INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES

REDBOOK 1969 PART II

REPORTS ON RESEARCHES IN THE ICNAF AREA IN 1968

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Note

REDBOOK 1969 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 1968. The third book contains Part III, Selected Papers from the 1969 Annual Meeting.

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1969

PART II. REPORTS ON RESEARCHES IN THE ICNAF AREA IN 1968

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PART II. REPORTS ON RESEARCHES IN THE ICNAF AREA IN 1968

I. Canadian Research Report, 1968

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

The St. John's Biological Station of the Fisheries Research Board of Canada carried out fisheries and oceanographic researches in Subareas 1, 2 and 3. The Atlantic Oceanographic Laboratory of the Bedford Institute engaged in oceanographical researches in Subareas 1, 2 and 3 and the Marine Ecology Laboratory of the Fisheries Research Board of Canada at Dartmouth carried out studies of the deep scattering layer 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 in Subareas 2 and 3.

The 1968 landings data reported in this document are preliminary data for Newfoundland only and are only approximately similar to the data which will be reported to ICNAF in May-June. The totals for the Canadian landings are not yet available.

Subarea 1

A. Status of the Fisheries

A Canadian trawler fished in West Greenland, Div.1E, but took only about 8 tons of cod.

B. Special Research Studies

I. Environmental Studies

1. Hydrographic Studies. As part of the study of the North Atlantic Deep Water by the Atlantic Oceanographic Laboratory, an atlas has been prepared of oceanographic sections occupied in 1965-1967. This includes temperature, salinity, dissolved oxygen and silica for Davis Strait, Labrador Basin, Denmark Strait and Newfoundland Basin.

II. Biological Studies

1. Atlantic salmon, *Salmo salar* L. During 1968, emphasis on Atlantic salmon research at the St. John's Station was directed toward the marine aspects of salmon ecology, particularly high seas distribution and effects of high seas fisheries on salmon stocks. The overall objective of several projects begun during the year is to determine ways of identifying fish of Canadian origin during the marine phase of salmon life history. Preliminary field work consisted of a field trip of about 6 weeks in Greenland to observe fishing techniques, collect length and age data from the commercial fishery and make collections for morphometric, meristic, parasitological and serological studies.

Subarea 2

A. Status of the Fisheries

I. Cod, *Gadus morhua* L.

The inshore cod fishery in Labrador was very poor, more than 40 percent lower than in 1967. This was due to less fish rather than less effort. For the first time a significant catch of cod and associated fishes was taken offshore in Subarea 2 by Canadian (Newfoundland) trawlers. Preliminary estimates of the amounts taken offshore, all in Div.2J, were 4,600 tons of cod and small amounts of American plaice, redfish, Greenland halibut and wolffish.

II. Harp seal, *Pagophilus groenlandicus* (Erxleben) and
Hood seal, *Cystophora cristata* Erxleben

Canadian catches of harp seals (preliminary figures) in 1968 in Subareas 2 and 3 were 33,000 young and 5,600 older seals, as compared with 31,000 and 11,000 respectively in 1967. Thus the catch of young harp seals by Canadian ships and landsmen was not reduced following an opening date for the fishery which changed from 12 March to 22 March, but the catch of older seals was halved following a closing date which changed from 30 April to 25 April. The Canadian catch of hood seals was 22 young and 13 old seals or 35 in all, compared with 1,240 in 1967. A lower availability of hood seals in 1968 is suggested.

An age sample of 600 moulting harp seals showed relative absence of 4-, 5- and 6-year-old animals following heavy catches of young in 1962, 1963 and 1964 (ICNAF Res.Doc.68/70). Since nearly all female harp seals are giving birth by 7 years of age, recruitment is expected to fall rapidly in this population beginning in 1969.

B. Special Research Studies

I. Environmental Studies

1. Hydrographic Studies. See Subarea 1 - I.

II. Biological Studies

1. Cod. The inshore Labrador cod catch was sampled mainly in August in 8 localities between Saglek in Div.2G and Pack's Harbour in Div.2J for length, age, sex, sexual maturity and food. Catch statistics were collected at selected locations. The following numbers of cod were measured and had otoliths taken: in Div.2G, 623 and 257; in 2H , 2,347 and 953; and in 2J, 3,524 and 1,141.

2. Atlantic salmon. On an *A.T.Cameron* cruise to the northern Labrador Shelf, 21 salmon were taken in 5 overnight drift net sets between 29 March and 5 April. About 1,800 m of nets were used for each set, with the gear fished at the surface over depths of 2,400-3,500 m, outside the seaward edge of the ice.

3. Harp and hood seals. Charter of a sealing vessel for two weeks in late April-early May allowed collection of a sample of 300 moulting harp seals after the end of the regular fishery. Comparison of an age sample of similar numbers taken during the fishery showed that the latter source is adequate for studying age composition, although full mixing of moulting animals does not occur until after 25 April. Thirty animals taken on deck were fully measured, weighed and examined. The relative absence of 4- to 6-year-olds did not allow precise determination of the mean age at maturation of female harp seals of this population, which age, however, lay between 4 and 6 years. Moulting animals were fat and feeding intermittently, perhaps below the core of the Labrador Current, because Isaacs-Kidd hauls in shallow water between the ice floes caught very little macroplankton.

Subarea 3

A. Status of the Fisheries

I. Cod

Total Newfoundland cod landings from Subareas 2-4 (but mainly from the inshore fishery of Subarea 3) increased by over 20,000 tons to 199,000 tons. In this total the landings from the inshore fishery of Div.2J decreased sharply from 1967, landings from the inshore fishery in Subarea 3 were slightly greater than in 1967 and landings from offshore vessels doubled to about 47,000 tons.

On the east coast in Div.3L, inshore landings were generally higher than in 1967 because of better catches in spring and summer of 1968. For the remainder of the year, inshore catch levels were below those of 1967 because of bad weather and absence of squid bait. In this division there was evidence of a strong 1964 year-class.

II. Haddock, *Melanogrammus aeglefinus* L.

Newfoundland haddock landings, mainly from Subarea 3, fell from 1,960 tons in 1967 to about 1,100 tons, the lowest since 1945 the year before the Newfoundland haddock landings began to increase by the use of otter trawlers.

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

Newfoundland redfish landings, almost all *S. mentella*, increased slightly from 28,000 to 29,000 tons. Landings from Subarea 3 fell about 50 percent from 14,000 tons in 1967 and landings from Subarea 4 increased about 50 percent from 14,000 tons in 1967.

IV. Flounders, American plaice, *Hippoglossoides platessoides* (Fabricius); Witch flounder, *Glyptocephalus cynoglossus* (L.); and Yellowtail flounder, *Limanda ferruginea* (Storer)

Newfoundland landings of American plaice from Subarea 3 declined by over 4,000 tons from the 49,000 tons landed in 1967. Witch flounders declined by about 1,600 tons from 5,968 tons in 1967 and yellowtail flounders increased by 2,800 tons from the 1,519 tons landed in 1967. Although there was a decrease in American plaice, the Newfoundland fishing effort for this species probably increased during the year.

V. Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum)

Newfoundland landings of Greenland halibut, almost all from the deep east coast bays of Newfoundland in Subarea 3, decreased by about 3,000 tons from the 16,595 tons (16,548 from Subarea 3) landed in 1967.

The mean length of the Trinity Bay commercial samples was 58.8 cm, a decrease from 62.7 cm and 61.4 cm in 1966 and 1967 respectively. The mean length of the Bonavista Bay commercial samples was 62.4 cm. The Bonavista Bay samples included a greater proportion of older fish than those from Trinity Bay.

From catch and effort data collected at 3 Trinity Bay localities, there has been a decrease in the catch per 90 m gill net set from 157 kg in 1966 to 68 kg in 1967 and to 41 kg in 1968. Coinciding with the decrease in the Greenland halibut catch per net has been an increase in the flounder (mainly witch flounder with some American plaice) catch per net set in these Greenland halibut nets from 2 kg in 1966 to 18 kg in 1968.

VI. Herring, *Clupea harengus* L.

Newfoundland herring landings increased by about 80 percent to about 146,000 tons. As in 1967, the landings were mainly from Div.3P in a winter-spring purse seine fishery for herring to be reduced to meal and oil. The increased landings resulted from increased effort and reduction capacity.

VII. Atlantic salmon

Newfoundland landings of Atlantic salmon in the commercial fishery (total from Subareas 2, 3 and 4) decreased by about 300 tons from the 1,800 tons taken in 1967.

VIII. Capelin, *Mallotus villosus* (Müller)

Newfoundland landings of capelin, mainly from Subarea 3, were about 3,500 tons, approximately the same as in 1967.

IX. Short-finned squid, *Illex illecebrosus* LeSueur

Squid were extremely scarce in the Newfoundland coastal area, with recorded commercial landings of only one ton compared with 6,900 tons in 1967.

B. Special Research Studies

I. Environmental Studies

1. Hydrography. The standard section, St.John's-Flemish Cap, was taken between 29 February and 6 March and again from 25-27 July. Station 27, 3.2 km off Cape Spear near St. John's, was occupied once or twice a month throughout the year. These observations are reported in another research document.

For work by the Atlantic Oceanographic Laboratory, Bedford Institute, see Subarea 1, B.I.

2.3. Plankton and Benthic Studies. A study of the distribution of planktonic foraminifera, both in the water column and in the sediments, for much of the Canadian Atlantic seaboard, has been continued by the Atlantic Oceanographic Laboratory.

4. Other Environmental Studies. The Sir Charles Hamilton Sound-Funk Island Survey has continued since 1964 and is part of the overall charting program by the Atlantic Oceanographic Laboratory to provide modern charts along the east coast of Newfoundland.

The deep sound-scattering layers in the sea have been found to occur with surprising uniformity over large areas of the North Atlantic. If, as suspected, bathypelagic fish are largely responsible for the scattering layers, these fish must be among the most abundant of the higher animal forms in the oceans. Even conservative estimates, based upon hydroacoustic surveys, make it seem likely that they represent an important stage in the biological production processes taking place in the open oceans.

In July a series of eight stations was sampled by the Marine Ecology Laboratory along the 2,000 m depth contour east and south of Newfoundland, using a large mid-water trawl fishing at 900-1,100 m. Simultaneously the depth and strength of the scattering layer was monitored from another vessel. Catch counts were high but the weight of the catches was generally low, averaging about 23 kg per hour's tow. The data are being analyzed with regard to abundance, size composition and distribution characteristics. Taxonomic studies are being undertaken at the Royal Ontario Museum.

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, maturity, spawning, food, location of catch, and catch per unit effort.

In early March, cod catches by the *A.T.Cameron* on Flemish Cap (using a No.41-Yankee otter trawl with a 24.1 m headline) were poor, the largest being 204 kg for a 30-minute tow. About 35 percent of the mature females were spent.

Also in early March good catches were taken on the eastern Grand Bank in depths of 120-320 m. The largest catch for a 30-minute tow was about 1,800 kg. About 95 percent of the cod were immature and small, averaging 0.9-1.4 kg. On the southwestern slope of the Grand Bank in May, cod catches were usually below 230 kg for a 30-minute tow.

In studies of the cod population of Div.3L, inshore cod catches were monitored for length, age, sex, etc. at Bonavista, St. John's and St. Mary's Bay.

A *Marinus* cruise in April-May in Trinity and Bonavista Bays showed that the large gill net cod would soon spawn. These cod apparently spawn mainly in the coastal areas, in contrast to the younger trap and handline fish which spawn before arriving in the coastal areas in late spring and early summer.

In a cruise of the *A.T.Cameron* to the northwestern slope of the Grand Bank and in the Avalon Channel from 27 May to 5 June, otter-trawl sets were taken on lines from 80 to 230 m. Cod and American plaice taken in 30-minute sets were usually from less than 90 to 320 kg. In the western part of the area there was a much higher proportion of cod over 60 cm in length than in the eastern part of the area where the 4-year-old cod with a strong mode at 45-47 cm dominated the catches. (This same age group was dominant in the coastal cod trap catches.) Many of the cod were feeding heavily on capelin which were present in large schools in many locations, being caught in the otter trawl and visible as heavy echo-sounder traces.

During May, a cruise of the *A.T.Cameron* was made to St. Pierre Bank to investigate the biology and distribution of cod in relation to temperature and depth and to determine the abundance of young cod in an attempt to predict contributions of various year-classes to the commercial fishery. Very small catches of commercial-sized cod were obtained but significant quantities of small cod (up to 250 per 30-minute tow) were taken with peaks at 19 cm on the northern part of St. Pierre Bank and 22 cm on the southern part. These were mainly of the 1966 year-class although 1965 and 1964 were also well represented. Cruises in 1967 also produced significant quantities of the 1964-1966 year-classes.

During 1968, analyses of data on the biology and fishery of cod in the southwest Newfoundland coast area (Div.3Pn) during 1952-1965 were completed and the results prepared for publication. Total effort and landings by all gears in 3Pn increased 2 to 3 times in 1960 over 1959 and remained at a higher level thereafter. As a result of this increase in effort, the proportion of larger and older cod in the longline catches decreased after 1959-1960 and the total mortality rate increased. Growth of the younger age-groups decreased during 1952-1965 because of a decline in bottom temperatures in the Gulf of St. Lawrence. Growth of older age-groups increased in the mid-1950's because of increased food supply due to mass mortality of herring in the Gulf but decreased thereafter as a result of decline in bottom temperatures.

As a result of a suggestion at the 1968 ICNAF Annual Meeting that in view of the more recent data on mortality and growth for 3N-O cod new assessments should be provided, assessments based on 1959-1962 data were made and a preliminary report presented to the mid-year meeting of the ICNAF Subcommittee on Assessments. Results indicated that greater benefits were predicted from the 1959-1962 data than from the earlier assessments on 1955-1958 data. Depending on the particular value of E chosen, maximum benefits to the otter trawl landings occurred at mesh sizes of 140-152 mm (5 1/2-6 inches). Immediate losses to the otter trawl landings were 11 percent or less for increases from 102 to 140 mm (4-5 1/2 inches).

2. Haddock. In a survey in May by the *A.T.Cameron*, the greatest haddock catch per 30-minute tow was 140 kg on the southern Grand Bank and 40 kg on St. Pierre Bank. The very low level of the stock is indicated by the low catches from 90 to 275 m where the haddock were most plentiful. In these most favourable depths there were averages of only 6.4 kg (11 fish) per tow in 24 tows on the southwestern Grand Bank and 8.6 kg (64 fish) per tow in 15 tows on the southern and western slopes of St. Pierre Bank. On the Grand Bank there was no evidence of a new year-class. On St. Pierre Bank a small 1966 year-class is present.

3. Redfish. An *A.T.Cameron* cruise to Flemish Cap in July-August 1968 yielded best catches of 2,220 kg (avg wt. 0.4 kg), 620 kg (avg wt. 0.25 kg), and 1,140 kg (avg wt. 0.7 kg) of *Sebastes mentella* redfish in 30-minute tows at depths of 275, 365 and 550 m respectively. These catches were all obtained on a line extending northward from the Cap. Catches on a line on the eastern slope of the bank were considerably smaller than those obtained on the northern line. No large catches of *S. marinus* redfish were obtained but in most sets at 275 m some of these redfish were taken (the best catch being 141 specimens weighing 123 kg). Studies on the diurnal availability of redfish indicated that catches were more variable at 275 m than they were at 550 m.

4. American plaice. A survey of a small section of the eastern slope of the Grand Bank in early October produced catches of 540, 680, 1,450, 350, 1,320 and 1,360 kg at 110, 130, 145, 165, 185 and 365 m respectively. Catches at comparable depths just 4 nautical miles away produced 115, 255, 180, 80 and 45 kg (to 185 m only).

In order to carry out a study of the population dynamics of this species, the major emphasis during the year was on age determination from otoliths collected from commercial trawlers in 1953-1968.

5. Yellowtail flounder. Compilation of data on various aspects of the biology of this species is nearing completion. It was decided to include age and length data collected during 1968 in order to give a better estimate of mortality since better separation of this species in the Newfoundland statistics and apparently increased fishing for it began in 1965.

6. Greenland halibut. Samples were obtained from Trinity Bay, Bonavista Bay, Notre Dame Bay, Gulf of St. Lawrence and the Grand Bank for studies of age, sex and maturity.

Stomachs were collected from Greenland halibut sampled on the gill net trips in Trinity, Bonavista and Notre Dame Bays. Capelin comprised about 85 percent of the diet of Greenland halibut above 25 cm. Below 25 cm the food items were mainly euphausiids, small shrimps and amphipods. Other food items of larger Greenland halibut were shrimp of various species, Greenland halibut, cod and euphausiids.

Gill net mesh selection experiments were carried out in Trinity, Notre Dame and Bonavista Bays, using 152-, 178-, and 203-mm (6-, 7- and 8-inch) mesh monofilament gill nets. These experiments suggest that at present for these three particular mesh sizes, an increase in mesh size yields a decrease in numbers but an increase in weight per unit of fishing effort.

7. Herring. Most of the Newfoundland herring catch is taken in winter and spring on the western half of the south coast of the island. In this population between Hermitage Bay and Cape Ray, no consistent differences in migration time, maturity, age composition or size were found. This population migrated inshore to the various bays along the southwest coast in late November and early December and were abundant until about the middle of March. The decline in abundance during the next few weeks progressed westward across the area. Herring from the southwest coast during this winter-spring period show a wide range in maturity with most stages present. Near ripe and freshly spent fish were most abundant in December and January. Inshore spawnings were observed in late April and early May in Hermitage Bay.

In preliminary assessments of abundance, the natural mortality index was estimated at 0.30 and it was also estimated that during the 1967-1968 season the seine catch of 143,000 tons was between 0.35 and 0.51 of the estimated population.

Based on the number and nature of spawning reports received, the level of spring spawning near the beaches around Newfoundland in 1968 appeared to be about the same as in 1967 and less than in 1966. In Notre Dame Bay, spawning took place in deeper water than usual, continuing the trend observed in 1967. Although no spawnings have been observed at other times than in May and June, maturity stages of herring samples of the Newfoundland catch indicate that a large number of herring spawn later in the year.

8. Capelin. The *Investigator II* carried out cruises in Trinity Bay using mid-water and Isaacs Kidd trawls and plankton nets.

From 30 January-2 February capelin schools were dispersed but mainly outside the 180 m contour and at a depth of 9-220 m at temperatures of 0°C or less. They were feeding very little.

From 27 February-7 March the capelin were concentrated in large schools at depths between 155 and 220 m at temperatures from -0.5 to 0.0°C at the bottom of the cold layer and almost all in the outer part of the bay. The largest concentration found was a school about 1 1/4 nautical miles long and 25-55 m deep near the mouth of the bay. Stomachs were empty and the fat content of the larger fish ranged from 12.5 to 14.5 percent.

From 28 March-4 April there was considerable vertical migration of large schools from usually less than 75 m at night to 90-185 m in the daytime. Temperatures down to 185 m were less than -0.5°C. The capelin were beginning to feed and fat content of maturing fish ranged from 8.4-11.4 percent.

From 13-17 May the only large schools of capelin located were outside the 180 m contour in the upper 25 m and were immature capelin. Many small comet-shaped traces located at generally less than 25 m below the surface were probably small schools of maturing capelin on their way to the spawning beaches. Temperatures at the depths where these small schools were seen were 0.5 to 1.5°C. Eight maturing capelin taken on 31 May were still feeding and their fat content ranged from 5.6 to 6.6 percent.

On 10-14 September, 23-30 October and 11-18 December the bay was surveyed by echo-sounder and no large schools or concentrations of capelin found. Small comet-shaped schools similar to those found in May were dispersed all over the bay at depths from 55 m to the surface. Often these small schools would form a loose concentration.

At Middle Cove near St. John's, beach spawning began on 19 June at beach water temperatures of 5.4 to 5.9°C. Beach spawning ended on 12 July when the water temperature near the beach was 9.8 to 10.4°C. The first larvae in this area were taken on 19 July and the last on 28 August. Fat content declined from 1.9-3.2 percent on 19 June to 1.0 to 1.7 percent on 10 July. In this period the average total length of the male capelin declined from 194 to 177 mm and females from 177 to 155 mm.

In an *A.T.Cameron* cruise to the Southeast Shoal of the Grand Bank on 8-18 July it was indicated that spawning had ended about a week earlier. Catches consisted mainly of dead mature males. Only one set produced live capelin and these were 98 percent females, all spent. Many recently hatched larvae were taken on 12 July. The fat content of recently dead male capelin ranged from 0.2 to 0.5 percent and of spent females from 0.6 to 1.1 percent.

9. Atlantic salmon. Investigations of morphometric and meristic characters of North American smolts were begun to determine whether these might be of use in determining area of origin of fish taken at sea. Data collected during 1968 will allow preliminary evaluation of variation in these characters between major river systems. Much of the initial effort in this study was directed to development of criteria and techniques for measuring and counting. Plans for 1969 include extension of this study to European rivers.

Material for parasitological and biochemical studies was also collected in Greenland to evaluate the usefulness of these techniques in separating groups of salmon by area of origin. Studies of salmon parasites will continue from the work begun at the St. Andrews Station several years ago. Biochemical studies will begin early in 1969.

During the past year, analysis was completed on the size, age and sex composition of 5,049 salmon sampled at Bonavista, Port Union and St. Anthony during the period 1960-1963. The sea-age composition of the sample was: grilse, 48 percent; 2 sea-year salmon, 43 percent; 3 sea-year and older salmon, 3 percent; and previously spawned salmon, 6 percent. The average fork lengths of the maiden salmon were: grilse, 54.1 cm; 2 sea-year salmon, 72.9 cm; 3 sea-year salmon, 88.4 cm; and 4 sea-year salmon, 96.5 cm. The average round weights of the maiden salmon were: grilse, 1.9 kg; 2 sea-year salmon, 4.5 kg; 3 sea-year salmon, 8.7 kg; and 4 sea-year salmon, 13.2 kg.

At Bonavista in a sample of 3,830 salmon from the commercial fishery females outnumbered males in all sea-age groups: grilse, 58 percent female; 2 sea-year salmon, 73 percent female; 3 sea-year and older salmon, 90 percent female; and previously spawned salmon, 65 percent female.

10. Pink salmon, *Oncorhynchus gorbuscha* (Walbaum). The 5,334 pink salmon that returned to North Harbour River in 1967 were allowed to spawn naturally in the river. Egg deposition was estimated to be 4,400,000. The fry were not counted but fry survival from eggs in plastic cases in the river gravel was 87 percent. The hatching period was 10-28 November, the earliest in these experiments by about 7 weeks. (Atlantic salmon eggs in the same location hatched from 15 January to 11 April.) Fry were seen in the river from 2 April to 23 May. Fry began running to sea earlier than usual, the usual run from the river being in May. Juveniles remained in St. Mary's Bay as late as September when 5,000 were sighted and October when 7,000 were seen. Specimens taken in October averaged 190 mm in fork length.

In studies of predation of fry in the sea near the mouth of the river from 9 May to 4 June, 6 percent of the Atlantic salmon smolts, 5 percent of the seaward migrating brook trout and 2 percent of the seaward migrating brown trout had 2, 2 and 1 fry per fish respectively. In 1,673 herring, capelin, cod, sculpins, cunners, brook trout and mackerel taken from 21 May to 26 July no pink salmon fry were found.

From 5.9 million pink salmon eggs from British Columbia planted in North Harbour River in November 1966, 1,353 fish returned to the river in 1968 between 6 August and 4 October with a peak on 22 August. Spawning occurred in the river between 8 and 22 September with the peak about 15 September.

From the commercial fishery an additional 933 fish were recorded, 724 of these being taken in St. Mary's Bay. A total of 35 pinks was recorded from 5 other rivers.

B. Subareas 4 and 5
by F.D.McCracken

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 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. 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

Cod landings on the mainland were up about 10 percent over 1967, nearly to 1966 levels, and made up about 35 percent of the total weight of groundfish landed. The increase was for Nova Scotia ports and presumably mainly from Div.4V, W, X and 5Z. Landings from Div.4T appeared to be about 9 percent lower, probably due to effort shifts to queen crab and redfish by the otter trawl fleet. Sizes and ages of cod taken from Div.4T were similar to 1967, with a modal size at 46 cm and 4-year-old fish (1964 year-class) dominant. The 1963 year-class also remained important. Discards of cod were negligible, about 1 percent.

II. Haddock

Total haddock landings declined about 10 percent from 1967 levels, but quantities landed from Subarea 4 were probably about the same as in 1967. Haddock taken in Div.4W in spring were about the same size as in 1967, with most being from 38-60 cm. The dominant year-class was 1963, with 1962 also prominent.

III. Flatfish

Total landings of flatfish (plaice, witch, yellowtail and winter flounder) were lower by 10 percent. Decreased landings were general from Div. 4V, W and S. Diversion of small otter trawlers to queen crab fishing caused a drop in Div.4T winter flounder landings from 1,563 to 158 tons, which accounts for about 35 percent of the total decrease in landings.

Atlantic halibut landings declined 12 percent from 1967 levels.

IV. Pollock

Pollock landings have remained fairly steady over the past 3 years. A small increase (about 3 percent) followed the small decline (5 percent) in 1967. Markets influenced these landings.

V. Redfish

Landings of redfish have continued the rising trend begun in 1963. Most of the increase has been from the Gulf of St. Lawrence (Div.4R-S-T) and has resulted from successful survival of a series of new year-classes. The successful year-classes followed a period of about 8 years of extremely poor recruitment.

Preliminary estimates based on age-distribution analysis of redfish stocks suggest that yield from the fishery will be significantly lower in 1969 than in 1967-1968. However, further year-classes of small redfish have succeeded in settling to bottom in some areas of the Gulf of St. Lawrence, and it is not anticipated that any decrease in catches should be too dramatic or of long duration.

VI. Sea scallop, *Placopecten magellanicus* Gmelin

Total landings of scallops increased about 68 percent to 12,400 tons whole weight (1,483,000 kg meats). Offshore landings at about the same level as 1967 were mainly from the Lurcher region of Div.4X. A small fishery (187 tons) developed in Div.4V. Most increases came from the inshore fishery in the Bay of Fundy region (3,400 tons) and from the southern part of Div.4T (7,500 tons) where landings reached an all time high.

VII. Herring

Herring landings in Subarea 4 (excluding Div.4R) were 377,000 tons, up 114,000 tons (43 percent) over 1967, as a result of a rapidly expanding industrial fishery. Greatest increases occurred in Div.4X (80,000 tons) and Div.4T (33,000 tons). There were small increases in Div.4W (400 tons) and Div. 4V (50 tons), but fisheries there are so far not important.

VIII. Swordfish

Landings of swordfish for all ICNAF areas amounted to 4,500 tons, a slight decrease (7 percent) from 1967. There were no significant changes in area of capture and about 50 percent of the total catch was from Subarea 4. The decrease in landed weight resulted partly from the smaller size composition of fish caught. With increasing fishing pressure on the stocks, this trend is likely to continue.

IX. Mackerel, *Scomber scombrus* L.

Mackerel landings (excluding Div.4R) amounted to 10,790 tons, a decrease of 3 percent from 1967. Landings from Div.4V-W-X decreased from 8,000 tons in 1967 to 5,700 tons. Landings from Div.4T-S increased from 3,200 tons in 1967 to more than 5,000 tons, probably as a result of higher water temperatures there during the early part of the season.

X. Tuna

Tuna landings at 260 tons declined 13 percent, and most fish were taken while swordfishing. Several species are included in the landings but are not separated. The bluefin fishery in St. Margaret's Bay (Div. 4X) was almost a complete failure.

XI. Sharks

Incidental landings of porbeagles *(Lamna nasus)*, mako *(Isurus oxyrinchus)*, and hammerheads *(Sphyrna* sp.) were only 11 tons (50 tons in 1967).

XII. Atlantic salmon

The catch of Atlantic salmon (commercial plus angling) declined to about 830 tons, compared to landings of about 1,350 tons in each of the previous 2 years. Most decrease in catches occurred in Div.4R-T. The angling catch at 133 tons declined by about 47 percent, with low river discharge contributing to the decrease. Grilse comprised about 70 percent of the angling catch.

B. Special Research Studies

I. Environmental Studies

1. Hydrographic Studies. In June, plankton, fish eggs and larvae sampling in Div.4T was carried out along with occupancy of over 200 physical oceanographic stations at 98 sites. Earlier surveys suggested that gyres, 10-20 km in diameter, were present and moving through the system. Current meters and parachute drogues were employed to study the nature and persistence of these gyres.

The ice forecast survey for Div.4R-S-T, consisting of standard oceanographic stations, was undertaken in November and the Halifax Section (Div.4W) was monitored 6 times.

The moored buoy program in Div.4X and W, initiated in 1967, was continued. Analysis of the current meter records has shown the existence of inertial motions, and that tidal ellipses associated with tidal motions are of different shapes at different sites on the Scotian Shelf.

In September, current meters were placed along the 1,000-m depth contour at the edge of the Shelf, and a series of oceanographic stations occupied to study the complex mixing of water from the Labrador Current and Gulf Stream which occurs there.

The detailed study of St. Margaret's Bay, initiated in 1966 as part of a system production study, was continued. Emphasis in the field program was placed on measuring the exchange of water between the bay and off-lying areas, and monitoring the general T-S distribution at weekly intervals from June to November and fortnightly during other months.

Environmental studies related to fisheries problems were continued with special emphasis on circulation and on long- and short-term variations of water properties. The two main areas studied were: Bay of Fundy-Gulf of Maine and adjacent Continental Shelf, and the southwestern Gulf of St. Lawrence. However, circulation studies are also being carried out over the Continental Shelf to the east, including the Newfoundland area.

Surface and bottom circulations in the eastern Gulf of Maine are best described, for the moment, as those of an upwelling area with bottom convergence towards the southwestern Nova Scotia coast. This convergence appeared stronger in spring and summer and weaker in autumn and winter.

Average surface drift in the Gulf of St. Lawrence showed a counter-clockwise circulation with no evidence of a return circulation along the North Shore. The drift and recovery of drift bottles in the Gulf of St. Lawrence were used to make a preliminary estimate of surface water escapement through Cabot and Belle Isle Straits.

The long-term cooling trend along the Canadian Atlantic coast was still evident during 1968 with a smaller decrement of temperature than previously. Short-term changes in water properties were followed from quarterly observations offshore and daily observations at coastal stations. Data indicate that an intrusion of relatively high temperature and high salinity waters occurred in the deeper layers of the Gulf of Maine between January and April. The effect of this intrusion was felt during the next 6 months from surface to bottom in the Bay of Fundy-Gulf of Maine area. In the southwestern Gulf of St. Lawrence, spring and summer surface temperatures were generally 1°C higher than normal.

2. Plankton studies. Combined plankton-physical oceanography investigations have been carried on in St. Margaret's Bay and out to LaHave Basin. In spring, a clockwise eddy containing the largest plankton population densities lay adjacent to the mouth of the bay and inshore from the 50-fathom line. Further offshore was a strong westerly flow of cold water with low plankton densities. This may have been acting as a barrier, holding neritic populations against the coast. In summer, there is a regular pattern of increasing salinity with isohalines sloping from the bottom towards the surface as one moves away from the shore. Neritic plankton populations develop in the fresher, less denser waters close to shore. These patterns are disrupted by strong offshore winds, and are thought to cause major exchanges of bay water with offshore water.

3. Miscellaneous. Charts of sea surface temperature, layer depth, selected bathythermograms and wave data for Subareas 3, 4 and 5 were prepared and broadcast daily by the Maritime Command Weather Office of the Canadian Forces. The annual input of data for these charts exceeds 100,000 sea surface temperature observations and approximately 17,000 bathythermograms.

II. Biological Studies

1. Cod. Intensive study of the southern Gulf of St. Lawrence cod as a model for investigation of changing fish population parameters was continued.

The September, small-mesh, otter trawl survey indicated that the usually dominant 3-year-olds were not as abundant as in 1967. Also, the 1964 year-class (3-year-olds in 1967) was not as abundant in 1968 as had been expected, but was still above average.

Egg and larval surveys were continued to investigate recruitment mechanisms and compare the effect on survival of annual variations in environmental conditions. Time of disappearance of ice cover, water temperature, relative surface drift, damage or deformity of young eggs, relative number of eggs spawned, and availability of food for larval fish have all been found to be important factors.

Accumulated data on stomach contents of cod from Div.4T have been analyzed and are being published in a comparison with data from other areas. Continued use of the trawl camera during surveys provides data on populations of benthic organisms that may be related to food selection of cod and other groundfish species.

2. Haddock. Three research vessel cruises from Browns Bank to Sable Island Bank confirmed that the 1964-1967 haddock year-classes are small throughout the area. First indications are that the 1968 year-class may be considerably better than those of the previous 4 years.

3. Silver hake. Observations on gill disease in silver hake showed that the incidence was slightly lower than in 1967 and there was a marked decline in intensity. This may be associated with increased abundance of juveniles as shown in research vessel catches, indicating increasingly good year-classes in 1967 and 1968; these should be of commercial size in 1970-1972. The occurrence and distribution of a trematode parasite *(Anthocotyle merlucci)* on the gills are being studied.

4. Sand launce. An analysis of stomach contents shows that the sand launce feeds mainly on copepods on Nova Scotia banks. Marked differences have been found in the lengths-at-age, otolith sizes, and otolith structures of launce from different parts of the banks. These indicate the existence of a number of separate populations whose characteristics are being determined.

5. Argentine. Studies of the taxonomy, population dynamics and species composition of the intestinal trematode parasites were completed. Initially, differences in the latter suggested separate populations of the fish, but later results showed a gradual change in the characteristics from south to north, indicative of a single stock with fairly continuous distribution. Work on fecundity of argentines on Nova Scotia banks was continued. Ripening argentines were found in abundance between 170 and 200 fathoms along the edge of the Continental Shelf in February. The spawning concentration in Emerald Basin was sampled at the beginning of May and was found to be almost identical in size composition to the 1967 concentration there, but was at a more advanced stage.

6. Mesopelagic fishes. Further collections of mesopelagic fishes were obtained in waters adjacent to the Continental Shelf. Seven species collected are previously unrecorded from Canadian waters. The most common species

in these collections is the myctophid, *Benthosema glaciale*, and its age, growth and distribution are being studied.

7. Food resource and digestion rate studies. Studies of food resource division among fishes in Passamaquoddy Bay indicated that species there overlap little in their major food-energy sources. Most have at least one major food source unshared with any other species or with only one other species. Because of the partial overlap in prey lists, the fishes form an ordered predation series wherein only adjacent fish species are well associated by prey species. However, the strength of the food-environment partitioning is partially facultative. In summer, when krill, *Meganyctiphanes*, is abundant, several species of fish feed heavily on it, while in the winter, when it is not so abundant, it is a major food source for only a few species.

Replicate experiments with young cod acclimated to various temperatures from 2 to 15°C reconfirmed that meal size is a limiting factor to digestion rate. Arithmetic increases in meal size gave logarithmic increases in digestion rate. A study of seasonal variation in gross energy content of major food sources for Passamaquoddy Bay fishes was continued, using an oxygen bomb calorimeter for caloric value determinations.

8. Herring. Research was concentrated chiefly in the Bay of Fundy (Div.4X) and Gulf of St. Lawrence (Div.4T). Artificially fertilized ova from spring-spawning herring in Div.4T developed normally in the laboratory and hatched in 17 days at 7.2°C. Ova of autumn-spawning herring from Div.4T hatched in 14 days at 7.3 to 8.0°C. Studies of larval abundance and distribution from quarterly cruises in Div.4X, 5Y and 5Z show variations in vertical distribution and size of larvae. Data are being examined for dominant faunal associates and for extent of mixing of Georges Bank and Bay of Fundy populations.

About 200 samples (34,000 fish and 7,500 pairs of otoliths) of juvenile and adult fish were collected from commercial fisheries in Div.4X and 4T. Size ranges and age compositions were essentially the same as in previous years except for the Nova Scotia side of the Bay of Fundy where mean lengths and ages were somewhat lower. However, the indicated change is probably a result of differences in season of sampling. The 1966 year-class was dominant (80-90 percent) in Div.4X. In Div.4T, the 1959 and 1960 year-classes, which were most abundant in 1967 samples (39.6 and 23.0 percent respectively), continued dominant.

Echo-sounder and sonar surveys in Div.4X and 5Y were carried out in March, April and November. Large numbers (300-500) of schools were located on each cruise, but most probably contained less than 5 tons. A few large schools (3,000-12,000 tons) were observed in Div.4X in March and in Div.5Y in November.

Continuing studies of the optical appearance of otolith nuclei from herring in Div.4T show that this method of separating spring- and autumn-spawning components of the stock is unreliable.

Condition (fatness) studies showed no consistent relationship between mean length and percent fat for any area. Seasonally, there is a rapid increase during May and June but little change thereafter. The lowest values were obtained in April (3.2 percent). From July to November, mean fat content ranged from 11.8 to 13.8 percent. The seasonal variation in fat content is somewhat greater for spring spawners than for autumn spawners.

9. Mackerel. Sampling for size and age composition from commercial landings in Subarea 4 continued. Mean lengths of 26.2 cm in Div.4X, 33.3 cm in Div.4W and 35.7 cm in Div.4T support the hypothesis that there are three distinct size groups of mackerel in Subarea 4 during the summer months.

10. Swordfish. Research on this species is reported under Subarea 5.

11. Atlantic salmon. Recently increased smolt taggings have been extended to additional rivers and stocks to better determine salmon utilization. Hence, total recapture data should be treated cautiously in making year-to-year comparisons. However, total figures presented here include all recent smolt tagging in Canada.

From 63,000 tagged smolts liberated in 1965 (1,090 adult recoveries) and 87,000 liberated in 1966 (795 adult recoveries), approximately 12 percent of the recoveries were made in West Greenland, about 40 percent as large salmon in Canada and 45-50 percent as grilse in Canada.

From 128,000 tagged smolts liberated in 1967 there have been 457 recoveries, for which the ratio of recaptures in West Greenland:grilse in Canada is 1:10.

Nearly 165,000 tagged smolts were liberated in 1968.

12. Scallop. A research submarine was used for *in situ* studies of scallop populations in the Northumberland Strait (Div.4T). Densities of scallops and other species were measured. Scallops are aggregated into discrete beds with densities in excess of 3/sq m.

Studies on the survival of scallop discards, returned to bottom in cages, revealed that 2-4 hours exposure on deck resulted in 50-100 percent mortality.

III. Gear and Selectivity Studies

Acoustic echo-counting equipment was used along with experimental fishing to obtain information on distribution of fish aggregations. The equipment counts the echoes from each transmission in a vertical column from the sea bed to approximately 20 m above bottom. This column can be subdivided to give vertical as well as horizontal fish population distributions. Data from tests carried out on the Scotian Shelf and in the Gulf of St. Lawrence are being analyzed by mathematical consultants at the University of Toronto. Their findings are being used to modify the equipment and develop survey techniques.

IV. Miscellaneous Studies

Studies on an unfished population of American plaice in St. Margaret's Bay have confirmed that the stock is almost completely isolated from stocks on the Scotian Shelf, for, of 8,000 tagged, only 3 were returned from outside the bay; 200 from inside. The stock size is of the order of 2 million fish or 1/16 m^2. The greater part of the biomass and production occurs between 30 and 40 fathoms. In shallower water they compete with winter flounders.

Subarea 5

A. Status of the Fisheries

I. Cod

Canadian mainland landings of cod were 15,127 tons in 1966 and 8,523 tons in 1967. Landings in 1968 were probably about the same as in 1967.

