INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES

REDBOOK 1970 PART II

REPORTS ON RESEARCHES IN THE ICNAF AREA IN 1969

(from Serial Numbers 2357, 2367, 2384, 2385, 2386, 2390, 2392, 2397, 2401, 2402, 2405)

Note

REDBOOK 1970 appears in 3 books. The first book contains Part I, Proceedings of the Standing Committee on Research and Statistics. The second book contains Part II, Reports on Researches in the ICNAF Area in 1969. The third book contains Part III, Selected Papers from the 1970 Annual Meeting.

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Issued from the Headquarters of the Commission

Dartmouth, N.S., Canada

1970

PART II. REPORTS ON RESEARCHES IN THE ICNAF AREA IN 1969

CONTENTS

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I. Canadian Research Report, 1969

A. Subareas 1, 2 and 3
by W. Templeman

The St. John's Biological Station of the Fisheries Research Board of Canada engaged in fisheries and oceanographic researches in Subareas 1, 2 and 3. The Atlantic Oceanographic Laboratory of the Bedford Institute and the Marine Ecology Laboratory of the Fisheries Research Board of Canada at Dartmouth carried out oceanographical researches in Subarea 3. The Arctic Biological Station of the Fisheries Research Board of Canada in Ste. Anne de Bellevue studied the harp and hood seals and whales in Subareas 2 and 3.

The landings data for 1969 for Canada were not available at the time this document was being prepared and any landings data used are preliminary and for Newfoundland only and are only approximately similar to the data which will be reported to ICNAF in May-June.

Subarea 1

A. Status of the Fisheries

As far as I know at the present time, there was no Canadian fishery in this subarea.

II. Biological Studies

1. Atlantic salmon, *Salmo salar* L. In the Labrador Sea - West Greenland area (2 September-10 October) 627 salmon were caught and 385 tagged. Most of the work was done in Disko Bay (about 69°10'N, 52°30'W). The lower ratio of fish tagged to fish caught relative to the Port aux Basques salmon tagging experiment, discussed later, was probably due to a combination of factors, including unfavourable weather, great amount of gear used (longer time to patrol the nets) and great susceptibility of salmon to injury during this time of the year. Recaptures to 31 December 1969 totalled 14, of which 13 were from West Greenland and 1 from northeast Newfoundland. The latter is the fifth Canadian recapture of a Greenland-tagged salmon, and the first such recapture in the year of tagging; all others being in the following year.

Size and age distributions were derived from 616 salmon from the Godthaab shore net fishery in 1968, and 627 fish taken by research vessel drift nets in 1969. In each year fish which had completed 1 year of sea life accounted for 96% of the samples, the balance being fish of 2 sea years and previous spawners. Fish of smolt ages 2 and 3 accounted for 75% of the 1968 sample and 80% of the 1969 sample; salmon of smolt age 2 were more numerous in 1968.

Average size at capture of 1-sea-year salmon declined with increase in smolt age. Overall average sizes for 1-sea-year fish and for all fish were greater in 1969 than in 1968 (average fork length for all fish sampled was 64.1 cm in 1968 and 67.0 cm in 1969). This was also true for each smolt class within the 1-sea-year group.

So far, 242 salmon caught off West Greenland have been analysed electrophoretically and classified according to 3 independent protein systems where qualitative differences are known to occur between North American and European salmon. The usefulness of these systems and their hereditary basis were evaluated in cooperation with the Swedish Salmon Research Institute in the years 1965-1967. Two of the systems are located in the blood serum and consist of (1) a migration difference for one of the transferrin bands and (2) qualitative differences in the band pattern of the slow $alpha_2$-globulins. These systems are visualized by employing different buffer systems. The third difference, which proved reliable in only about 20% of the cases, is a slight but significant difference in the liver esterase zymograms. Evidently the enzymatic activity in the liver is correlated with type of diet or other environmentally controlled variation which is absent in young salmon reared under laboratory control.

The results of this investigation indicate that North American salmon make up 43% of the salmon stocks off West Greenland (most of the material was collected over a 10-day period in Disko Bay). However, this figure may vary considerably due to seasonal and annual fluctuations in stock composition. No apparent schooling of fish from the two continents could be detected, the salmon being distributed at random in the nets. A sample of 17 salmon caught in the south Labrador Sea roughly halfway between Cape Farewell and Labrador contained 11 (65%) fish of European origin.

The results of this investigation are substantiated by examination of mean smolt ages from scale readings where it was found that the means were significantly different between salmon classified as American and European, respectively. Also, a sample of tagged American salmon caught in Greenland waters was similar to those classified as American fish according to protein analysis. The higher mean smolt age in American fish verifies earlier results.

Further support to the protein studies was obtained from a comparison of the mean length of the fish, that of European fish being significantly higher. It was indicated that abundance and intensity of infestation of certain internal parasites were significantly different between the two samples.

Studies to determine if parasites might be useful to separate stocks of salmon caught on the high seas continued in 1969. Work as confined to parasites which earlier studies had indicated might be useful as biological tags. Emphasis was placed on the geographic distribution and abundance of the larval nematode *Anisakis* sp. and the adult tapeworm *Eubothrium crassum*. Two

other species which also showed some promise, the tapeworm larvae *Hepatoxylon trichiuri* and *Tentacularia coryphaenae*, were very rare in salmon in 1969 and were omitted from the studies. A total of 1,426 adult salmon from 10 sampling stations, collected in the fall of 1968 and throughout 1969, was examined in 1969.

Studies on apparent differences in fluorescence characteristics of *Anisakis* larvae from Canadian and European fish continued. Specimens from the west coast of Scotland and the North Sea exhibited characteristics previously attributed only to North American *Anisakis*. This finding is consistent with biochemical studies which have shown that *Anisakis* larvae in salmon from both sides of the Atlantic belong to the same species.

Biochemically identified North American salmon in Greenland, 1969, contained significantly less *Anisakis* larvae than did biochemically identified European salmon. The former contained an average of 4.5 larvae per host while the latter contained 7.1 larvae. Similarly, the incidence of *E. crassum* was higher in North American salmon (23.8%) than in European salmon (13.4%). The abundance of *Anisakis* larvae and *E. crassum* in biochemically identified North American salmon conformed with their abundance in salmon tagged in Canada and caught in Greenland in 1969. These studies support biochemical techniques for identifying North American and European Atlantic salmon on the high seas and indicate that these parasites warrant further investigation.

In 1969 the intensity of infestation of *Anisakis* in Canadian stocks varied from 2.75 per host(East shore, Bay of Fundy) to 7.75 per host (Pack's Harbour, Labrador). Similar variations were observed in the 1968 data. With documentation of the abundance of *Anisakis* in North American salmon stocks in Greenland, identification of stocks which have been to Greenland seems possible. Preliminary analyses indicate that salmon caught in the Miramichi and Chaleur Bay areas harbour *Anisakis* populations very similar to those in North American salmon caught in West Greenland. Preliminary conclusions on data from stocks in the Bay of Fundy and Newfoundland areas await results of age determinations.

In the two years 1968-69 there was no change in the mean abundance of *Anisakis* in mixed populations of salmon in West Greenland. In 1968 there were 5.96 per host; in 1969, 5.97 per host. However, considerable annual variation in the abundance of *E. crassum* in Greenland is evident (17-55% infested).

In 1969 ultraviolet light was used for the first time during routine examination of Atlantic salmon viscera for *Anisakis* larvae. The technique, which causes the nematodes to fluoresce brightly, was formerly used by other workers to find parasitic nematodes in fish muscles. It was compared with standard searching procedures for *Anisakis* and found to be superior. Practically all larvae were found within the first six minutes of searching with ultraviolet light but a maximum estimate of only 26% of the larvae present were found during the same period with visible light illumination. Qualitative differences in fluorescence characteristics of different species of nematodes greatly simplified preliminary identification of the parasites. Of the two species commonly found in Atlantic salmon, *Anisakis* sp. fluoresced a brilliant bluish-white but

Contracaecum aduncum larvae and adults fluoresced pale to bright yellow.

III. Gear and Selectivity Studies

Surface gillnets of different mesh sizes were fished at West Greenland and at Port aux Basques in Subarea 3. These were mainly of Ulstron twine, but some monofilament nets of 152-mm mesh were also used in each area. Highest catch rates at Port aux Basques were obtained with 114-mm and 133-mm Ulstron nets (other mesh sizes were 152 and 165 mm) and the 152-mm monofilament nets (about 2.4 salmon per mile of net per hour fished during the period 22 May-10 June). At West Greenland the monofilament nets outfished the best Ulstron nets (127 mm) by a ratio of 2.2:1. During a 10-day period of fishing in Disko Bay, catches by monofilament nets averaged 3.7 salmon per mile of net per hour fished.

Monofilament nets appeared to produce more viable fish for tagging. Condition ratings assigned as fish were being tagged in each area were higher on the average for monofilament nets than for Ulstron nets. From the fish tagged at Port aux Basques from Ulstron nets, the return was 33%; the return from monofilament nets was 47%.

Subarea 2

A. Status of the Fisheries

I. Cod, *Gadus morhus* L.

The Newfoundland-Labrador inshore cod fishery was a failure, producing only 4,200 tons compared with 17,900 in 1968 and 27,700 in 1967. This was due to lack of fish and not to lack of effort. The mean length of cod sampled in the coastal fishery of 2J decreased in the July and August samplings from 59 and 58 cm in 1960-64 to 56 and 53 cm in 1965-69.

B. Special Research Studies

I. Environmental Studies

1. Hydrographic Studies. The standard section off Seal Island in southern Labrador was occupied in early August for the first time since 1965. See the research document on hydrography of the Newfoundland area for details. (ICNAF *Redbook* 1970, Pt.III).

II. Biological Studies

1. Cod. The inshore Labrador cod landings were sampled at 2 localities in 2H and 3 in 2J in July-August. Thirty-six hundred and sixty cod were measured and 940 otolithed. Biological studies on cod and collection of statistics in selected areas were continued.

2. Harp seal. *Pagophilus groenlandicus* (Erxleben). Ice was almost completely absent in early March in the normal whelping areas of harp seals off southern Labrador, northeastern Newfoundland and in the southern part of the Gulf of St. Lawrence. Seals in Subarea 2 whelped near George's Island in Hamilton Inlet. There is strong evidence that a large percentage of seals moved from Subarea 4 to Subarea 2 to find ice for whelping.

Subarea 3

A. Status of the Fisheries

I. Cod

Canadian landings in Subarea 3 were not available when this report was written and only general accounts of the status of the fisheries can be given.

On the northern part of the northeast coast of Newfoundland in 3K the cod fishery was a failure as it was in Labrador. Many cod from this area spawn on the outer slopes of Hamilton Inlet Bank with the Labrador cod.

In 3L the yields of cod from traps and handlines were generally high during the summer and resulting landings were higher than for several preceding years. As occurred in 1968, for the remainder of the season yields from line gears were low because stormy weather prevented regular fishing, and non-appearance of squid in the coastal areas caused a shortage of bait for the fisheries.

On the east coast generally through new construction an increasing proportion of the inshore fleet is becoming more mobile and versatile in operating, and increased amounts of other groundfish species (Greenland halibut, plaice, witch and wolffish) are being landed in the longline and gillnet fisheries.

In 3Ps the inshore fishery was about at the same level as in 1968.

II. Haddock, *Melanogrammus aeglefinus* L.

Newfoundland haddock landings at about 2,450 tons, probably mainly from 3P, almost doubled the previous year's catch but were still at a very low level.

III. Redfish, *Sebastes mentella* Travin and *Sebastes marinus* (L)

Newfoundland redfish landings from Subareas 4 and 3 increased by about 4,000 tons to 32,000 tons. Most of this catch was from 4R.

IV. American plaice, *Hippoglossoides platessoides* (Fabricius); Witch flounder, *Glyptocephalus cynoglossus* (L.); Yellowtail flounder, *Limanda ferruginea* (Storer) and Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum).

Newfoundland landings of American plaice almost all from Subarea 3 increased by 15,000 tons to 67,000 tons. This was due to increased effort. On the Grand Bank catch per effort of Newfoundland trawlers engaged in the fishery for American plaice in terms of kilograms per hour's fishing fell from 851 kg in 1956 to 499 kg in 1968.

Yellowtail flounder landings rose from 4,400 to 6,000 tons and witch flounder landings fell slightly from 6,700 to 6,100 tons. An analysis of research vessel and commercial catches indicates an apparent increase in abundance of yellowtails on the Grand Bank since 1961-62. This is coincident with a reduction in the haddock population but the relation between the two is uncertain.

Greenland halibut landings, mainly from the deep bays of the east coast of Newfoundland and almost all from Subarea 3, fell from 13,400 to 12,000 tons as the rich fishing ground of Trinity Bay became relatively unproductive because of overfishing by gillnets.

A further decrease is evident in the average catch of Greenland halibut per gillnet in Trinity Bay from 41 kg in 1968 to 23 kg in 1969.

Also, there was a decrease in the average catch of Greenland halibut per gillnet in Bonavista Bay from 53 kg in 1968 to 21 kg in 1969.

The average length of Greenland halibut caught in commercial gillnets in Trinity Bay has decreased since 1966; the average for males caught decreased from 59.1 cm in 1966 to 56.2 cm in 1969; the average for females decreased from 62.2 cm to 59.8 cm in the same period.

Most of the Greenland halibut fishery during 1969 was carried out in Notre Dame Bay and vicinity.

V. Herring, *Clupea harengus* L.

Herring landings in Newfoundland almost all from Subarea 3 rose by about 28,000 tons to 168,000 tons. Most was taken in winter-spring and was the result of increased effort.

In the autumn of 1969, despite a substantial increase in the number of seiners, the herring fishery had a slow start both at Magdalen Islands in November and subsequently along the south coast of Newfoundland. Landings for July-December 1969 totalled 51,000 tons compared with 60,000 tons in October-December 1968. Unusually high water temperature conditions which

prevailed throughout the fishing areas to the end of December undoubtedly inhibited the concentration of herring into schools and their movement into the fjords where they can be fished more readily by seiners than offshore.

VI. Atlantic salmon

Newfoundland landings of Atlantic salmon from the commercial fishery (total of Subareas 2, 3 and 4), at 1,440 tons were the same as those of 1968.

VII. Capelin, *Mallotus villosus* (Muller)

Newfoundland landings of capelin of 3,300 tons and mainly from Subarea 3 were at the same level as in 1968.

VIII. Short-finned squid. *Illex illecebrosus* LeSueur

Squid were again extremely scarce as in 1968 with only 22 tons being recorded.

B. Special Research Studies

I. Environmental Studies

1. Hydrographic Studies. The five standard sections across the continental shelf and Labrador Current which, apart from the St.John's-Flemish Cap section had not been taken since 1965, were occupied again at the usual times in July-August using the Department of Fisheries and Forestry vessel, Cape Freels. The results of these sections are presented in a separate document (Res.Doc.70/36).

During the 1965-66 season 13 hydrographic stations were established about 5-10 nautical miles offshore along the south coast from Fortune Bay to Port aux Basques to observe the seasonal pattern of surface to bottom water temperatures and its relationship to the distribution and availability of herring along the coast. The stations were occupied in February and March 1966 and not again until the autumn of 1968. Subsequently the stations were occupied periodically between October and February by the *Investigator II*.

Normally,water temperatures in late November and early December range between 3 and 4°C in the upper 80 m, decreasing to about 1.5°C at 140 m and increasing to about 4°C at 220 m. By January temperatures range between 1.5 and 2°C from the surface to 140 m and increase to 4 to 5°C at 220 m.

During November and December water temperatures ranged from 5 to 6°C in the upper 90 m, decreased to 1.5 to 2.0°C at 140 m, and increased to the usual 4 to 5°C at 220 m. These unusually high late autumn and early winter water temperatures long the south coast probably caused the herring

to remain outside the fjords and thus made it more difficult for seiners to locate and catch them.

In conjunction with the geologists a north-south oceanographic section across the Newfoundland Basin and running south into the Sargasso Sea was occupied using the Bathysonde. This line was chosen because it crossed several different water masses which will enable correlation to be made between the water masses and data on plankton distribution in the water and sediments collected by geologists.

2. Plankton Studies. Plankton surveys were carried out in Cabot Strait, on St. Pierre Bank and along the south coast of Newfoundland as part of a program aimed at establishing where the various components of our coastal zooplankton originate.

3. Other Environmental Studies. The general navigational charting program of AOL along the east coast of Newfoundland was continued. The Sir Charles Hamilton Sound Survey was completed in 1969. Charting of the eastern approaches to Fogo Island was continued.

II. Biological Studies

1. Cod. The commercial fishery for cod, both inshore and offshore was sampled in important Newfoundland fishing ports. Information was gathered on size, age, growth, sexual maturity, spawning, food, location of catch, and catch per unit effort.

In the inshore cod of 3L, recruitment to the fisheries has been fairly regular for the past few years although there are some regional differences in the contribution of the year-classes. Traps first catch the faster-growing 4-year-olds. These (1965 year-class) were strongly represented in trap catches at St. John's but were not numerous in other areas. Most of the cod caught by traps in areas studied were of the 1964 year-class, which was dominant in handline catches and present as smaller fish in the longline catches. Longline and gillnet catches were dominated by fish of the 1961 and 1962 year-classes.

Increased catches in traps during 1969 are attributed in part to growth of fish of the 1964 year-class, large quantities of which were discarded as undersized in 1968.

A cruise of the *A.T. Cameron* to the Avalon Channel-northern Grand Bank, 20-29 October (using a No.41-Yankee otter-trawl with a 24.1 m headline) investigated the abundance of cod in this area before the survivors of the inshore fishery were forced by cooling coastal waters to retreat to neighbouring offshore deepwater areas. Sets were made on lines of fishing stations in depths generally ranging from 75 to 230 m, and extending from the northern edge of the 90-m plateau of the Grand Bank, across the Avalon Channel and over the northern edge of the bank. No concentrations of cod were found at

any depths. The only catches over 230 kg per 30-minute haul were one of 270 kg in 200 m (-1.1°C) and another of 380 kg in 255 m (-0.3°C) on the slopes off Trinity Bay. No age-group was particularly strong.

During March a cruise of the *A.T. Cameron* was made to St. Pierre Bank to determine the abundance of young cod. Average catches were 220 and 266 fish per 30-minute drag on two lines on the northern part and 281 and 118 fish per 30-minute drag on two lines on the southern part. The 1967 year-class was not abundant.

In two cruises of the *A.T. Cameron* to the eastern part of the Grand Bank (ICNAF Div.3N) in May and June, cod of the 1966 year-class (3-year-olds), with peaks at 39-44 cm in the length frequencies, dominated the catches. Best catches per 30-minute drag were obtained in 230 m (1,455 fish, 1,700 kg) on the earlier cruise and in 180 m (3,187 fish, 1,900 kg) on the later cruise. Catches of 2-year-old fish were small.

During a cruise to Divs. 3N and 3O in November, catches of all sizes of cod were extremely low. In Div. 3N in a total of 11 sets on two lines, the best catch was 248 fish (150 kg) per 30-minute drag in 275 m, and in Div.3O the best catch was 17 fish (23 kg) per 30-minute drag in 75 m in a total of 12 sets. Cod with peaks in the length frequency at 33-35 and 42-44 cm (2- and 3-year olds) dominated the catches. Catches of 1- and 2-year-olds were small indicating that the 1967 and 1968 year-classes are probably not good.

Mesh assessments on cod from ICNAF Div.2J using data from 1964-68 indicated long-term gains of only 6% or less to the otter-trawl landings with increases from 114 up to 140 mm mesh unless M was as low as 0.10 which is unlikely.

An assessment of changes in cod landings which would have occurred off eastern Newfoundland (ICNAF Divs. 3K and 3L) during the period 1964-68, if increases in the mesh size of otter-trawl codends had been made, has been completed. The current codend mesh size in use is 114 mm. If the mesh size had been increased, there would have been immediate losses to the otter-trawl fishery, but long-term changes would have been beneficial to all sections of the fishery, including the otter-trawl fishery. If the instantaneous natural mortality had been as high as 0.30, the optimum mesh size for the otter-trawl fishery would have been 140 mm, but for the fishery as a whole, the optimum size would have been 152 mm. If the instantaneous natural mortality had been 0.20 or lower, the optimum mesh size for all sections of the fishery, including the otter-trawl fishery, would have been 152 mm.

For Divs. 3N and 3O, long-term gains in landings with increases from 110-mm to 140- and to 152-mm mesh were predicted for both 1959-62 and 1963-66. Immediate losses were 10-13%.

For Div. 3Ps significant long-term gains to the total landings during 1964-68 were predicted even at 152-mm mesh (9-30%) whereas for otter-trawl landings significant gains would only have been realized if M had been between 0.20 and 0.30. Immediate losses ranged from 5 to 24%.

2. Haddock. During November, haddock were found to be extremely scarce on the southwestern slope of the Grand Bank. In 12 thirty-minute otter-trawl sets of the *A.T. Cameron* only 54 haddock were caught, all of them being large commercial size. Indications are that survival from the 1967 and 1968 year-classes is extremely low and no commercial fishery is possible for the near future at least.

Haddock of the 1966 year-class, with length-frequency peaks at 34-35 cm and 40-41 cm, on two lines on the southern part of St. Pierre Bank, comprised almost the entire research vessel catch of haddock in March. The 1966 year-class was much less abundant on the northern part of the bank, catches being 36 and 87 fish per 30-minute drag on two separate lines as compared with 209 and 376 fish per 30-minute drag on two lines on the southern part. The 1967 and 1968 year-classes seem to be almost complete failures.

3. Redfish. An echo-sounder survey accompanied by baited handline fishing revealed large numbers of redfish, *Sebastes mentella*, almost continuously distributed from a position approximately midway between Labrador and Greenland to the Labrador continental shelf. An attempt at using vertical longlines with herring and capelin for bait (a total of 8 lines extending from the surface to 550 m over water greater than 2,700 m in depth) was not successful and only one redfish was taken at a depth of about 275 m. However, handlines baited with herring, capelin or myctophid lanternfishes proved very successful at catching the redfish and on one occasion 5 redfish were taken on the 6 hooks of the line. These redfish were usually within the 140-275 m depth zone and continued to appear at these depths on the echo sounder and to be caught at these depths even when the ship was over the shelf at a depth of 550 m quite close to the position where previously we had fished a No.41.5 otter trawl on the bottom.

In an *A.T. Cameron* trip from Newfoundland to Greenland and back in September and October an echo-sounder survey was carried out to examine the extent of the pelagic population of redfish. The echo sounder was run practically continuously over both the outward and inward tracks and showed recordings exactly similar to those obtained in the August trip to the Labrador Sea when the recordings were confirmed as redfish by handline fishing on at least seven different occasions. In addition, on one occasion on the outward trip to Greenland, handline fishing confirmed the recordings as redfish.

These results indicate that in areas off Labrador and on the northeast Newfoundland Shelf the pelagic population is not spacially discrete from those redfish which inhabit the edge of the coastal banks and which are the basis for the commercial redfish fishery. With redfish undertaking the

vertical movements that they are known to make both diurnally and seasonally, it is difficult to escape the conclusion that the pelagic stocks are mixing with the bank-dwelling stock. The extent of this mixing and the possibility of replacement of the slope stock by individuals from the pelagic stock assumes importance.

4. American plaice. Comparison of the growth curves for 1953-56 and 1965-68 of American plaice landed by commercial trawls indicates, on the average, an increase in the size at age of about 5-6 cm for the northern half of the Grand Bank and 8-9 cm for the more southerly areas of the bank. These increases would seem to indicate negative correlation between the rate of growth and the population size or density. The catch per effort by Newfoundland trawlers of American plaice on the Grand Bank in 1968 was only about 60% that of 1956, indicating a considerable decrease in the standing stock of American plaice. Additionally, there probably has been a reduction in the size of the cod population along the seaward slope of the bank because of the big increase in the total effort for that area. Plaice and cod both feed on capelin and sand launce at certain periods of the year so that a reduction in both the numbers of plaice and cod reduces competition for these two items of food.

5. Greenland halibut. A gillnet survey using 155-mm, 178-mm and 203-mm monofilament gillnets was conducted in Fortune and Hermitage bays and Bay D'Espoir during September 1969. No catches of commercial amounts were obtained in any of the three bays, the largest catch being 130 kg from 9 gillnets in a depth of 480-490 m and bottom temperature of 0.60°C in Fortune Bay.

Two hundred and thirty-eight Greenland halibut were tagged in White Bay during October 1969. One return from Notre Dame Bay indicated that this fish had migrated about 75 nautical miles in a period of 2 months.

6. Herring. Investigations to elucidate the size, distribution and migratory pattern of the herring stocks which contribute to the autumn and winter purse-seine fishery were intensified in 1969. Efforts were continued to improve the collection of information on area of capture through log book records and port interviews of seiner captains. Sampling of seiner landings was carried out at Harbour Breton and Isle aux Morts. About 8,000 specimens were examined for length, weight, sex, maturity, nematodes and meristics, and the otoliths taken for age determinations. Length, sex and maturity were recorded for an additional 3,000 herring.

Age determinations are as yet incomplete, but length composition data for 1968-69 from the area between Port aux Basques and Hermitage Bay reveal that the mode was at 33 cm compared with 32 cm for the 1967-68 season. Over 95% of the herring were within the 30-36 cm size range. As in earlier years the composition of samples by maturity stages indicates a mixture of spring and autumn spawners, the latter comprising about two-thirds of the catches. Immature herring were rare in the samples.

The monthly distribution of catches along the south coast of Newfoundland indicate that herring arrive from the westward in late November and within a few days are distributed widely in the fjords between Burgeo and Bay D'Espoir. After January the fishery gradually shifts westward and the last catches for the season are usually made off the southwest corner of Newfoundland in April. About 3-4 weeks prior to the appearance of herring in south coast waters, there is a fairly intense fishery at Magdalen Islands and Bird Rocks. Also, about 1-2 weeks after the herring disappear from the south coast in April, a short spring fishery occurs at the Magdalen Islands again, and this is followed by a substantial summer fishery in the southwestern part of the Gulf of St. Lawrence.

In September 1968 and again in October 1969 the *Investigator II* carried out larval surveys using Isaacs-Kidd midwater trawl along the south coast between Fortune Bay and Port aux Basques, extending up to 25 nautical miles offshore. While capelin larvae were numerous in the catches, very few herring larvae were caught, indicating that late summer and early autumn spawning in the area is insignificant, if it exists at all. Thus the south coastal waters cannot be considered a major spawning area for the great numbers of autumn-spawning herring which subsequently over-winter in the fjords there.

During 1969 moderate herring spawning occurred in Fortune Bay (south coast) and in St. Paul's Bay (west coast) in May; an extensive spawning occurred in St. George's Bay on the west coast at intervals from late April to early June. There was a report of autumn spawning in St. John Bay on the northwest coast. The occurrence of some maturing herring in samples taken in mid-August in southern Labrador coastal waters and near Conche in northeastern Newfoundland indicates that either some late summer or autumn spawning occurs in the northeastern Newfoundland or southern Labrador areas, or the ripening herring were migrants from the Gulf of St. Lawrence where autumn spawning is known to occur.

A quantitative study of spring spawning aimed at estimating the size of the spawning stock from egg deposition was planned for 1969. On the basis of previous spawnings in the area, and accessibility, St. Mary's Bay was selected as a preliminary study area. However, herring were very scarce in comparision with previous years. This is attributed to the heavy mortality of herring in Placentia Bay in the winter and spring as a result of phosphorus poisoning. The occurrence of "red" herring in St. Mary's Bay early in the spring indicated a migration of the stock from Placentia Bay to St. Mary's Bay. As a result of the decreased abundance of herring only a relatively small amount of spawning occurred in late May and early June and this was restricted to Colinet Arm. A series of bottom grabs with a Petersen dredge revealed that spawning took place over rocky bottom in depths of from 4 to 9 m; small quantities of eggs were washed up on the shore. Spawning occurred at bottom temperatures between 3 and 5°C.

7. Capelin. Beach spawning of capelin at Middle Cove near St. John's John's was characterized by an early start (14 June) and a premature end (27 June). This is attributed to high and rapidly rising surface temperatures near the beach which were 6°C on 11 June and in excess of 9.5°C on 27 June. Spawning was observed again on 5 July when surface temperatures at the beach had dropped to 8.9°C, and sporadic spawning was reported up to 11 July when the surface temperatures had reached 10°C. Temperatures of the exposed egg-bearing sand were also very high and by 27 June had reached 18°C at a depth of 15 cm. These high temperatures undoubtedly caused a rapid hatching of the capelin eggs in and on the sand as capelin larvae were caught on 27 June, less than two weeks after the first spawning. The first catch of capelin larvae in 1968 was made 4 weeks after the first spawning. Capelin eggs were observed in the sand at Middle Cove up to 5 August and the last catch of recently hatched capelin larvae, i.e. larvae with yolk sacs, in this cove was on 14 August. Surface temperatures were then 13°C.

As part of a research project initiated in 1967 the research vessel *A.T. Cameron* carried out an annual survey of the Southeast Shoal of the Grand Bank from 19 June to 2 July to determine the distribution, abundance and spawning characteristics of capelin in the area. Previous annual cruises to the Southeast Shoal in 1967, 1968 had been unsuccessful in that bottom-spawning had been completed by the time the cruises began. However, in 1969 large bottom concentrations of spawning capelin were detected by echo sounder mainly on the southern, western and northwestern parts of the shoal and catches up to 2800 kg were obtained. These catches consisted mainly (80-98%) of spent or partly spent male capelin with fat contents ranging from 2.6 to 1.3% and were obtained in bottom depths ranging from 44 to 55 m. Bottom temperatures in the spawning localities ranged from 3.1 to 4.5°C, although on the north-eastern and eastern portions of the shoal where no spawning concentrations were located bottom temperatures as low as 0.2°C were recorded. Spawning had begun before 20 June as was evidenced by the capture of live spent capelin on that date a considerable distance north of the shoal. Although dead capelin were quite numerous on the Southeast Shoal by 1 July, the capture of male capelin with developing spawning ridges and female capelin with maturing eggs in late June indicated that spawning would probably continue until mid-July. Capelin larvae were not present in any of the plankton hauls that were made in the Southeast Shoal area indicating that hatching had not yet begun.

8. Atlantic salmon. At Port aux Basques (2 May-10 June) 270 salmon were caught by drift nets and 247 (91.5%) were tagged. The high proportion tagged was made possible by continuously patrolling the nets in a small boat. Returns to 31 December 1969 totalled 90 (36.5%); this is almost triple the rate of return from a similar experiment in the same area in 1937. The returns were distributed as follows: West and southwest Newfoundland, 24%; Miramichi river and drift net fisheries, 39%; Chaleur Bay, 12%; Quebec North Shore, 17%; Gaspe Peninsula and Anticosti, 5%; Nova Scotia, 3%. About 20% of the returns were from angling.

In 1968, 3,009 smolts in Salmonier River, St. Mary's Bay, Newfoundland, were tagged with an internal anchor tag inserted into the body cavity. This is the last of a series of experiments designed to develop an easily applied smolt tag. The returns as grilse in 1969 were 29 or 0.96%. Of these 16 were angled in Salmonier River and 13 were caught in the commercial fishery (11 in salmon gillnets and 2 in codtraps). The recaptures were quite local being distributed from Trinity Bay (southern part of Newfoundland east coast) to Placentia Bay (immediately west of St. Mary's Bay). Not one was taken in a river other than Salmonier and only six were reported from outside the St. Mary's Bay area.

9. Pink salmon. *Oncorhynchus gorbuscha* (Walbaum). Returns of pink salmon in 1969 were the progeny of the 5,334 pink salmon which had been allowed to spawn naturally in North Harbour River in 1967. The egg deposition from these fish was estimated at 4,400,000.

The run of pink salmon into North Harbour River in 1969 extended from 20 July to 2 October with the peak on 8 September, a week or more later than other years. There were 992 pinks counted at the fence and 124 below the fence giving a total of 1,116 in 1969 as compared with 1,353 in 1968 and 5,334 in 1967. Most of the spawning took place between 15 and 20 September, and was distributed over 5.8 km of the main river and 0.8 km of a tributary, Cataract Brook. There were 584 females in the spawning run giving an estimated egg deposition of 0.9 million. After spawning, 580 redds were counted.

In addition to the returns to the parent stream of North Harbour River, 425 were reported from 11 other rivers, 2 were taken in the sport fishery in salt water, and 1,060 were caught in the commercial fishery giving a total return of 2,603 fish in 1969 as compared with 2,426 in 1968 and 8,500 in 1967. Of all the known returns in 1969 only 56% were in the St. Mary's Bay area whereas the percentages in this area were 91 in 1968 and 78 in 1967. Better homing was expected of the adults in the 1969 spawning run because they were the offspring of parents that spawned naturally in North Harbour River in 1967.

From egg samples placed in plastic cases in the gravel of the main river, the time of eyeing and hatching and survival rates were determined. The time of eyeing was 25 October in 1968 and 15 October in 1969. The hatching period was 9-20 December in 1968 and 5-9 December in 1969. Rate of survival was 80%, 24 April 1969 and 87%, 8 April 1968. (Comparable rates for Atlantic salmon in this river were much lower, namely 51% and 47% respectively).

The downstream migration of fry in 1969 started 17 April, reached a peak 29-30 April, and ended 12 May. By the mark-and-recapture method the estimated number at the mouth of the river was found to be 860,000 which is 76% of the estimated egg deposition in 1968. In 1968 nine females spawned in the controlled flow egg channel and in 1969 the number of fry leaving the channel was 11,000 by actual count which is 78% of the estimated egg

deposition. The three methods of determining survival rates gave remarkably similar results, namely 76%, 78%, and 80%.

The seaward migration of fry was followed by visual observations in the river and in St. Mary's Bay. They were seen in the river from 18 April to 6 May and in St. Mary's Bay from 10 June to 10 July. There were 22 sightings and the estimated number seen was around 30,000. All of the fry seen were within 0.3 to 15 m from the shore and from the surface to a depth of 2.5 m. The greatest distance from the mouth of the river where fry were seen was 35 km on the west side of the bay.

B. Subareas 4 and 5

by J. S. Scott

Research on oceanography and fish stocks in Subareas 4 and 5 was carried out by the following Canadian establishments: the St. Andrews Biological Station, the Marine Ecology Laboratory (Dartmouth), the St. John's Biological Station, the Arctic Biological Station (Ste. Anne de Bellevue) of the Fisheries Research Board of Canada; the Bedford Institute of Oceanography of the Department of Energy, Mines and Resources; and la Station de Biologie Marine (Grande-Rivière) du Ministère de l'Industrie et du Commerce of the Province of Quebec. Reports on researches by many scientists, whose names appear in the list of Canadian scientists engaged in work concerned with ICNAF problems, were used in preparing this submission. Preliminary statistics of landings used in reporting on the status of the fisheries were in part obtained and compiled by the Canadian Department of Fisheries and Forestry. The status of fisheries and special research studies on harp and hood seals are reported separately in Appendix I.

Subarea 4

A. Status of the Fisheries*

I. Cod.

Mainland landings were down about 6% from 1968, but constituted about 38% of the total weight of groundfish landed. Landings from the Gulf of St. Lawrence and Cape Breton areas (Div.4R, 4S, 4T, and 4Vn) continued the upward trend since 1967; those from Nova Scotia Banks and Georges Bank (Div. 4Vs, 4W, 4X, and 5Z), which had increased in 1968, were down slightly below the 1967 level. These changes can be partly attributed to a diversion of effort from the Nova Scotia Banks to the northern Gulf of St. Lawrence (Div.4R

*The preliminary figures for 1969 in this report are based on actual landings by the mobile fleet (vessels over 25 gross tons) and estimated inshore landings.

and 4S), particularly by otter trawlers of 150 gross tons and upward. Sizes and ages of cod from Div. 4T changed slightly in 1969. The 1964 year-class, now 5 years old, was still dominant, confirming predictions that it was above average size.

II. Haddock

Total landings declined about 14% from 1968 levels and about 23% from 1967 levels. Poor recruitment in recent years has been a contributing factor in the decline. The last good year-class in 1963, together with the 1962 year-class, has sustained the fishery since 1967, but with diminishing returns. More than 95% of the haddock landings on the Canadian mainland are from Div. 4W, 4X, and Subarea 5. The lower abundance of haddock in these areas tended to divert the larger, more mobile units to other areas and other species, thus further decreasing haddock landings.

III. Flatfish

Total landings (plaice, witch, yellowtail, winter flounder, and Greenland halibut) were up 6% from 1968 and only slightly below the 1967 landings. Increases and decreases in the various Divisions appear to reflect changes in effort rather than changes in abundance.

Atlantic halibut landings at 1,374 metric tons declined 26% from 1968 and 33% from the 1967 landings of 2,060 metric tons.

IV. Pollock

Pollock are caught mainly in Divs. 4W and 4X and Subarea 5. Landings have remained relatively stable over the past 4 years at approximately 16,000 to 18,000 tons per year.

V. Redfish

The rising trend in redfish landings, begun in 1963, continued into 1969. Increases were registered in all areas and divisions except 4Vs. Approximately 85% of the Canadian mainland landings were taken in the Gulf of St. Lawrence (Div. 4R, 4S, and 4T).

VI. Other groundfish

Other groundfish include hake, cusk, wolffish, skate, angler, and any of the common groundfish species not recorded by species name. Together they comprise about 5% of the total landings. Cusk and hake are of importance to the inshore fisheries in several locations but generally are taken as incidental catches and do not vary much from year to year.

VII. Sea scallop, *Placopecten magellanicus* Gmelin

Total landings of scallops increased from the 1968 figure of 12,400 metric tons to 14,245 metric tons whole weight (1,716,000 kg meats). By far the largest fraction of inshore landings came from Div.4T.

Div.4T produced 8,605 metric tons; Div.4X produced 4,119 metric tons; Div.4V and 4W together produced 1,036 metric tons. A new area in Div. 4W was fished in 1969 (Western Bank) and produced 923 metric tons.

VIII. Herring

Landings in Subarea 4 (excluding Div.4R) amounted to 319,000 tons, a decrease of 58,000 tons (15%) from the record landings of 1968. In Div.4T landings (143,000 tons) were nearly 50% greater than they were in 1968. This increase was more than offset by smaller landings in Div.4X where landings decreased from 280,000 tons in 1968 to 170,000 tons in 1969. In Div.4W (6,200 tons) landings were higher than in 1968, and in Div.4V (225 tons) they were lower.

IX. Swordfish

Canadian landings for all ICNAF areas amounted to 4,300 tons in 1969. This is only slightly (3%) less than the amount landed in 1968 but continues the downward trend which started immediately after the first full year (1963) of longlining for swordfish. Data processing is incomplete but the proportion of the catch taken in Subareas 5 and 6 was approximately the same (50%) as in 1968. The combined catch for Subareas 3 and 4 is also unchanged but, in contrast to the previous year, most of it came from Subarea 3. There was no appreciable change in either fishing effort or size composition during 1969. However, the high proportion of small swordfish in landings from some areas is cause for concern about the future of this fishery.

X. Mackerel, *Scomber scombrus* L.

Mackerel landings in Subarea 4 (excluding Div. 4R) amounted to 12,800 tons, an increase of 2,000 tons (19%) over 1968 landings. Landings along the southwestern part of the Atlantic coast of Nova Scotia (Div.4W and 4X) were substantially (75%) higher than they were in 1968 and there was a smaller but significant increase in Div. 4V from 1,770 tons in 1968 to 2,080 tons in 1969. In the Gulf of St. Lawrence (Div.4T and 4S) however, landings decreased from 5,000 tons in 1968 to 3,700 tons in 1969. The difference in landings for the two years may be more a reflection of a change in fishing effort, particularly in relation to the herring fisheries, than a change in availability of mackerel.

XI. Tuna

Total Canadian landings of tuna in 1969 amounted to 1,300 tons of which 900 tons were mixed yellowfin and skipjack from the eastern Pacific and the Gulf of Guinea. The remainder (400 tons) was made up of several species (unidentified) landed incidentally by swordfish fishermen and small quantities of giant bluefin taken by traps in St. Margaret's Bay (Div.4X). No details are available.

XII. Sharks

Incidental landings of porbeagles (*Lamna nasus*), mako (*Isurus oxyrinchus*), and hammerheads (*Sphyrna* sp.) amounted to 7.5 tons as compared to 11 tons in 1968.

XIII. Atlantic salmon

Total catch (commercial plus angling), exclusive of Div.4R, declined to 670 metric tons, compared to 804 tons from the same areas in 1968. Commercial catches decreased by 10 to 20% in Divs.4S-W and by 60% in 4X (catch 31 tons) where special restrictive measures were applied to the principal fishery. The angling catch (167 tons) was 25% higher than in 1968. Grilse comprised 60% of numbers caught by angling.

B. Special Research Studies

I. Environmental studies

1. Hydrographic studies. Investigations of seasonal changes in surface axial and cross channel tidal streams and their relationships to internal tides were continued. Data were collected from seven strings of three current meters each, moored at 10 km intervals along the axis of the St. Lawrence estuary (4T) at the end of April and again in late September and early October. Studies of salinity and temperature distribution and evolution of heat budget were carried out in Chaleur Bay.

Gyre studies in the southwestern part of the Gulf of St. Lawrence included a two-week survey in the Gaspe-Bradellé drogues to determine surface circulation features.

The ice forecast survey (Div.4R, 4S, 4T) consisting of standard oceanographic stations was undertaken in November.

The Scotian Shelf (Div.4X, 4W) oceanographic and moored buoy program, initiated in 1967, was discontinued early in 1969. The Halifax Section was monitored five times.

Detailed study of St. Margaret's Bay--Div.4X-- continued in 1969.

Studies of circulation of surface-bottom waters over the continental shelf from Bay of Fundy-Gulf of Maine to Newfoundland and Labrador continued. An exceptionally strong surface southwesterly drift (7-9 miles per day), intensified by strong easterly winds, was evident in Gulf of Maine in winter 1969. It had subsided by spring. Accumulated data from the lower Laurentian Channel indicate a northerly bottom drift along the western slopes of St. Pierre Bank (3P).

Surface temperatures along the Canadian Atlantic coast were generally warmer than in 1968 and above the long-term averages at all seasons. In the deep waters of the Gulf of Maine, the intrusion of relatively warm and highly saline waters, which started in late winter of 1968, persisted until the beginning of 1969 but had regressed by spring. The temperature of the warm, deep layer in Cabot Strait increased from about 4.3°C in 1966 to 5.4°C in 1969.

Runoff conditions and flushing times in the Miramichi estuary (4T) were studied in connections with pollution and salmon movement.

2. Plankton Studies. Zooplankton surveys were carried out on the Scotian Shelf, Cabot Strait and off the South Coast of Newfoundland to determine where the various components of the coastal plankton originate.

A special effort was made to determine herring spawning areas along the Scotian Shelf.

3. Miscellaneous. The Navigational Charting program in the eastern half of the Gulf of St. Lawrence (Div. 4R, 4T) was completed in 1969.

Charts of sea surface temperature, layer depth, and selected bathythermograms for Subareas 3, 4, 5 and 6 were prepared and broadcast daily by the Maritime Command Weather Office of the Canadian Forces.

II. Biological Studies

1. Cod. Survey cruises for eggs and larvae (4T) were continued in connection with recruitment studies.

Study of population changes in cod stocks in southern Gulf of St. Lawrence (4T) continued. Sampling of commercial landings showed average sizes slightly larger than in 1968, with 4- and 5-year-olds dominant. Tagging confirmed that fish move seasonally from Magdalen Shallows (summer) to Laurentian Channel (winter).

2. Haddock. Results of research cruises in 4X and 4W indicate that recruitment to the fishery remained low and that the 1968 year-class is poor. Tagging in eastern Bay of Fundy (4X) indicates that there is a small stock of resident fish there but that the summer fishery in this area is based mainly on fish which migrate to Browns Bank area for winter and spring months.

3. Silver Hake. Monitoring of incidence and intensity of gill disease in 4V, 4W, 4X continued. The intensity remained very low in both adults and in the juveniles which formed the bulk of the catches.

4. Northern Sand Launce. Morphometric differences have been determined in groups of launce from different areas. Their relationships to environmental factors are being studied.

5. Argentine. Sampling for fecundity studies was completed.

6. Mesopelagic Fishes. Collecting was terminated and the results were analysed. Age, growth and vertical distribution of the dominant species, *Benthosema glaciale*, were studied. A diurnal vertical migration from centres of distribution at 250 fathoms by day to 25-50 fathoms at night was indicated.

7. Flatfish. A study of niche diversity in grey sole (witch flounder) in the Scotian Shelf was completed. The species occupies three diverse ecological niches during its development: (1) egg and pelagic larval phase of up to one year; (2) deepwater phase--metamorphosing fish settle as juveniles in 100-250 fathoms; (3) shallow water phase--young adults move onto the banks.

Monitoring of intensity and incidence of liver disease and parasite infestation in yellowtail flounder continued.

8. Food Resource and Digestion Rates. Studies of food resource division continued in Passamaquoddy Bay and were extended to include comparison with Arctic assemblages at Dease Strait, N.W.T. Experiments on rates of gastric emptying in young cod indicated that the rate increases with acclimation temperature to about 15°C but is subsequently reduced. Rate of emptying is proportional to volume of food in the stomach. Continuing study of seasonal changes in gross energy content of major natural fish foods indicates material from Passamaquoddy Bay is not as rich as that from St. Margaret's Bay. Ecology of common species of Cumacea, Mysidacea and shrimps in relation to predation by commercial fishes was studied and observations on primary productivity were made in Chaleur Bay.

9. Groundfish surveys. The first of an intended series of annual, statistically designed survey cruises in 4W was completed. It is hoped to extend the surveys to cover the whole of the Scotian Shelf (4Vs, 4W, 4X) with the objective of providing data on which to base recruitment predictions, particularly for haddock, and abundance estimates.

10. Sea scallop. Studies were continued (4T) on drag efficiency and survival of discards. Scuba observations revealed an 11% catch of all scallops in the drag path and a 4% mortality of uncaught scallops. Mortalities due to deck exposure in 1969 were much lower than studies in 1968 had indicated.

A photographic survey of scallop beds in the Bay of Fundy (4X) in August 1969 confirmed the general scarcity of scallops noted by commercial fishermen. A research submersible (Shelf Diver) working in the same area in September estimated that population densities were less than 0.1 scallop per sq m over the commercial grounds.

11. Herring. The development of large-scale fisheries for adult herring in the Bay of Fundy (Div.4X) began to show effects on the stocks in 1969. There was a marked reduction in the availability of adults during the summer-autumn season, possibly a result of the very high fishing intensities of recent years. There was also a reduction in the availability of 'sardines' but equally poor fishing seasons have been recorded in recent years, and evidence is not conclusive that recruitment to the 'sardine' year-class has been affected.

Racial studies continued in the Gulf of St. Lawrence (4T). The strong year-classes of 1959 and 1960 in Div.4T were again dominant in 1969 samples although to a lesser degree than in previous years. The 1964 and 1965 year-classes were both strong and are replacing the older year-classes in the fishery.

Studies of morphometric and meristic characters including vertebral numbers, gill-rakers, fin-rays, otolith types, and l_1's indicate the discreteness of two main spawning groups of herring in the southern Gulf of St. Lawrence (Div.4T).

A series of plankton cruises was carried out to study the distribution and abundance of larval herring in Divs. 4X and 5Z. Centres of larval abundance occurred only in the Bay of Fundy and near the northern edge of Georges Bank, and only during the late autumn and early winter months. The results support the view that autumn spawnings off southwest Nova Scotia and on Georges Bank are the main sources of recruitment to herring stocks in this region.

Attempts to survey a herring spawning bed from a submersible demonstrated the potential value and practicality of the method but no spawning concentrations in the area of search were found.

12. Mackerel investigations were restricted to sampling for size composition from commercial catches in the Bay of Fundy (Div.4X). Mackerel caught on the west side of the Bay are considerably smaller (mean length 267 mm) than those caught on the east side (mean length 320 mm).

13. Swordfish. Special research on swordfish is reported under Subarea 5.

14. Tuna. The behaviour of large bluefin tuna was studied in St. Margaret's Bay (Div.4X) during July, using sonic tags that were also capable of telemetering water and fish temperatures. Four fish were tracked

for a total of 30 hours and 200 km. They all left the Bay within 6 hours of release but did not seem to be unduly disturbed by the tagging operation and appeared to have fed soon after release.

