RESTRICTED

INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES

Serial No.1821
(D.a.66)

ICNAF Res.Doc.67/21

ANNUAL MEETING - JUNE 1967

USSR Research Report, 1966

by K.G.Konstantinov and A.S.Noskov

The total catch obtained by the USSR fleet in the ICNAF Area in 1966 was 711,201 tons (Table 1), which was 141,896 tons less than in 1965.

The catch of silver hake decreased considerably (331,418 tons or 38.8% of the total catch in 1965, against 131,696 tons or 18.5% of the total catch in 1966).

Catches of herring, argentine, pollock (saithe), mackerel and flounders increased.

Table 1. Species composition of USSR catches (in metric tons) in the Convention Area, 1966.

Species	Subarea					Total Catch	
	1	2	3	4	5	tons	%
Herring	-	-	-	2,227	117,346	119,573	16.5
Argentine	-	-	119	14,983	33,938	49,040	6.9
Cod	1,070	32,305	49,325	10,977	16,755	110,432	15.1
Haddock	-	-	4,435	20,566	48,409	73,410	10.7
Pollock (saithe)	-	-	689	7,254	2,611	10,554	1.5
Silver hake	-	-	-	10,323	121,373	131,696	18.5
Red hake	-	-	44	2,173	82,889	85,106	12.0
Flounders	-	1,205	24,318	13,817	938	40,278	5.6
Halibut	12	220	51	130	60	473	0.1
Redfish	74	2,305	31,464	13,943	939	48,725	7.0
Wolffish	-	102	15	77	312	506	0.1
Ocean pout	-	-	-	-	6,231	6,231	0.9
Scup	-	-	-	-	257	257	0.1
Mackerel	-	-	-	1,234	5,446	6,680	0.9
Butterfish	-	-	-	-	3,865	3,865	0.5
Sea robins	-	-	-	-	98	98	0.1
Angler fish	-	-	-	640	692	1,332	0.3
Dogfish and skate	-	-	-	1,534	5,254	6,788	0.9
Squid	-	-	-	104	341	445	0.1
Other and unidentified	17	1,071	4,642	1,378	8,604	15,712	2.2
Total	1,173	37,208	115,102	101,360	456,358	711,201	100.0

Subarea 1

A. Status of the Fisheries

In July, a large refrigerator trawler fished for a short period in Subarea 1, but catches were poor; the total catch of cod amounted to 224 tons, the average catch was 0.6 tons per one hour of trawling. Most of the trawl hauls were made in Div.1C. In addition, research vessels took part in the investigations in Subarea 1.

B. Special Research Studies

I. Distribution, feeding, age and sizes of cod

The R/V Pobeda made two cruises, one in May-August and the other in September-November.

In May-July, the area lying to the north of 62° was not covered with ice. Oceanographic investigations showed that the water temperature in the near-bottom layers was much higher than that in more southern areas. This resulted in the cod appearing in the shallow areas north of 62°. Thus, in May-June, cod commercial concentrations were observed in Div.1B, 1C and 1D at depths of 80-120 m, whereas cod catches exceeding one ton per trawl haul were taken in Div.1E at depths of 200-350 m.

In September-November, after warming of the shallow waters, cod were in commercial concentrations at depths of 40-120 m also in Div.1E. Throughout their summer-autumn feeding, cod were concentrated mainly in the areas rich with food species, such as Euphausiidae, sand launce, shrimp, the young of redfish in the temperatures of 1.0°-4.5°C in the off-bottom layers.

Thus, in May-June considerable concentrations of Euphausiidae,and of cod feeding on Euphausiidae, were discovered on the western slopes of banks (from Danas Bank to Store Hellefiske Bank), at the boundary between cold and warm waters in depths from 100-300 m. In September-November, cod feeding on Euphausiidae were found in concentrations in the area of Holsteinsborg Deep and Banana Bank at depths of 120-300 m. It should be noted that during the period of feeding on Euphausiidae, the West Greenland cod usually keep over the bottom. At that time, the Euphausiidae and fish stocks are recorded by the fish finder in water masses. Catches in the bottom trawl were small in number (from several hundred kg up to one or two tons per hour of trawling).

Of the small shoaling fish, the sand launce is the main food of cod. In July, dense concentrations of cod were discovered feeding intensively on sand launce on the fishing grounds in Div.1D and 1E (from Frederikshaab Bank to Fyllas Bank). In September-November, considerable concentrations of cod were found in the sand launce spawning area, mainly on Fyllas Bank at depths 40-80 m, and cod catches were from 0.1 tons to 3-5 tons per hour of trawling.

The young of redfish (4-5 cm long) were a basic food of cod. In autumn, cod concentrations were observed along the course of drift and settlement of the redfish young, i.e. in areas of Nanortalik Bank and Banana Bank at depths of 90-180 m.

In May-August, trawl catches consisted mainly of cod of 50-70 cm average length. Small cod of 35-50 cm in length were found mainly to the south, i.e. from Cape Farewell to Banana Bank and especially in the area of Frederikshaab Bank. In May, large cod over 70 cm in length made up a considerable part of the catches in Div.1C, 1D and 1E. In June-July and following months, large cod were dispersed throughout the area and their percentage in the catches was not high.

In the first half-year, individuals of the 1961 year-class (5 years old and 52-60 cm average length) persisted in the catches. In all divisions, these individuals made up from 30 to 88% of the total number of specimens caught. Cod (63-70 cm long) of the 1960 year-class, made up from 3 to 40%. In May-June, 6-year-old fish were mainly on the Biezymyanaya and Frederikshaab Banks and in July-August - in the area from Banana Bank to Store Hellefiske Bank. Four year-old cod (43-49 cm long) ranked third in numbers in the catches. Sometimes the four-year-olds made up to 40% of all the fish caught, especially on Biezymyanaya and Frederikshaab Banks. It should be noted that the 1962 year-class of cod is very widely distributed. Cod more than 6 years of age were seldom seen. Nine year-olds, representing the rich 1957 year-class, averaged about 12%, 7-8 year-olds from 1 to 11% of the fish caught.

In the second half-year, the age composition in the catches changed considerably. Specimens 6 years and older were dispersed throughout the area and were rarely caught except in Div. 1D. Many young specimens of the 1962 and 1963 year-classes were found in catches (mean length of the 4 year olds reached 46-53 cm and that of the 3 year olds, 34-46 cm).

