INTERNATIONAL COMMISSION FOR  THE NORTHWEST ATLANTIC FISHERIES

REDBOOK 1968 PART II

REPORTS ON RESEARCHES IN THE ICNAF AREA IN 1967

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Note

REDBOOK 1968 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 1967. The third book contains Part III, Selected Papers from the 1968 Annual Meeting.

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PART II. REPORTS ON RESEARCHES IN THE ICNAF AREA IN 1967

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PART II. REPORTS ON RESEARCHES IN THE ICNAF AREA IN 1967

I. Canadian Research Report, 1967

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 2 and 3. The Bedford Institute of Oceanography and the St. Andrews Biological Station of the Fisheries Research Board of Canada engaged in researches in Subareas 1-3. Canadian landings by subarea were not available when this report was written and the figures used for Newfoundland landings are preliminary and not by subarea, except where the fishery is mainly or wholly confined to one subarea. The status of the fisheries and special research studies on harp and hood seals in Subareas 2 and 3 are reported separately in Appendix I.

Subarea 1

A. Status of the Fisheries

There was no Canadian fishery in Subarea 1.

B. Special Research Studies

I. Biological Studies

1. Atlantic salmon, *Salmo salar L.* The *A.T.Cameron* took 54 Atlantic salmon in Subarea 1 between 17 September and 5 October. In offshore waters 5 drift sets (900 m/set) yielded 12 salmon; in fjords 4 sets yielded 23 salmon. Set-nets (180 m) in fjords yielded 18 salmon from 8 sets. Only 1 salmon was taken in 8 offshore longline sets (490 hooks/set); none in 4 sets in fjords. Most salmon were taken near the surface in water between 3.1 and 4.3°C; one was taken in water of 1.8°C. No salmon were taken in one drift net set in Subarea 2 (J) (52°23'N; 52°18'W: surface temperature 5.9°C). Forty specimens were brought to St. Andrews for study of their parasites.

Subarea 2

A. Status of the Fisheries

I. Cod, *Gadus morhua* L.

Cod landings of 31,000 tons from the inshore Labrador area were slightly higher than the 24,000 tons landed in 1966.

B. Special Research Studies

I. Environmental Studies

The hydrographic section on the southern Labrador Shelf from Seal Islands across Hamilton Inlet Bank was taken on 26-27 October.

The marine geology program of the Bedford Institute of Oceanography included bottom sampling and a bathymetric survey along the Labrador Shelf, in cooperation with the Hydrographic Service charting program.

Drifter experiments were initiated in Div.2J to study the surface and bottom circulation.

II. Biological Studies

1. Cod. Monitoring of age, length, sex and sexual maturity in the commercial cod landings was carried out in 5 inshore Labrador localities and the following numbers of cod were measured and otolithed: in Div.2G, 573 and 247; in 2H, 1,646 and 724; and in 2J, 8,618 and 1,432.

A survey by the *A.T.Cameron* was carried out from 18 October to 6 November to study autumn distribution of cod in the area. Fifty-three successful fishing sets were made on lines of stations extending from Cape Harrison in Subarea 2 to the La Scie Shelf in Div.3K. Best catches of cod occurred in depths of 145 and 180 m. Catches approaching 900 kg in 30 minutes were taken off Cape Harrison and near St. Anthony. Larger catches (up to 2,760 kg) occurred on Hamilton Inlet Bank. Comparative fishing trials with the German research vessel, *Walther Herwig*, were engaged in for 2 days during this cruise. The results are reported in another document.

Subarea 3

A. Status of the Fisheries

I. Cod

Newfoundland cod landings from Subareas 3 and 4 (mainly from the inshore fishery of Subarea 3) were about 143,000 tons, about 24,000 tons less than in 1966.

Landings from the inshore fishery during 1967 were generally lower than in 1966 although in a few areas catches were higher. An improved autumn fishery was insufficient to bring total landings up to the 1966 level. At Bonavista and St. John's the catch per haul in the cod trap fishery was below the 1966 level, at St. Mary's the catch was higher over a short period, while at Burin it was higher throughout the season. Generally small cod sizes reflect the low age (4 and 5 years) of the majority of fish in the catch.

In the gill net fishery in various areas, although there was seasonal success in some localities, such as Burin, with the rapidly increasing total effort annually the catch per unit of effort is declining, although the size of cod continues to be large in most localities.

In the inshore cod fishery it seems quite unlikely that additional increases in effort will yield a correlated increase in catch. Already in areas where different gears are operating on the same sizes of cod the competitive effects are noticeable.

II. Haddock, *Melanogrammus aeglefinus* (L.)

Newfoundland landings of haddock (from Subareas 3 and 4) fell slightly to about 1,940 tons. The spawning stock of haddock in Subarea 3 is now at a very low level with no indication of successful year-classes on the Grand Bank and an indication of minor success for the 1966 year-class on St. Pierre Bank.

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

Newfoundland redfish landings (from Subareas 3 and 4), almost all *S. mentella*, decreased to about 28,500 tons from 34,850 tons in 1966 of which about half were from Subarea 3.

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

Newfoundland landings of flounders, mainly American plaice from Subarea 3, increased slightly to 54,000 tons from 51,000 tons (88 percent American plaice) in 1966.

V. American plaice

On the Grand Bank, total Newfoundland effort for American plaice has been less, in recent years to 1966, north of 46°N and effort has increased rapidly on the eastern Grand Bank from 46°N southward to the tail of the bank. On the western part of the northern area, landings by the Newfoundland otter trawling fleet per hour's fishing have remained at about 450 kg and on the eastern part have declined in recent years from about 900 kg or over in the late 1950's to about 730 kg per hour. In the southeastern area south of 46°N, Newfoundland landings of American plaice per hour's fishing in recent years to 1966 are still as high, at about 680 kg, as they were in the late 1950's and higher than they were in the early 1960's.

Although complete information is not yet available, it is probable that the Newfoundland effort for American plaice in 1967 was greater than that in 1966.

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

Greenland halibut landings, almost entirely from the deep east coast Newfoundland bays in Subarea 3, increased slightly to about 15,600 tons from about 14,900 tons in 1966. The average length of the 1967 commercial catch of Greenland halibut sampled in Trinity Bay was 61.4 cm compared with 62.7 cm for 1966. This small decrease, when a larger one might have been expected from the considerable decrease in catch-per-unit effort, may be due to the use of larger mesh. Gill nets with 203 mm mesh were mainly used in 1967 compared with chiefly 165 and 178 mm mesh gill nets in 1966.

From catch and effort data on the commercial fleet collected at 3 Trinity Bay localities, the average landings of Greenland halibut per 90 m gill net in 1967 was 68 kg round weight compared with 157 kg in 1966. The average landings per 90 m longline decreased but not so greatly to 20 kg round weight in 1967 from 24 kg for 1966.

VII. Herring, *Clupea harengus* L.

Newfoundland herring landings mainly from Subarea 3 (especially Div. 3P but some from Subarea 4) increased greatly to 83,000 tons from 28,000 tons in 1966. This resulted from greatly increased purse seiner effort to supply herring for meal. Eighty-nine percent of these landings were used for fish meal compared with 69 percent of the smaller landings of 1966.

VIII. Atlantic salmon

Newfoundland commercial landings of Atlantic salmon (total from Subareas 2, 3 and 4) increased to 1,760 tons from 1,400 tons in 1966.

IX. Capelin, *Mallotus villosus* (Müller)

Total capelin landings of 3,500 tons (from Subareas 2, 3 and 4) were lower than the 4,850 tons landed in 1966. These are mainly landings as estimated by fishery officers. The decrease is due to decreased effort not to lack of capelin. The use of capelin for fish meal is increasing slowly but its use as cod bait is declining because of the increasing use of gill nets, and its use as fertilizer for potatoes and as food for dogs is decreasing also. The proportion used for producing fish meal was 28.5 percent which was only 90 tons higher than the 18.7 percent used for meal from the larger landings of 1966.

X. Swordfish, *Xiphias gladius* L.

Expansion of the swordfish fishery in Subarea 3 continued in 1967. Landings increased 24 percent to about 1,480 tons, all taken within the July-October period. New fishing areas are chiefly in the warm waters east of the tail of the Grand Bank.

XI. Short-finned squid, *Illex illecebrosus* (LeSueur)

Squid landings increased to 6,300 tons from 5,000 tons in 1966.

B. Special Research Studies

I. Environmental Studies

1. Hydrography. The standard section, St. John's-Flemish Cap, was taken on 25-27 July and Station 27, 3.2 km off Cape Spear, was occupied once or twice per month throughout the year. These observations are reported in Redbook 1968, Part III.

The survey, by the Bedford Institute of Oceanography, of the Sir Charles Hamilton Sound was continued for the third year, and will provide for new charts and current information in this area. A major hydrographic charting survey on the Grand Bank was continued with approximately 85,000 sq km being surveyed in 1967.

For the second consecutive year, drifter experiments were carried out in Subarea 3 (K, L, O, Ps) as part of a general program of circulation studies at the surface and along the bottom. Releases of drift bottles and sea-bed drifters were also made regularly at Station 27.

II. Biological Studies

1. Groundfish generally. The commercial inshore fishery for cod and the offshore otter trawl fishery for various groundfish species were sampled in important Newfoundland fishing ports. The information on age, growth, maturity, spawning, factors affecting distribution and abundance, catch-per-unit effort and the contributions of various year-classes to the fishery provide basic information for stock assessment.

2. Cod. Near the mouth of Trinity Bay on 3-6 March, cod caught in 255-285 m were feeding heavily on capelin. Although the cod were mainly large, younger fish 1-3 years old were also included in the catch. On 5-6 November in the same area in 148-320 m, the cod caught were mainly small.

In cruises of the *A.T.Cameron* to St. Pierre Bank in April-May and November-December, few large cod were caught, but fairly large numbers of small, 2- and 3-year-old cod were taken in depths of 75-145 m. Meristic studies suggest a separation of northern and southern St. Pierre Bank cod.

On the northeastern Grand Bank on 10-12 June, cod was generally the most abundant species caught. In the shallower depths (64-115 m), 3-year-olds were most abundant, but deeper the cod were generally aged 5 years and older.

In cruises of the *A.T.Cameron*, good cod catches were taken in June on the southeast slope of the Grand Bank and in July-August on the northern part

of the Southeast Shoal. These cod were mainly less than 45 cm in length. The cod catch per 30-min tow with a No.41 net (24.1 m headrope) on the southwestern Grand Bank in November was only 23 fish (15 kg).

Studies on the biology and distribution of cod caught in the commercial gill net fishery in the inshore area are continuing. Observations on these cod have shown that the majority of cod caught in drift nets on the east and southeast coasts of Newfoundland spawn in the bays and coastal areas in spring, in contrast to the smaller mature cod in cod trap and line catches in summer which apparently spawn before coming to the coast from offshore.

The inshore commercial cod fishery in Subarea 3 was sampled by 60,000 length measurements of random samples and the collection of otoliths from 7,000 fish.

3. Haddock. The catch of haddock per 30-min tow was 6 fish (4 kg) on a cruise to the Grand Bank in November. On St. Pierre Bank, the catches per 30-min tow in April and December were 254 (44 kg) and 186 (22 kg) respectively. Catches of one-year-old fish were good, but this year-class is apparently not as strong as the 1955 year-class was at the same age on St. Pierre Bank and there is doubt that it will become of much commercial importance.

4. Redfish. During the period 18-25 December, several good catches of baby redfish were taken by the *A.T.Cameron* on the southwestern slope of the Grand Bank. On each of the 4 lines visited, covering almost the complete range of the southwest slope of the Grand Bank, at least one catch of over 2,900 juvenile redfish was taken during the 30-min hauls which were standard for the trip. The largest catch, 9,570 juvenile fish, was obtained at a depth of 141-152 m at 43°22'00"N, 51°26'30"W. These young fish formed a well separated group with a mean length varying from 11.1 to 11.7 cm.

5. American plaice. A comparison of day and night catches was made during 3 days fishing, eight 1-hour otter-trawl sets per day, by the *A.T. Cameron* at a locality on the northeast slope of the Grand Bank at a depth of 110 m. The catches at 0200 and 2300 hr (Newfoundland Standard Time) were on the average the smallest, 103 and 151 kg, and the early morning 0500 hr and the early evening 2000 hr average catches were the largest, 381 and 347 kg. There was not much difference, however, in the catches in the six 3-hour periods between 0500 and 2000 hr, the catches from 0800 to 1700 hr ranging from 230 to 318 kg. American plaice grow slowly and do not reach minimum commercial length (30 cm) until between ages 6 and 7 on the southern half of the Grand Bank and between 8 and 10 years in the more northerly areas of this bank.

6. Herring. Beginning with the 1966-67 fishing season, herring investigations were concentrated on the population biology of the stocks supporting the major fisheries. Routine procedures were established for collecting, processing and reporting catches, spawnings and sampling data.

Fishing areas, based on land boundaries for the Department of Fisheries landing areas and ICNAF fishing areas, were described for the Newfoundland

herring fishery. These areas were incorporated in an area map for Canada's east coast herring fisheries, developed, in cooperation with the St. Andrews Station, for use in a standard log book. Catches for the 1964-65, 1965-66 and 1966-67 seine fisheries were compiled by area and week of capture from log books and/or plant records. Landings by other gears were compiled by herring fishing areas from records supplied by the Department of Fisheries. These data were reported along with an historical study of Newfoundland herring landings in a manuscript entitled "Herring landings and catches in Newfoundland and their implications concerning the distribution and abundance and stocks" submitted for publication as an FRB Technical Report.

Reports of herring spawnings in 1966, solicited from fishery officers and other interested parties, were compiled and reported in Circular No.14 distributed by this Station in July 1967. A similar report on the 1967 spawnings is in preparation, indicating some rather major shifts in the location and/or timing of spawnings from previous years.

During the 1966-67 fishing season, 222 samples were taken on a regular basis from the commercial catches at the two major ports of landing and at seven government bait depots. An additional 65 samples were taken on research cruises. Data on age, length, weight, sex, maturity and the number of vertebrae are being compiled for inclusion in an annual series of data records. They will be analyzed in 1968 along with similar data for the 1964-65, 1965-66 and 1967-68 seasons.

Techniques and procedures for estimating and recording the age of Newfoundland herring from otoliths were established in 1967. Age determinations at St. John's compared favourably with those by three other agencies in an otolith exchange program. However, there was appreciable disagreement between the various readers on the age of individual fish, indicating the need for further refinements in ageing techniques. This study is reported in a manuscript entitled "Ageing of herring at the St. John's Biological Station" submitted for publication as an FRB Technical Report. During 1967, age determinations were carried out for the 18 samples collected during the 1964-65 season, the 43 samples taken during the 1965-66 season and 50 of the 287 samples taken during the 1966-67 season.

In the 1966-67 season the herring moved onshore in quantity in the Bonne Bay area of the west coast of Newfoundland in the latter part of November and were found there until January. The onshore movement in quantity in the bays and inlets of the western half of the south coast of Newfoundland apparently begins in December and the main purse seiner fishery was from January to March. The fishery increased in April in the most western part of the south coast and the southern part of the west coast in the La Poile-Port aux Basques-St. George's Bay area. On the eastern parts of the south coast, in Fortune Bay and St. Mary's Bay, the main fishery was in April to early May, after which only small amounts of herring were caught by seine. Spring spawnings have been reported from most areas of the coast. Although no autumn spawnings were reported in 1966, the state of maturity of the herring samples suggests that many and perhaps most Newfoundland herring spawn in the late summer or later.

Additional information on herring researches is reported in *Redbook* 1968, Part III.

7. Pink salmon, *Oncorhynchus gorbuscha* (Walbaum). From 3,300,000 eggs of pink salmon from Lakelse River, British Columbia, planted in a controlled flow channel in North Harbour River, St. Mary's Bay, Newfoundland, 25 November-3 December 1965, about 3,000,000 fry left the river in May 1966. A few juvenile pinks from this run were seen in St. Mary's Bay as late as August and October 1966, the length in the latter month being 20 cm.

In 1967 the known returns of adult pink salmon from this planting were 8,440, of which 5,334 entered North Harbour River and 122 were noted in 10 other rivers (9 in Newfoundland and 1 in Quebec). Of these, 40 entered Come by Chance River in Placentia Bay and 31 Colinet River in St. Mary's Bay. The catch in the commercial fishery was 2,961, of which two-thirds were taken in Placentia Bay and St. Mary's Bay on the south coast of Newfoundland and the remainder on the east coast from White Bay to the Avalon Peninsula. Because a close check could be kept only on St. Mary's Bay where 1,169 pink salmon were caught commercially, it is certain that large numbers, possibly several thousand, of pink salmon escaped notice and were unrecorded in the commercial fishery in the other areas of Newfoundland. Three pink salmon were reported from Nova Scotia, 2 from Quebec and 2 from Labrador, at Forteau in the Strait of Belle Isle.

Spawning in North Harbour River occurred during September and was distributed along 5 miles of the main river and on 1 mile of a tributary. Egg deposition was estimated to be 4,400,000.

The 1967 returns were considerably different from those of 1966 when only 638 pink salmon (419 to North Harbour River) returned from the plantings of a similar number of eggs (3,400,000) in 1964, from which the estimated number of fry descending in 1965 was 2,900,000. It is apparent that conditions of survival at sea were unusually favourable for the 1967 fish and this agrees with the higher returns than usual of Atlantic salmon in 1967 despite the toll of the new Greenland fishery, although in the latter case where the numbers of smolts are unknown, the favourable survival may equally well have been in the river life.

8. Capelin. Research in 1967 was concentrated on a year-round investigation of the distribution, feeding, growth and maturation of an inshore population of capelin and on a comparative study of beach and offshore spawning stocks of capelin. The first of these two projects was carried out in Trinity Bay, whose extended length and wide range of depths made it well suited for this purpose. Capelin spawning on the beach at Outer Cove on the outer coast of the Avalon Peninsula and a few miles north of St. John's provided convenient access to an inshore spawning, and offshore spawning was examined on the Southeast Shoal of the Grand Bank.

The Trinity Bay capelin population was surveyed and sampled in early March by the *A.T.Cameron* and in early June and early November by the

Investigator II. In early March echo-sounder tracings showed the capelin concentrated near the bottom in relatively deep (130-220 m), cold (-0.4 to 0.5°C) water. The older (4-6 years) maturing fish had resumed feeding after cessation of feeding in winter and had a higher fat content. They were schooled separately from the younger (2-4 years) immature fish. By early June, the capelin had moved up into warmer shallower (less than 35 m) water inside the 183 m contour on the northern side of the bay. The older, mature capelin had ripened and had moved in toward the beaches where they were easily taken in gill nets. They had ceased feeding and their fat content was much lower than in March. They were still segregated from the younger, unripe fish which were feeding farther offshore in depths of 9-35 m, where they were readily captured by midwater trawl. By November the capelin had scattered and could not be detected by echo-sounder. A few were trawled from the bottom in depths of 165-255 m where the water temperature ranged from -0.5 to 1.1°C.

The spawning of capelin on the Southeast Shoal of the Grand Bank must have taken place in late June in 1967. On the *A.T.Cameron* cruise in late July and early August, capelin were taken in significant quantities in only 3 of 41 bottom drags. These fish were all spent and were much smaller than the maturing capelin taken there in early June. The spawning ridges on the males were in an advanced state of regression and many of the capelin, particularly females, were feeding. No capelin eggs were taken in bottom grabs but large numbers of capelin larvae from 7 to 9 mm in length were taken in surface plankton tows.

Observations of beach spawning at Outer Cove were carried out from 1 June to 10 August. Capelin began rolling on 19 June and spawning continued until 10 July. The rapid rise in temperature during this period (from 5.7°C to 10.4°C) probably forced the younger (2-3 years), late-maturing fish, to spawn offshore as the beach spawners were mainly older fish.

9. Swordfish. Biology and distribution of swordfish were investigated during one cruise on the commercial fishing vessel *Jane R.* and another on the research vessel *A.T.Cameron*: 144 specimens were examined for size, sex, food, and parasites, and 8 others were tagged and released. Individual weights ranged from 18.5 to 135 kg with a mean of 59 kg for 137 fish. The catch was predominantly female (3:1). Hooking rates were low (less than 1 percent), presumably as a result of competition from other large pelagics. Fishing was most productive in areas where surface temperatures were above 18°C. Preliminary analysis of stomach contents indicates greater variety in diet than in most areas north of Cape Cod.

10. Short-finned squid and cephalopods generally. Weekly random samples of short-finned squid were obtained from Holyrood, Conception Bay, for biological studies on growth, maturity, parasites, and feeding. A total of 6,500 specimens was examined. The program initiated there in 1966 to investigate the relationship between squid catch and physical factors was continued.

Work continued on collections of cephalopods from off all Canadian coasts. A synopsis of the recent Cephalopoda of Canada (48 species collected

to date) is in press and two larger systematic papers (one a bulletin on the squid of the Northwest Atlantic and adjacent Arctic, the other on systematics and biology of the sepiolid squid *Rossia*) are nearing completion.

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 of the Fisheries Research Board of Canada; the Bedford Institute of Oceanography of the Department of Energy, Mines and Resources; and la Station de Biologie marine du Ministère de l'Industrie et du Commerce of the Province of Québec. 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. 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

Landings of cod on the Canadian mainland were again the highest in weight for any single fish species, comprising about 39 percent of total groundfish landings. The total was down about 4 percent from 1966. Statistics of landings in northern New Brunswick from the Div.4T population indicated that the landings declined another 11 percent. The decrease in total landings is due to reduced landings from Div.4T and Subarea 5. The range of sizes and ages of cod landed from the Div.4T fishery remained much the same as in 1966, with peak numbers at 46 cm. The 1963 year-class was dominant. Discards remained low, about 1 percent.

II. Haddock

Haddock landings from Subarea 4, which increased about 25 percent in 1966, increased another 2 percent in 1967. The increase was in Div.4X while Div.4V-W were slightly lower than in 1966. Sizes of haddock landed did not change significantly from 1966.

III. Flatfishes

Combined landings of the various flatfish (plaice, witch, yellowtail, winter flounder) decreased about 25 percent from those in 1966. Statistics show a significant decrease in plaice and witch landings from Div.4T, accounting for much of the loss.

Total Atlantic halibut landings were 9 percent higher due to a slight rise in landings from Div.4X.

IV. Pollock

Pollock landings continued a downward trend, decreasing from 1966 by 14 percent. The decline is recorded for Div.4V, W and X.

V. Redfish

Redfish landings were mainly from Div.4R-S-T and were almost double those in 1966. Recent landings have been much higher than in the early 1960's. Most of this increase came from greater fishing effort on a series of new year-classes.

VI. Sea scallop, *Placopecten magellanicus* Gmelin

Offshore landings came principally from Browns Bank (4X) and increased by 40 percent to about 1,400 metric tons whole weight. Inshore landings from the Bay of Fundy continued to decline from 2,000 tons in 1966 to about 1,400 tons in 1967 (172,000 kg meats). Landings increased markedly from the southern Gulf of St. Lawrence, reaching 4,200 tons (1,400 in 1966), the highest recorded for this inshore fishery.

VII. Herring

Herring landings amounted to more than 256,000 tons, an increase of about 28,000 tons (12 percent) over 1966. Increases occurred in Div.4T (26,000 tons) and 4X (2,000). Landings decreased slightly in Div.4S and 4W, but less than 1 percent of the herring catch is taken there.

VIII. Swordfish

Landings of swordfish at about 1,300 tons were about 200 tons greater than in 1966. They contributed about 33 percent to total Canadian landings of this species.

IX. Mackerel, *Scomber scombrus* L.

Mackerel landings amounted to about 11,000 tons, a decrease of 400 tons from 1966. Landings increased in all divisions except 4T, where there was a decrease of more than 40 percent to about 3,100 tons.

X. Tuna

The total catch of tuna amounted to about 300 tons, a 50 percent increase over 1966 landings. The increase was due chiefly to larger bluefin

catches in St. Margaret's Bay (4X). Offshore catches include several species not recorded separately in statistics.

XI. Sharks

Landings of porbeagles, makos, and hammerheads amounted to little more than 50 tons in 1967.

XII. Atlantic salmon

The catch of Atlantic salmon from Subarea 4 at about 1,350 tons (commercial plus angling) was about the same as in 1966. Grilse made up about 70 percent of the angling catch.

B. Special Research Studies

I. Environmental Studies

1. Hydrographic Studies. Observations of coastal surface temperatures were continued at six monitoring stations from the Bay of Fundy to the Gulf of St. Lawrence. Negative anomalies were predominant almost everywhere except in the central Gulf of St. Lawrence (4T) from Gaspé Peninsula to Magdalen Islands. However, Northumberland Strait (4T) experienced below-normal temperatures. The average surface temperatures at St. Andrews (4X) during the second and third quarters was the lowest since the 1920's. In general, surface temperatures were lower in 1967 than in 1966 in Div.4W-X by 0.1 to 0.5°C.

The annual mean temperature on the bottom (90 m) at the entrance of the Bay of Fundy was the lowest since the 1930's, with a negative anomaly of 1.2°C. Temperatures of the deep warm layer in Cabot Strait (4V) showed continued cold period conditions, 4.2 to 4.5°C compared to 4.3°C in 1966. Low bottom temperatures in the northern Northumberland Strait during August resulted from a slow warming of the bottom layer.

Unusual environmental conditions, highly stratified waters with extreme temperatures, were studied during the summer in Chaleur Bay and northern Northumberland Strait in relation to herring and lobster fisheries respectively.

Circulation studies, based on recoveries of drift bottles and sea-bed drifters, were continued in all areas, with the largest number of releases since 1960. Special efforts were made in the eastern Gulf of Maine, Georges Bank (5Y-Z), and central and western Scotian Shelf (4W-X).

Material collected for primary productivity studies in the Gaspé region of Div.4T between May and November is being analyzed. Analysis of data on hydrography, zooplankton, and benthos, collected between 1952 and 1963, was a main concern of la Station de Biologie marine, Grande-Rivière, Qué.

A survey of the western Gulf of St. Lawrence was carried out in June and July. Current meters were installed at eight sites from Cabot Strait to

Pointe des Monts to learn more about the scale of response of the water to meteorological disturbances and to observe the Gaspé current system in more detail.

A Scotian Shelf moored-buoy program was initiated in January to obtain time-series temperature, current speed and direction data for an extended period of time at four sites ranging in depth from 80 to 1,000 m. The hoped-for data series at surface, intermediate, and deep water, are incomplete owing to instrument failures, losses, and insufficient ship time to recover and reset moorings. However, they give potentially valuable information on the magnitude and frequency of short-term variations, and it is intended to maintain the moorings throughout 1968.

In August, temperature and salinity were observed over a rectangular grid of approximately 80 stations covering the central Scotian Shelf. The grid was occupied three times during the month. Results indicated a high stability of water masses during the whole period.

The Halifax Section was monitored five times during the year, and the Gulf of St. Lawrence ice forecast survey was undertaken in November.

Detailed study of an inshore bay (St. Margaret's) (4W) was intensified as part of a system production investigation. The sampling program is designed primarily to yield information on rate of exchange of bay with outside water, circulation patterns within the bay, and seasonal temperature and salinity distribution. The results indicate that partial flushing occurs intermittently within periods of a day or two. The degree, frequency, and relation to events in the approach area are of interest in the data analysis.

2. Benthic Studies. Sedimentological and geochemical studies of several parts of the Gulf of St. Lawrence were continued with increased emphasis on use of current meters in conjunction with sediment collections at selected sites. Mineralogical and geochemical analyses were concerned with sources and patterns of dispersal of sediments, and indicate the influence of glaciation and sea-level rise, relative to recent current patterns, wave actions, and ice-rafting. Significant chemical modifications of iron- and manganese-bearing sediments are still taking place in the sediment.

A physiographic chart of the lower Laurentian Channel and Gulf of St. Lawrence has been prepared and will extend the coverage provided by the US Geological Survey Chart of the Atlantic Seaboard from Florida to Nova Scotia.

3. Other Environmental Studies. Daily sea surface temperature and surface layer depth charts were prepared for Subareas 3, 4 and 5 from over 100,000 sea surface temperatures and 16,600 bathythermograph reports. The analyzed data were broadcast daily by Canadian Forces Maritime Command Weather Office, as radio facsimile. In addition, synoptic wave data charts were prepared and broadcast twice daily.

II. Biological Studies

1. Cod. A study of changes in the status of the southern Gulf of St. Lawrence cod stock since mesh regulation was introduced indicated that density-dependent changes, particularly in recruitment, had occurred. The Div. 4T cod stock is surveyed each year by otter trawling, and the 1967 survey indicated a larger than usual 1964 year-class, which should enter commercial landings in 1968. However, a change of vessels used in the survey may have influenced results. Relative catching abilities of these units (R/V *Harengus* and *E.E.Prince*) will be tested in 1968.

Groundfish ecology studies in the southern Gulf of St. Lawrence included investigation of recruitment mechanisms for cod and other groundfish species, using a variety of catching gears, in egg, larval, and juvenile fish surveys.

Measurements and otolith collections from the commercial inshore fishery were obtained between June and September from Div.4R cod.

2. Haddock. Haddock of all sizes were scarce in catches of R/V *E.E.Prince* in Div.4W in July. Previous estimates that the pre-commercial 1964 and 1965 year-classes are small were confirmed. In addition, the 1966 year-class was poorly represented in survey catches.

Analysis of year-class strengths from 1943 to 1961, as represented in landings, showed the marked influence on the fishery of some relatively large fluctuations. Maximum number of fish landed from a single year-class appears to have been about 34,000,000 (excluding the recent USSR fishery in 1965). Minimum numbers were about 7,000,000.

3. Hake. Hake *(Urophycis tenuis)* were tagged in the eastern Northumberland Strait (4T) to study their distribution and movements. Of 2,270 individuals tagged in August, 378 (17 percent) had been returned by the end of December. Gradual movement away from the tagging area was indicated.

4. Pleuronectids. In the Sable Island region (4W) yellowtail flounder are infected by *Ichthyophonus*, a fungal epizootic. Photomicrographs indicate that there are often serious lesions in the liver, kidney, heart, mesenteries, and nervous tissue, sometimes leading to death. The build-up of fall fat also appears to be reduced by the disease, which could decrease winter survival.

5. Silver hake. The suggestion that the Georges Bank and Scotian Shelf stocks are separate populations has been investigated but no significant differences in morphometric or meristic characters have been found. A high incidence of gill disease, particularly in the more northerly stocks, has been discovered and is being investigated as a means of separating populations and as a factor in periodic fluctuations in abundance.

6. Sand launce. Catch records and records of launce in stomach contents of predators show that the fish is widely distributed in shallow water at all seasons (Fig. 1), occurs in local concentrations and is an important food item to many commercial species, particularly cod. The fish matures in its second year and has a short, well-defined breeding season (December-January). Meristic counts indicate that the launce on the banks is *Ammodytes dubius*, although its large size and winter breeding season are not in accord with what is recorded elsewhere for this species.

7. Argentines. The spawning concentration of argentines in Emerald Basin (4W) was sampled on four occasions. Spawning had begun by mid-March, continued through April and May, reaching completion before the end of June. Length and age compositions and fecundity estimates were obtained from this stock.

Egg and larval surveys, using a 6-foot Isaacs-Kidd net, in Emerald Basin and off the edge of the adjacent Continental Shelf (4W-X) took small numbers of eggs below 100 fathoms throughout the area sampled, with no evidence of large concentrations.

Vertebral counts from various localities from Georges to St. Pierre Bank showed small variability, suggesting there is little separation into distinct stocks. However, variations in the species composition, incidence and intensity of infestation of the intestinal parasites indicate the existence of separate populations of the fish host, and also furnish evidence of differences in distribution and feeding habits of the fish at different ages.

8. Food-resource division. Data analysis was completed for a study of food-resource division in a community of Passamaquoddy Bay (4X) fishes. There are four components of the fish community: summer seasonal fish species, winter seasonal fish species, non-seasonal or regular species, and occasional or uncommon species. The summer seasonals use major food-energy sources not utilized by the regulars. The winter seasonals and regulars utilize the same major food-energy sources.

9. Short-finned squid, *Illex illecebrosus*. A survey cruise of the *A.T.Cameron* studied the distribution and biology of the short-finned squid from 16 March to 13 April on the Continental Shelf and Slope from southern Nova Scotia to Cape Hatteras. Data were obtained on distribution, size, and sexual maturity of *Illex* in this area.

10. Redfish. Studies on the new, good year-classes in Div.4R-S-T are of particular interest as they followed a period of about eight years when the production of new year-classes of redfish in the area was negligible, and appeared at a time when the stocks of old redfish were almost exhausted.

In research vessel hauls in the Gulf of St. Lawrence in May, relatively few adult redfish had extruded their larvae and redfish larvae were scarce in plankton samples. A successful 1966 year-class of redfish was found with a modal length of about 8 cm.

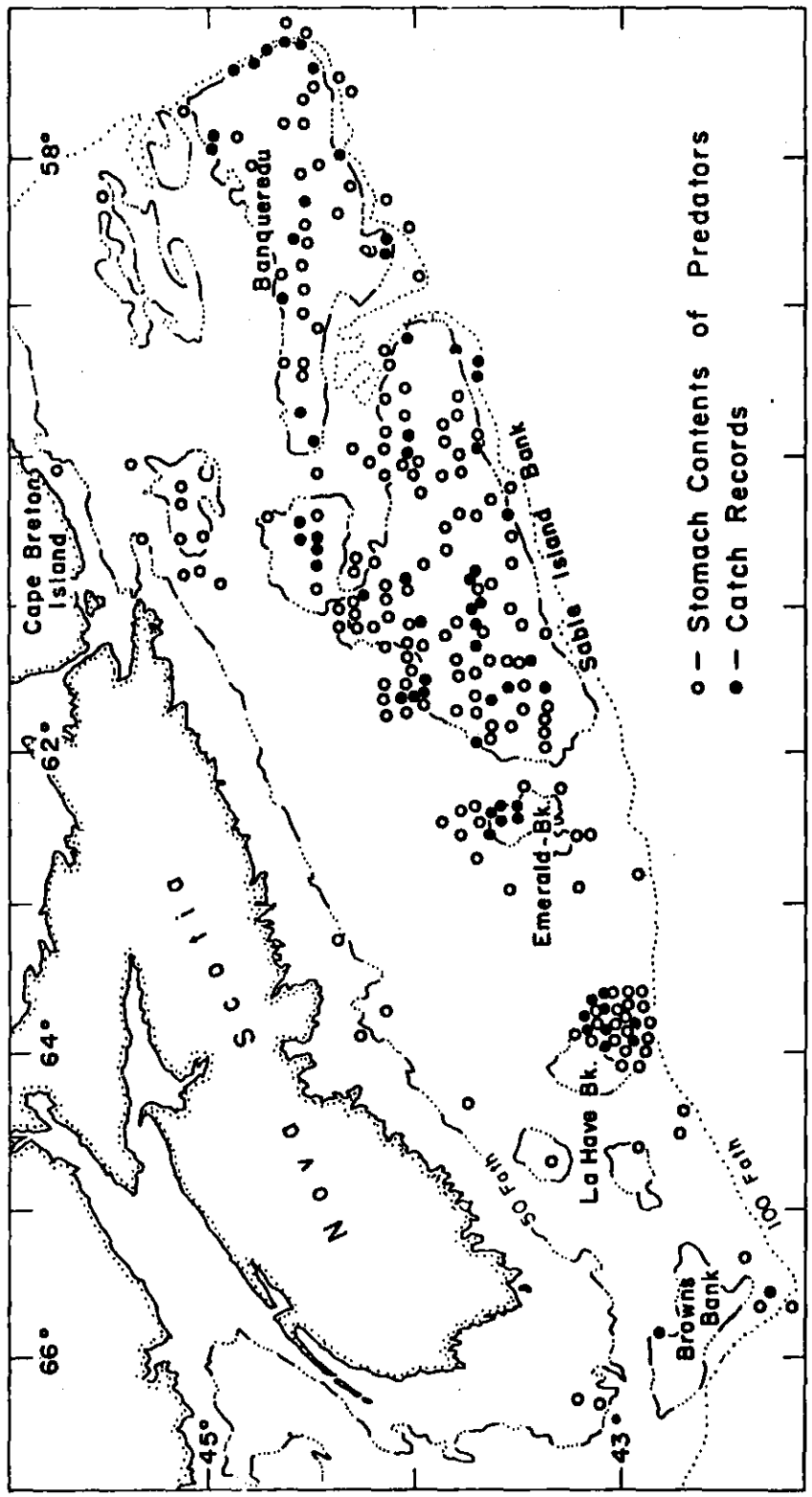

Fig. 1. Records of sand launce on the Nova Scotian banks (FRB research cruises 1956-67).

11. Scallop. Surveys begun in 1966 on the Nova Scotia side of the Bay of Fundy were completed and revealed low abundance of scallops on the inshore beds. Most scallops were of an advanced age. The offshore beds in the Bay of Fundy support good populations of scallops, although these are unattractive to the inshore fishermen because of their small meat size and the distance of the beds from port. A survey of the Lurcher area (4X) was also completed. Present abundance is too low to support a fishery.

Underwater observations on scallop dispersion were continued in Passamaquoddy Bay, using Scuba diving techniques. Similar observations on the Richibucto beds (4T) concerned the role of swimming activity in reducing scallop drag efficiency.

12. Herring. Research was concerned chiefly with the effects of increased exploitation on the stocks, and 199 samples (29,517 fish) from the Bay of Fundy and Gulf of St. Lawrence were examined for size and age. Preliminary analysis indicates little change in these parameters during 1967. In southern New Brunswick (4X) stocks, consisting chiefly of juveniles (sardines), the 1965 year-class was predominant (69.9 percent) in landings until September when the 1966 year-class entered the fishery. From October through December, 71.4 percent of the fish examined were of this year-class. The 1963 and 1964 year-classes which had contributed most to the 1966 fishery, were relatively unimportant in 1967 (12.8 and 8.1 percent respectively).

Off southwest Nova Scotia (4X) both juveniles and adults contribute to the fishery. A slight increase in mean length and mean age is consistent with the continued dominance of the 1963 and 1961 year-classes.

Herring spawning surveys were carried out in Chaleur Bay during both spring and autumn spawning seasons. Spring spawning was light to moderate over a large inshore area on the south side of the bay. Autumn spawning occurred in deeper water and later than usual, presumably as a consequence of abnormally high water temperatures early in the season. Examination of purse seine catches indicated that the major autumn spawning area was near Cape Gaspé.

Fecundity studies are in progress for all major herring stocks. Preliminary results show a mean of 55,000 eggs for 32.4-cm (mean length) herring from spring spawning stocks in Div.4T.

Condition (fatness) studies were continued and expanded to include the effects of temperature and feeding. Mean fat values ranged from 1.6 to 24.3 percent of the wet weight. Lowest values were obtained from small herring (10-15 cm) in Div.4X during the spring. Highest values were from large herring (30-35 cm) in Div.4T during late summer and early autumn.

Basic principle of herring ageing techniques were examined. The results showed clearly that definition of spring and autumn spawned fish by means of otolith nucleus type (opaque or hyaline) is suspect. A by-product of this study was the inference that most problems of ageing older herring can be resolved by using both scales and otoliths from the same fish.

13. Mackerel. Investigations were continued by sampling commercial landings and by tagging. Mean lengths, ages, and weights from 1,764 individuals suggest three distinct groups of mackerel along the Nova Scotia coast (4V-W-X) during the summer. Spawning occurred from late June through July in the Gulf of St. Lawrence and in St. Margaret's Bay. The 1960 year-class predominated in early sampling, but the 1965 year-class became most important subsequently. Altogether, 1,607 tagged fish were released in two localities. Recoveries ranged from 1.2 to 9.2 percent and indicated an early season migration into the Gulf of St. Lawrence, and an irregular wandering thereafter.

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

15. Tuna. During the summer, 201 giant bluefin (182-273 kg) were tagged and released in St. Margaret's Bay. In addition, 309 individuals of various species (swordfish, tunas, and sharks) were tagged and released in offshore areas between Cape Hatteras and the Flemish Cap. In the Gulf of Guinea, 436 tunas (chiefly yellowfin and skipjack) were tagged and released. Twelve of the above tags were recovered plus eight from taggings in previous years. Included in the results were two giant bluefin tagged in Nova Scotian waters and recaptured off Massachusetts, providing the first direct evidence of a relationship between the stocks of these two areas.

16. Atlantic salmon. From 42,000 smolts tagged in 1965, 134 (only two as 2-sea-year fish) have been recorded from Greenland waters and 821 in Canadian waters (481 as grilse and 340 as 2-sea-year fish).

From 38,000 tagged in 1966, 76 were reported from Greenland by March 1968 and 286 were reported as grilse from home waters.

In 1967, the Fisheries Research Board liberated 63,000 tagged smolts in Maritime rivers and the Department of Fisheries about 50,000.

Studies of Atlantic salmon from the Little Codroy River, Newfoundland, indicate that, on the average, about 3.5 percent of the smolts survived. About 65 percent of the returning adults were taken by the commercial fishery, and the remainder, which represent about 1 percent of the migrating smolts, returned to the natal river.

III. Gear and Selectivity Studies

A combination of theoretical studies and fishing experiments has indicated that the catch of fish on the Scotian Shelf depends at least as much on changes in "availability" as on changes in abundance. Echo-sounding equipment, designed to measure the availability, was constructed at the Marine

Ecology Laboratory. An operating field test indicated that the equipment is working according to expectation. The program is designed to provide information necessary in developing a fisheries information and forecasting service.

IV. Miscellaneous Studies

Studies of unfished populations hold many keys to the understanding of effects of fishing, but unfished natural stocks are almost unknown in temperate waters. The American plaice population of St. Margaret's Bay, which, from our studies in 1966-67, seems completely isolated from stocks outside the Bay, is therefore an almost priceless rarity. Measurements of population parameters show it to be unusually slow-growing, with low rate of reproduction and possibly a food-limited biomass density. Observations are continuing with the aim of testing hypotheses of productivity control.

Subarea 5

A. Status of the Fisheries

I. Cod

Landings of cod from this subarea were over 10,000 metric tons in 1965 and over 15,000 tons in 1966. However, landings in 1967 declined to about 8,000 metric tons.

II. Haddock

Landings of haddock were 15,048 tons in 1965 and 18,960 tons in 1966. Landings in 1967 decreased to 13,625 tons.

III. Scallop

Landings of scallops from Georges Bank of about 42,000 tons (5,040,000 kg meats) increased slightly over the 1966 catch of 41,000 tons. Most effort was concentrated on the northeastern edge of the bank.

The number of vessels in the offshore fleet decreased from about 60 to 54, of which 48 fished regularly. There was no effort south of the Convention Area on the Virginia beds which produced 50 percent of the 1966 offshore fleet catch.

IV. Herring

Landings of herring were approximately 6,500 tons. Small herring, "sardines", from Div.5Y accounted for most of the catch, although substantial catches of adults in Div.5Z were recorded for the first time.

V. Swordfish

Swordfish landings at 1,300 tons were about 500 tons less than in 1966. However, landings from Subarea 6 increased to about 600 tons (*ca.* 325 tons in 1966). Total landings in the two regions at 1,900 tons were about 200 tons below those reported for 1966.

VI. Tuna

There was no Canadian tuna fishery in Subarea 5. Incidental catches of several species of tuna by swordfishermen 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 scallop data with the US Bureau of Commercial Fisheries continues.

2. Herring. Two samples of herring (200 fish) were obtained from the northern edge of Georges Bank in October, one from a purse seine and the other from a mid-water trawl catch. The length range of the former was 28.9 to 36.3 cm (mean 31.6 cm) and of the latter, 22.8 to 35.0 cm (mean 31.4 cm). Herring from these samples were not aged.

3. Swordfish. Research on swordfish was concerned with abundance estimates, distribution, size and age composition, food and feeding habits, sex, maturity, and migrations. Average number and total weight of fish caught per trip were substantially higher, but the mean size decreased about 7 percent to 125.5 lb (57 kg). The distribution of catches indicates a gradual expansion of the fishery offshore within the boundaries of the Gulf Stream. There were no recoveries of tagged swordfish during 1967.

Studies of food and feeding habits were completed and results presented for publication.

Subareas 2 and 3

A. Status of the Fisheries

Harp and Hood Seals

Canadian catches of harp seals were 31,000 young and 11,000 older animals or 42,000 in all; of hood seals, 655 young and 585 old, or 1,240 in all.

B. Special Research Studies

II. Harp and Hood Seals

(1) Age and ovary samples were collected from shore fisheries near St. Anthony, Newfoundland, and, through fishery officers, from a Canadian sealing vessel. Material was also analyzed from a Norwegian sealing vessel (see Seal Panel Contribution No.1).

(2) Analysis of returns from capture-recapture marking (tagging) experiment in Subareas 2 and 3 was completed.

(3) Intermixing of one-year-old seals between Subareas 3 and 4 was studied from tag recoveries (see Seal Panel Contribution No.1).

(4) The survival rate of hood seals in Subareas 2 and 3 was studied from age samples collected before and after a lapse of 12 years (see Res.Doc. 67/83).

Subarea 4

A. Status of the Fisheries

Harp and Hood Seals

Canadian catches in Subarea 4 were 96,000 harp seals taken by ships, aircraft and landsmen, of which 91,000 were young-of-the-year and 5,000 were older animals. Hood seals are fully protected by Canada in Subarea 4, but four were taken by landsmen at the northern border (see Res.Doc.67/86, Addendum).

B. Special Research Studies

II. Harp and Hood Seals

(1) Age-class survival and reproductive rate were monitored as indices of the state of the stock.