II. Haddock

Landings of haddock on the Canadian mainland were probably slightly lower than the 13,625 tons landed in 1967. Landings in both years are considerably lower than the 18,960 tons landed in 1966.

III. Scallop

Landings of scallops from Georges Bank of about 40,000 tons (4,810,000 kg meats) decreased slightly from the 1967 catch of 42,000 tons. As in 1967, effort was concentrated on the northeastern edges of the bank; number of days fished were similar in both years. The number of vessels in the offshore fleet was 49 compared to 48 in 1967. Landings from Subarea 6 were about 3,500 tons.

IV. Herring

Canadian landings were almost certainly more than double the 6,500 tons reported in 1967. Increased catches consisted mainly of adult herring from Div.5Z and the southern part of Div.5Y.

V. Swordfish

About 40-45 percent of the total Canadian swordfish landings (4,500 tons) probably came from Subareas 5 and 6 and appear to have shown little change from 1967.

VI. Tuna

Incidental catches of several species by swordfish fishermen 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 US Bureau of Commercial Fisheries continues.

2. Herring. Research was restricted to studies of larval abundance and distribution reported under Subarea 4.

3. Swordfish. Research was concerned chiefly with life history and ecology with emphasis on distribution and abundance, food and feeding habits, and recruitment. Commercial landings have been relatively stable for the past 3 years, but swordfish less than 50 pounds, dressed weight, now constitute a much larger proportion of the catch. These small fish may belong to a previously unexploited size class but there are indications of a general reduction in the size composition of the stock. Larval swordfish were collected for the first time near the Windward Islands in the Caribbean Sea, suggesting that spawning occurs in the Guinea Current system.

4. Miscellaneous. The migrations of large pelagic fishes continue to be of interest: 265 sharks, 74 tunas, and 25 swordfish were tagged and released during the year. Six tags were recovered, three of them from yellowfin tuna in the tropics - two released in 1967 in the Gulf of Guinea and the other in 1968 in the Bay of Guayaquil. Two blue sharks and a swordfish were also recaptured, the latter of special interest since it was the first return of a new type of harpoon tag.

5. Short-tailed squid. An otter trawl survey was made on the Continental Shelf from Georges Bank to North Carolina in August and September. *Illex* squid were taken in all sets except for four in 25-100 fathoms in Raleigh Bay, N.C. Largest catches were obtained off Cape May and Chesapeake Bay, the greatest number in a half-hour set being 740. Total catch for the cruise was slightly over 4,000 specimens, most of which were of the same size groups normally fished at this time of year in Newfoundland.

A study of the systematics and biology of the sepiolid squids of the genus *Rossia* in the Canadian area was completed.

Subarea 4

A. Status of the Fisheries

Harp and Hood Seals

Canadian catches of harp seals (preliminary figures) were 56,600 young and 4,600 older animals, a decrease from 91,000 young and 5,000 older animals in 1967. The decrease in catch of young followed a change in the opening date for the fishery to 18 March from 7 March, with no change in the quota of 50,000 young animals permitted to be taken by ships and aircraft south of 50°N Lat. Hood seals remained totally protected.

Study of age samples of migrating entrant harp seals showed adequate to strong survival of recent age classes following a mean kill of young animals of 88,000 in 1965-1967 inclusive, three years when the quota has been in force with the same opening date. Only following a kill of 110,000 young seals in 1963 has survival of the corresponding year-class been markedly depressed.

B. Special Biological Studies

II. Harp and Hood Seals

(1) Sampling of southward migrant harp seals continued from two shore stations in January. As well as age frequencies, the mean age at first reproduction of females was computed, and it fell from near 5 years in previous years to 4.3 years, suggesting that recent kills averaging 88,000 young annually are near sustainable yield for the population of harp seals in Subarea 4. (The catch of older seals in Subarea 4 has always been low and is here disregarded.)

(2) From 7 to 17 March, prior to the start of the fishery, 2,200 young harp seals were tagged from helicopters around the Magdalen Islands and early post-natal natural mortality was studied. Small numbers of adult female harp seals were tagged or branded, and small numbers of young branded. A visiting Norwegian scientist collected blood samples from adult females and young for serological studies. Under permit, visiting Canadian investigators collected twenty live young for studies in aquaria, and made anatomical and biochemical studies of seals on the ice. Also under permit, personnel of the Canadian National Museum collected animals for habitat groups of harp and hood seals.

II. Danish Research Report, 1968

by Erik Smidt

Subarea 1

A. Status of the Fisheries

The table shows the nominal catch by species taken by Denmark (Greenland) in Subarea 1, 1968:

Species	Nominal catch* (in tons)	Increase or Decrease from 1967 (%)
Cod	21,343**	-22
Redfish	136	-22
Wolffish	3,836	+42
Greenland halibut	1,571	-14
Atlantic salmon	580***	-56
Capelin	200	-95
Sand eel	235	-39
Other fish	223	+10
Deep sea prawn	5,604	- 1
Total	33,728	-23

*Preliminary figures
**Excluding 7,204 tons landed by small Faroese boats in Faeringehavn (1D)
***Excluding Danish drifters (approximately 280 tons)

The total catch decreased considerably in 1968. Only the fishery for wolffish and lumpsucker (roe) increased, and the deep sea prawn fishery was constant. The main trends for the most important fisheries are:

I. Cod

1. The fisheries. The great overall decrease from 1967 to 1968 was due to a failing fishery in the northern districts (1A-1D). In the southernmost districts (1E-1F), the fishery increased. The main cause of the decrease is possibly that the dominant new 1963 year-class did not compensate for the decline in the previously dominant 1961 year-class. Another cause may be that the Greenlanders are mainly fishing in inshore waters, where many small-sized fish are taken in pound nets while the offshore longline fishery from big cutters has hitherto been a failure.

2. Forecast for the cod fishery. The Greenlanders' cod fishery is expected to become somewhat better in 1969 than in 1968 because of the growth of the dominant 1963 year-class. Further, the 1965 year-class is expected to be of some importance as small-sized fish in the pound net catches.

II. Atlantic salmon

The decline in the Greenland gill net fishery for salmon seems to be due to smaller fish stocks in the coastal waters than in previous years. In the open sea, where Danish, Norwegian and Faroese drift net fishing is carried out, the stock seems to have been more constant.

III. Other fish

The fishery for wolffish increased in the northern divisions, partly due to increasing interest when the cod fishery failed here. A smaller decrease occurred in catches of redfish and flatfishes, and a considerable decrease took place in the fishery for industrial fish, especially capelin.

IV. Deep sea prawn

A small decrease in the prawn fishery must be ascribed to market conditions as there are no signs of a decrease in stock.

B. Special Research Studies

I. Environmental Studies

1. Hydrography. (See F. Hermann, Danish hydrographic investigations in West Greenland waters, 1968, ICNAF *Redbook* 1969, Pt.III).

II. Biological Studies

1. Cod.

a. Eggs and larvae. In connection with the hydrographic investigations, samples were taken by 2 m stramin net in Davis Strait on the standard sections and at the fixed station in the mouth of the Godthaab Fjord. Continuous hauls were made in the upper water layer from about 50 m to the surface (maximal wire lengths 225 m).

Eggs (Fig. 1) were taken in considerable quantities in April and May on the Sukkertoppen, Godthaab and Frederikshaab sections, mainly over the western slopes of the fishing banks. Few were taken in June.

Larvae were taken in June-August, mainly in July (Fig. 2) when the greatest numbers were taken on the Sukkertoppen section and on some stations between the Sukkertoppen and the Holsteinsborg sections. The numbers of larvae do not indicate a rich 1968 year-class for the future fishery, but perhaps one of mean strength.

b. Occurrence of small cod (age-groups I, II and III). In pound net catches from Holsteinsborg, Sukkertoppen and Godthaab districts (Nos.20, 29 and 21 in Fig. 4) and in a catch taken with a prawn trawl in the Davis Strait west of Godthaab (depth 300 m, January 1969), the 1965 year-class was well

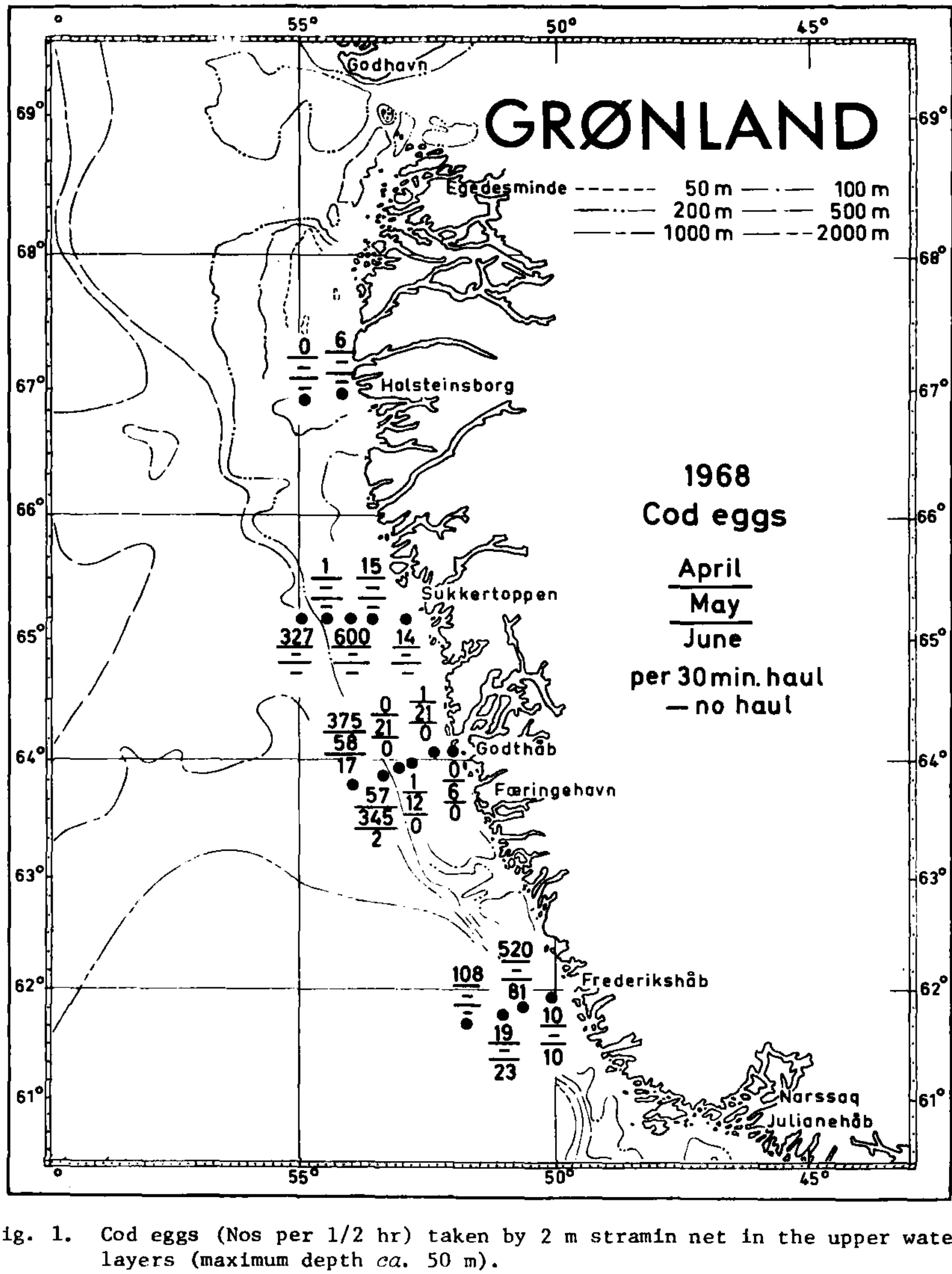

Fig. 1. Cod eggs (Nos per 1/2 hr) taken by 2 m stramin net in the upper water layers (maximum depth *ca.* 50 m).

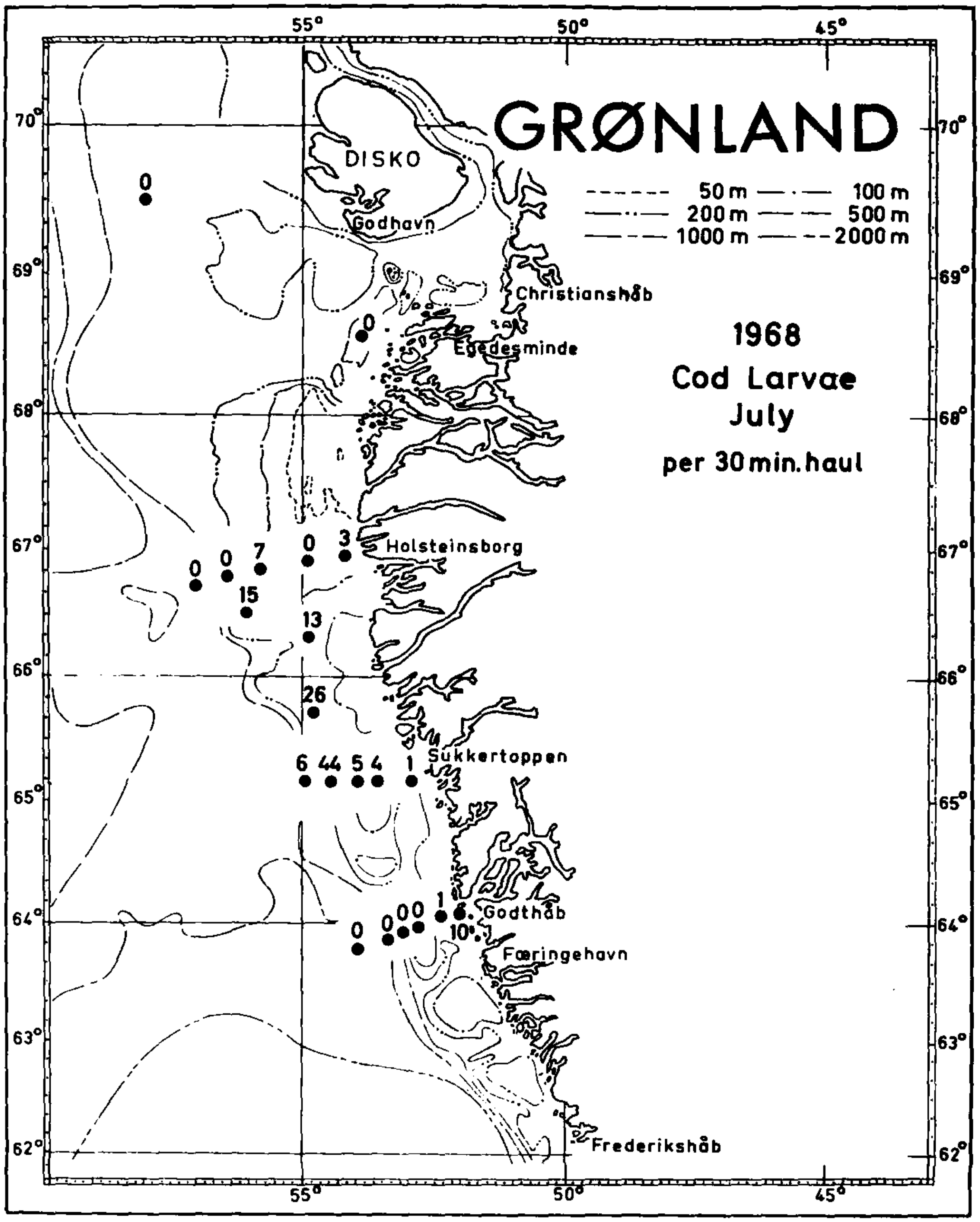

Fig. 2. Cod larvae (nos per 1/2 hr) taken by 2 m stramin net (maximum depth *ca.* 50 m).

represented. Presumably it will become a relatively rich year-class in the commercial catches in the coming years in agreement with predictions put forward in the Danish Research Report, 1965 (ICNAF *Redbook* 1966, Pt.II) because of favourable water temperatures that year.

c. Age and size of cod in the commercial stock. Figure 3 (Samples 1-7) shows the age and size of cod taken by a Faroese trawler.

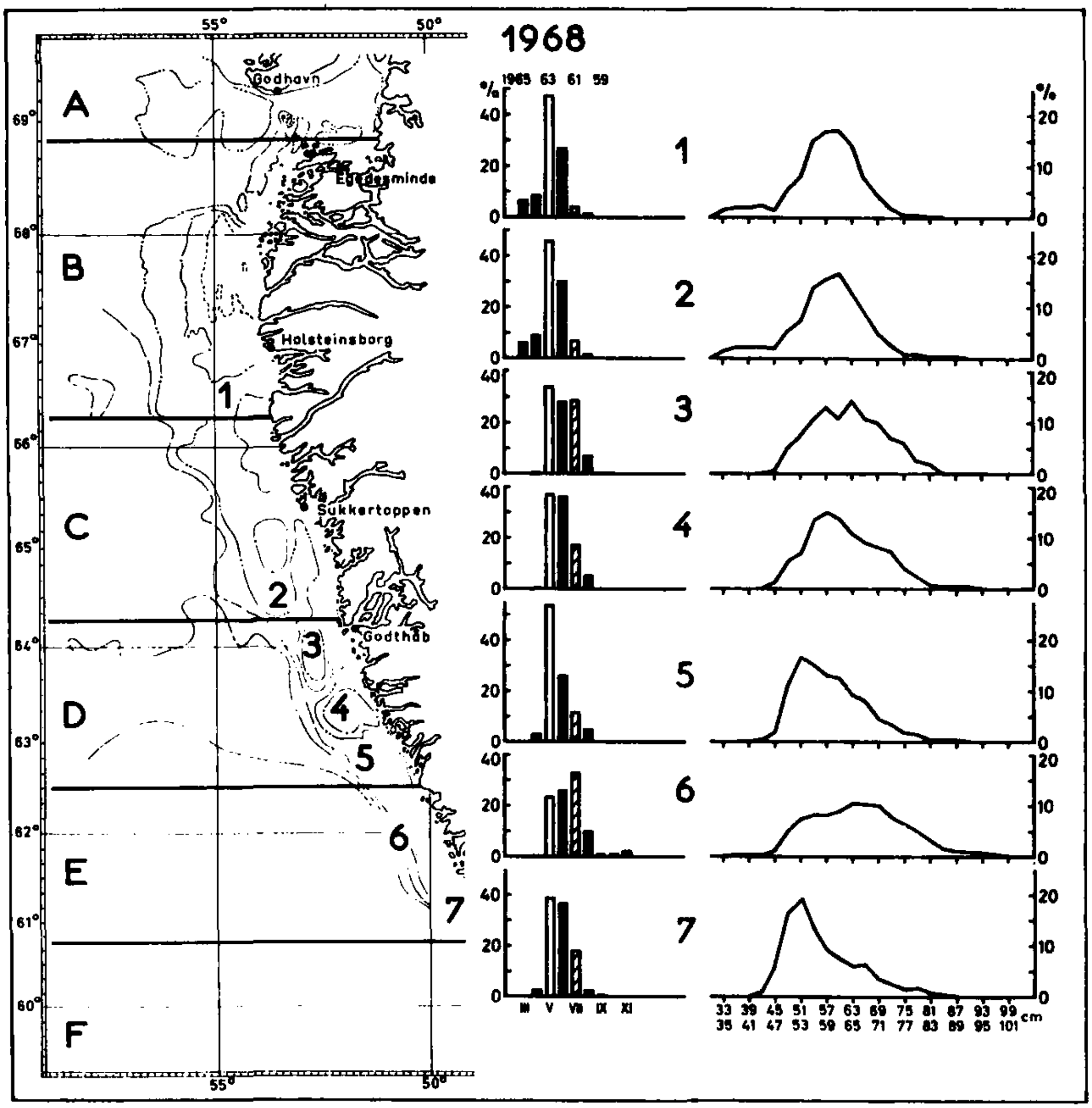

Fig. 3. Age and length compositions of cod taken by the Faroese trawler *Skalaberg*. Samples 1-7.

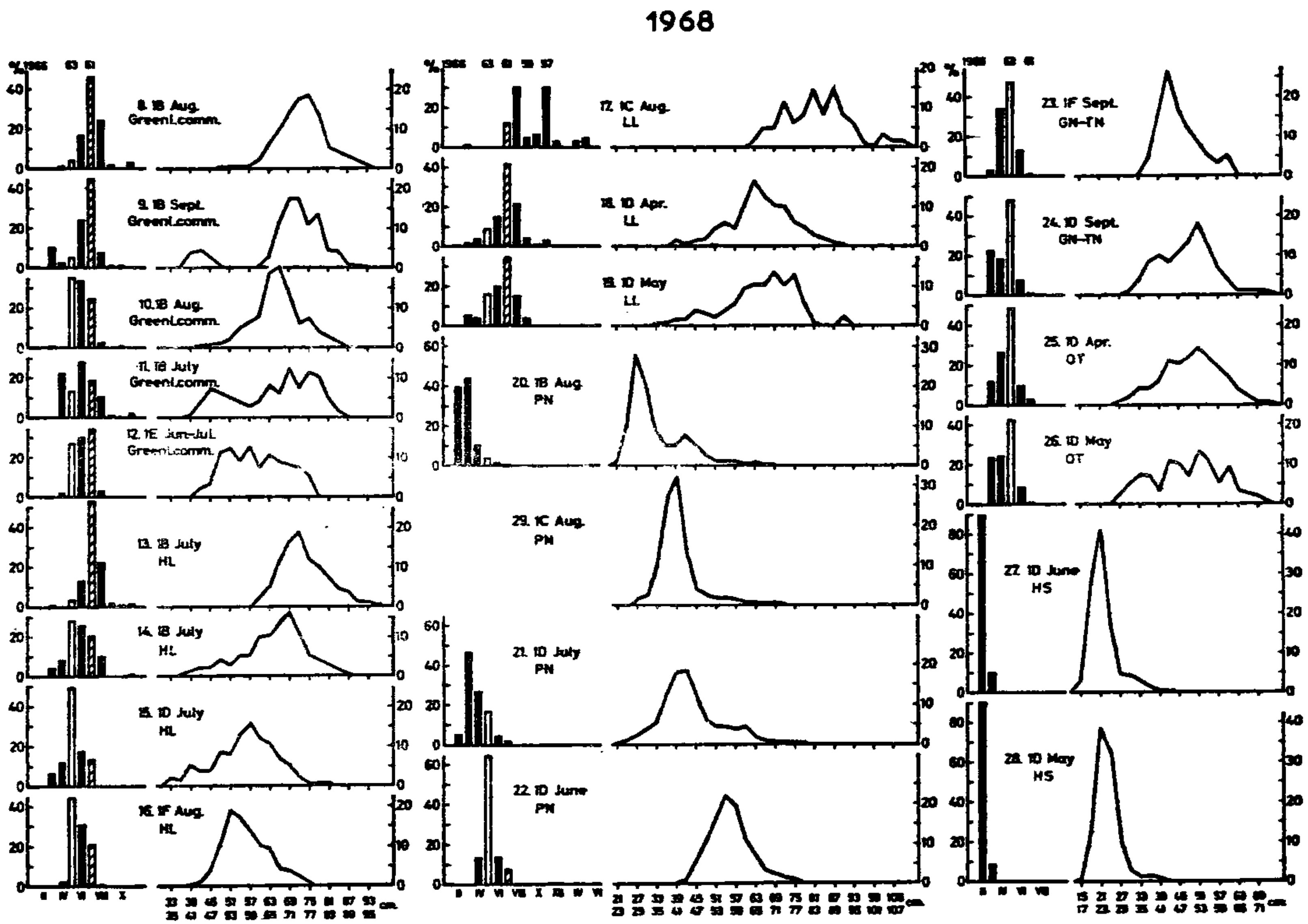

Fig. 4. Age and length compositions of cod from Greenland commercial catches (Samples 8-12) taken by different gears (longlines, handlines and pound nets) and from research catches (Samples 13-29) taken by handlines (HL), longlines (LL), pound nets (PN), gill nets and T-nets (GN-TN), otter trawl (OT, mesh size 36 mm), hand seine (HS, small meshes).

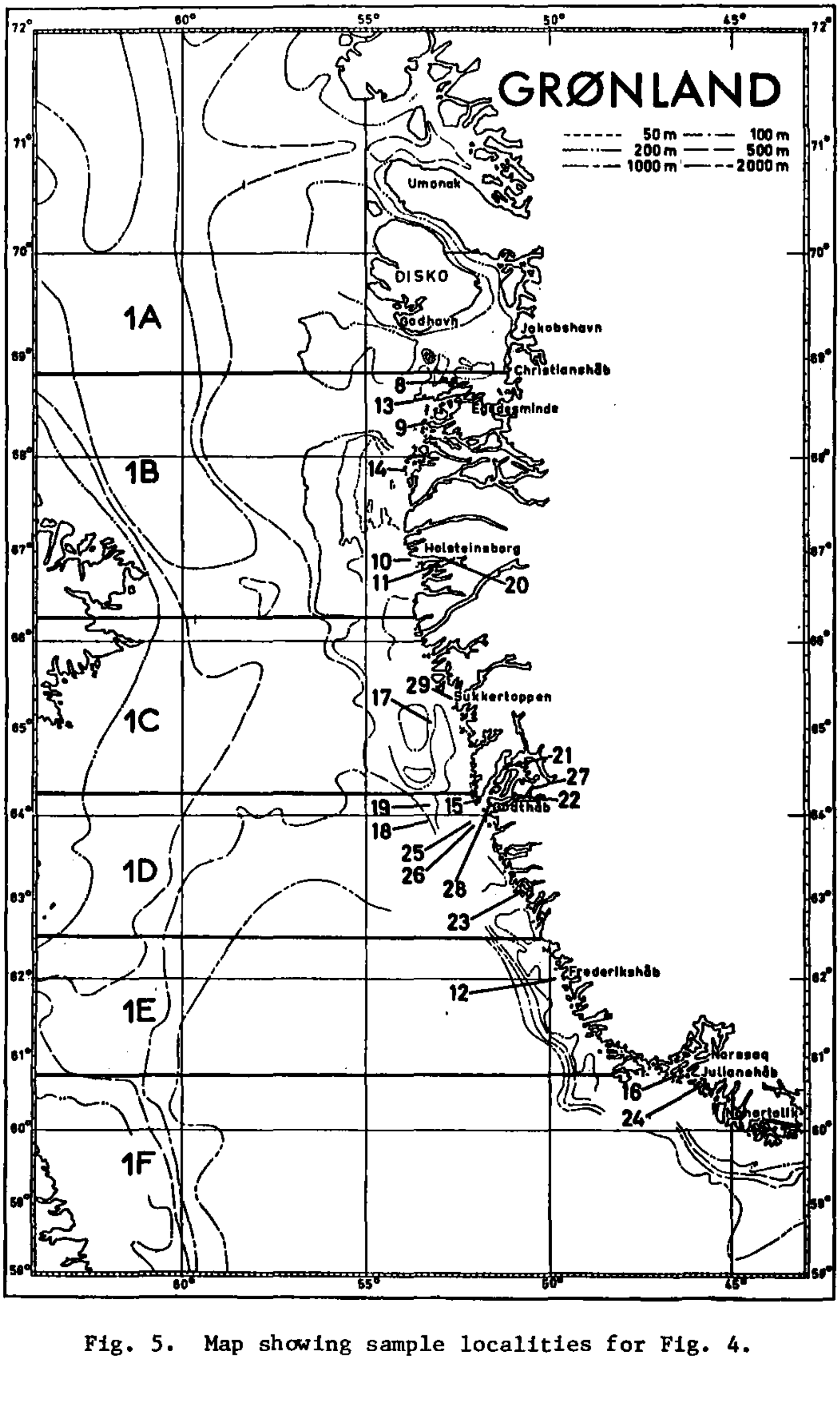

Fig. 5. Map showing sample localities for Fig. 4.

Figure 4 (Samples 8-12) shows the age and size of some Greenland catches taken by various gears (longline, handline and pound net). Further, Fig. 4 shows age and size of research catches (Samples 13-29) taken by various gears. The figures, which are based on a total of 5,082 age determinations and 24,217 length measurements, show that the 1963 year-class was predominant in most catches in 1968, followed by the 1961 year-class which was predominant in 1967. The previously rich 1960 year-class was only scarce in 1968.

d. Tagging experiments. A total number of 2,562 cod was tagged. Of these 1,513 were small cod (less than 50 cm total length) caught mainly in inshore waters by pound nets. Details are given in the table:

	Inshore		Offshore	
Div.	small cod	big cod	small cod	big cod
1B	462	143	7	495
1C	-	-	1	40
1D	1,011	12	-	-
1F	32	359	-	-
Total	1,505	514	8	535

2. Atlantic salmon. The research work, which is organized by the ICES/ICNAF Joint Working Party on North Atlantic Salmon, was carried out by UK, Canadian and Danish scientists from 23 August to 4 November in Godthaab and Julianehaab districts. Fishing experiments were made with poor results, 676 salmon being taken in gill nets, 26 in T-nets and only 11 on drift lines. Only 44 salmon were tagged.

From the tagging experiments in Greenland in 1967, 9 recaptures have been reported, 5 from the same district in Greenland and 2 from Ireland, 1 from Canada and 1 from Scotland.

The tagging experiments in 1968 gave 4 recaptures all in the same district, Godthaab (1D), and a few days after tagging.

The following salmon tagged in other countries were recaptured in Greenland waters: from Canada, 51; USA, 4; Scotland, 16; England, 8; Ireland, 1; Sweden, 1.

3. Other fish species. Materials for capelin studies were collected in different districts, and tagging experiments on redfish and on Greenland halibut in Godthaab Fjord were continued.

4. Deep sea prawn. Trawling experiments for *Pandalus borealis* in Davis Strait have been continued in 1968 with good results in the deep north of Store Hellefiske Bank and in the Sukkertoppen Deep and the Godthaab Deep.

III. German (FRG) Research Report, 1968

A. Subarea 1 and East Greenland
by Arno Meyer

A. Status of the Fisheries

I. Subarea 1

The two trends in the German fishery off West Greenland, mentioned in last year's report, continued:

1. The percentage of landings of fresh iced fish decreased further and made up only 6 percent of the round fresh weight of all landed fish. In 1968 most of the fish was deep-frozen and a small part salted (for export).

2. The trend to a seasonal fishery from winter to early summer further increased (Fig. 1). From August to December the fishing activity off West Greenland nearly came to an end. More and more the German factory ships exploit only the bigger cod (the schools of pre-spawners, spawners and post-spawners), and thus preserve the schools of young immature cod, which are fished mainly in the second part of the year. Thus this new type of seasonal fishery provides for a much better and more rational utilization of the Greenland stock of cod and has already reduced considerably the percentage of industrial fish and discards.

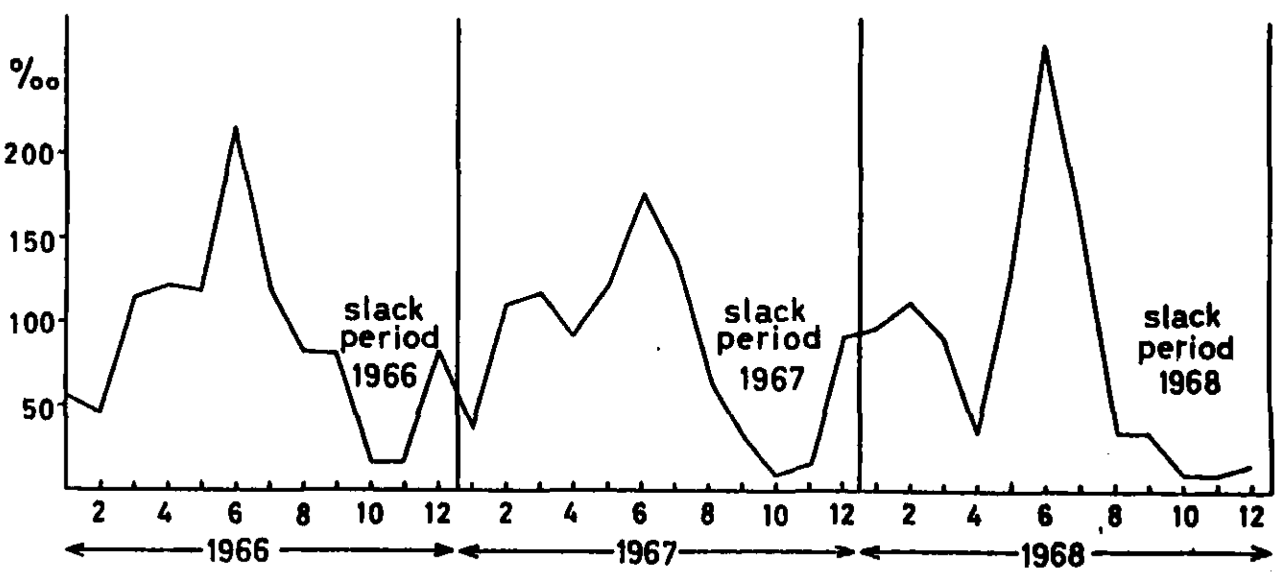

Fig. 1. Monthly German landings (in round fresh weight) from Subarea 1 in 1966, 1967 and 1968 as a percentage of the total yearly landings. Because of the long trips of the factory trawlers, the corresponding curve for the time of the catches would lie 1-1 1/2 months to the left.

Table 1. German nominal catches in tons (industrial fish included) off Greenland, 1962-1968.

	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
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
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

Table 2. Discarded fish in Subarea 1 in tons, 1968

	Cod	Redfish	Species unknown	Total
1B	1	-	-	1
1C	470	15	78	563
1D	649	36	105	790
1E	0	36	54	90
1F	26	30	56	112
Total	1146	117	293	1556

Table 3. Average gross registered tonnage of German trawlers fishing in Subarea 1, 1968.

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)

Table 1 shows that the nominal catch in Subarea 1 decreased slightly from 155,000 tons to 146,000 tons. This small decrease was not the consequence of unfavourable stock conditions but due to less fishing activity. Although the fishery off West Greenland was very profitable, many trawlers left Greenland for Labrador (Fig. 1) where from February to the middle of April extremely heavy concentrations were found (see B. Subareas 2-5 by J. Messtorff).

The good fishing conditions during the first half of 1968 off West Greenland resulted in a further increase in the average catch per fishing day to 22.8 tons, the highest figure since 1952, when German trawlers started fishing in Subarea 1. This further increase in catch per fishing day was mainly due to the very paying catches by mid-water trawls in Div.1E from the end of May to the beginning of July.

On the other hand, the decreasing trend in the redfish fishery continued in total output as well as in catch per fishing day.

II. East Greenland

As a consequence of decreasing market demand for fresh iced fish, German fishing activity off East Greenland decreased by 37 percent. The fishery, however, was better than during the 3 preceding years. The catch per fishing day increased for cod as well as for redfish.

III. Forecast for 1969

The two mentioned trends in the German fishery off West Greenland will continue. The fishing effort will decrease further and will be extremely high in the second quarter of the year only. The catch per fishing day will probably increase further for: (1) the trawlers will only work during times with highest daily output, (2) all ships will be equipped with mid-water trawls, (3) the very rich 1961 year-class will probably give its greatest output in 1969, all the more since all cod of this year-class will have reached maturity, and (4) the stock of mature fish will be enlarged by the spawners of the 1962 and 1963 year-classes. Owing to the probable poor state of the younger year-classes, the following years will result in a continuing decrease in total output as well as in catch per fishing day. A further increase in mesh size at least to 150 mm to ensure a better conservation of the young but very fast growing immature cod, would result in a much better utilization of the Greenlandic cod and help to reduce this impending decrease in total international output.

The total output of cod and redfish off East Greenland cannot be predicted. It is conditioned by the further market demand for fresh fish and as in all years by the varying ice conditions on the fishing grounds. The catch per day probably will increase further for (1) the mass of the 1961 year-class will spawn off East Greenland, and (2) the fishery on the rocky grounds of East Greenland is carried out more and more only by the few very experienced captains.

B. Special Research Studies

I. Environmental Studies

1. Hydrography. Unfortunately in 1968 there was no possibility to repeat the hydrographic work in late autumn as in the 5 preceding years. The *Walther Herwig* was ordered to go earlier and completed the standard sections from Cape Farewell to Great Halibut Bank in July and August.

The hydrographic investigations (Fig. 2 and 3) showed that the Arctic component of the West Greenland Current was well developed and reached great depths. The 2°C isotherm went down to 200 and 250 m. The banks were covered by very cold water. On Fyllas Bank even temperatures below 0°C were measured. On Little Halibut Bank the temperatures in 60 to 200 m ranged between 0.6 and 0.9°C. Off South Greenland (Cape Farewell and Nanortalik Bank) low temperatures were also found. The western part of Noname Bank was covered exclusively by water of more than 2°C. Comparing these 1968 temperatures with those measured at the same time of the year by F. Hermann in 1961 and 1964 and by W. Templeman in 1965, we see that the July-August temperatures in 1968 were extremely low and that in 1961, 1964 and 1965 on Fyllas and Little Halibut Bank the temperatures were 2 to 2.5°C higher. Also, the surface temperatures were considerably lower in 1968. On 24 July, for instance, surface temperatures down to -0.31°C were found over Noname Bank. The Atlantic part of the West Greenland Current had temperatures up to 4.6°C. In 1965 and 1964, these were more than 5°C.

All captains fishing off West Greenland reported the most severe ice conditions ever experienced during the first half of 1968. Even in July and August *Walther Herwig* met great quantities of ice often forcing the ship, which was on its way north, to steam westward as far as 54°W.

In October 1968, *Anton Dohrn* worked 3 sections across Dohrn Bank. Two parallel sections from south to north showed that the eastern part of the bank was covered by very cold Arctic water, the western part, however, by warm Atlantic water. A section across the northern part of Dohrn Bank parallel to the border of the shelf running from ENE to WSW (Fig. 4) gives a good picture of this hydrographic situation. The very cold Arctic water of the East Greenland Current is coming from the northeast. The warm water over the western part of the bank is water of a right branch of the Irminger Current. The water of this branch is running in northern direction along the eastern side of the Storfjord Deep and brings warm water to the Øst Bank area. There may be the possibility that in summer and fall the cod follows this warm water and that possibilities for catching cod may exist along the eastern side of the Storfjord Deep and the western and northern part of the Øst Bank.

The rather cold bottom water at Station 1152 with salinities of 34.80 to 34.90‰ must be the so-called "intermediate water" originating from the left branch of the West Spitzbergen Current, which is running parallel to the East Greenland Current to the south and coming to an end between Dohrn Bank and Angmagssalik.