15. Atlantic Salmon. Serological and electrophoretic studies were undertaken to determine whether genetically different populations of Atlantic salmon occurred in the North American Atlantic rivers. Electrophoretograms of blood transferrins indicate that there are some distinct populations.

Returns from tagged hatchery-reared smolts of selected grilse versus 2-sea-winter parentage have shown 70% of more of the progeny maturing at the same age as their parents.

Over 132,000 hatchery-reared and 32,000 wild smolts were tagged and liberated in stock-evaluation and utilization studies. In addition 3,500 mature salmon were tagged and subsequently liberated as they passed through fisheries and research installations or after use as fresh brood-stock for hatcheries.

Among recoveries from 49,000 tagged, wild smolts liberated between 1964 and 1967 about 40% were recorded as grilse in Canada, 8% from Greenland fisheries, 40% from Canadian fisheries and 2% as home-river spawning escapement. Similar proportions were recovered from 49,000 tagged, hatchery-reared smolts of late-run parentage.

Recoveries from 39,000 tagged, hatchery-reared smolts of early-run parentage were over 60% as grilse, 7% in Greenland, 42% in Canadian fisheries and under 1% as spawning escapement.

In the above studies about 1/4 of the grilse were recorded as spawning escapement.

Returns from a 1968 liberation of 28,000 tagged, wild smolts indicate a survival rate of about 3.8% after 1 1/2 years, about twice the average rate of return for a 2-year period (about 1,000 returns as grilse in Canada plus 50 from Greenland).

Studies, by sonic tracking, of adult salmon entering rivers indicate much slower progress in estuarine areas with substantial industrialization and shipping activity as compared to undeveloped areas.

III. Gear and Selectivity Studies.

Acoustic echo counting equipment constructed at the Marine Ecology Laboratory, has continued to undergo field calibration trials and progress has been made in the development of survey and analyses techniques to determine fish school patterns. Direct comparisons of otter trawl catches with simultaneous fish counts were made in 4T. Comparative experiments in use of lights for fishing were continued at the Station de Biologie marine, Grand-Rivière, Que.

IV. Miscellaneous Studies

At the Atlantic Oceanographic Laboratory a diving "Batfish" has been designed for towing from a moving ship and capable of undulating between pre-set depths. The fish is made from glass fibre reinforced plastic and is extremely rugged. To date only temperature and pressure sensors have been fitted, but it is planned to add conductivity and a plankton counter. Recording from the sensors is made aboard ship.

Subarea 5

A. Status of the Fisheries *

I. Cod

Canadian mainland landings from Subarea 5 were down by 34% from 1968, continuing the decline in recent years. The actual landings are as follows:

Year	1966	1967	1968	1969
Landings (metric tons)	15,127	8,529	9,195	6,047

II. Haddock

Landings on the Canadian mainland from Subarea 5 were less than half of the landings in 1968. Landings since 1966 are as follows:

Year	1966	1967	1968	1969
Landings (metric tons)	18,960	13,629	9,445	4,045

Poor recruitment since 1963 is the main factor in the decline in haddock landings from Subarea 5.

III. Sea Scallop

Landings of scallops from Georges Bank (5Z) showed a decrease from the 1968 catch by 4,000 metric tons; only 36,000 tons whole weight (4,380,000 kg meats) were landed in 1969, despite an addition of 5 boats to the offshore fleet. As in 1967 and 1968, most effort was on the north-eastern edges of the bank. Only two trips were made to Statistical Subarea 6 for a catch of 18 tons whole weight.

* The preliminary figures for 1969 in this report are based on actual landings by the mobile fleet (vessels over 25 gross tons) and estimated inshore landings.

IV. Herring

The herring fishery in Subarea 5 was significantly smaller than in the two previous seasons. Landings amounting to little more than 3,000 tons were recorded from the southern part of Div. 5Y.

V. Swordfish

Swordfish landings for the whole ICNAF area are included in the report for Subarea 4. Area-of-catch data are still incomplete but there appears to have been no major changes from previous years although Subarea 3 made a proportionately greater contribution to landings than Subarea 4 on the basis of 1968 figures. Subareas 5 and 6 account for approximately 50% of the total annual catch (4,300 tons in 1969).

VI. Tuna

Swordfish fishermen catch and land small quantities of tuna. Several species (bluefin, bigeye, albacore, and yellowfin) are included but are not identified. Total Canadian landings of tuna for the ICNAF area are included in the report for Subarea 4.

B. Special Research Studies

I. Biological Studies

1. Scallop. Scallop catch statistics continued to be collected from offshore fleet log records and catches were assigned to 10 min squares for Georges Bank. Collaboration and exchange of Georges Bank and Subarea 6 scallop data with the U.S. Bureau of Commercial Fisheries continues.

2. Herring research was restricted to studies of larval abundance and distribution reported under Subarea 4 and to examination of a few samples from commercial catches on Jeffreys Bank (Div.5Y) and Georges Bank (Div.5Z).

3. Swordfish. The mean size of swordfish continued to decline and is now 62 kg (round weight) as compared with 103 kg in 1963, the first full year of the longline fishery. This cannot be explained solely by the expansion of effort into areas yielding larger numbers of smaller fish and the possibility of overfishing must not be overlooked.

The rate of growth of swordfish appears to be rapid with fish reaching a weight of about 4 kg in September of their first full year of life (assuming April-August spawning) and about 15, 39, 69, and 113 kg respectively in the following four years. Tagging returns, although only three in number, indicate that subsequent growth is equally rapid.

An examination of the gills and gastro-intestinal tracts of 18 swordfish showed numerous nematodes (*Contracaecum incurvum*) and a few giant

digenetic trematodes, *Hirudinella marina*. In the rectum, there was a high incidence of the cestode *Fistulicola plicatus*. On the gills, *Tristoma coccineum* and *T. integrum* occurred. The difference in relative incidence of *T. coccineum* and *T. integrum* on swordfish from the Mediterranean and the Atlantic and the presence of a distinct species of *Tristoma* on Hawaiian swordfish suggest that these monogenetic trematodes may be useful as biological tags to distinguish populations of swordfish.

4. Miscellaneous. Recaptures of tagged blue sharks suggest an anticlockwise seasonal migration with fish wintering in the Gulf Stream. Some fish move east during the spring and then north and west along the edge of the continental shelf between the Grand Banks and Georges Bank during the summer and early autumn. Other sharks apparently move straight into the continental shelf areas south of Cape Cod in the summer and probably perform a similar but much reduced migratory pattern.

APPENDIX I

Subarea 4

A. Status of the Fisheries

Harp and Hood Seals

The major feature of the 1969 sealing season was an almost complete absence of ice in the normal whelping areas for harp seals in the southern Gulf of St. Lawrence (Subarea 4)in early March. The seals therefore whelped close inshore on available ice in Northumberland Strait and around the shore of Prince Edward Island (Subarea 4). There is strong evidence (see Special Research Studies) that a large percentage of seals moved from Subarea 4 to Subarea 2 in order to find ice for whelping. The distribution of catches reflects this movement.

Age samples obtained during 1969 show excellent survival of the 1968 age-class of harp seals, from which a catch of 156,000 young harp seals was made by all agencies and in both Subareas in 1968, as compared with catches of about twice this figure in the immediately preceding two years. This low catch probably lies close to or slightly below sustainable yield. The low catch was achieved by means of late starting dates in both Subareas.

B. Special Research Studies

Harp and Hood Seals

CANADIAN ATLANTIC SEAL CATCH

Year	Harp Seals			Hood Seals			
	Young	Older	Total	Young	Older	Total	Grand Total
1968							
Gulf	59,735	6,102	65,837	-	-	122	65,959
Front	32,907	5,692	38,599	12	13	25	38,624
Total	92,642	11,794	104,436	-	-	147	104,583
1969							
Gulf	46,901	4,787	51,688	112	-	112	51,800
Front	111,984	7,726	119,710	439	349	788	120,498
Total	158,885	12,513	171,398	551	349	900	172,298

(1) During March 1969 nearly open water in the Gulf of St. Lawrence for the first time in 17 years (since 1953) gave a unique opportunity to study the behaviour of harp seals faced with the near-absence of ice for whelping. The estimate of seals whelping around Prince Edward Island was about 50,000 of

which 32,000 were taken at the fishery. The usual number whelping in this area is estimated at 100,000 to 150,000. Careful study showed no evidence of any massive drownings of young. It is very probable therefore that the majority of animals moved to the Labrador coast to whelp.

(2) Many young seals surviving the fishery in the Gulf fell prey to oil pollution. Samples identified the oil as bunker "C" probably discharged into Northumberland Strait on January 30, 1969. It was already heavy and broken into underwater globs, and young seals, but not old seals, became heavily fouled. Young were tagged by Arctic Biological Station staff, and subsequent tag recoveries show that heavily fouled young seals hunted in the Strait of Belle Isle during April had probably picked up the oil at the southern site. While the majority of fouled seals were alive, some dead seals were reported both around Cabot Strait and in Belle Isle Strait. Further mortality will be studied from a comparison of tag recovery rates with previous years.

II. Danish Research Report, 1969

by Sv.Aa. Horsted

Subarea 1

A. Status of the Fisheries

The nominal catches taken by Denmark (Greenland) in 1969 are given in the following table:

Table 1. Greenlanders' nominal catches, 1969 (provisional figures).

Species	Nominal catch (tons)	Increase or Decrease from 1968 (%)
Cod	21,315*	0
Redfish	56*	-59
Wolffishes	3,356	-13
Greenland halibut	1,221	-22
Atlantic salmon	1,240**	+114
Capelin	175	-13
Sand eel	225	-4
Lumpsucker roe (not converted to round, fresh fish)	256	+61
Other fish (mainly Arctic char)	181	+218
Deep sea prawn	5,982	+7
Total	34,007	+1

* Excl. 2,934 tons cod (-59%) and 82 tons redfish (+52%) landed by small Faroese boats in Faeringehavn (Div.1D).

** Excl. Danish drifters (app. 410 tons).

I. Cod

1. The fisheries. After a decrease of about 23% from 1967 to 1968 the nominal catch by the Greenlanders in 1969 was similar to that in 1968. It is remarkable, however, that nearly 10% of the Greenlanders' catch of cod was taken by their first trawler, which began fishing in late May. Without the intake of this new effort Greenlanders' catches would have continued the downward trend.

Last year's research report predicted a small increase in the Greenlanders' cod fishery, but this prediction did not come true. The main reason

for this is the extremely severe ice condition in the first 7-8 months of the year. Polar ice ("storis") occupied the whole inshore region from Cape Farewell to Godthaab until the beginning of August causing great difficulties for the spring and summer pound-net fishery especially, and also creating difficulties for the activity of the trawler.

2. Forecast for 1970-71. Although a small increase in 1969 catches was expected by normal fishing conditions, it should be mentioned that the catch would still have been rather poor compared to most years in the 1960 decade due to the poor recruitment in recent years and to the heavy exploitation in the decade (excl. 1969). Percentage age composition given in histograms will nearly always show one or two predominant year-classes, but these may nevertheless be poor compared to good year-classes no longer existing. At present no real strong year-classes seem to be present in the exploited stock or among the pre-recruits and the total international catch is, therefore, expected rather low in the years 1970-71 at least, especially if continued severe ice conditions cause a further withdrawal of non-Greenlandic fishing vessels from the subarea.

II. Atlantic salmon

Salmon stock and catches, especially in the offshore areas, were reported to be very good from the beginning of August to late October when fishermen reported that salmon disappeared rather suddenly from the fishing area. Inshore stock and catches varied very much between districts being very poor in the whole of Div. 1F and around Godthaab in 1D but probably normal in other districts. For the first time some Greenland vessels participated in the offshore drift net fisheries. Greenlanders' catch more than doubled from 1968 to 1969 but is still lower than in the years 1964, 66 and 67. All catches consisted of fish in excellent condition. For further information see the Report of the ICES/ICNAF Joint Working Party on North Atlantic Salmon, February 1970 (Comm.Doc. 70/13).

III. Other fish

Fisheries for wolffishes, redfish and Greenland halibut decreased, whereas the rather important fishery for lumpsucker, the roe of which is used for caviar, increased. Catches of Arctic char trebled due to a probable similar increase in effort.

The decrease in the traditional fishery for Greenland halibut can probably be ascribed partly to the extensive prawn fisheries which take great quantities of very small Greenland halibut.

IV. Deep sea prawn

An increase in catches was possible as the capacity of the most important plants was increased, e.g. by further installation of peeling

machines. Prawns are now fished inshore in all divisions, the most important grounds still being those in the Disko Bay, Div. 1A, accounting for about 90% of the total catch.

B. Special Research Studies

I. Environmental Studies

1. Hydrography. (See F. Hermann, Hydrographic conditions off West Greenland during 1969, ICNAF *Redbook* 1970, Pt.III).

II. Biological Studies.

1. Cod

a. Eggs and larvae. Hauls with a 2 m stramin net were taken at the standard hydrographic sections in Davis Strait in April-August and at a permanent station at the entrance to Godthaab Fjord (Div. 1D). Oblique hauls were taken from approximately 50 m to surface (wire length 225-0 m).

Careful analysis has shown that part of the eggs (in 1969 17%) called cod eggs when sorting them macroscopic on board vessel were presumably *Brosmius* eggs. Figures presented here show what is regarded to be pure cod eggs whereas figures in Danish research reports of most recent years no doubt contain non-cod eggs although not necessarily as many as 17%.

Eggs taken in April and May are shown in Fig.1. Number of eggs is small compared to 1968 and other years. As in previous years the main spawning areas are found on the western slopes of the West Greenland fishing banks (Div. 1D-1C). Ice prevented the planned hauls in Div. 1E.

In previous years the best period for taking the larvae has been in July. Various circumstances unfortunately made it impossible to operate in July 1969. Comparison with the amount of larvae taken in previous years is, therefore, difficult. However, the number of larvae taken in June and August (Fig. 2) does not give any support to optimism as to the strength of the 1969 year-class of West Greenland origin, nor does the hydrographic situation do so, except probably for Div. 1B.

b. Occurrence of pre-recruit cod (age-groups I, II and III). Age-group I (the 1968 year-class) has not been observed in any catches by small-meshed gears, nor in any significant numbers by visual observation on shallow water.

Age-group II (the 1967 year-class) has been observed in pound-net catches in Div. 1B (Sample 1 in Fig. 3) and is also likely to constitute part of the reported discarded fish from pound-net catches in Div. 1C. In Div. 1D, however, discarded amounts were not great compared to Div. 1B and 1C, so the 1967 year-class does not seem to be of any importance in the southern part of

the subarea and of only minor importance in the northern part.

Age-group III (the 1966 year-class) constituted by far the major part of pound-net catches in Div. 1B (Sample 1), and although most individuals (those below approximately 40 cm total length) are normally discarded the age-group is also represented in the landings (Sample 2). The age-group is also likely to constitute the major part of discards in Div. 1C. Furthermore this age-group has been observed in Div. 1D, inshore by beach-seine (Sample 6) and offshore by small-meshed otter trawl (Samples 10-13). The 1966 year-class thus seems to be of some importance, but it is rather difficult to compare its size to former strong year-classes as for example the year-class 1961. In an effort to get comparable figures between years of the pre-recruits some standard trawling stations have been set up. Regular trawling will take place here by a standard trawl, 36 mm codend. As we have no comparison to previous years the figures for 1969 do not tell very much about the strength of the pre-recruit year-classes. They are, however, given here for the (in respect to cod) best standard station for future reference.

Table 2. Number of cod per hour's trawling on standard station "Godthaab Dybet" 63°56'N:52°21'W., depth approximately 300 m. Otter trawl, 36 mm codend. Ref. Nos. 4142, 4164, 4168 and 4213 correspond to Samples 10, 11, 12 and 13 respectively in Fig. 3.

Date	Ref.No.	Total time trawled (min.)	No. of hauls	No. of cod per hour and age-group						
				II	III	IV	V	VI	VII	VIII+
8-9 Jan.	4142	183	3	0	70	208	68	27	8	13
21 Feb.	4164	45	1	0	103	261	109	41	8	4
4 Mar.	4168	120	2	0	65	157	89	47	9	6
7-8 May	4213	180	3	2	273	130	12	8	0	1

c. Age and size distribution of cod in landings. In Div. 1B, 1C and 1D inshore pound-net landings consisted mainly, in some cases nearly exclusively, of the 1965 year-class (Samples 2, 3, 8 and 9) although in some landings from the Godthaab Fjord (1D) the 1963 year-class was the predominant one (Sample 7). The 1965 year-class is furthermore strongly represented on the standard trawling station in Div. 1D offshore mentioned in Section II, 1, b, (Samples 10-13) and even in research vessels longline catches in the same division (Samples 16-20). It is remarkable, however, that landings from the trawler in Div. 1C-1D hardly contain fish of this year-class (Samples 5 and 14), the most likely explanation for this being that most of these relative small fish did escape the 140 mm meshed codend. It is further remarkable that the 1965 year-class is nearly completely absent from samples in Div. 1E, in research samples (Samples 21, 22) as well as in Greenlanders' commercial samples (Samples 28, 29, Fig.4).

In most cases, where the 1965 year-class is of minor or no importance it is substituted by the relative good year-class 1963, this especially being

the case in Div. 1E (Samples 21, 28, 29) for gears other than long-line, whereas a long-line sample in Div.1E is dominated by the (originally) very good year-class 1961 (Sample 22). The 1961 year-class has furthermore been of some importance in commercial landings in Div. 1B (Samples 23-25) where also year-class 1960 still is of some importance. These two year-classes, 1960 and 1961, together with year-classes 1962 and 1963 have also contributed considerably to trawler landings from Div. 1C-1D (Samples 5 and 14), the same being the case for a research hand-line catch in Div. 1D (Sample 15).

d. Tagging experiments. A total number of 2,434 cod was tagged. Of these 1,205 were small cod (less than 50 cm total length) caught mainly in inshore waters in Div. 1D by pound nets or beach seine. Details are given in the following table:

Div.	Inshore		Offshore	
	small cod	big cod	small cod	big cod
1B	3	53	0	0
1C	0	0	53	366
1D	1,139	5	4	507
1E	0	0	6	298
Total	1,142	58	63	1,171

2. Atlantic salmon. Research was carried out in collaboration with scientists from UK and Canada. As special papers on this work were presented to the ICES/ICNAF Joint Working Party on North Atlantic Salmon only a very brief summary is given here.

Research efforts were concentrated on tagging salmon caught offshore on floating long-lines and on measuring the unknown tagging mortality for gill-net caught salmon. Unfortunately only small quantities of salmon were caught in the UK-Danish experiments. Floating long-lines offshore in Div. 1B yielded a total catch of 66 salmon of which 44 were tagged being in apparently excellent condition. At Godthaab 15 salmon caught in inshore gillnets were tagged.

Further efforts concentrated on sampling catches for age and size distribution, blood and tissue samples.

At least 307 salmon tagged in Europe-North America have been re-captured in Greenland waters in 1969. Of these 180 have been received (bought) as round fresh fish which will be used for parasite investigations.

3. Other fish. Materials for studies of capelin were collected in several districts. Material on Greenland halibut was collected at Jakobshavn (Div.1A), where fishing is taking place from the ice in winters, and at Godthaab (Div. 1D). Twenty-seven redfish and 1,075 Greenland halibut were tagged in the Godthaab Fjord (Div. 1D).

4. Deep sea prawn. Research catches have been sampled, especially those taken on offshore grounds in Div. 1B-1D. The purpose is to obtain information on possible seasonal variations in stock size on the various grounds and of possible year-class fluctuations, and to estimate potential stocks.

6. Seals. Preliminary research on seals has started. At first an evaluation of the reliability of catch statistics and of age determination of material previously collected is planned. Steps have been taken to sample harp and hood seals in 1970. Canada and Norway have kindly offered their assistance in establishing this work.

C. Practical Fishing Experiments

For several years the Royal Greenland Trade Department has conducted practical fishing experiments in Greenland waters. The main purpose is to investigate possible potentials in the sea and to try new fishing methods. Results of this work are evaluated in close cooperation with the fisheries biologists. The most important experiments in 1969 have been:

I. Experimental fishing for sand eel.

Sand eels were trawled on the offshore banks in Div. 1D in June and August, 21 days fishing yielding 192 tons. Hauls varied from 30 to 70 minutes with a mean catch of 2.1 tons per hour. Part of the catch has been frozen as bait for the long-line cod fishery.

II. Experiments in the prawn fishery.

These experiments have concentrated on locating grounds with big prawns and on methods for ensuring the best quality, especially during handling and storage on board. High quality of the prawns is necessary for best results in modern mechanical peeling, and careful handling combined with efficient cooling on board vessels seems to meet demands efficiently.

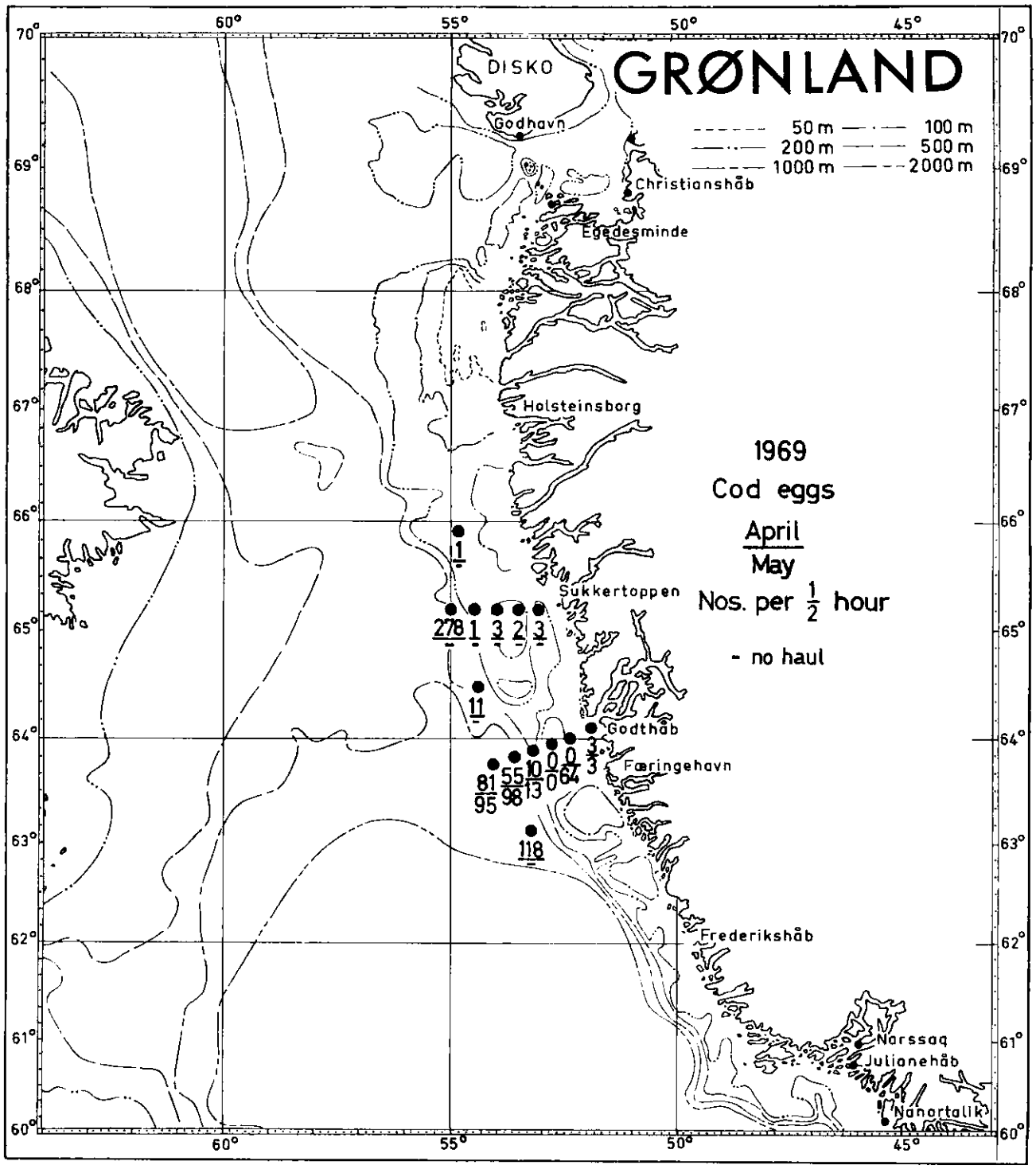

Fig. 1. Cod eggs (numbers per 1/2 hour) taken by 2 m stramin net in the upper water layers (maximum depth about 50 m).

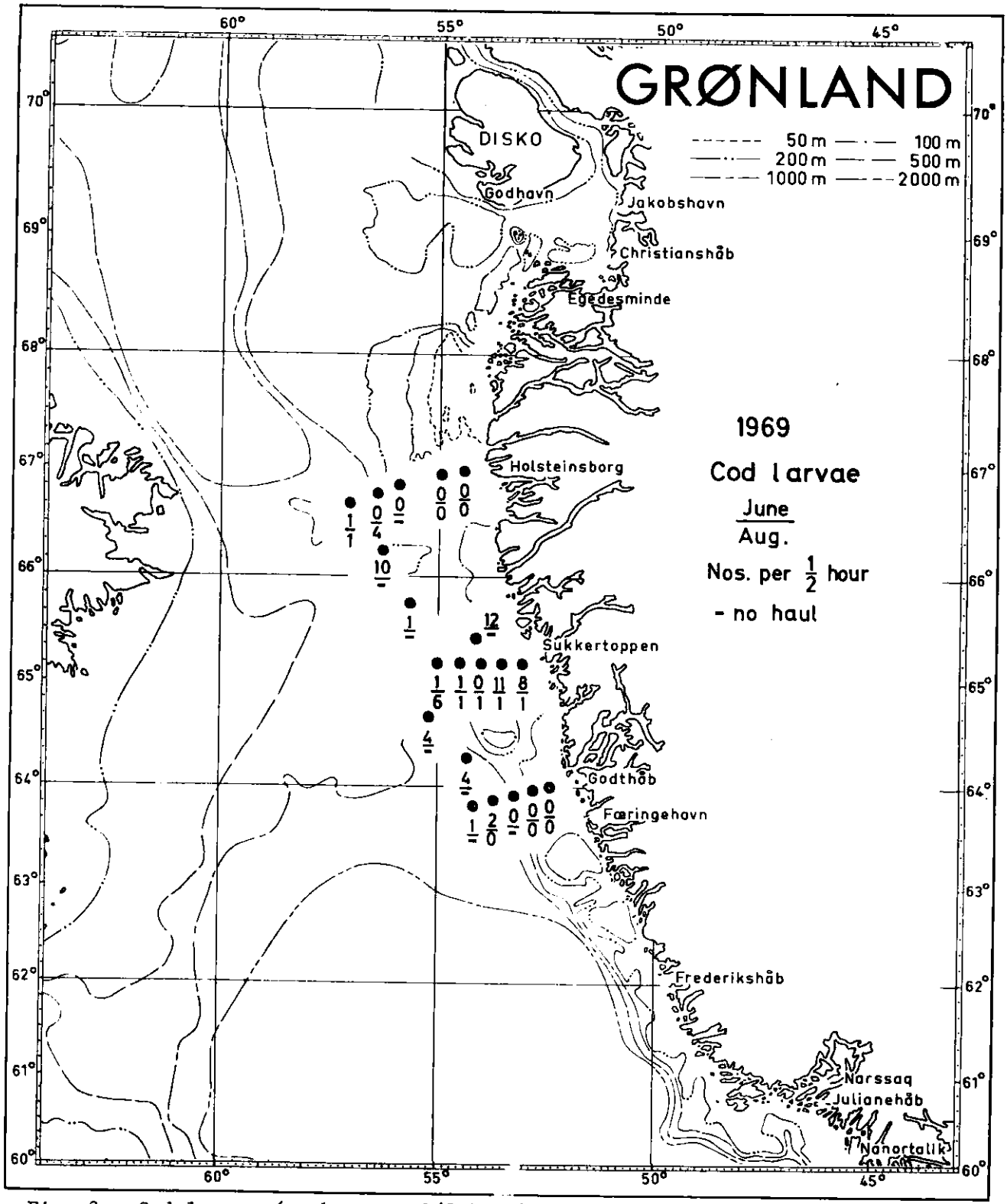

Fig. 2. Cod larvae (number per 1/2 hour) taken by 2 m stramin net in the upper water layers (maximum depth about 50 m).

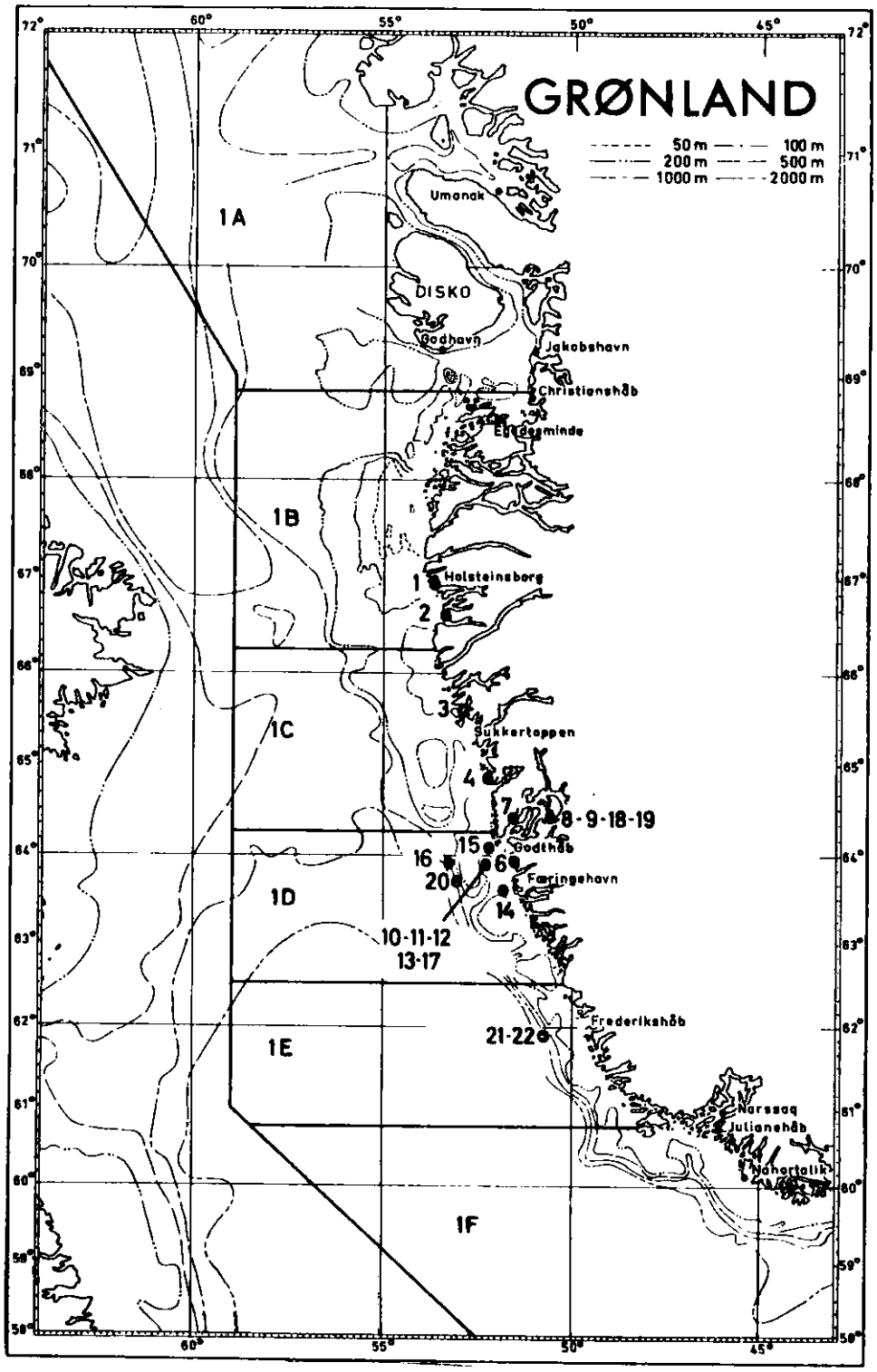

Fig. 3. Map showing locations at which samples reported upon in Fig. 4 were taken.

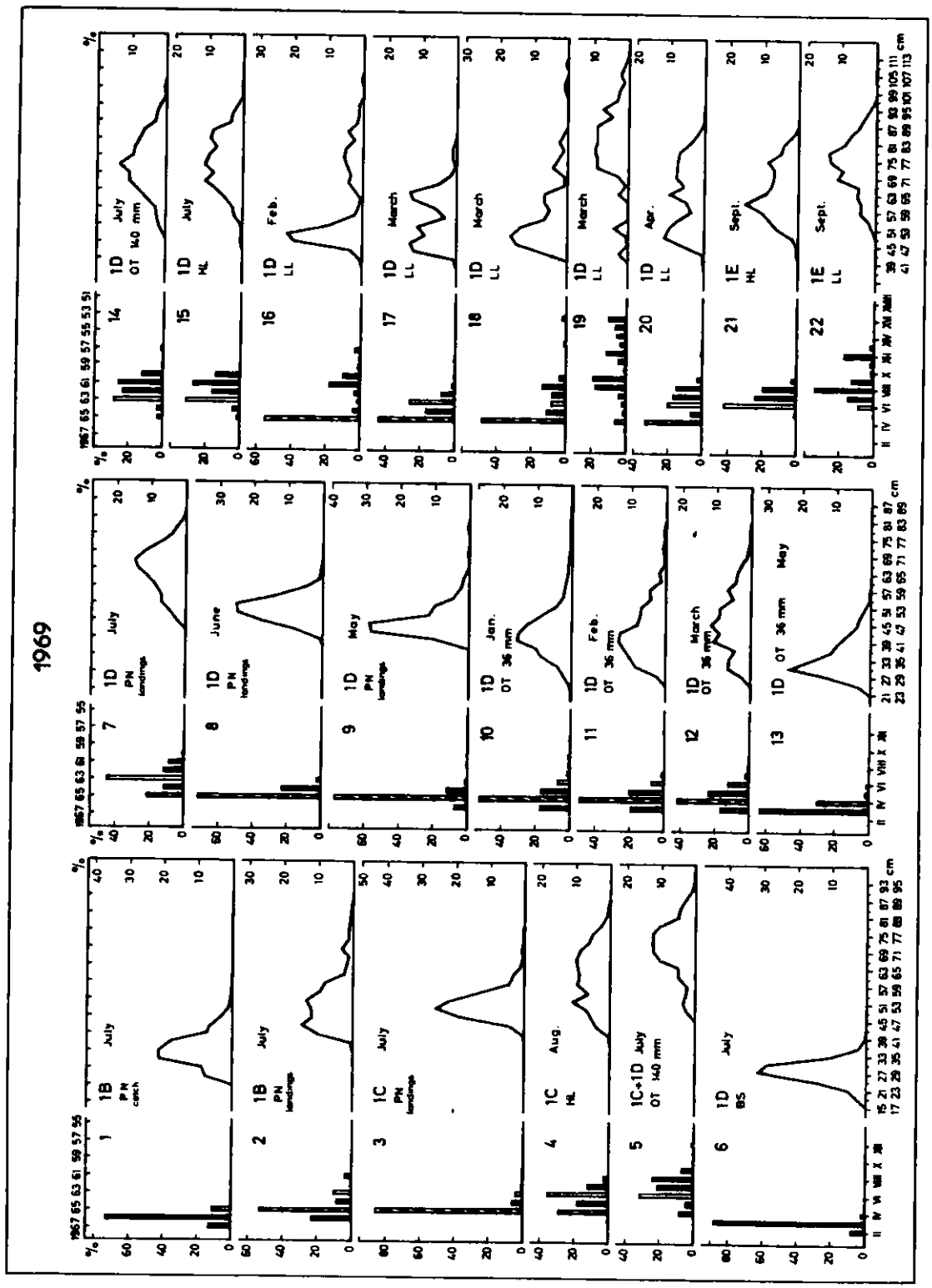

Fig.4. Age and length compositions of cod sampled by the fisheries investigations from research vessel (Samples 4, 6, 10–13, 15–22) or from commercial vessels (Samples 1–3, 5, 7–9, 14). BS = beach seine, HL = hand line, LL = long line, OT = otter trawl (mesh size in codend added), PN = pound net.

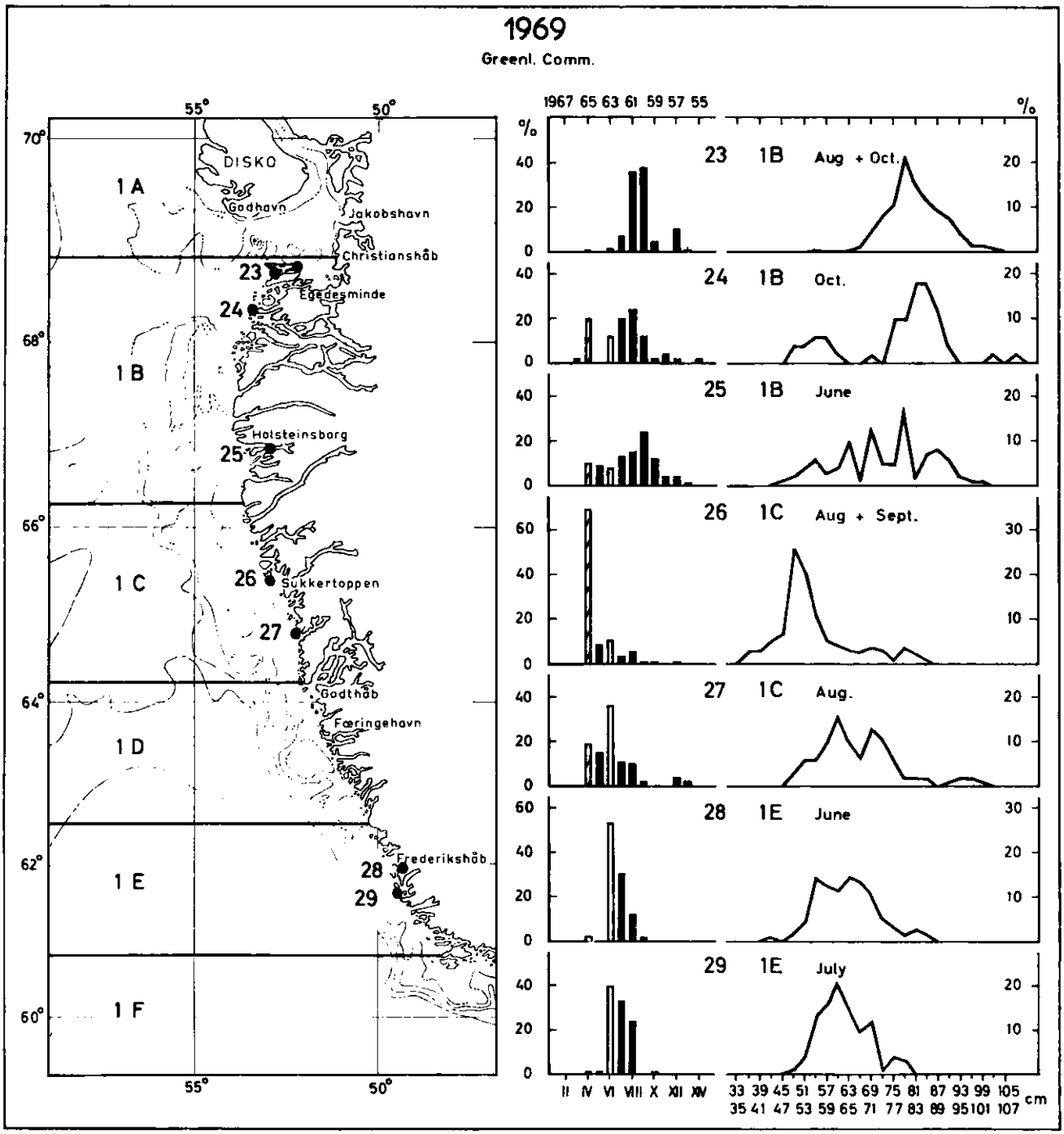

Fig. 5. Age and length compositions of cod sampled by Greenland fishermen from their commercial landings. Gear unknown, but not trawl.

III. German (FRG) Research Report, 1969

A. Subarea 1 and East Greenland

by A. Meyer and W. Lenz

A. Status of the Fisheries

Table 1 gives the nominal catch off West and East Greenland, taken by the fleet of the Federal Republic of Germany in 1962 to 1969. The catch varied during these years between 116,000 and 251,000 t. The considerable decrease in 1969 to 116,000 t was due to less fishing activity in Subarea 1.

I. Subarea 1

The fishing activity of German trawlers off West Greenland in 1969 decreased by 44%, the catch dropped by 49% from 146,000 t to 75,000 t, which makes up only 37% of the maximum output in 1963. Most (95%) of the total catch were caught during the first 7 months, mainly from April to July. Cod made up 90%. Redfish made up 9% and was caught mainly in the southern Div.1F.

This unexpected decrease in effort and catch was due to the lucrative catches off Labrador up to 10 April (see section B, Subareas 2-5) and the unusual heavy flow of ice northward to Banana Bank in May to July which blocked the whole coast and often all parts of the banks. Thus there was no possibility to repeat the very profitable pelagic fishery of 1968 on post-spawners in the Frederikshaab-Danas Bank area. Several factory trawlers left West Greenland and worked off East Greenland, Iceland, and in the northeast Atlantic. In July the fishery in Subarea 1 ended. The fleet of factory trawlers left for the herring fishery in Subarea 4 and 5 (see section C, Subareas 4 and 5). During the last 3 months of the year some fresh fish and freezer trawlers returned to Subarea 1, fishing mainly in the southern divisions, but only with moderate success.

II. East Greenland

Off East Greenland ice also hampered the fishery, but not in as large a scale as off West Greenland. Therefore, for the first time, several factory trawlers moved to the eastern side of Greenland. Thus the catch off East Greenland increased by 53% to 40,500 t, of which 35% consisted of cod and 61% of redfish. The average daily catch was nearly the same as in 1968.

III. Forecast for 1970

The output of the German fishery in Subarea 1 in 1970 will depend as in the preceding year on the catching possibilities off Labrador and on the ice conditions off West Greenland. During the first 3 months of 1970 the

fishing activity in Subarea 1 was very small due to the exceptionally good fishery off Labrador. In April ice again hampered the fishery, which caused the whole fleet to move for a short time to southeast Greenland. However, it appears that - as predicted by the German Hydrographic Institute - the quantity of ice, transported by the East Greenland Current in winter 1969/70 is less than in 1968/69. If, in May to July, the ice permits fishing with pelagic nets in Div. 1E on the shoals of postspawners in May to July, there might be a very high output because the stock of spawners returning from East Greenland and made up of the good year-classes of 1961, 1962 and 1963 is in rather good shape. As in the preceding years the fishery by the German trawlers probably will end in July with the onset of the slack period. Thus effort and catch in 1970 in Subarea 1 will again be smaller than during the period 1962 to 1968.

The total output of cod and redfish off East Greenland cannot be predicted because the magnitude of the fishery on the East Greenlandic banks depends on the market demand for fresh iced fish and on the ice situation which is subject to a great extent to the atmospheric situation. The prospects for the cod fishery during the first 5 months are good, due to the rather good size of the East Greenlandic stock of spawners (year-classes 1961, 1962 and 1963).

B. Special Research Studies

I. Environmental Studies

1. Hydrography. (by W. Lenz)

In March and October 1969 from the German R/V *Walther Herwig* some hydrographic sections were worked across the fishing banks off the Greenland coast. Temperature and salinity were measured by Nansen cast and bathythermograph.

In looking at the results one should keep in mind, that in summer 1968 the conditions were highly abnormal with negative temperature and salinity anomalies down to 500 m off the western slopes of the banks. But, due to summer heating at the surface and to increasing inflow of warm waters from the Irminger Sea the situation became roughly normal in November 1968. (F. Hermann, 1969).

March 1969: The hydrographic measurements from March 1969 represent the situation just before the extreme ice period 1969, when all fishing grounds off West Greenland were almost completely covered by ice, something which had not happened at least since 1925. A trend to this could already be observed in March 1969, because the ice frontier off East Greenland was mostly following the continental slope and around Cape Farewell it had moved as far as Noname Bank (normally the progress of ice stops off Cape Desolation).

Table 1. Subarea 1 and East Greenland. German nominal catches in tons (industrial fish included), 1962-1969

	Year	Days fishing	Cod	Catch per fish.day	% industrial	Redfish	Catch per fish.day	% industrial	Total	Catch per fish.day	% industrial
West Greenland (Subarea 1)	1962	6,584	133,404	20.3	5.1	57,902	8.8	5.2	200,932	30.5	7.7
	1963	7,175	152,934	21.3	4.2	44,355	6.2	4.7	202,923	28.3	8.6
	1964	5,639	107,982	19.1	7.7	22,956	4.1	10.0	137,794	24.4	10.9
	1965	5,882	107,127	18.2	13.3	18,476	3.1	10.3	131,445	22.3	14.7
	1966	4,696	82,928	17.7	12.8	14,911	3.2	6.1	102,029	21.7	13.1
	1967	6,305	137,773	21.9	9.1	13,600	2.2	3.0	155,606	24.7	9.4
	1968	5,819	132,498	22.8	5.3	11,858	2.0	1.8	146,432	25.2	5.3
	1969	3,234	67,431	20.9	4.0	6,964	2.2	5.2	75,293	23.3	4.3
East Greenland	1962	1,660	14,317	8.6	0.5	25,032	15.1	1.2	40,999	24.7	1.2
	1963	2,182	13,677	6.3	0.5	31,368	14.4	1.4	47,700	21.9	2.2
	1964	3,287	29,400	8.9	0.2	38,154	11.6	2.3	71,364	21.7	2.5
	1965	2,734	11,746	4.3	0.6	33,491	12.2	4.5	47,877	17.5	4.4
	1966	1,827	7,231	4.0	0.7	23,222	12.7	6.3	32,006	17.5	6.0
	1967	2,157	13,025	6.0	0.1	22,879	10.6	4.7	37,803	17.5	4.4
	1968	1,361	9,825	7.2	0.2	15,432	11.3	2.0	26,417	19.4	2.0
	1969	2,164	14,292	6.6	0.9	24,587	11.4	4.6	40,505	18.7	4.2
Total Greenland	1962	8,244	147,721	17.9	4.6	82,934	10.1	4.0	241,931	29.3	6.6
	1963	9,357	166,611	17.8	3.9	75,723	8.1	3.3	250,623	26.8	7.4
	1964	8,926	137,382	15.4	6.1	61,110	6.8	5.2	209,158	23.4	8.0
	1965	8,616	118,873	13.8	12.1	51,967	6.0	6.5	179,322	20.8	11.9
	1966	6,523	90,159	13.8	11.8	38,133	5.8	6.2	134,035	20.5	11.4
	1967	8,462	150,798	17.8	8.4	36,479	4.3	4.1	193,409	22.9	8.4
	1968	7,180	142,323	19.8	4.9	27,290	3.8	1.9	172,849	24.1	4.8
	1969	5,398	81,723	15.1	3.5	31,551	5.8	4.8	115,798	21.5	4.3

Table 2. Discarded fish in Subarea 1 in tons, 1969

	Cod	Redfish	Species unknown	Total
1C	134	18	19	171
1D	191	32	34	257
1E	27	20	33	80
1F	3	38	13	54
Total	355	108	99	562

Table 3. Average gross registered tonnage of German trawlers fishing in Subarea 1, 1969

1962	832 G.R.T.	(589 - 1561)
1963	864 G.R.T.	(566 - 1561)
1964	890 G.R.T.	(648 - 1561)
1965	1015 G.R.T.	(651 - 2557)
1966	1094 G.R.T.	(537 - 2557)
1967	1095 G.R.T.	(632 - 2557)
1968	1163 G.R.T.	(640 - 2557)
1969	1319 G.R.T.	(651 - 2684)

Figure 1 and 2 show the core of the southerly Irminger Current as a small but deep reaching band with maximum values of 6.7°C and 35.12°/oo. A branch of this current can be seen over the East Greenland shelf in Fig.1 overlain by the cold East Greenland Current. This was found earlier during the 1963 NORWESTLANT surveys. At the slope, water appears with the same T-S characteristic as the Northeast Atlantic Deep Water, which is found below 1000 m (NORWESTLANT - Atlas). But since the water further east has a lower density, the colder water at the slope must tend to sink, so that it comes from somewhere north rather than from the deeps. At the slope of the Discord Bank (Fig.2) no trace of this water is found any more. Off Discord Bank the core of the Irminger Current lies deeper than in the north and its temperature has decreased.