(2) An aerial photographic survey was made of a herd of harp seals occurring in the northern Gulf of St. Lawrence.

(3) Study was made of behaviour of adult female harp seals with young.

(4) Juvenile hood seals were marked (tagged) (see Seal Panel Contribution No.1).

II. Danish Research Report, 1967

by Paul Hansen

Subarea 1

A. Status of the Fisheries

The following table shows the nominal catch by species taken by Denmark (Greenland) in Subarea 1, 1967:

Species	Nominal catch (in tons)	Increase or Decrease from 1966 (%)
Cod	27,523	-5
Wolffish	2,706	+9
Greenland halibut	1,834	-29
Atlantic salmon	1,280[1]	+2
Other fish for consumption	373[2]	-58
Capelin	3,735	+175
Sand eel	320	-34
Other industrial fish	383	
Deep sea prawn	5,644	+5
Total	43,798	+1

[1] Does not include catches by Danish and Faroese drifters
[2] Including 143 tons lumpsucker roe not converted to whole fish

The total nominal catch for 1967 is unchanged from 1966 but the composition of the catch in 1967 differs somewhat from that of 1966. The main trends for the most important species are:

I. Cod

There has been a 5 percent overall decrease in nominal catch from 1966 to 1967. This is due to a great decrease in the northernmost districts (Div.1A, 1B) whereas there has been some increase in the southern districts (Div.1C-1F).

The 1960 and 1961 year-classes have been of major importance to the fishery. The 1963 year-class has also been of some importance, especially in pound net catches in Div.1D-1F, although not all specimens of this year-class have reached the required minimum size (42 cm total length) for filleting. There has been an unknown but not insignificant discarding of cod belonging to this year-class.

The 1963 year-class seems to be the only year-class of some importance since the 1961 year-class. No information is available about the 1966 and 1967 year-classes. This 1963 year-class will probably predominate the 1968 and 1969 catches. The 1960 and 1961 year-classes may still be of some importance for the longliners but will not contribute much to the handline and pound net fishery in 1968 and 1969.

The 1968 fishery has, to late March, shown a serious decrease of 65 percent compared to the 1967 fishery at the same time but the major part of this decrease may possibly be ascribed to severe weather and ice conditions.

II. Atlantic salmon

The 1967 fishery is very similar to that of 1966. Greenland fishermen fished with fixed gill nets in inshore waters only.

III. Other fish

The catches of wolffish increased by 220 tons (9 percent) whereas the fishery for Greenland halibut decreased by 735 tons (29 percent) from 1966 to 1967.

Production of lumpsucker roe decreased from 579 tons in 1966 to 143 tons in 1967.

The fishery for industrial fish (capelin, sand eel and other fish) increased by 2,020 tons (84 percent) from 1966 to 1967. The fishery for sand eel started in 1967, using a single otter-trawl vessel. Catches were very promising but technique and experience is not yet adapted to that fishery.

The important fishery for deep sea prawn increased in Disko Bay but decreased in southernmost Greenland, giving an overall increase of 5 percent compared to 1966.

B. Special Research Studies

I. Environmental Studies

Very little hydrographic work has been done and no plankton collections have been taken owing to the fact that only the small 30-ft motor boat was available most of the season. On account of different circumstances, R/V *Dana* could not work in Greenland waters in 1967 and *Adolf Jensen I* could only be used until May. The new vessel *Adolf Jensen II* came to Greenland ultimo September and started work primo October.

1. Hydrography. Regular observations have been taken only at the station at the entrance to the Godthaab Fjord from January to August and in December. In January and February rather high temperatures were found near the bottom and only in the uppermost 10 m were negative temperatures found. In the spring and first summer months the temperatures were a little below the normal in the uppermost layers. In December the uppermost water layers were cooled very much while the bottom temperatures were about or a little below the normal.

II. Biological Studies of fish by species

1. Cod

a. Larvae. No fishing with stramin net for cod larvae was carried out in 1967.

b. Occurrence of small cod (age-groups I, II and III). Very few small cod younger than 4 years have been taken by fishing with prawn trawl. There is reason to believe that the 1966, 1965 and 1964 year-classes are poor ones.

c. Age and size of cod in commercial stock. Figure 1 shows the length and age composition of catches taken in pound nets in Igaliko Fjord and in the coastal area near Sermersoq (Div.1F) in July. The two catches are very much alike. The 1963 year-class was predominant in both catches and the maxima on the length curves were between 39 and 41 cm.

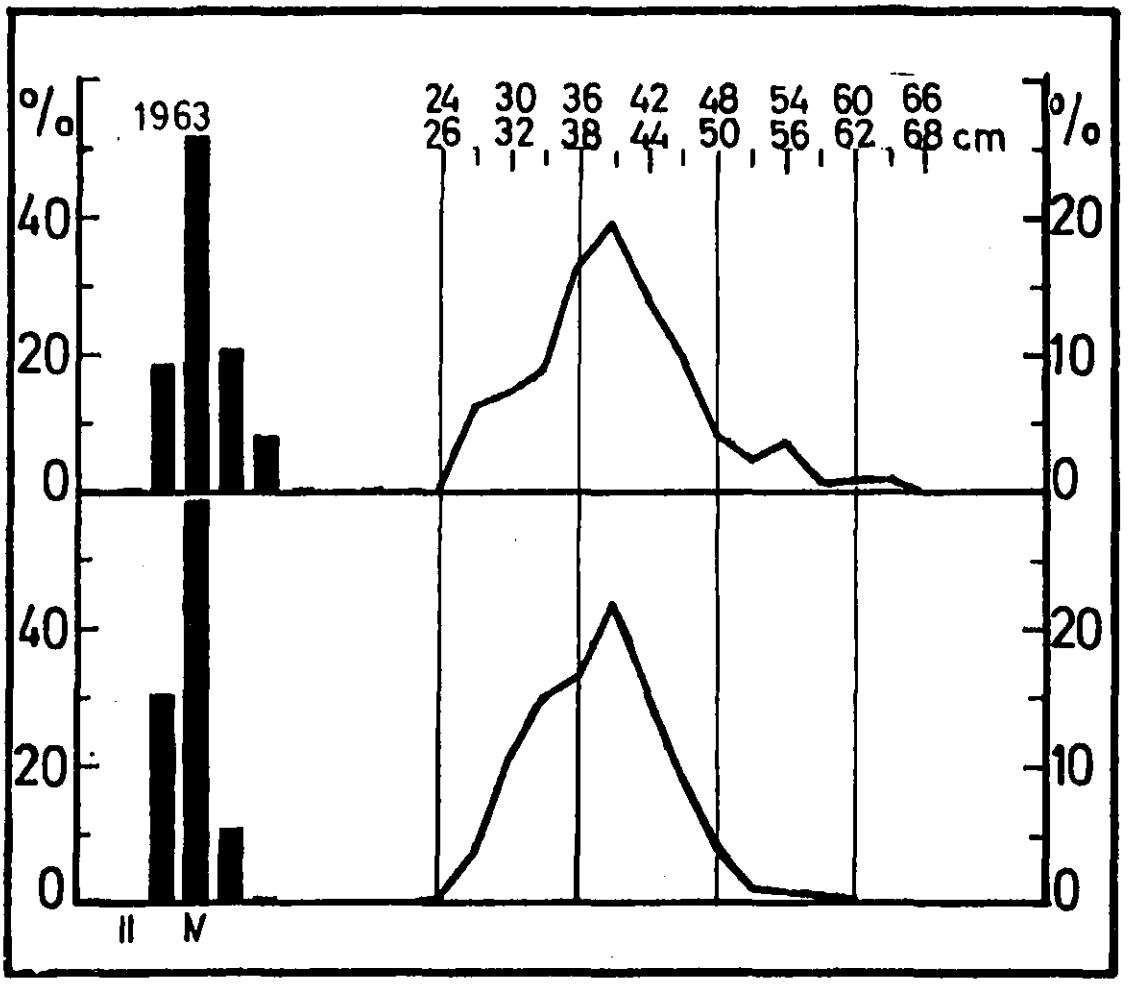

Fig. 1. Cod. West Greenland. Length and age composition of pound net catches in inshore waters Div.1F in July 1967.

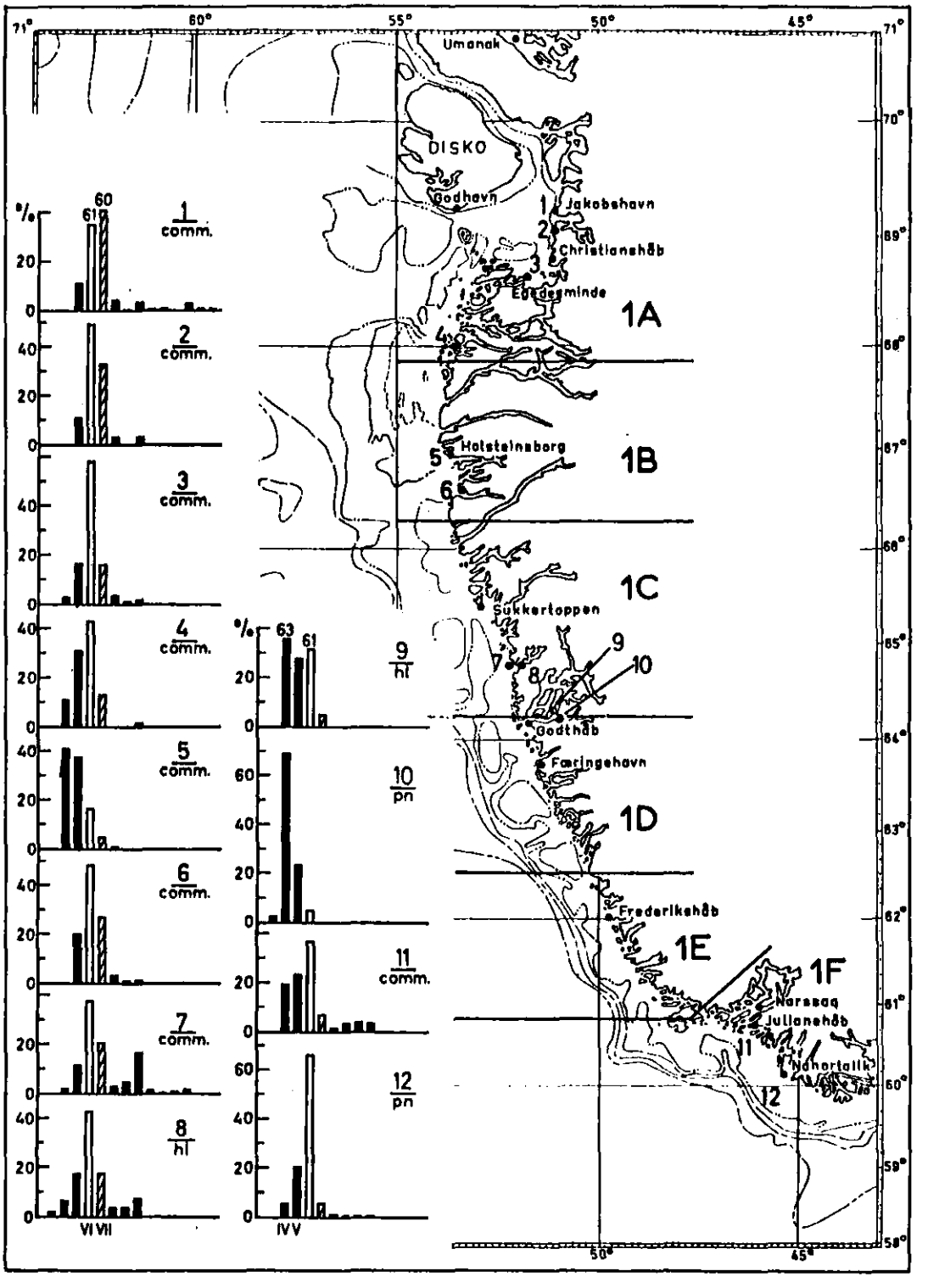

Fig. 2. Cod. West Greenland. Age composition of Greenlanders' catches from inshore waters, 1967.

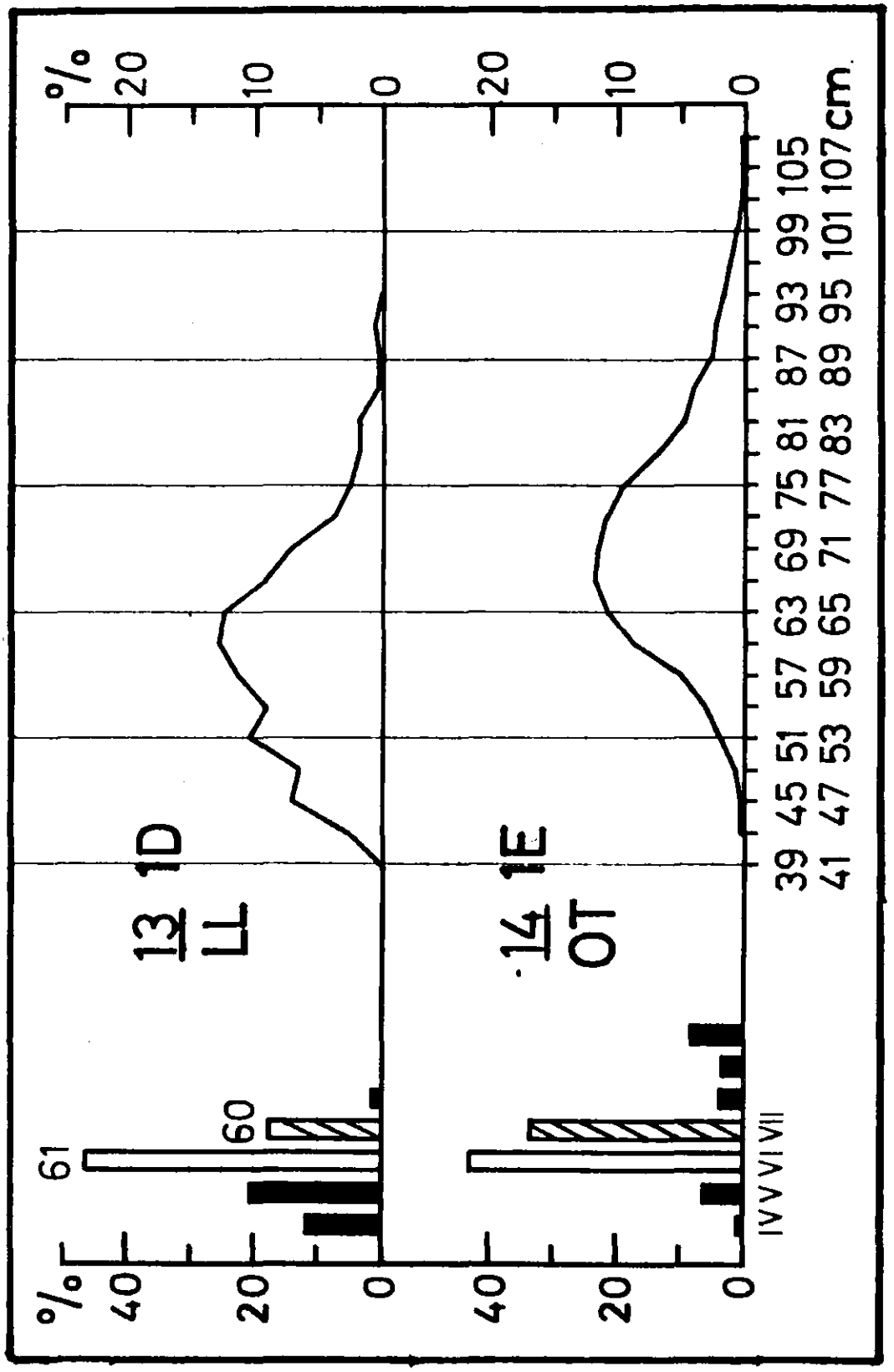

Fig. 3. Cod. West Greenland. Length and age composition of longline (LL) and trawl (OT) catches. No.13 Fylla Bank (1D) and No.14 Frederikshaab Bank (1E), 1967.

Figure 2 gives the age analyses of cod from the Greenlanders' catches. It is evident that the 1960 year-class has decreased very much since last year. It predominated only in one sample taken on the northernmost station, Div.1A, No.1. In the Godthaab Fjord (1D) and in Divs.1E and 1F it is nearly absent. In all other samples except Nos.5, 9, and 10, the 1961 year-class predominates. Year-classes older than 1960 are very rare. Only in one sample, No.7 in Div.1C, is an old year-class, 1957, represented with more than 15 percent; in all other samples, except No.8 in Div.1C where it is between 5 percent and 10 percent, it is below 5 percent. Between youngest year-classes, the 1963 year-class predominates in three samples, No.5 in Div.1B, and Nos.9 and 10 in Div.1C.

Figure 3 shows the age and length composition in two catches. No.13 is a longline catch taken on Fylla Bank (Div.1D) from a Greenland longline vessel. No.14 is from a sample from the Faroese trawler *Skalaberg* from Frederikshaab Bank (Div.1E); this material is collected between 11 May and 18 June. The trawl sample has much bigger and older year-classes of cod than the longline catch. Usually the opposite is the case. The reason must be, to some degree, due to the fact that the small cod caught by the trawler have been discarded and therefore not measured.

d. Tagging experiments. 960 cod were tagged in coastal area and fjords in Div.1C and 1D.

2. Atlantic salmon. Similar to 1966, material for salmon studies were collected in collaboration with English, Scottish and Canadian scientists. In addition, fishing experiments with T-net were carried out. From 22 August to 13 November, 1,874 salmon were caught, 1,848 in gill nets and only 26 in T-nets. A total of 372 salmon was tagged, 358 (19.4 percent) taken in gill nets and 14 (53.8 percent) taken in T-net. The high percentage of undamaged salmon caught in T-net makes it desirable to use that gear, but T-net catches are so small that if a reasonable number of salmon must be caught for tagging the gill net must be preferred. It is, however, planned to continue the fishing experiments with T-net in 1968. Ten salmon from each of Div.1B, 1C, 1E and 1F have been sent to a Canadian specialist to be investigated for parasites. Measurements and weights together with samples of scales have been collected at different fishing stations. From the tagging experiments in 1966 in Greenland, four recaptures have been reported from foreign rivers. Three were recaptured in Scotland and one in Canada. 186 salmon tagged in foreign countries were recaptured in Greenland waters in 1967. The tags were distributed as follows: Canada 106, USA 38, Scotland 27, England 6, Sweden 8, and Iceland 1.

III. French Research Report, 1967

A. Subareas 1, 2, 3 and 4
by J. Morice and Ch. Allain

A total of 148,300 tons of cod was taken by metropolitan French vessels in the Convention Area in 1967.

Subarea 1

A. Status of the Fisheries

In 1967, 41,370 tons of cod were caught in Subarea 1 between April and October. Best catches took place in May in Div.1D and 1C and in June in 1B.

Subarea 2

A. Status of the Fisheries

Subarea 2 was frequented almost all year. Best catches were made in Div.2J in February and April and especially from September to November. A total of 24,660 tons was taken from the subarea.

Subareas 3 and 4

A. Status of the Fisheries

In Subarea 3, where 69,786 tons were taken, fishing began in February. Best catches were made in March in Div.3Pn, 3Ps and 3M, then in April and July in 3L. In Div.3K, fishing was carried out all year; however, best catches were made from September to November.

Only 12,438 tons of cod was fished from Subarea 4, 10,460 tons of which came from Div.4R mainly from January to April.

B. Special Research Studies

Observations were made in these subareas from the oceanographic trawler *Thalassa* in March and April between 46°00' and 42°50' from St. George Bay to Emerald Bank.

I. Environmental Conditions

Six hydrographic sections consisting of 72 stations were made as follows:

1 - from the bank southeast of Grand Bank to Cape Spear;
2 - from St. Pierre to the Tail of the Grand Bank;
3 - across St. Pierre Bank (from the southern edge to St. Pierre);
4 and 5 - in the Laurentian Channel, perpendicular to its axis, at a point in its southeast extremity and at another at the level of Misaine Bank;
6 - off Halifax and across Emerald Bank.

A total of 635 temperatures and salinity measurements were made on these sections. At the same time, 137 BT's were taken at fishing locations to establish temperature charts at the different levels.

We shall only present here the chart of bottom temperatures, at the different trawling locations and at Sections 2 and 6 across the Grand Banks and off Halifax, which are most representative of the hydrographic situation in the area studied.

Distribution of Surface and Bottom Temperatures

In the surface layer, there are the waters brought by the Labrador Current or cooled on the spot by the proximity of the Shelf, and to which are added the continental waters, of which those, very cold, of the St. Lawrence occupy the major part of the Shelf. Their temperature is less than 0°C in the channel which separates Newfoundland from the Grand Banks, and in the Gulf of St. Lawrence; it is less than 1°C in the shore areas of Nova Scotia.

These very cold waters circulate uniformly in the form of a very elongated lobe on the edge of the eastern slope of the Grand Banks which they outline at its southeast extremity, then bend toward the northwest to the trawling grounds. This front undergoes some very rapid changes due to the withdrawal or the formation of ice which had been observed off Cape Spear on the east coast of Newfoundland and off Cape Anguille in Cabot Strait but which, during the cruise, had well advanced southward.

The warmer water of the Atlantic Drift, which circulates extensively, partly penetrates the trawling grounds on the Grand Bank where we find a temperature of 4.27°C, and in the south part of the Laurentian Channel 2.5°C, and off Halifax in the Emerald Bank area 3.58°C.

With this area in full winter state, surface temperature is near the minimum. It is lowest (-1.8°C) in the Avalon Channel and at Cape Anguille, *i.e.*, in the immediate vicinity of the ice pack.

The bottom temperature situation (Fig. 1), which is of more direct interest in the otter trawl fishing, is as follows:

In the Newfoundland area, cold water less than 0°C which is found all along the northern edge of the banks, reaches almost to St. Pierre Island and Green Bank. The lowest temperature is found in Haddock Channel (-0.46°C).

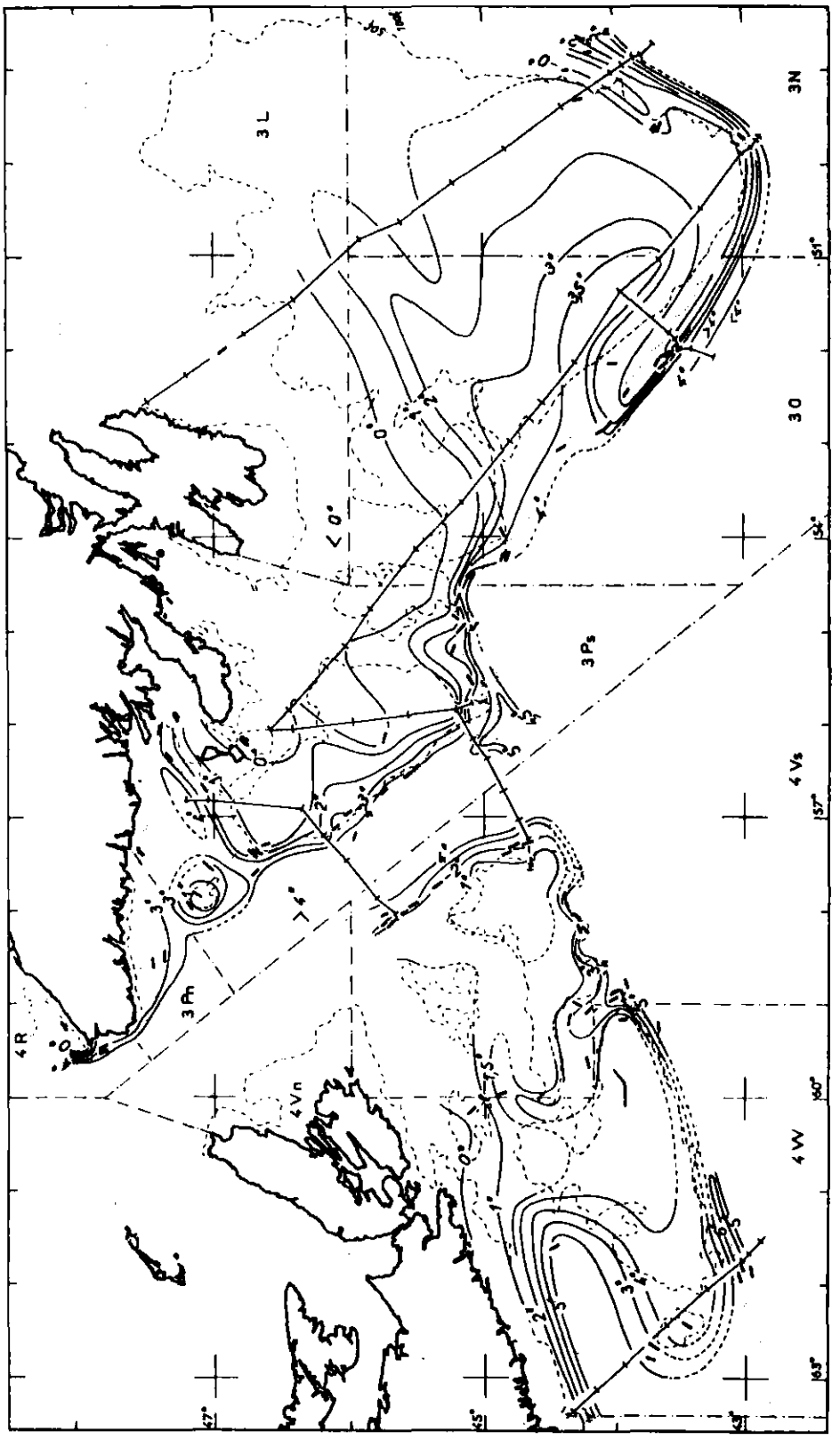

Fig. 1. Map of the region studied. The different hydrographic sections are shown in solid lines with cross marks to indicate station locations. Trawl hauls are shown by solid rectangles oriented in the direction of the haul. The isotherms show the bottom temperature. ICNAF divisions are delimited by dash-and-dot lines.

Elsewhere, the 0° C isotherm reaches Cape Anguille and along the coast of Nova Scotia. In the latter area, the low temperatures are found on the shallows of Banquereau and Sable Island and remain below 2°C.

The Labrador Current extends, as at the surface, around the edge of the Grand Bank in 0°-3.5°C isotherms.

Further out to sea, in depths of 300-400 m, flows warmer water, the narrow lobe of which is marked by a thermal maximum of 6.85°C off Emerald Bank and a little greater than 4°C at the southeast extremity of the Grand Bank. It consists of slope water, a result of the North Atlantic Drift continuing into the Gulf Stream.

This slope water penetrates the deep areas of the "Scotian Gulf" (off Halifax 5.70°-5.00°C), of the "Gully" (between Sable Island and Banquereau Banks, 4.40°-2.00°C), and fills the Laurentian Channel and Cabot Strait where it has a temperature of over 4.20°C. From the channel, it penetrates the deep areas of the northeast of St. Pierre Bank to Fortune Bay (3.70°C) and pushes between the two parts of St. Pierre Banks, and into Halibut Channel (4.50°-2.00°C).

This warmer water finally returns to the Grand Banks, starting from the trawling grounds and advancing northeast almost to the Virgin Rocks and southeast almost to the east flat, but its temperature decreases from 4.00°-1.00° following a mixing with the northern current.

Vertical Distribution of Temperature

The section from St. Pierre to the Tail of the Grand Banks (Fig. 2) gives a good resumé of the situation in the southern part of the Newfoundland Banks. It shows a certain vertical similarity in temperatures which is characteristic of the winter situation.

Cold Labrador and local water goes partly into the western channels occupying all the section between St. Pierre Island and Baleine Bank, giving a minimal temperature of -0.53°C at 50 m, and partly on the slopes where a real layer surrounded by a 3°C isotherm shows prominently to a depth of 300 m, giving a minimal temperature of -0.72°C at 50 m depth. Between these two lobes circulates warmer slope water of 4.27°-3.00°C.

On the slope, below 300 m, temperature increases to 4.70°C, indicating the presence of extensive Atlantic water.

As for the section which, starting from Halifax, crosses Emerald Bank to reach the Nova Scotia slope (Fig. 3), it shows how the still very cold waters from Cabot Strait reach this latitude widening their influence over the shallows of the bank (minimum 0.90°C to 3.00°C at the edge of the slope).

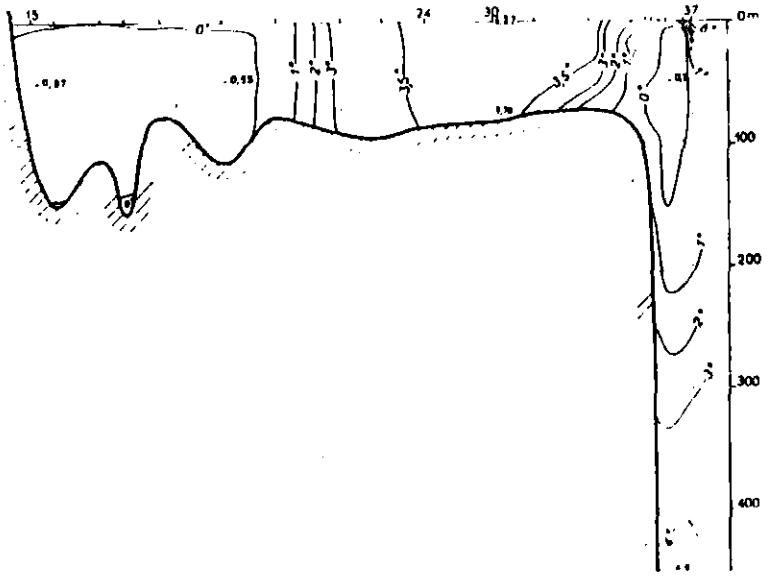

Fig. 2. Vertical temperature distribution from Cape Spear to the southeast edge of the Grand Bank.

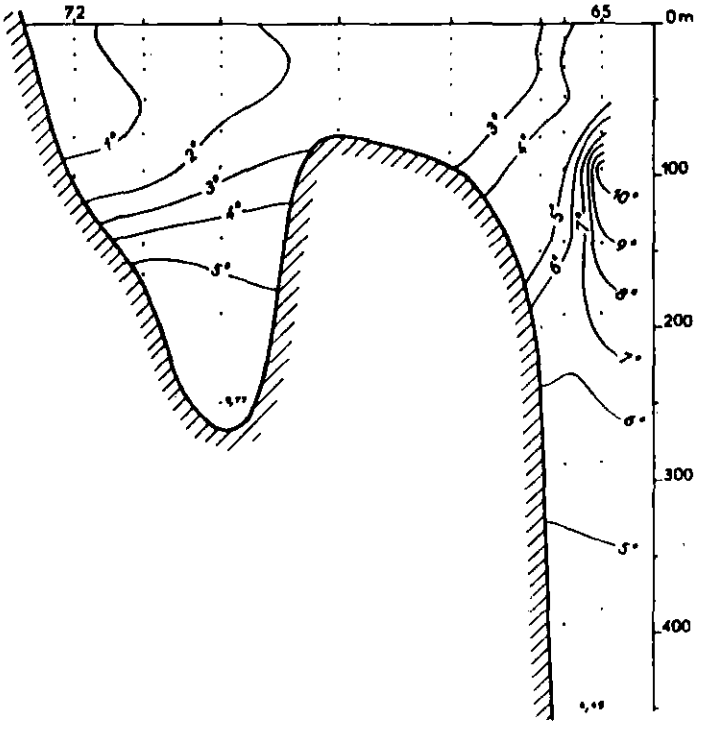

Fig. 3. Vertical temperature distribution from off Halifax over Emerald Bank.

The contrast in the water of the western edge of the Gulf Stream is very marked, where the temperature reaches 10.00°C at 100 m, diminishing progressively with depth to 4.00°C at 1,200 m.

This slope water, which penetrates widely into the "Scotian Gulf", reappears in the trough between the offshore slope and the shallows, with a bottom temperature of 5.77°C.

In conclusion, and in spite of the small amount of comparable material available for this period of the year, one can say that, generally, one finds here, the classic opposition of the different formations recognized successively by Bjerkan, Beaugé and Canadian oceanographers. It seems, however, that an early warming takes place in the southern Grand Bank, while a characteristic wintery situation exists in the Nova Scotia section.

II. Observations on the Fishing

The fishing was carried out with two modified trawls (Lofoten type), one of nylon and the other of polyethylene, of 31.20 m headrope and with a stretched mesh of 140-100 mm. For stock studies, they were fitted with a 50 mm codend and a baiting of 60 mm meshes.

Oval otter boards weighing 1,000 kg were used. The ground wire (bridle) was 50 m long. Upper legs were 6.70 m high and lower legs 18.50 m. Sinking by steel bobbins of 45 cm diameter weighing 105.5 kg in the square and 148.2 by wing.

Results of observations by the sounder showed that the polyethylene trawl has a greater vertical opening than that of the nylon trawl, 4.20-4.50 m against 3.60-4.0 m.

Yield of Main Species in Relation to Depth and Temperature

Of 86 trawlings, only 62 hauls which are grouped by sections were retained for calculating of yields/hr.

Commercial species were cod *(Gadus morhua)*, redfish *(Sebastes marinus mentella)*, American plaice *(Hippoglossoides platessoides)*, haddock *(Melanogrammus aeglefinus)*, grey sole or witch *(Glyptocephalus cynoglossus)*.

Table 1 for main species and Fig. 4 for cod and redfish give the yields obtained in kg/hr/haul, at various depths for the Newfoundland sections on the one hand (Div.3O, 3N, 3Ps, 3Pn and 4R of ICNAF) and Nova Scotia sections on the other (Div.4Vs and 4W).

Best cod catches were made between 175 and 250 m in the two zones with a maximum yield of 1,000 and 3,650 kg. The first figure, however, is an average of 9 hauls and the second a single haul made on Misaine Bank. In the Nova Scotia section, some good yields were made around 125 m. Generally, catches were in temperatures from 1°-3°C.

Table 1. Average yields (kg/hr) of fish by depth and by ICNAF divisions.

Sections	Depth (m)	No.of Stns.	Cod	Redfish	American plaice	Witch	Haddock	Skate	Argentine
Section 3 N									
Grand Bank	50-100	2	12.5	-	18	-	-	-	-
	100-220	1	162	460	13.3	-	5	16.7	-
	220-300	2	3227	418	33	5.5	-	4	-
Section 3 O									
Grand Bank	100-220	3	134	250	932	40	112	66	-
	220-300	5	145	802	200	372	416	31	-
	> 300	1	-	190	100	1450	-	-	-
Green Bank	100-220	3	207	12	23	44	116	21	-
	220-300	1	72	177	24	62	7	12	13
Section 3 Ps									
St. Pierre Bank	50-100	3	148	5	241	6	101	26	-
	100-220	2	329	442	38	86	205	46	-
	220-300	5	291	250	9	101	94	39	26
	> 300	1	-	251	5	19	-	-	99
Halibut Channel	100-220	2	235	28	33	26	28	25	-
Green Bank	100-220	3	336	35	16	11.5	4	63	-
	220-300	1	120	900	20	1000	-	40	80
Burgeo Bank	100-220	1	843	135	-	-	-	-	-
	220-300	1	-	989	12	36	-	2	-
Fortune Bay	100-220	1	66	125.5	13.5	65.5	38	-	-
	220-300	1	29	35	39	196	26	77	-
Section 3 Pn									
Bottom of Port-aux-Basques	100-220	2	297	44	1.5	1.5	2	-	-
	220-300	1	168	1940	-	-	-	-	30
Section 4 R									
Cape Anguille	100-220	3	636	40.5	16	6	19	3	-
Section 4 Vs									
Banquereau	50-100	2	-	-	66	-	-	53	-
	100-220	3	179	388	198	8	10	48	188
	220-300	2	19	272	2	22	-	36	299
Goulet	100-220	5	365	31	41	49	116	32.5	39
	220-300	1	63.5	405	15	11	490	-	-
Misaine Bank	100-220	3	1564	237	89	10	7	-	-
	220-300	1	23	182	-	153	-	-	-
Section 4 W									
Emerald Bank	50-100	1	68	-	5	-	67	-	-
	100-220	2	27	7.5	5	4	21.5	6.5	6
Sable Island	50-100	1	20	-	1200	-	-	200	-
	100-220	3	26.5	128	7	7	3	5	143
Canso Bank	100-220	2	492	161	87	46.5	-	7	-

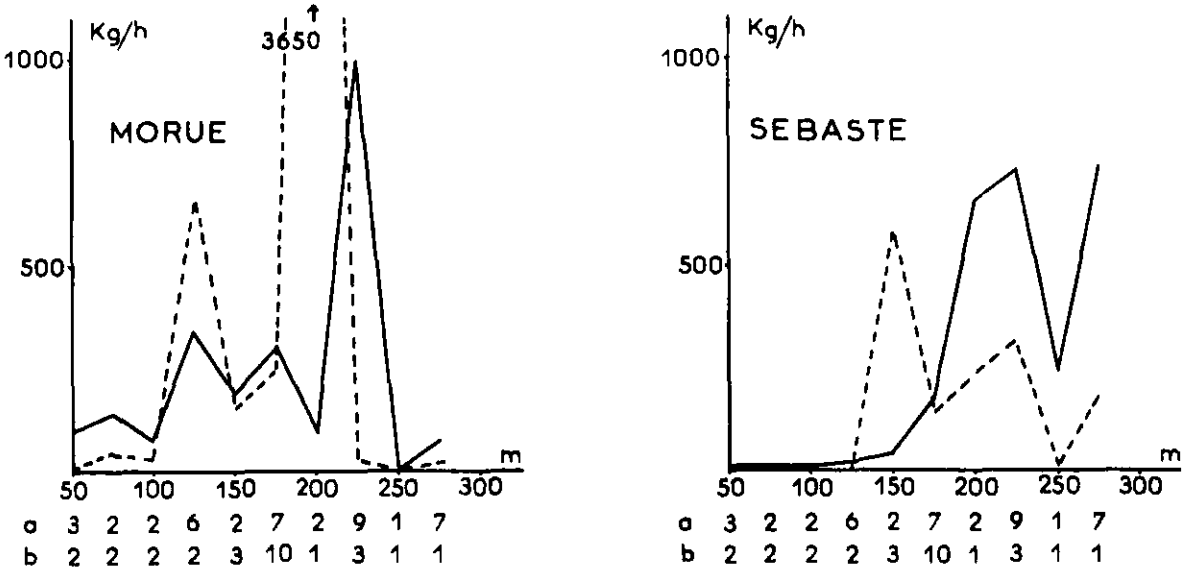

Fig. 4. Average yields (kg/hr) of cod and redfish at different depths on Newfoundland Banks (solid line) and on Nova Scotia Banks (broken line). a = number of hauls on Newfoundland Banks; b = number of hauls on Nova Scotia Banks.

Concerning redfish, it is only abundant from 175-200 m (200-700 kg/hr) in the Newfoundland region when water temperatures were greater than 3°C. It appears at lesser depths on the edge of Nova Scotia (570 kg/hr at 150 m) where the waters warm more rapidly (more than 4°C) and is less abundant at great depths of the same sector (maximum 300 kg/hr near 225 m).

Haddock catches varied with an average yield of 410-490 kg/hr from 220-300 m on the trawling grounds and in the "Gully". This fish is found most often from 1.50°-3°C on the Grand Banks and from about 3°C in the second sector.

American plaice were fished regularly from 50-200 m with an average yield of 930 kg east of Sable Island. It prefers 1°-3°C temperatures.

Grey sole or witch, taken with an average yield of 40 kg/hr from 100-220 m, is most abundant at great depths reaching 1,450 kg/hr in the Grand Bank section.

Among the other species taken were included the skate, fished regularly at an average rate of 40 kg/hr, and the argentine which occurred especially in the south part of Banquereau from 150-250 m (300 kg/hr). Herring were found between Burgeo Bank and Cape Ray where catches of 300-530 kg/hr were made at 170 m in 2°-3°C.

Observations on the Stocks and the Biology of the Main Species

1. Cod. Previous works, notably those of Templeman (1961), show that the cod population of the southern banks of Newfoundland and of Nova Scotia is divided in winter into small stocks over the slopes.

Cod of the Southwest Grand Bank have the greatest rate of growth, with maximum lengths of 120-140 cm. Spawning begins in April, ending early in July, with a maximum during the second half of May and the beginning of June.

Important concentrations were observed in winter and at the beginning of spring on the slopes southwest of the Newfoundland Banks and, more particularly, at the entrance to Halibut Channel. In these sections, certain hauls gave best results, 704-5,750 kg/hr on the cold vertical front; 580 kg/hr at the entrance to Halibut Channel; 580-1,210 kg/hr on the slope south of St. Pierre Bank. Some good catches were made off Cape Anguille, 1,260 kg/hr; in the southeast part of Misaine Bank, 800-3,650 kg/hr and in the "Gully", 1,150 kg/hr. These strong concentrations are situated most often in the zones of temperature contrast, with preference for 2°-3°C.

The majority of individuals captured were 30-40 cm long (Fig. 5). The dominant mode is 39 cm in the Grand Bank region (Div.3O), 40 cm in that of St. Pierre Bank and of Green Bank (Div.3Ps), and 44 cm on the slope east of Nova Scotia (Div.4Vs). In each of these sectors and for deep-caught fish, there is a second less marked mode around 61-62 cm length.

No females had reached the spawning stage; some males, by contrast, were near it.

2. Redfish. The *mentella*-type dominates in all sectors. After Templeman, redfish of Nova Scotia and the southern banks of Newfoundland belong to the same stock, limited to the east slopes of the Grand Banks. They are fished from 175-200 m, when temperatures are more than 3°C.

Certain hauls took 460-800 kg/hr on the Grand Banks, 440 kg/hr on St. Pierre Bank, 900 kg/hr on Green Bank, and 980-1,900 kg/hr on Burgeo Bank.

Lengths vary, generally, from 17-35 cm (Fig. 6). In Div.3O (southwest of Grand Bank, to Halibut Channel), modes seemed to be distributed by depths, 29 cm in 220-300 m, and 35 cm in deeper water. It is the same in Div. 3Ps (St. Pierre and Green Banks). In the other zones, lengths are no greater than 17-27 cm and young of less than 10 cm are taken on Grand and Burgeo Banks from 100-300 m.

Gonads of males and females show that the resting stage or first developmental stage is dominant, but a certain proportion of females had developed larvae.

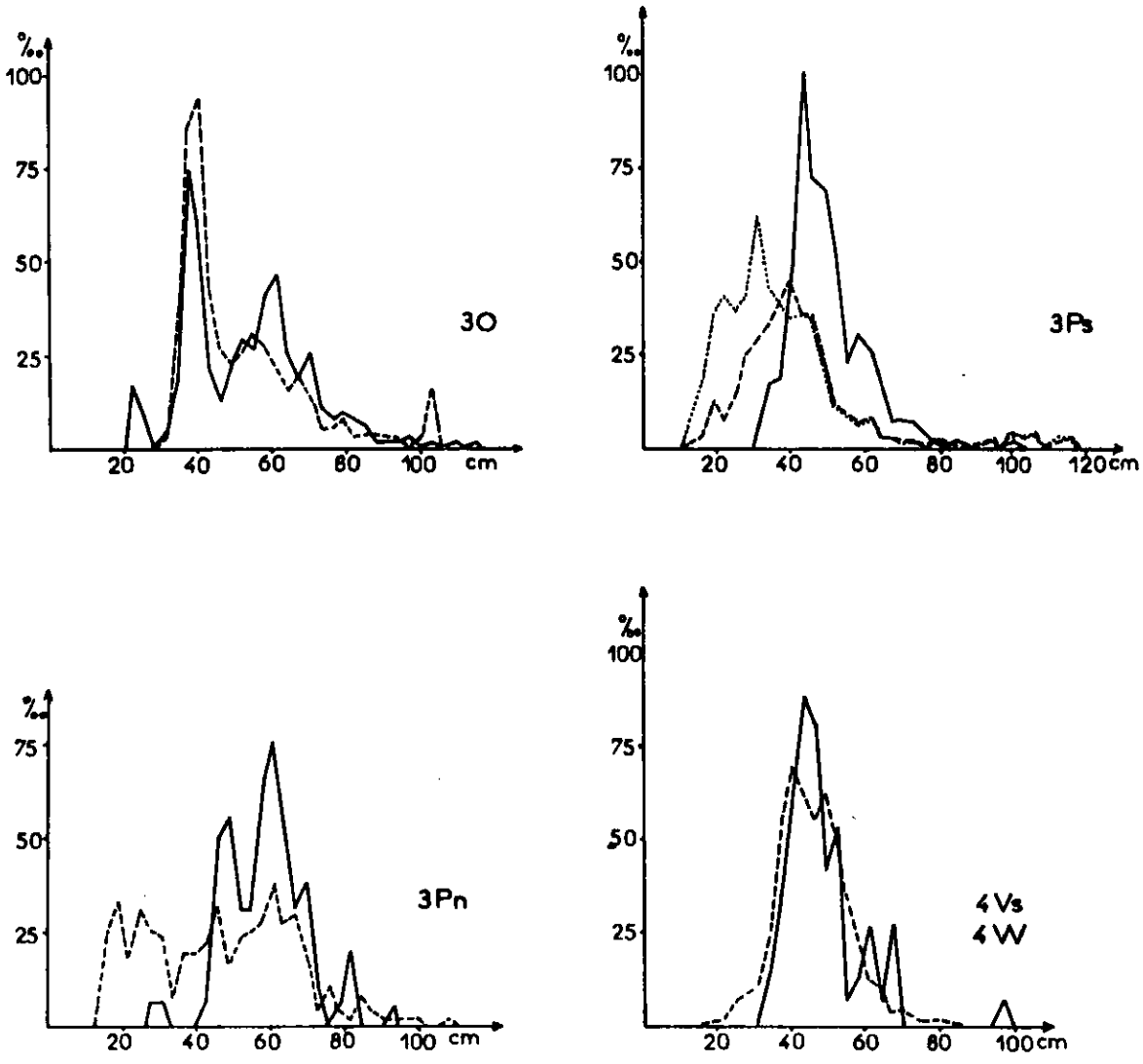

Fig. 5. Length frequencies of cod from Newfoundland Banks (Div.3O, 3Ps, 3Pn) and from Nova Scotia Banks (Div.4Vs, 4W). Dotted line = 50-100 m; broken line = 100-200 m; solid line = 220-300 m.

