INTERNATIONAL COMMISSION FOR  THE NORTHWEST ATLANTIC FISHERIES

REDBOOK 1962 PART II

REPORTS ON RESEARCHES IN THE ICNAF AREA

IN 1961

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NOTE: Following a decision by the Commission in its 1962 Annual Meeting this year's Redbook includes in addition to the Proceedings of the Standing Committee on Research and Statistics and Selected Papers from the 1962 Annual Meeting also the Research Reports for the year 1961 (the research reports up to and including the year 1960 are published in the Annual Proceedings Vols. 3-11). Summaries of Researches, hitherto included in the Redbook, will now appear in the Annual Proceedings.
Due to this great increase in the volume to be included, the 1962 Redbook appears in 3 parts:

PART I Proceedings of the Standing Committee on Research and Statistics

PART II Reports on Researches in the ICNAF Area in 1961

PART III Selected Papers from the 1962 Annual Meeting.

Erik M. Poulsen,
Executive Secretary.

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RESEARCH REPORTS BY MEMBER COUNTRIES

I. Canadian Research Report, 1961.

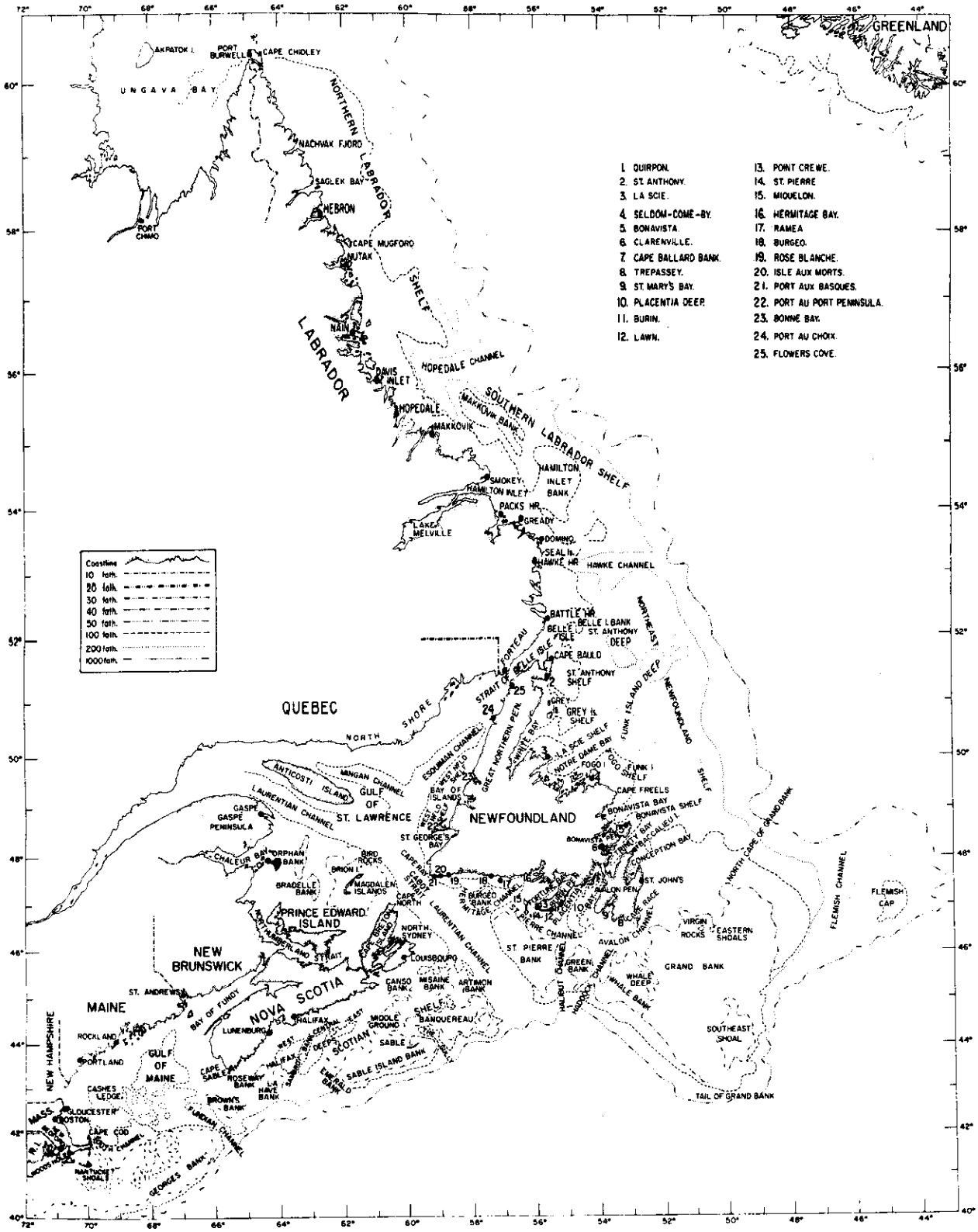
A. Subareas 2 and 3
by W. Templeman

Canadian researches on groundfish in Subareas 2 and 3 in 1961 were carried out mainly by the Biological Station of the Fisheries Research Board of Canada at St. John's. Hydrographic work was done by the Atlantic Oceanographic Group of the Fisheries Research Board and by the St. John's Station.

Cod, Gadus morhua L. The inshore cod fishery in most areas of Newfoundland was considered to be extremely poor. Although it is believed that the chances for a successful trap fishery are generally better in the hydrographic conditions subsequent to a cold winter, the 1961 fishery did not prove so, though the previous winter was very cold. Observations indicate that combinations of various factors probably resulted in the poor fishery in various areas. In many areas the weather was unusually sunny, warm and calm and the resulting brightness undoubtedly kept cod from the shallow fishing areas. Also the surface layers of water warmed so rapidly that on the east coast during the trapping season in July temperatures were too high to expect that catches could be large. It was evident that for many cod of the inshore population spawning was delayed, many fish not having spawned by July. These fish were very likely in colder or deeper water than usual over winter. However, during the fishing season the inshore and deep-water temperatures in 1961 on the northeast coast of Newfoundland and off southern Labrador were not lower than usual. Cod pursue the capelin to the shore in June, but although capelin were fairly abundant in 1961 in most areas they spawned on the beaches only for short periods and then moved to deeper water to complete their spawning. Thus the cod could feed abundantly on capelin without coming into the shallowest inshore areas.

Sampling of the codtrap catches for age and length composition of cod was carried out in July - August at Quirpon-St. Anthony, La Scie, Seldom-Come-By, Bonavista, St. John's, Trepassey and Burin. Young cod are generally 4 years old when they appear in the commercial codtrap fishery. During 1961, 4-, 5- and 6-year-old fish of the 1957, 1956 and 1955 year-classes, respectively, together made up about 70-95% of the total numbers of fish caught in traps in the various areas.

From 1958 to 1961, 4-, 5- and 6-year-old cod comprised 77, 71, 89 and 80% respectively, of the trap catches of cod at St. John's and from 1959 to 1961, 93, 94 and 94%, respectively, at Burin.



Map showing names mentioned in the text as well as recognized names for some localities related to fishing and chief fishing grounds of Subareas 2, 3, 4, and 5 and, also, suggested names for other features of the fishing grounds chiefly in Subareas 2 and 3.

Both at St. John's and Burin cod enter the trap fishery as 4-year-olds, are fully recruited at 5 years of age, have decreased in abundance at 6 and 7 years of age, and usually by 8 years of age are no longer important contributors to this fishery. Thus to maintain a trap fishery at a fairly high level a reasonably constant supply of new recruits to the fishery is necessary. A succession of poor year-classes or several poor year-classes occurring close together would undoubtedly cause a decrease in the codtrap fishery.

At St. John's and Burin the 1955 year-class showed considerable strength and contributed by number about 60% of the trap catches in 1960 and 30% in 1961.

In the line-trawl fishing the 6-year-old fish are usually of most importance with 5-year-old fish and older year-classes up to but rarely above 10 years of age contributing significantly.

At Isle aux Morts in 1961 the 1955 and 1954 year-classes dominated the catches in both March and April, but in June and July the 1954 and 1953 year-classes were dominant. Other year-classes fairly well represented were the 1956, 1953 and 1952 year-classes in March and April and the 1955, 1952 and 1951 year-classes in June and July. The younger age-groups seem to take part in the seasonal migration into the Gulf of St. Lawrence, whereas the older age-groups tend to remain in the Isle aux Morts area.

Catch-per-unit-of-effort statistics for codtraps in the Burin area show that the catch per haul in both weight and numbers may have been on the increase from 1953 to 1957. The catch per unit of effort decreased in 1958 owing to stormy weather, but increased markedly in 1959 owing to the entrance of the 1955 year-class. It remained about the same in 1960 but decreased drastically in 1961, probably because of unfavourable hydrographical factors. The line-trawl catch per 100 lines decreased by about 50% from 1953 to 1961. The variations in numbers per 100 lines were not as great as in the numbers per haul in codtraps. Year-classes entering the line-trawl fishery in 1955 and 1959 caused temporary interruptions in the downward trend, while a year-class entering in 1957 had no effect on this decline, possibly because of the lesser proportion of older fish caught in 1957 than in 1956. The catch per unit of effort continued to decline in 1960 and 1961 because no good year-classes entered the fishery since 1959.

Comparisons of the weight per unit of effort contributed to the catch at Burin by each year-class of cod since it entered the fishery showed that for 1959-61 the 1955 year-class has contributed by far the most in weight to the trap fishery, followed by the 1954, 1953, 1956 and 1957 year-classes in that order. Similarly, in the line-trawl fishery in the years 1959-61 the 1955 year-class has again contributed most, followed in order of quantity by the 1953, 1954, 1952, 1951, 1956 and 1957 year-classes.

Catch and effort data were collected for the Bonavista cod fishery during the 1961 season and sampling was carried out in July and September. At Bonavista the fishery was extremely poor and catches were below the level of the relatively poor fishery of 1960. Total cod landings amounted to about 6,800,000 pounds, of which 32% was from handlines (jiggers and baited hooks), 28% from codtraps, 15% from line trawls and 25% from longlines.

Calculations of catch per unit of effort at Bonavista have indicated for the handline fishery a small decline since 1957. In 1961 there was a further drop to a low of about 570 pounds per boat per day. The steady decline in the catch per haul for the trap fishery continued from 5,300 pounds per haul in 1954 to a low of 1,960 pounds in 1961. It is possible, however, that the low yield in the trap and handline fisheries was greatly influenced by low availability of cod in the inshore areas due to the unusual hydrographic and other conditions prior to and during the 1961 fishing season. In the offshore longline fishery also, the steady decline in the average catch of cod per line (50 hooks) continued in 1961 to give the lowest yield since the beginning of the fishery in 1952. The catch per line in the offshore deep-water areas was only 35 pounds compared with over 100 pounds from 1952 to 1954 and about 85 pounds in 1957.

Observations on the year-class structure of the inshore cod catches have indicated that the potential supply of cod for the inshore fishery is good for the next few years so that, if favourable hydrographic conditions occur, the downward trend in the commercial trap and handline fishery could be reversed. For the longline fishery, however, it is apparent that each time a sufficiently large concentration of cod occurs on the deep-water grounds, the large European otter trawlers are attracted to the area and are able to reduce such concentrations before the local longlining fleet can reap the benefit of them.

The annual survey to gather information on the inshore distribution and relative abundance of small cod of the 0+, 1+ and 2+ age-groups was carried out in September and October. A small Danish seine, with a small-meshed, lined codend was hauled by hand to various beaches surveyed, beginning in St. Mary's Bay on September 8 and ending in the northern arms of Notre Dame Bay on October 23. In 130 successful sets the 0+ age-group of cod occurred in small numbers, generally from 0 to 15% of the total cod taken in a particular area. The three age-groups of cod were generally caught in smaller numbers in 1961 than in 1960. This seems to indicate the possibility of the 1961 year-class being poor and supports the assumption made after the 1960 survey that the 1960 year-class is weak as well.

Water temperatures near the seining beaches in the St. Mary's Bay, Avalon-Southern Shore and Conception Bay areas were somewhat lower in 1961 than in 1960 and 1959 but from Bonavista Bay northward they were consistently higher in 1961 in areas surveyed in 1959 and 1960.

Two groups were evident in the length distribution of the 0+ age-group of cod in the Notre Dame Bay area, one with a modal group at 4 cm, the other at 10 cm. In Trinity Bay, Conception Bay, Avalon-Southern Shore and St. Mary's Bay the small-sized 0+ cod were indicated by modal groups at 4-5 cm. Observations of adult cod during July revealed that, long after the regular spawning season, many cod not yet spawned would be spawning later in 1961. It is possible, therefore, that the smaller fish of the 0+ age-group indicated by the 4-cm mode in the length distribution are progeny of the late-spawning cod while the fish indicated by the 10-cm mode are from the earlier-spawning cod. The scarcity of the larger sizes of the 0+ age-group in most of the survey areas could indicate poor survival from the earlier-spawning fish.

Studies of cod distribution and abundance, as well as of age and length distributions of the catch, have been made from data collected on groundfish survey cruises of the A. T. Cameron over the past two years. Survey operations were carried out over most of the continental shelf and offshore banks of ICNAF Subareas 2 and 3 by means of half-hour tows with a No. 41-5 otter trawl with a 1 1/8-inch mesh nylon liner in the codend, a 79-foot headrope and a 100-foot groundrope.

Age distributions of the cod obtained in the A. T. Cameron cruise to the Labrador Shelf in August 1960 showed that in the north (ICNAF Division 2H) 3-year-old fish (1957 year-class) made up almost 25% of the catch, while fish of ages 3-5 (1957, 1956 and 1955 year-classes) together accounted for more than 55% of the catch. Older fish were more prominent on Hamilton Inlet Bank (ICNAF Division 2J) where only 25% of the catch was of ages 3-5, while almost 50% was of ages 6-10. The 1955 (age 5) and 1953 (age 7) year-classes were most abundant in the southern part of the area. Growth is slow in the area as a whole and although fairly old fish occurred in most of the catches, few were greater than 80 cm in length.

A survey cruise was also made to the northeast Newfoundland Shelf in August 1960 and five groups of stations were fished. Depths fished throughout the cruise ranged from 110-406 fathoms. Cod catches in the area of the Funk Island Deep were invariably small, everywhere less than 500 pounds per half-hour tow. Only three catches in excess of 1,000 pounds were obtained in the survey, those being taken on the northern slope of the Grand Bank in depths of 152-205 fathoms and at temperatures of 2.4 to 3.1°C. The catches during this survey consisted largely of young and small fish, the 1957 year-class alone (age 3) accounting for almost 40% of the catch for the whole cruise. Another 20% was 4- and 5-year-old fish (1956 and 1955 year-classes).

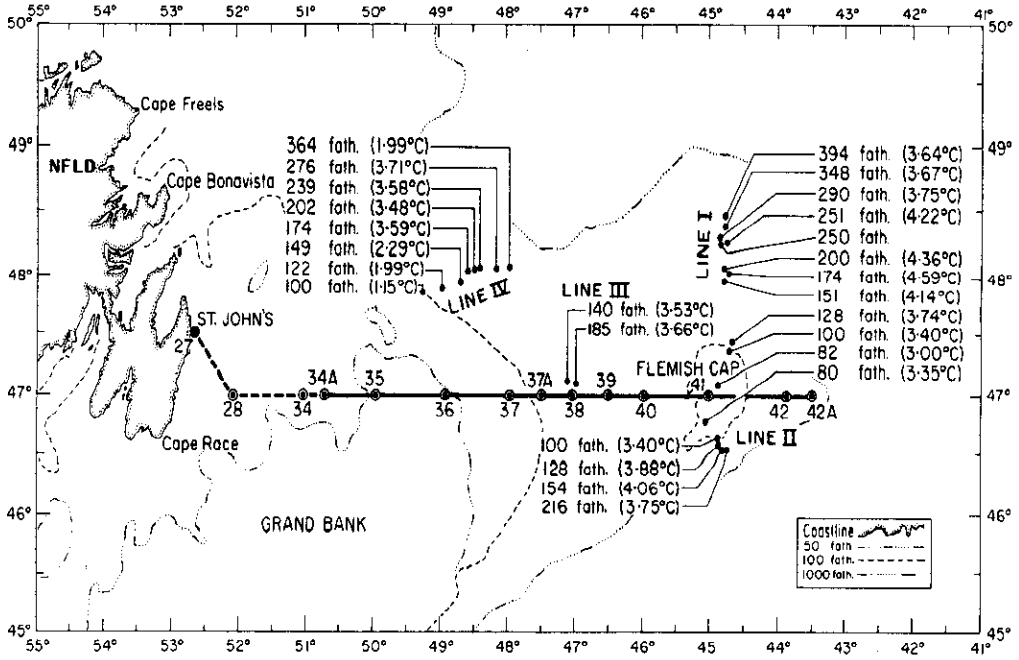


Fig. 1. Stations, fathom depths and bottom temperatures where half-hour otter-trawl drags were made by the A. T. Cameron, March 20-29,1961. (Note the line of Hydrographic Stations 27-42A and see Fig. 4A for temperature section taken during this cruise.)

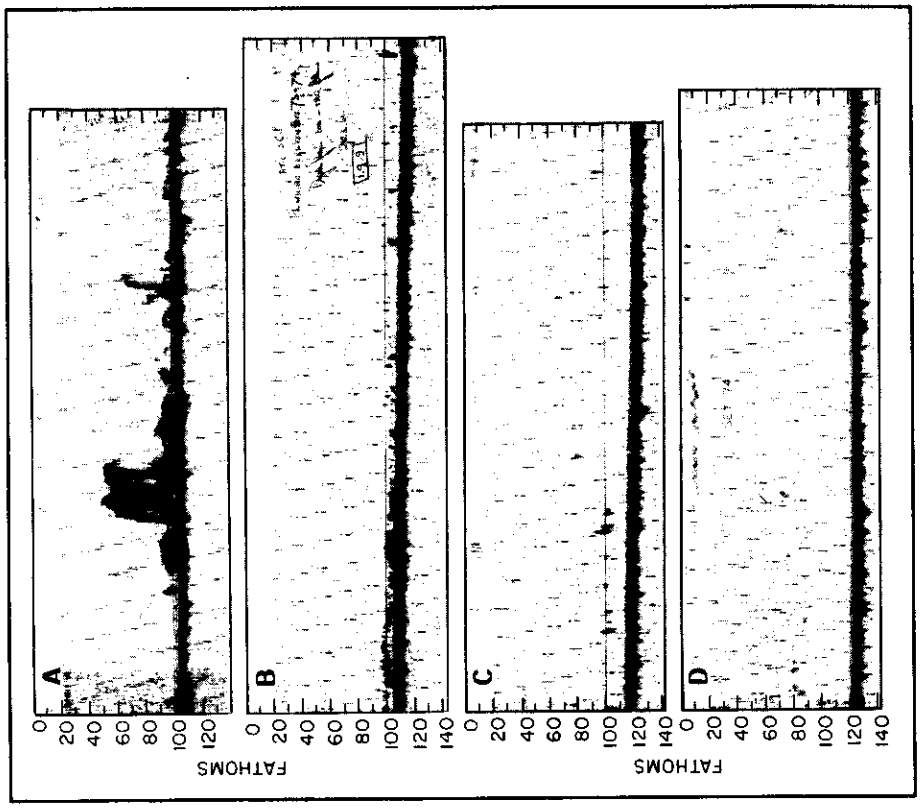


Fig. 2. Echo-sounder record of cod and possibly capelin, Line IV northern Grand Bank, March 28, 1961. A, half-hour drag at 100 fathoms (8,000 lb cod); D, half-hour drag at 122 fathoms (3,000 lb cod); B and C, ranging from end of A (100 fathoms) to beginning of D (122 fathoms).

The 1955 year-class was strongest among cod of commercial size on the southern Grand Bank and the remains of a strong 1952 class are visible. The 1956 and 1957 year-classes are both moderately strong but the strongest young year-class is that of 1958 which comprises more than 30% of the catch in most samples.

The warmer water conditions of the southern Grand Bank cause cod to grow faster than those of the north and there were greater numbers of large fish in the southern catches. On few parts of the bank, however, were big cod abundant and fish over 10 years old seldom made up more than 10% of the catch.

St. Pierre Bank was only surveyed once during the 1960-61 period, in June, 1960. The cod were found to be concentrated on the top of the bank, taking advantage of the warming of the surface water to move into the shallow feeding areas. Catches were everywhere rather small, however, and only one exceeded 1,000 pounds. At this time St. Pierre Bank had a remarkably young cod population, with very few fish older than 6 years or longer than 70 cm. The 1955, 1956 and 1958 year-classes comprised 75% of the catch and the bulk of the remainder was made up by the 1957 year-class.

In the cruise of the A. T. Cameron to Flemish Cap and northern Grand Bank, March 20-29, 1961 (Fig. 1) cod were scarce on Line I north of Flemish Cap -- largest catch 510 pounds in 175 fathoms (4.6°C). They were more plentiful south of Flemish Cap (Line II) with significant numbers at all depths from 100 to 216 fathoms. The greatest amount, 1,900 pounds, was taken at 216 (200-237) fathoms at a bottom temperature of 3.8°C, along with 1,800 pounds of redfish. Most of the mature spawning cod were to the south of Flemish Cap rather than to the north.

There was a moderately good catch of large cod (2,300 lb) at 140 fathoms (3.5°C) on the NE corner of the Grand Bank (Line III).

On the northern Grand Bank (Line IV) a large catch of cod (8,000 lb per half-hour tow) was made at 100 fathoms (1.2°C) and a smaller catch (3,000 lb) at 120 fathoms (2.0°C). At greater depths and increasing temperatures there was a quick decrease in catch to 660 pounds at 150 fathoms (2.3°C) and to 100 pounds at 240 fathoms (3.6°C). In this area the cod on the 100-fathom contour formed a large body, readily visible on the Simrad echo sounder (Fig. 2) but, in spite of the large catch, to a great degree off the bottom and temporarily unavailable to the bottom trawl. As the vessel moved toward deeper water of 120 fathoms the cod on the echo-sounder record gradually came off the bottom and in the 120-fathom set no accumulations were seen near bottom on the echo sounder in spite of the 3,000-pound catch in a half hour.

What is the cause of these accumulations of cod ? One possibility is temperature. The maximum cod concentration north of Flemish Cap at 175 fathoms (4.6°C) and south of Flemish Cap at 200 fathoms (3.8°C) cannot be ascribed to temperature preference, the bottom temperatures between 100 and 200 fathoms ranging only from 3.4 to 4.6°C on the northern line of stations and between 3.4 and 4.1°C on the southern line. These Flemish Cap cod were mainly recently spent and feeding heavily. On the northern Grand Bank cod were most abundant at the lowest temperature, 1.2°C (100 fathoms). Again it is doubtful that the temperatures in the water deeper than 100 fathoms are restrictive, the range from 100 to 200 fathoms being 1.2 to 3.6°C. The cod were mainly maturing and would spawn in a month or two. They were feeding well. Where an overlying cold layer of water below 0°C exists, as in this area, cod are often numerous just below it. The preference may be for low temperature, as shallow a depth as possible, a particular type of bottom, or food.

Another possibility is that where temperatures are not restrictive these feeding cod are concentrated by food. In the Newfoundland area many of the cod concentrations are in areas where capelin abound. At Flemish Cap capelin were not present, probably because the water is too warm for this cold-water fish. There were abundant young cod and redfish, however, the cod concentrations in the shallower water, 95-130 fathoms, feeding mainly on small cod and those in the deeper water, 150-240 fathoms, almost entirely on small redfish. The cod concentrations on the northern slope of the Grand Bank on Line IV were in the shallower 100-120-fathom depths and were feeding almost entirely on young capelin. It is probable that in both of these areas, while seasonal or other habits and factors were presumably operating, food was more important than temperature in producing the cod concentrations encountered.

On Flemish Cap almost all the cod were spent, having spawned in March and some probably as early as February, because many of the male testes were in recovery stages with pink edges. Most of the remaining females had some clear eggs and would spawn in April while a few would not spawn before May. On the northeast Grand Bank (Line III) and at the North Cape of the Grand Bank (Line IV), on the other hand, none of the cod had spawned and none of the females had clear eggs. All, except a small number which were still in the spent condition from the previous year's spawning, were in the early stages of egg development with egg diameters mainly about 0.3-0.4 mm and the first spawning could not be expected before May-June.

On Flemish Cap cod of ages 3-5 (1958, 1957 and 1956 year-classes) made up 75% of the catch. Age 6 cod (1955 year-class), abundant in other Newfoundland areas, were scarce on Flemish Cap. Old fish were also comparatively scarce.

On the northern slope of the Grand Bank the 1955 year-class with a modal length of 58 cm was the most abundant of the commercial-sized fish (40% of the catch). The 1957 year-class was also well represented and the 1958 year-class, below commercial size, very numerous.

Haddock, Melanogrammus aeglefinus (L). Otter-trawling surveys were carried out in March and in June over the southern half of the Grand Bank. During the March cruise it was found that most of the shallow area of the bank to a depth of 50 fathoms was covered with cold water, the bottom temperatures being close to 0°C, and haddock were scarce. Along the south-western slope of the Grand Bank bottom temperatures were higher and more favourable for haddock. The best catches were obtained in depths of 100-120 fathoms where the bottom temperatures were 2.5 to 3.5°C.

The regular spring survey was carried out in June about five to six weeks later than usual and no large concentrations of haddock were found. The best catches (1,000-1,300 lb per half-hour tow) occurred in 40-50 fathoms. It appeared that the winter concentrations in the deep water along the southwest slope had dispersed and the haddock were well into their early summer migration northeast and eastward across the southern part of the bank.

During the summers of 1959 and 1960 large concentrations of haddock were located in shallow water of 25 fathoms on the Southeast Shoal of the Grand Bank, the catches averaging more than 10,000 pounds per hour's dragging. During the summer of 1961 two visits were made to this area, but haddock were not found in sufficient abundance to carry out the planned selectivity experiments.

From the catch-length frequencies and age determination of otolith samples obtained during the Grand Bank survey in June 1961, the most abundant group present was the 1955 year-class (with a mode at 36-37 cm), which accounted for nearly 65% by number of the research-vessel catches. The once very abundant 1949 year-class together with the 1952 and 1953 year-classes have become so reduced in numbers that they comprised less than 5% of the catches. The 1956 year-class, probably about one quarter as abundant as the 1955 year-class, survived only moderately well and all year-classes since then, with the exception of a small 1958 year-class, have been almost complete failures.

The length and age composition of the commercial haddock landed by Newfoundland trawlers confirms the above picture. As the 1955 and 1956 year-classes become reduced, the future of the haddock fishery is not bright. The small 1958 year-class can not be expected to provide a very significant addition to the commercial fishery. Even if good survival of young occurs in 1962, it will be four to five years before the haddock of this brood grow to marketable size.

Redfish, Sebastes marinus mentella Travin and Sebastes marinus marinus (L). The comprehensive survey of the redfish of the Newfoundland area by the A. T. Cameron has been continued in 1961 with cruises to Flemish Cap, the North Cape of the Grand Bank and the eastern slope of the Grand Bank.

Three lines of stations on the eastern slope of the Grand Bank were examined from September 13-21, 1961, and on all lines maximum redfish catches occurred in the general depth range of 125-200 fathoms. The largest catches, 8,400 and 7,200 pounds per half-hour drag, were taken at 150 and 175 fathoms, respectively, on the southernmost line (Lat. 43°30'N). These consisted mainly of small fish, with a preponderance of males. The centre of abundance of the large males on the northern line (Lat. 47° N) was at 175 fathoms, while for the females it lay 25 fathoms deeper -- at 200 fathoms. Only seven marinus-type redfish were taken during the trip. These occurred at 125 fathoms on the two northerly lines.

The A. T. Cameron carried out a survey cruise to Flemish Cap and northern Grand Bank in March 20-29, 1961 (Fig. 1). All catches were in half-hour drags in daylight sets. North of Flemish Cap on Line I marinus-type redfish were scarce, the best catches were 140 pounds in 175 fathoms, 70 in 200 and only 5 in 150 fathoms. In the summer and autumn in this area the best catches of marinus are in 125-150 fathoms. (In a previous cruise of the A. T. Cameron to this area north of Flemish Cap in November 1958 two catches of about 3,000 pounds marinus and 1,500 pounds mentella, and 1,800 pounds marinus and 1,800 pounds mentella were obtained in two half-hour tows at 150 fathoms and only about 10 pounds of marinus to 2,300 and 2,600 pounds mentella in two tows at 200 fathoms.) Mentella-type redfish were most plentiful (3,400 lb) at 290 fathoms and the second best catch (2,300 lb) at 350 fathoms. The best of two catches at 250 fathoms was 1,800, and at 200 fathoms and shallower catches were very low (290-12 lb). There was an unusual abundance of large males at 350 fathoms. Usually females are more plentiful in these very deep sets.

These depths for good redfish catches are at least 50 fathoms deeper than we have found in this same area in previous years during summer-autumn. While this result is based on very few hauls, it corresponds approximately with V.I. Travin's observations (ICNAF Ann. Proc. 9: 81-85, 1959) that dense aggregations of redfish occur in Divisions 3M (Flemish Cap), 3K and 3L at depths of 300-450 metres (165-245 fathoms) and in the winter months on Flemish Cap to 600-650 metres (330-355 fathoms).

On the southern slope of Flemish Cap on Line II there was a fairly good catch of mentella (1,800 lb) equally mixed with cod at 200-240 fathoms, but stormy weather prevented deeper fishing.

On Flemish Cap bottom temperatures and mid-water temperatures in the redfish range were between 3.7 and 4.6°C, little different from and not lower than those found during summer. The concentration of the Flemish Cap redfish at greater depths in winter is therefore due to some other factor than temperature.

On the northern slope of the Grand Bank on Line IV the best catch of mentella was 5,100 pounds at 240 fathoms with catches half this size at 200 and at 175 fathoms. All these good catches were made at bottom temperatures of 3.5 to 3.6°C. On all lines mentella sizes increased with depth.

In the northern Flemish Cap sets the mentella females with the best developed larvae in their ovaries were found in the deep water at 250 and 290 fathoms (March 21-22). Here usually a high percentage of the larvae were hatched, a few females were already spent and 5-10% of the females had larvae all hatched, fully developed and ready for extrusion.

At 200, 175 and 150 fathoms (March 22) there were very few mature mentella females in the catch and both mentella and marinus (encountered in moderate numbers at 175 fathoms) females were generally at least several weeks behind the mentella of 250-290 fathoms in development. Instead of having a large number of fish with 50-100% of the larvae in the ovary hatched as at 250-290 fathoms, at the shallow depths most of the females had larvae 2-10% hatched and this, in most cases, was presumably artificial hatching due to pressure changes and other physical shocks.

On the northern slope of the Grand Bank (Line IV) there was the same spawning picture for mentella as at Flemish Cap. The mentella females with the most highly developed larvae lay deep. At 275 fathoms (March 29) about 12% of 49 mature females examined had already spawned and about 45% had larvae 100% hatched and ready for extrusion. At shallower depths the percentages spent in the present year and 100% hatched and ready for extrusion, respectively, at 240, 200 and 175 fathoms (March 29) were approximately 10, 10; 3, 8; 0, 4% (numbers of mature females examined respectively 29, 38, 23).

Bottom temperatures on the northern slope of the Flemish Cap (Line I) at 290, 250, 200, 175 and 150 fathoms were respectively 3.75, 4.22, 4.36, 4.59, and 4.14°C and near the North Cape of the Grand Bank at 275, 240, 200 and 175 fathoms 3.71, 3.58, 3.48 and 3.59 °C, respectively. On the northern Grand Bank (Line IV) although bottom temperatures at 275 fathoms were only slightly higher than at the shallower depths females migrating upward at night, if they went very far upward, would encounter considerably and progressively lower temperatures at the shallower depths than would those at 275 fathoms. This, however, was not true of the Flemish Cap. Here the redfish rising at night from 300 and 250 fathoms would have encountered slightly higher temperatures whereas those rising from the higher temperatures at 200 and 175 fathoms probably would have encountered still

It seems likely, therefore, that while the local temperatures at a depth range corresponding to the daily vertical migration must determine the speed of larval development in the ovary, there is apparently a tendency for the mature mentella females to move downward in winter and early spring to depths of 250-300 fathoms and that the tendency to move downward is triggered by ovarian development.

At Flemish Cap there were large numbers of small redfish 7 1/2 - 15 cm long. These were scarce in the catches but very abundant in cod stomachs which often contained 4 or 5 little redfish of 7 1/2 - 12 cm long in a single stomach. (Young cod of all sizes were also numerous, including the smaller sizes of about 10-25 cm which, although appearing in the catches, seemed to be relatively more numerous in cod stomachs.) A 1 1/8-inch mesh nylon codend liner was used and a large proportion of even the 8-10 cm redfish, very abundant in cod stomachs, should have been retained by it. Very likely, therefore, most of these young fish were higher off the bottom than the otter-trawl mouth and were being obtained by the cod by pelagic feeding at higher levels. Evidently the Flemish Cap circulatory system is excellently suited to retention of cod and redfish larvae and young fish.

On the northern slope of the Grand Bank (Line IV) there were some young cod, but young redfish below 24 cm were almost entirely absent.

Redfish food and feeding. Fishing experiments in Hermitage Bay have enabled extended collections of redfish stomach contents to be made at a single locality. The redfish is shown to be almost exclusively a pelagic feeder and in Hermitage Bay the feeding regime is based largely upon two species of euphausiid -- Meganyctiphanes norvegica and Thysanoessa raschii.

In relation to their weight small redfish feed more intensively than the large and in addition to large redfish show a preference for larger food organisms, eating a high proportion of sub-adult capelin when these are available. Examination of the data relating to the problem of stomach eversion indicates that empty stomachs are more likely to evert than those containing food.

Seasonal variations in redfish feeding in Hermitage Bay are thought to be related to seasonal movements and the abundance of euphausiids. Superimposed upon this pattern are variations attributable to the physiology of the sexual cycle.

American plaice, Hippoglossoides platessoides (Fabr.). A survey of the commercial American plaice areas of the Grand Bank was carried out during 1961. Approximately 2,000 American plaice were tagged using Petersen disk tags and by February 1962 about 100 of these had been returned. The incidence of jellied fillets of plaice was found to be very low. Otolith studies indicate that plaice are

on the average as much as 10 cm smaller at comparable ages on the northern half of the Grand Bank than they are on the eastern and southeastern sections.

Commercial trawler catch and effort statistics indicate a sharp increase in effort in all major plaice fishing areas for the northern, eastern and southeastern parts of the Grand Bank. This has resulted in a gradual decline in the catch per unit of effort for the latter areas, whereas for the northern half of the Grand Bank the catch per unit of effort has remained steady in spite of a sharp increase in the effort.

Hydrography. The hydrographic sections from southern Labrador to the southern Grand Bank were taken by the Investigator II and the A. T. Cameron between July 22 and August 21.

In the Seal Islands, Labrador section (Fig. 3A) in 1961 surface temperatures were generally several degrees lower than in 1960 but in spite of the unusually cold water of 1960-61 there were no temperatures lower than -1.03°C in contrast to the usual existence of temperatures as low as -1.3 to -1.5°C. Bottom temperatures also of the inshore deep water and of the southern part of Hamilton Inlet Bank intersected by this section were higher than usual. In the deep water on the offshore seaward slope of Hamilton Inlet Bank where temperatures of over 4.0°C were present in 1960 and in 1957, temperatures had reverted to the normal below 4°C.

In the Cape Bonavista section (Fig. 3B) the temperature picture at all levels in 1961 was not much different from that in 1960. There were, however, no temperatures of -1.5°C and lower in 1961, whereas a small volume of this very cold water was present shoreward in 1960.

In the St. John's-Flemish Cap section (Fig. 4B) there was more water below -1.0°C and colder bottom water in the deep inshore layer and on the top of the Grand Bank in 1961 than in 1960, but the actual lowest temperatures to be found (-1.3°C inshore, -1.0°C offshore) were slightly higher in 1961 than the corresponding 1960 temperatures (-1.4 and -1.3°C). Over the western part of the Grand Bank the superficial layer of warmer water was thinner in 1961, but in the remainder of the section temperatures were little different from those of 1960.

In the section from St. John's across the Grand Bank and the northern part of the Southeast Shoal of the Grand Bank (Fig. 5A) temperatures were not widely different from those in 1960, but the water with temperatures below 0°C and below -1.0°C lay considerably deeper shoreward in 1961, and the volume of cold water below 0°C and below 2°C in the eastern branch of the Labrador Current was considerably less in 1961. The lowest temperatures were slightly lower in 1960 (-1.5°C inshore and -1.2°C offshore) compared with -1.4 and -1.1°C, respectively, in 1961.

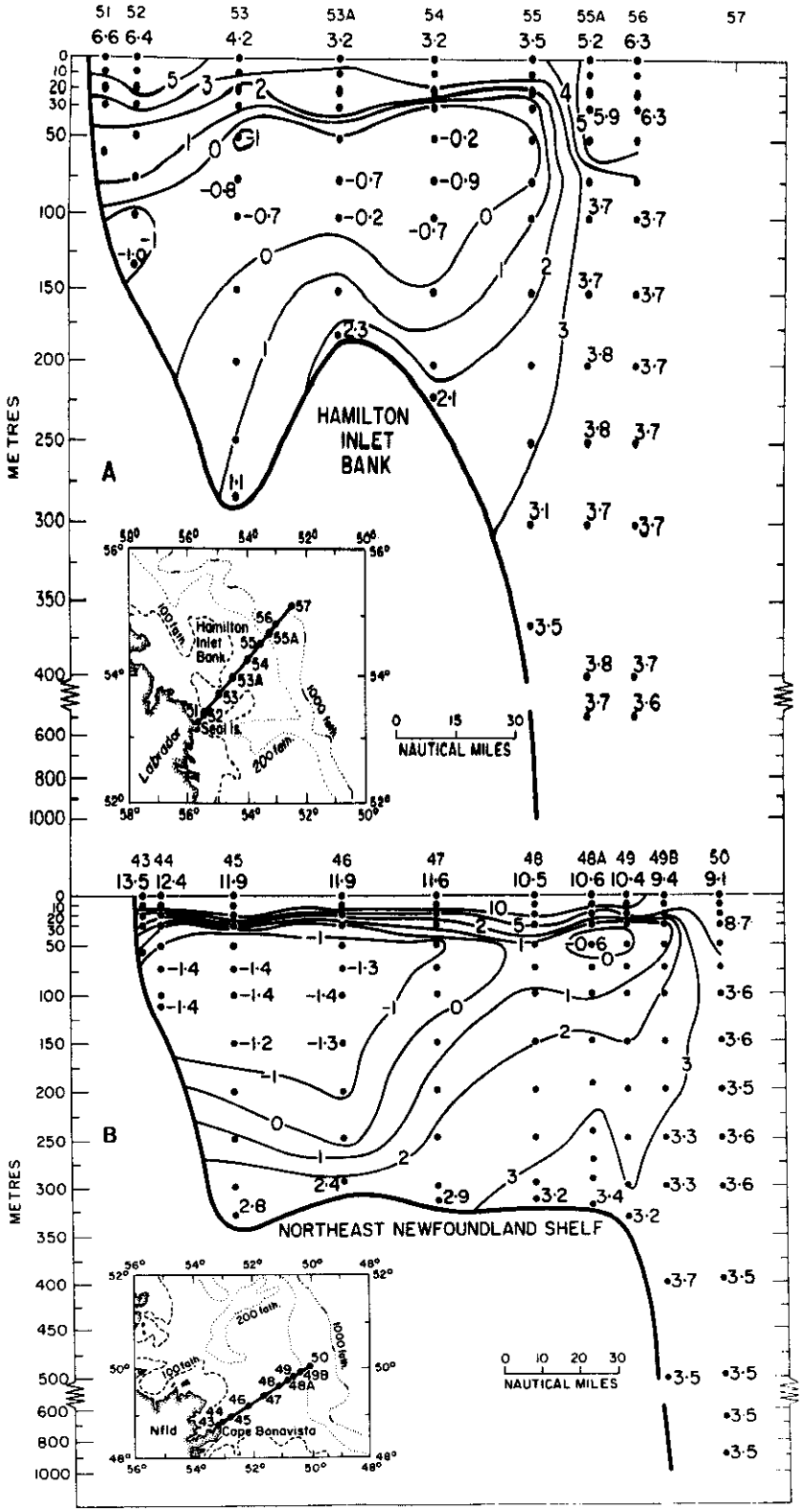


Fig. 3. Temperature sections, °C: A, off Seal Islands across southern tip of Hamilton Inlet Bank, Labrador, July 31 August 1, 1961; B, off Bonavista, July 27-28, 1961.

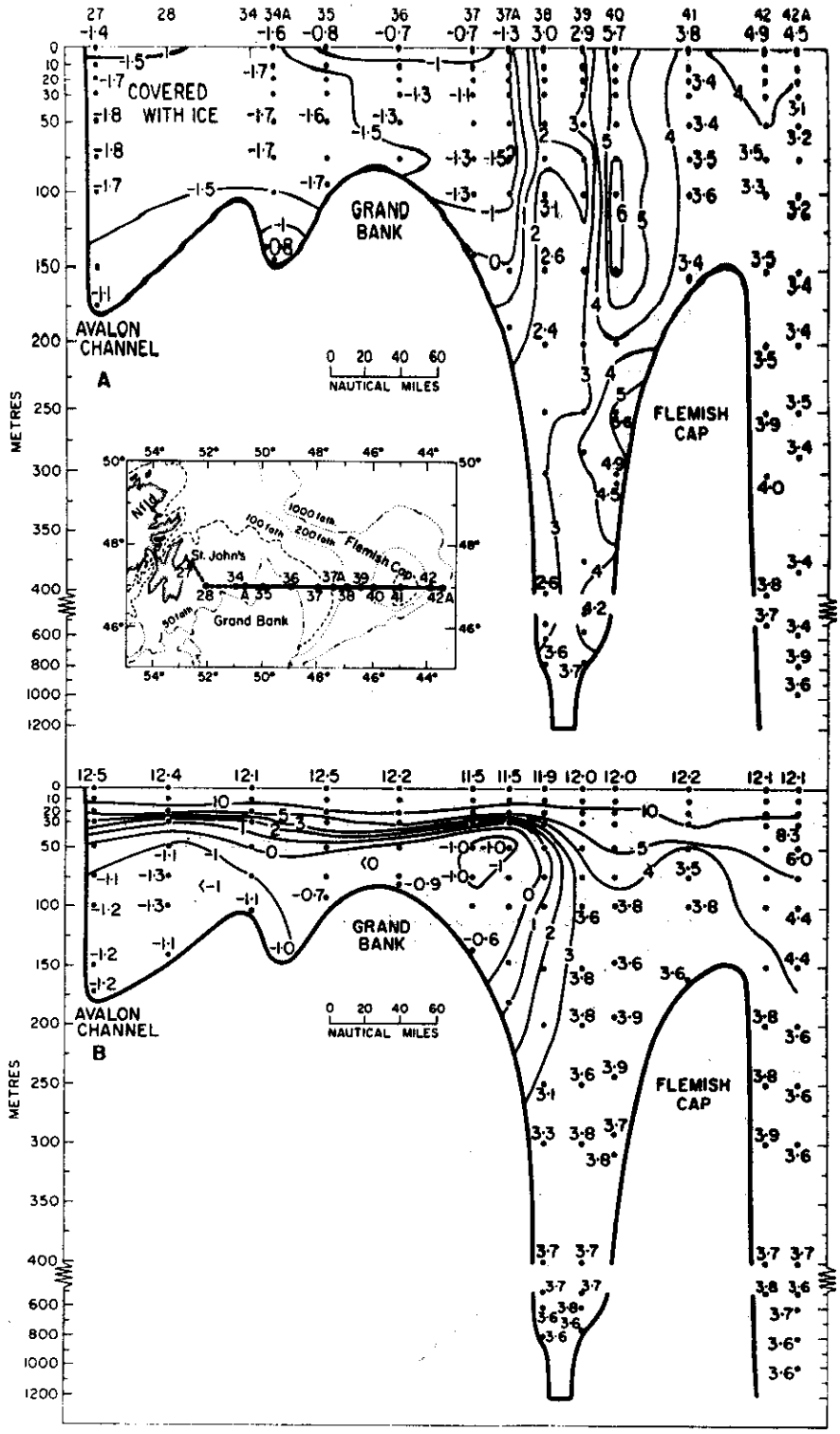


Fig. 4. Temperature sections, °C, St. John's-Grand Bank-Flemish Cap: A, March 25-27, 1961; B, July 22-25, 1961.

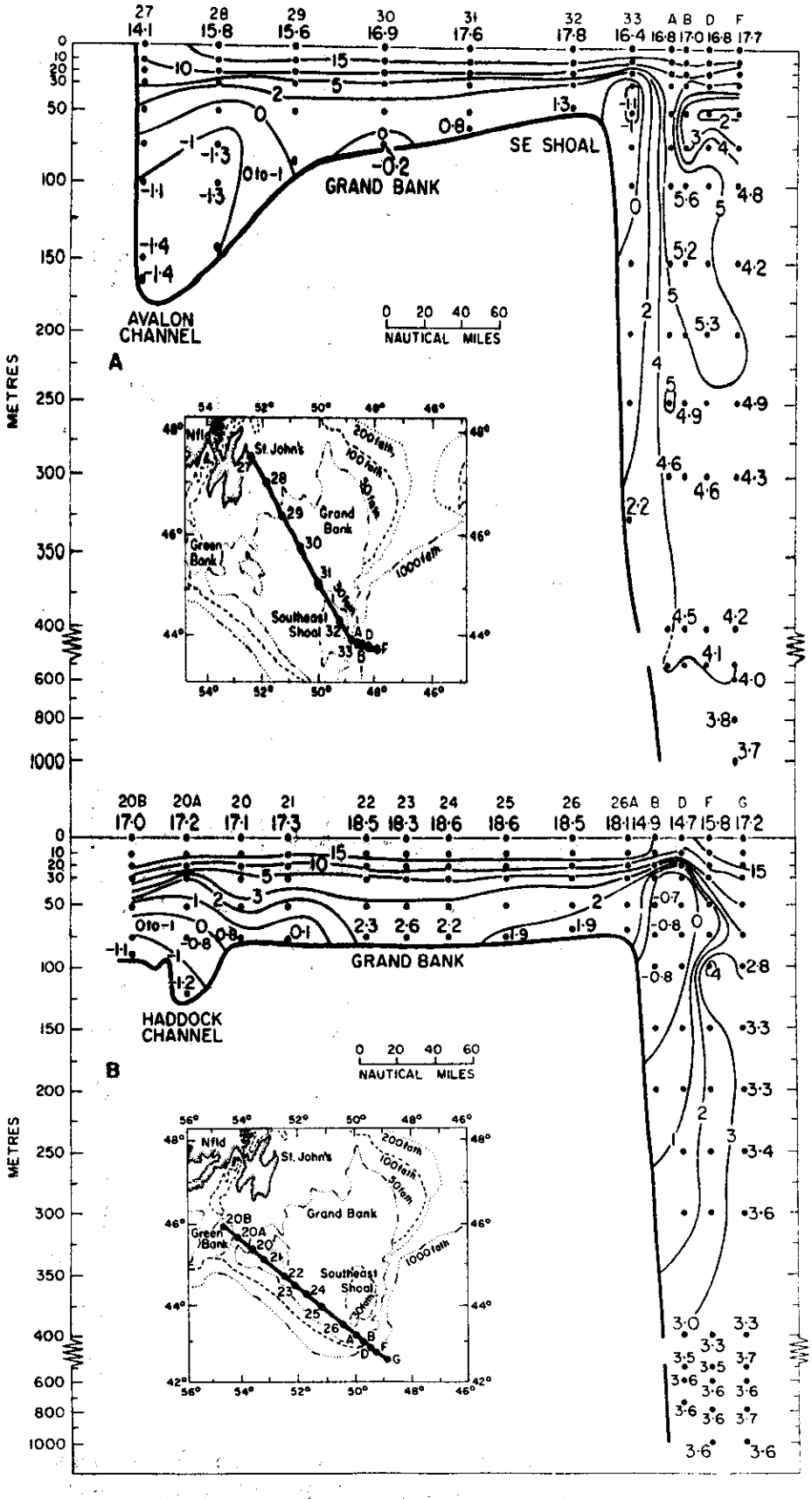


Fig. 5. Temperature sections, °C; A, St. John's-SE slope of the Grand Bank, August 16-18,1961; B, Green-Bank-SE Grand Bank August 18-21,1961.

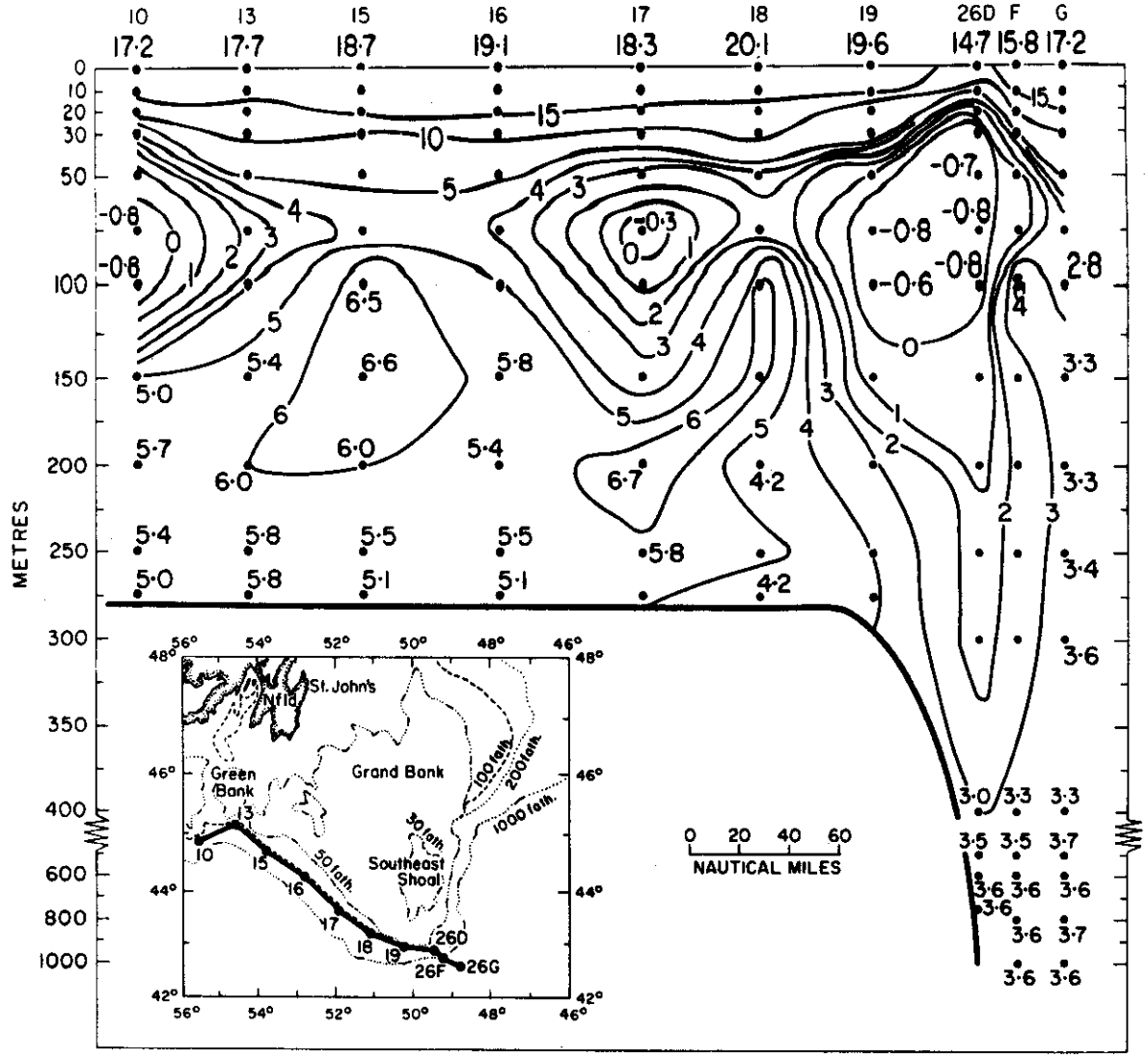


Fig. 6. Temperature section, °C, along SW edge of the Grand Bank, August 18-21, 1961.

