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The total catch obtained by the USSR fleet in the ICNAF area in 1964 was 617,313 tons.

Table 1 shows the 1963 and 1964 catches of the main commercial species.

Table 1. Species composition of USSR catches in the Convention area, 1963-64.

Species	1963		1964	
	tons	%	tons	%
Cod	81,658	16.6	129,053	20.9
Haddock	6,504	1.3	12,925	2.1
Silver hake	230,380	46.9	248,455	40.2
Other Gadoids	5,528	1.1	11,830	1.9
Redfish	37,535	7.6	44,079	7.1
Scups	6,578	1.3	1,494	0.2
Herring	100,036	20.4	133,195	21.6
Argentine	12,337	2.5	17,773	2.9
Flat-fish	3,282	0.7	4,904	0.8
Other fish	7,808	1.6	13,605	2.3
Total	491,446	100.0	617,313	100.0

The catches of all species, particularly cod and herring have increased. On the other hand, the catch of scups has remained steady.

Table 2 shows the species composition of USSR catches in ICNAF subareas for 1963-64. In 1964 Subarea 1 was not fished by the USSR fishing vessels; research and exploratory vessels alone operated and fished in this Subarea. The increase in catches in Subareas 2 and 3 may be attributed largely to an increase in the catches of cod and redfish. The catch in Subarea 4 decreased due to a drop in silver hake and redfish catches. The increase in the total catch from Subarea 5 resulted from an increase in herring and silver hake catches.

Table 3 gives the distribution of the total catch by subareas.

Table 3. Distribution of the USSR catch by Subareas, 1963-64

Subarea	1963		1964	
	tons	%	tons	%
1	6,302	1.3	-	-
2	25,116	5.1	69,294	11.2
3	63,756	13.0	96,923	15.7
4	165,440	33.6	115,166	18.7
5	230,832	47.0	335,930	54.4
Total	491,446	100.0	617,313	100.0

Table 2. Species Composition of USSR catches (in metric tons) by Subareas for 1963-64

	1		2		3		4		5		Total	
	1963	1964	1963	1964	1963	1964	1963	1964	1963	1964	1963	1964
Cod	5,053	-	20,833	57,097	40,201	56,464	10,221	10,064	5,350	5,428	81,658	129,053
Haddock	62	-	8	-	372	1,943	3,701	5,499	2,361	5,483	6,504	12,925
Silver hake	-	-	-	-	-	-	123,023	81,147	107,357	167,308	230,380	248,455
Other Gadoids	-	-	-	-	108	1,272	1,443	5,000	3,977	5,558	5,528	11,830
Redfish	868	-	3,808	8,636	19,485	31,339	12,288	3,659	1,086	445	37,535	44,079
Scups	-	-	-	-	-	-	1,946	-	4,632	1,494	6,578	1,494
Herring	-	-	-	-	-	-	2,707	2,472	97,329	130,723	100,036	133,195
Argentine	-	-	-	-	-	-	8,127	4,943	4,210	12,830	12,337	17,773
Flat-fish	35	-	251	1,268	2,056	3,431	631	146	309	59	3,282	4,904
Other fish	284	-	216	2,293	1,534	2,474	1,353	2,236	4,221	6,602	7,608	13,605
Total	6,302	-	25,116	69,294	63,756	96,923	165,440	115,166	230,832	335,930	491,446	617,313

## SUBAREA 1

### A. Status of the Fisheries

In 1964 no regular fishing was conducted by the USSR fishing vessels off West Greenland. The area was visited by exploratory and research vessels which caught only 760 tons of fish for research purposes. Severe ice conditions complicated the operations of these vessels during the spring months.

### B. Special Research Studies

#### I. Environmental Studies

1. Hydrography. Altogether 4 exploratory and research vessels conducted routine hydrological studies and worked 32 standard sections in Davis Strait and on the West Greenland shelf.

In January 1964, the temperature of the 0 - 50 m layer along the West Greenland coast was found to be below zero. Compared with 1963 conditions, the cold water brought by the West Greenland Current was more extensive. Very severe ice conditions were observed in May 1964 along the southwestern coast of Greenland. The temperature of water in the 0 - 50 m layer was 0.6 - 1.2°C lower than in May 1961. However, in the 200 - 500 m layer the water temperature was higher in 1964 than in 1961.