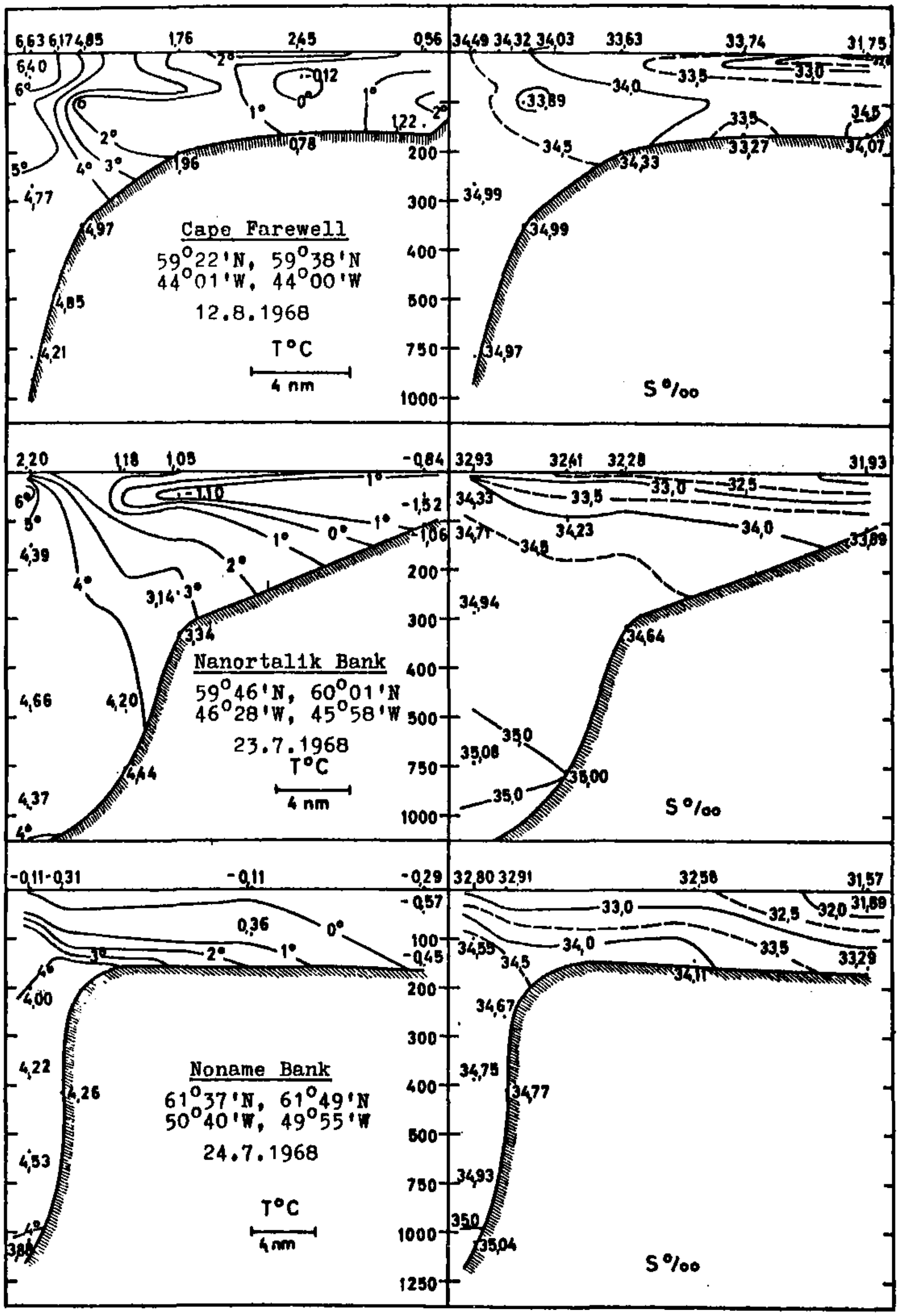

Fig. 2. Hydrographic sections off West Greenland (temperature and salinity) in July-August 1968.

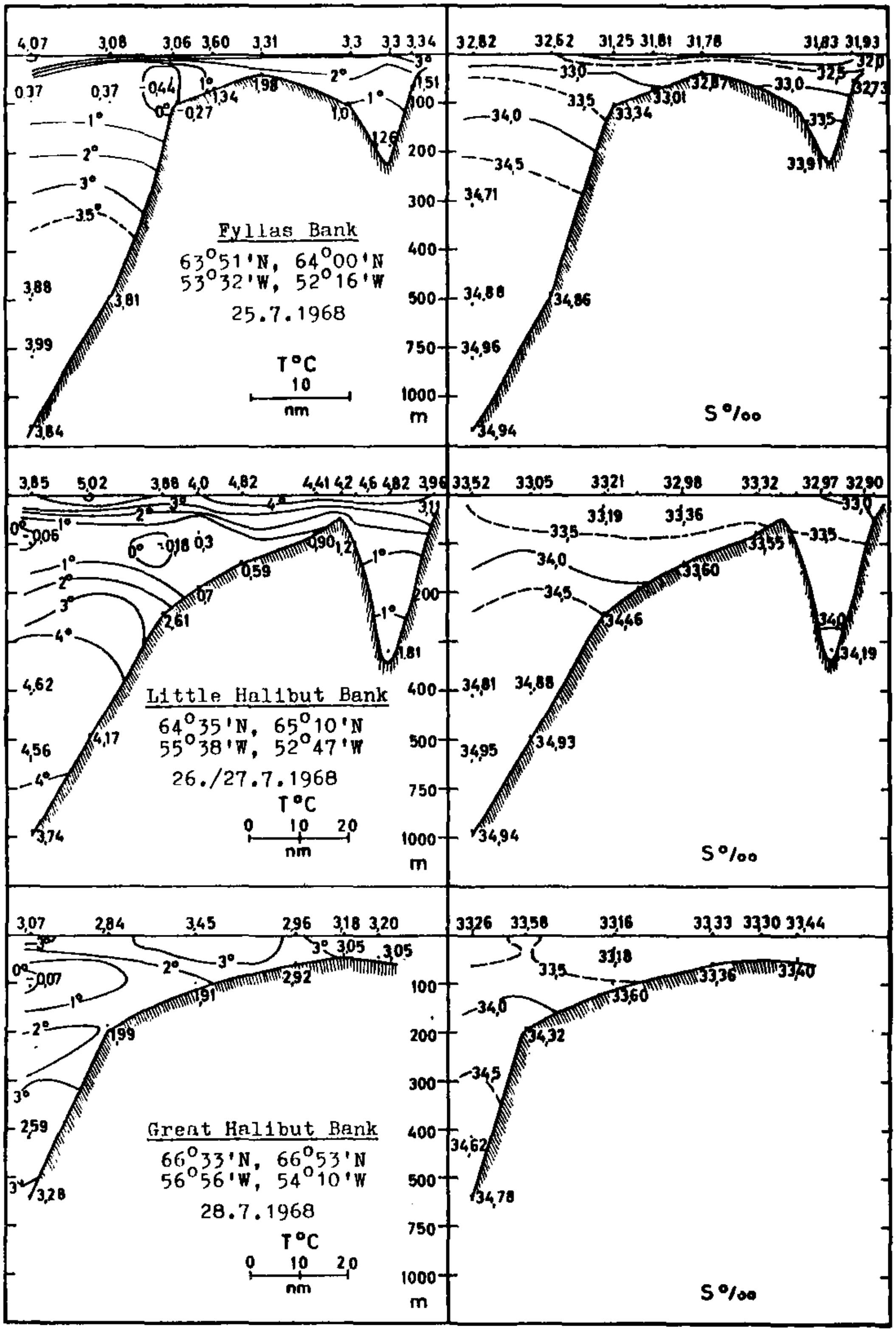

Fig. 3. Hydrographic sections off West Greenland (temperature and salinity) in July-August 1968.

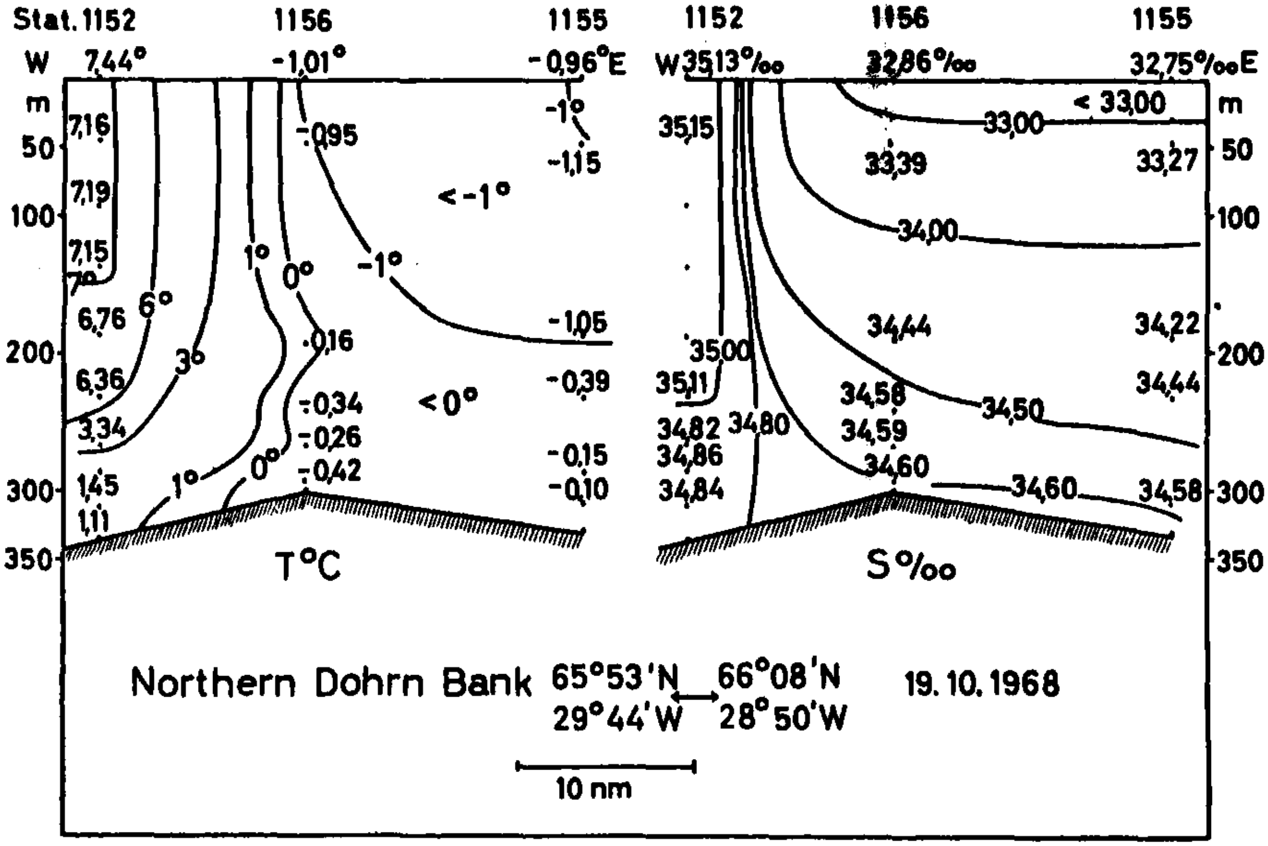

Fig. 4. Section across the northern part of the Dohrn Bank in October 1968.

II. Biological Studies

1. Subarea 1. In 1968, the 1961 and 1963 year-classes of cod dominated, the 7-year-olds in the first half of the year and the 5-year-olds in the second half. Owing to the fact that the major part of these two year-classes are of East Greenlandic origin, the best fishing possibilities were off southwest and south Greenland. Fishery on the northern banks gave bad results and we must conclude that the younger year-classes are poor.

Again in 1968, no real spawning places were found off West Greenland. After spawning, very big concentrations of post-spawners mixed with a varying percentage of older immature cod were fished in Div.1E. These very inactive schools were mostly pelagic and were successfully fished by mid-water trawls. Figure 5 gives the age composition of these schools on Frederikshaab Bank. The 1961 year-class dominated with 55 percent, followed by the 1962 year-class with 29 percent. Maturity studies showed that in the middle of June 12 percent of the 5-year-olds, 65 percent of the 6-year-olds, 82 percent of the 7-year-olds and 100 percent of the 8-year-old cod were mature and had spawned. Towards the end of the pelagic fishing season the percentage of immature cod increased, thus showing that the spawned fish left the area and were starting their feeding migration.

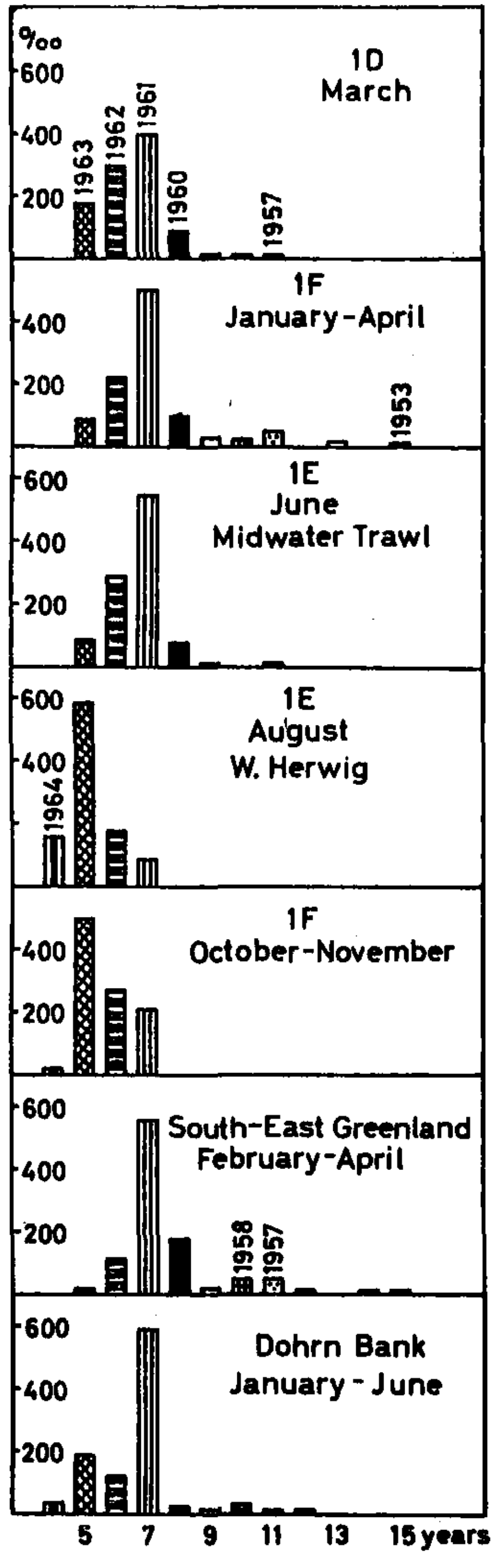

Fig. 5. Age composition (in ‰) of commercial catches and by *Walther Herwig* in Subarea 1 and off East Greenland.

The main task of the research trip of *Walther Herwig* in July and August was to search for further catching possibilities by mid-water trawl. But all pelagic echo traces found were not schools of commercial fish but consisted of capelin, sand eels, squids, jelly fish and young flatfishes. The catches of cod with bottom trawl on the northern banks (1B-1D) were more than poor. Only in the southern part of Div.1E and on Nanortalik Bank were some cod concentrations found on the bottom. In these catches the 1963 year-class dominated with 50 to 60 percent. A similar age composition was also found in cod catches of the few commercial trawlers fishing off South Greenland in the last quarter of the year.

2. East Greenland. Also off East Greenland, most cod was fished during the first half of the year. The age composition shows that off southeast Greenland, Angmagssalik and Dohrn Bank, the 1961 year-class dominated with 55 and 59 percent respectively. On the spawning grounds off southeast Greenland (Discord, Bille and Fylkir Bank) the 1960 year-class was second strongest with 17 percent, whilst off Angmagssalik and in the Dohrn Bank area the 1961 year-class was followed by the 1963 year-class.

In the spring of 1968, a considerable emigration of the 1961 year-class must have taken place from Greenland to the Icelandic spawning grounds. This can be deduced from the age composition of the Icelandic cod catches off southwest and northwest Iceland. Further evidence is the reduced mean length of the 7-year-old cod in Iceland and the structure of the otoliths. This immigration into Icelandic waters by 1968 was rather unexpected, for normally east Greenlandic year-classes emigrate to Iceland at 8 years of age. We may expect that in 1969 a further emigration to Iceland of this very rich year-class will take place (see Meyer: German investigations of Icelandic cod 1953-1968, *Annales Biologiques*, Vol.25, 1969).

References

Hermann, F. Hydrographic conditions off West Greenland, 1961. ICNAF *Redbook* 1962, Pt.II.

in Danish Research Report, 1964. ICNAF *Redbook* 1965, Pt.II

Templeman, W. Hydrographic observations in Subareas 1, 2 and 3, July-August 1965. *Annu. Meet. int. Comm. Northw. Atlant. Fish.* 1966, Res.Doc.66/43, Serial No.1652 (mimeographed)

Krass, W. Die hydrographischen Untersuchungen mit *Anton Dohrn* auf dem ost- und westgronlandischen Schelf im September-Oktober 1955. Berichte der DWK, N.F. Band XV, 1959.

B. Subareas 2-5
by J. Messtorff

Subarea 2

A. Status of the Fisheries

Extremely good cod fishing conditions from February to middle of April resulted in a seasonal increase of the German fishing activity off Labrador. No fishing was carried out during the summer months. Later in the year only a few factory trawlers tried to fish but soon left the subarea again because of unsatisfactory catches until the 1968/69 winter/spring season started at the very end of December. The German fishery took place in Div.2J (Hamilton Bank) but was occasionally extended to Div.2H.

The preliminary catch and effort data for 1968 given in Table 4 therefore refer mainly to the successful spring season, which yielded the second highest total catch since the beginning of the German Labrador fishery in 1958. In spite of a 16 percent greater fishing effort (days fished) than in 1967, the average total catch per fishing day increased by about 10 tons and reached its highest value since 1961 when the redfish catches started to decline considerably. The fishing on pure cod concentrations by German trawlers in 1968 is clearly demonstrated by the fact that 98 percent of the total catch consisted of cod. The average catch per fishing day of 35.7 tons had never been reached before by the German cod fishery in the Northwest Atlantic.

There was no redfish fishery. The small redfish by-catch was negligible and even less than the amount of other by-catch fish.

The percentage of whole ("industrial") fish converted to fish meal on board was extremely low in 1968 (Table 4). On the other hand, there was a slight increase in discarded cod (Table 5) because the capacities of the fish meal plants on board were often fully occupied in processing the large amount of offal from the very large catches.

B. Special Research Studies

There was no field research in 1968, but during a Northwest Atlantic survey *Walther Herwig* carried out some hydrographic observations and biological studies on the cod concentrations at Hamilton Bank (Div.2J) in February 1969. The examination of this material is not yet completed. Further field work off Labrador is planned for the autumn of 1969.

Market sampling of commercial catches could not be carried out because the landings consisted entirely of deep-frozen and processed fish. At present the introduction of sampling of commercial catches at sea is being tested.

Table 4. Subarea 2, nominal catches in tons (1958-1968) (including industrial fish = fish converted to fish meal on board).

Year	Days fished	COD Catch	COD Catch per day fished	COD % indus-trial	REDFISH Catch	REDFISH Catch per day fished	REDFISH % indus-trial	OTHER FISH Catch	OTHER FISH Catch per day fished	OTHER FISH % indus-trial	TOTAL Catch	TOTAL Catch per day fished	TOTAL % indus-trial
1958	622	618	1.0		22,909	37.0		516	0.8		24,043	38.7	
1959	900	3,238	3.6		34,604	38.5		345	0.4		38,187	42.4	
1960	1,156	12,145	11.4		29,181	25.2		1,305	1.1		42,631	36.7	
1961	732	11,088	15.2		8,307	11.4		1,599	2.2		20,994	28.8	
1962	93	882	9.5	4.1	1,939	20.8	15.9	68	0.7	0	2,889	31.1	11.9
1963	76	1,050	13.8	12.3	941	12.4	12.0	59	0.8	67.8	2,050	27.0	13.8
1964	495	3,559	7.2	14.4	5,079	10.3	10.5	1,029	2.1	91.3	9,667	19.5	20.5
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

Table 5. Discarded fish in Subarea 2 in tons, 1968 (1967 in brackets).

Div.	COD	REDFISH	OTHER FISH	ALL SPECIES
2G	- (1)	- (-)	- (-)	- (1)
2H	28 (103)	2 (14)	5 (26)	35 (143)
2J	362 (96)	22 (5)	20 (38)	404 (139)
Total	390 (200)	24 (19)	25 (64)	439 (283)

Subareas 3-5

A. Status of the Fisheries

Apart from the herring fishery in Subareas 4 and 5 (see C. Subareas 4, 5 and 6, by K. Schubert), there was no German fishing activity in these subareas.

B. Special Research Studies

No special research studies except on herring (see C. Subareas 4, 5 and 6, by K. Schubert) were carried out in 1968. But *Walther Herwig* undertook a survey in January-February 1969, during which observations on the hydrographic conditions, and the abundance of fish as well as biological studies were carried out in each subarea. The material is not yet worked up but it may be noted that the abundance of haddock on Georges Bank (Div.5Ze) was found to be extremely poor. An echo survey went completely negative and the total haddock catch of 8 test hauls consisted of 2 specimens. In Subarea 4, haddock was more but only moderately abundant especially on Browns Bank (Div.4X) with a maximum catch of 350 kg and in "The Gully" (Div.4Vs) with 1,000 kg per trawling hour.

C. Subareas 4, 5 and 6
by K. Schubert

A. Status of the Fisheries

Nineteen stern freezer trawlers operated with pelagic nets in Subarea 4 (11 trawlers), 5 (19 trawlers) and 6 (1 trawler) in March and from July to December, mainly for herring.

Moreover, for the first time, the German lugger fleet participated in this fishery in Subdiv.5Ze with ten ships from July to November. Catch, effort, catch-per-unit effort and discarded fish are given in Tables 6 and 7.

In March, only 1 trawler was working in Div.6A. The trawler fleet returned to 5Ze at the end of June working here until the beginning of November. In the same month a part of the fleet shifted to Subdiv.4Vn and 4Vs, where they were fishing until the end of December (Fig. 6 and 7).

The lugger fleet started at the end of May and were fishing until November in the Subdiv.5Ze (Fig. 8).

Figure 9 shows the mean catch per hour on a five-day basis of three German freezer trawlers in Subdiv.5Ze, 4Vn and 4Vs in 1968, and Fig. 10 the corresponding figures in kantjes (= 2 baskets) per hour of six German luggers in Subdiv.5Ze in 1968.

Table 6. Nominal catch, effort, catch-per-unit effort and discards of German factory freezer trawlers, Subareas 4, 5 and 6, in 1968 (including industrial fish).

Subarea	4Vn,4Vs	5Ze							6A
Month	Dec	July	Aug	Sept	Oct	Nov	Dec	Total	March
				Nominal catches (tons)					
Herring	10,555	4,573	12,532	14,322	17,739	10,001	3,504	62,671	413
Mackerel	-	-	6	7	28	116	163	320	2
Others	2	3	7	1	8	3	2	24	0
Total	10,557	4,576	12,545	14,330	17,775	10,120	3,669	63,015	415
				Effort					
Days fishing	191	102	344	309	354	299	126	1,534	11
				Catch per day (tons)					
Herring	55.3	44.8	36.4	46.3	50.1	33.4	27.8	40.9	37.5
Mackerel	-	-	0	0	0.1	0.4	1.3	0.2	0.2
Others	0	0.1	0.1	0.1	0	0	0	0	0
Total	55.3	44.9	36.5	46.4	50.2	33.8	29.1	41.1	37.7
				Discards					
Herring	-	-	-	50	654	165	-	869	-
Others	-	-	100	-	-	-	25	125	-
Total	-	-	100	50	654	165	25	994	-

Table 7. Nominal catch effort and catch per unit effort of German luggers in Subarea 5.

Subarea	5Ze					
Month	July	Aug	Sept	Oct	Nov	Total
			Nominal catch (tons)			
Herring and Total	1,021	2,201	2,173	2,290	152	7,837
			Effort			
Days fishing	216	310	221	216	36	999
			Catch per day (tons)			
Herring and Total	4.7	7.1	9.8	10.6	4.2	7.8

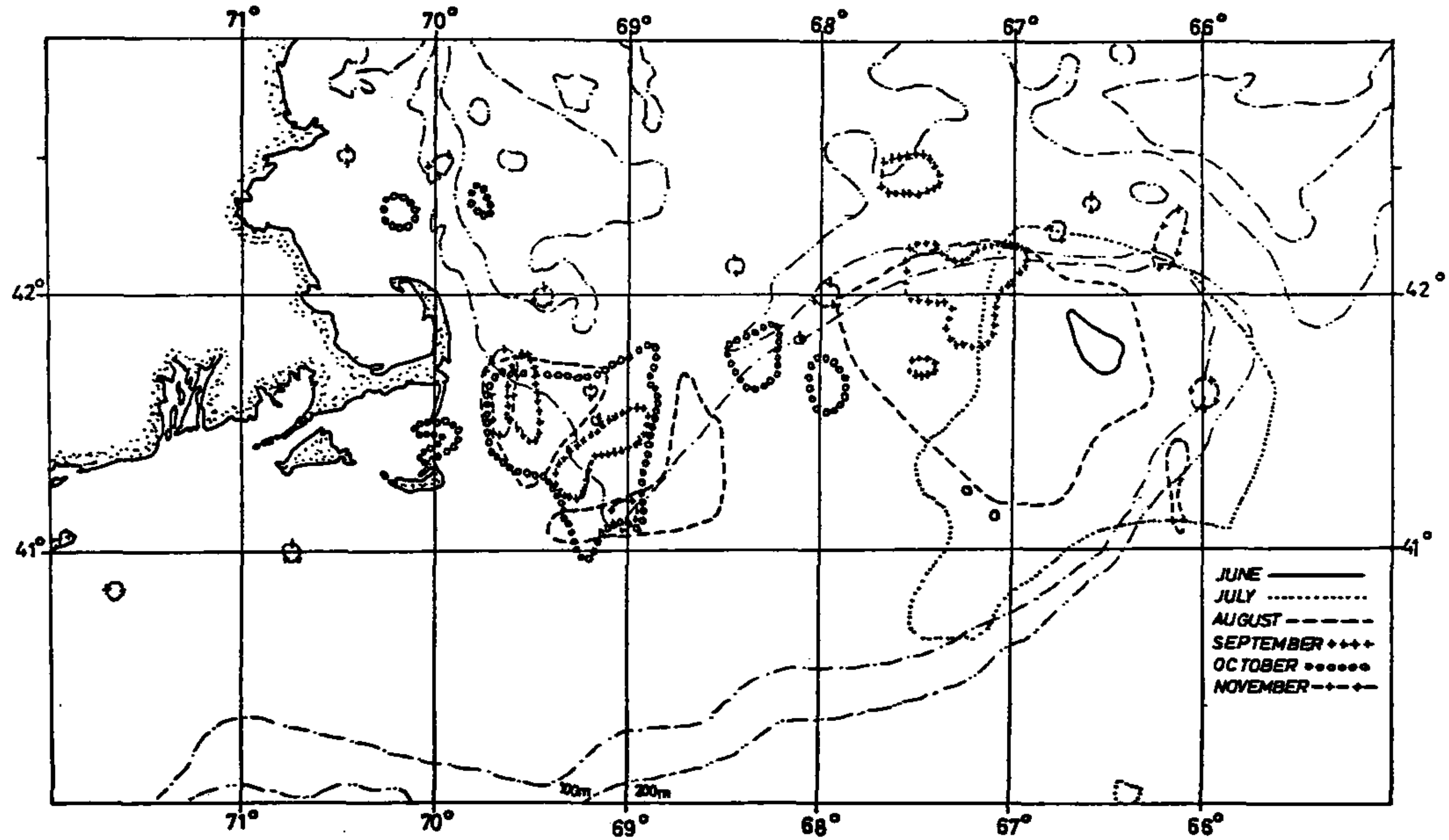

Fig. 6. Herring. Fishing area of German freezer trawlers in Div.5Z.

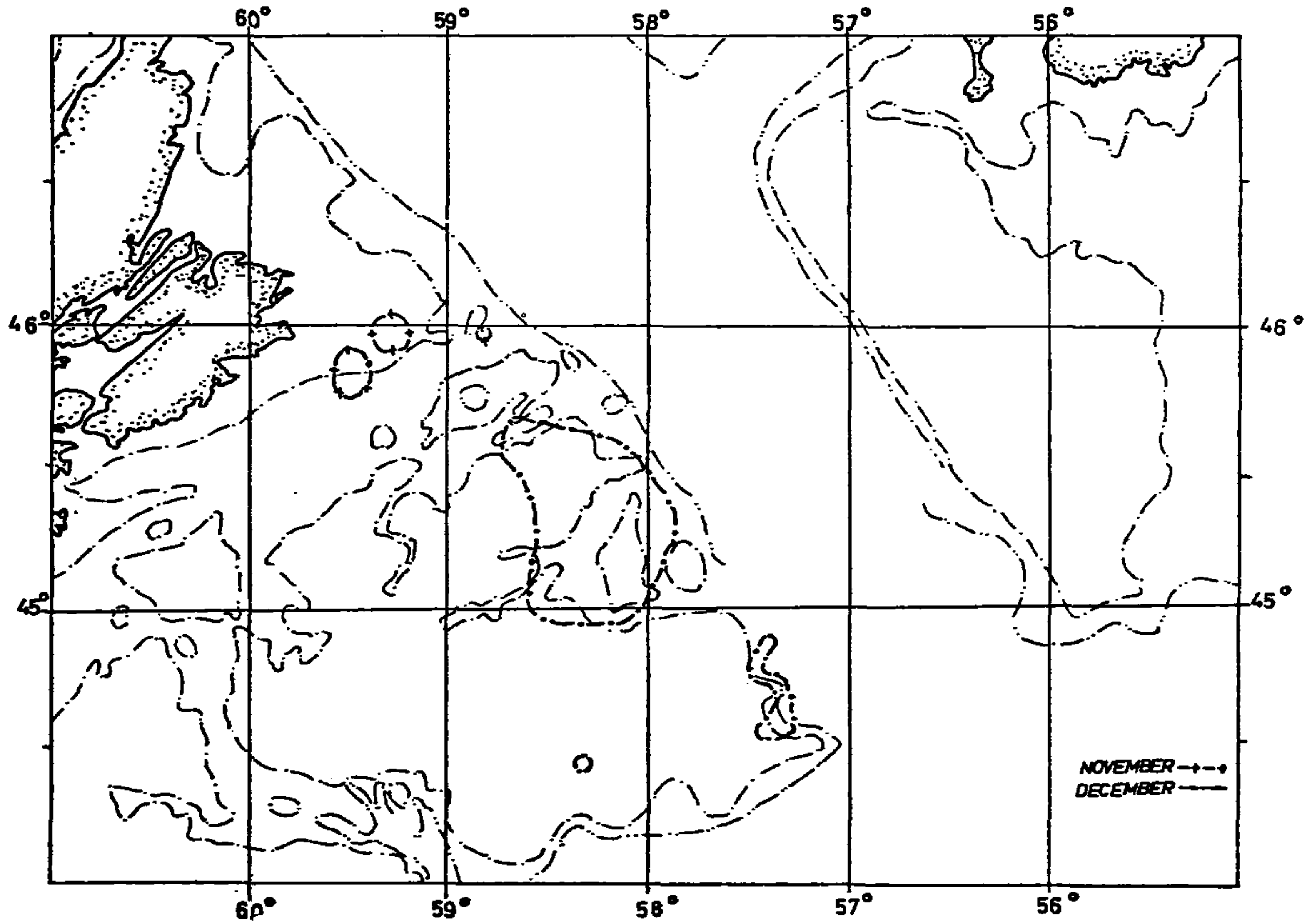

Fig. 7. Herring. Fishing area of German freezer trawlers in Div.4V.

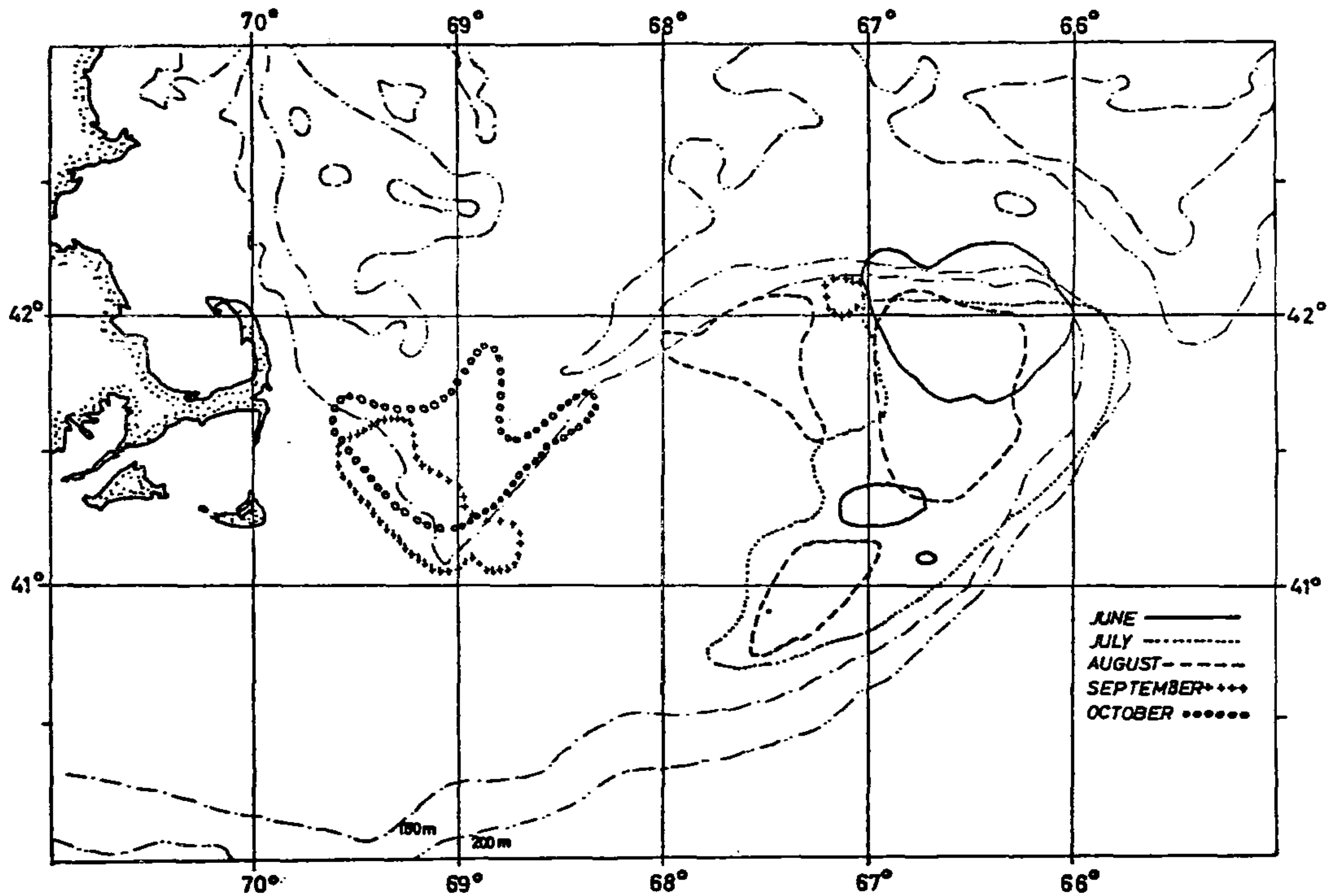

Fig. 8. Herring. Fishing area of German lugger in Div.5Z.

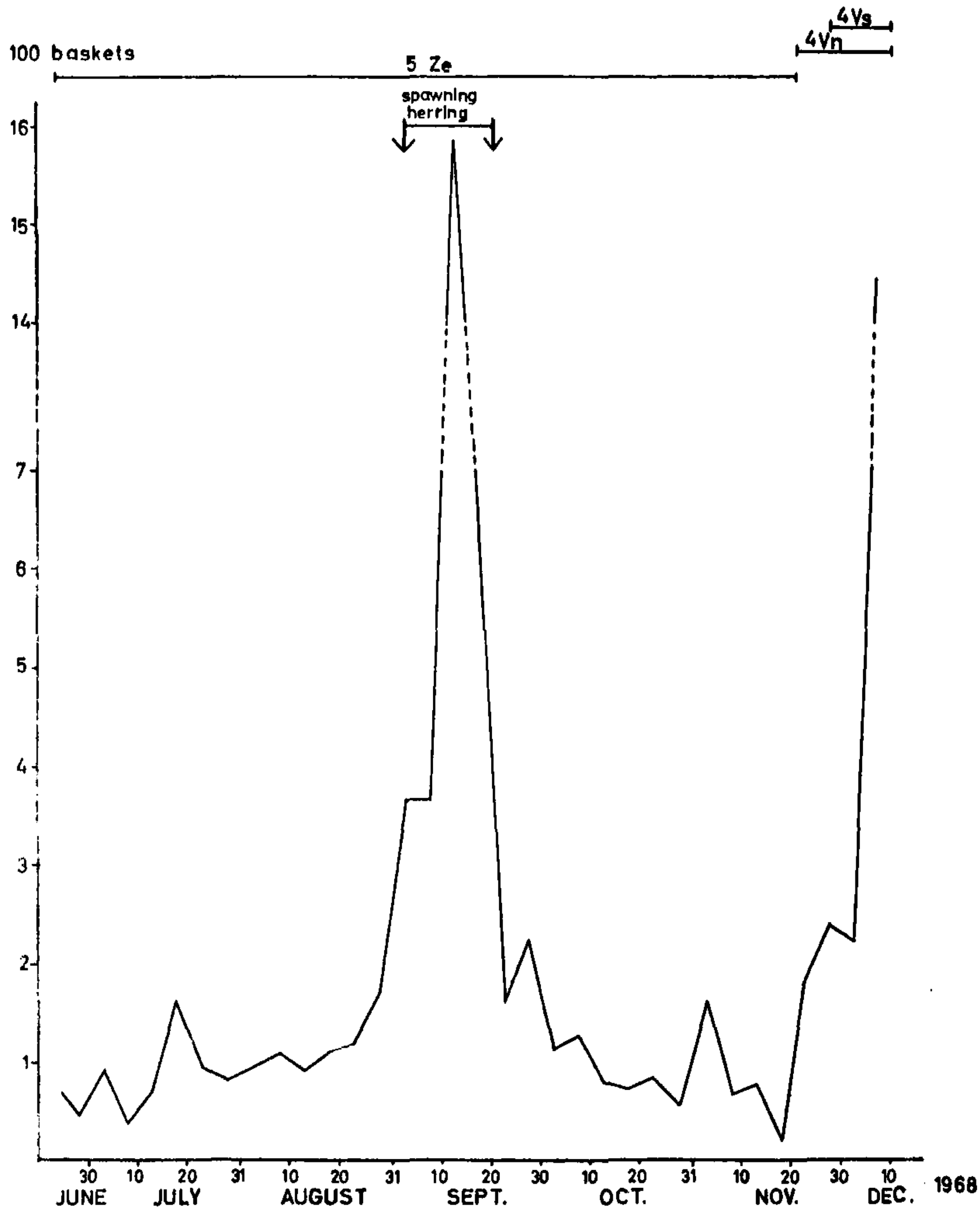

Fig. 9. Herring. Catch per hour (baskets) on an average of about 5 days of three of German freezer trawlers in Div.5Z and 4V.