From Noname to Little Halibut Bank four sections were worked in the first half of March (Fig. 3-6). Comparable measurements in previous years were made usually about 4 weeks later in the year (J. Blindheim, 1967); F. Herman, 1969). Nevertheless, the temperature in the surface layer is similar to that in the spring of 1968, namely below 0°C with a salinity of less than 33.6°/oo down to 50 m. In the Irminger component of the West Greenland Current off the slope, the temperature exceeds 5°C from Noname to Little Halibut Bank. This is 0.5°C higher than in April 1968 and off Little Halibut Bank even more than a degree. If this is the result of the high values found in November 1968, then there has been warm water with high salinities throughout the whole winter, which caused a decrease of vertical convection and brought the temperatures at the surface to below -1°C, especially in the north, by winter cooling. This can also be the reason for the 0° isotherm running deeper to the north.

In the trough between the banks and the coast the waters show the same T-S characteristics as the waters off the slope, but at slightly greater depths.

October 1969: When the R/V *Walther Herwig* worked five sections from Cape Farewell to Holsteinsborg (Fig.7-11) in October 1969, many icebergs were seen on all banks south of Fyllas Bank. Off the southwest coast sometimes there were more than a hundred, a residue of the extreme ice conditions in spring and summer.

As a consequence of the continuous melting of the ice, temperatures below 0°C were found up to Fyllas Bank. The corresponding salinities decrease from 32°/oo at Cape Farewell to 31°/oo above Fyllas Bank . No sub-zero temperatures are reported for October 1968 (F. Hermann 1969). These abnormal surface conditions in 1969 have also influenced the temperature on the banks where on Frederikshaab and Fyllas Bank they are below 1°C.

The Irminger component off the western slope is again well developed as in the autumn of 1968. Off Holsteinsborg, however, temperatures and salinities are lower by 2°C and 0.2°/oo in the core than off Fyllas Bank. It can be assumed that temperature and salinity will soon increase on the northern banks.

In general, it might be said, that in the winter 1969/1970 the situation off West Greenland will be normal since off Cape Farewell temperatures and salinities are already similar to those for earlier years, except just off the coast. While the temperature exceeds 6°C, (6.4° in the core), the salinity does not reach 35°/oo. If this water with lower salinity will continue to flow northwards, it can result in an increase of vertical mixing with surface waters.

In March 1970 *Walther Herwig* worked again off West Greenland Temperature measurements from Fyllas Bank show the following differences to March 1969:

While the surface waters are slightly warmer (above -1°C, except near the coast), the 0° isotherm lies about 100 m and the 2° isotherm 150 m deeper. Indeed, this can be a result of the predicted increase in vertical mixing.

The core of the Irminger component is found at the same depth with the same temperatures of just over 5°C.

As in October 1967 (only 6 days earlier in the month) a north-south section through Davis Strait was worked along 58°00'W by *Walther Herwig* (Fig.12). From 300 m to the bottom the same front is found at exactly the same position (65°00'N) as in 1967; but the horizontal gradients are slightly smaller. In the interpretation of this section it has to be said that it cuts the front at an acute angle, because the general direction of the front is NNE to SSW at that latitude; farther north the front turns to the left. The westerly branch of the West Greenland Current in 1969 looks quite similar to that in 1967, although the upper 250 m shows more complicated mixing processes. The horizontal stratification of surface salinity might not be valid, since the salinities have not been measured continuously with depth like the temperatures have with the bathythermograph. Between 250 and 400 m a layer of warmer water (greater than 2°C) leads from the westerly branch to the northerly branch (see Fig.11) of the West Greenland Current, i.e. the separation of the two branches has not fully taken place yet.

References

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Lee, A. [Editor] Environmental Surveys - NORWESTLANT 1-3, 1963. *Spec. Publ. int. Comm.Northw.Atlant.Fish.*, No.7, 1968.

II. Biological Studies

The increased fishing in the two most southern Div. 1E and 1F is a new trend in the German fishery in Subarea 1. The output here increased from 27% of the total catch in Subarea 1 in 1967 to 42% in 1968, and 50% in 1969 despite the fishery on the southern ground being much more hampered by ice during the last two years than that on the northern grounds.

The greater availability of cod in the southern divisions is due, since 1956 to a considerable increase of the East Greenlandic stock of cod. While from 1945 to 1955 off East Greenland, only one good year-class (1945) appeared, several moderate to rich year-classes were born in the following eight years, namely in 1956, 1958, 1961, 1962 and 1963. Of these year-classes, the 1956 and especially that of 1961 achieved great commercial importance. After having reached maturity these rich year-classes also affected the fishery on the Icelandic spawning grounds (in 1964, 1968, and 1969). A substantial portion of each East Greenlandic year-class is transported as brood by the Irminger and East Greenland Current to Subarea 1 and grows up off South and Southwest Greenland. The northern boundary seems to lie at about 64°N (Fyllas Bank), and the West Greenlandic year-classes, born on the western slopes of the banks from about 62° to 64°30'N are mostly growing up on Fyllas, Little and Great Halibut Bank. Good West Greenlandic year-classes appeared nearly every 3 years (1947, 1950, 1953, 1957, 1960). But since 1960 only the probably moderate 1965 year-class has appeared. An interesting question - and important for the future of the Greenlandic fishery - is whether the increase in East Greenlandic year-classes and a possible decrease in West Greenlandic year-classes is a new trend, a trend which could be connected with the increase of atmospheric circulation in the Greenland area.

In 1969, 20,092 length measurements were made and 5,456 otoliths were taken. They showed that the 1961 year-class during its migration to the spawning grounds off East Greenland and during and after spawning was of greatest commercial importance in Div. 1E and 1F in January and February and off East Greenland in March to June (see Table 4). From May to July very little of this rich year-class could be fished as returning postspawners off Southwest Greenland. From the very successful pelagic fishery in 1968 on Frederikshaab and Danas Bank we know, that the postspawners migrate, mainly over the coastal side of the banks which in 1969 were all covered by ice. Thus the 1969 ice situation reduced considerably the effort on the mature part of the stock. The catches of the fleet (as observed on board of a factory trawler and from samples) on the western slopes of the banks consisted mainly of juvenile fish of the 1963 and 1962 year-classes.

R/V *Walther Herwig* made two trips to Greenland in March and October. The 1965 year-class was only found predominating on Little Halibut Bank and in some catches on Fyllas Bank. However, catches were very poor. No fish of this year-class were found off South Greenland. The predominant year-class in October on the southern banks was that from 1963. These 6-year-old fish are also well represented off East Greenland especially in the Heimland-Angmagssalik

area. However, the 1963 year-class does not nearly reach the importance of the 1961 year-class.

With the new egg-counting device, constructed by Schulz in the Hamburg Institute, the eggs collected off Southeast Greenland in March 1969 from cod of 66 to 96 cm were counted. The number of eggs varied between 0.5 to 4 million. Figure 13 shows that the number of eggs increase with the length of the fish. The average length of the spawners was 79.3 cm, which corresponds to an egg number per spawner of 1.3 million.

Table 4. Age composition of cod caught off Greenland, 1969
(R = research catch, C = commercial catch).

Division		Month	Year-classes													
			68	67	66	65	64	63	62	61	60	59	58	57	56	≤56
1 B	R	10	-	144	127	117	33	159	201	126	68	5	5	10	-	5
1 C	R	3	-	-	9	637	162	140	31	16	-	-	5	-	-	-
1 C	R	10	-	23	132	254	65	168	115	144	50	6	6	37	-	-
1 D	R	3	-	-	-	459	262	192	60	14	-	-	-	13	-	-
1 D	R	7	-	-	-	32	86	364	209	223	76	-	-	5	5	-
1 D	R	10	11	23	127	73	72	248	185	171	43	15	3	17	-	12
1 E	R	4	-	-	-	-	136	648	175	41	-	-	-	-	-	-
1 E	R	6	-	-	-	-	128	545	225	100	1	-	-	1	-	-
1 F	C	1	-	-	-	-	63	262	238	403	8	2	6	6	12	-
1 F	R	6	-	-	-	-	179	535	219	63	2	-	-	-	2	-
1 F	R	10	-	-	7	3	253	545	103	89	-	-	-	-	-	-
S.E.Greenland	C	2-4	-	-	-	-	13	86	176	535	84	22	21	30	12	21
Angmagssalik	R	4	-	-	-	6	92	219	171	501	11	-	-	-	-	-
Dohrn Bank	R	3	-	-	5	18	65	111	143	642	16	-	-	-	-	-

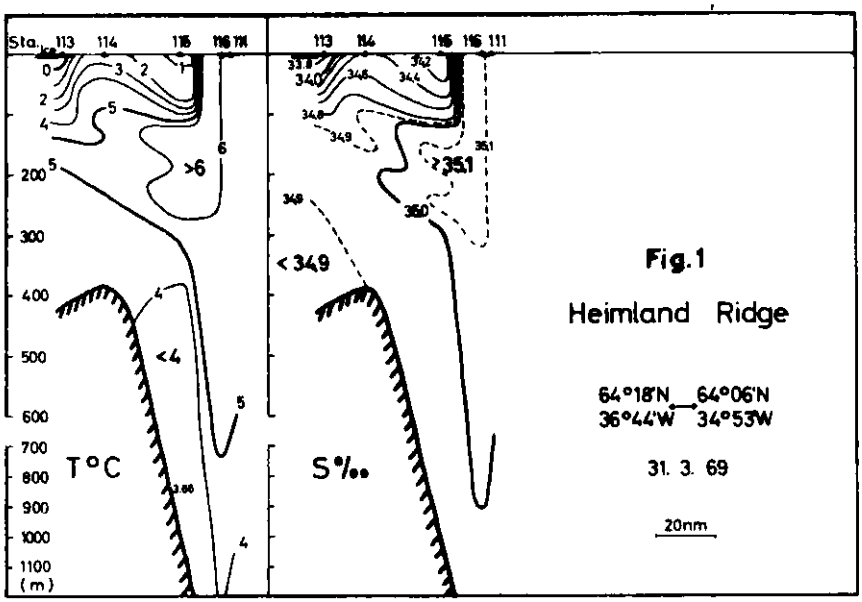


Fig.1

Heimland Ridge

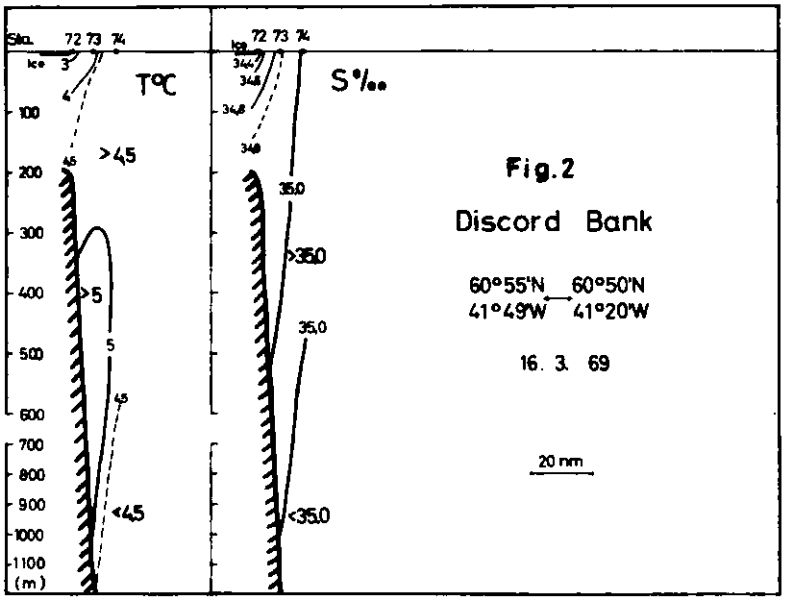


Fig.2

Discord Bank

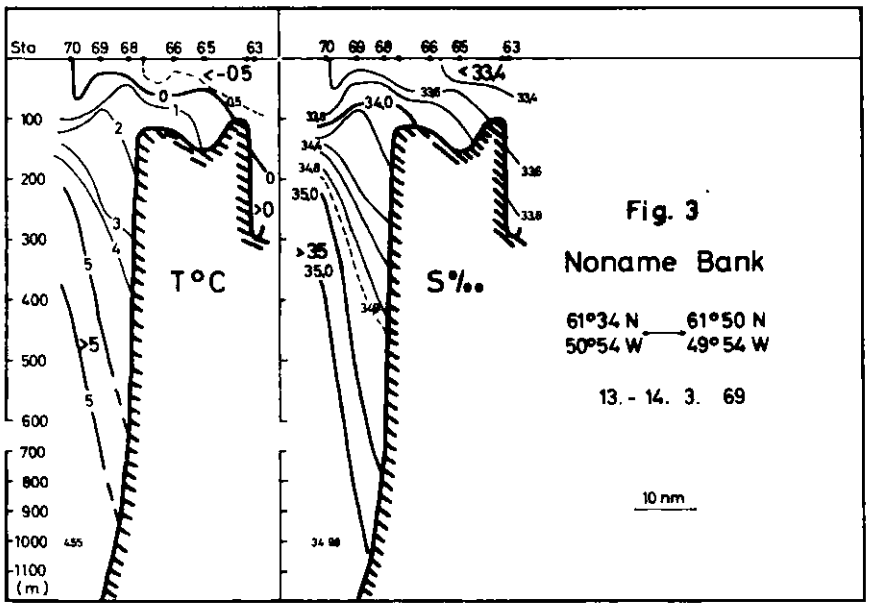


Fig. 3

Noname Bank

61°34 N ⟶ 61°50 N
50°54 W ⟶ 49°54 W

13. - 14. 3. 69

10 nm

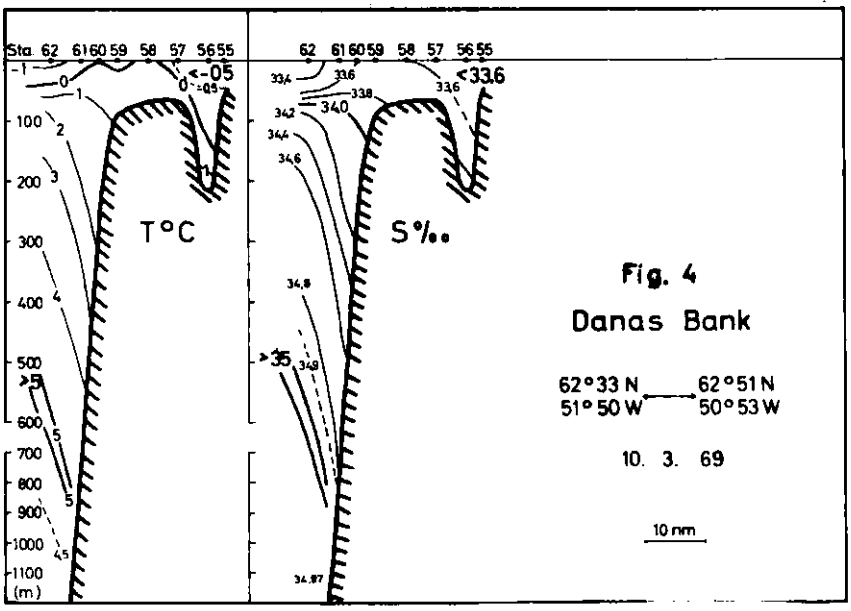


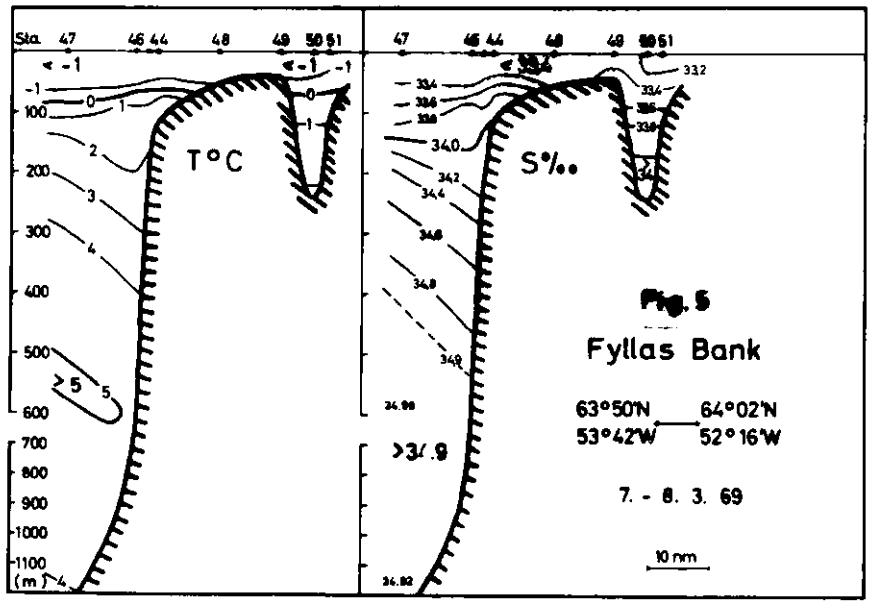
Fig. 4

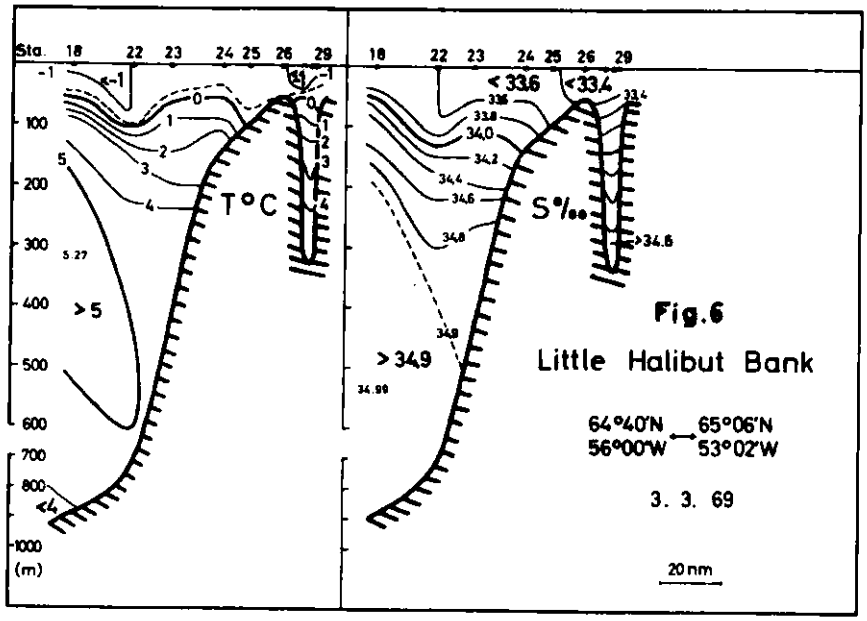
Danas Bank

62°33 N ⟶ 62°51 N
51°50 W ⟶ 50°53 W

10. 3. 69

10 nm


Sta. 47 46 44 48 49 50 51
T°C
S‰
Fig. 5
Fyllas Bank
63°50'N 64°02'N
53°42'W 52°16'W
7. - 8. 3. 69
10 nm


Sta. 18 22 23 24 25 26 29
T°C
S‰
Fig. 6
Little Halibut Bank
64°40'N 65°06'N
56°00'W 53°02'W
3. 3. 69
20 nm

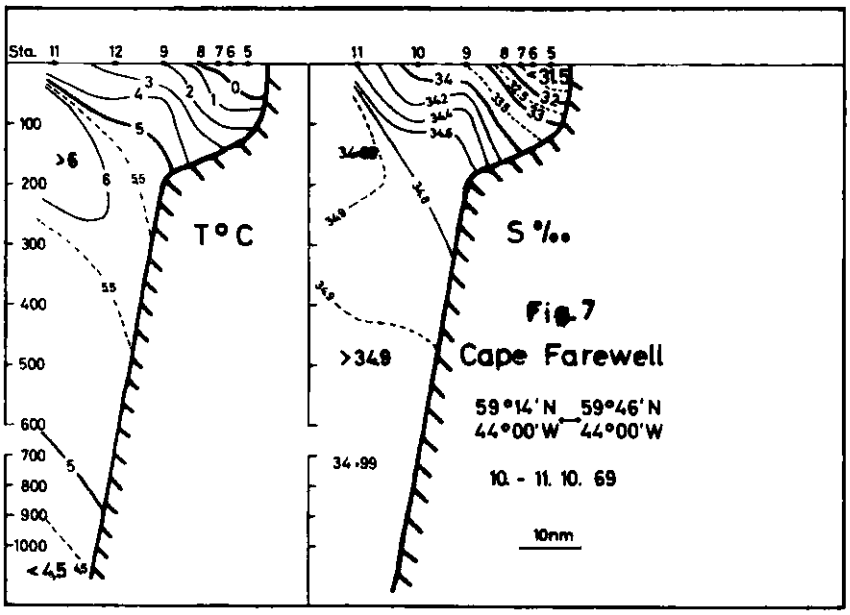

Sta. 11 12 9 8 7 6 5
11 10 9 8 7 6 5
T°C
S ‰
>6
<4,5
>34,9
34,99
Cape Farewell
59°14'N — 59°46'N
44°00'W — 44°00'W
10. - 11. 10. 69
10nm

Fig. 7

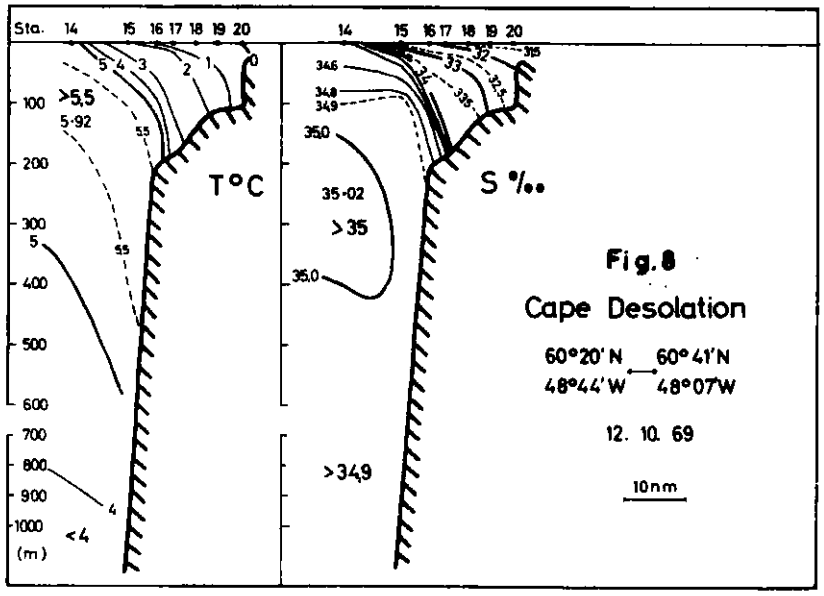

Sta. 14 15 16 17 18 19 20
14 15 16 17 18 19 20
T°C
S ‰
>5,5
5·92
35·02
>35
>34,9
<4
(m)
Cape Desolation
60°20'N — 60°41'N
48°44'W — 48°07'W
12. 10. 69
10nm

Fig. 8

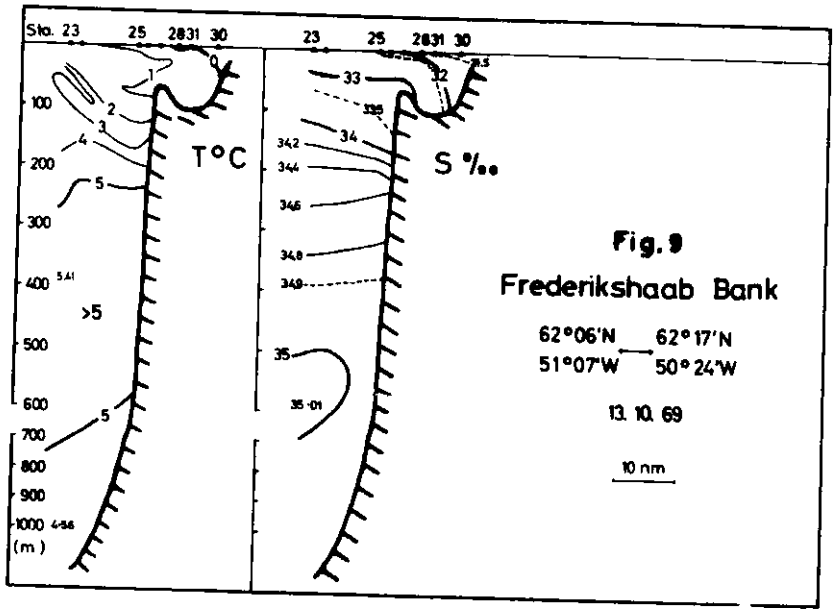


Fig. 9

Frederikshaab Bank

62°06'N ⟷ 62°17'N
51°07'W ⟷ 50°24'W

13. 10. 69

10 nm

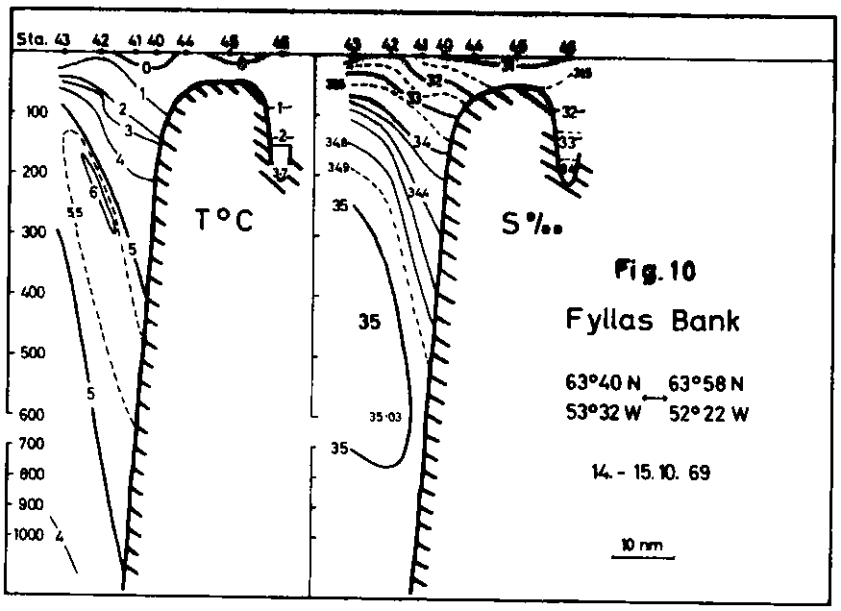


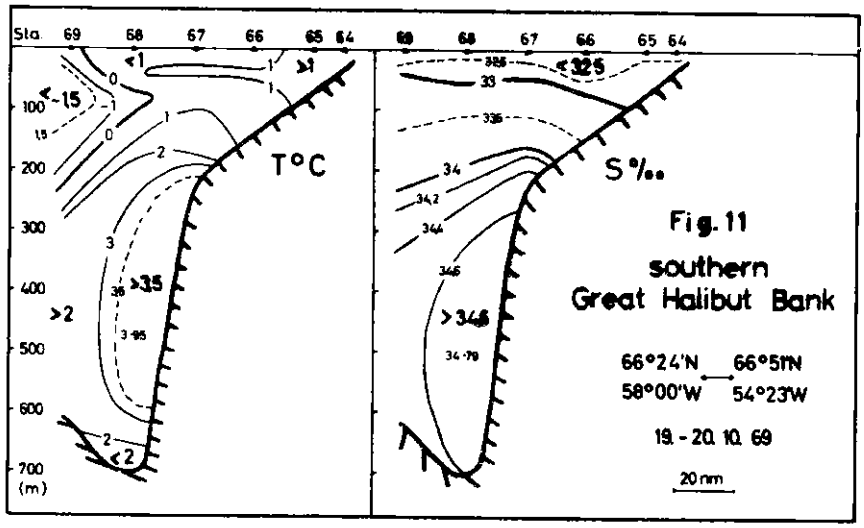
Fig. 10

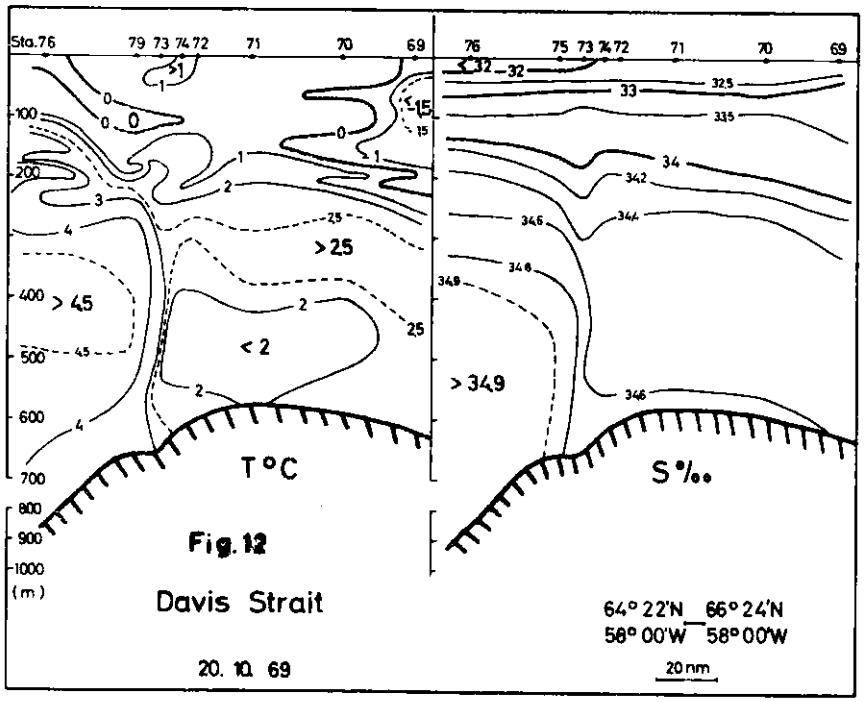
Fyllas Bank

63°40 N ⟷ 63°58 N
53°32 W ⟷ 52°22 W

14. - 15. 10. 69

10 nm


Sta. 69 68 67 66 65 64
T°C
S ‰
Fig. 11
southern
Great Halibut Bank
66°24'N 66°51'N
58°00'W 54°23'W
19. - 20. 10. 69
20 nm


Sta. 76 79 73 74 72 71 70 69
T°C
S ‰
Fig. 12
Davis Strait
20. 10. 69
64° 22'N 66° 24'N
58° 00'W 58° 00'W
20 nm

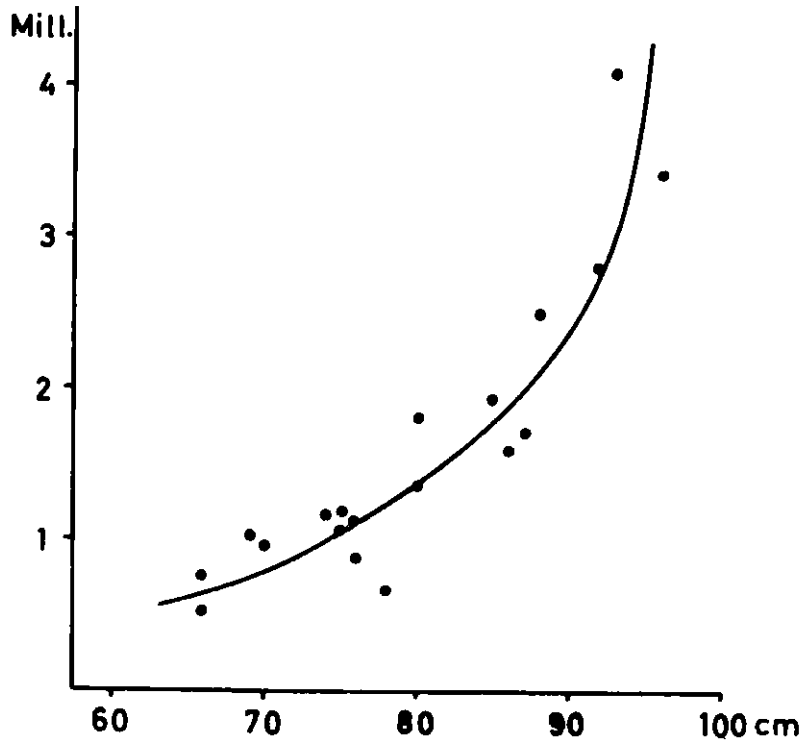


Fig. 13. Relation between quantity of eggs per ovary and length of the cod.

B. Subareas 2 - 5 (excluding herring)

by J. Messtorff

Subarea 2

A. Status of the Fisheries

Due to extremely good cod fishing conditions and increased fishing activity, the highest total catch hitherto arrived at by German trawlers off Labrador was taken in 1969. For comparison, the nominal catches of the last five years are given in Table 5.

Fishing took place from January to July. However, 87% of the total catch was taken during the main season from February to April, although the fishing operations were sometimes hindered by severe ice conditions. More than 70% of the catches were taken in Div. 2J. Division 2H was fished only in January and February. No catches were reported from Div. 2G. From May to July only mixed trips between Labrador and Greenland were recorded. As in the preceding year, 98% of the total catch consisted of cod.

There was no special redfish fishery. The small redfish by-catch was even less than 50% of the by-catch of other fish.

The percentage of industrial fish increased only slightly from 1968. However, the amount of discarded cod (Table 6) was 8-9 times greater than in 1968, indicating that a larger proportion of the catch was small cod, especially in Div. 2J.

B. Special Research Studies

I. Environmental Studies

Hydrographic sections were carried out by R/V *Walther Herwig* across Hamilton Inlet Bank (Div. 2J),on the same line as the Canadian standard section, in February (restricted on account of ice) and October and across the Labrador Current off Cape Chidley (Div. 2G) in October. The results are given in Messtorff and Lenz, Hydrographic Observations in Subareas 2-5, 1969 (ICNAF *Redbook* 1970, Part III).

II. Biological Studies

Studies on the Labrador cod stock were carried out during two cruises of R/V *Walther Herwig*. On account of ice in February, 1969, samples could only be obtained within the area of the commercial fishery at the slope of Hamilton Bank (Div. 2J). The mean length of cod was 57.2 cm and 5-8 year-old cod (year-classes 1961-64) were predominant. In October, 1969, the mean length of cod was found to be considerably lower with 39.8 cm in the same area and the fish were mostly 3-4 years old (year-classes 1965 and 66). At the same time, larger but less abundant cod were found in Div. 2H and 2G with mean lengths of 50.2 and 53.2 cm respectively.

Table 5. Subarea 2. German nominal catches in tons (1965-1969).
(including industrial fish = fish converted to fish meal on board).

		COD			REDFISH			OTHER FISH			TOTAL		
Year	Days fished	Catch	Catch per day fished	% industrial	Catch	Catch per day fished	% industrial	Catch	Catch per day fished	% industrial	Catch	Catch per day fished	% industrial
1965	1,323	41,556	31.4	13.3	2,891	2.2	1.2	1,151	0.9	60.0	45,598	34.5	13.8
1966	2,132	63,610	29.8	7.8	2,750	1.3	13.2	1,541	0.7	46.4	67,901	31.8	8.9
1967	1,251	30,589	24.5	8.4	1,616	1.3	17.1	310	0.2	80.0	33,115	26.5	9.3
1968	1,489	53,186	35.7	1.5	301	0.2	4.7	747	0.5	24.8	54,234	36.4	1.9
1969	2,099	71,735	34.2	3.4	400	0.2	28.5	1,088	0.6	25.8	73.223	34.9	3.8

Table 6. Discarded fish in Subarea 2 in tons, 1969
(1968 in brackets).

	COD	REDFISH	OTHER FISH	ALL SPECIES
Div.2H	905 (28)	17 (2)	207 (5)	1129 (35)
Div.2J	2362 (362)	40 (22)	565 (20)	2967 (404)
Total	3267 (390)	57 (24)	772 (25)	4096 (439)

Subarea 3

A. Status of the Fisheries

Only 257 tons of cod were taken from Div. 3K.

B. Special Research Studies

I. Environmental Studies

Two hydrographic sections across the Grand Bank, one at 47°N to Flemish Cap (Canadian standard section) and one southward to the southwestern slope, were carried out by R/V *Walther Herwig* in February 1969. The results are given in Messtorff and Lenz, *op. cit.*

II. Biological Studies

Cod and haddock were sampled for length and age composition by R/V *Walther Herwig* in February 1969, as follows:

Division	Species	Mean Length (cm)	Number
3L	Cod	49.5	245
3M	Cod	54.5	428
	Haddock	66.8	78
3O	Cod	55.0	295
	Haddock	46.4	367
3Ps	Cod	51.3	222
	Cod	55.4	2,406
	Haddock	43.6	432

Subarea 4

A. Status of the Fisheries

Except for herring there was no commercial fishery.

B. Special Research Studies

I. Environmental Studies

Two hydrographic sections across Cabot Strait between Cape Breton Island (Div.4Vn) and Burgeo Bank (Div. 3Ps), and two across Emerald Bank (4W), were carried out by R/V *Walther Herwig* in February and October, 1969.

The results are given in Messtorff and Lenz, *op. cit.*

II. Biological Studies

Cod and haddock were sampled for length and age composition by R/V *Walther Herwig* in February 1969 and silver hake in November 1969, as follows:

Division	Species	Mean Length	Number
4Vn	Cod	60.6	95
		49.2	1,477
		53.8	690
		57.3	794
		48.7	1,185
4Vs	Haddock	44.8	678
4W	Haddock	51.7	14
	Silver hake (see Res.Doc. 70/91)		-
4X	Cod	74.3	52
	Haddock	49.6	625

Subarea 5

A. Status of Fisheries

Except for herring, there was no commercial fishery.

B. Special Research Studies

I. Environmental Studies

Hydrographic sections across the eastern and western part of Georges Bank were carried out by R/V *Walther Herwig* in January, as well as in November 1969. The results are given in Messtorff and Lenz, *op. cit.*

II. Biological Studies

Length and age composition of silver hake (*Merluccius bilinearis*) and offshore hake (*M. albidus*) from the southern slope of Georges Bank (Div. 5Ze) were sampled by R/V *Walther Herwig* in January and November 1969. Both species were found in the same catches at almost equal numbers. Notes on their distinction are given by Mombeck in ICNAF Research Bulletin No. 8, 1971.

C. Subarea 4 and 5 (herring only)

by K. Schubert

A. Status of the Fisheries

A total of 29 freezer stern trawlers operated with pelagic nets in Subarea 4 (25) and Subarea 5 (29) from January to March, May and June to December mainly for herring. Figure 14 shows the operations from June to December. The total catch in 1969 in these two Subareas amounted to 90,941 tons. In Subarea 4 the catch was 6,949 tons in winter and spring and 14,474 tons in November/December. In late autumn it increased from 10,557 tons to 14,474 tons. This increase was due to a higher effort which increased from 191 to 464 fishing days. However, the catch per day showed a strong decline from 55.3 tons to 31.2 tons (43.6%).

In Subarea 5 the catch amounted to 69,518 tons (62,671 tons in 1968). The increase was due mainly to a higher effort which increased from 1,534 to 1,932 fishing days, whereas the catch per day decreased from 40.9 tons to 35.9 tons (12.9%). (Table 7).

Figure 15 shows the mean catch per day in baskets on an average of about 5 days from 11 German freezer trawlers in 31 trips.

B. Special Research Studies

To date 45 samples and 16,657 measurements from Subareas 3, 4 and 5 were investigated. These were taken from several factory ships and one research vessel.

From Div. 5Ze (Georges Bank) in July to November, 10 samples and 4,773 measurements were examined.

The average length fluctuated between 28.57 cm and 32.42 cm (Fig.16). The length range varied from 20.5 cm to 37.5 cm, with peaks at 28.0 cm (July), 25.5 cm, 28.5 cm, 30.5 cm (August), 29.0 cm (September), 26.0 cm, 31.5 cm (October) and 31.5 cm (November).

Maturity stage 4 was predominant in July, whereas in August the stages 5 and 4, in September stage 5 and in October stage 7 formed the bulk of the samples (Fig. 17). The spawning presumably took place from the middle of September to the middle of October.

The average number of vertebrae varied between 56.36 and 56.40, the average number of gillrakers fluctuated between 49.53 to 49.58 (Table 8). The meristic characters were the same as in 1968.

Table 7. Nominal catch, effort, catch-per-unit effort and discards of German factory freezer trawlers, Subareas 4 and 5, in 1969 (including industrial fish).

Subarea	4 Vn			4 Vs						4 W		4					
Month	XI	XII	Total	I	II	III	V	XII	Total	XII		Total					
Nominal catches (tons)																	
Herring	1664	5213	6877	2033	2060	2711	145	7597	14546	95		21518					
Total	1664	5213	6877	2095	2061	2712	145	7933	14946	192		22015					
Effort																	
Days fishing	40	138	178	37	38	52	6	286	419	10		607					
Catch per day (tons)																	
Herring	41.6	37.8	38.6	54.9	54.2	52.1	24.2	26.6	34.7	9.5		35.4					
Total	41.6	37.8	38.6	56.6	54.2	52.2	24.2	27.7	35.7	19.2		36.3					
Discards (tons)																	
Herring	-	-	-	-	5	-	-	-	5	-		5					
Total	-	-	-	-	5	-	-	-	5	-		5					

Subarea	5 Y						5 Ze							5 Zw			
Month	VIII	IX	X	XI	XII	Total	VII	VIII	IX	X	XI	XII	Total	VIII	IX	Total	Total
Nominal catches (tons)																	
Herring	1631	3077	1048	1633	2798	10187	1254	7258	16087	19607	10411	4028	58915	234	86	321	69423
Total	1681	3087	1050	1653	4006	11477	1259	7568	16134	19658	10495	4057	59171	236	86	322	70970
Effort																	
Days fishing	66	106	26	43	119	360	30	227	413	496	267	122	1555	8	9	17	1932
Catch per day (tons)																	
Herring	24.7	29.0	40.3	38.0	23.5	28.3	41.8	33.2	39.0	39.5	39.0	33.0	37.9	29.4	9.6	18.9	35.9
Total	25.5	29.1	40.4	38.4	33.7	31.9	42.0	33.3	39.1	39.6	39.3	33.3	38.1	29.5	9.6	18.9	36.7
Discards (tons)																	
Herring	9	4	14	-	-	27	-	40	21	251	-	-	312	1	0	1	340
Total	28	15	14	-	-	57	-	127	79	251	-	-	457	4	1	5	519

Table 8. Meristic characters of herring from different divisions of Subareas 3, 4 and 5, 1969 (VS = average vertebral count; Rf = average gillraker count)

Month	I-III	VII	VIII	IX	X	XI	XII	Division
VS		56.40(299)	56.40(198)	56.29(98)	56.36(466)			Georges Bank
Rf		49.53(298)	49.58(197)	49.53(100)	49.55(469)			5 Ze
VS		56.36(200)	56.42(523)	56.48(199)	56.31(293)	56.37(98)		Gulf of Maine
Rf		49.71(200)	49.68(477)	49.59(199)	49.56(300)	49.71(199)		5 Y
VS							56.33(98)	Blocks Island
Rf							49.63(100)	5 ZW
VS				56.40(81)				Sable Island
Rf				49.66(82)				4 W
VS	56.60(387)						56.62(198)	Misaine, Banquereau
Rf	49.57(331)						49.30(175)	4 Vs
VS						56.43(100)		St. Pierre
Rf						50.05(100		3 Ps

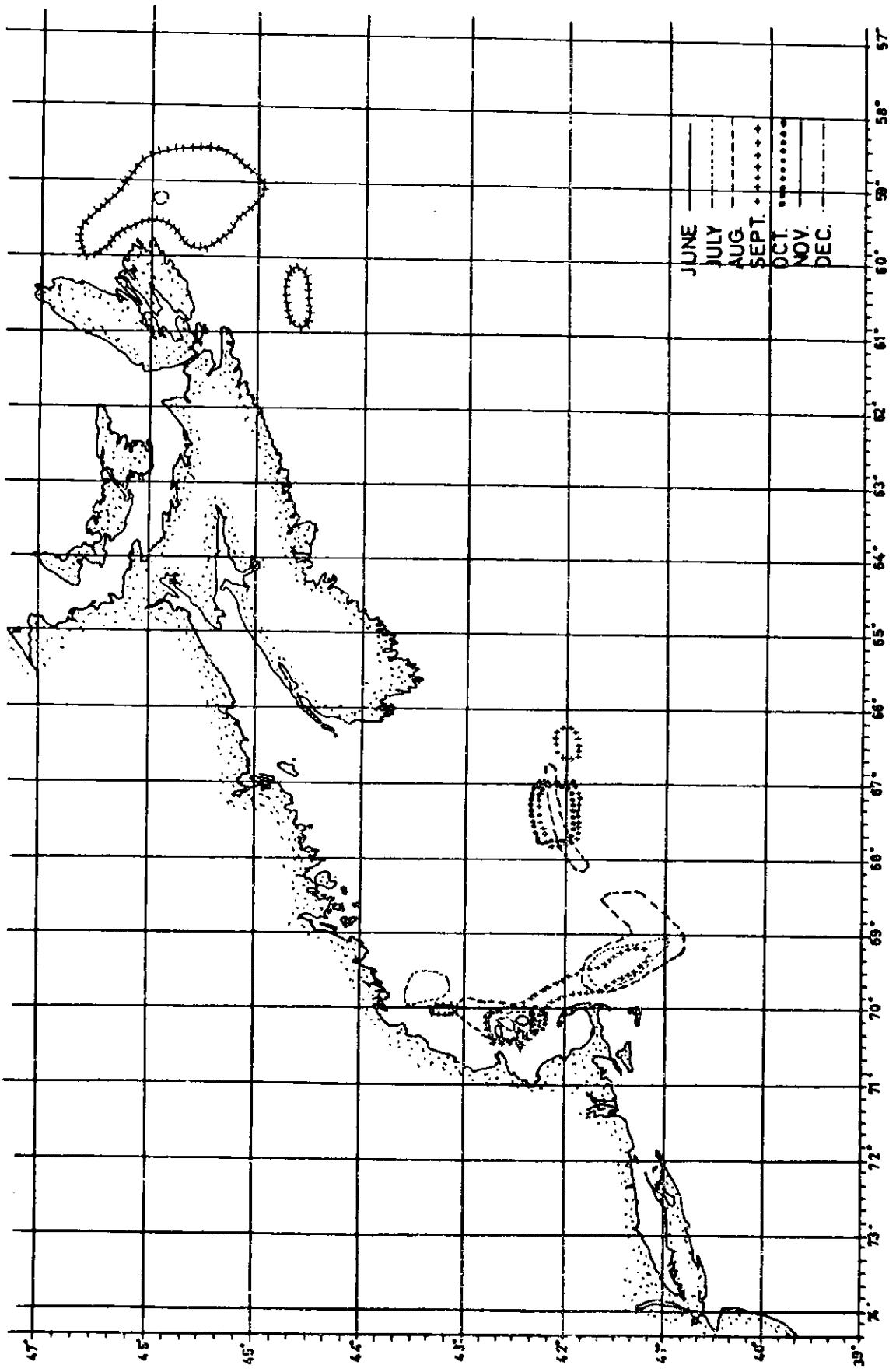


Fig. 14. Herring. Fishing area of German (Fed. Rep.) freezer trawlers in Subareas 4 and 5 (1969).

