and 2). Redfish concentrations were observed at 110-210m in temperatures of 5°-8°C. In area III redfish was caught by trawl in the Gulf of Maine in concentrations at 150-200m and 3°-7°C.

(b) The distribution of pelagic and bathypelagic species.

As mentioned above, reliable data on the distribution and abundance of this group of fishes cannot be obtained using the 27.1m trawl. However, the great number of stations occupied permits an approximate judgement of the distribution and biomass of these species.

Herring was found at 60-200m in temperatures ranging from 3° to 11°C. Considerable concentration were observed in the deep parts of the Scotian Shelf (4X). Herring made up a significant proportion of the total yield from areas I and III because of its high catches. As in many other cases, Browns Bank was characterized by peculiarities in relation to herring fishing (Tables 1, 2) since the proportion of herring in the catches were considerably less than in the nieghbouring areas.

Argentine occurred on the slopes of the western part of the Scotian Shelf mainly (4X) where it made up a rather important portion of the total catch. The concentrations of argentine were found at 180-215m in 4°-6°C.

Spiny dogfish was entirely absent in area I, was occasionally caught in area II and contributed a considerable share of the total catch from the western part of area III where it occurred at depths of 35-80m in temperatures of 9°-12°C.

Butterfish was caught in the area of Nantucket Shoals and in the southern part of Georges Bank.

Among the fishes grouped under the title "other fishes", herring of the genus Alosa predominated by weight and number.

Squid, Illex illecebrosus, was generally found in areas I and II along the slopes of the Shelf. Concentrations were found in deep waters at 6°-10°C. On Georges Bank abundance decreased sharply and Loligo pealii began to occur in the catches.

(c) The assessment of pure stock

The choice of catchability coefficients for assessment of biomass of flatfishes, rays and silver hake was described in the section "Materials and Methods". It was assumed that, during the summer survey (July-August), the behaviour of these species on the Scotian Shelf and in the area of Georges Bank was, in general, analogous to the behaviour of the same species during the US groundfish surveys on the shelf and on Georges Bank.

The element of subjectivity in the coefficients obtained was, of course, rather significant. Thus, too much importance cannot be attached to the assessments of pure stocks (Table 3).

These assessments should be considered tentatively showing the opportunities for the fishery of one or another species. The importance of the data received in this way will increase to a great extent if similar surveys are carried out annually. This provides a chance to compare the fluctuations of the stock of the various species.

The data appear to support previously mentioned opinions on the peculiarities of the environmental conditions in area II. Plaice, a cool-water-loving species appeared to be the most numerous in area I. The biomass of yellowtail flounder in this area was also high. According to US data (Edwards,1968) another centre of abundance of this species is in the southern part of New England. Judging from the results of the 1963-65 survey mean biomass of yellowtail flounder was about 76,000 tons. The stock of rays in areas I and III was approximately the same. As expected, the biomass of silver hake appeared to be the highest in area III. However, the stocks turned out extremely high, especially in the area III; they didn't agree with the results of fishery. Perhaps there is some mistake in our calculation of the coefficients of catchability and availability. The coefficient of catchability for silver hake in the areas of commercial concentrations is considered to be higher than 0.2.

The data on stock sizes, summarized by areas investigated, suggest it is possible to catch 20-25 thousand tons of flatfishes (plaice and yellowtail flounder combined) from these areas annually. Similar recommendations cannot be made for silver hake based on the results of our survey.

Conclusions

1. Results of a trawl survey on the Scotian Shelf and Georges Bank carried out during the cruise of the research vessel "Blesk" in July-August 1968 provide information on distribution and abundance of the bottom and near-bottom species of fish in the areas mentioned. The data on pelagic species are less reliable.

2. A considerable number of young silver hake of the 1967 year-class found in area I(ICNAF Div.4W) suggests the appearance of a strong year-class in this area.

3. The data on the distribution and abundance of many species in the areas investigated suggest that Browns Bank (ICNAF Div. 4X) is unique.