In the section at about 40 fathoms (75 m) extending close to the southwest slope of the Grand Bank (Fig. 5B) in 1961 there was a little more water below -1.0°C in the Haddock Channel than in 1960 but in the eastern branch of the Labrador Current the coldest water was -0.8 C whereas there was a small volume at -1.1°C present in 1960. Otherwise the water temperatures in the two years were fairly similar.

In the section at 275 metres (150 fathoms) fringing the south-western slope of the Grand Bank (Fig. 6) in 1961 there was much less water below 0°C and below 2°C than in 1960 in the eastern branch of the Labrador Current and above-bottom temperatures toward the tail of the bank were several degrees higher than in 1960.

In all the sections in the intermediate layer (on bottom in the shallower areas) little trace could be found of unusually cold water or an unusual volume of water below 0°C and below -1°C resulting from the much-below-average air temperatures with the unusual amount of ice formation observed in the winter of 1961.

In 1961 the St. John's-Flemish Cap section was done on March 25-27 (Fig. 4A) as well as at the usual time in late July. The winter of 1961 in the St. John's area was very cold with a most unusual amount and thickness of ice. The ice extended seaward on this section to Station 34A, over 80 nautical miles from St. John's. Deep-water temperatures east of and at the top of Flemish Cap in March were close to those in July (Fig. 4B) but on the western slope of Flemish Cap temperatures between 200 and 300 metres were approximately a degree centigrade higher and at 400-500 metres a half degree centigrade higher in March than in July. In the deep water of the eastern slope of the Grand Bank bottom temperatures were only slightly lower in March than in July. On the surface of the Grand Bank, however, in 100 metres and less very low temperatures of -1.6 to -1.7°C were found in March compared with -0.7 to -0.9°C in August. Most of the mass of water from the top of the Grand Bank to shore had temperatures of -1.6 to -1.8°C in March compared with lowest temperatures of -1.1 to -1.3°C for a much smaller mass of water below -1°C situated shoreward in July. Surface temperatures were of course much lower, ranging from -1.4 to -1.6°C shoreward in March to 3.8 to 5.7°C over Flemish Cap whereas in July all surface temperatures were between 11.5 and 12.5°C.

The Atlantic Oceanographic Group conducted an oceanographic cruise in Subareas 2 and 3 in co-operation with Lamont Geological Observatory, Columbia University, during August and September. While emphasis was given to geophysics and marine geology, physical, chemical and biological observations were carried out throughout the cruise.

The Division of Oceanographic Research, Department of Mines and Technical Surveys, occupied a series of oceanographic stations in the Labrador Sea and Baffin Bay during the late summer of 1961 in C.M.S. Labrador. The data, primarily physical, will be published in a data record.

B. Subareas 4 and 5, Biology
by W. R. Martin

The Canadian Research Report for Subareas 4 and 5 differs from that of earlier years in that oceanographic studies and investigations by the Quebec Department of Fisheries are reported separately as Parts C and D. This section, Part B, describes investigations of cod, haddock, American plaice, pollock and scallops by the Biological Station of the Fisheries Research Board of Canada, St. Andrews, N. B.

Cod, Gadus morhua L. The dominant species of the southwestern Gulf of St. Lawrence (4T) is cod. Changes in the methods and intensity of fishing have had major effects on stock and landings. The continuing investigation of this cod resource provides the Commission with forecasts of the fishery and effects of restrictions on fishing.

Definition of cod populations is of basic importance to assessment studies. Cod tagged off eastern Nova Scotia in February 1960 at 80 fathoms in Sydney Bight (937 fish) were returned in significant numbers (147 in 1960 and 1961). During winter months most returns were taken by European trawlers fishing along the western slope of the Laurentian Channel from Scatari Bank to the Magdalen Islands. More returns were taken during summer months by Canadian vessels fishing in the southwestern Gulf of St. Lawrence, particularly in the Chaleur Bay area. Most of these Canadian returns came from otter trawls, but large numbers were also taken by other gears, particularly hook and line. Only two tags were returned from outside the 4T-4Vn area, one across the Laurentian Channel (3Pn) and one from Banquereau (4Vs).

Returns (140) from the Western Bank (4W) cod tagging (506 fish) of March 1960 were mainly taken in the tagging area. None of the returns came from the 4T-4Vn area.

About 1,500 cod were tagged in the vicinity of Seven Islands (4S) in October 1961. It is too early to assess the returns. However, it is apparent from a comparison of the biological characteristics of these fish with those of 4T that the cod population sampled in the Seven Islands area does not mix to any great extent with 4T cod. Age composition, growth, age at maturity, feeding and parasitization differed in the two areas.

Results confirm earlier evidence that the cod of the 4T and 4Vn area are distinct from those of 4R, 4S, 4Vs and 4W. This cod stock is fished by Canadians in the Magdalen Shallows-Chaleur Bay area of 4T from spring to autumn. During winter months the commercial sizes are found in deeper water along the Laurentian Channel off Cape Breton (4T east and 4Vn) where they are

fished by European trawlers. Winter ice conditions limit fishing. The unusually large ice coverage in 1961 reduced the amount of winter fishing on this cod stock, and only three tags were returned by European trawlers.

Prior to 1947 about 10 million codfish were landed annually from Division 4T, almost entirely by Canadian line fishermen. Since then, trawling, mainly with small otter trawlers, has become increasingly important to the Canadian fishery. European trawling, mainly with large otter trawlers, has also increased. About half the total landings from this stock are now taken by European fleets during winter months when cod are concentrated near the 100-fathom depth contour off eastern Nova Scotia. In 1960 total numbers landed by all countries were about 35 million cod.

Studies of catch curves for the years 1956 to 1958 and returns from cod tagged in 1955 and 1956 show high fishing ($F = 0.4$) and total ($Z = 0.5$) mortalities for the late fifties. Catch curves plotted from data collected in research-vessel hauls from 1959 to 1961 suggest still higher mortalities ($Z \doteq 0.7$). With such intensive fishing, 5-year-old cod made up 40% of the cod landed by draggers in Canada in 1961, and cod over 7 years were barely 10% of the landings. The average weight of the cod landed was only 2.7 pounds, gutted, head on. Survey catches show that cod will be even smaller in 1962. The bulk of the landings will be made up of 5-year-old fish of the 1957 year-class with a modal length of about 46 cm. Average length of landed dragger fish will be about 51 cm (2.5 lb. gutted). Catch per hour dragged is expected to be similar to that of 1961, about 500 pounds for late-summer fishing by 50-ton draggers. Total landings will depend on availability of fish as determined by hydrographic conditions, effect of ice cover on winter fishing by Europeans, and the amount of Canadian fishing effort on this population.

The conversion to otter trawling has greatly reduced the size and age at which cod are first captured. Since the traditional fisheries have used large cod for salting, the conversion to small-mesh otter trawls resulted in heavy discards of small unmarketable cod at sea. In order to reduce this waste of fish, the Commission recommended use of 4 1/2-inch manila meshes, or the equivalent in other types of twine, for cod and haddock dragging in Subarea 4. This mesh size was adopted by Canadian draggers in 1957. The introduction of technological changes, particularly production of fresh fillets and frozen-fish blocks, provided markets for smaller cod. A six-year study (1956 to 1961) of the quantities and sizes of 4T cod discarded at sea by Canadian draggers has shown that these mesh and technological changes have reduced the percentage discarded from 25 to 6 by numbers and from 9 to 2 by weight. It is estimated that total numbers of cod discarded in a dead or dying condition from south-western Gulf of St. Lawrence cod catches by the international fleet decreased from about 7 million fish in 1956 to about 1 million fish in 1961. Adoption

of large-mesh codends reduced the numbers of cod discarded by about 3 1/2 million fish. A further reduction in discards of about 2 1/2 million fish resulted from the change to smaller sizes culled for landing.

Investigations of the effects of changes in the environment and fishing on recruitment, growth and mortalities of 4T cod are continuing in order to provide background for making best use of the resource. Inter-species relationships are taken into account.

Tentative conclusions are that annual landings from the 4T cod population doubled in response to intensive trawling. Landings are now declining from the 1956-1959 peak to a new level.

Haddock, Melanogrammus aeglefinus (L). Good catches of haddock were made by the commercial fleet in the Western-Emerald area (4W) of Nova Scotia banks during the winter and early spring of 1961. A survey cruise by the A. T. Cameron in late April and early May indicated that haddock had been concentrated in water of 3 to 5°C as in 1959 and 1960. In contrast to the earlier years, water of this temperature appeared to cover a much smaller area in 1961. Concentration of haddock in this smaller area of suitable bottom temperatures provided good fishing at depths of 45 to 60 fathoms.

The size and age compositions of research-vessel surveys during the years 1958 to 1961 have been matched against those of commercial landings, as a basis for predicting trends in the Nova Scotia bank haddock fishery.

In 1958 the 1952 year-class was dominant in the fishery, and survey catches showed that strong 1956 and 1957 year-classes could be expected to enter the fishery.

By 1959, the 1956 and 1957 year-classes had grown to modal lengths of 34 and 25 cm, respectively. The two year-classes appeared to be of about equal strength. Commercial landings relied mainly on older haddock, particularly those of the 1952 year-class.

In 1960 the 1956 and 1957 year-classes were again dominant in survey catches. The 1958 year-class was poorly represented and the 1959 year-class was just entering the small-mesh research-vessel catches. Older haddock, particularly the 1955 year-class, provided the basis for the commercial fishery.

By 1961, the 1956 and 1957 year-classes overlapped in size, with a modal length of about 46 to 40 cm. The two year-classes were again of about equal strength, but only the older 1956 year-class contributed significantly to commercial landings. The 1955 and 1954 year-classes were important to the

fishery. In research-vessel catches the 1958 year-class was poorly represented, and the 1959 year-class was less abundant than the 1957 year-class at the same age.

The haddock year-classes of 1956 and 1957 should provide good landings in 1962. Landings in 1963 and 1964 will probably decrease because of the poor 1958 year-class.

In addition to fluctuations in landings resulting from variations in year-class strength, hydrographic conditions produce significant changes in availability as observed in 1961. Seasonal fluctuations of this kind are difficult to predict.

American plaice, Hippoglossoides platessoides (Fabr.). The most important species of flounder in commercial landings from Subarea 4 is the American plaice. This species is second to cod in dragger landings from the southwestern Gulf of St. Lawrence (4T). In 1961 biological studies of plaice were continued in this area.

Winter surveys from the A. T. Cameron in January 1960 and 1961 provided information on winter distribution of plaice. Small catches of immature plaice (less than 40 cm) were taken at all shoal-water stations (28 to 55 fathoms) in both years. At intermediate depths (65 to 100 fathoms) similar catches of small plaice were taken in 1960 at stations off Gaspe and northern New Brunswick. Fishing at these depths was done farther south off the Magdalen Islands in 1961. Plaice of all sizes were caught, with greatest numbers at 100 fathoms. The largest winter catches of all sizes of plaice were taken at depths of 125 to 200 fathoms in 1960.

The winter depth distribution of plaice along the northern sections in 1960 was compared with the depth distribution in June, August and October 1959 as observed from the Harengus. Good catches of all sizes of plaice were taken from shoal water in June and August. By October very few fish were taken there.

It is concluded that plaice have a shoal-water distribution in the Magdalen Shallows/Chaleur Bay area of 4T in spring and summer. In autumn they move to deep water (4°C) along the western slope of the Laurentian Channel where they concentrate in winter. Small plaice (under 40 cm) move with the large fish, but many remain in the below 0°C shoal water throughout the winter.

There is no evidence that plaice migrate south to the Cape Breton area, as described for cod.

Pollock, Pollachius virens (L). Otter-trawler landings of pollock have become increasingly important to the Canadian mainland groundfish fishery. A study of the biology of pollock at the mouth of the Bay of Fundy was started in 1960 and continued in 1961.

Returns from 991 medium and large pollock (60-85 cm) tagged off Grand Manan and Campobello Islands near the boundary of Divisions 4X and 5Y in the summer of 1960 were 126 or 13% by December 1961. The returns show a southern migration in autumn to the winter spawning area of the southern Gulf of Maine (5Z) (Fig. 1). In the summer of 1961 a few returns were taken in the "Western Hole" fishery between Browns and LaHave Banks (4X), but most returns came from the tagging area. The returns explain the absence of pollock from the tagging area in winter months by demonstrating a southern migration in autumn months and a return northern migration in spring months.

The summer distribution of pollock at the mouth of the Bay of Fundy was surveyed at sea on draggers and by sampling commercial landings. A similar distribution was observed in the two years. Large fish (65 to 85 cm) were caught in the Wolves Bank-River area on the north side of the Bay of Fundy. Medium fish (60-75 cm) were caught south of Grand Manan Island, on Yankee Bank on the south side of the Bay of Fundy, and in the "Western Hole" area south of western Nova Scotia. Small fish (40-65 cm) were caught on grounds to the west of Nova Scotia. Since otter-trawl and handline catches from the same ground had similar size distributions, it is concluded that gear selection has little influence on the observed schooling pattern of pollock distribution.

Most of the pollock caught by otter trawls were above the sizes released by 4 1/2-inch manila meshes. Catches of small fish were too low for a study of selectivity and meshing of pollock in 4 1/2-inch mesh nets.

Sea scallop, Placopecten magellanicus Gmelin. Canadian sea scallop landings by the offshore fleet increased again in 1961 to a record 4.58 thousand metric tons of shucked meats (38 thousand tons round weight). All landings by this fleet came from Georges Bank (5Z). These landings were heavier mainly because more Canadian boats were fishing (28 cfd. 20 in 1960) but also because the boats fished harder and carried more crew for shucking meats. The small-boat inshore fishery in Subarea 4 landed 0.3 thousand tons of shucked meats.

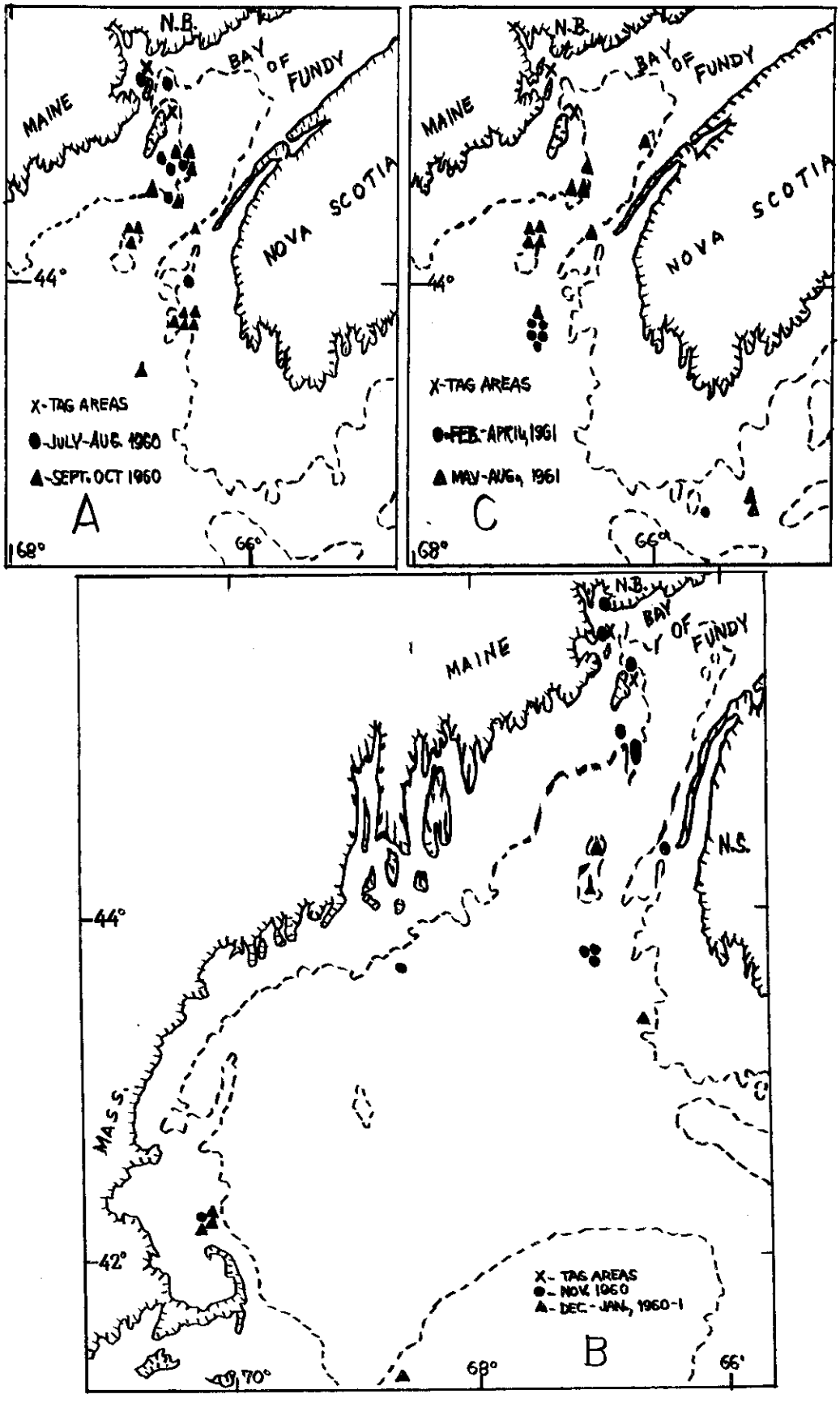


Fig. 1. Reported locations of recoveries from pollock tagged in summer

Two trips were made on offshore scallop draggers to sample catches and study commercial practices. Unlike 1960, most boats in 1961 reported dragging almost continuously to maintain high landings. Deck loading, which was the most prominent feature of the fishery in 1960, was less common in 1961. This resulted mainly because the extremely large year-class which provided the high catches of 1960 had been largely fished out in that year and contributed much less to 1961 catches. The 50% cull point remained the same as in former years, at a shell height of 95-100 mm. As was the case in 1959, discards comprised over 50% of 1961 catches for some areas of the bank. Five boats used drags with 4-inch rings and the remainder of the fleet used 3-inch rings. Evidence of mass mortalities was observed again on certain parts of the bank, although it was not as pronounced as in 1960.

The commercial scallop dragger Cape Eagle was chartered for a research cruise to Georges Bank as part of a joint Canadian-United States investigation of the advisability of introducing a minimum ring size regulation to the Georges Bank scallop fishery. An intensive study was made on the variability of scallop population density within unit areas (10 minutes of latitude and 10 minutes of longitude). A comparison was made of catches by drags with 3-inch and 4-inch rings and by drags with single and multiple linkage. Results of this joint study were reported at the 1962 ICNAF meeting and publication of data has been arranged.

A laboratory program, investigating aspects of the biology of the sea scallop, was continued in 1961. Major emphasis was devoted to a study of the sea scallop larval stages which have not previously been described. Scallops were spawned in the laboratory and the larvae reared by feeding them on cultured phytoplankton. Larvae were raised for 42 days but they did not settle in this time. A record of the stages up to this time was made. It is planned to continue this work in 1962 in an effort to explain the cause of variations in year-class strength.

C. Subareas 4 and 5. Oceanography
by L. M. Lauzier

Co-ordination of oceanographic research in Subareas 4 and 5 made possible a concentrated study by the scientists of various disciplines; physics, geology, chemistry and biology. The co-operating organizations were: the various establishments of the Fisheries Research Board of Canada on the east coast, the Institute of Oceanography of Dalhousie University, the Division of Oceanographic Research and the Canadian Hydrographic Service of the Department of Mines and Technical Surveys. Vessels employed in the research programs were: C.N.A.V. Sackville, C.G.S. A. T. Cameron and C.H.S. Baffin.

The monitoring sections off Halifax, N. S., and across Cabot Strait were covered four times in 1961. The temperature and salinity distributions of the section off Halifax are given in Figure 1. In general, the conditions in 1961 off Halifax were similar to those of 1959 with below average temperatures on the bottom. The intermediate cold-water layer was well developed from spring to autumn. Along the edge of the continental shelf an intrusion of warm water in February brought about a steep temperature gradient along the bottom. In Cabot Strait, the intermediate cold-water layer, with below zero temperature, was more developed in 1961 than in the previous two years. The volume of the warm deep layer had somewhat decreased since 1959. The zone on the slopes, covered by water between 1.0 and 4.0°C, has been observed to be deeper in the last three years as compared to previous years. Early winter observations on the western slopes of the Laurentian Channel north of the Magdalen Islands also show a deepening of this zone. The extent of the cold water (-1.0 to 0.0°C) over the Magdalen Shallows in mid summer seemed to be greater than in recent years.

Monitoring of surface and bottom temperatures along the Canadian Atlantic coast was continued during the year. The 1961 temperatures, at all stations, revealed a general decrease from the 1960 values. The seasonal variations of temperatures in 1961 were featured by a slow vernal and aestival warming followed by a slow cooling in the last four months of the year. The bottom temperatures in the coastal waters off Nova Scotia were the lowest observed since 1950.

The circulation of surface and bottom waters was studied on the Scotian Shelf, the Gulf of Maine - Bay of Fundy area and the Gulf of St. Lawrence. Surface drift bottles and sea-bed drifters were used as well as Pisa tubes, plywood drifters, radar drift poles, current meters and G.E.K. The various phases of the circulation studies have been undertaken to gain a better knowledge of the tidal streams and the non-tidal drift and their effects on the environment.

The marine geology studies of the Gulf of St. Lawrence and of the Scotian Shelf have indicated the broad distribution features of the soft sediments and the hardness of the bottom. The studies of bottom organisms are providing a preliminary assessment of the relationships of biomass, depth distribution and bottom types.

Geochemical and chemical studies of the sediments and the waters of the Gulf of St. Lawrence were initiated this year. The turbidity of the waters of the Gulf is being examined as an additional parameter for identifying and tracing the water masses and their movements.

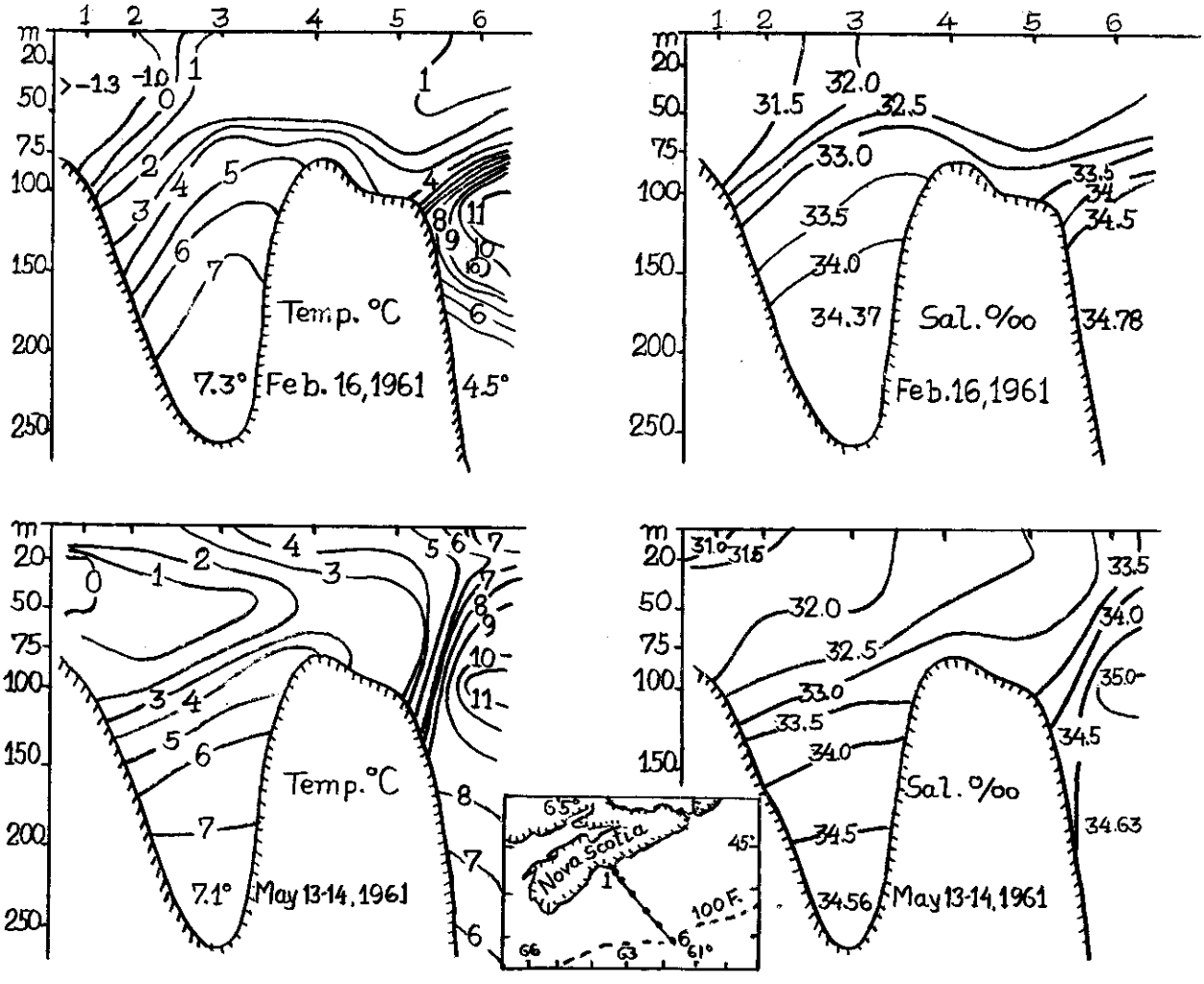


Fig. 1. Hydrographic sections off Halifax, N.S., 1961. Temperature °C, salinity o/oo. Continuation on p. 30

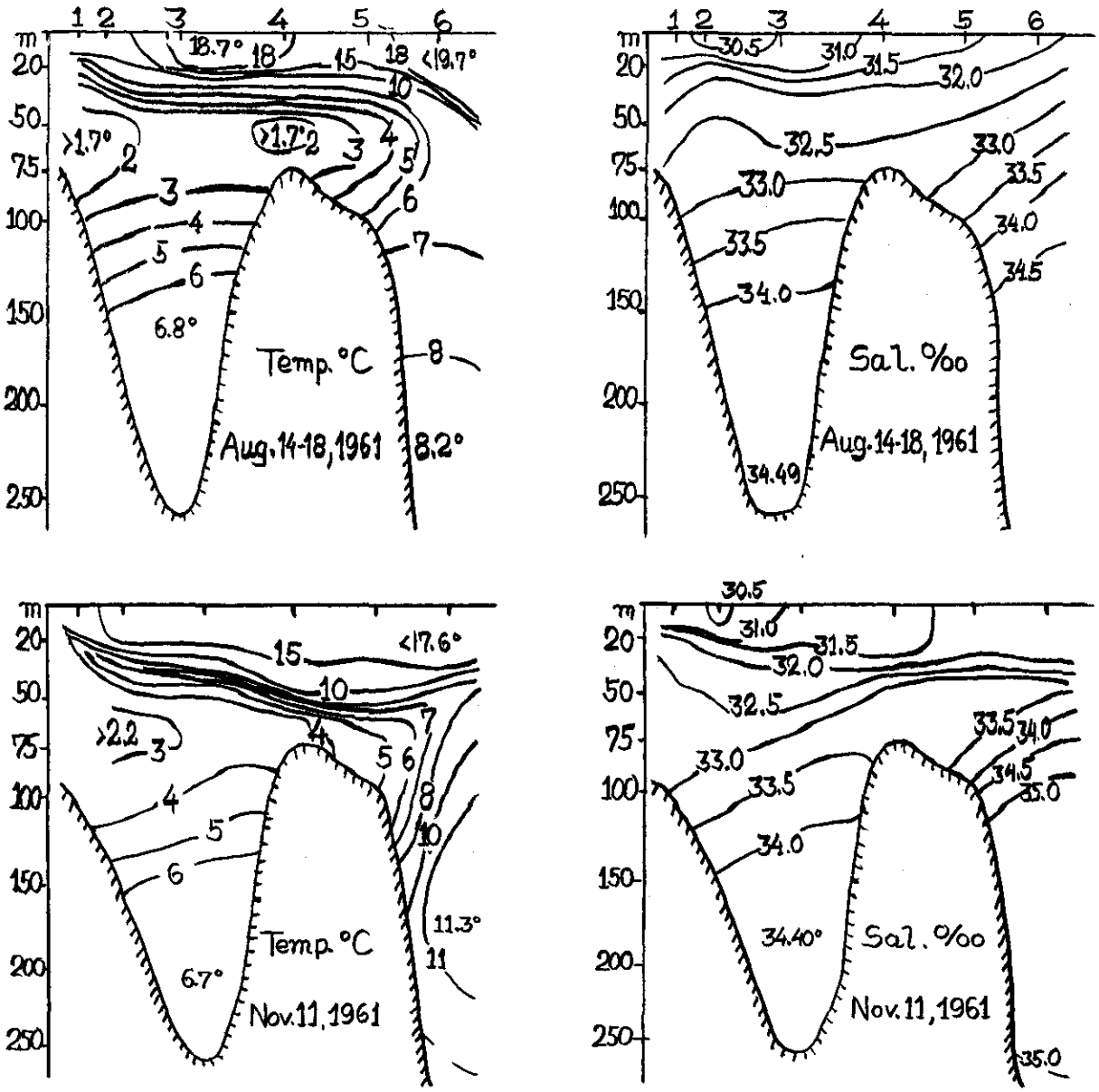


Fig. 1. Continued.

D. Divisions 4S and 4T
by A. Marcotte

Research of interest to the Commission is carried out by the Marine Biological Station of the Quebec Department of Fisheries at Grand River, Que., in Divisions 4T and 4S.

Hydrography. As usual, hydrographic sections were taken in Chaleur Bay (4T) from June 7 to August 31, 1961. In general, bottom water temperatures in the Bay were slightly higher than in 1960, but were still low, ranging from -1.0 to 1.0°C. Warming up of the bottom water at the beginning of the fishing season was slow.

Investigations in marine sedimentation of this area, initiated in 1960 have been continued in 1961.

Plankton. Zooplankton production has been studied in Chaleur Bay. In 1961 this production was relatively poor compared to that of 1960, both in the inner part of the Bay and in adjacent waters (0.25 ml/m^3 for 1961; 0.45 ml/m^3 for 1960). Plankton was found to be most abundant in August, water temperature being highest at that time. Copepods and Coelenterata were less numerous; other important groups such as Appendicularia, Cladocera and larval Euphausiacea were found in roughly the same quantities.

Food of cod. The study initiated in 1960, on the food of cod as related to their vertical migrations, was continued in 1961. The main purpose is to study the value of presence or abundance of specific preys, chiefly small crustaceans, as indicators of cod vertical movements. Gill nets and otter trawl were used for the 24-hour observations made twice a month. Two gill nets were used together, one on the bottom, the other at about 5 fathoms from the bottom. The otter trawl was bipartitioned horizontally, each section leading to separate codends, so as to fish from the bottom to one fathom above bottom, and from there to the headrope.

Preliminary analyses indicate that more fish were caught by otter trawl in the daytime (78 per tow) than at night (43 per tow). With both otter trawl and gill nets catches in the lower net were larger than those in the upper net during both day and night sets. A greater proportion of the total catch was caught in the upper trawl and upper gill net in the daytime than at night (43 versus 33% with otter trawl and 46 versus 37% with gill nets).

Main prey animals were much the same as in 1960, except that the euphausiid Thysanoessa was largely replaced by Meganyctiphanes. There was also in 1961 a delay of two weeks, as compared with 1960, in the period of peak abundance of main prey species in cod stomachs, i.e., herring, euphausiids, capelin. A similar delay was observed in some hydrographic features, mainly surface temperature, of the area.

Survey. In 1961, the groundfish census in Chaleur Bay area, initiated a few years ago, was continued. Two series of observations were made from June 22 to August 5, covering 11 stations on each cruise. The results of the 1961 survey are compared with those of previous years as follows

Year	Mean length of codfish (cm)	Percentage of codfish measuring less than 38 cm	Average number of fish per one-hour tow
1959	40.6	54	181
1960	41.2	48	185
1961	42.4	40	124

The fishery. As a whole the fishery has been relatively good for the Quebec fishing fleet; increase in catches was slight for cod and greater for redfish, flounders and halibut. The major part of dragger operations was carried out in 4S where draggers found satisfying catches. Contributions of longliners were poor. To be noted also is the development of inshore fishing for cod with gill nets, with reports of good catches of fair-size fish (mean length 67 cm in 4S).

II. Danish Research Report, 1961.

A. Biology *
by Paul M. Hansen

A. Cod Fry and Small Cod in Coastal Waters and on the Offshore Banks of West Greenland in 1961.

1. Occurrence of eggs and larvae.

Cod eggs were very scarce in the catches in 1 m stramin net, in 30 min. hauls with 100-50 m wire in the Godthaab Fjord, as was also the case in the two previous years. Hauls were taken in January, February, March, April and May. The first eggs were taken 22 March in the inner part of the fjord but in small numbers. The best catch was 150 eggs. In the middle and last part of May cod eggs were more numerous. In two catches 1870 and 1427 eggs were taken.

Investigations on the occurrence of cod eggs and larvae over Fylla Bank were carried out 24 April and 27 June. At each date hauls with 1 m stramin net, in 30 min. with 100-50 m wire were taken on three stations: 1. Between the coast and the bank. 2. Over Fylla Bank. 3. Western slope of Fylla Bank.

The results were: (No. of larvae are given in brackets)

St.	1	2	3
24 April	79 (0)	1 (0)	787 (0)
27 June	0 (22)	0 (14)	0 (0)

On Station 3, 441 eggs and one larva were taken 24 April in one haul with 300 m wire.

Fig. 1 shows the catches of cod larvae with 2 m stramin net by "Dana" in July. The numbers of larvae in the catches in Davis Strait were very small. The highest numbers were 26 larvae taken 26 July in two hauls with 100-25 m wire far west of Fylla Bank (63°43'N. 58°42'W. and 64°24'N. 58°37'W.) In a haul 28 July on 66°17'N. 54°29'W. with 100-25 m wire, 25 larvae were caught. On all the other stations with the exception of two, the numbers of larvae were below ten. The reason for the small catches may be the exceptionally large size of the larvae in July 1961. More than 66% were over 20 mm. Probably many of the largest larvae escaped from the gear. Owing to this fact it is impossible to form an estimate of the value of the 1961 year-class.

* Cod tagging see Addendum, page 158.

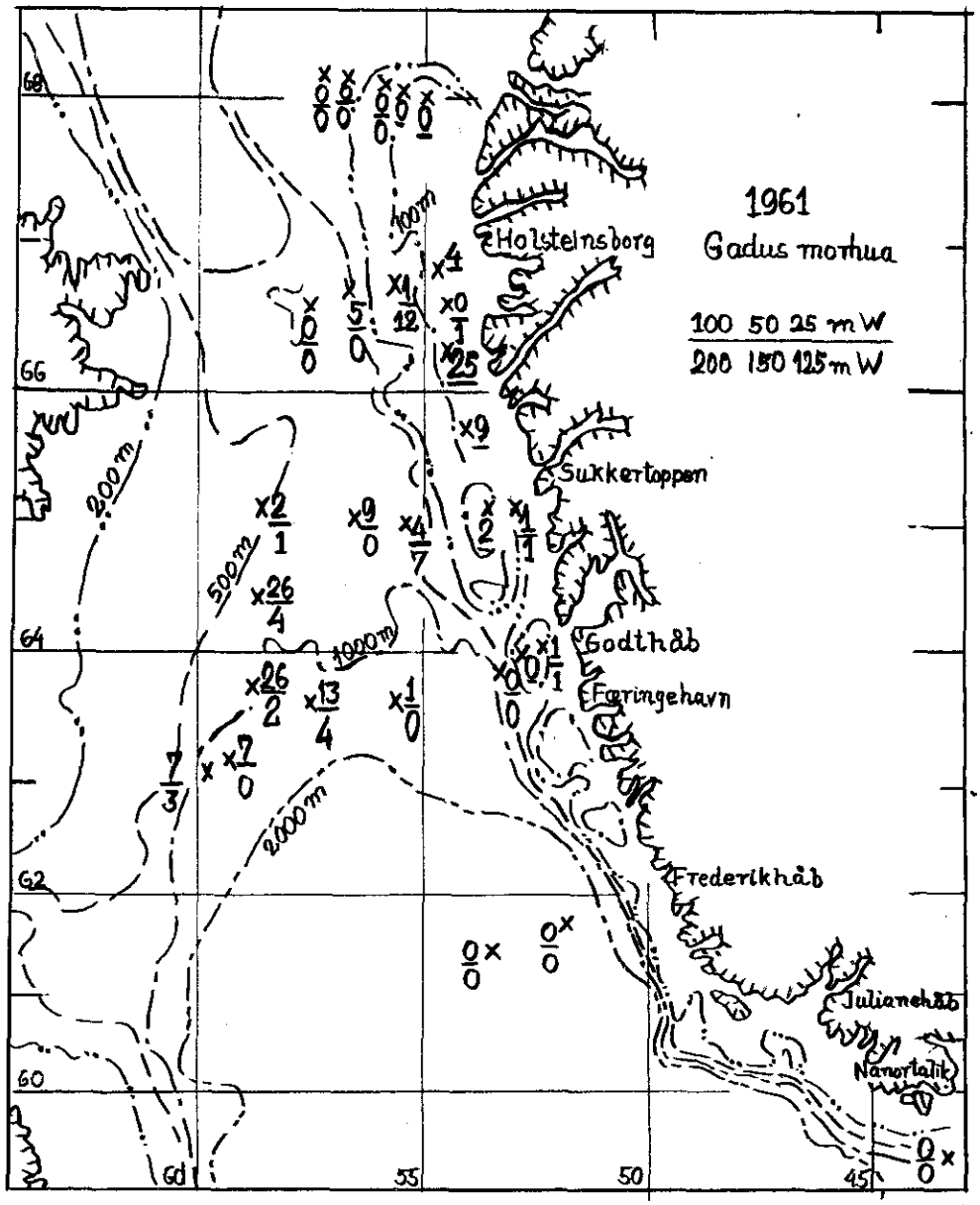


Fig. 1. Numbers of cod larvae caught per 30 minutes step-hauls with the 2m stramin net, 1961.

2. Occurrence of age-groups I, II and III.

Only two samples of small cod were collected in 1961. One sample (64 individuals) was taken with shrimp trawl in the coastal area south of Godthaab (1D) 10 February. The sample contained practically only one age-group, namely the III-group (1958 year-class). The other sample was taken with hand seine from the shore near Godthaab (1D). This sample contained 771 small cod. The length frequencies show that age-groups I and II (1960 and 1959 year-classes) were represented in equal numbers.

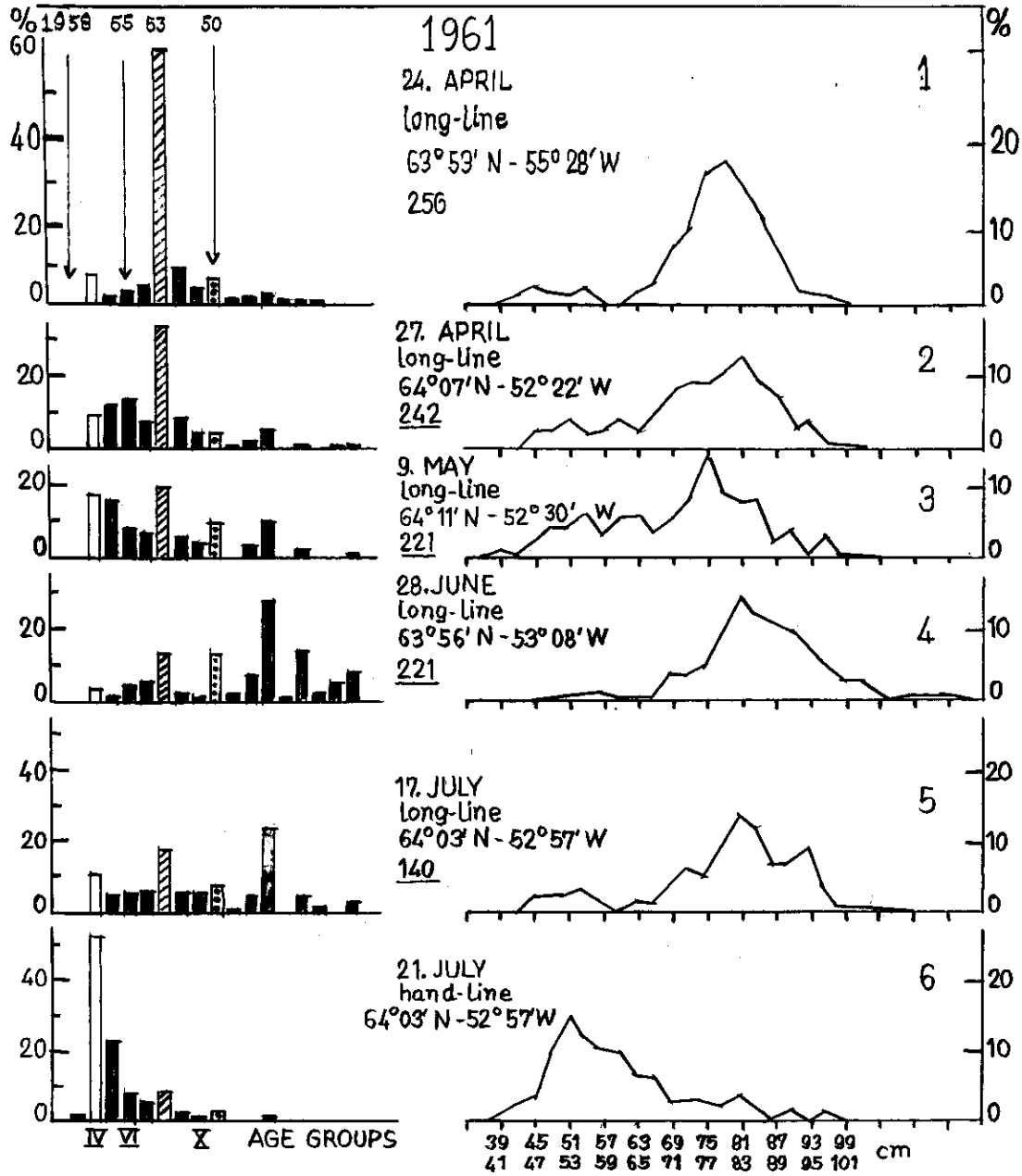


Fig. 2. Age-and length distribution of cod caught on long-lines and hand-lines on offshore banks in 1961.

Only few small cod were observed close to the shore in the coastal region in all divisions. The only exception was the harbour of Christianshaab (1B) where large shoals of small cod occurred in July and August feeding on waste discarded from the shrimp plant. From the size of these small cod it

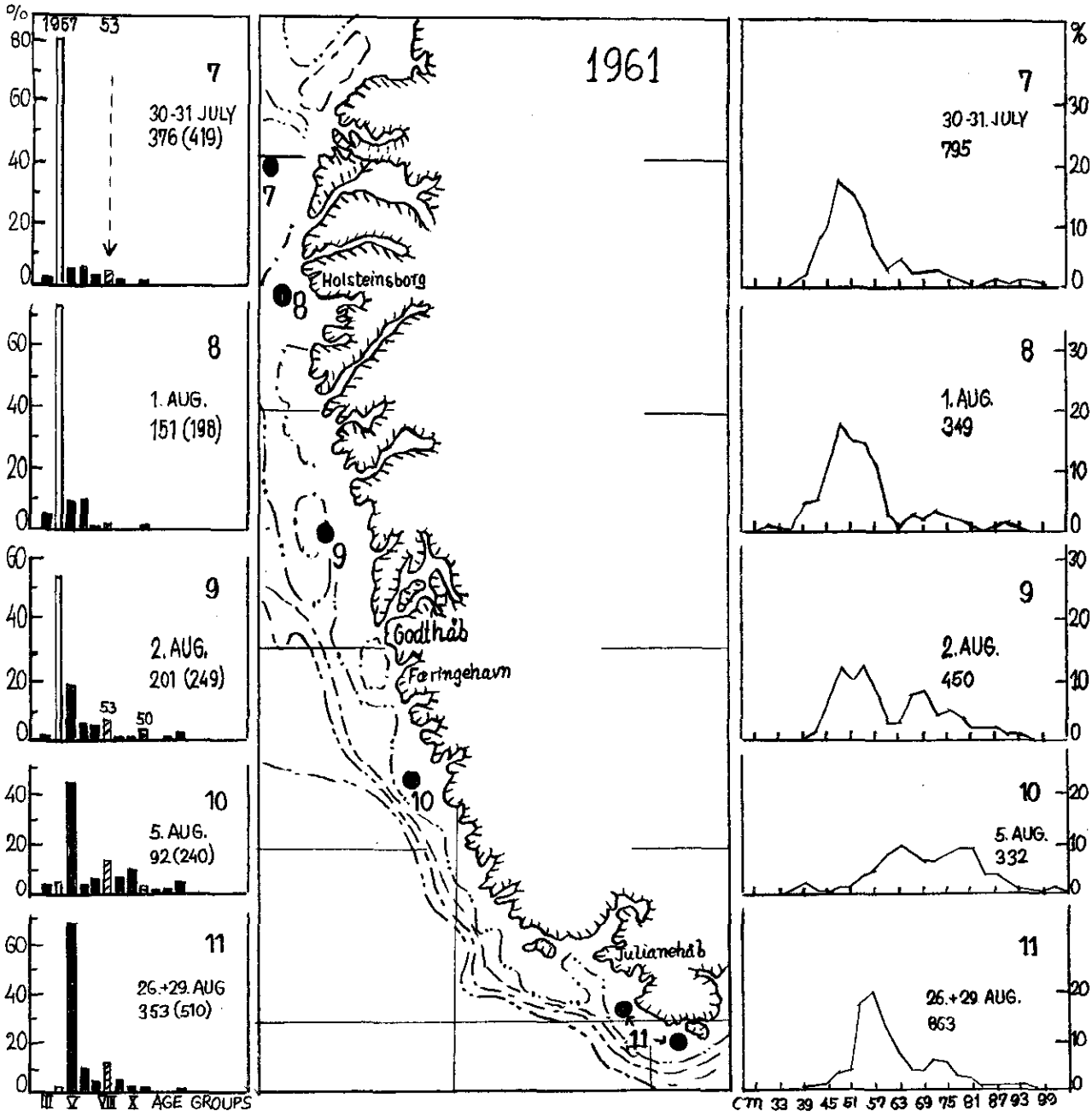


Fig. 3. Age-and length (by 3 cm-groups) distribution of cod caught on hand line offshore banks in 1961.

was easy to distinguish three age-groups: I, II and III. The I-group was found in shallow water close to the shore, while the II- and III-groups occurred in deeper water at some distance from the shore, the II-group in the middle of the harbour and the III-group farther out near the entrance to the harbour. This phenomenon has been observed in the harbour of Christianshaab every year since the shrimp plant was built.

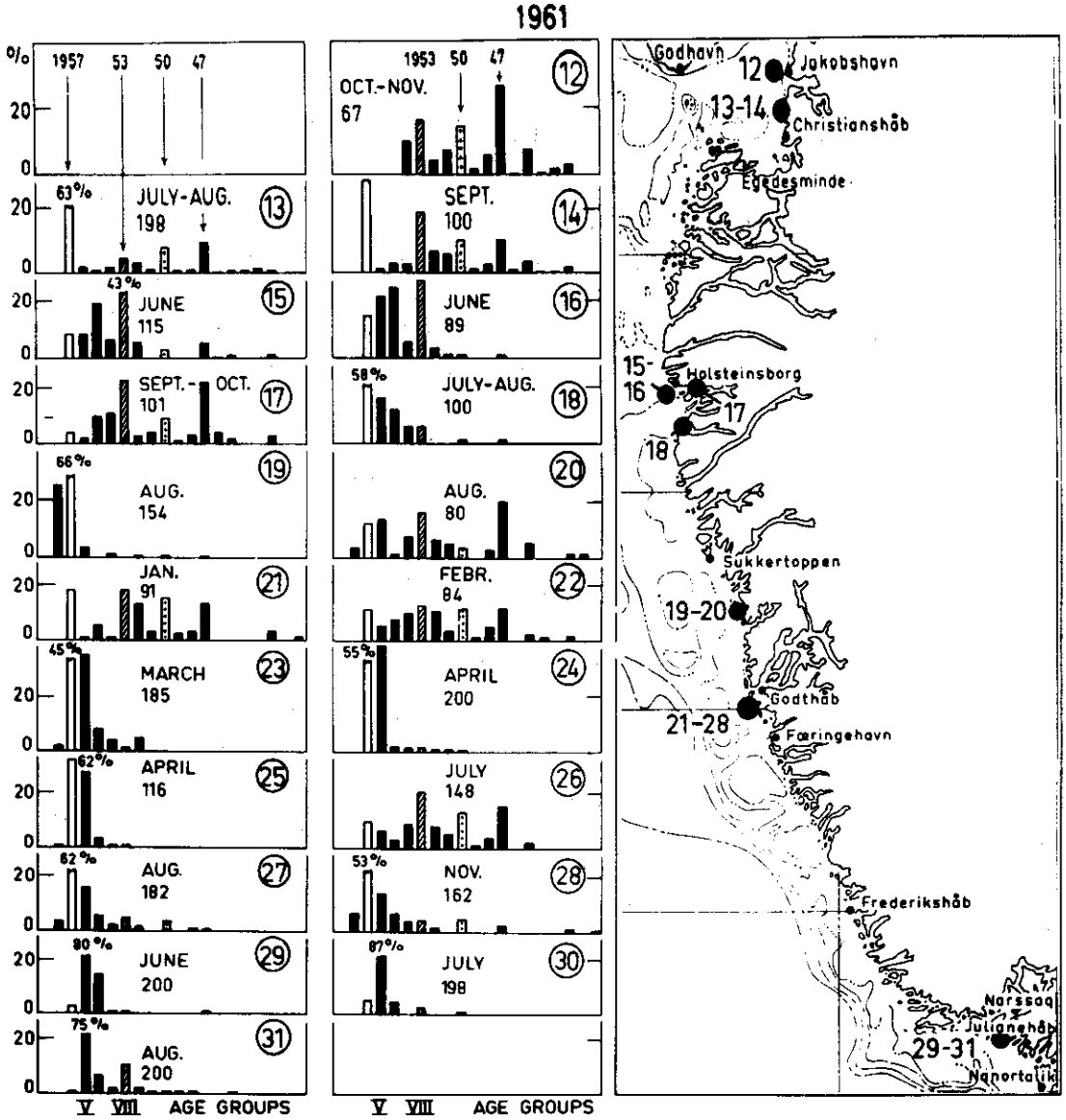


Fig. 4. Age distribution of cod caught in inshore waters and fjords in 1961.