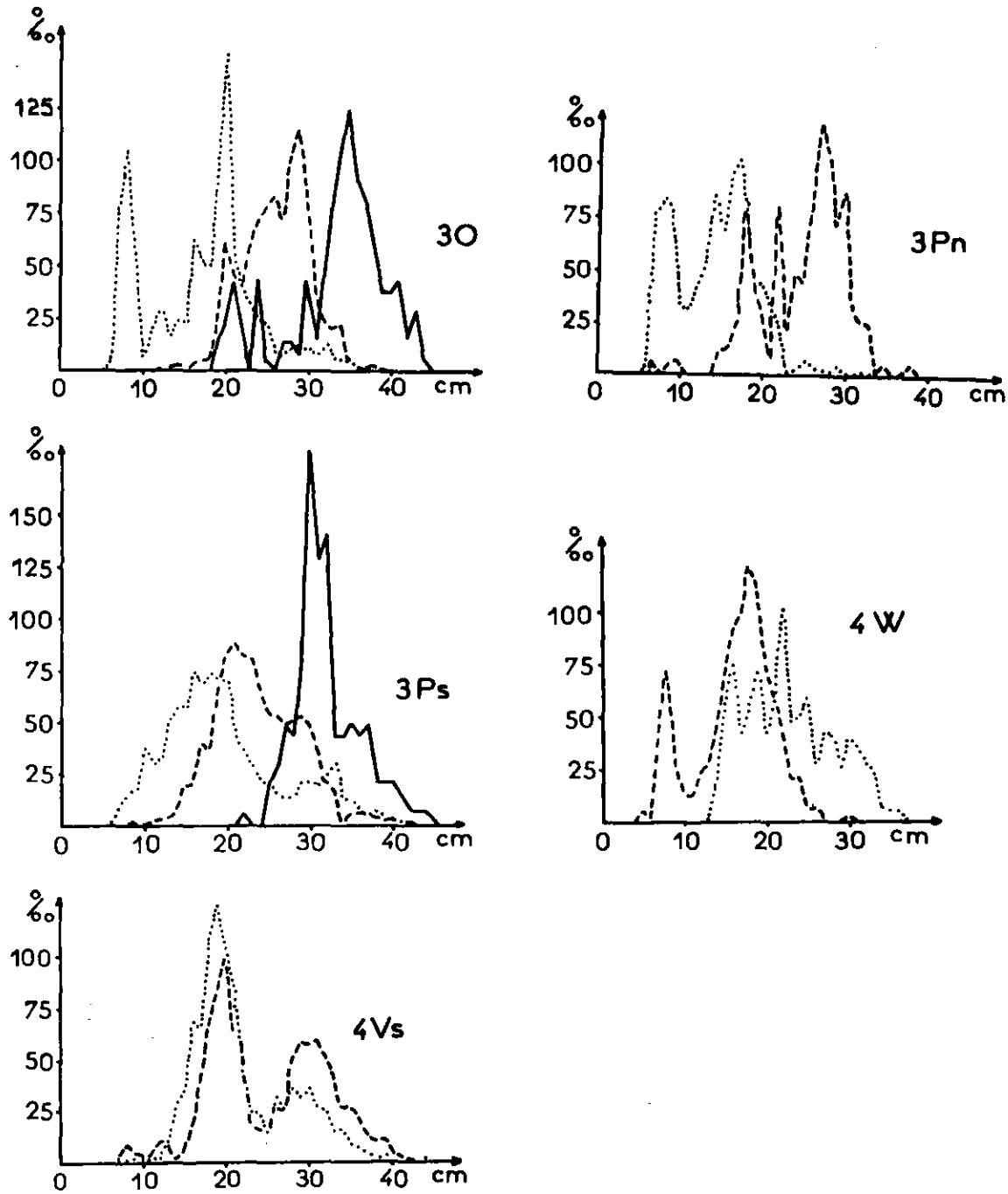

Fig. 6. Length frequencies of redfish from Newfoundland Banks (Div.3O, 3Ps, 3Pn) and Nova Scotia Banks (Div.4Vs, 4W). Dotted line = 100-220 m; broken line = 220-300 m; solid line = greater than 300 m.

3. American plaice. Most captured individuals were 20-35 cm and the best catches had mode lengths from 25-32 cm on St. Pierre and Grand Banks (Fig. 7).

Maximum yields occurred in Southwest Grand Banks, 930 kg/hr and east of Sable Island, 1,200 kg/hr.

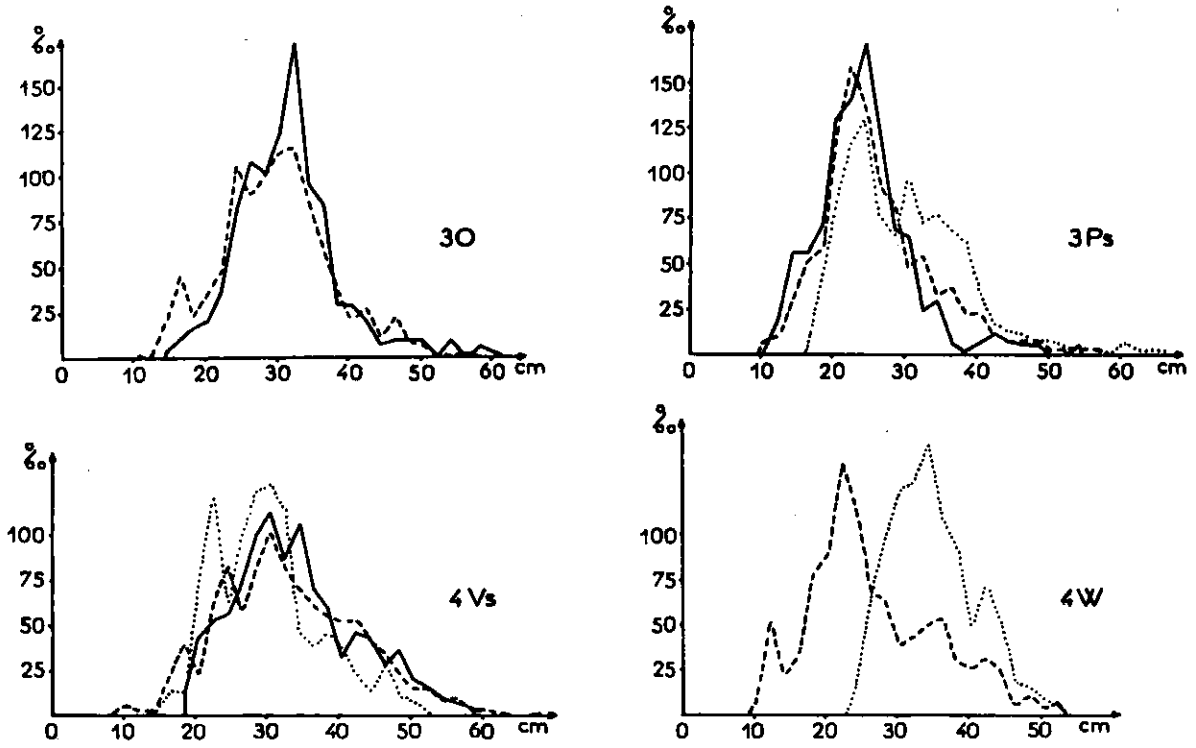

Fig. 7. Length frequencies of American plaice from Newfoundland (Div.3PO, 3Ps) and Nova Scotia (Div.4Vs, 4W). Dotted line = 50-100 m; broken line = 100-220 m; solid line = 220-300 m.

4. Herring and Alewives. Best herring catches were made between Burgeo Bank and Cape Ray, 300-540 kg/hr. They were non-mature, with a modal length of 33 cm.

On the Nova Scotia Banks, some herring were also found but in small quantities, 7-10 kg on Banquereau, Misaine Bank, the "Gully" and Emerald Bank.

As for alewives, of an average length of 28 cm, they were taken on South Canso Bank and Emerald Bank, with a yield of 60 kg/hr for 3 trawl hauls.

IV. German (FRG) Research Report, 1967

A. Subarea 1 and East Greenland
by Arno Meyer

A. Status of the Fisheries

I. General

In 1967 German trawlers again fished off West Greenland throughout the year. Compared with earlier years there are now two trends in the German fishery in Subarea 1.

1. The percentage of landings of fresh, iced fish is decreasing (1967: only 12 percent of the round fresh weight of all fish landed). On the other hand, the percentage of deep-frozen fish is rapidly increasing (1967: 70 percent). The share of salted products varies from year to year depending on the German and international market situation. In 1967, 18 percent of the round fresh weight of fish sold for direct human consumption were salted.

2. Most fishing in Subarea 1 is carried out from December to June/July. Fishing activity during the slack period from July/August to November decreased more and more in the last two years, because of the low and not paying catches during these months (Fig. 1). Many trawlers are fishing now during the summer and fall period for herring either in the North Sea, off NE Iceland or (since 1967) in Div.5Z and 6A (see this report, Part C, by Schubert). Thus we notice a new trend for seasonal fishing only by the German trawlers. But the time of the fishing season has changed, *i.e.* from early summer to autumn in 1952-58 to a fishery nowadays from early winter to late spring. And this has great biological consequences for the Greenland stock of cod. During winter and spring mostly the large and paying concentrations of the larger, mature cod are fished while during the summer and fall the scattered shoals of smaller, immature cod are caught more. Thus, the winter and spring fishery is not only much more profitable for the fisherman, but results in a much higher utilization of the Greenland stock of cod (see A. Meyer, *Redbook* 1967, Pt.III, p.3-21), giving the young cod, (which grow very fast until they become mature and almost double their weight each year), a chance to grow and not be caught too early.

Table 1 shows that, for the first time since 1962, the year 1967 brought a considerable increase in the output of the German fishery off West Greenland as well as off East Greenland. The total nominal catch in Greenland waters increased by 44 percent from 134,000 tons to 193,000 tons. In 1967, the waters off Greenland were again the most important fishing grounds for German trawlers. The biggest increase was in Subarea 1, where the nominal catch increased by 53 percent from 102,000 tons to 156,000 tons, while the effort increased by only 34 percent. Thus the catch per fishing day after permanent decreases since 1962 increased for the first time from 21.7 tons to 24.7 tons per day. But we have to bear in mind that this increase in catch-per-unit

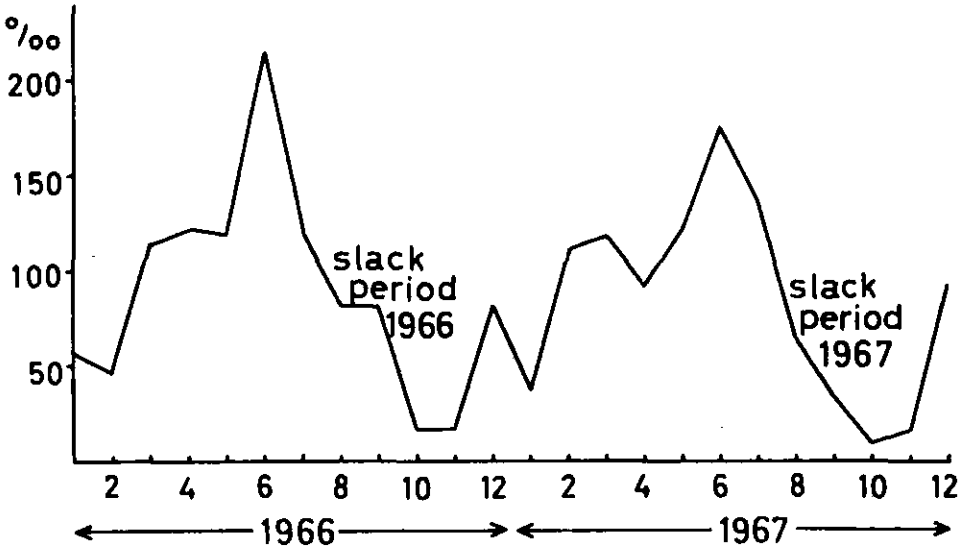

Fig. 1. Monthly German landings (in round fresh weight) from Subarea 1 in 1966 and 1967 in percent of the total yearly landings. Because of the long trips of the factory trawlers, the corresponding curve for the time of the catches would lie 1-1 1/2 month to the left.

effort is not only caused by better stock conditions, but is also the consequence of the trend to seasonal fishery mentioned above, that is less fishing during the 1967 slack period with its very low catches per fishing day. On the contrary, off East Greenland the increase in catch to 38,000 tons was only caused by a corresponding higher fishing effort. The catch per fishing day was again 17.5 tons, the same as in the preceding two years.

The mentioned trend to more seasonal fishing in winter and spring also explains the decrease in the percentage of industrial fish (Table 1). The same applies to the decrease in discarded fish in Subarea 1 (Table 2) from 1,264 tons in 1966 to 856 tons in 1967. But this decrease is also affected by less activity of those trawlers fishing only for fresh iced fish. Table 3 shows that the average gross tonnage of German trawlers fishing in 1967 in Subarea 1 for the first time has not increased further.

II. Cod

The great increase in nominal catch in 1967 was only due to the increase in catches of cod, particularly in Subarea 1. Here the nominal catch increased by 66 percent to 138,000 tons and the average catch per fishing day rose to 21.9 tons. The latter figure is the highest since the German trawlers started fishing in Subarea 1 in 1952. Also off East Greenland catches and catch per fishing day increased.

Table 1. German nominal catches in tons (industrial fish included) off Greenland, 1962-67.

	Year	days fishing	Cod	catch per fish.day	% ind.cod	Redfish	catch per fish.day	% ind.redf.	Total	catch per fish.day	% ind.total
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
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
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	57,967	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

Table 2. Discarded fish in Subarea 1 in 1967 in tons.

	Cod	Redfish	Spec.unknown	Total
1B	48	0	2	50
1C	185	0	63	248
1D	344	11	76	431
1E	35	8	35	78
1F	17	18	14	49
Total	629	37	190	856

Table 3. Average gross tonnage of German trawlers fishing in Subarea 1 from 1962-67.

1962	832 BRT	(589 - 1561)
1963	864 BRT	(566 - 1561)
1964	890 BRT	(648 - 1561)
1965	1015 BRT	(651 - 2557)
1966	1094 BRT	(537 - 2557)
1967	1095 BRT	(632 - 2557)

III. Redfish

The catches of redfish decreased further. The total output off West Greenland as well as off East Greenland was the lowest ever experienced. The same is true of the average catch per fishing day.

IV. State of Fisheries in the first 4 months of 1968 and forecast for the coming years

As expected the German trawlers again had a successful winter season due to the rich 1961 year-class. But a lot of factory trawlers left Greenland for Labrador where even larger concentrations were found. Because of the bad market situation for fresh frozen cod, almost no wet fish trawlers worked off West Greenland. Those few trawlers fishing for wet fish were working in Div. 1E and 1F with the intention of catching redfish also.

In 1968 therefore there will probably again be a decrease in nominal catch as well as in effort and probably also a small drop in catch-per-unit effort. Possibly none of the next at least 5 following years will reach the 1967 figures. The trend observed in the German fishery off West Greenland for a real seasonal fishery only during winter and spring will continue. Possibly in 1968 or 1969 German trawlers will stop fishing in Subarea 1 during the slack period.

B. Special Research Studies

I. Environmental Studies

1. Hydrography. Again, as in the preceding 4 years, in late autumn several hydrographic stations from Cape Farewell to Great Halibut Bank were worked for temperature and salinity (Fig. 2-3). The Atlantic component of the West Greenland Current was well developed with temperatures up to 6°C in the south, 5.45°C off Fyllas Bank, and 4.13°C off the southern part of Great Halibut Bank. As can be seen from Table 4, the temperatures on the slope of the shelf and on the banks were partly considerably lower in 1967 than in the very warm years 1964 and 1965.

The salinity of the Atlantic water was the highest ever found, and this observation can be taken for granted, for all salinity measurements were made twice. With the exception of the most northern section, the salinity everywhere reached 35‰. The highest salinity was found off Fylla Bank in 910 m with 35.30‰. Even off the slope of the southern Great Halibut Bank in 300 m depth, a salinity of 34.73‰ was measured. Thus again in winter 1967 off West Greenland, probably there will be a great difference in salinity between the upper and the deeper water layers. This could possibly have caused a stratification and a diminution of the convection and the heat exchange during the first months of 1968. The consequence of such a hydrographic situation could be a poor year-class of cod again in 1968 (see Blindheim, *Redbook* 1967, Pt.IV, p.86-105).

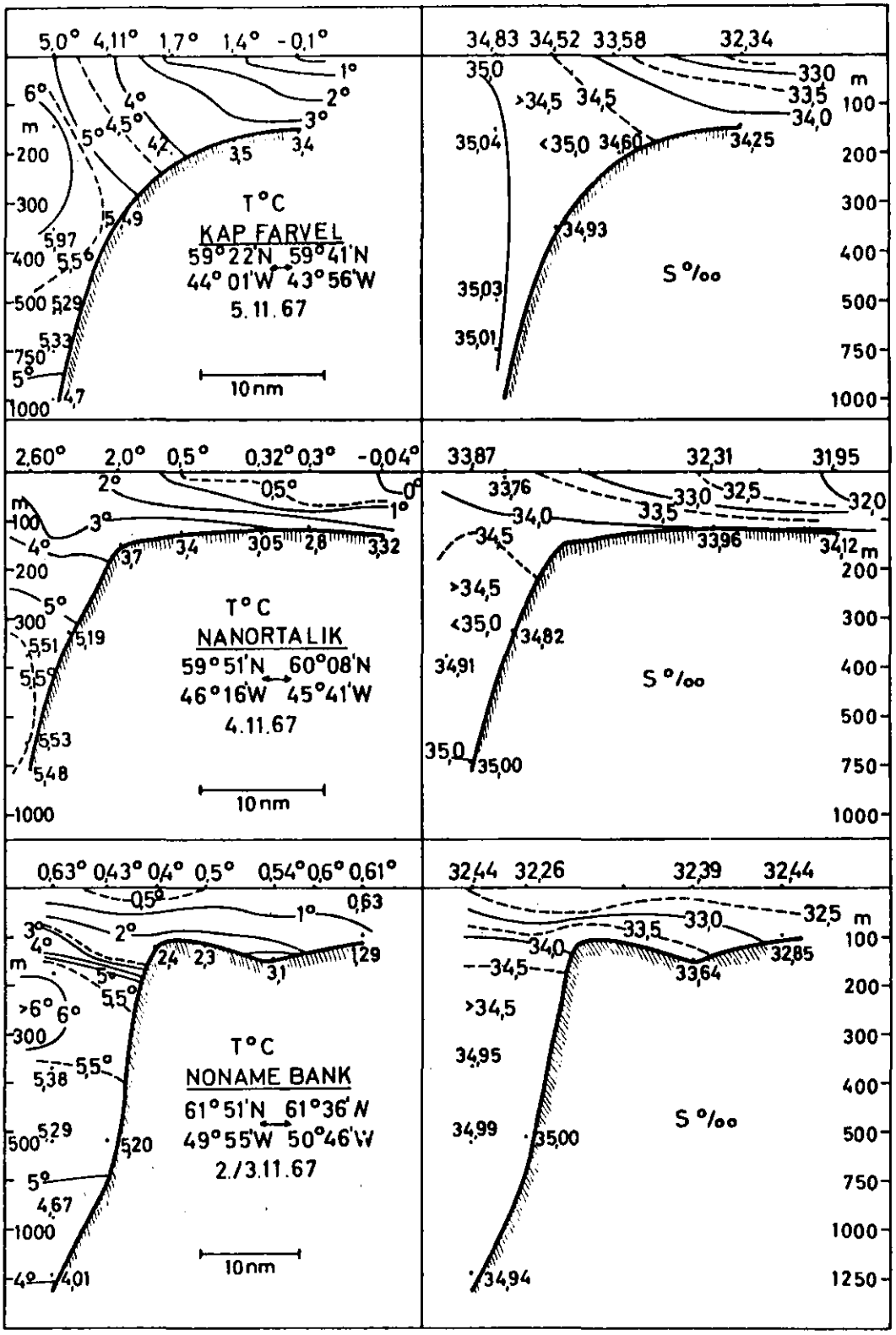

Fig. 2. Hydrographic sections off West Greenland (temperature and salinity) in October/November 1967.

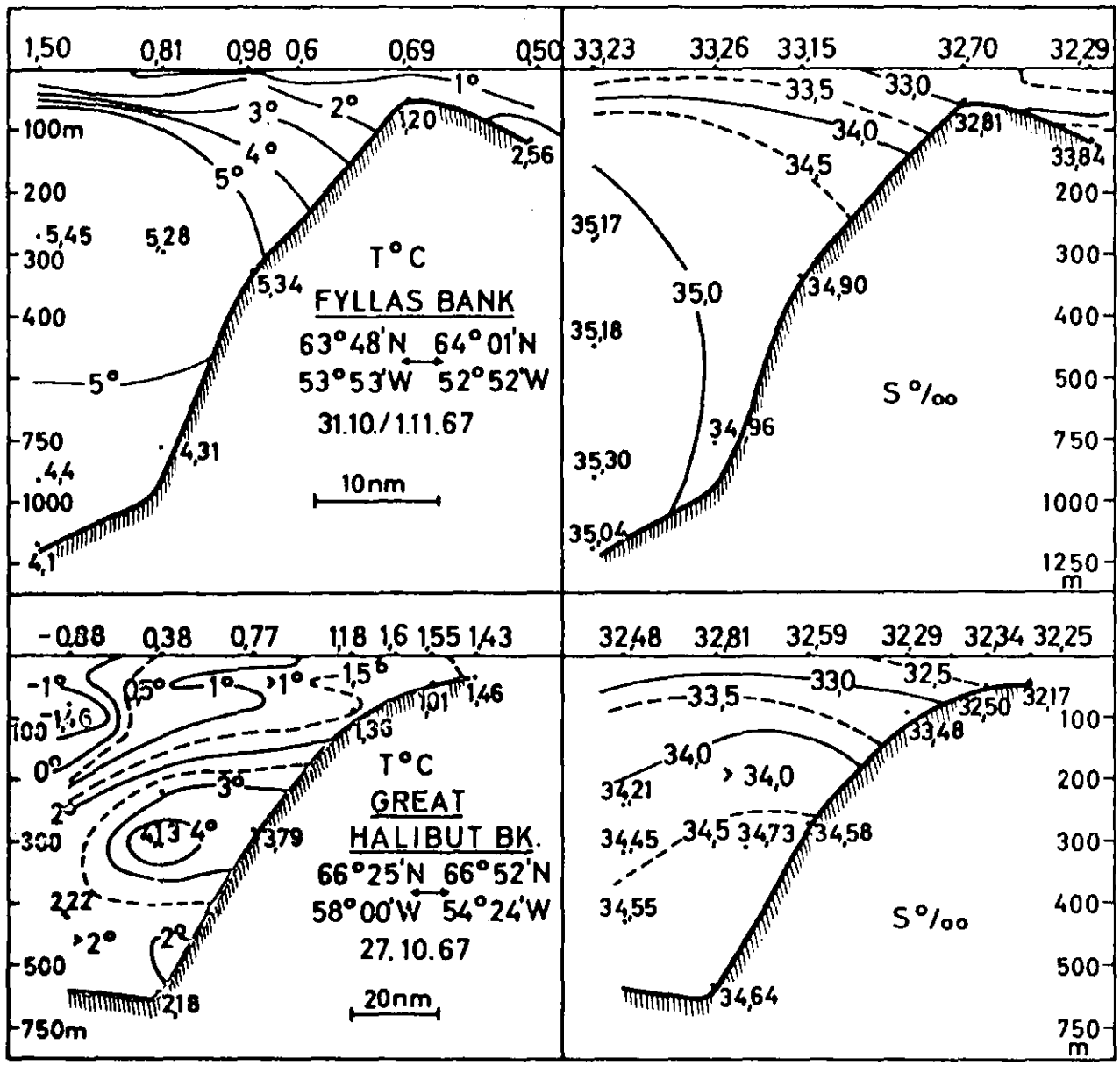

Fig. 3. Hydrographic sections off West Greenland (temperature and salinity) in October/November 1967.

For the first time *Walther Herwig* operated in the middle of the Davis Strait across the "Greenland-Baffinland Ridge" a south-north section along 58°W from 63°30'N to 66°25'N. Figure 4 shows, on its left side, the left branch of the West Greenland Current at depths of 200-1,000 m on its way to Baffinland and Labrador. The temperature in the centre of this current was more than 5°C and the salinity ranged between 34.70 and 34.95‰. On the right side of the section beyond 200 m lies the deeper water of Baffin Bay with temperatures between 1° to 2.9°C and salinities from 34.00 to 34.56‰. The very sharp frontier

Table 4. Temperatures (°C) in late autumn of 1963-67 on the western slopes in different depths and on the banks of Nanortalik, Fyllas and Great Halibut Bank.

	Nanortalik (60°N)							Fyllas Bank (64°N)							Great Halibut Bank (66°40'N)						
Year	date	500	400	300	200	150	outside Bank	date	500	400	300	200	100	outside Bank	date	500	400	300	200	100	outside Bank
1963	-	-	-	-	-	-	-	9.Dec.	5.3	4.7	4.3	3.1	0.9	0.8-0.2	7.Dec.	-	5.1	5.0	4.2	2.0	2.0- -0.1
1964	6.Nov.	-	-	-	>5	5.0	4.5-2.7	10.Nov.	<6	<6	>6	>6	5.2	5.0-3.9	12.Nov.	-	-	-	5.8	3.0	2.9-1.6
	23.Nov.	-	-	-	>6	5.0	4.5-0.7														
1965	19.Nov.	6.4	6.4	6.4	6.2	4.7	4.7-4.4	21.Nov.	6.1	6.1	6.0	5.0	2.5	2.7-2.1	30.Nov.	-	5.3	5.4	5.1	2.6	2.0-0.0
1966	8.Oct.	5.7	5.3	4.4	3.8	3.6	3.6-2.5	13.Oct.	6.0	5.9	5.8	5.6	2.6	2.6-2.4	-	-	-	-	-	-	-
1967	4.Nov.	5.4	5.3	4.9	4.2	3.7	3.7-2.8	1.Nov.	4.8	5.2	5.0	3.6	2.0	2.0-1.2	27.Oct.	1.9	2.5	3.8	2.8	1.7	1.8-1.5

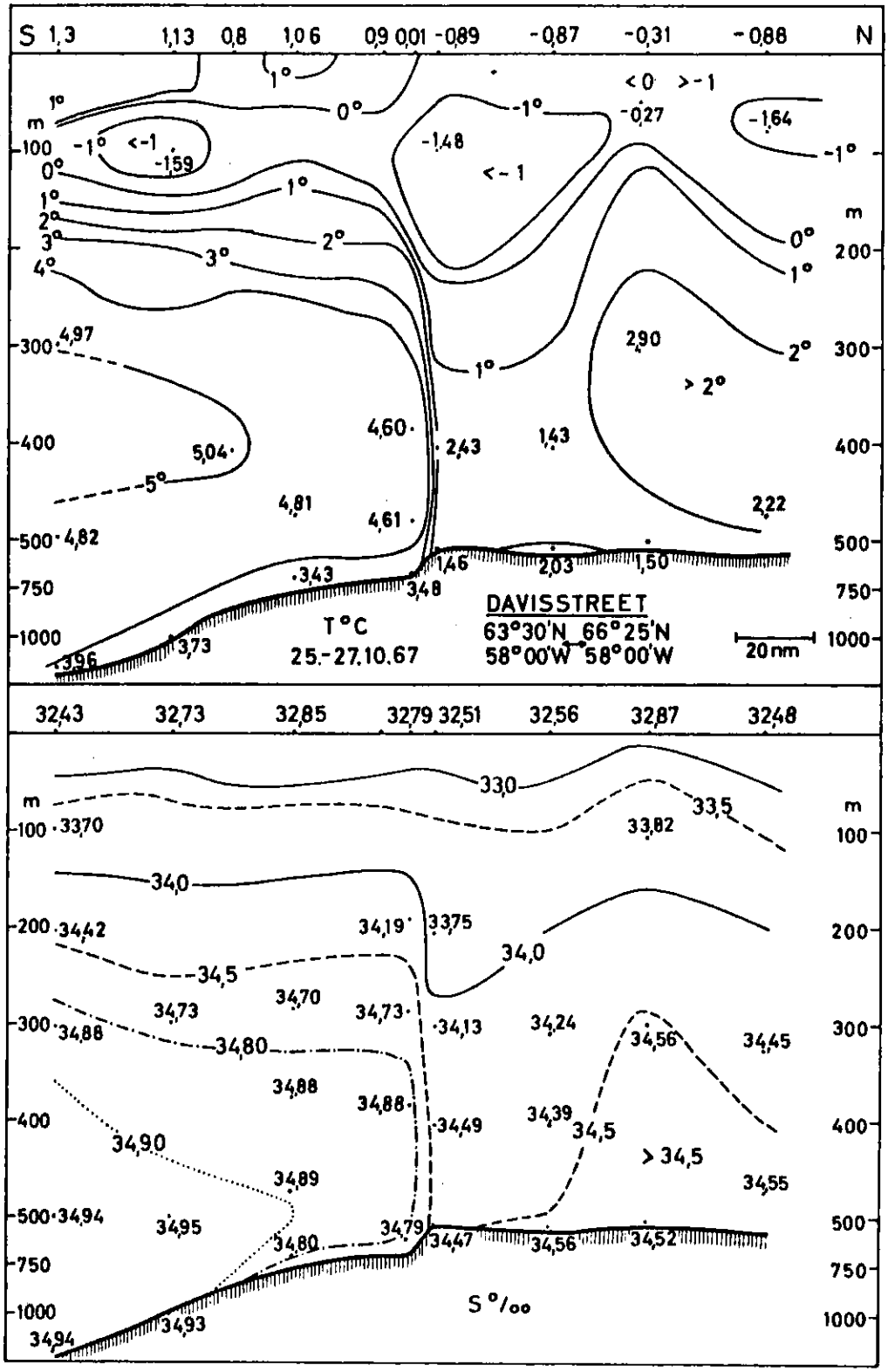

Fig. 4. Hydrographic section across the "Greenland-Baffinland Ridge" along 58°W from 63°30'N to 66°25'N (temperature and salinity) on 25-27 October 1967

between these two water masses was found at the end of October just in 65°N. In the upper water layers we see the very cold "Baffinland Current" running southward. The coldest water of less than -1°C flows at a depth of 70 to 200 m. Its salinity is 33 to 34‰. The salinity at the surface ranged between 32.43 and 32.78‰.

We know from the Denmark Strait that the Arctic bottom water passes the ridge in pushes or waves. From this very interesting section across the "Baffinland Ridge" we get the impression that on the northern side of the ridge (right side of the section) just a new wave of water with more than 2°C temperature and more than 34.50‰ salinity is approaching from the north to pass the ridge.

II. Biological Studies

1. Cod. The age determinations revealed - as predicted in the last report - that the very rich 1961 year-class (acccording to Horsted (1967) the second strongest since 1947) was the main reason for the increase in the catch-per-unit effort in 1967. The concentrations of pre-spawners as well as those of the spawners and post-spawners of this year-class (either first or second time spawners) made up 50 to 60 percent of the total catch on all fishing grounds in Div.1D to 1F (Fig. 5a-d). The good 1960 year-class accounted for 20 to 30 percent during the winter and spring season. The age determinations again showed that fishing effort off West Greenland during the sixties was so high that after 10 years of age even rich year-classes have completely lost their commercial importance as can be seen from the very low percentage of the rich 1957 year-class.

In winter and spring the percentage of industrial fish or discards is almost negligible. In summer, however, this percentage rises, especially when the trawlers lose the shoals of post-spawners which become more and more dispersed during their feeding migrations. Already in June on Fylla and Lille Hellefiske Bank, of 1,000 fish utilized for human consumption, at least 550 small fish had to be turned into fish meal (Fig. 5e). This demonstrated that during summer the younger year-classes 1962 to 1964, cod of 3 to 5 years of age, made up more than 50 percent of the catches by numbers.

The research catches of *Walther Herwig* (Fig. 6) show best the real age composition in autumn. Because of the wide dispersion during the feeding migration of the 1960 and 1961 year-class and the weakness of the 1962 to 1964 year-classes, the catches were small. The research ship fished with a 110 mm net and it was again interesting to note that, *e.g.* off Holsteinsborg (where two biologists of *Walther Herwig* boarded a German factory trawler and measured the catches fished at the same time on the same ground) the commercial trawler not only had the same poor catches as the research ship but that the average length composition of cod was slightly smaller than that found on board *Walther Herwig*. This shows again (see A. Meyer, Redbook 1967, Pt.III, p.13 and Fig. 3) that for several reasons the *effective* mesh size of commercial trawlers is much smaller than the measured one and that biologists were right in taking 100 mm as the effective mesh size in their recent stock calculations and stock assessments.

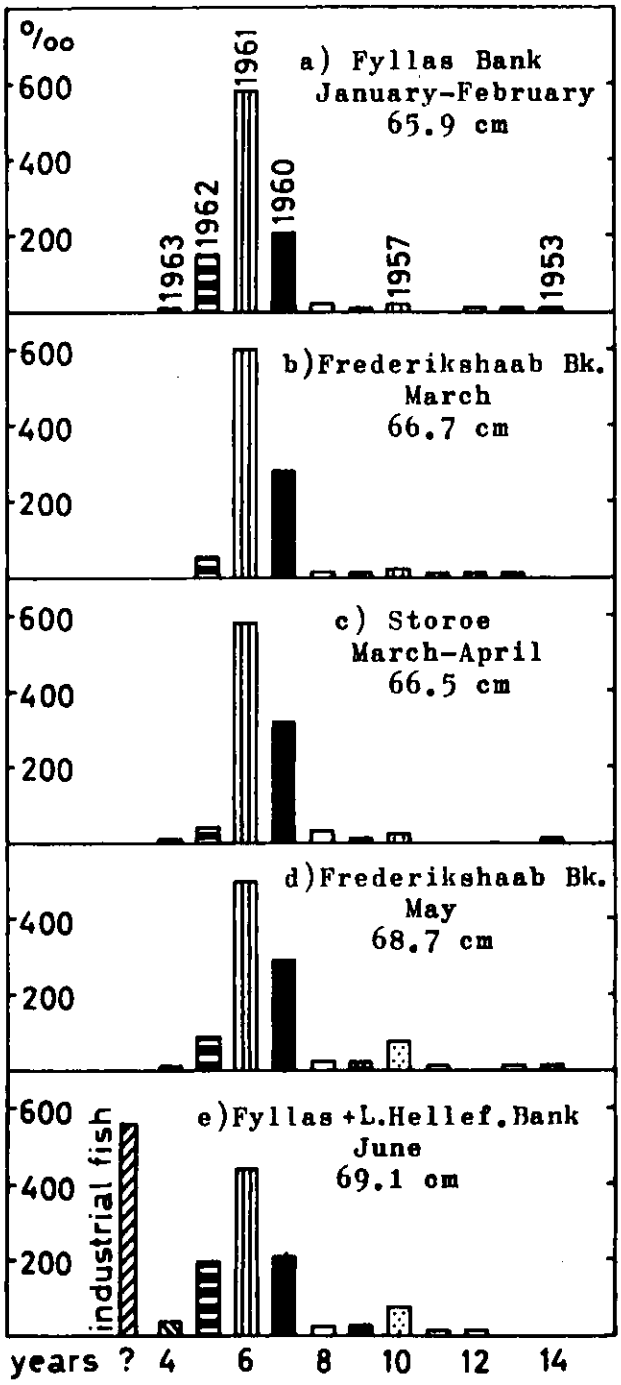

Fig. 5. Age composition (in %) of commercial catches in Subarea 1 in 1967. Catches a-d without any industrial fish; catch e with additional industrial fish (see text).

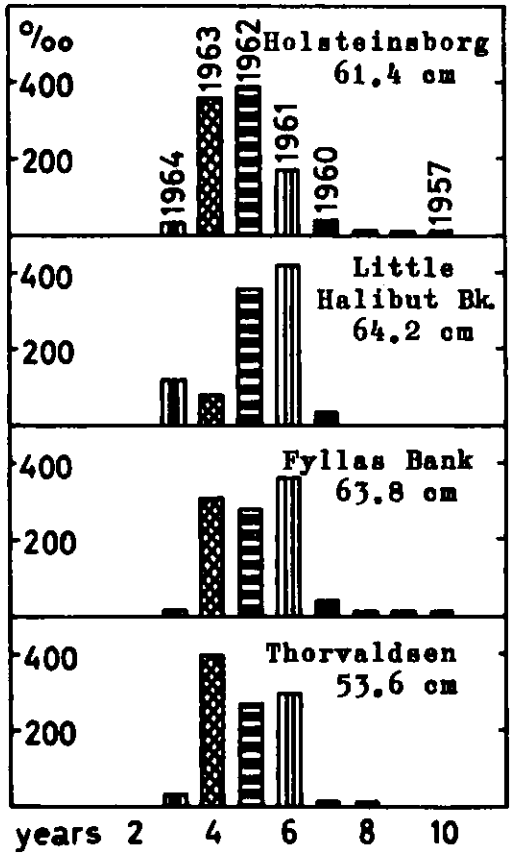

Fig. 6. Age composition (in %) of research catches of *Walther Herwig* in Subarea 1, October/November 1967.

The age composition found by *Walther Herwig* on the different fishing grounds shows clearly that the mentioned trend to seasonal winter and spring fishing by the German trawlers and a possible future temporary cessation of the Greenland fishery during the more or less unprofitable slack period would result in a very simple but effective conservation method for the stock of small, immature cod in Subarea 1. Germany is by far the leading fishing nation in Greenland waters. Thus the new trend to increased herring fishery in autumn will be of some benefit for the Greenland cod fishery and is in itself a new form of a conservation measure in regulating the fishery of heavy fished stocks.

Off Southeast Greenland (Fig. 7a-c) the percentage of the 1961 year-class reached up to 80 percent in 1967, as well in winter as in summer. This shows that the 1961 year-class is not only of West Greenland origin but is especially of East Greenland origin. Owing to the later onset of maturity, the percentage of this year-class makes up only 20 percent on the real spawning grounds (Fig. 7b). On the spawning grounds Bille and Fylkir Bank, the 1960 and the 1957 year-classes were of greatest commercial importance. Further to the north on Heimland Ridge, Angmagssalik, and especially on Dohrn Bank (Fig. 7d-e), the East Greenland 1958 year-class was again, as in 1966, by far the most important year-class during the spawning season. The other good East Greenland 1956 year-class is decreasing; however the few, though very large, 11-year-old cod of 87 to 117 cm (average 97 cm) of length and 6 to 15 kg of weight are still of great commercial importance. During autumn, also on Dohrn Bank, the 1961 cod were by far the strongest year-class (Fig. 7e).

While mostly the year-class composition off Iceland and off East Greenland is almost the same, it is interesting to note that, for the first time, a strong East Greenland year-class is only of medium size in Icelandic waters. For mostly with 8 years the majority of an East Greenlandic year-class matures and migrates to the spawning grounds off East Greenland, we may expect a very profitable fishery for spawning cod in March and April 1969, possibly (if ice conditions are not too bad) with a greater total output than in the record year 1964, when the good 1956 year-class matured. Of further interest will be whether the 1961 year-class will only spawn off East Greenland or will also migrate to Iceland.

2. Redfish. New special studies for ageing of redfish began in the laboratory in Bremerhaven. The first results will be discussed at the Redfish Symposium in Lowestoft in 1968.

3. Haddock. Small quantities of haddock - up to 100 baskets per trip - are often caught mostly in the winter months off Southeast Greenland. These haddock are always large. The average length of a market sample in February 1967 was 64.9 cm. The age composition is given in Table 5. We cannot say whether the haddock off SE Greenland is a small and independent Greenlandic stock. In some years we found young haddock off SW Greenland. From the comparison with the Icelandic age composition of catches of German trawlers off SW Iceland in April-May 1967, we might presume that this could be an independent small stock. A captain also reported having seen large female haddock with running eggs off Southeast Greenland.

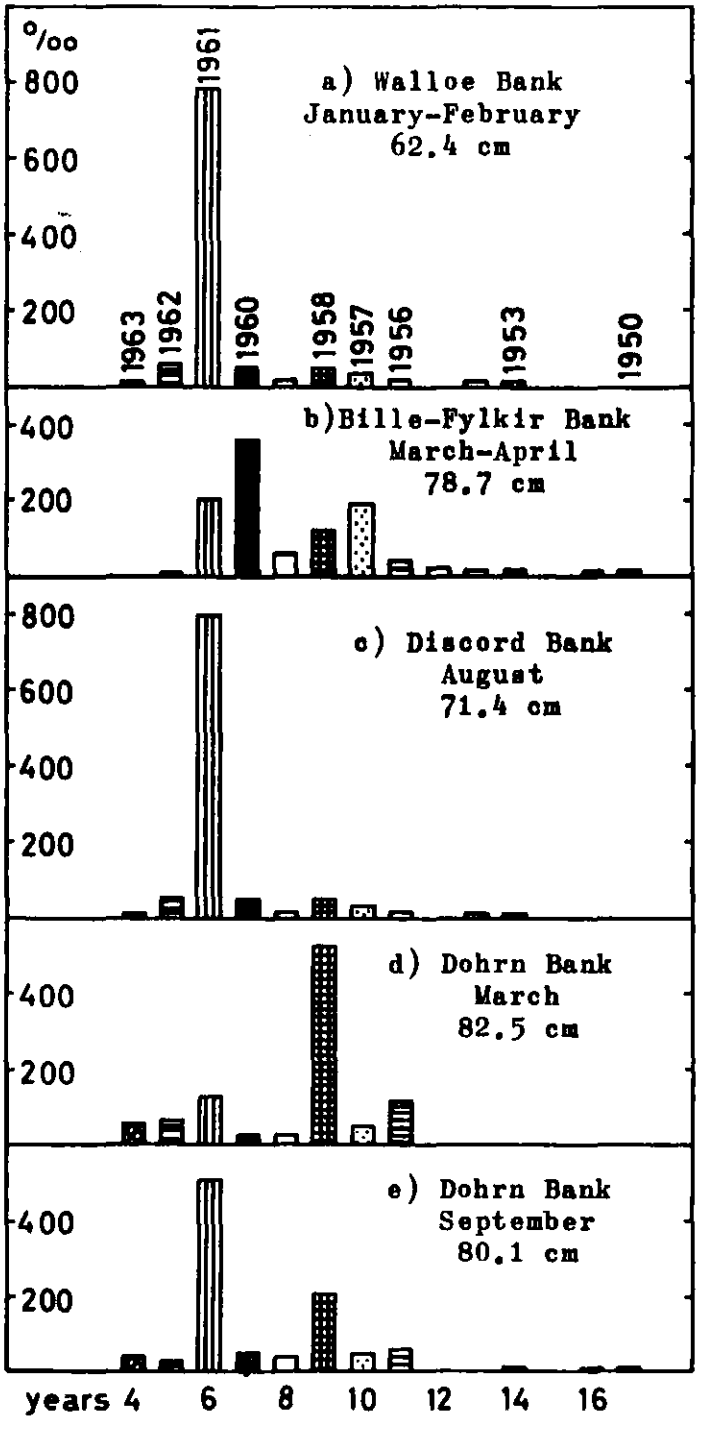

Fig. 7. Age composition (in ‰) of commercial catches off East Greenland in 1967.

Table 5. Age composition (%) of haddock caught off Southeast Greenland in February 1967 and off Southwest Iceland in April-May 1967.

Year-class	SE Greenland	SW Iceland
1964	-	12
1963	64	264
1962	203	304
1961	248	143
1960	243	250
1959	219	12
1958	23	1
1957	-	13
1956	-	1

B. Subareas 2-4
by J. Messtorff

Subarea 2

A. Status of the Fisheries

The German fishing activity as well as the total catch off Labrador decreased sharply in 1967. For comparison with the preceding years, the nominal catches and catch per day fished of German trawlers from 1965 to 1967 are given in Table 6. The quantities of fish discarded at sea are given separately for 1966 and 1967 in Table 8. Against 1966 the total catch of 1967 amounted to only 49 percent and was still by 12,500 tons less than in 1965. Although the fishing effort (days fished) decreased below the level of 1965, the average total catch per day fished dropped remarkably from 34.5 tons (1965) to only 26.5 tons in 1967.

As in the years before the main fishing operations took place at the beginning of the year from January to April. No fishery at all was carried out during July and August. Altogether there were only few trawlers which landed pure Labrador catches. Almost all fishing vessels operating in Subarea 2 were factory trawlers which often changed fishing grounds several times during one trip between Labrador and Greenland.

I. Cod

As in the years before the German fishery off Labrador was confined to a pure offshore cod fishery (93 percent of the total catch). The fishery during the seasons mentioned above took place namely in Div.2H and 2J along the edge of the Continental Shelf and on Hamilton Inlet Bank. As shown in Table 6, the nominal catch of cod in 1967 reached barely half the yield of the year before and also the catch per day fished decreased considerably although the fishing effort was even lower than 1965.