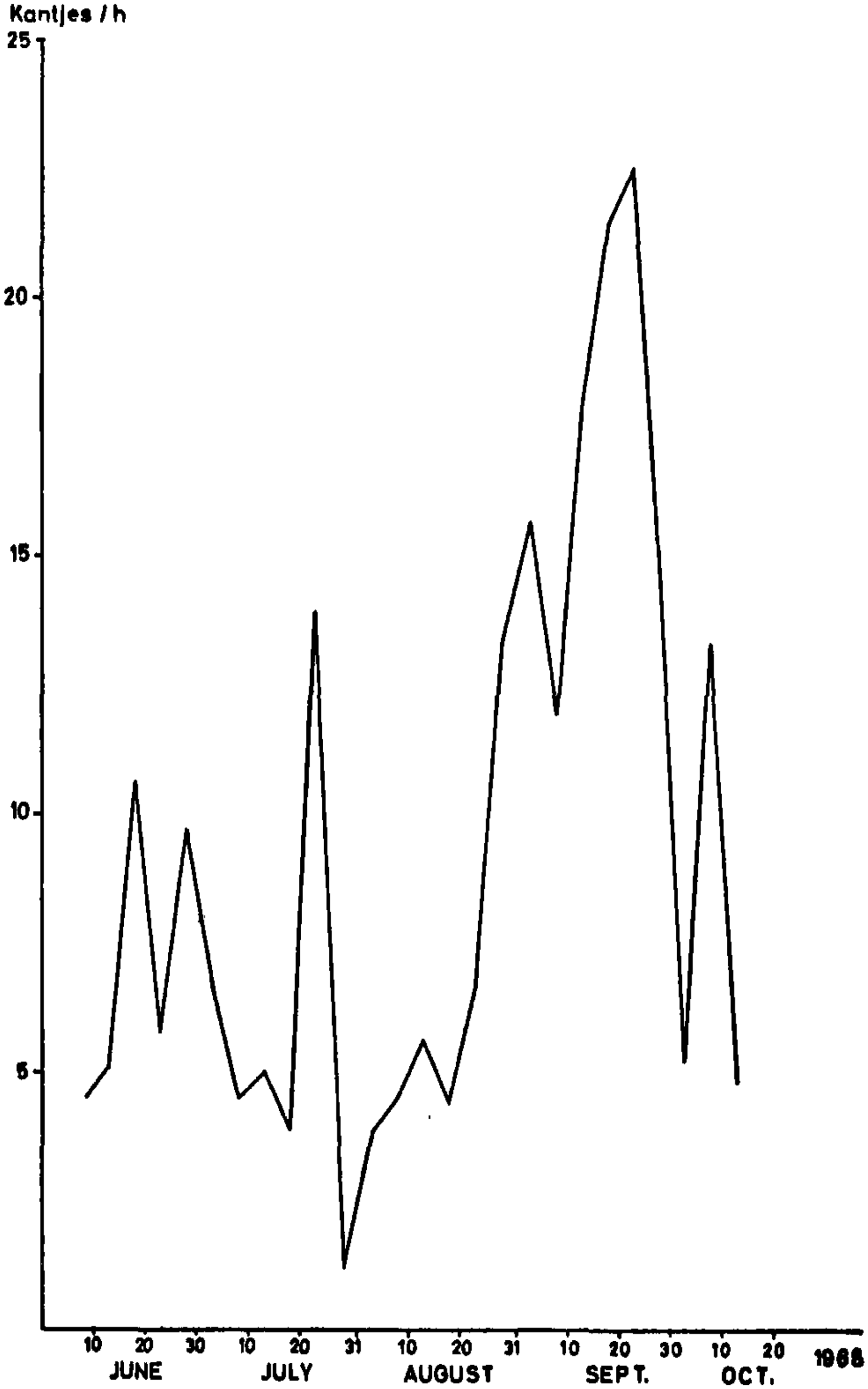

Fig.10. Herring. Catch per hour (1 kantjes=2 baskets) on an average of about 5 days of six German luggers in Div.5Z.

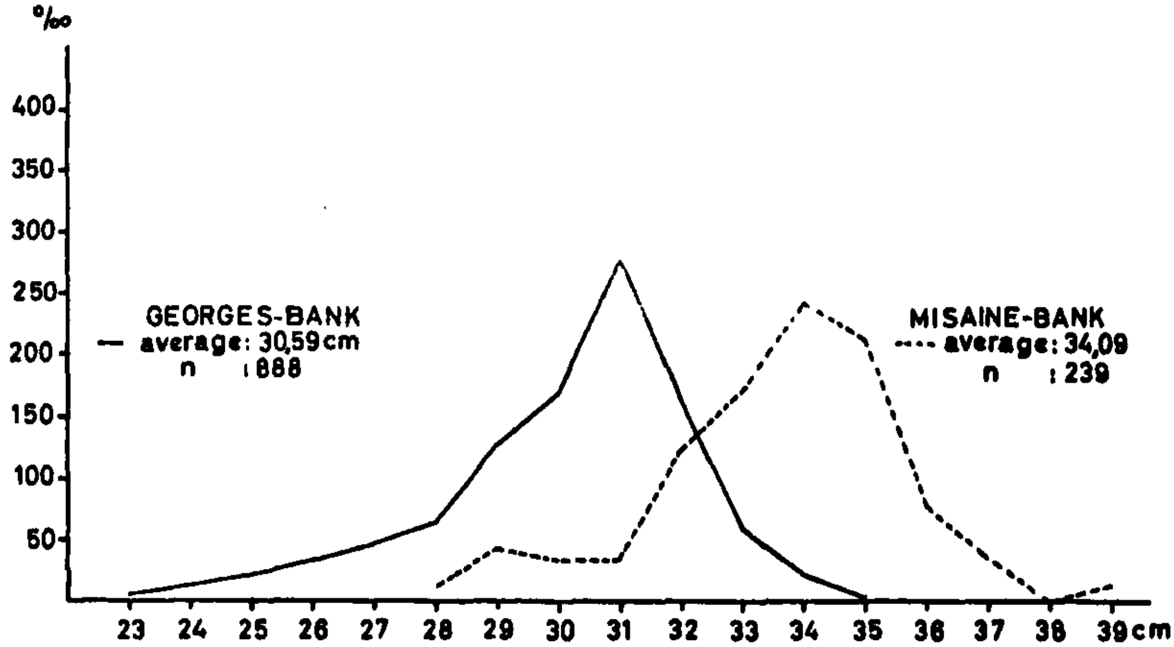

Fig. 11. Herring. Length composition. Div.5Z and 4V.

B. Special Research Studies

I. Biological Studies

Four samples (888 herring) from the Georges Bank in August and two samples (239 herring) from Misaine Bank in December were examined (Table 8).

The average length of all Georges Bank herring was 30.59 cm. The length range varied from 24-35 cm, with a peak at 31 cm. On Misaine Bank the average length was 34.09 cm with a fluctuation from 28-39 cm and a peak at 34 cm (Fig.11).

On Georges Bank, maturity stages 5 (656‰) and 4 (207‰) were predominant, whereas on Misaine Bank stage 8 formed the bulk of the catches (955‰).

Investigations of meristic characters showed that the herring of the two subareas belonged to different stocks. The average number of vertebrae was 56.36 and 56.60.

Age composition on Georges Bank showed a change from 1967. In 1968 the 1963 year-class (305‰) dominated. Of some importance also were the 1961 (196‰), 1960 (182‰), 1962 (116‰) and 1964 (111‰) year-classes. On Misaine Bank, there was a very old stock. The year-classes older than 1959 were predominant (632‰) but also the 1960 (130‰) and 1959 (114‰) year-classes had some importance (Fig. 12).

Table 8. German biological data: ICNAF Area 5Ze and 4Vs, 1968.

Length composition ‰	Georges Bank	Missaine Bank
Area	Georges Bank	Missaine Bank
Month	VIII	XII
Gear	PT	PT
Sample	S	S
cm		
23.0	6	
23.5	1	
24.0	2	
24.5	12	
25.0	9	
25.5	12	
26.0	17	
26.5	17	
27.0	26	
27.5	20	
28.0	32	4
28.5	32	8
29.0	55	17
29.5	71	25
30.0	78	13
30.5	90	21
31.0	146	17
31.5	129	17
32.0	96	33
32.5	68	88
33.0	50	63
33.5	9	117
34.0	10	117
34.5	10	126
35.0	2	129
35.5		84
36.0		50
36.5		25
37.0		21
37.5		13
38.0		-
38.5		-
39.0		8
39.5		4
Total	1000	1000
n	888	239
Mean length cm	30.59	34.09

Age composition

Year-class	Age	‰ Georges Bank VIII	‰ Missaine Bank XII		Length Georges Bank VIII	Length Missaine Bank XII	L_1 Georges Bank VIII	L_1 Missaine Bank XII	Vertebrae Georges Bank VIII	Vertebrae Missaine Bank XII	Gill rakers Georges Bank VIII	Gill rakers Missaine Bank XII
1967	1	-	-	$\bar{x}$ s^2 n	-	-	-	-	-	-	-	-
66	2	5	-		22.00 4.750 2	-	13.50 - 1	-	57.50 0.500 2	-	48.00 - 2	-
65	3	68	-		24.96 1.896 28	-	14.25 5.791 8	-	56.39 0.846 28	-	49.07 1.773 28	-
64	4	111	-		27.46 1.731 46	-	12.83 6.764 9	-	56.40 0.582 43	-	49.20 1.935 44	-
63	5	305	43		29.73 0.915 126	29.88 0.859 8	12.50 2.419 44	9.50 - 1	56.42 0.493 123	56.29 0.489 8	49.79 2.442 118	50.29 0.232 8
62	6	116	54		30.88 0.995 48	31.80 1.132 10	13.85 3.000 17	-	56.28 0.609 46	57.10 1.212 10	49.88 2.610 41	49.10 2.101 10
61	7	196	27		31.30 1.061 81	32.10 2.840 5	12.19 6.572 13	-	56.28 0.436 79	56.40 0.300 5	49.56 2.982 75	50.60 1.840 5
60	8	182	130		31.45 0.943 75	33.21 0.567 24	13.46 5.159 26	11.50 - 1	56.36 0.715 72	56.36 0.240 22	49.54 2.611 74	50.00 3.739 24
59	9	2	114		31,50 - 1	34.21 0.718 21	13.50 - 1	-	57.00 - 1	56.40 0.366 20	47.00 - 1	50.05 1.548 21
<59	>9	15	632		33.67 0.972 6	35.30 1.883 117	13.00 0.500 2	12.70 6.710 5	56.33 0.289 6	56.68 0.333 116	49.50 0.350 6	49.34 2.539 117
Total Number		1000 413	1000 185	$\bar{x}$ s^2 n	29.94 4.801 413	34.36 3.422 185	13.13 4.104 121	12.07 4.983 7	56.37 0.564 400	56.61 0.529 181	49.57 2.493 389	49.57 2.476 185

Stages of maturity

Stages	‰ Georges Bank VIII	‰ Missaine Bank XII		Vertebrae Georges Bank VIII	Vertebrae Missaine Bank XII	Gill rakers Georges Bank VIII	Gill rakers Missaine Bank XII
1	21	-	$\bar{x}$ s^2 n	57.11 0.613 9	-	49.11 1.113 9	-
2	9	10		55.50 1.083 4	56.00 - 2	49.25 0.937 4	51.00 2.000 2
3	25	10		56.30 0.466 10	56.00 - 2	49.00 5.400 11	46.00 18.000 2
4	207	10		56.47 0.507 88	56.00 - 2	49.59 1.156 84	50.00 2.000 2
5	656	-		56.31 0.520 281	-	49.61 2.648 270	-
6	11	5		56.50 0.333 4	58.00 - 1	49.00 2.000 5	47.00 - 1
7	71	10		56.40 0.737 30	56.00 - 2	49.58 2.324 31	49.00 2.000 2
8	-	955		-	56.62 0.520 178	-	49.79 2.276 182
Total Number	1000 439	1000 191	$\bar{x}$ s^2 n	56.36 0.551 426	56.60 0.520 187	49.57 2.483 414	49.62 2.680 191

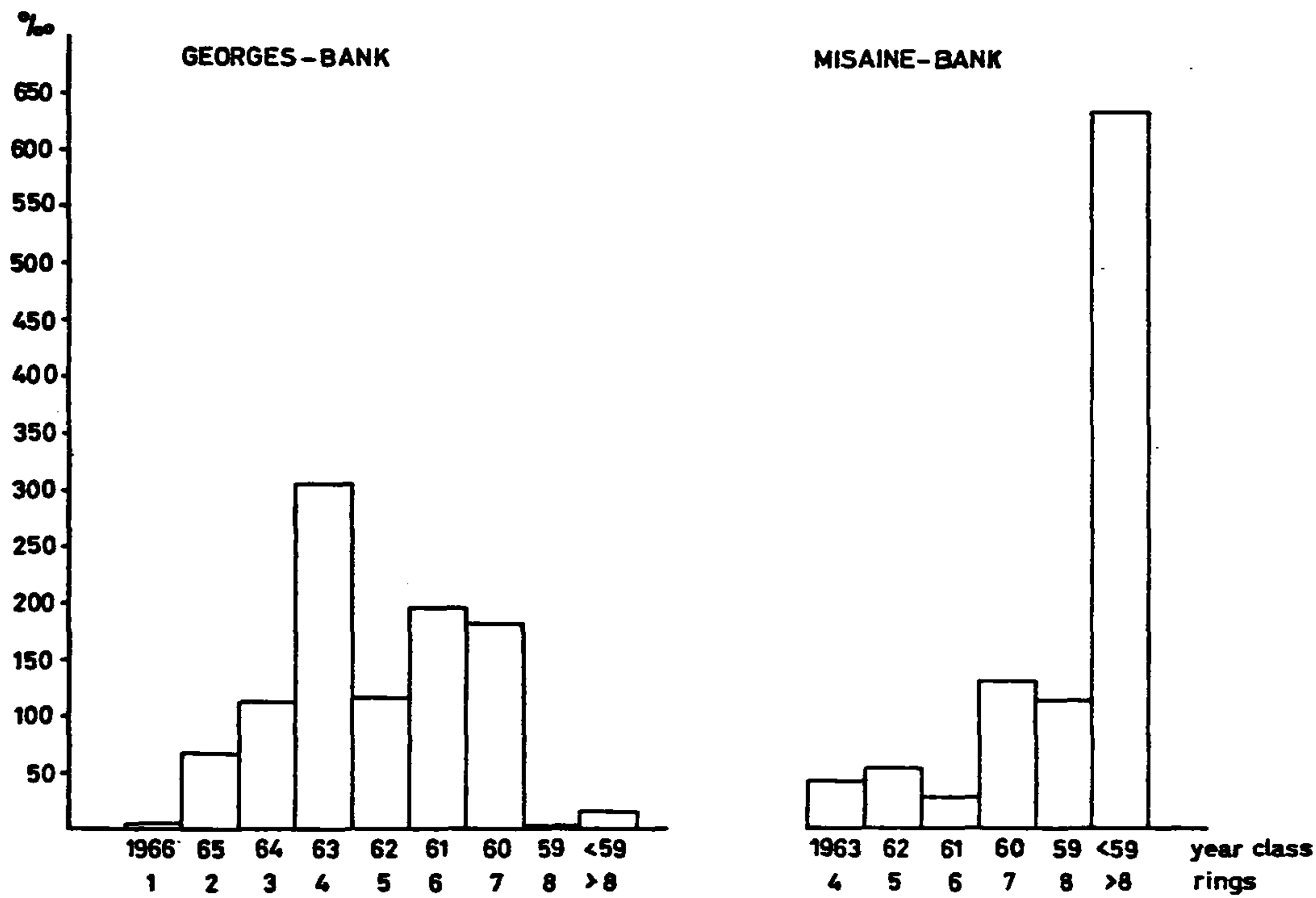

Fig. 12. Herring. Age composition, Div.5Z and 4V.

IV. Icelandic Research Report, 1968

by Jon Jonsson

There was practically no Icelandic fishery in the ICNAF Area in 1968.

Only two trawlers fished in the area, one for 7 days in May and the other for 13 days in October. Both ships fished in Div.3K. The total number of hours fished was 251 and the number of hauls made was 150.

Total landings were 398 tons, mainly redfish (328 tons). Cod amounted to 68 tons and the rest consisted of halibut and Greenland shark.

In the East Greenland area, Icelandic fishing effort was also substantially lower than in 1967 but higher than in 1965 and 1966 (Table 1).

Table 1. Landings and fishing effort of Icelandic trawlers fishing at East Greenland.

Year	1965	1966	1967	1968
Trawling hours	4,763	4,074	7,619	5,143
Tons:				
Cod	4,798	3,866	9,993	5,899
Redfish	3,048	3,512	9,965	5,975
Tons per 100 hrs				
Cod	101	95	131	115
Redfish	64	86	131	116

Several samples are available of landings from Icelandic trawlers fishing in this area in 1968, most of them from April-May in the Angmagssalik area (Jonsmid).

Table 2 shows the length and age distribution of these samples together with the average lengths of the various age-groups. There is a clear dominance of the 1961 year-class and the age distribution is rather similar to that on the Icelandic spawning grounds at the same time. The 1963 year-class is more strongly represented in the East Greenland samples than in the Icelandic ones.

Table 2. Cod. Length and age composition of Icelandic trawler landings. Angmagssalik area, 11 April-29 May 1968.

Length composition			Age composition			
cm	no	‰	Year-class (age)	no	%	Length (cm)
40-44	3	3	1965 (3)	2	0.3	44.5
45-49	17	15	1964 (4)	29	3.7	54.1
50-54	40	35	1963 (5)	272	29.6	63.0
55-59	109	95	1962 (6)	185	18.4	68.6
60-64	178	155	1961 (7)	383	38.2	74.5
65-69	207	180	1960 (8)	43	4.2	79.0
70-74	219	191	1959 (9)	12	1.0	83.4
75-79	159	139	1958 (10)	29	2.6	88.5
80-84	85	74	1957 (11)	13	1.3	96.1
85-89	51	44	1956 (12)	6	0.7	96.5
90-94	31	27	1954 (14)	2	0.2	115.5
95-99	20	17	1952 (16)	2	0.2	101.5
100-104	17	15	1950 (18)	1	0.1	81.0
105-109	7	6				
110-114	3	3				
115-119	2	2				
Total	1,148		Total	979		

V. Norwegian Research Report, 1968

by Erling Bratberg and Johan Blindheim

Subarea 1

In 1968, Norwegian fisheries investigations were carried out in the area between Nunarsuit and Sukkertoppen from 23 April to 14 May. Five hydrographical sections were worked. During the period from 24 April to 9 May, bottom longline with No.2, 4 and 6 hooks was used at 9 localities, and from 6 May to 14 May trawling was carried out at 10 stations.

A. Status of the Fisheries

I. Cod

1. Age and length composition of the commercial stock. The 1961 year-class decreased from 48.8% in 1967 to 34.4% in 1968 in the total Norwegian research vessel catch on bottom longline (No.6 hook) but is still the dominating year-class. The 1960 year-class decreased from 31.6% to 9.2%. Older year-classes play a minor part in the catches. The 1963 year-class has increased rapidly, from less than 2% in 1967 to 24.6% in 1968 (Fig.2). The total catch on bottom longline, No.2, 4 and 6 hooks combined, shows nearly the same picture as the catch on No.6 hooks (Fig. 3). The total trawl catch is dominated by the 1963 year-class, 36.6%, followed by the 1962 and 1961 year-classes with 27.8 and 21.2% respectively. Also in the trawl catches older year-classes play an insignificant part (Fig. 4).

The length composition in the total bottom longline catch is shown in Fig. 5. The overall mean length is considerably lower than in 1967. The mean length varied from one locality to another and the smallest fish were caught off Nunarsuit (Table 1).

Figure 6 shows the length composition in the total trawl catch. The overall mean length is 62.3 cm which is considerably lower than in 1967 when the overall mean length in the trawl catches was 66.3 cm.

2. Forecast for the cod fisheries. The Norwegian bottom longline catches off West Greenland in 1969 will most probably be dominated by the 1963 year-class. The 1960, 1961 and 1962 year-classes are expected to decrease. The mean length of the cod will likely also decrease, and a decline in the catch per unit effort for the Norwegian longliners is to be expected.

B. Special Research Studies

I. Environmental Studies

1. Hydrography. Between 24 April and 2 May 5 hydrographic sections were worked (Fig. 1). The ice conditions were not as severe as in 1967 and only

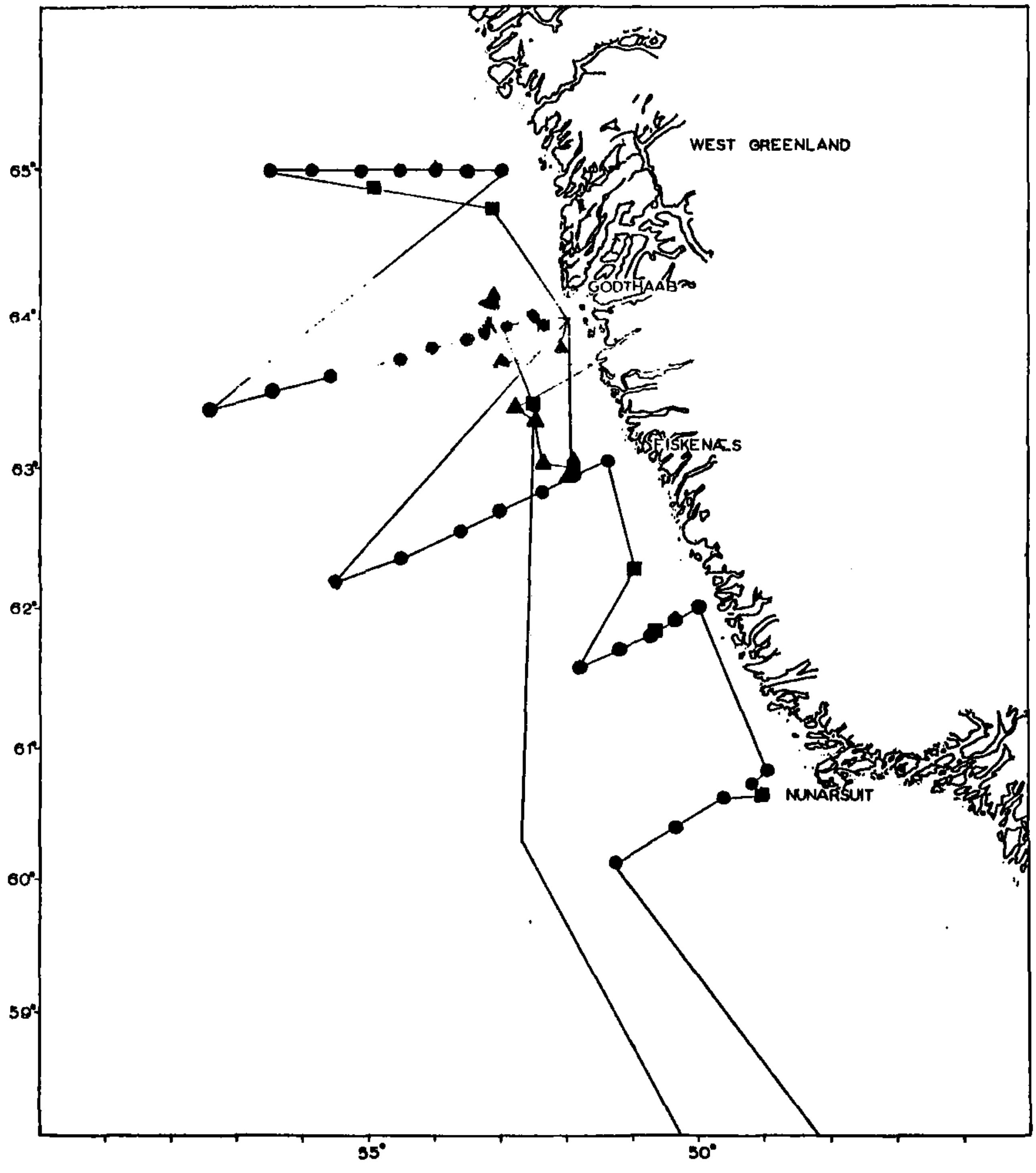

Fig. 1. R/V *Johan Hjort*, West Greenland, April-May 1968. Route and net of stations - ●: hydrographical station; ■ : bottom longline station; ▲ : trawl station.

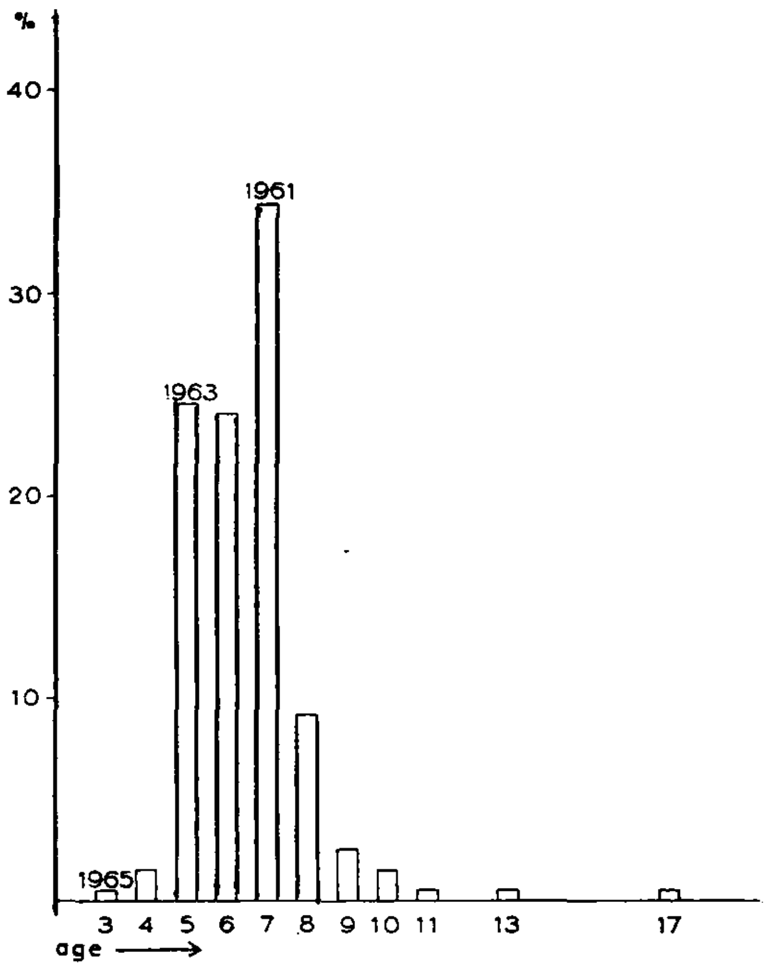

Fig. 2. R/V *Johan Hjort*, West Greenland, April-May 1968. Cod. Age distribution. Total bottom longline catch, No.6 hook.

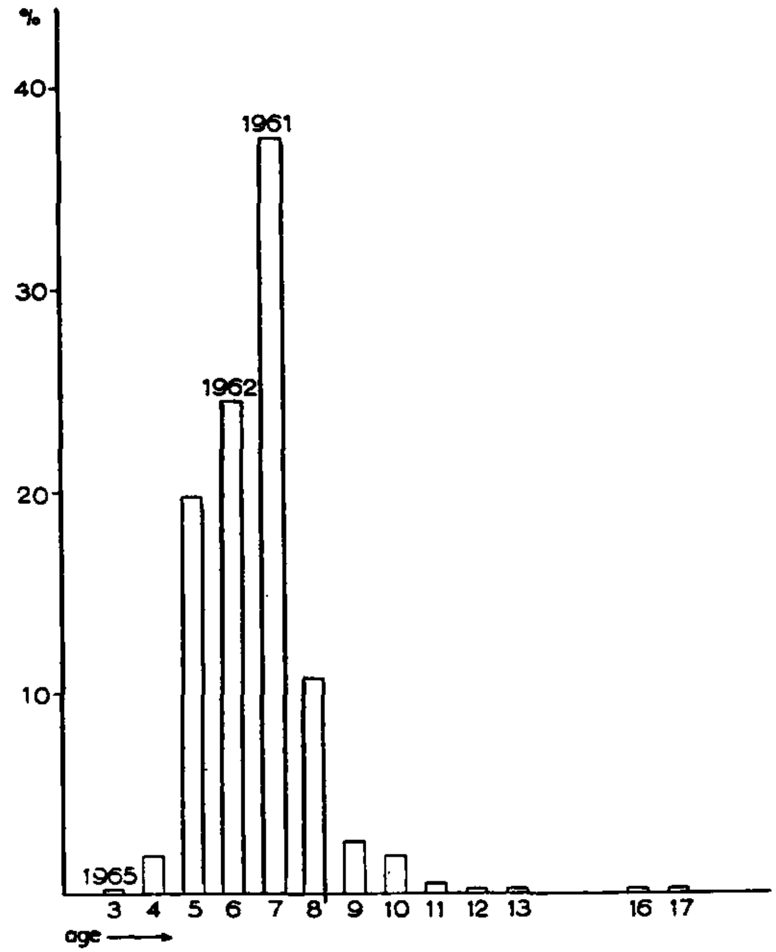

Fig. 3. R/V *Johan Hjort*, West Greenland, April-May 1968. Cod. Age distribution. Total bottom longline catch, No.6, 4 and 2 hooks combined.

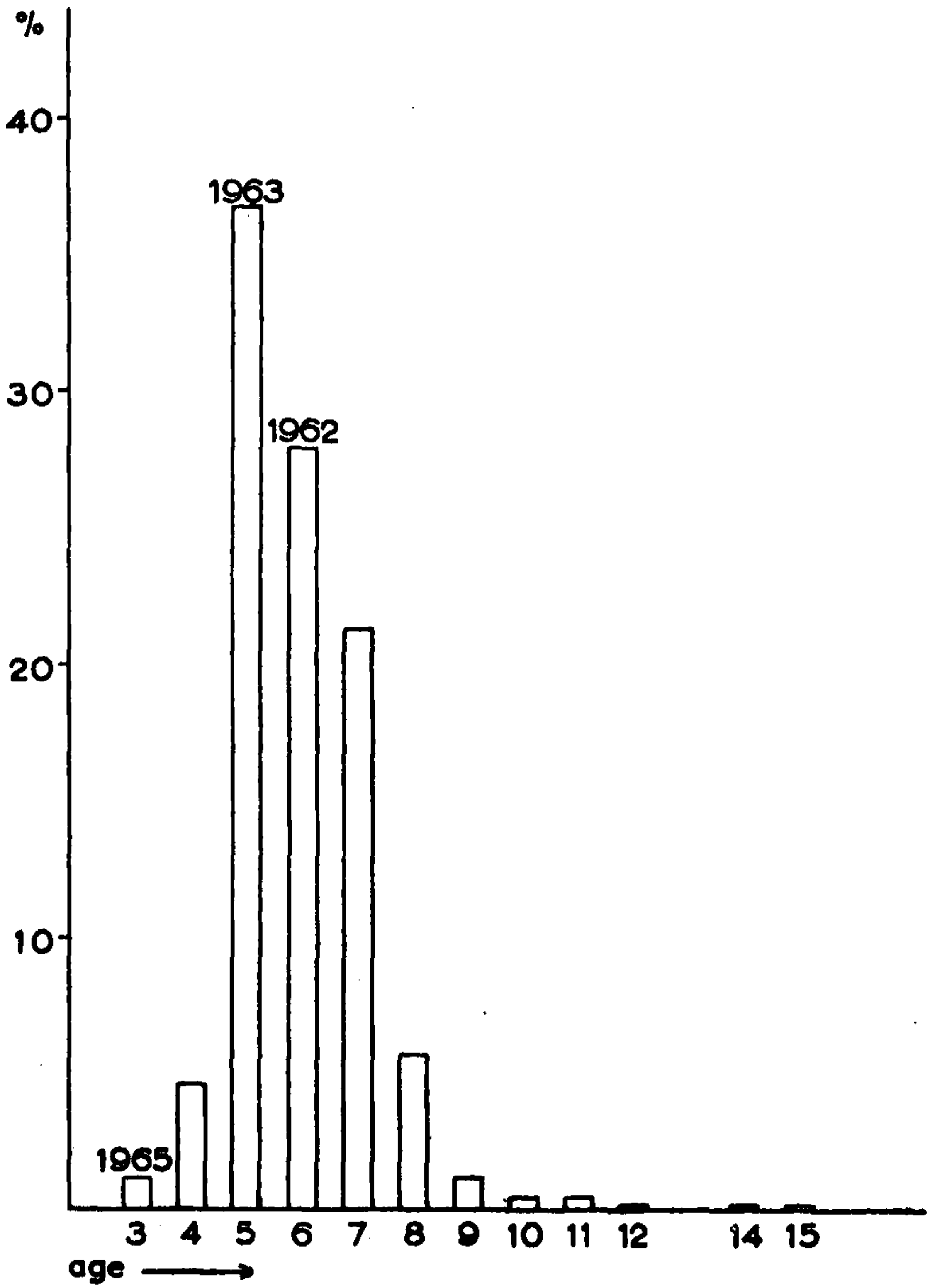

Fig. 4. R/V *Johan Hjort*, West Greenland, May 1968. Cod. Age distribution. Total trawl catch.

Fig. 5. R/V *Johan Hjort*, West Greenland, April-May 1968. Cod. Length composition. Total bottom longline catch, No.6, 4 and 2 hooks combined.

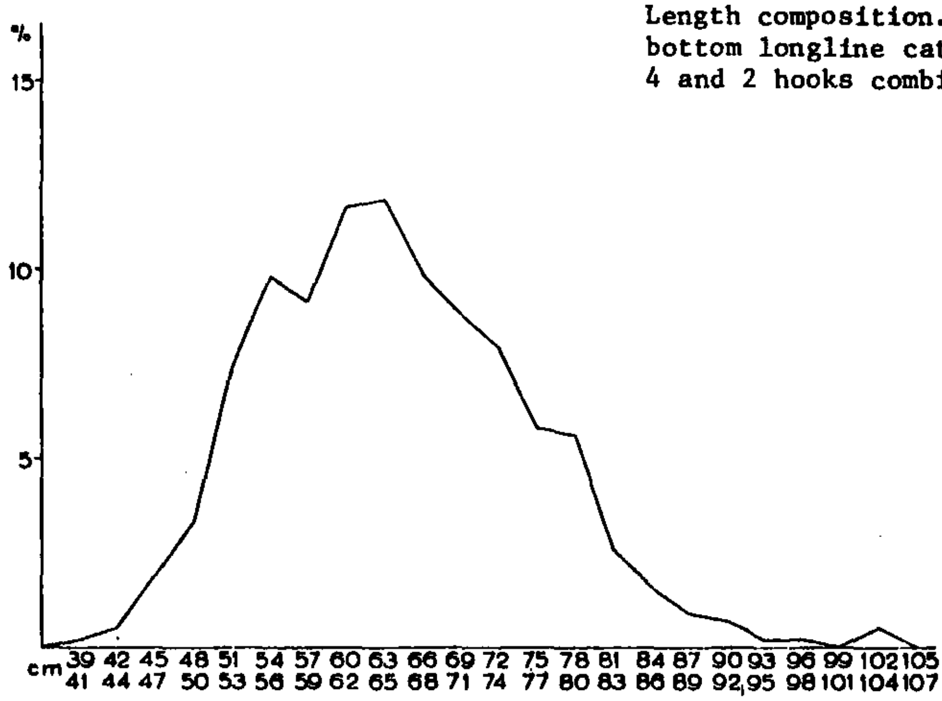

Fig. 6. R/V *Johan Hjort*, West Greenland, May 1968. Cod. Length composition. Total trawl catch.

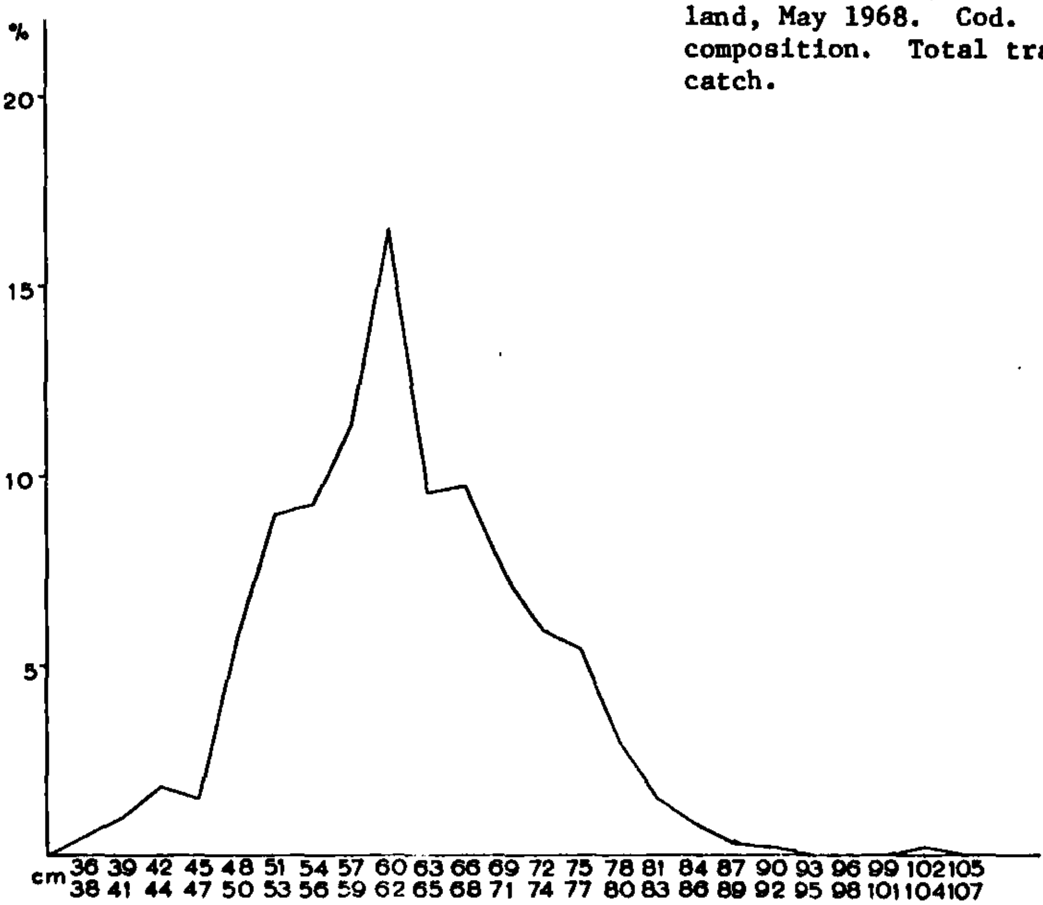

Table 1. Mean length of cod taken on bottom longline gear using No.2, 4 and 6 size of hooks off West Greenland. R/V *G.O.Sars* 1967; R/V *Johan Hjort* 1968. (Number of cod lengthed in parentheses).

Stn No	Bank	Position 1967	Position 1968	Hook No. 6, 1967 Mean Length	Hook No. 6, 1968 Mean Length	Hook No. 4, 1967 Mean Length	Hook No. 4, 1968 Mean Length	Hook No. 2, 1967 Mean Length	Hook No. 2, 1968 Mean Length	Total 1967 Mean Length	Total 1968 Mean Length
1	Off Nunarsuit	N60°22' W48°12'	N60°40' W49°03'	69.2	60.8 (75)	69.8	63.2 (56)	70.9	65.9 (42)	69.4 (170)	62.8 (173)
2	Noname Bank	N61°46' W50°40'	N61°51' W50°39'	69.8	63.6 (29)	69.9	62.7 (19)	71.1	62.4 (14)	70.0 (157)	63.1 (62)
3	Frederikshaab Bank	N62°18' W50°57'	N62°17' W50°57'	69.1	67.4 (40)	68.3	72.2 (37)	69.8	71.9 (18)	69.0 (277)	70.1 (95)
7	Fylla Bank	N64°10' W53°05'	N64°07' W53°06'	69.9	69.1 (12)	68.8	75.8 (4)	69.6	54.7 (3)	69.4 (183)	68.2 (19)
8	Fiskenaes Bank	N63°15' W52°17'	N63°26' W52°31'	66.7	67.3 (12)	68.5	63.5 (8)	69.0	67.8 (4)	67.8 (369)	66.1 (24)
9	Dana Bank	N62°50' W51°45'	N62°59' W51°53'	67.6	66.1 (27)	67.8	65.5 (11)	68.8	66.5 (13)	67.9 (356)	66.1 (51)
Tot.				68.3	64.2(195)	68.6	66.2(135)	69.6	66.3 (94)	68.7(1512)	65.3 (424)

the westernmost station in the section along 65°N was omitted due to ice.