In May-July, 2,000 cod and in September-November 2,500 cod were tagged. Throughout 1966, the number of the specimens recaptured was 1.2% of the fish tagged and released in May-July. Some of the tagged fish were caught immediately in the area of tagging. Thus, many specimens released on Banana and Fylla Banks in May-

June remained there during the summer and autumn months. But, some tagged specimens were caught far to the north. Thus, the 72 cm cod tagged on Fyllas Bank on 27 May were caught in September in the eastern part of Store Hellefiske Bank. Specimens tagged in the area of Holsteinsborg Deep and in the central part of Store Hellefiske Bank in May-July were caught in the northern part of Store Hellefiske Bank and in the area of Disko Island in August-September.

Subarea 2

A. Status of the Fisheries

I. General

The annual catch is given in Table 2.

Table 2. Annual catch and catch per one hour of trawling for Subarea 2 (in metric tons).

Divisions	Total catch by all types of trawlers					Average catch per one hour of trawling BMRT
	Cod	Redfish	Flounders	Others	Total	
2G	268	22	5	5	300	-
2H	6,032	438	368	243	7,081	2.96
2J	26,005	1,845	1,052	925	29,827	3.08
Subarea 2	32,305	2,305	1,425	1,173	37,208	3.05

In 1966, the catch in Div.2H increased slightly compared to that for the other divisions of Subarea 2. Catch in Div.2J was as usual the highest. In 1965, the ratio of catches in Div.2J and 2H was 10:1, but in 1966 only 4:1.

II. Cod

The increased commercial importance of Div.2H was caused by the peculiarities in cod distribution in 1966. In the winter of 1965-1966, the water temperature on the Labrador Shelf was considerably higher than that observed for a number of years and, consequently, the first commercial concentrations of cod were found earlier than usual.

In 1966, the average catch per one hour of trawling (BMRT) was 3.05 tons in Subarea 2, while in 1965 it was 3.27 tons. Such a decrease in catch was partially due to the fact that in 1966 the fleet was working in the area where the bottom was unfavourable for trawling (2H). It can also be explained by a decrease in the number of cod of the Labrador stock caused by an intensive fishery in previous years. As shown in Table 3, the average length of the cod in trawl catches is gradually decreasing. For the last five years, the average age and weight of cod has declined due to the almost complete disappearance of the older individuals in the trawl catches (Table 4). The young cod survey carried out by the Soviet ichthyologists in Subareas 2 and 3 showed that the abundance of new year-classes of the Labrador cod fluctuated only slightly. Thus, every year the commercial stock is recruited by approximately an equal amount of the growing fish. Table 5 shows the average catches of young cod per one hour of trawling determined by a special fish counting trawl for all the divisions of the Subarea 3. Relative abundance of the young of the Labrador cod stock may be determined from the catches of young on the North Newfoundland Bank (3K).

Cod larvae are brought there by the water currents from the main spawning grounds situated in North Labrador. The young cod inhabit the waters of the North Labrador Bank during their first years of life, then migrate gradually to the north and return to the Labrador Shelf. As seen from Table 5, the bulk of cod taken by the fish-counting trawler was age 2+ and 3+; the average catch of such individuals is almost always the same. Unlike the cod stock of the West Greenland or of the Barents Sea, fluctuations are not normal for the Labrador cod stock.

Table 3. Average length (cm) of cod in Div.2J

Year	January	February	May	June	October
1960	57.3	57.2	52.1	49.3	55.4
1964	52.2	53.9	51.3	48.8	53.2
1965	51.5	54.2	51.3	48.8	55.4
1966	51.9	52.2	47.7	44.4	50.9

Table 4. Age composition (%) of cod in Div.2J in February 1961 and 1966

Year	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Avg age	Avg wt (g)
1961	14	47	114	169	143	97	93	70	60	70	53	37	26	6	7	3	9.5	2,197
1966	56	230	200	246	150	96	16	3	3	-	-	-	-	-	-	-	6.6	1,196

Table 5. Average catch (number of individuals) per one hour of cod trawling of different year-classes from 0+ to 3+.

Year-class	0+						1+						2+						3+					
	3K	3L	3M	3N	3O	3P	3K	3L	3M	3N	3O	3P	3K	3L	3M	3N	3O	3P	3K	3L	3M	3N	3O	3P
1958																			10	10	4	1	-	?
1959																			15	10	42	1	1	1
1960							5	2	1	3	-	3	21	11	7	8	1	4	11	8	1	1	-	1
1961	1	1	3	1	1	6	3	4	1	4	3	6	11	8	8	1	2	5	24	11	1	4	1	1
1962	1	1	8	1	7	42	2	5	4	8	2	7	20	28	3	5	1	6	24	13	-	6	1	2
1963	1	2	1	1	1	3	1	8	4	5	1	13	15	40	20	18	2	12						
1964	1	1	1	41	24	31	3	15	-	137	13	22	36	31	-	30	1	17						
1965	1	1	-	1	1	5																		

This is caused by relatively stable conditions on the spawning grounds and in the manner of the drift of eggs and larvae of the Labrador cod stock. Eggs and larvae are brought by the current to the south (but not to the north, as is the case with the cod eggs and larvae near West Greenland and in the Barents Sea). Thus, the Labrador cod fingerlings cannot be driven into the zone of Arctic waters where they die immediately. Stable annual recruitment of the Labrador cod stock should result in an almost invariable age-size composition.

But, taking into account some decrease in the average length and age, it can be supposed that fishery has a certain effect on the stock. This effect is still very insignificant, however, and the stocks of the Labrador cod are in comparatively good condition. Cod is fished intensively by large vessels in the winter-spring months; in the second half of the year cod come to the coastal shallow areas, gulfs and straits. In the first half of the year, cod fishing is impeded by floating ice. Cod spawning near North Labrador seems to be protected by natural conditions. Thus, there are no grounds for expecting a sharp decrease in the abundance of the Labrador cod or in the productivity of their fishery in the near future. In 1968, the average catch per one hour of trawling in Subarea 2 might be expected to be lower in comparison with the level of 1967, but not more than by 10-12%.

III. Flounders

Commercial vessels fished on the spawning grounds of witch flounder (Glyptocephalus cynoglossus) in Div. 2J, at approximately 53°30'N and 52°15'W. Spawning was observed mainly in March at depths 550-560 m. The mode of the size range of fish was 57 cm.

B. Special Research Studies

I. Environmental Studies

1. Oceanography. Scouting and research vessels conducted observations on the temperature and the chemical composition of water. According to observations made along the Section 8A, the water temperature on the Labrador Shelf remained much higher than the average for many years; the cold Labrador Current

became weaker. By August, positive temperature anomalies became somewhat lower, but by January they rose again due to slow irradiation in the atmosphere. A detailed characteristic of oceanographic conditions in Subarea 2 is given in a special paper.