Table 6: Subarea 2, nominal catches in tons (1965 - 1967) (including industrial fish = fish converted to fish meal on board)

year	COD days fished	COD catch	COD catch per day fished	COD % industrial	REDFISH catch	REDFISH catch per day fished	REDFISH % indust.	OTHER FISH catch	OTHER FISH catch per day fished	OTHER FISH % indust.	TOTAL catch	TOTAL catch per day fished	TOTAL % indust.
1965	1323	41556	31.4	13.3	2891	2.2	1.2	1151	0.9	60.0	45598	34.5	13.8
1966	2132	63610	29.8	7.8	2750	1.3	13.2	1541	0.7	46.4	67901	31.8	8.9
1967	1251	30589	24.5	8.4	1616	1.3	17.1	310	0.2	80.0	33115	26.5	9.3

Table 7: Subarea 3, nominal catches in tons(1965 - 1967) (including industrial fish = fish converted to fish meal on board)

year	days fished	COD catch	COD catch per day fished	COD % industrial	REDFISH catch	REDFISH catch per day fished	REDFISH % industr.	Haddock* catch	Pollock* catch	OTHER FISH catch	OTHER FISH catch per day fished	OTHER FISH % indust.	TOTAL catch	TOTAL catch per day fished	TOTAL % indust.
1965	724	8147	11.3	3.1	1057	1.5	4.2	44	6	1420	2.0	53.4	10674	14.7	9.9
1966	572	8806	15.4	15.6	305	0.5	36.7	-	-	268	0.5	80.2	9379	16.4	18.1
1967	66	613	9.3	18.3	347	5.3	2.0	-	-	39	0.6	43.6	999	15.1	13.5

*) Catch per day fished not calculated, because days fished not broken down by divisions where Haddock and Pollock are abundant. - Industrial fish not known.

Table 8: Subarea 2, discarded fish (tons) by divisions in 1966 and 1967 (not included in nominal catches of table 6)

Year	COD Total	COD 2G	COD 2H	COD 2J	REDFISH Total	REDFISH 2G	REDFISH 2H	REDFISH 2J	OTHER FISH Total	OTHER FISH 2G	OTHER FISH 2H	OTHER FISH 2J	ALL SPECIES Total	ALL SPECIES 2G	ALL SPECIES 2H	ALL SPECIES 2J
1966	564	40	200	324	32	-	-	32	110	8	39	63	706	48	239	419
1967	200	1	103	96	19	-	14	5	64	-	26	38	283	1	143	139

II. Redfish

The redfish catches reported in Table 6 have been entirely taken as by-catch of the offshore cod fishery and amounted to nearly 5 percent of the total catch in the subarea. Compared with the preceding year, the redfish proportion did not change significantly (4-5 percent) and the catch per day fished remained on the same low level.

B. Special Research Studies

I. Environmental Studies

During a survey by R/V *Walther Herwig* from 13-23 October four hydrographic sections across the Labrador Current (Fig. 8-10) were taken between Cape Chidley (Div.2G) and Hamilton Inlet Bank (Div.2J). The location of the fourth and southernmost section coincided with the Canadian standard section from Seal Island across Hamilton Inlet Bank and was occupied on 19-20 October and one week later by the Canadian R/V *A.T.Cameron*. For comparison both observations are published by May and Messtorff in *Redbook* 1968, Part III.

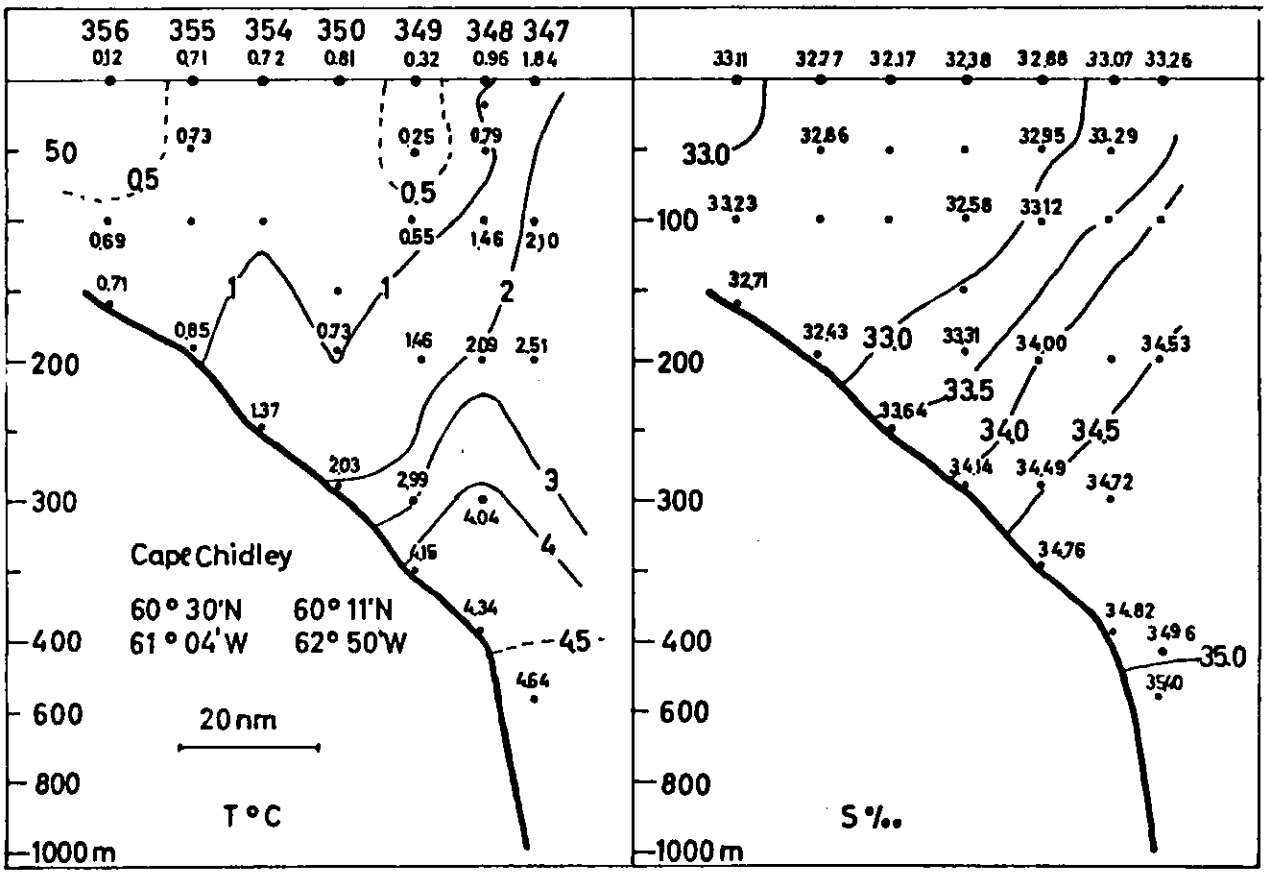

Fig. 8. Temperature and salinity distribution off Cape Chidley (Div.2G) compiled from *Walther Herwig* data, 13-14 October 1967.

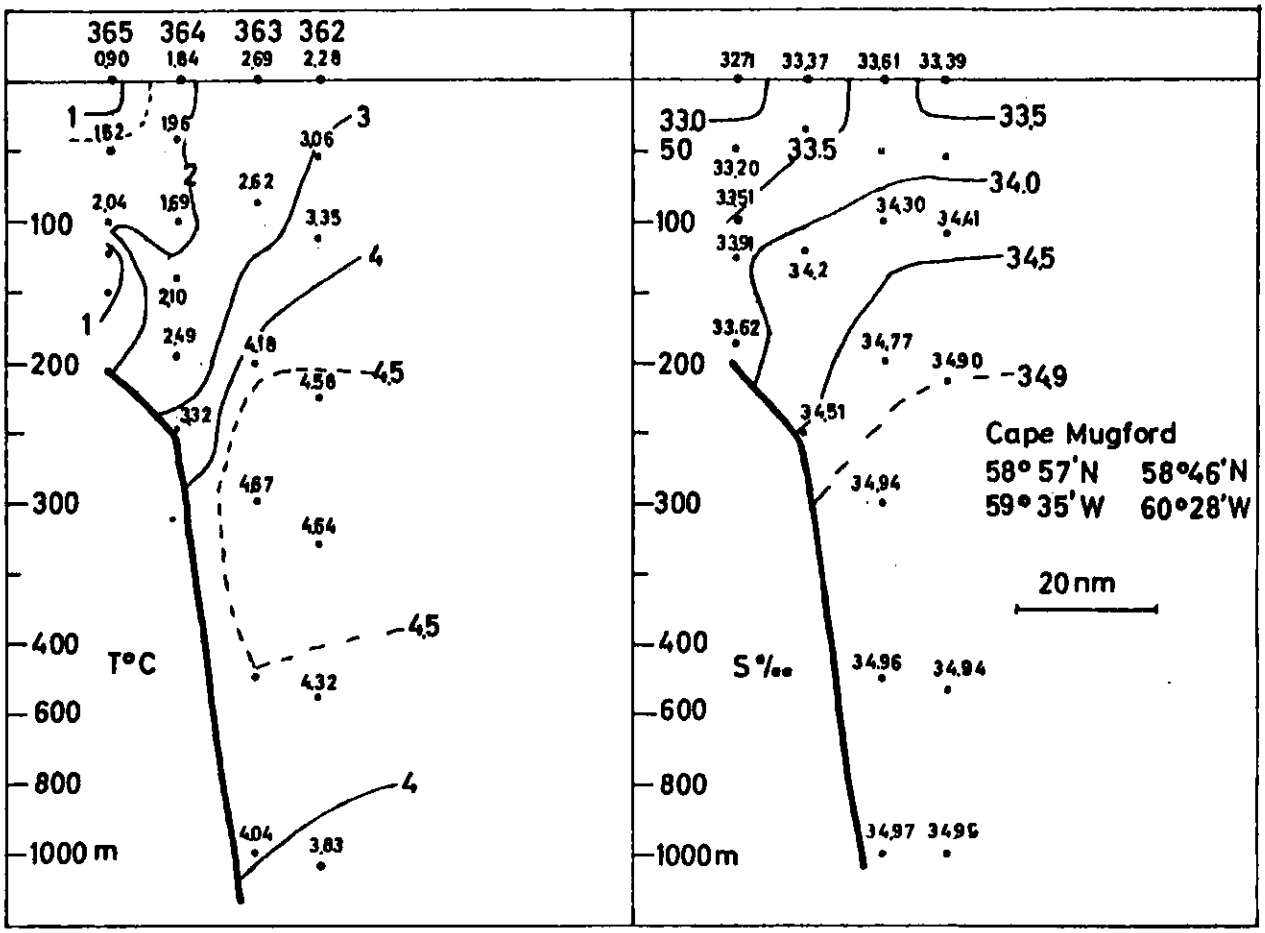

Fig. 9. Temperature and salinity distribution off Cape Uivuk (Saglek Bay, southern part of Div.2G) compiled from *Walther Herwig* data, 16 October 1967.

Off Cape Chidley (Fig. 8), the frontier between the colder water masses of lower salinity from the Baffin Land Current and the warmer Atlantic water (isolines of 2°C and 34‰) reached the bottom at the slope of the shelf in almost 300 m. In 450 m bottom temperatures increased to 4.5°C and extremely high salinities up to 35.40‰ were recorded. Such high salinities were also found somewhat later on the same cruise off West Greenland (Subarea 1). On the shelf shallower than 200 m water temperatures were found to be lower than 1°C from surface to bottom.

At the steeper slope of the shelf in the southern part of Div.2G (Fig. 9), the 2°C - respectively 34‰ - isolines already reached the bottom in about 200 m. But water warmer than 4.5°C did not reach the bottom until 1,000 m and salinities did not exceed 35‰.

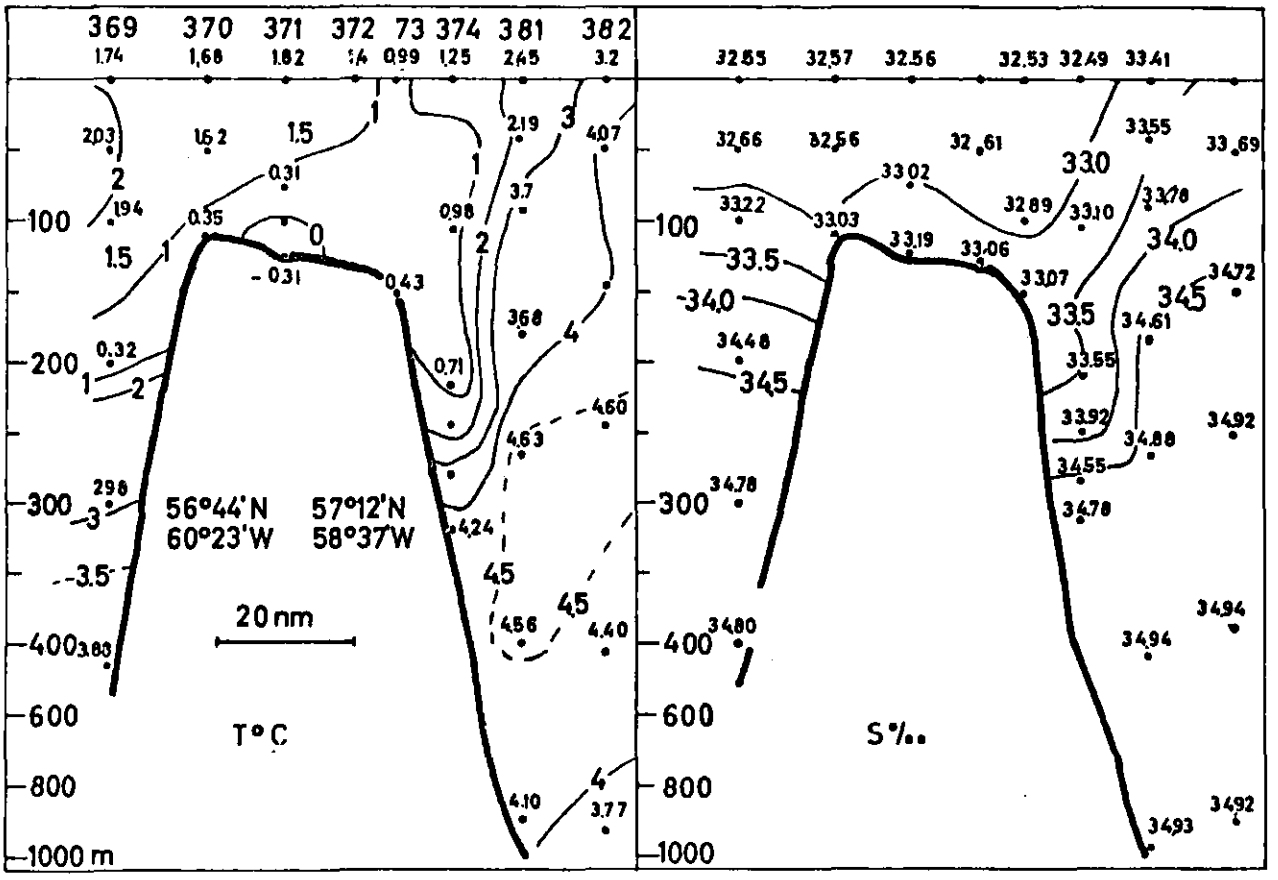

Fig. 10. Temperature and salinity distribution off Dog Island (Div.2H) compiled from *Walther Herwig* data, 17-18 October 1967.

Similar hydrographic conditions were revealed by the third section in Div.2H (Fig. 10). Here also the deep inshore channel west of the bank was supplied with warmer Atlantic waters of higher salinity in depths over 250 m, whereas the top of the bank was covered by cold water masses.

The hydrographical conditions at the southeastern slope of Hamilton Inlet Bank were found to be almost the same as described above. Only the core of the cold water near the shelf edge between 100-200 m was of greater volume at the time of the first observation.

II. Biological Studies

1. Cod. Due to the unsteady character of the German fishing operations off Labrador, only few samples for length and age distribution of commercial catches could be obtained from January until March. Compared with the length frequency distribution obtained in the same season of the preceding year, about 22 percent more cod below 55 cm lengths were caught and the average length

decreased from 61.1 cm (1966) to 57.8 cm (1967). Due to the relatively small number of samples, however, these figures might not be entirely reliable.

A survey was carried out by R/V *Walther Herwig* from 13-23 October to study the abundance of cod off Labrador (Div.2G-J) in autumn. On 33 stations preferably near the edge of the shelf where temperature conditions were more favourable and on Hamilton Inlet Bank 30 min hauls with the bottom trawl were made. These include comparative fishing trials with the Canadian research vessel *A.T.Cameron*, the results of which are reported by May and Messtorff in *Redbook* 1968, Part III. Fishing conditions for cod were very moderate. Maximum catches of 1,000 kg per hour trawling were obtained in the southern part of Div.2G and in Div.2H. In Div.2J cod were considerably smaller (m.L. 45.5 cm) as in the northern divisions (m.L. 53.0 cm).

2. Redfish. For the same reasons as for cod no sampling of commercial catches could be obtained. During the survey carried out by R/V *Walther Herwig* in autumn, the length distribution of adult redfish in the catches was determined and additionally some samples of young redfish could be obtained to study the validation of age determinations.

Subarea 3

A. Status of the Fisheries

The German fishing activity as well as the total catch in the subarea decreased considerably. For comparison with the preceding years, the nominal catches and catch-per-day fished by German trawlers from 1965 to 1967 are given in Table 7. Contrary to Subarea 2, no fish have been reported as being discarded at sea. Against 1966 the total catch of 1967 amounted to only 10.6 percent. The fishing effort (days fished) reached only 11.6% of that of 1966, but the average total catch per day did not drop considerably. Fishery took place only in Div.3K and 3L and was restricted to several short visits of single trawlers at different times of the year.

I. Cod

The cod fishery yielded 61 percent of the total catch from the subarea and amounted to only 6.9 percent of the catch in 1966. Also the catch-per-day fished decreased considerably against the years before.

II. Redfish

The redfish catches increased by 17 percent against 1966 although there was a remarkable reduction in the total fishing effort as mentioned above. Accordingly the catch-per-day fished increased from 0.5 tons in 1965 to 5.3 in 1967.

B. Special Research Studies

No special research studies were carried out.

Subarea 4

There was no German fishery in the subarea and no special research studies were carried out.

C. Subarea 5 and 6
by K. Schubert

A. Status of the Fisheries

Thirteen stern freezer trawlers operated with pelagic nets in Subareas 5 and 6 and made 25 trips from July to December, mainly for herring (99.6 percent). Catch, effort and catch-per-unit effort are given in Table 9.

Table 9. Nominal catch, effort and catch-per-unit effort of German (Fed. Rep.) factory freezer trawlers in Div.5Z and 6A. Catches in August-December 1967 include industrial fish.

Month	Aug	Sep	Oct	Nov	Dec	Total
	Nominal Catches (tons)					
Herring	2,330	1,311	2,799	5,861	11,815	24,116
Mackerel	-	-	-	-	91	91
Spiny dogfish	-	-	-	-	2	2
Others	3	1	-	1	9	14
Total	2,333	1,312	2,799	5,862	11,917	24,223
	Catch per day (tons)					
Herring	54.2	23.8	50.0	40.9	41.0	41.7
Mackerel	-	-	-	-	0.3	0.1
Spiny dogfish	-	-	-	-	0	0
Others	-	-	-	-	0	0
Total	54.2	23.8	50.0	40.9	41.3	41.8
	Effort					
Trips	2	2	3	6	12	25
Days of trip	90	96	93	200	540	1,019
Days per trip	45.0	48.0	31.0	33.0	45.0	40.8
Fishing days	43	55	56	136	288	578
Fishing days per trip	21.5	27.5	18.7	22.7	24.0	23.1
Fishing hours	425	508	896	1,087	3,309	6,225
Fishing hours per trip	213	254	299	181	276	249
Fishing hours per day	9.9	9.2	16.0	8.0	11.5	10.8

Table 10 shows the discarded fish in these subareas.

Table 10. Fish discarded (in tons) by German factory feezer trawlers in Div.5Z and 6A, August-December 1967.

Month	Aug	Sep	Oct	Nov	Dec	Total
Species unknown	20	325	775	1,995	1,500	4,290

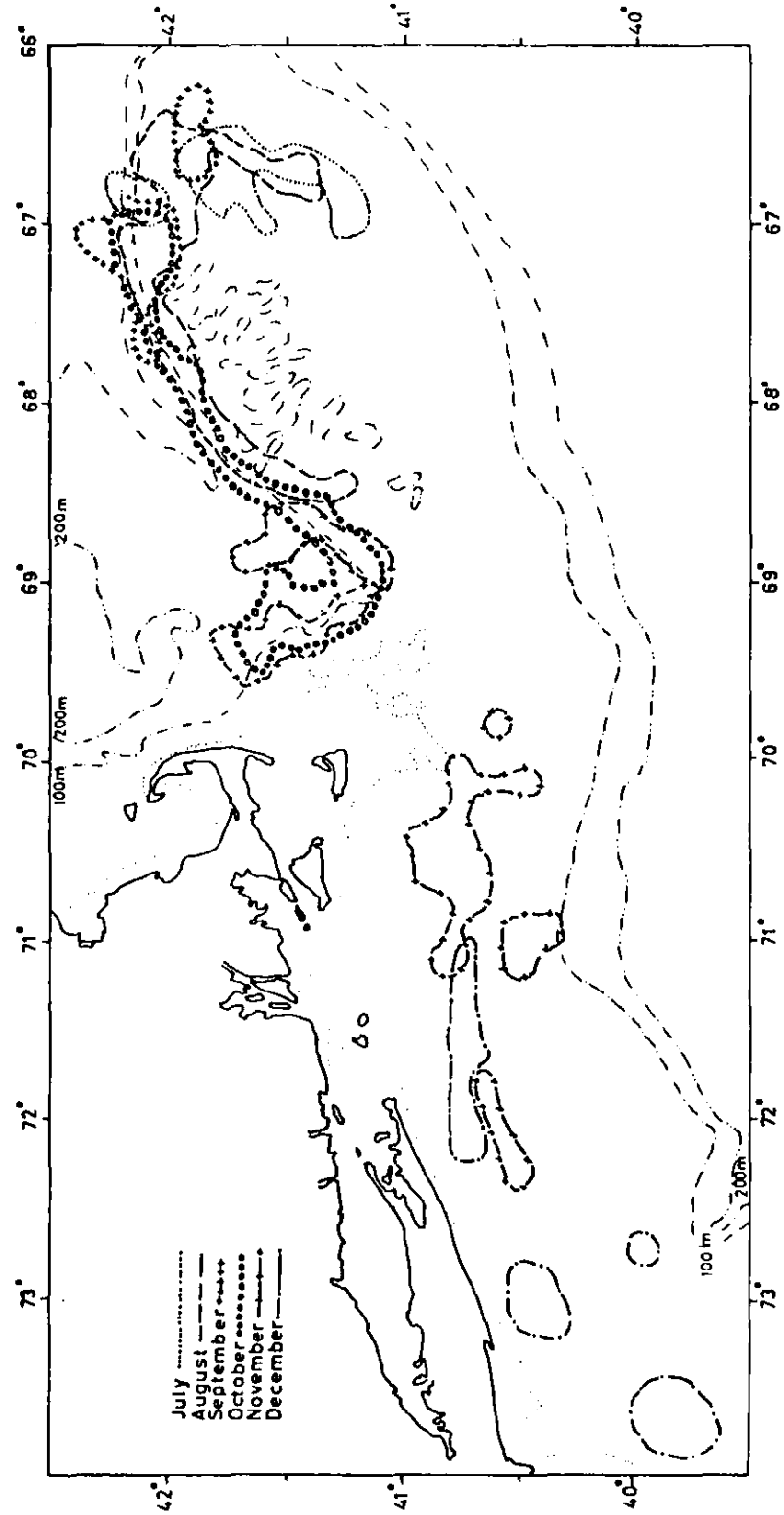

Fig. 11. Herring. Fishing area of German (Fed. Rep.) freezer trawlers in Div.5Z and 6A. July-December 1967.

The fishing began in July on Georges Bank between 41°-42°N and 66°67'W (Div.5Ze). In August the fleet shifted along the northern slopes of the bank to 68°30'N. With the beginning of spawning in September the fishing was between 67°-67°30'N. In the first ten days of October the trawlers continued fishing in the same area. However, in the second and third ten days they shifted westward where between 69°-69°30'W a good fishery was established until the first ten days of November. In the second ten days the herring was rediscovered near Nantucket Lightship (Div.5Z). They were often very runaway and moved westward. At the beginning of December the fleet was fishing off Long Island (Div.6A). The fishing ceased during the second ten days of December off New York and New Jersey (Fig. 11).

Figure 12 shows the daily catch per hour of a German freezer trawler during the season.

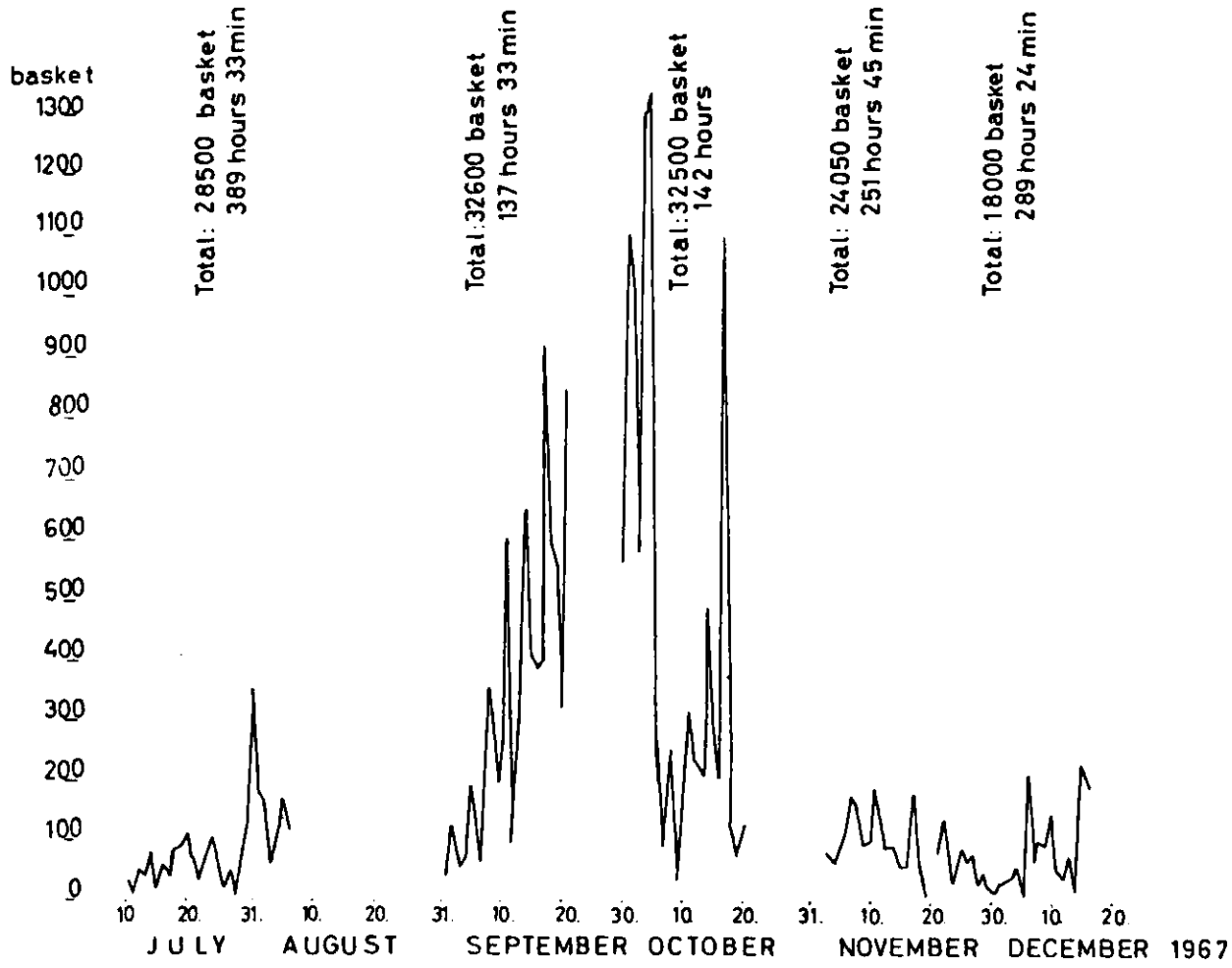

Fig. 12. Herring. Daily catch per hour (baskets) of German freezer trawlers in Div.5Z and 6A. July-December 1967.

B. Special Research Studies

I. Biological Studies

Four samples of 508 herring from different localities and months (September-December) were examined. The average length of all herring was 30.41 cm. The length range varied from 24-35 cm, with a peak at 31 cm (Fig. 13). Maturity stage 5 was predominant in the September sample (90 percent), whereas 6 percent and 4 percent were stages 4 and 6 respectively. The main spawning was in September between 67°00'-67°30'N and around 42°W. The October sample showed that the spawning in this area was finished. Ninety-seven percent of the herring were spent and only 2.6 percent were maturity stage 5. However, we must suppose, after reports from the fishermen who found full herring (stage 5) in larger concentration in October between 68°69'W along the 100 m line, that there are other spawning areas. The sample in the Nantucket area (Div.5Zw) in November was formed of spent herring (95.3 percent), only 4.7 percent were recovering fish. The sample in December from Div.6A showed that the maturity stage 8 was predominant (95 percent); 5 percent were spent herring (stage 7).

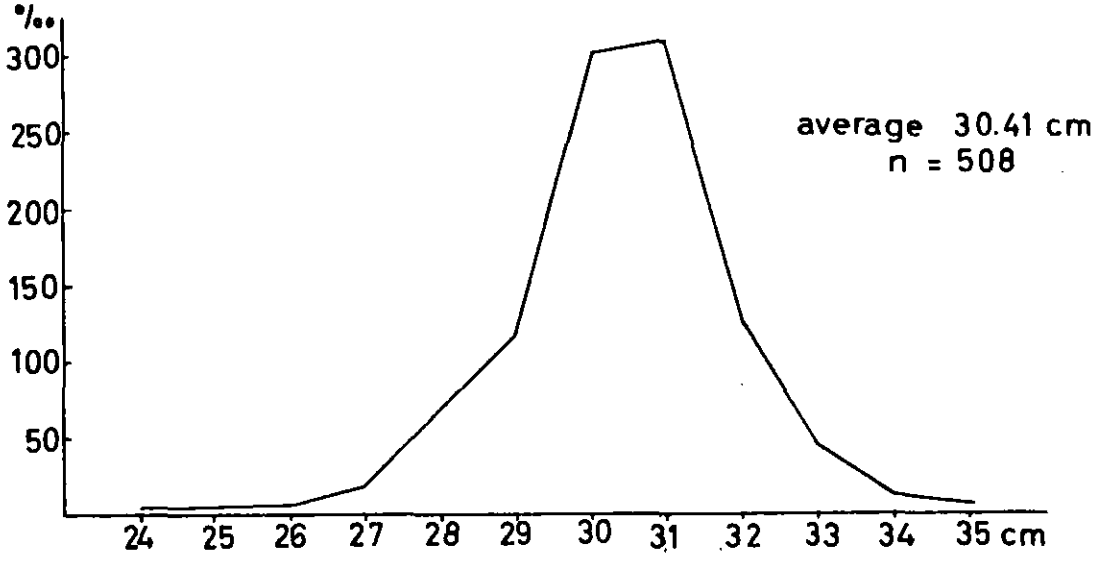

Fig. 13. Herring. Length composition. Div.5Z and 6A, September-December 1967.

The investigation of meristic characters showed that the herring fished in the different months presumably belonged to the same stock. Table 11 shows the average number of vertebrae and gillrakers in herring in the different months.

Table 11. Meristic characters of herring, Div.5Z and 6A, September-December 1967.

Month	Sep	Oct	Nov	Dec
Vertebrae (avg no.)	56.33	56.37	56.37	52.21
Gillraker (avg no.)	49.68	50.20	49.62	49.79
No. of fish sampled	100	41	43	100

The age composition (Fig. 14) showed the predominance of the 1960 year-class (460 percent). This year-class, now 7-years-old, seems to be a very strong one. Of some importance also were the 1961 (185 percent), 1962 (165 percent) and 1963 (85 percent) year-classes.

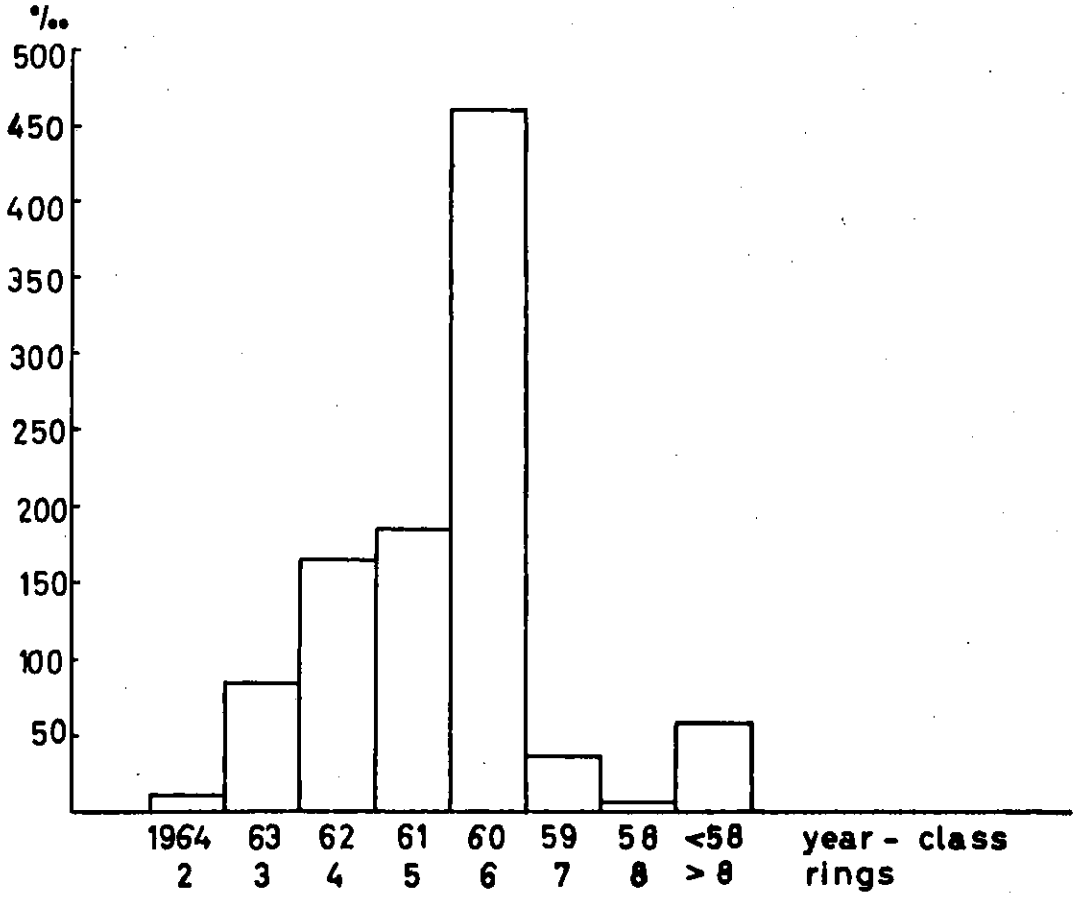

Fig. 14. Herring. Age composition. Div.5Z and 6A, September-December 1967.

V. Icelandic Research Report, 1967

by Jón Jónsson

Subareas 1, 2 and 3

A. Status of the Fisheries

The Icelandic fishery in the ICNAF Area was substantially lower in 1967 than in previous years. The fishing effort in the whole area was only 26 percent of the 1964-66 annual average. The greatest reduction in fishing effort took place in Subarea 1, where the number of hours fished was only 6 percent of the 1964-66 annual average (Table 1). There was also a marked reduction in fishing effort in other subareas. In Subarea 3, the number of hours fished was 56 percent of the 1964-66 annual average.

This reduction in fishing effort is clearly reflected in the catches. Only 349 tons of cod are reported taken from the whole area compared to the annual average of 4,342 tons for the period 1964-66. The redfish catches are about 70 percent of the average.

The cod catches are too small to permit a reasonable comparison of catch-per-unit effort with previous years, but figures from all areas show about half of the 1964-66 annual average.

As for redfish, the catch-per-unit effort was much higher than in previous years, and twice the 1964-66 annual average in Subarea 3.

B. Sampling of cod from commercial trawlers

No samples of cod are available from Subareas 1, 2 or 3, but several samples were collected from East Greenland in April and May. They all show a clear dominance of the 1961 year-class. Other year-classes of importance seem to be those from 1960, 1958 and 1957.

Table 1. Fishing effort and catches of redfish and cod by Icelandic trawlers in Subareas 1, 2 and 3 in the years 1964, 1965, 1966 and 1967.

Subareas	1				2				3				Total			
Years	1964	1965	1966	1967	1964	1965	1966	1967	1964	1965	1966	1967	1964	1965	1966	1967
Hours fished	2,314	1,918	1,271	152	111	368	196	95	1,709	2,117	1,897	834	4,580	4,403	3,359	1,081
Redfish (tons)	1,954	1,253	968	176	379			129	1,999	1,942	2,191	1,809	4,341	3,195	3,159	2,114
Redfish tons/100 hrs	84	65	76	116	341			136	117	92	116	217	95	73	94	196
Cod (tons)	3,091	3,376	1,965	119	114	598	381		887	1,235	1,196	230	4,274	5,209	3,542	349
Cod tons/100 hrs	134	176	155	78	103	163	194		52	58	63	28	93	118	105	32

VI. Norwegian Research Report, 1967

by Erling Bratberg and Johan Blindheim

Subarea 1

Norwegian fisheries investigations were carried out off West Greenland in the area between Nunarsuit and Sukkertoppen from 5 April to 8 May. Five hydrographical sections were worked. Bottom longline was used on 12 localities, and trawling was carried out on 17 stations (Fig. 1)

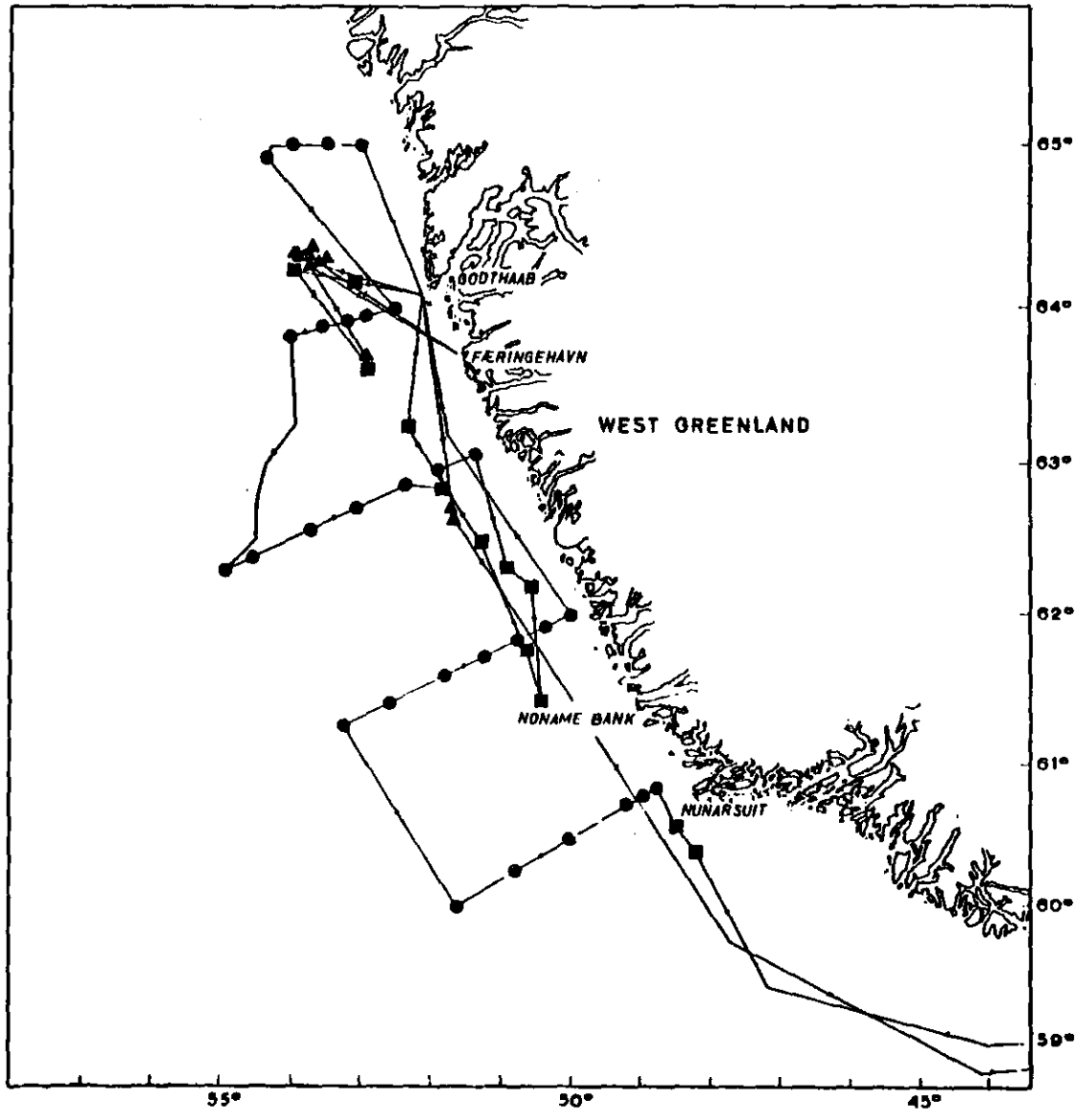

Fig. 1. R/V *G.O.Sars*, West Greenland, April-May 1967. Route and net of stations. ● hydrographical station; ■ bottom longline station; ▲ trawl station.

A. Status of the Fisheries

I. Cod

1. Age and length composition of the commercial stock. In 1967, the 1961 year-class dominated the total catch on bottom longline (hook No.6), with 48.8 percent (Fig. 2). The 1960 year-class decreased in importance, from 42.2 in 1966 to 31.6 percent in 1967. The 1957 year-class decreased further, from 11.6 percent to 2.1 percent of the total catch. On the other hand, the proportion of cod 7 or more years old has increased from 5.3 percent to 42.3 percent.

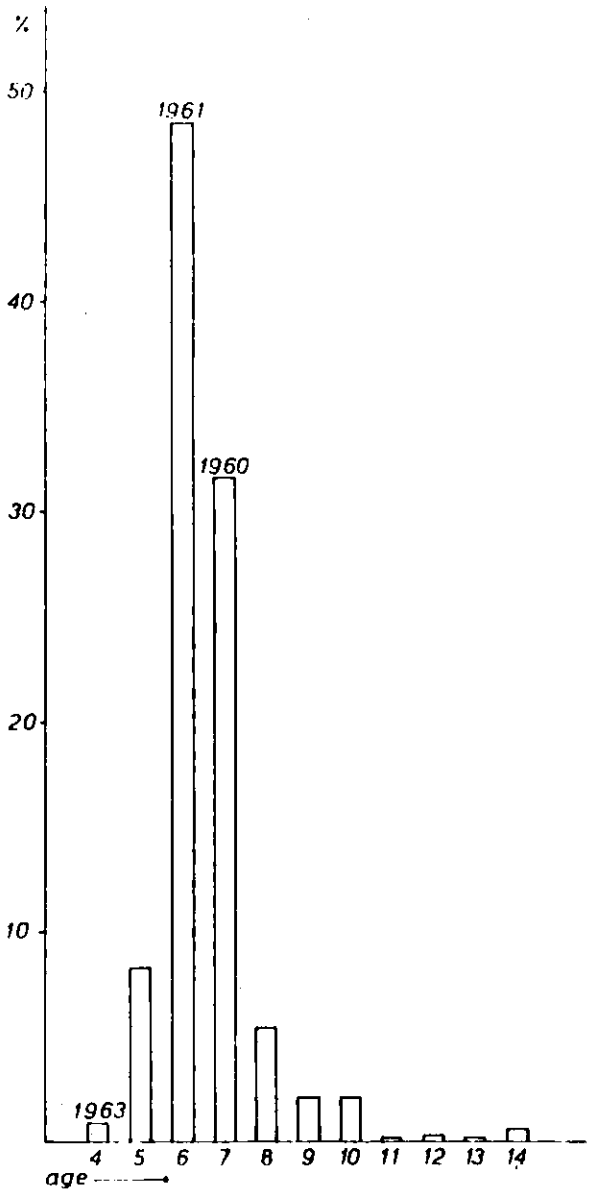

Fig. 2. R/V *G.O.Sars*, West Greenland, April-May 1967. Cod. Age distribution. Total bottom longline catch.

The length distribution in the total bottom longline catch is shown in Fig. 3. The overall mean length was approximately the same as in 1966 (Table 1). The mean length varied from one locality to another. The smallest fish were found on Dana Bank and on Fiskenaes Bank, 66.2 cm, and the largest fish were taken on Lille Hellefiske Bank, 76.3 cm.