In July-September 1964, a rapid and intense warming of water was observed. The distribution pattern of the warm water of the West Greenland Current was similar to that observed in previous years. Similar to 1961-1963 a stream of relatively cold water with a temperature of 1 - 2°C and salinity of 34.5‰ was observed at 500 - 650 m in the area of the Canada-Greenland Ridge between 58° and 59°E.

In September 1964, the stream of the West Greenland Current was very distinct as usual but the water temperature increased rapidly during the second half of the year and in November was 1.3°C higher than in the same month in 1963.

2. Plankton. Plankton sampling was done by the vessels that conducted hydrological studies. Plankton samples taken from mid-water off West Greenland in September 1964 were characterized by the abundance of Aglantha digitale and small Copepoda. Mature Calanoida were in the near-bottom layers only.

Distribution of Euphausiidae along the coast of West Greenland was studied in January and May. The abundance of Euphausiidae was mainly neritic species such as Thysanoessa inermis and Thysanoessa raschii which were most abundant on Lille Hellefiske, Banan and Fyllas Banks. On Fiskenaes, Danas and Frederikshaab Banks, these species were scarce or absent.

Stable concentrations of Th. raschii were observed on Store Hellefiske Bank.

#### II. Biological Studies

1. Cod. The 3-year-old cod belonging to the rich 1961 year-class, which were 36 to 38 cm long in the first half of the year, were most abundant on Frederikshaab Bank and, in some instances, formed as much as 15% of the number of cod in the catch. On Fyllas, Banan and Lille Hellefiske Banks, they were less abundant and formed about 4 - 11% of the catch. In the second half of the year, the 3-year-old cod reached a length of 50 cm and occurred more often in catches on Fyllas and Banan Banks making up as much as 25 - 30% of the catch.

The 4-year-old cod belonging to the highly abundant 1960 year-class which ranked first in catches kept to more northern areas and were most abundant on Fiskenaes, Fyllas, Banan and Lille Hellefiske Banks. These cod made up 33 - 85% of the catch by number. Mean length of these cod was 46 - 48 cm in the first half of the year and 58 cm in the second half of the year.

The 5-year-old cod belonging to the 1959 year-class (mean length 57 to 61 cm in the first half and 65 cm in the second half of the year) occurred in catches in relatively small numbers, in some cases making up 20% in Div. 1C and 1D. On the average the share of this year-class in catches did not exceed 5-10%.

The same applies to the 6-year-old cod belonging to the 1958 year-class (mean length 64 - 70 cm). The 6-year-olds were most abundant in spring on Frederikshaab Bank. Cod belonging to the rich 1957 year-class which formed the basis of fishery in 1962-63 occurred in considerably smaller numbers.

The 7-year-olds were most abundant in catches (15 to 30%) at the beginning of the year on Banan, Fyllas and Fiskenaes Banks during the period of their spawning migrations through these areas. In May, 7-year-olds made up about 36% by number, of the spawning cod on Frederikshaab Bank. Towards the end of the year (November-December) they were again caught in considerable numbers on the central banks. The mean size of 7-year-olds was 71 - 74 cm in the first half of the year and 79 - 80 cm in the second half of the year. The 8-year-old cod (80 - 88 cm mean length) of the 1956 year-class were of some importance on Frederikshaab Bank in May where they made up 12 to 13% of the catch; on other banks, their numbers were insignificant (2 - 4%). Older age-groups were represented in very small numbers (0.1 to 8%) and mainly in spawning and post-spawning concentrations on the southern banks. On Frederikshaab Bank, cod belonging to the rich 1953 year-class amounted to 7-8%.

In 1964 fishing conditions off West Greenland were less favourable than in 1963. Concentrations of wintering cod in the area of central banks which contributed to a good and stable fishery in the first half of 1963 were, in 1964, less abundant and unstable. Cod belonging to the rich 1956 and 1957 year-classes which formed the basis of the fishery in 1963 were, in 1964, almost all mature and started performing earlier and longer migrations to spawning grounds, which resulted in a shorter winter fishery on Banan and Fyllas Banks. The bulk of young cod of the 1960 and 1961 year-classes which were spending the winter on these banks had not yet reached commercial size and could not contribute to a productive fishery.

The fishery for post-spawning cod in 1964 was hampered due to severe ice conditions.

The cod fishery off West Greenland in the next 2 or 3 years is expected to be good due to the abundant 1960 and 1961 year-classes.