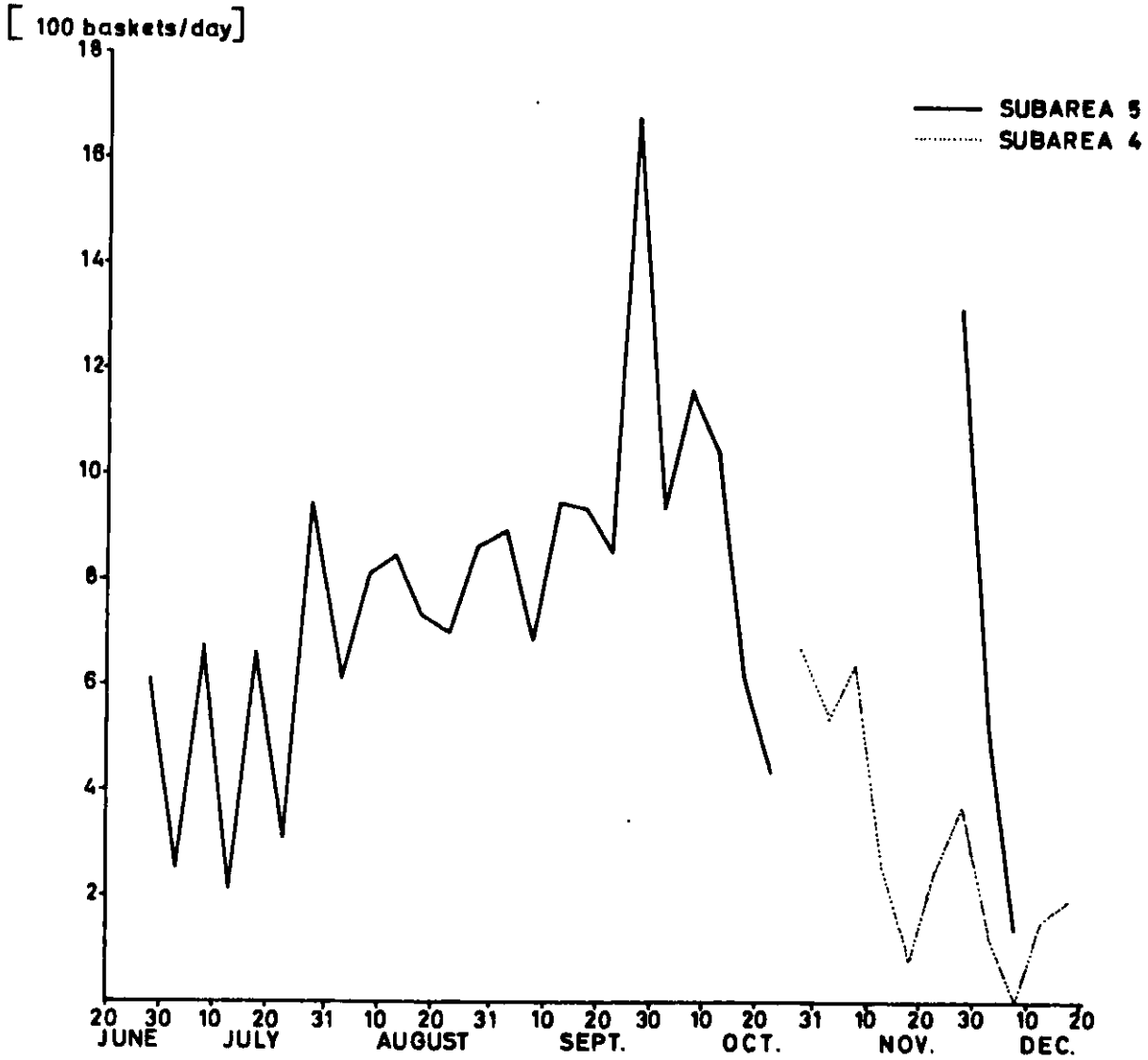


Fig 15. Herring. Catch per day (baskets) on an average of about 5 days of 11 German freezer trawlers in 31 trips.

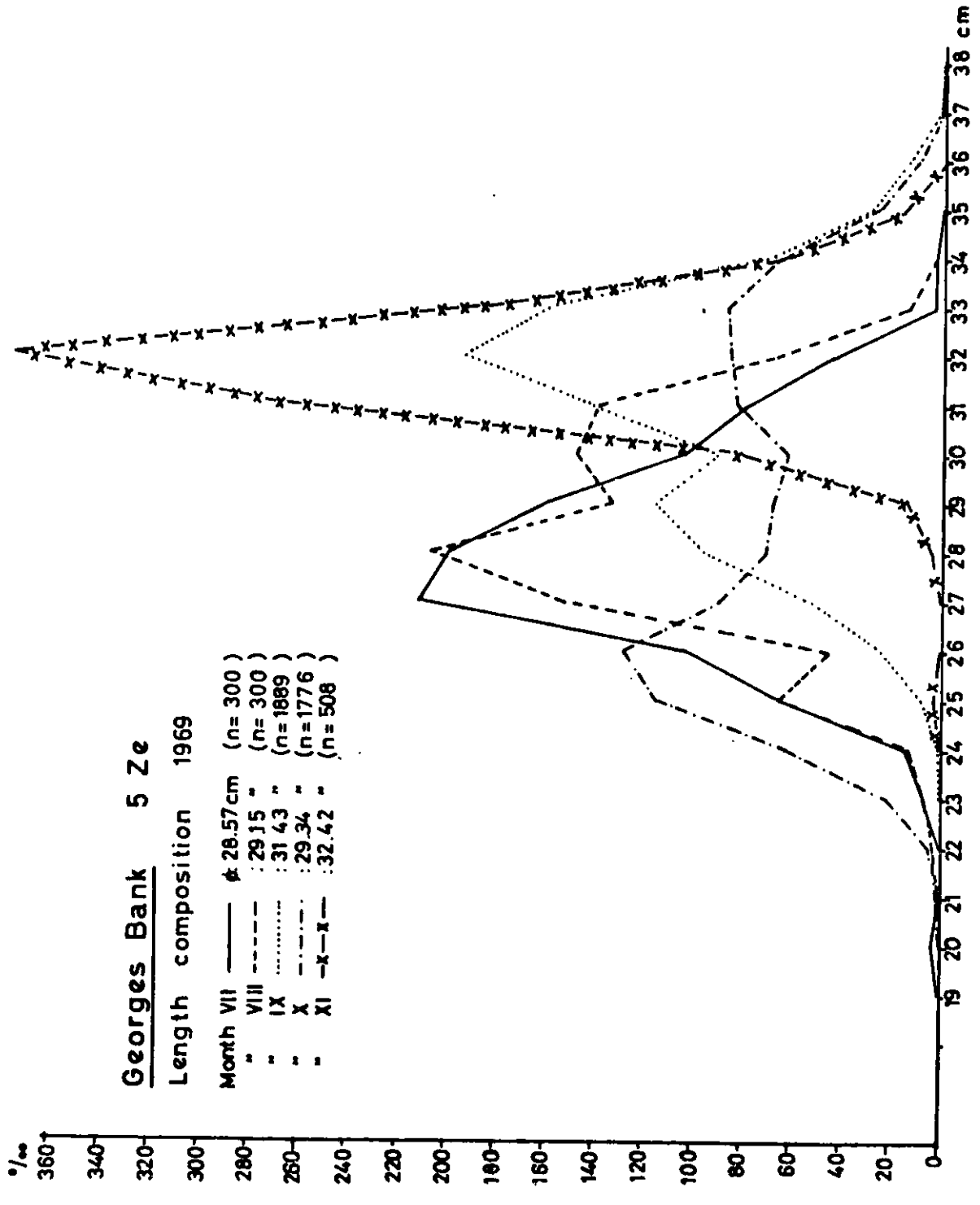

Georges Bank 5 Ze
Length composition 1969
Month VII ——— ø 28.57cm (n= 300)
" VIII - - - - - : 29.15 " (n= 300)
" IX ..... : 31.43 " (n=1889)
" X -.-.-. : 29.34 " (n=1776)
" XI -x-x- : 32.42 " (n= 508)
‰
cm

Fig. 16

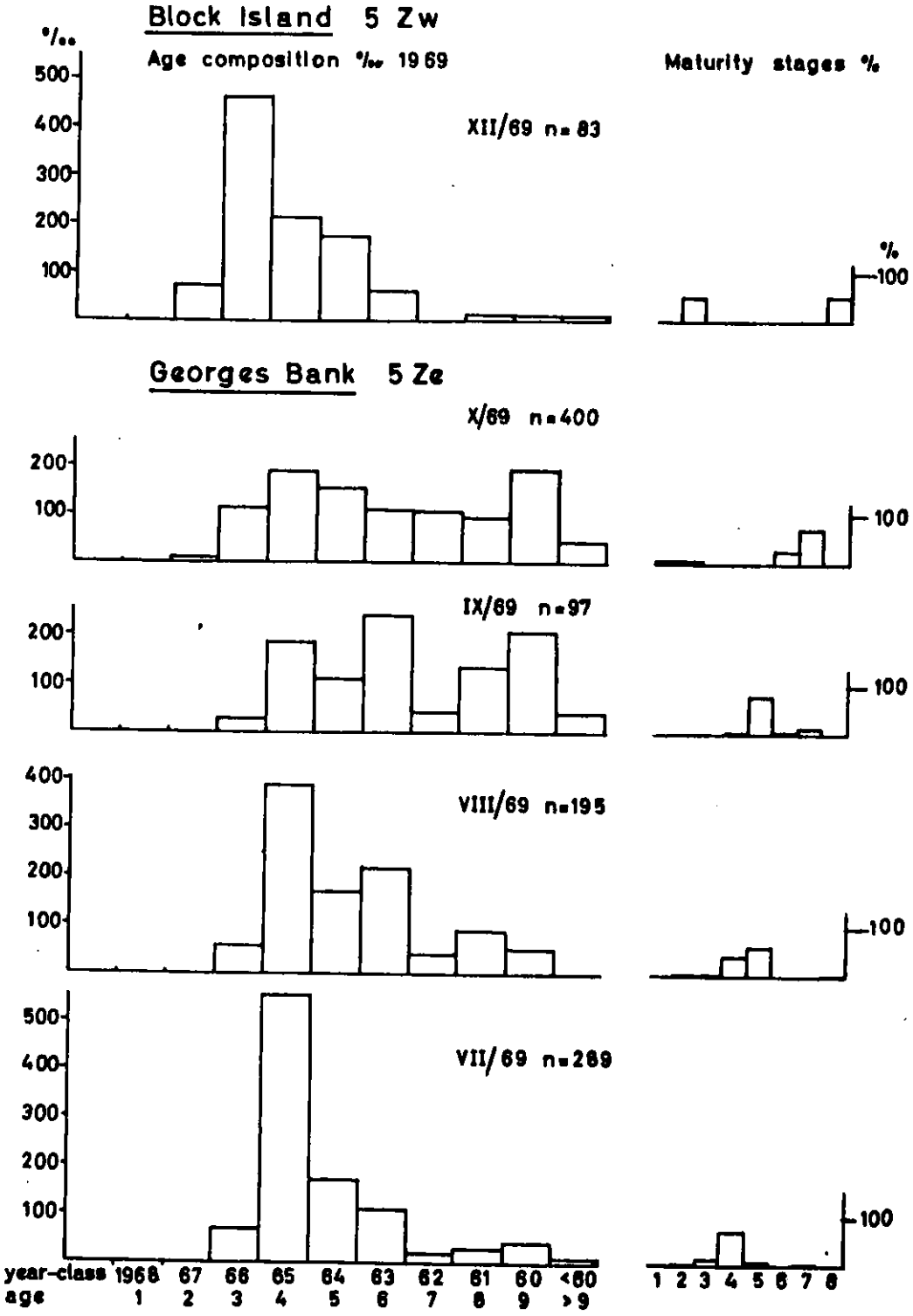

Block Island 5 Zw
‰
Age composition ‰ 1969
Maturity stages %
500
400
300
200
100
XII/69 n=83
%
100
Georges Bank 5 Ze
X/69 n=400
200
100
100
IX/69 n=97
200
100
100
400
300
200
100
VIII/69 n=195
100
500
400
300
200
100
VII/69 n=269
100
year-class 1968 67 66 65 64 63 62 61 60 <60
age 1 2 3 4 5 6 7 8 9 >9
1 2 3 4 5 6 7 8

Fig. 17

In July younger year-classes (1962-1966) formed the main part of the samples. The 1965 year-class (554°/oo) was predominant. In August the 1965 year-class (385°/oo) was dominant too, but the 1963 (215°/oo)and 1964 (170°/oo) year-classes were of some importance. In the next two months more older herring appeared in the samples. In September the dominant herring were from the 1963 (248°/oo), 1960 (207°/oo) and 1965 (186°/oo) year-classes, the 1961 (134°/oo) and 1964 (113°/oo) year-classes were important, too. October shows the predominance of the 1960 (190°/oo), 1965 (185°/oo), 1964 (155°/oo) year-classes, moreover the 1961-1963 (305°/oo) and 1966 (112°/oo) year-classes had some importance. The quota of herring older than 9 years was very small (Fig. 17).

From Div. 5Zw (Block Island) one sample from December was examined. The average length amounted to 27.36 cm. The length ranged from 20.0 cm - 33.5 cm (Fig.18). Maturity stages 8 and 2 were predominant (Fig.17).

From the meristic characteristics it seems that the herring in this area belong to a different stock from the Georges Bank stock. The differences are based on the higher average number of gillrakers. The average number of vertebrae was 56.33, of gillrakers 49.63 (Table 8).

The age composition shows the predominance of the 1966 year-class (458°/oo). The 1965 (205°/oo) and 1964 (169°/oo) year-classes were also important (Fig.17).

From Div. 5Y (Gulf of Maine) 32 samples and 3,146 measurements taken from July to December were investigated. The average length varied from 27.52 cm to 33.31 cm. The length ranged from 16.5 cm - 37.0 cm. From July to September larger herring were in the samples, from October to December the share of the smaller herring increased. (Fig. 19).

In July maturity stage 4 was dominant, in August and September stage 5, whereas in October stages 7 and 2 were found in the samples (Fig. 20). From the meristic characteristics it seems that in the different months different stocks were in the Division. In July, August and November herring with higher average of gillrakers were found in the samples (49.68-49.71), whereas in September and October herring with characteristics (49.56-49.59) from Div. 5Ze inhabited this area (Table 8).

The age composition in July is composed of more older herring than that of Georges Bank. The dominant year-classes are 1961 (217°/oo), 1960 (190°/oo), 1964 (147°/oo), 1963 (142°/oo) and 1965 (114°/oo). In August and September the composition is similar. The 1960 (219°/oo respectively 321°/oo), 1961 (174°/oo/173°/oo), 1963 (207°/oo/133°/oo), 1964 (127°/oo/103°/oo) and 1962 (114°/oo/130°/oo) year-classes are dominant. In October and November the age composition changed. More younger fish were in the samples. The 1966 (331°/oo/375°/oo) year-class was predominant. The 1960 (148°/oo/139°/oo) and 1963 (115°/oo/125°/oo) year-classes were important in both months. In October the 1963 (115°/oo), 1964 (115°/oo) year-classes and in November 1965 (111°/oo) were important. (Fig.20).

Block Island 5 Zw

Length composition 1969

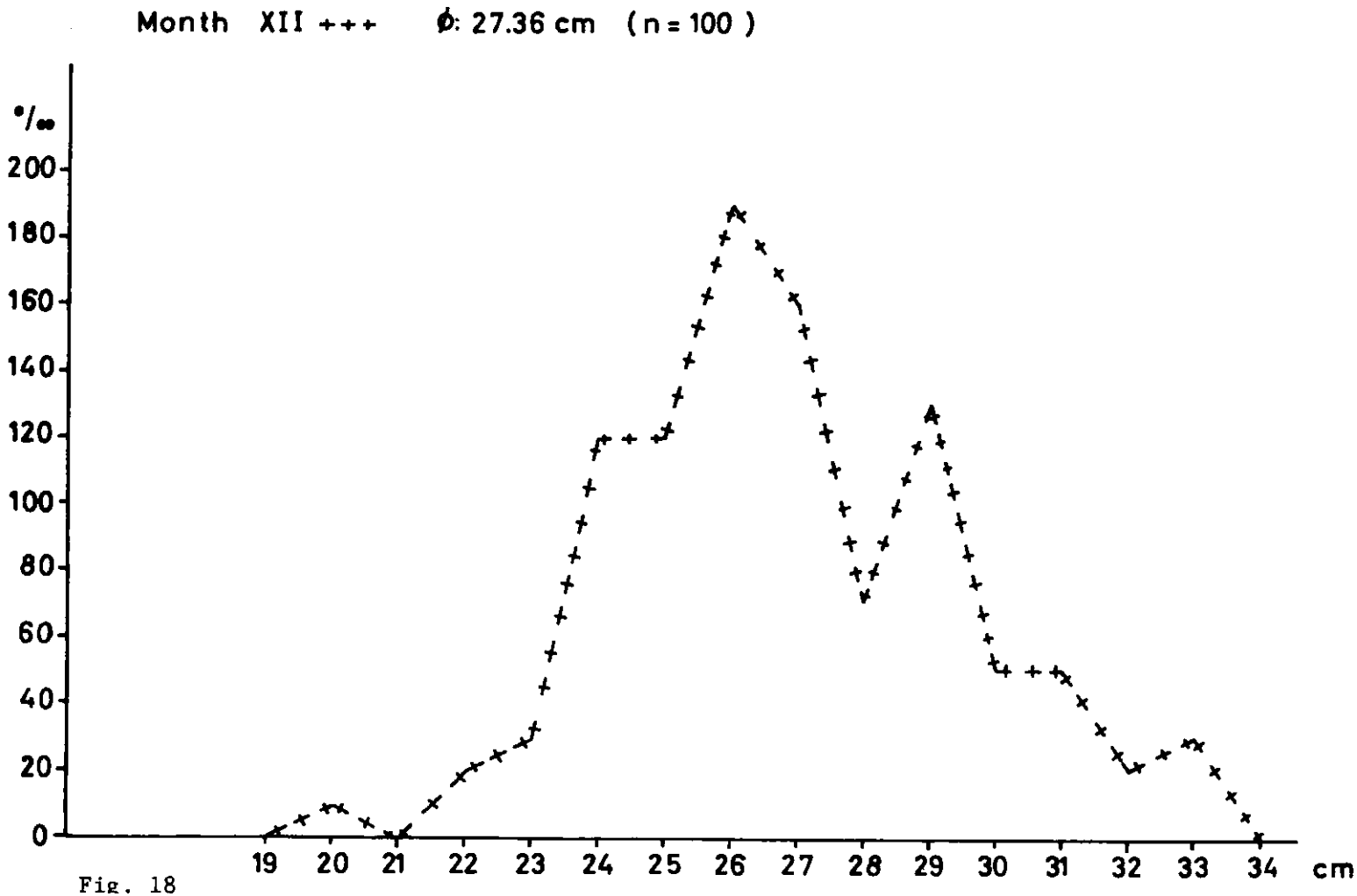


Fig. 18

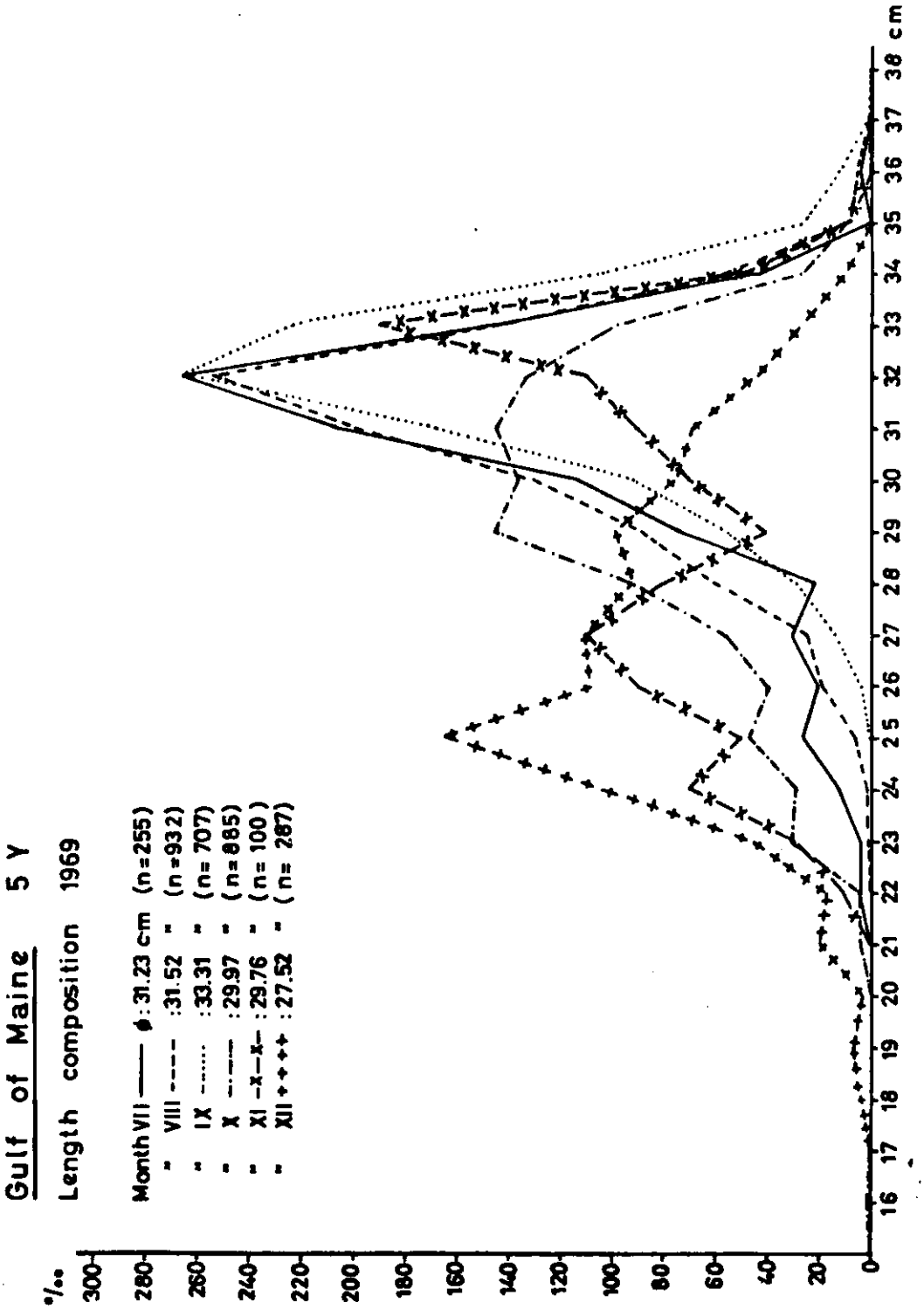

Gulf of Maine 5 Y
Length composition 1969
‰
Month VII —— ø: 31.23 cm (n=255)
" VIII ---- :31.52 " (n=932)
" IX ..... :33.31 " (n=707)
" X -.-.- : 29.97 " (n=885)
" XI -x-x- : 29.76 " (n=100)
" XII +++ : 27.52 " (n=287)
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 cm

Fig. 19

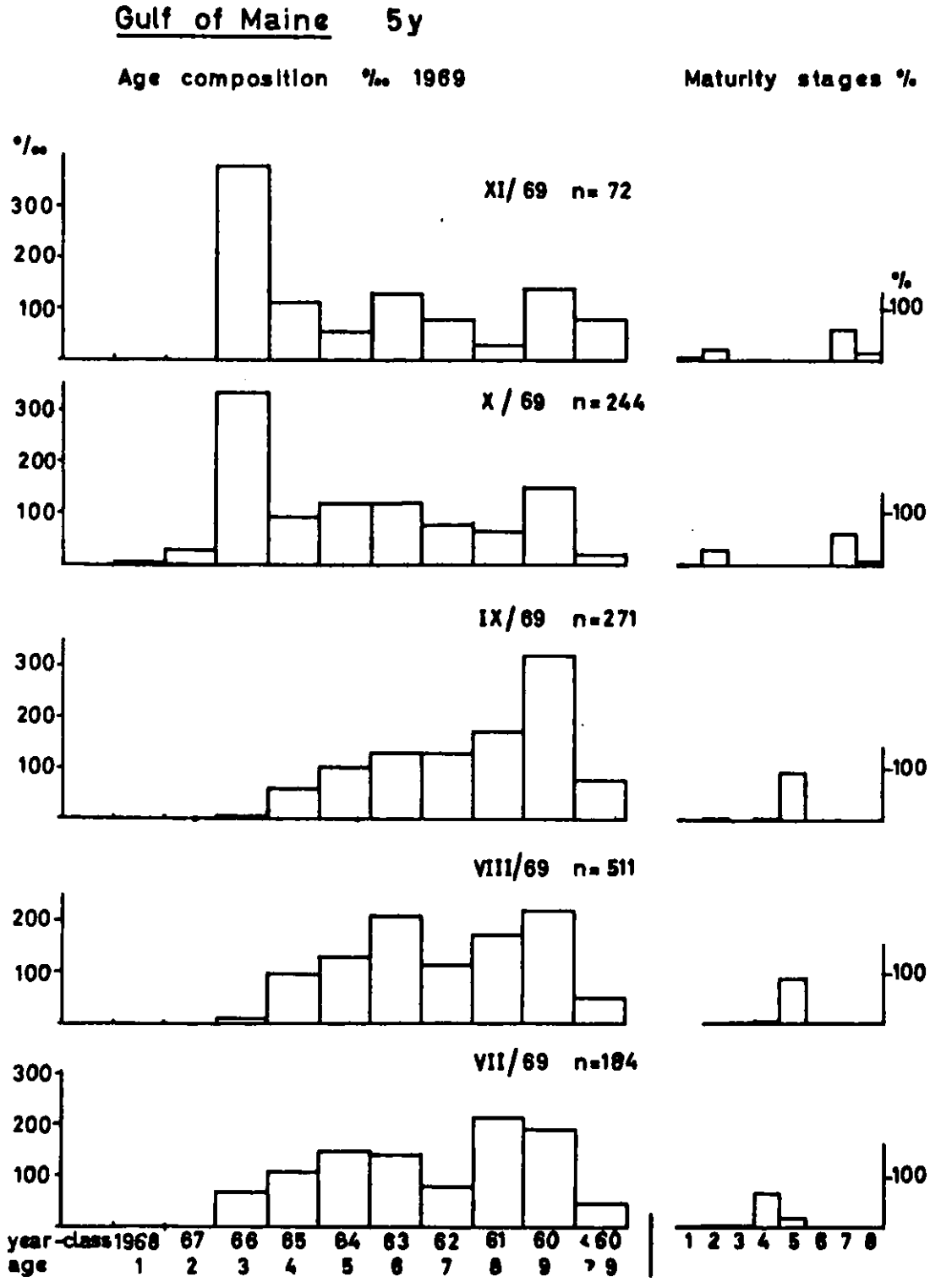

Gulf of Maine 5y
Age composition ‰ 1969
Maturity stages %
‰
300
200
100
XI/69 n= 72
X / 69 n=244
IX/69 n=271
VIII/69 n= 511
VII/69 n=184
%
100
year-class 1968 67 66 65 64 63 62 61 60 <60
age 1 2 3 4 5 6 7 8 9 >9
1 2 3 4 5 6 7 8

Fig.20.

From Div. 4W (Sable Island) in September and November came two samples and 895 measurements. The average length was 30.70 cm in September and 32.63 cm in November. The length ranged from 26.0 cm - 38.5 cm. The peak of the curves was in both months 31.0 cm. The portion of smaller herring was higher in September whereas in November more larger herring were present (Fig.21). The maturity stages 5 and 7 were dominant (Fig. 22).

The average number of vertebrae was 56.40, of gillrakers 49.66. This herring does not belong to the stock from Div. 5Ze. (Table 8). The age composition showed the predominance of the 1963 (263°/oo) and 1964 (231°/oo) year-classes. The 1961 (138°/oo), 1960 (123°/oo)and 1965 (123°/oo) year-classes were also of some importance (Fig. 22).

In Div. 4Vs (Misaine Bank-Banquereau) in January, February, March and December, 6 samples and 1,119 measurements were investigated.

From January-March the average was 33.61 cm. The length ranged from 21.0 cm to 40.0 cm. In December the average length was 34.33. The length in this month ranged from 26.0 cm to 38.0 cm. Mainly large herring were in the Div. 4Vs. (Fig.23).

From January to March and in December stage 8 was predominant, some admixture of stage 1-5 were also present (Fig. 22).

From the meristic characteristics it seems that in the months of January, February and March and in December, two different stocks were in the area. They had a high average number of vertebrae (56.60/56.62), but they were different in their average number of gillrakers (49.57, respectively 49.30). (Table 8).

The year-classes older than 1960 (681°/oo/675°/oo) were predominant in both periods. Also the 1960 year-class had some importance. The portion of all other year-classes was small (Fig.22).

From the Div.4Vn (Cape Breton, Scatari) only 948 measurements from October (391 herring) and November (557 herring) are available. The average length in October was 32.11 cm, in November 31.81 cm (Fig.24).

From Div. 3Ps (St.Pierre) one sample from November was examined. The average length amounted to 30.63 cm (Fig.25). Maturity stages 8 and 2 were dominant (Fig.22).

The meristic characteristics showed a low average number of vertebrae (56.43), but a high average number of gillrakers (50.05). (Table 8). The year-classes older than 1960 (270°/oo) had the largest share, but also the 1966 (216°/oo), 1965 (135°/oo), 1963 (135°/oo) and 1964 (108°/oo) year-classes had some importance (Fig.22).

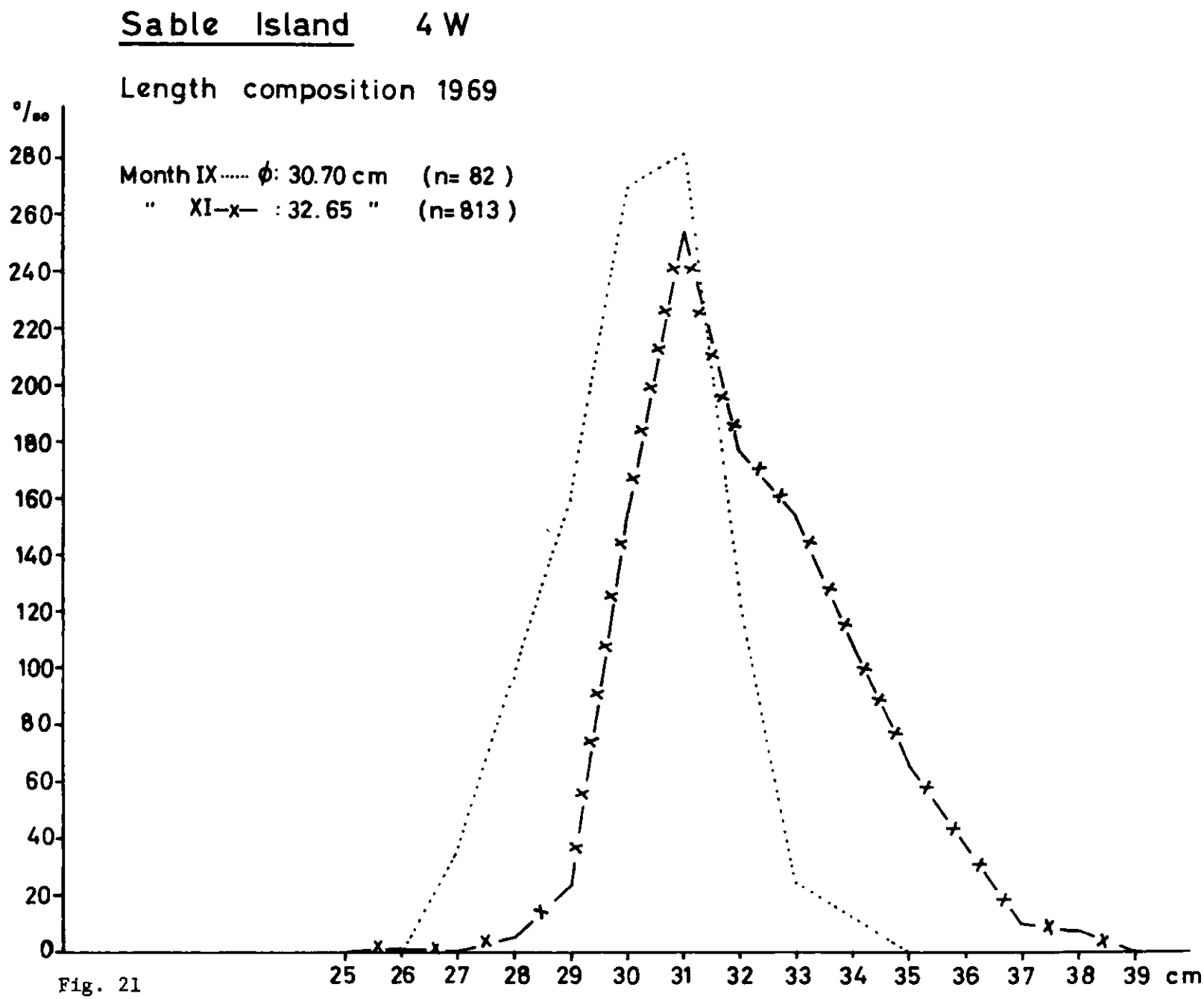

Sable Island 4 W
Length composition 1969
°/oo
Month IX ..... ϕ: 30.70 cm (n= 82)
" XI–x– : 32.65 " (n=813)
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 cm

Fig. 21

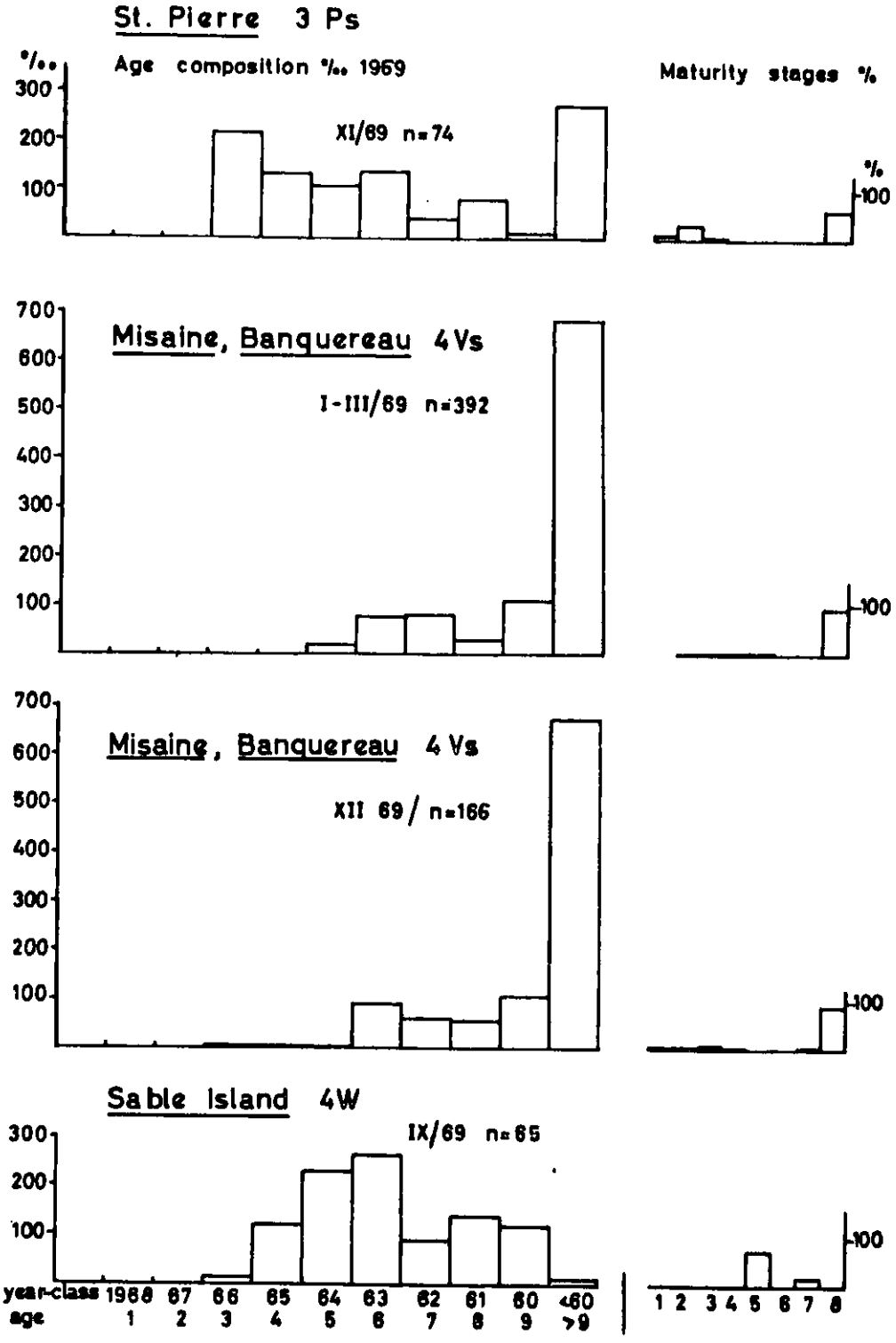

St. Pierre 3 Ps
‰
Age composition ‰ 1969
Maturity stages %
300
200
100
XI/69 n=74
%
100
700
600
500
400
300
200
100
Misaine, Banquereau 4Vs
I-III/69 n=392
100
700
600
500
400
300
200
100
Misaine, Banquereau 4Vs
XII 69 / n=166
100
Sable Island 4W
IX/69 n=65
300
200
100
100
year-class 1968 67 66 65 64 63 62 61 60 <60
age 1 2 3 4 5 6 7 8 9 >9
1 2 3 4 5 6 7 8

Fig.22

Misaine, Banquereau 4 Vs

Length composition 1969

Month I-III —— ϕ: 33.61 cm (n=1119)
" XII ++++ : 34.33 " (n= 200)

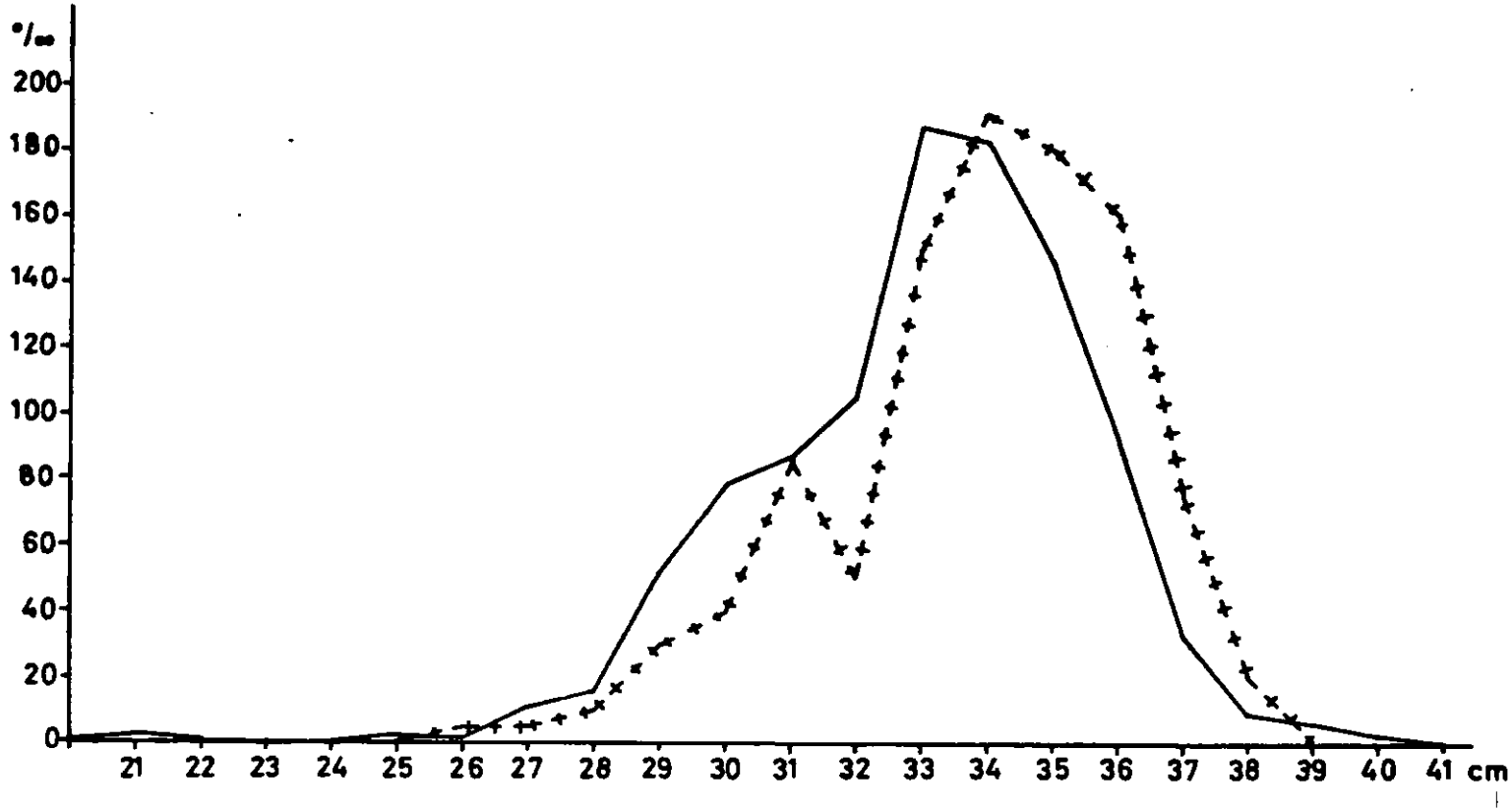


Fig. 23

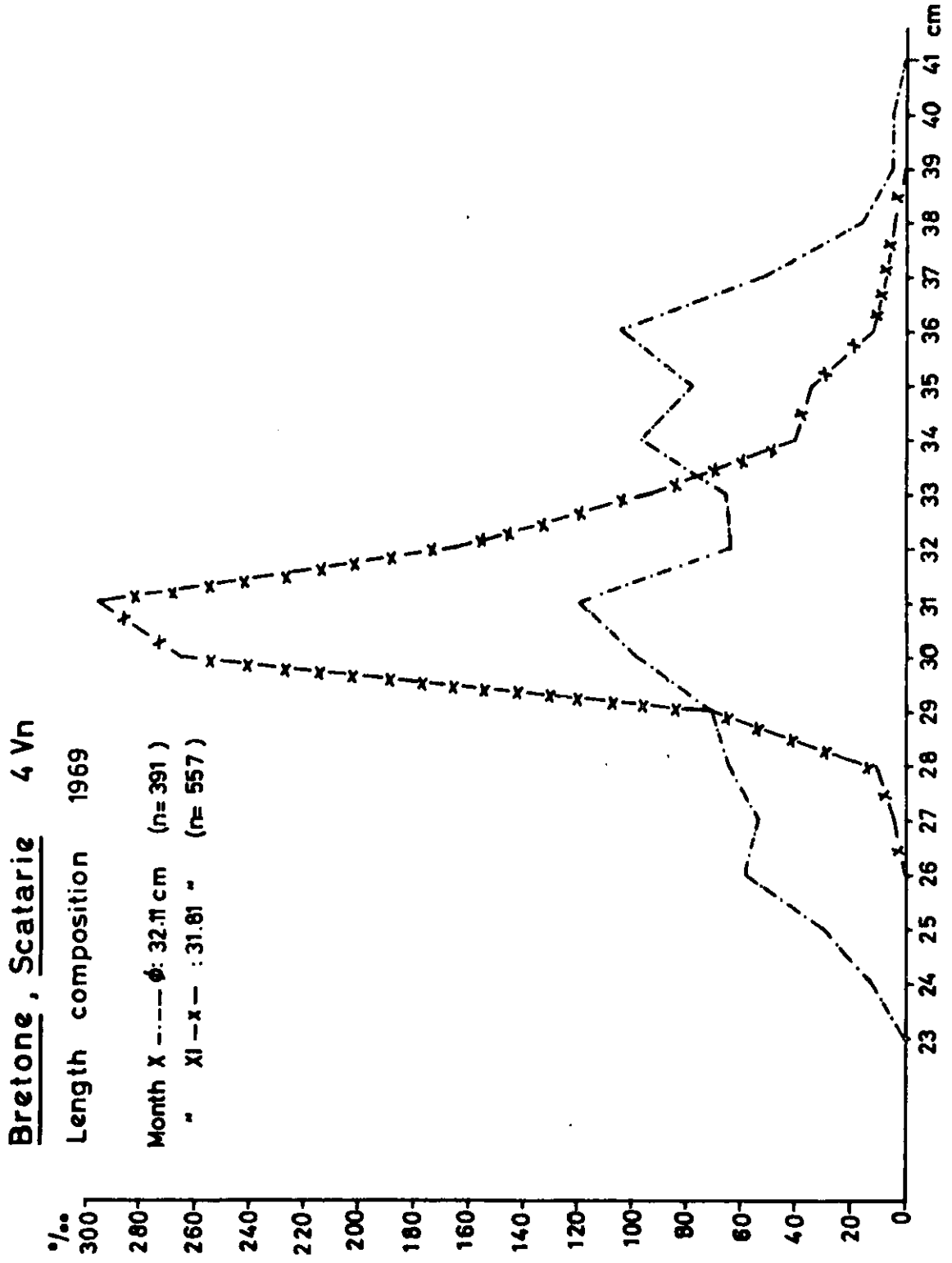

Bretone , Scatarie 4 Vn
Length composition 1969
Month X -·-·- ϕ: 32.11 cm (n= 391)
" XI —x— : 31.81 " (n= 557)
‰
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 cm

Fig. 24

St. Pierre 3 Ps

Length composition 1969

Month XI —x—x— ϕ: 30.63 cm (n= 100)

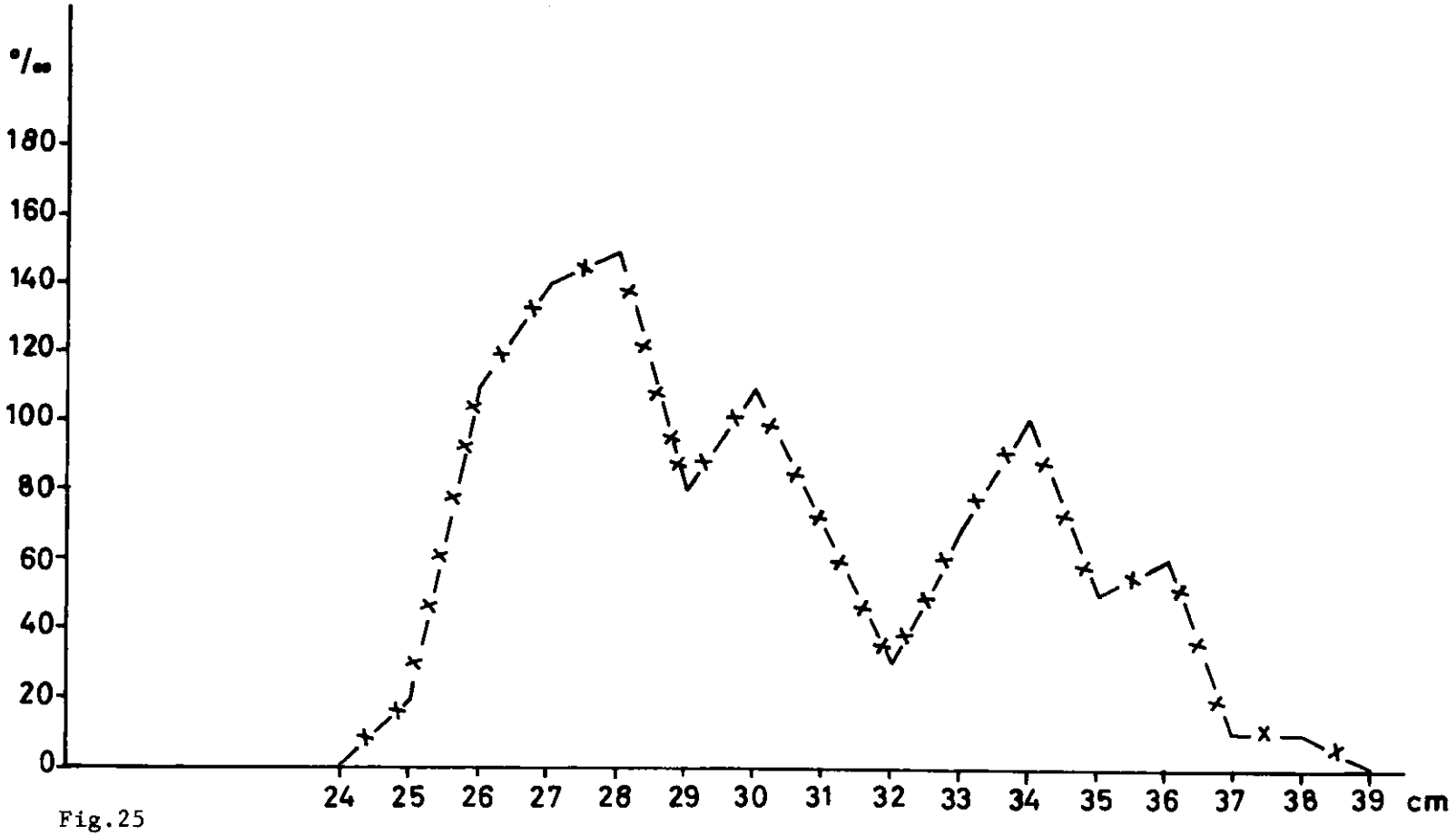


Fig.25

IV. Icelandic Research Report, 1969

by Jon Jonsson

Subarea 1 and East Greenland

A. Status of the Fisheries

The Icelandic fishery for cod and redfish in the ICNAF area in 1969 was on a very low level.