2. Forecast for the cod fisheries. In 1968 the Norwegian bottom longline catches off West Greenland most probably will be strongly dominated by the 1961 year-class. The 1960 year-class is expected to decrease further, and the 1962 year-class does not seem to be of any considerable strength. The mean length of the cod in the catches is expected to increase due to the growth of the 1961 year-class.

B. Special Research Studies

I. Environmental Studies

1. Hydrography. Five hydrographic sections were worked between 7 and 18 April (Fig. 1). In the northern part of the investigated area the ice conditions were rather severe. Thus the section across the Fylla Bank could only be worked about 50 nautical miles off the coast. Off the western slope of Lille Hellefiske Bank it was not possible to make any observations.

The sections which were worked off Frederikshaab and across Fylla Bank are illustrated in Fig. 4 and 5. They show that the Arctic component of the West Greenland Current was well developed. The surface layer had low salinities and a very stable stratification. The convection during the winter was thus limited to the upper layers, and the temperatures here were accordingly below normal.

The Irminger component of the West Greenland Current did not show as high temperatures and salinities as in 1966 but were still above normal. In the three most southern sections the highest temperatures and salinities were about 4.80°C and 34.98‰. West of Fylla Bank the temperatures in the Irminger Current exceeded 5.00°C and salinities of 35.00‰ were observed.

II. Biological Studies

1. Cod eggs. Sampling of cod eggs was carried out on all stations. The preliminary results indicate an unsuccessful result of the spawning as few cod eggs were found and most of the cod had completed spawning.

2. Cod distribution. The echo survey and the bottom longline fishing showed that shoals of cod were present in the whole area investigated. The heaviest concentrations were found on the western banks in depths from about 180 to 280 m. Partly pelagic shoals of cod were located on the western slope of Lille Hellefiske Bank off Sukkertoppen and continuously about 50 nautical miles southeastward. Between latitude 62°03'N, longitude 51°22'W and latitude 62°57'N, longitude 51°53'W heavy concentrations of pelagic cod were found in depths from 150 to 250 m.

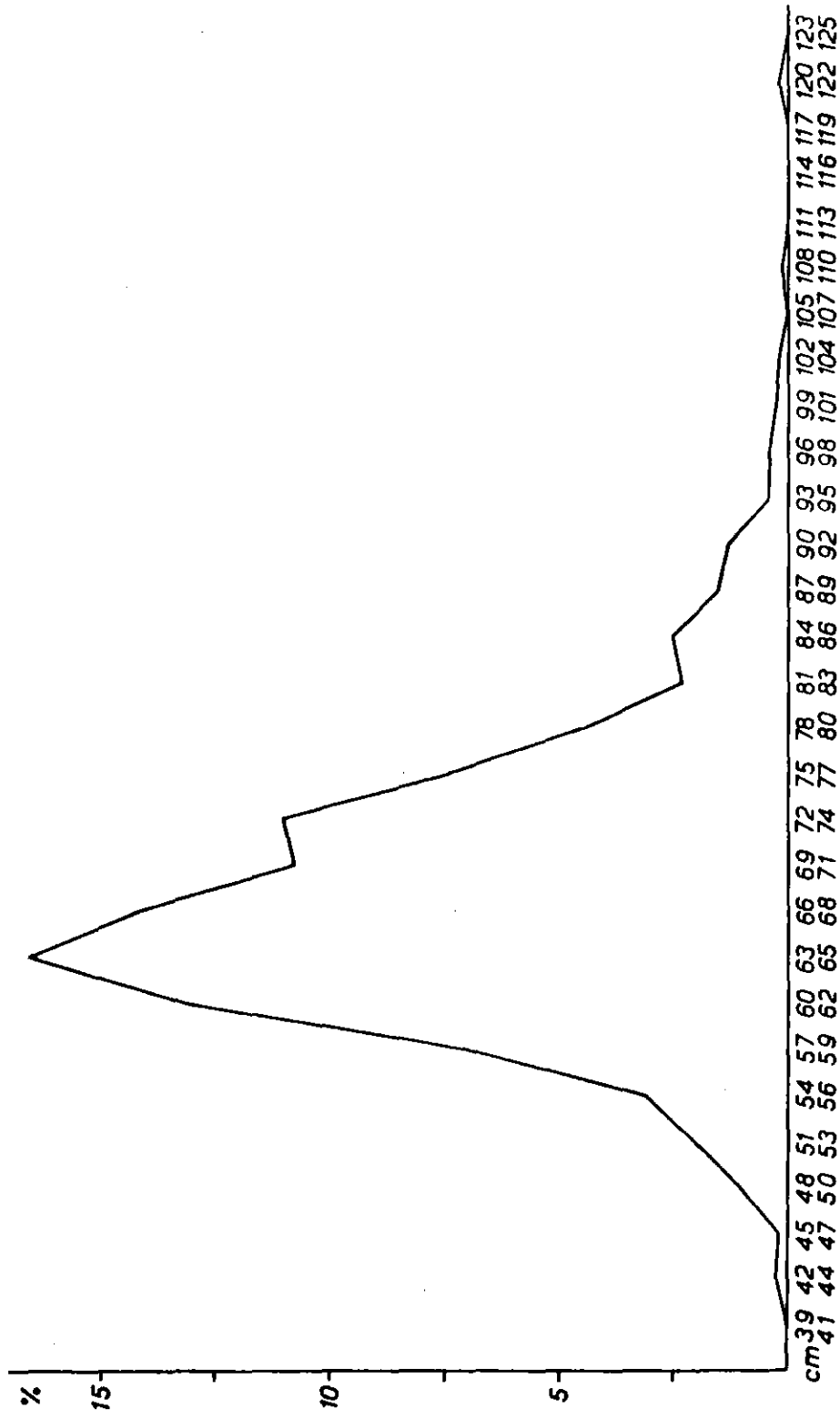

Fig. 3. R/V *G.O.Sars*, West Greenland, April-May 1967. Cod. Length distribution. Total bottom longline catch.

Table 1. Mean length of cod at different fishing stations off West Greenland. R/V *Johan Hjort* 1966; R/V *G.O.Sars* 1967.

Station		Bank	Position		Gear	Mean length (cm)	
1966	1967		1966	1967		1966	1967
1	1	Off Nunarsuit	60°20'N 48°10'W	60°22'N 48°12'W	Bottom long line	71,8	69,2
2	2	- " -	60°36'N 48°32'W	60°34'N 48°30'W	- " -	68,7	70,2
14	6	Noname Bank	61°46'N 50°40'W	61°26'N 50°24'W	- " -	76,0	68,6
15	7	- " -	61°26'N 50°24'W	61°46'N 50°40'W	- " -	73,1	69,8
12	4	Fredrikshaab Bank	62°18'N 50°57'W	62°18'N 50°57'W	- " -	70,3	69,1
13			62°11'N, 50°36'W		- " -	64,4	
11	8	Dana Bank	62°30'N 51°15'W	62°29'N 51°15'W	- " -	68,7	66,2
10	3	- " -	62°50'N 51°46'W	62°50'N 51°45'W	- " -	69,7	67,6
16	9	Fiskenæs Bank	63°15'N 52°17'W	63°15'N 52°17'W	- " -	73,0	66,7
17	12	Fiskenæs/Fylla Bank	63°31'N 52°14'W	63°38'N 52°54'W	- " -	67,5	66,2
		Total southern banks				70,3	68,0
9	10	Fylla Bank	64°10'N 53°14'W	64°10'N 53°05'W	- " -	58,7	69,9
7		West of Banan Bank	64°18'N 54°44'W		- " -	65,1	
6	11	Lille Hellefiske Bank	64°13'N 54°25'W	64°14'N 53°55'W	- " -	66,3	76,3
4		- " -	66°05'N 55°17'W		- " -	63,3	
8		- " -	65°00'N 53°06'W		- " -	66,9	
3		- " -	66°29'N 54°26'W		- " -	65,1	
		Total northern banks				64,2	71,9
		Total all banks				68,5	68,3

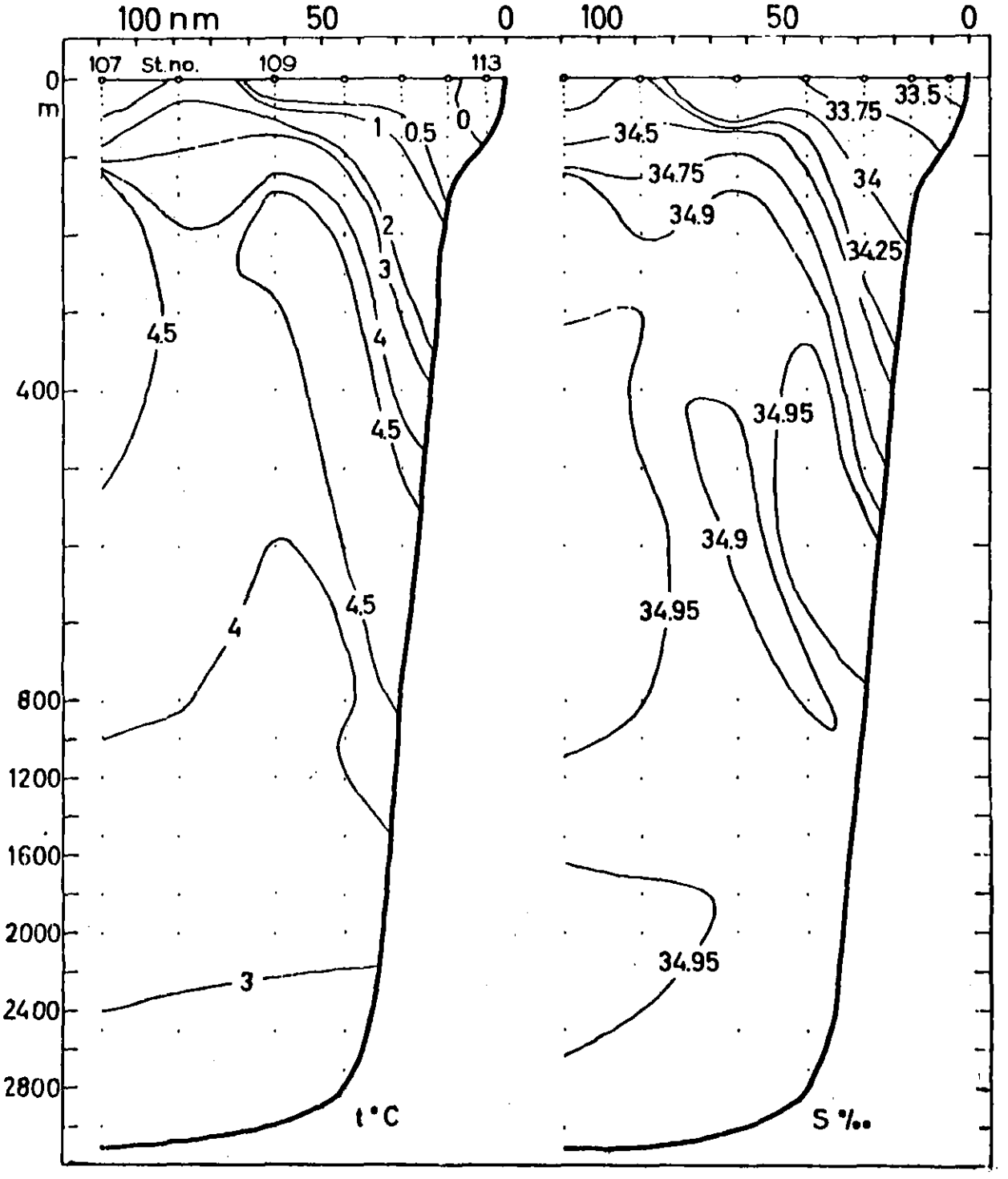

Fig. 4. R/V *G.O.Sars*, West Greenland, 8-9 April 1967. Hydrographical section off Frederikshaab.

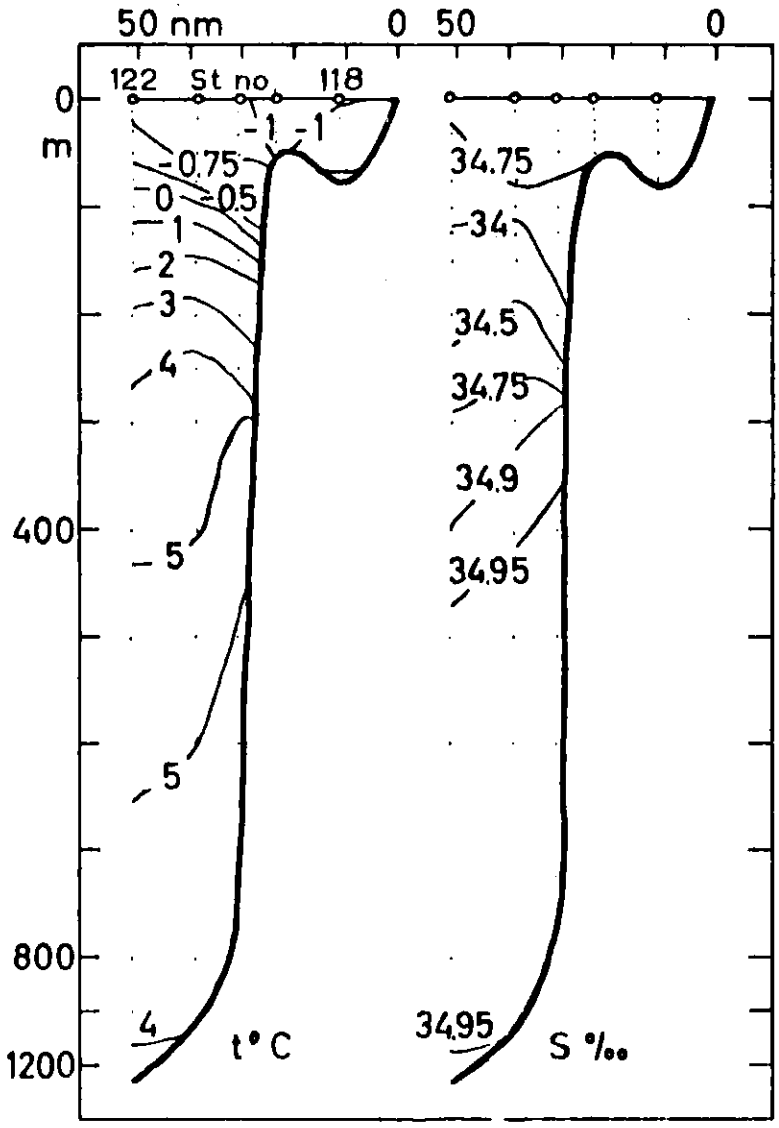

Fig. 5. R/V *G.O.Sars*, West Greenland, 14-16 April 1967. Hydrographical section across Fylla Bank.

III. Selection experiments

Selection experiments with No.2, 4 and 6 hooks on bottom longline were carried out on all fishing stations. Table 2 shows the number of cod caught, their mean length on the different hooks on each station, the total number and the overall mean length of the cod on each hook size. The significance of the differences in catch and mean length are not tested, but the table indicates that the No.6 hook takes the greatest numbers of cod, while the No.2 hook takes the greatest lengths.

Table 2. R/V *G.O.Sars*, West Greenland 1967. Hook selection. Cod.

Station	Position	Hook no.						Total	
		6		4		2			
		Number	Mean length (cm)	Number	Mean length (cm)	Number	Mean length (cm)	Number	Mean length (cm)
1	60°22'N. 48°12'W	70	69,2	56	69,8	44	70,9	170	69,4
2	60°34'N. 48°30'W	158	70,2	152	70,6	87	72,1	397	70,7
3	62°50'N. 51°45'W	161	67,6	117	67,8	78	68,8	356	67,9
4	62°18'N. 50°57'W	133	69,1	90	68,3	54	69,8	277	69,0
6	61°26'N. 50°24'W	78	68,6	57	68,6	35	72,9	170	69,3
7	61°46'N. 50°40'W	75	69,8	51	69,9	31	71,1	157	70,0
8	62°29'N. 51°15'W	159	66,2	140	66,2	81	68,9	380	66,8
9	63°15'N. 52°17'W	171	66,7	111	68,5	87	69,0	369	67,8
10	64°10'N. 53°05'W	72	69,9	64	68,8	47	69,6	183	69,4
11	64°14' N. 53°55'W	33	76,3	31	75,0	21	81,6	85	75,9
12	63°38'N. 52°54'W	124	66,2	67	66,6	43	68,2	234	66,7
Total		1237	68,3	938	68,6	611	70,4	2786	68,9

VII. Polish Research Report, 1967

by F. Chrzan

Total Polish catches in the ICNAF Area increased from 72,034 tons in 1966 to 120,032 tons in 1967. This is due, mainly, to the increase in fishing effort. On different fishing grounds, mainly in Subareas 2 and 3, 20 Polish factory trawlers fished principally for cod and then for other species. These vessels made 52 trips to the ICNAF Area compared with 39 trips made by 17 factory trawlers in 1966. Moreover, 5 freezer trawlers, 14 side motor trawlers and 20 steam trawlers operated in Subarea 5, mainly for herring. These vessels made 43 trips. Comparative data for the years 1967 and 1966, with respect to major species and their percent relation in the catches, are given in Table 1.

Table 1.

	1967		1966	
Species	tons	percent	tons	percent
Redfish	11,897	9.9	14,962	20.8
Cod	57,663	48.1	36,448	50.6
Flatfish	5,514	4.6	3,334	4.6
Greenland halibut	3,321	2.8	1,119	1.6
Halibut	146	0.1	168	0.2
Other fish and groundfish	3,273	2.7	1,334	1.8
Mackerel	507	0.4	6	-
Herring	37,711	31.4	14,663	20.4
Total	120,032	100.0	72,034	100.0

Above data shows the decrease of redfish and actual increase of cod and herring in the catches.

Subarea 1

A. Status of the Fisheries

In March and June one trawler was operating in search of good concentrations of fish. The results of these reconnaissance catches are given in Table 2.

Table 2.

ICNAF	Catch in metric tons		No. hours	No. days
Div	Redfish	Cod	fishing	fished
1B	2	572	251	28
1C	1	19	55	7
1E	3	32	4	23
Total	6	623	310	58

As a matter of fact, only cod was found in this subarea, the good concentrations of which were recorded by echosounders over stony, uneven bottom and thus they were not available for bottom-trawl catches, whereas over those bottoms, which were suitable for trawling - the yield of cod catches was rather poor.

B. Special Research Studies

In the middle of June, 3,396 cod were measured and otoliths taken from 334 specimens in Div.1B. The length of measured cod ranged 30-107 cm, mean - 58.8 cm. Most abundant were fish in the length 48-65 cm. Also in June, in Div.1C, in which rather poor concentrations of redfish of the *marinus*-type were encountered, 261 fish were measured. The length of these fish ranged from 20 to 65 cm, mean length - 42.2 cm. Most of the redfish were in the length 40-50 cm. In the sample there were 36 percent males and 64 percent females.

Subarea 2

A. Status of the Fisheries

A total of 18 trawlers operated in Subarea 2 for 9 months. In the period from July till September, in view of very poor yield obtained from those fishing grounds, no fishing operations were maintained. The yield and fishing effort in Subarea 2 are given in Table 3.

Table 3.

ICNAF Div.	Catch in metric tons				No. hours fishing	No. days fished
	Redfish	Cod	Flat-fish	Other fish		
2G	-	1,039	74	-	340	28
2H	69	8,504	515	-	3,420	272
2J	2,659	28,592	1,526	3	13,820	1,081
Total	2,728	38,135	2,115	3	17,580	1,381

The yield of the catches obtained by the vessels in these fishing operations differed depending upon the season and division. In June, the catches in the fishing grounds 2G were poor, whereas intensive fishing was carried out in December, when the yield in this last month of the year reached 44 tons per day. In Div.2H more intensive catches were made only in January, March and May - the yield obtained was 24.6 to 34.2 tons daily. In Div.2J, in which fishing activity was greater than in the other divisions, the following yields were obtained in particular months: January - 31.0 tons; February - 32.0 tons; March - 23.8 tons; April - 28.1 tons; May - 40.9 tons; June - 19.3 tons; October - 19.5 tons; November - 18.8 tons and December 28.4 tons daily.

Since, in Subarea 2, fishing operations of Polish vessels were carried out approximately in the same months of 1966 and 1967, it is interesting to compare the yields calculated per 1 hour trawling. These yields were: in 1966 - 2.65 and in 1967 - 2.45 tons per one hour trawling. It appears from

this comparison that fishing yield dropped in 1967 by about 7.5 percent. The decrease seems to be connected both with the introduction of the Polish-type chafer, giving better selection than was formerly obtained with double codend, and a smaller size of cod in the spring concentrations. The mean length of cod was 53.6 cm in 1966 and 51.6 cm in 1967.

B. Special Research Studies

From 15 May to 21 June, length measurements were performed on 6,481 cod and otoliths taken from 564 fish in Div.2J. In May lengths ranged between 21-86 cm, mean length - 51.6 cm. The fish of the length 42-62 cm were most numerous, and their age ranged from 5 to 9 years. In June, the cod were of smaller size and though lengths ranged from 18 to 113 cm, the mean length was 41.9 cm. Most abundant were fish of the length 35-65 cm.

From our observations on the maturity of gonads, it appears that in Div.2J the spawning in the deeper waters was in its final stage in May, whereas in the shallower waters it was considerably retarded. This is evidenced by the observations carried out in the middle of June in the offshore fishing ground (position 54°00'N-55°43'W). There the majority of cod were in the resting stage, 9.1 percent of fish with running gonads (stage VI) and 22.5 percent of fish with gonads in stages IV and V.

Redfish sampling was carried out in Div.2J aboard commercial vessels in May and June. During this period, 3,828 *mentella*-type redfish were measured and 427 otoliths taken. The redfish of the type *marinus* were found in smaller quantities - 1,882 specimens were measured and 78 otoliths taken.

The lengths of the redfish *mentella* were: 21-50 cm - mean length 35.2 cm. In May, the females made up 61.7 percent of the investigated stock (58.8 percent were with running gonads). In June there were 51.4 percent of females (only 15.7 percent with running gonads).

More *marinus*-type redfish were caught in May than in June. The lengths of the fish were 31-63 cm; mean length - 48.2 cm. Most of the captured fish were 40-48 cm in length. In the stock there were 67.5 percent females and almost 90 percent of them with either running or spent gonads.

In Div.2J material on American plaice *(Hippoglossoides platessoides)* was also collected. From length measurements of 1,144 fish, it appears that most fish were in length-classes 30-40 cm - mean length 37.7 cm. The readings of 299 otoliths show that the catches were made up of age-groups III-XXII. Most abundant were fish 7, 8 and 9 years old, which comprised, in total, 53.5 percent of the sample.

Subarea 3

A. Status of the Fisheries

A fishing fleet of 19 factory ships operated in Subarea 3, with different numbers fishing in particular months of the year. In addition, at the

height of the fishing season 5 side motor trawlers were also fishing. Catches and fishing effort in Subarea 3 are given in Table 4.

Table 4.

ICNAF Div	Catch in metric tons				No. hours fishing	No. days fished
	Redfish	Cod	Flatfish	Other fish		
			Factory trawlers			
3K	3,564	4,286	2,663	-	7,027	549
3L	1,152	5,849	3,677	-	8,961	522
3M	587	4,152	91	-	2,812	220
3N	3,371	3,255	253	-	3,381	297
3O	1	290	72	-	329	23
3P	117	-	-	-	104	10
			Side motor trawlers			
3K	-	1,073	-	495	884	160
Total	8,792	18,905	6,756	495	23,498	1,781

From Table 4 it appears that most of the vessels carried out their fishing operations in Div.3K and 3L. Much less fishing activity is noted in Div.3M and 3N.

Exploitation of the fishing grounds in Div.3K was not distributed evenly throughout the year. The greatest number of fishing days was noted here in October and November and less in April, May and December. In the other months, catches were very poor. In the months of more intensive fishing, the yields obtained were as follows: January - 14.7 tons; February - 18.4 tons; March - 34.7 tons; April - 27.2 tons; May - 17.1 tons; October - 17.6 tons; November - 19.1 tons and December - 24.8 tons per day

Exploitation of the fishing grounds in Div.3L was commenced first in March. However the yields obtained there were much lower than in Div.3K. Mainly cod and flatfish were caught and the yields were as follows: April - 14.6 tons; July - 18.7 tons; September - 19.3 tons and October - 14 tons per day.

The fishing ground of Flemish Cap (Div.3M) was exploited only in March. The yield reached 26.4 tons per day.

In Div.3N, in which cod and redfish were caught, the yield obtained in August amounted to 26.6 tons and in September to 19.0 tons per day.

Side motor trawlers were fishing only during the period of spawning concentrations of cod, obtaining the following yields: February - 8.2 tons; March - 7.6 tons and April - 19.0 tons per day.

Though the catches of Polish factory trawlers in Subarea 3 in the years 1966 and 1967 differed considerably both in respect of fishing activity

and fish species caught, still, the comparison of fishing yield might to some extent provide an index of the state of the fish resources. In 1966, the total yield was 1.68 tons per hour trawling, whereas in 1967 - 1.43 tons per one hour trawling, a drop of about 14.9 percent. For many years the object of the Polish fisheries was redfish. The decrease of the redfish resources in Subarea 3 may seem to have had an adverse effect upon the total yield of Polish factory trawlers.

B. Special Research Studies

Main species were sampled aboard commercial vessels in June and July and aboard R/V *Wieczno* in autumn months.

1. Cod. 2,339 specimens from the northern part of the Great Newfoundland Bank were measured in the period from 2 June to 28 July. The length of the fish ranged from 18 to 116 cm; mean length - 60.1 cm. Fish of 51-71 cm length predominated in the catches, being 6 to 12 years old. Examination of gonads showed that at the end of July 28 percent of fish were still maturating (stage V) or running (stage VI, VII). In 1967, the cod caught on these grounds were larger and older than in 1966.

2. Redfish. This species was sampled in July only in Div.3K. 3,455 *mentella*-type redfish were measured and 368 otoliths taken. Lengths ranged from 18 to 48 cm; mean length was 32.7 cm. The most abundant were fish 28-39 cm in length. Examination of gonads showed that 90 percent of the females were in the resting stage.

In October 1,440 *mentella* redfish were measured. Lengths ranged from 22 to 50 cm with the 34 to 44 cm lengths predominating. Mean length was 39.2 cm. There were 79 percent females.

3. Flatfish. In Div.3K no large concentration of American plaice was encountered. Only 112 fish were measured. Their mean length was 37.2 cm.

In Div.3L American plaice was abundant in June and July. 3,973 fish were measured. Most of the fish were 30-38 cm in length. Mean length was 36.5 cm. From the reading of 111 otoliths, it appeared that age-groups IV to XV were represented in the catch. The most abundant were fish 8 and 9 years old, which were 39.6 percent of the sample. As regards sexual maturity, in June 40 percent of the females had gonads in stage II and 20 percent in stage VIII, whereas 20 percent of males had gonads in stage VI.

In Div.3N fishing yield was poor in October. Only 423 individuals of American plaice were measured. Their mean length was 40.3 cm.

Good fishing results of Greenland halibut were obtained in Div.3K in August at 400-500 m (1,100 kg per one hour trawling). 1,165 fish were measured. Their mean length was 55.6 cm. Most fish were of the 55 to 65 cm length-classes. All of the fish were in the resting stage of maturity.

Studies on Selectivity

Selectivity studies were again carried out in 1967 by R/V *Wieczno*. For a report on these studies see Res.Doc.68/4 - F. Bucki, W. Strzyzewski and G. Zdziebkowski: The selectivity of codend with Polish chafer made of 10 mm stylon for cod and redfish catches.

Subarea 4

A. Status of the Fisheries

Towards the end of June and the beginning of July, only one trawler was scouting for fish concentrations in Subarea 4. The results of this scouting and the fishing effort are given in Table 5.

Table 5.

ICNAF	Catch in metric tons				No. hours	No. days
Div	Redfish	Hake	Flatfish	Herring	fishing	fished
4V	156	-	-	17	104	8
4W	-	19	1	17	71	5
Total	156	19	1	34	175	13

Yields varied from 7.4 tons per day in Div.4W to 21.6 tons per day in Div.4V. Such a variation in yield was not attractive to other factory trawlers.

No research work was carried out in Subarea 4.

Subarea 5

A. Status of the Fisheries

In this subarea 5 factory trawlers, 1 large stern freezer trawler, 4 smaller stern freezer trawlers, 20 side motor trawlers and 14 side steam trawlers took part in the fishing operations. Catches and fishing effort are given in Table 6.

Table 6.

ICNAF	Catch in metric tons						No	No
Div	Redfish	Hake	Flat-fish	Herring	Mackerel	Other fish	hours fishing	days fished
				Factory trawlers				
5Z	155	114	10	5,530	-	-	1,763	248
				Large freezer trawler				
5Z	-	11	-	1,518	180	660	759	88
				Freezer trawlers				
5Z	-	51	-	3,701	25	712	1,693	268
				Side motor trawlers				
5Z	-	249	-	17,809	312	110	6,454	1,292
				Side steam trawlers				
5Z	60	323	99	9,119	-	526	10,219	992
Total	215	748	109	37,677	517	2,008	20,888	2,888

In Subarea 5, factory trawlers caught herring from July to October. They obtained the best fishing yield of 43.2 tons per day in October.

The big freezer trawler made two trips to Georges Bank. In May-June yields were 33 tons per day, in October only 19.1 tons per day and in November 21.2 tons per day.

Freezer trawlers carried out their fishing operations from July till November, obtaining the following yields: August - 15.4 tons; September - 15.9 tons; October - 17.5 tons and November - 17.5 tons per day.

Motor trawlers operated from April to December with large fluctuations in their yields. In May during 51 fishing days mean daily yield amounted to 24.6 tons; in July (with 195 fishing days) - 19.3 tons and in November (with 245 fishing days) only 10.7 tons.

Steam trawlers operated from February to November. Mean daily yields were as follows: March - 5.2 tons; July - 11.1 tons; September - 17.5 tons; October - 9.2 tons and November 10.0 tons.

In herring fishing, carried out by the factory trawlers, there was a considerable decrease in the yield. In 1966, these vessels obtained 4.24 tons of herring per one hour trawling. In 1967, the yield dropped to 3.14 tons per hour. Thus, for this type of vessel, the yield decreased by about 26 percent.

Some slight decrease in yield was noted for the freezer trawlers which, in 1966, obtained 2.27 tons per one hour trawling and, in 1967, 2.19 tons. In the latter case the decrease of herring yield was only 3.5 percent.

B. Special Research Studies

Nine hydrographic sections were made by R/V *Wieczno* on Georges Bank from 31 October to 14 November 1967. These sections were prepared along almost the same lines as in 1966. On 39 stations temperature measurements were made and water samples were taken for salinity, oxygen and phosphate contents. Temperature sections are given in Table 7.

In the first half of November, surface temperatures on Georges Bank remained above 10°C. The lowest surface temperatures (8.50-9.96°C) were noted northwards of 42°N. Temperatures in the bottom layers depended, of course, upon the depth and geographical position, although, in general, rather warm water covered the bottom.

Surface salinities did not exceed 33.0‰. The salinity of bottom layers ranged from 32.0 to 33.5‰. The 33.5‰ isohaline covered more or less accurately the 100-m isobath. At greater depths and in oceanic waters, salinities were considerably higher.

Oxygen content was rather high, both at the surface and at the bottom. All over Georges Bank, down to a depth of about 200 m, there was 5 ml/liter O_2. Only within the range of the North Atlantic Drift at the position

Table 7.

Position \ Depth (m)	Temperatures (°C) 0	10	25	50	75	100	150	200	Bottom
Section along 68° meridian - 31 October-1 November 1967									
42°25'N									
68°00'W	11.73	11.80	11.70	9.98	6.97	5.58	4.94	-	6.06 (190 m)
42°08'N									
68°00'W	11.96	11.94	11.93	11.94	7.84	5.87	4.74	6.14	6.21 (250 m)
44°55'N		(16m)		(41m)		(91m)			
68°00'W	12.43	12.52	-	11.66	-	5.58	-	-	5.30 (140 m)
44°50'N									
68°00'W	12.00	11.98	10.47	6.18	-	-	-	-	6.25 (61 m)
Section along 67° meridian - 2-3 November 1967									
41°01'N									
67°04'W	10.70	10.52	10.30	9.96	-	-	-	-	9.90 (70 m)
40°46'N									
67°00'W	10.56	10.96	10.27	8.98	7.54	-	-	-	6.90 (101 m)
40°38'N									
67°00'W	13.11	12.96	12.54	8.22	6.96	6.72	7.15	7.80	8.27 (255 m)
40°36'N									
67°00'W	11.94	-	11.76	8.87	7.73	7.08	8.00	7.90	5.20 (600 m)
Section along 67°30' meridian - 5-6 November 1967									
41°00'N		(19m)		(44m)					
67°40'W	10.40	10.42	-	10.41	-	-	-	-	10.26 (69 m)
40°42'N									
67°33'W	10.55	-	10.54	10.48	-	-	-	-	7.66 (86 m)
40°34'N									
67°32'W	11.87	11.84	11.84	8.18	6.94	6.94	-	-	8.64 (143 m)
40°22'N						(98m)	(147m)	(176m)	
67°32'W	13.18	-	13.15	7.96	7.12	8.41	8.29	8.01	5.00 (530 m)
Section southwest off Corsair Canyon - 6-7 November 1967									
41°34'N									
66°56'W	11.70	11.70	11.70	11.70	-	-	-	-	11.69 (66 m)
41°22'N									
66°36'W	9.70	9.70	9.26	8.98	8.02	-	-	-	-
41°12'N									
66°19'W	11.45	11.43	11.45	7.56	6.24	6.36	-	-	6.38 (116 m)
41°10'N									
66°16'W	11.90	11.88	11.91	7.40	5.29	5.78	6.42	6.58	7.18 (250 m)
41°09'N									
66°12'W	12.60	-	12.50	8.06	3.46	4.24	5.90	6.69	4.81 (530 m)

(continued)

Table 7 (continued).

Position \ Depth (m)	Temperatures (°C) 0	10	25	50	75	100	150	200	Bottom
	Section NNE off Corsair Canyon - 7-8 November 1967								
41°34'N 66°56'W	11.70	11.70	11.70	11.70	-	-	-	-	11.69 (66 m)
41°40'N 66°24'W	10.38	10.37	10.34	9.87	-	-	-	-	9.35 (88 m)
41°42'N 66°08'W	9.82	9.82	9.75	7.88	7.53	-	-	-	7.55 (95 m)
41°46'N 65°42'W	13.00	13.04	13.29	9.89	5.40 (82m)	5.96	6.01 (164m)	6.65 (246m)	6.88 (260 m)
41°48'N 65°32'W	12.70	-	-	10.80	8.30	-	9.09	7.74	4.93 (600 m)
	Section Georges Bank-Browns Bank - 9 November 1967								
42°06'N 66°20'W	9.13	9.08	9.05	8.34	6.62	-	-	-	6.08 (95 m)
42°14'N 66°15'W	9.60	9.69	9.20 (29m)	6.10 (54m)	6.30	6.02 (98m)	(157m) 6.52	6.06	6.69 (256 m)
42°31'N 66°07'W	10.50	10.52	10.40	5.90	4.80	4.82	-	-	5.78 (149 m)
42°40'N 65°58'W	7.74	7.74	7.71	7.64	7.48	-	-	-	7.46 (84 m)
	Section along 67° meridian - 10 November 1967								
42°23'N 67°00'W	8.50	8.51	8.30	5.75	5.08	5.70	6.66	6.46	6.25 (330 m)
42°10'N 67°00'W	9.86	9.86	9.64	9.04	7.00	-	-	-	5.65 (110 m)
42°05'N 67°00'W	9.96	9.98	9.98	8.50	-	-	-	-	8.08 (63 m)
	Section along 68°30' meridian - 12 November 1967								
40°10'N 68°30'W	12.04	12.06	12.09	11.13	9.48	9.58	10.30	10.45	5.10 (500 m)
40°14'N 68°30'W	11.72	11.77	11.76	11.08	11.27	10.14	10.52	10.56	8.54 (292 m)
40°30'N 68°30'W	10.90	10.88	10.52	9.77	9.25	-	-	-	9.72 (96 m)
40°38'N 68°30'W	10.52	10.50	10.52	10.14	-	-	-	-	9.68 (84 m)
	Section along 69°00' meridian - 14 November 1967								
39°58'N 69°00'W	11.10	11.10	11.14	15.48 (60m)	13.30 (80m)	14.50	12.90 (124m)	11.20	4.64 (600 m)
40°05'N 68°57'W	11.15	11.14	11.17	9.14	9.36	9.70	10.22	-	9.62 (142 m)
40°18'N 69°00'W	10.30	10.40	10.35	10.81	9.86	-	-	-	9.75 (85 m)
40°40'N 69°00'W	10.80	10.78	10.78	10.46	-	-	-	-	10.45 (68 m)
40°56'N 69°00'W	11.08	11.09	11.04	10.99	-	-	-	-	10.95 (73 m)
41°29'N 69°00'W	9.70	9.65	9.10	5.30	4.20	4.39	-	-	4.40 (140 m)

39°58'N-69°00'W and at a depth of 200 m was there observed lower oxygen content (3.5 ml/liter).

Phosphates, measured in milligrams P_2O_5 per $1m^3$, were relatively high on Georges Bank. In the shallower waters they were 5 to 20 mg P_2O_5/m^3. Along the 100-m isobath, phosphates amounted to 40 mg/m^3. Below 100 m, there was 50 and in some cases even above 60 mg P_2O_5/m^3.

Plankton samples were taken at 49 stations. From the material examined, it appears that in autumn, in the Georges Bank zooplankton, the following groups occur: Copepoda, Chaetognatha, Ctenophora, Appendicularia, larvae of Decapoda, eggs and larvae of fishes. Copepoda occurred most often. They also made up the main food for the herring.

II. Biological Studies

Herring. Herring were sampled in August-October aboard the factory trawler *Aries*. 11,874 fish were measured. In November 1,500 herring were measured and 200 otoliths taken aboard R/V *Wieczno*. The lengths of herring in the catches were 26-36.5 cm. 2,206 herring otoliths were read for age. The 1960 year-class was predominant.

Observations on environmental conditions in relation to herring catches show that, in November, the best fishing results were obtained when the temperature in bottom layers was 8-9°C and the salinity ranged from 32.5‰ to 33.5‰.

More detailed data on herring investigations are given in Res.Doc. 68/53 - F. Chrzan and B. Draganik "Some observations on herring caught in Georges Bank".

Haddock. 1,196 haddock were examined aboard *Aries* and R/V *Wieczno* from August to November. From August to September two length groups, 27-39 cm (mean 35.0 cm) and 43-58 cm (the 50-55 cm length-class predominant) were caught. In November, most of the haddock captured were 35-38 cm in length. Fish in the catches were 3-7 years old. Most abundant was the 1962 year-class (5-year-old fish) which made up 78.3 percent of the catch.

For more detailed data on haddock see Res.Doc.68/54 - Cz. Zukowski: Some data on catches and biology of haddock, *Melanogrammus aeglefinus* L., from Georges Bank and Sable Island Bank.

American plaice occurred as a by-catch in herring catches. The length of fish was 18-54 cm, mean 27.5 cm.

Yellowtail. This species was caught in small quantities along with herring. 748 fish were measured in November. Their length was 18-49 cm, mean 32.7 cm. Most of the fish were 30-35 cm in length. 122 otoliths were read. The age-groups determined were II-IX. Most abundant were fish 5 and 6 years old, which made up 53.2 percent of the sample.

Further observations are given in Res.Doc.68/52 by A. Kosior: Some biological data on yellowtail, *Limanda ferruginea* Storer, from the southern part of Georges Bank, November 1967.

VIII. Portuguese Research Report, 1967

by Manuel Lima Dias

In 1967, the Portuguese fishing fleet of side and stern trawlers (otter trawls) and dory vessels (line trawls) took a total of 237,275 tons of cod from the ICNAF Area as shown below:

Subareas	1	2	3	4	Total
Side trawler	1,098	37,798	82,808	5,949	127,653
Stern trawler	1,139	15,524	17,294	1,510	35,467
Total	2,237	53,322	100,102	7,459	163,120
Line					
Dory vessel	60,474	-	13,681	-	74,155
TOTAL	62,711	53,322	113,783	7,459	237,275

This report presents the status of fisheries in the four subareas where the Portuguese fleet fished and includes observations made from commercial trawlers in Subareas 2 and 3, on lengths, ages, stage of maturity and probable age at first maturity. All samples were taken at random before discarding the undersized fish; for the age/length keys the same procedure is followed as in our report to the 1967 ICNAF Annual Meeting (Res.Doc.67/18). Detailed information on the samples will be included in the *Sampling Yearbook* for 1967.

Subarea 1

A. Status of the Fisheries

I. Cod

As in 1966, the major fishery was carried out by the dory vessel fleet (60,474 tons). Catches by the otter trawler fleet totalled only 2,237 tons. Both fleets fished in Div.1B, 1C, 1D and 1E during the second, third and fourth quarters of 1967. Best catches were made in July in Div.1B (11,910 tons), in May in Div.1C (8,163 tons) and in July in Div.1D (7,911 tons) by the dory vessel fleet. Catches (tons) by dory vessels and trawlers (side and stern) by division and by months may be found in Appendix Table I in ICNAF Res.Doc. 68/12.

Subarea 2

A. Status of the Fisheries

I. Cod

As in the previous year, only otter trawlers (side and stern) fished in this subarea. The total catch was 53,322 tons or 8,876 tons greater than the catch in 1966. The otter trawl fleet fished in Div.2H and 2J from January

to December. Total catch by side trawlers was greater than that by stern trawlers (37,798 and 15,524 tons respectively). The catches (tons) made by side and stern trawlers, by divisions and by months, may be found in Appendix Table II in ICNAF Res.Doc.68/12.

Samples for biological study were obtained in Div.2J from 25 April to 27 May as follows:

Sample Group	Sample numbers	Date	Depth (m)	No Lengths	No Aged
Div.2J					
A	1-2-3-4-5	25-30 April	200	650	300
B	6-7-8-9-10 11	1-27 May	180-400	725	625

a. Lengths (Fig. 1). Lengths ranged from 22 to 91 cm classes. Mean lengths for sample group A - 49.4 cm and for sample group B - 51.6 cm.

b. Ages (Fig. 1). In April, as well as in May, the most important age-groups were V and VI (1962 and 1961 year-classes). The respective mean ages were for A - 6.05 years and for B - 6.41 years.

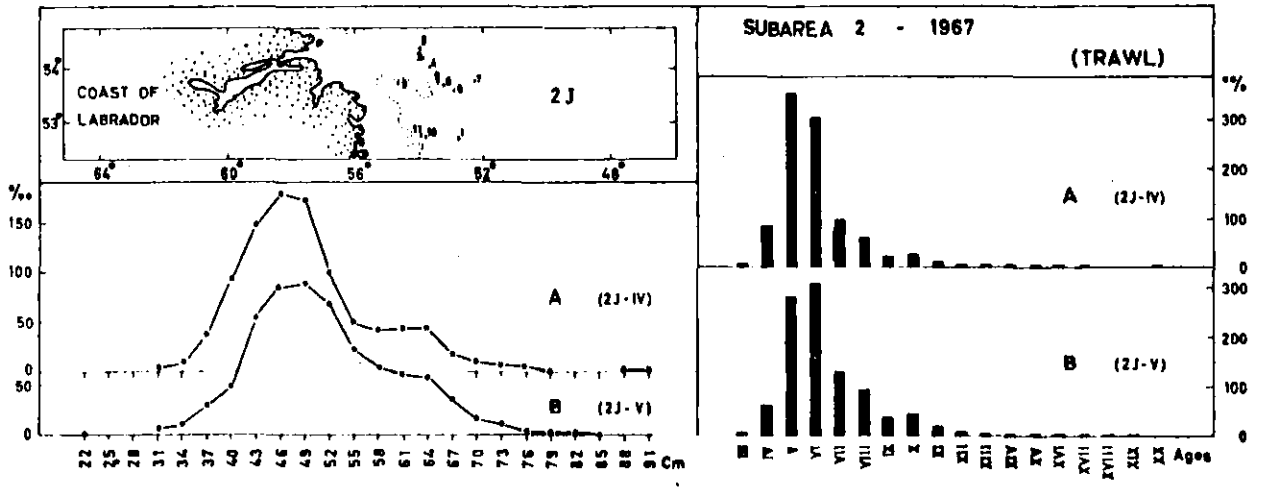

Fig. 1. Cod. Subarea 2. Length and age composition, April-May 1967.

c. Growth. Growth is shown in the following table of average lengths (figures in brackets are numbers of fishes for each quarter of the year).

Div.2J

Year-class	Age-group	2nd Quarter April	2nd Quarter May	
1964	III	32.2	28.7	(3)
1963	IV	38.7	38.1	(70)
1962	V	44.7	45.2	(250)
1961	VI	49.0	50.0	(267)
1960	VII	55.5	56.2	(122)
1959	VIII	60.0	60.0	(91)
1958	IX	65.3	64.0	(39)
1957	X	65.6	65.0	(43)
1956	XI	67.1	67.7	(22)
1955	XII	79.2	74.3	(9)
1954	XIII	66.6	66.9	(2)
1953	XIV	67.0	75.5	(2)
1952	XV	73.0	78.3	(2)
1951	XVI	73.0	73.0	(1)
1950	XVII	76.0	76.0	(1)
1949	XVIII	76.0	-	(1)
1948	XIX	-	-	-
1947	XX	-	76.0	(1)

d. Stage of maturity (Fig. 2). In Div.2J in April, about 40 percent of the males and 70 percent of the females were in the resting or recovering stage, while about 16 percent of the males and about 30 percent of the females were in the developing one. The spawning stage was observed in about 25 percent of the males and 10 percent of the females. The post-spawning stage was detected also in the males and females but only in a significant percentage (10 percent) in the males. In the same division in May, the resting or recovering stage was observed in about 70 percent of the females and about 40 percent of the males. In the females only the post-spawning appeared with some intensity (about 10 percent), while in the males the developing, spawning and post-spawning stages were observed about 30 percent, 6 percent and 12 percent respectively.