2. Redfish. Investigations were carried out in May and September. In autumn, only individual specimens of young redfish, up to 25 cm long, were caught by trawls with fine-meshed flappers. South of 64°N mid-water trawls caught up to 400 one-summer-old fish from depths of 200 - 300 m.

Serological studies were carried out in the later half of the year in an attempt to extend knowledge on the systematics of the genus Sebastes and to distinguish local stocks.

## SUBAREA 2

A. Status of the Fisheries

Catch in tons						
	Cod	Haddock	Redfish	Flatfish	Other fish	Total
1963	20,833	8	3,808	251	216	25,116
1964	57,097	-	8,636	1,268	2,293	69,294

I. Cod.

In Div. 2J, cod occurred in commercial quantities from January to mid-July and from October to December. Most stable catches were taken during the former period. In Div. 2H, dense cod concentrations were discovered in the latter half of January and, in Div. 2G, in the latter half of February. However, difficult ice conditions prevented the fishery from utilizing commercial cod concentrations in these Div.

The efficiency of the cod fishery by stern trawlers (BMRT) in Div. 2J remained at the 1961-1963 level. The size composition of cod in trawl catches was similar to that in 1963. The bulk of the catches consisted of 45 - 63 cm long fish. Cod belonging to the 1956 and 1957 year-classes were numerically predominant in the catches.

II. Redfish.

The greater part of the redfish catch in the Labrador area was obtained in the spring during the cod fishery when considerable amounts of redfish were caught with cod at depths over 400 m. In October, dense concentrations of Sebastes mentella with about 10% of Sebastes marinus were fished successfully in 300 - 450 m off central Labrador. BMRT catches per hour trawling amounted to 7-8 tons. Males, 38 cm long, with gonads at stages V, VI and VI-II of maturity were dominant. The mean length of females was 38-40 cm.

B. Special Research StudiesI. Environmental Studies.

1. Hydrology and plankton. Altogether five research and exploratory vessels took part in collecting hydrological and hydrobiological material, some of them performing two or three cruises.

Compared with 1963, a slight warming of water masses was observed. However, 1964 remained a moderately cold year. The inflow of cold polar water increased towards summer. The section occupied off Cumberland Peninsula in September showed that the Canadian Polar Current was more intense than anytime during the past four years.

Along the coasts of Baffin Island, mass development of phytoplankton and spawning of Calanoida was observed in September.

II. Biological Studies.

1. Cod. Observations on the distribution of pre-spawning and spawning concentrations of Labrador cod were conducted from May to September. These observations seem to confirm the conclusions reached in 1963 that the main spawning grounds of cod are located in Div. 2G.

Spawning cod also occurred in Div. 2J and 2H. They belonged, mainly, to age-groups younger than those in Div. 2G. The dominant size of mature cod was 54 - 56 cm in Div. 2G and 48 - 50 cm in Div. 2J and 2H.

In March, April and early May, cod eggs were found along the whole length of the edge of the continental slope in Subarea 2. The greatest number of eggs per one vertical haul by egg net was obtained in Div. 2G.

Eggs at the earlier stages of development were dominant.

2. Redfish. Material was collected regularly on size and age composition, feeding and distribution. Observations at depths over 600 m were continued and showed that mature redfish were absent from great depths.

In June 1964, work aimed at studying the structure of the redfish stock in north-western Atlantic was started to confirm the presence or absence of isolated local populations and groups of Labrador-Newfoundland Sebastes mentella.

SUBAREA 3

A. Status of the Fisheries

	Catch in tons						Total
	Cod	Haddock	Other Gadoids	Redfish	Flat-fish	Other fish	
1963	40,201	372	108	19,485	2,056	1,534	63,756
1964	56,464	1,943	1,272	31,339	3,431	2,474	96,923

I. Cod.

Big deep-freeze trawlers fished for cod mainly on Flemish Cap Bank in March and on the northern Newfoundland Bank from February to April. Side trawlers fished on the northern Newfoundland Bank in March and June and on Flemish Cap Bank throughout the entire second half of the year. Redfish were also caught here.

II. Redfish.

Fishing for Sebastes mentella was carried out in late May and in December on Flemish Cap Bank at depths over 500 m. In May, the catch per two hours trawling was 5 tons. The bulk of the catch was composed of 33-35 cm long specimens. Females were in post-spawning condition and were feeding heavily. Main concentrations occurred in feeding areas. In the second half of November, side trawlers operated on the northeastern slope and in the adjacent area of the northern Newfoundland Bank where they fished on fairly dense cod and redfish concentrations. The mean daily catch by a side trawler was 5-7 tons. In December, dense redfish concentrations were located and successfully fished at depths over 500 m on the slopes of Flemish Cap Bank.