II. Tagging

About 5,000 specimens, mainly cod, were tagged by Soviet ichthyologists. The results of tagging for 1960-1966 are also given in a special paper.

III. Experiments on trawl selectivity

Trawl selectivity without chafing gear and with chafing gear of the Polish type was determined by a group of scientists from PINRO in Div.2J, where the commercial trawler Vitebsk operated. Eighty experimental trawlings were made, and all the fish caught were measured. Results showed that the chafing gear proposed by the Polish specialists differed in selectivity very slightly from that of the USSR type. Detailed results of the experiments are given in a special paper.

Subarea 3

A. Status of the Fisheries

I. General outline

The annual catch is given in Table 6.

Table 6. The total catch and the catch per one hour of trawling in Subarea 3 (in metric tons).

Div.	General catch by all types of trawlers					General catch per one hour of trawling BMRT
	Cod	Redfish	Flounders	Others	Total	
3K	3,610	2,951	1,650	465	8,676	2.41
3L	888	282	148	98	1,416	1.78
3M	5,138	6,954	4,003	1,061	17,156	1.07
3N	31,596	5,851	10,091	1,499	49,037	2.19
3O	7,427	14,667	8,059	6,420	36,573	2.52
3P	666	759	418	401	2,244	2.29
Subarea 3	49,325	31,464	24,369	9,944	115,102	2.33

Compared to 1965, the importance of the fishery on the southern slopes of the Grand Bank (3N and 3O) rose considerably, but there was some decrease in catch on Flemish Cap Bank (3M) and in Div.3K and 3L.

II. Cod

The bulk of the commercial trawl catches consisted of individuals 50-60 cm in length. In July 1966, in Div.3N, the mean length of cod was 59.3 cm.

III. Redfish

In 1966, Soviet trawlers caught redfish mainly to the south of the Grand Bank. The fishery has almost ceased on Flemish Cap Bank, where the redfish stock (Sebastes mentella) isolated and fished for a long time has decreased considerably in number. It should be noted that the redfish age-size composition does not change despite the intensive and long-time fishing (Table 7). This peculiarity of the redfish is common in all other areas of the North Atlantic.

IV. Flounders

American plaice (Hippoglossoides platessoides) formed the bulk of flounders caught on the southern slope of the Grand Bank. Of the 1,500 specimens measures in Div.3N in December, 50% were from 40 to 50 cm in length.

Table 7. Mean length (cm) of redfish on Flemish Cap Bank in August.

Year	Male	Female
1962	33.37	35.31
1964	33.37	35.14
1966	33.69	36.09

B. Special Research Studies

I. Environmental Studies

Research and scouting vessels Sevastopol, Kreml, Rossia, Pobeda, Novorossijsk made temperature measurements on standard oceanographic Sections 1A, 2A, 3A and in all the areas where commercial fish concentrations were discovered. On some sections, the oxygen and nitrogen content and salinity rate were also determined. The main results of oceanographic observations are given in a special paper.

II. Biological Studies

In May-June, samples of fish eggs and larvae were taken on the Grand Bank to determine more exactly the area of haddock mass spawning and the areas of dispersion of their developing eggs and larvae. The samples collected are being worked up.

III. Counting of the young

As in the previous five years, counts of young cod and haddock were made in Subareas 2 and 3. It was found that, during the last few years, poor year-classes of haddock were found on the Grand Bank. Table 5 shows that there was an extremely high abundance of young cod of the 1964 year-class on the south of the Grand Bank and on St. Pierre Bank (Div.3O and 3P and especially 3N). There is no doubt that, upon reaching commercial size in 1968-1969, cod of that extremely abundant year-class should increase the catches on the Grand Bank. At the same time, the mean length of cod in trawl catches will be somewhat less due to a strong recruitment to the stock by the young fish.

Subarea 4

A. Status of the Fisheries

Silver hake

In 1966, the catches of silver hake continued to decrease sharply and were only 10,323 tons (Table 8). The reduction in catches is caused by a decrease in commercial concentrations on the Nova Scotian Shelf during all seasons of the year. As was noted in 1965, that fact can be explained by a decrease in the stock abundance. The decrease in number was caused by the entry into the fishery of a series of poor year-classes of 1961-1964.

Table 8. Catches of silver hake by the USSR commercial fleet in Subarea 4 (in thousand tons).

Year	1962	1963	1964	1965	1966
Catch	8.8	123.0	81.1	50.0	10.3

Silver hake were caught on the slopes of the banks of the Nova Scotian Shelf from May to the end of October, but, as a rule, the catches were not high.

In the near future, hake abundance will, apparently, be at a low level. This fact could be due to poorer conditions for silver hake reproduction and living with the cooling of waters on the Nova Scotian Shelf.

Haddock

In 1966, haddock catches were 20,566 tons (Table 9). Haddock concentrations were less dense and stable than in 1965.

Table 9. Haddock catches by the USSR commercial fleet in Subarea 4 (in thousand tons).

Year	1962	1963	1964	1965	1966
Catch	2.6	3.7	5.5	45.5	20.6

In May-July, haddock were caught with argentine, flounder and pollock on the continental slope. In August-September, haddock were caught in Sable Island shallows, but in considerably less numbers than in 1965.

Argentines

Argentines were caught along the slopes of the shelf from Banquereau to Browns Banks, the bulk being taken on the slopes of Browns Bank. In 1966, argentine catches reached 14,983 tons (Table 10).

Table 10. Argentine catches by the USSR commercial fleet in Subarea 4 (thousand tons).

Year	1963	1964	1965	1966
Catch	8.1	4.9	5.6	15.0

Argentine, from 19 to 45 cm long, were taken in the catches by research-scouting vessels.

C. Special Research Studies

I. Environmental Studies

1. Oceanography. In 1966, 8 cruises were made by research and scouting vessels in Div.4X and 4W for the purpose of studying mid-year and seasonal changes in hydrographic conditions over the Nova Scotian Shelf. Observations were made on standard sections and stations (Fig. 1).

As in previous years the minimum temperature in the intermediate cold layer, the depth of occurrence of the 5° isotherm and the average temperature in the layer from 100 m to bottom were determined. It was found that the process of cooling begun several years ago continued in 1966.

The Halifax section (Fig. 2) (completed 6 times during the year) shows that, in January, the water temperature in the near bottom layers in the central deep waters of the Scotian Shelf was higher than 5°C and, in other months, was below 5°C.

In winter and spring, the water temperature in the off-bottom layer between LaHave and Emerald Bank was 1.3° below that in the winter and spring of 1965.