The sections off Frederikshaab and across Fylla Bank (Fig. 7 and 8) show that the Arctic component of the West Greenland Current was well developed also in 1968. The distribution of temperature and salinity was much like that in 1967. Thus the mean temperature, -0.91°C, in the upper 50 m in the Fylla Bank area was about the same as in 1967, -0.95°C, and the mean salinity was 33.584‰, in 1967 33.657‰. These means are based on observations at the standard depths between 0 and 50 m at the 5 eastern stations in the section across the Fylla Bank. Such means have been worked out for the years 1959-1968 and the ten year mean for this period is -0.04°C and 33.769‰.

The vertical extent of the Arctic water seems to have increased compared with the situation at the same time in 1967. This is in agreement with the somewhat less stable stratification which was observed in 1968 compared with the stratification in the three preceding years.

The temperature and salinity in the Irminger component of the West Greenland Current have decreased since 1967. Temperatures above 5°C were observed only in the section along 65°N. The highest salinities in this section did not exceed 34.96‰. In the three southern sections temperatures above 4.15°C were not observed and in the southernmost section only, off Nunarsuit, a few salinities exceeded 34.95‰.

II. Biological Studies

1. Cod eggs. Sampling of cod eggs was carried out at all stations. The preliminary results indicate a medium successful spawning compared with other years.

2. Cod distribution. The echo survey and the bottom longline fishing showed a few very small shoals of cod in the area investigated. The bottom longline and the trawl catches were the smallest ever obtained off West Greenland by Norwegian research vessels. Pelagic shoals were not located.

III. Selection experiments

Selection experiments with No.2, 4 and 6 hooks on bottom longline were carried out on all fishing stations. The results indicate that the No.6 hook takes the fish with the smallest lengths but caught the greatest number.

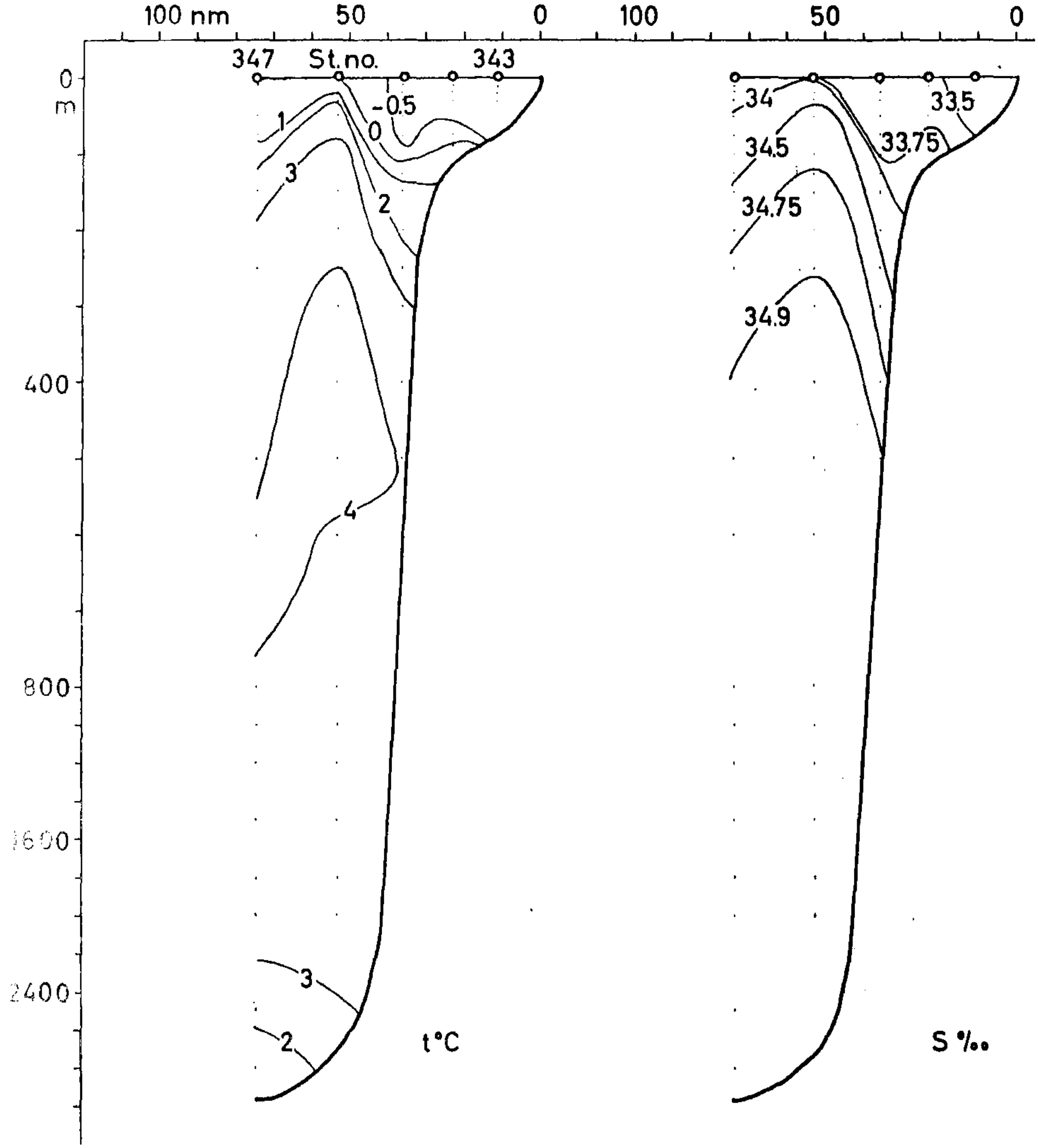

Fig. 7. R/V *Johan Hjort*, West Greenland, 25 April 1968. Hydrographical section off Frederikshaab.

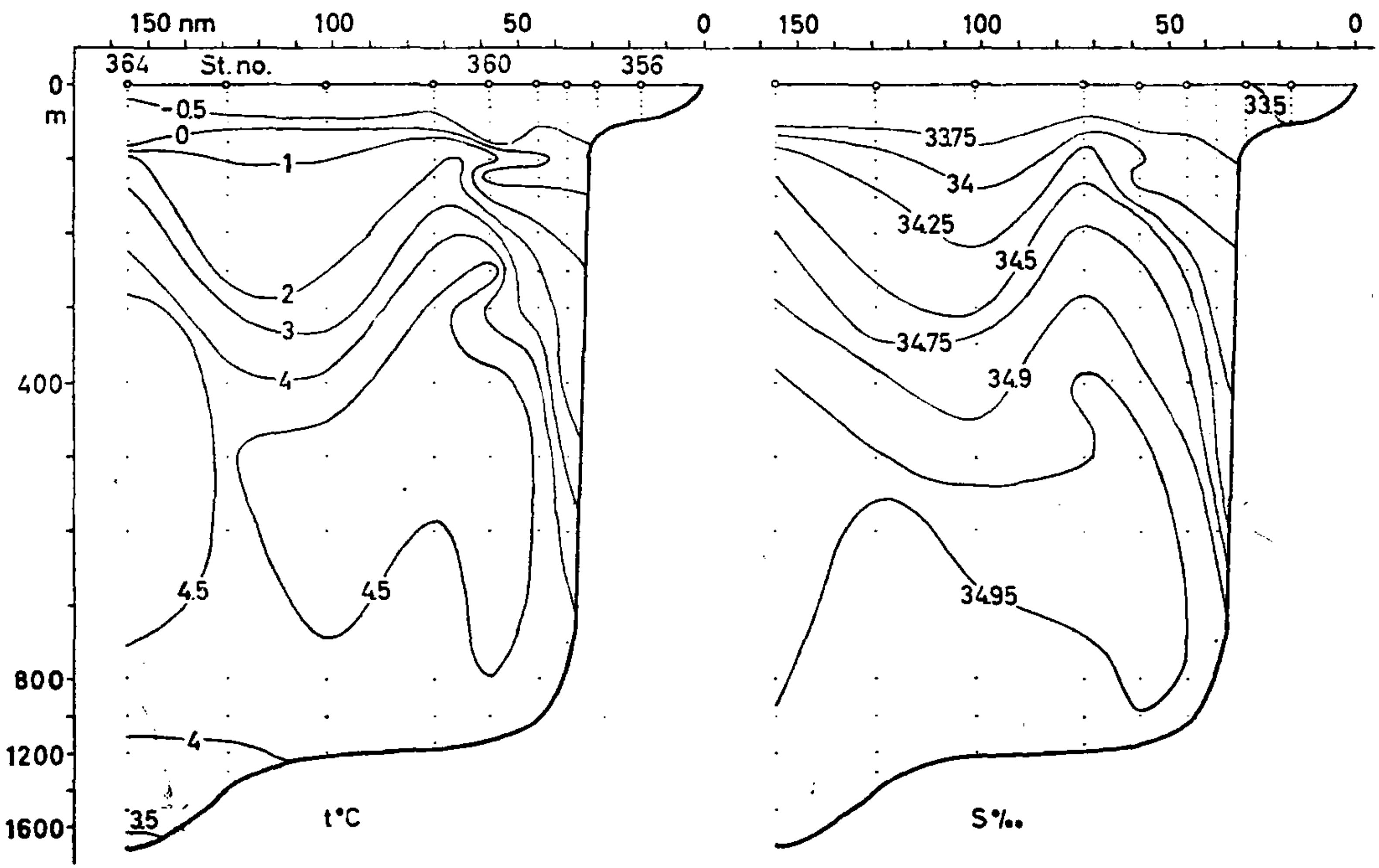

Fig. 8. R/V *Johan Hjort*, West Greenland, 30 April 1968. Hydrographic section across Fylla Bank.

VI. Polish Research Report, 1968

by F. Chrzan

Total Polish catches in the ICNAF Area increased from 120,032 tons in 1967 to 187,042 tons in 1968. This was due, primarily, to the increase of fishing effort and also partly to an increase of fishing yield in comparison to the year 1967. Also, fishing vessels, particularly those of a smaller tonnage, operated along with three mother-ships, and thus reduced their loss of time for voyages between fishing grounds and the ports in Poland.

In Subareas 2 and 3, 22 factory trawlers fished mainly for cod, but also for some other species. These vessels made 67 trips to the ICNAF Area compared to 52 trips made by 20 factory trawlers in 1967. Moreover, 12 freezer trawlers, 15 side motor trawlers and 36 steam trawlers operated in Subarea 5, fishing herring. They made a total of 110 trips. The comparative data for the years 1968 and 1967, with respect to major species and their percent relation in the catches, are given in Table 1.

Table 1.

Species	1968		1967	
	tons	percent	tons	percent
Redfish	7,260	3.9	11,897	9.9
Cod	90,941	48.6	57,663	48.1
Flatfish	4,120	2.2	5,514	4.6
Greenland halibut	5,808	3.1	3,321	2.8
Halibut	90	0.1	146	0.1
Haddock	1,296	0.7	-	-
Hake	923	0.5	-	-
Mackerel	10,300	5.5	507	0.4
Herring	64,317	34.4	37,711	31.4
Other species	1,987	1.0	3,273	2.7
Total	187,042	100.0	120,032	100.0

Above data show a decrease of redfish and a marked increase of cod, mackerel and herring in the catches. Since haddock and hake were included under the item "other fish" in 1967, it is not possible to determine a change in their catches in 1968.

Subarea 1

A. Status of the Fisheries

In the period April-June, two factory trawlers were carrying out trial fishing in Div.1C, 1D and 1E. In view of the gear damage due to rough bottom and a rather low daily fishing yield (about 15 tons per day), these vessels shifted to the Labrador fishing grounds. The catches and fishing effort in Subarea 1 are given in Table 2.

Table 2.

ICNAF Div	Catch in metric tons		Hours fishing	Days fished
	Redfish	Cod		
1C	55	114	100	11
1D	13	724	366	33
1E	-	23	11	1
Total	68	861	477	45

No research studies were carried out in Subarea 1.

Subarea 2

A. Status of the Fisheries

A total of 21 factory trawlers operated in Subarea 2. From July to November, in view of a poor yield obtained from these fishing grounds (1.1 to 1.5 tons per hour trawling), only reconnaissance hauls were made from time to time. Proper fishing operations were carried out from January to June and in December. The catches and fishing effort in Subarea 2 are given in Table 3.

Table 3.

ICNAF Div	Catch in metric tons					Hours fishing	Days fished
	Red-fish	Cod	Green-land halibut	Halibut	Flatfish		
2G	1	925	62	-	-	354	23
2H	10	17,519	1,338	29	9	6,498	576
2J	1,301	51,301	586	35	453	15,643	1,357
Total	1,312	69,745	1,986	64	462	22,495	1,956

In January good abundance of cod was found in Div.2G. The dense ice floes, however, moving along with the Labrador Current impeded fishing operations and compelled the fishing fleet to shift gradually towards southern fishing grounds. Thus, in the first quarter of the year, the catches were made in Div.2H and 2J, along continental slopes from Makkavik Bank via Hamilton Inlet Bank to Sundall. In spite of difficulties among moving ice floes, it was still possible to maintain catches in these fishing grounds and to obtain good results. In February, the mean fishing yield obtained from Makkavik Bank by Polish trawlers amounted to 57.0 tons per day (7.3 tons per hour's fishing). Catches of cod per day could have been greater, but were limited by the daily processing capacity.

In Div.2J, fishing operations were maintained longer than in other divisions. The following daily yields were obtained in particular months: January - 40.4 tons; February - 54.0 tons; March - 41.8 tons; April - 38.8 tons; May - 34.3 tons; June - 27.2 tons and in December - 32.4 tons. These yields were considerably larger than in the same months in the year 1967.

Since Polish trawlers have operated in the same manner in Subarea 2 in the last three years, it is interesting to compare fishing yields calculated per 1 hour trawling. They were as follows: in 1966 - 2.65; in 1967 - 2.45 and in 1968 - 3.27 tons per hour's trawling. From these data it appears that the yield in 1968 increased by 33.4% in comparison to 1967 and by 23.4% in comparison to 1966.

B. Special Research Studies

The materials for research studies were collected both aboard commercial fishing vessels and aboard R/V *Wieczno.*

I. Cod

Measurements of cod made in January (the geographical position 56°14'N-57°40'W) showed that fish of mean length 52-54 cm were most numerous in the catches. In February (position 53°30'N-52°40'W) most of captured cod were 42-46 cm. In March (position 54°20'N-53°24'W), larger cod of 48-54 cm were predominant. In October cod of 30-92 cm were caught in Div.2J at depths of 200-300 m. Measurements of 1,270 specimens gave a mean length of 53.9 cm and the most abundant group was fish of 42-65 cm (77.3%). The age of the fish examined was 5-10 years. Both the size and age of fish and the fishing yield point to good resources of cod in Subarea 2. More detailed data are given in ICNAF Res.Doc. 69/58 by E. Stanek - "Observations on the stock of cod in the fishing grounds of Labrador (Div.2J) and Newfoundland (Div.3K) in the years 1963-1968".

II. Redfish

In Div.2J, 1,241 *mentella*-type redfish were measured aboard factory trawler *Aries*. The males were of the length 24-45 cm - mean 32.8 cm. The females were 25-50 cm - mean 36.3 cm. The gonads of females were in resting stage.

III. American plaice

By the middle of October, 785 fish were measured in Div.2J. Their length ranged from 21 cm to 62 cm. The fish of the length 25-36 cm made predominant group in the catches. The mean length of all the fish measured was 34.6 cm. Age readings showed age-groups IX-XX+. The most abundant were age-groups VI to IX, making 54% of the total number of fish examined.

Subarea 3

A. Status of the Fisheries

In Subarea 3, 19 factory trawlers operated in particular months of the year. In view of the high fishing yields obtained from the Labrador region in the first quarter of the year, the cod fishing grounds in Subarea 3 were not exploited intensively. As a matter of fact, a larger number of vessels started their fishing operation for the first time here in April. Thus, the season of best yields which come during the cod spawning period was not fished. Fishing effort and fishing results obtained from Subarea 3 are given in Table 4.

Table 4.

ICNAF Div	Catch in metric tons						Hours fishing	Days fished
	Red-fish	Cod	Green-land halibut	Halibut	Flat-fish	Other fish		
3K	5,590	16,682	3,732	18	3,289	125	21,844	1,518
3L	219	1,004	88	8	337	-	1,522	148
3M	49	71	-	-	1	-	87	8
3N	22	6	-	-	3	-	83	14
Total	5,880	17,763	3,810	26	3,630	125	23,536	1,688

The above table shows that fishing vessels operated mainly in Div.3K, whereas much less fishing was carried out in Div.3L, 3M and 3N.

The fishing in Div.3K was more or less intensive in particular months of the year. Most of the fishing days were in June, July, August, October and November - less or considerably less in the other months of the year. The following were mean daily yields in successive months of the year: January - 37.0 tons; February - 61.4 tons; March - 26.3 tons; April - 26.0 tons; May - 21.7 tons; June - 26.5 tons; July - 11.8 tons; August - 19.9 tons; September - 16.9 tons; October - 15.0 tons; November - 17.7 tons and December - 18.6 tons.

No intensive fishing was carried out in Div.3L. The vessels made trips to these grounds only from March to October since the yield there was much lower than in Div.3K. On Flemish Cap (3M) Polish vessels attempted to fish in March, July and November but without good results.

B. Special Research Studies

I. Cod

The materials for studies were collected in Div.3K. Total of 6,156 cod specimens were measured and 403 otoliths read for age. In October the lengths of cod in the fishing grounds at depths of 280-345 m ranged from 28 to 111 cm (mean length 52.3 cm). Most of the fish in the catches (65.2%) were 42-62 cm and age-groups V-IX.

Cod captured in November were 23-77 cm in length. Fish of 45-59 cm and 5 to 8 years old made up 54.2% of the catch. At this time only 15% of cod had gonads in the developing stage (III), whereas 85% were with gonads in the maturing virgin and recovering spent stage (II). At this stage of gonad development they do not yet show the tendency to gather into shoals.

II. Redfish

In October-November 2,632 redfish (type *mentella*) were measured and otoliths taken from 400 specimens in Div.3K. The length of males ranged 22-44 cm - mean 34.9 cm; the length of females ranged 23-51 cm and their mean length was 37.5 cm. Gonads were in the recovering stage (II).

In February, 255 *mentella* redfish from Div.3O were measured. Lengths ranged between 11 and 41 cm - mean 30 cm. The females differed only slightly in length from the males.

According to the observations based on fishing yield and length composition of the catch it appears that the stock of redfish was rather poor and it is hardly possible to expect good fishing results in the immediate future.

III. American plaice

Flatfish were sampled in Div.3P aboard R/V *Wieczno* and in Div.3K and 3L aboard commercial fishing vessels.

In February 944 fish were measured in Div.3P. The range of their length was between 12 and 55 cm with mean length of 30.3 cm. The most abundant was the length-class 24-34 cm. From the readings of 174 otoliths it appeared that age-groups V to XIV were represented in the stock and fish 6 to 9 years old made up 84.6% of the catch.

In October, 4,130 specimens of American plaice were measured in Div.3K with the range of their length between 20-63 cm and mean length 40.4 cm. The length-class 35-45 cm was predominant. The age-groups IV to XX+ were determined from the reading of 600 otoliths. Fish 7 to 12 years old made up 51% of the catch.

Also in October, but in Div.3L, 1,003 fish were measured. Their lengths ranged between 21-61 cm; their mean length was 36.6 cm. The fish of the length 30-40 cm were the predominant group. From the readings of 201 otoliths, the occurrence of fish in age-groups V to XX+ was determined. Fish 6 to 12 years comprised 75% of the catch.

IV. Witch

A total of 2,611 fish from the autumn catches made in Div.3K were measured. Their length ranged between 31-66 cm; their mean length was 49.1 cm. The most numerous were fish of the length 45-53 cm. The readings of 300 otoliths showed that the catches were made up of age-groups IV-XX+. Fish 12 to 16 years old made up 56.3% of the catch.

V. Greenland halibut

Polish catches of this species increased and fishing yield was better than in 1967. The measurements of 1,937 specimens showed that the length of fish caught ranged between 25 and 93 cm and their mean length was 50.7 cm.

C. Hydrographic Research

From 21 to 28 February, hydrographic section (26 stations) was made, starting at the eastern slope of the Great Newfoundland Bank (45°51'N-47°43'W) through the western slope of Green Bank (45°03'N-54°31'W) up to the southwest slope of St. Pierre Bank (45°43'N-56°29'W). At the eastern edge of the Great Bank, the surface temperatures were slightly above 0°C. The temperature rose with increasing depth reaching 4.44°C at the depth of 550 m. The temperatures below 0°C were noted from the middle part of the Great Bank towards Green Bank and reaching a depth of 75 m. Over Green Banks and St. Pierre Bank, the temperatures in the surface layers remained above 0°C (0.71, 1.47, 0.56°C). Here also the rise of temperature was noted along with increasing depth. At the position 45°03'N-54°31'W, the highest temperature, 8.09°C, was noted at a depth of 200 m.

The surface salinity, which in the eastern part of the Great Newfoundland Bank was 32.70‰, dropped to 31.83‰ over Green Bank and again rose to 32.20‰ over St. Pierre Bank. Bottom salinities for these regions were 34.47‰, 32.83‰, 32.01‰ respectively.

On 26 stations the oxygen content at the surface oscillated within 7.26-8.34 ml/liter O_2, with mean value 7.66 ml/liter O_2. With the increase in depth, a gradual decrease of oxygen content was noted. Only in a few places was the oxygen content below 5 ml/liter O_2. It thus appears that oxygen content in the area investigated was rather high.

Phosphate content fluctuated considerably. At the surface, it was 20-30 P_2O_5 milligrams per 1 m^3, while at the bottom it was 25-60 mg/1 m^3. The mean P_2O_5 content at the bottom was 38 mg/1 m^3.

Subarea 4

A. Status of the Fisheries

Catches in Subarea 4 were poor. Only in March, June and July a few vessels searched for good fish concentrations. The reconnaissance trips were conducted by one large freezer trawler, one side motor trawler and one steam side trawler. The results of the search and the fishing effort are given in Table 5.

The freezer trawler obtained an average of 2.63 tons per hour's trawling or 21.7 tons per day. However, almost 45% of the catch was the so-called "other fish" which are of little interest to fishermen. The motor trawler obtained an average of 2.57 tons per hour's trawling (14.2 tons per day). and the steam trawler, 0.8 ton per hour's trawling (6 tons per day). At the same time vessels catching herring on Georges Bank obtained much better results. These circumstances made fishing vessels leave Subarea 4 and shift to better fishing grounds.

Table 5.

ICNAF Div.	Catch in metric tons: Cod	Herring	Mackerel	Other fish	Hours fishing	Days fishing
		Large freezer trawler				
4W	12	369	86	211	297	38
4X	-	25	-	187	42	3
		Side motor trawler				
4W	16	122	12	14	51	12
4X	-	49	-	-	32	3
		Steam side trawler				
4X	-	172	-	-	204	28
Total	28	737	98	412	626	84

B. Special Research Studies

The research studies in Subarea 4 were carried out on herring aboard the vessel *Walpusza* and on demersal fish aboard the vessel *Wieczno*.

I. Herring

The best conditions for bottom trawl catches were found in June in the region of Emerald Bank. Temperatures and trawl catches seem to show that at that period herring remain at the sea bed in temperatures ranging from 5.5° to 7.5°C. Smaller herring (up to age-group VI inclusive) occurred at depths of 90-100 m, and the yield was 1-2.5 tons per hour's trawling. Older fish occurred at greater depth where they were less densely concentrated and yielded lower catch per unit of fishing effort.

A total of 4,495 herring were measured. Their length ranged 27-39 cm. At 90-100 m fish of 29.5-30.0 cm were most abundant. In the deeper places - being less numerous - herring of the mean length 34.0-34.5 cm occurred. The readings of otoliths showed that herring on Emerald Bank were 4 to 11 years old. Older fish were seldom encountered. Most abundant in the stock examined were the 1963 year-class, 41%, and the 1960 year-class, 17.1%. In comparison to the herring stock of Georges Bank, the stock from Subarea 4 consisted of older year-classes, which points to its lower rate of mortality.

II. Haddock

By the middle of March the research vessel *Wieczno* encountered large concentrations of this species in the central part of Emerald Bank. With a mean fishing yield of 750 kg per hour's trawling, haddock comprised 90% of the catch.

In the other fishing grounds of Subarea 4, this species was found in rather small quantities. During March, 6,685 fish were measured in various fishing grounds. Their length ranged between 16 to 80 cm, mean length being 49.7 cm. The length-class 40-55 cm was predominant. From the reading of 455 otoliths, age-groups I to XI were noted. In spite of the fact that age-group IV was the most numerous in the sample, it seemed to be poor. Of course, it is subject to high fishing mortality. With poor recruitment of younger age-groups, a decrease in fishing yield should be expected.

III. Redfish

Only once and only over the eastern slopes of the Sable Bank was a concentration of *mentella*-type redfish encountered. A yield of 750 kg per hour's trawling was obtained and 693 fish were measured. Lengths ranged from 26 to 39 cm, mean length - 34.5 cm. The stock of redfish in Subarea 4 is rather poor.

IV. American plaice

Measurements of 640 fish from Banquereau were made. Lengths ranged between 14 to 48 cm with a mean length of 29.5 cm. Most lengths found were 25-35 cm. A total of 100 otoliths were read for age. The age groups determined were IV-X. Most of the fish were age-groups V-VII, which made up 88% of the sample. In March the vessel *Wieczno* obtained a yield of 50 to 250 kg per hour's trawling.

In the region of Sable Bank where larger fish occurred, 558 specimens were measured. Their length ranged from 19 to 62 cm; the mean length was 34.2 cm. Most of the fish were 28 to 36 cm. In the sample, age-groups V-XIV were found. Fish 6 to 9 years old made up 82.5%. The vessel *Wieczno* obtained here 375 kg of American plaice per hour's trawling.

V. Yellowtail

In the region of Sable Bank this species occurred in considerably smaller quantities than American plaice. Actually it was only a by-catch of the 568 specimens measured, lengths ranged between 20 and 49 cm with a mean length of 33.7 cm. According to otolith readings they were in age-groups V-XI. Yellowtail of the length 30-36 cm - 6 to 8 years old - made up 87.5% of the sample.

C. Hydrographic Research

Hydrographic studies were carried out from 1 to 19 March in the area from Banquereau Bank to Emerald Bank. The prevailing temperatures of the surface layers were next to 0°C, while on Banquereau Bank, Middle Bank and off the coast of Nova Scotia they were below zero (Middle Bank - 1.22°C). In the first half of March, surface temperatures on Sable Bank were about 1°C and on Emerald Bank 2-3°C. In the region of Banquereau and Middle Bank, the temperature at the bottom remained below zero - -0.37 and -0.20°C respectively. In general, the temperatures increased with increasing depth, reaching a maximum at from 140 to 180 m (above 9°C). On Sable Bank, the bottom temperatures were 1-2°C and on Emerald Bank almost 6°C. Along the shelf of Nova Scotia from east to west there was a rise in temperatures noted both at the surface and at the bottom.

Surface salinities ranged between 31 to 32‰. Greater differences in salinities were observed in bottom layers. The lowest salinity was noted on Sable Bank (31.67‰). On Banquereau it was about 32‰ and on the Emerald Bank 32.88‰.

Oxygen content in the surface layers all over this area amounted to 7-8 ml/liter O_2. First at the depth greater than 80 m the oxygen content decreased, dropping down to 5 ml/liter O_2, at the depth of 180 m. The lowest oxygen content was noted at the position 44°66'N, 62°50'W, at which it was 3.81 ml/liter O_2.

The phosphates in the surface layers amounted to 25-30 mg P_2O_5 per m^3. At the bottom the phosphate content was higher. Content was highest at the edge of Nova Scotia Shelf (60-70 mg P_2O_5 per 1 m^3).

In the depression between Emerald Bank and Sable Bank considerable concentration of haddock was observed. It occurred in a temperature of about 6°C, salinity 32.5-33.5‰ and oxygen content 5-6 ml per liter O_2.

Subarea 5

A. Status of the Fisheries

In this subarea 4 factory trawlers, 8 large stern freezer trawlers, 4 smaller stern freezer trawlers, 15 side motor trawlers and 36 steam side trawlers took part in the fishing. The catch and the fishing effort in Subarea 5 are given in Table 6.

On Georges Bank herring catches were made from April until December inclusive with varying intensity. From January to April, fishing intensity was very low. The main object of the Polish fisheries in this fishing ground is herring and partly mackerel - the fishermen consider other species here as a by-catch. Hence the fishing operations are principally adapted to the season of herring catches.

Factory trawlers were at first in search of bottom fish. They caught herring partly in August and mainly in September. Fishing yield obtained by them in these months was respectively 1.8 and 8.3 tons per hour's trawling, whereas per day they obtained 22.6 and 43.5 tons. The high yield per hour trawling, with rather low yield per day, shows that in September these vessels could not take full advantage of fishing possibilities because of their limited freezing capacity.

Table 6.

ICNAF Div.	Catch in metric tons							Hours fishing	Days fished
	Cod	Haddock	Hake	Flat-fish	Herring	Mack-erel	Other fish		
5Z				Factory trawlers					
	958	-	-	7	5,457	-	2	876	153
				Large freezer trawlers					
	854	534	515	-	8,978	5,899	766	5,653	689
				Smaller freezer trawlers					
	129	239	92	23	2,920	756	238	3,212	261
				Side motor trawlers					
	575	405	281	-	18,840	2,917	351	9,803	1 745
				Steam side trawlers					
	28	108	35	-	27,303	588	227	24,530	2,789
Total	2,544	1,286	923	30	63,498	10,160	1,584	44,074	5,637

Large freezer trawlers fished from April to December, obtaining the following yields in successive months of the fishing period: April - 36.2; May - 22.0; June - 22.2; July - 20.9; August - 33.3; September - 33.6; October - 21.7; November - 16.5 and December - 23.4 tons per day.

Small stern freezer trawlers also fished from February to November, but their yields were not evenly distributed through the whole period: February - 25.8; March - 21.6; April - 25.4; May - 15.0; June - 16.4; July - 5.6; August - 15.7; September - 16.2; October - 9.5 and November - 16.4 tons per day. These data show that the vessels of this type had rather poor yields during the peak season for herring.

Side motor trawlers fished from April to December, obtaining the following yields: April - 17.2; May - 13.3; June - 12.9; July - 17.0; August - 12.2; September - 18.1; October - 7.6; November - 10.2 and December - 9.4 tons per day.

Steam side trawlers fished from March to November, obtaining the following yields: March - 9.5; April - 10.5; May - 8.1; June - 9.0; July - 9.7; August - 8; September - 19.1; October - 5.2 and November - 7.8 tons per day.

On the whole factory trawlers, fishing only in the peak season, obtained better yields in 1968 than in 1967, whereas stern freezer trawlers had lower fishing yields in the peak season. Better yields were obtained by the steam trawlers. A comparison of the yields for 1968 and 1967 is given in Table 7.

Table 7.

Type of vessel	Yield in metric tons per hour's trawling	
	1968	1967
Factory ship	7.33	3.29
Large freezer trawler	3.10	3.11
Small freezer trawler	1.37	2.65
Side motor trawler	2.38	2.86
Side steam trawler	1.15	1.00

In 1968 Polish vessels operated almost exclusively in Div.5Ze. Only 4.0% of fish were caught in Div.5Zw.

B. Special Research Studies

Research studies in Subarea 5 were conducted aboard research vessel *Wieczno* and the scouting vessel *Walpusza*. Herring were measured also aboard commercial fishing vessels.

I. Herring

A total of 22,042 herring were measured for the various fishing grounds. Their length ranged from 22 to 36 cm. The most abundant group in the catches comprised herring of the length 30-33 cm.

A total of 2,150 otoliths were read for age studies. These readings showed that age-groups III to XI (1965-1959 year-classes) occurred in the catches. The most abundant was the 1960 year-class (36.8%). The next in abundance was the 1963 year-class (19.6%) and the third the 1961 year-class (19.5%). The 1962 year-class was much less abundant (11.2%). Thus the exploited stock consisted of rather older year-classes.

The results of scouting for younger fish were rather poor. Only in the Gulf of Maine was a large concentration of herring of the age-group III (the 1965 year-class) encountered. It made up 8% of the total mass of herring caught here. On other fishing grounds, the proportion of this year-class in the catches was only 0.1 to 2%. The 1965 year-class made up only 1.3% of the total material investigated. Hence, it seems the abundance of this year-class will be rather low.

Some other observations and the more detailed data on herring from Subarea 5 are found in ICNAF Res.Doc.69/57 by F. Chrzan and B. Draganik - "The results of studies on herring from the region of Nova Scotia, Georges Bank and Statistical Subarea 6".

II. Haddock

Haddock was not the object of interest in Polish fisheries. Hence the studies of this species were carried out on a rather small scale.

A total of 2,583 haddock from Georges Bank were measured in the second half of March. The length of the fish were in the range from 12 to 79 cm; their mean length was 47.4 cm. The length frequency distribution had two peaks relating to fish lengths of 37-41 cm and 48-57 cm.

Age studies comprised readings of 300 otoliths and determination of age-groups I-VII. Most fish were of the age-group IV (47.4%). Much less numerous were fish 2 and 3 years old.

This points to poor recruitment into the commercial stock. The 1966 year-class which should strengthen the commercial stock of haddock in 1970, does not seem to be abundant. In these circumstances further decrease of haddock catches may be expected.

C. Hydrographic Research

Hydrographic studies were carried out from 5 to 20 September and again from 13 to 28 October.

In September the investigations were carried out in the northern and southwestern regions of Georges Bank. Surface temperature in the northern part (above 41°00'N) was 13.22°C while in the southern part (position 40°34'N-67°00'W) it was 24.33°C. The temperature of bottom layers was 3.75°C (at the position 41°33'N-67°00'W). At the bottom of the shallowest parts of Georges Bank temperatures of 10-14°C were recorded.

Surface salinities ranged from 32.36‰ to 35.48‰. Over the major part of the Bank area the surface salinities were from 32.5‰ to 33.00‰. Below 100 m the salinity was in general considerably higher than in the surface layers.

In October the observations were carried out in the southeastern and eastern parts of Georges Bank. Surface temperatures, depending on geographical position, remained within the range from 12.25°C to 20.00°C (over the southeastern slope of Georges Bank). At the bottom, temperatures varied from 6.60°C to 14.16°C.

Surface salinities ranged from 31.08‰ (at the position 41°45'N-65°43'W) to 34.65‰ (at the position 41°10'N-65°19'W).

In the shallower parts of Georges Bank, down to 80 m, no very great variation in the salinities was noted. At greater depths, the salinities were higher and in some places reached 35‰.

D. Invertebrates

Observations were made on the occurrences of lobsters, shrimps and squids.

In autumn 123 lobsters of an average weight 2,060 g were caught over the southern slopes of Georges Bank. Of this number there were 72 females, of which 13 were bearing eggs.

Shrimps were captured over the southern slope of Georges Bank at a depth of 90 to 180 m. The yield obtained was on the average 500 kg per hour trawling. Mainly *Pandalus borealis* was caught, while *Pandalus montagui* made up a by-catch of 5-10%. An average number of 120 shrimps was found in 1 kg sample.

Squids were caught at the positions 39°37'N-39°45'N and 72°02'W. The catches were made up entirely of the species *Loligo pealei*. From two hauls 5.5 tons of squids were landed. Mean length of the mantle of these cephalopods ranged from 15 to 20 cm.

VII. Portuguese Research Report, 1968

by Manuel Lima Dias

In 1968, the Portuguese side and stern trawlers (otter trawlers and dory vessels (line trawls))caught a total of 219,365 metric tons of cod from the ICNAF Area (Table 1).

Table 1. Portuguese cod catches, in tons, 1968.

Subareas	1	2	3	4	Total
Side trawl	1,322	41,417	73,122	4,958	120,819
Stern trawl	12,972	18,919	11,629	1,972	45,492
Total trawl	14,294	60,336	84,751	6,930	166,311
Line (Dory vessel)	18,462	-	34,592	-	53,054
Total All gear	32,756	60,336	119,343	6,930	219,365

Total catches were lower by almost 18,000 tons than in 1967 due to a decrease of about 21,000 tons in the dory vessel catches. Otter trawlers took about 78% of the total catch in 1968 (side trawlers took 55%) and were most successful in Subarea 3. Best fishing by dory vessels was in the third quarter and by the otter trawlers in the second quarter (Fig. 1 and 2).

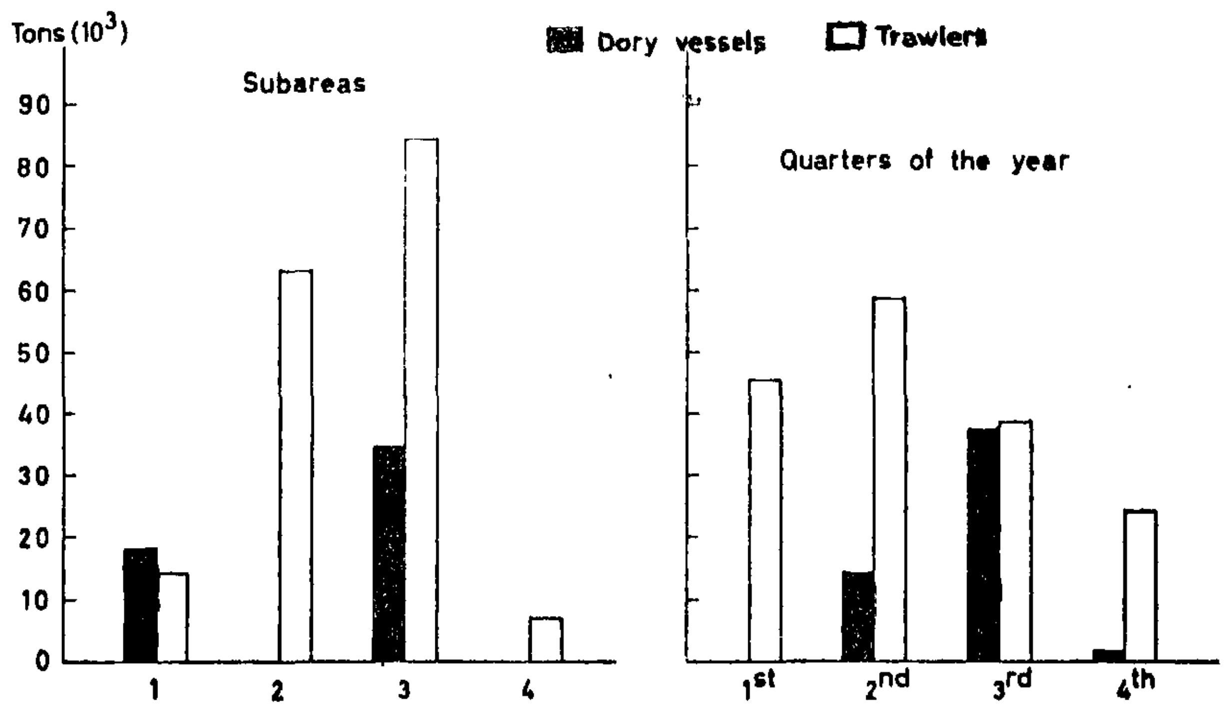

Fig. 1. Cod catches (in tons) by subareas and quarters. Portuguese dory vessels and trawlers, 1968.