B. Special Research Studies

I. Environmental Studies.

1. Hydrology and plankton. Studies conducted by five research and exploratory vessels revealed that there was a slight warming both in Subarea 3 and in Subarea 2 in the first half of 1964. Thus, in the spring of 1964, in the section made along 47°N the mean temperature of the 0 - 100 m layer was 1.14°C higher and that of the 0 - 500 m layer 0.15°C higher than in the spring of 1963.

In January-February 1964, the annual quantitative survey of Euphausiidae was conducted off Labrador and Newfoundland. Oceanic species, Meganyctiphanes norvegica and Thysanoessa longicaudata, were dominant in these areas. Considerable amounts of Th.inermis and Th.raschii were only recorded on Saint Pierre Bank and on the southwestern slope of the Grand Newfoundland Bank. The latter two species were absent from samples taken on Flemish Cap Bank.

## II. Biological Studies.

1. Cod. A young cod survey was carried out in January-March and in December 1964. Samples were taken with a 25 m bottom trawl with a conventional bag and a 6-8 long, 10 mm mesh, cod-end flapper. Specimens up to 35 cm long were only considered.

In February 1964 on the part of the northern Newfoundland Bank surveyed (Div. 3K), the majority of young cod occurred in 200 - 300 m in the frontal zone of mixed waters of Polar and Atlantic origin with temperatures ranging from 2° to 3°C. In January, catches at 300 m contained up to 200 specimens of young cod per hour's trawling. The bulk of the catches contained young cod 24 - 35 cm long. Only single young specimens were taken by trawl at depths over 350 m.

Great numbers of young cod were discovered on the northeastern slope of the Grand Newfoundland Bank (Div. 3L). In February, test fishing revealed that, in this Div. young cod occurred mainly from 150 m - 350 m, in mixed waters with temperatures varying from -1° - 3°C. At 200-350 m, young cod catches per hour trawling were 100 to 200 specimens. Young cod, 26 - 33 cm long, were dominant in the catches.

On Flemish Cap Bank (Div. 3M), single specimens of young cod occurred in catches taken in February. The total number of young cod caught here was considerably lower than in the other areas surveyed. In December, the catch per hour trawling at 145-160 m contained 90 specimens.

On Saint Pierre Bank (Div. 3P) in March, the majority of young cod occurred at 100 - 300 m. The catch per hour trawling at 150 m was sometimes as high as 200 specimens.

On the southwestern and southeastern slopes of the Grand Newfoundland Bank (Div. 3O and 3N), young cod occurred in March in insignificant quantities. In December 1964, a large concentration of young cod was discovered here mainly at depths ranging from 100 - 250 m. Catches per hour trawling were sometimes as high as 250 to 900 specimens. Young cod did not occur in catches taken below 250 m.

In the northern part of Div. 3K, commercial concentrations of cod occurred from January to July. In late June and early July, cod concentrations migrating toward the Newfoundland coast were discovered in the western part of the area. Size composition changed during the course of the year. The dominant length was 55 - 57 cm in January-February, 46 - 48 cm in March, 49 - 51 cm in April-June, 58 - 60 cm in July, 55 - 57 cm in August, 43 - 45 cm in September, 58 - 60 cm in November and 55 - 57 cm in December. These changes in size composition were connected with the spring migration of mature cod to the Labrador area and summer migration back to the coast of Newfoundland. In Div. 3K, cod eggs occurred from March to May. The eggs were at different stages of development, more often at stages III and IV. These eggs appear to have been carried from the northern Labrador area (Div. 2G) and partly from central Labrador (Div. 2H).

2. Haddock. Distribution of young and adult haddock was studied in four areas. A young fish survey was conducted with the help of a trawl with an 8 mm mesh flapper.