The average temperature in the 100 m - bottom layer was also considerably lower than in 1965 (in winter, by 2.3°; in spring, by 0.5°; in summer, by 1.3°). In autumn, the difference was not observed.

In February-March, the penetration of waters from the slopes to the shelf was investigated in Subarea 4.

Detailed results of these investigations are given in a special paper.

II. Biological Studies

Silver hake

From June to August in Div.4W the length of hake caught ranged from 20 to 60 cm. Individuals 28-34 cm long were dominant. In July, the mean length was 31.8 cm and in August, 32.5 cm. As in two previous years, the three-year-olds (22.4%), the four-year-olds (41.0%) and the five-year-olds (23.8%) were the most abundant.

Haddock

From June to October, haddock from 28 to 40 cm in length were dominant in the Sable Island area. In July, the mean length of haddock was 37.0 cm, in August - 33.5 cm and in October - 38.9 cm.

From July to September 1966, the otoliths of 793 haddock were collected and studied to determine the age composition. In addition, in November 1965, the age of 100 specimens was determined.

Table 11. Haddock age composition in catches by scouting and commercial vessels in the Sable Island area in 1965-1966 (%).

Year	Month	Age 1	2	3	4	5	6	7	No. of specimens
1965	November	-	-	3.0	29.0	42.0	23.0	3.0	100
1966	July-September	2.0	6.5	52.2	25.0	10.3	3.1	0.9	793

The analysis of the age composition of fish caught in 1966 confirmed the conclusions of the Canadian investigators that there was a relatively high abundance of the 1963 year-class.

Subarea 5

A. Status of the Fisheries

Silver hake

Silver hake catches on Georges Bank amounted to 121,373 tons (Table 12).

Table 12. Silver hake catches by the USSR commercial fleet in the area 5Z (thousand tons).

Year	1962	1963	1964	1965	1966
Catch	41.9	107.4	163.3	281.4	121.4

The decrease in commercial silver hake concentrations on Georges Bank has continued since 1964. In the summers of 1962-1963, the most dense concentrations including pre-spawning and spawning ones were observed on the southern slopes. In winter, concentrations were found to the north of Georges Bank in the Gulf of Maine. But, since 1964, hake concentrations have not been seen in winter in the Gulf of Maine, and these concentrations have decreased gradually in the summer on the southern slopes. In 1966, silver hake concentrations were dispersed and unstable in spite of the favourable oceanographic conditions observed in that area.

In 1966, the bulk of silver hake was caught to the southwest of the ICNAF Area in the Hudson Canyon.

In the winter and spring of 1966, silver hake were taken as by-catch in the red hake catches taken on the slopes of Georges Bank to the west of 69°W. In summer, the red hake made up the bulk of fish caught on the southern slopes. From

the end of the summer to October, silver hake were fished on the northwestern slopes of Georges Bank and in the Nantucket shallows.

In general, one can say that the stocks of silver hake inhabiting the waters of Georges Bank decreased considerably or that the bulk of the fish shifted to the area of Georges Bank (to its southwestern part). But the latter is less probable, since race investigations show that a separate population of silver hake inhabits the area to the west of Cape Cod peninsula. In 1967, and perhaps in the following years, the stocks and catches of silver hake on Georges Bank will be considerably lower than in 1962-1965.

Haddock

In 1966 and especially in the second half of the year, a decrease in the Georges Bank catches was observed (Table 13).

Table 13. Haddock catches taken by the USSR commercial fleet on Georges Bank (thousand tons).

Year	1962	1963	1964	1965	1966
Catch	1.1	2.4	5.5	81.9	48.4

During January to March, the best catches of haddock were made on the southern slopes of Georges Bank and in April, on its southeastern slopes. In January, the catches per one hour of trawling by BMRT averaged 2.8 tons, in February - 3.7 tons, in March - 3.1 tons and in April - 2.8 tons.

During that period, haddock concentrations were found in the areas at depths from 40 to 270 m where the off-bottom temperature was 3-4°C.

In summer and autumn, haddock were caught in small numbers on the northwestern, northern and northeastern slopes of Georges Bank.

Herring

In 1966, the commercial fleet fished for herring more intensively than in 1965, and their catches increased (Table 14).

Table 14. Herring catches taken by the USSR commercial fleet on Georges Bank (thousand tons).

Year	1962	1963	1964	1965	1966
Catch	151.1	97.3	130.7	36.3	117.3

Late in May and in June, herring fishing was, as usual, conducted on the southern slopes at depths 50-100 m.

During July to August, herring were fished on the eastern, northern and southern slopes and in September and in the beginning of October in the spawning areas on its northern slopes.

At the end of the first ten-day period, after spawning, the herring dispersed and no more were caught.

Red hake

In January and February, red hake was the main object of a fishery on the southwestern slopes of Georges Bank at depths 150-250 m where the off-bottom temperature was 6-7°C.

In March, red hake concentrations began to shift to the southwestern slopes of Georges Bank, and catches gradually decreased. From May to July, red hake were fished lightly on the southern slopes of Georges Bank, and from August to September on the northwestern slopes. Red hake lengths ranged from 24 to 57 cm

in catches, mean length from 31 to 34 cm. Three- and four-year-olds were the most abundant.

C. Special Research Studies

I. Environmental Studies

Oceanography

Four standard surveys were completed on Georges Bank throughout 1966. The sections and stations in the area of the surveys are given in Fig. 1. Data on those surveys showed (Fig. 3, 4, 5) that the time of a temporary warming in 1966 did not correspond to that in 1965. The warm waters of the Gulf Stream had less influence on the southeastern and southern slopes of the bank. Waters of a cold intermediate layer are distributed more widely. In the summer of 1966, the minimum water temperature of this layer was 2-3°C lower than in the corresponding period in 1965. Thus, cooling which had started in previous years continued in 1966.

Plankton

Zooplankton samples were taken at the standard stations in April, June, July, August and October. A Juday net made of silk bolting cloth, N 38, was used. At present the samples are being analyzed in the laboratory.

In June and July, ichthyoplankton collections were made on the southern slopes of Georges Bank to study silver hake spawning.

In August and October, the ichthyoplankton was sampled in the northern part of Georges Bank to study the distribution of herring larvae in the area of the spawning grounds.

II. Biological Studies

Silver hake

(a) Studies of the age and size composition in catches

Throughout the year, 113 samples (300 individuals in a sample) were measured and the age in 2,236 specimens was determined by otoliths and scales. Individuals from 24 cm to 32 cm in length were predominant. The mean length of all the fish measured was 28.6 cm.