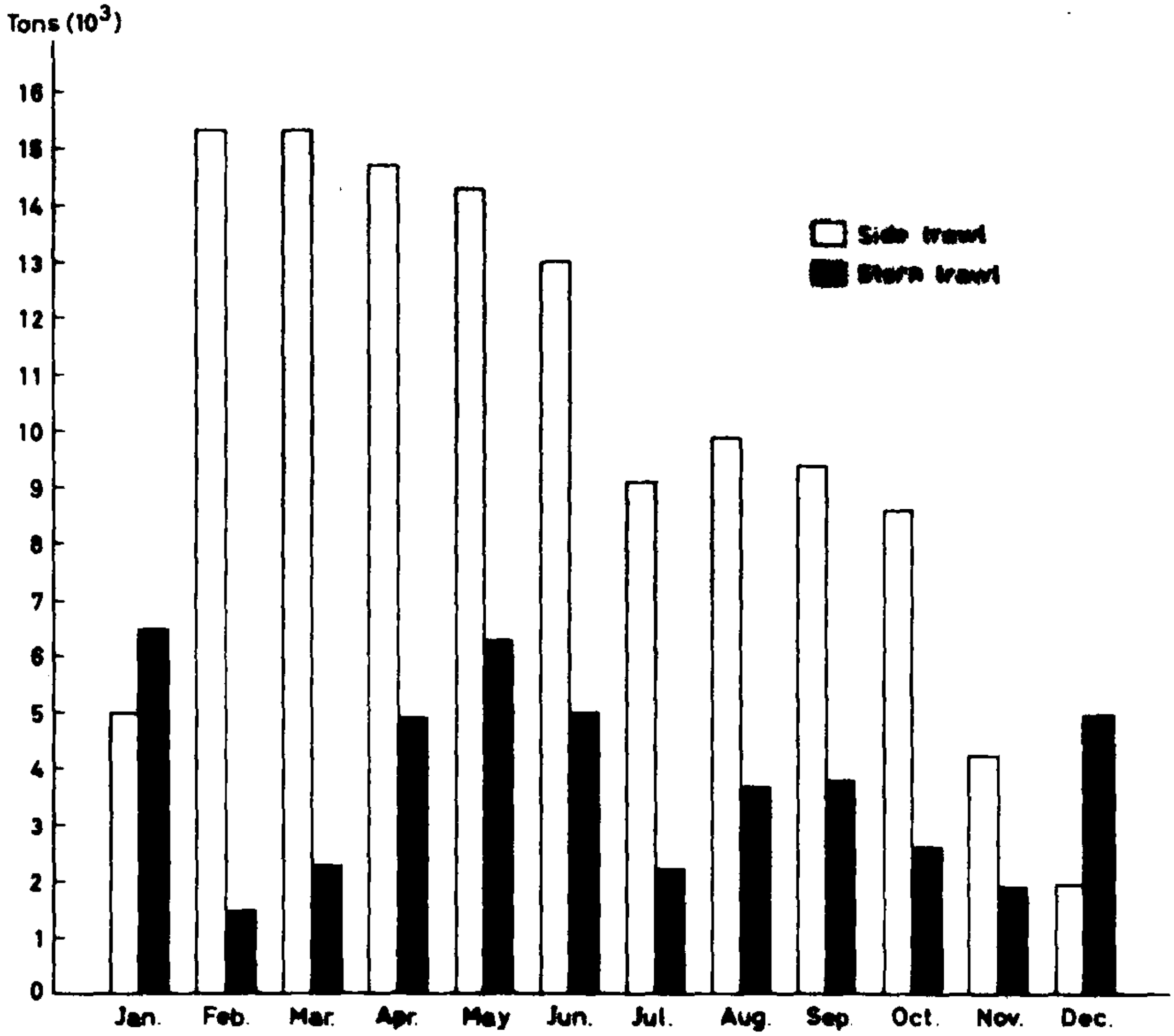

Fig. 2. Total catches (in tons) of Portuguese trawl fleet (side and stern trawlers) by months, 1968.

This report, in addition to reviewing the status of the fisheries in Subareas 1-4, presents data on lengths, ages, maturity and probable age at first maturity from random sampling on board commercial trawlers and dory vessels before discarding the undersized fish. Detailed information on the samples for length and age are included in the ICNAF Sampling Yearbook.

Subarea 1

A. Status of the Fisheries

The Portuguese trawlers and dory vessels fished only in Div.1CDE in the second and third quarters of the year, taking almost 33,000 tons. Total catch by dory vessels was greater than that by the otter trawlers (mainly by stern trawlers). Best catches were made by the dory vessels in Div.1C during the second quarter (8,000 tons).

B. Special Research Studies

Samples for biological study were obtained from the dory vessels fishing in Div.1C as follows:

Sample	Date	Depth (m)	No Lengths	No Ages
A	18-19 May	128-177	152	152
B	4-21 June	183-220	724	474

a. Lengths (Fig. 3). Lengths ranged from 34 to 130 cm classes. Mean lengths were A - 69.3 cm and B - 71.7 cm.

b. Ages (Fig. 3). Age-group VII was the most important, followed by VIII and VI.

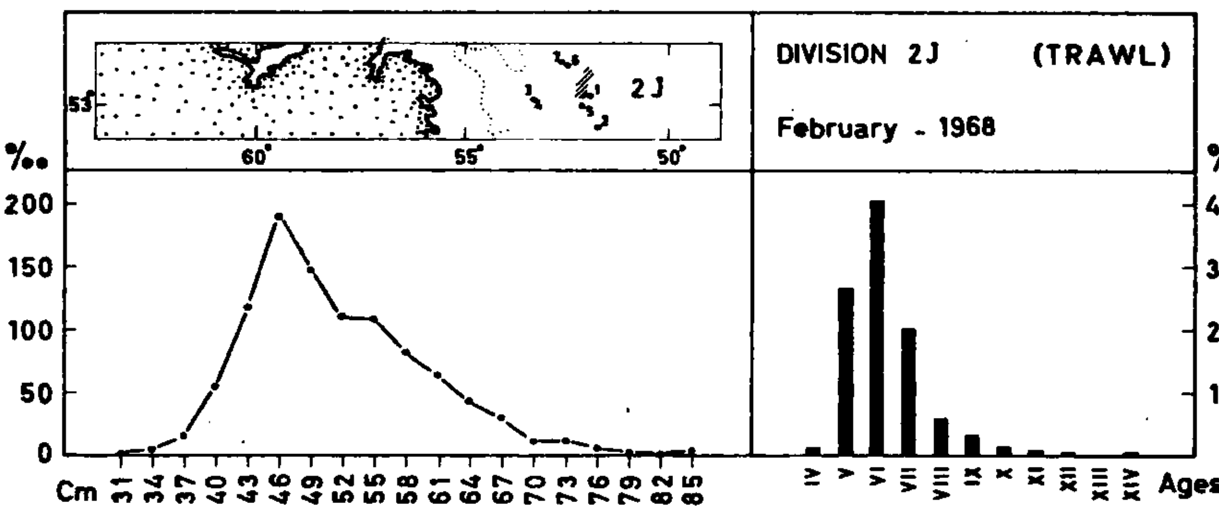

Fig. 3. Cod. Subarea 1. Length and age composition of line fishery, May-June 1968.

c. Growth. Fish sampled in May and June in Div.1C. (Figures in brackets are numbers of fish.)

Year-class	Age-group	2nd Quarter May (cm)	June (cm)	
1965	III	38.7	38.4	(10)
1964	IV	45.8	44.5	(18)
1963	V	55.6	56.2	(45)
1962	VI	62.5	63.5	(67)
1961	VII	68.8	69.3	(187)
1960	VIII	75.3	75.5	(159)
1959	IX	78.5	80.3	(43)
1958	X	81.1	84.1	(32)
1957	XI	88.3	87.4	(41)
1956	XII	83.0	87.1	(9)
1955	XIII	87.4	92.1	(3)
1954	XIV	82.7	90.6	(4)
1953	XV	87.5	94.2	(7)
1952	XVI	-	-	-
1951	XVII	-	100.0	(1)

d. Stage of maturity (Fig. 4). Greatest percentage of fish were, for males, in the resting and recovering stages of maturity and, for females, in the developing stage.

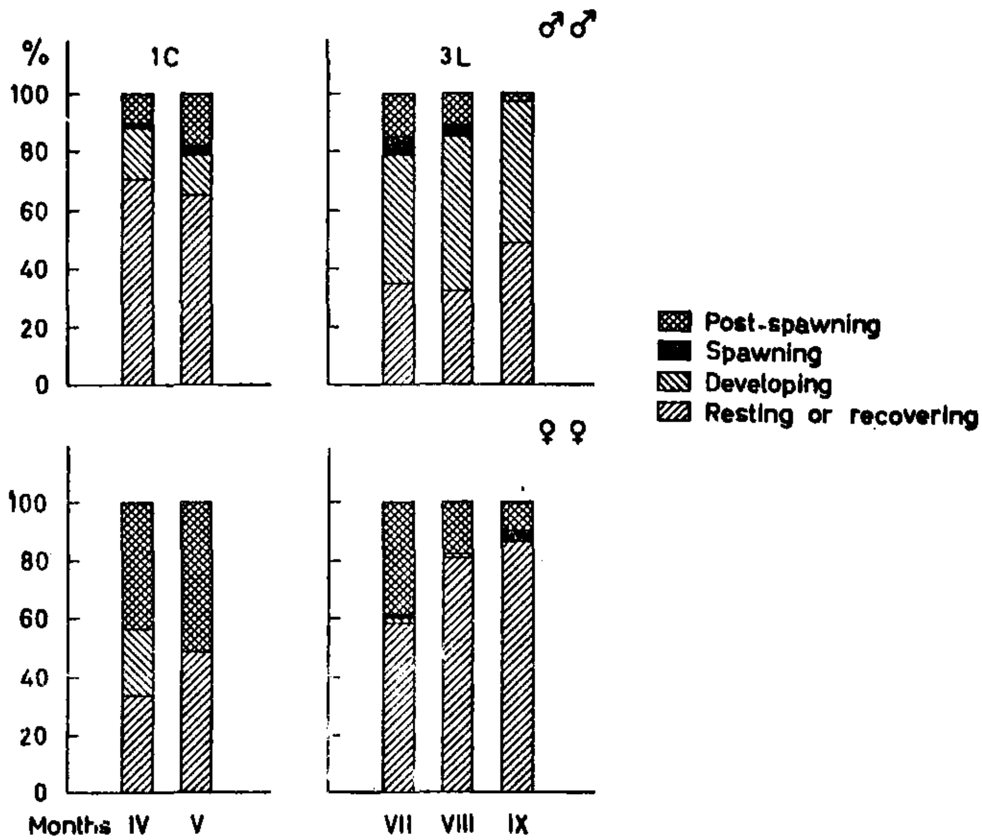

Fig. 4. Stages of maturity. Line trawl fishery for cod in Div.1C in May and June and Div.3L in July, August and September 1968.

e. Age at first maturity.

Age group \ 1st spawn.	♂♂							♀♀					
	VI	VII	VIII	IX	●	?	Total	VI	VII	VIII	⊖	?	Total
III					7		7				3		3
IV					10		10				8		8
V					25		25				20		20
VI					28		28	1			38		39
VII	1	12			81	2	96	4	10		77		91
VIII	4	33	2		33		72	2	19	1	64	1	87
IX	1	12	1		12	2	28	1	9		5		15
X		9	2		5	2	18	1	6	3	3	1	14
XI		6	3		5	1	15		9	14	3		26
XII		5	2		1		8			1			1
XIII			1			1	2		1				1
XIV			2		1		3			1			1
XV		2		1			3			2	1	1	4
XVI													
XVII						1	1						
No observed	6	79	13	1	208	9	316	9	54	22	222	3	310

● = Unknown, includes immature fish; ? = Doubtful first maturity.

Subarea 2

A. Status of the Fisheries

The total catch of 60,336 tons was taken by otter trawlers, 68% by side trawlers. Best catches were made in the first and second quarters in Div. 2J.

B. Special Research Studies

Samples for biological study were obtained from the otter trawl catches in Div.2J, as follows:

Sample Nos	Date	Depth (m)	No Lengths	No Aged
1-10 incl.	8-21 Feb	260-400	1,401	575

a. Lengths (Fig. 5). Lengths ranged from the 31 to 85 cm classes. Mean length was 51.5 cm.

b. Ages (Fig. 5). Age-group VI (1962 year-class) was most important. Mean age was 6.3 years.

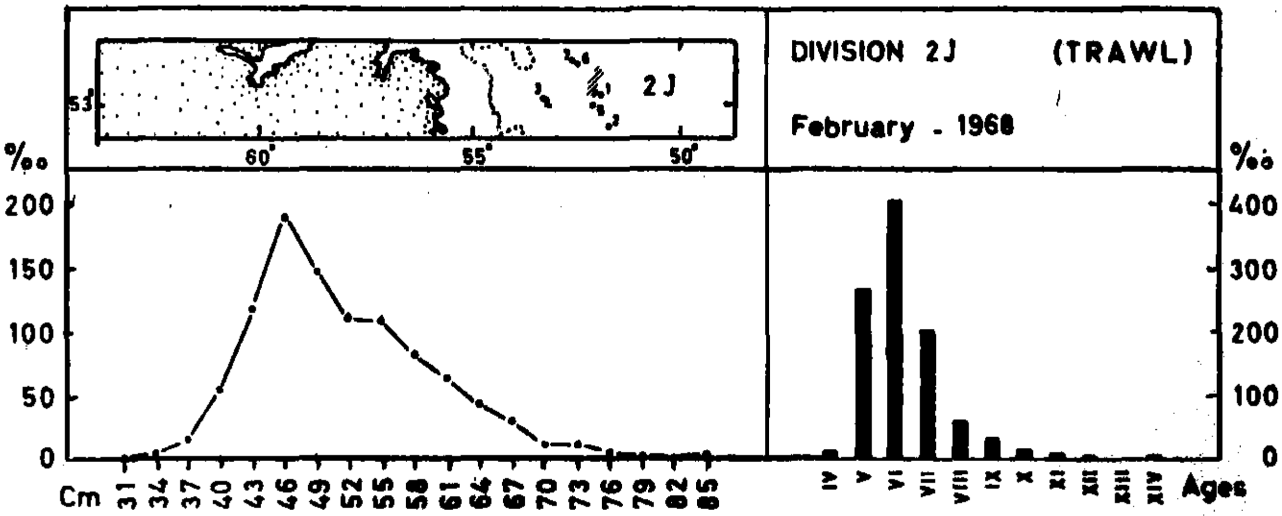

Fig. 5. Cod. Subarea 2. Length and age composition in the otter trawl fishery, February 1968.

c. Growth. Growth of fish sampled in February in Div.2J is shown below:

Year-class	1964	1963	1962	1961	1960	1959	1958	1957	1956	1955	1954
Age-group	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV
Length (cm)	37.8	43.9	50.1	56.7	61.4	67.1	73.1	64.9	69.0	-	73.0
No. fish	10	154	225	113	31	19	12	6	4	-	1

d. Stage of maturity (Fig. 6). In February about 60% of the females are in the resting or recovering stage of maturity with the remainder in the developing stage. Of the males about 20, 60 and 20% are in the resting or recovering stage, developing, or spawning stage respectively.

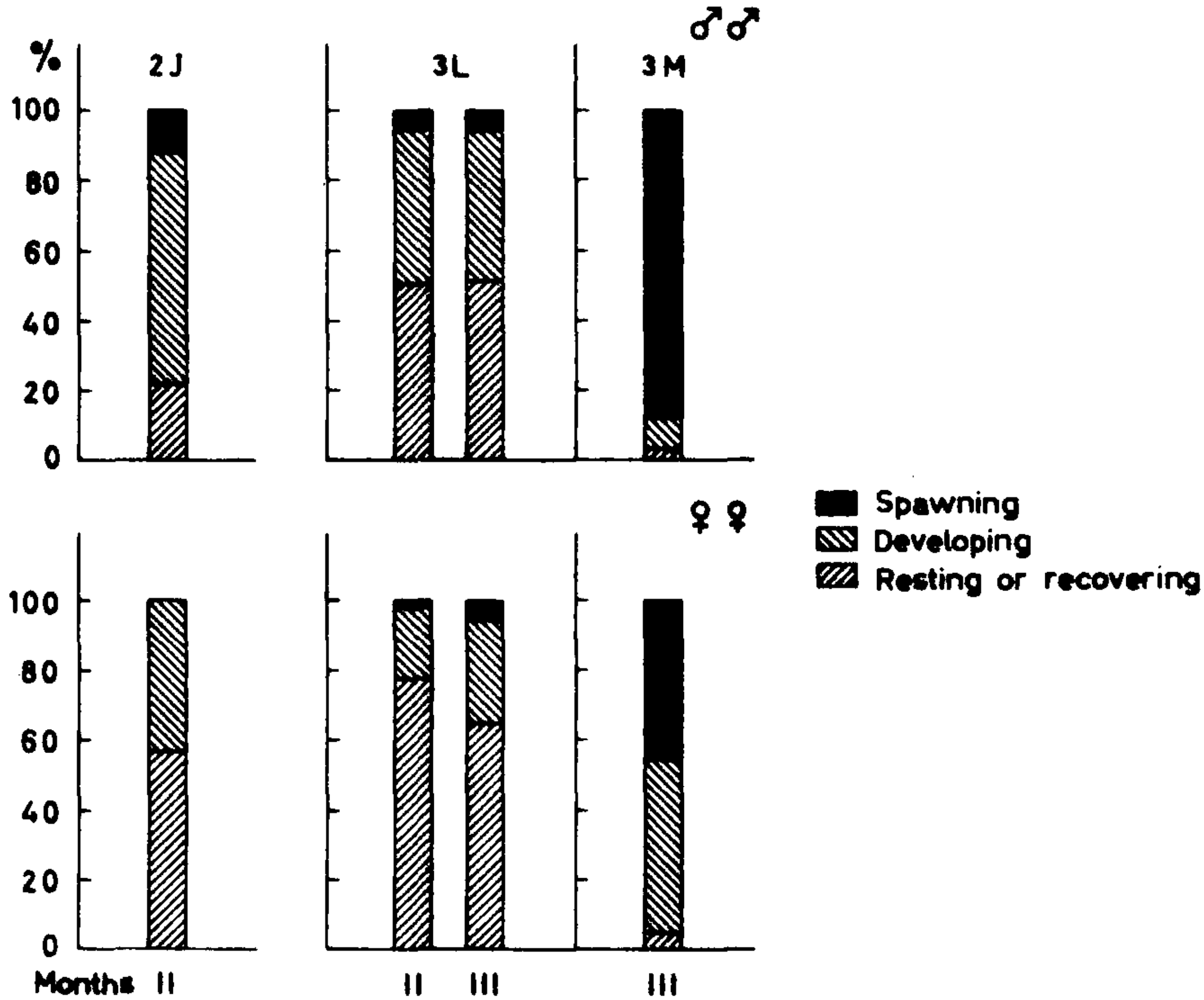

Fig. 6. Stages of maturity. Otter trawl fishery for cod in Div.2J, 3L and 3M in February and March 1968.

e. Age at first maturity.

Div.2J

1st spawn. / Age-group	♂♂ VI	VII	VIII	θ	?	Total	♀♀ VII	VIII	θ	?	Total
IV	-	-	-	1	-	1	-	-	9	-	9
V	-	-	-	82	-	82	-	-	72	-	72
VI	3	-	-	112	-	115	-	-	110	-	110
VII	5	3	-	52	-	60	2	-	51	-	53
VIII	1	4	-	9	3	17	4	-	8	2	14
IX	1	4	-	3	-	8	3	3	1	3	10
X	1	-	1	-	2	4	6	2	-	-	8
XI	1	-	1	-	1	3	2	1	-	-	3
XII	-	2	-	-	1	3	1	-	-	-	1
XIII	-	-	-	-	-	-	-	-	-	-	-
XIV	-	-	1	-	-	1	-	-	-	-	-
No obser ved	12	13	3	259	7	294	18	6	251	5	280

θ - Unknown including immature fish; ? - Doubtful first maturity

Subarea 3

A. Status of the Fisheries

The Portuguese trawlers and dory vessels took a total of almost 120,000 tons. Over 50% was taken in the third quarter and in Div.3L. About 30% of the total catch was made by the dory vessels (Fig. 1).

B. Special Research Studies

Samples for biological study were obtained from the trawler fleet as follows:

Sample Group and Nos.	Date	Depth (m)	No. Lengths	No. Ages
For Div.3L				
A (1-3)	26-28 Feb	180	400	200
B (4, 9-14)	1-31 Mar	175-260	650	400
For Div.3M				
C (5-8)	6-10 Mar	400-410	750	300

and from the dory vessel fleet as follows:

For Div.3L				
A	7-31 July	18-55	946	399
B	3-29 Aug	18-37	900	350
C	6-28 Sep	18-37	825	225

a. Lengths. Lengths of trawl-caught cod (Fig. 7) ranged from 46 to 112 cm classes. Mean lengths were A - 54.7 cm; B - 50.1 cm; and C - 64.8 cm.

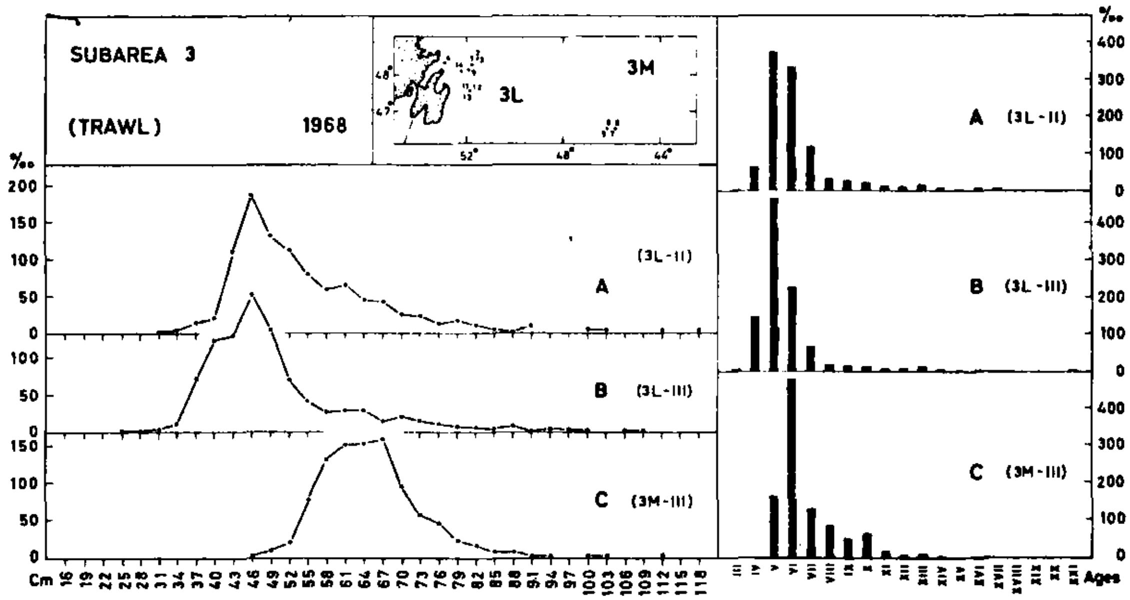

Fig. 7. Cod. Subarea 3. Length and age composition in trawl fishery, 1968.

Lengths of line-caught cod (Fig. 8) ranged from 40 to 132 cm classes. Mean lengths were A - 70.4 cm; B - 65.9 cm; C - 65.9 cm.

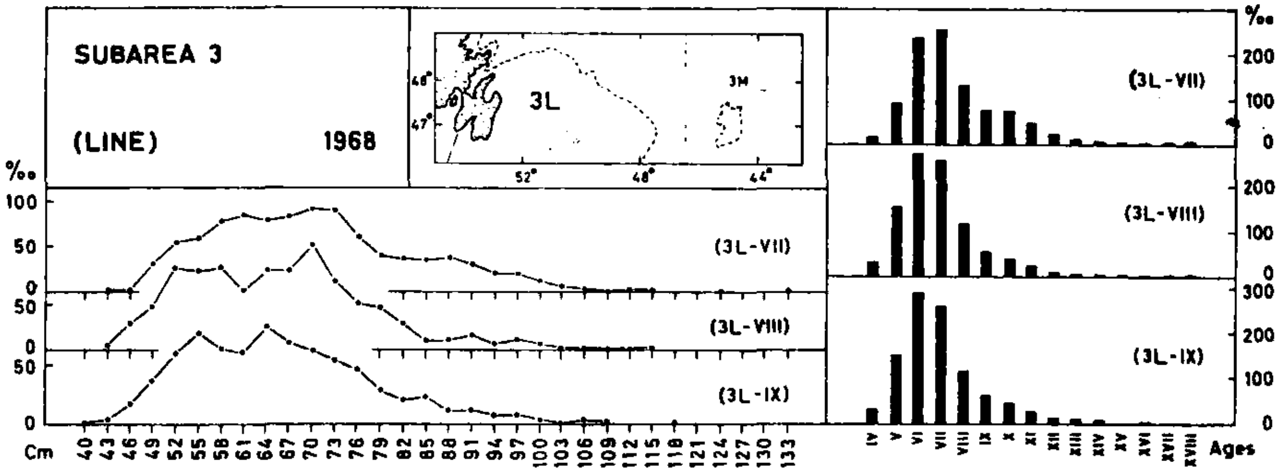

Fig. 8. Cod. Subarea 3. Length and age composition in line fishery, 1968.

b. Ages. Ages of trawl-caught cod (Fig. 7) ranged from 3 to 16 years with the V, VI and VII age-groups (1963, 1962 and 1961 year-classes) dominant. Mean ages were A - 6.2; B - 5.7; C - 6.7 years.

Age-group VI and VII followed by V and VIII were the most important in the line-caught cod fishery (Fig. 8). Mean ages were A - 7.5; B - 6.9; C - 6.9 years.

c. Growth.

	Avg length (cm) of Trawl-caught cod			Avg length (cm) of Line-caught cod			
Year-class and Age-group	Feb	Mar	No. of Fish	Jul	Aug	Sep	No. of Fish
1965 (III)	31.0	23.4	(3)				
1964 (IV)	42.2	39.9	(68)	49.0	48.0	48.4	(16)
1963 (V)	46.6	44.7	(231)	53.1	52.0	52.2	(102)
1962 (VI)	54.5	53.0	(153)	60.5	59.7	59.8	(247)
1961 (VII)	62.3	62.7	(62)	68.7	68.5	68.1	(256)
1960 (VIII)	71.0	71.3	(18)	75.1	74.2	74.3	(129)
1959 (IX)	73.0	73.5	(15)	80.6	78.3	78.4	(73)
1958 (X)	78.0	78.6	(15)	87.9	85.9	86.1	(67)
1957 (XI)	80.5	80.2	(7)	91.2	86.5	88.2	(41)
1956 (XII)	84.2	87.2	(8)	93.7	90.7	91.6	(20)
1955 (XIII)	89.9	88.2	(11)	91.8	91.5	90.8	(11)
1954 (XIV)	96.0	96.8	(13)	95.3	93.2	101.4	(7)
1953 (XV)	82.0	82.0	(1)	115.0	115.0	-	(1)
1952 (XVI)	109.8	104.0	(3)	106.0	106.0	106.0	(1)
1951 (XVII)	112.0	-	(1)	112.0	112.0	-	(1)
1950 (XVIII)	-	-	-	124.0	115.0	-	(2)
1949 (XIX)	-	-	-				
1948 (XX)	-	-	-				
1947 (XXI)	-	109.0	(1)				

d. Stage of maturity. Figure 6 shows the percentage of male and female cod in the various stages of maturity in the trawler fishery in Div.3LM in February and March. Spawning in Div.3L was earlier than in Div.3M.

Figure 4 shows the maturity stages in Div.3L in the line fishery in July, August and September. Females were mainly in the resting or recovering stage, while males were in the resting or recovering and the developing stages.

e. Age at first maturity.

Div. 3L (Trawler)

1st spawn. / Age-group	♂♂ VI	VII	VIII	IX	0	?	Total	♀♀ VI	VII	VIII	0	?	Total
III	-	-	-	-	1	-	1	-	-	-	2	-	2
IV	-	-	-	-	34	-	34	-	-	-	34	-	34
V	-	-	-	-	97	-	97	-	-	-	134	-	134
VI	4	-	-	-	66	1	71	1	-	-	81	-	82
VII	1	5	-	-	22	1	29	2	5	-	26	-	33
VIII	2	1	-	-	4	-	7	2	3	-	6	-	11
IX	-	1	1	-	10	-	12	-	-	-	2	1	3
X	-	3	1	-	6	-	10	-	-	-	2	3	5
XI	-	1	-	1	2	-	4	-	1	-	2	-	3
XII	-	1	-	-	5	-	6	-	-	1	1	-	2
XIII	-	3	2	-	3	-	8	1	-	1	1	-	3
XIV	-	-	-	-	-	1	1	-	1	-	1	-	2
XV	-	-	-	-	-	-	-	-	-	1	~~1~~	-	1
XVI	-	-	-	-	1	-	1	-	1	1	-	-	2
XVII	-	-	-	-	-	-	-	-	-	-	-	1	1
XXI	-	-	-	-	-	-	-	-	-	1	-	-	1
No observed	7	15	4	1	251	3	281	6	11	5	292	5	319

Div.3M (Trawler)

1st spawn. / Age-group	♂♂						♀♀					
	VI	VII	VIII	θ	?	Total	VI	VII	VIII	θ	?	Total
V	-	-	-	38	-	38	-	-	-	12	-	12
VI	3	-	-	74	-	77	1	-	-	60	-	61
VII	1	1	-	14	-	16	1	3	-	18	-	22
VIII	2	5	-	10	-	17	2	1	-	6	-	9
IX	-	3	-	3	-	6	1	5	1	2	-	9
X	-	5	-	1	1	7	-	11	2	1	1	15
XI	-	-	1	1	-	2	-	3	1	-	-	4
XII	-	-	1	-	-	1	-	-	-	-	1	1
XIII	-	2	-	-	-	2	-	-	-	-	-	-
XIV	-	-	-	-	-	-	-	1	-	-	-	1
No observed	6	16	2	141	1	166	5	24	4	99	2	134

θ - Unknown including imature fish

? - Doubtful first maturity

<u>Div. 3L</u> (Line)

1st spawn. / Age-Group	♂♂						♀♀						
	VI	VII	VIII	⊖	?	Total	VI	VII	VIII	IX	⊖	?	Total
IV				7		7					9		9
V				54		54					48		48
VI	2			116		118	1				128		129
VII	8	3		105	1	117	3	6			125	5	139
VIII	3	6		57		66	3	15	1		43	1	63
IX		11	1	20	2	34	1	9	2		25	2	39
X	1	6	6	10	4	27	1	9	11		16	3	40
XI		1	2	8	2	13		5	6	1	9	7	28
XII		3	3	5	3	14					4	2	6
XIII		1	1		2	4		1	4		1	1	7
XIV				3	1	4		1	1	1			3
XV											1		1
XVI										1			1
XVII					1	1							
XVIII			1			1						1	1
No. Observed	14	31	14	385	16	460	9	46	25	3	409	21	514

Subarea 4

A. <u>Status of the Fisheries</u>

The Portuguese trawlers took about 7,000 tons (5,000 by side trawlers and 2,000 by stern trawlers) from Div.4R, Vn during the first, second and third quarters of the year (Fig. 1 and 2).

VIII. Romanian Research Report, 1968

by M. Niculescu-Duvaz

Subarea 5

A. Status of the Fisheries

Romanian fishing in the North Atlantic in 1968 took place between 40°-43°N and 68°-71°W (1 August-23 October) in ICNAF Div.5Z and 5Y.

Generally, herring was the main species fished in the same locations Nantucket and Georges Bank, as in 1967, using this time, both bottom and pelagic trawl, night and day.

The quantity caught was 3,463 tons with Clupeidae making up 2,385 tons (68.9%).

Table 1 shows the species composition of the Romanian catch in 1968.

Table 1. Distribution of catch (tons and percent) by species in the Romanian fishery in 1968.

Statistics group		Species	Catch: metric tons by species	Catch: metric tons total group	Catch: percent by species	Catch: percent total group
1	Clupeidae	*Clupea harengus*	2,135)	2,385	61.6	68.9
		Pomolobus aestivalis	250)		7.3	
2	Gadidae	*Gadus morhua*	235)		6.8	
		Melanogrammus aeglefinus	11)	501	0.4	14.7
		Merluccius bilinearis	255)		7.3	
3	Scombridae	*Scomber scombrus*	284	284	8.2	8.2
4	Sharks and Rays		212	212	6.1	6.1
5	Other unidentified species		81	81	2.1	2.1
	Total			3,463		100.0

The average catch per day was 24.5 tons in 1968 and 23.3 tons in 1967.

This fishing increase is due to both bottom and pelagic fishing, fish shoals being followed closely day and night. Pelagic fishing was practised during the night with better results.

The decrease in catch of Clupeidae in comparison with the rest of species (especially blueback herring - *Pomolobus aestivalis*) is due to the Romanian fishing vessels arriving late in the area and remaining for a shorter period than in previous years. Consequently the catches of *Pomolobus aestivalis* in the south Nantucket area and the catches of *Clupea harengus* from the remaining area - Georges Bank and Great South Channel were smaller than in 1967.

The total Clupeidae catch per day in 1968 averaged 16.9 metric tons compared with 18.1 metric tons in 1967.

Table 2 shows the quantities of all species caught and landed for the years 1965-1968.

Table 2.

Year	Fished	Catch in metric tons		Tons/day
		Landed		
		Frozen for human consumption	Processed for industrial purposes	
1965	3,208	1,612	1,696	34.8
1966	3,533	1,938	1,495	32.7
1967	1,729	1,028	701	23.3
1968	3,463	2,400	1,063	24.5

Compensating for the lower Clupeidae catches in 1968 was the increased catch of other species and Gadidae, *Merluccius bilinearis* and *Gadus morhua*.

B. Special Observations

I. Clupeidae

In 1968, as in previous years (*i.e.* 1967), fishing for Clupeidae yielded better results. This fishing was on *Clupea harengus* and *Pomolobus aestivalis* concentrations, which are distinct for Div.5Z and 5Y; our fishing vessels were present during this concentration.

a. Atlantic herring, *Clupea harengus*, was more scattered on Georges Bank and between Cape Cod and the Gulf of Maine (41°-44°51'N and 65°40'-71°W), while *Pomolobus aestivalis* was found south of Nantucket (southern part of Div. 5Z and northern part of Subarea 6: 31°-41°N and 69°31'-71°W).

Herring was found in two dense concentrations, one northwest and east of Georges Bank, at 50-100 m depth, between 67°45'-66°W, north and south of latitude 42°N, and the other north of Great Channel to near Cape Cod between 41°-42°N and 68°30'-61° W.

These two concentrations in different locations are two different populations of herring (*Clupea harengus*):

(a) The herring population on Georges Bank was found, during August, concentrated for feeding and fattening. The length group was between 23-31 cm (3-8 years old). The proportion of the 6-8 year olds (length 26-31 cm) increased as the spawning period, which was estimated to be between 1 September-1 October, approached. Food was composed exclusively of Euphausiidae (*Meganyctiphanes norwegica*). After 16 August individuals with empty digestive tract and spawning pigmentation appeared.

The spawning period for this population, in 1968, began approximately on 1 September on the northern part of Georges Bank between 41°58'-42°09'N and 66°58'-67°20'W, and lasted about 24-26 days, at temperatures of 13°-15°C. The sex ratio was 45% male and 55% female. The 6-7 year old (27-30 cm in length) were 92.5%, while the younger, 3-5 year olds (under 26 cm in length) were only 7.5%.

(b) The herring population located north of Great South Channel represented a herring concentration composed of a smaller percentage (66.8%) of the 6-8 year olds (27-32 cm in length) than the population on Georges Bank. But the percentages of younger, 3-5 year olds (21-26 cm in length) fish was greater - 33.2%. Therefore the average age of the herring population north of the Great South Channel is less than that of the population located on Georges Bank. The herring shoals found here could be considered as younger, although 6-8 year olds are dominant in the population. The spawning period begins earlier, on 28-30 August, when individuals with spawning pigmentation and empty digestive tracts appear. Individuals capable of spawning appear earlier in September. After 15 September this herring population moves for spawning purposes probably to the Gulf of Maine coast areas.

After 25 August our fishing vessels move to the northwest of Georges Bank because of herring concentrations there.

For the entire population the ratio between sexes is 50% male and 50% female. There is a slight increase in the number of males in the catches before the spawning period (end of August).

b. Blueback herring, *Pomolobus aestivalis*, was fished in 1968 as in previous years south of Nantucket, at an average surface temperature varying between 16°-20°C. The temperatures lower than 16°C resulted in the shoals scattering. The biggest catches were made at higher temperatures from 1 August to the beginning of September (Fig. 1).

With the colder September waters the *Pomolobus* concentrations broke up and moved to the fresh-water spawning area. At this time the stage (3) of maturation of the gonads and the food in the stomachs show that *Pomolobus* comes into the area to fatten before moving off to spawn.

Fish 4-6 years of age (19-24 cm in length) were dominant, making up 80%.

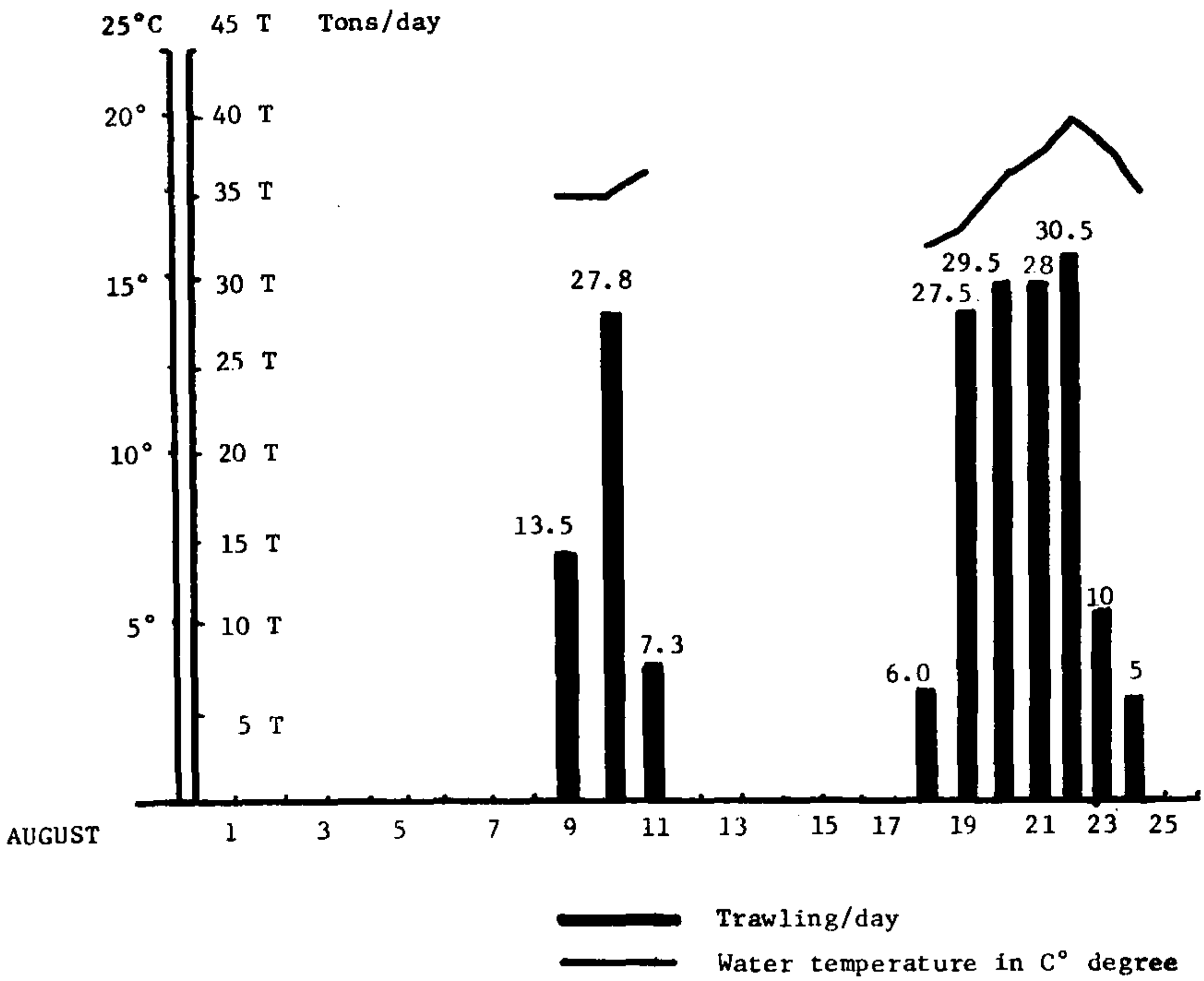

Fig. 1. Variations in catch of *Pomolobus aestivalis* with temperature between 9-11 and 18-24 August 1968 in south Nantucket area.