Icelandic trawlers only fished for a total of 242 trawling hours in Div. 3K. The total amounted to 87 tons of cod and 294 tons of redfish.

One boat fished with gillnets in Div. 1D. It spent 85 days at sea landing in Iceland 365.4 tons of cod caught in June, July, August and September.

At East Greenland 11 Icelandic trawlers caught 3,441 tons of cod and 4,251 tons of redfish in 1969. The total number of trawling hours in this area was 3,480.

Icelandic long-liners made 16 trips to East Greenland. The total amount of fish landed was 1,034 tons. Of this, 652 tons were cod, 174 tons tusk and 93 tons redfish.

B. Special Research Studies

I. Biological Studies

Several samples of cod are available of landings from trawlers fishing in this area, mainly from the Angmagssalik area and the Fylkisbank. The age distribution and average lengths of the various age-groups in these samples is shown in Table 1.

Table 1. Age and length of cod landed from Icelandic trawlers fishing at East Greenland 8 April - 16 June 1969
(A = Angmagssalik; F = Fylkisbank)

	A		F		A		A		F	
	8-11 April		30 April		3-4 May		5-14 May		14-16 June	
Age	%	cm	%	cm	%	cm	%	cm	%	cm
4	1.0	44.5					1.0		1.0	53.0
5	13.0	61.0	4.1	56.3	17.3	61.5	17.5	59.3	21.2	57.6
6	26.4	71.5	18.4	67.9	21.4	65.0	34.0	68.3	38.4	62.9
7	26.4	72.5	15.3	72.1	21.4	69.8	20.6	71.3	17.2	69.8
8	27.5	80.9	52.0	78.8	32.7	76.6	17.5	79.1	18.2	74.0
9	3.1	86.3	2.0	80.5	2.0	83.5	6.2	82.0	2.0	70.0
10	1.0	87.0	4.1	85.5	2.0	81.5	1.0	96.0	1.0	
Total	193		98		98		97		99	

The fishery was mainly based upon the year classes from 1961, 1962 and 1963, which is in quite good accordance with the age distribution in the commercial fishery in 1968. The 1961 year-class was especially abundant on the Fylkisbank in April and the age distribution is in good agreement with the age distribution of the cod on the Icelandic spawning grounds at the same time.

The 1961 year-class was far more numerous on the Icelandic spawning grounds in 1969 than could be expected from experimental trawlings in Icelandic waters in recent years, so it is good reason to believe that a substantial part of it was of East-Greenlandic origin.

Subarea 5

A. Status of the Fisheries

One boat carried out fishery for herring with purse seine in Div.5Ze in the months January to October. The catches were highest in July-September. The total herring landed amounted to 12,786 tons.

V. Norwegian Research Report, 1969

by Erling Bratberg

Subarea 1

Norwegian fisheries research was carried out off West Greenland from 19 April to 7 May. Four hydrographic stations were worked, and bottom long-line with equal numbers of No.2, 4 and 6 hooks was used at 10 stations (Fig.1).

A. Status of the Fisheries

I. Cod

1. Age and length composition of the commercial stock. In 1969, the 1961 year-class still dominated in the Norwegian research vessel catches by bottom long-line with No.6 hooks, but it has decreased from 34.4% in 1968 to 28.7% in 1969. The 1960 year-class has increased in strength since last year, from 9.2% to 15.2%, but this increase is most probably temporary as this year-class in 1966 and 1967 constituted 42.2 and 31.6% of the catch respectively. Older year-classes play a minor part in the total catch, only 8.4%. The promising 1963 year-class has decreased considerably, from 24.6 to 11.4%. The 1965 year-class seems to be a bit promising as it has increased from less than 1% in 1968 to 17.7% in 1969 (Fig. 2).

The total research vessel catch on bottom long-line, No.2, 4 and 6 hooks combined, shows nearly the same picture as the total catch on No.6 hooks (Fig. 3).

Figure 4 shows the length composition of the catch on No.6 hooks. The mean length is 69.2 cm. The mean length on No. 2, 4 and 6 hooks combined was 71.2 cm. These mean lengths are considerably higher than in 1968 when they were 64.2 and 65.3 cm respectively.

2. Forecast for the cod fisheries. The commercial Norwegian bottom long-line catches off West Greenland will also in 1970 most probably be dominated by the 1961 year-class, but this year-class is nevertheless expected to decrease. The younger year-classes will probably constitute more than 50% of the total catch. The mean length in the catches is expected to be approximately the same as in 1969.

B. Special Research Studies

I. Environmental Studies

1. Hydrography. Between 19 and 24 April four hydrographical sections were worked. (Fig. 1). The ice conditions were very severe and the two innermost stations of the section off Nunarsuit had to be omitted. Further, the whole section across Frederikshaab Bank and the innermost and the two outermost stations in the section off Sukkertoppen were omitted due to ice.

The sections across Dana Bank and across Fylla Bank are shown in Fig. 5 and 6. The distribution of temperature and salinity show that the Arctic component of the West Greenland current was well developed also in 1969. The Irminger component of the current seemed to have the same strength as in 1968, and temperatures above 5°C were observed only in the section off Sukkertoppen.

The mean temperature based on observations at the standard depths between 0 and 50 m at five eastern stations in the section across the Fylla Bank was -0.86°C. This mean temperature indicates a weak tendency in increasing temperatures in the surface layers compared with 1967 and 1968 when the corresponding means were -0.95 and -0.91°C respectively. However, compared with the ten year mean 1959-1968, -0.04°C, the temperature is still very low.

II. Biological Studies

1. Cod eggs. Sampling of cod eggs with a Juday net was carried out on all the stations. The preliminary examination of the sampled material indicates a poor result of the spawning as very few cod eggs were found, and as most of the cod had completed the spawning.

2. Cod distribution. Pelagic shoals of cod were not registered. The bottom long-line fishing showed relatively good concentrations only on the southwestern slope of Lille Hellefisk Bank.

III. Selection Experiments

Selection experiments with No. 2, 4 and 6 hooks on bottom long-lines were carried out on all the fishing stations. The results (Table 1) confirm the results from the two previous years and indicate that the greatest number and smallest fish are caught on the No.6 hooks, and that the smallest number but greatest lengths are found on the No. 2 hooks.

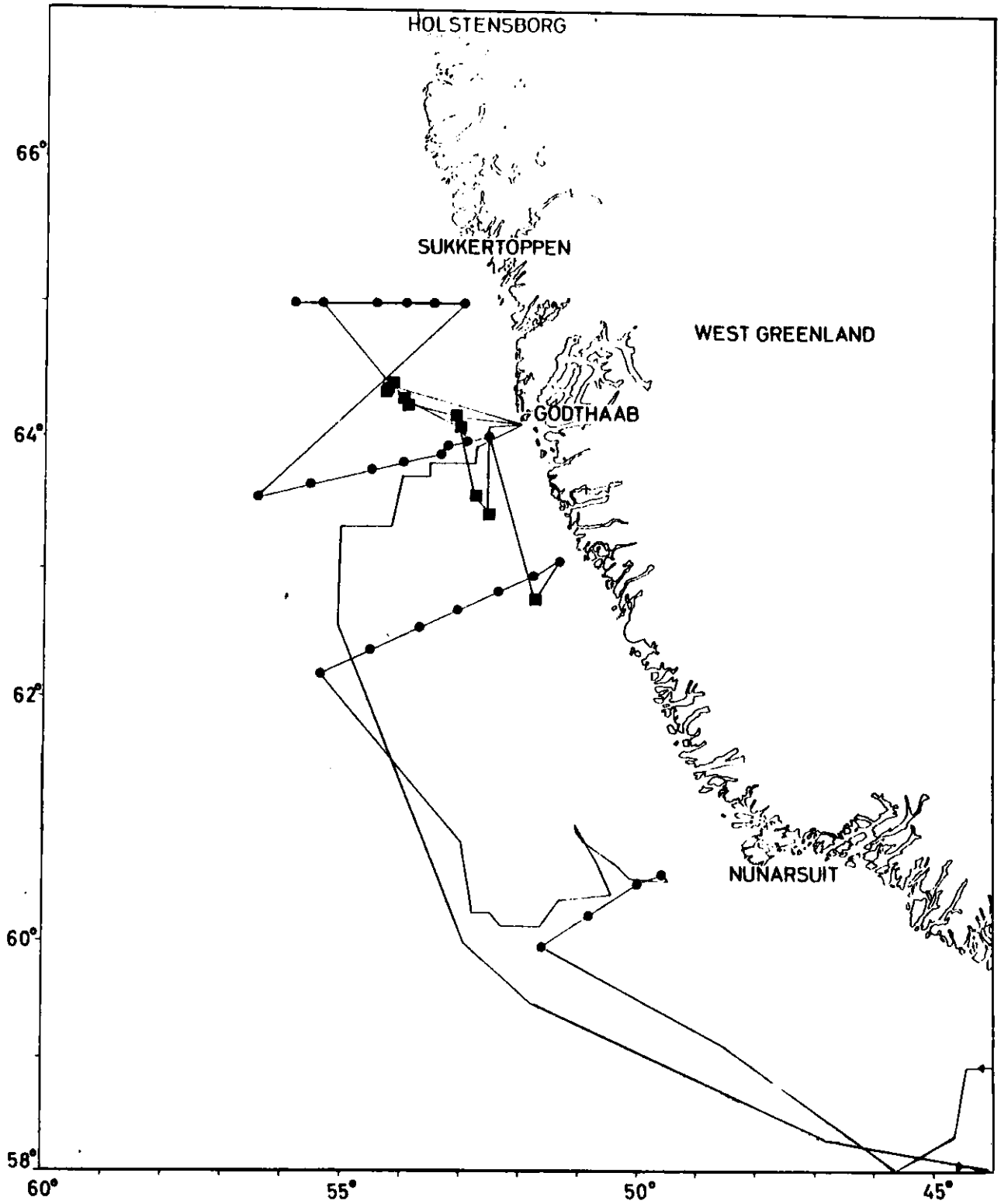


Fig. 1. R/V *G.O. Sars*, West Greenland, April-May 1969. Route and net of stations. ● : hydrographical station, ■ : bottom long-line station.

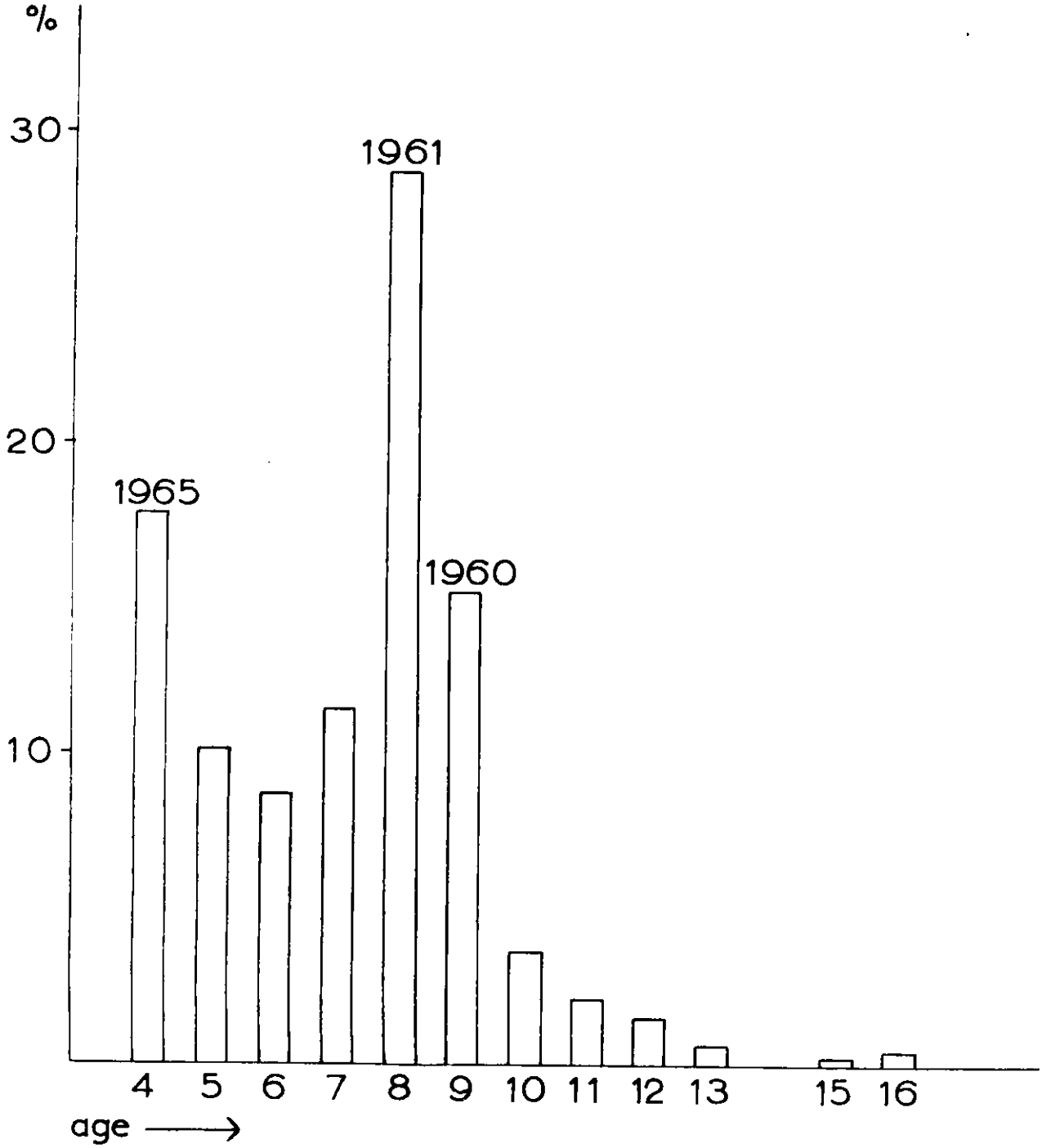


Fig. 2. R/V *G.O. Sars*, West Greenland, April-May 1969. Cod. Age distribution. Total bottom long-line catch, No. 6 hook.

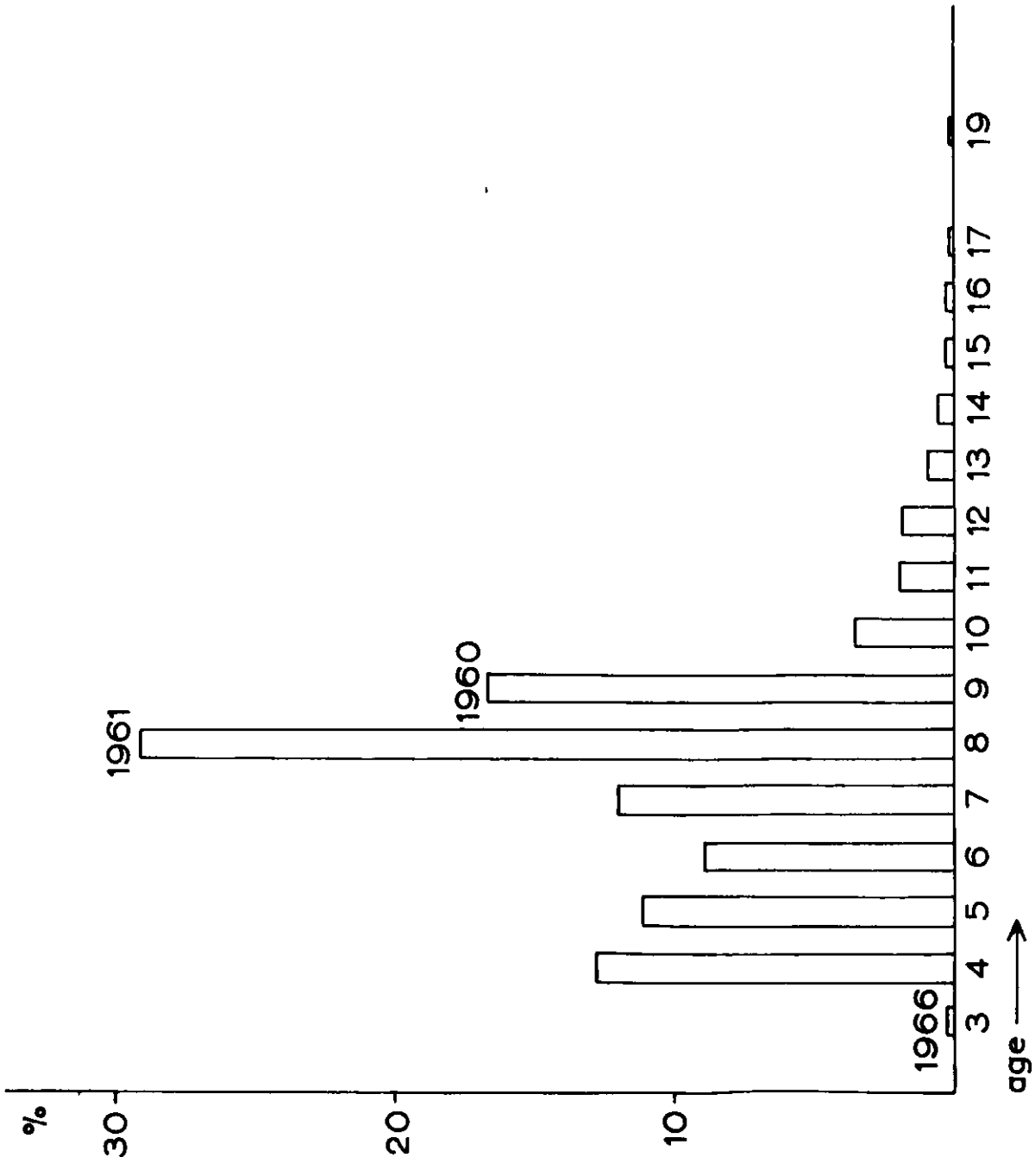


Fig. 3. R/V *G.O. Sars*, West Greenland, April-May 1969. Cod. Age distribution. Total bottom long-line catch, No.2, 4 and 6 hooks combined.

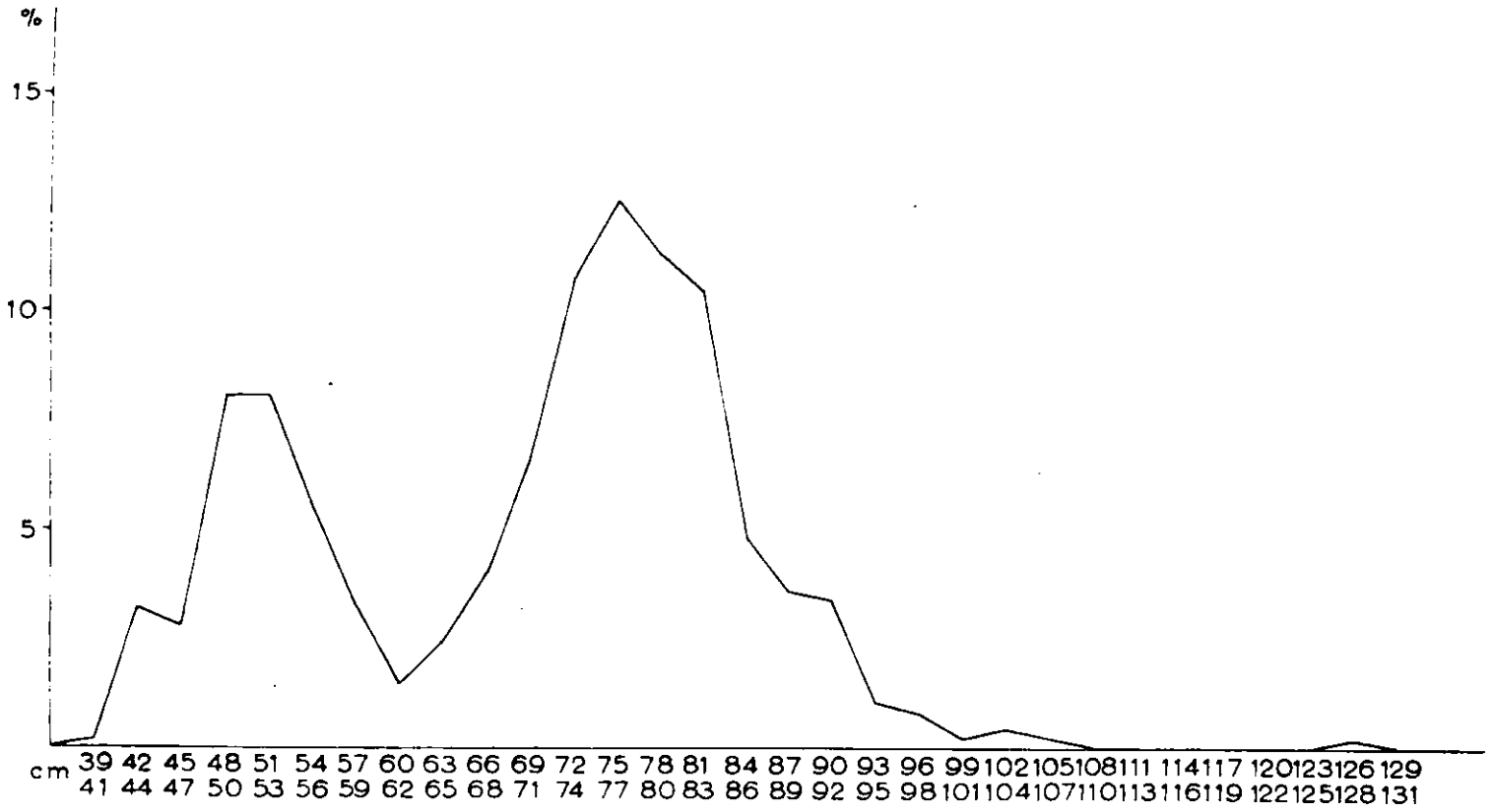


Fig. 4. R/V *G.O. Sars*, West Greenland, April-May 1969. Cod. Length composition. Total bottom long-line catch, No.6 hook.

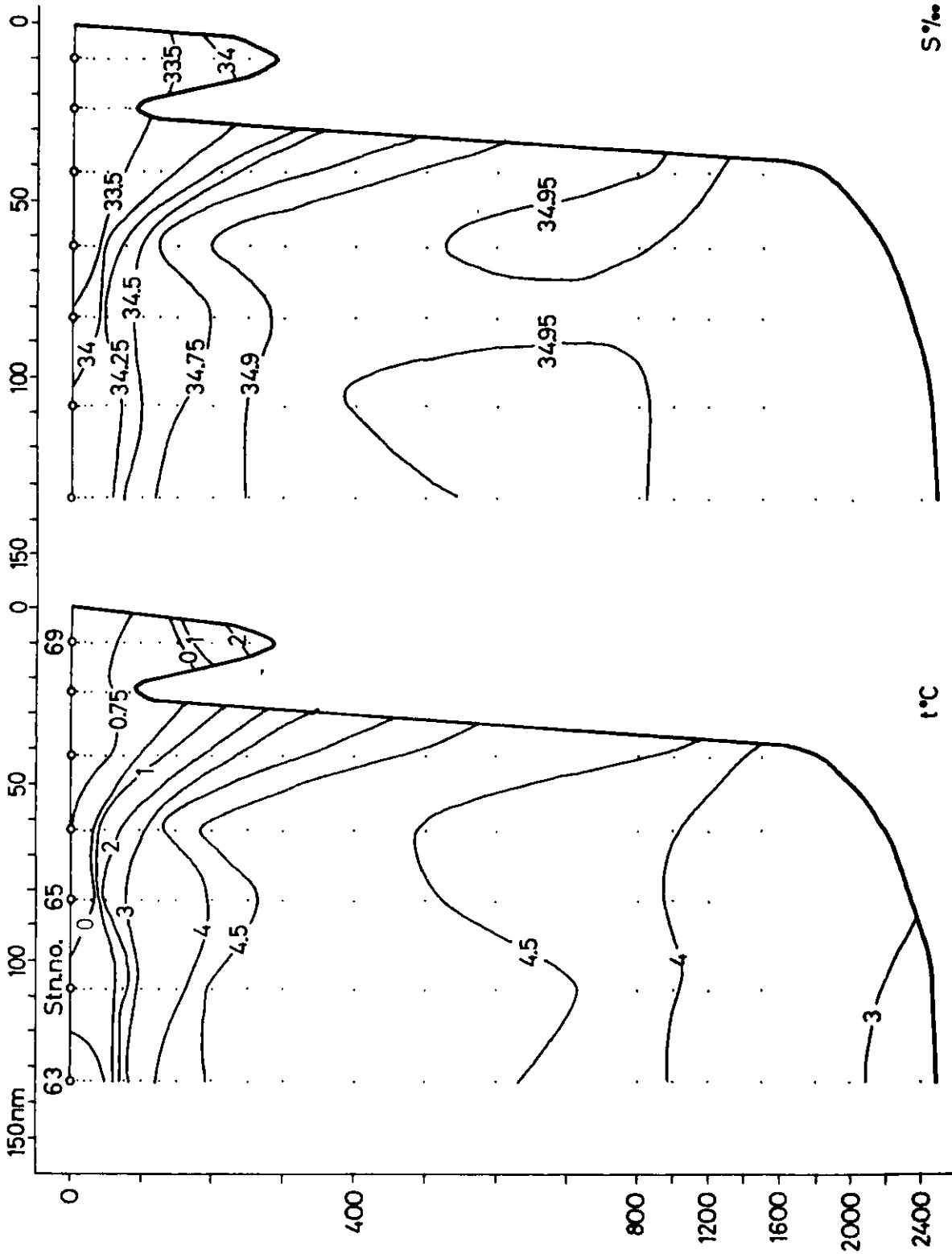


Fig. 5. R/V *G.O. Sars*, West Greenland, April 1969. Hydrographical section across Dana Bank.

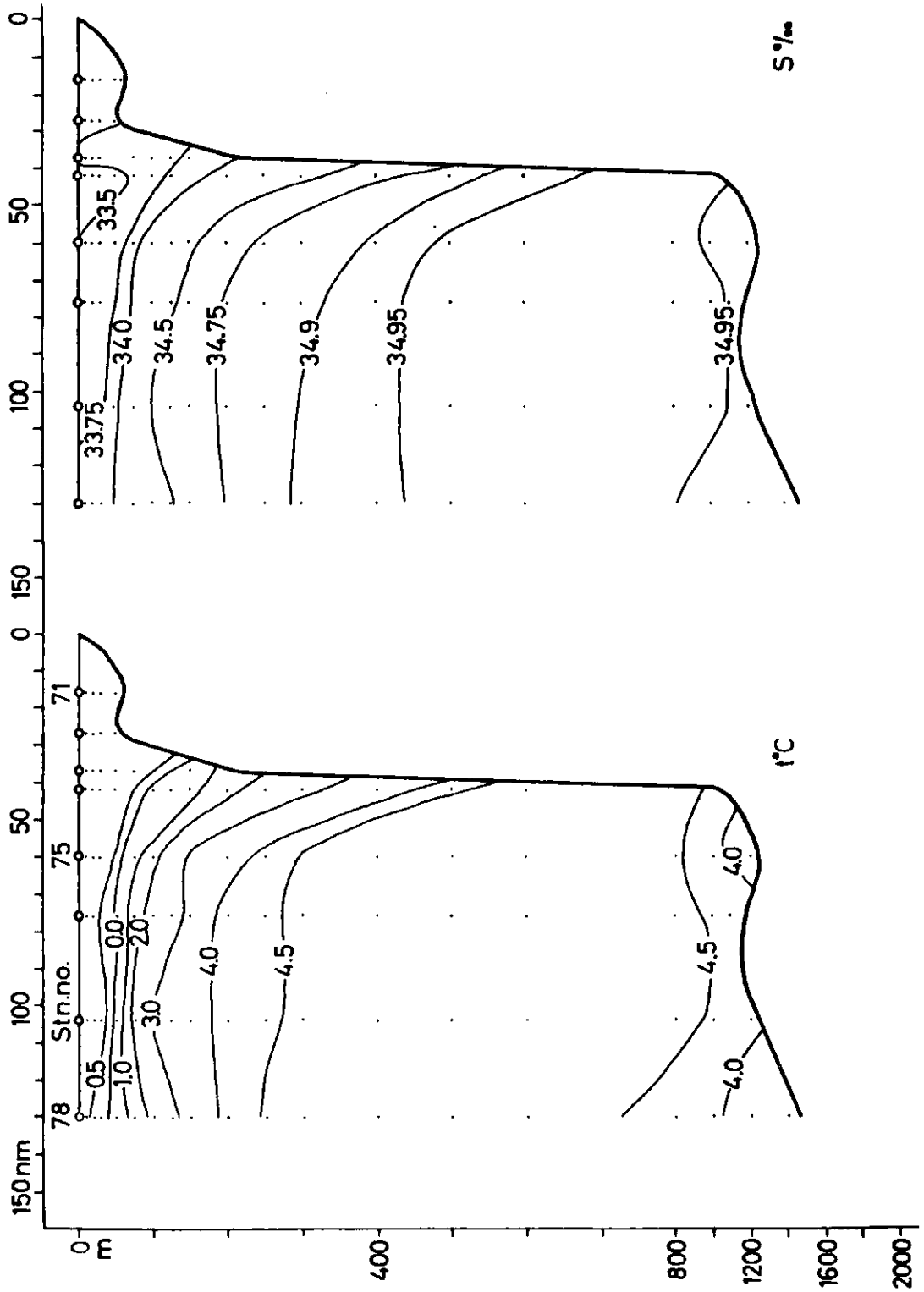


Fig. 6. R/V *G.O. Sars*, West Greenland, April 1969. Hydrographical section across Fylla Bank.

VI. Polish Research Report, 1969

by F. Chrzan

Total Polish catches in the ICNAF Area decreased from 187,042 tons in 1968 to 159,863 tons in 1969. This was due primarily to the decreased yield of cod in Subarea 2 and of herring in Subarea 5.

In Subareas 2 and 3, 23 factory trawlers, of 2,600 gross tons each, operated mainly for cod in the winter. In other seasons along with cod they caught other species. These vessels made 63 trips to the ICNAF Area as compared to 67 trips of 22 factory trawlers in 1968. Moreover, 7 large freezer trawlers of the capacity 3,100 gross tons each, 4 freezer trawlers of 1,400 gross tons, 10 side motor trawlers and 29 steam trawlers participated in fishing operations in Subareas 4 and 5. These vessels caught mainly herring and in the second place, mackerel. In total they made 111 trips compared to 110 trips of freezer vessels and side trawlers made in 1968. Vessels of smaller tonnage, as in 1968, operated with 3 mother ships, thus reducing the loss of time for voyages between fishing grounds and home ports. Data for the years 1969 and 1968, including major species and their percent relation in the catches, are compared in Table 1.

Table 1.

Species	1969		1968	
	tons	percent	tons	percent
Redfish	14,083	8.8	7,260	3.9
Cod	76,680	48.0	90,941	48.6
Flatfish	2,196	1.4	4,120	2.2
Greenland halibut	5,440	3.4	5,808	3.1
Halibut	91	0.1	90	0.1
Haddock	458	0.3	1,296	0.7
Hake	292	0.2	923	0.5
Mackerel	13,448	8.3	10,300	5.5
Herring	37,223	23.3	64,317	34.4
Other species	9,952	6.2	1,987	1.0
Total	159,863	100.0	187,042	100.0

The above data shows slight increase of redfish, mackerel and other species in the catches with simultaneous decrease of landings of cod, haddock, hake and particularly herring.

Subarea 1

A. Status of the Fisheries

In May 1969 one of the factory trawlers made an attempt to fish in Div. 1C, 1D and 1E. It did not obtain satisfactory results (only 10.6 tons per day) and therefore moved to other fishing grounds, where it could obtain better fishing yield. The catch and fishing effort in Subarea 1 are given in Table 2.

Table 2.

ICNAF Div.	Catch in metric tons			No. hours fishing	No. days fished
	Redfish	Cod	Other Species		
1C	2	144	-	166	17
1D	2	92	-	87	11
1E	1	118	1	44	6
Total	5	354	1	297	34

No research studies were carried out in Subarea 1.

Subarea 2

A. Status of the Fisheries

Early in the season 21 factory trawlers operated in Subarea 2. Their activity was greatest from January till March. In the other months fishing intensity was very low, while in August and September the Polish fishing fleet did not operate at all in Labrador waters. Landings and fishing effort in Subarea 2 are given in Table 3.

Table 3.

ICNAF Div.	Catch in metric tons						No.hours fishing	No. days fished
	Redfish	Cod	Greenland halibut	Halibut	Flat-fish	Other Species		
2G	-	1,149	67	2	4	-	400	30
2H	73	14,704	929	2	197	-	6,142	495
2J	485	46,148	1,265	16	384	12	15,310	1,324
Total	558	62,001	2,261	20	585	12	21,852	1,849

Fishing operations were commenced in January in Div.2G and 2H. Good results were obtained but ice floes moving from the north compelled the vessels to shift towards Div.2J. Here the abundance of fish, however, was not as good as in those fishing grounds which were covered with ice. The proper season for

cod catches ended in early April. Daily fishing yields in Subarea 2 in consecutive months were as follows: January - 35.9 tons; February - 48.8 tons; March - 42.4 tons; April - 14.8 tons; May - 13.0 tons; June - 19.2 tons; July - 12.1 tons; October - 13.5 tons; November - 12.0 tons and December - 25.8 tons.

Polish vessels use bottom trawls on the Labrador fishing grounds taking cod in winter and flatfish in other seasons. Since the same type of fishing gear has been in use for many years, it is interesting to compare mean annual fishing yields per 1 hour trawling. In recent years they were: in 1966 - 2.65 tons, in 1967 - 2.45 tons, in 1968 - 3.27 tons and in 1969 - 2.99 tons.

In view of the decreased yield from April till November, the number of vessels operating here was smaller than in 1968. In general, the fishing effort (number of hours fishing) in Subarea 2 decreased by 3% from that in 1968.

B. Special Research Studies

I. Cod.

In Div. 2H 7,565 cod were measured and 1,132 otoliths read for age on M/T *Dalmor*. The observations included length and age composition at various depths. The average lengths of cod in the sample ranged from 24 to 86 cm and their age from 2 to 19 years. Fish were larger and older with increasing depth.

At 300-350 m the lengths of cod in the catches were 24-77 cm and their ages 2-18 years. Most fish were 30-38 cm in length and were 4-and 3-years old (1965 and 1966 year-classes together made up 54.6%).

Cod caught at 350-400 m were 24-83 cm in length. They were 2 to 18 years old. The most abundant were individuals 45-59 cm in length, 6 and 7 years old (1963 and 1962 year-classes - 42.0%). Mean length of these fish was 50.2 cm; mean age - 6.8 years.

At 400-450 m cod in the catches were 27-86 cm in length. Their ages were from 3 to 19 years. Mean length was 51.6 cm and mean age 7.1 years. Also at this depth and at 350-400 m cod were 45-49 cm in length and 6 and 7 years old (1963 and 1962 year-classes - 45.9%).

Below 450 m cod were 30-83 cm in length and 3-19 years old; their mean length - 55.4 cm and mean age - 8.0 years. The most abundant cod were 48-62 cm long and 6,7 and 8 years old (1963, 1962 and 1961 year-classes, - in total 60.2%).

In Div. 2J 10,254 cod were measured and 1,411 otoliths read for age. As in Div. 2H distinctly marked differences were noted in the length

and age of cod caught at various depths.

At 350-400 m lengths ranged from 24 to 83 cm and ages from 2 to 18 years; mean length was 49.8 cm, mean age - 6.4 years (1963 and 1962 year-classes - both up to 57.0%).

At 400-450 m the catch consisted of fish 30-80 cm in length and 3 to 19 years of age; their mean length - 54.0 cm, mean age - 7.1 years. Cod 45-62 cm in length and 6 and 7 years of age were predominant (1963 and 1962 year-classes, which made up 59.0% of the catch).

Cod captured below 450 m were 33-95 cm long and 2 to 18 years old - their mean length was 59.6 cm and their mean age - 8.0 years. The most abundant in the catches were fish 51-65 cm in length and 6, 7 and 8 years of age (1963, 1962 and 1961 year-classes - in total 61.9%).

During the period of observations, i.e. in January and February, the following fishing yields were obtained from particular depths:

350-400 m	-	5,060 kg per 1 hour fishing
400-450 m	-	4,200 kg per 1 hour fishing
and below 450 m	-	4,990 kg per 1 hour fishing

II. Redfish

In Div. 2J 1,009 redfish (type *mentella*) were measured and 200 of their otoliths read for age. The length of these fish ranged from 20 to 51 cm - mean length was 33.2 cm. Fish ranging from 30-36 cm in length and from 9 to 14 years of age occurred most often in the catches.

III. American plaice

In Div. 2J 4,279 specimens were measured and 499 otoliths collected. In the sample in February occurred fish 25-66 cm in length with mean length of 44.2 cm. The age of these fish was determined to be within the age-groups VI to XX+, while most of the fish were of the length ranging between 40-52 cm and belonged to age-groups XIV to XVII.

In May and June in the same Division occurred fish of the lengths 23-60 cm, (mean length 37.2 cm) within age groups IV - XX+. Most often occurred here fish in the length-classes 29-40 cm, belonging to age-groups VII - X.

IV. Greenland halibut

One thousand and eighty-four fish were measured in May aboard a commercial vessel. Their length ranged from 30-90 cm; mean length - 52.9 cm. The most abundant were fish of lengths from 45 to 65 cm, which made up 76.5% of the catches.

Subarea 3

A. Status of the Fisheries

In this Subarea factory trawlers operated mainly in the period from April till July. In the other months of the year fishing operations were considerably less intensive. Catch and fishing effort in Subarea 3 are given in Table 4.

Table 4

ICNAF Div.	Catch in metric tons					No. hours fishing	No. days fished
	Redfish	Cod	Greenland halibut	Halibut	Flatfish		
3K	5,194	13,303	3,128	23	1,393	14,092	910
3L	247	78	17	-	31	503	39
3O	345	193	10	5	3	500	37
3Ps	780	6	3	7	-	587	36
Total	6,566	13,580	3,158	35	1,427	15,682	1,022

The above data show that fishing operations were carried out mainly in Div.3K. Both the effort and fishing yield were subject to considerable fluctuations. Mean daily yields in consecutive months were as follows: April - 28.7 tons, May - 28.0 tons, June - 15.0 tons, July - 19.1 tons, August - 20.6 tons, September - 13.1 tons and October - 11.8 tons. In other Divisions of Subarea 3 the intensity of fishing operations was low. Reconnaissance for redfish gave rather poor results.

It might be interesting to compare catch-per-unit-effort for Polish factory trawlers in the recent two years in Subarea 3. According to our data the catch per 1 hour trawling in 1968 amounted to 1.33 tons, while in 1969 it was 1.58 tons. In spite of an increase of catch-per-unit-effort total landings decreased from 31,234 tons in 1968 to 24,766 tons in 1969. This was caused by withdrawal of a considerable number of vessels, which were shifted to fishing grounds in the Barents Sea. Thus catch per 1 hour trawling was reduced by 33.4% as compared to 1968.

B. Special Research Studies

I. Cod

Sampling was carried out only in Div. 3K. In June and July a total of 3,370 cod, caught at 250-300 m, and 300-350 m were measured.

The length of fish from 250-300 m ranged from 27 to 86 cm; mean length - 52.4 cm. Most of the captured cod ranged in length from 42 to 62 cm. These were fish 5, 6 and 7 years old (1964, 1963 and 1962 year-classes) which made up 64.2% of the catch.

The length of cod caught at 300-350 m ranged from 21 to 92 cm with a mean length of 48.6 cm. Cod of the length 42-56 cm made up 68.4% of the catch. They were 5 and 6 year-old fish, i.e. 1964 and 1963 year-classes.

II. Redfish

One thousand nine hundred and thirty-two redfish specimens (type *mentella*) were measured in Div. 3K. They were 24-51 cm in length (mean length 38.8 cm). Most of the fish were 35-40 cm in length. Age readings from otoliths showed that they ranged in age from 5 to 32 years. However, most of the captured fish were 14 to 21 years old.

Also 1,278 specimens of redfish of the type *marinus* were measured. Their lengths were 31 to 68 cm; mean length - 49.5 cm. The most abundant were fish 47-55 cm in length. According to otolith readings in the sample the fish were 11 to 32 years old.

III. American plaice

One thousand six hundred and ninety fish were measured aboard M/T *Columbus* in May and June in Div. 3K. The lengths of these fish ranged from 20 to 62 cm (mean length - 42.4 cm). Age-groups V to XX+ were determined on the basis of 254 otolith readings. Age-groups XIII to XX+ made in total 68.7% of the catches of this species.

IV. Witch

Observations on length and age of witch were carried out in the period from May till July in Div. 3K. Altogether 2,216 fish were measured and 355 otoliths read. The fish of the lengths 22-65 cm with mean length 46.3 cm occurred here. Most of the fish in the catches were in the length range 40-47 cm. In total age-groups III to XX+ were determined. In the catches the most abundant were age-groups X to XVII, making 64.8% of the landings of this species.

V. Greenland halibut

In Div. 3K, 971 fish were measured. They were 30-90 cm in length; their mean length was 55.3 cm. The length-classes 45-65 cm made up 67.8% of the catches.

VI. Grenadier

During the catches, carried out in the region of Ritu Bank and Sundall from May till July, 3,096 specimens of *Macrourus berglax* were measured. The length of these fish ranged from 31 to 85 cm, though most of the fish were 46-65 cm in length and made up 71% of the catches of this species.

Two hundred and three otoliths of this species were collected, but their reading for age was very difficult in spite of application of different methods of preparation. On the basis of those otoliths which could be read it may be assumed that the sample had fish 2 to 17 years old. Probably there were also older fish.

Subarea 4

A. Status of the Fisheries

Six factory trawlers, 3 freezer trawlers of the capacity 3,100 gross tons each and 1 side motor trawler fished mainly redfish and herring in this Subarea. Their fishing operations were carried out in the first quarter of the year for herring and in the period from September till November for redfish. The landings and fishing effort are given in Table 5.

Table 5.

ICNAF Div.	Catch in metric tons					No.hours fishing	No. Days fished
	Redfish	Cod	Flat-fish	Herring	Other Species		
				Factory trawlers			
4Vn	4	71	13	-	-	125	12
4Vs	6,894	21	67	-	-	4,892	323
				Freezer trawlers of 3,100 gross tons each			
4Vs	-	13	-	4,593	875	1,604	160
4X	-	-	-	140	50	106	6
				Side motor trawlers			
4X	-	-	-	122	29	148	22
Total	6,898	105	80	4,855	954	6,875	523

Herring catches were made by freezer trawlers mainly from Misaine Bank and Banquereau Bank in Div. 4Vs. Also redfish were caught in the region of Banquereau Bank. Factory trawlers operating for redfish obtained the following daily yields: in September - 17.3 tons, in October 21.3 tons, in November - 24.3 tons and in December - 8.9 tons. Freezer trawlers fishing herring obtained much higher yields: in January - 26.4 tons, in February - 33.0 tons, in March - 39.0 tons and in April - 33.9 tons per day.

B. Special Research Studies

I. Herring

Altogether 1,230 fish were measured mainly on Misaine Bank, from

10% of which the otoliths were collected. The length of fish ranged from 26 to 38 cm with a mean length 32.3 cm. It was very difficult and partly even impossible to determine the age of fish above 33.5 cm in length. The presence of age-groups III to XIII was found. Probably there were also older age-groups.

II. Argentine

The results of research studies on this species are given in a paper by Zukowski "Some biological data on argentine *Argentine silus* Ascanius from the Nova Scotia Area" (ICNAF Res.Doc. 70/64).

Subarea 5

A. Status of the Fisheries

In this Subarea 5 factory trawlers, 9 large freezer trawlers (3,100 gross tons), 4 smaller freezer trawlers (1,400 gross tons), 10 side motor trawlers and 29 steam trawlers operated. The side trawlers, both motor and steam, operated with mother ships. Landings and fishing effort are given in Table 6.

Table 6

ICNAF Div.	Catch in metric tons						No hours fishing	No days fished
	Cod	Haddock	Hake	Herring	Mackerel	Other Species		
				Factory trawlers				
5Ze	75	-	-	1,680	-	435	1,705	165
				Freezer trawlers of 3,100 gross tons each				
5Ze	69	458	292	4,975	3,085	2,073	4,814	455
5Zw	152	-	-	1,211	1,050	983	990	106
				Freezer trawlers of 1,400 gross tons each				
5Ze	107	-	-	2,469	2,125	3,346	4,275	344
				Side motor trawlers				
5Ze	113	-	-	6,870	4,307	930	8,789	1,063
5Zw	94	-	-	313	992	203	882	136
				Side steam trawlers				
5Ze	21	-	-	14,542	1,787	1,223	27,026	2,742
5Zw	9	-	-	308	75	55	609	64
Total	640	458	292	32,368	13,421	9,248	49,090	5,075

On Georges Bank steam trawlers commenced herring fishing in February. In successive months they obtained the following total yield in tons per day

(herring and other species together): February - 5.81; March - 5.55; April - 6.72; May - 8.54; June - 6.99; July - 7.27; August - 5.09; September - 6.89; October - 5.17 and November - 5.56.

Side motor trawlers commenced their operations first in May. Their catch in tons per day was as follows: May - 11.45; June - 14.38; July - 11.35; August - 11.18; September - 12.60; October - 9.60; November - 9.09 and December - 10.67. In the last two months these trawlers also fished in Subdiv. 5Zw obtaining, in November, 11.50 tons per day and in December, 12.67 tons per day.

Large freezer trawlers also operated from May till December. Having larger freezing capacity they caught comparatively more of other species along with herring than side trawlers. Their yields (including all captured species) were as follows: May - 34.14; June - 26.78; July - 19.56; August - 23.13; September - 23.29; October - 23.77; November - 31.23 and December - 22.25 tons per day. In Subdiv. 5Zw these vessels obtained even higher yields; in November - 34.60 and in December - 29.06 tons per day fishing.

Smaller freezer trawlers caught other species along with herring, particularly mackerel. The yields obtained by these vessels from June till December fluctuated considerably and were as follows: June -24.04; July - 28.65; August - 22.51; September - 28.61; October - 19.89; November - 21.50 and December - 21.60 tons per day fished.

Factory trawlers operated for herring from July till October, obtaining, however, rather poor results: July - 11.87 tons; August - 17.61 tons; September - 12.16 tons and October - 12.60 tons per day.

B. Special Research Studies

I. Herring

The observations on herring were carried out on Georges Bank and in the Cape Cod region. The results of the studies are given in two contributions to the 20th ICNAF Annual Meeting:

1. F. Chrzan, B. Draganik - length and age composition of herring in Polish catches (Res. Doc. 70/62).
2. B. Draganik, B. Rast - The fecundity of Georges Bank herring, (Res.Doc.70/63).

II. Redfish

Observations on redfish, which was a by-catch in the Georges Bank fishery were carried out aboard M/T *Centaurus*. Five hundred and seventy-two fish were measured and 100 otoliths collected. The lengths of redfish (type *mentella*) ranged from 18 to 42 cm with a mean length of 25 cm. In the catches, however, fish 21-27 cm in length occurred most often. From otolith readings the span of age of redfish from Georges Bank was found to be from 5 to 20 years, but mainly 6 to 9 year olds.

VII. Portuguese Research Report, 1969

by M. Lima Dias

During 1969 the Portuguese fleet fished in ICNAF statistical Subareas 1, 2, 3 and 4, mainly for cod. Total cod landings, 182,349 m tons, were lower than in 1968, 219,365 tons (Fig. 1). This was due to a decrease in the landings by both the trawlers (side and stern) and the dory vessels.

The decrease in trawler landings amounted to 24,000 tons, while the decrease for dory vessels was somewhat less (13,000 tons).

Best fishing by trawlers occurred in Subarea 3 with 98,832 tons landed; the dory vessels operated mainly in this Subarea (37,468 tons) and also in Subarea 1 where they took about 15% (2,429 tons) of the total catch by the line fishery.