The mean length of fish caught in Nantucket shallow was 26.2 cm in May, 26.8 cm in June, 30.5 cm in July, 28.4 cm in August; on the southern slopes of Georges Bank it was 26.7 cm in May, 29.2 cm in June, 28.8 cm in July and 28.4 cm in August.

Of the total number of specimens sampled in 1966, on the average 17.3% were 2-year-old fish, 45.5% 3-year-olds, 27.3% 4-year-olds and 4.1% were 5-year-olds.

(b) Race investigations

In 1966, morphological and serological studies were continued to identify local stocks of silver hake. The number of vertebrae, gill rakers and branchiostegal rays as well as the relation between otolith weight and length of fish body were analysed.

Studies of the albumen in the blood serum of silver hake caught in Div. 4W and 5Z were made by the electrophoresis method. They showed that the correlation between the albumen components is of specific nature.

From the data available one can conclude that a number of stocks inhabit the areas in question. But, it is difficult to determine the degree of mixing of these stocks. This problem may be solved in further investigations.

(c) The estimation of young silver hake abundance

Work on searching for and counting silver hake young was completed by the R/V Olonets in October-December 1966. The trawling areas are shown in Fig. 6.

A bottom trawl with a 27.1 m head rope was used. A codend with a mesh size of 10 mm from knot to knot was used. A total of 132 trawl hauls was made. Each haul lasted for one hour.

Estimates of the abundance of all individuals of total length 15-25 cm, those representing mainly the 1965 year-class, were made. In Subarea 1, silver hake young were not observed. In Subarea 2, young were found at depths of 70-120 m. The maximum catch per one hour of trawling was 182 specimens, the average catch was 39 specimens. In Subarea 3, young were observed everywhere in the area from Georges Bank to Hudson Canyon at depths of 70-200 m. The maximum catch per one hour of trawling was 216 specimens, the average was 35 specimens. In Subarea 4, young were found mainly at depths of 150-250 m. The most dense concentrations were discovered in the southern part of the subarea. The maximum catch per one hour of trawling was 526 specimens, the average was 113.

Haddock

Observations on size and age composition of haddock caught by research and commercial vessels were made throughout the year. The samples were usually taken by research vessels in haddock fishing areas. Haddock caught were from 28 to 85 cm long. Mean length gradually increased during the year. Thus, in January it was 39.9 cm, in February - 38.0 cm, in June - 46.6 cm, in October - 46.8 cm and in November - 50.9 cm.

The age of 365 specimens caught in May, September and December 1965 and of 1,088 specimens caught from January to December 1966 was determined for age composition studies. Individuals from two to seven years of age were found among the fish sampled. The 1962 year-class dominated the catches in 1965 and 1966 (Table 15).

Table 15. Haddock age composition on Georges Bank, 1965 and 1966 (%).

Year	Month	Age 2	3	4	5	6	7	No. of Specimens
1965	V	97.0	3.0					68
	IX	11.7	64.5	21.8	1.5	0.5		197
	XII		20.0	64.0	16.0			100
1966	I		46.4	50.5	3.1			194
	III	1.0	84.8	14.2				97
	VIII	0.5	9.5	53.7	34.7	1.5		198
	IX		40.0	59.0	1.0			100
	X		23.4	43.3	29.3	2.0		99
	XI		15.5	57.0	20.3	2.0		400

The relatively high abundance of the 1962 year-class confirms the results of the US investigations.

Herring

(a) Research studies on the age and size composition in the catches

In 1966, regular research on the age and size composition of herring catches were made in different areas of Georges Bank. A total of 286 samples (each sample included 300 specimens) were taken for length measurements. Age of 2,898 specimens was determined.

Individuals 28-33 cm long were predominant in the catches. In the first half of the year, mean length ranged from 25.8 cm to 30.5 cm; in July-September - from 29.7 cm to 31.9 cm.

Herring 2 and 3 years of age were found only as single individuals and averaged only 1.5% in the catches for the period. In addition, 5.9% were 4-year-old fish, 31.6% were 5-year-olds (1961 year-class), 47.3% were 6-year-olds (1960 year-class), 11.6% were 7-year-olds and 2.1% were 8-year-olds. Thus, in 1966, as in 1963-1965, the 1960 year-class was dominant in the catches.

This year-class has already been reduced due to natural and fishery mortality. In 1967, its abundance will be still lower. Other year-classes are

much poorer compared to the 1960 year-class. Thus, in 1967 the herring stocks of Georges Bank will be considerably reduced.

(b) Observations on herring spawning

In September and in early October of 1966, observations on herring spawning were continued on the northern slopes of Georges Bank to estimate the eggs deposited and to determine the abundance of the spawning population. As in 1965, two spawning areas were discovered near the northern slopes of Georges Bank. In one case, the area covered by the eggs was 10.8 km^2, in the other it was 8.3 km^2.

The spawning in the first case was observed on 19-20 September, and that, in the second one, on 28-29 September. The layers of eggs were 5-6 cm thick. Their minimum quantity in the samples was 0.2 kg/m^2, their maximum, 17.8 kg/m^2.

From the total number of the eggs deposited, the average fecundity of fish, the correlation of different sexes and the average weight of one specimen, the total stock of the spawning population was estimated as 150,000 tons.

Red hake

Observations on the composition of red hake catches were made by the research vessels. Simultaneously, otoliths were collected for age determination. The most abundant specimens were 28 to 38 cm in length.