B. Cod Investigations, Offshore Banks and Coastal Waters, West Greenland, 1961. (Commercial fish)

1. Offshore banks.

Otoliths of 2101 cod were collected from the offshore banks: 1080 from long line catches on Fylla Bank by the "Adolf Jensen" in April-July; 1021 from hand line catches by the "Dana" and the "Adolf Jensen" 17 July-5 August on Store Hellefiske Bank, Lille Hellefiske Bank, Fylla Bank and Dana Bank.

The age compositions and length frequencies are given in Fig. 2. Large old cod belonging to the year-classes 1953 and 1947 predominate in the long line catches.

In the two catches No. 1 from the western slope of Fylla Bank depth 270 m and No. 2 from the east of Fylla Bank depth 80-170 m, the 1953 year-class predominates with about 60% and 30% respectively. Both catches are taken in April when the spawning has nearly finished. The percentage of immature cod were 11.4% (No. 1) and 46.3% (No. 2). The smallest amount of immature individuals was found in the catch from the western slope of Fylla Bank in the spawning area. Of the cod spawning this year 95.6% (No. 1) and 93.9% (No.2) were spent and 4.4% (No. 1) and 6.1% (No. 2) had ripening milt or roe.

In sample No. 3, Fylla Bank, May, the 1953 year-class is still predominating but only with 19.4%; the second and third largest year-classes are 1957 (17.6%) and 1956 (15.4%).

In sample No. 4, west of Fylla Bank, 120-325 m, June, the old 1947 year-class predominates with 27.6%. The second best is the 1945 year-class with 13.1%, followed by the 1950 and 1953 year-classes, both with 12.2%.

The samples Nos. 5 and 6 are from catches taken 17th and 21st July east of Fylla Bank, depth 75-130 m. In No. 5, a long line catch, the 1947 year-class predominates with 23.6%, the 1953 year-class is represented with 17.9% and 1957 with 11.4%. Sample No. 6, a hand line catch, is quite different in age composition from No. 5 although it is taken in the same place and depth. The 1957 and 1956 year-classes together make up about 75% of the sample; 1957 constitutes 52.2% of the sample.

The mean ages, lengths and weights of cod from the six samples are as follows:

Sample Nos.	1	2	3	4	5	6
Mean age	8.3	7.7	8.0	12.7	9.9	5.2
" length	76.3	74.4	71.7	86.1	79.6	61.0
" weight	3.8	3.8	3.4	6.3	-	-

The age compositions and length frequencies of cod in hand line catches from "Dana" are given in Fig. 3. The 1957 year-class predominates strongly in the samples from the northern banks, Store and Lille Hellefiske Banks. In sample No. 7 from the northern Store Hellefiske Bank (68°00' N.) the 1957 year-class amounts to 81.2%, while it amounts to 73.8% in sample No. 8 (66°53' N.). In the sample from Lille Hellefiske Bank the 1957 year-class still predominates with 54.8%.

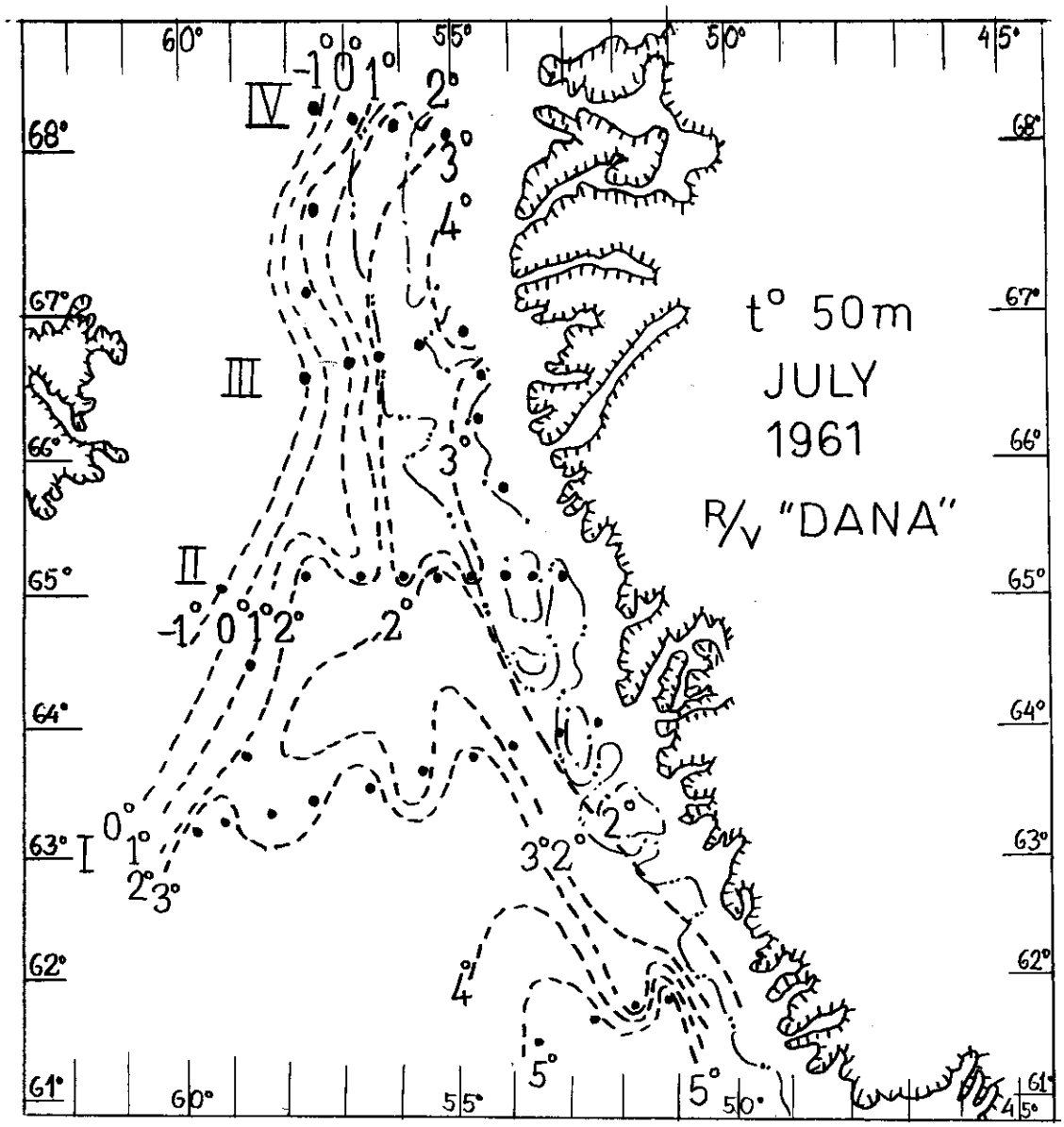


Fig. 5. Location of stations and distribution of temperature at 50 m, July, 1961.

The sample from Dana Bank is quite different from the samples of the northern banks in age and size composition. The 1956 year-class predominates with 43.2% while the 1957 year-class only amounts to 4.9%. The length frequency graphs in Fig. 3 show clearly that the number of larger cod increase gradually in the samples from north to south. In the samples from Store Hellefiske Bank by far the largest number of cod are too small to be of any value in the fishing industry.

Sample No. 11 is from the Nanortalik and Cape Farewell regions. In this sample the 1956 year-class predominates with 67.4%.

2. Inshore waters and fjords (Fig. 4).

20 samples were taken from coastal areas as follows:

Division	A	B	C	D	F
Nos.	12-14	15-18	19-20	21-28	29-31

All samples from Divisions C and D, and sample No. 16 from B, are from catches taken by "Adolf Jensen". All other samples are from catches landed by Greenland fishermen.

A. Sample No. 12 is from a long line catch in deep water and consists of old year-classes with the 1947 year-class predominating (26.9%). The 1953, 1950 and 1954 year-classes amount to 16.4%, 14.9% and 10.4% respectively. In Nos. 13 and 14 1957 predominates with 63.1 and 28.0%.

B. The 1953 year-class predominates in Nos. 15 and 17. In 17 it is followed very closely by 1947 year-class. Sample 16 is taken from a catch with shrimp trawl in which the predominating year-class is 1953 with 27%, close to are 1955 with 24.7% and 1956 with 21.3%. In sample 18 the 1957 year-class amounts to 58%.

C. The two samples 19 and 20 from this division are taken in the same place and at the same time. No. 20 is from a long line catch, No. 19 from hand line. As usual the long line catch contains older year-classes than the hand line catch. In No. 20 the strongest represented year-class is 1947 with 20% , 1953, 1956 and 1957 are represented with 16.3, 13.8 and 12.5% respectively. No. 19 contains only small young cod with 1957 strongly predominant amounting to 65.5%.

D. As mentioned before, all eight samples are from catches taken by "Adolf Jensen". Nos. 21, 22, 26 and 29 are from long line catches, while Nos. 23,24, 25 and 27 are from hand line. In No. 21 1953 and 1957 are of equal strength. In the long line samples Nos. 22 and 26 the 1953 year-class predominates, while 1957 predominates in No. 28 with 53.1%. With exception of No. 25 in which 1956 is strongest (62.1%) the hand line samples have 1957 as the predominating year-class, with 1956 as the next best.

F. The three samples 29, 30 and 31 are characterised by the very strong predominance of the 1956 year-class, 80,87 and 75% respectively.

The old 1947 and 1953 year-classes are still of importance in the long line catches from deep water. Of the younger year-classes the 1957 and 1956 are by far the richest; the former occurs chiefly in the northern area, Divisions A, B and C. In D it is followed rather closely by 1956. In F 1956 is the richest year-class among the young cod, while 1957 is poorly represented. This difference in the occurrence of these two year-classes is in coincidence with the distribution of young cod observed in 1959. (See ICNAF Ann. Proc. Vol. 10, page 33-34).

C. Redfish

The continued trawling experiments for small redfish in the Godthaab Fjord, which started in 1952, have been carried out in every month of 1961 with the exception of June. The total catch amounted to 9072 redfish. Length distributions of the samples will be presented in ICNAF Sampling Yearbook.

No tagging experiments have been carried out in 1961.

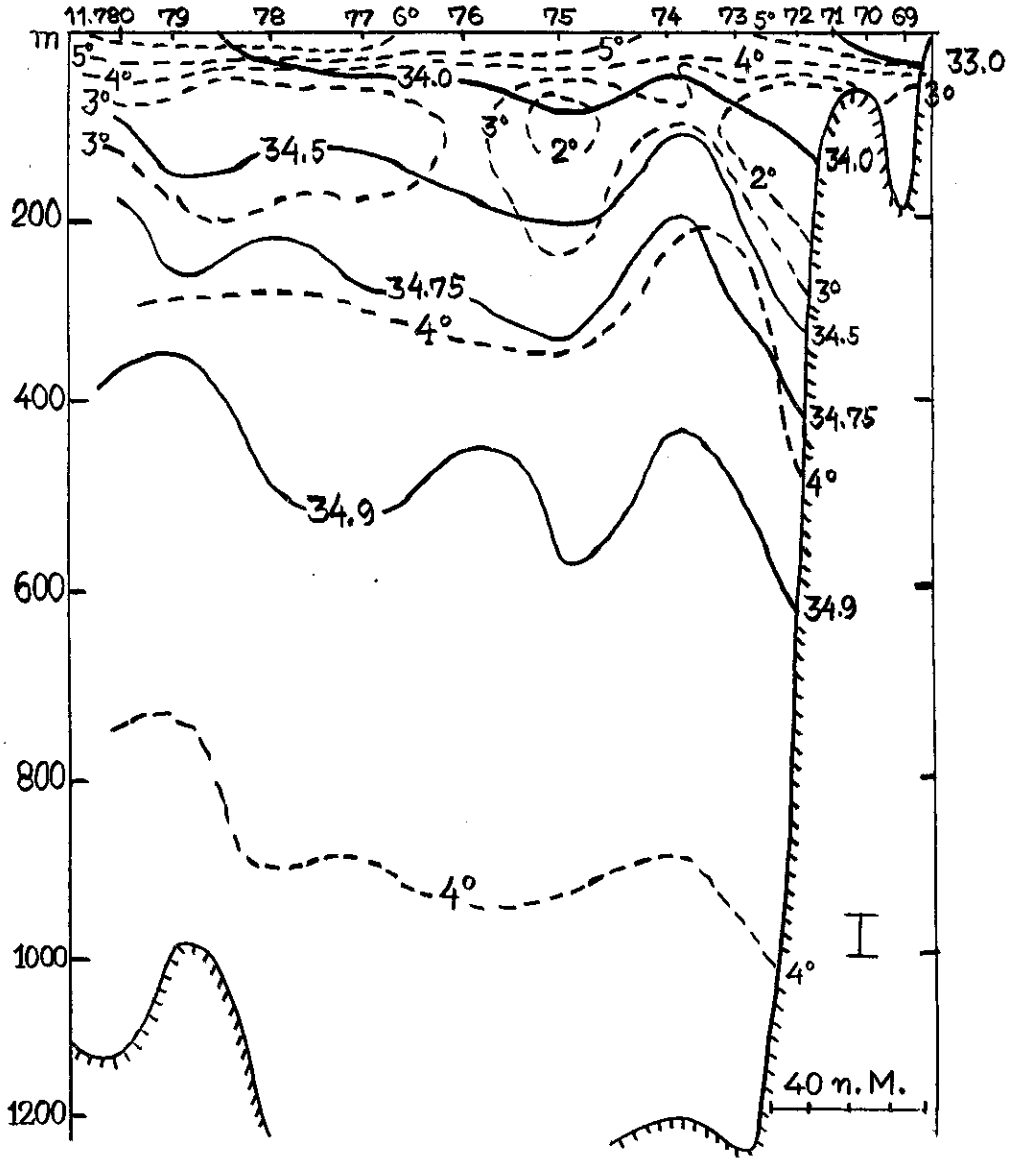
11 of the 281 redfish tagged in Qorqut in the Godthaab Fjord in 1960 have been recaptured in 1961. 5 were recaptured at the tagging locality. Another 5 at Kapisigdlit in the innermost part of the fjord about 30 miles from Qorqut. Of special interest is a recapture taken by an Icelandic trawler south of Fiskenaes Bank (62°55'N. 52°05'W.), 11 August, 1961. The fish was tagged 24 May 1960 at Qorqut, the lengths at tagging and at recapture were 43.5 cm and 44.5 cm respectively. This recapture probably indicates that the stock of redfish in the Godthaab Fjord is not a local one.

B. Hydrographic Conditions off West Greenland, 1961.
by F. Hermann

In 1961 the M/C "Adolf Jensen" worked the Fylla Bank section in April and June. R/V "Dana" worked the sections over Fylla Bank, Lille Hellefiske Bank, Store Hellefiske Bank and off Egedesminde in July. The positions of the "Dana" stations are shown in Fig. 5. Furthermore the standard station at the entrance of Godthaab Fjord was worked throughout the year by M/C "Adolf Jensen" and M/C "Tornaq".

Fig. 5 shows the distribution of temperature at 50 metres in July. A comparison with earlier years shows that the water temperature all over the area was considerably higher than usual. Of the last ten years only the year 1960 shows water temperatures nearly as high as those found in July 1961 in the surface layers.

Fig. 6. Section I across Fylla Bank, July 24-26, 1961.



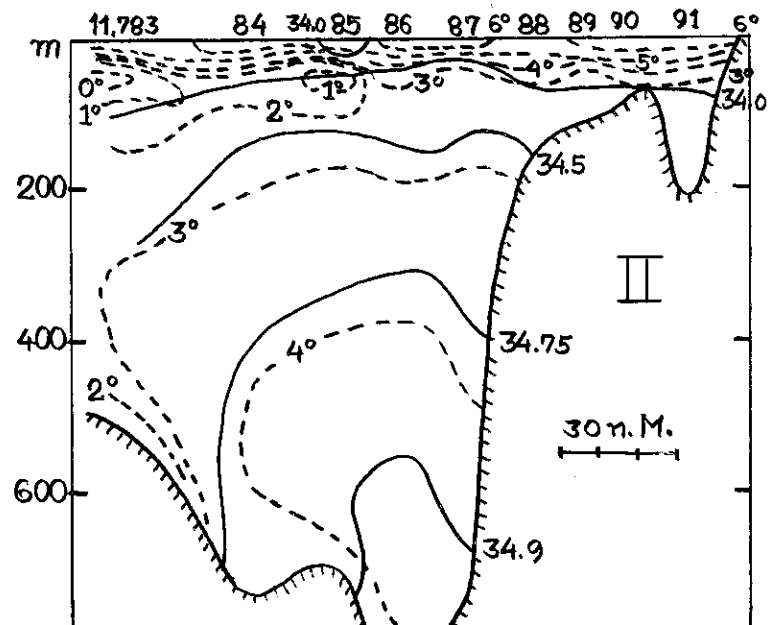
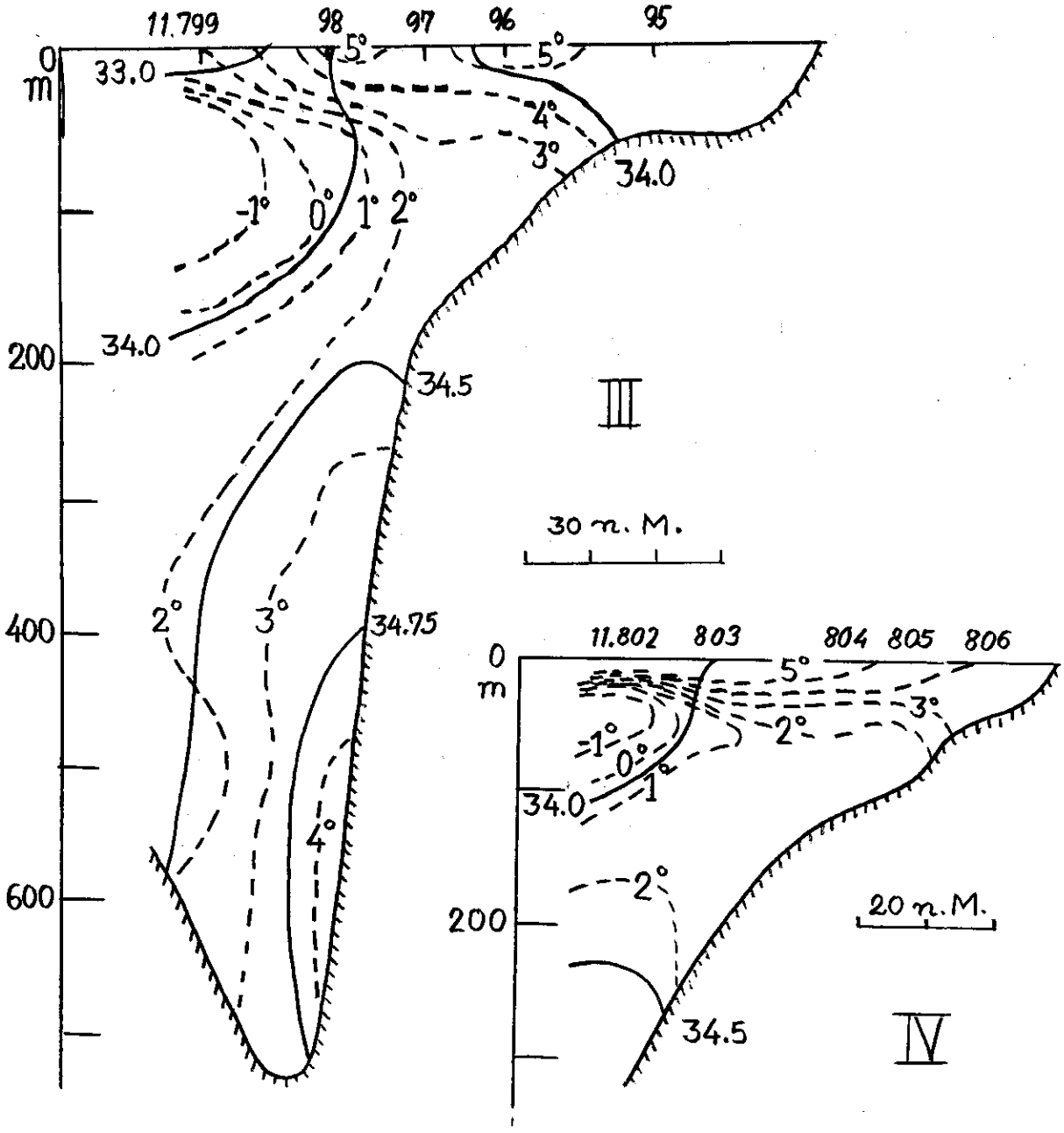


Fig. 7. Section II across Lille Hellefiske Bank, July 27-28, 1961.



Figs. 8 and 9. Section III across Store Hellefiske Bank, July 29, 1961. Section IV off Egedesminde, July 30, 1961.

Over the shallow part of Fylla Bank (40 metres) the temperature was on 24th April 0.5°C, on 27th June 3.1°C and on 24 July 3.9°C. The hydrographic situation in July is further illustrated by the sections I to IV (Figures 6 to 9). The sections show that the minimum temperature in the polar component of the West Greenland current off the western slope of the banks in section I and II, was higher than usual. The Irminger component of this current was well developed.

The variation of the temperature throughout the year at the station at the entrance of Godthaab Fjord (64°07' N-51°53' W) is shown in Fig. 10. Also here relatively high temperatures prevailed. No temperatures below zero were observed and a strong inflow of warm bottom water seems to have taken place in October-November. In the first months of 1962 a strong cooling of the water occurred and subzero bottom temperatures were recorded in March 1962.

C. W. Greenland. Researches by the Danish Institute for Fishery and Marine Research-Faroe Division. by J. S. Joensen.

Investigations of catches were carried out on board the Faroese commercial trawler "Skálaberg" (955 br.t.) fishing on the W. Greenland Banks from 21 May to 17 June, 1961. During these 27 days the trawler made 327 hauls (320 hours). The total catch was 925 tons round fresh, close to 3 tons per one hour.

The catch was salted on board, and only cod over abt. 45 cm were used. The used part of the catch was 750 tons round fresh. 175 tons or 19% of the total catch was discarded. This discarded part included:

Small cod (below 45-50 cm)	- ca. 118 tons
Wolffish (3 species)	- ca. 36 tons
American plaice	- ca. 20 tons
Redfish	- ca. 1 ton

The length distribution of the discarded cod was as follows:

cm	No.	cm	No.
12-14	1	39-41	211
18-20	1	42-44	288
21-23	1	45-47	182
24-26	2	48-50	47
27-29	10	51-53	11
30-32	29	54-56	2
33-35	51	57-59	1
36-38	90	60-62	1

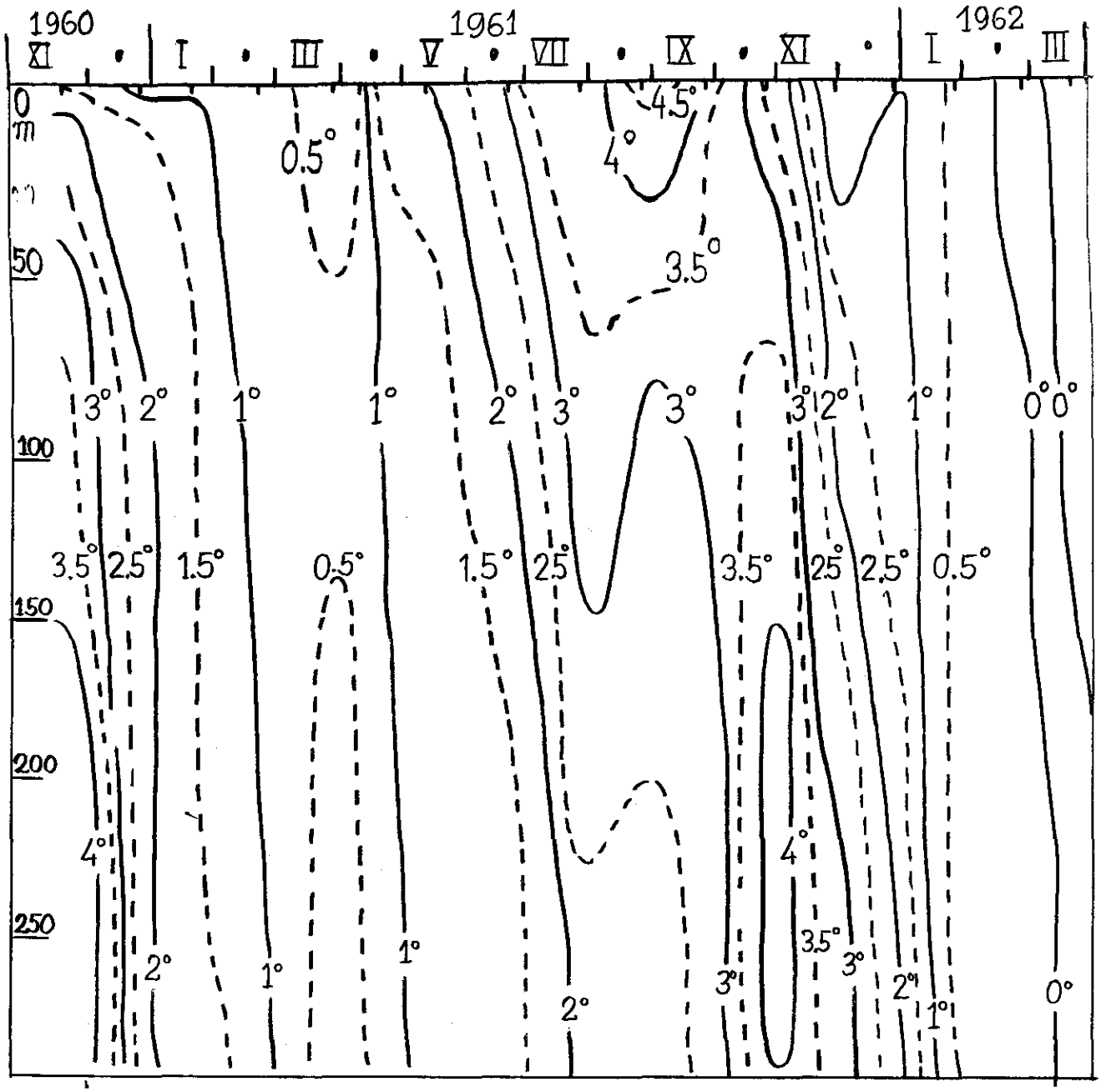


Fig. 10. Distribution of temperature at the entrance to Godthaab Fjord during Nov. 1960 - March 1962.

The collected data includes a total of 10,532 cod; 7,432 cod were measured and otoliths were taken from 3,100 cod.

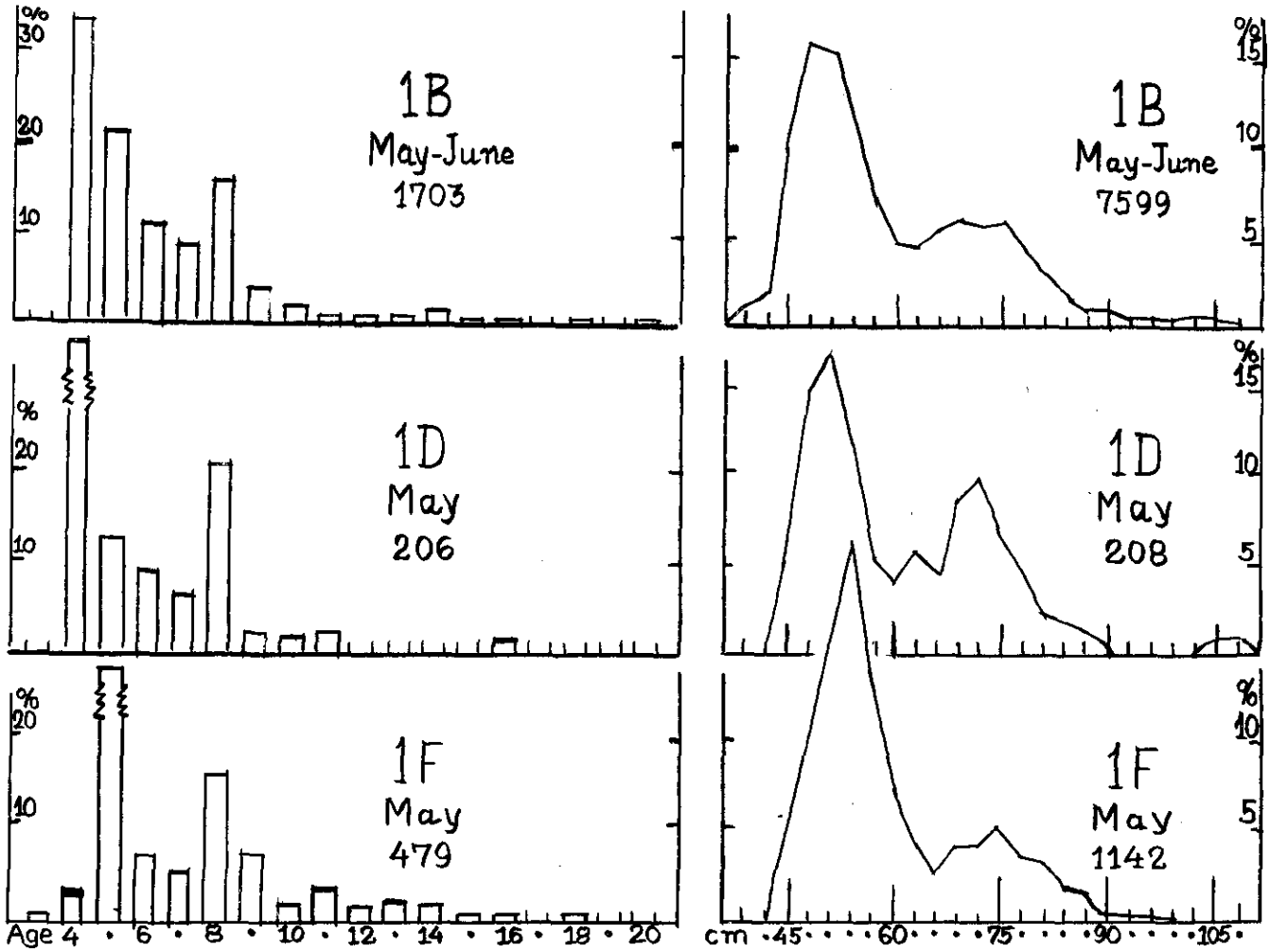


Fig. 11. Age-and length (3 cm groups) distribution of cod.

Fig. 11 shows the age-and length distribution of the cod. In the northern divisions, 1B and 1D, the IV-Group (1957 year-class) predominates, whilst in the south the 1956 year-class is completely dominating, constituting almost 60% of the used part of the catch.

By far the largest part of the discarded cod consists of the 1957 year-class; this year-class is thus still more predominating than it appears from Fig. 11, which only shows the used part of the catch.

III. French Research Report for 1961

by J. Ancellin and Ch. Allain.

The following operations were carried out by France in 1961 in the ICNAF area:

I. Observations from the deep sea trawler "Bois Rosé" in February to April, 1961, in the Gulf of St. Lawrence and south of Newfoundland (Subareas 3 and 4).

II. A cruise by the oceanographic vessel "Thalassa" in the region of the Grand Bank, the St. Pierre Bank and Banquereau (Subareas 3 and 4).

III. Hydrographic sections made on board the "L'Aventure".

I. Observations from the Trawler "Bois Rosé".

A provisional report was given in ICNAF Document No. 33, 1961 Annual Meeting. The detailed data concerning the size and age distribution of the cod is under preparation and will be given in the "Sampling Yearbook".

II. Cruise by the Oceanographic Vessel "Thalassa" July-August, 1961.

The oceanographic vessel "Thalassa" carried out a research cruise in the area south of Newfoundland from 18th July to 5th September, 1961. The main regions investigated (Subareas 3 and 4) are: The slopes south-west of the Grand Bank, St. Pierre Bank, St. Pierre and Miquelon Islands, and Banquereau. The operations carried out were trawlings, dredgings, v.s. soundings and hydrographic observations. A preliminary report of the results of these observations is given below.

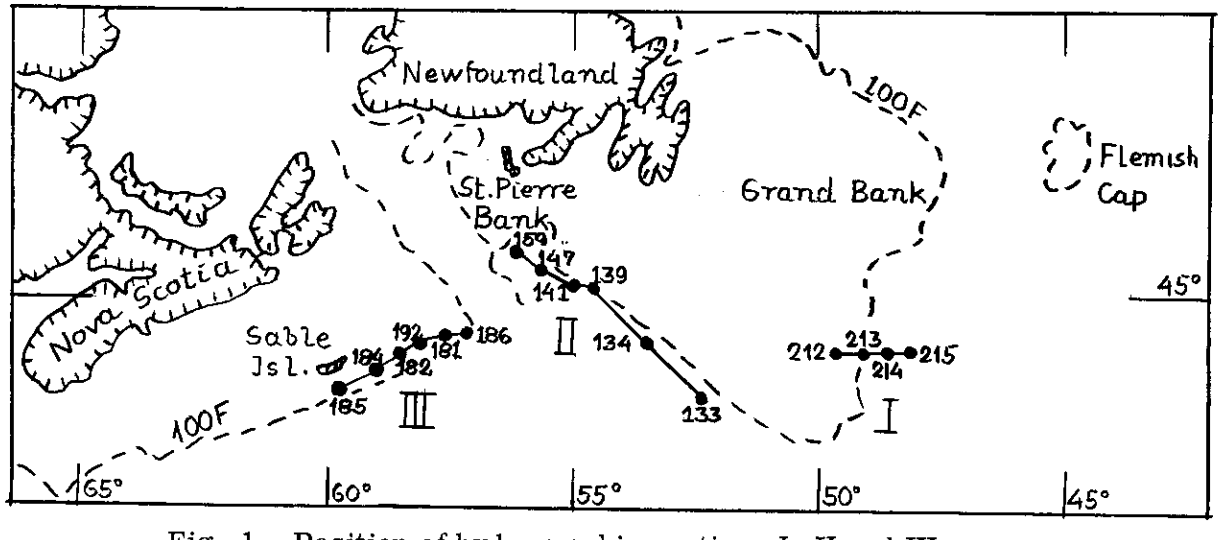


Fig. 1. Position of hydrographic sections I, II and III.

A. Trawlings

The head-rope of the trawl used is 30 m and the ground-rope 41 m, the trawl mesh is 50 millimeters from knot to knot. For rough bottom the trawl was provided with rollers.

a. Subarea 3, the slopes southwest of the Grand Bank, St. Pierre Bank and St. Pierre and Miquelon.

On the slopes south and southwest of Grand Bank and south of Green Bank 12 trawlings were made. The general depths fished are between 150 and 600 metres.

Good catches of Sebastes (5 to 6 tons per hour) were made at depths of 300 to 400 metres in water with a temperature of 4 to 5° C. in the region south of 43°50' N.Lat., in the following locations: 43°04'N.Lat.- 50°53'W. Long. and 43°43'N.Lat.- 52°20'W. Long. Sebastes still predominated north of 53°50'N.Lat. on the slopes of the Grand Bank and the Green Bank, but here the catch was not more than one ton per hour.

The other catches, from the slopes west of St. Pierre Bank in water of 3 to 6°C., and on the Bank itself in water of 3 to 4°C. (a total of 6 hauls), consisted in the main of haddock, silver hake, Sebastes and cod. It can be noted inter alia, that one haul of 1 hour and 30 minutes made on the slopes (45°35'N. Lat.- 56°34'W. Long., 220 metres depth) yielded 926 kg of fish, of which 518 kg were Merluccius bilinearis, and that another haul of one hour on the Bank (45°38'N. Lat., - 55°53' W. Long., 46 metres depth) provided 363 kg fish of which 418 kg were cod.

b. Subarea 4, Banquereau

A total of 11 trawl hauls were made in depths between 150 and 350 metres in the following regions: a) the slopes northeast of Banquereau, b) the slopes towards the south until the longitude of Sable Island.

Satisfactory catches of Sebastes (the species was found in water of 3 to 7°C) were made in the two following locations: 45°22'N. Lat.-57°51' W. Long. on the slopes of Mimia Bank (north of Banquereau, 170 to 220 m) where 2,500 kg of this species were taken in a haul of 20 minutes; and on 44°12'N. Lat. - 58°09'W. Long. (slopes south of Banquereau), where 1,100 kg were caught in a haul of 50 minutes.

A haul of 40 minutes at 44°31'N. Lat. (the southeast point of Banquereau - 180 m) yielded 2,000 kg, 1,300 kg being cod.

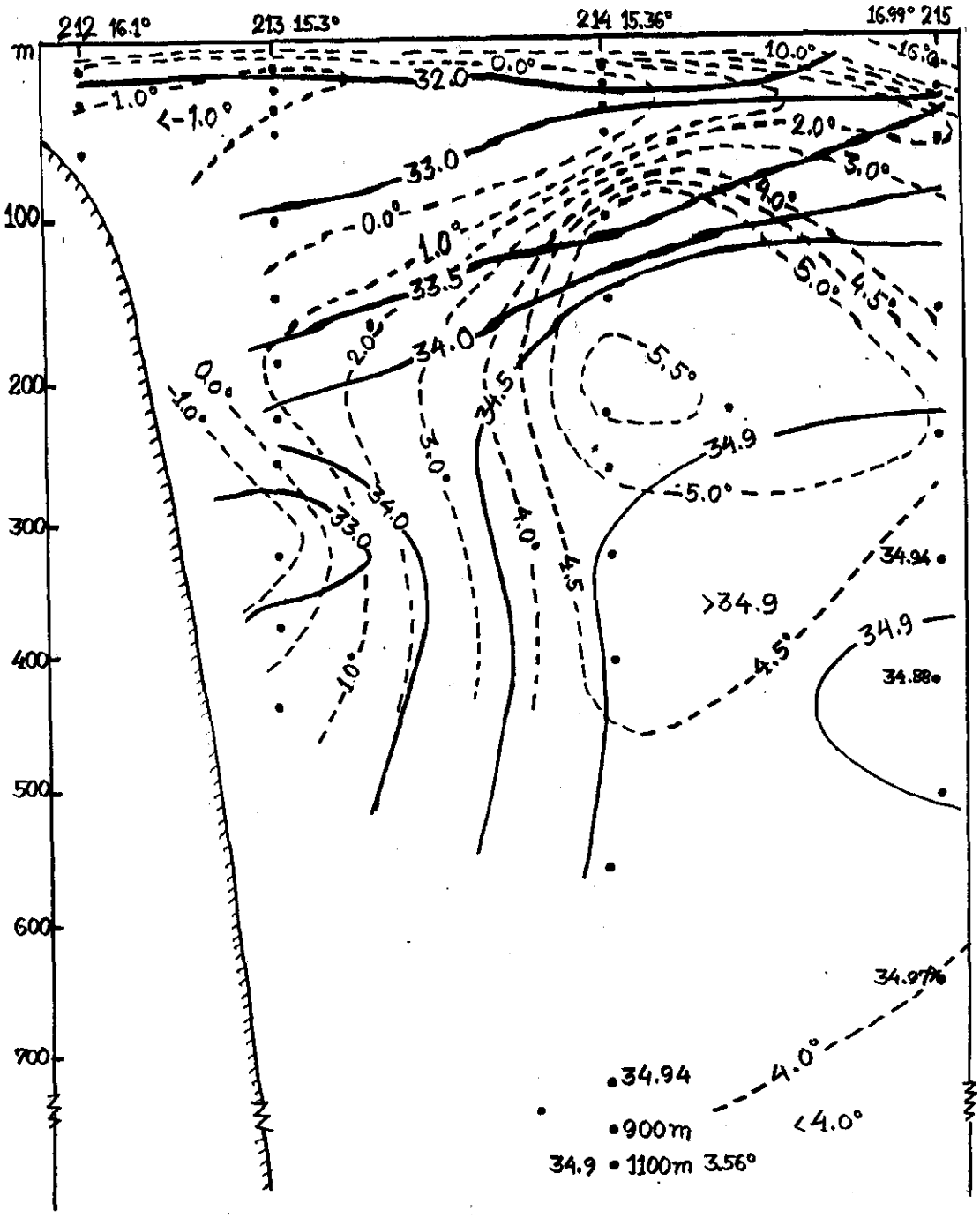


Fig. 2. Section I. East slope, Grand Bank, 27-28 August, 1961. Salinity o/oo - bold lines; temperature °C - stippled lines.

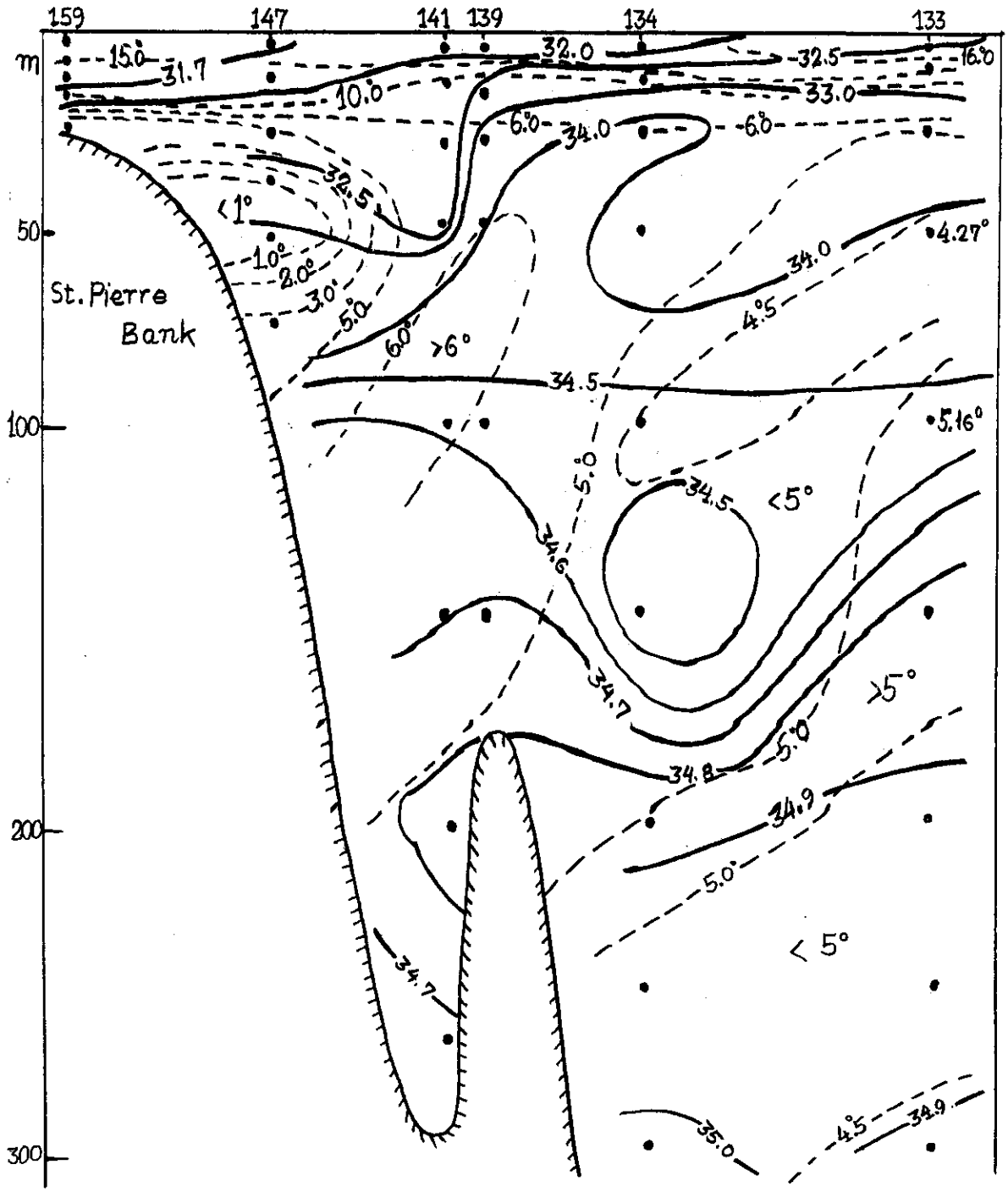


Fig. 3. Section II. SE - Grand Bank - St. Pierre Bank, end of July. Salinity o/oo - bold lines; Temperature °C - stippled lines.

Finally, the Great Silver Smelt (Argentina silus), which is not marketed at St. Pierre, was caught in abundance in water of 7 to 8° C. in the two following locations: 43°39' N. Lat. - 59°10' W. Long. (south-east of Sable Island, 220 m; 3,700 kg in one hour) and 43°37' N. Lat. - 59°40' E. Long. (south of Sable Island; 170 m, 2,800 kg in one hour).

B. V.S. Soundings - Bottom Configuration

On the slopes southwest of Grand Bank, the bottom is almost everywhere very rough at depths below 300 to 400 metres. The trawlings were generally carried out at depths between 100 and 400 metres. A haul at 600 m yielded only poor results. The slopes to the west of St. Pierre Bank, however, were for the main part favourable for trawling; the depth did not exceed 300 to 350 m. In the region of Banquereau, the bottom is rather smooth on the slopes to the east of the Bank, as well as southeast of Sable Island, as soundings between 250 and 300 m reveal. The conditions for trawlings in the other regions of the slopes were varying.

C. Hydrography

Three hydrographic sections were taken during the cruise (see Fig. 1).

a) Section I. (Fig. 2) Slopes east of Grand Bank following the 44° N. Lat. (Subarea 3), 27-28 Aug. 1961

Below the surface water (which had reached a temperature of 16° C.) the Labrador Current constituted an intermediate tongue between 20 and 150 m along the slopes; the tongue extended seawards, becoming thinner (minimum temperature -1°C., salinity 32.22 o/oo). The thinnest part, farthest offshore, overlies Atlantic water which occupied the depths in this region between 100 to 700 m (maximum temperature 5.50° C., maximum salinity 34.94 o/oo).

The mixed waters (1 to 4°C., 33 to 34.5 o/oo) were found where the above mentioned two types of water met, and occupied the deeper part of the slope below 200 m, penetrating - due to increased density by cooling - down to 1,000 m. The deepest water layers investigated had a temperature of 4° C.

b) Section II (Fig. 3). Slopes southwest of Grand Bank and south of St. Pierre Bank (Subarea 3).

In the region of the slopes (70 to 600 m) between southwest of Grand Bank and St. Pierre Bank the following observations were made in the end of July:

1) A heating of the surface water down to about 20 m to 16°C.

2) An influx of warm Atlantic water (4-6°C, >34 o/oo) from southwest occurred along the slopes between 50 and 400 m with its maximum toward the southwest in the Whale Deep.

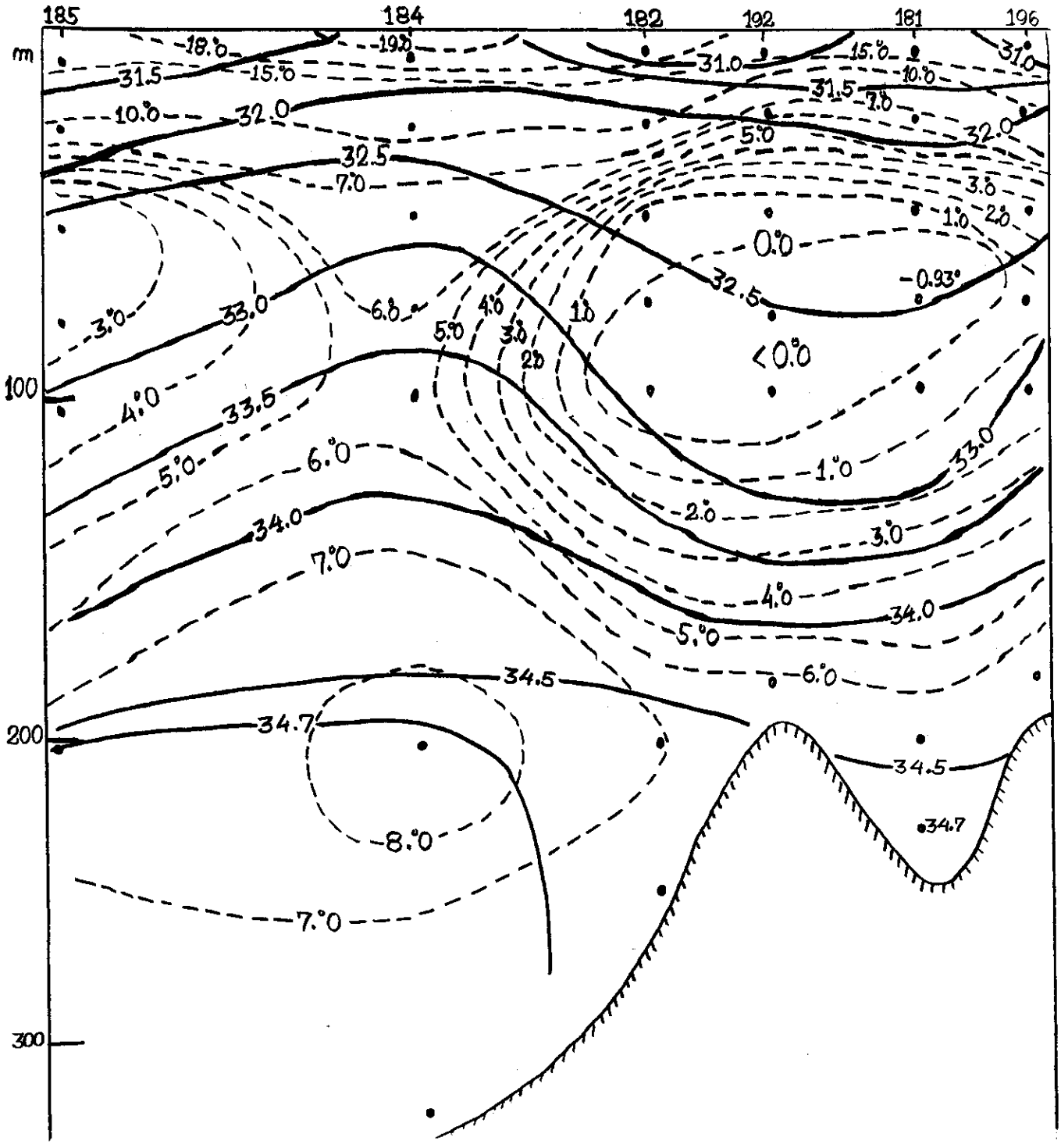


Fig. 4. Section III. Slopes southeast of Banquereau, 11-13 August, 1961. Salinity o/oo - bold lines; temperature °C - stippled lines.