Table 1

Subareas	Line	Trawl			Line + trawl
	(dory vessels)	(side)	(stern)	(total)	
1	2,429	1,864	11,506	13,370	15,799
2	-	50,239	15,843	66,082	66,082
3	37,468	55,474	5,890	61,364	98,832
4	-	1,636	-	1,636	1,636
Total	39,897	109,213	33,239	142,453	182,349

Table 1 shows landings by subareas and gear. Except in Subarea 1 best landings were made by side trawlers. The dory vessels took only about 22% of the total catch. The otter trawlers fished mainly in Subareas 2 and 3 during all four quarters of the year (Fig. 2).

Best fishing by dory vessels was in Div. 3L (32,686 tons) and the lowest in Div. 1A (207 tons). The side trawlers fished intensively in Subarea 3 - 55,747 tons (with 36,115 tons in Div. 3L).

The highest trawler landings were in the first quarter of the year, 59,162 tons (51,420 tons landed in Subarea 2). Best fishing by dory vessels was in the third quarter (as in 1968) with great success in Subarea 3.

The present report in addition to reviewing the status of fisheries, presents also data on lengths, ages, maturity and probable age of first maturity obtained from random sampling onboard commercial trawlers before discarding the undersized fish.

Detailed information on the samples for length and age, are included in the ICNAF Sampling Yearbook.

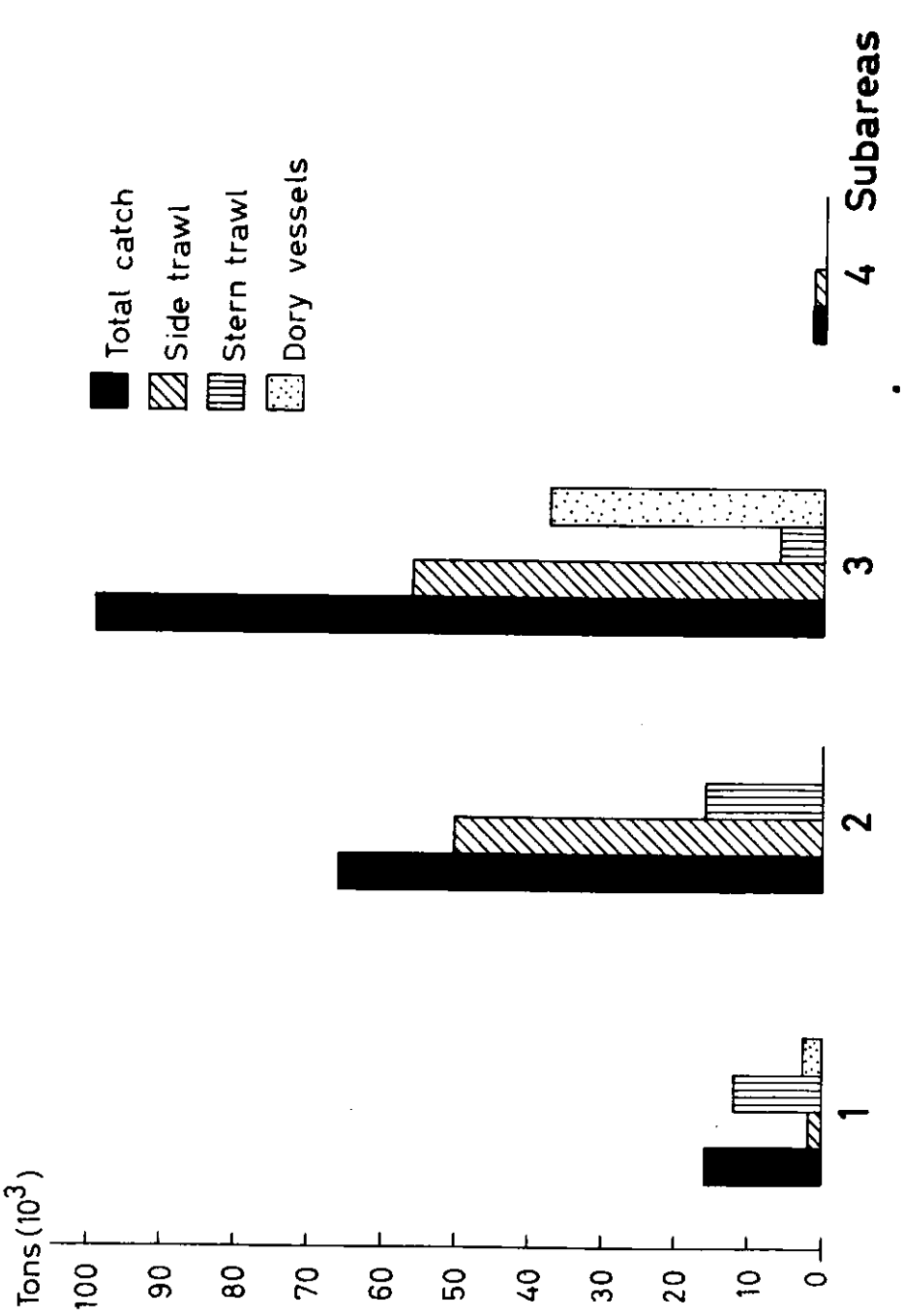


Fig. 1 - Cod catches (in tons) of Portuguese fishery fleet by subareas

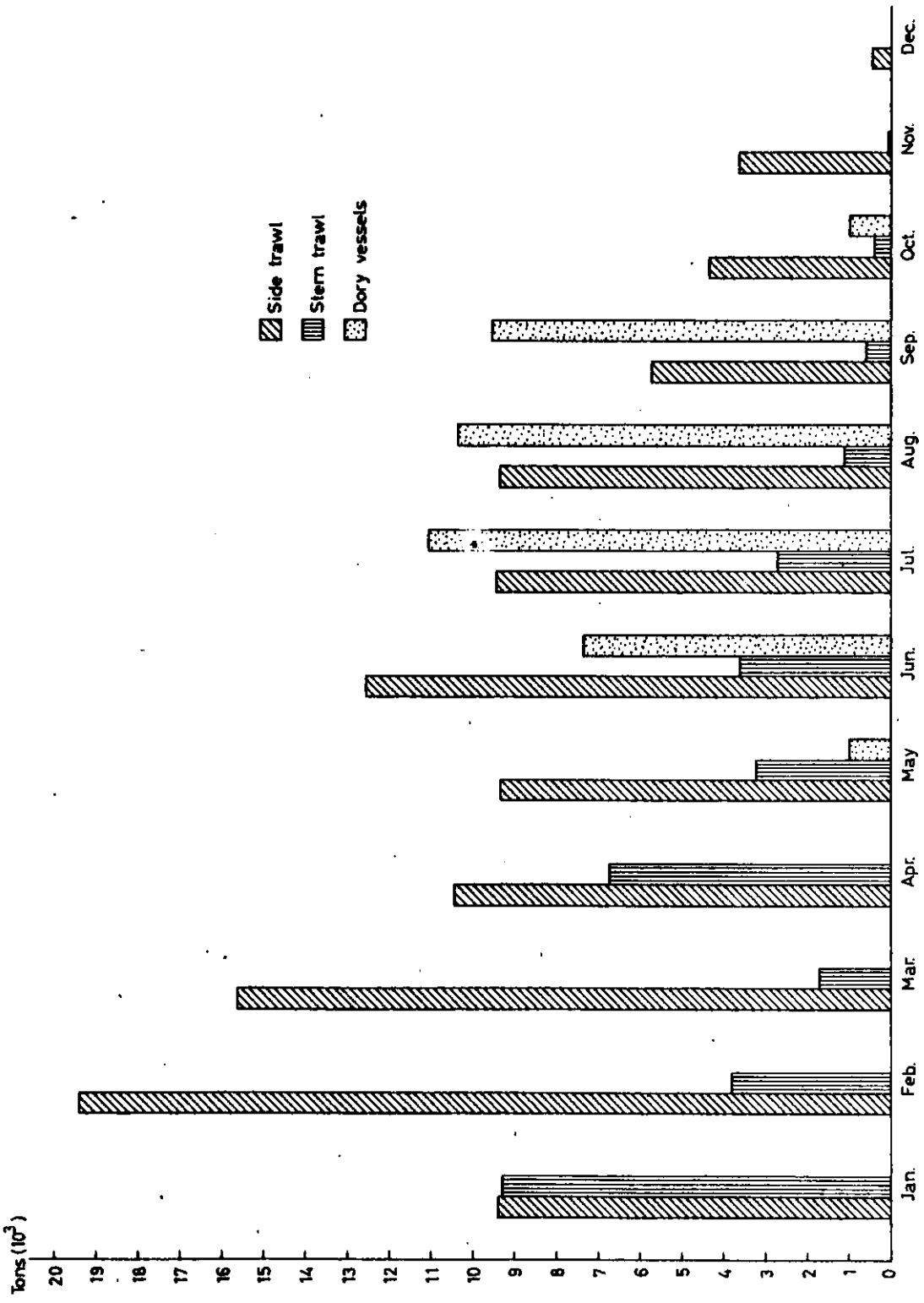


Fig. 2. Total catches of cod (in metric tons) of Portuguese fishery fleet (trawlers and dory vessels) by months, 1969.

Subarea 1

A. Status of the Fisheries

The trawlers fished only in Div. 1B, C, D, E during the second quarter of the year (13,370 tons landed); the dory vessels only fished in May and June and the results are somewhat poor - 2,429 tons.

B. Special Research Studies

Samples for biological study of cod were collected from the trawler fleet in Div. 1C, 1D, 1E, 1F as follows:

Div.	Samples	Date	Depth(m)	No.lengths	No.ages
1C	A	7-18 May	200-300	182	100
"	B	7-10 June	300	125	75
				307	175
1D	C	4-10 April	300	242	242
"	D	3-30 May	300	920	295
"	E	2-8 June	300-500	153	78
				1315	615
1E	F	11-25 April	300	1250	350
"	G	2-19 May	150-300	369	219
				1619	569

a) Lengths. The lengths (Fig.3) ranged from 28 to 112 cm: mean lengths (cm) were: A - 62.0; B - 74.2; C - 58.7; D - 68.6; E - 69.5; F - 58.4; G - 62.5.

b) Ages ranged from 3 to 12 years (Fig. 3). In Div.1C age-groups IV and VIII dominated in May while in June age-groups VI, VII, VIII and IX prevailed.

In Div. 1D age-groups IV, V VI and VII were the dominant ones in April; in May and June age-groups VI, VII VIII and IX were dominant.

In Div. 1E age-group VI was the most important in both months studied, followed by the VII and V age-groups. Mean ages were: A - 6.3; B - 7.7; C - 5.7; D - 6.8; E - 6.9; F - 6.3; G - 6.5.

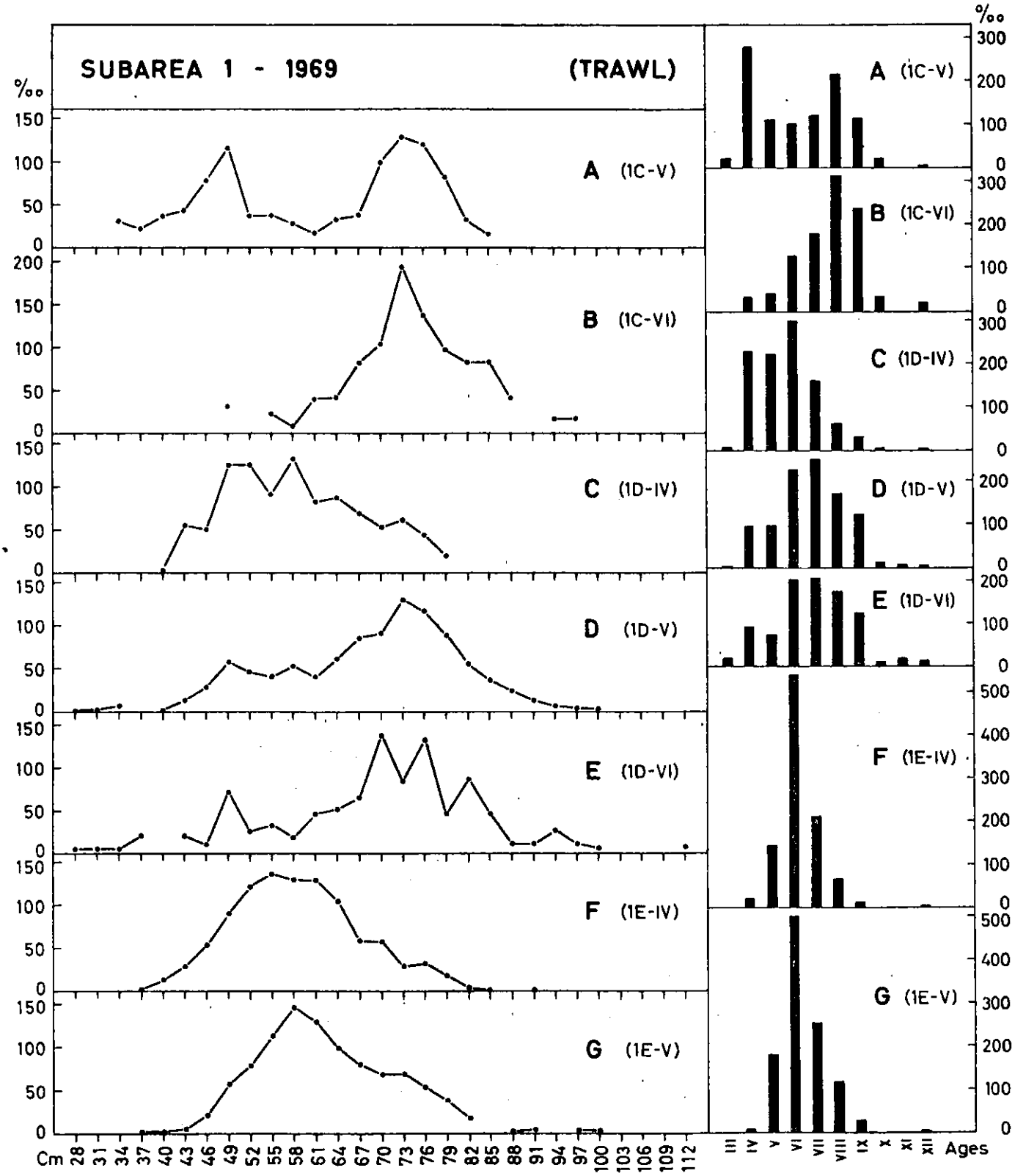

SUBAREA 1 - 1969
(TRAWL)
‰
A (1C-V)
B (1C-VI)
C (1D-IV)
D (1D-V)
E (1D-VI)
F (1E-IV)
G (1E-V)
Cm
Ages

Fig. 3

c) Growth (trawl caught fish)

Div. 1C

Year class	1966	1965	1964	1963	1962	1961	1960	1959	1958	1957
Age-group	III	IV	V	VI	VII	VIII	IX	X	XI	XII
May	36.2	45.1	51.6	66.3	71.9	74.7	76.3	78.1	-	85.0
June	-	50.5	57.4	67.3	72.2	76.3	80.4	80.5	-	89.0
No.of fish	(4)	(55)	(24)	(24)	(28)	(48)	(34)	(5)	-	(3)

Div. 1D

Year-class	1966	1965	1964	1963	1962	1961	1960	1959	1958	1957
Age-group	III	IV	V	VI	VII	VIII	IX	X	XI	XII
April	40.0	48.2	53.2	61.7	67.8	71.0	74.6	74.3	-	76.0
May	40.0	48.0	53.4	65.1	72.7	76.7	79.4	77.4	88.9	86.6
June	37.0	47.0	53.0	66.4	72.6	76.8	79.5	77.0	91.2	90.9
No.of fish	(2)	(110)	(112)	(168)	(113)	(63)	(39)	(4)	(2)	(2)

Div. 1E

Year-class	1965	1964	1963	1962	1961	1960	1959	1958	1957
Age-group	IV	V	VI	VII	VIII	IX	X	XI	XII
April	63.9	49.1	57.2	64.1	71.8	76.9	-	-	76.0
May	46.5	50.8	58.7	65.9	73.4	77.1	-	-	76.0
No. of fish	(4)	(49)	(297)	(151)	(56)	(11)	-	-	(1)

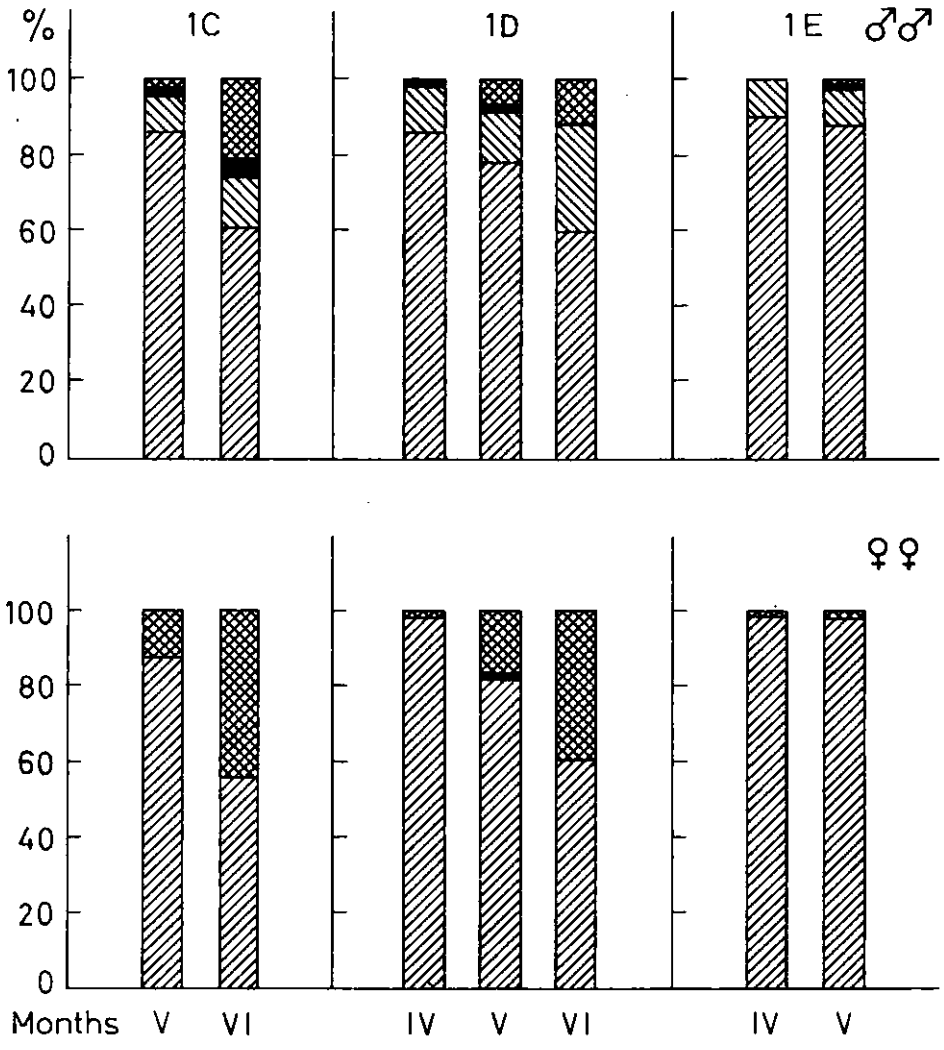
d) Stage of maturity (Fig. 4). The majority of the fish sampled in Div. 1C, 1D and 1E (males and females) were in the resting or recovering stage; however in June (in Div. 1C and 1D) about 50% of the females observed were in the post-spawning stage. This stage was also detected in reasonable percentage in the males in June (Div. 1C) and May (Div. 1D).

e) Age at first maturity. Observations on age at first maturity in Div. 1C, 1D and 1E shows that a very high percentage of the fish were immature animals whose otolith were not convenient for recognizing the first maturity. However, a low percentage of fishes with first maturity at VII years and yet a lower percentage at VI and VIII years were observed.

Subarea 2

A. Status of the Fisheries

Only the trawlers fished in this Subarea. Altogether 50,239 tons were landed by side trawlers and 15,843 tons by stern trawlers. The best catches were made in the first quarter (51,420 tons). Fishing was more successful in Div. 2J than in 2H (59,869 and 6,213 tons respectively). Only 25% of the total subarea catches were made by stern trawlers.


%
1C
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100
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0
Months V VI IV V VI IV V
Post-spawning
Spawning
Developing
Resting or recovering

Fig. 4

B. Special Research Studies

Material for research studies was collected from Div. 2J in March and April as follows:

Samples	Date	Depth	No. of lengths	No. of ages
A	29-30 March	300-500	246	246
B	1-6 April	300-500	550	400

a) Lengths (Fig.5) ranged from 28 to 100 cm classes. Mean lengths were: A - 52.6 cm, B - 54.8 cm.

b) Age compositions. Figure 5 shows that the 1963, 1962, 1961 and 1964 year-classes prevailed in Div. 2J (VI, VII, VIII and V age-groups). Mean ages were: A - 6.7 years and B - 6.6 years.

c) Growth. Fish sampled in March and April in Div. 2J.(Figures in brackets are numbers of fish).

Year-class	1965	1964	1963	1962	1961	1960	1959	1958	1957	1956	1955
Age-group	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV
March	34.0	40.6	49.2	55.6	60.9	65.8	71.7	72.3	-	70.0	100.0
No.of fish	(8)	(23)	(101)	(70)	(25)	(5)	(7)	(5)	-	(1)	(1)
April	34.9	45.1	51.3	58.4	63.0	68.5	74.0	71.9	67.0	73.0	85.0
No.of fish	(7)	(47)	(150)	(117)	(45)	(21)	(6)	(3)	(2)	(1)	(1)

d) Stage of maturity. In March the males and females observed showed about 50% of fish in the spawning stage and about 25% in the resting or recovering and developing stages with a very low percentage in the post-spawning stage. In April the spawning stage consisted mainly of males and the resting or recovering and developing were of the females as well as the spawning stage, this latter with a higher percentage relatively to the other two. The post-spawning stage was best represented in the females (Fig. 6).

e) Age at first maturity. Most of the otoliths observed from both males and females were not suitable for establishing the age at first maturity. However, it was possible to establish some of them at the V, VI and VII age-groups.

Subarea 3

A. Status of the Fisheries

Total cod landed from Subarea 3 amounted to 98,832 tons with 37,468 tons taken by dory vessels and 61,364 tons by trawlers.

The best fishery occurred, for dory vessels and trawlers in the third quarter with 30,678 tons and 24,626 tons respectively. The trawlers fished in Div. 3K, 3L, 3M, 3N and 3Ps with best catches made in 3L. The line

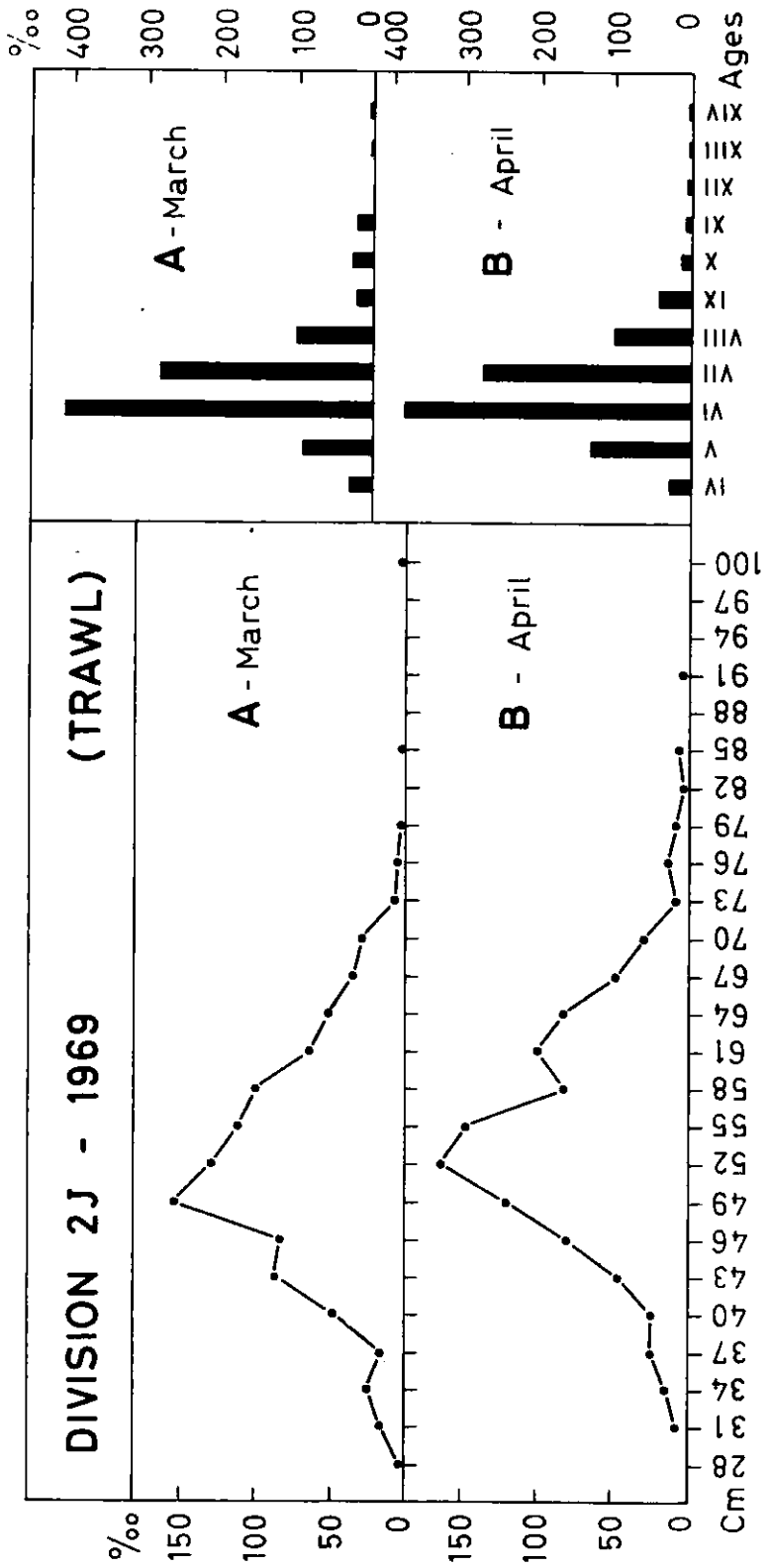
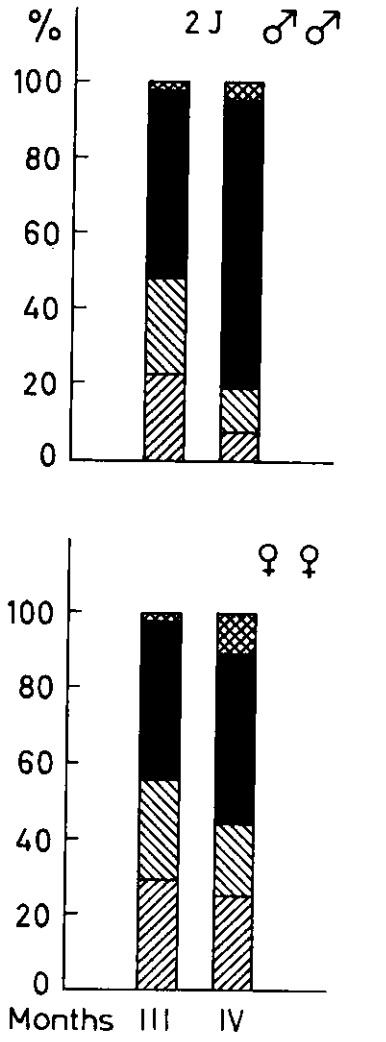


Fig. 5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Months III IV
Post-spawning
Spawning
Developing
Resting or recovering

Fig. 6

fleet fished in only 3L (32,686 tons) and in 3N (4,782 tons).

Best catch for trawlers occurred in June (12,408 tons), and the lowest in February (118 tons). The dory vessels fished very well in July (10,955 tons) while May was a poor month (192 tons).

a, b) Length and age compositions. Samples for biological study were obtained from trawl catches in Div. 3L, between 5 and 20 of July in 200 m to 300 m depth. The number of lengths measured was 1,784; the fishes aged 384.

The lengths ranged from 19 cm to 82 cm classes (Fig. 7).

Age-groups V, VI and IV predominated (1964, 1963 and 1965 year-classes). Mean length was 49.3 cm and mean age 5.3 years.

c) Growth. The table below refers to fish sampled in July (figures in brackets are numbers of fish).

Year-class	1966	1965	1964	1963	1962	1961	1960	1959	1958	1957
Age-group	III	IV	V	VI	VII	VIII	IX	X	XI	XII
3rd quarter	33.2	37.7	47.3	55.3	62.8	71.5	88.0	115.0	82.0	76.0
No. of fish	(7)	(61)	(130)	(144)	(36)	(2)	(1)	(1)	(1)	(1)

d) Stage of maturity. As shown in Fig.8 most of the females sampled in July were in resting or recovering stages (more than 90%). A very low percentage were in the post-spawning stage.

About 65% of the males were in the resting or recovering stages, about 30% in the developing stage and a very low percentage in the spawning and post-spawning stages.

e) Age at first maturity. About 90% of the observations were from immature fish or from samples where it was difficult to decide the age at first maturity.

Subarea 4

A. Status of the Fisheries

Side trawlers fished (1,636 tons) this Subarea in March, May and September. They caught only 1,300 tons in Div.4R and 306 tons in 4Vn. March was the best fishing month (1,198 tons).

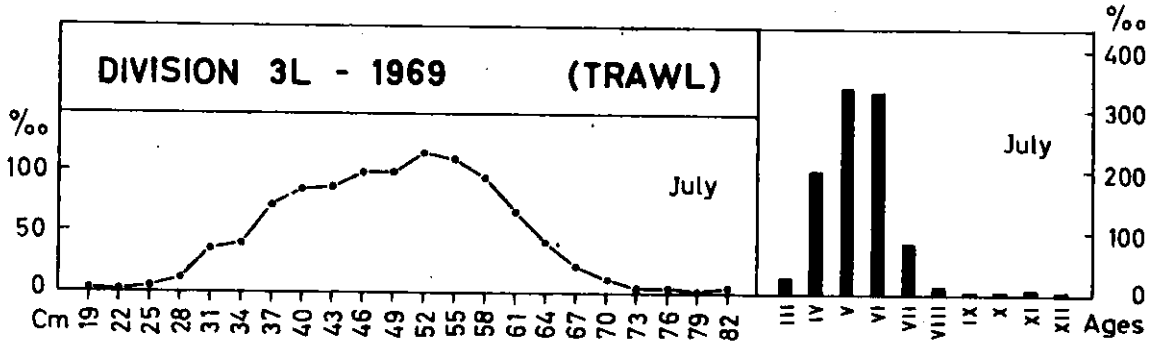
DIVISION 3L - 1969 (TRAWL)
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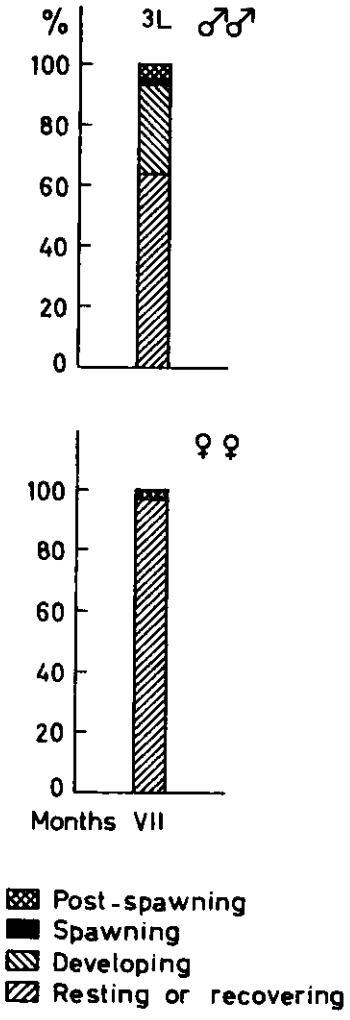
Fig. 7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Months VII
Post-spawning
Spawning
Developing
Resting or recovering

Fig. 8

VIII. Spanish Research Report, 1969

by M.G. Larrañeta and J. Rucabado

Seventeen trawlers and 144 pair trawlers (these vessels represent 72 gears) operated in the ICNAF area in 1969. Total catch was 293,972 tons, of which 98% was cod and 2% haddock and other species (white hake and pollock) compared to 341,311 tons in 1968 of which 96% was cod, 3% haddock and 1% other species (white hake and pollock).

Table 1. Nominal catch by Spanish trawlers, 1968 and 1969, by Subareas.

Subarea	1968			1969		
	Otter Trawlers	Pair Trawlers	Total	Otter Trawlers	Pair Trawlers	Total
1	196	21,526	21,722	1,856	21,925	23,781
2	32,575	278	32,853	33,148	4	33,152
3	66,673	138,883	205,556	31,367	142,038	173,405
4	3,182	59,981	63,163	3,636	44,472	48,108
5	-	18,016	18,016	-	15,526	15,526
Total	102,626	238,684	341,310	70,007	223,965	293,972

Samples of cod were taken from the M/T *Bochorno* in Subareas 2, 3 and 4 for the data on length, age and sex reported below.

Subarea 1

A. Status of the Fisheries

Pair trawlers more than doubled their catch (21,526 tons in 1969; 9,676 tons in 1968) in Subarea 1. Catches were mainly in Div. 1B and 1D. Otter trawler catches were negligible (196 tons in 1969).

Subarea 2

A. Status of the Fisheries

This subarea was, as in 1968, fished almost exclusively by otter trawlers. Almost all the catch (33,005 tons of a total of 33,148 tons) was taken in Div. 2J.

B. Special Research Studies

Sixteen samples (3,150 cod) in September, October and November were examined, and 119 age determinations carried out. The average length was 53.3 cm and the average age 5.7 years, ranging from 3 to 11 years.

In Table 2 the length frequency distribution and in Table 3 the age composition are given.

Table 2. Length frequencies

Subarea 2	
cm	°/oo
33-35	2
36-38	15
39-41	39
42-44	84
45-47	87
48-50	132
51-53	134
54-56	146
57-59	143
60-62	124
63-65	50
66-68	25
69-71	14
72-74	4
75-77	1
Total	1000

Table 3. Age composition

Subarea 2		
Year-class	Age	°/oo
1966	3	14
1965	4	63
1964	5	371
1963	6	300
1962	7	121
1961	8	30
1960	9	14
1959	10	4
1958	11	3
Total		920

The predominant year-classes were 1963 and 1964, as in the 1968 samples, but the modal class changed from the 1963 year-class (5 age-group) in 1968, and the 1964 one (5 age-group) in 1969.

The sex composition was made up directly from samples, and ratios calculated for cod less than 53.5 cm (immature) and greater than 53.5 cm (mature) grouping every two months (Table 4). In November-December the sex ratio deviates significantly ($P < 0.01$) from 50%.

Table 4. Sex ratios. Subarea 2

		Sep-Oct		Nov-Dec	
Cod	Sex	No.	%	No.	%
< 53.5 cm	male	42	59	15	47
	female	29	41	17	53
	Total	71	100	32	100
> 53.5 cm	male	55	47	10	23
	female	62	53	33	77
	Total	117	100	43	100

Subarea 3

A. Status of the Fisheries

Total catch was 173,405 tons, just less than 15% lower than in 1968 because of the fewer otter trawlers. Division 3L provided best fishing for both otter and pair trawlers.

B. Special Research Studies

Fifty-five samples (13,246 cod) in March, April, May, July and September were examined and 350 age determinations carried out. In Table 6 the age distribution is shown, with a mean age of 6.25 years. The ages range from 4 to 15 years.

The predominant year-classes were 1962, 1963 and 1964 and the modal class 1963 (6 year-group). In 1968 the predominant year-classes were 1963 and 1964, and also the modal class 1963 (5 year-group).

Table 5. Length frequencies

Subarea 3	
cm	°/oo
33-35	7
36-38	20
39-41	37
42-44	60
45-47	87
48-50	95
51-53	124
54-56	128
57-59	133
60-62	123
63-65	69
66-68	46
69-71	28
72-74	18
75-77	9
78-80	8
81-83	3
84-86	1
87-89	-
90-92	1
Total	997

Table 6. Age composition

Subarea 3		
Year-class	Age	°/oo
1965	4	79
1964	5	199
1963	6	350
1962	7	226
1961	8	65
1960	9	32
1959	10	24
1958	11	5
1957	12	1
1956	13	2
1955	14	-
1954	15	1
Total		984

Sex ratios in Table 7 show a significant deviation ($P > 0.01$) from 50% in March-April and May-June for cod greater than 53.5 cm and in May-June for cod less than 53.5 cm. The sex ratio for cod less than 53.5 cm in March-April suggests ($P < 0.05$) some segregation of sexes.

Table 7. Sex ratios. Subarea 3

Cod	Sex	Mar-Apr No.	%	May-Jun No.	%	Jul-Aug No.	%	Sep-Oct No.	%
< 53.5 cm	male	117	43	51	30	21	54	6	46
	female	153	57	118	70	18	46	7	54
	Total	270	100	169	100	39	100	13	100
> 53.5 cm	male	122	36	23	19	21	49	8	53
	female	220	64	97	81	22	51	7	47
	Total	342	100	120	100	43	100	15	100

Subarea 4

A. Status of the Fisheries

Total catch decreased in 1969 by 8% to 48,108 tons due to poorer catches of cod in Div. 4Vs.

B. Special Research Studies

Sixteen samples (3,841 cod) were examined, and 157 age determinations were carried out. Average length 56.0 cm. Mean age 5.9 years. The age ranges from 3 to 16 years.

The length frequency distribution is given in Table 8, and the age composition of catches in Table 9. As in Subarea 3, the dominant year-classes were 1962, 1963 and 1964, with 1963 (6 year group) the modal class. The dominant year-classes in 1968 were 1963 and 1964, and the modal class 1963 (5 year group). According to Spanish sampling, status of the fisheries in Subarea 2, 3 and 4 showed a similar feature in the presence of the very rich 1963 year-class.

Table 8. Length frequencies

Subarea 4	
cm	°/oo
33-35	3
36-38	12
39-41	21
42-44	48
45-47	74
48-50	94
51-53	122
54-56	141
57-59	152
60-62	141
63-65	75

Subarea 4	
cm	°/oo
66-68	52
69-71	29
72-74	21
75-77	9
78-80	5
81-83	1
Total	1000

Table 9. Age composition

Subarea 4		
Year-class	Age	°/oo
1965	4	80
1964	5	226
1963	6	305
1962	7	162
1961	8	79
1960	9	32
1959	10	14
1958	11	6
1957	12	1
Total		943

Sex ratios (Table 10) do not reveal any significant departure from 50%, only in July-August for cod greater than 53.5 cm there seems to be some difference ($P < 0.05$).

Table 10. Sex ratios. Subarea 4

Cod	Sex	Jul-Aug No.	Jul-Aug %	Sep-Oct No.	Sep-Oct %
< 53.5 cm	male	15	37	9	47
	female	26	63	10	53
	Total	41	100	19	100
> 53.5 cm	male	21	32	72	49
	female	44	68	76	51
	Total	65	100	148	100

Subarea 5

A. Status of the Fisheries

Catches of mainly cod from Div. 5Ze decreased 3,000 tons to 15,000 tons in 1969.

IX. USSR Research Report, 1969

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

The total USSR catch in the Convention Area in 1969 was 875,265 tons (Table 1), i.e. 133,965 tons more than in 1968.

There was a considerable increase in the catches of silver hake (particularly in Subarea 4), red hake, ocean pout and butterfish (in Subarea 5) and redfish (in Subarea 3).

The total herring catch increased slightly (by 14%), but its distribution over the fishing area was different compared to that in 1968: there was a decrease in the catch in Subarea 5 and a sharp increase in Subarea 4.

The catches of cod and grenadier decreased.

Subarea 1

A. Status of the Fisheries

The USSR commercial fleet did not operate in Subarea 1. Two hundred and forty-five tons of cod, grenadier, halibut and redfish were caught by scouting vessels, mainly in the summer months.

B. Special Research Studies

I. Environmental Studies

In September hydrographic Section 10-A was worked by R/V *Persey III*; its eastern part (between 65°33'N, 53°45'W and 65°03'N, 58°16'W) crosses the West Greenland Current. As seen from Table 2, 1969 may be classed with the cold years. The cooling is most pronounced in the 200-500 m layer.

Table 1. Species composition of the USSR catch in the Convention Area, 1968 and 1969

Species	1969 (by subarea)					1969 total	1968 total
	1	2	3	4	5		
Herring	-	-	-	65,609	100,463	166,072	129,758
Argentine	-	-	-	4,075	1,632	5,707	3,374
Cod	21	130,550	56,882	2,784	646	190,883	245,956
Haddock	-	-	-	235	65	300	3,159
Pollock (saithe)	-	-	-	62	165	227	454
Silver hake	-	-	-	46,323	66,826	113,149	47,299
Red hake	-	-	-	1,358	45,051	46,409	11,873
Grenadier	68	651	11,682	-	-	12,401	26,812
Flounders	-	6,842	35,515	12,914	27,419	82,690	99,144
Greenland halibut	123	7,386	2,814	-	-	10,323	9,515
Redfish	33	5,212	70,119	2,152	15	77,531	35,364
Wolffish	-	169	111	31	-	311	844
Ocean pout	-	-	-	89	19,996	20,085	4,324
Scup	-	-	-	14	200	214	1,782
Alewife	-	-	-	-	25,147	25,147	21,235
Mackerel	-	-	-	4,075	47,547	51,622	43,522
Butterfish	-	-	-	15	9,479	9,494	1,596
Sea robin	-	-	-	-	1,758	1,758	1,130
Angler fish	-	-	1,745	3,295	2,069	7,109	4,639
Dogfish and skate	-	-	2,562	2,633	12,630	19,825	13,582
Squid	-	-	-	65	1,182	1,247	2,473
Other	-	3,628	7,462	3,766	17,906	32,762	33,465
Total	245	154,437	188,892	151,495	380,196	875,265	741,300

Table 2. Average September water temperature (0°C) along Section 10-A crossing the West Greenland Current.

Depth (m)	1961	1962	1963	1964	1966	1967	1969
0-50	4.20	4.70	4.25	4.38	2.72	1.62	2.75
0-200	2.78	2.92	3.25	2.83	2.41	0.97	1.25
200-500	3.60	3.98	3.34	4.84	5.02	3.50	3.26

II. Biological Studies

Cod. In May-June over 2,500 cod caught by the bottom trawl on the central West Greenland banks were measured on board the scouting vessel *Neptune* (Table 3). Length compositions based on Table 3 data show a peak

(major or minor) on the right-hand side at 72-74 cm. The peak seems to be formed mainly by the 1962 year-class fish. Fish around 50 cm long were also relatively abundant. They probably belonged to the 1965 year-class. There is strong evidence pointing to this being a fairly rich year-class. This seems to be even more likely when it is considered that in 1965 a poor cod generation appeared in the Barents Sea and the strength of cod year-classes in the Barents Sea and in the West Greenland area tends to changing conversely.

Table 3. Size composition of cod catches °/oo in the West Greenland area, 1969.

Length (cm)	May	June	
	Div.1D	Div.1C	Div.1D
30-32			5
33-35	1		7
36-38	1		19
39-41	3		20
42-44	10	10	32
45-47	22	17	89
48-50	58	112	106
51-53	86	130	74
54-56	72	46	35
57-59	109	35	19
60-62	115	59	30
63-65	66	53	28
66-68	66	81	57
69-71	64	91	72
72-74	72	131	116
75-77	70	78	105
78-80	61	74	57
81-83	52	53	58
84-86	25	10	33
87-89	17		14
90-92	17	17	13
93-95	4		5
96-98	6	3	3
99-101	1		2
102-104	1		1
105-107	1		
Total /oo	1000	1000	1000
No. of fish	1,381	285	953
Mean length (cm)	65.47	65.17	63.88

Subarea 2

A. Status of the Fisheries

The annual catch is given in Table 4.

Table 4. The annual catch per hour trawling (metric tons)

Div.	Total catch by trawlers of all types							Average catch per hr trawling by BMRT
	Cod	Grena-dier	Red-fish	Floun-ders	Hali-but	Others	Total	
2G	248	387	48	20	215	26	944	1.86
2H	7,006	-	99	114	523	167	7,909	2.06
2J	123,295	264	5,064	6,708	6,648	3,605	145,584	3.23
Subarea 2	130,549	651	5,211	6,842	7,386	3,798	154,437	3.14

B. Special Research Studies

I. Environmental Studies

In July hydrographic Section 8-A across Hamilton Inlet Bank was made by the R/V *Persey III*. Along the AB portion of the section between 53°40'N, 55°44'W and 54°50'N, 53°32'W the water temperature in the 0-200 m layer, as on 15 July was - 0.40°C, i.e. 0.49°C lower than the long-term summer average. Thus the hydrographic forecast given in the USSR Research Report (ICNAF Redbook 1969, Part II) has come true.

In November hydrographic Section 8-A was repeated by the R/V *Rossiva* and again the water temperature in the 0-200 m layer (as on 1 November) along the portion of the section crossing Hamilton Inlet Bank was found to be lower than the long-term average; the temperature in the 200-500 m layer was found to be slightly higher than the long-term average (Table 5).

Table 5. Average water temperature (0°C) along the AB portion of Section 8-A across Hamilton Inlet Bank (November 1).

Depth (m)	1958	1962	1964	1965	1966	1967	1968	1969	1958-1969 average	1969 anomaly
0-50	1.28	1.58	0.98	1.30	2.41	2.00	2.29	0.82	1.58	-0.76
50-200	0.59	1.34	-0.18	1.06	1.44	0.89	-0.18	0.56	0.69	-0.13
0-200	0.79	1.49	0.17	1.13	1.72	1.19	0.50	0.50	0.94	-0.44
200-500	-	1.70	0.98	-	2.47	0.95	0.31	1.64	1.34	+0.30

II. Biological Studies

1. Cod.

a. Age composition. As seen from Table 6 trawl catches taken off South Labrador in January-March were dominated by cod at the age of 6, 7 and 8 full years belonging to the 1963, 1962 and 1961 year-classes. As repeatedly shown earlier (e.g. ICNAF Redbook 1969, Part II) the strength of these year-classes is slightly higher than the long-term average level. This conclusion is also supported by the results of young cod surveys. Table 11 shows than in Div. 3K (where young cod are to be found which are brought by currents from the spawning grounds on the continental slope of the Labrador area) the 3 year-olds and the 4 year-olds belonging to the 1961, 1962 and 1963 year-classes were slightly more numerous than the 3 and 4 year-olds of other generations. By being gradually recruited to the commercial stock the cod of the 3 successive abundant year-classes contributed to an increase in the yield of the trawl fisheries in the Labrador area in 1968 and 1969.

Table 6. Age composition of cod (°/oo) from bottom trawl catches in the South Labrador area (Div. 2J).

Year-class	(age)	January	February	March
1966	(3)	18		
1965	(4)	110	38	28
1964	(5)	157	130	92
1963	(6)	219	303	200
1962	(7)	139	235	213
1961	(8)	115	170	190
1960	(9)	67	50	107
1959	(10)	53	33	63
1958	(11)	51	18	37
1957	(12)	39	7	20
1956	(13)	22	12	23
1955	(14)	6	2	11
1954	(15)	2	2	7
1953	(16)	2		7
1952	(17)			1
1951	(18)			1
Total (°/oo)		1000	1000	1000
No. of fish		510	600	898
Mean age (years)		7.08	6.89	7.73

b. Yields and forecast of cod fishery. Another factor which caused an increase in the yield of the trawl fishery in 1968 and 1969 was the pattern of cod distribution on the continental slope of the Labrador area. In hydrographically colder years the wintering and spawning cod keep southward and deeper than in warmer years. The descent of cod to deeper layers

contributes to an increase in the density of the concentrations. Figure 1 shows the profile of the continental slope in the Labrador area. It can be seen that within the depth range of 300 to 400 m the cod concentrate on a smaller area (and thus form denser concentrations) than within the depth range of 200 to 300 m. The horizontal and vertical distributions of the Labrador cod in the first quarter of the year was found to be closely related to the water temperature in the 50-200 m layer recorded in November of the previous calendar year. As shown by Table 5, on 1 November 1968, the water temperature along Section 8-A was lower than the long-term average. This circumstance (combined with the recruitment to the commercial stock of individuals belonging to 3 relatively abundant year-classes) contributed to the higher productivity of the trawl fishery in the first quarter of 1969 (Fig. 2).