In mid-March haddock were scattered over the southern part of Saint Pierre and Green Banks (Div. 3P) and were caught in 140 - 490 m at near-bottom temperatures ranging from -1.2° - 3.3°C. Catches of 0.1-0.2 tons per hour trawling were obtained in 180-250 m at the water temperature from 2.2° - 2.3°C. The bulk of the catch was haddock belonging to 1962 year-class. The largest catch of young fish (450 specimens per hour trawling) was taken on the southern part of Saint Pierre Bank at 150 to 300 m and at 0.5°C. In Division 3O, haddock were also scattered from 100 - 590 m. Water temperature just off the bottom was 0.2° to 3.2°C. Catches of 0.1 - 0.2 tons per hour trawling were taken at 155 - 215 m in temperatures from 1.2° - 1.3°C. Haddock caught (up to 660 specimens per hour trawling) were of the 1962 year-class from 230 - 275 m at 1.4°C, trawl catches were 0.3 tons per hour. The bulk of the catches was made up of haddock belonging to the 1962 and 1961 year-classes. Up to 0.1 tons of mature haddock per hour trawling were caught in 300 - 590 m depths at 3.2°C. In early June, no commercial concentrations were found on the shallows of Div. 3N. In early October, trawl catches of up to 0.3 tons per hour were made on the southern part of Saint Pierre and Green Banks at 110 to 185 m. The bulk

of the catch consisted of 1961 and 1962 year-classes. No commercial concentrations were found in Div. 3N. In mid-December, 55<sup>4</sup> haddock of the 1964 year-class were taken after an hour's trawling in the western part of Saint Pierre (Div. 3P) at 85 to 150 m depth and 0.1°C.

Larger haddock were dispersed along the edge of the bank slopes at the bottom temperatures of 2 - 4°C. The bulk of the catch consisted of the 1962 year-class.

On the southwestern and southern slopes of the Grand Bank (Div. 3O and 3N), haddock were at 100 to 240 m in 2° - 3°C. The best trawl catches of 0.2 - 0.3 tons per hour were made at 100 m and 2°C and at 180 - 240 m and 1.4°C.

The bulk of the catch was made up of the 1962 and 1961 year-classes. Individual specimens of the 1964 year-class were caught.

#### SUBAREA 4

##### A. Status of the Fisheries

	Catch in tons						
	Cod	Haddock	Silver hake	Other gadoids	Redfish	Scups	Herring
1963	10,221	3,701	123,023	1,443	12,228	1,946	2,707
1964	10,064	5,499	81,147	5,000	3,659	-	2,472

  

	Argentine	Flatfish	Other fish	Total
1963	8,127	631	1,353	165,440
1964	4,943	146	2,236	115,116

##### I. Silver hake.

As in 1963, the main fishery in Subarea 4 was for silver hake. A decline in the 1964 catch may be attributed to conditions less favourable for fishing than in 1963.

In 1963, trawlers were able to fish for silver hake throughout the year. In 1964, hake concentrations were only observed from late February to the second half of September. The concentrations were unstable and the trawlers often had to start searching for concentrations. The absence of hake concentrations in the winter of 1964 from areas where they occurred in previous years seems to be accounted for by a drop in the temperature of water on the Nova Scotian shelf. Thus, in the winter of 1962-1963, the temperature in the off-bottom layer in the depression between Sambro and Emerald Banks, where dense hake concentrations were observed, was between 5.5° and 7.8°C; at the same period in 1963, it never rose above 6°C. In early February BMRT-type vessels were fishing for hake on the slopes of La Have Bank. In March BMRT-type trawlers were fishing successfully on the slopes of Sambro Bank. Trawl catches per hour ranged from 2 - 4 tons and contained up to 5% of argentine. In May some vessels were fishing on the edge of the slopes off Sable Island. The average trawl catch was 3.2 tons per hour. In June, the density of hake concentrations decreased and trawl catches did not exceed 3 tons per hour. In July-August, successful fishing was carried out in the Nova Scotian gut at 80 - 180 m and, in September, on the shallows of Sable Island. In late September there was a sharp drop in hake catches and in October-November, contrary to the previous year, no commercial concentrations were discovered in the area of Sable Island.

The by-catch of the hake fishery in Subarea 4 consisted of cod, redfish, haddock and argentine.

B. Special Research StudiesI. Environmental Studies.

1. Hydrography. Hydrological investigations were carried out from research-exploratory vessels. A total of 5 cruises was made to Subareas 4 and 5. Investigations were conducted both in standard sections and in areas of commercial concentrations of fish.