4. The assessments of pure stocks of flatfishes, rays and silver hake are rather approximate and only give a general idea of the prospects for fishing these species. However, surveys similar to those detailed in this paper, if carried out annually, would greatly increase the reliability of the data.

References

1. Bigelow H. B. and W. C. Schroeder, 1953 Fishes of the Gulf of Maine. Bull.Fish. and Wild Serv. 53:60-74

2. Edwards R. L. 1968 Fishery Resources of the North Atlantic Area. The Future of the Fishing Industry of the United States. Univ. of Washington Publications in Fisheries. New Series, Vol.4 1968;52-60.

3. Konstantinov K. G. and A. S. Noskov, 1966. Soviet Research Report, 1965. Int.Comm.Northw.Atlant., Fish., Redbook 1966, Pt. 2:86-105.

Table 1

Mean catch per haul (30 min.) by species and areas

No.	Species	Areas		
		I	II	III
		Kg/number of fish	Kg/number of fish	Kg/number of fish
1.	Atlantic herring	38.37/149	16.41/60	44.30/253
2.	Silver hake	4.68/69	7.26/36	22.53/144
3.	Redfish	18.09/144	7.77/50	3.60/13
4.	Haddock	3.74/16	17.00/19	8.24/4
5.	Cod	2.43/4	16.55/7	8.45/4
6.	Argentine	1.77/11	17.07/83	-
7.	Red hake	0.08/1	0.20/1	3.00/15
8.	Plaice	7.79/31	1.41/5	1.54/3
9.	Yellowtail flounder	5.45/18	0.21/1	3.11/12
10.	Witch	0.62/2	1.20/3	1.37/2
11.	Longhorn sculpine	0.37/1	0.37/2	0.95/6
12.	Butterfish	-	-	7.60/69
13.	Rays (Raja)	11.82	4.45	13.7
14.	Spiny Dogfish	-	0.74/1	19.23/17
15.	Other fishes	9.95	5.07	16.10
16.	Squids	23.51/226	30.77/195	0.31/2

Table 2

Percent ratio of biomass of various species in catches

No.	Areas	I	II	III
	Species	%	%	%
1.	Atlantic herring	30.0	12.9	28.6
2	Silver hake	3.7	5.7	14.7
3.	Redfish	14.0	6.1	2.3
4.	Haddock	3.1	13.4	5.3
5.	Cod	2.0	13.1	5.4
6.	Argentine	1.4	13.4	-
7.	Red hake	0.1	0.2	1.9
8	Plaice	6.0	1.1	1.0
9.	Yellowtail flounder	4.3	0.2	2.0
10.	Witch	0.5	0.9	0.9
11.	Longhorn sculpins	0.3	0.3	0.6
12	Butterfish	0	-	4.9
13.	Rays (Raja)	9.0	3.5	8.9
14.	Spiny dogfish	-	0.7	12.4
15.	Other fishes	7.6	4.3	10.9
16.	Squids	18.0	24.2	0.2
		100.0	100.0	100.0

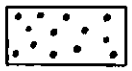
Table 3

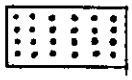
The assessment of pure stocks of some species in the areas of Nova Scotian Shelf and Georges Bank (in tons)

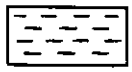
Species	Areas			
	I	II	III	Total
Plaice	78,829	1,407	10,285	90,521
Yellowtail flounder	22,430	178	11,148	33,756
Rays	39,751	7,895	40,219	87,865
Silver hake	51,315	36,483	245,327	333,125
Total:	192,325	45,963	306,969	545,257

Legend

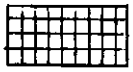
for Figs.1-13

 - haul with catches less than 1 kg.

 - 1 - 10 kg.

 - 11 - 50 kg.

 - 51 - 100 kg.

 - 101 - 200 kg.

 - > 200 kg.