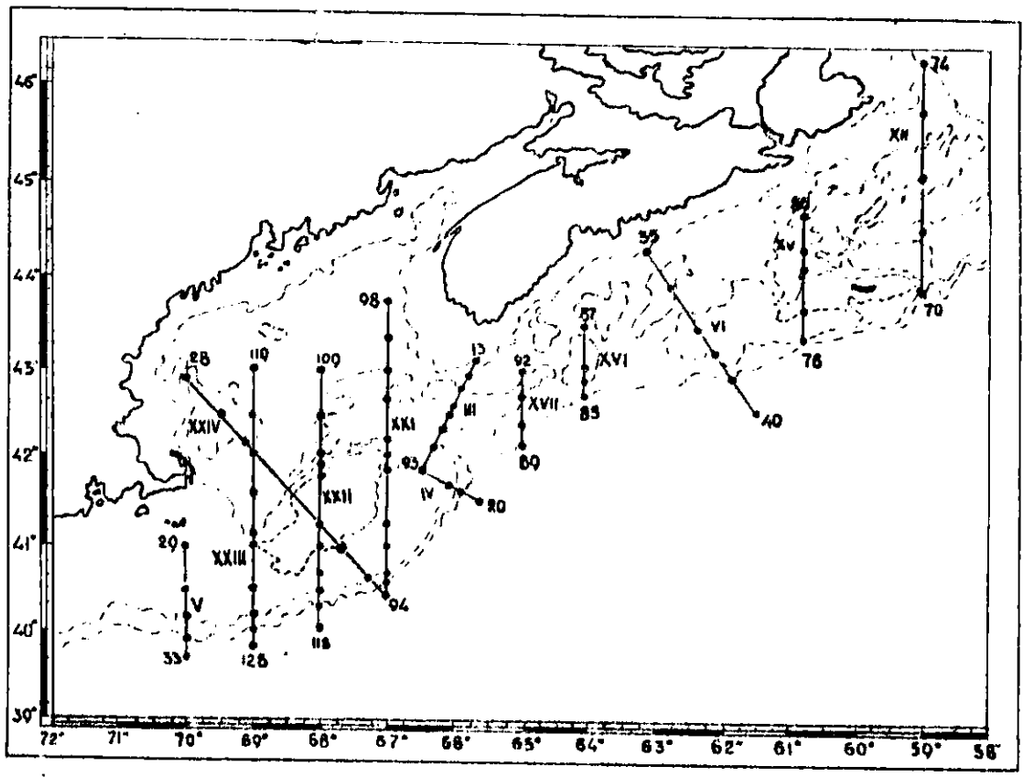

Fig. 1. Location of the standard sections

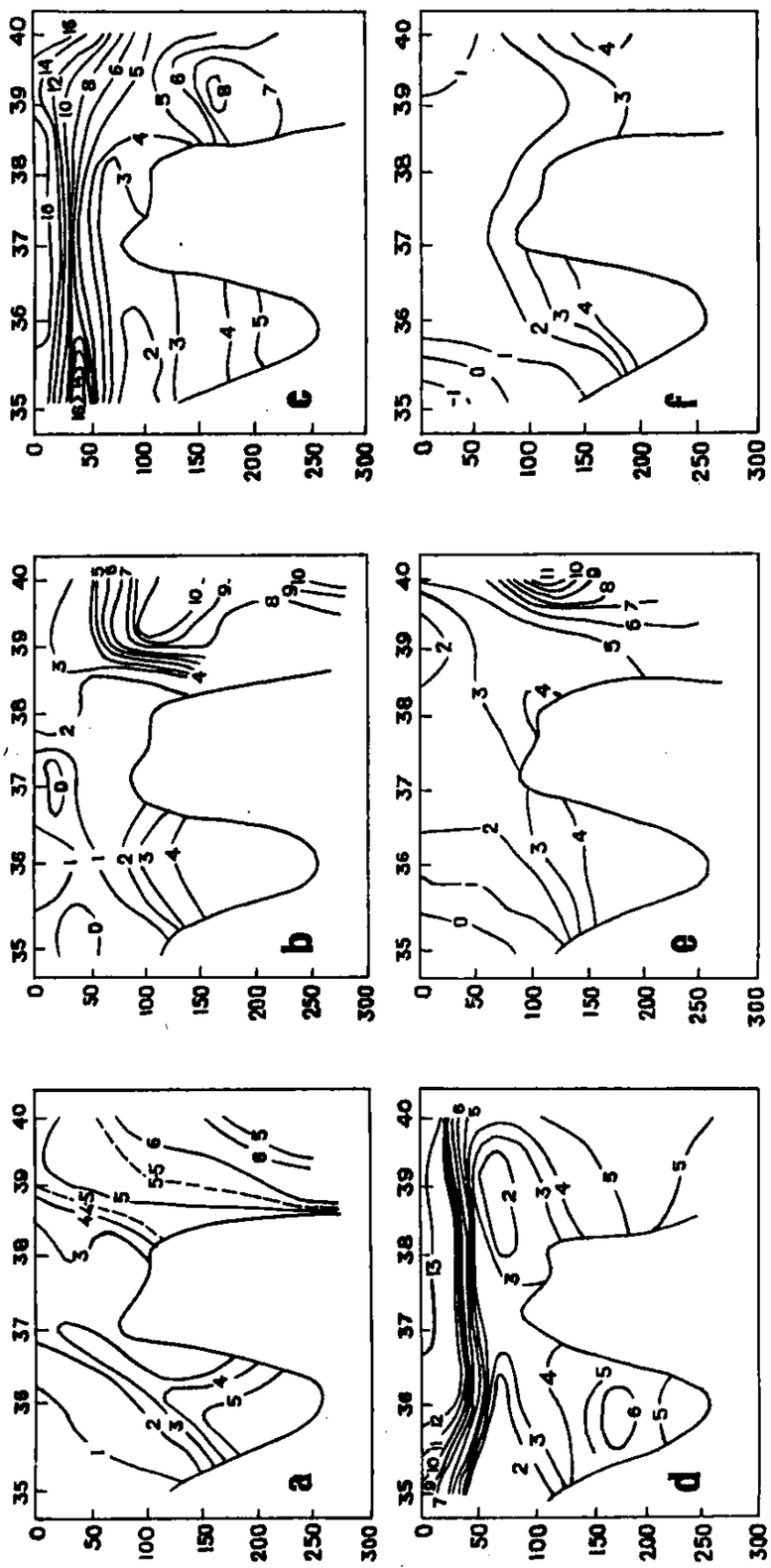

Fig. 2. Distribution of water temperatures in the Halifax section, 1966: (a) 28-30 January, (b) 5-10 April, (c) 4-5 August, (d) 10-11 October, (e) 6-10 February, (f) 24-25 February.