3) The presence of a tongue of cold intermediary water (about 1°C.) with a low salinity at depths of 30 to 100 m on the slopes east of St. Pierre Bank and south of the Fletan Channel. This tongue stretches about 20 miles seawards, becoming thinner.

c) Section III, Fig. 4. Region of Banquereau (Subarea 4).

At the middle of August, cold water was present in great quantity in layers above the Bank.

On the northeast slopes (surface temperature ca. 4°C.), Atlantic water constituted a deeper layer from 150 m and downwards. This Atlantic water was overlaid by a cold water patch (0 to 4°C.) ranging from 30 to 150 m.

Along the slopes southeast of Baneuereau and Sable Island (section III), the Atlantic tongue was more important and penetrated in the direction SW-NE with a maximum temperature of 8° at 200 m depth. This tongue was most predominating at the opening of the channel between Banquereau and Sable Island, and in this region it, by its upward moving, divided the cold water of low salinity off the slopes into two bodies.

D. Observations in the Region of St. Pierre and Miquelon (Subarea 3).

The cruise of the "Thalassa" included a series of researches in the region of the St. Pierre and Miquelon Islands:

a) Fishing experiments with lobster pots were carried out with no results.

b) V.S. soundings permitted to define the position and the profile of certain rocky grounds called "basses" and used by the dory fishermen (hand line). A new fishing ground of this kind was located.

c) Dredgings showing the nature of the bottom were carried out, as well as soundings with the GALEAZZI TURRET.

d) Hydrographic observations in the beginning of August showed that the surface water had been heated to 16.05° C. to a distance of 10 miles to the south of St. Pierre Island and to 16.28°C. to a distance of 8 miles to the north of Cape Miquelon. Closer to the coast the surface temperature was 13.15°C. (south-west of St. Pierre Island). At a depth of about 25 m the offshore water (9 miles to the south of St. Pierre) measured 3.36°C. and the inshore water around 7°C. At 50 m depths (Roche Miquelon exterieure) the temperature decreased to 1.75°C.

E. Scallop (Pecten magellanicus) Dredgings (Subarea 3)

Several hauls with scallop drags were carried out on the St. Pierre Bank. The best yields (10 kg of scallops per 15 minutes haul) were obtained at 45°44' N.Lat. and 55°52' W.Long. The mode of the length curve was 12 cm and the scallops were relatively old (4-9 years).

III. Hydrographic Observations Made on Board the Frigate "L'Aventure".

Seven hydrographic stations in deep water were operated on the 14th and 17th November, between Newfoundland and the Azores Islands.

NOTE: The detailed data of the measurements (cod and redfish) and other biometric data collected on board the "Thalassa" are being prepared for final rendering in the Sampling Yearbook.

IV. German Research Report, 1961

A. Cod Investigations in Subarea 1
by Arno Meyer [1)]

Subarea 1

German trawlers have fished off Greenland for the last ten years. This fishery was - as that of other nations fishing around Greenland - in the beginning only a seasonal fishery, restricted to the spring and summer months. Since 1958 the fishery has become, in spite of most difficult weather conditions, expanded over the whole year, and for the last two years it has been so intense that Greenland since 1961 is the most important fishing area for the German trawlers; the development of the fishery is shown in Table 1. The up to now only provisional figures for the fishery off Greenland in 1961 show a landing of 159,000 tons (gutted), of which cod account for 55.6% and redfish for 42.4%. The rapid increase of the catches was in the main caused by a stronger fishery off S. Greenland (Division 1F) and W. Greenland (1B-1E). Off W. Greenland alone the cod landings increased from 1960 to 1961 to 60,000 tons, or to three times the 1960 landings - also on account of a greater production of salt cod.

Investigations on the cod at sea could only be carried out during a cruise with the "Anton Dohrn", mainly for mesh-size studies off E. Greenland, and during a cod-tagging cruise by a commercial trawler. All other data collected are from landings of trawlers, including samples of ungutted cod preserved especially for research. A total of 48 samples are available, including 19,358 length measurements, 8,079 otoliths and 635 observations on maturity.

West Greenland (Division 1B - 1E)

Fishery was carried out off W. Greenland through the whole year, except in the period 16 January to 24 February. Exceptionally low air-temperatures (down to -26°C) obstructed the fishery considerably during March. As already noted in the German Research Report for 1960 (Serial No. 876), German trawlers succeeded for the first time to locate, during March (1961), large concentrations of spawning cod far westwards off the Banan Bank in surprisingly deep water, 350 - 550 m. The spawning was at its peak by the end of March and the beginning of April, when 48% of the mature cod were in the spawning stage, 34% were just about to spawn, 14% had finished spawning, and 4% were close to finishing. About 10% of the cod in the

1) The tables giving detailed data on length and age will be published in the "Sampling Yearbook".

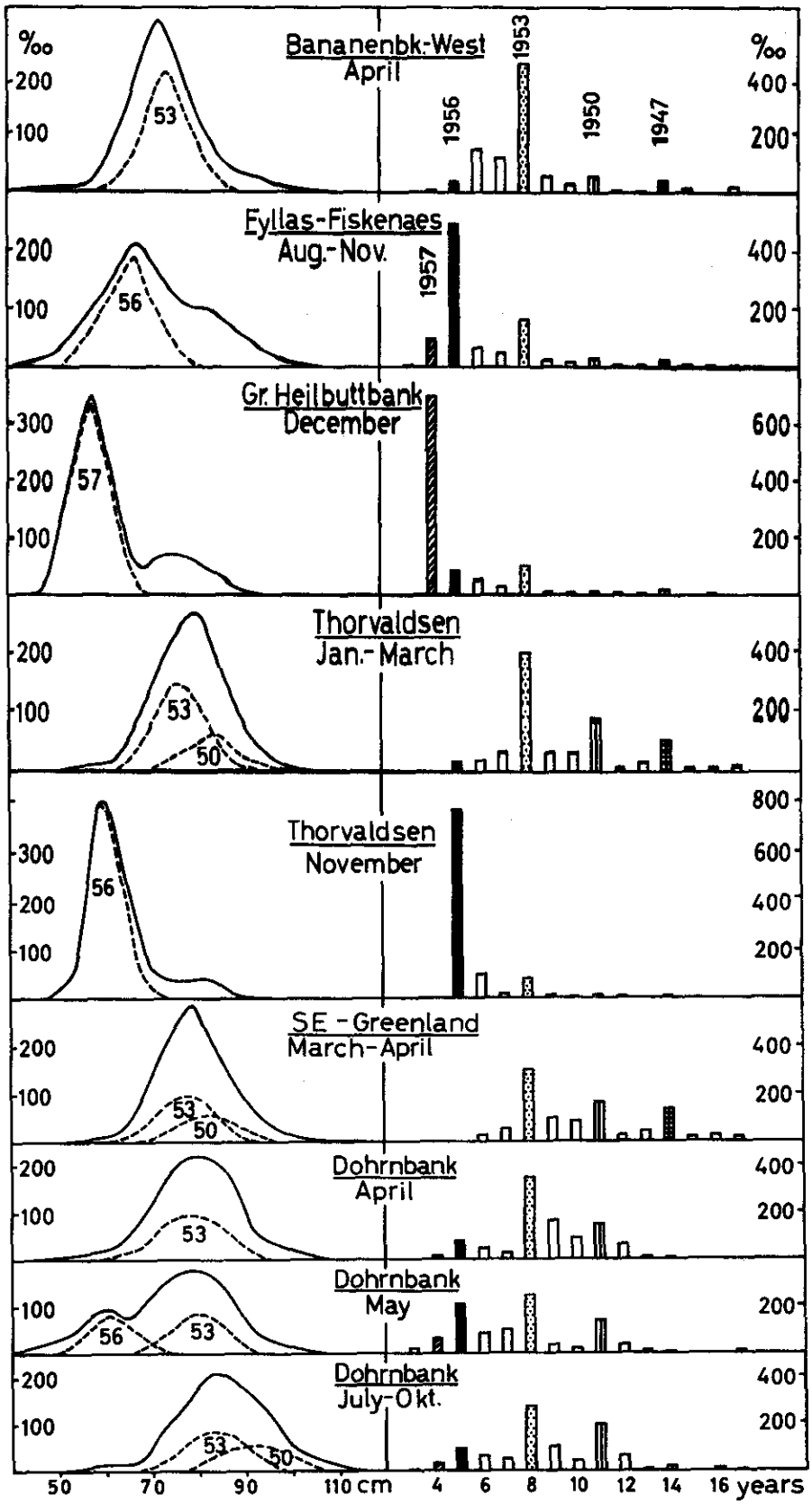


Fig. 1. Cod. Length-and age distribution.

spawning concentrations were young, immature cod. The 1953 year-class was predominating with 48% (see Fig. 1); the 1955 and 1954 year-classes accounted for 17 and 11% respectively. The previously so strong year-classes of 1950 and 1947 only amounted together to 8%. The amounts of immature cod in the year-classes were as follows 1957 - 100%, 1956 - 100%, 1955 - 16%, 1953 - 5%, and 1952 - 14%. The landings from the trawlers in the preceding period (January to mid-March), from the area Fylla and Banan Bank showed a similar age-composition, with the only difference that here - in more shallow water - the still immature 1956 year-class was the next-strongest with 15%. The mean lengths were about the same, 73.1 cm. in January - March and 73.6 cm. in March-April.

Cod is generally caught in shallower water than redfish. The observations from 1961 show, however, that in the spawning season the cod can be concentrated off West Greenland in greater depths than the redfish. Similar observations of a reversion of the depth-zones for cod and redfish were made during the cod spawning season off S. E. Greenland. Already in the German Research Report for 1960 it was noted that 550 m was in no way the greatest depth for spawning cod, and that the cod concentrations at this depth had not decreased in strength, only the bottom conditions had not permitted fishery below this depth. The prevailing hydrographic conditions off West Greenland indicate that the spawning cod must migrate into greater depths due to the deep level of the warm Atlantic component of the West Greenland Current. Therefore, further spawning places, south of 64°N, must be sought farther westwards than has been the case up to now. The most recent observations show that the transport of Greenland cod larvae by means of the left branch (towards Baffin Land and Labrador) of the West Greenland Current must be considerably greater than previously considered. It is possible that the varying strength of the year-classes - i.e., the amount of young cod left in Greenland waters - is directly dependent on the depth range and volume of the Atlantic component of the West Greenland Current. The correlation between water temperature and year-class strength, observed by Rasmussen, may, therefore, well be related to the depth range and to the more eastern or western displacement of the warm Atlantic water. The solution of this problem would be a promising part of the international hydrographic researches planned for the next year.

The older year-classes were, as in previous years, found in the area of the southern West Greenland banks, especially at Noname Bank. Here, and in the best fishing season, beginning of June, the old and strong 1950 and 1947 year-classes accounted together for 20%, in 1960 even for 38%. Due to the high mean lengths (1950 year-class: 84.1 cm; 1947 year-class: 85.0 cm) of these 11 -14 years old cod the exceptionally high average for Greenland cod of 76.9 cm was observed (in 1960 75.3 cm). The 1953 and 1954 year-classes predominated at Noname Bank with 31 and 22% respectively.

The autumn and early-winter catches presented a completely different composition of the stocks. The 1956 year-class (with a mean length of 66.1 cm) predominated with 50% in the landings from Fylla and Fiskenaes Banks from mid August to beginning of November, whereas the successful December-fishery on the southern part of Store Hellefiske Bank depended on the exceedingly strong 1957 year-class which accounted for 70%. At the end of the 5th growth season this new-recruited 1957 year-class had an average length of 57.5 cm.

The future fishery in Subarea 1 will depend upon these two very rich 1956 and 1957 year-classes. Both present a typical distribution. The 1957 year-class has (as the once so rich 1947 year-class) a northern distribution, whereas the 1956 year-class (as the famous 1945 year-class) is mainly distributed in the southern Divisions 1D to 1F, mostly in 1F. The importance of the 1956 year-class to the fishery was already predicted from the German search-trips in 1958. From the now established picture of distribution it can be concluded that this year-class to a considerable extent is derived from East Greenland (possibly also in part from Iceland), whereas the rich 1957 year-class is derived from the West Greenland cod stock. The exhaustive fishery on the rich, older 1950 and 1947 year-classes with the resulting rejuvenescence of the stock is now causing for West Greenland the ending of the period with catches of relatively large fish, and we can for the future expect lower mean lengths for the cod in the catches. Besides the two year-classes of 1956 and 1957, the 1953 year-class will be the only important one in 1962/63.

South Greenland (Division 1F)

The ice-conditions were more favourable in 1961 than in 1960, causing the fisheries for cod and redfish off South Greenland to continue through almost the whole winter. The unusual high mean length of 78.7 cm. for the cod caught here from the end of January to mid March is noteworthy. The older 1953, 1950 and 1947 year-classes were predominating in the catches with 40, 17 and 10% respectively. Observations on maturity revealed that this stock was almost exclusively composed of mature individuals in the pre-spawning stage (V). The previous observations, the tagging results and the observed uniform age-and-length composition of the catches from March - April proved that these large cod were migrating toward the spawning places off East Greenland, where the spawning reaches its maximum in April. That the cod during its spawning migration toward the east pass South Greenland in the late winter becomes evident also from the fact that the South Greenland cod-fishery remains idle from mid-March to end of April, to begin anew in the end of April or the beginning of May, and then again with catches of large cod with an age similar to that found in late winter.

The fishery for the large re-migrating post-spawners changes soon to a fishery for young, immature cod. The catches from mid May to beginning of July

were predominated by the rich 1956 year-class (53%, mean length 55.8cm.) which is especially abundant in the South. In November this year-class had reached a length of 60.2 cm. and increased its frequency % to 76. The slower growth of the cod in the colder water of South Greenland is clearly denoted by the fact that the 1956 cod on Fylla Bank at the same time already had reached a length of 67.8 cm. The 1957 year-class which prevails on the northern banks (1B and 1C) was only observed in few specimens off South Greenland.

East Greenland

(a) Southeast Greenland (Discord Bank to Moesting Ground)

The winter fishery for cod and redfish on the difficult fishing grounds of SE Greenland was again much obstructed by heavy ice floats and strong gales, but the few good fishing days were successful. An intense spawning of cod was observed especially on Fylkir Bank and Bille Bank. Also here the spawning cod was observed at great depth, about 400 m. The spawning shoals which were the subject of fishery from beginning of March to beginning of April had almost the same length-and age composition as the landings from South Greenland in January-March.
The three most important year-classes, 1953, 1950 and 1947, were represented in the catches by 30, 17 and 13.5% respectively.

(b) East Greenland (Heimland Ridge to Dohrn Bank)

Only few cod were landed from the redfish fishing ground off Angmagssalik. A by-catch of cod, investigated on an "Anton Dohrn" trip, end of July, showed a predominance of the 1953 year-class (43%), it was followed by the 1950 year-class (19%) and the 1952 year-class (17%). The maturity investigations re-confirmed the earlier observations of the relatively late maturing of the East Greenland cod. In spite of a mean age of almost 9 years with a length of 83.5 cm., 58% of the cod were still immature. The following percentages of each year-class were immature: 1953 - 60%, 1952 - 76%, 1951 - 46%, and 1950 - 22%!

Since the beginning of the fishery on Dohrn Bank in 1955, this at first pure redfish ground has gradually changed into a cod ground. The bank is fished on through almost the whole year; it presents, however, the most favourable fishing conditions in winter and spring when the East Greenland cod concentrate there for spawning or pass on its spawning migration to Iceland. For two years this former redfish ground has even sustained a salt cod fishery from March to May.

In all the samples from the Dohrn Bank, January to December, the rich, older 1953 and 1950 year-classes predominated with up to 35 and 32%, this means that the cod fished on the Dohrn Bank in 1961 were relatively large, as in the preceding years. Thus

the Dohrn Bank is actually not a nursery ground for immature cod. Among the few young cod the 1956 year-class is prevailing with up to 21%. This predominance of the 1956 year-class on Dohrn Bank may also confirm the already mentioned conclusion that the rich stock of 1956 cod off south and southwest Greenland originated from East Greenland or from Iceland.

The 1947 cod which in 1961 still were of considerable commercial importance off South and East Greenland, were almost completely missing in the Angmagssalik and Dohrn Bank areas. The 1947 cod are obviously - judging from the structure of the otoliths and the slower growth rate - West Greenland cod. They originally grew up under conditions of over-population and under-nourishment on the northern banks off West Greenland, then they spread toward the south, appeared since 1954/5 in great numbers off South Greenland, and finally, in 1956 and 1957, they constituted a considerable part of the catches at Angmagssalik and on Dohrn Bank. Since 1958 cod of the 1947 year-class are, however, poorly represented in the catches from Angmagssalik and Dohrn Bank.

Cod Taggings

From October 1959 to October 1960 1728 cod were tagged off SW., S. and SE Greenland. From these taggings a further number of 28 returns were reported in 1961, the total number of returns now being 3.5%. These new results coincide well with the picture of the migrations in the Greenland-Iceland area given in the German Research Report for 1960. Five cod tagged in the Noname Bank-Nanortalik area were recaptured at Iceland, all were large, mature fish; four of them were taken off NW. Iceland, the fifth (1952 year-class, 77 cm. long) had been tagged 1 May 1960 off Nanortalik and was recaptured 18 1/2 months later 1,100 miles away off Glettingnaes (East-Iceland) with a length of 94 cm; it had obviously in the winter 1960/61 begun its spawning migration to NW. Iceland (one spawning ring in the otoliths), and after the spawning, completed its feeding migration to E. Iceland; another (1950 year-class) was caught 11 months later on the Heimland Ridge.

Six other large cod, tagged in May off S. Greenland (obviously re-migrants from the spawning off E. Greenland) migrated to the region Fylla Bank - St. Hellefiske-Bank. Three of them were caught there within 53 - 76 days after the tagging - mean migration - speed 3.7 - 7.2 miles per day. One cod of the 1950 year-class tagged in the beginning of May 1960 at Moesting Ground (E. Greenland) was recaptured 16 months later on Fylla Bank. All immature and smaller cod were either rather stationary or had migrated toward the coast. The greatest growth observed was 19 cm (from 45 to 64 cm) within 17 1/2 months (29-4-1960 to 16-10-1961).

Another tagging experiment was carried out in Nov./Dec. 1961 from a trawler fishing for fresh cod off Angmagssalik and Dohrn Bank. As the cod here were caught with redfish and at great depth, their survival capacity was much decreased. Therefore, only 111 cod were tagged. Returns have not yet been reported.

Table 1

10 years German fishery off Greenland in t. (figures for 1961 provisional)

	West Greenland						South Greenland					
Year	Cod	%	Redfish	%	Rest%	Total	Cod	%	Redfish	%	Rest%	Total
1952	822	71.8	300	26.2	2.0	1145	1250	95.4	0	0	4.6	1310
1953	668	90.4	1	0.1	9.5	739	1337	85.4	151	9.6	5.0	1565
1954	829	86.0	106	11.0	3.0	964	153	88.4	10	5.8	5.8	173
1955	5753	28.5	13959	69.2	2.3	20170	287	56.6	202	39.8	3.6	507
1956	23669	76.9	6065	19.7	3.4	30780	566	46.5	574	47.2	6.3	1216
1957	7816	34.2	14605	63.9	1.9	22863	964	73.9	268	20.5	5.6	1305
1958	18241	63.9	9252	32.4	3.7	28549	6684	75.4	1732	19.5	5.1	8863
1959	11142	38.3	16042	55.2	6.5	29061	2252	56.4	1558	39.0	4.6	3995
1960	18664	50.9	14894	40.6	8.5	36662	522	8.3	5395	85.5	6.2	6310
1961	60617	63.8	28255	29.7	6.5	95025	9801	38.4	13406	52.5	9.1	25522

	East Greenland						Greenland total					
Year	Cod	%	Redfish	%	Rest%	Total	Cod	%	Redfish	%	Rest%	Total
1952	-	-	-	-	-	-	2072	84.4	300	12.2	3.4	2455
1953	-	-	-	-	-	-	2005	87.0	152	6.6	6.4	2304
1954	-	-	-	-	-	-	982	86.4	116	10.2	3.4	1137
1955	3001	6.5	40948	88.9	4.6	46067	9040	13.5	55109	82.6	3.9	66744
1956	7437	16.6	33094	74.1	9.3	44683	31672	41.3	39733	51.8	6.9	76681
1957	5838	26.8	13638	62.5	10.7	21804	14619	31.8	28513	62.0	6.2	45971
1958	4553	31.3	8883	61.1	7.6	14538	29478	56.7	19866	38.2	5.1	51952
1959	9691	31.4	19186	62.2	6.4	30869	23082	36.1	36785	57.5	6.4	63927
1960	15378	31.1	30250	61.2	7.7	49421	34560	37.4	50538	54.7	7.9	92389
1961	10938	28.6	25743	67.3	4.1	38234	88348	55.6	67405	42.4	2.0	158784

B. Subareas 2, 3, 4: Fishing conditions and hydrography.
by J. Messtorff

Field-work was restricted to one search-trip in March/April 1961. The main purpose of this trip was to examine the fishing conditions for cod and to find out if there are possibilities for a profitable commercial saltfish-fishery by German trawlers at that time of the year in the Gulf of St. Lawrence (4R, 4T), off the south coast of Newfoundland (3P) and east and southeast off Cape Breton Island (4V).

During 1961 commercial fishery was carried out by German trawlers mainly off South Labrador (2J, Sundall and Hamilton Inlet Bank) and off the north-east coast of Newfoundland (3K, Ritubank). Some trawlers temporarily also fished on the north-east slope of Newfoundland-Bank (3L) and on Flemish Cap (3M). From these regions market samples have been collected.

Subarea 2

The main season for German trawlers fishing in the Northwest Atlantic was from January till the beginning of March 1961 when an increased concentration of cod yielded good catches. During that time up to 20 trawlers were fishing off South Labrador, mainly in the Sundall-and Hamilton Inlet Bank area (2J). The proportion of cod amounted to 60-80% and in several cases to even more than 90% of the landings. In early April a scouting trawler visited the Sundall area but did not find satisfactory fishing conditions. Experimental hauls yielded an average catch per trawling hour of about 2 t. Cod predominated in the catches with 70%, the rest consisting of redfish. The best catches were made in depths of 360 to 400 m, but the proportion of fish which were too small for the German market conditions was rather high. From April to June 1961 only few salting trawlers temporarily fished for cod off South Labrador, whereas no fishing at all took place in July and August 1961. During the last four months of the year German trawlers only occasionally visited the fishing grounds off South Labrador.

Subarea 3

Fishing conditions and activities off the north-east coast of Newfoundland especially on Ritubank (3K) were almost the same as on the near-by fishing grounds off South Labrador (2J). Mostly there was no clear distinction between these two areas, and both often were reported as "Belle Isle".

Along the north-eastern slope of the Newfoundland Bank (3L) some German trawlers fished successfully for redfish in January and February, and up to 9 vessels from end of August until middle of October 1961.

The Flemish Cap area (3M) was only occasionally visited by single deep-freezing trawlers. In the middle of March 1961 experimental hauls were carried out by a scouting trawler yielding 3-4 t redfish per trawling hour on the northern slope in depths of 400-500 m. The mean length of redfish was 35.6 cm. There was no remarkable by-catch of cod. Further experimental hauls in different depths (290-460 m) on the southern slope of Flemish Cap yielded neither remarkable catches of redfish nor of cod. During search-trips in September and November 1959 average catches of 8.5 t cod (60%) and redfish per trawling hour have been made in the same area.

On the search-trip in March/April 1961 fishing conditions on the south-western slope of the Newfoundland Bank (30) were found unsatisfactory. Experimental hauls on St. Pierre Bank (3P) were more successful. In depths of about 250 m maximum catches per trawling hour amounted to 3t cod, 1 t haddock and 0.5 t coalfish. Additionally a relatively great number of large halibut (up to 8 fish per haul) were caught. Catches on Burgeo Bank (3P) also proved unsatisfactory: maximum catch 1 t cod in 190-250 m, and over 258 m mainly small redfish up to 1.5 t per trawling hour. Near Isle aux Morts (3P, North) one haul of 3.5 t cod per trawling hour was made, but further hauls were far less successful. The same instability of fish concentration and catches was observed on all fishing grounds off the south coast of Newfoundland (3P). Quite the same observation was made on the search-trip in April/May 1960. These conditions did not allow a profitable commercial fishery by German trawlers although in this area the length-composition of cod (average 59.5 cm) was more suitable for the German market than for instance in Subarea 4.

Subarea 4

When the search-vessel arrived in the Gulf of St. Lawrence (4R) in the middle of March 1961 fishing conditions for cod were found quite good. Only 5 hauls were made giving a total catch of 50 tons of cod with 6.5 tons per one hour. The fishing depth was 230-285 m. The length-composition of cod, however, proved not so satisfactory as the quantity of catches. The average length of cod was only 56.7 cm. Thus a great portion of the cod was too small for the present German market conditions. The length-composition of cod in 4R was about the same as in April, 1960. Already at the end of March, 1961, the fishing season in 4R was nearly finished as the average catch per trawling hour had decreased to less than 1 t. At the same time the search-vessel met with rather dense cod concentrations in the area between St. Paul and the ice-limit west of Cape North (4T). Within 24 hours (11 hauls) a total of 83.5 t cod was caught. The average catch per trawling hour was about 5 t. But with a mean length of only 54.9 cm these cod were still smaller than in 4R. Along the edge of Cabot Strait off Cape Breton Island (4V, North) fishing conditions were rather poor at the end of March.

Experimental hauls yielded at the most about 1 t of very small cod per one hour (mean length 41.2 cm). In the second half of March, 1961, rather good fishing conditions were found in the area of Artimon Bank and especially on the northern edge of Banquereau (4V) in remarkably shallow water (80-100 m). The catches proved to remain rather constant over the examined period of about 10 days. At maximum 10 t of cod were caught after 2 hours trawling and the average catch per one hour was 1.5 t. With a mean length of 58.6 cm these cod were considerably larger than those of the Gulf of St. Lawrence. Therefore, a daily production of about 5 t salted fish could be achieved. Occasionally a by-catch of coalfish up to 1 t per trawling hour was obtained, whereas haddock catches were very poor. No remarkable catches could be made on the southern slope of Banquereau.

Hydrographic observations

On the search trip in March/April 1961 a bathythermograph was used to get an impression of the water temperature conditions on the different fishing grounds. Measurements were taken in the following areas:

Flemish Cap - 3M

As expected water temperatures in this area were relatively high also in March. The lowest temperatures were measured on the shelf plateau in shallower water.

surface:	1.5°C
bottom at 165 m:	2.0°C

Above the north-eastern slope of Flemish Cap there was already a considerably increase of temperatures.

surface:	2.7°C
bottom at 200 m:	3.0°
" at 260 m:	3.7°

Eastern edge of Newfoundland Bank - 3L

The central and northern part of the Bank was still more or less covered with ice.

surface:	-1.5°C
bottom at 120 m:	-0.3°

Southwest edge of Newfoundland Bank - 3O

surface: between -0.5° and 0°C; in shallower water decreasing temperatures until -1.0°C in 80 m depth; bottom water at 100 m again + 1.5°C. On the slope of the bank temperatures of bottom water were rising with increasing depth.

bottom at 150 m:	4.0°C
" at 250 m:	5.0°

Beyond the slope in deeper water maximum temperatures of about 8°C were measured already in depths of 100-150 m.

Southwest edge of St. Pierre Bank - 3P

surface:	-1.5°C
100 - 150 m :	0°
bottom at 200 m :	+2.5°
" at 250 m :	3.5°

Gulf of St. Lawrence - 4R (in the ice-free part between Cape Ray and Cape St. George).

surface:	about -2°C
100 - 150 m :	0°

with increasing depth temperatures were rising considerably. Bottom water at main fishing depth = 240-260 m: about +4°C.

Banquereau - 4V, South

surface:	between -1° and -2°C
90 m :	0°
bottom at 100 m:	until +1° (main fishing depth!)
" at 200 m:	+3.5°C

Shelf edge south of Sable Island - 4W

surface :	between -0.5° and +0.5°C
50 m :	+1.0°
150 m :	3.0°
200 m :	4.0°

C. Mesh Selection Experiments on Redfish
by Dr. H. Bohl

Investigations on the selection of redfish were carried out with FRV "Anton Dohrn" during July 1961 on the East Greenland fishing ground Angmagssalik (64°34' - 64°50'N; 35°07' - 35°20'W, depth: 360-450 m). A German deep sea bottom trawl was used. Several codends made of "Perlon" and Manila were tested according to the cover method. The cover enveloped the whole topside of the codend, the underside of the codend was blinded with small-meshed netting.

The catches consisted of a mixture of both mentella-type and marinus-type of Sebastes marinus. Other species of fish and evertebrates never reached more than 25% of the catch weight. The catches mostly ranged between 20 and 40 baskets. Larger catches, up to 60 baskets, were very rare.

Sizes of fish were taken to the nearest centimeter, from the mouth closed (including the hook of the mentella-type) to the tip of the caudal fin. The mesh measurements were made with the WESTHOFF 1959 model exerting a pressure of 4 kg.

Table 1

Codend No.	29	6	17	28	26
Material	"Perlon"	"Perlon"	"Perlon"	"Perlon"	Manila
Mode of making	knotless, single twine	double braided	double braided	double braided	double braided
Average mesh size (mm)	122	131	139	146	147
Number of hauls	5	11	8	6	5
Total No. of redfish	5036	10960	7466	6414	3337
Selection range (cm)	10.0	14.5	13.0	14.5	15.0
No. of fish within the selection range: codend	1653	2929	2622	2651	1571
cover	1190	1795	1743	2935	1180
50% retention length (cm)	35.3	33.5	37.2	41.2	38.4
Selection factor	2.9	2.6	2.7	2.8	2.6

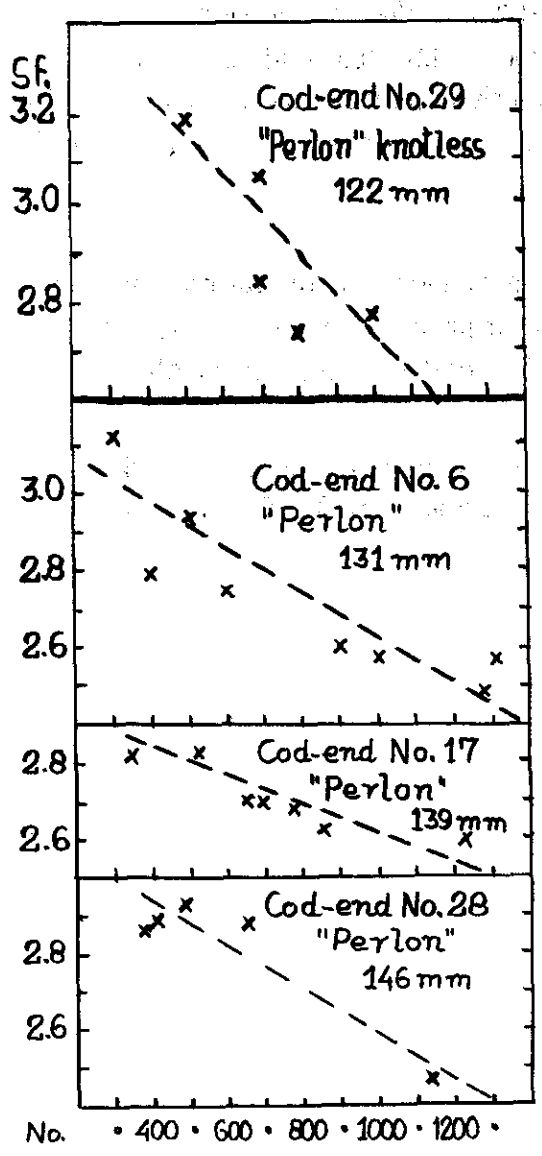


Fig. 1. Relation between selection factor and catch size. Ordinate-selection factor abscisse - no. of redfish in the cod-end.

The following facts can be seen from Table 1:

1. The selection factors of knotted "Perlon" codends increase from 2.6 at a mesh size of 131 mm to 2,7 at 139 mm and to 2,8 at 146 mm mesh size.

2. In the knotless "Perlon" codend (mesh size 122 mm) the selection was much better (sf. 2.9) than in knotted "Perlon" codends.

3. The selection factor 2.6 was found for a Manila codend with 147 mm mesh size. This result confirms the well-known fact that codends made of polyamide fibre show a better selection than those made of Manila.

In spite of the small variation in quantities caught it was tried to demonstrate the influence of catch size on the selection. Unexpectedly a clear relationship was found by plotting the selection factors calculated for each catch against sizes (Fig. 1). Only hauls with nearly the same towing duration (80-90 minutes) were included. The figure shows that the selection factors decrease with increasing catch sizes. This result demonstrates definitely that a biologically sensible minimum mesh size for redfish can never be derived from selection data which are mainly based on small or medium catches. Redfish is often caught in large quantities by which the process of selection is supposed to be hindered to a high degree. Therefore, it must even be feared that a conservation of redfish stocks by means of mesh regulations is not possible.

Once more the redfish meshing problem was of particular interest. It could be shown that the number of meshed fishes is higher in larger catches than in smaller ones. - The Manila codend (147 mm) contained less meshed fish than the "Perlon"

codends of the same or smaller mesh size. - The relation between quantity of meshed fishes and mesh size is not yet completely analysed. Under conditions as found during July 1961 off Angmagssalik "Perlon" codend meshes of about 139 mm appear most liable to mesh redfish. The number of meshed redfish was 96, i.e. 13.8% of the redfish caught in this codend and its cover. Larger-meshed as well as smaller-meshed codends contained fewer meshed fish.

The average length of meshed individuals increases with the increasing mesh size from 40.8 ± 0.2 to 46.0 ± 0.3 cm. At last it should be mentioned that the average sizes of meshed fishes correspond to the 70-89% retention length.

Reference: H. Bohl: German Mesh Selection Experiments on Redfish 1961, ICES, Comp. Fishing Committee, Paper No. 88, C.M. 1961.

V. Icelandic Research Report, 1961.

A. Cod at West Greenland.

by Jón Jónsson

The Icelandic fishery for cod at West Greenland is exclusively carried out by trawlers. In 1961 the total Icelandic catch of cod in this area amounted to 10,600 tons compared to 4,700 tons in 1960.

The greatest part of the annual catch was taken in the months July-August. The number of fishing trips in 1961 was substantially lower than in 1960, 61 compared to 105 in 1960. The increase in the catch of cod in 1961 is mainly due to greater fishing effort for this species.

In 1961 a total of 1600 otoliths were collected in 8 samples of trawler caught cod from the West Greenland fishing banks.

The samples were taken from the landed catch, therefore sex and maturity are listed in only few cases.

The age-and length distribution of these samples is also shown in Fig. 1. The table providing the detailed data will be given in the 1961 "Sampling Yearbook".

The samples cover the area from Cape Farvel to Fyllas Bank (Divisions 1D - 1F) and can be separated into three groups according to seasons sampled.

Five samples were taken in April, and four of these show a marked and stable dominance of the 1953 year-class. The average length of this year-class as 8 years old was about 77 cm.

This year-class seems to have been fairly evenly distributed in the area sampled and shows a very uniform rate of growth.

The sample from Fiskenaes Bank in the beginning of April shows a great dominance of the 1956 year-class, and this year-class is also very pronounced in the two samples from September. In these samples the 1953 year-class is much less prominent, but in the sample from December these two year-classes were found in almost the same quantities.

The good year-classes from 1947 and 1950 can also be traced in the samples, but they were of no importance to the fishery.

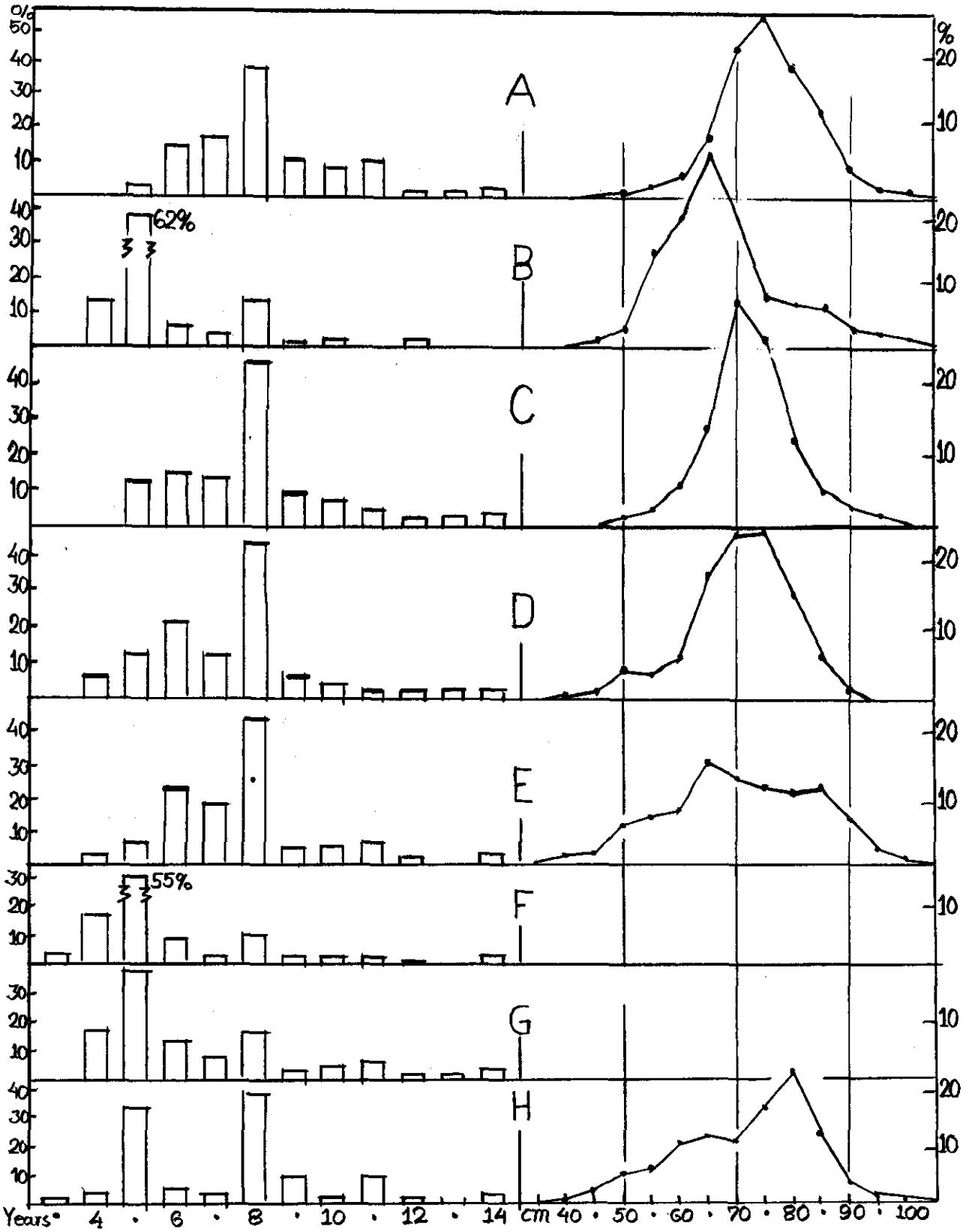


Fig. 1. Age distribution of cod at West Greenland, 1961. A-Frederikshaab 1-3 April; B-Fiskenaes Bk. 5-6 April; C-Dana Bk. 10-12 April; D-Fylla Bk. 23-26 April; E-Fylla Bk. 24-27 April; F-Fiskenaes Bk. 5-8 Sept.; G-Fylla Bk. 8 Sept; H-Cape Farvel 26-27 Dec.

B. Redfish.
by Jakob Magnússon.

In the Annual Proceedings for the year 1956-57, Vol. 7 a short note is given on the development of the Icelandic fishery for redfish at West Greenland.

During the year 1956 a very good catch was obtained off East Greenland, caused by a less intensive fishery for redfish at West Greenland. In 1957 a still considerable catch was taken at West- and East Greenland. However, the catch was decreasing in spite of more intensive fishing, and as this trend continued in 1958 it was decided to send an expedition to the banks off Labrador and Newfoundland in order to search for redfish.

On a cruise in July 1958 great concentrations of redfish were found and a large fishery for redfish was started from Iceland in Division 2J. A second cruise was made in September the same year and the fishery was extended to 3K. (See also ICNAF Ann. Proc. 1958-59).

The fishery for redfish continued throught the year 1958 and until the beginning of February, 1959, when it was discontinued because of bad weather and unfavourable ice conditions. The fishery was resumed in May 1959. The catch, though still excellent, was becoming poorer. In July 1959 a cruise was made in order to search for redfish in more southern regions, mainly on the NE slope of the Grand Bank and Flemish Cap. A commercial fishery was established on the NE slope of the Grand Bank. In 1960 the catch was still poor with some exceptions. Two cruises to the region extended the fishery to a new place in 3K which for a while yielded somewhat larger catches. But very soon the catches became poor. In 1961 the catch was very low at Newfoundland and the fishery for redfish was discontinued for the greater part of the year.

This very brief outline of the Icelandic fishery for redfish in the Newfoundland area needs some explanation. In 1958 and 1959 the concentrations of redfish at Sundáll and Ritubanki were enormous, and the fishery remained good for one year. However, the total quantity of redfish caught in the Newfoundland area in 1959 was smaller than in 1958, although the fishery in 1958 was only of 5 months duration.

During the period from July 1958 to 1961 the main fishery took place on two principal fishing grounds, Sundáll in 2J and Ritubanki in 3K. These fishing grounds are on the edge of the continental shelf. A few more limited grounds were discovered by the fishermen, and expeditions gave considerable catches for a while.

Table I shows the development of the fishery for redfish from Iceland at Newfoundland and Labrador during the period 1958-1961:

Table I. Catch in 1000 tons by divisions.

	2J	3K	Others	Total
1958	31.0	48.4		79.4
1959	9.6	55.7	3.6	68.9
1960	4.5	6.5	0.9	11.9
1961	0.1	4.2	0.2	4.5
Total:	45.2	114.8	4.7	164.7

During this period material on redfish was collected both on cruises and from commercial catches. Great variation in size of the redfish occurred from one place to another. Generally the redfish was of good commercial size from Ritubanki (in 3K)and Sundáll (in 2 J). On the Hamilton Inlet Bank the redfish was infected with parasites and other defects in the flesh, and to such a great extent that fishery on this bank was not carried out on a large scale. In some places within these divisions the redfish were so small that the trawlers stopped fishing in spite of good catches.

The average length distribution and the annual deviation from the average have been calculated for 2J and 3K separately for the years 1958 to 1961. The data from cruises and from the landed catch are given separately.

Table II shows the material collected in 2J and 3K during the period 1958-1961.

Table II.

	Cruises		Landed		Total	
2J	Samp.	Nos.	Samp.	Nos.	Samp.	Nos.
1958	47	10,731	2	633	49	11,364
1959	3	600	3	959	6	1,559
1960	19	2,368	-	-	19	2,368
	69	13,699	5	1,592	74	5,291

	Cruises		Landed		Total	
3K	Samp.	Nos.	Samp.	Nos.	Samp.	Nos.
1958	29	5,666	4	1,303	33	6,969
1959	8	1,659	9	2,951	17	4,610
1960	20	398	2	408	22	4,389
1961	2	201			2	201
	59	11,507	15	4,662	74	16,169

In Figs. 1 and 2 the average length distribution and the deviation from the average for the years 1958-1961 are shown for divisions 2J and 3K. The great variation in the deviation is mainly due to a fishery at different places within the divisions themselves, where the size of redfish varied very much from one place to another. At Sundâll (2J) in 1959 e.g. the fishery was mainly carried out in greater depths where the redfish was of a smaller size (see also Ann. Proc. 1958-59). But in 1960 the trawling again was carried out in shallower water where the redfish still remained bigger than in deeper water.

The impression from this material is that even within the same division the size of the redfish can vary very much from one place to another and/or according to depths. Further, that the differences in size from one year to another are sooner due to that fact than to a general trend or influence from the fishing. However, there might be an exception for the biggest redfish (over 50 cm) in 3K, which were mainly caught on Ritubanki.

In Table III the mean size of redfish is given, for comparison, in all Subdivisions where Icelandic trawlers fished for redfish during the period 1958-1961. (Two samples from 1957 and 1962 are also included). The mean sizes for redfish caught on cruises and from commercial landings are calculated separately.

Table III:

	1C	1B	1E	1D	2G	2H	2J	
Year	Cruise	Cruise	Land.	Land.	Cruise	Cruise	Cruise	Land.
1957			44.6					
1958						38.2	38.0	43.1
1959	45.1	42.7			35.8		37.1	39.2
1960	39.0		41.9				40.4	
1961				45.5				
1962			41.9					

	3K		3L	3M
Year	Cruise	Land.	Cruise	Cruise
1957				
1958	41.0	37.3		
1959	37.3	37.9	36.3	35.2
1960	42.8	37.4		
1961		39.0		
1962				

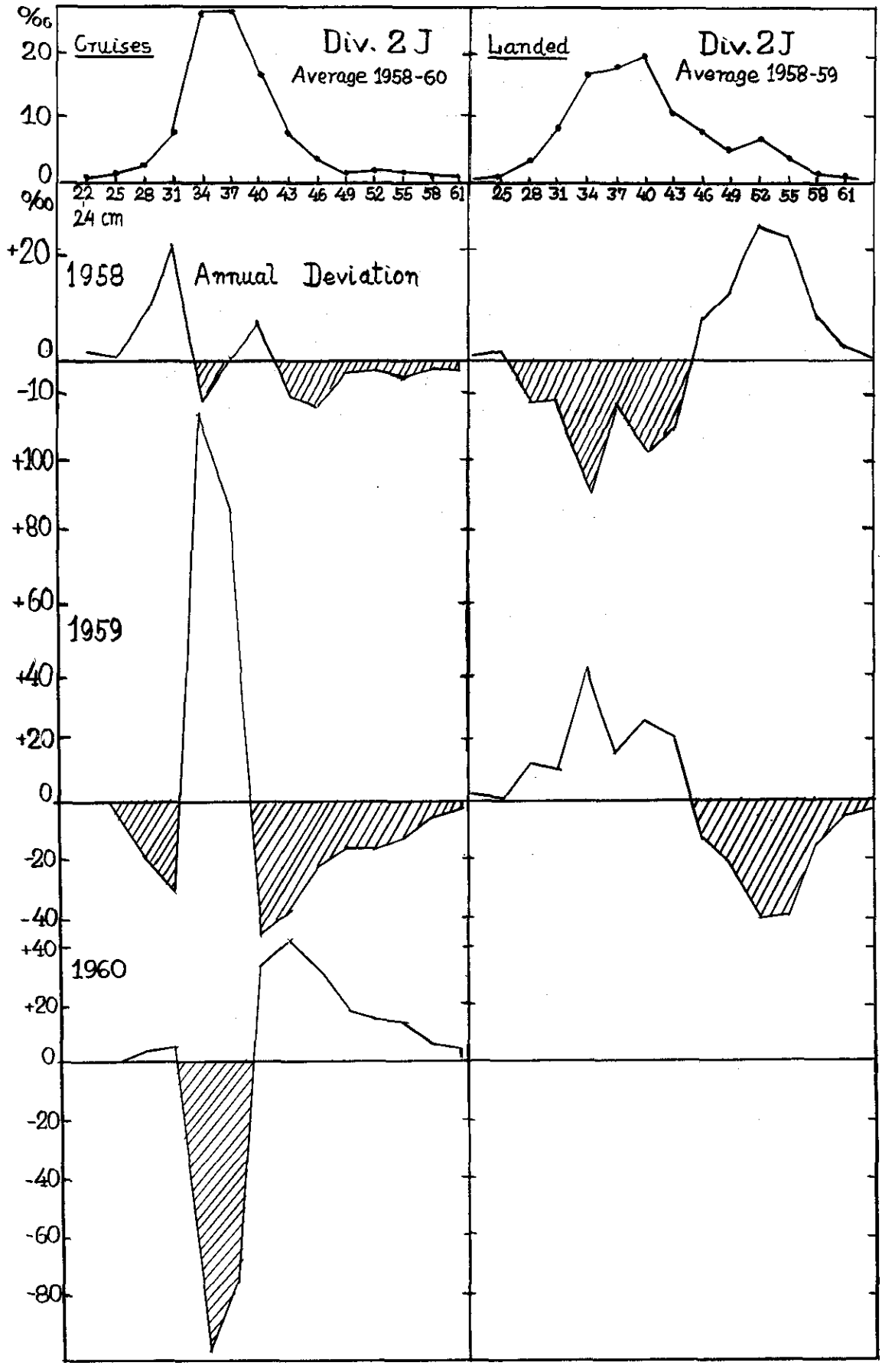


Fig. Redfish. Average length distribution and deviation from mean, 2J.

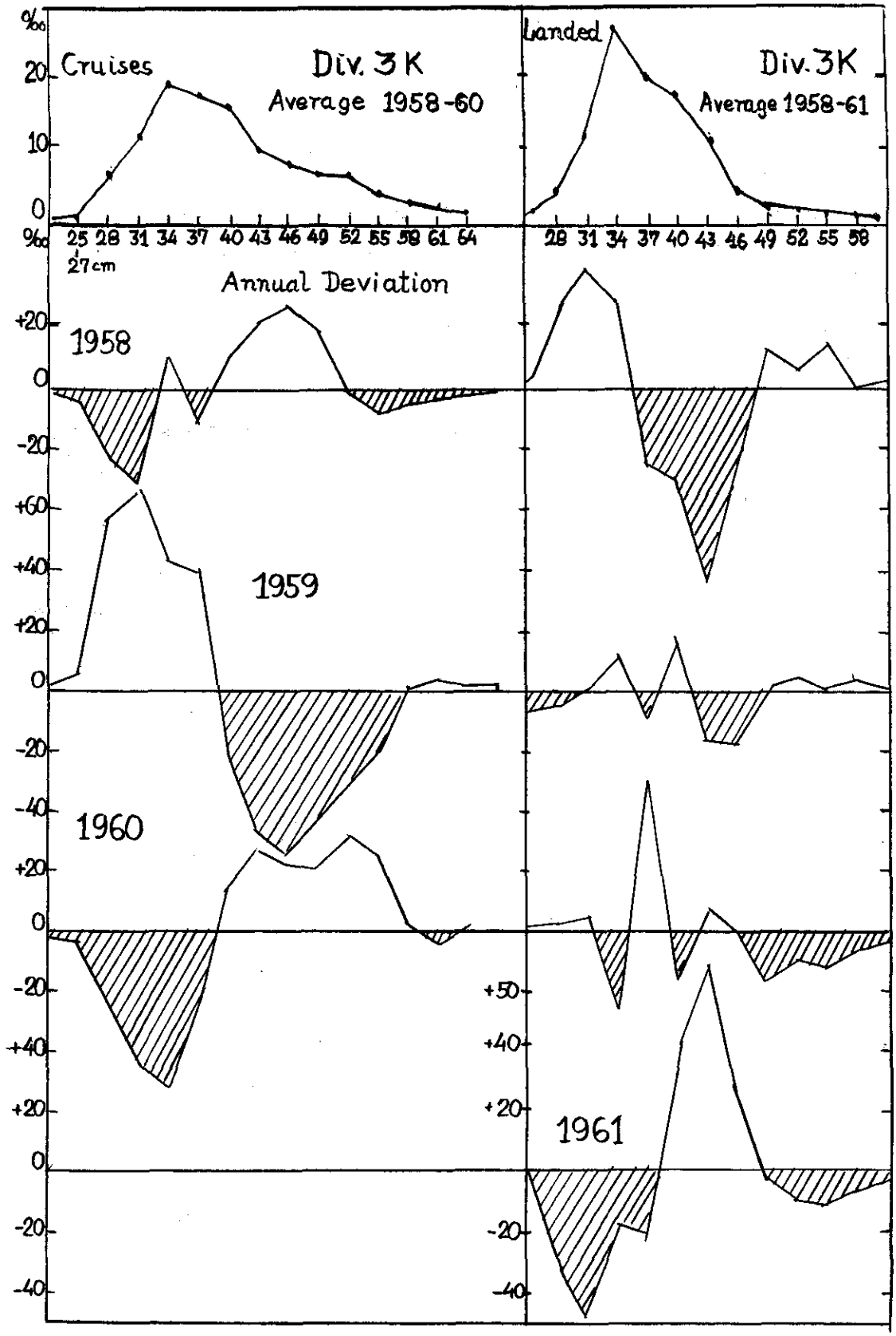


Fig. 2. Redfish. Average length distribution and deviation from mean, 2J.