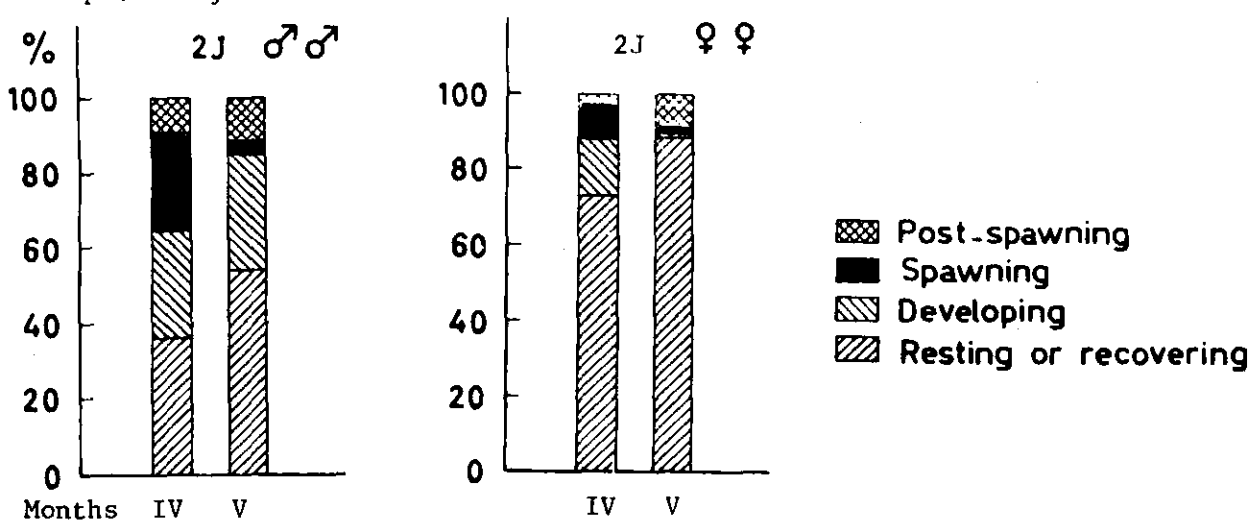

Fig. 2. Cod. Subarea 2. Stages of maturity, 1967.

e. Age at first maturity.

Div.2J

1st spawn. / Age-group	♂♂ VI	VII	VIII	θ	?	Total	♀♀ VI	VII	VIII	IX	X	θ	?	Total
III												3		3
IV				38		38						32		32
V				108		108						142		142
VI				111	1	112	6					149		155
VII	6			49		55	4	4				58	1	67
VIII	1	7	1	20		29	6	16				36	4	62
IX	2	5	2	7	3	19		5	4			9	2	20
X	1	8	3	1	3	16	3	8	10			3	2	26
XI		1	2	1	2	6		1	7	3		3	1	15
XII					1	1		3	3			1	1	8
XIII						-		1	1					2
XIV						-			2					2
XV			1			1				1				1
XVI						-				1				1
XVII		1				1								-
XX											1			1
No. observed						386								537

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

Subarea 3

A. Status of the Fisheries

I. Cod

The catches in this subarea during 1967 totalled 113,783 tons, a considerable increase over the preceding year, which totalled 68,709 tons. The 1967 total includes catches by line trawl (13,681 tons), by side trawl (82,808 tons) and stern trawl (17,294 tons). The Portuguese fleet fished in all divisions of the subarea in all months of the year. The dory vessels fished only during the second and third quarters. The best catch was made by the side trawlers (82,808 tons), followed by the stern trawlers (17,294 tons), and the smallest catch by the line trawlers (13,681 tons). Best catches were made in Div.3L with a total (line and trawl) of 78,684 tons, and the lowest were made in Div.3O with only 49 tons, fished exclusively by line vessels. The highest catch by trawlers (side and stern trawlers) occurred also in Div.3L (66,908 tons) and the lower catches by trawlers (except Div.3O with only 49 tons caught by line vessels) was in Div.3Ps (807 tons). In the line fishery, the best catch was made in Div.3L (11,776 tons), and the lowest one was from 3O, 49 tons. There are no records of catches by line in Div.3K, 3M and 3Ps. The results of the 1967 catches by line and otter trawl by month may be found in Appendix Table III in ICNAF Res.Doc.68/12.

Samples for biological study were obtained only in Div.3L, from 19 March to 22 July, as follows:

Sample Group	Sample numbers	Date	Depth (m)	No Lengths	No Aged
Div.3L					
A	4-5-6-7-8	19-28 March	150	550	250
B	10-11-12-13-15	4-15 April	150-200	475	300
C	16-17-18-19-21 22-23-24-25	11-24 May	150-300	1,130	475
D	26-27-28-29-30 31-32-33-34-37 38-39-40	1-30 June	150-300	1,550	500
E	41-42-43-44-45 46-47-48-49-50 51-52	3-22 July	200-300	1,450	472

a. Lengths (Fig. 3). Lengths ranged from 22 to 133 cm classes. Mean lengths were A - 53.3 cm, B - 52.7 cm, C - 57.4 cm, D - 57.2 cm, E - 53.8 cm.

b. Ages (Fig. 3). In Div.3L, we observed ages from 3 to 19 years, with a marked predominance of the V and VI age-groups (1962, 1961 year-classes). In all divisions, the IV, VII and VIII age-groups (1963, 1960 and 1959 year-classes) were also important. Mean ages were: A - 5.9 years, B - 5.8 years, C - 6.2 years, D - 6.3 years, E - 5.7 years.

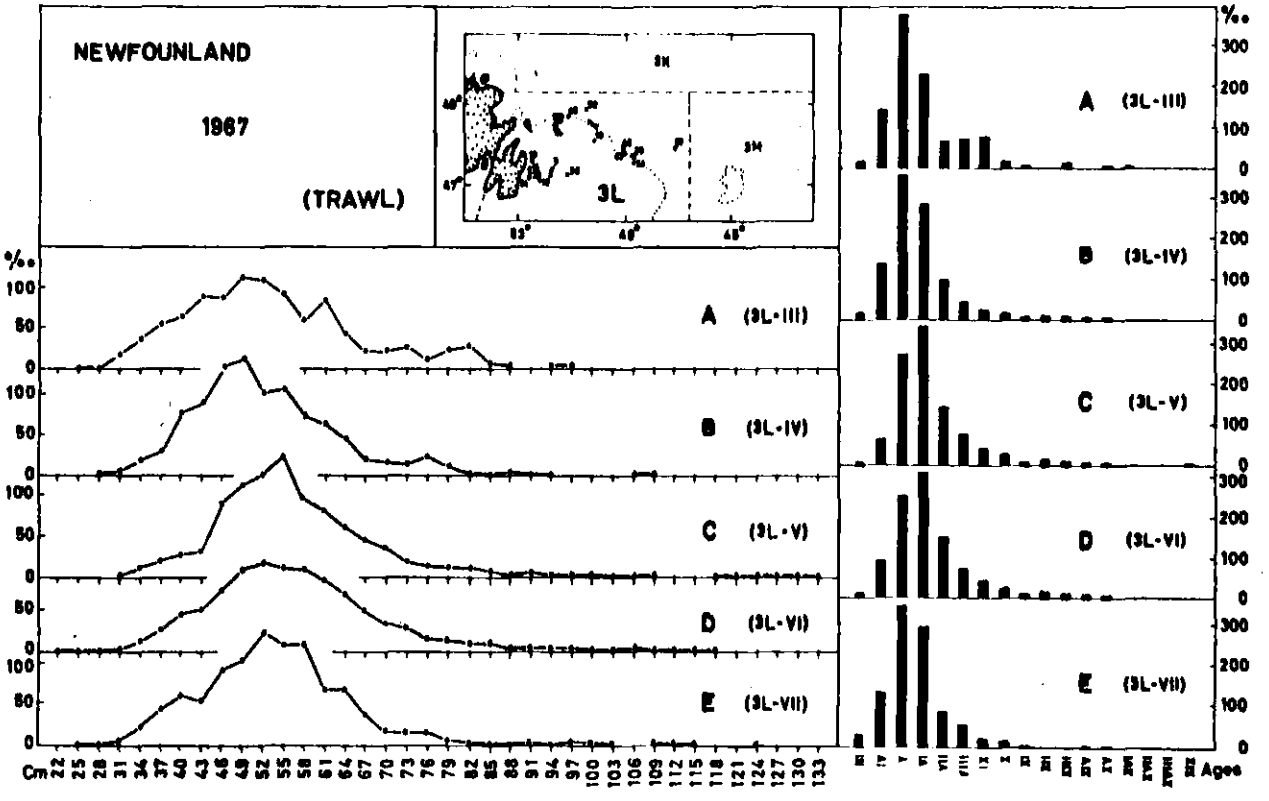

Fig. 3. Cod. Subarea 3. Length and age composition, March-July, 1967.

c. Growth. Growth is shown in the following table of average lengths (figures in brackets are numbers of fishes for each quarter of the year).

Div.3L

Year-class	Age-group	1st Quarter March		2nd Quarter April		May		June		3rd Quarter July	
1964	III	30.3	(5)	34.4		37.1		33.0	(14)	36.3	(14)
1963	IV	38.8	(29)	40.1		40.2		39.6	(142)	40.1	(56)
1962	V	47.6	(73)	47.5		49.2		48.5	(386)	49.8	(162)
1961	VI	55.9	(50)	57.7		55.7		56.3	(383)	56.8	(147)
1960	VII	62.5	(20)	61.7		62.2		62.8	(167)	62.4	(40)
1959	VIII	67.1	(26)	68.2		67.8		68.0	(84)	67.3	(26)
1958	IX	76.7	(32)	75.3		76.5		75.2	(50)	70.7	(11)
1957	X	81.1	(5)	78.8		85.1		84.9	(26)	76.2	(11)
1956	XI	81.5	(2)	79.0		81.0		80.6	(5)	93.0	(2)
1955	XII	-	-	87.3		91.8		93.5	(10)	-	-
1954	XIII	81.3	(4)	100.4		101.0		96.7	(4)	-	-
1953	XIV	-	-	106.0		104.5		104.9	(2)	100.0	(2)
1952	XV	102.0	(3)	82.0		82.0		82.0	(1)	100.0	(1)
1951	XVI	94.0	(1)	-		-		-	-	-	-
1950	XVII	-	-	-		-		-	-	-	-
1949	XVIII	-	-	-		-		-	-	-	-
1948	XIX	-	-	-		130.0		-	(1)	-	-

d. Stage of maturity (Fig. 4). The observation of the stages of maturity during 1967 in the first, second and third quarters gave us the following percentages of different stages in males and females. The most important one was in the females, the recovering or resting, with percentages higher than 70 percent in all months; yet in the females the developing stage appears in March, with about 20 percent and in the other months with lower percentages. The spawning stage only in June (in the females) presents a reasonable percentage (about 12 percent), while in the other months the respective percentages are lower. Finally, in the females, the post-spawning stage only is represented with a significant percentage in June and July. In the males we can also see that in all months the recovering or resting stages appear always with a significant percentage, higher than 40 percent. The developing stage was also observed in the males with about 20 percent in March, 14 percent in April, more or less 30 percent in May, about 40 percent in June and July. More frequent than in females, the stage of spawning appears in the males with the following percentages: about 24 percent in March, 10 percent in April, 14 percent in May, 16 percent in June and about 4 percent in July. The post-spawning stage was detected only in reasonable percentages, about 6 percent, in May and June and 12 percent in July.

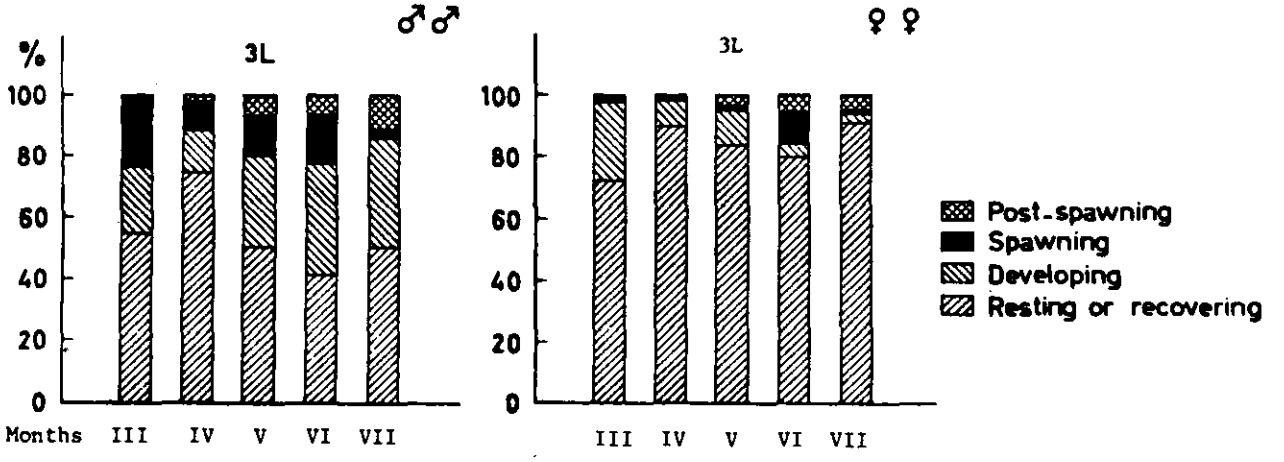

Fig. 4. Cod. Subarea 3. Stages of maturity, 1967.

e. Age at first maturity.

Div.3L

1st spawn. / Age-group	♂♂ VI	VII	VIII	IX	X	θ	?	Total	♀♀ VI	VII	VIII	IX	X	θ	?	Total
III	-	-			-	18	-	18						15		15
IV						132		132						95		95
V						319		319						302		302
VI						282		282	7					291		298
VII	2	2				110	1	115	1	7				104		112
VIII	2	12				50	2	66	2	10	5			52	1	70
IX	1	7	4			30	2	44	2	13	8			23	3	49
X		2	3			9	6	20		7	4			9	2	22
XI		1	1			3		5			1			2	1	4
XII		2	1	1	1	1	2	8			1			5		6
XIII												2			2	4
XIV				1			1	2					1	1		2
XV							2	2			1	1			1	3
XVI							1	1								
XVII																
XVIII																
XIX															1	1
No. observed								1,014								983

Subarea 4

A. Status of the Fisheries

I. Cod

In 1967, as in 1966, only the otter trawler fleet operated in this subarea. It caught a total of 7,459 tons which is a decrease from the 1966 catch of 10,830 tons. The side and stern trawlers fished in all months of the first quarter and also in April and September. The best catch was 3,681 tons which was made in January (2,382 tons by side trawlers and 1,299 tons by stern trawlers). The best catch was obtained from Div.4R and the smallest from 4Vn, with 6,180 tons and 85 tons respectively. The catches obtained from side and stern trawl, by month and by division, may be found in Appendix Table IV in ICNAF Res.Doc.68/12.

IX. Romanian Research Report, 1967

by M. Niculescu-Duvaz

Subarea 5

A. Status of the Fisheries

Romanian fishing in the Northwest Atlantic in 1967 took place between 12°15'-40°15'N and 70°55'-65°45'W, in ICNAF Subarea 5. Bottom trawl fishing was carried out between 30-80 m in the Nantucket Island region and between 60-175 m on Georges Bank. The quantity of fish caught was 1,729 tons, of which 77.7 percent (1,344 tons) were Clupeidae. Table 1 shows the species composition of the 1967 catch.

Table 1. Nominal catch by species and species groups in 1967.

Species groups	Individual species	Catch			
		metric tons		percent	
		by species	total group	by species	total group
Clupeidae	Blueback herring (*Pomolobus aestivalis*)	1,012	1,344	58.5	77.7
	Atlantic herring (*Clupea harengus harengus*)	332		19.2	
Gadidae	Cod (*Gadus morhua*)	10	56	0.57	3.2
	Haddock (*Melanogrammus aeglefinus*)	1		0.05	
	Silver hake (*Merluccius bilinearis*)	45		2.58	
Mackerel	Mackerel (*Scomber scombrus*)	109	109	6.3	6.3
Sharks and skates	-	70	70	4.0	4.0
Other unidentified species	-	150	150	8.8	8.8
Total		1,729	1,729	100.0	100.0

Table 2 shows that the catch in 1967 was lower than that of the previous years, 1965 and 1966. Catch per day averaged 23.3 tons in 1967, 34.8 tons in 1965 and 32.7 tons in 1966.

Table 2. Nominal catch and disposition in metric tons in 1965, 1966 and 1967.

Year	Total catch	Portion frozen (for human consumption)	Portion processed (for industrial purposes)	Catch per day
1965	3,208	1,612	1,696	34.8
1966	3,433	1,938	1,495	32.7
1967	1,729	1,028	701	23.3

Table 3 shows that the decrease in catch is due to the lower catches of Clupeidae and Gadidae, in 1967, than in previous years. In 1965 and 1966, the average catch per day for Clupeidae (herring) was 24.7 tons and 24.3 tons respectively, and in 1967 the catch was only 18.1 tons per day.

Table 3. Total nominal catch and catch per day in metric tons in 1965, 1966 and 1967. (Figures in brackets relate to individual species).

Species groups	Individual species	Total catch 1965	1966	1967	Catch/day 1965	1966	1967
Clupeidae	*Clupea harengus*) *Pomolobus aestivalis*)	2,277	2,553	1,344	24.7	24.3	18.1
Gadidae	*Gadus morhua*)			(10)			(0.13)
	Melanogrammus aeglefinus)	562	573	56	(1) 6.1	5.4	0.75(0.01)
	Merluccius bilinearis)			(45)			(0.64)

The lower catches in 1967 are due to weather conditions, which altered the thermocline, thus keeping the summer herring shoals at intermediate depths and requiring mid-water fishing. They are due, also, to the dispersal of the herring shoals to the east, and to the lateness of the schooling for spawning. During the summer shoaling was limited and schools were scarce in the bottom water layer over Georges Bank.

B. Special Research Studies

I. Biological Studies

a. Clupeidae. A distinction was made between the fishing and behaviour of the common herring *(Clupea harengus harengus)* and the blueback herring *(Pomolobus aestivalis)* caught in Div.5Z during 1967.

1. Common herring were found in feeding and fattening concentrations mainly in the July-15 September period in the central and eastern part of Georges Bank between 41°05'-41°15'N and 66°37'-66°50'W; 41°25'-41°55'N and 66°06'-66°50'W; 41°45'-42°00'N and 66°10'-66°25'W. Loose schools ranged horizontally between 4-50 m over depths from 50-100 m. The beginning of the

spawning concentrations on Georges Bank in 1967 was about 15 September. The best fishing was between 30 September and 3 October. A single trawl haul in this period gave more than 30 tons. For spawning purposes the herring moved from the eastern-central part to the northern part of Georges Bank. Some herring schools were thus caught on the northern part of the bank, between 41°47'-42°17'N and 67°05'-68°00'W. The big concentrations were between 41°47'-42°17'N and 67°05'-67°25'W (Fig. 1). During the fattening period, herring of 26-28 cm in length (6-8 years old) were dominant (73 percent). Basic food items were euphausiidae. Larger herring 28-31 cm in length (over 8 years old), were found separately at a depth of 150 m in canyons (Corsair Canyon) along with *Argentina silus* concentrations. Table 4 shows the age distribution of herring caught in 1967.

Table 4. Percentage age composition of Atlantic herring catches on Georges Bank in 1967.

Age (years)											
1	2	3	4	5	6	7	8	9	10	11	12
-	-	-	0.6	1.3	18.0	29.0	26.2	14.0	7.3	2.0	1.6

The 6-8 year-old fish are dominant. Also the 8-10 year-old fish (28-31 cm in length) form an important percentage of the catches. In the spawning period, herring of the length-classes, 26-28 cm and 28-31 cm, were found at the same depth.

2. Blueback herring was another important Clupeidae in Div.5Z. Concentrations were found south of Nantucket Island between 40°20'-41°00'N and 69°35'-71°00'W. Here, they remained in large concentrations until 10-15 September when they scattered and left the area. From the end of August to about 15 September, blueback herring were found separately in large concentrations between 40°25'-40°57'N and 70°10'-70°55'W (Fig. 1). Here the catch at this time was over 45-50 tons/day. After 15 September the blueback herring left the area. Table 5 shows the age distribution of blueback herring caught in 1967.

Table 5. Percentage age composition of blueback herring catches south of Nantucket Island in 1967.

Age (years)					
1	2	3	4	5	6
-	14.6	24.7	33.0	16.1	11.6

The 3-4 year-old fish were dominant (57.7 percent).

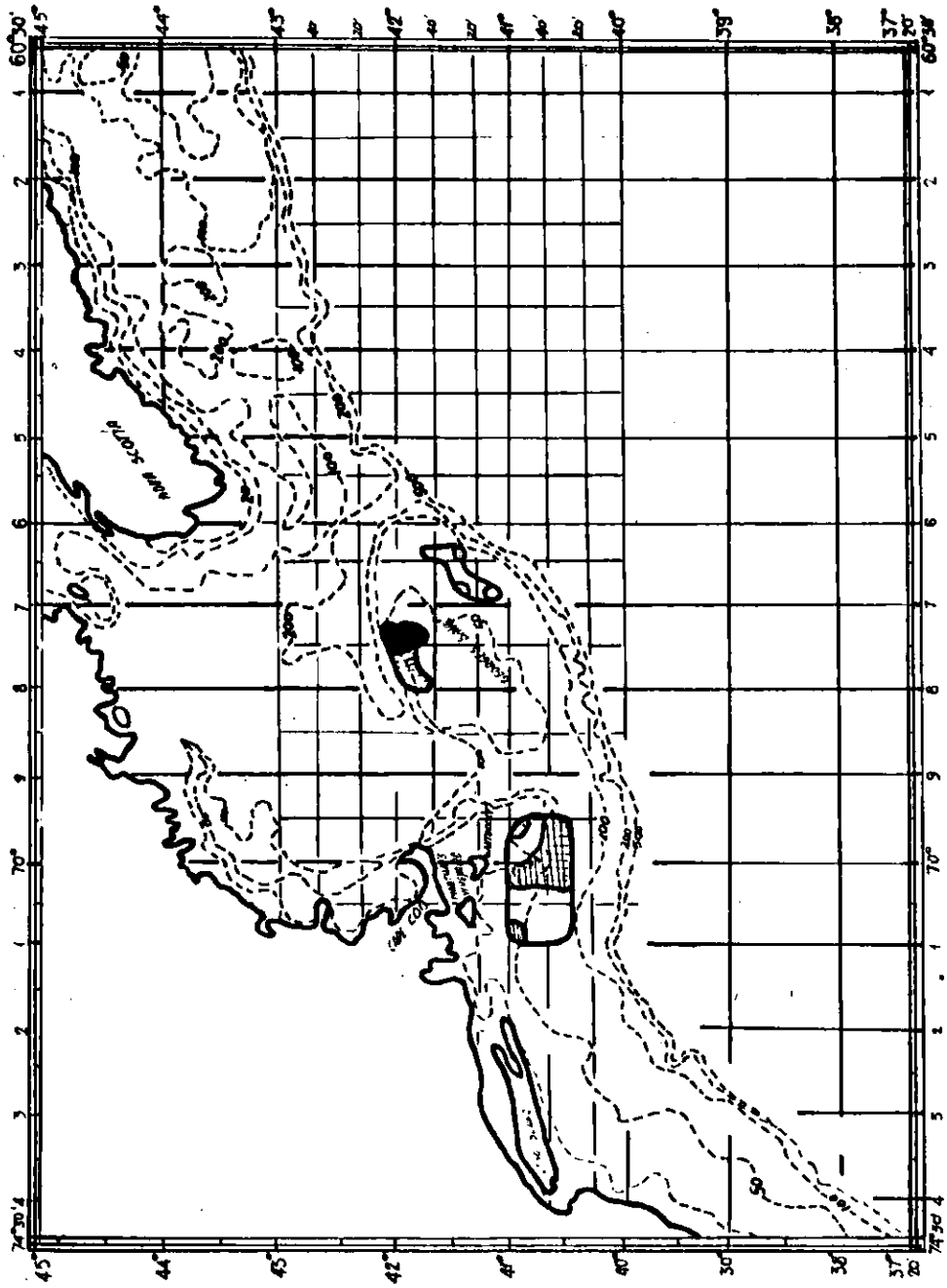

Fig. 1. Distribution of blueback and Atlantic herring in Subarea 5 in 1967.

Clupea harengus spawning concentrations (● maximum)

Clupea harengus feeding concentrations (⊛ maximum)

Pomolobus aestivalis feeding concentrations (⊞ maximum)

b. Gadidae. The Gadidae represented by cod *(Gadus morhua)* and silver hake *(Merluccius bilinearis)* were caught as a by-catch average about 1 ton per trawl haul in the herring catches. The large cod and haddock concentrations were found to the north of Georges Bank, between 41°45'-42°10'N and 42°10'-42°17'W, and 67°05'-67°20'W, during July and August. Concentrations of the two species was partly due to the presence of *Ammodytes americanus*, a bottom fish which constituted a good feeding item for the Gadidae northward of Georges Bank. The dominant lengths were 40-45 cm for haddock and 50-60 cm for cod. Young cod concentrations dominated by those 15-23 cm in length were identified mainly between 41°05'-44°33'N and 66°35'-66°50'W. Cod of 21-27 cm in length occurred more frequently in the night catches. Haddock of 32 cm average length were caught in the Nantucket area.

c. Mackerel *(Scomber scombrus)* were found in addition to blueback herring in the south Nantucket area. Larger concentrations were found in August and September, south of a zone between 40°20'-41°00'N and 69°40'-70°20'W, and especially between 40°20'-40°30'N and 69°40'W. Their average length was 27.3 cm.

d. Other species, especially sharks, skates and flatfishes, in addition to Gadidae (haddock particularly) replaced the Clupeidae in the bottom zones when they migrated to the surface layer. This migration took place especially during the night and on the strong foggy and cloudy days.

II. Environmental Studies

a. Meteorological conditions. The fishing area in 1967 was characterized by lower temperatures than in previous years. Thus, in July and August, average temperatures were between 14.4°C and 17.8°C on Georges Bank and 20.1°C and 20.7°C south of Nantucket Island. The winds blew from the S, SW and E most of the time, at strength 3-4 on the Beaufort scale. The winds from the N, NE and NW blew a few days in September at strength 5 on the Beaufort scale. The hurricanes were recorded earlier and more frequent and they influenced the water temperature and the mixing processes. Of the hurricanes, DORA's low pressure centre contributed substantially to water (exchange) mixing.

b. Water temperature. On Georges Bank the temperatures were generally low from July to October, 11.2° to 14.7°C at the surface and 6.2° to 9.2°C at a depth of 70-100 m. The thermocline was situated at about 10 to 15 m during the summer and confined the herring in the surface layers. In the Nantucket region, due to the warm current, average temperatures were greater (20.3°C) and were conducive to blueback herring and mackerel concentrations. At the end of August average temperatures had dropped to 19°C and continued to drop to an average of 14.4°C in September. With this lowering of temperature, the blueback herring left the area during the autumn. During the summer, the thermocline remained near the bottom at a depth of 25-30 m ensuring a large blueback herring concentration and permitting good catches at this depth. Figure 2 shows the temperature distribution and the location of the thermocline over Georges Bank and in the Nantucket area. The vertical migrations, as well as the concentrations on the bottom of the Clupeidae in Div.5Z, were determined, in addition to the temperatures, by the concentrations of food organisms made up of Calanoidae and Euphausiidae, bottom invertebrates and bottom fishes such as Gadidae, sharks and rays, etc.

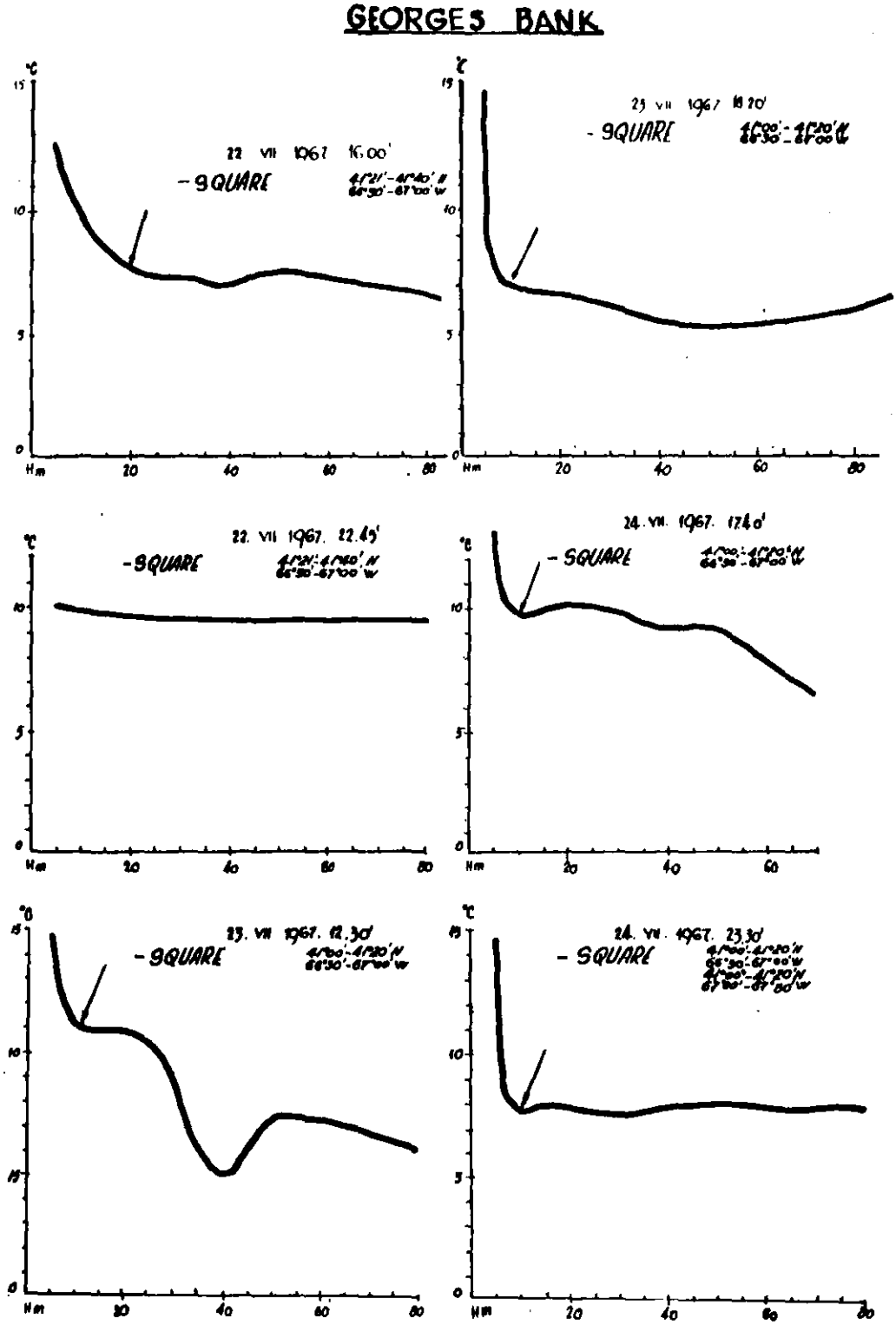

Fig. 2. Temperature/depth relationship at various locations over Georges Bank, July and October 1967.

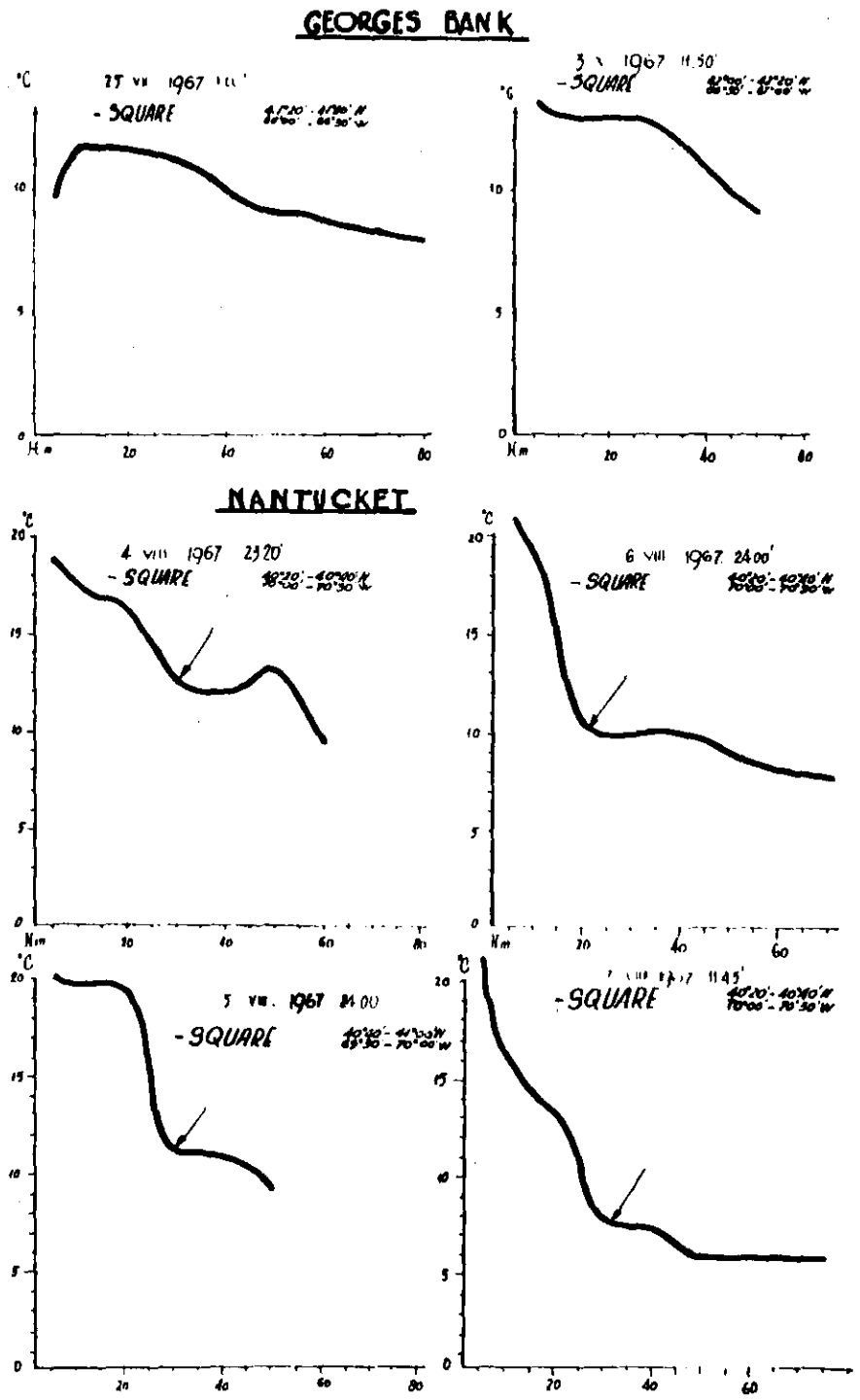

Fig. 2 (cont'd). Temperature/depth relationship at various localities over Georges Bank, July and October 1967, and in the Nantucket area, August 1967.

X. Spanish Research Report, 1967

by O. Rodriguez Martin

Statistical Information

Twenty-three trawlers and 126 pair trawlers (these vessels represent 63 gears) operated in the ICNAF Area during the year 1967. Total tonnage of these vessels is about 76,000 tons. About 4,180 fishermen make up the crews. Total catch was 289,735 tons, of which 96 percent was cod, 2 percent haddock, and 2 percent other species (white hake and pollock).

Table 1. Statistical ICNAF, 1967.

	1.966			1.967		
	TRAWLERS	PAIR TRAWLERS	TOTAL	TRAWLERS	PAIR TRAWLERS	TOTAL
1-B		896	896	110	145	255
1-C		507	507	151	1.940	2.091
1-D		2.100	2.100	500	4.986	5.486
1-E	43	-	43	370	2.605	2.981
TOTAL SUB.1	43	3.503	3.636	1.137	9.676	10.813
2-G	181	-	181	-	-	
2-H	4.600	-	4.600	779	-	779
2-J	43.290	550	43.840	36.036	142	36.178
TOTAL SUB.2	48.071	550	48.621	36.815	142	36.957
3-K	9.304	8	9.312	9.498	86	9.584
3-L	20.053	13.164	33.217	34.265	26.142	60.407
3-M	4.275	-	4.275	2.437	664	3.101
3-N	2.765	29.935	32.700	9.307	41.962	51.269
3-O	270	20.838	21.108	188	28.828	29.016
3-Pn	1.122	585	1.707	2.480	33	2.513
3-Ps	1.323	23.099	24.422	748	21.085	21.833
TOTAL SUB.3	39.112	87.629	126.741	58.923	118.800	177.723
4-R	1.060	50	1.110	3.824	-	3.824
4-T	-	13	13	370	464	834
4-Vn	16	2.260	2.276	1.460	1.366	2.826
4-Vs	24	20.298	20.322	87	20.363	20.450
4-W	-	27.997	27.997	-	17.444	17.444
4-X	-	961	961	-	2.614	2.614
TOTAL SUB.4	1.100	51.579	52.679	5.741	42.251	47.992
5-Z	-	9.531	9.531	-	16.251	16.251
TOTAL SUB.5	-	9.531	9.531	-	16.251	16.251
TOTAL GENERAL	88.326	152.882	241.208	102.616	187.120	289.736

Table 2. Statistical ICNAF, 1967.

CONCEPTS.	OTTER TRAWLERS.	PAIR TRAWLERS.	TOTALS.
Number of vessels	23	126 (1)	149
Tons. R.B.	30.874,5	45.922,8	76.797,3
Crew.	1.309	2.851	4.160
No. of days on grounds	5.496	13.810	19.306
No. of days fished	4.775	11.247	16.022
No. of sets	22.730	29.509	52.239
No. of trawl hours	66.482	111.742	178.224
CATCHES			
Cod	102.536,4	177.169,8	279.706,2
Haddock	50,7	7.115,7	7.166,4
White Hake	09,9	515,7	525,6
Pollock	18,9	2.318,7	2.337,6
TOTAL CATCHES	102.615,9	187.119,9	289.735,8

APPLIED CONVERSION FACTOR: 3

(1) As these vessels are "pair-trawlers" they represent only 63 trawl gears.

XI. USSR Research Report, 1967

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

The total USSR catch in the ICNAF Convention Area in 1967 was 576,001 tons (Table 1), *i.e.* 135,200 tons less than in 1966. Catches of haddock decreased considerably (73,400 tons in 1966 against 8,400 tons in 1967). The catch of silver hake decreased from 131,700 to 72,500 tons. Catches of red hake, argentine and other species also decreased, whereas the catches of cod, herring and mackerel increased.

Table 1. Species composition of USSR catches (in metric tons) in the Convention Area, 1966 and 1967.

Species	1967						1966
	1	2	3	4	5	Total catch	Total catch
Herring	-	-		581	123,572	124,153	119,573
Argentine			802	4,191	2,022	7,015	49,040
Cod	570	20,728	141,987	1,744	511	165,540	110,432
Haddock	-	-	5,317	753	2,316	8,386	73,410
Pollock (saithe)	-	-	66	299	345	710	10,554
Silver hake	-	-	-	2,476	69,984	72,460	131,696
Red hake and White hake	-	-	1,684	311	37,593	39,588	85,106
Flounders	-	2,183	54,703	324	3,907	61,117	40,278
Halibut	-	2,424	5,334	-	15	7,773	473
Redfish	260	5,263	33,388	67	-	38,978	48,725
Wolffish	-	56	304	-	-	360	506
Ocean pout	-	-	-	-	261	261	6,231
Scup	-	-	-	-	347	347	257
Mackerel	-	-	-	62	11,907	11,969	6,680
Butterfish	-	-	-	-	1,406	1,406	3,865
Sea robins	-	-	-	-	124	124	98
Angler fish	-	-	-	-	-	-	1,332
Dogfish and skate	-	-	-	-	3,961	3,961	6,788
Squid	-	-	-	6	330	336	445
Other	-	676	21,199	379	9,323	31,577	17,712
Total	830	31,330	264,724	11,193	267,924	576,001	711,201

Subarea 1

A. Status of the Fisheries

The USSR commercial fleet did not work in Subarea 1. About 800 tons of cod and redfish were caught by research and scouting vessels.

B. Special Research Studies

I. Environmental Studies

Hydrographic observations were conducted by the vessels *Pobeda*, *Volgograd* and *Novorossiisk*. Data obtained by these vessels showed that since November 1966 to March 1967 the average temperature in the 0-50 m layer along the southwestern Greenland coast dropped from 1.08°C to -0.57°C, and it dropped from 1.98°C to -0.46°C on Fyllas and Fiskenaes Banks. Cooling of water masses was uneven in the autumn-winter period 1966-67: to the end of autumn, the daily rate of cooling reached 0.05°C, but to the end of winter the temperature dropped only by 0.01°C per day. The average water temperature (0°C) in 1967 in the near-bottom layer over some banks fished is shown in Table 2.

Table 2. Average water temperature (0°C).

Bank, depth (m)	March	July	August	September
Frederikshaab				
less than 100	2.40	0.52	1.68	-
100-200	4.90	4.54	3.51	-
Fiskenaes				
less than 100	2.13	0.39	0.81	0.96
100-200	3.86	3.77	-	4.50
Fyllas				
less than 100	-	-	1.89	1.79
100-200	-	-	-	4.91
Lille Hellefiske				
less than 100	-	-	1.26	1.88
100-200	-	1.33	1.66	3.56
Helder				
less than 100	-	-	1.53	0.93
100-200	-	-	-	3.43
Store Hellefiske				
less than 100	-	-	2.93	2.92
100-200	-	-	-	2.31

A marked inflow of cold waters of the Canadian Polar Current was observed at northern banks in August, and their mixing with warm current to the west of banks resulted in the decrease in the average temperature by 0.6-1.3°C in comparison with other years (Table 3).

Table 3. Average water temperature (0°C).

Bank, depth (m)	1961	1962	1963	1964	1966	1967
Lille Hellefiske						
less than 100	2.31	2.54	2.38	1.71	2.34	1.88
100-200	3.92	3.79	4.14	4.19	4.81	3.56
Store Hellefiske						
less than 100	-	4.48	3.44	2.97	3.74	2.91
100-200	-	3.91	4.28	4.87	2.60	2.31

In 1967, a very low water temperature was observed along the hydrographic Section 10-A, crossing two continuous currents (Table 4).

Table 4. Average water temperature (0°C) along Section 10-A (Lille Hellefiske Bank), September.

Depth	Canadian Polar Current					West Greenland Current					
(m)	1961	1962	1963	1964	1967	1961	1962	1963	1964	1966	1967
0-50	0.42	1.44	-1.36	1.01	-0.17	4.20	4.70	4.25	4.38	2.72	1.62
0-200	-0.58	-0.73	-0.99	-0.24	-1.18	2.78	2.92	3.25	2.83	2.41	0.97
200-500	2.80	2.21	-	2.28	0.79	3.60	3.98	3.34	4.84	5.02	3.50

As seen above, the average water temperature was lower in September 1967 than in September 1961-65. In 1967, an extremely low temperature was observed in the 0-200 m layer of the West Greenland Current. The fall of temperature was due to coming of cold waters of the Canadian Current from the northwest.

Water temperature of the West Greenland Current on Fyllas (Section 11-A) and Fiskenaes (Section 12-A) Banks is given in Table 5.

Table 5. Average water temperature of the West Greenland Current along the Sections 11-A (Fyllas Bank) and 12-A (Fiskenaes Bank), September.

Depth	Section 11-A					Section 12-A				
(m)	1961	1962	1963	1964	1967	1961	1962	1963	1964	1967
0-50	5.21	4.38	4.75	4.09	2.52	5.05	4.01	3.68	5.10	3.11
0-200	5.07	3.94	4.99	4.88	2.71	5.78	5.25	5.66	4.92	3.77
200-500	4.38	4.55	4.87	5.34	4.47	4.76	4.74	5.08	5.46	4.86

Those data show that in September the water temperature was lower than in previous years. Thus, in 1967 the water temperature was 1°C lower on the central banks, 2°C and even 2.5°C lower than in the previous years in the northern areas due to the influence of the Canadian Current.

II. Biological Studies

1. Cod

a. Distribution and density of stocks. In March-April, July-September some scouting and research vessels type *Kreml* were working.

In March, off Southwest Greenland at the depths 115-380 m, cod catches were not great in amount, not more than 100-200 kg per one hour trawling. Immature cod of the average size prevailed in catches taken from the depth less than 200 m; this cod slightly fed on benthos organisms and on young redfish. Large spawning cod were observed at the depth more than 200 m.

In the first half of March in the area off Frederikshaab Bank at depths 300-350 m, the catches of pre-spawning and spawning cod of the

average and large size made 2-3 tons per one hour trawling. In the second half of March and early in April, catches decreased up to 200-300 kg; cod sizes also reduced. In that period, cod, mainly immature and of middle and small sizes, began to concentrate at less 200-250 m depths (catches were up to 1.0 tons per hour trawling).