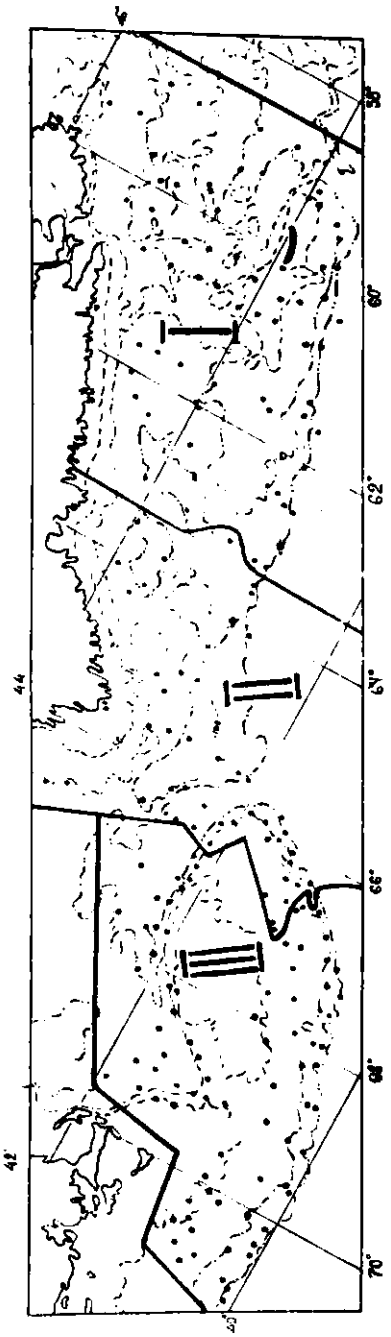


Fig. 1. The chart displaying the areas of surveys and the location of trawling stations.

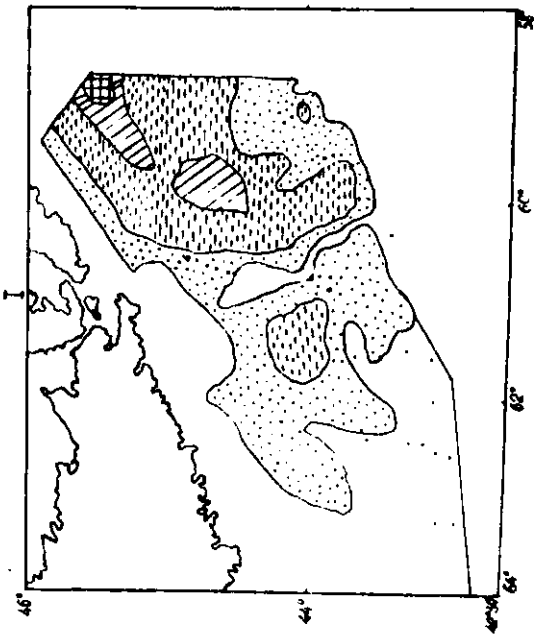


Fig. 2. The distribution of plaice, *Hippoglossoides platessoides*, in the area I.

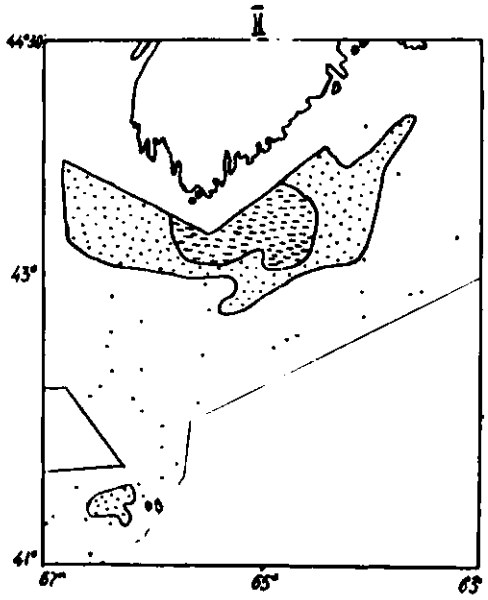


Fig. 3. Distribution of plaice in Area II.