VI. Italian Research Report, 1961.

Observations on the Italian Fishery in the ICNAF Area.

by Francesco Matta

Being charged by the Ministry of the Mercantile Marine, I took part in a winter fishing trip in the Convention Area, from January 15th to April 12th, 1962, to examine some samples of the ichthyc fauna and to establish their features in relation to fishing zone, season and gear used.

1 - Vessel Type

The otter trawler "Genepesca I" has a gross tonnage of 1650, an overall length of 76,5 m, and an engine of 1251 HP. It has four refrigerated holds, each with a capacity of 350 mc. There is also a filleting machine Baader 38, two skinning-machines Baader 47 and a digestor Vevey with a capacity of 2mc. for the production of meal and fish oil.

The crew consists of 53 persons. The staff employed in the fishing operation, making and storing the fish products, is divided into two groups of sixteen persons, each taking a six hour turn.

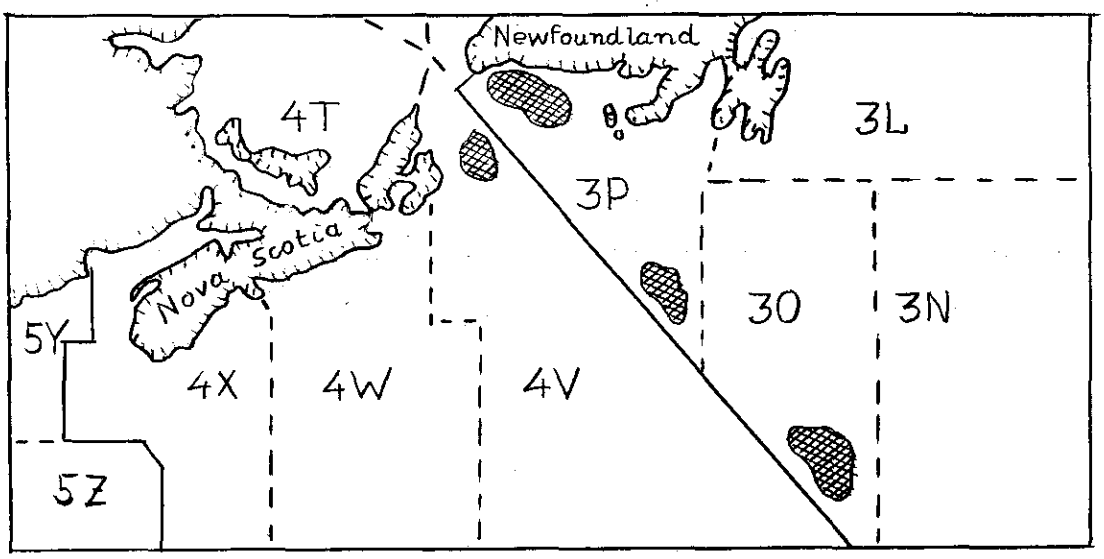


Fig. 1. Zones of fishing on a cruise with the otter trawler "Genepesca I" S. of Newfoundland in February-March, 1962.

The species used on board "Genepesca I" are: Gadus morhua, Melanogrammus aeglefinus, Gadus virens, Hippoglossus hippoglossus, and Sebastes mentella. The size of the fish beheaded and tailless must be not less than 20 cm in length. All specimens which have a total length less than 35 cm are discarded.

2 - Fishing Gear

The trawl used are of the French type, manufactured of nylon; the head-line measures 25.5 m. and the ground-rope 35.5 m. The size of the meshes of the cod-end was 110-120 mm stretched measure, wet and used.

3 - Area and Season of Fishery

The fishery began the first February along the south-western edges of the Newfoundland Bank where important catches of haddock and pollack were made. Later the fishery covered the Fletan and St. Pierre Bank region. On the 8th February, the fishery was carried out off the south coast of Newfoundland until the 17th February off Cape Anguille when a spawning area for cod was found at a depth of 250-300 m, where the bottom was covered with Ptilota plumosa. Some trials were also made east of Scatari with modest results.

4 - Quantities caught, Yields and Discards

From the 1st of February to the 12th of March, 174 hauls were made with 378 hours of fishing, and 800 tons fish were caught with an average of 4,6 tons per haul and 2 tons per one hour of fishing.

The activity of the "Genepesca I" from February 1st to March 12th may be presented as follows:

Subarea	Division	Number of hauls	Hours of fishing	Tons of fish caught	Tons per haul	Tons per hour
3	3 O	14	33	113	8	3,4
3	3 P	112	237	383	3,4	1,6
4	4 R	35	80	276	7,9	3,4
4	4 V	13	28	30	2,3	1,07
		174	378	802	4,6	2,1

The quantities of fishes stored, of fillets, meals and oil, are by species as follows:

- Cod	kg	297,730
- Haddock	"	40,650
- Pollock	"	37,590
- Halibut	"	1,750
- Redfish	"	160
	kg	377,880
- Fillets	"	21,672
	kg	399,552
- Meal	"	23,000
- Oil	"	1,000
	kg	423,552

The discards can be estimated at about 50% of the amount caught. In this are included: 1) the species which are not used, like Skate, Dabs, Catfish, etc.; 2) the undersized fish; 3) the refuse from the production of frozen, beheaded fish and fillets.

5 - Biological Observations

The following 11 samples were examined:

Number of sample	Date	Division	Position	Locality	Species	Number of specimens
1	1/2/62	3 O	43°30' N 52°05' W	S. W. Bank Newfound	Haddock	199
2	3/2/62	3 O	43°23' N 52°00' W	idem	Haddock Pollock	93 54
3	5/2/62	3 P	45°09' N 55°13' W	S. Fletan	Cod	88
4	8/2/62	3 P	47°19' N 58°35' W	Bay de la Poile	Cod	711
5	9/2/62	3 P	47°19' N 58°12' W	idem	Cod	142
6	17/2/62	4 R	47°46' N 59°28' W	Cape Anguille	Cod	200
7	19/2/62	4 R	47°47' N 59°30' W	idem	Cod	550
8	21/2/62	4 R	47°45' N 59°30' W	idem	Cod	152
9	27/2/62	3 P	47°31' N 58°32' W	Bay de la Poile	Redfish	107
10	27/2/62	3 P	47°18' N 58°27' W	idem	Cod	120
11	1/3/62	4 V	46°11' N 58°52' W	Scatari	Cod	636

1 - Observations on the Cod

The cod represented 78% in weight of the material stored. The most important catches were made along the southern coasts of Newfoundland, between Port aux Basques and Burgeo Bank and at Cape Anguille.

a) Total length

Total lengths of cod from the samples are as follows:

Number of sample	Date	Division	Locality	Depth m.	Length	Mode cm.
1	5/2/62	3 P	S. Fletan	152-179	34 - 88	66
2	8/2/62	3 P	S.Bay Poile	195-228	31 - 87	48
3	9/2/62	3 P	idem	175-190	41 - 75	51
4	27/2/62	3 P	idem	220-272	40 - 75	48
5	17/2/62	4 R	C.Anguille	245-285	35 - 80	60
6	19/2/62	4 R	idem	170-320	36 - 71	48
7	21/2/62	4 R	idem	273-278	38 - 71	51
8	1/3/62	4 V	Scatari	140-178	30 - 74	45

b) Sex

Division 3P

The sample caught on February 5th at 152-179 m. of depth, showed 73% of males and 78% of females in the resting stage and only 27% of the males and 22% of the females in the developing stage. The sample caught on the 9th February at 175-190 m. showed more specimens with gonads in the developing stage (56% of the males and 32% of the females), while 10% of both sexes were in the post-spawning stage. The sample caught on the 27th February at 220-272 m showed a higher percentage of specimens in the developing stage, viz. 63% males and 47% females, while 15% and 8% respectively were in the post-spawning stage.

Division 4R

A sample caught on February 17th at 245-285 m showed 75% males and 62% females in an advanced developing stage, near spawning, and 6% and 4% respectively in the post-spawning stage. The sample caught on the 21 February showed a higher percentage of specimens in the resting stage (33% males and 56% females), while the specimens in the developing stage were lower, respectively 50% and 31%. 14% males and 9% females were in the post-spawning stage. Obviously an uninterrupted migration to the spawning area occurred.

Division 4V

The sample caught on 1st March at 140-178 m showed 46% males and 35% females with gonads in the developing stage, while 36% males and 34% females were in the post-spawning stage.

c) Age-distribution

Division 3P

At the beginning of February, in the southern part of Fletan Channel males of age V and VI and females of age VII and VIII predominated. In the sample caught the 9th February at the southern part of the Poile Bay, males of age V, VI and VII and females of age V and VI predominated. In the sample caught on the 27th February in the same place, males of age VII and females of age IV were more numerous.

Division 4R

On the 17th February, off Cape Anguille, predominated males and females of the V and VI group, while the V group predominated in the sample caught on February 21st in almost the same area.

Division 4V

In the sample caught on 1st March in the Scatari region predominated specimens of both sexes of the VI age-group.

Year-Class	Age 1962	Mean lengths cm											
		Males						Females					
		3P 5/2	3P 9/2	3P 27/2	4R 17/2	4R 21/2	4V 1/3	3P 5/2	3P 9/2	3P 27/2	4R 17/2	4R 21/2	4V 1/3
1959	III	34,0	-	43,5	43,0	-	40,0	39,5	45,0	-	42,5	39,5	37,0
1958	IV	41,0	45,3	46,6	48,8	41,5	41,0	46,6	48,5	46,6	51,9	43,9	42,3
1957	V	52,0	52,0	48,6	52,8	47,0	45,6	60,8	50,9	48,6	51,5	47,0	46,5
1956	VI	62,0	55,3	55,0	53,2	51,6	48,4	65,0	58,0	55,7	58,0	49,8	48,0
1955	VII	65,0	61,4	59,8	61,0	56,3	53,5	72,0	67,0	60,5	64,2	53,8	52,0
1954	VIII	70,0	69,0	65,4	63,0	56,0	58,0	74,0	76,0	66,4	68,3	60,5	-
1953	IX	-	81,0	67,0	-	61,0	62,0	79,0	-	72,3	74,0	66,3	69,0
1952	X	-	-	70,5	-	68,0	-	94,0	-	-	76,0	-	-
1951	XI	-	-	-	-	-	-	-	-	-	-	68,0	-

2 - Haddock

This species was found everywhere, but only in small quantities. The most important catches were made during the first days of February along the edges southwest of the Newfoundland Bank.

a) Total length

Total length of haddock in the samples are:

Number of the sample	Date	Division	Locality	Depth m.	Length	Mode cm
1	1/6/62	3 O	Newf. Bank	155-224	32 - 57	41
2	3/2/62	3 O	"	160-205	36 - 61	40

b) Sex

Division 3O

The sample caught on February 1st at 155-224 m consisted of 199 specimens of which 90 were males and 109 females. Females were more numerous than males and attained also a greater size. 90% of the males and 80% of the females were in the resting stage. The sample caught on February 3rd at 160-205 m consisted of 93 specimens, 40 males and 53 females. The sizes and the sex-and maturity distribution was as in the preceding sample.

3 - Pollock

This species was found sporadically and in small quantities. The most important catches were made in the beginning of February along the south-western edges of the Newfoundland Bank.

a) Total length

The total length in the sample caught on February 2 in the Division 3O at 160-205 m ranged between 74 and 100 cm. with a mode of 87 cm.

b) Sex

The sample examined consisted of 54 specimens, 21 males and 33 females. Females were not only more numerous than males but also of larger sizes. Many specimens showed gonads in the developing stage.

4 - Sebastes mentella

This species was found almost always during the fishing trip, but in small quantities. The most important catches were made along the southern coast of Newfoundland. Only one sample was examined. It consisted of 107 specimens caught the 27th February in 3P, off Port aux Basques, at 218-236 m.

a) Total length

The total lengths were between 28 and 39 cm. with a mode at 32 cm. Females were larger.

b) Sex

In the sample examined, 80 specimens were males and 27 females. The males were more numerous than the females. (males 75%; females 25%). Almost all males had gonads in an advanced developing stage; the females were in spawning stage.

Further data will be published later.

VII. Norwegian Research Report
by Erling Bratberg.

In 1961 two scientific cruises were made to Greenland waters with the research vessel "Johan Hjort" (Directorate of Fisheries, Institute of Marine Research, Bergen).

West Greenland

On the first cruise the investigated area was between the Nanortalik Bank and the Holsteinsborg Deep (Fig. 1), and the working days were between April 12th and May 11th.

Hydrography

8 hydrographical sections were worked between April 21st and May 8th. Temperatures were also registered in connection with all the fishing experiments. The isotherms for some of the sections are shown in Figs. 2-5.

The temperatures did not indicate any unusual change in the West Greenland Current. As usual cold water of Arctic origin with temperatures below 2°C covered the tops of the banks, while mixed water of mostly Atlantic origin characterized the

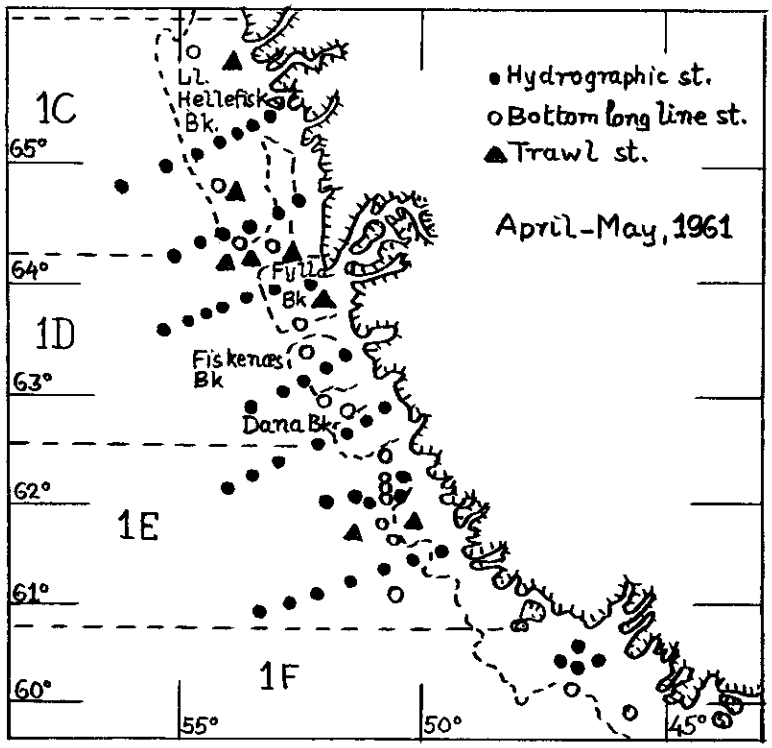


Fig. 1. "Johan Hjort". W-Greenland. April-May, 1961. Routes and stations.

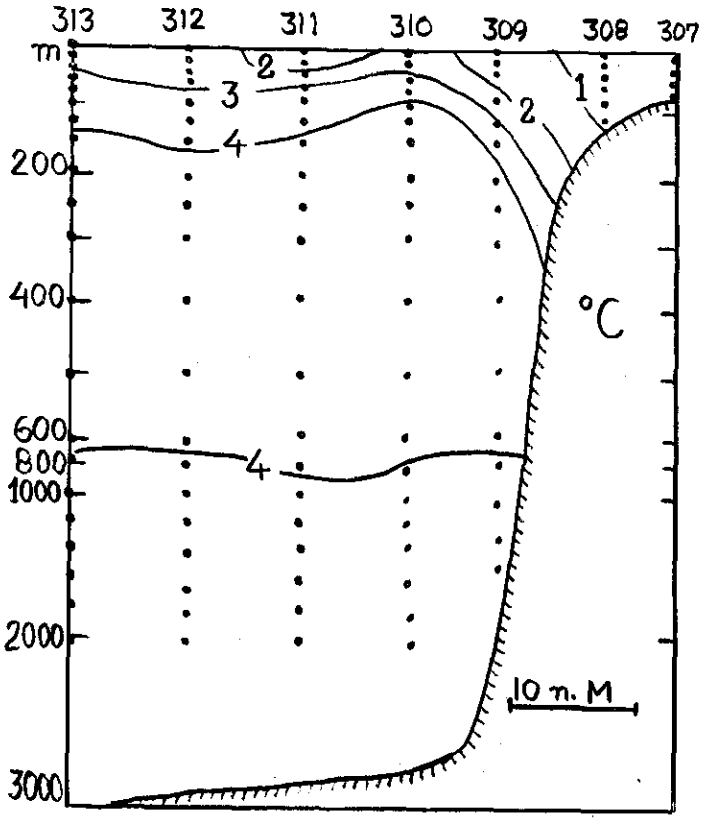


Fig. 2. "Johan Hjort", West Greenland April-May, 1961. Temperature section from Noname Bank and westward.

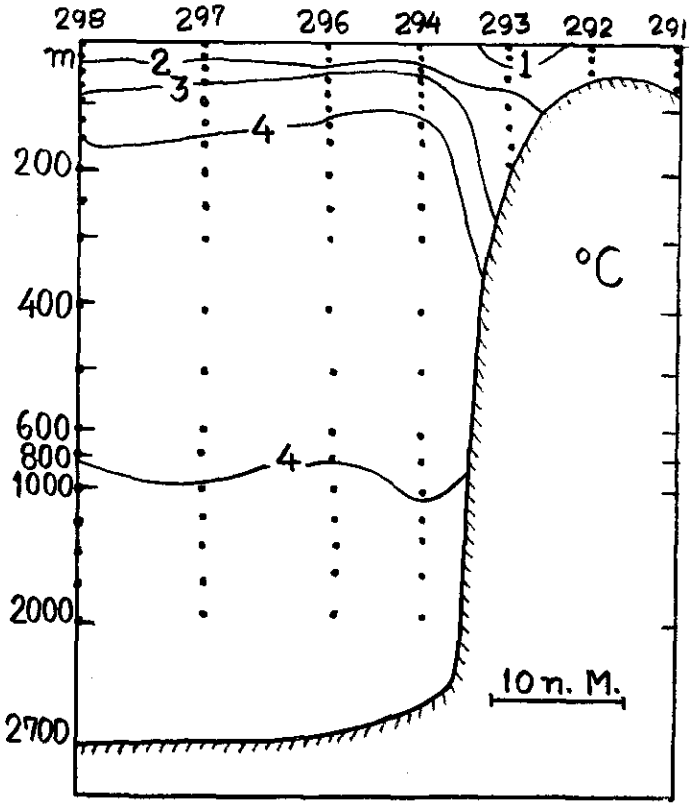


Fig. 3. "Johan Hjort", West Greenland April-May, 1961. Temperature section from Dana Bank and westward.

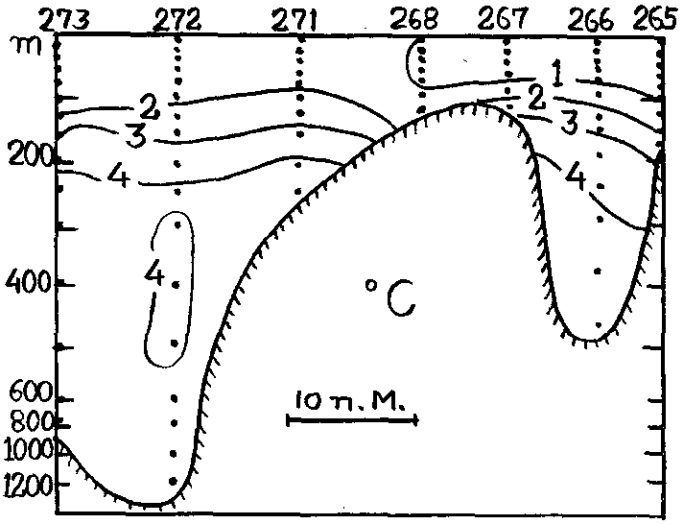


Fig. 4. "Johan Hjort", West Greenland April-May, 1961. Temperature section from Banan Bank and westward.

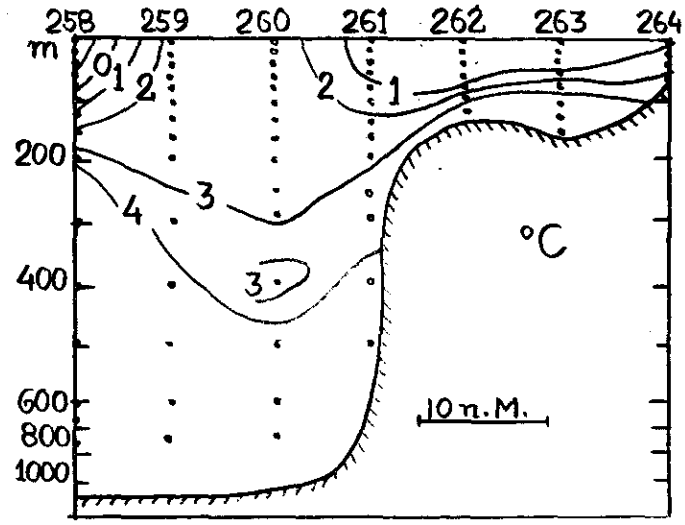


Fig. 5. "Johan Hjort", West Greenland April-May, 1961. Temperature section from Sukkertoppen and westward.

water masses on the western slopes below. However, compared with the hydrographical situation at approximately the same time in 1959 and 1960 the temperatures seemed to be somewhat higher in the surface layers in 1961. The comparatively high temperatures in the surface layers may have been due to stirring caused by the wind, but the good ice conditions may also have been a cause.

The drifting ice came unusually late. The Nanortalik Bank and the waters off Julianehaab, usually covered with ice from early March, were generally open. Scattered drifting ice was not met before the northernmost station. Further, heavy pack ice was first observed off Søndre Strømfjord, 66°05' N - 56°05' W.

The high temperatures in the surface layers may, on the other hand, have been caused in part by a heavier inflow of warm Atlantic water in 1961 than at the same time in 1959 and 1960.

Cod investigations

The fishing experiments showed comparatively good catches in the whole investigated area. Only on one station, in the Holsteinsborg Deep, was the catch really poor. Almost all the cod had completed the spawning, but were nevertheless in very good condition, and for a great part the fish were well fitted for Norwegian commercial purposes.

The distribution of the cod on the banks was much the same as in 1960. In some places, however, the mature cod were found in still shallower water than previously at the same time. This was probably caused partly by the good temperature conditions in the upper water layers and partly by migration to the feeding grounds after spawning. The immature cod this year were also found on the tops of some banks where the temperature was relatively low.

The length of the cod varied from bank to bank. The largest fish were caught on the four southern fishing stations and on Lille Hellefisk Bank where the mean length of the cod on the northernmost station was 80.74 cm. The smallest cod were taken on Fylla Bank where the mean length was 73.8 cm. In one long line catch here the mean length was only 55.41 cm. These cod were also the smallest taken without regard to gear.

Fig. 6 and 7 show the length and age composition of the total catch of cod taken on bottom long line. The mean length is 76.27 cm. At the same time last year the mean length was only 73.27 cm. In Divisions 1B, 1C, 1D, 1E and 1F the mean lengths were in April 74.01, 77.69, 73.74, 78.06 and 76.31 cm respectively. Samples were also taken from Divisions 1D and 1F in May. The mean lengths were then 73.76 and 77.46 cm. The increase in the overall mean length must for the

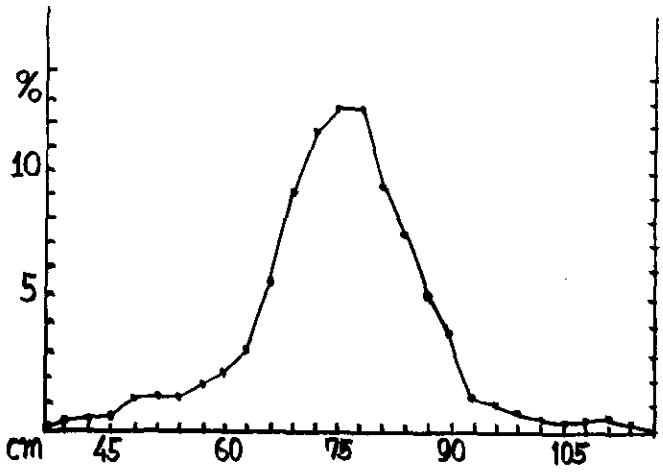


Fig. 6. "Johan Hjort", West Greenland, April-May, 1961. Cod, length composition (3-cm groups). Total bottom long line catch.

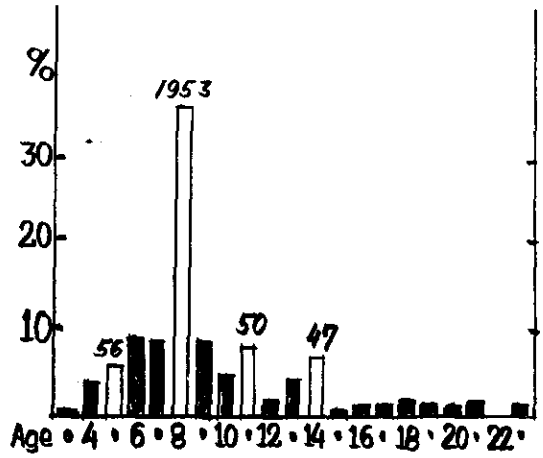


Fig. 7. "Johan Hjort", West Greenland, April-May, 1961. Cod, age composition. Total bottom long line catch.

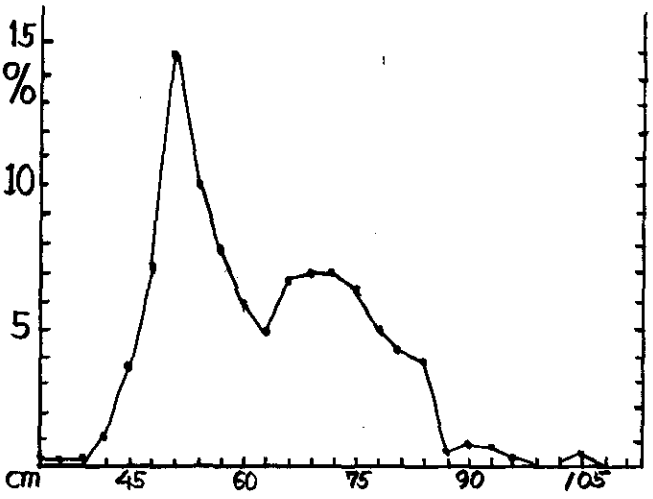


Fig. 8. "Johan Hjort", West Greenland, April-May, 1961. Cod, length composition. Total trawl catch.

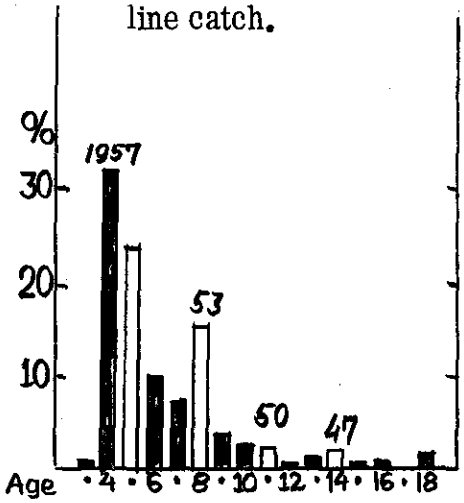


Fig. 9. "Johan Hjort", West Greenland, April-May, 1961. Cod, age composition. Total trawl catch.

greatest part be due to the growth of the 1953 year-class which constitutes 37% of the total long line catch and has a mean length of more than 77 cm. On the other hand the percentage of fish more than 9 years old has increased since last year, and these fish are of course also playing a great part in the mean length increase. The increase in the mean length could suggest a lack in the recruitment to the long line fishery, but such an interpretation is probably incorrect. The long line catch is not representative for the cod population as here only the mature part of the stock is fished.

In Figs. 8 and 9 are shown the length and age composition of the cod in the total trawl catch. Compared with the bottom long line catch the trawl catch is dominated by small fish. For a great part the cod in the trawl catches are immature, and the sampled material from these catches is thus not representative for the West Greenland cod population. The material, however, may give a hint regarding the recruitment to the long line fishery.

Compared with the trawl catch in 1960 there is again a strong 4 year old group, but not as dominant as last year. The loss of dominance of the 4 year old fish in 1961 is probably due to the 1956 year-class. As 4 year olds last year this year-class was promising, and now the year-class seems to confirm this. In other words, probably the 1956 year-class will be a strong one and give good recruitment to the cod long line fishery in the next years.

The 1947 and 1950 year-classes will probably play a very little part in the West Greenland cod long line fishery in 1962. The 1953 year-class will be dominant, but its importance seems to be decreasing. The mean length of cod caught on long lines may remain much the same as in 1961, but this depends on the influence of the 1956 year-class. If the influence of this year-class is going to be strong, we may have a slight decrease in the mean length of the cod in the bottom long line catches.

Halibut investigations

Attempts were made on 4 localities with halibut long line, but only 14 halibut were caught. The bycatch of halibut on the cod bottom long line was better. The total catch was 122 halibut. Also this year the halibut were rather small and immature. Fifty-four halibut were tagged, and as usual the tag was a yellow plastic disk in the gill cover.

East Greenland

The second cruise in 1961 was to East Greenland waters. Here the area between Cape Farewell and Cape Dan was visited on the days from August 23rd to September 12th (Fig. 10)

Hydrography

Between August 24th and September 5th 3 hydrographical sections were worked. Temperature registrations by means of a bathythermograph were made on 17 other localities, most of them in connection with the fishing experiments. The temperatures in the sections are shown in Fig.s 11-13.

Compared with 1959 the water seems to be warmer in 1961, especially in the Arctic component of the East Greenland Current. Only at Cape Dan were temperatures below 1°C recorded. The Arctic component of the current seemed also not to be so heavy as in 1959. The comparative warmer temperatures may to some degree be due to the very good ice conditions at that time. Between Cape Farewell and Cape Dan there was no drift ice before the 5th September. At that time drift ice came from the northeast into the area off Cape Dan. In addition, the warmer temperatures must have been caused partly by a heavier influx of Atlantic water from the Irminger Current.

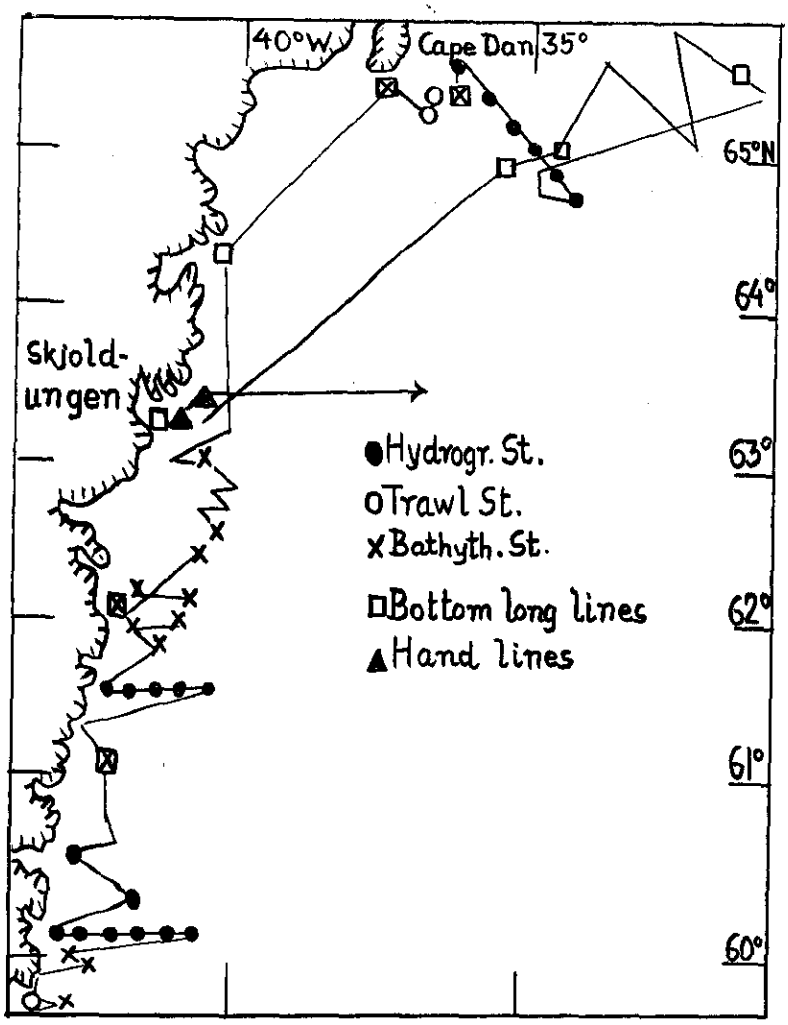


Fig. 10. "Johan Hjort", East Greenland, Aug.-September, 1961. Routes and stations.

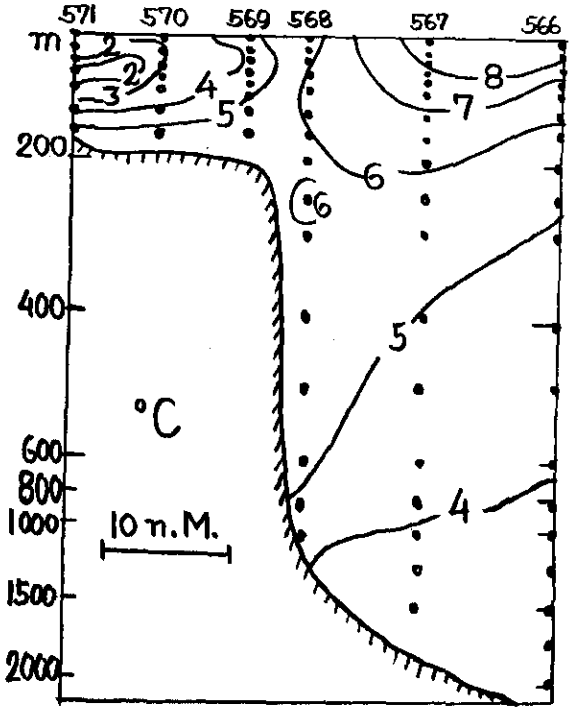


Fig. 11. "Johan Hjort", East Greenland, Aug.-Sept., 1961. Temperature section from Prins Christian Sund and eastward.

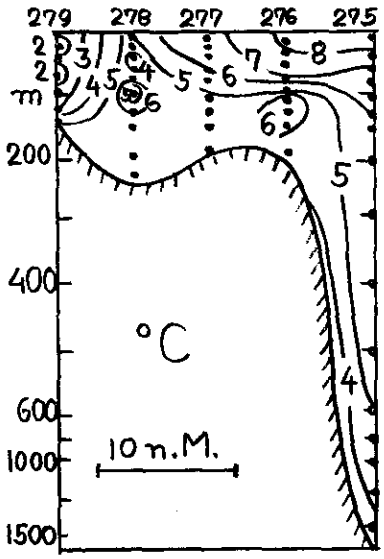


Fig. 12. "Johan Hjort", East Greenland, Aug.-Sept., 1961. Temperature section off Cape Tordenskjold.

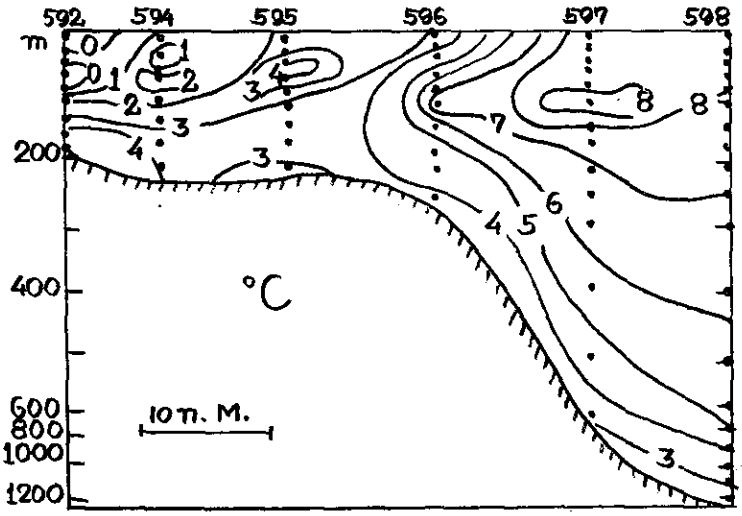
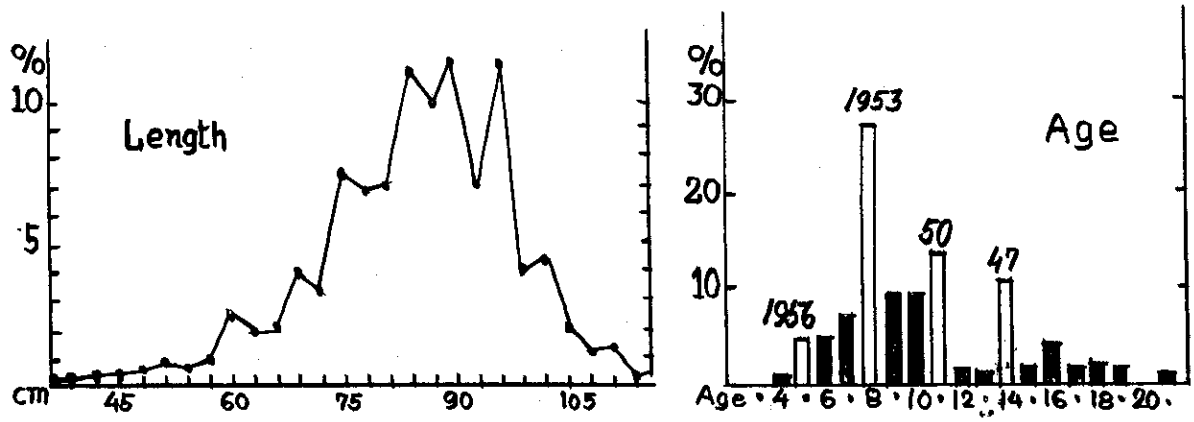
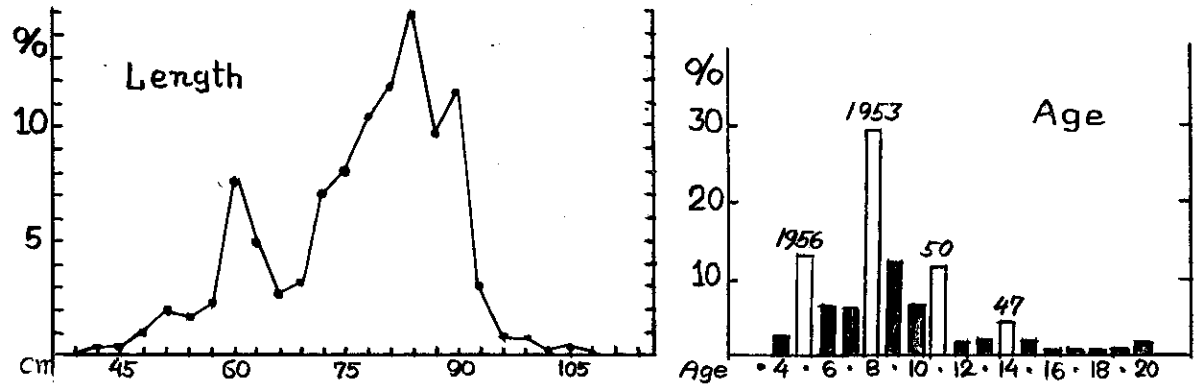


Fig. 13. "Johan Hjort", East Greenland, Aug.-Sept., 1961. Temperature section from Cape Dan and southeastward.



Figs. 14-15. East-Greenland, August-September, 1961. Total bottom long line catch. Cod.



Figs. 16-17. East-Greenland, August-September, 1961. Total hand line catch. Cod.

Cod investigations

The fishing experiments showed this year no localities where cod were completely absent, but compared with 1959 the catches on bottom long line off the coast were rather poor. Only off Cape Dan, about 5 n. miles offshore, the catch was really good. In Skjoldungen very good catches were obtained by hand line.

In Fig. 14-17 are shown the length and age composition of the cod in the total catches on bottom long line and on hand line. The mean length of the cod caught on bottom long line is 85.9 cm, nearly the same as in 1959 (86.1 cm). The largest cod were found off Cape Dan. Here the mean length was 93.4 cm. The cod which were caught on hand line had a smaller mean length. In the South-and Northfjord in Skjoldungen the mean lengths were 74.2 and 80.3 cm respectively. All the cod were in very good condition and had for a great part a satisfactory size for Norwegian commercial purposes.

The 1953 year-class is dominant and the 1950 year-class has comparatively the same strength in the catch both on long line and hand line. On the other hand there is a slight difference in the age composition. In the long line catch the 1947 year-class

plays a relatively great part and is a reason for the high value in the mean length. The 1947 year-class is much weaker in the hand line catch. Here the 1956 year-class is comparatively strong and seems to be promising for the recruitment to the long line fishery for the next years.

From the investigations in East Greenland waters in 1959 and 1961 it seems safe to conclude that a combined cod bottom long line and hand line fishery might be profitable. During the beginning of the season, from the middle of June to the middle of August, cod are found partly in pelagic shoals on the banks off the whole coast from Cape Farewell to Angmagssalik. Later in the season the fish move into some of the fjords where they feed on capelin and the fry of capelin. In the Angmagssalik fjord and the North-and Southfjord in Skjoldungen the conditions are of such a nature that the cod move nearly unfailingly into these fjords.

Halibut investigations

Ninety-one halibut were caught on halibut and cod bottom long line. The biggest catch, 36 halibut was taken about 5 n. miles off Cape Dan. The mean length in the total halibut catch was 89.1 cm. All the halibut were in good condition, and in part they had an adequate size for Norwegian commercial needs.

Tagging experiments

The tagging experiments which were started in 1959 in East Greenland waters, were continued. A total of 397 cod were tagged. This year only 21 cod were tagged on the Cape Dan Bank. The others were tagged in the North- and Southfjord in Skjoldungen. Both Lea tags and yellow plastic disks were used. In addition 35 halibut were tagged with yellow plastic disks.

VIII. Polish Research Report, 1961.

Investigations on the Length, Weight, Sex and Yield of the commercial Fish caught in August-September 1961 on the NE Slope of the Grand Bank.

by Jan Elwertowski
Sea Fisheries Institute, Gydnia

1. Vessel and fishing period

The investigations were carried out on the factory trawler "Kastor", 2879 BRT, engine power 2400 HP in the period from 1 August till 30 September, 1961. On the 7th, 8th and 22nd of September 1961 fishing was stopped because of the menace of the two hurricanes "Betsy" and "Esther".

2. Fishing ground and depth

The area of operation was on the NE Slope of the Grand Bank (Division 3L) at 230 - 400 m. Most often the trawling was made between 270 - 300 m.

3. Technique and gear

The technique used on the "Kastor" is stern-trawling. On the fishing ground were used bottom trawls made of sisal and nylon, 100-feet in size, with 100 mm mesh (stretched) in the cod-end.

4. Fishing effort and catch

The number of trawling hours were as follows:

August	414.5 hours
September	388.5 hours
Total	803 hours

5. Catch composition and yield per unit effort by depth zones

Thorough investigations were carried out in the areas on the catch composition and the yield per unit of fishing effort. The data are given in Table I.

6. Investigations on the redfish (Sebastes sp.)

The samples investigated consisted of redfish of the mentella type (98% of all investigated fish) and of the marinus type (1.3%). The total length of both types

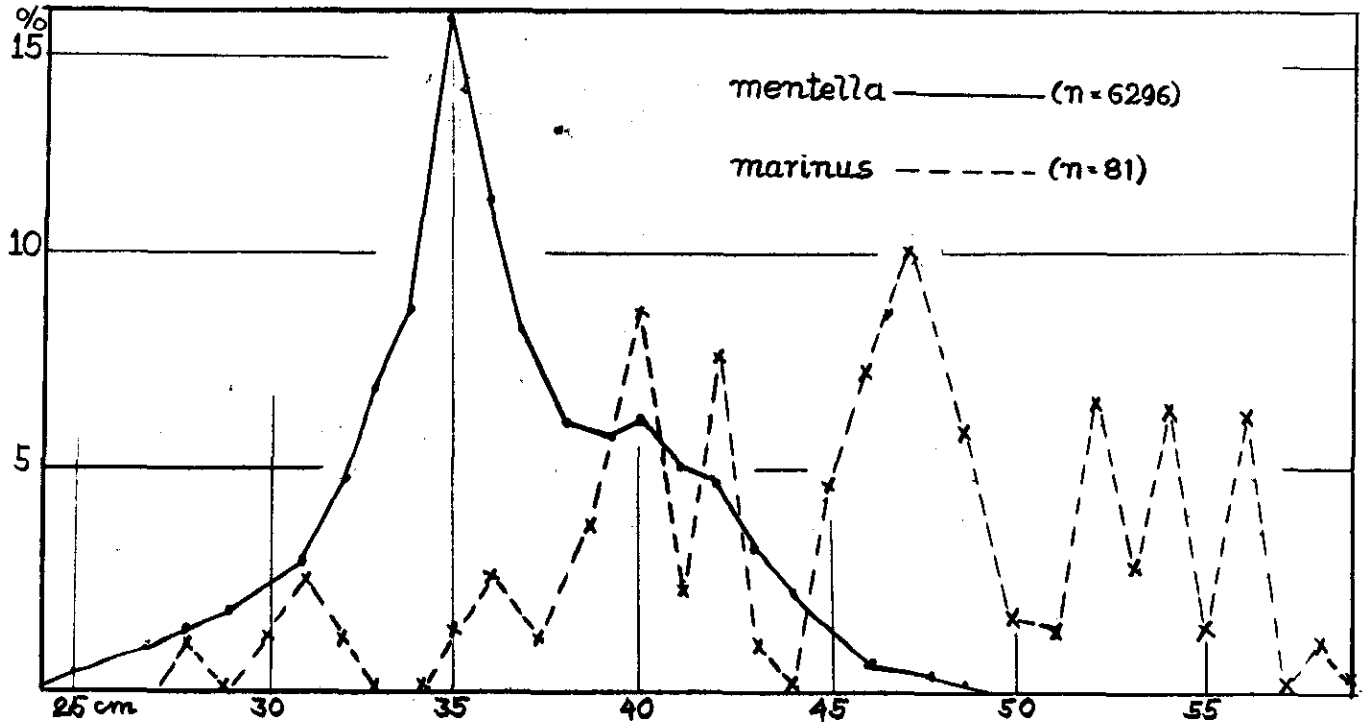


Fig. 1. Length composition of redfish type marinus and type mentella caught on NE slope of Grand Bank in August-September, 1961.

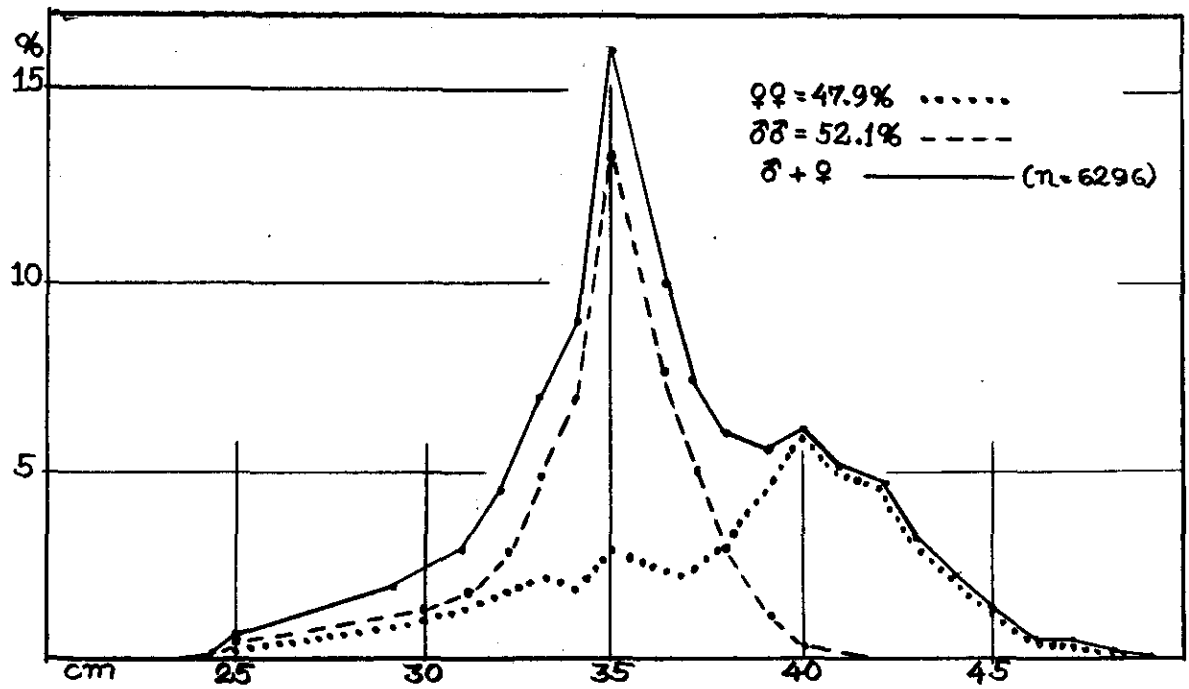


Fig. 2. Length of females and males of redfish type mentella caught on NE slope of Grand Bank in August-September, 1961.