In March, commercial cod was observed in trawl catches at depths 150-400 m on Danas and Fiskenaes Banks; catches ranged from 0.2 to 3.0 tons per hour trawling. Small and medium immature cod feeding on benthos organisms in small numbers prevailed at depths 150-250 m, whereas at depths 250-400 m the bulk of catches was represented by spawning cod of middle and large sizes.

To the end of March-early April, immature and post-spawning cod made concentrations on Fiskenaes and Fyllas Banks at depths 80-300 m. But, the fishery was not stable here. The catches fluctuated within large ranges, from 0.2 to 5-6 tons per hour trawling. The absence of mass concentrations of food organisms did not favour the stability of cod concentrations.

In July, trawlings off Southwest Greenland were almost not conducted due to great concentrations of ice formed. In that period, commercial concentrations of cod (catches from 0.5 to 0.3 tons) were found on Danas, Fiskenaes and Banan Banks, where *Ammodytes* were in great numbers at depths 40-80 m. Cod stomachs were filled with *Ammodytes*. Sizes of cod on all the banks varied widely from 35 to 85 cm and even more; the feeding concentrations consisted of immature as well as of mature and post-spawning cod.

In August, a lot of banks were investigated, but relatively stable commercial concentrations of cod could be observed only on few banks. During the intensive feeding, cod was very mobile. In the area of Store and Lille Hellefiske Banks at depths 40-300 m, catches of cod did not exceed 1.0 tons per trawling; in most cases they were 200-300 kg. Small and the average immature and post-spawning cod feeding on *Ammodytes*, shrimps and other bottom organisms, prevailed in catches. The lack of great concentrations of cod on the banks was caused by their feeding for the most part in a narrow coastal zone.

The most dense concentrations were observed at that time on Banan and Fyllas Banks at depths 30-120 m (catches 1-3 tons per hour trawling), where great concentrations of *Ammodytes* were observed. Stomachs of cod of all sizes were filled with *Ammodytes*. But, cod was very mobile also on those banks making horizontal and vertical migrations. In comparison with the northern areas, where catches consisted mainly of small and medium-sized cod, the catches taken on Banan and Fyllas Banks were mainly of big-sized cod.

On Fiskenaes Bank, cod also fed intensively on *Ammodytes*, but did not form stable concentrations; the catches did not exceed 200-300 kg.

Very unstable concentrations of small and medium-sized cod were found on Frederikshaab Bank in depths 60-250 m. Sometimes catches amounted

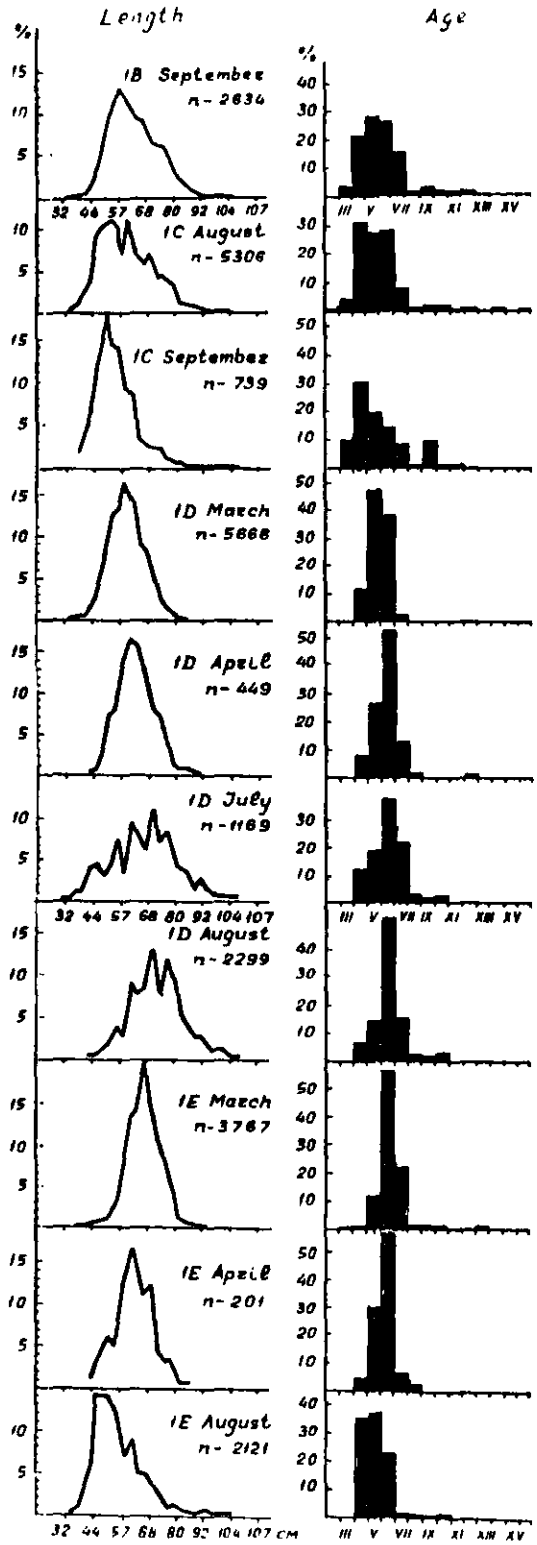

Fig. 1. Size and age composition of cod catches, Subarea 1, 1967.

to 1-2 tons per hour trawling. But, the bulk of cod was apparently keeping in the water column and fed on the pelagic organisms - *Ctenophora, Appendicularia, Amphipoda, Euphausiids,* luminous anchovy etc. The readings of instruments for fish finding in this region were not bad; nevertheless, the catches mostly did not attain 200-400 kg per hour trawling.

In September, commercial cod concentrations were nowhere observed throughout all the area from Danas Bank to the shallow of the Disko Island. The catches were not more than 300-600 kg per hour trawling. Cod concentrated throughout a large area in search of food.

b. Age composition. In March-April, the bulk of catches consisted of 1961 and 1962 year-classes (the medium size of 6-year-old cod ranged between 64.9-65.2 cm, those of 5-year-olds were from 57.2 to 57.9 cm). The rich 1960 year-class which prevailed in catches in the previous two years sharply decreased in catches at the age of seven. Only in Div.1E in March, the share of 1960 year-class was great (up to 22 percent by the number of specimens). In March-April, cod more than 7 years of age were negligible (1-4 percent).

In the second half of the year, the number cod older than 6 years increased slightly. Thus, in September 9-year-old cod specimens made up 10 percent of trawl catches in Div.1C. Cod of the 1963 year-class appeared in the catches. In the first half of the year, 4-year-old cod made 1-12 percent (by number of specimens), whereas in the second half they increased in numbers up to 35 percent in some areas (medium sizes of 4-year-olds were from 44.8 cm to 55.0 cm). In the next two years some decrease in stocks of the West Greenland cod and, apparently, in fishery productivity is to be expected as the abundance of the 1962-64 year-classes is average and even below average.

Subarea 2

A. Status of the Fisheries

The annual catch is given in Table 6.

Table 6. Annual catch and catch per hour trawling, Subarea 2 (in metric tons).

Div	Total catch by trawls of all types						Average catch per hr trawling by BMRT
	Cod	Redfish	Flounders	Halibut	Others	Total	
2G	449	135	-	-	-	584	1.81
2H	5,913	1,003	719	1,775	200	9,610	2.25
2J	14,366	4,125	1,464	649	532	21,136	1.97
Subarea 2	20,728	5,263	2,183	2,424	732	31,330	2.05

In comparison with 1966, the total catch of fish by the USSR trawl fleet in Subarea 2 changed slightly. It is necessary to note the following important facts.

A relative significance of Div.2J fell some more. In 1965, the ratio between fish catch in Div.2J and in Div.2H and 2G was 10:1; in 1966, only 4:1; and in 1967, only 2:1. In other words, fish concentrations (mainly cod) located further to the north from year to year. Simultaneously, the average catch of fish per hour trawling also decreased. A gradual shifting of the area of cod distribution to the north and the decrease in the productivity of the trawl fishery are regularly connected. Successful trawl fishing in Subarea 2 was favoured by the southern distribution of cod. Thus, early in 1968, the main cod concentrations were distributed further south than in previous years. The relative significance of Div.2J increased, and the average catch per hour trawling sharply increased. The relation between cod distribution in Subarea 2 and the productivity of the trawl fishery depends on the conditions for fleet operations. This problem is discussed in a special report by Konstantinov (Res.Doc.68/36).

As seen from Table 6, the 1967 redfish catch in Subarea 2 was higher than previously. The increased proportion of redfish in trawl catches was partially caused by the worsening of conditions for cod fishing and the change of some vessels to redfish fishing.

B. Special Research Studies

I. Environmental Studies

Hydrographic research accomplished in Subarea 2 showed that, in 1967, the main constant currents, including the cold Labrador branch, intensified making 1967 water temperature lower than in late 1965 and 1966 in the main hydrographic sections. Data on sea water temperatures in Subarea 2 are considered in detail in a special report by Burmakin (Res.Doc.68/37).

II. Biological Studies

1. Cod

a. Mean length and changes in abundance. 200,000 specimens caught by bottom trawl were measured; age was determined for 2,197 individuals. Table 7 shows mean cod length in Div.2J for the same months of 1960 and 1964-68.

Table 7. Mean length (cm) of cod from trawl catches, Div.2J.

Year	January	February
1960	57.3	57.2
1964	52.2	53.9
1965	51.5	54.2
1966	51.9	52.2
1967	50.2	47.9
1968	52.2	51.5

One can see that the mean length of cod began to decrease from year to year (undoubtedly, influenced by the increased fishery) and then became stable. The average age of cod changed in the same way. Thus the dynamic equilibrium was, apparently observed between the commercial catch and the annual natural recruitment of cod stock. This equilibrium was not also affected by natural fluctuations in the abundance of year-classes (fluctuations), as the strength of year-classes of the Labrador cod was stable enough (due to slightly varied conditions of spawning as well as due to the south drift of eggs and larvae). Table 9 shows the relative number of young cod in different areas; the strength of year-classes of the Labrador cod may be determined from the catches of the young specimens in Div.3K, where larvae of the Labrador cod are carried by the current. It is evident that the abundance of year-classes of the Labrador cod varied only slightly in comparison with the cod of the southern part of the Grand Bank and of St. Pierre Bank.

b. Marking. In 1967, 4,158 tagged cod were released in Subarea 2 from the research and scouting vessels. Up to 1 March 1968, 30 specimens (0.72 percent) were returned. In addition, in 1967, 66 specimens marked in 1963-66 were caught. All the specimens for which the locality of recapture was known were caught in Div.2H, 2J, 3K and 3L. These data confirm once more the availability of one common cod stock on the Labrador Shelf and in the southern part of the Grand Bank.

c. Forecast of cod fishery. In 1968, hydrographic conditions continued to become colder in the Labrador area. Thus, early in 1969 cod concentrations will be distributed more southerly than in 1967. Division 2J will be of greater importance for trawl fishery, the catch per hour trawling will increase (in comparison with figures for 1967).

Subarea 3

A. Status of the Fisheries

The annual catch is given in Table 8.

Compared with 1966, an increase in total catch was observed for Subarea 3, and, also, almost for each of its divisions, especially for Div.3N and 3O (mainly due to the growth in cod catches) and for Div.3K (due to a special fishery for grenadier, *Macrurus rupestris*, at depths of 600-800 m).

B. Special Research Studies

I. Environmental Studies

Oceanographic investigations at standard sections showed some intensification of the Gulf Stream and its proximity to the southern slope of the Grand Bank. More detailed results of oceanographic observations are given in a special paper by Burmakin (Res.Doc.68/37).

Table 8. Annual catch and catch per hour trawling in tons, Subarea 3.

Div.	Total catch by trawls of all types							Average catch per hour trawling by BMRT
	Cod	Grenadier	Redfish	Flounders	Halibut	Others	Total	
3K	9,241	15,692	839	1,802	3,160	921	31,655	2.04
3L	3,536	17	769	-	-	110	4,432	1.67
3M	5,886	-	65	-	-	150	6,101	1.78
3N	45,723	3	12,793	17,007	2,071	2,496	80,093	2.42
3O	73,122	-	17,706	33,438	69	8,990	133,325	2.37
3P	4,479	190	1,216	2,456	34	743	9,118	2.02
3	141,987	15,902	33,388	54,703	5,334	13,410	264,724	2.27

Table 9. Average catch (number of individuals) of young cod per hour trawling.

Year-class	Age	0+				1+				2+				3+			
	Div.	3K	3N	3O	3P	3K	3N	3O	3P	3K	3N	3O	3P	3K	3N	3O	3P
1958														10	1	0	2
1959										21	8	1	4	15	1	1	1
1960						5	3	0	3	11	1	2	5	11	1	0	1
1961		1	1	1	6	3	4	3	6	20	5	1	6	24	4	1	1
1962		1	1	7	42	2	8	2	7	15	18	2	12	24	6	1	2
1963		1	1	1	3	1	5	1	13	36	30	1	17	17	7	3	4
1964		1	41	24	31	3	137	13	22	8	73	42	58				
1965		1	1	1	5	1	14	12	21								
1966		1	2	15	7												

II. Biological Studies

1. Cod

a. Changes in abundance. During the early months of 1967, an estimate of the abundance of young cod was made in Subarea 3. The main results obtained are given in Table 9.

The availability of an extremely high abundance of 1964 year-class cod in the waters of southern Grand Bank and St. Pierre Bank was again confirmed. Cod of this year-class have already reached commercial size and considerably increased the total cod stock. Apparently, the abundance of the 1963 year-class was also somewhat higher than average. Thus, in 1969, the state of the cod stocks will be satisfactory in the southern part of the Grand Bank and on St. Pierre Bank.

b. Marking. In 1967, 2,980 cod were marked in Subarea 3. Of these, 21 specimens (0.70 percent) were returned up to 1 March 1968. In addition, 27 specimens marked from 1961-66 were recaptured. These results confirmed that the limits of distribution of two main cod stocks (Labrador and southern Newfoundland) lie approximately along the 46° latitude; north of this parallel lies the zone of stock mixing. Flemish Cap cod are to be considered as a separate stock.

2. Redfish. Studies on the size and age composition in trawl catches of redfish, their maturity stage and feeding were carried out in all the areas of mass distribution of redfish. Thus, for example, it was confirmed that larval extrusion took place in April-May in the northern part of Div.3K at depths of 200-400 m where, in 1967, very dense concentrations of redfish (*mentella*-type) were found with 80 percent females at the extrusion stage. The mean length of the females was 43.5 cm; the average age was 21.5 years.

In January, *mentella*-type redfish concentrations were found between 48° and 49°N on the Continental Slope, depths 400-500 m; females at the stage of egg maturity comprised 70 percent of all individuals caught. The mean length of the females was 38.4 cm; the average age was 18.5 years.

3. Grenadier *(Macrurus rupestris)*. From October to the beginning of December, dense concentrations of grenadier *(Macrurus rupestris)* were fished by some BMRT in Div.3K at depths of 600-800 m. The length of grenadier in trawl catches varied from 35 to 95 cm; the mean length was 64.7 cm and the average weight was 618 g. The weight of liver was about 5.8 percent of the total fish weight. Males were 64.4 percent and females 35.6 percent of the total catch. Grenadier concentrations remained at the same area of slope some months in succession.

Subarea 4

A. Status of the Fisheries

I. Silver hake

In 1967, the catch of silver hake continued to decrease sharply and was only 2,500 tons. This catch was the lowest for the total period of the silver hake fishery (Table 10).

Table 10. Silver hake catches in Subarea 4, 1962-67 (000's tons).

Years	1962	1963	1964	1965	1966	1967
Catches	8.0	123.0	81.1	50.0	10.3	2.5

The decline in silver hake catches began in 1964 and was particularly sharp in the period 1966-67. This may be explained by the decline in its abundance due to poor year-classes, as well as a considerable decrease in fishing effort, as the trawlers moved to other areas. There are no data on the future of the stock and its fishery.

II. Haddock

In 1966, USSR haddock catches decreased to 20,600 tons and in 1967 to 700 tons in comparison with 45,500 tons in 1965 (Table 11).

Table 11. USSR haddock catches from 1962-67, Nova Scotia area (000's tons).

Years	1962	1963	1964	1965	1966	1967
Catches	2.6	3.7	5.5	45.5	20.6	0.7

The sharp decrease in catch in 1967 resulted from vessels not encountering sufficient haddock concentrations and there were only occasional by-catches with other species. The main reason for the decrease in concentrations is the decrease in stocks, as very rich 1962 and 1963 year-classes were followed by poor year-classes.

Due to the randomness of haddock catches, only a little quantity of age samples was taken. Thus, in Div.4X, one sample of 99 specimens was taken in April and another of 98 individuals in May. It turned that the 4-year-olds prevailed in the samples: in April - 88 percent and in May 81.9 percent. Thus, judging from limited sampling, the catches consisted mainly of the 1963 year-class.

In May, the sample of 196 specimens taken in Div.4W consisted of 1-year-olds (3.5 percent), 2-year-olds (0.5 percent), 3-year-olds (24.4 percent), 4-year-olds (33.6 percent), 5-year-olds (26.3 percent), 6-year-olds (9.0 percent) and 7-year-olds (0.5 percent).

III. Argentine

In 1967, catches of argentine along the slope of the Scotian Shelf (Div.4X and 4W) decreased to 4,200 tons in comparison with 15,000 tons in 1966 (Table 12). But the proportion of argentine in the USSR catches increased from 14 percent in 1966 to 41 percent in 1967. Fishing for argentine was mainly conducted in Div.4X from April to October.

Table 12. USSR argentine catches in the Nova Scotia area, 1963-67 (000's tons).

Years	1963	1964	1965	1966	1967
Catches	8.1	4.9	5.6	15.0	4.2

B. Special Research Studies

I. Oceanography

In 1967, four standard hydrographic surveys were made in the ICNAF Area. The position of stations and sections is shown in Fig. 2. In addition, bathythermograph surveys in some sections of Subarea 4 were completed throughout the year. The distribution of water temperature along Sections I and VI is shown in Figs. 3 and 4. The data obtained show that in 1967 winter cooling in the Nova Scotia area was less intensive than in 1966. The surface temperature was 2°C to 2.5°C higher than in 1965 and 1966. In the winter of 1967, the bottom temperature was 1°C higher in the Sambro deeps in comparison with 1966, and the temperature from surface to bottom averaged 3-5°C higher. The winter temperature of the surface and bottom layers in Cabot Strait was 2°C higher than in 1966.

In spring, the water temperatures, in general, approached the 1965 level, except for April when temperatures were the same as in 1966.

In summer, the temperature in the surface layers of a considerable part of the Scotian Shelf was 2°C to 3°C higher in comparison with the 1966 level, except for the areas of Browns, Roseway, LaHave Banks and the Sable Island shallows. Data obtained on the Halifax section show a 1°C rise of temperature in the centre of the cold intermediate layer, and a 2°C to 3°C rise in the near bottom layer. In August, surface temperatures were 5°C higher at stations along Section I (Cabot Strait), as compared to those in August 1965. The data on the temperature distribution at depths show that modified Gulf Stream waters (6.1°C-7.5°C in its central part) enter Cabot Strait.

II. Biological Studies

1. Silver hake. In 1967, studies on the age composition of silver hake catches was continued. Otoliths were taken for age determination and preserved in ethyl alcohol.

Age studies showed that in 1967 the catches consisted mainly of 3-, 4- and 5-year-olds. The 4-year-old specimens made up 61.0 percent, a maximum

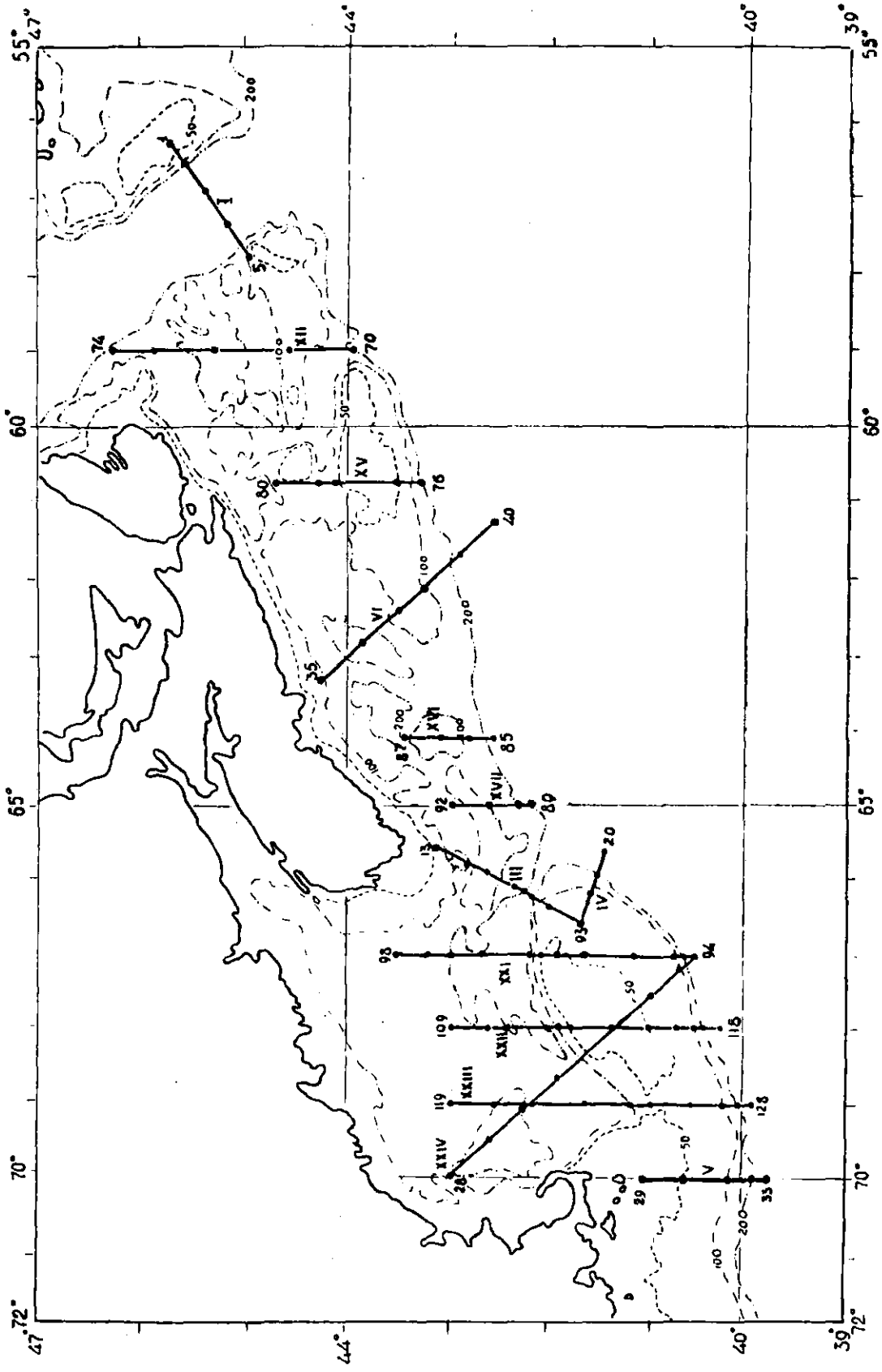

Fig. 2. Scheme of distribution of standard oceanographic sections.

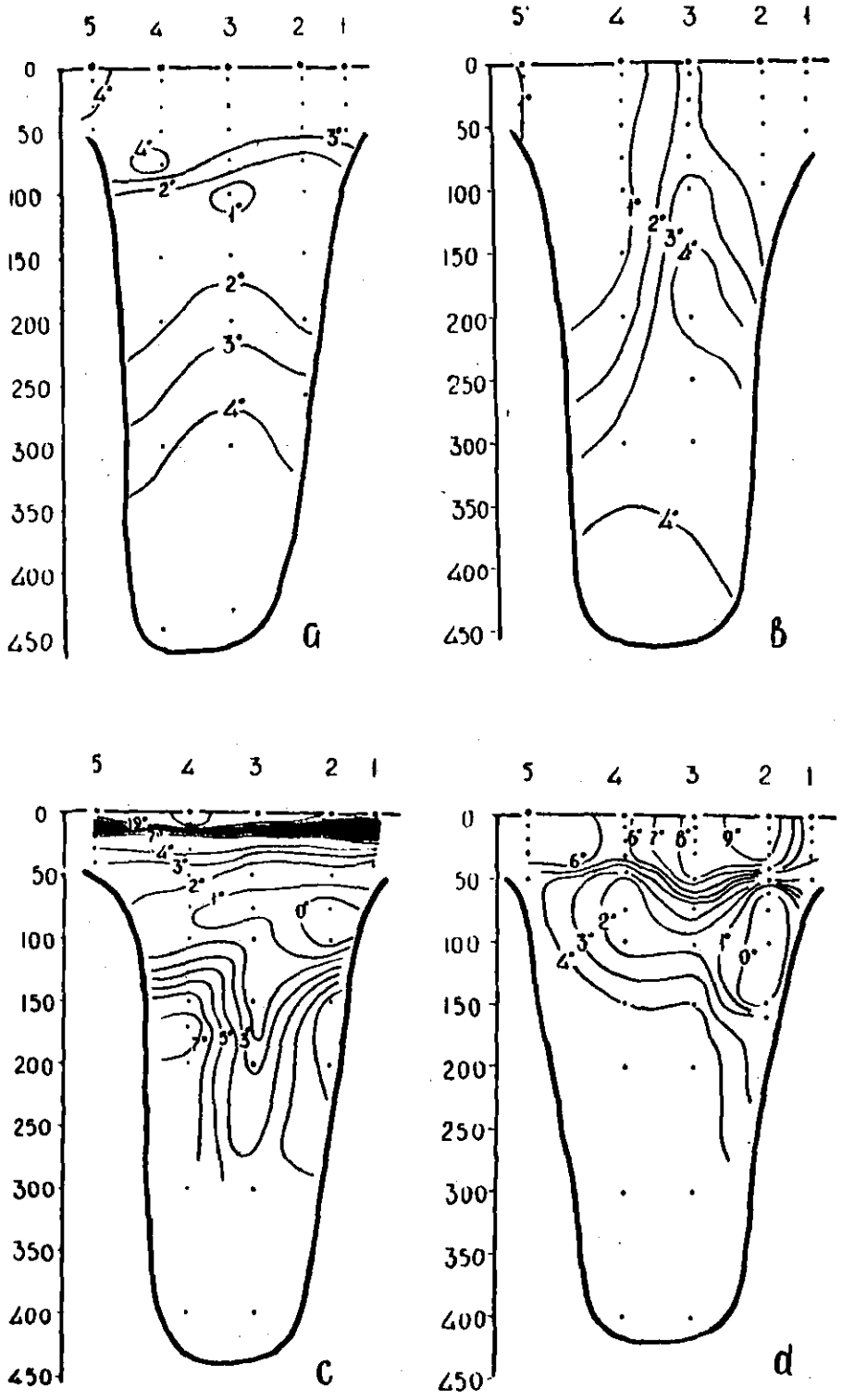

Fig. 3. Distribution of water temperature along Section I, 1967:
a) 8-9 January; b) 13 April; c) 11-12 August; d) 22 November.

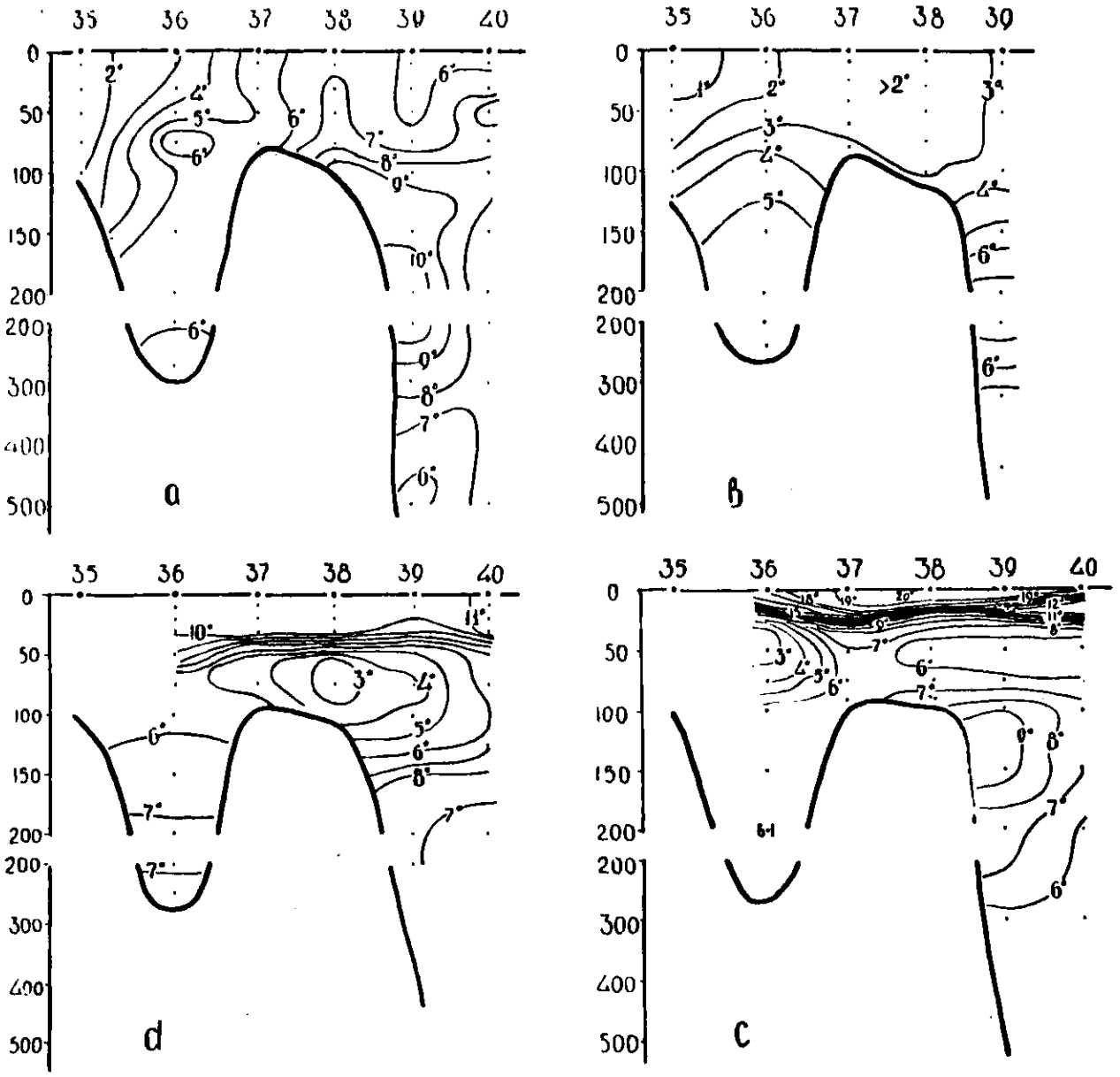

Fig. 4. Distribution of water temperature along Section VI, 1967:
a) 30 January; b) 9 April; c) 14 August; d) 12-16 November.

for the period 1963-67 (Table 13), and the 3-year-olds were the least (14.8 percent) for the same period. Table 13 shows that, in 1964, the proportion of 3-year-olds decreased, but 4- and 5-year-olds increased. Total catches and catch per hour trawling declined, allowing us to conclude that the recruitment of silver hake stocks decreased from year to year causing the observed decline in abundance.

Table 13. Age composition (%) of silver hake catches in the area of Sable Island, 1963-67.

Years \ Age	1	2	3	4	5	6	7	8	9	Total	Mean Age
1963	0.04	6.38	56.42	31.1	5.66	0.31	0.05	0.03	0.01	100.0	3.37
1964	0.28	2.23	31.57	45.13	16.41	3.96	0.42	-	-	100.0	3.89
1965	-	0.21	20.10	50.84	24.46	2.28	0.11	-	-	100.0	4.09
1966	-	13.10	22.80	38.50	22.30	3.20	0.10	-	-	100.0	3.80
1967	-	0.7	14.8	61.0	19.4	3.6	0.5	-	-	100.0	4.12

In 1967, the study of silver hake feeding was continued, a table was made to show the stomach content index, the frequency of occurrence of the organisms in the food mass in fish collected in 1965-67 by the scouting vessels in Subareas 4 and 5 of the ICNAF Area and further to southwest.

2. Argentine. In 1967, the morphology and the growth rate of argentine were studied. Preliminary results of a comparison of argentine from catches taken on the slopes off Sable Island and on Browns Bank showed that two independent stocks inhabited these areas.

Subarea 5

A. Status of the Fisheries

I. Silver hake

In 1967, USSR catches of silver hake decreased sharply to 70,000 tons in comparison with 281,400 tons in 1965 and 121,400 tons in 1966 (Table 14).

Table 14. USSR catches of silver hake (000's tons), Subarea 5, 1962-67.

Years	1962	1963	1964	1965	1966	1967
Catches	41.9	107.4	163.3	281.4	121.4	70.0

The main reason for the steady decrease is the reduction in stock abundance. In 1967, a sharp decrease in catches was also due to the fact that some vessels changed their fishing area and the resultant commercial effort decreased considerably. Thus, in 1967 the total number of trawling hours for BMRT, which took the bulk of silver hake, was only 40,683 compared with 123,704 in 1966.

II. Haddock

In 1967, the USSR haddock catches on Georges Bank decreased sharply to 2,300 tons in comparison with 81,900 tons in 1965 and 48,400 tons in 1966 (Table 15). The decrease was due to the reduction in commercial concentrations and in commercial effort. The stocks are not expected to increase in the near future; thus, haddock catches will apparently be small.

Table 15. USSR catches of haddock on Georges Bank (000's tons), 1962-67.

Years	1962	1963	1964	1965	1966	1967
Catches	1.1	2.4	5.5	81.9	48.4	2.3

III. Red hake

Red hake was fished by USSR vessels both in Subarea 5 and south of the ICNAF Area.

Table 16. USSR catches of red hake (000's tons), Subarea 5 and south of the ICNAF Area (Subarea 6), 1963-67.

Subarea	1963	1964	1965	1966	1967
5	3.4	3.6	58.5	85.1	37.6
South of Subarea 5 (Subarea 6)	0.8	8.3	11.7	25.7	14.9
Total	4.2	11.9	70.2	110.8	52.5

As seen from Table 16, red hake catches increased sharply in 1965 and 1966, but decreased in 1967. The high catches in 1965-66 were due to an increase in commercial concentrations and commercial effort, the low catches in 1967 to a decrease in red hake stocks and commercial effort.

IV. Herring

In 1967, the USSR herring catches on Georges Bank increased somewhat to 123,600 tons in comparison with 117,300 tons in 1966 (Table 17).

Table 17. USSR herring catches (000's tons), Georges Bank, 1962-67.

Years	1962	1963	1964	1965	1966	1967
Catches	151.1	97.3	130.7	36.3	117.3	123.6

The rise of herring catches during the last two years was due to increased commercial effort. At the same time, the abundance of herring in 1966 and especially in 1967 was lower than in 1964 and 1965. The decrease in herring stock in 1966-67 was due to the decrease in the abundance of a relatively rich 1960 year-class and of the average 1961 year-class, due to natural and commercial mortality.

B. Special Research Studies

I. Environmental Studies

1. Oceanography. Throughout 1967, four seasonal standard oceanographic surveys were completed in Subarea 5 according to the scheme shown in Fig. 2. In winter, a survey was made in January-February, in spring - in

April, in summer - in August, in autumn - in November. In addition, throughout the year, bathythermograph observations were made during micro-surveys in some areas of Georges Bank and the Gulf of Maine. In winter, the temperature was 1°C higher throughout the water mass along Section III (Fig. 5a), and 4° to 6°C higher along Section V in comparison with 1966 (Fig. 7a). In summer, there was an intensive influx of warm oceanic waters into the deep-water part of the Gulf of Maine (Fig. 6b). An intensive approach of warm waters to the East Channel also was observed in Section III, whereas the core of a cold intermediate layer either was not observed at all or it slightly modified (Fig. 5c). In the area of the eastern slopes of Georges Bank (Section IV), the temperature of the core of an intermediate layer was 1°C higher than in the summer of 1966.

Higher water temperatures in deep-water areas in Subarea 5 in 1967 than in 1966 can apparently be explained by a more intensive advection of slope waters to the shelf.

2. Plankton. In 1967, plankton research was continued in the area of Georges Bank. In January, April, July, August, October and November standard stations were occupied by scouting vessels and plankton samples were collected by Dzeddy net. The results of analysis of zooplankton samples taken in 1966 showed that average zooplankton biomass was lower than in 1965.

3. Ichthyoplankton. To study the distribution and abundance of silver hake, red hake and herring eggs and larvae, collections of ichthyoplankton were made on the southern slopes of Georges Bank twice in June and once in August, whereas on the northern slopes it was made in August, October and November.

In addition, 112 samples were collected by plankton samplers during the joint investigations with US scientists. Samples are being analyzed in the laboratory.

II. Biological Studies

1. Silver hake

a. Studies on the age composition of catches. The age composition of catches was studied throughout the year. Age determinations were made from otoliths of 3,100 fish. Using the tables of age/length data, the results of the age determinations were converted to mass measurements of catches. The analysis of the age composition of catches showed that in 1967 the bulk of catches consisted of 3- to 5-year-old fish (Table 18).

Table 18. Age composition (%) of silver hake catches in the area of Georges Bank, 1962-67.

Age / Years	1	2	3	4	5	6	7	8	9	Total	Mean Age
1962	0.24	6.78	36.36	50.43	4.01	1.43	0.76	-	-	100	3.59
1963	-	0.20	34.32	48.34	16.44	0.45	0.13	0.07	0.05	100	3.84
1964	0.14	11.36	45.44	28.58	10.68	2.92	0.78	0.10	-	100	3.51
1965	0.92	10.40	58.07	28.02	2.22	0.31	0.04	0.02	-	100	3.21
1966	4.5	17.3	45.5	27.3	4.1	0.9	0.4	+	-	100	3.14
1967	1.1	2.7	29.7	47.8	15.2	2.5	0.7	0.2	0.1	100	3.85

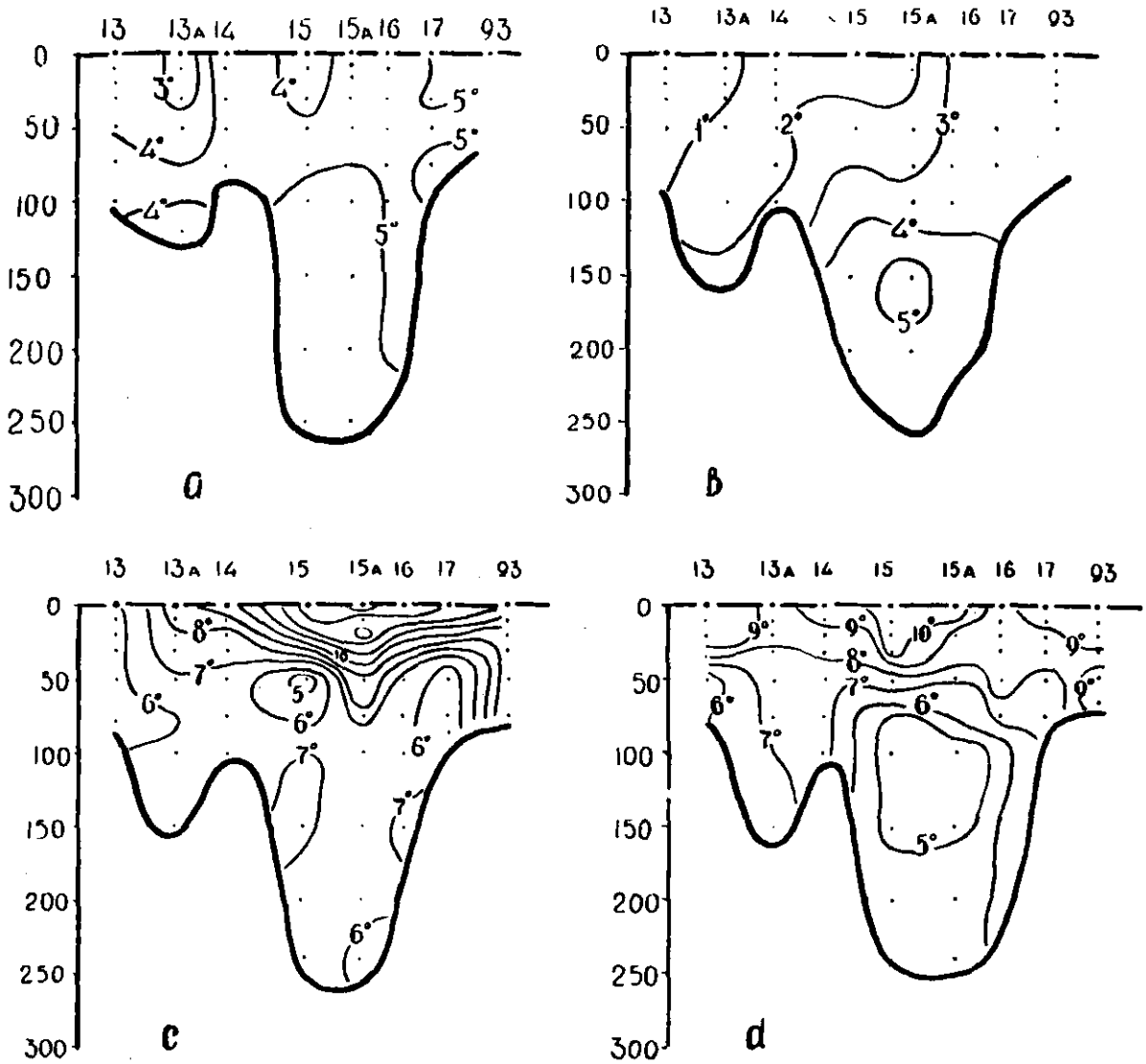

Fig. 5. Distribution of water temperature along Section III, 1967: a) 27 January; b) 6 April; c) 13 August; d) 13-14 November.

The proportion of 3-year-olds averaged 29.7 percent, of 4-year-olds 47.8 percent and of 5-year-olds 15.2 percent. One- and 2-year-olds were few in number (1.1 percent and 2.7 percent). Fish 6 years and older made in total 3.5 percent. In comparison with the three previous years, when the proportion of 3-year-olds was higher than that of 4-year-olds, in 1967, the number of the latter was considerably higher than that of the 3-year-olds.

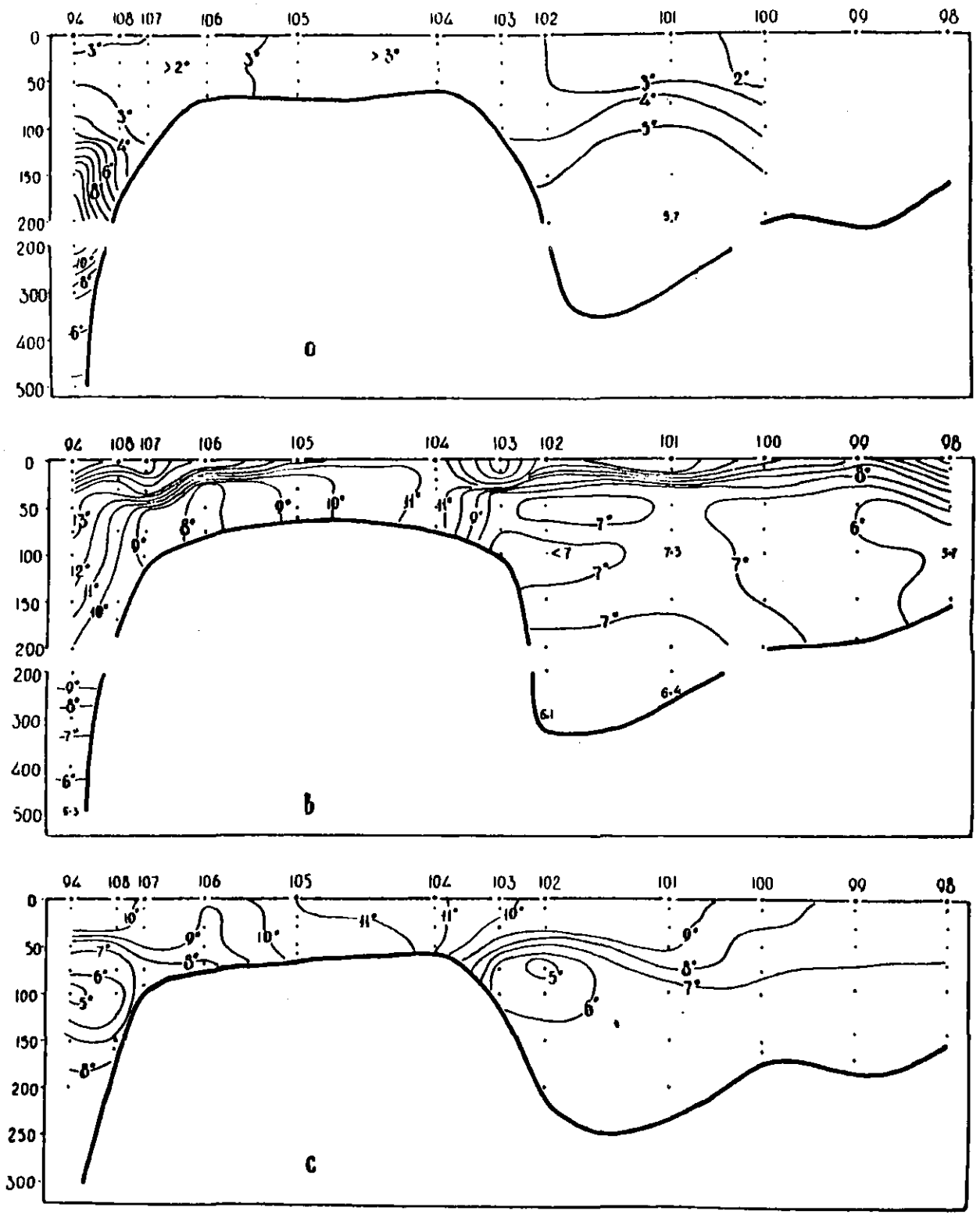

Fig. 6. Distribution of water temperature along Section XXI, 1967: a) 4-5 April; b) 10-12 August; c) 11-12 November.