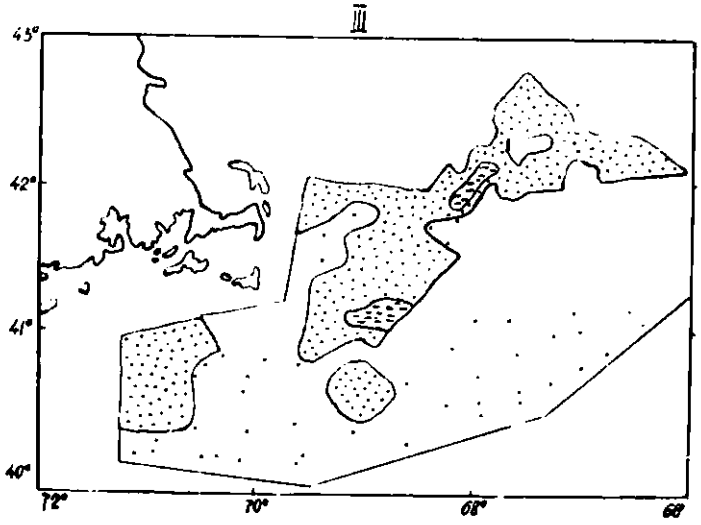


Fig. 4. Distribution of plaice in Area III.

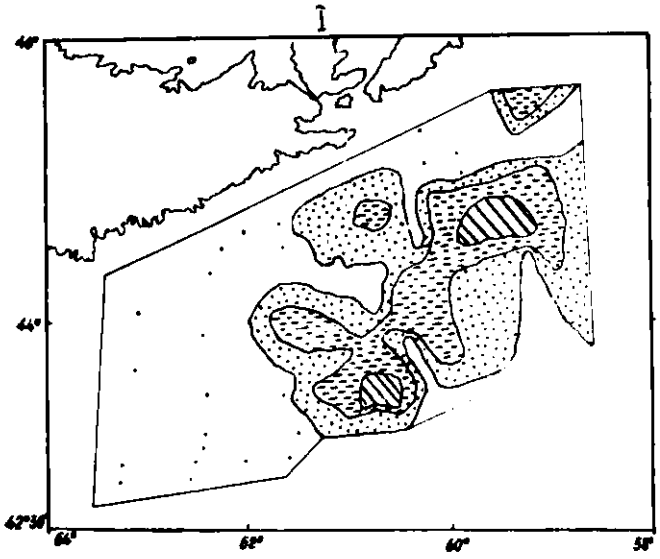


Fig. 5. Distribution of yellowtail flounder in Area I.

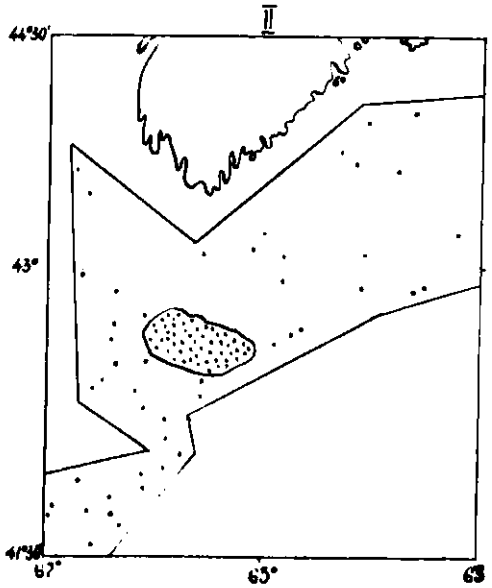


Fig. 6. Distribution of yellowtail flounder in Area II.