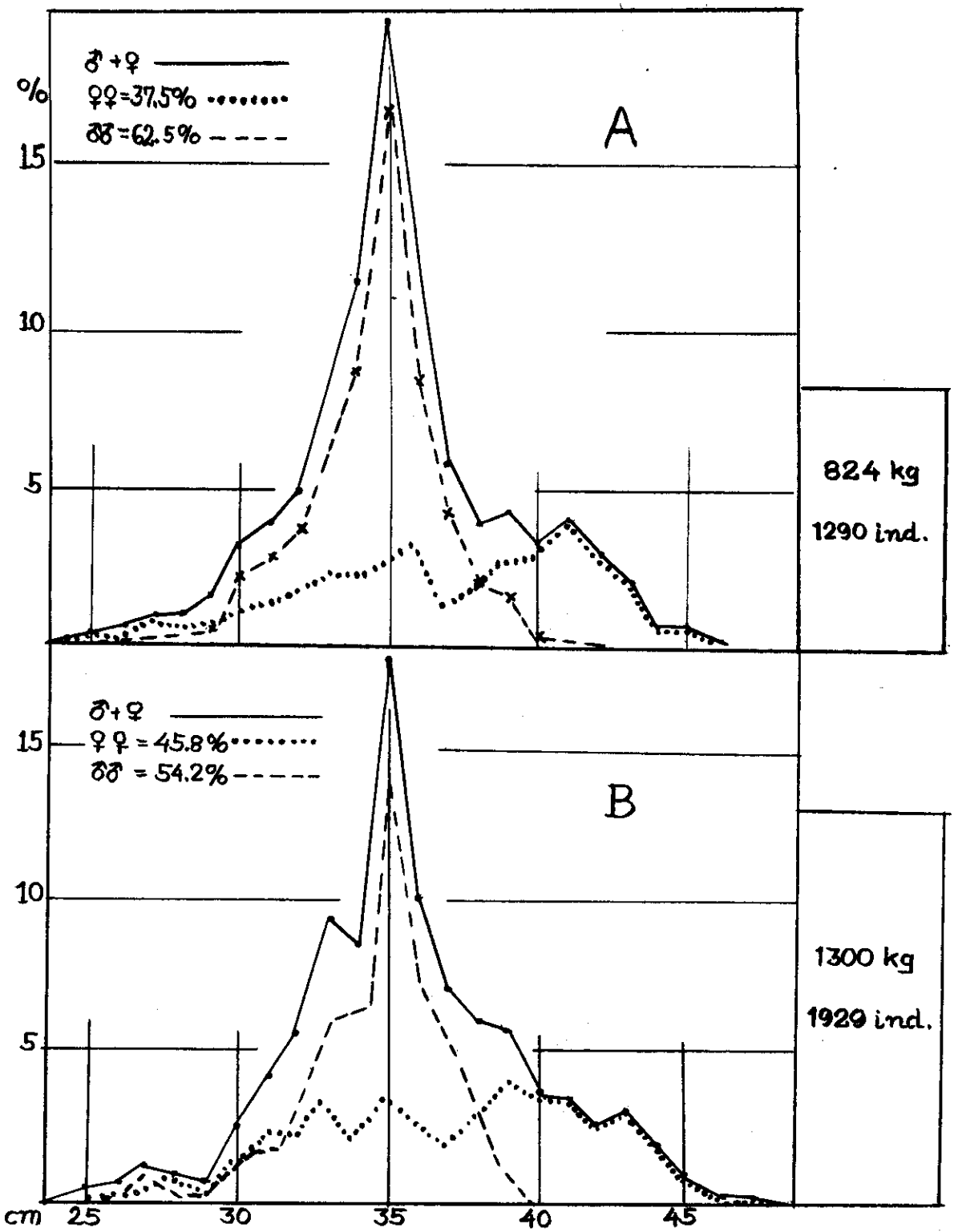


Fig. 3. Length of redfish type mentella caught on the NE slope of Grand Bank, Aug.-Sept., 1961 in 5 depth zones = A - 250 to 270 m, 48°10'N - 49°10'W; B - 290 to 300 m, 48°00'N - 48°40'W.

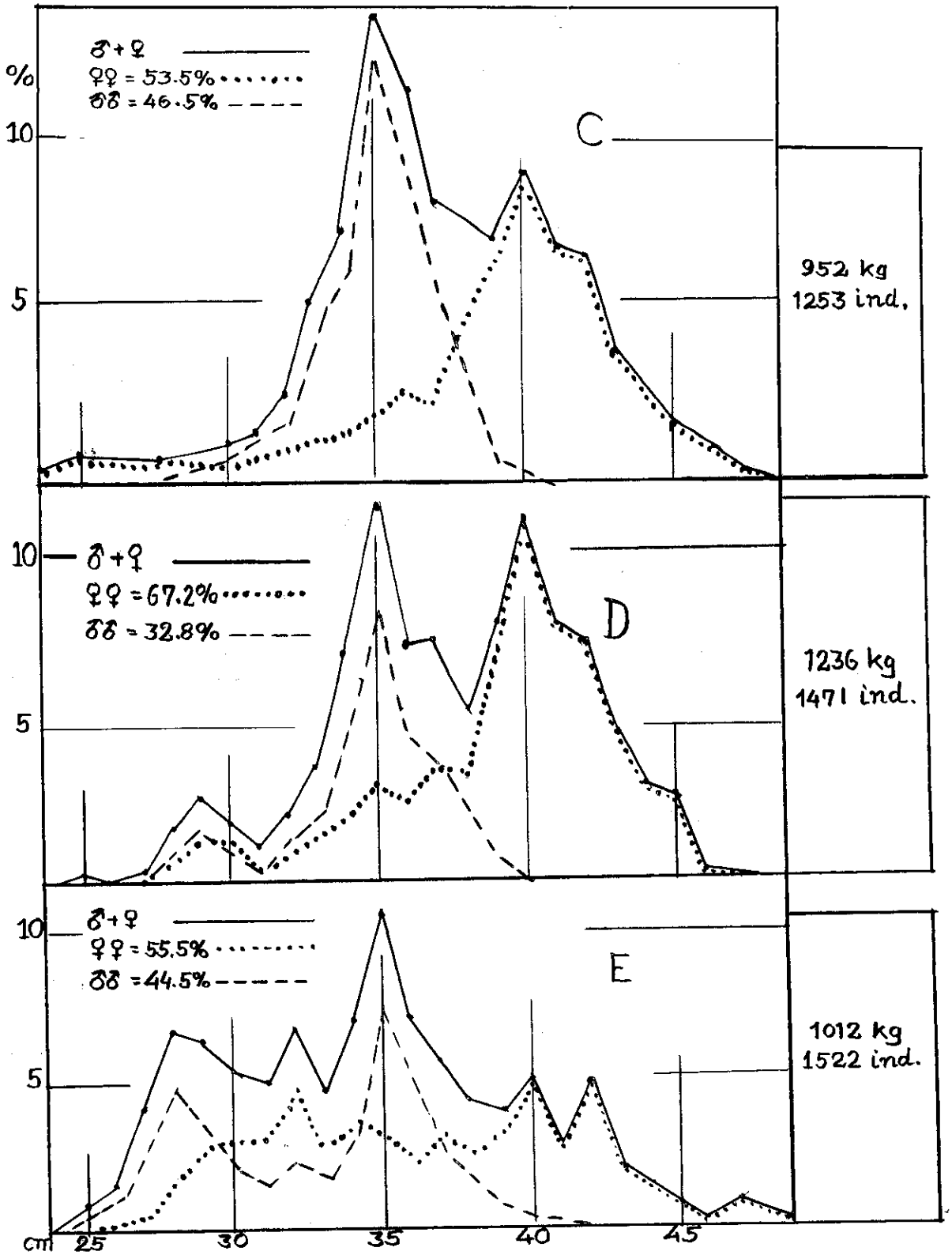


Fig. 3 continued. C - 310-320 m, 47°55'N - 48°05'W; D - 330-350 m, 47°55'N-47°35'W and E - 310-350 m, 47°35'N - 47°10'W.

is shown in Fig. I.*; for mentella separately for males and females in Fig. 2. Length and sex composition of mentella varied in relation to depth of fishing (Fig. 3). The percentage of females and the average length of fish caught increased with growing depth.

Exceptional conditions were found in the area of latitude 47°35'N and longitude 47°10'W (situated towards the south of the other three depth zones). Here were found, besides large percentages of males, also large numbers of fish of small size (chiefly males) of modal length 27-28 cm.

Table I shows that in the by-catch from this area quite a number of cod and some gray sole (Glyptocephalus cynoglossus) occurred, species not found at the same depth further to the north.

Table I. Catch composition and yield from the various depth zones on the NE slope of Grand Bank in Aug.-Sept.,1961.

	Position			The catch per one hour trawling in kg								
	Date	N.Lat. W.Long.	Depth	Redfish	Cod	Wolffish	American plaice	Gray sole	Greenland Halibut	Halibut	Other fish	Total
A	15-23 Aug.	48°10' - 49°10'	250-270	824	310	49	326	.	13	1	37	1,560
B	24-30 Aug.	48°00' - 48°40'	290-300	1300	219	43	75	.	21	2	53	1,713
C	1-14 Sep.	47°55' - 48°05'	310-320	952	101	14	9	.	12	4	12	1,104
D	15-19 Sep.	47°55' - 47°35'	330-350	1236	92	10	3	.	14	1	6	1,362
E	20-21 Sep.	47°35' - 47°10'	310-350	1012	232	8	2	14	6	4	34	1,312
Average for total trip from 1 Aug. to 30 Sep. 1961				929	164	37	124	.	17	5	96	1,372

* The tables on which Figs. 1,2 and 3 are based will be given in the Sampling Yearbook for 1961.

It seems that the above-mentioned peculiarities of the area of 47°35' N and 47°10' W are due to the particular hydrological conditions of this area.

The weight of redfish, type mentella, is shown in Table II. Using for the relation length-weight the general equation: $W = c\ L^3$, the following length-weight relations are found for each of the sexes of the redfish caught on the NE Slope of Grand Bank in August-September, 1961:

females - $W = 0.0151\ L^3$
males - $W = 0.0137\ L^3$
females plus males - $W = 0.0145\ L^3$

Table II.

Length - weight relation observed for redfish type mentella caught in August-September, 1961, on the NE slope of Grand Bank.

Length cm	females	males	females plus males
	average weight in g		
27	295		295
28	352	255	320
29	410	325	368
30	420	405	411
31	472	(405)	(419)
32	503	469	479
33	(503)	493	(496)
34	572	547	553
35	689	584	597
36	714	644	656
37	774	702	732
38	871	719	791
39	923	813	895
40	1001	990	1000
41	1072		1072
42	1119		1119
43	1193		1193
44	1293		1293
45	1238		1238
46	1360		1360
47	1413		1413
48	1705		1705

7. Cod length measurements

One sample of cod caught in depth zone 250-270 m was measured (See Table III).

8. Length measurements of Hippoglossoides platessoides

In the depth zone 250-270 m the factory-trawler "Kastor" caught considerable amounts of Hippoglossoides platessoides. The length composition is given in Table III.

9. Measurements of Greenland halibut (Rheinhardtius hippoglossoides)

The length composition of Greenland halibut caught at a depth of 250-270 m., is shown in Table III.

Table III. Length compositions in frequency o/oo of cod, American plaice and Greenland Halibut.

cm	cod Fr. o/oo	American plaice Fr. o/oo	Greenland Halibut Fr. o/oo
16 - 20		8	
21 - 25		36	
26 - 30	18	85	
31 - 35	58	119	49
36 - 40	58	172	69
41 - 45	64	208	215
46 - 50	64	204	231
51 - 55	87	119	167
56 - 60	140	47	132
61 - 65	115	2	56
66 - 70	110		56
71 - 75	93		21
76 - 80	93		7
81 - 85	47		7
86 - 90	6		
91 - 95	12		
96 - 100	23		
> 100	12		
No. of species	172	721	144

IX. Portuguese Research Report, 1961

by Glicinia V. Quartin

The present paper provides a summary of the sampling operations carried out on board the Portuguese cod trawlers during the 1961 fishery in Subareas 2 (Labrador), 3 (Newfoundland) and 4Vn, 4R and 4T (Nova Scotia, Gulf of St. Lawrence). The operations include: size-and age composition, observation of weight, sex ratio, stage of maturity, first spawning, and parasitization. The methods used for the sampling and the study are the same as in previous years (vide Portuguese Research Report, 1956, Annual Proceedings Vol. 7.).[1)]

I. Observations on Cod(Gadus morhua L.) in Subarea 4, 1961.

Nine samples, 1,750 individuals, were collected from a trawler. 600 otoliths were read for age determination. The samples were grouped by divisions and months of capture as far as it was possible (Table 1, Figure 1).

Table 1: Cod, Subarea 4, grouping of samples. * = no otoliths.

Sample gr.	Samples	Division	Dates
A	1-6	4R	11-31 Mar. 61
B	3	4R	13 Mar. 61
C*	2-5	4R	12-29 Mar. 61
D	4	4VN	24 Mar. 61
E	7	4VN	3 Apl. 61
F *	8*	4VN	4 Apl. 61
G	9	4T	13 Apl. 61

1. Age distribution (Fig. 1)

Division 4R (March)

Group A. The following age-groups predominate: V - 42%; VI - 22%; VII - 18%; and IV - 12%. The remaining age-groups are represented by less than 6%, the age-group VIII with only 4%.

Group B. This group, although from the same division and dates, presents a differing distribution, with the following dominance of age-groups: VIII - 22%; V - 21%; VII - 17%; V - 14%; and IX - 10%. The samples in this group are from greater depth than those in Group A, and the larger individual size is to be noted (vide the curves in Fig. 1).

1) The tables giving the data on which the figures in this paper are based will appear in the Sampling Yearbook for 1961.

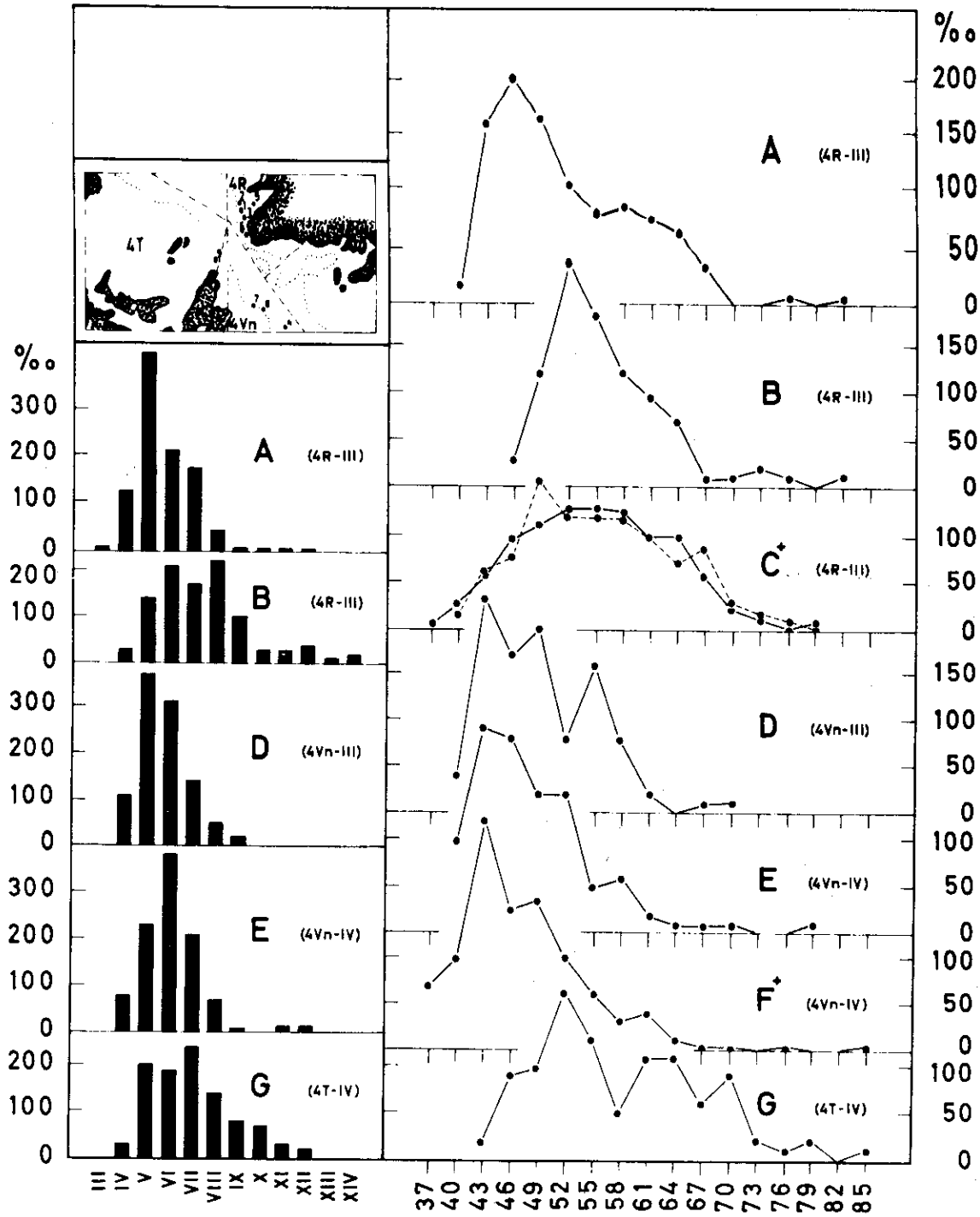


Fig. 1. Cod, Subarea 4. Trawl samples. Map of sample positions (left above), age-distribution (left below) and length distribution (right); day samples - full lines, night samples - stippled lines.

Division 4Vn

Sample Group D, from March, shows the following dominance of age-groups: V - 37%; VI - 31%; VII - 14%; and IV - 11%.

Sample Group E, from April, presents a distribution similar to that found in March, viz: VI - 38%; V - 23%; and VII - 21%. The age-group IV is represented by only 8%.

Division 4T

The only sample from this division is from April (Group G); the following age-groups predominate: VII - 24%; V - 20%; VI - 19%; and VIII - 14%. The age-group IV, which was fairly well represented in the divisions previously mentioned, is almost non-existent here - only 3%.

Summary. The predominating year-classes in the samples investigated are 1954, 1955 and 1956. The two first-mentioned predominated since 1959. The 1956 year-class maintains its place since 1960 when it appeared for the first time. The 1953 year-class, which was very abundant in the samples from 1960 is only sparsely represented this year; however, it predominates in the samples from 4R - March Group B).[1]

2. Length distribution (Fig. 1)

Division 4R (March)

Group A. The range of length distribution is from 40-82 cm; the length curve is unimodal, with the peak off 46 cm; the mean length is 51.6 cm.

Group B. The length curve is unimodal with the peak at 52.0 cm; the distribution is limited to the classes 46 to 82 cm; the mean length is 56.5 cm.

Group C. The range of lengths varies in the day samples between 37 and 79 cm, with the peak off the classes 52 to 55 cm. The night samples show a length distribution between 40 and 79 cm; the curve is bimodal, with peaks off 49 and 67 cm; the mean length of the day samples is 55.3 cm, of the night samples 55.7 cm.

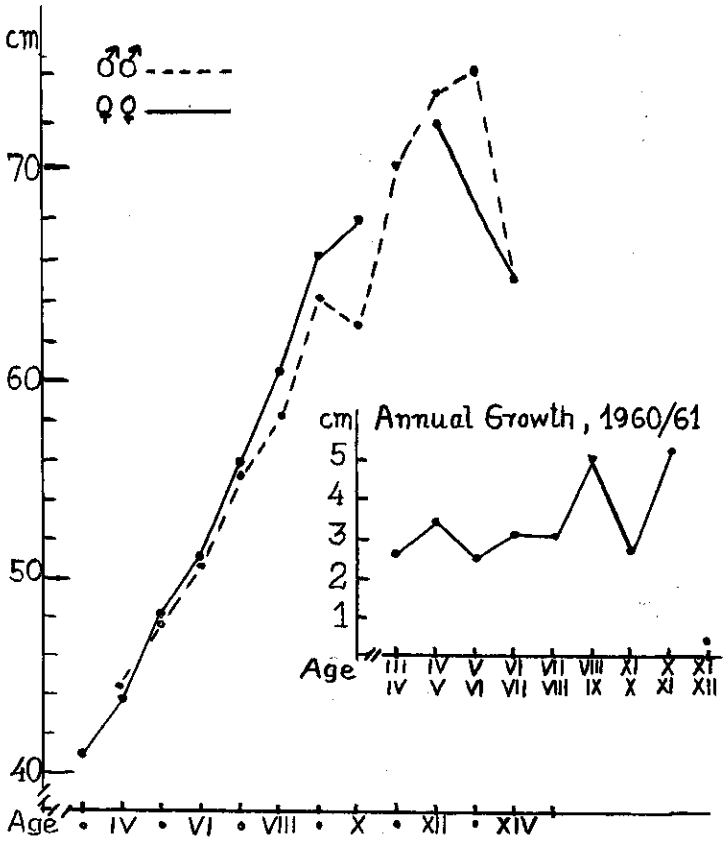
Division 4 Vn

Group D (March). The length distribution ranges between 40 and 70 cm. The curve is trimodal, with peaks off the classes 43, 49 and 55 cm. The mean length is 49.3 cm.

Group E(April). The length curve is multimodal, with the highest peak off 43 cm. The range of lengths is from 40 to 79 cm. The mean length is 48.5 cm.

Group F (April). Also here the length curve is multimodal and the highest peak is also off 43 cm. The range of lengths runs from 37 to 85 cm. The mean length is 47.3 cm.

1) The abundance of the year-classes in the fisheries in this division in 1956, 1957 and 1958 appears from the Portuguese Research Report for 1958 (Annual Proceedings Vol. 9).



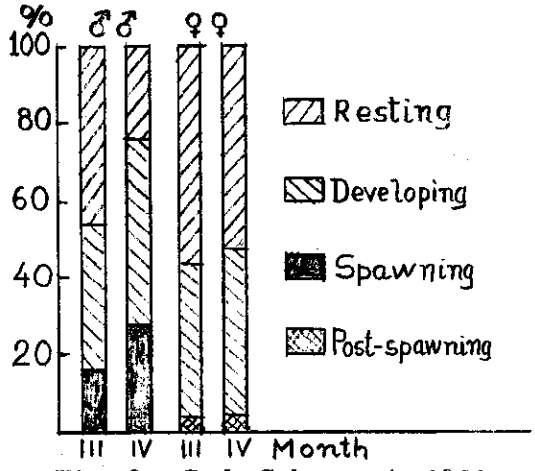


Fig. 3. Cod, Subarea 4, 1961. Trawl. Stage of maturity.

Fig. 2. Cod, Subarea 4, 1961. Trawl. Mean length of age-groups and annual growth.

Division 4T (April).

Group G. The length curve is multimodal, with the highest peak off the class of 52 cm. The range of lengths is from 43 to 85 cm. The mean length of the sample is 51.0 cm.

3. Growth (Fig. 2)

The mean lengths of males and females separately are shown combined for all samples from 4R, 4Vn and 4T. The curves show the inflection point to be at the sixth year. The growth rate is a little higher for the females than for the males; from the ninth or tenth year a decrease in growth rate is observed.

4. Sex Ratio

The samples show in their totality a slight predominance of the males, accounting for 51-56%, except for sample group D where the two sexes are equally abundant.

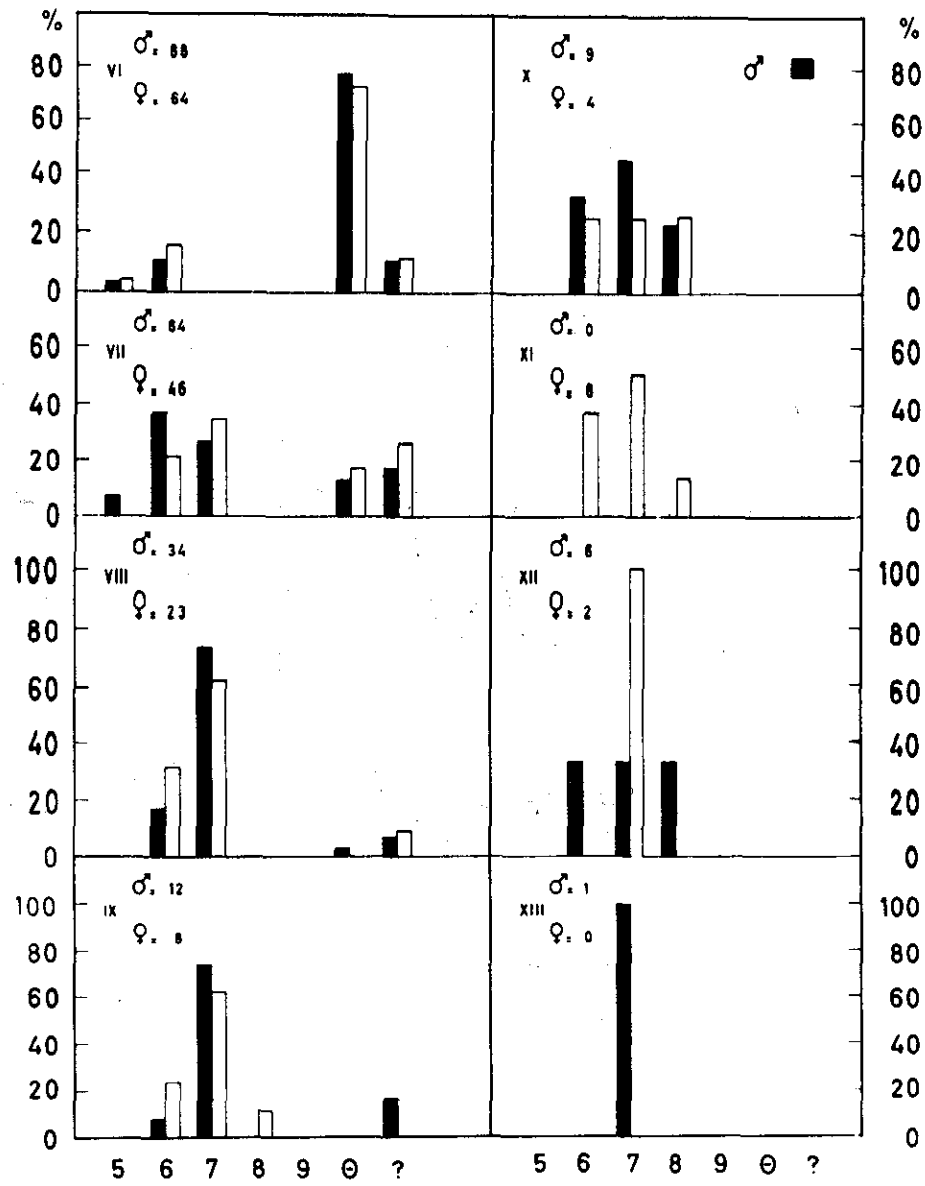


Fig. 4. Cod. Subarea 4. Age (5-9) at first maturity for males (black) and females (white) of the age-groups VI - XIII.

5. Stage of Maturity (Table 2, Fig. 3)

Males. In March the majority are in the resting or the recovering stage (47%); 38% are in the developing stage and the remaining 15% are spawning. In April the number of males in the developing stage has increased to 49%; 26% are in the spawning stage and only 25% in the resting stage.

Females. In March 58% are in the resting stage, 41% in the developing stage and 1% are post-spawners. In April the distribution is similar; resting - 56%, developing - 42% and post-spawners - 2%.

Table 2. Cod, Subarea 4 (R, Vn and T). Stage of maturity, determined by macroscopic observations of the gonads: March-April.

	March		April	
Stage of Maturity	♂♂ %	♀♀ %	♂♂ %	♀♀ %
Resting	47.0	58.0	25.0	56.0
Developing	38.0	41.0	49.0	42.0
Spawning	15.0	-	26.0	-
Post-spawning	-	1.0	-	2.0
No. of obs.	203	197	111	89

6. Age at First Maturity (Table 3, Figure 4)

In connection with the age readings the year in which the majority of the cod attain maturity for the first time was determined. The year of first maturity falls between the 5th and 8th year; the 7th year is the most frequent (25-100%).

II. Observations on Cod in the Newfoundland Region (Subarea 3)

A total of 54 samples (8,386 specimens) were collected from trawlers operating in Divisions 3K (Belle Isle), 3L (Grand Bank) and 3Pn and 3M during the fishery in 1961 from the end of February to the end of November. In connection with the measurements, otoliths were collected from 4,400 cod; determinations of sex and maturity were carried out together with 3,986 measurements and 500 weighings. Investigations on the amount of parasitization and on the specification of the species of parasites were carried out, but are not considered further in this report. The samples were, in conformity with the adopted procedure, grouped according to division and month, except for samples showing a distinctly differing age composition. (Table 4).

1. Age Distribution (Fig. 5)

The age was determined for 2,754 otoliths. This is the first time that it has been possible to compile such a high number from this subarea in the Portuguese research reports; until now only a summary has been given of the age of the stock in 3K (Belle Isle) for the years 1955/56 (Portuguese Research Report, Annual Proceedings Vol. 7). The reading and interpretation of the cod otoliths from this subarea is difficult, and the results presented must be used with some reservation and may be revised later on.

Table 3. Cod, Subarea 4, R, Vn and T. Age at first maturity, males and females of age-groups VI-XIII; samples from March-April.

Age Group		Males 1st spawning V	VI	VII	VIII	θ	?	Total	Females 1st spawning V	VI	VII	VIII	θ	?	Total
VI	N	2	9	-	-	68	9	88	2	9	-	-	46	7	64
	%	2.3	10.9	-	-	77.3	10.2	100	3.1	14.1	-	-	71.9	10.9	100
VII	N	4	24	17	-	8	11	64	-	10	16	-	8	12	46
	%	6.3	37.5	26.6	-	12.5	17.2	100.1	-	21.7	34.8	-	17.4	26.1	100
VIII	N	-	6	25	-	1	2	34	-	7	14	-	-	2	23
	%	-	17.7	73.5	-	2.9	5.9	100	-	30.4	60.9	-	-	8.7	100
IX	N	-	1	9	-	-	2	12	-	2	5	1	-	-	8
	%	-	8.3	75.0	-	-	16.7	100	-	25.0	62.5	12.5	-	-	100
X	N	-	3	4	2	-	-	9	-	1	1	2	-	-	4
	%	-	33.3	44.4	22.2	-	-	99.9	-	25.0	25.0	50.0	-	-	100
XI	N	-	-	-	-	-	-	-	-	3	4	1	-	-	8
	%	-	-	-	-	-	-	-	-	37.5	50.0	12.5	-	-	100
XII	N	-	2	2	2	-	-	6	-	-	2	-	-	-	2
	%	-	33.3	33.3	33.3	-	-	99.9	-	-	100	-	-	-	100
XIII	N	-	-	1	-	-	-	1	-	-	-	-	-	-	-
	%	-	-	100	-	-	-	100	-	-	-	-	-	-	-

NOTE: ⊖ indicates no spawning mark

Table 4. Cod, Subarea 3. Grouping of samples. * = no otoliths.

Sample-gr.	Samples	Division	Dates
A	1-3-5	3PN	24-28 Feb. 61
B*	2	"	25 Feb. 61
C	6-9-11	"	2-14 Mar. 61
D*	8	"	4 Mar. 61
E	15	"	28 Mar. 61
F	16	"	1 Apl. 61
G	17-20	3Ps	10-21 Apl. 61
H*	19	"	19 Apl. 61
I	21-22	3L	26-29 Apl. 61
J*	23	"	30 Apl. 61
K*	25	"	3 May 61
L	24-28-29	"	2-10 May 61
M*	27	3K	7 May 61
N	30	"	2 Jun. 61
O	32-33	"	30-31 Jul. 61
P*	34-37	"	1-4 Aug. 61
Q	36-38-39	"	3-14 Aug. 61
R	43	"	22 Oct. 61
S	44-48-50-51-54	"	3-26 Nov. 61
T*	47-52	"	7-23 Nov. 61

First Cruise (February-June)

Division 3Pn, February - Group A, March - Group C. The age distribution is the same in these two groups; the prevailing age groups are: VI - 24 to 31%; VII - 22 to 13%; V - 16 to 22%; and VIII 14 to 11%. In Group E from the same division and from March, younger fish are predominating: V - 35%; IV - 22% and VI - 18%. In Group F from April, the dominant age groups are: VII - 21%, VIII - 20%; VI - 18%; V - 10%; and IX - 19%.

Division 3Ps, April, Group G - predominating age groups: VI - 37%; V - 19% and VII - 14%.

Division 3L, Grand Bank, Group I, April. Predominating age groups: VI - 32%; V - 15%; and VII - 11%. Group L, May. Strong predominance of age group VI - 42% and V - 21%.

Division 3K, Belle Isle. Group N, June. Dominating age groups: VII - 26%; IX - 15%; X - 11% and V - 10%.

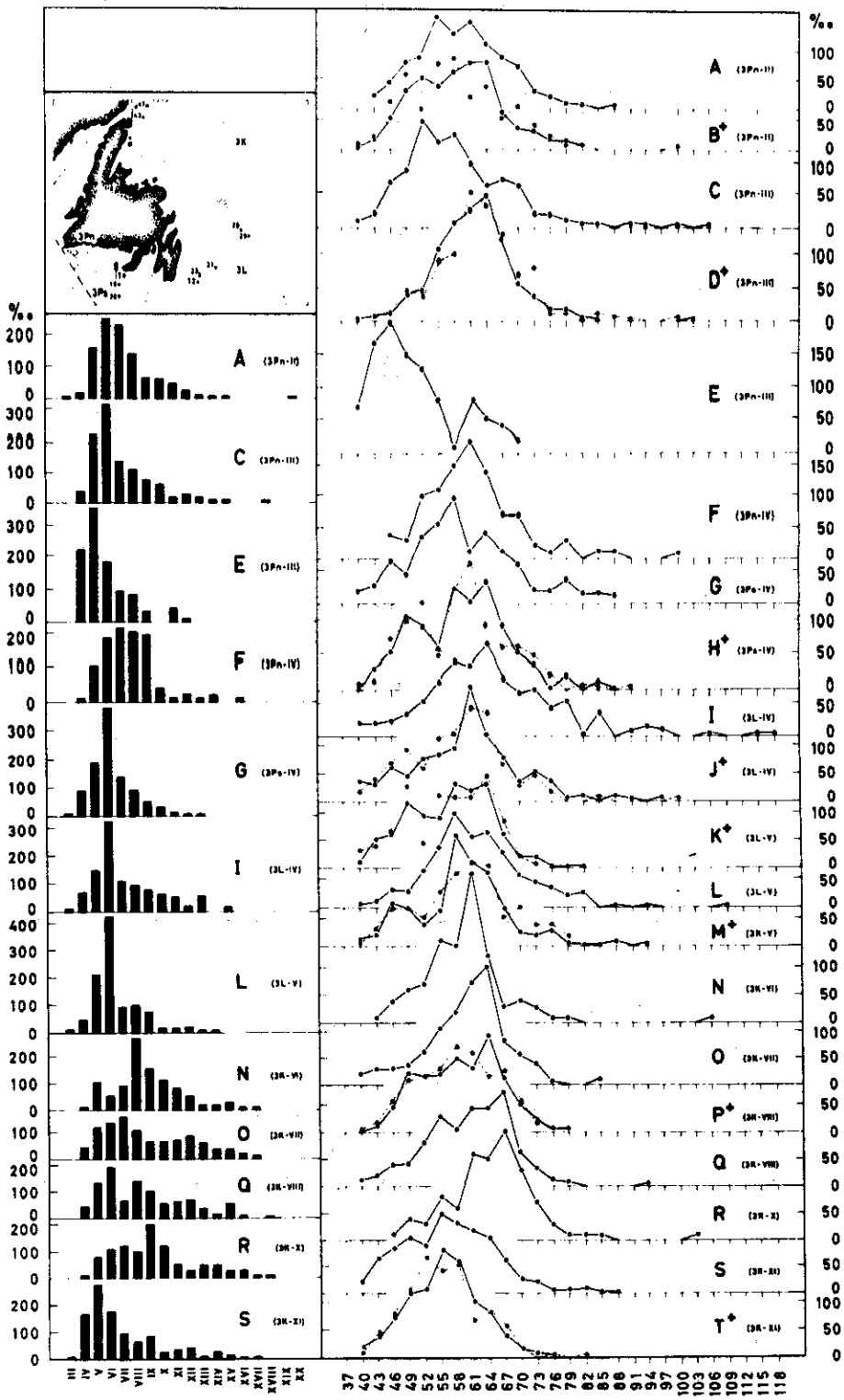


Fig. 5. Cod, Subarea 3. Map of sample positions (left above), age distribution (left below) and length distribution (right). Day samples - full lines, night samples - stippled lines.

Second Cruise (July-November)

Division 3K. Group O (July). The most abundant age groups are: VII - 15%; VI - 14%; V - 11%; and VIII - 10%. Group Q (August). The dominating age groups are VI - 19%; VIII - 14%; V - 14%; and IX - 10%. Group R (October). The dominating age groups are: IX - 20%; VII - 12%; X - 12%; VI - 11% and VIII - 10%. Group S (November). The rather young age groups are predominating: V - 28%; VI - 17% and IV -16%.

Summary for Subarea 3

No single year-class can be pronounced as predominating, but one notes a rather constant abundance of several year-classes; 1955, 1956, and also 1954. It is also to be noted that the older 1952 and 1953 year-classes are still present in Division 3K; also the young 1957 year-class is represented.

2. Length Distribution (Fig. 5)

In addition to the samples from which otoliths were taken are eight further samples with length measurements. The general results of the study of the samples are:

In Groups A and C (Division 3Pn - February to March) the abundant cm-groups are: 52-55-58 and 61; this is contrary to the case in Group E from March, which presents a bimodal curve with peaks at 46 and 61 cm, corresponding to the dominating of the age-groups IV-V-VI in these samples.

In Group F (April) there is one main peak, off 61 cm, apparently in connection with the predominance of the age-groups VII-VIII-IX.

In Groups G, I and L (April-May) the larger length frequencies are found in the classes 58 and 61 cm (age-groups V-VI-VIII).

In the samples from 3K a greater abundance of the age-groups above VII occurs in connection with larger frequencies of the higher length classes; this is especially apparent in Groups Q and R (August-October) where the highest peaks are off 67 cm. However, cod of smaller sizes are also present, cm-classes 55 and 61. Group S from November includes mainly younger cod with peaks in the cm-classes 49 to 55.

The range of the lengths is from ca. 43 to 88 cm, reaching exceptionally 118 cm in one sample.

The samples show a slight prevalence of larger cod in day samples to night samples. In the length curves of the day samples the peaks are found in classes 58 to 64 cm, in the night samples, however, in classes 58-61 cm, in some cases even as low as 49 cm. In the day sample (T-3K-Nov.) the peak is off 55 cm.

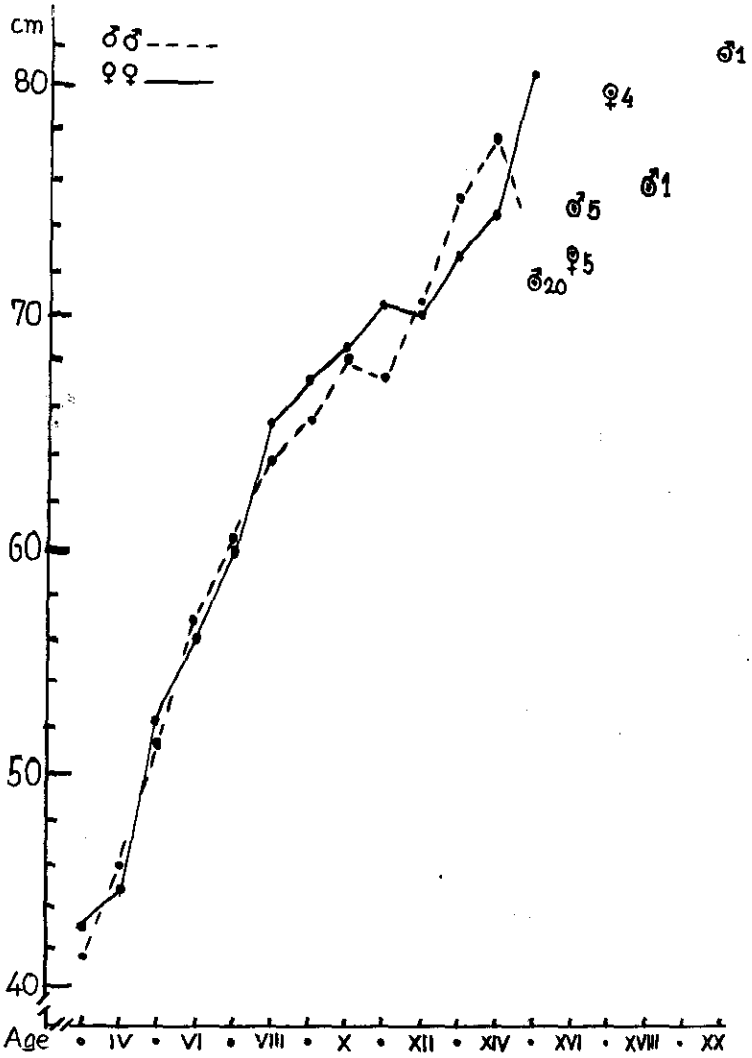


Fig. 6. Cod, Subarea 3.1961. Mean length of age-groups.

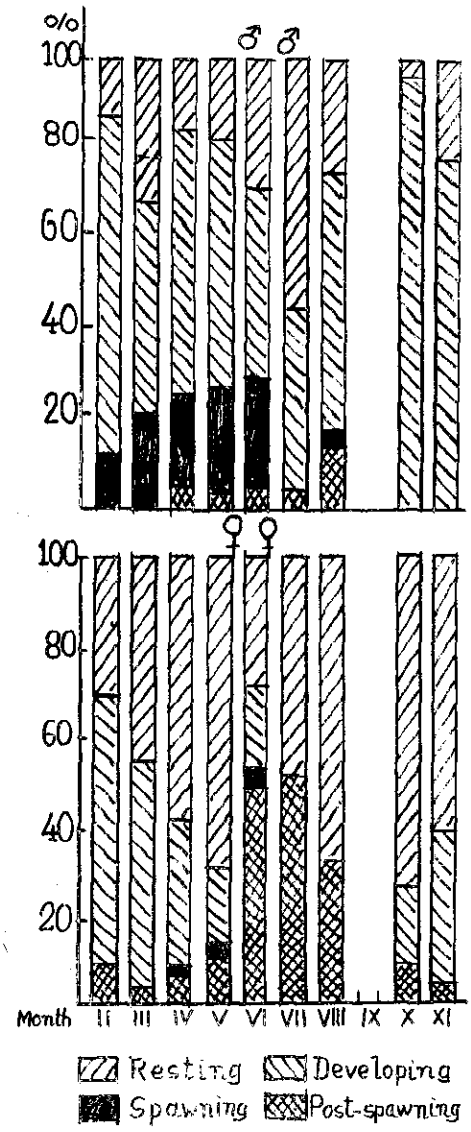


Fig. 7. Cod, Subarea 3,1961. Stage of maturity.

3. Growth (Fig. 6)

The average lengths of females and males by age groups are shown in Fig. 6. The growth (all samples together) is about the same up to age VII; from that age and upwards, the females grow a little stronger. The point of inflection is at age V; in the curve for the males this point is at age VI. From age VII the growth rate of males and females decreases; a kind of stop in the growth appears for the females between the XI and XII year, and for the males between the X and XI year. After these ages the growth again increases.

4. Sex Ratio

The males generally predominate in the samples (54-56%). Only in four of the groups in 3K (mainly in July-August) are the females more abundant than the males.

Table 5. Cod, Subarea 3 (Pn, Ps, L and K). Stage of maturity, determined by macroscopic observations of the gonads; February-November.

Stage of Maturity	February ♂♂ %	February ♀♀ %	March ♂♂ %	March ♀♀ %	April ♂♂ %	April ♀♀ %	May ♂♂ %	May ♀♀ %	June ♂♂ %	June ♀♀ %
Resting	12.4	30.2	33.5	47.5	15.5	59.0	18.8	71.5	32.5	30.5
Developing	76.4	60.4	47.5	50.5	58.0	33.8	53.6	19.1	37.5	18.6
Spawning	11.2	–	19.0	–	24.5	1.4	26.8	0.6	27.5	3.4
Post-spawning	–	9.4	–	2.0	2.1	5.7	0.7	8.6	2.5	47.5
No. of observ.	161	139	200	200	290	210	138	162	40	59

Stage of Maturity	July ♂♂ %	July ♀♀ %	August ♂♂ %	August ♀♀ %	October ♂♂ %	October ♀♀ %	November ♂♂ %	November ♀♀ %
Resting	59.7	51.4	29.6	69.6	3.6	73.3	26.7	61.7
Developing	39.5	–	58.3	–	96.4	17.8	73.3	35.2
Spawning	–	–	0.9	–	–	–	–	–
Post-spawning	0.8	48.6	11.1	30.3	–	8.9	–	3.1
No. of observ.	129	70	108	191	55	45	273	227

It appears that there are proportionately more females in day catches than in night catches.

5. Stage of Maturity (Table 5, Fig. 7)

Males. From February to June the majority are in the developing stage (37-76%), a rather high percentage (11-28%) are spawners; the remaining are in the resting stage, including immature and recovering individuals (12-33%), and in the post-spawning stage (2-3%). From July to November only 0.9% of the males were spawning; the majority (40-96%) were in the developing stage; 4-60% were in the resting stage, and in the sample from August 11.1% were post-spawners.

Females. Only few spawning females were observed, 0.6 to 3.4% between April and June. During the period of observation, February to November, 2-48% were post-spawners, the highest figures are from June, July and August; 18-76% were in the developing stage, the highest percentage was in February, with decreasing percentages

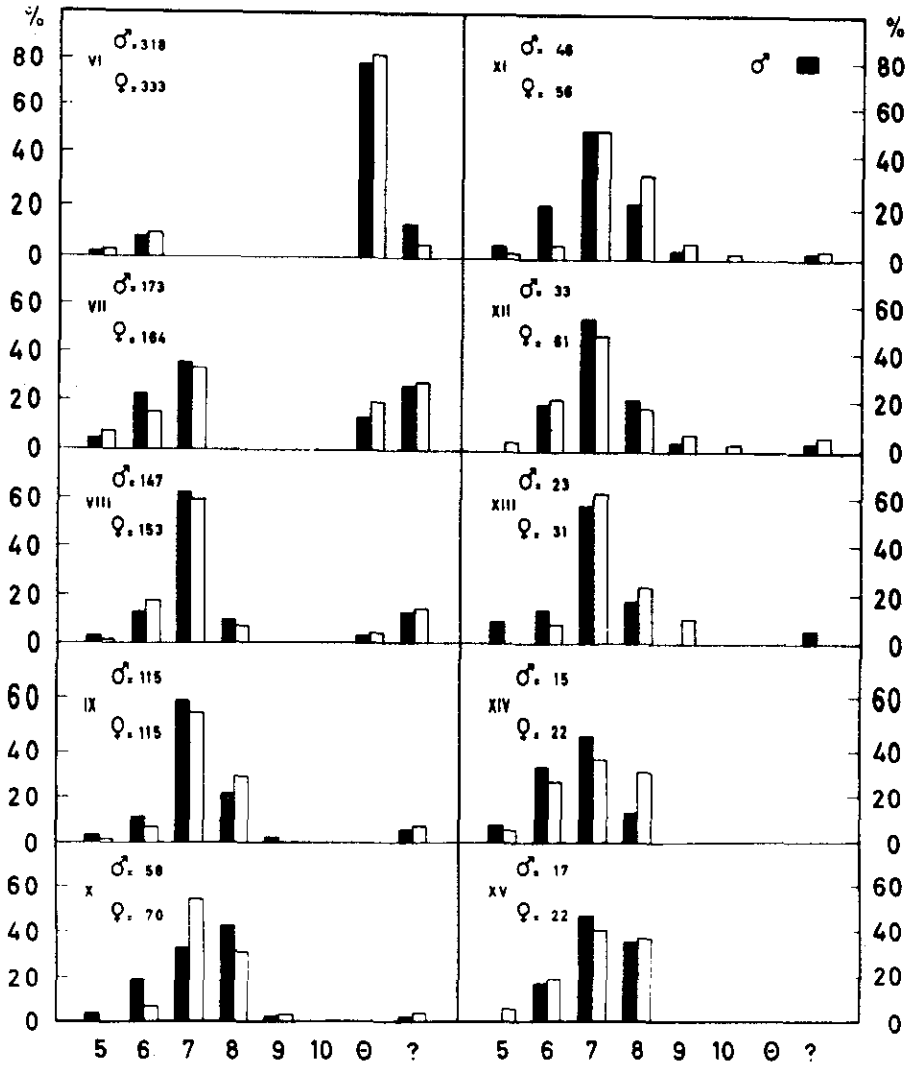


Fig. 8. Cod, Subarea 3. Age (5-10) at first maturity for males (black) and females (white) of age-groups VI-XV.

until June. No females in the developing stage were observed in July-August, but again in October-November (17-35%). From February to June 30-71% were in the resting stage, increasing to 51-73% in July to November.

6. Age at First Maturity (Table 6, Fig. 8)

The spawning zones were not very clear in the otoliths from Subarea 3. The first maturity was found to occur between the 5th and 11th year (exceptionally in the 10th year), the 7th year being the most common.

Table 6. Cod, Subarea 3. Age at first maturity, males and females of age-groups VI-XV, Samples from February-November.

Age Group		Males 1st spawning V	VI	VII	VIII	IX	⊖	?	Total	Females 1st spawning V	VI	VII	VIII	IX	X	⊖	?	Total
VI	N	1	28	-	-	-	247	42	318	2	30	-	-	-	-	271	30	333
	%	0.3	8.8	-	-	-	77.7	13.2	100	0.6	9.0	-	-	-	-	81.4	9.0	100
VII	N	7	38	60	-	-	22	46	173	12	25	53	-	-	-	30	44	164
	%	4.0	22.0	34.7	-	-	12.7	26.6	100	7.3	15.2	32.3	-	-	-	18.3	26.8	100
VIII	N	3	19	91	12	-	3	19	147	1	25	90	10	-	-	6	21	153
	%	2.0	12.9	61.9	8.2	-	2.0	12.9	99.9	0.7	16.3	58.8	6.5	-	-	3.9	13.7	99.9
IX	N	4	13	67	25	1	-	5	115	1	9	65	34	-	-	-	6	115
	%	3.5	11.3	58.3	21.7	0.9	-	4.4	100.1	0.9	7.8	56.5	29.6	-	-	-	5.2	100
X	N	1	11	19	25	1	-	1	58	-	5	39	22	2	-	-	2	70
	%	1.7	19.0	32.8	43.1	1.7	-	1.7	100	-	7.1	55.7	31.4	2.9	-	-	2.9	100
XI	N	2	9	23	10	1	-	1	46	1	3	28	18	4	1	-	2	56
	%	4.4	20.0	50.0	21.7	2.2	-	2.2	100.5	1.8	5.4	50.0	32.1	7.1	1.8	-	3.6	100
XII	N	-	6	18	7	1	-	1	33	2	13	29	10	4	1	-	3	61
	%	-	18.2	54.6	21.2	3.0	-	3.0	100	3.3	21.3	47.5	16.4	6.6	1.8	-	4.1	100
XIII	N	2	3	13	4	-	-	1	23	-	2	19	7	3	-	-	-	31
	%	8.7	13.0	56.5	17.4	-	-	4.4	100	-	6.5	61.3	22.6	9.7	-	-	-	100.1
XIV	N	1	5	7	2	-	-	-	15	1	6	8	7	-	-	-	-	22
	%	6.7	33.3	46.7	13.3	-	-	-	100	4.6	27.3	36.3	31.8	-	-	-	-	100
XV	N	-	3	8	6	-	-	-	17	1	4	9	8	-	-	-	-	22
	%	-	17.7	47.1	35.3	-	-	-	100.1	4.6	18.2	40.9	36.4	-	-	-	-	100.1

Table 7. Cod, Subarea 2. Grouping of samples.