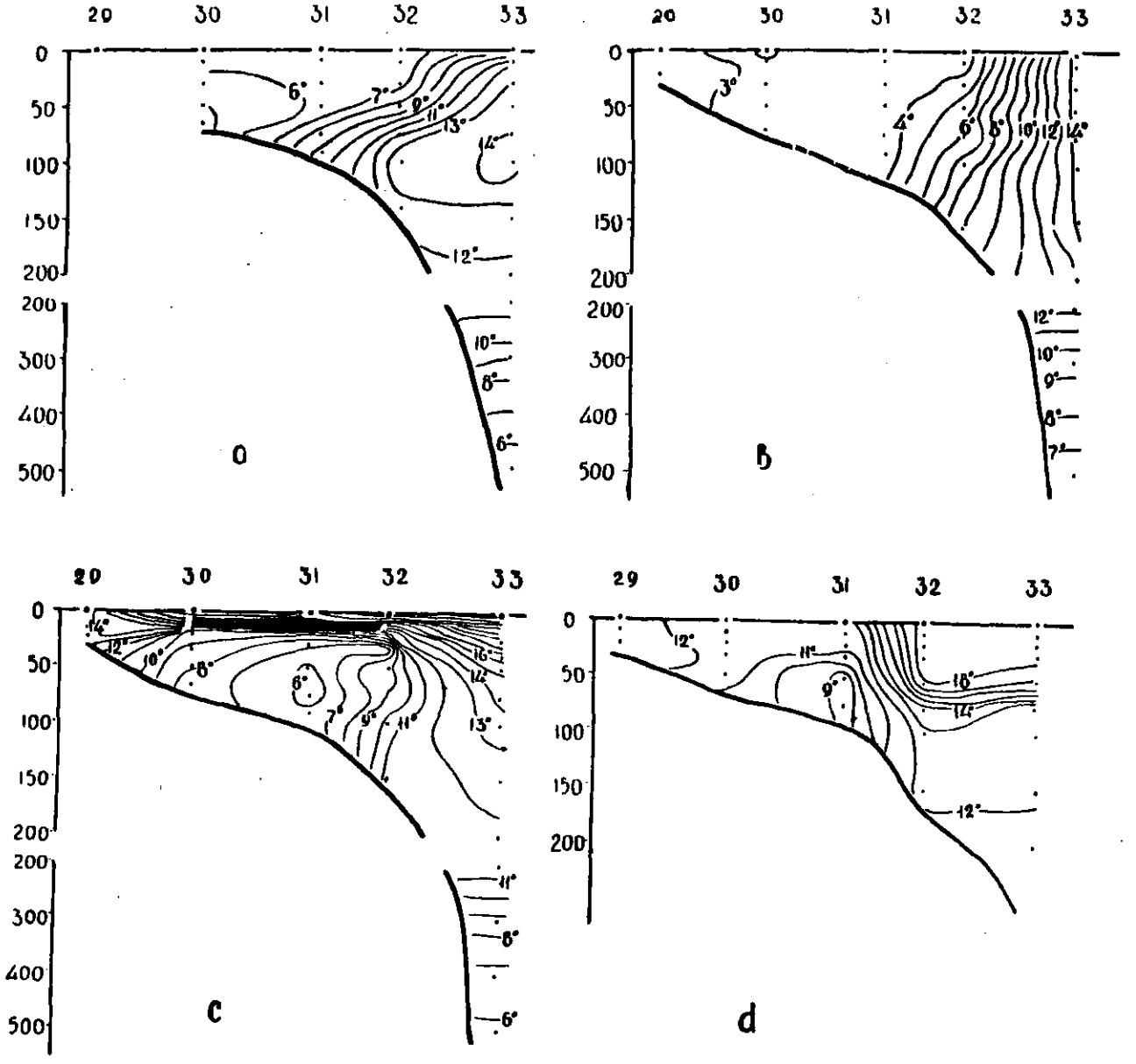

Fig. 7. Distribution of water temperature along Section V, 1967: a) 24-25 January; b) 1 April; c) 4 August; d) 4-5 November.

This can be explained by the fact that, in 1964-65, the "rejuvenation" of the silver hake stock was observed due to an intensive fishery and to its relatively even recruitment. In 1967, due to the recruitment to the commercial stock of a relatively poor 1964 year-class, the role of the 3-year-olds became less, whereas the 4- and 5-year-olds became of greater importance. Simultaneously, the silver hake stocks decreased as is evident from the size of the concentrations of fish and their catch per effort.

b. Racial studies. In 1967, studies were continued on the identification of silver hake stocks in the area of Georges Bank and in the area of the US Middle Atlantic states by the methods of precipitation (in agar), immunophoresis and the reactions of hemoagglutination. For this purpose, 1,075 samples of silver hake blood serum were collected. Of these, 635 samples were treated on board the vessel and methods of precipitation and hemoagglutination were used. The remaining 440 samples were taken to a laboratory for electrophoretic and immunophoretic analyses of serum albumin of silver hake blood. During the cruise, 281 specimens were analyzed by the method of precipitation in agar and 3,525 reactions were made. 354 specimens were analyzed and 2,124 reactions made by method of hemoagglutination. From the data obtained, some distinct antigenic divergences were found between the hake from Georges Bank and those from Middle Atlantic states. Simultaneously, an attempt was made to establish the percentage of mixing of these two local stocks during the autumn-winter period.

2. Haddock. In 1967, very few haddock age samples were collected as the haddock catches were few and small. Of 199 specimens taken on the northern slopes of Georges Bank, 48.7 percent were 4-year-olds of the 1963 year-class; 33.1 percent were 5-year-olds of the 1962 year-class and 7.5 percent were 6-year-olds of the 1961 year-class. Other age-groups were only slightly represented. In a sample taken from catches in March, 45.0 percent were 4-year-olds and 47.0 percent were 5-year-olds. These data show that in 1967 the bulk of the haddock catches was made up of the 1962 and 1963 year-classes which had been numerous in previous years.

3. Red hake. In 1967, work was completed on summarizing the data on catch composition, biological characteristics and stock identification of red hake. The type of population dynamics was determined and total fishing and natural mortalities were calculated. It was found that the majority of red hake reached maturity at the age of 2-3. The rate of total instantaneous mortality (Z) was 1.3, natural mortality (M) 0.9 and fishing mortality (F) 0.4. Two local stocks were identified: one on the southwestern slope of Georges Bank and the other in the area of Hudson Canyon. These results are given in a special report by Richter (Res.Doc.68/38).

4. Herring

a. Analysis of age composition of herring catches showed that specimens were from 2 to 9 years of age with the bulk of the catches made up of 6- and 7-year-olds. Thus, 0.3 percent were 2-year-olds, 0.3 percent 3-year-olds, 3.6 percent 4-year-olds, 11.8 percent 5-year-olds, 36.6 percent 6-year-olds, 42.2 percent 7-year-olds, 5.0 percent 8-year-olds, and only 0.2 percent 9-year-olds. Thus, in 1967 as in 1964, 1965 and 1966, the bulk of the catches were made up of the 1960 and 1961 year-classes. The 1963 and, apparently, 1964 year-classes were poor. If the stock is not recruited by abundant year-classes in the next few years, a further reduction in the herring abundance on Georges Bank can be expected.

b. Studies on the feeding of herring larvae. Analysis of the intestine content was made of 323 herring larvae collected in September and October 1965 on southern slopes of Georges Bank. The body length of the larvae sampled ranged mainly from 5.5 mm to 8.7 mm. Food was not found in the intestines of the bulk of larvae (84.5 percent). In October most of the 5.5-7.9 mm larvae fed on nauplii and larval *Lamellibranchiata* and different *Copepoda*. In November, 8.8-9.9 mm larvae fed mostly on *Copepoda* and nauplii, and the proportion of *Lamellibranchiata* in the food decreased.

XII. United Kingdom Research Report, 1967

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

Subareas 1-5

A. Status of the Fisheries

The expansion in United Kingdom fishing activity in the Northwest Atlantic continued in 1967 with an increase of 50 percent in the overall level of fishing effort and a consequential but rather smaller increase in landings (25 percent) from 60,000 tons to 75,000 tons. The increased fishing effort reflects further expansion of the freezer trawler fleet, which accounted for 85 percent of the total effort in 1967. Fishing by side trawlers decreased, and the *Fairtry* factory trawlers were withdrawn from service in this area during the year.

The fishing by the side trawler fleet was restricted to Subareas 1 and 3, with the emphasis on the former, whereas the freezer trawlers fished all five subareas, centred on Newfoundland. The increase in UK landings is almost entirely accounted for by this increase in fishing in Subarea 3, landings from elsewhere being much the same as in 1966. However, the average annual catch per 100 hours fishing declined by approximately 10 percent in both Subareas 2 and 3. This index of stock abundance for Subarea 1 showed an improvement, largely due to a short period of very good fishing in the early summer. Catch rates during the latter part of the year were similar to those in 1966.

B. Special Research Studies

I. Sampling of Stocks

Routine length and age sampling of commercial catches has been continued.

In May 1967, a trip was made in a commercial trawler to West Greenland to observe whether codends made of heavier than normal twine were as durable as normal codends worked with a tight, topside chafer. The codend was made of 75s terylene instead of the normal 120s terylene, and was 120 mm mesh. The trawler worked mainly in Frederikshaab Gully; the maximum catch was 300 baskets and bags of 70 baskets were taken aboard in single lifts (1 basket = 30 kg approximately). The catch was almost entirely cod. One codend was used throughout the trip and proved entirely satisfactory, showing no exceptional wear.

In November, the M/V *Ross Renown* was chartered to make a survey of the Newfoundland Grand Bank. Apart from three hauls on Flemish Cap, and a few hauls on top of the bank south of St. John's, trawling was confined to the edge of the bank in 100-135 fathoms eastwards from a point due south of Cape Race,

then northwards to the northeast corner, and finally westwards towards Cape Spear.

The catches consisted mainly of cod, haddock being caught in very small numbers. The maximum catch of cod was 90 baskets per two-hour tow. Stratified otolith samples were taken and preliminary examination of the data indicated that approximately 20 percent, by numbers, of the catch of cod consisted of the 1964 year-class.

Four hundred and forty-three blood samples were also taken from cod for immunogenetical studies. Preliminary results from these show genetical differences in populations from different areas of the bank, with a notable distinction between cod at Flemish Cap and those in the Grand Banks area.

II. Selectivity experiments

The selectivities of three types of codend were tested on this survey; an Ulstron codend, with and without a tight, topside chafer with the same mesh size as the codend, and a Nufil codend without a topside chafer. The chafer reduced the selection factor of the Ulstron codend for cod from 4.3 to 3.8 (50 percent points = 495 mm and 440 mm). The Nufil codend had the same selection factor as that of the Ulstron codend (both these materials are forms of polypropylene).

III. North Atlantic salmon

Investigations of the West Greenland salmon were continued during the autumn of 1967, along the same general lines as in 1966, with particular reference to tagging in the coastal area. No attempts were made in 1967 to catch salmon for tagging in the offshore area. Seven scientists from the United Kingdom took part in the program, with the assistance over the first part of the inshore tagging program of an English netsman.

In 1965 and 1966, gill nets had been used as the main method of catching fish for tagging, but in both years only a small portion of the fish caught was in a condition suitable for tagging. Northumbrian T-nets (a form of trap net very similar to the Norwegian kilenot) were therefore fished in 1967, to see if they would produce a higher proportion of taggable fish. Though they were better than the gill nets in this respect, they caught very few fish. In all 1,546 fish were caught (1,518 by gill net and 28 by T-net) and, of these, 347 were tagged (332 from the gill net catches and 15 from the T-net catches). Two of the tagged fish were recaptured in Greenland waters, both within the Godthaab area.

Four of the salmon tagged in Greenland in 1966 were recaptured in home waters during 1967, one in Canada (in the Miramichi estuary) and three in Scotland (two in the Tweed and one in a tributary of the Spey).

Investigations of the blood characteristics (particularly the blood groups) and other biochemical characteristics (*e.g.*, the liver esterases) of

West Greenland salmon were continued, and eye lenses were collected for later examination of their protein characteristics. In addition, a number of salmon were examined for parasites.

During the spring of 1967, 22,000 smolts were tagged in England and Wales from two river systems, and in Scotland 25,444 smolts were tagged, from five river systems. So far, records have been received of the recapture at West Greenland in 1967 of 18 of the smolts tagged in the United Kingdom in 1966 (3 tagged in England and Wales and 15 tagged in Scotland). Further, a kelt tagged in England and Wales in 1967 was recaptured at West Greenland later in the year.

IV. Environmental Studies

UK research vessels made no environmental surveys in the ICNAF Area in 1967, but members of the Lowestoft, Aberdeen and Edinburgh laboratories were engaged in completing the report of the NORWESTLANT Surveys.

The survey by the Continuous Plankton Recorder, operated from the Oceanographic Laboratory, Edinburgh, was continued in the ICNAF Area in 1967, along the same general lines as in previous years. It was financed by H.M. Treasury through the Natural Environment Research Council and by the Department of the United States Navy through Contracts N62558-3612 and F61052-67-C0091, between the Scottish Marine Biological Association and the Office of Naval Research, Department of the US Navy.

Recorders, sampling at a depth of 10 m, were towed at monthly intervals along standard routes by cutters of the US Coast Guard and merchant ships from Denmark, Iceland and the United Kingdom. The total mileage sampled was 24,000, made up of 2,900 miles in Subarea 1, 4,800 in Subarea 2, 12,700 in Subarea 3, 2,900 in Subarea 4, and 700 miles in Subarea 5.

This sampling forms part of an ecological survey of the North Atlantic Ocean and the North Sea, concerned particularly with the study of the abundance, distribution and composition of the plankton over a long period of years. Detailed information may be obtained on request from the Director, Oceanographic Laboratory, Craighall Road, Edinburgh 6, Scotland.

The spring outbreak of phytoplankton in 1967 was earlier and more abundant than usual in Subareas 1, 2 and 3; *Thalassiosira* spp. and *Chaetoceros* spp. were particularly numerous in May. In contrast, numbers of diatoms were low over the Grand Banks and in coastal waters in Subareas 4 and 5. *Calanus finmarchicus* is the dominant copepod in the ICNAF Area surveyed by the Plankton Recorder. Young stages of *Calanus* were abundant in May in the coastal waters west of Greenland (this is about a month earlier than usual) and numbers were extremely high in oceanic waters east of the Strait of Belle Isle in June. Adult *Calanus* were present in numbers close to the long-term mean in oceanic waters, but, like the phytoplankton, were below average in the coastal waters of Subareas 4 and 5 and over the Grand Banks. The numbers of Euphausiacea

(mostly *Thysanoessa longicaudata*) were close to or slightly below the average everywhere in 1967.

Young *Sebastes* spp. were abundant in the oceanic populations south and southeast of Greenland, but their numbers were slightly below average in the area east of Newfoundland. The populations of *Sebastes* in these two areas are thought to be separate stocks, identified as such by differences in their patterns of pigmentation.

XIII. United States Research Report, 1967

by Herbert W. Graham

The United States landed fish from ICNAF Statistical Subareas 3, 4, 5, and 6 and conducted research in these subareas as well.

Subarea 3

A. Status of the Fisheries

I. Redfish

Redfish landings by the United States from Subarea 3 came from Div. 3N and P (Table 3.1). Because of reduced fishing effort, landings per day fished may not be indicative of true abundance trends.

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

Year	Landings	Days Fished	Landings/Day Fished
1962	14,257	932	15.3
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

B. Special Research Studies

I. Environmental Studies

The United States Coast Guard Oceanographic Unit carried out the expanded program initiated in 1966. One of the important problems being investigated is the short-term variability of the Labrador Current. The standard sections 1 to 6 were occupied as during 1966. The Ocean Station Program concerning stations BRAVO to ECHO was carried out as in preceding years.

Subarea 4

A. Status of the Fisheries

I. Haddock

Fishing effort in Subarea 4 was primarily concentrated in Div.4X. Increased landings were a result of higher levels of haddock abundance and effort, though mostly the latter (Table 4.1).

Age compositions for 1966 and 1967 are not available. The increased abundance is presumed to be a result of recruitment of the larger than average 1962 and 1963 year-classes. This trend of increasing abundance should continue over the next year or two.

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

Year	Landings	Days Fished	Landings/Day Fished[1]
1962	6,388	875	7.3
1963	7,223	1,111	6.5
1964	8,488	1,132	7.5
1965	3,685	567	6.5
1966	2,473	526	4.7
1967	5,014	928	5.4

[1] Landings per day are based on Browns Bank statistics

II. Cod

United States cod landings from Subarea 4 were 1,453 metric tons in 1967 compared to 983 metric tons in 1966. This increase in landings is related to the rise in effort of the haddock fleet.

III. Redfish

Redfish landings by the United States from the Gulf of St. Lawrence (Table 4.2), Div.4R, S and T, increased in 1967. This seems to be a result of rising abundance, continuing the trend of recent years. US redfish landings from the Scotian Shelf (Div.4V, W, X) declined sharply in 1967 due to decreased abundance and effort (Table 4.3). Total landings (all countries) from this area declined sharply in 1964-65 but nearly doubled in 1966.

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

Year	Landings	Days Fished	Landings/Day Fished
1962	68	8	8.7
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

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

Year	Landings	Days Fished	Landings/Day Fished
1962	29,375	3,376	8.7
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

B. Special Research Studies

I. Environmental Studies (see under Subarea 3)

II. Biological Studies

1. Haddock. The cooperative study by the US and Canada on age and length compositions of the stocks in Div.4X is continuing. All data for the years 1962 through 1966 have been processed to provide estimates of the numbers landed, by length and age categories. These data are now being analyzed to provide estimates of mortality and effects of fishing.

Studies of the dynamics of haddock stocks, based on analysis of seasonal research surveys conducted from 1963-65, are also underway.

2. Groundfish surveys. A fall trawl survey by the *Albatross IV* covered most of Div.4X. This is part of a more general survey, reported under Subarea 5 research.

Subarea 5

A. Status of the Fisheries

I. Haddock

United States haddock landings from Georges Bank (Div.5Z) dropped sharply in 1967 (Table 5.1). The decline was caused primarily by decreased haddock abundance.

Age compositions (Fig. 1) show 4- and 5-year-olds (1963 and 1962 year-classes) dominating the catch in 1967. *Albatross IV* surveys since 1963 indicate that the four year-classes subsequent to 1963 have been much below average (Table 5.2). Hence, further decreases in abundance on Georges Bank are expected through 1970.

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

Year	Subarea 5	Div.5Y	Div.5Z		
	Landings	Landings	Landings	Days Fished	Landings/Day Fished
1962	54,412[1]	5,003	49,378	7,838	6.3
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

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

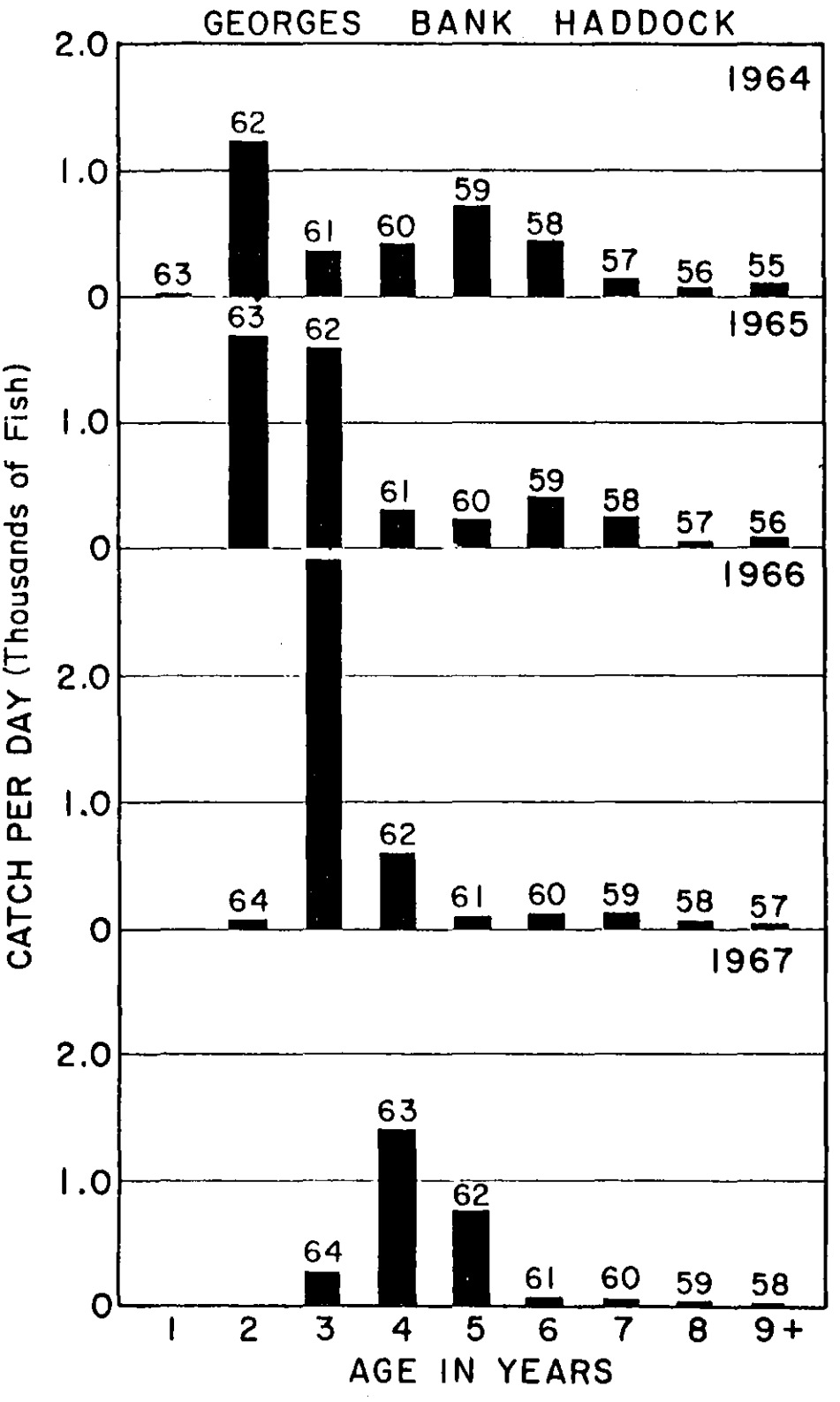

Fig. 1. Age composition of Georges Bank haddock, 1964-67.

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

Year	Index	Year	Index
1958	8.5	1963	12.6
1959	9.6	1964	2.0
1960	2.4	1965	1.2
1961	1.4	1966	1.5
1962	2.6	1967	0.0

II. Cod

Cod landings from the subarea by the US (Table 5.3) increased slightly in 1967. Cod are generally taken incidental to haddock and the catch rate, while not an exact measure of abundance, indicates a generally stable abundance over the last few years.

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

Year	Landings	Landings/Day Fished
1962	18,626	1.2
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

III. Silver hake

Landings of silver hake for food (Table 5.4) decreased sharply in 1967. Industrial landings, which accounted for a small proportion of the total, were slightly higher. The abundance trend continued downward in 1967. In 1961, the US accounted for 100 percent of the landings. In 1966, when total landings had increased 381 percent to 162,144 metric tons, the US share was 25 percent.

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

	Total	Subarea 5 North[1]		Subarea 5 South[2]	
Year	Subarea 5	Landings	Landings/Day	Landings	Landings/Day
1962	49,604	44,271	18.5	5,333	-
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	2.7

[1] Primarily food fish from north of Cape Cod.
[2] Primarily industrial from south of Cape Cod.

IV. Redfish

United States redfish landings from Subarea 5 were higher in 1967 than in 1966 (Table 5.5). Landings per day, however, levelled out after sharp increases in 1965 and 1966. The recent level of fishing is relatively low, and the stocks are evidently recovering from the intense fishing of the 1950's.

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

	Total Subarea 5	Div.5Y (Gulf of Maine)		
Year	Landings	Landings	Days Fished	Landings/Day Fished
1962	12,540	10,196	2,549	4.0
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

V. Yellowtail

Total US yellowtail landings in 1967 was about 82 percent of that in 1966 (Table 5.6). Apparent abundance increased slightly; the drop in landings was caused by reduced effort.

In 1967, the age composition (Fig. 2) of yellowtail from Subarea 5 was dominated by 3-year-olds (1964 year-class). The strength of this year-class and the incoming 1965 year-class (2-year-olds) was responsible for increased abundance, which is expected to remain near the same level in 1968.

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

[1] 1965-67 figures contain a small amount of industrial yellowtail landings.

VI. Red hake

Red hake landings by the US in 1967 came to 5,759 (Table 5.7) metric tons, or about 1,500 metric tons more than landed in 1966. Landings per day increased for the first time since 1964, but are still relatively low.

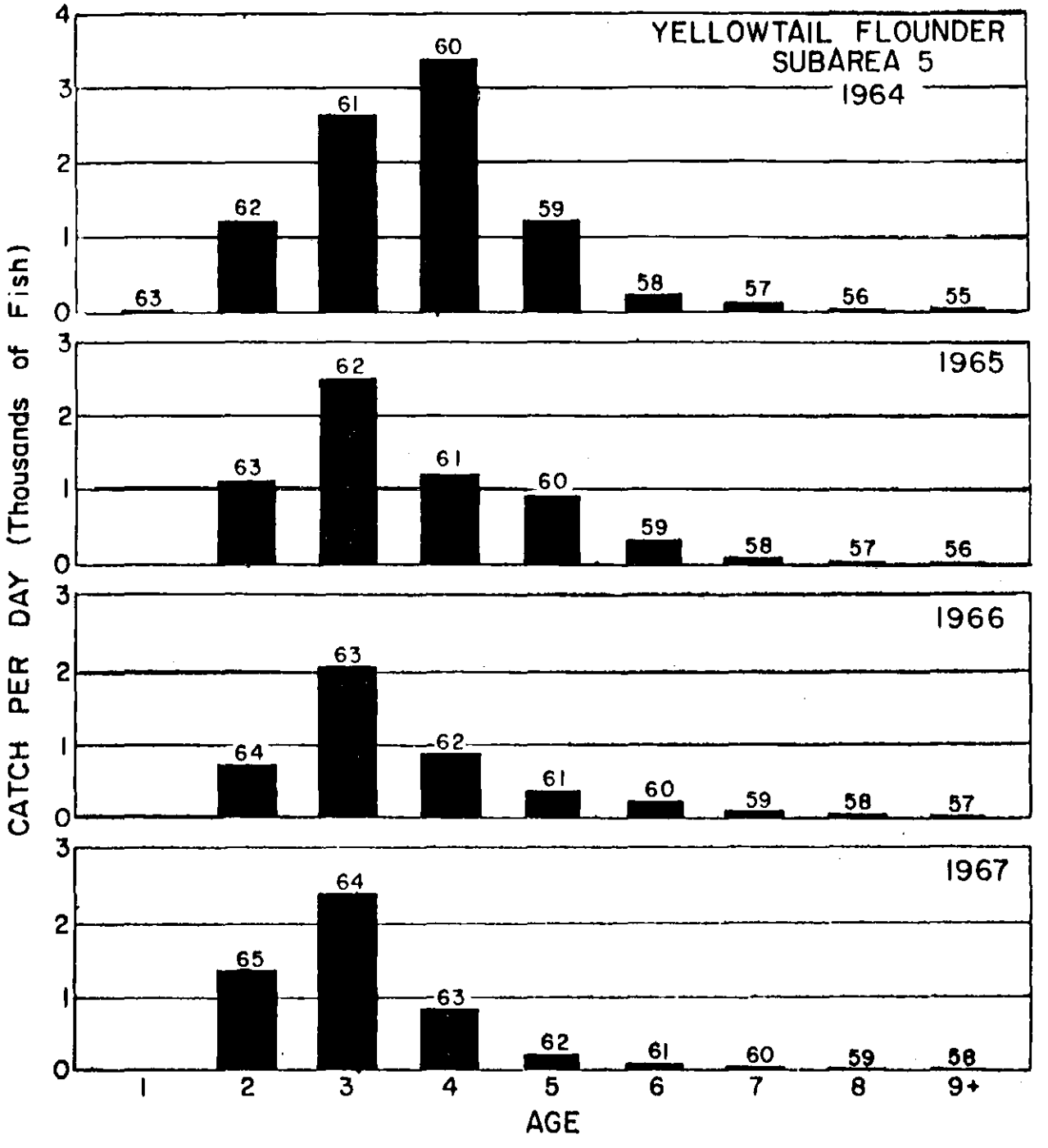

Fig. 2. Age composition of Subarea 5 yellowtail flounder, 1964-67.

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

Year	Total Landings	Div.5Y Landings	Div.5Z[1]		
			Landings	Days Fished	Landings/Day Fished
1962	2,471	1,076	1,395	-	-
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	1,049	5.4

[1] Predominantly industrial statistics

VII. Industrial Groundfish Fishery

New England industrial landings (Table 5.8) decreased 16 percent in 1966. In 1967, this trend was reversed. Species composition of the industrial catch changed considerably in 1966 and 1967 with decreases in red and silver hake, and an increased eel pout and flounder catch.

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

Year	Total Landings	Species Composition (%)				
		Silver hake	Red hake	Flounder	Eel pout	Other
1962	26,666	-	-	-	-	-
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

VIII. Herring

The catch of herring in the State of Maine continued to be poor in 1967 with total landings of 29,302 metric tons. A catch of 15,423 metric tons in Central Maine was the best since the two good years of 1962 and 1963. The big change in the sardine landings for Maine has been the decrease in Western Maine where the smallest catch since 1951 was made in 1967. In 1966 and 1967, Western Maine contributed only an average of 27 percent of the State's landings as compared to an average of 40.5 percent from 1953 through 1964. The cause of the continuing trend for the fishery to decline in Western Maine is not understood but this decline has been coincidental with declining sea water temperatures. Our sampling has revealed no evidence for an unusual abundance of parasites or diseases that could explain the decline in Western Maine.

Age composition of the Maine sardine landings is shown in Table 5.9. The 15 percent contribution of 4-year-old fish is the highest on record in the Maine sardine industry reflecting both the scarcity of younger fish and the expansion of the use of purse seines in the fishery.

Table 5.9. Age composition of the Maine sardine landings in 1967.

Age-group	Year-class	Percentage
I	1966	9
II	1965	51
III	1964	22
IV	1963	15
V and greater	1962 or earlier	3

The 1961 year-class dominated the samples taken from Georges Bank during June, September, and October. Adult herring samples taken from coastal Gulf of Maine were predominantly of the 1963 year-class; those taken in Nova Scotia were predominantly of the 1961 year-class. The range in ages of herring taken from all three areas was from 3 to 8 years. Length ranges were as follows: Georges Bank 20.3 to 33.7 cm, coastal Gulf of Maine 17.4 to 33.8 cm, and Nova Scotia 20.6 to 34.0 cm.

IX. Lobsters

The US catch of lobsters in 1967 was about 12,240 metric tons compared with 14,000 metric tons in 1966. About 1,950 metric tons were taken by the offshore fishery.

X. Sea scallops

United States sea scallop landings from Georges Bank increased somewhat in 1967 (Table 5.10). Research vessel indices for 1967 indicated an increase in stock abundance; however, the landings-per-day fished did not increase. Increased effort apparently affected the increase in landings.

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
1962	5,687	8,806	1.1	99.1
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

B. Special Research Studies

I. Environmental Studies

Hydrographic studies. The *Albatross IV* made temperature observations on all cruises conducted in the area. In general, temperatures continued the decline that has been observed during the past few years.

A study of the long-term temperature trends in the upper 100 m of water in the Gulf of Maine-Georges Bank area was completed and is reported in another research document.

The US Coast Guard conducted two hydrographic cruises (in September and December) occupying a grid of stations in Subarea 6 and the northern part of Subarea 5. Results are reported in another research document.

The ESSA Coast and Geodetic Survey vessels *Explorer* and *Peirce* made two cruises each in March and April 1967 gathering oceanographic data for studies of the Gulf Stream which flows in a meandering path along the south edge of the ICNAF Area. During these cruises the Stream was fairly typical for this region. Between Cape Hatteras and approximately 63°W, the Stream meandered within its usual limits. Wave-like features occupied an envelope approximately 100 miles wide and during at least part of the period propagated quite rapidly to the east. An anti-cyclonic (warm) eddy about 60 miles in diameter as defined by the position of the 15°C isotherm in the sharp thermal front at 200 m depth was observed in the process of detaching itself from the stream and drifting into ICNAF Div.4X and 5Z. Temperatures from 17.0°C to 17.5°C were found in the upper 250 m within the eddy, and the 10°C isotherm was depressed below 400 m. Current speeds comparable to the Gulf Stream were encountered in transversing this eddy. Almost simultaneously and in the same longitude (66°W), a cyclonic eddy was reported by Navy and WHOI researchers to have separated on the Sargasso Sea side of the Stream.

Environmental monitoring was conducted at Boothbay Harbour, Maine throughout the year. Continuous recordings were made of sea surface temperature (-5 ft MLW), air temperature, precipitation, bottom temperature (-22 ft MLW), salinity, tide level, wind speed and direction, dew point, and barometric pressure.

Surface water temperatures during the first six months of 1967 were much lower than those of recent years, but the last six months saw temperatures about the same or higher than those of the last year or two. The annual mean for 1967 was 7.3°C, the lowest since 1940.

The Woods Hole Oceanographic Institution continued its lightship program and its program of bottom and surface drift measurements in the western part of Subarea 5.

Plankton productivity. The Institution carried out a special study in the Gulf of Maine to determine the productivity of marine phytoplankton. It was demonstrated that the total annual production of organic matter in the marine environment requires more nutrient materials than can be found in the near-surface waters at any given time of the year. The observed rate of production must be maintained by the regeneration of nutrients in the biological cycle and by vertical mixing. The results indicate that nearly half of the daily requirement for nutrients may be met by the regeneration of elements. The phytoplankton population has a very rapid turnover rate and the necessary

nutrient elements are supplied by rapid recycling. Instead of a single crop during the year, as is typical of terrestrial communities, the oceanic population produces several crops during the year. The ratio between the available supply and the requirement for nutrients indicates a recycling six to ten times each year in coastal waters.

Coastal plankton. Plankton studies along the coastal Gulf of Maine were carried out by the Boothbay Harbour Laboratory. Observations on the seasonal variations in the composition, abundance, and distribution of zooplankton in coastal waters of the Gulf of Maine was continued in 1967. As in each of the previous years of the survey since 1963, mean annual volumes were highest in the western area (Cape Ann, Massachusetts to Cape Elizabeth, Maine), moderate in the central area (Cape Elizabeth to Mt. Desert Island, Maine) and low in the eastern sector (Mt. Desert Island to Machias Bay, Maine). Volumes in 1967 were about two times higher in the western area (11 cc/100m^3) than in 1966, but in the central and eastern areas volumes for the two years were not significantly different. The between-year differences in volumes in the western area resulted from an increase in the abundance of the euphausiid, *Meganyctiphanes norvegica*. The predominant zooplankters in the samples were copepods. Eight other groups (taxa) constituted more than 1 percent of the zooplankton; three were holoplanktonic (appendicularians, cladocerans, and euphausiids), and five were meroplanktonic (fish eggs, crustacean eggs, and larval cirripeds, decapods, and brachyurans). The predominant copepod species, *Calanus finmarchicus*, was less numerous than in the previous year. The lower mean annual water temperatures (the lowest recorded in 20 years) along the coast may have delayed the summer breeding of *C. finmarchicus*.

Collections of zooplankton made offshore were also examined during the year. The distribution of pontellid copepods was used to delineate the region of mixing between coastal and oceanic surface waters during an incursion in summer of Gulf Stream water over Georges Bank. The greatest changes in the distribution of pontellids were at 21°C and between 32.5‰ and 33.0‰ salinity.

During the year determinations were made of the food utilized by herring in coastal waters of the Gulf of Maine. Larval herring preyed on copepod nauplii, copepodites and adults; crustacean eggs; gastropod eggs; unidentified invertebrate eggs; pelecypod larvae; cirriped larvae; and decapod larvae. Copepods were the predominant prey organisms. Species occurring most frequently were in the genera *Acartia, Temore, Eurytemors, Oithona,* and *Pseudocalanus.* The variety of food organisms increased with the length of larvae from hatching in autumn to juvenile metamorphosis in late summer. This is the result of the onset of breeding among many of the meroplanktonic zooplankters in spring and summer. Juvenile herring of the 1965 and 1966 year-classes preyed heavily on copepods; the prey species occurring most frequently and in greatest numbers was the copepod *Calanus finmarchicus*. Larger herring of the 1961 and 1962 year-classes also preyed primarily on copepods, particularly *C. finmarchicus* and *Centropages typicus*.

As part of the US/USSR Cooperative Plankton Sampling Investigation, comparisons were made of the catching efficiencies of the Gulf III and paired Brown-McGowan (bongo) zooplankton samplers. In each of the 30 replicate hauls completed, the Gulf III undersampled several of the abundant copepod species, indicating that the bongo nets collect more of the forage organisms utilized by herring, and provide better samples of forage distribution and abundance than the Gulf III sampler. Replicate sampling is being continued through each of the seasons in 1968.

Benthic studies. The US continued its studies of the benthic fauna in the area between Hudson Canyon and Nova Scotia. The results showed that the macrobenthos is most plentiful (averaging 1,000 to 5,000 specimens and 100 to 500 g/m^2 of bottom) on the Continental Shelf in a broad band around the periphery of the Gulf of Maine and extending southward along the coastal area to New Jersey, and offshore in southern New England to the Hudson Canyon region. A particularly large area of high abundance occurs in a band 30 to 60 miles wide in the region south of Martha's Vineyard and extending eastward about 150 miles to the eastern part of Georges Bank. Low densities (less than 100 specimens and less than 50 g/m^2 of bottom) of benthic animals generally occur in the deeper portions of the Gulf of Maine, the shelf area southeast of Nova Scotia, and in the offshore deep water beyond the edge of the Continental Shelf.

II. Biological Studies

Haddock. Studies of the abundance trends and effects of fishing are continuing. A new method of estimating abundance from commercial statistics is being developed that will more accurately reflect population abundance, and be less susceptible to changes in the distribution and type of fishing effort.

Analysis of the data collected by the seasonal groundfish survey cruises has been started. This data provides a set of random observations of the population abundance independent of that derived from commercial statistics. The integration of the two types of information will provide more meaningful study of the population dynamics.

Analysis of data from the 9 seasonal surveys from August 1963 to February 1966 has provided some interesting information on mortality rates.

In 1964, landings from Div.5Z were 63,620 metric tons. In 1965, they were 149,591 tons, an increase ratio of 2.35. The total mortality rates for the two periods, calculated from the survey data, were as follows:

	Total Mortality	
Age-groups	1964	1965
III	0.40	1.98
IV	0.90	1.46
V	0.66	0.75
VI	0.86	1.06
VII	0.90	1.08
VIII	0.48	0.94
Total	0.70	1.08

This represents an overall increase of 154 percent, but increases in the younger age-groups were considerably higher than for the older age-groups.

The 2-year-old fish are normally being recruited, even to the small mesh survey trawl, during the year, so that often the apparent abundance is greater at the end of the year than the beginning. The 2-year-old age-group recruited during 1964 gained in apparent abundance by a factor of 1.50, but the same age-group declined in apparent abundance by a factor of 0.82 during 1965. This indicates that perhaps the 2-year-old fish were also more heavily fished in 1965 than in 1964, assuming that recruitment rates did not change.

At any rate, there appears to have been an increase in fishing rate from about 70 percent, which has been the average rate for many years, to 80 or 90 percent in 1965. Landings decreased somewhat in 1966, but the fishing rate was still much higher than that corresponding to the estimated maximum equilibrium yield level.

Yellowtail. Studies of age and growth, and total mortality have been completed during 1967, and have been submitted for publication in the ICNAF *Research Bulletin*. Studies of nylon mesh selectivity were also completed and the results documented for the 1968 Annual Meeting. These studies enabled us to re-assess the effects of mesh size on yields, and a document summarizing the assessment has been prepared.

Silver hake. Studies of age and growth have continued. These are complete to the extent that routine ageing of survey catches and commercial landings has begun.

Studies of effects of fishing are continuing. Part of the joint US/USSR groundfish survey studies will be applicable to this aspect of work.

Red hake. Studies of age and growth are continuing. Population abundance trends are being monitored, but lack of good abundance indices limits the conclusions which can be drawn. This aspect will be studied more intensively in the coming year.

Joint US-USSR groundfish surveys. The US *Albatross IV* and the USSR *Albatros* conducted joint trawling operations in Div.5Zw and Statistical Subarea 6 during October 1967. These operations included experimental designs to measure the effects of the two vessels and two different trawls on the catch of groundfish, and a coordinated comprehensive survey of the entire area.

The operations were most successful, and a report of the studies of the data is included in the Research Document series.

Herring. Von Bertalanffy growth curves were calculated for herring from Western and Eastern Maine, Nova Scotia and Georges Bank. Herring from Georges Bank are faster growing and reach an ultimate smaller size than do herring from Nova Scotia and Maine. The growth parameters agree with findings

made with meristic characters that herring from Georges Bank are not of the same group as herring from Nova Scotia or Maine.

The abundance of larvae within the bay and estuarine region of Boothbay, Maine, was low during the year, continuing into a fifth year downward trend coincidental with a decline in the coastal sardine fishery. Comparisons of the distributions of larval herring and salinity suggested that the larger catches of larvae were associated with the plumes of estuarine discharge along the coast of the Gulf of Maine. Analyses of collections of larval herring suggest that they enter the coastal area from beyond the offshore limits (28 km) of our sampling area as well as being spawned locally.

Tuna (tagging). Investigations involving the tagging of tuna and tuna-like species has continued in 1967. Release and recaptures in 1967 (Jan-Sept) and the period 1954-67 were as follows:

		Bluefin	Skipjack	Sailfish	White Marlin	Greater Amberjack	Other	Total
Total 1967	Recapture	602	0	11	5	33	2	653
	Release[1]	721	13	676	430	185	112	2,137
Total 1954-67	Recapture	1,529	85	64	37	217	37	1,969
	Release	8,793	2,034	8,550	4,181	2,060	2,796	28,414

[1] (Jan-Sept)

Twelve percent of the recaptures of bluefin in 1967 were tagged in 1967, the same percentage as recorded in 1966. The average age of bluefins in 1967 landings was 2.4 years compared to 1.4 years in 1966. Recruitment of 1-year-olds into the fishery was the poorest in several years.

Examination of release and recapture data has resulted in some preliminary insight into migration patterns and delineation of stocks. However, more detailed analyses and study are needed before final conclusions can be drawn.

Salmon. Atlantic salmon tagging projects in the State of Maine were continued in 1967; about 82,000 hatchery smolts were tagged. In addition, tagging of adult spawners was continued. Fishway trapping facilities on the Machias and Narraguagus Rivers permitted the tagging of a large proportion of the fish in the spawning runs into these rivers.

Tags from the 1967-tagged smolts were returned from the same areas and in about the same order of magnitude as were the tags from the 1966-tagged smolts. Through mid-summer, the post-smolts were captured in the herring fisheries in the Bay of Fundy. During late July, tagged post-smolts were recovered from the mackerel fishery operating in the vicinity of Halifax, Nova Scotia.

Tag returns in 1967 from the 1966-tagged smolts and from the post-kelts were a little more variable. In 1967 (second sea-year), the 1966-tagged smolt salmon were found during July around the southern and easterly coasts of Newfoundland, along the Labrador coast, and a few fish were in the vicinity of the Greenland coast. Late summer and fall captures came mostly from the Greenland fishery. However, by early winter, the fish had apparently left the Labrador Sea area and were migrating southward along the northeasterly and easterly Newfoundland coasts. The tagged post-kelts were taken in the same areas as in past years, but possibly in greater numbers. Tags from post-kelts tagged in Maine were returned in 1967 from the southern, eastern and north-eastern Newfoundland coasts as well as from the Greenland salmon fishery.

Lobsters. Since January 1965, experiments have been conducted on the life history and population dynamics of the "inshore" lobster, *Homarus americanus*, in the Gulf of Maine. An external tag was developed and field tested; the back tag ("Sphyrion" tag) does not affect growth, mortality or behaviour of the lobster and is retained through the moult. Estimates of survival, mortality (fishing and natural), exploitation, growth, migrations and population size have been made for a population endemic to Monhegan Island. A two-year study of the ecology of the lobster was made using Scuba. Lobster habitat, predators and associated bottom organisms were documented through underwater photography. Population structure as a function of depth, habitat and water temperature was studied. Nocturnal behaviour during the four seasons of the year has been studied.