Before the start of 1970 the water temperature along Section 8-A was also lower than the long-term normal, but the difference was quite small. Since the cooling and the warming of the sea occur periodically each 3 or 4 years the negative anomaly along Section 8-A may by November 1970 change into a positive one, which will affect unfavourably the productivity of the Labrador cod trawl fisheries in the first quarter of 1971. Besides, by 1971 the commercial stock of the Labrador cod may decrease because the relatively abundant 1961, 1962 and 1963 year-classes will have almost lost their significance in the fishery whereas the new year-classes are less abundant. Consequently, in the first quarter of 1971 the commercial trawlers fishing in the Labrador area will probably have a slightly lower catch per hour trawling or days fished than in 1968 and 1969.

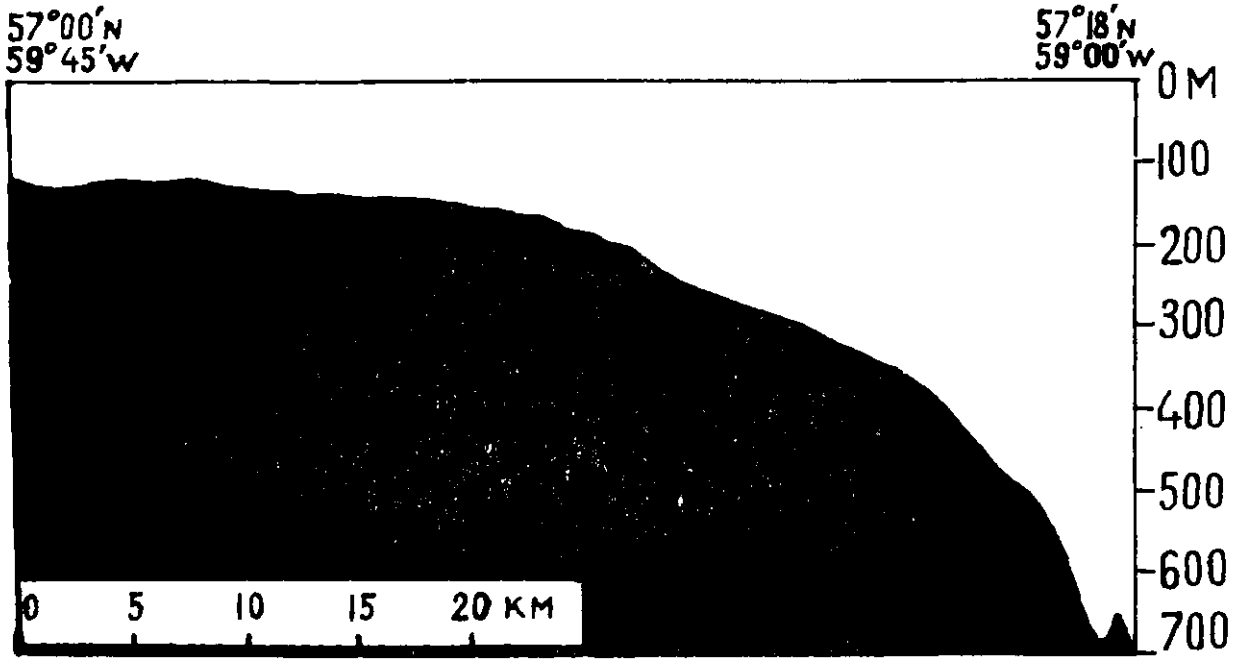

Fig. 1. The profile of the continental slope in Subarea 2 (Labrador area).

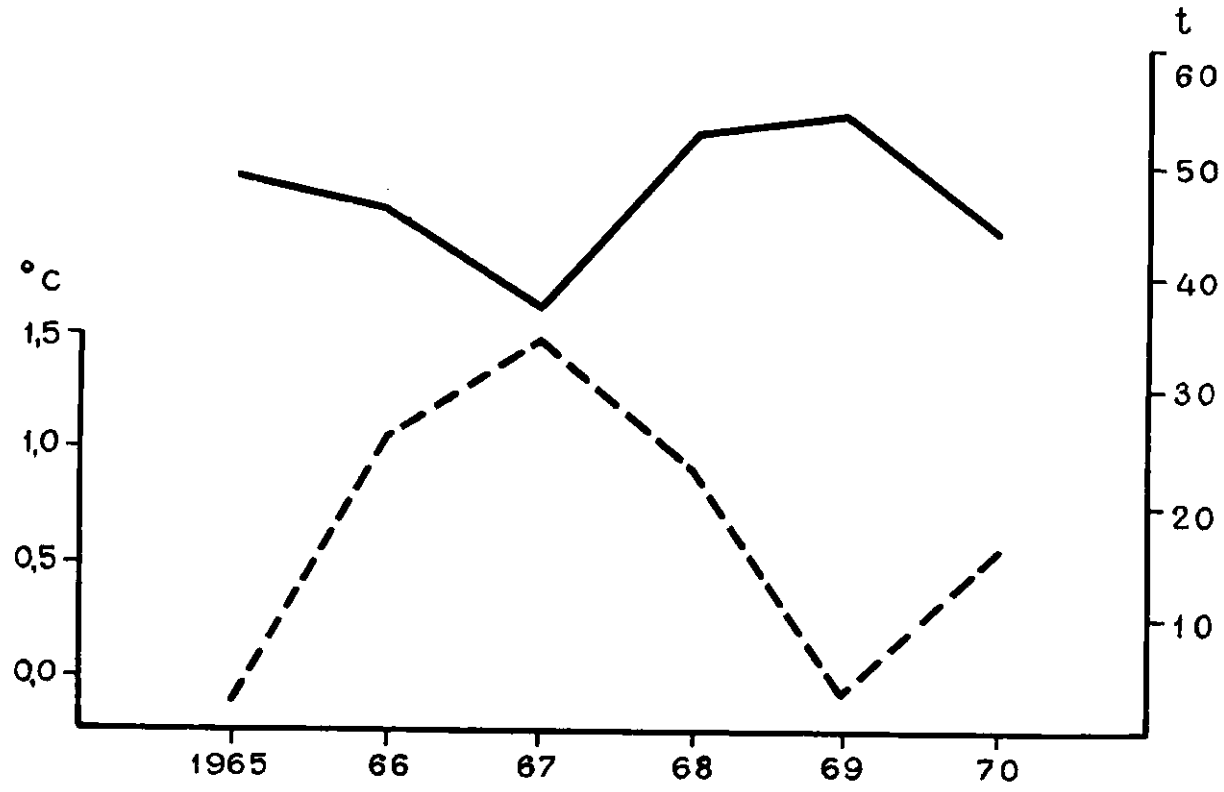

Fig. 2. Average catch by BMRT-type vessels per day fished in Subarea 2 (Labrador area) in February (solid line) and the water temperature in the 50-200 m layer along the AB portion of Section 8-A on 1 November of the previous calendar year (broken line).

c. Tagging. Altogether 2,338 cod were marked with hydrostatic tags and released in the South Labrador area (Div. 2J). Some of the tagged fish have been recaptured and a comparison of the release and recapture positions shows that the tagged fish (Table 7, Nos. 1-2) performed typical summer migrations from the continental slope shoreward.

In 1969 some cod were also recaptured which had been tagged in the Labrador area in earlier years, e.g. in 1964 (Table 7, Nos.3-5). Thus it seems that the cod may carry the hydrostatic tags used by Soviet fishery biologists without shedding them for 5 or more years.

Table 7. Data on the release and recapture of some tagged cod.

No.	Released			Length of fish (cm)	Tag No.	Recaptured			
	Date	Lat.N	Long.W			Date	Lat.N	Long.W	Country
1	20 May 1969	52°35'	53°48'	59	50251	4 July 1969	52°20'	55°50'	Canada
2	20 May 1969	52°47'	53°46'	59	50468	7 July 1969	51°32'	55°40'	Canada
3	21 April 1964	53°53'	53°20'	59	61637	10 April 1969	56°14'	57°40'	Poland
4	25 April 1964	54°52'	54°45'	58	38005	10 April 1969	56°14'	57°40'	Poland
5	30 June 1964	54°55'	53°45'	50	57446	30 March 1969	54°50'	54°05'	Poland

2. Redfish

Table 8 shows the age composition of deepwater redfish *Sebastes mentella* Travin, caught at 480-490 m on the eastern slope of Hamilton Inlet Bank in January. It is interesting to note that both for males and females the age composition has two peaks. One of the peaks is formed by small immature fish at the age of 10-11 years and the other by big mature fish aged 20 and more years. The fish of middle ages (13-15 years) are less numerous.

The double-peaked age (and length) composition of both *mentella*- and *marinus*-type redfish is a typical phenomenon observed in different areas of the North Atlantic, the Norwegian and the Barents Seas. This phenomenon may be explained by the mixing of two (or several) stocks differing in age, length and growth rate. But there may be another explanation which seems to be more correct: during the middle period of their life redfish disperse in the mid-layers and comparatively rarely descend to the bottom.

The movement of redfish to mid-layers is probably associated with intensive feeding before the onset of sexual maturation and it is common knowledge that redfish feed only on bathypelagic and not on bottom organisms. During this period of their life redfish rarely occur in bottom trawl catches.

Table 8. Age composition of *mentella*-type redfish from bottom trawl catches in Div. 2J in January.

Year-class	(age)	Males	Females
1962	(7)	8	13
1961	(8)	41	44
1960	(9)	73	63
1959	(10)	65	95
1958	(11)	180	89
1957	(12)	81	44
1956	(13)	57	32
1955	(14)	57	57
1954	(15)	65	19
1953	(16)	81	6
1952	(17)	57	32
1951	(18)	41	50
1950	(19)	32	95
1949	(20)	81	70
1948	(21)	49	89
1947	(22)	24	95
1946	(23)	8	63
1945	(24)		25
1944	(25)		6
1943	(26)		13
Total (°/oo)		1000	1000
No. of fish		123	158
Mean age (years)		14.14	16.21

3. Grenadier

In October concentrations of grenadier *Macrurus rupestris* were found in the north Labrador division (2G) at the depth of 520 to 800 m. Of the 2,851 individuals measured 64.6% ranged from 60 to 74 cm (inclusive), the mean length was 67.1 cm. Some individuals were 90 cm long but all the fish were immature. The stomach contents were dominated by bathypelagic invertebrates (mainly *Thermisto*) and fish (most often lantern anchovy). The successful autumn feeding was evidenced by the high fatness of the grenadier (liver weight to total fish weight relation), which averaged 11.3%.

In October 1,323 grenadier were measured which had been caught by a bottom trawl from 465 to 940 m in the central Labrador division (2H). The mean length was 58.6 cm, i.e. less than that of grenadier caught in the north Labrador area (2G). The males were also more numerous than females and no mature individuals were found in the catches. The food composition was the same and the fatness was 8.8%.

Subarea 3

A. Status of the Fisheries

The annual catch is given in Table 9.

Table 9. Annual catch and catch per hour trawling (metric tons).

Div.	Cod	Grena-dier	Red-fish	Floun-ders	Hali-but	Others	Total	Average catch per hr trawling by BMRT
3K	23,895	11,682	8,246	7,147	1,836	3,865	56,671	2.10
3L	665	-	391	533	57	141	1,787	1.65
3M	283	-	2,061	113	-	94	2,551	2.34
3N	8,384	-	22,068	9,324	441	3,268	43,485	2.11
3O	20,789	-	15,344	14,058	461	3,204	53,856	2.18
3P	2,866	-	22,009	4,340	19	1,308	30,542	2.47
Subarea 3	56,882	11,682	70,119	35,515	2,814	11,880	188,892	2.13

B. Special Research Studies

I. Environmental Studies

Temperature observations were made along standard hydrographic Sections 1-A, 2-A, 3-A, 4-A and 6-A.

Particular attention is to be given to the eastern portion (H_2) of Section 6-A (between 47°00'N, 46°30'W and 47°00'N, 46°00'W). The temperature along this portion of the section characterizes the intensity of the North Atlantic Current (Table 10).

Table 10. Water temperature(0°C) along H_2 of Section 6-A in April 1968 and 1969.

Depth (m)	14 April 1968	26 April 1969
0-50	4.03	5.36
50-200	4.37	4.94
0-200	4.30	5.04
200-500	4.80	4.48

Thus, in the spring of 1969 the North Atlantic Current seems to have been more intensive than in the spring of 1968.

II. Biological Studies

Cod. As in previous years a young cod survey was made in Subarea 3. Results for some Divisions are presented in Table 11.

Division 3K contains young fish which at the stage of egg or larva are brought by currents from the spawning grounds off Labrador. The best indication of a year-class strength is the catch of young fish at the age of 2+.

Young fish aged 0+ and 1+ keep near the shore and rarely occur in our sampling trawls. At the age of 3+ cod often reach the length at which they are already placed into the group of "adult" fish. Besides, at the age of 3+ cod start moving from Div. 3K northward to the Labrador area.

Table 11 shows that young cod at the age of 2+ belonging to the 1961, 1962 and 1963 year-classes were fairly numerous in Div.3K. It was mentioned above that these year-classes formed the bulk of trawl catches off South Labrador in 1969. The same year-classes predominated in Div. 3K (Table 12) where the cod of the same stock as in the Labrador area are to be found.

From Table 11 it can be seen that the 1964 and 1965 year-classes seem to be slightly less successful than those of the previous years. This may unfavourably affect the abundance of the commercial stock of Labrador cod in 1971. In later years, though, the stock may be expected to become more abundant again due to the very good 1966 year-class.

Table 11 also clearly shows the extremely high strength of the 1964 year-class on the southern slopes of Grand Bank and on St. Pierre Bank (Div. 3N, 3O and 3P). This explains the sharp increase in cod catches in these areas in 1967-1969. It should be noted that the 1965 and 1966 year-classes are also good year-classes. The 1967 year-class is considerably poorer but the 1968 year-class seems to be very good.

Table 11. Average catch (number of fish) of young cod per hour trawling with the sampling trawl.

Year-class	0+				1+				2+				3+			
	3K	3N	3O	3P	3K	3N	3O	3P	3K	3N	3O	3P	3K	3N	3O	3P
1958													10	1	0	2
1959									21	8	1	4	15	1	1	1
1960					5	3	0	3	11	1	2	5	11	1	0	1
1961	1	1	1	6	3	4	3	6	20	5	1	6	24	4	1	1
1962	1	1	7	42	2	8	2	7	15	18	2	12	24	6	1	2
1963	1	1	1	3	1	5	1	13	36	30	1	17	17	7	3	4
1964	1	41	24	31	3	137	13	22	8	73	42	58	28	16	7	10
1965	1	1	1	5	1	14	12	21	15	23	20	25	22	60	9	9
1966	1	2	15	7	3	27	17	32	27	37	34	28				
1967	1	1	2	3	8	3	4	20								
1968	1	6	18	40												

Table 12. Age composition of cod(°/oo) from bottom trawl catches on North Newfoundland Bank.

Year-class	(age)	March	April	May
1965	(4)	17	37	20
1964	(5)	127	136	153
1963	(6)	280	234	260
1962	(7)	263	237	210
1961	(8)	163	197	247
1960	(9)	63	57	50
1959	(10)	27	63	27
1958	(11)	7	20	20
1957	(12)	27	13	3
1956	(13)	7	-	7
1955	(14)	10	3	3
1954	(15)	3		
1953	(16)	3	3	
1952	(17)	3		
Total (°/oo)		1000	1000	1000
No. of fish		300	300	300
Mean age (years)		7.15	7.08	6.96

Haddock. During the past decade none of the haddock year-classes on the southern Grand Bank was good. One of the reasons could have been the generally severe hydrographic conditions which were favourable for the spawning of cod but not haddock which is a much warmer-water species. The haddock stock on the southern slopes of Grand Bank was replenished mainly by young fish brought from St. Pierre Bank. During the past decade the best year-classes there were those of 1966 and 1967 but they were not nearly so good as the long-term average.

The young haddock survey and the analysis of the vertebrae numbers enabled the Soviet fishery biologists to reach the conclusion that in 1968 young haddock of local origin appeared on the southern slopes of Grand Bank. It is felt that now we have the first indications of the restoration of the South Newfoundland haddock stock.

Redfish. Regular redfish studies have long been conducted on Flemish Cap Bank where the Soviet commercial fleet started fishing 14 years ago. Altogether 3,197 *mentella*-type redfish were measured on Flemish Cap Bank in September 1969. The mean length was 32.53 cm for males and 33.48 cm for females.

As is known, intensive fishing may cause a decline in the abundance of the *mentella*-type redfish but their mean length in trawl catches has never been observed to decrease. The USSR Research Report, 1966 (ICNAF Redbook 1967, Part II) quoted the mean lengths of the male and female *mentella*-type redfish

caught on Flemish Cap Bank in August 1962, 1964 and 1966. In September 1969 the mean lengths of males and females were slightly lower (by 1 and 2 cm respectively) but this cannot be considered as an indication of the diminishing size of the *mentella*-type redfish because the size composition of this fish changes with depth, month and the slope of the Bank. This matter is considered in more detail in a separate report (ICNAF Res. Doc. 70/47).

Regular observations permitted the conclusion to be drawn as to the age at which *mentella*-type redfish reach maturity in different areas (Table 13).

Table 13. The age of mass maturation of *mentella*-type redfish in different areas.

Area	Males	Females
South Labrador	11	13
North-eastern slope of Grand Bank	9	11
Southern slopes of Grand Bank	8	10
Flemish Cap Bank	11	13

It can be seen that the first to reach maturity are redfish from the southern slope of Grand Bank. Commercial trawl catches of this fish always consist of small (mainly 25 to 35 cm) but mature individuals. It should be noted that on the southeastern slope of Grand Bank *mentella*-type redfish are slightly bigger than on the southwestern slope because the biggest individuals generally move from the western to the eastern part of the Bank.

Grenadier. From June to December (inclusive) 9,737 grenadier, *M. rupestris*, were measured in Div. 3K of which 5,846 fish were 45 to 62 cm long. As in other areas of the North American continental slope there was a sharp predominance of males in trawl catches (in August-December they formed 69.2% of the total, see Table 14).

No mature fish were found. The dominating food items found in the stomachs were shrimp, squid, *Themisto*, *Cumacea* and fish. The average liver weight in November was 6.1% of the weight of fish.

By using an original method it was possible to obtain the first data on the age and growth rate of the North-American grenadier. These fish grow very slowly; the males of medium size (with a weight of 500 to 700 gm and a length of 65 to 70 cm including the tail) are aged 12 to 14 years. Females are slightly superior to males in both linear and weight growth.

Tagging of commercial fish. Table 15 gives the numbers of fish tagged in various Newfoundland divisions.

Table 14. Length composition of grenadier (°/oo) in Div. 3K in November 1969.

Length (cm)	Males	Females	Length (cm)	Males	Females
27-29	1		63-65	99	71
30-32	2		66-68	69	68
33-35	4	5	69-71	83	73
36-38	6	9	72-74	60	51
39-41	17	23	75-77	38	38
42-44	28	35	78-80	14	19
45-47	50	57	81-83	6	11
48-50	87	106	84-86	4	5
51-53	110	120	87-89	1	1
54-56	81	85	Total (°/oo)	1000	1000
57-59	100	94	No. of fish	1,780	791
60-62	140	129	Mean length (cm)	59.4	58.7

Table 15. Tagging of commercial fish in Subarea 3.

Div.	Cod	American plaice	Yellowtail flounder	Other	Total
3K	142	-	-	-	142
3L	1,854	26	-	2	1,882
3N	-	379	1,017	6	1,402
3O	345	36	31	28	440
3P	-	100	-	-	100
Subarea 3	2,341	541	1,048	36	3,966

Subarea 4

A. Status of the Fisheries

Silver hake. The catch of silver hake increased sharply from 3,400 tons in 1968 to 46,400 tons in 1969 (Table 16). This increase is explained by the fact that commercial concentrations of silver hake appeared which were successfully fished by the BMRT-type vessels from spring to autumn. In 1966-1968 commercial concentrations were insignificant due to the depression of the stock and in those years silver hake were caught incidentally in fishing for other species.

Table 16. Silver hake catches in Subarea 4 in 1962-1969 (metric tons).

Year	1962	1963	1964	1965	1966	1967	1968	1969
Catch	8,825	123,023	81,147	49,987	10,323	2,476	3,441	46,323

Table 17. Age composition (%) of silver hake in the Sable Island area in 1962-1969.

Year \ Age	1	2	3	4	5	6	7	8	9	Total (%)	Mean age
1962	27.70	36.96	20.93	9.09	2.11	0.21	+	+	-	100.0	2.19
1963	0.04	6.38	56.42	31.1	5.66	0.31	0.05	0.03	0.01	100.0	3.37
1964	0.28	2.23	31.57	45.13	16.41	3.96	0.42	-	-	100.0	3.89
1965	-	0.21	20.10	50.84	24.46	2.28	0.11	-	-	100.0	4.09
1966	-	13.10	22.80	38.50	22.30	3.20	0.10	-	-	100.0	3.80
1967	-	0.7	14.8	61.0	19.4	3.6	0.5	-	-	100.0	4.12
1968	0.3	11.1	31.9	34.9	15.7	5.3	0.7	0.1	-	100.0	3.74
1969	6.0	5.9	37.2	34.1	11.9	3.3	1.1	0.5	-	100.0	3.57

In spring silver hake were caught at depths of 150-300 m on the southern slopes of Emerald Bank. Mackerel, herring and argentine were caught along with silver hake. In summer silver hake were fished on the slopes of Emerald and Middle Banks and on the Sable Island shoal. In autumn the proportion of silver hake in catches decreased and that of flounder and herring increased.

Silver hake was represented in catches by specimens with the body lengths ranging from 24 to 35 cm. Samples for age composition were taken in the first, second and fourth quarters of the year. In the third quarter when most of the catch was taken no samples for age studies were obtained. The age composition based on the samples taken in the first, second and fourth quarters is presented in Table 17.

The age composition of silver hake changed in the course of the year, with the number of 2- and 3-year-olds higher in autumn than in spring. This suggests that the stock is now replenished by the new 1966 and 1967 year-classes which are better than those of 1964 and 1965 and thus in 1970 the silver hake stock may be expected to remain at the 1969 level.

Haddock. In 1969 the haddock catch dropped to 200 tons (Table 18). This is the lowest catch on record for the fishery. The decline in catches is explained mainly by the low abundance of the stock and by the fact that fishing vessels started fishing for other species. It was not possible to sample haddock for size and age composition as practically only individual specimens were caught.

Table 18. Haddock catches in Subarea 4 in 1962-1969 (metric tons).

Year	1962	1963	1964	1965	1966	1967	1968	1969
Catch	2,567	3,701	5,499	45,458	20,566	753	589	235

No changes in the catch trend are expected in 1970 as compared to 1969 because all year-classes recruited to the stock are poor.

Argentine. The catch increased to 4,100 tons in 1969 compared with 1,600 in 1968 but remained considerably lower than the catch in 1966 (Table 19). Generally, the argentine fishery is underdeveloped and does not reflect the condition of the stock. At present argentine is a potential object of fishery.

Table 19. Argentine catches in Subarea 4 in 1963-1969 (metric tons).

Year	1963	1964	1965	1966	1967	1968	1969
Catch	8,127	4,943	5,611	14,983	4,191	1,589	4,075

Argentine were mainly caught at depths of 150-250 m as a by-catch in the hake fishery on the slopes of Middle, Emerald and Browns Bank in spring and autumn.

In the catches taken by scouting vessels in the area of Emerald and La Have Banks in February, March and April argentine was represented by specimens at the age of 2 to 15 years (Table 20).

Table 20. Age composition of argentine from catches by scouting vessels in Subarea 4 in February-April 1969.

Age	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Number (%)	0.1	0.1	0.5	6.3	9.2	17.9	27.9	24.7	8.1	2.7	1.6	0.1	+	0.8

It is evident from the table that the bulk of the catch consisted of specimens at the age of 6 to 10 years and the modal age-groups were those of 8 and 9.

Mackerel. In 1969 the mackerel catch dropped to 4,100 tons as compared to 9,400 tons in 1968. The decline in the catch is explained by the fishermen paying more attention to fishing for other species, in particular for herring. The mackerel stock is not fished intensively and this species may be considered a potential object of fishery in this area.

Herring. Until 1969 in the area of Browns, Emerald and Banquereau Bank off Nova Scotia herring was caught in insignificant quantities in fishing for other species. From 1962 to 1968 the catches ranged from 600 to 5,900 tons with the average of 2,500 tons (Table 21).

Table 21. Herring catches in Subarea 4 in 1962-1969.

Year	1962	1963	1964	1965	1966	1967	1968	1969
Catch	900	2,700	2,500	5,900	2,200	600	2,800	65,609

In 1969 the herring catch rose sharply due to the intensification of the fishery on the slopes of Banquereau Bank in January-May. Herring concentrations were observed at 40 to 200 m in the eastern and southeastern parts of the Bank in the near-bottom layers at water temperatures of 0.3 to 2.0°C. Concentrations were very dense and stable until May when herring started their migration to the inshore waters of Cape Breton and the concentrations became more active. At the beginning fishing was conducted with pelagic trawls from the "Atlantic"-type RTM vessels but in March SRT and SRTR vessels also joined the fishery using pair seining and purse seining methods.

During the entire period the catches were high: for RTM the average catch per hour trawling was 8.6 tons, for SRT and SRTR it was 1.3 tons (pair seining) and 22.1 tons (purse seining) per haul.

In winter and spring herring was represented in catches by specimens ranging from 25 to 43 cm in length; mean length was 34.6 cm (Fig.3).

The age composition of herring from two 450-fish samples taken in February is also given in Fig. 3. The age ranged from 4 to 12 years. Nine-year-olds were predominant (25.7%).

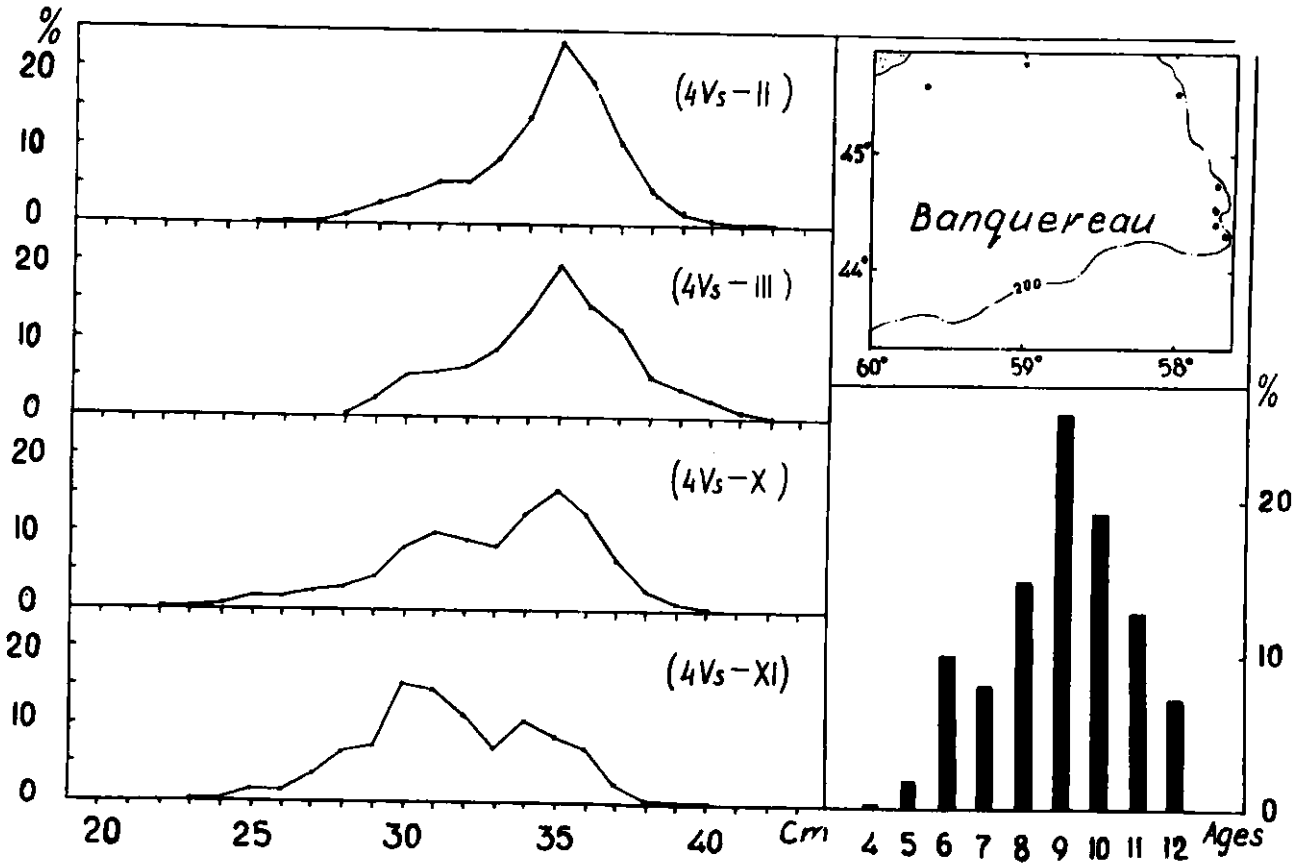

Fig. 3. Size and age composition of herring catches on Banquereau Bank (Div.4Vs).

B. Special Research Studies

I. Environmental Studies

Hydrography. In 1969 hydrographic observations were continued by conducting standard seasonal surveys (the station grid is given in the USSR Research Report, Redbook 1967, Part II). Temperature measurements were also taken on scouting vessels searching for fish concentrations. Four standard hydrographic surveys were conducted during the year: in January, April,

August and October. The analysis of data shows that in 1969 the water temperature was higher than in 1968. In the area of the Nova Scotian channel the temperature near the bottom ranged from 5 to 10°C during the year whereas in 1968 it was 2 to 3°C lower (Fig. 4). Elsewhere, the water temperature was at the 1968 level.

II. Biological Studies

Argentine. A comparison was made of the meristic characteristics of argentine caught on the southern slopes of Browns Bank and on the slopes off Sable Island. The following characteristics were compared: the number of rays in the anal, pectoral, dorsal and pelvic fins; the number of gill rakers on the first arch and the number of vertebrae. Reliable differences were found in the number of vertebrae and the number of rays in the anal fin. On the average, the number of the anal fin rays and the vertebral number were found to be higher in argentine caught on Browns Bank than in the fish caught at Sable Island. Differences in growth rate were also observed. At the same age the Browns Bank argentine are longer than the Sable Island fish.

Joint USSR-US groundfish surveys in Subarea 4. During the joint USSR-US surveys in November and December, 95 hauls were made by SRTM No.806 *Ecliptika* with the American No.36 trawl and the 26.4 m Soviet redfish trawl. The hauls were made at random stations in the area of Banquereau, La Have and Browns Banks. The material obtained is being processed.

Subarea 5

A. Status of the Fisheries

Silver hake. In 1969 the silver hake catch in Subarea 5 was 66,800 tons (Table 22).

Table 22. Silver hake catches in Subarea 5 in 1962-1969 (metric tons)

Year	1962	1963	1964	1965	1966	1967	1968	1969
Catch	41,900	107,357	167,308	281,431	121,373	69,984	43,858	66,826

A slight increase in the catch in 1969 may be attributed to the general increase of the fishing effort in Subarea 5 and to the concentration of the fishing vessels in the Nantucket shoal area where the main silver hake concentrations were observed. As shown by the preliminary information from the joint USSR-US surveys the abundance of the silver hake stock in 1969 continued to decline and was found to be lower than the 1968 level. During the year BMRT-, RTM- and SRTM-type vessels caught silver hake along with other species. The bulk of the catch was obtained in summer and in autumn. During winter and spring silver hake were caught along with red hake at 150 to 350 m on the slopes off Block and Veatch Canyons. From May to December silver hake were fished on the Nantucket shallows. The catches contained red hake, mackerel, flounder, butterfish, ocean pout, skate and spiny dogfish.

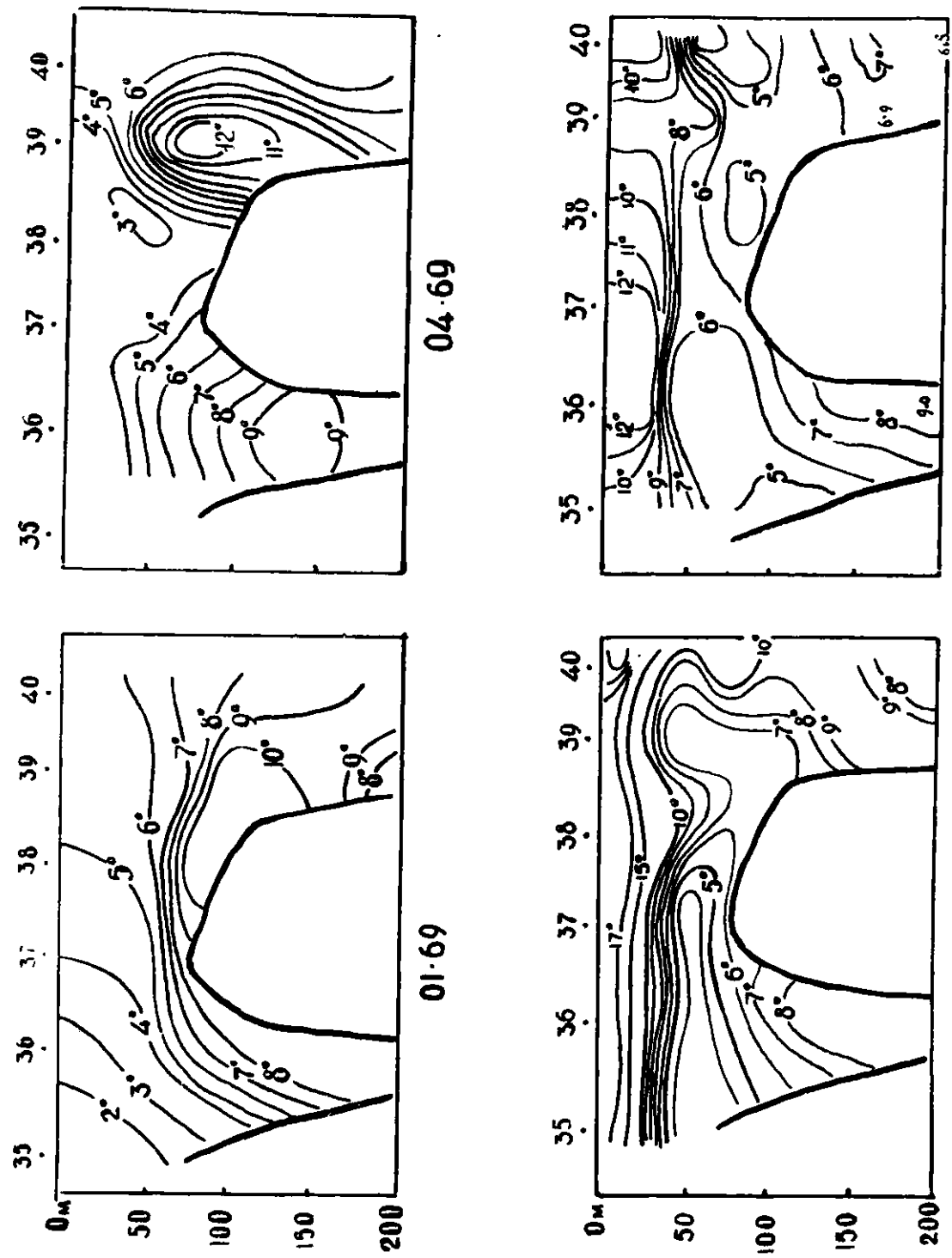

Fig. 4. Water temperatures along the Halifax section in January, April, August and November 1969.

On the southern and southeastern slopes of Georges Bank, where until 1964 a very successful silver hake summer fishery had existed, no commercial concentrations were observed. Neither were any commercial concentrations found on the northern and northwestern slopes.

As in the preceding years the major part of the catches was formed by 3- and 4-year-olds (Fig. 5).

In 1962, 1963 and 1967 the 4-year-olds were more numerous than the 3-year-olds and in 1964, 1965, 1966 and 1969 the reverse was observed. These changes in the relative abundance of 3- and 4-year-olds may be attributed partly to the fluctuations in the abundance of year-classes and partly to the areas and periods in which the sampled catches were taken.

On the spawning grounds of the southern slopes of Georges Bank the proportion of 4- and 5-year-olds was higher than on the feeding grounds of the northwestern slopes of Georges Bank or the Nantucket shoal. The relative abundance of 2-year-olds in these years fluctuated between 0.2 and 11.4%, that of 5-year-olds between 2.2 and 15.5% and that of 6-year-olds from 0.9 to 5.7%. One-year-olds, 7-year-olds and older fish were represented in the catches only by individual specimens. Thus, no sharp changes in the age composition of the Georges Bank silver hake were recorded during the period from 1962 to 1969. It is true that in 1964-1966 the relative contribution of the 4-year-olds followed a downward trend but they were again predominant in 1967.

However, significant changes in the stock abundance and in the catch took place during the same period. The size of commercial concentrations and the catches of silver hake on the eastern Georges Bank (Div. 5Ze) decreased compared to 1964. A similar trend was observed in the western part of Subarea 5 (Div. 5Zw) beginning with 1967. The catch-per-unit effort declined at a higher rate than the total catch because the fishing effort increased almost every year. Beginning with 1968 the silver hake concentrations decreased so much that these fish became only a by-catch in other fisheries, whereas in 1963-1966 they were the main object of the fishery.

The decline in the stock abundance takes place mainly due to natural causes as a result of the recruitment of relatively poor year-classes.

The annual recruitment of 3-year-olds to the stock averages 30 to 50% and the remaining part (50 to 60%) which consists mainly of 4- and partly 5-year-olds is annually removed from the stock by natural mortality.

Since the stock decline and, consequently, the drop in silver hake catches in Subarea 5 which took place recently is attributed mainly to natural causes, fishery regulation measures may not have any decisive effect on their size.

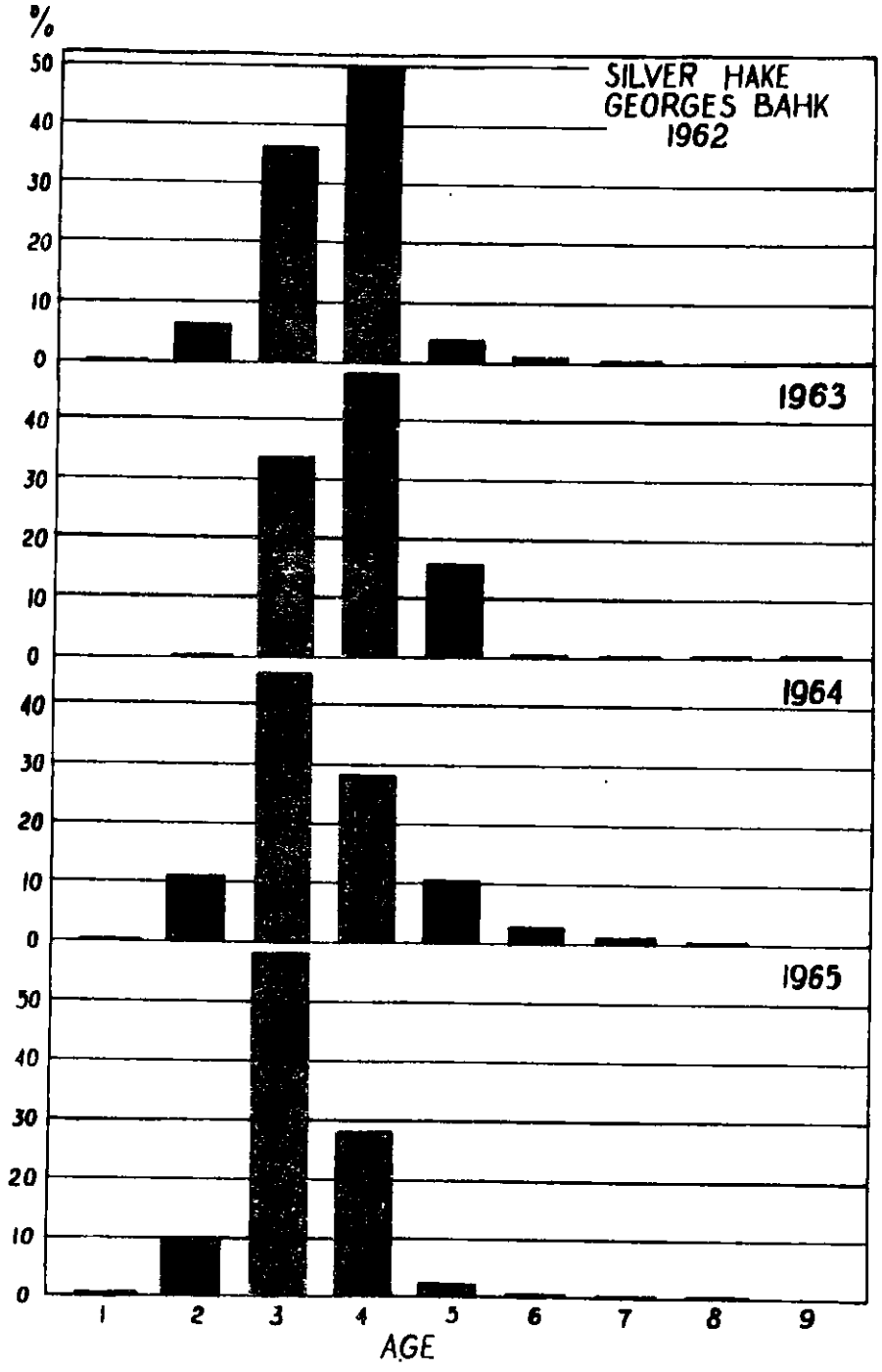

Fig. 5. Age composition of silver hake catches on Georges Bank in 1962-1969.

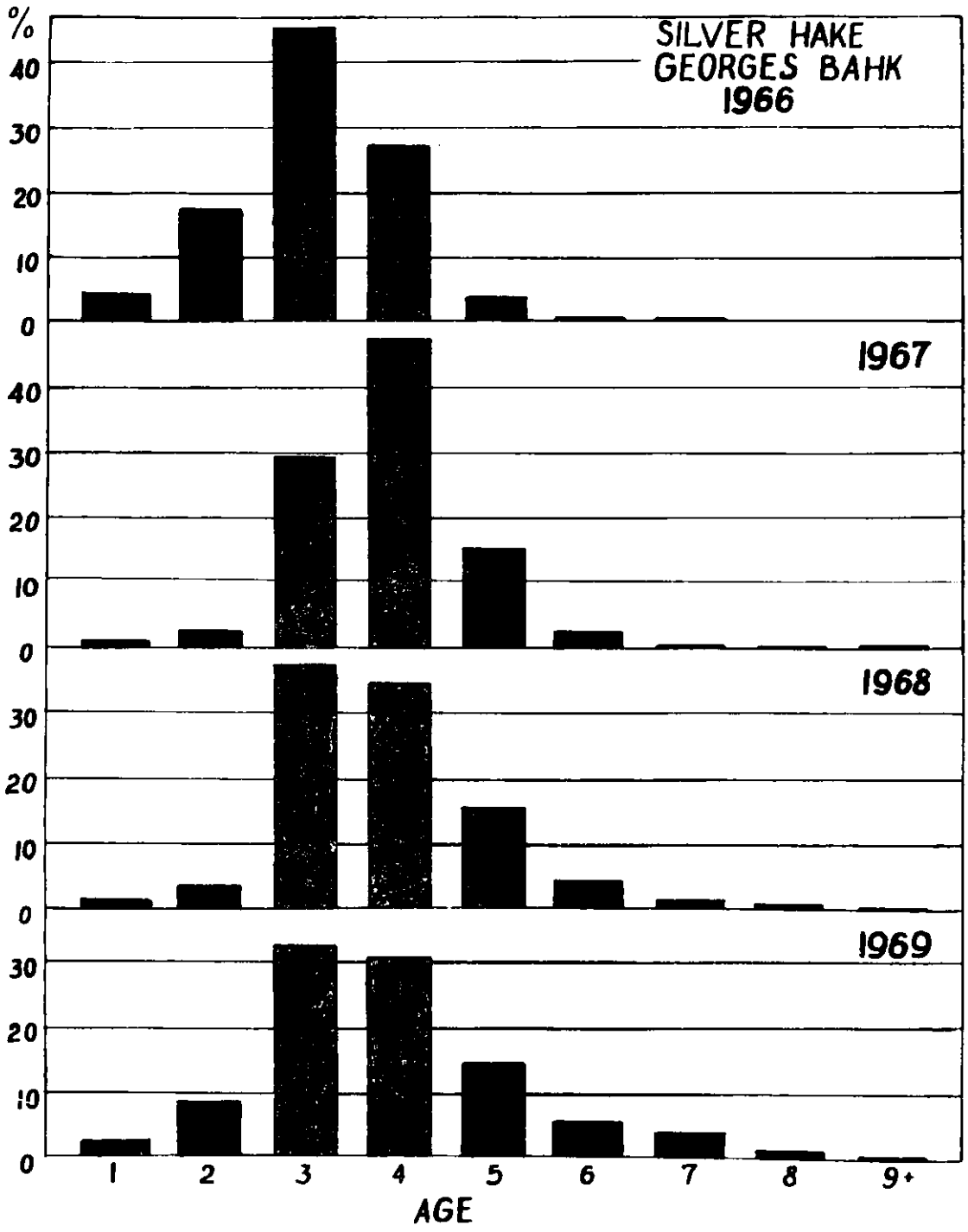

Fig. 5 (continued) Age composition of silver hake catches on Georges Bank in 1962-1969.

Haddock. In 1969 no commercial concentrations were observed on Georges Bank and haddock were sometimes caught as individuals when the vessels were fishing for other species. The recorded haddock catch was less than 100 tons.

Table 23. Haddock catches in Subarea 5 in 1962-1969 (metric tons).

Year	1962	1963	1964	1965	1966	1967	1968	1969
Catch	1,131	2,361	5,489	81,882	48,409	2,316	1,397	65

Beginning with 1963 all haddock year-classes appeared to be poor and it is only the 1969 year-class that is estimated to be better than the 1967 and 1968 year-classes. The estimation is based on the preliminary results of the joint USSR-US survey. In 1970 and 1971 the haddock stock will remain at a low level and in 1972 an increase in the stock abundance may be expected.

Red hake. In 1969 the red hake catch in Subarea 5 increased to 45,000 tons (Table 24).

Table 24. Red hake catches in Subarea 5 in 1963-1969 (metric tons)

Year	1963	1964	1965	1966	1967	1968	1969
Catch	3,500	3,600	58,500	82,900	37,600	11,300	45,051

The increase in the red hake catch in 1969 is attributed partly to an increase in the stock abundance and partly to an increase in the fishing intensity.

During summer and autumn red hake were caught along with other species on the Nantucket shoal. The major part of the catches consisted of 3- and 4-year-olds (75% on the average). Preliminary results of the stock estimation by control hauls show that in the autumn of 1969 the red hake stock was more abundant than in 1967 and 1968. With the same fishing intensity the catches in 1970 may be expected to remain at the 1969 level.

Herring. In 1969 the herring catch was 100,500 tons, i.e. 26,500 tons less than the 1968 catch (Table 25). The drop in the catch is attributed to a decline in the stock abundance with is evident from a drop in the catch-per-unit-effort. Though the fishing intensity in Subarea 5 was much higher in 1969 compared to 1968 the catches were lower.

Table 25. Herring catches in Subarea 5 in 1962-1969 (metric tons)

Year	1962	1963	1964	1965	1966	1967	1968	1969
Catch	151,144	97,329	130,723	36,349	117,346	123,572	126,965	100,463

The decline in the abundance of the herring stock is largely attributed to the fact that the strong 1960 year-class and the moderate 1961 year-class have by now been removed from the stock by natural and fishing mortality while the year-classes of 1962 to 1965 which have been recruited to the fishery happen to be poor (Table 26). Besides, there was a sharp increase in the total herring catch in the last two years: the total Subarea 5 catch by all countries went up from 166,300 tons in 1966 to 423,100 tons in 1968. All year-classes from 1962 to 1967 inclusive happened to be poor.