In 1964, the Nova Scotian shelf and Georges Bank were characterised by a considerable drop in water temperature as compared to 1962-63. This may be explained by a stronger influence of cold Labrador water and a weaker intrusion of warm Atlantic water. The average temperature in the mid-water and near-bottom layers was everywhere 2°- 3°C lower than in the previous year and in some areas (the Eastern Channel) as much as 5°C lower. The greatest decline in temperature was observed in April and May. A decline in water temperature which started in 1963 continued up to May 1964. From May to August, a considerable warming of lower water layers from 2.8°- 4.5°C to 6.5°-6.9°C was observed. Later the temperature was not stable, it was higher in the Eastern Channel and lower on the southeastern slopes of Georges Bank and the Nova Scotian Shelf. Towards the end of 1964, the mean temperature of the mid-water and near-bottom layers in the area of the Nova Scotian shelf and Georges Bank reached the level observed at the end of 1963.

II. Biological Studies.

1. Silver hake. In 1964, observations were continued on the size and age composition of the catches. As in 1963, scales were used for age reading. Some otoliths were also collected for comparison. A comparison of the results of age readings by scales and by otoliths showed that neither method is more advantageous. Difficulties in age determinations were experienced in both cases.

In 1964 the bulk of the catch was made up of 3- and 4-year-olds; the number of 5-year-old and older fish was insignificant. In July 3-year-olds made up 48.3% of the catch, 4-year-olds 40.6%, while 5-year-olds belonging to the 1959 year-class only 2.7%. In August, the percentages were 54.4, 31.3 and 7.7 respectively. The size composition of catches did not change much from the 1963 composition and ranged between 25 and 35 cm (mean length 30 cm). The bulk of the catch was made up of 3-year-old males and 4-year-old females which had attained sexual maturity for the first time. The number of 5-year-olds in the catches was insignificant due to the high natural mortality of hake at this age.

## SUBAREA 5

A. Status of the Fisheries

	Catch in tons						
	Cod	Haddock	Silver hake	Other Gadoids	Redfish	Scups	Herring
1963	5,350	2,361	107,357	3,977	1,086	4,632	97,329
1964	5,428	5,483	167,308	5,558	445	1,494	130,723

  

	Argentine	Flatfish	Other fish	Total
1963	4,210	309	4,221	230,832
1964	12,830	59	6,602	335,930

I. Silver hake.

In 1964, the USSR silver hake catch from Subarea 5 increased from that in 1963 and the fishery was conducted not only in summer but in winter and spring as well.

In January, BMRT-type vessels fished on hake concentrations in 150 - 300 m north of Georges Bank. The average catch per hour trawling was 3.3 tons. Better catches were made during the night hours. During the third ten-day period of February, the catches obtained in the day time were dominated by argentine and the day-time catches were greater than those taken at night. Toward the end of March, dense hake concentrations were discovered on the southwestern slopes of Georges Bank. From late March to late April, BMRT-type trawlers fished successfully in depths ranging from 180 - 280 m. The average catch per hour trawling was 4.2 tons in March and 4.6 tons in April. In May, there was a drop in catches. Catches obtained in June were comparatively low. The mean catch per hour trawling by BMRT-type vessels was 2.9 tons in May and in June. The decline in hake catches observed in May and in June seems to have been caused by the unfavourable hydrological conditions.

In 1962-1963, spawning concentrations of hake were observed on the southern slopes of Georges Bank in areas with near-bottom temperatures of 10° - 12°C. In 1964, the temperature of the near-bottom layers on the southern slopes of Georges Bank was only 6° - 7°C. Spawning concentrations were unstable and scattered over a large area along the edge of the continental slope. The temperature of 6° - 7°C was apparently not high enough for the formation of stable concentrations of spawning hake. The 1964 spawning was extended over a longer period of time than in 1962-1963. With a rise in temperature to 10°-11°C in July, hake concentrations became comparatively more dense and trawl catches amounted to 2.5-4.0 tons per hour.

In August and September some of the vessels started fishing for hake on the northwestern slopes of Georges Bank. Along with hake they caught some herring and haddock. In October-November, hake concentrations were poor.

## II. Herring

The increase in herring catches in 1964 was due to higher abundance resulting from the recruitment of the relatively rich 1960 year-class into the fishable stock.

In winter and in March, herring were fished on the northwestern and southern slopes of Georges Bank. Herring were fished intensively from May to early October. In May-June, trawl catches per hour by SRT-R-and SRT-type vessels were 0.7 - 0.9 tons. In August when herring concentrated on the northern slopes of Georges Bank and on the Bank itself, trawl catches increased to 1.5 tons per hour. During the pre-spawning and spawning period in September and early October, herring formed abundant concentrations in the northern part of Georges Bank at 40-50 m. SRT-and SRT-R-type vessels obtained high trawl catches per hour (average 10 tons)

After spawning, in October herring moved away from Georges Bank and fishing operations were terminated.