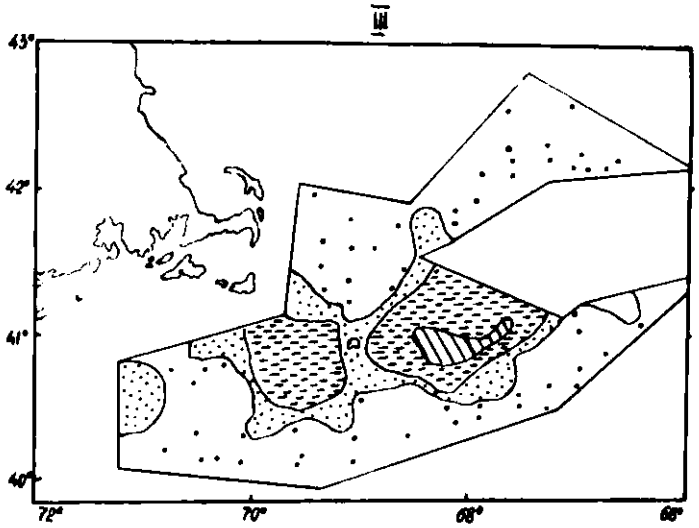


Fig. 7. Distribution of yellowtail flounder in Area III.

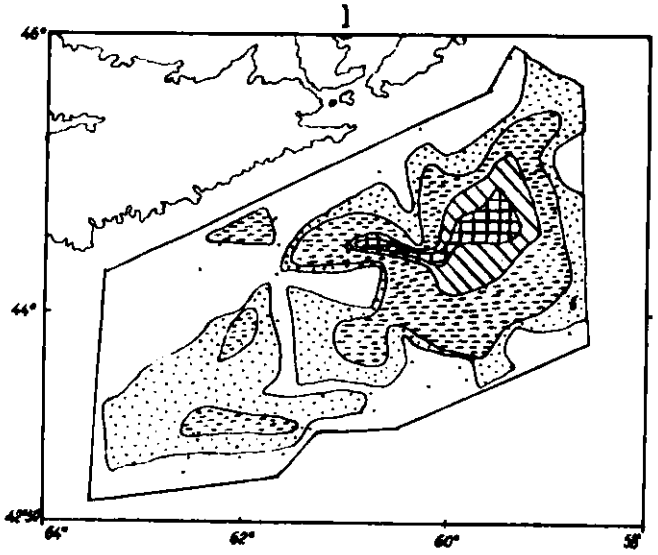


Fig. 8. Distribution of rays in Area I.

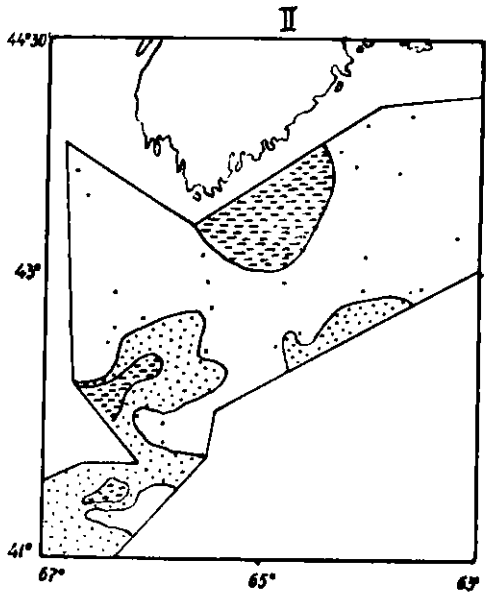


Fig. 9. Distribution rays in Area II.

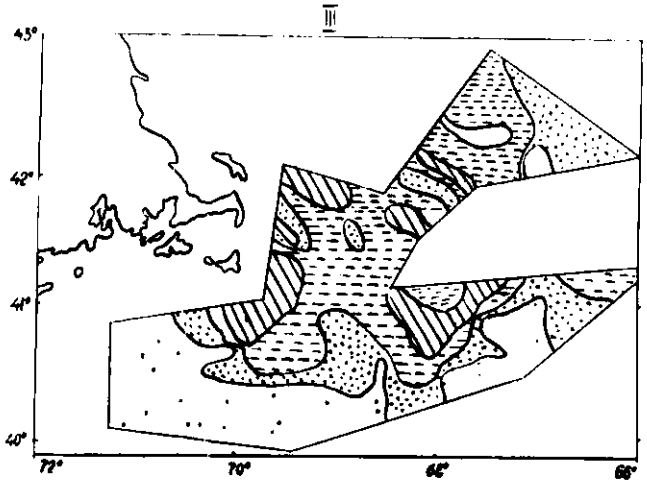


Fig. 10. Distribution of rays in Area III.