Sample Gr.	Ser. No. of Samples	Division	Dates
A	3-5-8-11	2J	15/17/21/26 May 61
B	23-28	2J	12-23 Sept. 61
C	39	2J	16 Nov. 61

NOTE: ⊖ indicates no spawning mark

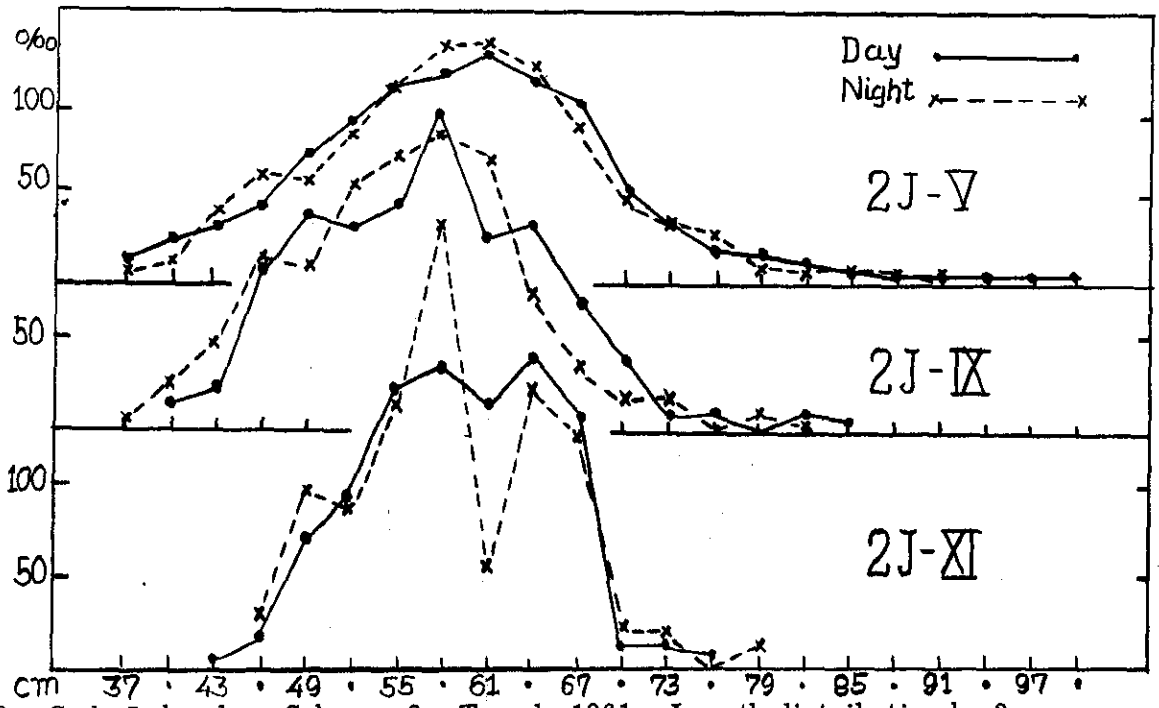


Fig. 9. Cod, Labrador, Subarea 2. Trawl, 1961. Length distribution by 3 cm-groups. Day samples - bold lines; night - stippled lines.

III. Observations on Cod off Labrador (Subarea 2)

A total of 40 samples were collected from trawlers. The grouping of the samples is shown in Table 7. For the present only seven samples (2,720 specimens) from Division 2J are considered.

1. Length Distribution (Fig. 9)

In Group A (May) the size distribution in the day samples ranges from 37 to 100 cm; the length curve is unimodal, with a peak at 61 cm; the mean length is 59.1 cm. The night samples do not present any appreciable difference from the day samples; the highest peak is in the 58 cm class, a lower is in the 46 cm class. The mean length is 59.1 cm, as in the day samples.

In Group B(September) the length curve for the day samples is trimodal, with peaks at 58-49 cm and 64 cm. The mean length is 57.2 cm. The curve for the night samples presents a clear predominance of the 58 cm class. The range of variation is from 37 to 85 cm.

In Group C (November) the day and night samples attain higher length frequencies, with peaks at 58 and 64 cm; this is especially pronounced in the night sample where the length class 58 cm reaches 24%.

IV. Weight Observations

Data on weight of fresh fish, of gonads, intestines and livers, were collected from cod from Subareas 2,3 and 4. These data will be considered in another paper, giving mean values by size classes, together with a description of methods and of conditions of weighing.

X. Spanish Research Report, 1961.

A. Size Distribution of Cod, 1961.

by O. Rodriguez Martin.

In 1961, as in previous years, two observers collected data aboard the trawlers "Vendaval" and "Aquilon", mainly for the study of length and age distribution of cod.

The material [1] collected includes for each month and division the following numbers of cod measured:

Month	2J	3K	3L	3M	3N	3Ps	4Vs	Total
March			241		194			435
April			1239			875	878	2942
May	1894		550					2444
June	560	453						1013
July								
Aug.		431	2615	273				3319
Sept.	2434							2434
Oct.	1574							1574
Nov.	198	185						383
Year	6660	1069	4645	273	194	875	878	14544

Subarea 2J (Fig. 1).

The Spanish fisheries do not use cod below a length of 40 cm, and the percentage quantities (as appearing from the data collected) of cod discarded in Subarea 2J were as follows:

May	June	September	October	November	Mean
6	9.6	7.7	7.8	0	6.2

The most frequent sizes (modes of length distribution curves) caught were in the same months:

May	June	September	October	November
57-59 cm	54-56 cm	60-62 cm	60-62 cm	57-59 cm

Subarea 3K (Fig. 2)

The percentages discarded and the modes of the length distribution curves were as follows:

June	August	November	Mean
2.2% - 60-62 cm	0.5% - 57-59 cm	1.1% - 60-62 cm	1.3%

1) Tables including the detailed data will be published in the 1961 Sampling Yearbook.

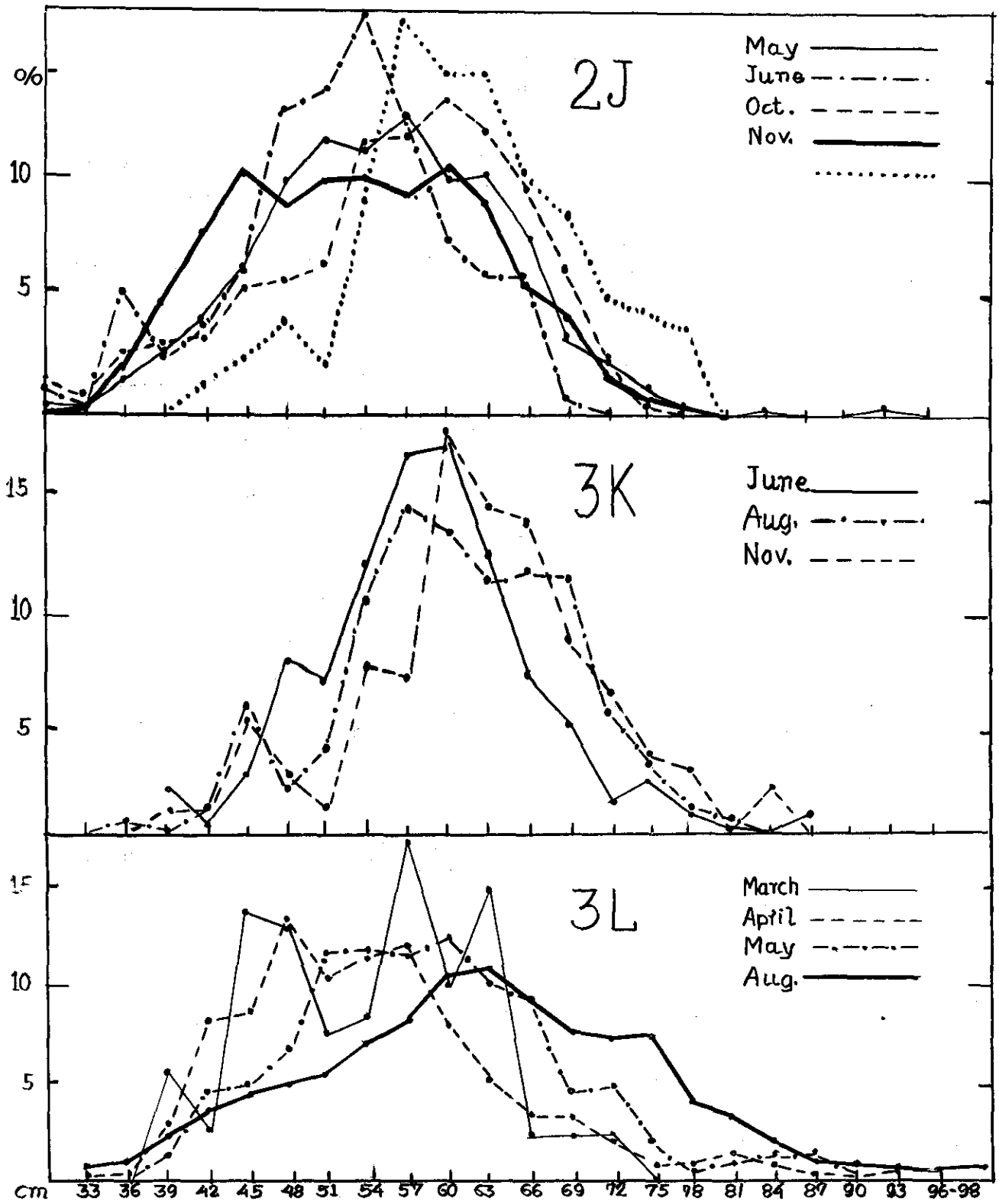


Fig. 1-3. Cod, length distribution, 3 cm-groups, Divisions 2J, 3K and 3L.

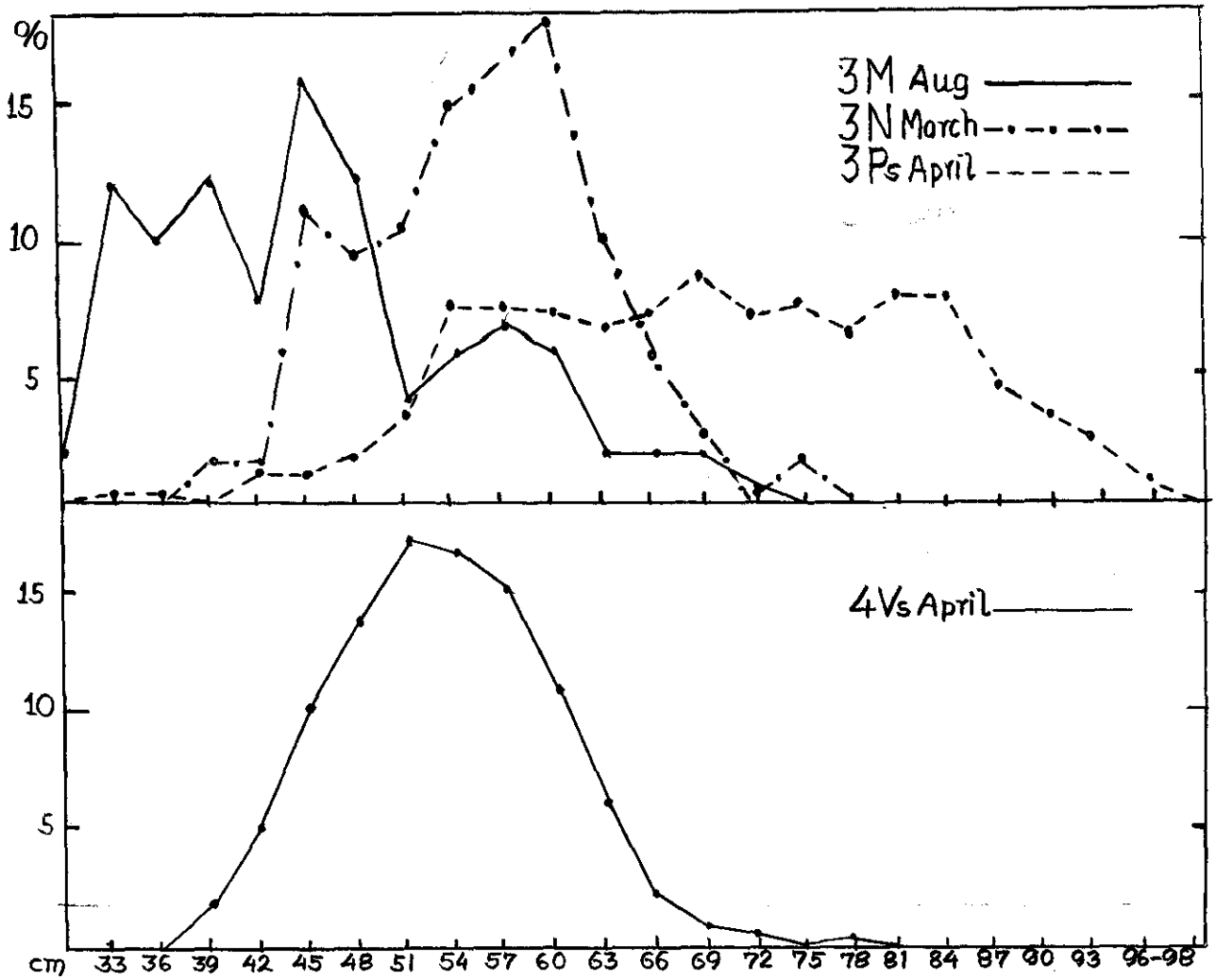


Fig. 4 and 5. Cod, length distribution, 3 cm-groups, Divisions 3M, 3N, 3Ps and 4Vs.

Subarea 3L (Fig. 3).

March - 5.4% - 57-59 and 63-65 cm
April - 3.3% - 57-59 cm
May - 1.7% - 60-62 cm
Aug. - 3.2% - 63-65 cm

Mean 3.4%

Subarea 3M (Fig. 4)

August: The sizes are very small (mode 45-47 cm) and the discards are large, amounting to 36.3%.

Subarea 3N (Fig. 4).

March: The discards do not exceed 1.5% and the mode of the length distribution is 60-62 cm.

Subarea 3 Ps (Fig. 4).

The stock of cod here presents larger individual sizes, with the mode at 69-71 cm, the sizes up to 84-86 cm are almost as abundant as the size class 69-71 cm. The discards are as low as 0.8%.

Subarea 4 Vs (Fig. 5).

April: No discards are reported although the mode of the length curve is as low as 51-53 cm.

B. Age and Growth of Cod caught by Spanish Fishing Vessels in Subareas 2-4, in 1961.

by A. Figueras, Inst. Fish. Inv., Vigo, Spain.

I. Material and Methods [1)]

The paper presents a summary of the results of investigations on the cod (Gadus morhua) in the ICNAF Convention Area in 1961, including growth and corresponding mean lengths by age-groups, relative abundance of year-classes by divisions of area, age at first spawning, and proportion of sexes.

The otoliths were collected on board the trawlers "Aquilon" and "Vendaval" of the company PYSBE by the observer D. Tomás García Leston in March-June and August-September, 1961 (Fig. 1). The otoliths of each individual were kept separately in envelopes with the following data: Date of capture, positions, size, sex, stomach contents. The methods of reading are the same as employed in previous papers: cutting by hand of the otoliths and observation in binocular microscope with low magnification, without preceding clearing, by means of lateral light concentrated in a narrow strong band. It was observed that the otoliths gain in clearness by a strong light limited to the lateral surface leaving the upper surface of the section of the cut otolith non-lighted. A polishing of the surface diminishes its clearness; this procedure has therefore been dropped.

The months with the most extensive sampling are (Table 1 attached): August-247 spec., September - 156 spec., April - 124 spec., May - 122 spec., and

1) Tables giving the detailed data will be published in the 1961 Sampling Yearbook.

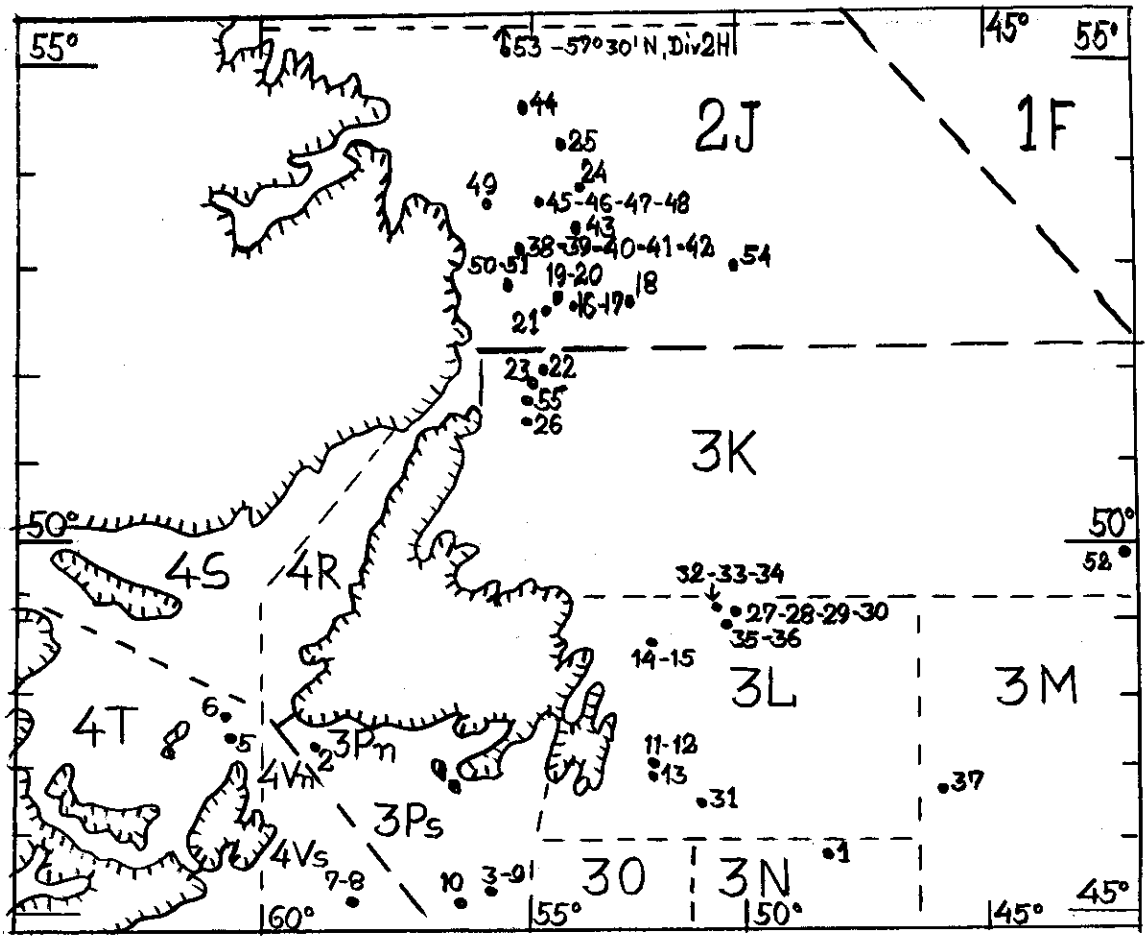


Fig. 1. Locations of samples from the fishery in 1961.

October - 107 spec. Almost all samples from September, October and May are from Division 2J, which is the best represented division. The divisions with the largest numbers of individuals sampled are: 2J-361, 3L-259, 3K-89 and 3Ps-46 (Fig. 1). The total number of individuals in the samples are 848, of which 776 or 91.4% provided satisfactory age readings.

II. Size Distribution.

The total length distribution is more similar to the length distribution in August-November ("Aquilon") than to that of March-June ("Vendaval"), due to the fact that the former period includes 540 individuals, the latter only 315, but perhaps also to the fact that the former period includes fish from areas very close to one another. However, both curves present distinct peaks, corresponding to similar peaks in the age distribution curves; thus the peak at 38 cm to age 2; 47.5 cm to 3; 50-55 cm to 4; 55-60 to 5; 60-65 cm to 6 and so on (Fig. 2). As the entirety of the samples comprises cod from different divisions, and as the growth rate varies from division to division (Figs. 3 and 4), these peaks represent average sizes corresponding to the average age for each group of the total sampling. For all samples the most abundant group is that of 57 cm, followed by that of 59 cm.

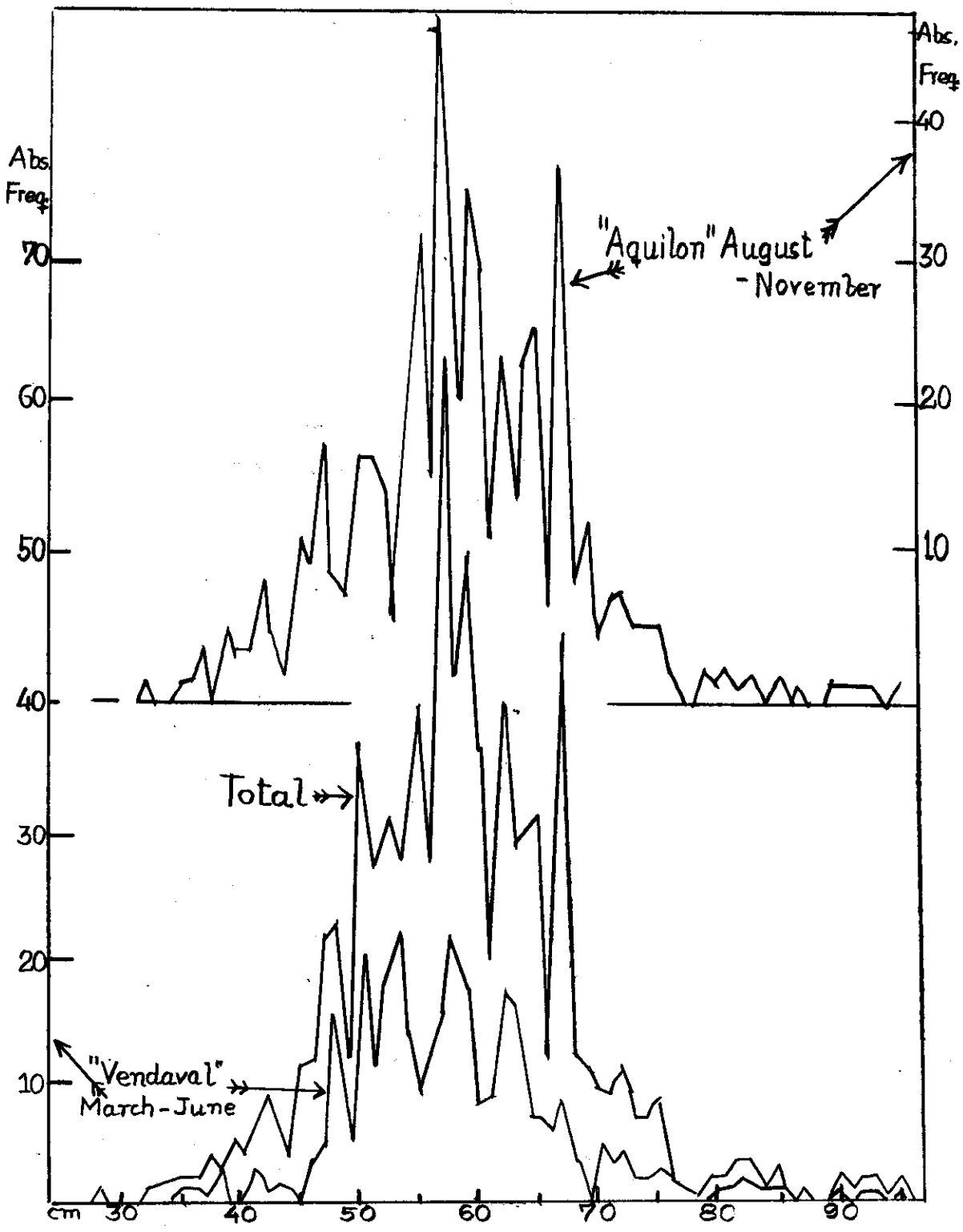


Fig. 2. Curves of absolute length frequencies by 1 cm-classes.

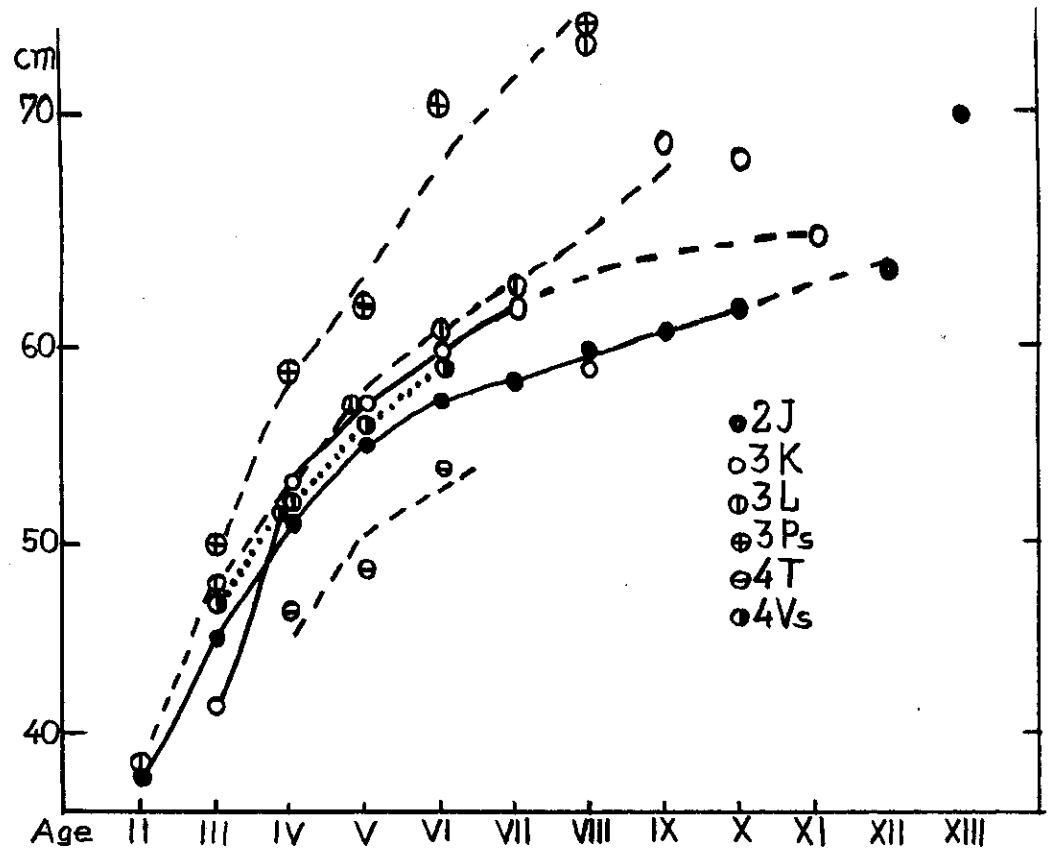


Fig. 3. Growth curves for divisions 2J, 3K, 3L, 3Ps, 4T and 4Vs for 1961. The full lines unite points representing the mean size for each age. The broken lines indicate approximate growth rates estimated from the data at hand.

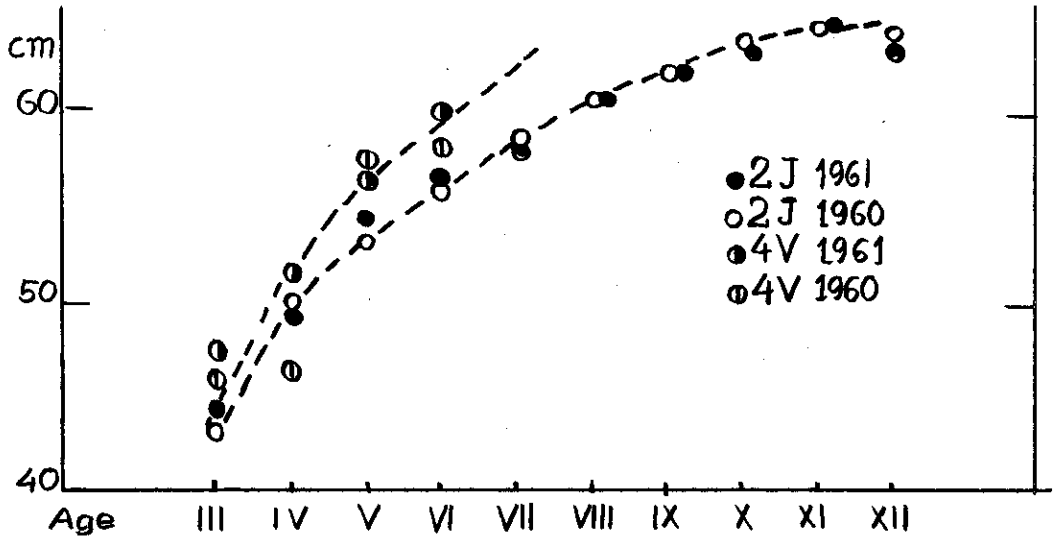


Fig. 4. Growth curves for divisions 2J and 4 Vs for 1960 and 1961.

III. Growth

The numbers of individuals investigated from 2H, 3N and 3M are rather low. Disregarding these divisions, the samples show (Fig. 3) a general increase of growth rate from 4T (the lowest) to 3 Ps(the highest); in between and arranged from lower to higher are 2J, 4Vs, 3K, and 3L. The growth curve closest to the theoretical one is that of 2J which includes the highest number of specimens (see Table 2). The most aberrant data based only on a low number of specimens are not considered.

A comparison with previous years can be made for 2J and 4V (Fig. 4). For 2J the mean sizes for each of the age-groups are practically the same in 1960 and 1961. The difference in size does not exceed one centimeter. Thus the rate of growth in 2J does not vary through the period considered. Almost the same holds good for 4V, except for some age-groups only represented by few individuals. For age groups III, V and VI the mean lengths are so close that the conformity in growth rate for the two years can be considered as established. For both years the growth in 4V is stronger than in 2J.

IV. Age Distribution.

The age distribution is presented in Figure 5, for Divisions 4 Vs, 3Ps, 3M, 3L, 3K, and 2J; the corresponding length distributions are shown in Figure 6. When 2H, 3N and 4T with only few individuals examined are disregarded it appears that the highest average age (6.9) is found for 3K; 2J(6.7) follows closely, for the preceeding year, 1960, a mean age of 7.3 was observed in 2J, 3L and 3Ps were close to one another with 5.55 and 5.54, respectively, the mean age in 3L was 5.7, followed by 4 Vs (4.47) and 3M (4.48). These data are not absolutely comparable, as the larger number of individuals in some samples may cause the inclusion of a few very small or very large specimens which could have a disturbing influence on the calculated averages. If the chances of appearance of the very young and the very old were the same the influence on the average would not be appreciable. However, it has been observed that among the young specimens of the sample, the larger ones are too strongly represented due to discard of the smaller ones. For this reason the comparisons of average ages in the various divisions must be considered with some reservation.

The following observations can be made from the length distributions in the separate divisions:

a. The presence of small individuals in 2J although the mean length (57.39 cm) is higher than in 3M (51.06 cm).

b. The presence of larger individuals in 3Ps and 3L, where the mean lengths are 68.14 and 60.19 cm. As figure 6 shows, the difference in mean length between 3L

and 2J is only 3 cm (3L is the highest).

c. The mean lengths in 3K (59.56 cm) and 3L (60.19 cm) are almost the same; this is also the case for 4 Vs (53.42 cm) and 3M (51.06 cm).

d. The highest mean length is observed for 3 Ps (68.44 cm) which also presents the strongest growth rate (see Fig. 3). The lowest mean length appears in 4T (50.92 cm), with the weakest growth (Fig. 3).

V. Age-Classes.

The relative predominance of the separate year-classes is presented in Figure 5. The 1956 year-class is the one which predominates in the highest number of divisions: 1958 - 3M, 1957 - 4Vs, 1956 - 3P, 3L, 3K, 1955 - 3K, 2J.

A greater abundance of the 1957 and 1955 year-classes was noted in 4Vs. The 1956 and 1955 year-classes are almost equally abundant in 2J and 3K; this confirms the prediction that the 1956 year-class would predominate in 2J, although also the 1955 year-class is fairly predominant. In 3Ps, 3M, and 3L the predominance of the 1956 year-class is clear and undisputed.

VI. Age at First Maturity.

The age at first maturity was determined from the spawning rings in the otoliths of the various year-classes in samples from the divisions studied (Table 3 attached), with the following results.

a. The large majority of cod spawned for the first time at age 6.

b. The scanty data available do not show any difference in age at first maturity for males and females, with the exception that for the 1948 year-class in 2J the females appear to have their first spawning later than the males; however, the scarcity of the material must be borne in mind.

c. The number of cod becoming mature for the first time at age 7 (11 spec.) and at age 8 (7 spec.) is very low compared to the majority of 51 specimens at age 6.

d. One male of the 1953 year-class in 2J appeared to have spawned for the first time at age 5. Once more it must, however, be stressed that the material is rather small, and that certain difficulties in estimating the spawning rings make it necessary to consider the results with reservation.

VII. Sex Ratio.

The study of the sex ratio reveals a considerable predominance of females (Table 4 attached). Only in 2J and 3K the percentages of males are above 25 (viz. 29 and 33% respectively), in the other divisions the male percentages are below 25. Here, as the Table 4 shows, the numbers of specimens in the samples do not

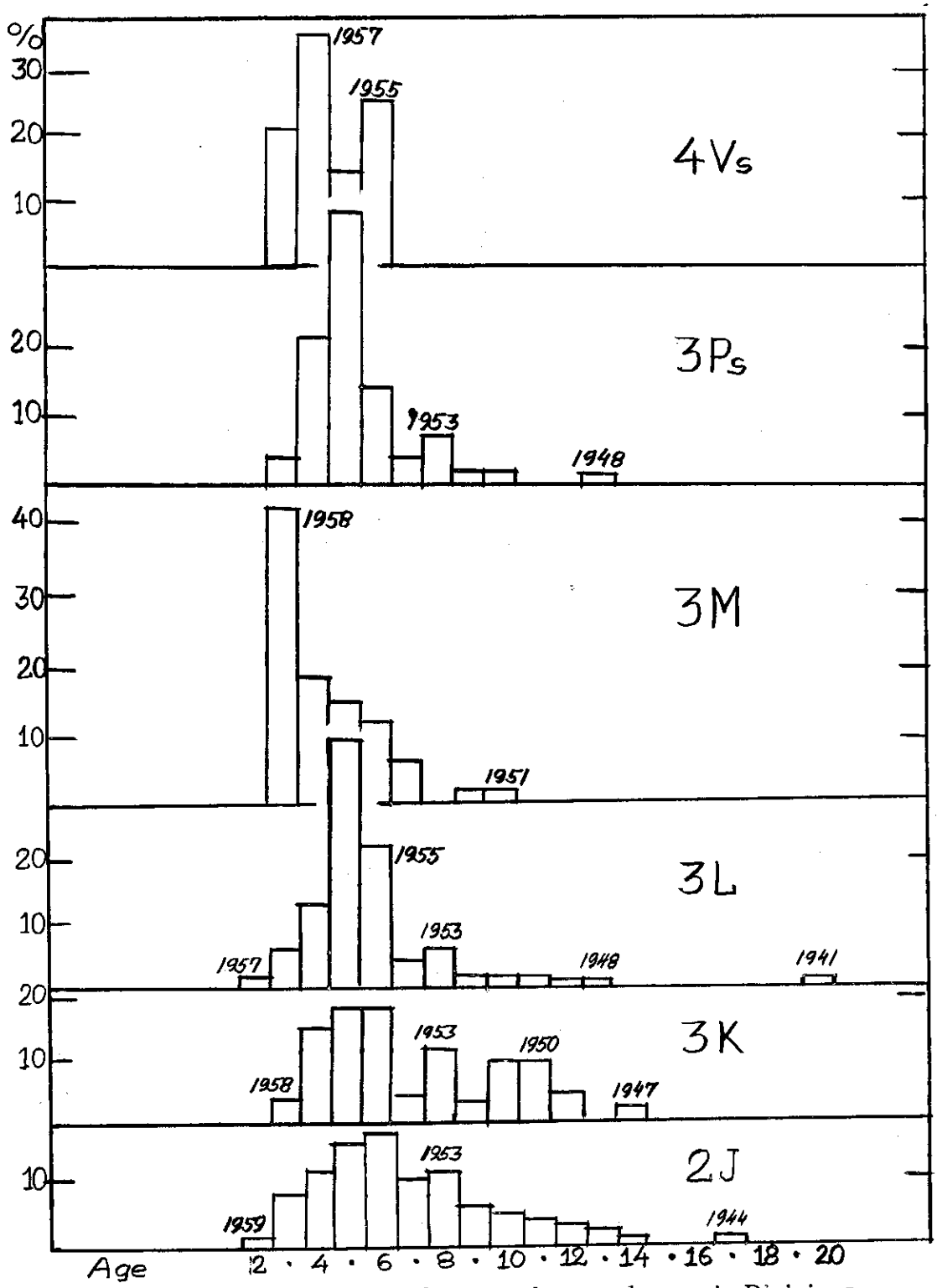


Fig. 5. Relative frequencies of ages and year-classes in Divisions 4 Vs, 3Ps, 3M, 3L, 3K and 2J in 1961.

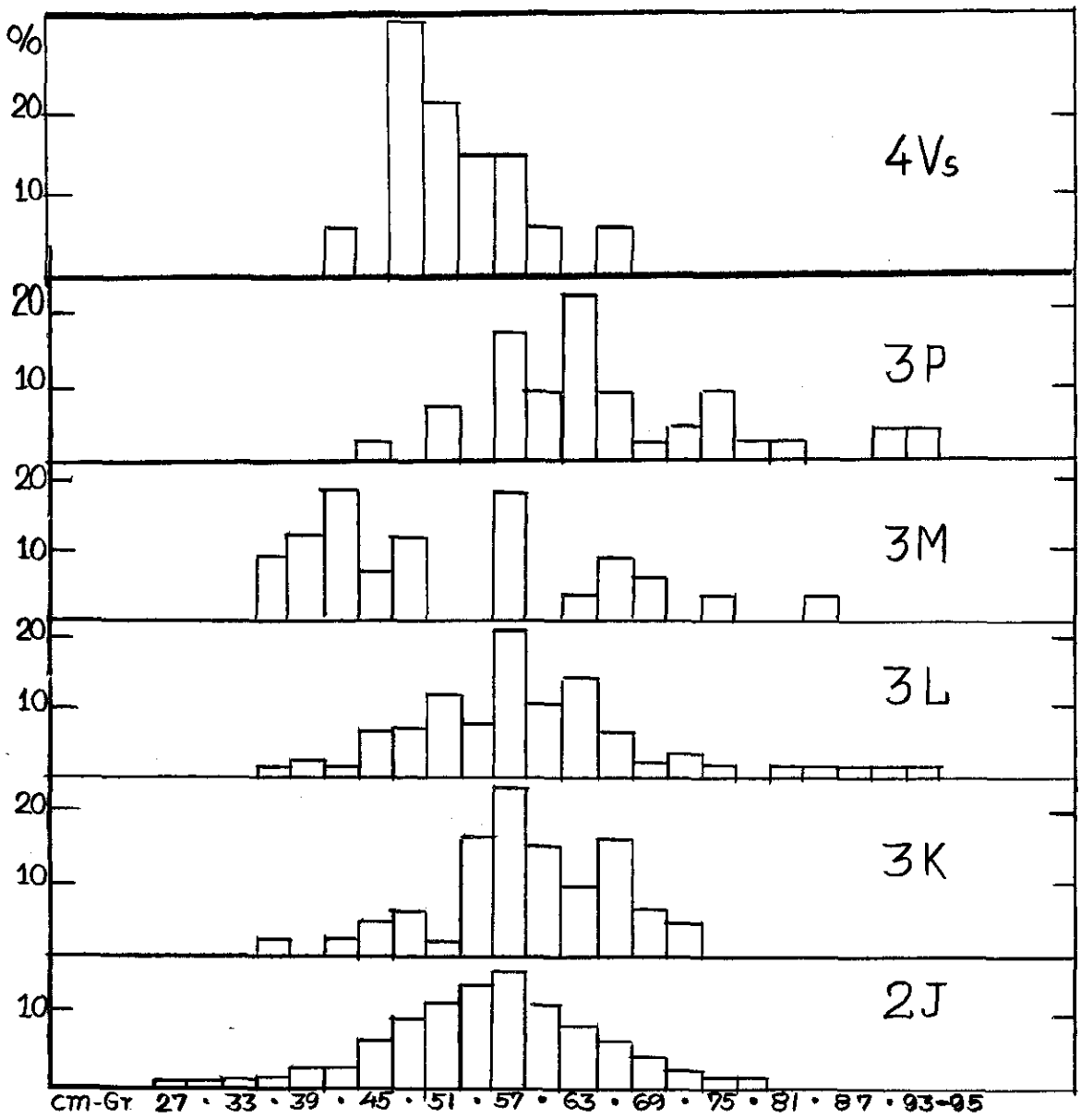


Fig. 6. Relative size frequencies for the separate divisions in 1961.

appear to influence the proportion of the sexes as the following arrangement of the percentages of males according to numbers of specimens in the samples shows:

Division	2J	3L	3K	3Ps	3M	4Vs	4T	2H	3N
No. of spec.	326	240	81	42	33	19	15	12	7
% males	29	19	33	14	18	11	13	25	0

The data from 3K and 2H especially support the assertion that the number of specimens does not influence the sex ratio figures. For all samples together the percentage of males is 24.

VIII. Summary and Main Conclusions.

a. The most common length group in the samples is the 57 cm group, and the mean length is 58 cm. The samples from the preceding year, 1960, showed a mean length of 60.8 cm.

b. The growth curves for the various divisions show that the growth rate is higher in Subarea 3 than in 2 and 4; the stock in 3Ps shows by far the highest growth rate.

c. A comparison of the years 1960 and 1961 shows a marked agreement of the growth rates for these two years in 2J and 4Vs.

d. The dominating year-classes are: Subarea 4-1957, Subarea 3-1956 and Subarea 2-1955.

e. The majority (74%) of all year-classes become mature for the first time at age 6; only 16% at age 7 and 10% at age 8.

f. The percentage of males in the samples is very low, only 24% as an average for all samples.

TABLE 1. Serial no., date, locality, no. of specimens, and subarea for each sample with otoliths.

No.	Date	Locality	No. of spec.	Sub-area
"Vendaval"		N. W.		
	March	Lat. Long.		
1	25	45,50-48,20	7	3N
2	26	47,20-59,06	14	3Ps
			21	
	April			
3	4	45,05-55,20	5	3Ps
4	16	- - - - - -	4	-
5	16	47,30-60,30	5	4T
6	17	47,40-60,35	12	4T
7	19	45,00-57,45	7	4Vs
8	21	idem.	13	4Vs
9	23	45,05-55,16	12	3Ps
10	24	45,05-55,45	14	3Ps
11	26	47,00-51,40	16	3L
12	29	47,00-51,50	12	3L
13	30	46,55-51,45	23	3L
			124	

No.	Date	Locality	No. of spec.	Sub-area
"Aquilon"		N. W.		
	August	Lat. Long.		
26	6	51,50-54,10	35	3K
27	10	49,05-50,15	13	3K
28	11	49,00-50,15	23	3L
29	12	49,10-50,15	17	3L
30	13	49,05-50,20	20	3L
31	16	46,42-50,45	18	3L
32	19	49,06-50,15	19	3L
33	20	49,06-50,15	16	3L
34	22	49,05-50,20	27	3L
35	23	48,55-50,10	11	3L
36	24	48,50-50,10	25	3L
37	28	46,50-45,50	23	3M
			247	

Table 1. Continued.

No.	Date	Locality	No. of spec.	Sub-area
	"Vendaval" N. W.			
	May	Lat. Long.		
14	8	48,45-51,55	18	3L
15	8	idem.	14	3L
16	18	52,35-53,20	17	2J
17	19	52,40-53,15	15	2J
18	20	52,30-52,20	18	2J
19	24	52,40-53,40	14	2J
20	30	52,40-53,20	11	2J
21	31	52,30-54,00	15	2J
			122	
	June			
22	2	52,00-54,00	11	3K
23	3	51,55-54,10	12	3K
24	6	53,50-53,20	12	2J
25	13	54,10-53,40	13	2J
			48	

No.	Date	Locality	No. of spec.	Sub-area
	"Aquilon" N. W.			
	September	Lat. Long.		
38	10	53,21-54,35	23	2J
39	13	53,35-54,00	7	2J
40	16	53,50-54,40	13	2J
41	17	53,50-54,40	15	2J
42	18	53,50-54,55	13	2J
43	21	53,30-53,10	28	2J
44	22	54,25-54,06	19	2J
45	23	53,40-54,00	24	2J
46	24	idem.	14	2J
			156	
	October			
47	8	53,50-54,35	18	2J
48	8	idem.	22	2J
49	9	53,30-55,20	13	2J
50	14	52,45-54,45	16	2J
51	14	idem.	12	2J
52	22	49,50-40,10	13	-
53	25	57,30-54,55	13	2H
			107	
	November			
54	1	53,00-50,20	12	2J
55	9	51,45-54,20	18	3K

Table 2. Distribution of samples by Subareas and dates, with no. of spec. investigated.

Div.	Sample	Date	No. of spec.	Total
2H	53	Oct. 25	13	13
2J	16-21	May 18,19,20 24,30,31	90	
	24-25	June 6,13	25	
	38-46	Sep. 10,13,16, 17,18,21-24	156	
	47-51	Oct. 8,9,14	78	
	54	Nov. 1	12	361
3K	22,23	June 2,3	23	
	26,27	Aug. 6,10	48	
	55	Nov. 9	18	89
3L	11-13	Apr. 26,29,30	51	
	14-15	May 8	32	
	28-36	Aug. 11-16,19, 20,22-24.	176	259
3M	37	Aug. 28	23	
	52?	Oct. 22	13	36
3N	1	Mar. 25	7	7
3Ps	2	Mar. 26	14	
	3,9,10	Apr. 4,23,24	32	46
4T	5,6	Apr. 16,17	17	17
4Vs	7,8	Apr. 19,21	20	20
				848

Table 3. Age at first maturity by year-classes and divisions (no. of spec.).

Ages	♂ 1947 ♀	♂ 1948 ♀	♂ 1949 ♀
6...	3K(1)	2J(1) 2J(1)	2J(4)
			3K(2)
7...	2J(1)		2J(1)
			3K(1)
8...		2J(1) 2J(3)	2J(1)

	♂ 1950 ♀	♂ 1951 ♀	♂ 1952 ♀	♂ 1953 ♀
5...				2J(1)
6...	2J(6) 2J(3)	3K(1) 2J(1)	2J(3) 2J(4)	2J(1) 2J(5)
	3K(1) 3K(1)	2J(4) 3K(2)	3M(1) 2H(1)	3K(2) 3K(1)
			3K(2)	
7...		2J(2) 2J(1)	2J(1) 2J(1)	♂ 1954 ♀
		2H(1) 3K(1)		6...
		3M(1)		2J(1) 2H(1)
8...	2J(1) 3K(1)			

Table 4. Frequencies, numbers and percentages, of males and females by divisions.

	2H			2J			3K			3L			3M		
	♂	♀	Tot.	♂	♀	Tot.	♂	♀	Tot.	♂	♀	Tot.	♂	♀	Tot
N	3	9	12	95	231	326	27	54	81	45	195	240	6	27	33
%	25	75		29	71		33	67		19		81	18	82	

	3N			3P			4T			4Vs		
	♂	♀	Tot.	♂	♀	Tot.	♂	♀	Tot.	♂	♀	Tot.
N	0	7	7	6	36	42	2	13	15	2	17	19
%	0	100		14		86	13	87		11	89	

C. Observations on the Fishery in Subareas 2 and 3 Made by Captains of Spanish Trawlers.

by J. Arambarri.

The fishing season in Subareas 2 and 3 which are closely related from the point of view of the Spanish commercial fishermen, lasted for the Spanish trawlers from the last days of April until December, 1961. About 90% of the fishing days were spent on the Belle Isle ground (3K) and the Hamilton Bank (2J). The peak of the fishing occurred in May, thereafter it gradually decreased to a low catch through the summer and until October, with the minimum catch in August. During this period a few occasional good catches were obtained. In 3K and 2J, May was the best month of the whole season. The average size of the cod (total length) was close to 60 cm.

Cod was the only species sought, although other species were caught accidentally. Redfish was the most frequent species mixed with the cod. Several species of flatfishes were taken regularly, but in minor quantities. All redfish and flatfish were discarded.

It was (as in previous years) reported that redfish often appear mixed with cod in large quantities on the eastern edges of the banks from Belle Isle to Hamilton Bank. It was also reported that both species move between depth zones from day to day and even from one trawl haul to another. Thus it happens that at the same depth one two hour's haul yields a catch of 100 kentals cod (split and salted) and about 10 kentals of round fresh redfish, while another haul following backwards on the same track (same depth) yields completely reverse proportions of the two species. There is little doubt about the similarity of the hauls, as they were checked by electronic navigational aids. Cases like these are reported mainly from late spring and early summer.

The beginning of July, 1961, marked a steady decline of the cod fishery, and by August the fairly large concentrations found at the beginning of the season had apparently scattered over the area or disappeared from the banks. From then on very few sizeable stocks were observed, and cod were not as concentrated as during the previous months. During the early fall and summer, large schools of capelin were observed in 2J and 3K. Stomach investigations showed that cod were feeding heavily on capelin. It was reported, but not technically proved, that the capelin were present in September, feeding apparently on young cod.

An important part of the large Spanish trawlers leave 2J and 3K during the summer for fishery in other subareas. The weather conditions in 2J and 3K were normal in the beginning of the season, but improved further during summer and fall. Air temperatures were higher than normal for the season and long periods of fine weather prevailed. Gales and rough seas which could hinder the fishery were less frequent than could be expected. This is reflected in the small amount of time (less than half of that in 1960) lost without trawling. Cod were less abundant on the banks, and more pelagic in occurrence on account of the fine weather.

XI. U.S.S.R. Research Report, 1961.

by L. N. Pechenik and
A. S. Noskov.