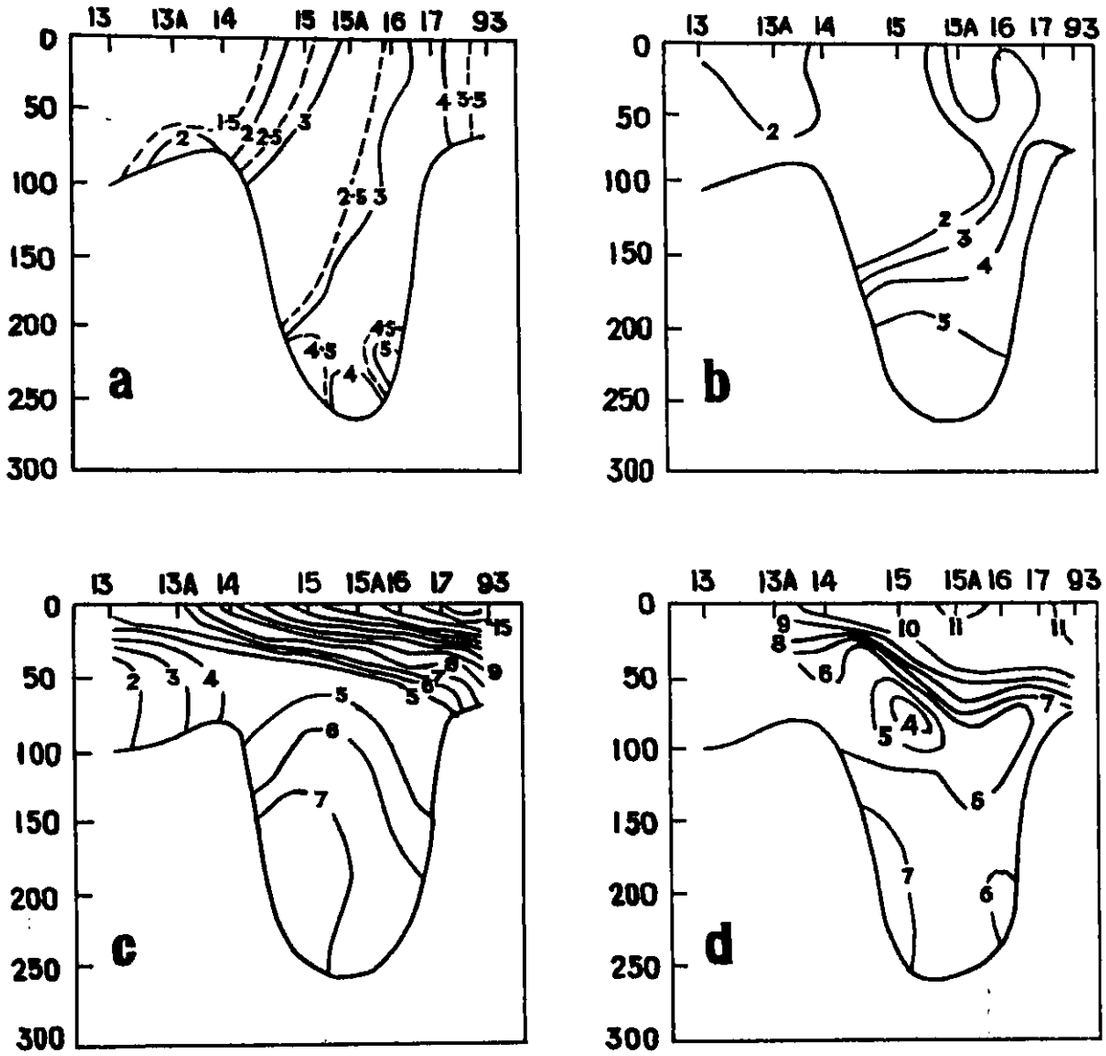

Fig. 3. Distribution of water temperatures in the channel between Browns and Georges Banks in 1966: (a) 29 January, (b) 4 April, (c) 4 August, (d) 10 October

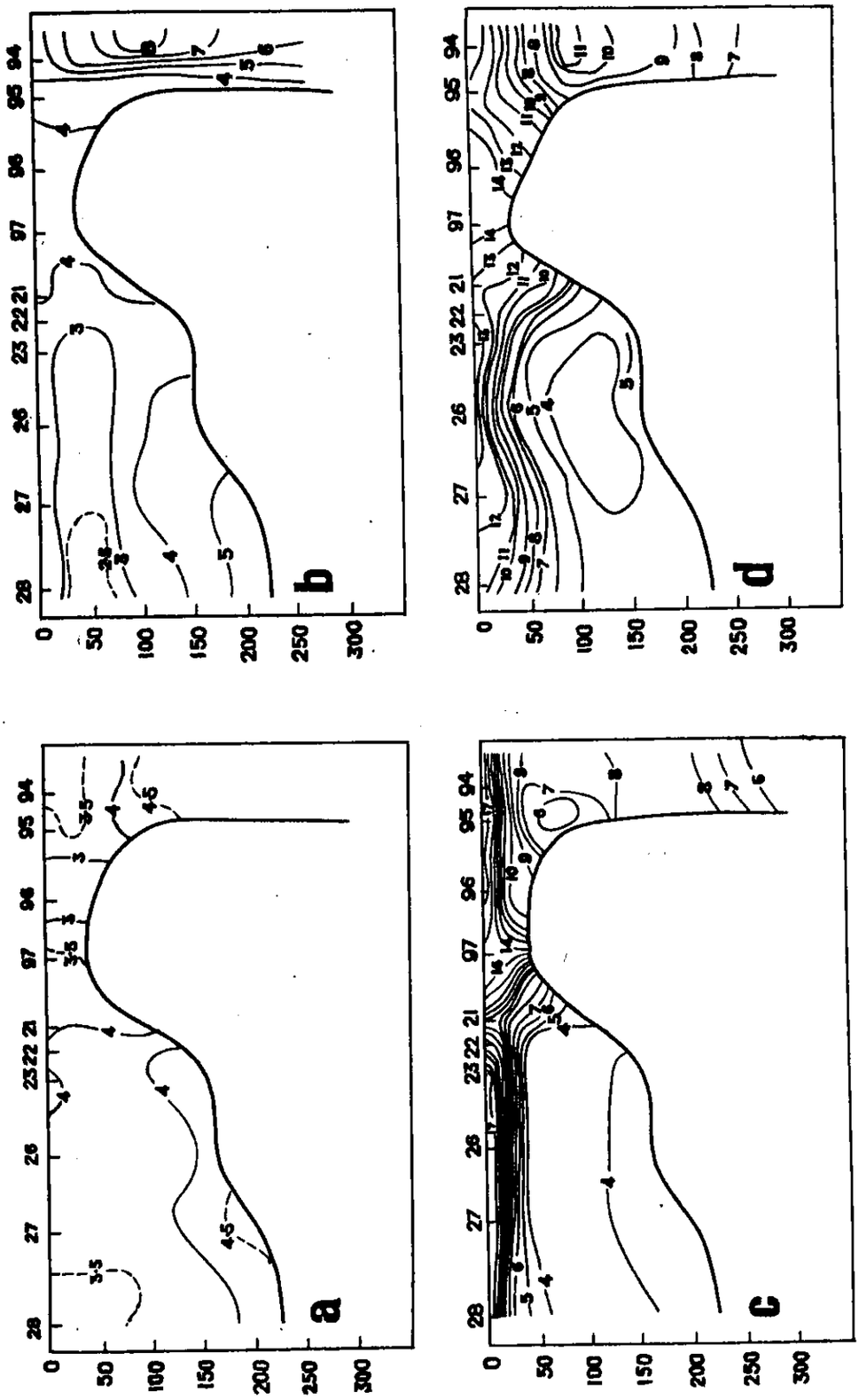

Fig. 4. Temperature distribution in Gulf of Maine-Georges Bank area (Section XXIV) in 1966: (a) 25 January, (b) 2 April, (c) 10 August, (d) 10 October