In 1970-71 the fisheries will be based on the poor 1962-1967 year-classes and it should be noted that at the age of 1 to 3 years these year-classes have already been exploited by US fishermen in the coastal Gulf of Maine areas and on reaching sexual maturity the 1962 to 1965 year-classes have been quite heavily exploited on Georges Bank and in adjacent areas. In 1970 and 1971 there will be a further decline in the herring stock and the adult herring catches are likely to drop.

Table 26. Age composition (%) of herring catches on Georges Bank in 1961-1969.

Year	Age										%
	1	2	3	4	5	6	7	8	9	10	
1961		2.0	7.8	27.9	50.8	10.1	1.4	+	+	-	100.0
1962		+	0.5	8.1	16.3	52.0	15.3	6.2	1.2	0.4	100.0
1963		+	38.8	13.5	29.7	13.8	3.0	1.2	+	-	100.0
1964		2.5	22.9	35.0	19.5	14.8	5.3	+	+	-	100.0
1965		0.2	10.1	35.8	39.8	13.1	0.9	0.1	-	-	100.0
1966		0.4	0.9	4.7	28.2	50.0	12.6	3.2	-	-	100.0
1967		0.3	0.3	3.6	11.8	36.6	42.2	5.0	0.2	-	100.0
1968	0.1	0.5	5.3	8.0	20.1	22.5	37.3	6.1	0.1	-	100.0
1969	-	1.6	6.8	14.2	24.6	26.1	14.4	10.8	1.2	0.3	100.0

Mackerel. The contribution of mackerel to the total USSR catch has been increasing since 1967(Table 27).

Table 27. Mackerel catches in Subarea 5 in 1962-1969 (metric tons)

Year	1962	1963	1964	1965	1966	1967	1968	1969
Catch	-	869	533	2,460	5,446	11,407	33,961	47,547

The considerable increase in the mackerel catches in 1968 and 1969 is explained by an increase in the stock abundance in recent years as well as by a more intensive fishery since following the decline in herring concentrations commercial vessels switched over to the mackerel fishery. The mackerel fishery was conducted on Georges Bank and on the Nantucket shallows from April to December.

The bulk of the catches consisted of fish with the body length of 24 to 37 cm. During summer and autumn the mackerel in catches were bigger than in spring. The mean body length in monthly catches ranged from 27.6 cm in April to 34.2 cm in September. Ninety-five percent of the mackerel catch was made up of 2- and 3-year-olds belonging to the 1966 and 1967 year-classes: in the four samples of 492 fish collected in May and June 2-year-olds made up 79.9%, 3-year-olds 15.7% and 4-year-olds 4.4%. The 1966 and 1967 year-classes seem to be relatively more abundant compared to other year-classes, which suggests that in 1970 the stock will remain at the level of 1969.

B. Special Research Studies

I. Environmental Studies

Hydrography. In 1969 hydrographic information in Subarea 5 was collected throughout the year by the AtlantNIRO research vessels. Four standard hydrographic surveys were made along the sections shown in Redbook 1967, Part II. Apart from standard surveys, bathythermograph stations were made at the time of control hauls and during searching. The data obtained allow the determination of the water temperature level in the area as compared to that of the preceding year. In the East Channel area and in the deep part of the Gulf of Maine the temperature level in 1969 was generally higher than in 1968. The temperature of the water over the central part of Georges Bank was close to the 1968 level while that of the water over the southern Georges Bank was lower than in 1968. In the area south of Nantucket Island the temperature level was similar to that in 1968 (Fig. 6 and 7).

Zooplankton. In 1969 the collection of zooplankton samples on Georges Bank was continued. The samples were collected with a Juday net at the time of the hydrographic surveys and also on the spawning grounds of silver hake, red hake and herring during the survey aimed at estimating the spawning efficiency of these species. The samples collected in 1965-1967 have been processed.

The information collected allows a preliminary conclusion to be reached on a considerable decrease in the zooplankton and seston biomass in 1967 as compared to 1965 and 1966 (Table 28).

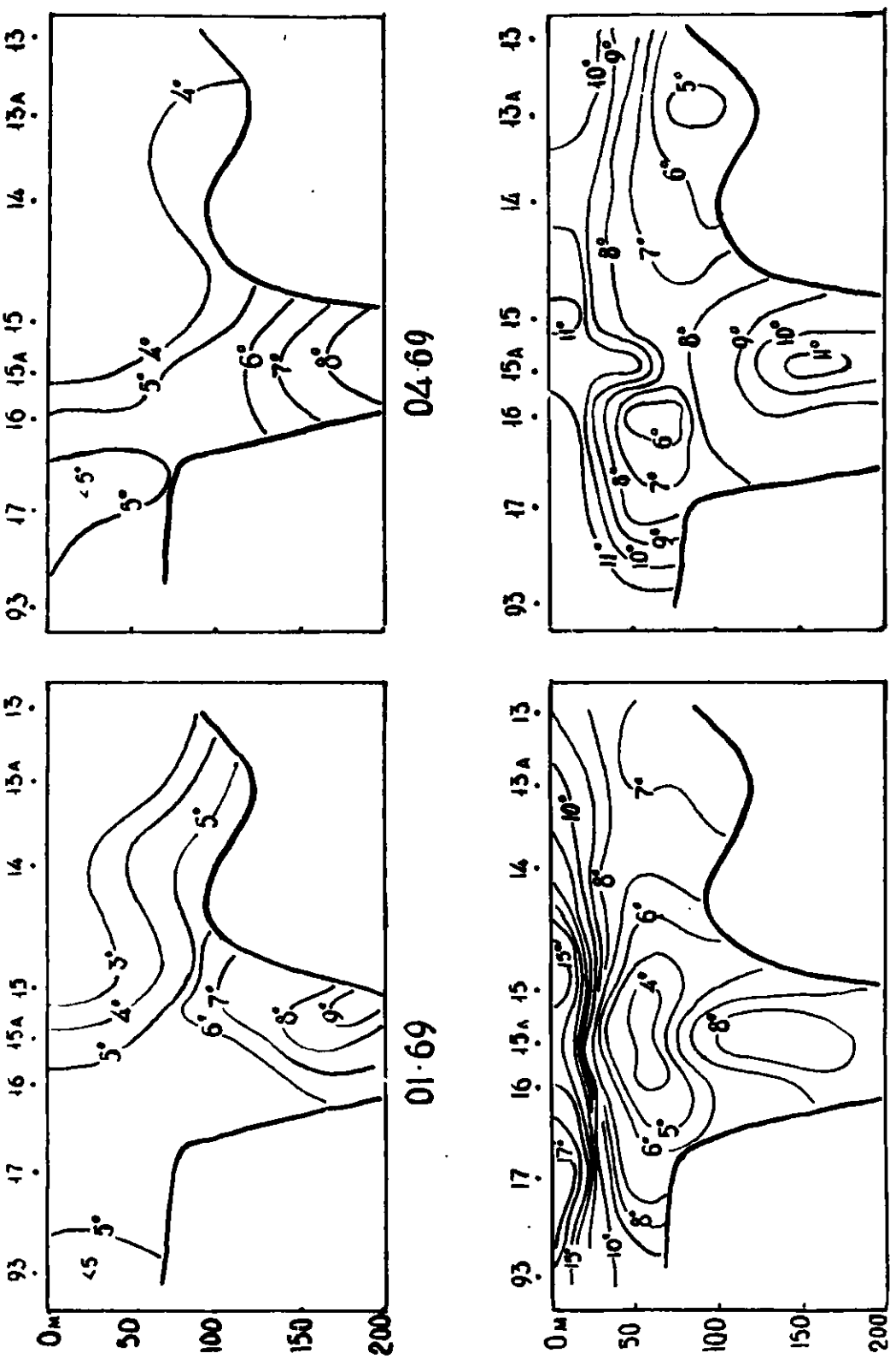

Fig. 6. Water temperatures in the East Channel in January, April, August and October 1969.

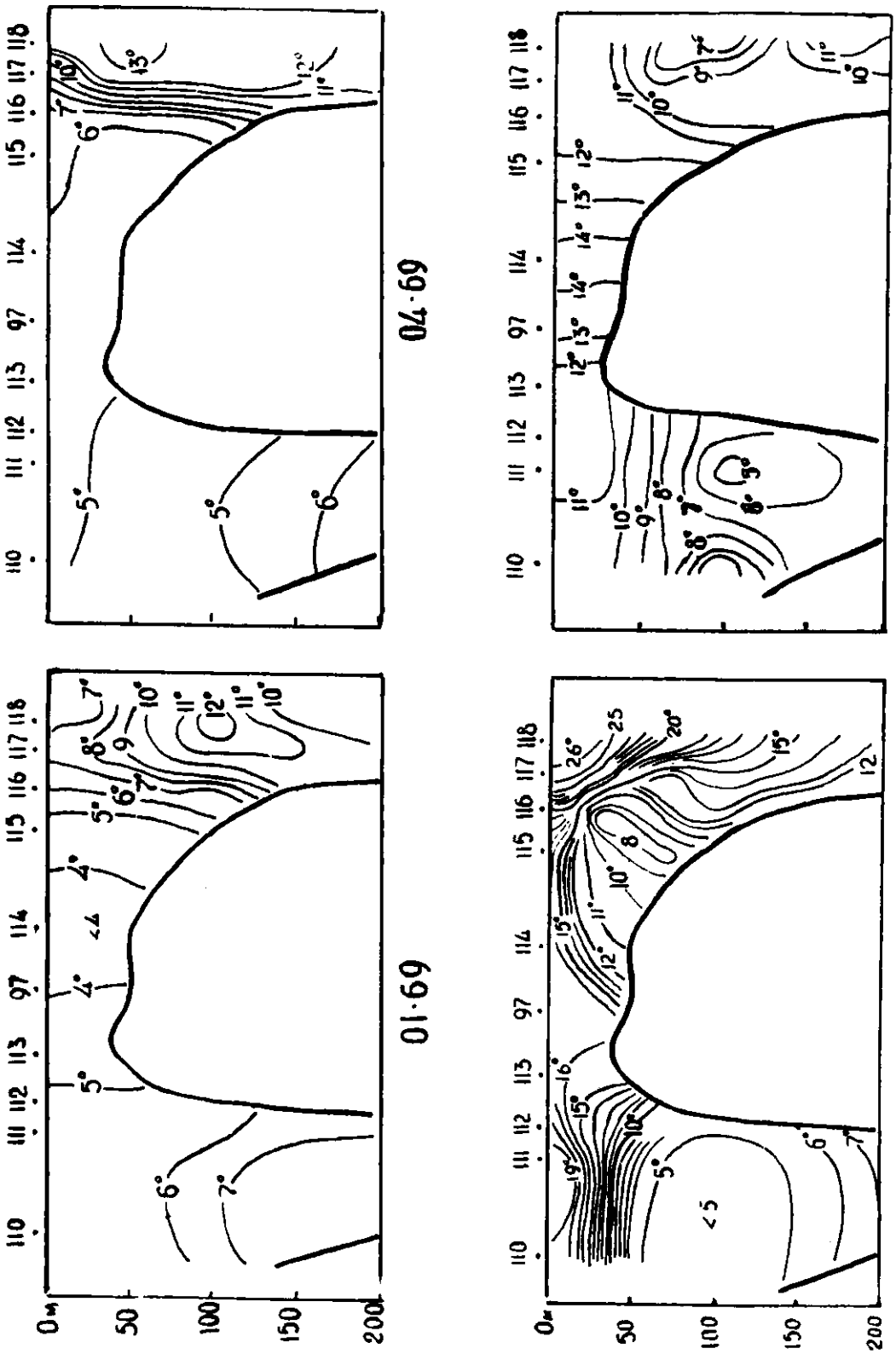

Fig. 7. Water temperature along Section XXII (38°W) in January, April, August and October 1969.

Table 28. Zooplankton (abundance) and seston biomass in 1965-1967.

Month	1965		1966		1967	
	Abundance (thousands under m^2)	Biomass (mg/m^3)	Abundance (thousands under m^2)	Biomass (mg/m^3)	Abundance (thousands under m^2)	Biomass (mg/m^3)
January	-	-	-	-	29	112
April	160	514	154	600	33	180
June	300	640	150	400	110	200
August	173	373	121	353	260	210
November	114	483	82	510	128	286

The causes of changes in the plankton productivity in 1967 are not clear.

Ichthyoplankton. The examination of the gut contents in silver hake larvae collected in July and August 1967 and 1968 shows than in 1967 the larvae which were 2.2 to 3.2 mm long mainly fed on the nauplial and copepodite stages of Copepoda sp. In 1968 the length of the larvae in samples ranged from 4.2 to 6.5 mm and the principal food items were the copepodite stages of various Copepoda while nauplii occurred in insignificant quantities. The silver hake larvae were found to have a diurnal feeding thythm: at 2-3 p.m. the proportion of full guts was 46%; at 4-5 p.m. it was zero and during the remaining part of the day the larvae were feeding intensively.

II. Biological Studies

Studies on the spawning of herring on Georges Bank. In September and October 1969 studies on the spawning of herring were continued with the aim of estimating the amount of eggs spawned and the abundance of spawning herring and of obtaining information on the distribution and drift of herring larvae. It was found that the spawning took place on two small spawning grounds (eastern and western). The eastern spawning locality was found and investigated on 20-21 September. Its central part was positioned at 67°16'5 W, 41°57'0 N. The area with eggs was found to be 1.8 km^2 and the weight of the spent herring was estimated to be 35,000 tons.

The western spawning ground was located on two areas close to each other with their centres positioned at 67°29'03 W, 41°58'0 N and 67°30'0 W, 41°57'6 N. The total area of the western spawning ground was 2.2 km^2 and the weight of spent herring was estimated to be 22,000 tons. In 1969 the spawning population was estimated to be about 60,000 tons whereas it was 150,000 tons in 1966; 530,000 tons in 1965 and 1,180,000 tons in 1964. Thus, there was a sharp decline in the abundance of spawning herring on the main Georges Bank spawning grounds in 1969 as compared to 1964 and 1965. The decrease in the amount of herring arriving at the spawning grounds is mainly due to a considerable reduction of the stock.

In October ichthyoplankton was collected with the IKS-80 net. On 11-16 October ichthyoplankton was sampled on the northern part and from 21 October to 1 November at standard stations over Georges Bank, Larvae occurred over the Bank with the main mass in the central part.

Joint USSR-US studies on the distribution and abundance of groundfish. In late October and early November the USSR *Ecliptica* and the US *Albatross IV* conducted a joint survey to study the abundance of groundfish on Georges Bank and in the Gulf of Maine by trawling. The *Ecliptica* made 54 and the *Albatross IV* 94 hauls of 30 min. duration each. The *Ecliptica* used a 24.6 m redfish trawl and the *Albatross IV* used a No.36 trawl. Preliminary results show that in 1969 the abundance of silver hake was slightly lower and that of red hake was higher than in 1968.

Statistical Subarea 6

A. Status of the Fisheries

In 1969 the Soviet catch in Statistical Subarea 6 increased to 107,300 tons. The increase is due to the intensification of the herring and mackerel fisheries.

Table 29. Catches in Statistical Subarea 6 in 1963-1969 (thousand metric tons)

Species	1963	1964	1965	1966	1967	1968	1969
Silver hake	4.2	16.9	17.3	92.9	18.6	15.0	7.2
Red hake	0.8	8.4	11.7	25.7	14.9	1.9	4.1
Herring	0.5	0.2	1.9	2.8	3.2	16.1	38.2
Mackerel	0.3	0.1	0.1	1.2	6.1	7.3	37.5
Other	2.1	2.6	2.4	8.4	4.3	12.4	20.3
Total	7.9	28.2	33.4	131.0	47.1	52.7	107.3

Silver hake. The 1969 silver hake catch of only 7,200 tons was considerably lower as compared to 92,900 in 1966, 18,600 in 1967 and 15,000 tons in 1968. The reduction is due to a decrease in the concentration resulting from a decline in abundance as well as the closure of the silver hake fishery on the edge of the shelf from January to March. In previous years the major part of the catch had been obtained in the first quarter of the year. Best silver hake catches were taken by the BMRT-type vessels on the shelf slope in the Hudson Canyon area in April. The main part of the catches was made up of specimens with the body length of 26 to 32 cm. The mean length in April was 31.5 cm. As in the previous years 3- and 4-year-olds were predominant. Five-year-olds were also fairly numerous (Table 30).

Table 30. Age composition (%) of silver hake catches in Subarea 6 in 1966-1969.

Year	Age										Total
	1	2	3	4	5	6	7	8	9	10	
1966	-	15.55	38.16	29.77	12.28	3.62	0.58	0.04	-	-	100.0
1967	2.00	2.44	44.65	46.64	4.03	0.22	0.02	-	-	-	100.0
1968	-	10.47	60.58	27.55	0.93	0.42	0.05	-	-	-	100.0
1969	-	8.5	27.0	30.8	15.5	7.2	5.1	3.3	2.2	0.4	100.0

The results of the autumn survey in 1969 showed that the abundance of silver hake was lower than in 1968, therefore no increase in the catches is expected in 1970 compared to 1969.

Red hake. In 1969 red hake were caught practically only off Hudson Canyon in April as in January-March the area of the red hake concentrations was closed and in May the red hake migrated to the coastal Nantucket area (Subarea 5).

Red hake was represented in catches by specimens at the age of 1 to 6 years. Three- and 4-year-olds belonging to the 1965 and 1966 year-classes were predominant (Table 31).

Table 31. Age composition (%) of red hake catches in Subarea 6 in 1969.

Age	1	2	3	4	5	6	Total	Mean age
Number (%)	8.3	10.8	50.2	25.1	5.5	0.1	100.0	3.1

Specimens belonging to the 1966 year-class made up 50.2%, which suggests a higher abundance of this year-class as compared to other year-classes. The prospects for the red hake fishery in 1970 are quite limited due to the closure of the fishing area in the first quarter of the year when red hake concentrations are formed.

Herring. In 1969 the herring catch increased to 38,200 tons compared to 16,100 tons in 1968. Herring were caught at 40 to 70 m from Delaware to Norfolk. The majority of the fish caught ranged from 27 to 33 cm; the mean length was 29 cm (Table 32).

Table 32. Age composition (%) of herring catches in Subarea 6 in 1966-1969.

Year	Age								
	2	3	4	5	6	7	8	9	%
1966	0.1	1.6	1.6	13.1	46.1	30.5	7.0	-	100.0
1967	-	0.4	2.4	13.0	41.9	39.5	2.8	-	100.0
1968	0.8	1.2	4.4	26.9	37.4	27.7	1.6	-	100.0
1969	0.2	6.2	10.3	30.2	18.8	16.6	16.1	1.6	100.0

Mackerel. The mackerel stock seems to be in good condition. Due to more intensive fishing the mackerel catch in 1969 rose to 37,500 tons from 7,300 tons in 1968. Mackerel was fished from February to May with the best effect achieved in the Delawere - Norfolk area (6B and 6C). The catches taken by the SRTR- and SRT-type vessels amounted to 6 to 10 tons per day fished.

B. Special Research Studies

I. Environmental Studies.

Hydrography. In 1969 no hydrographic observations were made in Subarea 6 except in August when standard Section XXV (Hudson Canyon) was worked. The temperature and salinity distribution along this section is presented in Fig. 8.

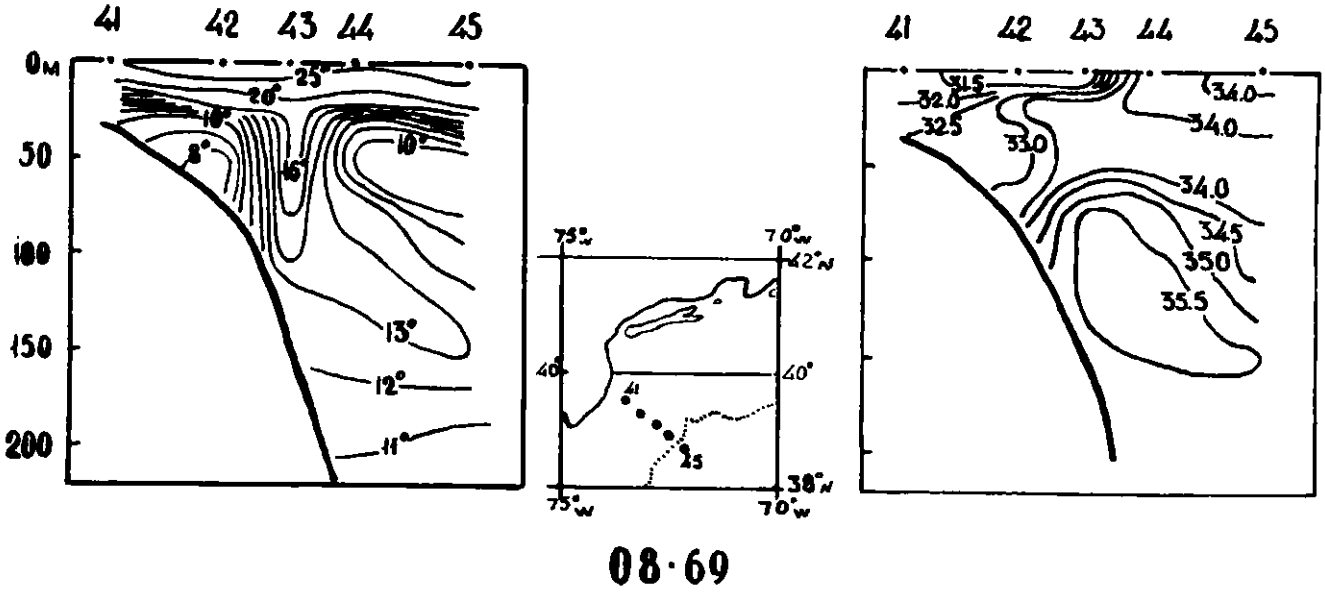

Fig. 8. Temperatures and salinities along the Hudson section in August 1969.

II. Biological Studies

Squid. In 1969 the material on the biological and fishery characteristics of the long-finned squid was summarized. The material had been collected in the Cape Hatteras-Cape Cod area in 1967 and 1968. Seasonal distribution was charted. From October to April long-finned squid form considerable concentrations at depths of 100 to 250 m on the continental slope from southwestern Georges Bank to Cape Hatteras. During November-December the concentrations in the southern part increased in March-April the northward movement of the concentrations is observed. With the warming of the coastal waters in May-June the squid move to shallow waters. In winter the highest quantities of squid occur in areas with the water temperature of 9 to 12°C. The spawning lasts from May to September.

A five-degree scale has been worked out for the visual determination of the state of gonad development.

Joint USSR-US groundfish surveys. The joint studies on the abundance and distribution of groundfish from Cape Cod to Cape Hatteras were continued in 1969 (the methods used are described in ICNAF Res. Doc. 68/87). From 8 to 19 October the Soviet *Ecliptika* made 66 hauls with a 24.6 trawl and the US *Albatross IV* made 100 hauls with a No. 36 trawl.

X. United Kingdom Research Report, 1969

Subareas 1-3

A. Status of the Fisheries

Prolific fishing in the northeast Arctic in 1969 attracted that part of the UK fleet which fished in the northwest Atlantic in 1968. As a result fishing effort fell from 30,000 hours in 1968 to 4,000 hours in 1969 and it was carried out by stern freezer trawlers in the first half of the year. Total catches of cod amounted to only 4,500 tons, half of which were caught in Subarea 3, the remaining small quantities coming from Subareas 1 and 2. The amount of fishing was too small to permit valid comparison with the status of the fisheries in 1968.

In view of the reduced fishing sampling of commercial catches from the ICNAF area was minimal.

D.J. Garrod
Fisheries Laboratory
Lowestoft

B. Special Research Studies

I. Environmental Studies

1. Hydrography. No hydrographic studies were carried out.

2. Plankton Studies. The Survey with Continuous Plankton Recorders, operated from the Oceanographic Laboratory, Edinburgh, continued in 1969 on the same basis as in other years. It was financed by the UK Natural Environment Research Council and by Contract F61052-67-C0091 between the Office of Naval Research, Department of the United States Navy and the Scottish Marine Biological Association.

Recorders are towed at a depth of 10 m, at monthly intervals, along standard routes by cutters of the US Coast Guard and merchant ships from Denmark, Iceland and the United Kingdom. During 1969, Recorders sampled for 1,333 miles in Subarea 1; 2,172 in Subarea 2 and 15,664 in Subarea 3. This sampling forms part of the laboratory's standard survey of the North Atlantic Ocean and the North Sea. Further details may be obtained on application to the Director, Oceanographic Laboratory, Craighall Road, Edinburgh, EH6 4RQ.

The spring outbreak of phytoplankton was extremely abundant over the Grand Banks, with a maximum in April. Numbers of diatoms were also higher than usual in the oceanic region of Subarea 3 in April and May; further north, in Subarea 2 and the southern part of Subarea 1, phytoplankton was scarce until July.

Adults of *Calanus finmarchicus* (the dominant copepod of this region) were scarce in the southern part of Subarea 1 in April and May, but, in contrast, were abundant in Subarea 3, particularly in March. The young stages of *Calanus* were below average in numbers.

Young stages of the population of *Sebastes* spp. found in American shelf and slope waters were abundant in the oceanic area east of the Grand Banks (Subarea 3M) in April and June. Elsewhere, as in 1968, they were scarce.

R.S. Glover
Oceanographic Laboratory
Edinburgh

3. No benthic studies were carried out.

II. Biological Studies

The investigation of the West Greenland salmon fishery was continued by UK scientists in 1969, six of whom took part in a tagging program at West Greenland during the fishing season.

The tagging program was divided into two parts. In one of these an attempt was made to assess the viability of salmon caught in shore gill nets by impounding them for a period after capture, using tagged and untagged fish. In the other part of the program a further attempt was made to investigate the possibilities of longlining as a means of catching salmon in a condition suitable for tagging. The results of both investigations were rather disappointing. In all, 26 live fish were caught in the gill nets and, as the number impounded was also low, no reliable conclusions could be drawn. A total of 65 fish was caught by longline, of which 43 were tagged in very good condition.

One of the salmon tagged in Greenland in 1968 was recaptured in Canada in 1969.

Investigations of the blood and other biochemical characteristics of West Greenland salmon and of some national and foreign stocks were continued and further observations were made on their parasite fauna.

Further batches of smolts were tagged in home waters during the spring of 1969. In England and Wales, 16,051 smolts (54% natural; 46% hatchery reared) were tagged, from seven river systems and in Scotland, 19,755 smolts (81% natural; 19% hatchery reared) were tagged from four river systems. By December 31, 1969, reports had been received of the recapture of 26 salmon at West Greenland, which had been tagged as smolts in the UK in 1968 (18 tagged in England and Wales and 8 tagged in Scotland).

K.A. Pyefinch, Freshwater Fisheries Laboratory, Pitlochry.

I.R.H. Allan, Salmon and Freshwater Fisheries Laboratory, London

B.B. Parrish, Marine Laboratory, Aberdeen.

Subareas 4 and 5

A. Status of the Fisheries

There was no UK fishery in Subareas 4 and 5 in 1969.

B. Special Research Studies

I. Environmental Studies

1. No hydrographic studies were made.

2. Plankton Studies. The Continuous Plankton Recorder Survey described under Subareas 1-3 was also carried out in Subareas 4 and 5. Recorders sampled for 4,476 miles in Subarea 4 and 744 miles in Subarea 5.

The young stages of *Calanus* were abundant in the coastal regions of these two subareas in June, that is slightly later than usual.

The young stages of the population of *Sebastes* spp. were scarce, as in 1968.

R.S. Glover
Oceanographic Laboratory
Edinburgh

3. No benthic studies were made.

XI. United States Research Report, 1969

by Herbert W. Graham

The United States landed fish from all ICNAF Statistical Subareas and conducted research in Subareas 1, 3, 4, and 5.

Subarea 1

A. Status of the Fisheries

The United States landed 200 metric tons of cod from the subarea, probably the first US landings from the subarea ever recorded.

B. Special Research Studies

The United States Coast Guard conducted oceanographic surveys from Melville Bay to Disco Island in conjunction with the International Ice Patrol West Greenland Glacier Survey. The Bureau of Commercial Fisheries cooperated to the extent of providing scientific personnel to collect benthic and sediment samples. The work was performed during the month of August.

Subarea 2

A. Status of the Fisheries

The United States landed 342 tons of cod from the subarea, the first since the establishment of ICNAF. The catch was primarily cod.

Subarea 3

A. Status of the Fisheries

I. Redfish

Redfish landings by the United States from Subarea 3 were considerably lower in 1969 than in 1968 (Table 3.1). Because of the very low fishing effort, landings per day fished is not a meaningful index of abundance.

Table 3.1 US redfish statistics, Subarea 3 (metric tons, round fresh).

Year	Landings	Days Fished	Landings/Day Fished
1963	12,089	882	13.7
1964	4,692	364	12.7
1965	772	51	15.0
1966	346	38	9.1
1967	150	16	9.3
1968	198	15	13.1
1969	33	1+	22.7

Subarea 4

A. Status of the Fisheries

I. Haddock

United States landings of haddock from Div. 4X decreased by 1,300 tons (Table 4.1). Landings from Browns Bank, the principal area fished by the US fleet within this Division, decreased by 1,000 tons. Both effort and abundance also showed reductions from 1968. *Albatross IV* groundfish surveys showed a slight improvement in the 1969 year-class; however, abundance will continue to decline for the next 3 or 4 years due to generally poor recruitment.

Table 4.1 US haddock statistics, Div. 4X (metric tons, round fresh).

Year	Div.4X Landings	Browns Bank		
		Landings	Days Fished	Landings/Day Fished
1964	8,488	6,978	930	7.5
1965	3,685	1,786	275	6.5
1966	2,473	939	200	4.7
1967	5,014	2,059	381	5.4
1968	3,156	2,278	506	4.5
1969	1,830	1,305	389	3.4

II. Cod

US fishing vessels landed 448 tons of cod from Subarea 4 in 1969 compared with 860 tons in 1968. This decrease in cod landings was probably due to the continued decline in fishing effort for haddock in this area.

III. Redfish

Redfish landings from the Gulf of St. Lawrence (Div.4R, S and T) by the United States decreased in 1969 (Table 4.2). Effort and abundance also decreased. US redfish landings and effort from the Scotian Shelf (Div. 4V, W and X) continued a decline that started in 1967 (Table 4.3). Because of the low effort; however, landings per day is probably not indicative of true abundance.

Table 4.2 US redfish statistics, Div. 4R, S, T (metric tons, round fresh).

Year	Landings	Days Fished	Landings/Day Fished
1964	12,278	735	16.7
1965	17,099	803	21.3
1966	12,766	608	21.0
1967	15,482	622	24.9
1968	16,437	740	22.2
1969	12,122	689	17.6

Table 4.3 US redfish statistics, Div. 4V, W, X (metric tons, round fresh).

Year	Landings	Days Fished	Landings/Day Fished
1964	15,636	2,369	6.6
1965	13,082	1,246	10.5
1966	16,680	1,183	14.1
1967	6,407	593	10.8
1968	4,635	297	15.8
1969	1,142	75	15.3

B. Special Research Studies

I. Environmental Studies

Many of the United States investigations in Subarea 5 included the southern part of Subarea 4 and are reported under Subarea 5.

II. Biological Studies

Haddock. The cooperative studies of haddock in Div. 4X by Canada and the USA have continued. A revision of the status of fisheries, and an assessment of fishing intensity corresponding to maximized yield has been completed. These estimates indicate the 18,000 tons annual quota set for 1970-72 is too high--the figure for 1970 should be about 12,000 tons.

In addition, data from the US research vessel surveys have been analyzed to provide estimates of mortality, abundance and recruitment. Year-classes since 1963 have been consistently poor, although some improvement in the 1969 year-class was noted. Recruitment to the fishery will thus be poor for several more years, and abundance will decline--the rate being dependent on the fishing intensity.

The data also indicate a rather high natural mortality of 1- and 2-year-olds during 1964 and 1965. This aspect requires further study.

Subarea 5

A. Status of the Fisheries

I. Haddock

Georges Bank (Div. 5Ze) haddock landings by the United States continued their predicted sharp decline (Table 5.1). Effort was curtailed drastically during 1969 and abundance was lower. The landings per day index does not reflect true abundance because of low effort and a change in the characteristic of the US fishing fleet. Another index method will be used in the future (see biological studies).

Age compositions from commercial landings (Fig. 1) indicate that 6- and 7-year-old fish (1963 and 1962 year-classes) made up 68% of the 1969 catch. The *Albatross IV* fall groundfish survey showed a below average 1969 year-class; the sixth successive year of poor recruitment (Table 5.2). This means a continued reduction in abundance for at least two more years on Georges Bank.

Table 5.1 US haddock statistics, Div. 5Y and 5Z (metric tons, round weight).

Year	Subarea 5 Landings	Div.5Y Landings	Div.5Z[1/]		
			Landings	Days Fished	Landings/Day Fished
1964	51,895	5,383	46,512	8,775	5.3
1965	57,027	4,204	52,823	9,432	5.6
1966	57,497	4,579	52,918	11,759	4.5
1967	39,580	4,852	34,728	9,386	3.7
1968	28,887	3,418	25,469	9,096	2.8
1969	18,858	2,402	16,456	5,308	3.1

1/ Predominately 5Ze landings.

Table 5.2 Research vessel index of relative year-class abundance of Georges Bank haddock based on autumn catches of 0-group fish.

Year	Index	Year	Index
1959	9.6	1964	2.0
1960	2.4	1965	1.2
1961	1.4	1966	1.5
1962	2.6	1967	0.0
1963	12.6	1968	1.0
		1969	1.1

II. Cod

Cod landings by the United States in Subarea 5 increased in 1969 for the third straight year (Table 5.3). The abundance index, although not precise, was slightly higher than in 1968.

Landings of cod have increased drastically with the influx of heavy haddock fishing in the mid-sixties. Increased pressure is continuing on cod now, and with the low stock density of haddock, the cod is bringing better market prices. Although we do not have an accurate assessment of sustainable yield, it is doubtful that the present yield trends can continue into the near future.

Table 5.3 Cod landings, Subarea 5 (metric tons, round weight).

Year	All Countries Landings	United States Landings	United States Landings/Day Fished
1964	28,416	15,478	1.0
1965	42,261	15,011	0.9
1966	57,055	15,343	1.1
1967	42,051	18,057	1.0
1968	48,900	21,045	1.4
1969	-	24,179	1.7

III. Silver hake

Total US landings of silver hake from Subarea 5 in 1969 decreased about 15,000 tons from 1968 (Table 5.4). Most of this decline was in landings of food fish in the Gulf of Maine. Abundance here decreased sharply due to poor recruitment since 1962. In the southern area landings decreased only slightly.

Table 5.4 US silver hake statistics, Subarea 5 (metric tons, round weight).

Year	Subarea 5 Landings	Subarea 5 North[1] Landings	Subarea 5 North[1] Landings/Day	Subarea 5 South[2] Landings	Subarea 5 South[2] Landings/Day
1964	53,145	39,479	15.1	13,666	11.5
1965	41,809	33,774	11.3	8,035	4.4
1966	40,771	37,545	12.7	3,226	1.4
1967	30,986	27,082	9.3	3,904	3.4
1968	35,902	32,426	14.0	4,762	4.0
1969	20,333	16,263	4.9	4,070	4.6

1/ Primarily food fish from north of Cape Cod

2/ Primarily for industrial use from south of Cape Cod.

IV. Redfish

Redfish landings from Subarea 5 by the United States doubled and effort increased significantly in 1969 when compared with 1968. Landings per day were slightly lower in 1969; however, abundance is still high, and continued good catches in the Gulf of Maine can be expected for 1970.

Table 5.5 US redfish statistics, Subarea 5 (metric tons, round weight).

Year	Total Subarea 5 Landings	Div. 5Y (Gulf of Maine)		
		Landings	Days Fished	Landings/Day Fished
1964	7,812	6,137	1,427	4.3
1965	6,986	5,045	742	6.8
1966	7,204	4,719	429	11.0
1967	10,442	6,746	649	10.4
1968	6,576	4,060	292	13.9
1969	12,038	9,637	824	11.7

V. Yellowtail

Total US yellowtail landings in 1969 from Subarea 5 increased 1,000 tons over 1968 (Table 5.6). This increase was primarily caused by additional effort on Georges Bank. Abundance was slightly lower and evidence points to lower recruitment in 1969.

Research studies have indicated a marked decrease in abundance, particularly of older age groups, associated with the high fishing intensity of the last few years. These studies suggest the need for curtailing fishing on this stock to maintain yields.

Table 5.6 US yellowtail statistics, Subarea 5 (metric tons, round weight).

Year	Landings	Days Fished	Landings/Day Fished
1964	36,340	9,822	3.7
1965	37,190[1/]	11,997	3.1
1966	31,020[1/]	15,510	2.0
1967	25,376[1/]	11,534	2.2
1968	32,578[1/]	10,859	3.0
1969	33,004[1/]	12,224	2.7

1/ 1965-1969 values include some landings for industrial purposes.

VI. Red hake

Subarea 5 red hake landings by the United States decreased about 1,300 tons from 1968 landings (Table 5.7). Effort dropped in 1969; however, abundance continued to exhibit a slight rise that started in 1967.

Table 5.7 US red hake statistics, Subarea 5 (metric tons, round weight).

Year	Subarea 5 Landings	Div.5Y Landings	Div. 5Z[1/]		
			Landings	Days Fished	Landings/Day Fished
1964	24,573	143	24,430	1,733	14.1
1965	13,493	192	13,301	1,462	9.1
1966	4,280	634	3,646	1,585	2.3
1967	5,759	92	5,667	1,012	5.6
1968	6,216	82	6,134	876	7.0
1969	4,923	140	4,783	583	8.2

[1/] Predominantly industrial landings from 5Zw.

VII. Industrial Groundfish Fishery

New England industrial groundfish landings from Subarea 5 were about 8,000 metric tons less in 1969 than in 1968 (Table 5.8). This is a reflection of market conditions since abundance indices were similar to 1968's level. Species composition was similar to that of the past two years, although the percentage of flounders increased slightly and that of eel pout decreased.

Table 5.8 New England groundfish landings from Subarea 5 for industrial purposes (metric tons, round weight).

Year	Total Landings	Species Composition (%)				
		Silver hake	Red hake	Flounder	Eel pout	Other
1964	24,890	20.0	42.6	11.6	0.9	24.9
1965	33,990	20.4	38.0	6.9	1.8	32.9
1966	27,461	9.6	10.2	18.2	25.0	37.0
1967	37,400	10.2	14.7	18.5	18.9	37.7
1968	34,729	9.9	17.2	16.5	24.2	32.2
1969	26,813	9.5	17.0	21.3	20.8	31.4

VIII. Sea scallops

United States sea scallop landings from Georges Bank were 300 tons higher in 1969 than in 1968 (Table 5.9). Effort, however, increased significantly and abundance was probably somewhat lower than in 1968.

Table 5.9 US sea scallop statistics, Subarea 5 (metric tons, weight of adductor muscle only).

Year	Landings	Days Fished	Landings/Day Fished	Research Vessel Index
1964	6,296	6,296	1.0	40.0
1965	1,509	2,156	0.7	33.5
1966	901	1,001	0.9	48.0
1967	1,309	1,870	0.7	63.0
1968	1,163	1,938	0.6	44.7
1969	1,465	2,930	0.5	-- 1/

1/ There was no research vessel cruise for scallop abundance estimate in 1969.

IX. Herring

The catch of Maine herring continued poor; only 24,000 tons were caught in 1969. Since 1964, when the catch of herring dropped to 28,000 tons from a previous 10-year average of 52,000 tons, the catch has remained at a low level, fluctuating between 24,000 and 32,000 tons. The reasons for the continued poor catch are unknown but it does not appear that the decline is due to overfishing by the Maine "sardine" fishery. Water temperatures fell steadily from 1953 through 1968 and may be a factor. Larger herring (ages 3 and 4) are being caught as a result of the low juvenile herring abundance and more purse seines are entering the fishery to search for herring farther offshore.

The fishery for adult herring from Jeffreys Ledge, and adjacent areas of the Gulf of Maine, continued. The catch by United States vessels declined to about 4,100 tons.

B. Special Research Studies

I. Environment Studies

The *Albatross IV* made temperature observations on all cruises conducted in the area. Quantitative plankton samples were taken at all trawl stations on the groundfish surveys (spring and fall).

The United States Coast Guard conducted two extensive surveys covering the area from Nova Scotia to Cape Hatteras. Results of these cruises will be published in US Coast Guard Bulletin.

Recording of a number of environmental factors was continued at the Bureau of Commercial Fisheries Laboratory at Boothbay Harbor, Maine. The mean surface sea temperature in 1969 was 8.9°C continuing the upward trend that started in 1967.

The Oceanographic Observation Post Program was continued through the cooperation of the Woods Hole Oceanographic Institution and the United States Coast Guard. Oceanographic observations are made continually at 11 lightships and light stations situated off the East Coast of the United States. Analysis of the data is made by the Oceanographic Institution and published by the Coast Guard.

Monitoring the abundance and distribution of zooplankton in the coastal waters of the Gulf of Maine was continued. As in previous years, copepods were the predominant zooplankton. Zooplankton biomass was significantly higher in the summer and autumn of 1969 than in 1968. Coastal waters were warmer and thermocline formation earlier than in 1968, favouring the development of unusually high phytoplankton blooms that may have favoured the survival of zooplankton.

The United States and USSR conducted further experiments in developing quantitative plankton gear using the *Albatross IV* and the Soviet vessel *Prognoz*. These experiments were conducted in the spring on Georges Bank and are further reported in another research document (ICNAF Res.Doc. 70/80).

II. Biological Studies

Haddock. A special study to devise a more accurate measure of relative population density for commercial catch per unit effort data is nearing completion. The index would be based on estimates derived from a factorial model incorporating area, vessel size and depth, and all vessels would be utilized. This appears better than the previous system of using only selected vessels, most of which are not now fishing.

Further studies of haddock population dynamics have continued, as well as routine monitoring of the fishery.

Studies of the spawning of Georges Bank haddock were continued. The following aspects of this spawning stock were noted:

1. The largest haddock spawn first, usually in shoal water on top of the banks, both inshore and offshore.

2. Prior to the onset of spawning, ripening haddock of all sizes are found in the deep waters along the Northern Edge of Georges Bank and in South Channel. The state of maturity of fish from deep water is usually one or two stages behind those from the shoals.

3. Ripening of the fish and their movement from deep water appear to be associated with seasonal warming of the bottom waters. However, this does not explain the early spawning of large haddock on the shoals.

4. The number of immature haddock in the samples has decreased steadily since sampling began in 1968. Less than 2% of the fish samples through March this year have been immature.

Yellowtail flounder. Analysis of tag returns from tagging conducted in the late 1950's was completed. Total and fishing mortality rates were estimated from these tagging studies and from virtual population estimates.

Analyses show a high total mortality rate and indicate very high fishing mortality.

Yield-per-recruit values were calculated using the Beverton and Holt model. The results indicate that an increased yield would occur with an increase in the age of capture and that a reduction in fishing mortality would also result in increased yield-per-recruit.

Further reporting of these studies is presented in another research document (ICNAF Res.Doc.70/87).

Cooperative Groundfish Surveys. The United States continued its cooperative work with the Soviet Union in conducting closely coordinated surveys of the groundfish in the area from Nova Scotia to Cape Hatteras as explained in a separate research document.

Herring. Studies on the population structure of herring in the Gulf of Maine and adjacent areas continued using meristic and biochemical methods. Significant differences in the frequencies of two types of enzymes were found between the Georges Bank stock and herring within the Gulf of Maine-Southwest Nova Scotia. These enzymes were an esterase and lactic dehydrogenase. Two additional enzymes (phosphoglucomutase and phosphohexoseisomerase) were found to be polymorphic in the herring of the Northwest Atlantic and samples are being run to compare the frequencies of the variant enzyme types in stocks from several areas.

A coordinated vessel survey of herring spawn on Georges Bank was conducted in the fall in cooperation with the USSR using the vessels *Albatross IV*. The Soviet vessels participating were the *Ekliptika* and the *Aliot*.

Lobster. The extensive tagging program on offshore lobsters was continued. By the end of 1969, 410 returns had been made from the 5,710 released. The distribution of tag returns indicates that deep-water lobsters move into shoal water in the spring and early summer and back into deep water in the fall and early winter. Of the 320 returns for which locations of recapture are known, 22% had moved distances less than 10 nautical miles, 58% between 10 and 50 miles, and 20% in excess of 50 miles. Lobsters demonstrating the most extensive migrations were predominantly females. The migratory behaviour of these of these "offshore" lobsters contrasts markedly with that of "inshore" lobsters that are essentially non-migratory.

A study of the effects of exploitation on size composition and sex ratio of the offshore lobster stocks has been conducted. Differences in size-composition and sex ratio among offshore fishing grounds are hypothesized as due to differences in the extent of exploitation.

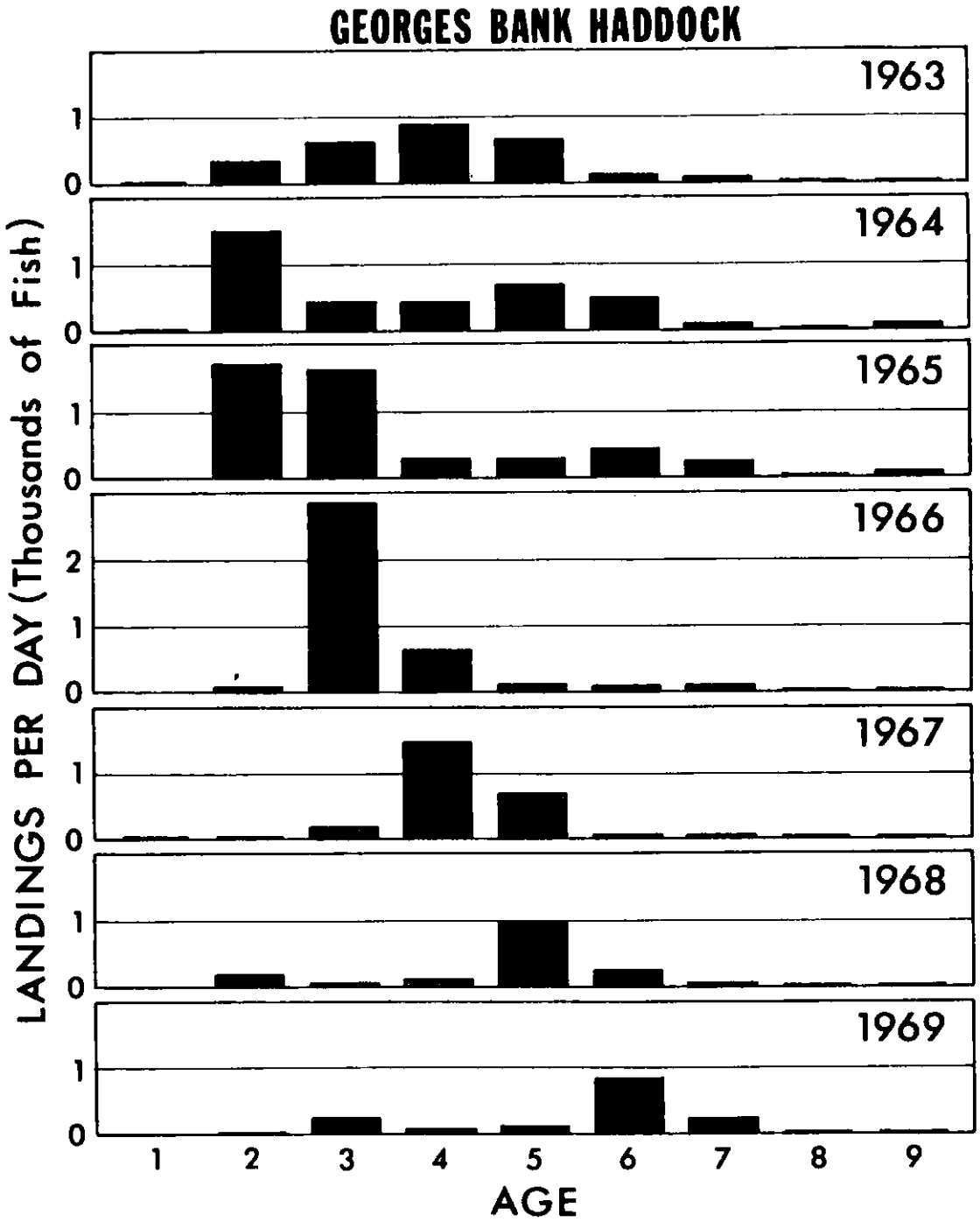

Fig. 1. Age composition of Georges Bank haddock.