II. Scombridae

The most important mackerel, *Scomber scombrus*, concentrations were found during August and September, northwest of Georges Bank, and in September-October on the northern part of Great South Channel. Mackerel catches were higher in 1968 than in 1967. The biggest catch was made on Georges Bank on 1 October. Fish 25-32.5 cm in length were dominant. Sex ratio was 53.1% male and 46.9% female; gonads were in stage 3 of maturation.

III. Gadidae

(a) Cod, *Gadus morhua*, and (b) haddock, *Melanogrammus aeglefinus*, were located on the northern and western part of Georges Bank. Length-class varied between 35-75 cm for *Gadus morhua* and 30-60 cm for *Melanogrammus aeglefinus*. Food of both species was *Ammodytes americanus*.

(c) Silver hake, *Merluccius bilinearis*, appeared in catches in the Nantucket area in more important quantities. Length-class varied between 27-35 cm. Sex ratio was 79.6% female and 20.4% male.

Generally speaking, Gadidae kept their growth rate, as in previous years; for *Gadus morhua* length-class was 50-75 cm; for *Melanogrammus aeglefinus*, 40-60 cm and for *Merluccius bilinearis*, 30-35 cm.

IV. Other Fish caught were Pleuronectidae, sharks and rays, with benthonic ones and *Lamna nasus* too, and also *Etrumius sadina* as pelagic species.

C. Environmental Conditions

I. Meteorological observations

Air temperatures varied daily between 16.3° and 19.2°C in August on Georges Bank and Great South Channel, and between 16.8° and 22.3°C on Nantucket. In September, temperatures varied from 15.5° to 13.7° and up to 20°C on Georges Bank and Great South Channel. Due to the cold layer of air and the Labrador Current, Georges Bank, strongly influenced by the meteorological conditions, presented a cooler climate with more frequent foggy days and winds than in southern zones (Nantucket) and the western part of Great South Channel.

Meteorological conditions also influenced the temperature of the surface water layers in these areas. Water was colder, with greater temperature variations, especially in the northern and northwestern part of Georges Bank.

Rainfall was rare and of short duration. Winds blew from the northwest, south and southwest, and sometimes from the north and the east, not over 5 on the Beaufort scale, usually 1-3.

There were no hurricanes in August and September.

II. Oceanographical observations

Water temperatures were influenced not only by the atmospheric conditions but also by the cold currents from Labrador, alternating with the warm ones from the coast and from the south converging at the northern parts of the area.

During the period 1 to 8 August on Georges Bank, warm currents penetrated into the eastern parts of the Shelf giving temperatures varying from 16.6° to 19°C. During 7 to 23 September, the surface layer was under the influence of the cold currents resulting in temperatures on the Shelf lowering to 13° and 14.8°C. Towards the end of September warm water layers again invaded the Shelf, and temperatures rose in the central and eastern parts to 16°C and even 17°C (average value).

Beginning in October, cold water was present anew, but average temperature values were 0.2°-3°C greater than in 1967 in the same period, for some northern and eastern areas of the Shelf where the average temperature was between 14.2° and 16°C.

In the Nantucket area, generally characterized by warm waters, the penetration of cold northern water beginning 22 August (Table 3) made average temperatures lower (from 18° and 20°C to under 16°C); the consequence was the dispersion of the *Pomolobus aestivalis* concentration. This change has also been noticed in the area between Cape Cod and Georges Bank, Western Great South Channel, where temperatures dropped to 13.8° and 15.2°C. After a short time the warm water returned and temperatures varied again around 18°C near the surface.

The beginning of October brought for the entire area cold waters which lowered the temperatures to 16°C and 18°C (2-8 October) and 15°-12° (to the end of the month).

Table 3 shows the temperatures (°C) the salinity (‰) at different depths and layers.

Table 3.

	August													
Depth (m) / Day	7		13		17		23		25		26		30	
Zone	41°48'N 68°12'W		41°37'N 66°56'W		41°13'N 67°58'W		40°22'N 70°21'W		41°25'N 69°24'W		41°25'N 69°24'W		41°22'N 67°12'W	
	°C	‰	°C	‰	°C	‰	°C	‰	°C	‰	°C	‰	°C	‰
0	14.4	-	13.0	32.1	16.0	-	16.0	-	13.4	-	11.4	-	13.2	32.0
10	13.0	32.0	12.6	31.8	14.0	-	16.0	-	11.0	30.0	7.2	-	12.0	-
20	13.0	-	12.2	31.8	13.0	-	11.0	-	11.0	-	6.8	31.0	11.3	-
30	12.0	-	12.0	-	13.0	32.0	9.0	32.0	9.0	-	6.8	-	11.3	31.8
40	10.0	-	12.0	-	13.0	-	8.6	-	7.8	-	6.8	-	10.9	-
50	9.0	-	12.0	-	12.6	-	8.5	-	6.0	-	6.4	-	9.9	-
60	7.0	-	12.0	-	10.3	-	8.5	-	-	-	-	-	8.4	-
70	7.0	-	18.0	-	10.3	-	8.4	-	-	-	-	-	8.0	-

	September			
Depth (m) / Day	4		15	
Zone	41°22'N 69°22'W		40°04'N 67°12'W	
	°C	‰	°C	‰
0	17.7	30.0	14.4	-
10	16.7	-	14.2	-
20	8.5	-	8.4	32.0
30	8.5	-	8.4	-
40	8.3	-	8.4	-
50	6.4	-	6.5	-
60	6.2	-	-	-
70	-	-	-	-

Analysing the temperatures and salinities one finds an isotherm zone with greater salinities and variable depths, located between 20-60 m; 20-40 m; 40-60 m; 10-20 m and 20-30 m.

These depths indicate the level of the cold water penetration, the mixture of waters with different temperatures and the thermocline positions in several situations.

Temperature differences between the thermocline and upper layers in points of contact, had, in 1968, values between 2.4°-8.2°C. The thermocline was situated sometimes on the upper part of the isothermal layer.

Pelagic species, *Clupea harengus* and especially *Pomolobus aestivalis* and *Scomber scombrus* remain around the thermocline, some species (herring) in the cooler stratum while others (*Pomolobus* and *Scomber*) are in the warmer ones and move in connection with the thermocline variations. This is why we consider as important the scientific research concerning the study of the variations and their consequences, *i.e.* fish concentrations, in order to determine a pelagic or a bottom fishery.

Concerning water transparency, one established during August and September, a variation in values between 16-14 m. Influencing this matter in 1968 was not only the feeble organism presence, but also the pronounced and frequent haziness as well as the reduced visibility.

D. Biological Observations

Preliminary analysis of samples showed a concentration of planktonic biomass at the limit of Georges Bank shelf, and especially the eastern, western and southern regions of Nantucket, and therefore the herring has concentrated during August in these regions.

Dominant groups were cryophile organism. Euphausiidae and *Meganyctiphanes norwegica* formed the herring food; *Calanus finmarchicus* and *Centropages typicus* (Copepodae) formed the principal food for *Scomber scombrus*. Secondly, *Discopliura* sp. and *Salpa* (Urocordatae) also formed herring food and influenced its concentration. *Pandalus*, a decapod crustacean, formed 24-66% of the food of the Gadidae (*Merluccius bilinearis* and *Urophycis chuss*) food.

Benthic food consisted especially of molluscs.

IX. Spanish Research Report, 1968

Statistical Information

Twenty-six trawlers and 145 pair trawlers (these vessels represent 72 gears) operated in the ICNAF area during the year 1968. Total tonnage of these vessels was 93,100 tons; 4,856 fishermen make up the crews. Total catch was 341,310.9 m tons, of which 96% was cod, 3% haddock, and 1% other species (white hake and pollock).

Table 1. Statistical ICNAF, 1968.

	1.967			1.968		
	TRAWLERS	PAIR TRAWLERS	TOTAL	TRAWLERS	PAIR TRAWLERS	TOTAL
1 A				-	30,-	30,-
1 B	110	145	255	-	8.466,9	8.466,9
1 C	151	1.940	2.091	175,5	2.824,2	2.999,7
1 D	500	4.986	5.486	-	9.276,3	9.276,3
1 E	376	2.605	2.981	21,-	784,5	805,5
1 F	-	-	-	-	144,-	144,-
TOTAL SUB.1	1.137	9.676	10.813	196,5	21.525,9	21.722,4
2 G	-	-	-	-	-	-
2 H	779	-	779	-	-	-
2 J	36.036	142	36.178	32.574,6	278,4	32.853,-
TOTAL SUB.2	36.815	142	36.957	32.574,6	278,4	32.853,-
3 K	9.498	86	9.584	13.355,1	465,-	13.820,1
3 L	34.265	26.142	60.407	45.652,2	39.904,2	85.556,4
3 M	2.437	664	3.101	4.041,-	3,6	4.044,6
3 N	9.307	41.962	51.269	518,1	36.064,8	36.582,9
3 O	188	28.828	29.016	181,5	34.731,9	34.913,4
3 Pn	2.480	33	2.513	1.916,7	305,7	2.222,4
3 Ps	748	21.085	21.833	1.008,3	27.408,3	28.416,6
TOTAL SUB.3	58.923	118.800	177.723	66.672,9	138.883,5	205.556,4
4 R	3.824	-	3.824	2.271,3	508,2	2.779,5
4 T	370	464	834	12,9	128,1	141,-
4 Vn	1.460	1.366	2.826	787,8	2.124,9	2.912,7
4 Vs	87	20.363	20.450	109,8	40.039,8	40.149,6
4 W	-	17.444	17.444	-	14.182,2	14.182,2
4 X	-	2.614	2.614	-	2.997,9	2.997,9
TOTAL SUB.4	5.741	42.251	47.992	3.181,8	59.981,1	63.162,9
5 Ze	-	16.251	16.251	-	17.713,2	17.713,2
5 Zw	-	-	-	-	303,-	303,-
TOTAL SUB.5	-	16.251	16.251		18.016,2	18.016,2
TOTAL GENERAL	102.616	187.120	289.736	102.625,8	238.685,1	341.310,9

Table 2. Statistical ICNAF, 1968

Concepts	Otter Trawlers	Pair Trawlers	Totals
Number of vessels	26	145 (1)	171
Tons, R.B.	34,145	58,955	93,100
Crew	1,448	3,408	4,856
No. of days on grounds	5,768	15,508	21,276
No. of days fished	5,064	12,626	17,690
No. of sets	23,435	30,139	53,574
No. of trawl hours	71,804.7	128,867	200,671.7
Catches			
Cod	102,078.9	227,100.9	329,179.8
Haddock	200.7	9,984.6	10,185.3
White hake	34.8	77.1	111.9
Pollock	311.4	1,522.5	1,833.9
Total Catches	102,625.8	238,685.1	341,310.9

Applied conversion factor = 3
(1) As these vessels are "pair trawlers" they represent only 72 trawl gears.

X. USSR Research Report, 1968

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

The total Soviet catch in the ICNAF Convention Area in 1968 was 741,300 tons (Table 1), that is 165,299 tons more than in 1967.

The increase of the total catch was mainly due to growth in catches of cod from 167,987 tons in 1967 to 245,956 tons in 1968, of mackerel from 11,969 tons in 1967 to 43,522 tons in 1968, of grenadier from 15,902 tons in 1967 to 26,812 in 1968, of flounders from 61,117 tons in 1967 to 99,144 tons in 1968 and of some other species.

Catches of silver hake decreased considerably from 72,460 tons in 1967 up to 47,299 tons in 1968, and those of haddock - from 8,386 tons in 1967 to 3,159 tons in 1968.

Subarea 1

A. Status of the Fisheries

One commercial BMRT in March-June and one fish finding trawler in January-February were working. Their total catch made 2,309 tons, mainly of cod.

B. Special Research Studies

I. Environmental Studies

The fish finding trawler *Volgograd* worked partially the standard hydrographic section 8-A lying between 59°24'N, 44°24'W and 58°09'N, 46°55'W. That part of the hydrographic section characterizes the Atlantic component of the West Greenland Current. The water temperature in the 0-50 m layer was 4.28°C, in the 0-200 m layer - 4.29°C, 50-200 m - 4.30°C and in the 200-500 m layer 4.37°C. Comparing the data with those of 1964, it is possible to note that in January 1968, the water temperatures in the 0-50m, 50-200 m, 0-200 m layers were higher by 1°C, 0.40°C, 0.63°C, and in the 200-500 m layer practically the same as in January 1964.

II. Biological Studies

1. Cod

a. Age Composition. As is evident from Table 2 that the 1962 and 1963 year-classes prevailed in number in Div.1C and 1D; 1961, 1962 and 1963 year-classes prevailed in number in Div.1E, the 1960 year-class was particularly rich. The 1962 and 1963 year-classes are apparently average in

Table 1. Species composition of the USSR catches (in tons) in the Convention Area, 1967 and 1968.

Species	1968						1967
	Subarea 1	Subarea 2	Subarea 3	Subarea 4	Subarea 5	Total catch	Total catch
Herring	-	-	-	2,793	126,965	129,758	124,153
Argentine	-	-	304	1,589	1,481	3,374	7,015
Cod	1,950	104,336	132,285	5,926	1,459	245,956	167,987
Haddock	-	-	1,173	589	1,397	3,159	8,386
Pollock (saithe)	-	-	82	231	141	454	710
Silver hake	-	-	-	3,441	43,858	47,299	72,460
Red hake	-	-	-	531	11,342	11,873	39,588
Grenadier *(macrurus rupestris)*	116	2,553	24,143	-	-	26,812	15,902
Flounders	43	2,061	62,186	29,842	5,012	99,144	61,117
Halibut	42	2,621	6,820	32	-	9,515	5,326
Redfish	90	3,086	32,002	186	-	35,364	38,978
Wolffish	3	81	760	-	-	844	360
Ocean pout	- -	-	-	-	4,324	4,324	261
Scup	-	-	-	-	1,782	1,782	347
Pomolobus	-	-	-	-	21,235	21,235	5,531
Mackerel	-	-	142	9,419	33,961	43,522	11,969
Butterfish	-	-	-	-	1,596	1,596	1,406
Sea robins	-	-	-	-	1,130	1,130	127
Angler fish	-	-	-	2,418	2,221	4,639	-
Dogfish and Skates	-	-	-	6,177	7,405	13,582	3,979
Squids	-	-	9	49	2,415	2,473	336
Others	65	3,820	12,470	2,880	14,230	33,465	10,066
Total	2,309	118,558	272,376	66,103	281,954	741,300	576,001

Table 2. Age composition of cod (%) caught by trawl off West Greenland, 1968.

Age group	Year-class	Div.1C					Div.1D				Div.1E		
		January	February	April	May	June	January	February	March	April	January	March	April
III	1965	0.2	1.1	22.7	10.7	7.6	0.1	0.3	1.9	1.0	-	0.4	1.8
IV	1964	1.9	5.5	14.7	9.4	8.5	1.1	4.3	14.6	7.7	1.7	2.3	6.6
V	1963	33.9	42.8	37.6	40.6	39.3	35.5	36.6	56.4	48.9	13.3	23.9	23.4
VI	1962	37.8	30.7	17.9	26.0	27.1	38.3	31.7	19.4	27.6	30.9	36.8	25.3
VII	1961	18.4	13.9	5.4	9.6	12.1	17.6	18.1	5.8	10.3	31.9	24.7	25.1
VIII	1960	6.1	4.8	1.4	3.0	4.3	5.9	7.0	1.5	3.4	16.8	9.2	12.2
IX	1959	1.1	0.8	0.2	0.5	0.8	1.1	1.2	0.3	0.7	2.7	2.3	2.5
X	1958	0.3	0.2	0.1	0.1	0.2	0.2	0.4	0.05	0.3	1.8	0.4	1.3
XI	1957	0.2	0.2	-	0.1	0.1	0.2	0.2	0.05	0.1	0.9	-	1.2
XII	1956	0.1	-	-	-	-	-	0.2	-	-	-	-	0.6

strength; the rich 1960 and 1961 year-classes decreased greatly in their abundance due to the intensive fishery and natural mortality.

From January to April, the relative number of the young specimens increased in Div.1C and 1D. This was because the mature cod left the fishing grounds for spawning.

In April, a series of trawl hauls was made with the mid-water trawl in the Holsteinborg area and in June in the Frederikshaab area.

The age-size composition in cod catches was the same as in bottom trawl catches (immature - at the Holsteinborg area, mature, post-spawned - at Frederikshaab Bank).

In comparison with 1967, the total fish catch by the USSR trawl fleet was three times greater, mainly due to a successful cod fishery in Div.2J in the first half of the year. The average catch per hour trawling increased considerably from 2.05 to 3 m tons.

Subarea 2

A. Status of the Fisheries

The annual catch is given in Table 3.

Table 3. Annual catch and catch per hour trawling (in tons)

Division	Total catch by trawler (all types)							Average catch hour of BMRT trawling
	Cod	Grenadier	Redfish	Flounders	Halibut	Others	Total	
2G	7,557	1,439	175	20	657	340	10,188	2.67
2H	13,301	682	457	189	471	452	15,552	3.39
2J	83,478	432	2,454	1,852	1,493	3,109	92,818	3.54
Total:	104,336	2,553	3,086	2,061	2,621	3,901	118,558	3.48

B. Special Research Studies

I. Environmental Studies

In November-December, the fish finding vessel *Neptun* made a hydrological section 8-A along Hamilton Inlet Bank (between stations 53°40'N, 55°44'W and 54°50'N, 53°32'W). Data on water temperature for different years by November 1 are shown in Table 4.

Table 4. Average water temperature (°C) along Section 8A (Hamilton Inlet Bank) by 1 November.

Depth (m)	1958	1962	1964	1965	1966	1967	1968	Average long-term mean	Anomaly 1968
0-50	1.28	1.58	0.98	1.30	2.41	2.00	2.29	1.69	0.60
50-200	0.59	1.34	-0.18	1.06	1.44	0.89	-0.18	0.71	-0.89
0-200	0.79	1.49	0.17	1.13	1.72	1.19	0.50	1.00	-0.50
200-500	-	1.70	0.98	-	2.47	0.95	0.31	1.28	-0.97

These data show that the water temperature to 1 November was, in 1968, much lower than the long-term mean for all layers (except the surface layer). This was due to a higher intensity of the cold component of the Labrador Current.

To the end of December 1968 and in January 1969, near-bottom waters with temperature below 2°C were spread more easterly than in the same months in 1963-1964 and 1966-1967. The water temperature in winter 1968-1969 was almost the same as in 1964-1967. Apparently, the water temperature in 1969 will be much below the norm, as it was in 1965.

A more detailed description of hydrographic conditions in Subarea 2 is given by Burmakin in ICNAF Redbook 1969, Pt.III.

II. Biological Studies

1. Cod

a. Age composition. Table 5 shows the age composition of cod in USSR trawl catches for a series of years in April-May in southern Labrador. In April-May, cod of all commercial ages are found in the southern Labrador area: the mature, migrating to the south after the spawning period and immature spent the winter on the Continental Slope. As seen from the table, the individuals of 1961, 1962 and 1963 year-classes prevailed in number in the 1968 commercial stock of Labrador cod. The strength of the year-classes mentioned is somewhat higher than the average level; that is also confirmed by the data on the counting of young cod (Table 7). Labrador cod at the age of 2+ and 3+ are keeping in Div.3K; they were brought there earlier with the current from the northern spawning areas. Table 7 shows that the 1961, 1962 and 1963 year-classes were abundant. The recruitment to the commercial size cod stock by the grown fish of the above-mentioned year-classes increased the density of cod concentrations exploited by the trawl fleet in the first half of 1968. Besides that, the decrease in temperature of the water column favoured mass cod distribution to the south, that also helped the operations of trawl fleet.

A gradual change of the age composition of the Labrador cod in the first years of the intensive trawl fishery is shown in Table 5 - the relative numbers of cod 10 years and older became scarcer. Then, towards the middle of the current ten-year period, a mobile equilibrium between the stock

Table 5. Age composition of cod (%), caught by trawl near South Labrador, April-May 1960-1968.

Year	Age of cod (by years)																	
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1960	1.2	3.8	4.4	8.0	14.6	13.5	13.3	11.4	10.0	6.2	3.6	4.6	3.4	1.4	0.5	0.1	-	-	-
1961	-	5.7	7.0	18.8	22.5	12.4	12.4	8.2	3.4	3.5	2.5	2.7	-	0.9	-	-	-	-	-
1962	0.7	2.0	16.0	23.5	14.8	10.0	6.8	6.9	4.3	3.5	3.3	1.9	1.5	1.4	1.7	1.0	0.1	0.1	0.1
1963	0.2	3.5	4.8	11.7	32.4	16.9	8.7	7.1	3.3	3.5	1.8	1.3	1.1	1.4	0.8	0.4	0.7	0.2	0.2
1964	-	1.9	7.3	9.8	23.0	28.2	8.6	4.0	4.3	1.9	2.4	0.6	1.3	0.2	0.2	0.3	-	-	-
1965	0.4	5.8	6.4	16.2	16.6	24.0	17.0	7.8	1.5	1.1	1.0	0.3	0.4	0.4	-	0.1	-	-	-
1966	-	21.4	31.9	16.7	15.8	5.4	4.8	2.3	0.4	1.3	-	-	-	-	-	-	-	-	-
1967	0.9	6.4	19.5	21.1	19.0	14.7	6.7	5.0	3.9	0.5	1.0	0.5	0.6	0.2	-	-	-	-	-
1968	0.2	2.1	21.0	20.5	19.6	16.4	8.9	4.2	3.1	2.9	0.4	0.4	0.3	-	-	-	-	-	-

Table 7. Average catch (number of specimens) per hour trawling of young cod.

Age-group	0+				1+				2+				3+			
Div.	3K	3N	3O	3P	3K	3N	3O	3P	3K	3N	3O	3P	3K	3N	3O	3P
Year-class 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				
1966	1	2	15	7	3	27	17	32								
1967	1	1	2	3												

Subarea 4

A. Status of the Fisheries

I. Silver hake

In 1968, catches of silver hake remained at a low level due to their low abundance, though in comparison with 1967 they increased slightly (Table 8).

Table 8. USSR silver hake catches (tons) in Subarea 4, 1962-1968.

Years	1962	1963	1964	1965	1966	1967	1968
Catches	8,825	123,023	81,147	49,987	10,323	2,476	3,441

Silver hake were taken as a by-catch. Only in certain periods did the BMRT catches consist mainly of silver hake. Thus, in May silver hake on the average made up 60% of BMRT catches taken on the slopes of the shelf in the area of the Emerald Bank at depths of 75-250 m. The catch of all species per hour trawling was at this time 2.2 tons. In October, November and December, when the greatest half of the USSR annual catch was taken, silver hake was always observed on the slope off Emerald Bank and on Sable Island to make up from 10% to 30% of the catch.

The analysis of the size composition of silver hake in catches in September and October showed that the length of the fish caught ranged between 18 cm and 65 cm; the bulk of catches were individuals from 24 cm to 31 cm in length (80%), the mean length was 27.9 cm.

II. Haddock

In 1968, the total catch of haddock was 589 tons (Table 9). Haddock was taken as a by-catch. A sharp decrease in haddock catches beginning from 1967 may be due to the vessels not being able to find the dense concentrations which provide the basis for good catches. The results of control trawlings suggest that there were few good haddock year-classes after 1963. Therefore, an increase in commercial stocks and hence in catches is not expected in the nearest future.

Table 9. USSR catches of haddock (tons) in Subarea 4, 1962-1968.

Years	1962	1963	1964	1965	1966	1967	1968
Catches	2,567	3,701	5,499	45,458	20,566	753	589

Because only single individuals of haddock were observed in catches, samples for size and age composition were not taken from the commercial catches.

III. Argentine

In 1968, the argentine catch continued to decline (Table 10), and was only 1,589 tons. The decrease can be explained by the fact that this species was not specially fished by trawlers, as their concentrations were not stable and usually they were found on slope areas with snaggy ground.

Table 10. USSR catches of argentine (tons) in Subarea 4, 1963-1968.

Years	1963	1964	1965	1966	1967	1968
Catches	8,127	4,923	5,611	14,983	4,191	1,589

The argentine catch was taken mainly in May, October and December. In May the argentine were caught simultaneously with other species on the southeastern slopes of Browns Bank at 120-300 m, off Sable Island at 120-200 m and Emerald Bank, at 100-250 m. In October and December, they were caught by BMRT on the southwestern slopes of Browns Bank at 160-240 m, and the catch per hour trawling averaged 3.7 tons without a by-catch of other fish species. The length of argentine from commercial catches fluctuated within the range 20 cm-43 cm. The mean length from catches taken in the area of Browns Bank was 27.3 cm in May, 30.0 cm in September, 30.3 cm in October and 30.8 cm in November. The mean length of argentine from catches off Sable Island was 25.0-23.3 cm. In future, with the intensification of the argentine fishery, catches may be increased as the stocks are only slightly exploited.

IV. Flounders

Up to 1965, the proportion of flounders in the total catches of the USSR was very insignificant. In 1965 their catches increased to 8,324 tons, in 1966 to 13,817 tons and in 1967 they dropped up to 324 tons. In 1968 they again increased sharply to 29,842 tons which was the peak for all the fishery period by the USSR (Table 11).

Table 11. USSR catches of flounders (tons) in Subarea 4, 1962-1968.

Years	1962	1963	1964	1965	1966	1967	1968
Catches	671	586	113	8,324	13,817	324	29,842

The fluctuations of the flounder catches in the above-mentioned years depended mainly on the intensity of the fishery, which in its turn was directly connected with the fishing conditions in different areas of the Northwest Atlantic. Thus, when conditions for the silver hake fishery worsened, the vessels began fishing for other species and, particularly, for flounders. Random analyses showed that American plaice *(Hippoglossoides platessoides)* and yellowtail flounder *(Limanda ferruginea)* prevailed in the catches.

V. Mackerel

Up to 1968, mackerel were very scarce in the USSR catches; they did not exceed 1,200 tons and only in 1968 did the catch reach 9,412 tons. The increase is due to their commercial concentrations, which in turn is possibly connected with the increased stocks. The same picture was observed in Subarea 5 and ICNAF Statistical Area 6. Mackerel were fished mainly as a by-catch in Div.4W from April to December. In October-December the catch met the demand. It should be noted that mackerel were not observed in catches taken in the late autumn and winter of recent years.

B. Special Investigations

I. Environmental Studies

In 1968, four hydrographic surveys were completed as previously (scheme of standard sections was given in the USSR Research Report, 1967, ICNAF Redbook 1968, Pt.II, p.121). In winter, observations at standard sections were made from 13 to 23 January, in spring from 2 to 9 May, in summer from 2 to 8 August, in autumn from 9 to 14 October. The water temperature was measured with deep water thermometers and the salinity was determined at each station at the standard depths. The results of surveys showed that the heat content in the water masses appeared to be higher in 1968 than in 1967 in all seasons. Such rise of the temperature may be connected with an intensive inflow of the Gulf Stream waters. This is presented in more detail by Sigaev in ICNAF Redbook 1969, Pt.III.

II. Biological Studies

1. Silver hake. Studies on the age composition of silver hake catches taken in Div.4W showed that 3-, 4- and 5-year old specimens prevailed there in May and June, but 2- and 3-year-olds in September-October (Table 12).

Table 12. Age composition (%) of silver hake catches in Div.4W, 1968.

Months	Age									
	1	2	3	4	5	6	7	8	9	Total
May	-	-	14.9	56.3	20.3	7.7	0.8	-		100.0
June	-	0.9	28.4	38.5	24.5	7.5	0.2	-		100.0
September) October)	0.9	32.4	52.4	9.9	2.4	0.8	1.0	0.2		100.0

A great dominance of 2- and 3-year-olds in autumn 1968 shows the entrance into the fishery of the 1965 and 1966 year-classes, whose abundance was somewhat higher in comparison with those providing the 1964 recruitment. But, there is no data confirming the increase of silver hake stocks to the 1963-1965 level.

2. Haddock. To study the age composition in July and August, six samples including 586 individuals were taken from the catches of herring trawls of fish finding trawler. Haddock was represented in these samples by the individuals from 1 to 10 years old. One-year-olds, 2-year-olds, 5- and 6-year-olds prevailed there. Thus, the first age-group comprised 12.5%, the second one - 19.1%, the third - 8.2%, the fourth - 7.2%, the fifth - 19.9%, the sixth - 21.8%, the seventh - 5.6%, the eighth - 3.5%, the ninth - 1.8% and the tenth age group - 0.1% of the sample.

3. Study of the stocks and distribution of bottom fish. In July and August, SRTM-815 *Blesk* conducted a trawl survey to study the distribution and stocks of the main commercial and mass fish species in the area of Nova Scotia Shelf. Hauls were made by herring trawl, 27.1 m at a speed of 3.5 knots for half an hour. Thus, an attempt was made to determine the absolute stock of the American plaice, yellowtail flounder, skates and silver hake. A great number of the young 1967 year-class of silver hake was found there.

Subarea 5

A. Status of the Fisheries

I. Silver hake

In 1968, catches of silver hake began to decline (Table 13). The decrease can be explained as a decrease in their commercial concentrations on Georges Bank, especially in summer. In 1968 a special silver hake fishery was no longer carried out on the southern slopes of Georges Bank during the summer, while it was successful up to 1966. The smaller silver hake concentrations were due to the decrease in their stocks.

Table 13. USSR catches of silver hake (tons) in Subarea 5, 1962-1968.

Years	1962	1963	1964	1965	1966	1967	1968
Catches	41,900	107,357	167,308	281,431	121,373	69,984	47,299

The decrease in stocks may be explained by the entry into the fishery of comparatively few concentrations.

From January to April, the BMRT-type vessels took silver hake together with red hake on the slopes of the shelf in Div.5Zw near Black and Veitch Canyons at 120-350 m. The catches averaged 60% silver hake, and the remainder was red hake (30%) and other fish (10%). In May, silver hake moved to the shallow waters and were caught together with other species on the Nantucket Bank, northwestern and south-western slopes of Georges Bank. The silver hake catch was greatest in August. In the immediate future silver hake catches will remain at a low level due to the continuing trend for their stocks to decrease.

II. Haddock

In 1968, haddock catches were only 3,159 tons, which was much less than the peak catches in 1965 and 1966 (Table 14).

Table 14. USSR catches of haddock (tons) in Subarea 5, 1962-1968.

Years	1962	1963	1964	1965	1966	1967	1968
Catches	1,134	2,361	5,483	81,882	48,409	2,316	3,159

The decrease in haddock catches may be explained as a decrease in their concentrations, which, in turn, are caused by the diminishing abundance of the rich 1962 and 1963 year-classes and by the entry into the fishery of the poor 1964 and 1965 year-classes. In 1969 and 1970, haddock catches will apparently remain at a low level.

III. Red hake

In 1968, red hake catches increased slightly. In January, March and August, red hake were fished very successfully together with silver hake on the Shelf slopes in Div.5Zw and in October in the Nantucket shallow waters. In winter, red hake catches were represented by the specimens from 22 cm to 56 cm in length (5Zw), with three from 28 cm to 37 cm (mean length - 33.3 cm) predominating.

The results of counting the abundance of red hake in the autumn of 1968 by means of control trawlings were the same as in 1967. Therefore, it may be supposed that in 1969, the catches will remain at a low level as in 1968.

IV. Herring

In 1968, herring catches from Subarea 5 increased to 126,965 tons in comparison with 123,572 tons caught in 1967 (Table 15).

Table 15. USSR catches of herring (tons) in Subarea 5, 1962-1968.

Years	1962	1963	1964	1965	1966	1967	1968
Catches	151,144	97,329	130,723	36,349	117,346	123,572	126,965

A slight increase in total catch of herring was accompanied by a decrease in catch-per-unit effort. Thus, the average catches per day by SRT and SRT-R dropped from 8.2 tons in 1967 to 6.5 tons in 1968. The total herring catch for the vessels of this type was 749,000 tons in 1968. Herring catch was conducted from March to December. The greatest catches were in May, July, August and September.

In spring, herring was caught in the western part of Subarea 5; in summer - on the southwestern, eastern and northwestern parts of Georges Bank, in September and October - in northern and northwestern areas of the Bank, in December - in the areas of the Nantucket Bank. In general, herring taken from catches were from 28 cm to 33 cm in length. The mean body length changed from 27 cm to 32 cm according to the month and the area.

In the next two years, a decrease in herring stocks is not expected; therefore the catches will remain at the 1968 level and, possibly, below it, if the effort is equal.

V. Mackerel

Up to 1967, mackerel were caught in small numbers (Table 16). In 1967, their catches reached 11,907 tons, and in 1968 increased to 33,961 tons.

Table 16. USSR catches of mackerel (tons) in Subarea 5, 1963-1968.

Years	1962	1963	1964	1965	1966	1967	1968
Catches	-	869	533	2,460	5,446	11,407	33,961

The growth in mackerel catches may be explained, first, by a considerable increase in commercial concentrations as well as by a greater commercial effort. Because of the decrease in concentration of other fish species, vessels had to fish mackerel.

Mackerel taken from the commercial catches were from 27 to 35 cm long. The mean length changed according to the month and area from 26.5 cm to 33.7 cm. The mackerel stocks are at a relatively high level, and, apparently, in 1969 their catches can be higher than the 1968 level.

B. Special Investigations

I. Environmental Studies

1. Oceanography. Throughout 1968, four standard seasonal hydrological surveys were made in Subarea 5: 13-23 January; 2-9 May; 2-18 August; 9-19 October. At each station at the standard depths, 0, 10, 20, 30, 50, 75, 100, 150, 200, 300, 400, 500 m, temperature was measured by deep-water thermometers and the salinity was determined. In addition, from 1 to 6 July and from 19 to 24 July, bathythermograph surveys were completed on southern Georges Bank and from 8 to 10 September and from 6 to 9 October on the northern part of the Bank. Plankton and ichthyoplankton samples were collected at the same time. Data from the surveys show the intensification of inflow of Gulf Stream waters in 1968 onto the southern and southeastern slopes of Georges Bank. In the winter of 1968, in East Channel, the temperature of the 100 m-bottom layer was 0.5°C-1.0°C higher than in 1967. In May and July, the advection of warm waters from the south onto the bank was observed up to a depth of 60-70 m.

In May, an intensive inflow of warm water to the East Channel was observed and from August to October the advection of warm water continued. In October, this inflow through the Eastern Channel intensified and the warm waters filled not only the deeps lying to the north of the bank, but also the areas outside of them. In August, bottom temperatures in the East Channel ranged from 8°C to 9.3°C and in October - from 8°C to 10°C. Thus, in 1968, the heat content of the water masses off Georges Bank was almost the same as in 1962-1963 and higher than in 1967.

2. Zooplankton. In 1968, during the seasonal hydrological surveys the collection of zooplankton samples was made with a Dzeddy net in Subarea 5. Zooplankton samples were collected during microsurveys of silver hake and herring spawning areas. In September, plankton was collected with plankton samplers to study the catchability of these gears under the different collecting conditions provided by the USSR *Blesk* with the US *Albatross IV* and the Canadian *Theta*.

3. Ichthyoplankton. In 1968, the collection of ichthyoplankton samples was continued in the silver hake and red hake spawning areas and the processing of samples collected in 1965 was completed. Analysis of the 1965 data showed that in the second half of June, in the beginning both of July and August the greatest number of silver hake eggs was found on the southern slopes of Georges Bank (from 115 to 1,450 specimens/m^2). In July, the egg number was less than in June and August. The maximum number of silver hake larvae was sampled on southwestern Georges Bank. It should be taken into account that larvae were larger there than on the southern slopes; this fact suggests that the eggs and

larvae were drifting in a southwesterly direction along the southern slopes of Georges Bank.

The abundance of red hake eggs and larvae in samples from the catches increased on the southern slopes of Georges Bank from July to early in August showing that the peak of red hake spawning was in the beginning of August. Red hake and silver hake larvae were drifting in a southwestern direction. The analysis of the intestinal content of silver hake larvae showed that they fed on nauplii and on different Copepoda stages.

II. Biological Studies

1. Silver hake

a. Age determination. From March to September 1968, 28 samples of silver hake were taken from the catches to determine the age composition. The age of 2,262 specimens was determined from otoliths. As seen from Table 17, the 3-, 4- and 5-year-olds prevailed in the catches, and the proportion of 3-year-old specimens decreased from 56.4% in March to 28.7% in September. But the 5-year-olds increased from 3.2% in March to 15.5% in September.

Table 17. Age composition (%) of silver hake catches in Div.5Z. March-September September 1968.

Months	Age									
	1	2	3	4	5	6	7	8	9	Total
March	-	8.9	56.4	30.7	3.2	0.4	0.3	0.1	+	100.0
June	-	0.3	37.6	45.0	14.2	2.2	0.4	0.2	0.1	100.0
August	2.6	1.6	27.6	37.3	20.5	4.9	2.4	2.2	0.9	100.0
September	4.7	2.9	28.7	25.2	23.9	10.0	2.6	1.3	0.7	100.0
Average	1.8	3.4	37.6	34.6	15.5	4.4	1.4	0.9	0.4	100.0

The size composition changed correspondingly to the age composition. Thus, in March, the mean length of silver hake was 27.3 cm, in June - 30.4 cm, in August - 33.7 cm and in September - 33.9 cm.

b. Population studies. Studies of serum and erythrocyte antigens of blood of silver hake from the areas of the Sable Island, Georges Bank and the Middle Atlantic States were continued to determine both the intraspecific biological groups of hake and the amount of their mixing at the autumn-winter period. A complex of the immunoserological methods (electrophoresis in agar gel, immunoelectrophoresis, reaction of precipitation in gel and hemoagglutination) were used.

A comparative analysis of the silver hake specific blood antigens found helped to distinguish three populations: the first one in the Sable Island area, the second on Georges Bank and the third population along the Middle Atlantic States. The populations of the last two areas can be observed in the mixed stocks during autumn and winter. It was also found that the antigen components of silver hake blood serum fluctuated slightly by sex, size and age during the autumn-winter period.