### B. Special Research Studies

#### I. Environmental Studies.

1. Zooplankton. In 1964, zooplankton samples were collected from the exploratory vessels at standard stations in March, May, August and October. Additional samples were taken on the slopes of Georges Bank in June and September. In all cases the entire depth from the bottom to the surface was sampled. A total of 567 samples was taken.

Analysis of the material collected suggests that, during the spring period, the abundance of plankton on Georges Bank was, on the whole, higher in 1964 than in 1963.

In 1964, two breeding periods for Calanus finmarchicus were observed: in February-March and in July-September.

The specific composition of zooplankton was poorer in 1964 than in 1963 due to lower temperatures.

2. Ichthyoplankton. In August 1964, ichthyoplankton was sampled on the hake spawning grounds in the southern part of Georges Bank.

Observations showed that, from 13-18 August, all samples taken on the southern slope contained hake eggs. In the 0 - 50 m layer, one cubic metre contained 1.1 - 30.4 eggs. Small numbers of eggs were encountered on the southeastern slopes. From 19-25 September, samples contained single larva of silver hake.

## II. Biological Studies.

1. Silver hake. In 1964 observations were continued on the size and age composition of the hake catches. Analyses of size and age composition of commercial and test catches seem to have confirmed the previous year's conclusions that the bulk of the catch consists of 3- and 4-year-old hake. The share of the 3-year-old fish (1961 year-class) was 31.8% in April, 33.3% in May, 45.4% in June, 54.3% in July and 44.1% in August.

The percentage of 4-year-olds was 52.3, 48.5, 40.6, 35.4 and 41.6 respectively. The average percentage of hake aged 5 full years and older for this period was only 11.0%. Males were predominant among the 3-year-olds but females among the 4-year-old fish.

Thus, observations conducted in 1964 seem to confirm that hake over 4 years of age are subject to high natural mortality.

Hake were tagged on Georges Bank from 18-28 August at 41°37'N and 68°18'W. Altogether 5,200 fish were tagged. Hake for tagging were taken from trawl catches. A total of 55 tags have been returned. However, since most of the tags have been returned by the consumers, it is difficult to say where the tagged fish were caught.

2. Herring. In 1964, observations on the age composition of catches revealed that, in January, herring belonging to the 1961 and 1960 year-classes were predominant in the catches (32.6% and 24.0% respectively). In March and April, catches were dominated by older herring belonging to the 1957 (up to 53.0%) and the 1956 (up to 37.3%) year-classes. In June, there was an increase in the percentage of herring of the 1959 and 1958 year-classes.

From July to October, when the main part of the herring stock was concentrated on the northern slopes of Georges Bank, the 1960 year-class was dominant (47.9% in July, 46.0% in August and 34.3% in September). Samples taken in July-September seem to give the most representative picture of the age composition of Georges Bank herring. The bulk of the catch is obtained at this time. Data on age composition seem to suggest that the 1960 and 1961 year-classes will predominate in the 1965 catches. The commercial herring stock is expected to increase somewhat from that in 1964.

In September and early October, the northern slopes of Georges Bank were surveyed to find out the areas, time and conditions of spawning and the numbers of eggs laid in order to be able to estimate the absolute abundance of the herring spawning population.

Four surveys were performed in the areas of pre-spawning and spawning herring concentrations. Egg samples were taken at stations with the "Ocean-50" bottom sampler (0.25 m<sup>2</sup>). At the same time, observations were made on the biological condition and distribution of herring and on the hydrological conditions in spawning areas. No eggs were taken during the first three surveys (4-5 September, 16-17 September and 27-28 September). The fourth survey (5 October) made after mass spawning from September 29 to October 4 resulted in masses of eggs being discovered over an area of about 50 km<sup>2</sup>. Of the 25 stations sampled eggs were taken at 10.

Eggs were deposited in several rows in a continuous 0.5 to 4 cm thick layer on pebble, gravel and shelly grounds in waters with temperatures ranging from 6° - 12°C. At all stations sampled, eggs were at the stage of larval formation (mainly at the stage of formation of head capsule). Individual dead eggs were discovered.