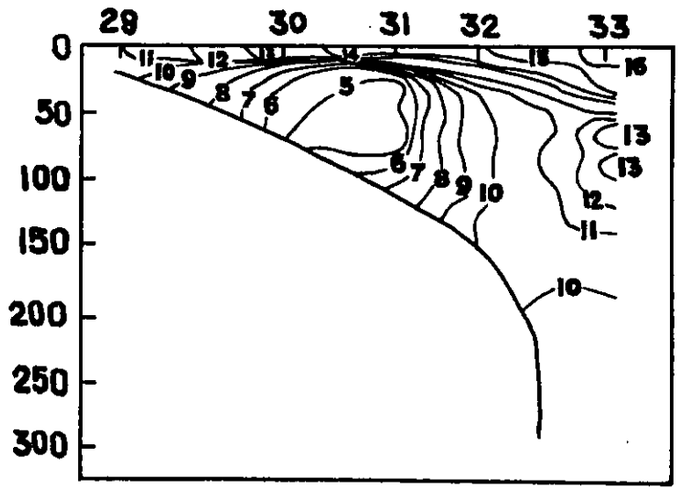

Fig. 5. Distribution of water temperatures over the continental slope to the south of Cape Cod (Section V) on 22 June 1966

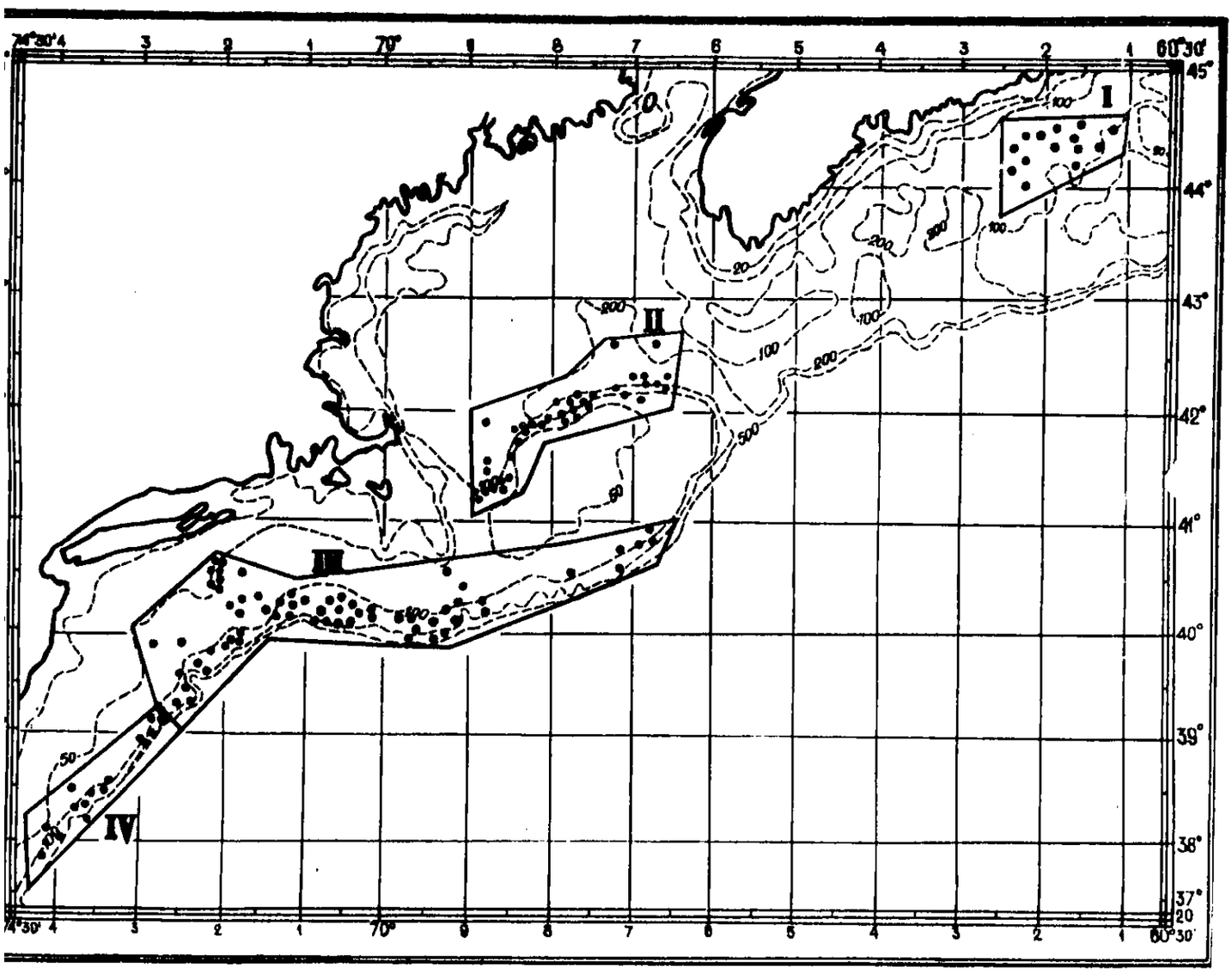

Fig. 6. Scheme of the regions investigated by the R/V Olonets and location of trawling operations.

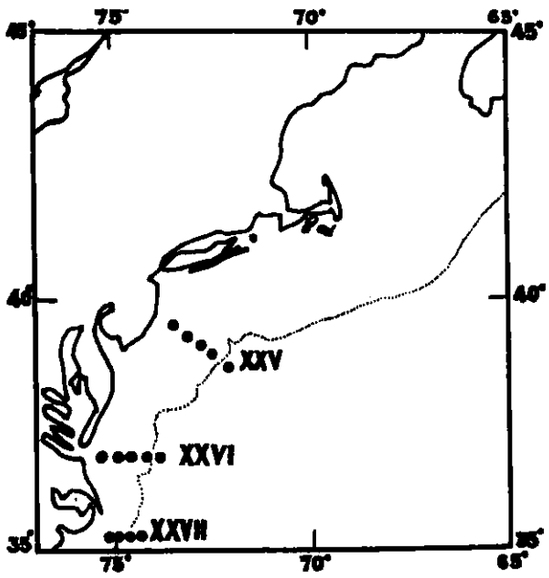

Fig. 7. Location of sections on the shelf along the United States coast of the ICNAF Area.