In addition, during this period, based on the data obtained, a preliminary determination of the quantity percentage of two silver hake populations found in mixed concentrations was made. It appeared that the silver hake population of the Middle Atlantic States observed in the Georges Bank area made about 14%, and silver hake population of Georges Bank inhabiting the area of Middle Atlantic States about 35%.

c. Studies on the feeding of silver hake. In 1968, the data on silver hake feeding were treated (they were collected in Div.4W, 4X, 5Z and 6A in 1965-1967).

The analysis of intestinal content was made for 42,515 specimens. Food was found in 16,597 intestines (39.1%). The species composition of organisms serving as a basis for silver hake feeding was determined. Fifty-seven species of invertebrates and fishes were included into the list of the organisms, 73.7% of them were represented by typical planktonic and bathypelagic species. Some peculiarities in feeding of silver hake of different size groups were discovered. Thus, the immature hake (less than 30 cm in length) fed mainly on Euphausiidae. But, with growth the proportion of fish in their feeding increases. The specimens from 35 cm to 40 cm long fed mostly on fish (frequency from 42% to 96%). Females more than 40 cm long fed exclusively on fish. Some differences were found in the intensity of feeding by areas and seasons.

While studying the daily regime of food consumption two peaks, one at 1000-1200 hrs and the other at 0200-0400 hrs, were observed for feeding of silver hake inhabiting the southern slopes of Georges Bank, the Shelf slopes of the Nantucket area in March and April. But early in May, three peaks, one at 0700-0800 hrs, another at 1400-1500 hrs and another at 0400-0500 hrs, were found in feeding of silver hake inhabiting the slopes of the Nova Scotia Shelf.

2. Haddock. In June, July and August 1968, otoliths were taken from 298, 100 and 200 haddock specimens respectively. The results of age determination showed that the bulk of the research vessels catches took haddock at 4, 5 and 6 years of age. It is possible to assume, that, in most cases, commercial haddock catches were also represented by 4-, 5- and 6-year-old fish at that time, because the fish finding vessels made control haulings in the fishery areas and used analogous trawls.

Table 18. Age composition (%) of haddock in the catches of fish finding trawlers on Georges Bank, 1968.

Months	Age							Total
	3	4	5	6	7	8	9	
June	5.6	24.2	16.7	29.5	12.3	10.7	1.0	100.0
July	5.0	26.0	55.0	13.0	1.0	-	-	100.0
August	-	25.5	35.0	37.5	2.0	-	-	100.0

3. Red hake. In 1968, the study of stock locality, age-size composition and growth rate of red hake was continued.

Statistically reliable differences in the otolith weight of fish of the same length and sex were observed for red hake from the southeastern and southern slopes of Georges Bank. Such differences were not observed for the red hake inhabiting the area from Cape Cod to Hudson Canyon or the area lying to southwest of Hudson Canyon. But, it is necessary to conduct further such investigations to obtain final conclusions.

Age of the red hake inhabiting the southeastern slopes of Georges Bank was mainly 4 to 5 years old (27.4% and 22.5% correspondingly).

Three- to 5-year-old fish prevailed on southern slopes of Georges Bank and in the area from Cape Cod to Hudson Canyon. These age groups comprised about 70% of the catches.

In comparison with previous years (1965-1966), "ageing" of red hake was observed in the main areas of the fishery, so the mean age increased by one year. "Ageing" may be apparently explained by the fact that recruitment to the commercial stock was from poor year-classes during the past few years.

No great changes were observed in the size composition of this species in comparison with the previous years; that cannot be said about the age composition.

The analysis of length and age data showed that in 1968 the growth rate of red hake was slightly slower than the rate in previous years.

4. Herring

a. Studies of age composition. From March to September 1968, the herring samples were systematically taken from commercial catches to study the age composition. Age determination was made by otoliths in 38 samples for 3,504 herring specimens. Thus, it was established that in March-September 1968, the age composition averaged for the first age-group - 0.1%, the second - 0.5%, the third - 5.3%, the fourth - 8.0%, the fifth - 20.1%, the sixth - 22.5%, the seventh - 37.3%, the eighth - 6.1% and the ninth - 0.1%.

Thus, in 1968, the bulk of catches were of herring of 5, 6 and 7 years of age, *i.e.* the 1961, 1962 and 1963 year-classes.

The 1961 year-class was average in abundance. In 1968 it decreased considerably in abundance due to natural and fishing mortalities. The 1962 and 1963 year-classes and the next ones may be related to relatively poor year-classes. The rich 1960 year-class has dropped out of fishery, comprising only 6.1% at the age of eight years. Thus, in 1969, the herring stocks will, on the whole, include poor year-classes which undoubtedly will influence the effectiveness of the fishery in 1969 and 1970.

b. Estimation of the spawning population from the number of eggs deposited. Egg counts on the spawning grounds in the northern part of Georges Bank showed that eggs were deposited over an area of 5.7 km^2, the stock of the spawning population was 130 thousand tons. However, some spawning grounds were not taken into account. By preliminary assessment, they made not more than 1 km^2.

Thus, in 1968, the spawning stock of herring on the northern part of Georges Bank comprised about 150 thousand tons which was considerably below the 1964-1965 level.

c. Population studies. In August-September 1968, the immunoserological blood studies from 1,200 specimens were conducted on spawning concentrations of herring in the northern part of Georges Bank.

Three phenotypes (three blood groups, *i.e.* A_1, A_2 and A_o) were found by the erythrocyte antigens. These phenotypes made the three-allelic system of blood groups named A - system.

It is supposed that the antigens "A" and "C" (described by Sindermann) are identical.

Surveys conducted on the spawning grounds show that two groups of herring are present, one of them is characterized by the absence of phenotype A_o.

XI. United Kingdom Research Report, 1968

by D.J.Garrod and B.B.Parrish

Subareas 1-5

A. Status of the Fisheries

Improved prospects for fishing in the northeast Atlantic led to a substantial redeployment of the UK fleet in the second half of the year, with a consequent decrease in fishing effort and nominal catches from northwest Atlantic grounds. Hitherto the fleet fishing in the ICNAF area has comprised wetfish side trawlers, stern freezer and factory trawlers. In 1968 fishing was restricted to the first two categories, and fishing by side trawlers fell to negligible proportions (13 trips compared with 71 in 1968). Fishing by freezer trawlers fell to 60% and the total fishing effort by side and stern trawlers combined was reduced to 55% of the 1967 level.

However, the diversion of UK effort has taken place mainly since the summer when catch rates for cod in the northwest Atlantic are tending toward a seasonally low level and, as a result, the average catch-per-unit-effort in 1968 was slightly higher than in 1967. Consequently the 40% fall in nominal catches of cod (76,500 tons in 1967 to 46,000 tons in 1968) was slightly less than the proportional reduction in fishing effort.

The changed distribution of fishing had greatest effect on UK fisheries at West Greenland and Newfoundland which were both reduced by about one half. However, at Greenland the catch-per-unit-effort increased slightly in Div.1C and 1D and there were a number of outstanding voyages to Div.1F. At Newfoundland and Labrador the catch-per-unit-effort also increased slightly. Fishing in Div.3K was particularly successful early in the year but in general the improvements reflect seasonal change in the distribution of fishing, which in all areas tended to concentrate in the early part of the year when catch rates are highest, rather than to a real improvement in stock abundance. No fishing took place in Subareas 4, 5 or 6.

Routine length and age sampling of commercial landings has continued but no research or charter trips were carried out in the ICNAF area in 1968.

Inspection of the length compositions shows that at West Greenland the average length of cod caught in Div.1D and 1E was slightly lower than in 1967, but in Div. 1F the proportion of cod longer than 60 cm increased considerably. At Newfoundland also, the proportion of small cod increased, particularly in Div.3L where 75% of cod landed measured less than 50 cm. These may be associated with recruitment of the 1964 year-class to the fishery. There was no change in the length composition of UK landings from Labrador.

B. Special Research Studies

I. Environmental Studies

Plankton studies

The survey with Continuous Plankton Recorders, operated from the Oceanographic Laboratory, Edinburgh, was continued in 1968 on the same basis as previous years in the ICNAF area. It was financed by the UK Natural Environment Research Council and by the Department of the United States Navy through contract F61052-67-C0091 between the Scottish Marine Biological Association and the Office of Naval Research, Department of the U.S. Navy.

Recorders, sampling at a depth of 10 m, were towed at monthly intervals along standard routes by US Coast Guard cutters and merchant ships from Denmark, Iceland and the United Kingdom. During 1968, there were 1,954 miles of sampling in Subarea 1, 3,460 in Subarea 2, 14,630 in Subarea 3, 4,651 in Subarea 4 and 982 in Subarea 5, making a total of 25,677 miles in the ICNAF area. 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 request from the Director, Oceanographic Laboratory, Craighall Road, Edinburgh, EH6 4RQ, Scotland.

As in 1967, the spring outbreak of phytoplankton was early in Subareas 2 and 3, with maxima in March in Subarea 3 and April in Subarea 2. Phytoplankton was abundant as usual over the Grand Banks from February until May, but numbers were low in the coastal regions of Subareas 4 and 5, where the highest numbers appeared from September onwards.

Young stages of *Calanus finmarchicus* (the dominant copepod in the ICNAF area) were abundant in April and May in Subareas 2 and 3, that is much earlier than usual. Numbers of adult *Calanus* were above average for most of the year in these areas. Copepods were more numerous than usual over the Grand Banks until June, but below average for the rest of the year.

Young stages of the population of *Sebastes* spp. found in North American shelf and slope waters were scarcer in 1968 than any year since they were first found in Recorder samples in 1963. None were found in June and July to the north of the Grand Banks, a region where high numbers usually occur. These results are in sharp contrast with the sampling from the oceanic population of *Sebastes* southwest of Iceland, outside the ICNAF area, where the larvae were much more abundant than usual.

II. Biological Studies

North Atlantic salmon

The investigation of the West Greenland salmon fishery was continued in 1968. Four scientists from the United Kingdom took part in the programme, together with an English salmon netsman.

The main item in the inshore tagging programme was a fuller test of Northumbrian T-nets, which had been tested to some extent in 1967. Pelagic long lines were also fished. The results of this tagging programme were disappointing as, in all, only 220 fish were caught, of which 41 were tagged. The number of fish caught in a condition fit for tagging was higher in the T-nets (13 out of 23) and the floating long lines (5 out of 11) than in the gill-nets (23 out of 186); the fish caught on long lines were in particularly good condition. Salmon were scarcer on the West Greenland coast in 1968 than in the previous three years and this, no doubt affected the research catches.

Investigations of the blood and other biochemical characteristics of West Greenland salmon were continued and salmon were collected for parasite studies. The results of the studies of blood groups and liver esterases suggest that the proportion of Scottish-type salmon in the West Greenland stock may be about 20%. This is, however, a preliminary and tentative estimate which requires confirmation.

Four tags have been returned from salmon tagged in West Greenland in 1967. Of these, two were caught in Ireland and one each in Canada and Scotland. A report was received stating that three more fish, bearing Greenland tags, were seen in the Miramichi River (Canada) in 1968.

Investigations in home waters in connection with the Greenland problem have also been continued and, in particular, during the spring of 1968, 37,182 smolts (chiefly hatchery-reared) were tagged in England and Wales from 10 river systems, and 21,033 smolts (chiefly wild) were tagged, from 4 river systems, in Scotland. So far, records have been received of the recapture in the West Greenland fishery in 1968 of 20 of the smolts tagged in the United Kingdom in 1967; 5 were tagged in England and Wales and 15 in Scotland.

XII. United States Research Report, 1968

by Herbert W. Graham

The United States landed fish from ICNAF Statistical Subareas 3, 4, 5 and 6 and conducted research in Subareas 1, 3, 4 and 5.

Subarea 1

The United States Coast Guard conducted oceanographic surveys in the neighbourhood of Disko 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 samples.

Twenty-one quantitative samples of the benthic fauna were obtained with a Van Veen grab sampler. Collections were taken at water depths from 72 to 747 m. Common components were polychaete worms, bivalve mollusks, echinoderms, and bryozoans. A large proportion of the organisisms were of small size, ranging from 5 to 20 m. The fauna was judged to be typical of macrobenthic invertebrates previously reported from Arctic soft-bottom habitats in the depth range.

Subarea 3

A. Status of the Fisheries

I. Redfish

Redfish landings by the United States from Subarea 3 were slightly higher in 1968 than in 1967 (Table 3.1). Indications point to an increased abundance; however, with the relatively low effort, fishing success may not be 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

Subarea 4

A. Status of the Fisheries

I. Haddock

Haddock landings by the United States were primarily from Div.4X. Landings decreased by almost two thousand metric tons (Table 4.1). Southeastern Nova Scotia (Brown Bank) is the principal area of fishing by the US fleet within this Division. US landings in this area were slightly higher than in 1967 because of increased effort; abundance was reduced. Preliminary analysis of length frequencies and age data for this area for previous years show that the 1963 year-class was fished heavily as 3- and 4-year olds (Table 4.2). Also this year-class might not have been relatively as strong here as on Georges Bank. This heavy cropping of the 1963 year-class as it first became available to the fisheries and the failure of subsequent year-classes to add materially to recruitment has resulted in the decreased abundance during 1968. Continued decreases are expected for at least two more years.

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

Year	Div.4X Landings	Browns Bank Landings	Browns Bank Days Fished	Browns Bank Landings/Day Fished
1963	7,223	5,277	812	6.5
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

Table 4.2 Percent age composition of Browns Bank haddock.

Year	Age 3	4	5	6	7	8	9+
1963[1]	1.5	26.8	27.3	17.4	15.4	8.1	6.4
1964[1]	2.3	9.2	47.1	15.9	7.9	8.0	9.5
1965[1]	1.0	4.5	15.4	39.0	19.2	7.5	13.5
1966	20.9	22.5	10.5	11.0	21.8	5.5	7.3
1967	-	48.4	31.1	6.6	4.9	6.0	2.7
1968[1]	-	1.4	58.1	28.7	4.1	2.3	5.5

[1] Quarter 1 and 2 only.

II. Cod

In 1968 the US cod landings from Subarea 4 were 860 m tons compared to 1,435 m tons in 1967. This decrease is probably related to the reduced effort for haddock over the year.

III. Redfish

Redfish landings from the Gulf of St. Lawrence (Div.4R, S, T) by the United States increased slightly in 1968 (Table 4.3). Effort increased and abundance remained close to the 1967 level. US redfish landings and effort from the Scotian Shelf (Div.4V, W, X) continued to decline in 1968 (Table 4.4). Because effort level was extremely low, landings per day fished may not be indicative of true abundance.

Table 4.3 US redfish statistics, Div.4R, S, T (metric tons, round fresh)

Year	Landings	Days Fished	Landings/Day Fished
1963	4,879	508	9.6
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

Table 4.4 US redfish statistics, Div.4V, W, X (metric tons, round fresh)

Year	Landings	Days Fished	Landings/Day Fished
1963	23,282	3,104	7.5
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	4,663	295	15.8

B. Special Research Studies

I. Biological Studies

1. Haddock. Cooperative studies with Canadian scientists on the stocks of haddock in Div.4X have continued. Statistics and market samples of length and age frequencies for the period 1962-1968 are being analysed to obtain estimates of mortality and to determine the status of this fishery.

Analysis of data from the US research vessel surveys is also being carried on to provide a second, independent estimate of the state of the stocks.

These studies should be completed in 1969. Preliminary results indicate an increased mortality rate commensurate with increased removals in recent years. Abundance is decreasing and all year-classes since that of 1963 are poor.

Subarea 5

A. Status of the Fisheries

I. Haddock

Georges Bank (Div.5Z) haddock landings by the United States continued their sharp decline due to decreased abundance (Table 5.1).

Age compositions (Figure 5.1) show 5- and 6-year olds (1963 and 1962 year-classes) making up 71% of the catch in 1968. The fall groundfish survey by *Albatross IV* showed a below average 1968 year-class; the fifth consecutive year of poor production (Table 5.2). A continued reduction in abundance on Georges Bank is expected through at least 1971.

A management program for this stock is urgently needed, and is being considered by the US and the Assessment Subcommittee (see biological studies).

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

Year	Subarea 5 Landings	Div.5Y Landings	Div. 5Z Landings	Div. 5Z Days Fished	Div. 5Z Landings/Day Fished
1963	48,892[1]	4,742	44,126	10,029	4.4
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	9,370	3.7
1968	28,887	3,418	25,469	9,096	2.8

[1] Total includes a small amount for which the division of catch was unknown.

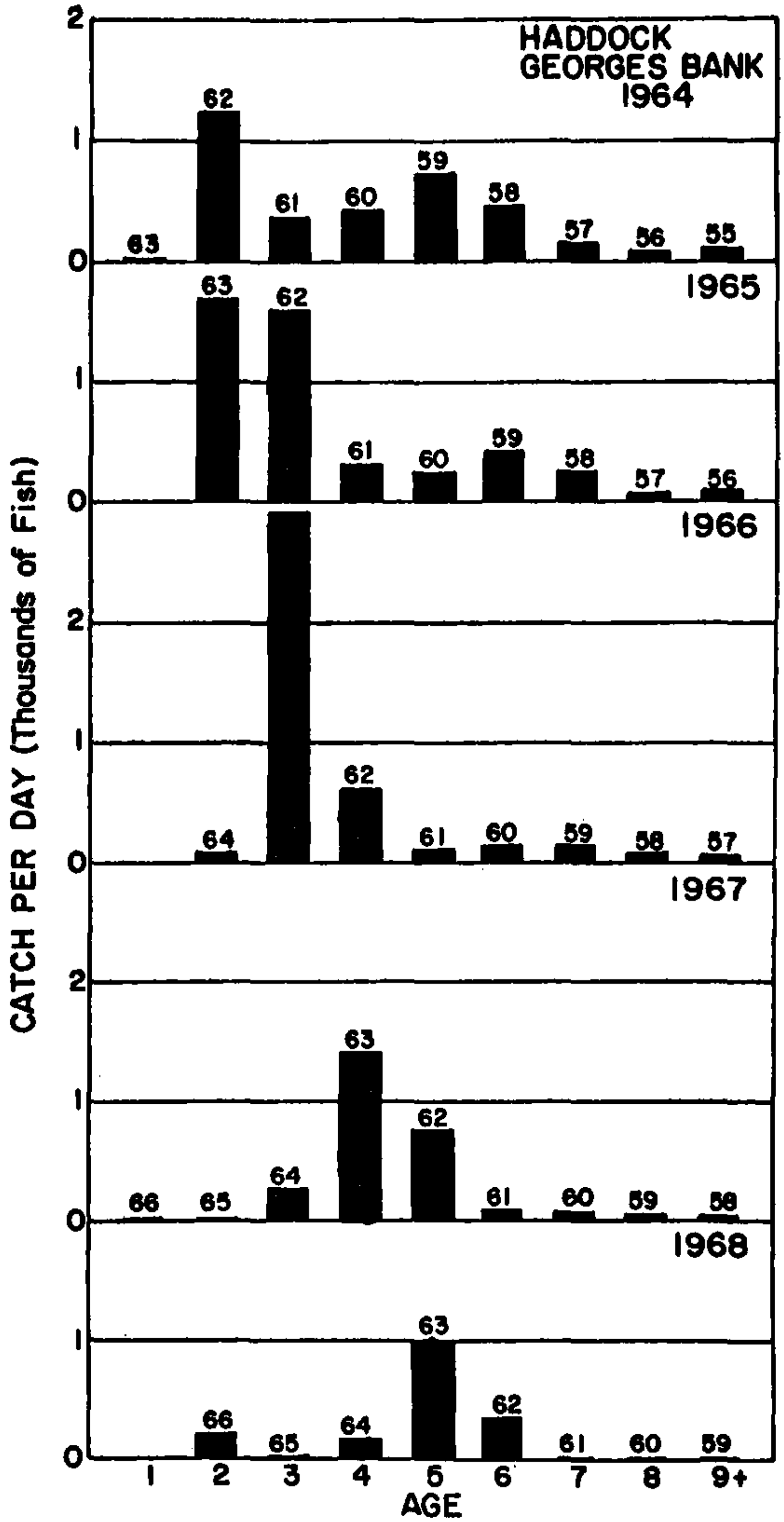

Fig. 1. Age composition of Georges Bank haddock.

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

II. Cod

Cod landings by the US in Subarea 5 for 1968 increased 2,000 m tons over 1967 (Table 5.3). Although the landings per day fished are not a precise indication of abundance of cod in the subarea, it is slightly higher than in 1967.

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

Year	Landings	Landings/Day Fished
1963	16,734	1.8
1964	15,478	1.0
1965	15,011	0.9
1966	15,343	1.1
1967	18,057	1.0
1968	20,877	1.4

III. Silver hake

Total silver hake landings from Subarea 5 by the United States was about 5,000 m tons above 1967 (Table 5.4). Most of the increase was for the food fishery in the Gulf of Maine where the abundance trend increased markedly. Catch rate and landings remained near the 1967 level in the southern part.

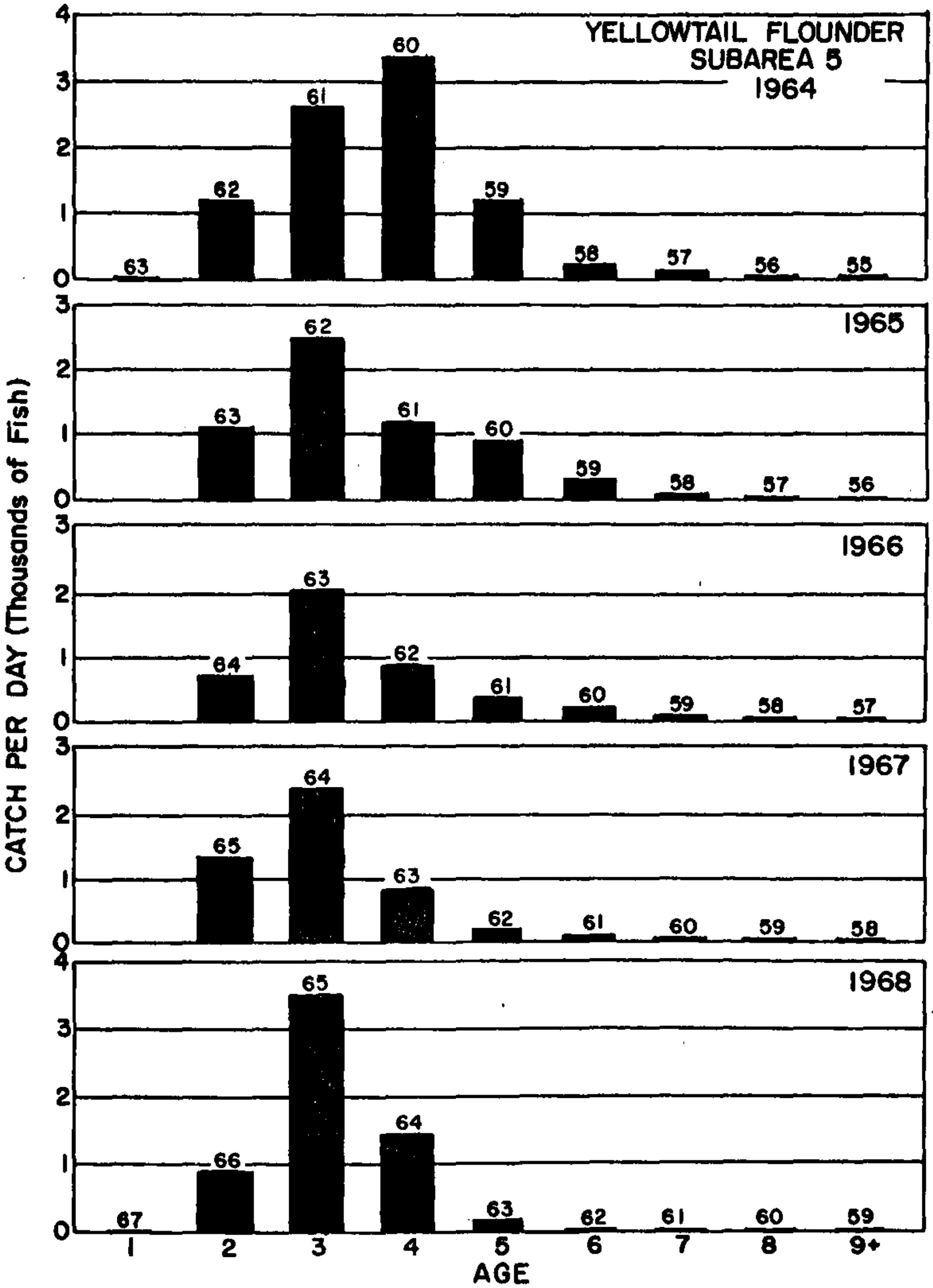

Fig. 5.2. Age composition of Subarea 5 yellowtail flounder.

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

Year	Subarea 5	Subarea 5 North[1]		Subarea 5 South[2]	
	Landings	Landings	Landings/Day	Landings	Landings/Day
1963	47,737	39,247	17.4	8,490	5.9
1964	53,145	39,479	15.1	13,666	11.5
1965	41,809	33,774	11.3	8,035	4.4
1966	40,200	37,545	12.7	2,655	2.0
1967	30,947	27,082	9.3	3,865	3.9
1968	35,842	32,366	14.0	3,476	4.0

1 Primarily food fish from north of Cape Cod.
2 Primarily for industrial use from south of Cape Cod.

IV. Redfish

Redfish effort and landings by the United States from Subarea 5 declined in 1968. Landings per day, however, were slightly higher. Abundance of this stock has apparently recovered markedly from its previous low state because of the reduced catches in recent years (Table 5.5).

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

Year	Total Subarea 5	Div.5Y (Gulf of Maine)		
	Landings	Landings	Days Fished	Landings/Day Fished
1963	8,871	6,785	1,655	4.1
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

V. Yellowtail

Total US yellowtail landings in 1968 from Subarea 5 increased significantly from 1967 (Table 5.6). A rise in abundance accounted for the landings increase.

The age composition of yellowtail in 1968 (Figure 5.2) showed a dominance of two strong year-classes; 1965 and 1964 (3- and 4-year olds). These two year-classes along with a relatively good 1966 year-class were responsible for the upswing in landings and abundance which should remain near the same level in 1969.

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

Year	Landings	Days Fished	Landings/Day Fished
1962	25,538	8,238	3.1
1963	35,220	9,031	3.9
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	32,564[1]	10,855	3.0

[1] 1965-1968 values include some landings for industrial purposes.

VI. Red hake

Red hake landings by the US in 1968 were about 500 m tons greater than in 1967 (Table 5.7). Landings per day continued a slow increase 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	Div.5Z[1] Days Fished	Div.5Z[1] Landings/Day Fished
1963	3,166	579	2,584	165	15.7
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

[1] Predominately industrial landings.

VII. Industrial Groundfish Fishery

New England industrial groundfish landings (Table 5.8) were slightly lower in 1968 than in 1967. Species composition remained relatively similar to 1966 and 1967 although red hakes did show some percentage increase, while the flounders decreased by an equal amount.

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
1963	26,020	19.5	43.7	4.4	2.1	30.3
1964	27,899	20.0	42.6	11.6	0.9	24.9
1965	34,044	20.4	38.0	6.9	1.8	32.9
1966	28,337	9.6	10.2	18.2	25.0	37.0
1967	38,688	10.2	14.7	18.5	18.9	37.7
1968	36,139	9.9	17.2	16.5	24.2	32.2

VIII. Herring

The catch of Maine sardines continues below average. The catch of 7,100 m tons in western Maine in 1968 was the third lowest in the 22 years of record keeping. The catch of 11,300 m tons in central Maine was the fourth lowest in 22 years. An hypothesis that the sardine distribution was recently shifted eastward is supported in 1968 with the largest catch in eastern Maine since 1958. Although this catch of 9,300 m tons is relatively small, compared to the catches of 15,000 to 30,000 m tons of the late 1940's and early 1950's, it may be a significant increase.

The number of cases of sardines packed (1,630,000) for 1968 was the largest number of cases packed since 1962 when the dominant 1960 year-class entered the fishery. The large pack was made possible by imports from Canada. The purse seine catch, which had increased steadily from 1963 to 57% of the total catch in 1967, declined to 28% in 1968.

The age composition of the 1968 sardine fishery of Maine, based upon an analysis of 355 samples (8,875 otolith pairs) is shown in Table 5.9. Immature herring formed 99% of the fish used. In 1968, 4-year-old fish were only 0.5% of the catch in contrast to 1967 when they contributed 15%, the highest on record.

Table 5.9 Age composition of the Maine sardine landings in 1968.

Age-group	Year-class	Percentage
I	1967	2.3
II	1966	83.6
III	1965	13.2
IV	1964	0.5
V	1963 or earlier	0.4

Sampling of the offshore herring fishery was limited to two autumn cruises, and among the fish obtained for study from the Georges Bank area, the 1962 year-class was most numerous. In the Gulf of Maine, the 1961 year-class was most numerous.

The gonadal condition of the specimens showed that spawning generally took place earlier this year than in 1967. Larval herring were captured in September on Georges Bank, indicating spawning in early September.

Fish in age-groups III-VIII from Georges Bank, the coastal Gulf of Maine, Nova Scotia and Subarea 6 ranged in length from 23.8-33.7; 19.6-35.1; 18.5-34.5; 12.9-33.7 cm respectively.

A substantial fishery for reduction developed during the year in the Jeffreys Ledge area of the Gulf of Maine. US and Canadian catches in this area approximated 30,000 tons. Vessels from other countries also fished in this area during late October.

IX. Sea scallops

United States sea scallop landings from Georges Bank declined in 1968 (Table 5.10) despite an increased effort. The research vessel index showed a sharp decline from 1967, while the commercial landings per day fished reflected only a slight decrease.

Table 5.10 US sea scallop statistics, Subarea 5 (metric tons, weight of adductor muscle only).

Year	Landings	Days Fished	Landings/Day Fished	Research Vessel Index
1963	7,906	7,906	1.0	45.4
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

B. Special Research Studies

I. Environmental Studies

Hydrographic studies. The *Albatross IV* made temperature observations on all cruises conducted in the area. The US Coast Guard conducted two hydrographic cruises in Subarea 6, 5 and southern part of 4. Results are reported in other research documents. In general, the declining temperature trend observed over the past decade appears to have stopped or reversed.

The US Coast Guard is now conducting oceanographic projects at all North Atlantic Ocean Stations manned by US Coast Guard cutters as reported in separate document.

At the Bureau of Commercial Fisheries, Boothbay Harbor Laboratory, daily, monthly, and annual means of Boothbay Harbor air and water temperatures are available since 1905. Throughout the year, continuous recordings were made of surface sea temperatures (-5.5 ft. MLW), air temperature, and precipitation at Boothbay Harbor. In addition, continuous recordings were made of bottom sea temperature (-22 ft. MLW), salinity, tide level, wind speed and direction, dew point, and barometric pressure.

Surface water temperatures during 1968 were generally higher than in recent years. The annual mean was 8.0°C., the highest since 1964, and the greatest upswing in one year since the downward trend started in 1951.

Coastal plankton. As in previous years since 1963, quarterly cruises were made to monitor the distribution, abundance, and composition of the zooplankton in coastal waters of the Gulf of Maine. The mean-annual volumes were not significantly different from that in 1967. The predominant zooplankters in the samples were copepods.

Experiments were continued on the catching efficiences of the Gulf III and Bongo plankton samplers. Simultaneous collections were made with both samplers in winter, spring, summer and autumn to sort out the effects of the variations in the different sizes of zooplankters occurring in the different seasons. Both samplers were fitted with 0.366 netting as in earlier experiments. From these recent experiments and earlier testing of the hydrodynamics of the Gulf III, it was concluded that the high mesh velocity of the Gulf III results in significant extrusion of the smaller zooplankters.

Cooperative environmental research between the US, Canada, and the USSR is reported in other documents.

Benthic Studies. The Woods Hole Laboratory continued its studies of the bottom invertebrates in the Gulf of Maine-Georges Bank area. Analyses of the quantitative aspects of 1,100 samples from the continental shelf and slope off New England were summarized during the year. A special study was made of the relation of faunal composition to depth. In shallower depths mollusks comprise 57% of the biomass but only 4% in depths greater than 2,000 m. Echiurids constitute less than 1% of the biomass in shelf waters but nearly one-third at depths greater than 1,000 m. A study of the life histories of some of the mysids important in groundfish diet was completed.

Samples were collected in the peripheral coastal zone of the Gulf of Maine to complete the coverage of the general area. Although all of the samples have not been analyzed, more than 15 communities of benthic invertebrates were encountered during this cruise. Some of the richest and most varied assemblages occurred in rocky areas along the Maine coast, off western Nova Scotia, and in the vicinity of Nantucket Shoals.

II. Biological Studies

Haddock. Because of the critically low level of the Georges Bank haddock stock, the United States intensified its studies of the dynamics of this population.

Utilizing commercial fishery statistics collected since 1932, we have defined for the equilibrium state corresponding to the maximum harvestable surplus, in terms of numbers of fish, the average population density, fishery removals and recruitment. Overexploitation and abnormal recruitment in the past few years have caused an extreme departure from equilibrium and led to a very low stock density in 1968. Some form of regulation of fishing mortality is required to prevent establishment of an equilibrium at this low level of harvestable surplus. We have, therefore, attempted to estimate the current and short-term projected densities and recruitment rates in order to establish a basis for management; i.e. estimates of the numbers of fish in the population which are available as surplus production. This task is complicated because of the lack of data on current total removals, and because the structure of the US fishing fleet has changed radically thus altering the past relationship between fishing success and stock density and distribution.

Approximate estimates of the current status have been obtained, and reported to the Assessments Subcommittee of ICNAF. In brief, the information to date indicates that if removals in 1968 were about 31,000 m tons, as seems likely, a catch in 1969 of 5,000 tons or more would probably exceed the recruitment of young fish. Thus, a rather severe reduction in removals is required to begin the process of rebuilding the stock to levels providing maximum surplus production.

Because of the changing nature of the fishing fleets it has been necessary to develop new techniques for estimating haddock abundance. A least squares analysis routine is being used for testing an additive factorial model with two sets of parameters (vessel class and depth). Hypothesis testing was virtually completed for the years 1962-1968 and it is planned to begin work on point estimations during 1969.

The study of the timing and distribution of haddock spawning is now in its second year. Mature haddock are sampled from the commercial landings and research vessel surveys for stage of development of gonads. Material is preserved for research being carried out by Canadian biologists studying fecundity.

A second phase of the study, this year being carried out jointly with biologists of the Soviet Union, is concerned with the distribution of eggs and larvae in the surface waters.

At the time of writing (April) it is apparent that haddock spawning in 1969 is earlier than observed in 1968. This is correlated with higher water temperatures in the Gulf of Maine. This study will be continued with the objective of defining the various factors that determine both the timing and the effectiveness of spawning.

Silver hake. Length-weight studies are continuing. These will be used to define and compare parameters for different segments of the Subarea 5 stocks.

Age validation studies, particularly emphasizing problems in ageing young fish - through their second year of life - have been completed.

Joint US-USSR Groundfish Studies. The US *Albatross IV* and the USSR *Blesk* conducted joint trawling operations in October-November 1968, which were similar to those reported for 1967 but extended over a larger area. A comprehensive survey using the same sampling design employed in 1967, was conducted in statistical Subarea 6 and Div.5Z. *Albatross IV* then continued its standard fall survey in Div.5Y and 4X, and *Blesk* conducted limited trawling operations in the same areas using a new US trawl. Additional vessel-gear comparison studies were conducted including measurements of trawl dimensions during towing.

Operations again went smoothly and a preliminary report of the studies is included in the Research Document series.

Herring. Four years of winter mortality estimates for larval herring have been determined. They suggested that (1) the mortality for larvae in the Sheepscot estuary varies greatly from year to year (22-52%) and is sufficiently severe to govern the subsequent spring abundance of larvae; and (2) the estimates of larval abundance should be made after the winter mortality to provide better comparisons between the strength of year-classes and the recruitment of herring to the coastal sardine fishery. Increased mortalities were correlated with a decline in the condition factor of the larvae during winter. The 1964 year-class suffered the highest winter mortality, had the lowest maximum abundance in spring and the greatest decline in the condition factor in winter.

Examinations were made on the seasonal variations in the food of juvenile herring in coastal waters of the Gulf of Maine. Only 5 zooplankton taxa occurred commonly in the alimentary tracts: copepods, cirriped larvae, cladocerans, decapod larvae, and pelecypod larvae. Copepods were the most important food; in all seasons. They increased in importance from a low incidence in 55% of the feeding juveniles in spring to 100% in winter.

Cladocerans occurred most commonly in summer (in 69% of the feeding herring), and autumn (76%). Among the other taxa, larval cirripeds were in 48% of the feeding fish in spring and 41% in summer.

Salmon. Figures for the Greenland fishery in 1967 are now complete and 41 tags of Maine origin were recovered in Subarea 1. Thirty-six of the tags were applied to smolts and 5 to kelts. Tag recovery figures from this fishery indicate that 40% of the kelt tags recovered in Subarea 1 are of Maine origin.

Tag recoveries in 1968 from all areas north of Div.5Y stands at 118 tags with 4 recovered in Subarea 1. An additional 164 tags were recovered in home waters. Tag returns for 1968 are incomplete.

Tagging studies are continuing with 76,600 tagged smolts released in the spring of 1968 and an additional 77,000 smolts tagged for release in the spring of 1969.

Preliminary data reveals a higher survival for 2-year-old hatchery-reared smolts. A comparison of 1-and 2-year-old smolts further indicates that fish must exceed 18 cm in total length if suitable returns are to be expected.

Home river catches were reduced in 1968. In the 5-year period 1964-68 the average annual sport catch has decreased 36% as compared to the average annual catch for the preceding 5-year period.

Lobster. Studies are underway to indentify the major stocks and subpopulations within the lobster resource. Major emphasis is placed on the relationships between offshore stocks on the outer continental shelf and those of immediate US coastal areas. Four approaches, namely, biochemistry, parasitology, tagging, and biostatistics, are directed toward fuller understanding of stock indentity. Additional studies include migratory behaviour, growth, natural mortality, and rate of exploitation. Seasonal abundance and distribution of planktonic larval stages will also be studied as part of a broader coastwide and offshore program.

In July 1968 a preliminary "aquaculture" program was commenced with the northern lobster, *Homarus americanus*. The objective of the program will be to obtain the information necessary to evaluate the economic feasibility of lobster culture. At present, studies are underway to determine the ecological requirements necessary for hatching lobster eggs under laboratory conditions. The ecological and nutritional requirements of laboratory-reared larvae and juveniles are being investigated also, with a view to increasing growth rate and molting frequency, and decreasing the high mortality suffered during these early stages.

Research in Statistical Subarea 6

The joint US-USSR groundfish surveys extended as far south as Cape Hatteras.

The Sandy Hook Laboratory of the Bureau of Sport Fisheries and Wildlife continued its aerial temperature surveys in cooperation with the United States Coast Guard covering the area from Cape Cod southward each month of the year.

The Laboratory is analysing samples collected on a plankton survey covering the area from Cape Cod to Cape Lookout, North Carolina. Larval hakes occur in these collections during the period May to December.

A special study of water circulation in the area 12 miles off Sandy Hook, New Jersey, by means of drift bottles and seabed drifters indicated a strong movement of bottom water to the north and northeast associated with strong prevailing northwest winds throughout November and December.