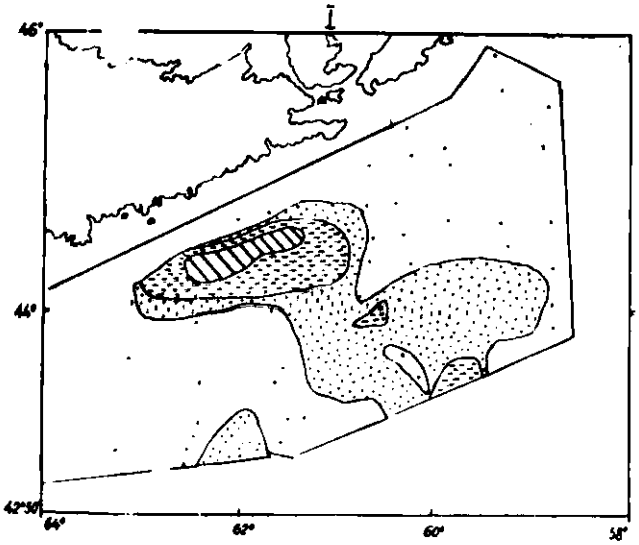


Fig. 11. Distribution of silver hake in Area I.

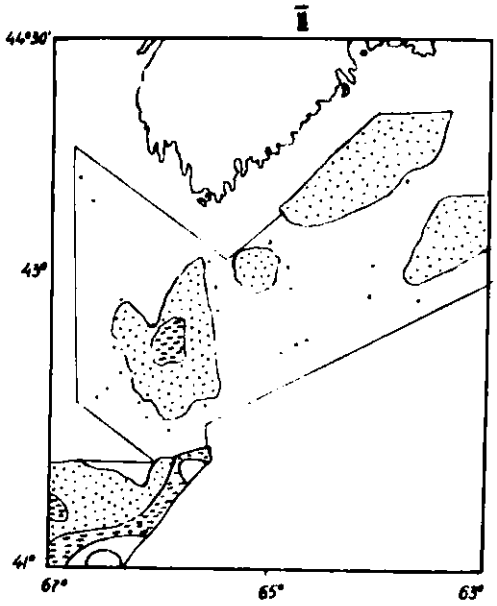


Fig. 12. Distribution of silver hake in Area II.

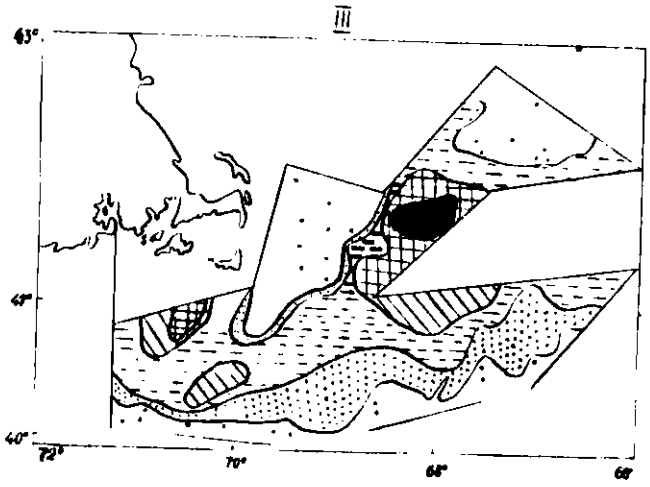


Fig. 13. Distribution of silver hake in Area III.