Investigations in the ICNAF Area in 1961 were conducted by the Polar Research Institute of Marine Fisheries and Oceanography (PINRO) and the Baltic Research Institute of Marine Fisheries and Oceanography (BALTNIRO) from scouting vessels and a vessel specialized for hydrological research, "Topseda", of the Murmansk and Kaliningrad exploratory fishing service.

The research cruises covered the regions of West Greenland, Labrador, Newfoundland, the Nova Scotia Shelf and Georges Bank. The various researches carried out included the sampling of data on catch composition, hydrological conditions, bottom relief, migrations and distribution of major commercial species and their food. The regions and periods of spawning were determined. Investigations on zooplankton and ichthyoplankton were also carried out. Studies on race composition and division of stocks of cod and redfish, previously started, were continued. Tagging experiments on cod and haddock with hydrostatic tags were carried out on a larger scale. The numbers of fish tagged in 1961 in the ICNAF Area amount to 2,583 of which 583 were tagged in Subarea 1, 635 in Subarea 2 and 1,361 in Subarea 3.

The "Topseda" made two hydrological surveys (May-June and August-September) in the waters of West Greenland, Labrador, Newfoundland and Nova Scotia. Future surveys will be carried out along adopted routes and within the same period of time.

At the end of the year a specialized cruise initiated systematic work on determining the abundance of young and the strength of year-classes of cod and haddock in the Labrador-Newfoundland areas.

In 1961 the scouting vessels "Novorossiysk", "Odessa", "Kreml", "Rossiya", "Volgograd", "Boguchar", "Balaklava" and middle-sized fishing trawlers (SRT) Nos. 4170, 4177, 4234 made 21 cruises to different parts of the Convention Area with groups of scientists on board. About 102,000 cod, 189,000 redfish and 24,000 haddock were measured.

Data for age determination were collected from 6,500 cod, 10,100 redfish and 2,500 haddock. 724 plankton samples were taken and stomachs of 29,000 specimens of fish were examined.

SUBAREA 1 (Figs. 1-3).

In 1961 the "Topseda" carried out two detailed hydrological surveys in Subarea 1. In addition, hydrological observations were made from the exploratory fishing vessels

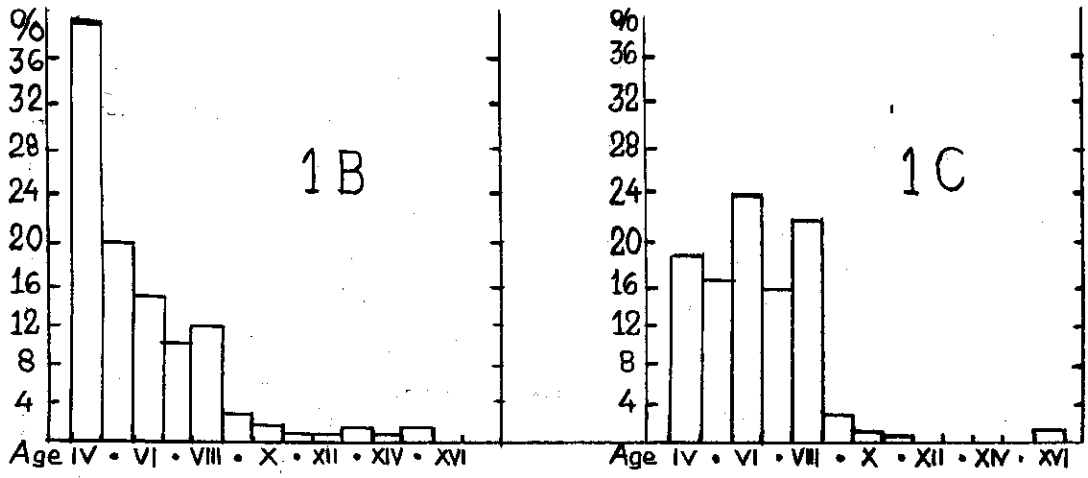


Fig. 1. Cod, off W-Greenland, 1961. Age composition.

"Volgograd" (April-May) and "Novorossiysk" (September-October); both vessels undertook one cruise to West Greenland.

The analysis of the material obtained shows that the hydrographic conditions in 1961 compared with those in 1959 and 1960 are characterized by the following peculiarities:

1. Favourable ice conditions caused early warming (in March), whereas in 1959-1960 the warming only started in April. By the end of May 1961 surface water temperatures reached 2° - 3° C. In September, due to increased contributions from the warm current, surface temperatures along the banks were 5°C, from south-west of Cape Farewell and until Ivigtut they rose to 7°-8° C.

2. In spite of early warming the temperature of the warm waters of the Irminger component in April-May on the slope and top of the Lille Hellefiske Bank was 1° - 1.5° below that in 1959-1960 for the same months, but towards September the temperature on the banks reached 3° - 4° C.

3. The intermediate cold layer on the Lille Hellefiske Bank was less developed in 1961 than in 1959-1960, only 50 m thick; on Store Hellefiske Bank it was 100 m thick, while in 1959-1960 it was 100-150 m thick on both banks. The cold water boundary had a more northern position than in 1959-1960.

The biological material collected during the two cruises indicated that in 1961, due to the early warming of waters, the main bulk of cod completed spawning in April; in May spawning cod were scarce.

In April the size compositions of cod in Divisions 1D and C were about the same with peaks at 50-53 and 62-65 cm (the mean lengths being 58.5 and 57.9 cm respectively).

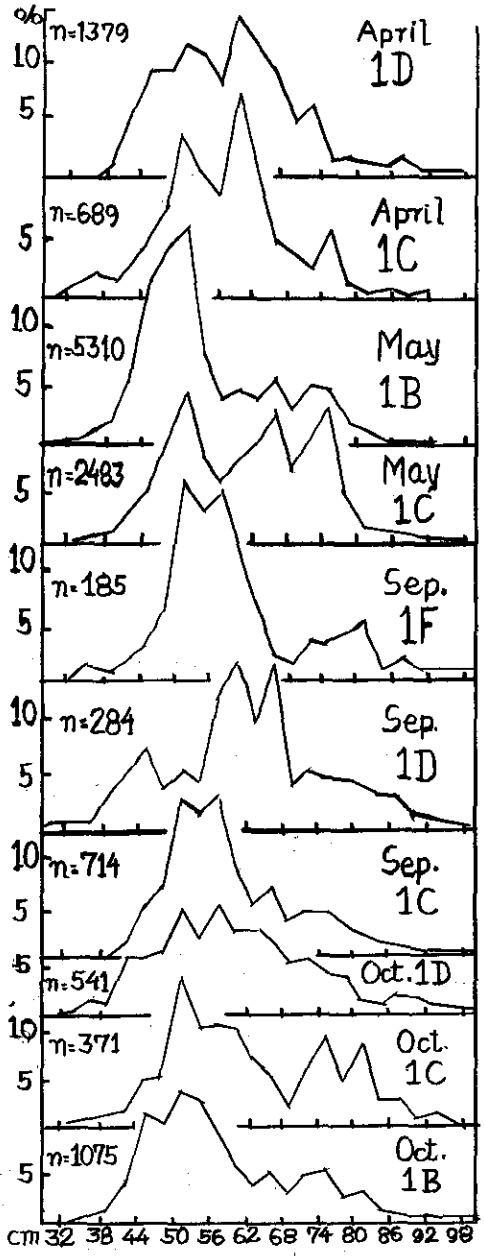


Fig. 2. Cod, off W-Greenland, 1961. Length composition.

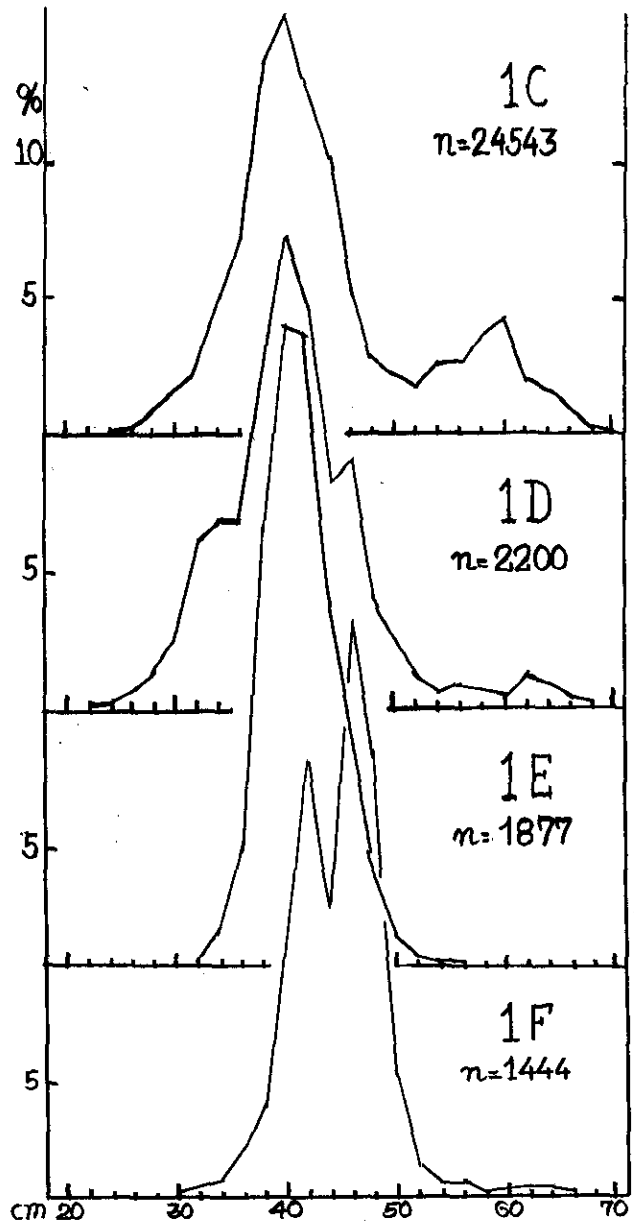


Fig. 3. Redfish, Sebastes marinus, W-Greenland, 1961. Length composition.

In May the quantities of large cod in 1C increased and the length curve was characterized by three peaks (the groups 53, 65, and 74 cm predominated). Higher water temperatures than in the previous year contributed to a considerably earlier formation of cod concentrations on Store Hellefiske Bank. In May cod of 44-53 cm long prevailed in 1B.

The feeding of cod was not intensive during the first cruise (April-May); this made the concentrations less stable. In early April 1960 cod were already intensively

feeding on sand-eel, whereas in the stomachs of cod examined in 1961 sand-eel only occurred in late May. The main type of food for cod in April-May was Euphausiidae. During May the fishery conditions improved. In early May cod catches were taken on Fylla and Banan Banks, in late May on Lille and Store Hellefiske Banks. Through September and in early October cod occurred in scattered quantities in mid-water layers. Only in mid-October, with the appearance of sand-eel, comparatively stable cod concentrations were formed near the bottom on Fylla Bank.

The pattern of length curves in the second part of the year remained nearly the same. In 1C sizes of 50-62 cm (mean length 60.64 cm) prevailed in September; in October the lengths varied from 50-62 to 74-80 cm (mean length 64.27). In 1D the curve was also rather irregular with lengths from 44 to 77 cm prevailing. In 1B specimens from 44 to 58 cm predominated as was the case in May. In September the mean length of cod in 1F was 59.90 cm.

Age determination indicated that 4 to 8 years old cod of the 1953-1957 year-classes constituted the main bulk of the trawl catches. The successful 1953 year-class was the most abundant in the 1958 fisheries accounting for 42.2% of the total trawl catch. This year-class prevailed also in 1959 (32.7%). In 1960 the new rich 1956 year-class entered the fishery, and accounted for over 28%. In 1960 the 1953 year-class took the second place (24.1%) and in 1961 the third place (18.2%). A new stronger year-class, that of 1957, was dominant in the catches. The 1955 year-class took the second place comprising 20.6% of the total catch. It should be noted that considerable numbers of 4-year-old cod were found in all divisions, the 1957 year-class was especially abundant in 1B. It is evident that this year-class is distributed over a wide area and must be regarded as the richest year-class of cod in the waters off West Greenland.

In spring "marinus" type redfish were taken mainly in 1C on the western slopes of Lille Hellefiske Bank. In April-May 1961 the distribution of redfish concentrations extended further north than in the same period of the previous years. Redfish catches ranged from 0.3 to 5.0 tons per hour trawling. As in previous years the mean lengths of redfish increased from 1C to E, with a mean length of 38.7 cm in 1C, 41.1 cm in 1D and 42.6 cm in 1E. The average age of redfish in 1C was 16.1 years. 16-18 years old fish were dominant in the catches.

As in previous years young redfish were scarce in catches from the slopes. According to Hansen, large quantities of young redfish (10-25 cm,) are found in the fjords (Godthaab, Julianehaab and others); their length composition remains constant for a number of years. There is every reason to suppose that the largest part of young redfish coming from theDanish Strait are transported into the fjords of West Greenland where they spend their first 10-15 years of life. At the same time the occurrence of great numbers of redfish below 41 cm in 1C (the length group 31-40 cm making up 62.6%) is accounted for by the fact that grown up redfish leave the fjords and inhabit the slopes of the adjoining banks.

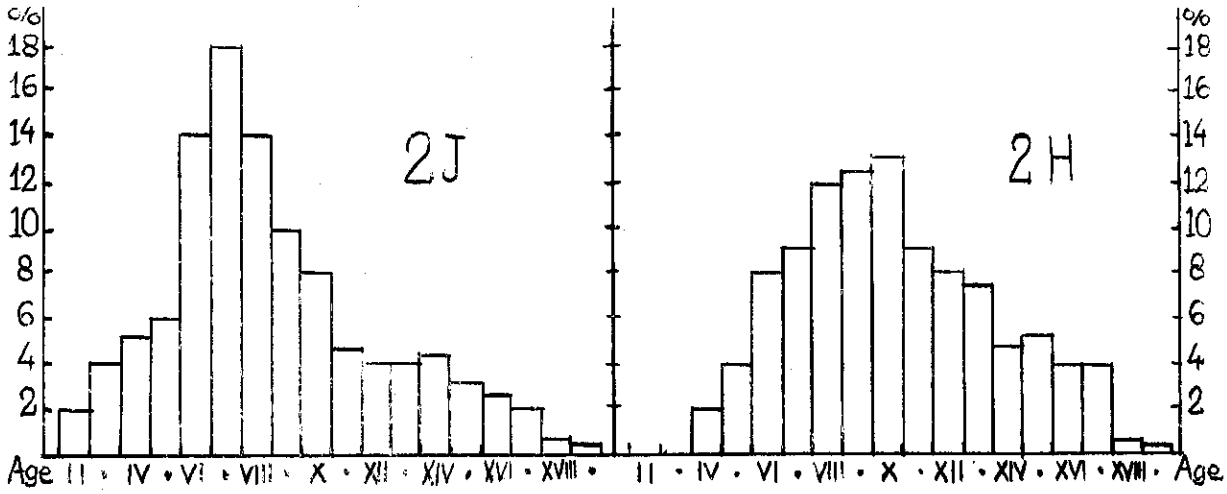


Fig.4. Cod, off Labrador, 1961. Age composition.

In 1961 as in previous years, females with maturing larvae and developing embryos were not recorded; evidently Sebastes marinus have not been breeding in the waters off West Greenland for the past few years. In autumn males in the stage of maturity close to copulation and in the period of copulation were found.

SUBAREA 2 (Fig. 4).

The previous studies of the hydrological regime in the Labrador and Newfoundland areas and the comparison of the data available with those obtained in 1961, allow us to determine the hydrological conditions in these areas. As regards the heat balance for the Labrador and Newfoundland Banks, 1959 was abnormally cold; the warming that began in 1960 is attributed to the weakening of the cold Labrador Current. In 1961, especially in the first half of the year, the warming of the waters proceeded. During June-July the mean temperature anomalies in the standard sections of Subarea 3 were above the normal.

In July the mean temperature anomaly in Subarea 2 of the whole Labrador Current approached the normal value. The core of the Labrador Current was cooler than usual. The temperature of the relatively warm waters transported by the current over the depths of 300-700 m was higher than usual (3°-4°C). A slight increase in the transportation of cold waters by the Labrador Current was observed from the end of July in the Newfoundland Bank area.

The Labrador area (2J) was the main fishing ground in the first part of 1961. Cod occurring throughout the period in stable concentrations on the south-eastern slopes of the Hamilton Bank, were fished successfully at depths of 285-360 m and with temperatures of 3° - 3.75° C near the bottom.

Division 2J accounted for 49% of the total catch of the trawl fleet operating in the ICNAF area in 1961. Scouting and research vessels operated in Subarea 2, mainly in 2J from February to December. Fishery operations in 2H, in May, July and September, were not regular. The material sampled from the scouting vessels was treated. The size range was between 32 and 135 cm with the 53 cm group predominating. Cod of 45 cm and over were mature. The fish were well nourished. Cod of 6-,7- and 8-years old comprised the bulk of the catches. In the catches in 2H, where the fishing trawlers operated for a short time (April-May) in the areas adjoining 2J, 8-,9-and 10-year old cod with a length of 56 cm predominated.

The analysis of the material available indicates that the size and age-distribution of the Labrador cod stock has not changed considerably during 1957-1961. Cod of older age groups are more strongly represented in the Labrador divisions than in the southern Newfoundland areas. Young cod occur more frequently in the southern area (south of the Hamilton Bank) along the deep-slope water.

The growth rates for cod in 2H and 2J (as well as in the adjacent 3K) are the same, and lower than in the southern region of the Grand Bank.

The main bulk of cod in the Labrador area spawn in April; in May the majority of cod are post-spawners.

The results from tagging experiments in the Labrador area confirmed the fact that cod from the northern regions do not migrate southward or vice versa. The tags were returned from the place of tagging within 3-7 months.

In early June, due to the warming of water masses at the Labrador coast, cod started to move from the slopes of the shelf into the coastal zone. An extensive survey of the Hamilton Bank area by a scouting vessel proved the absence of cod here at this period, only single specimens occurring in the catches.

Concentrations of Sebastes mentella were, in the beginning of the year, scattered, constituting in the main a by-catch of the cod fishery. In 2H the peak of the male length curve is at 35 cm. The length curve for females has two peaks at 35 and 40 cm. In May males accounted for 79% of the catches. In July the sex ratio became 1:1 owing to the fact that larger-sized females (38-40 cm) entered this region. Males were 14-16 years old, females 20-21. The number of males and females in 2J remained about the same throughout the year. On the average the length peaks during the period of investigations were at 34-35 cm for males, for females at 35-38 cm. The dominant age of the males is 13-14 years, single males reaching the age of 23; the most common age of the females was 15-19 years, with a few 28-year-old specimens occurring in the catches.

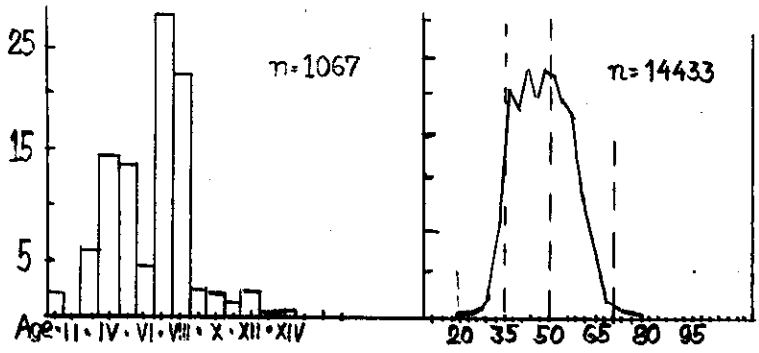


Fig. 5. Cod, Flemish Cap, Division 3M. Length and age composition.

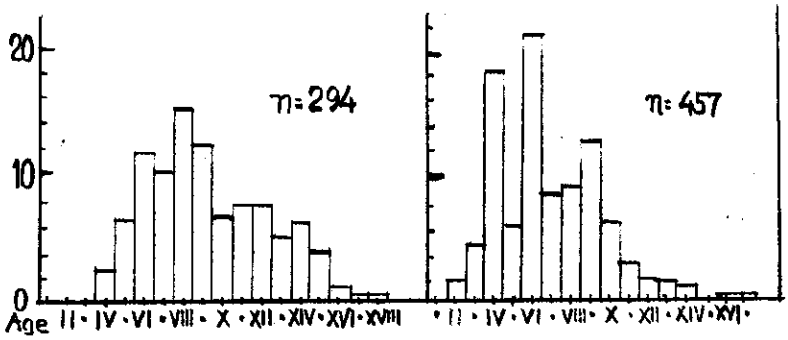


Fig. 6. Cod, 3K (left) and 3L (right), 1961. Age composition.

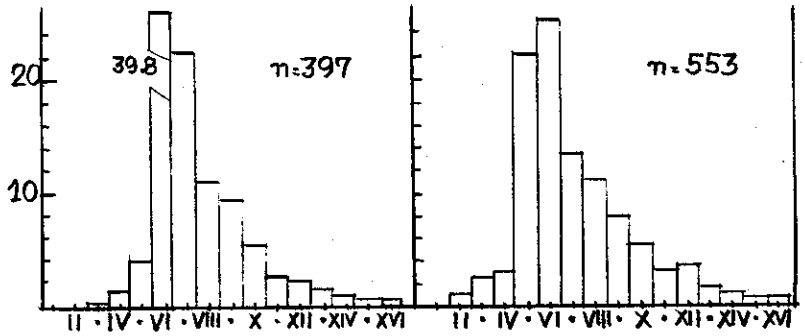


Fig. 7. Cod, 3O (left) and 3P (right), 1961. Age composition.

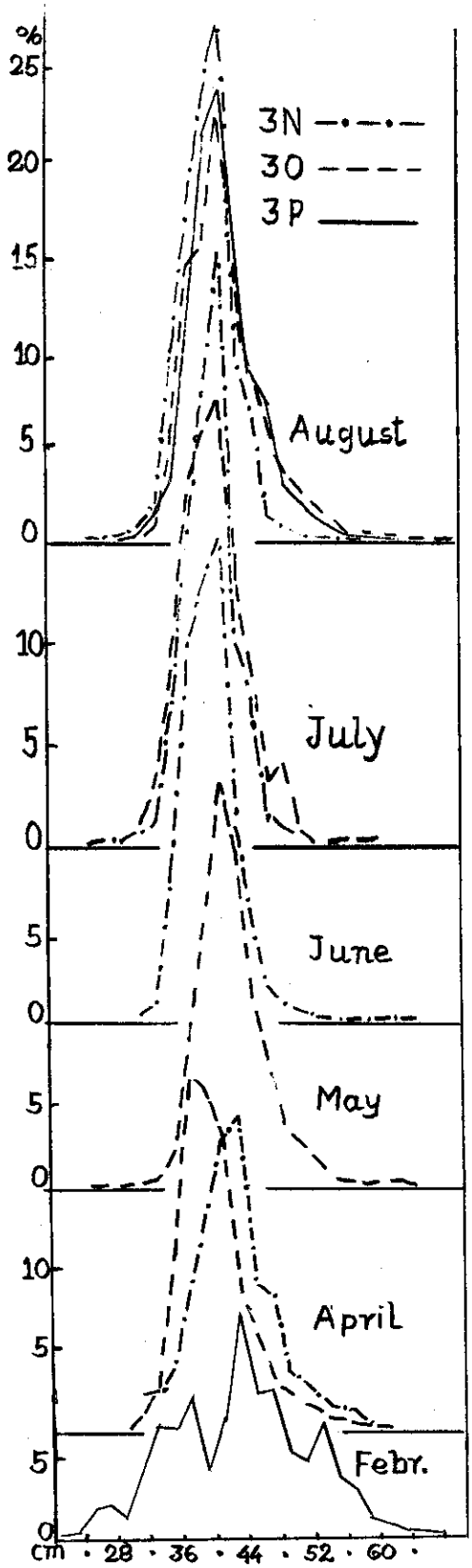


Fig. 8. Haddock, Subarea 3, 1961. Length composition.

SUBAREA 3 (Figs. 5-8).

The fishing operations in the northern Newfoundland area and in the divisions of the Grand Bank were conducted throughout the year but not continuously. In the second half of the year, (excluding August, September) the fishery was in the main for haddock (Divisions 3N and 3O).

Cod began to concentrate in the northern part of the Newfoundland Bank (3K) in April. Large post-spawners (fairly similar in size) with an admixture of immature cod comprised the bulk of the concentrations. The fish were intensively feeding on capelin and lantern anchovy. The predominant length of cod in 3K was 60 cm, and in 3L - 57 and 80-85 cm. The analysis of samples for age-determination indicated that 6-, 8-, and 9-year-olds prevailed in 3K, and 4-, 6- and 9-year-olds in 3L. Older cod were more abundant in 3K and 3L (as off Labrador) than in the southern divisions.

In 3M, beginning from September, feeding concentrations of cod were observed with the prevailing lengths of 42-44 and 51-53 cm and with an age of 4 and 7 years. Young cod were distributed over the whole shallow water layer of the division. Insignificant concentrations of cod were observed in August on the south-western slopes of the Grand Bank (Green Bank) in depths of 110-130 m; these cod were 59-62 cm long, 6-7 years old and in the II-III stages of maturity. Cod on the Flemish Cap (3M) are the first to spawn (February, March); on the north-eastern slope (3K) the spawning takes place in May, June; and the majroity of cod in the southern regions of the Grand Bank spawn in June.

The results of tagging experiments in 3P and 3O do not indicate long migrations of cod from these areas.

The studies carried out in 1961 proved that great quantities of young cod occur on the south-western slope and on the southern and eastern slopes of the Grand Bank in the deep slope water.

At the beginning of the year (January - February), due to the scattered character of the concentrations, redfish in Subarea 3 were taken only as by-catch of the cod fishery. Owing to the approaching spawning season in March, April and May the density of the redfish concentrations in 3K, 3M and 3N increased.

In April single frozen-fish trawlers operated periodically in the deep slope waters off the Labrador Shelf and the northern part of Newfoundland where good catches of redfish alone were obtained. Middle-sized trawlers of the Baltic fishery organizations took significant catches of redfish in April-May in 3K and in March, June and July in 3M.

The length distributions of Sebastes mentella in 3K and 3L are the same with the mean length of the females between 38.8 - 39.3 cm, and of the males between 34.1 - 34.8. In both divisions the majority of females were mature, ready for the shedding of larvae. The predominant ages for males were 14-15 years, for females 20-22 years. The sex ratio during the year was 1:1; except in 3K, where males in November constituted 36% and in 3L where the sex ratio in February was 3:1 (males 77.5%).

In Division 3M redfish were smaller than usual, the peak of the length curve for males was at 32-33 cm, for females at 35-36 cm; the prevailing age of the males was 11-12 years, and of the females 12-13 years. Over 40% of the females were mature, ready for the extrusion of larvae. In April males in 3O were in the III-IV maturity stages, females in the V-VI maturity stages; males accounted for 82.5%. In 3N males were 29.4%.

Dense concentrations of small Sebastes mentella, with a mean length of 28.6 cm and a mean age of 9-11 years, were found in April over the whole south-western slope of the Grand Bank between 130-160 m. These redfish were feeding intensively on capelin and kril.

In Subarea 3 the majority of the females completed extrusion of larvae in April. No dense concentrations of redfish were observed during July-December.

Haddock investigations in Subarea 3 during 1961 (3N and 3O) were carried out during May and proceeded throughout summer and autumn. Haddock with the peak of the length curve at 36-43 cm were present in the catches of the scouting vessels. In 3P the length curve in February had 3 peaks; 32-37 cm, 40-47 cm and 52-53 cm, with 42-47 cm predominating. The length distribution of haddock by divisions and months did not vary much; in 3N the mean length was 39.2 cm, in 3O 40.2 and in 3P 41.0. 3-8 year-old haddock with a considerable dominance of 4 and particularly 5-year-old specimens were found in the catches. In the data published by Templeman haddock are a year older, which may be attributed to different methods in age determination; this should be checked in the future.

In Division 3O spawning haddock were observed in late May, mass spawning took place in June. A few spawning haddock were found in 3N in July. The fishery was particularly successful from the beginning of July in shallow water, where haddock were feeding intensively on spawning capelin. During August-September the trawlers switched over to fishing for herring in 5Z. The fishery for haddock was resumed in 3N and 3O in October, when haddock were feeding on sand-eel.

SUBAREA 4

In February a scouting vessel in Subarea 4 took some age samples; 2,569 specimens of Sebastes mentella were measured. The mean length of males was 28.5 cm, of females 30 cm. The average age of males was 11.5 years, of females 12.5 years. The commercial trawlers did not fish in this region.

SUBAREA 5

In 1961 exploratory fishing in Division 5Z (Georges Bank) was carried out by the "Balaklava" and "Boguchar".

In April commercial concentrations of western Atlantic herring were observed, and three oceanographic surveys were made on the n-and nw-slopes of Georges Bank.

As a result of the analysis of the hydrological data it was established that:

1. The Georges Bank area is a region of complex inter-action of three water masses: Atlantic, Gulf of Maine and slope waters.

2. The central part of the bank is covered by the bank waters proper, which are a product of the above-mentioned water masses. The anticyclonic eddy in the centre of the bank evidently facilitates the formation of these water masses.

3. The dynamics of the waters in the Georges Bank area is mostly affected by north-eastern, north-western and south-western winds. North-eastern winds increase the flow of the slope waters along the continental slope and may lead to a complete destruction of the anticyclonic eddy over the bank. South-western winds intensify the penetration of Atlantic water masses of high salinity into the bank area.

4. During the year surface water temperatures on the bank vary from 3° to 19°C with maximum warming in August-September. In the first part of summer dense fogs retard the warming of waters.

5. In late summer the dilution of surface water was at its height (32.18 o/oo).

As the analysis of the biological data indicates, herring of Georges Bank belong to the sub-species Clupea harengus harengus typical of the whole of the North Atlantic. Judging by their morphological and biological characteristics (position of the dorsal and anal fins, number of rays, vertabrae number, age composition, growth rate, etc.) they may be regarded as bank herring which do not perform long migrations and are evidently an isolated stock.

The lengths of Georges Bank herring in the 1961 catches range from 17 to 34 cm with specimens of 25-26 cm prevailing. The age is 4-5 years. Spawning was observed from early September to the beginning of October.

Herring concentrations were successfully fished with mid-water trawls when they appeared in the mid-water layers and with drift-nets when they sank to the ground.

The trawl catch amounted to 426.6 thousand centners, the drift-net fishery resulted in 259 thousand centners making up a total of 685.6 thousand centners.

STUDIES ON LOCAL STOCKS OF COD AND SEBASTES MENTELLA TR.

On the basis of studies on race composition of cod, parasitological investigations and analysis of size variations in otoliths it can be concluded that the Labrador and Newfoundland areas are inhabited by isolated cod populations which, owing to their isolation, differ in a number of characteristics.

In the Labrador - Newfoundland areas four cod populations may be distinguished:

1. Cod of southern Labrador and the northern Newfoundland Bank.

2. Cod of the Flemish Cap.

3. Cod of the north-eastern and south-eastern Grand Bank.

4. Cod of the south-western Grand Bank.

Investigations, initiated in 1959-1960, were continued in 1961, and the material on the studies of redfish populations (Sebastes mentella Tr.) in the Labrador-Newfoundland areas was summarized. Plastic and meristic characteristics (height of body, length of head, diameter of eye, number of fin rays etc.) were compared so as to define the difference between the fish of the isolated population. Parasite fauna of redfish("natural tags") was studied as well as external red and black spots and internal black spots in muscles ("biological tags").

Morphoanatomic differences and the use of "parasitic" and "biological" tags suggest the existence of three Sebastes mentella stocks in the areas under investigation: the first comprises populations of Divisions 2J, 3K and 3L. The second stock inhabits the Flemish Cap, the third occurs off southern Newfoundland and on the banks of Nova Scotia and New England. In Division 3N an aboriginal population is found and considerable mixing between this population and specimens of the southern stock is observed.

PLANKTON INVESTIGATIONS

The plankton material sampled in the Newfoundland waters and in the Flemish Cap area in 1960 makes it possible to establish that the spring plankton development starts two months earlier in the warm waters off Flemish Cap and east of the Newfoundland Bank than in the cold Labrador waters. The propagation of Calanus finmarchicus in Atlantic waters occurs in March, whereas in Labrador waters mass spawning of Calanus was recorded only in June. The two water masses differ also as to phyto-plankton composition - the cold Labrador waters of the Newfoundland Bank are characterized by a prolonged and intensive spring development of diatoms, while this was not observed in the Atlantic waters. Peredineae were dominant in the phytoplankton.

During the summer a study of the distribution of Euphausiacea (one of the food items for fish) in the Newfoundland Bank area was carried out. The greatest numbers of Euphausiacea occurred on the central eastern slope of the Bank (about 800 individuals per hour trawling). On the northern slope Euphausiacea were present in smaller quantity (20-50 specimens per hour trawling). Very high numbers of Euphausiacea of the species Thysanoessa longicaudata were taken on Flemish Cap (10,000 - 11,000 individuals per hour trawling). Thysanoessa longicaudata was predominant on the northern slopes of the Newfoundland Bank in early spring (March), whereas an increase in the number of Thysanoessa inermis was observed in late summer. These changes result apparently from the seasonal fluctuations in the intensity of the Labrador waters. No seasonal changes in the quantitative proportions of various species of Euphausiacea were found.

The study of the ichthyoplanktonic material sampled during 1959-61 permitted a preliminary establishment of the location of spawning grounds of such commercial fishes as cod, redfish, American plaice, (Hippoglossoides platessoides) and of the non-commercial sand-eel.

Cod spawning grounds have been located off southern Labrador (2J), in the north-eastern slope region of the Newfoundland Bank, in the south-western area of Flemish Cap (3M), in the shallow waters of 3N and on the south-western slope of the Grand Bank (3O). Cod in these areas spawn during March to August. The maximum spawning is in April-May.

Redfish spawn on the north-eastern slope of the Grand Bank (3L), on the south-eastern part of Flemish Cap (3M), and in slope waters of the northern 3L. Redfish pre-larvae occur in the catches from April to August. The maximum spawning apparently takes place during April-May. In the Nova Scotia area no spawning of redfish was observed.

The spawning of American plaice is believed to take place off south Labrador (2J) and on the southern Newfoundland Banks (3M, 3N, 3O) during April, May and June.

A few haddock eggs were found in the Nova Scotia area (4V, 4W) in April, and on the Grand Bank in May (3L, 3N, 3O).

Sand-eel spawning grounds are situated on the south-eastern and south-western slopes and in the shallow waters of the Grand Bank (3O, 3N).

XII. United Kingdom Research Report, 1961.

by C. E. Lucas and R.J.H.Beverton.

Fishing

Factory trawlers fished in Subareas 1, 2 and 3. Conventional trawlers fished mainly in Subarea 1. A trial was made of transferring fish from a conventional trawler to a factory trawler at sea.

Sampling

4,227 cod from Subarea 1 were measured on the markets of Hull and Grimsby, and 180 otoliths collected. Following preliminary sampling by scientific staff, 19,000 fish were measured by members of the factory staff aboard the factory vessels FAIRTRY I, II and III (2,000 from Subarea 1, 3,000 from Subarea 2 and 14,000 from Subarea 3). The data from Subarea 1 are summarised in the attached table; the detailed data will be supplied in the Sampling Yearbook.

Research vessels

No research vessel work was done west of Cape Farewell in 1961, but the ERNEST HOLT worked in East Greenland waters during April and October-November, the second cruise in co-operation with two commercial trawlers.

Environmental studies

Although no research vessel surveys were made in the area during 1961, the North Atlantic Continuous Plankton Recorder Survey, operated from the Edinburgh Oceanographic Laboratory, was extended further in the ICNAF area. Records are now being obtained on two new routes: (a) between the U.K. and St. John's, Newfoundland and (b) between St. John's, Newfoundland and Boston, Massachusetts, via Halifax, Nova Scotia. Together with the records obtained between Iceland and Newfoundland, a total of more than 7,500 miles of routes was sampled during the year.

The new sampling has produced further information about the distribution of redfish larvae and has permitted the comparison of standing crops of plankton over the European and American continental shelves and the open ocean. The distribution of warm water plankton over the Grand Banks of Newfoundland has been shown clearly and regularly in samples taken throughout the year.

In part, this extension of the survey has been made possible by the award of

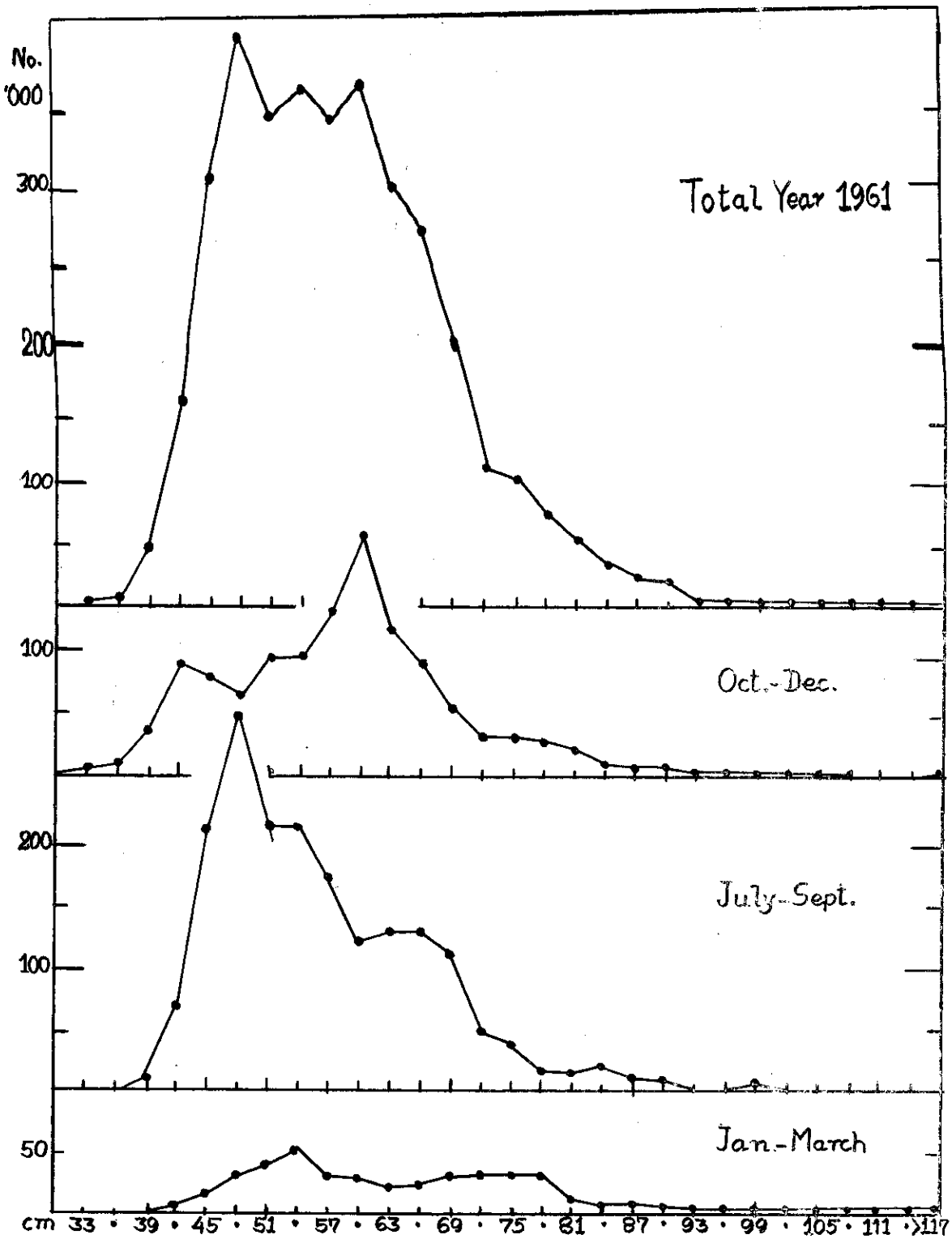


Fig. 1. Cod, 1961. Numbers landed in British ports from Subarea 1 (excluding factory trawlers). Numbers and weights (tons, gutted) - Jan/March: 435,538 - 960 t; July/Sept.: 1,924,817 - 3,020 t; Oct./Dec,: 1,217,348 - 1,680 t; Year: 3,577,703+5,660 t.

a contract from the U. S. Office of Naval Research, under which two Research Fellows will join the Edinburgh staff in 1962. The assistance of members of the staffs of the Icelandic Fisheries Laboratory and the Woods Hole Laboratory of the U.S. Bureau of Commercial Fisheries in supervising recorders during transit is also gratefully acknowledged.

Assessment Working Group

Members of the staffs of the Lowestoft and Aberdeen laboratories took part in resumed meetings (under the Chairmanship of Mr. R. J. H. Beverton), both in Lowestoft in March and during the course of the Commission's Annual Meeting in May. A report has been submitted to the Commission and prepared for publication.

Environmental Working Group

The initial meeting was held in Aberdeen during March (under the Chairmanship of Dr. C. E. Lucas). During the annual meeting a report was completed, providing a programme of research and plans for a Symposium in 1963. Members of the staffs of both Government laboratories worked with the Group and are at present closely concerned with developing plans for co-operation research vessel surveys in Subareas 1 and 2.

XIII. United States Research Report, 1961.

by Dr. Herbert W. Graham

Routine sampling of the landings of the major species was continued at the New England fishing ports. A detailed review of the interviewing and sampling procedures used at the fishing ports has been completed. As a result of this review, the sampling program has been expanded in some cases.

Concomitant with the improved interviewing and sampling program, we are developing a program to handle all of the data by automatic data processing equipment. As this program develops, we shall be able to work back into a large accumulation of historical records.

Research is also continuing to determine the optimum number and size of samples needed to obtain reliable estimates of the number of fish of each length and age taken from the Convention Area.

Haddock (Melanogrammus aeglefinus (L).)

The fishery -- In the first seven months of 1961, haddock abundance on Georges Bank exceeded that for 1960 and it was the highest since 1956 (Table 1). A major part of this increase was attributed to the strong 1958 year-class as 3-year-old fish (Fig. 1). An important contribution to 1961 landings also was made by the 1959 year-class (age group 2) which was about twice as large as the 1956 and 1957 year-classes but only one-half as large as the 1958 year class.

Table 1. --Trends in the Georges Bank haddock fishery

Year	Landings (thousands of pounds)	Days fished	Average landings per day (pounds)
1952	83,645	5,933	14,098
1953	69,476	6,511	10,671
1954	89,710	5,807	15,448
1955	78,942	5,059	15,603
1956	94,505	6,794	13,910
1957	89,251	7,825	11,406
1958	68,655	7,836	8,761
1959	69,350	9,432	7,353
1960	79,470	7,669	10,362
1961(first 7 months)	53,293	4,476	11,906

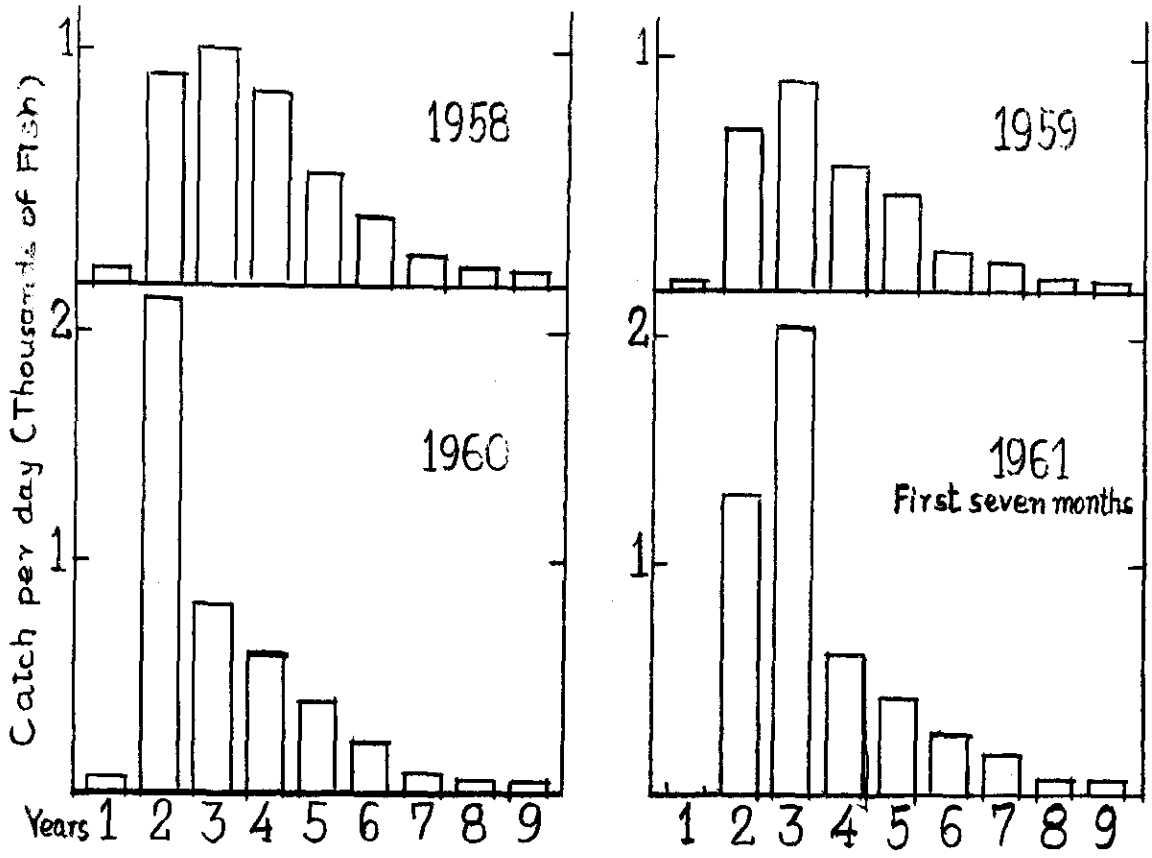


Fig. 1. Haddock, Georges Bank. Catch per day (in 1000 of fish) by age in years. 1958-61.

Small catches of young-of-the-year haddock in the 1960 and 1961 fall survey cruises suggest that abundance may drop again in 1962 and 1963 when the 1960 and 1961 year-classes enter the fishery as two-year-old scrod.

Predictions of year-class strength. -- Distribution of young-of-the-year haddock on fall survey cruises was examined with respect to geographic location, depth and bottom temperatures. In the South Channel the largest catches of "zero" haddock consistently occurred in the depth range 50-100 fathoms, and at temperatures below 45° F. On the northern edge of Georges Bank this same relationship was observed in some years; but in other years equally high catches were made in shallower and warmer water. These data suggest that improvements in precision of year-class predictions may be obtained by appropriate stratification of grounds for survey purposes.

U. S. - Canadian 4X Program. Substantial movement of haddock between Divisions 4X and 5Y, as shown by Canadian tagging studies, makes it necessary to consider the stocks in these Divisions jointly. The U. S. - Canadian cooperative exchange of data on Division 4X haddock was reviewed, and an agreement was made for its continuation. Essentially this consists of exchange of catch-effort statistics and size-age samples, with Woods Hole assuming primary responsibility for

analyzing commercial landings. Work was begun on a backlog of 4X haddock otoliths after reviewing evidence supporting validity of otolith age readings.

Cod (Gadus morhua L.)

The fishery.--Total U. S. cod landings in 1961 reached a 10-year high of nearly 44 million pounds (Table 2). Although each of the important New England ports reported increases in cod landings during the year, the largest increase -- over 3 million pounds -- was reported from Boston, Massachusetts.

Research.--Preliminary analysis of cod otoliths collected aboard the research vessel Delaware, revealed marked differences in the clarity of the hyaline zones for otoliths from different fishing grounds in the New England area. The zones in otoliths from fish collected in the offing of Cape Cod are not so sharply defined as those in otoliths collected in Ipswich Bay, north of Boston.

A critical study of scales and otoliths from the same fish is underway with material collected from 300 cod covering a wide range of sizes. Results of the study will be used to determine whether scales only, otoliths only, or a combination of the two will be used for routine age determination of commercial landings of cod.

Serological studies of cod blood were started in an effort to further delimit the groups or stocks of cod in New England waters. Results of the blood-group studies will be used to complement the extensive tagging study carried out in 1955-1958.

Table 2.--Trends in cod fishery

Year	Pounds landed (thousands)	Boston only (thousands of pounds)		
		Large	Market	scrod
1952	42,401	7,022	11,872	2,910
1953	31,899	5,718	9,410	1,528
1954	35,239	7,291	7,234	2,006
1955	32,369	6,504	6,835	1,945
1956	32,760	8,165	8,019	1,334
1957	31,911	7,608	8,319	1,559
1958	37,784	5,194	6,612	4,377
1959	40,758	5,739	8,098	3,872
1960	40,381	4,774	8,078	2,695
1961 1/	43,700	(Data not yet available)		

1/ (N.B. weights of market categories: scrod -1-1/2 - 2-1/2 pounds; market - 2-1/2 - 10 pounds; large - 10-25 pounds).

Silver hake (Merluccius bilinearis (Mitchill))

The fishery.-- The silver hake fishery in New England declined in 1960 due to the curtailment of the industrial fishery. In 1961 a drop in landings for food fish was due apparently to lowered availability and possibly abundance.

Table 3.--Trends in the New England silver hake fishery (millions of pounds).

Year	For Food	For Industrial	For animal food	Total
1952	117	9	2	128
1953	85	16	3	104
1954	90	21	6	117
1955	111	23	10	144
1956	89	30	11	130
1957	117	38	16	171
1958	107	23	17	147
1959	110	26	20	156
1960	103	4.6	20	127.6
1961 *	87	6.8	16	109.8

* preliminary estimates

Research.-- In the past year research on silver hake has included studies on behavior and selection (see section on mesh selection), and on availability and abundance. Although the data have not been fully analyzed at this time, a marked seasonal and secular change in availability of the population on different grounds is apparent in different years. Temperature appears to play a complex role in these local fluctuations in abundance.

Redfish (Sebastes marinus)

The fishery.-- United States redfish landings for 1961 totalled about 131 million pounds, the lowest since 1944 and approximately half the amount landed in 1951, the peak year of the U. S. fishery. Since 1955 fishing effort has varied between 7500 and 8000 boat-days fished annually with landings ranging between 134 and 157 million pounds. This fishing effort has been distributed in varying proportions among the four main fishing grounds, Gulf of Maine, Nova Scotia Banks, Gulf of St. Lawrence and the Grand Banks. Preliminary estimates indicate that the greatest portion of United States fishing effort in 1961 was expended on the Nova Scotian Banks with decreasing amounts in the Gulf of Maine, Grand Banks and Gulf of St. Lawrence, in that order. Fishing effort in the Gulf of St. Lawrence in 1961 was reduced to about 100 days, less than 5 percent of what it was 5 years earlier.

Table 4.--Trends in the redfish fishery

Year	Landings (thousands of pounds)	Calculated fishing effort (days fished)	Catch per day (thousands of pounds)	Landings (thousands of pounds)	Calculated fishing effort (days fished)	Catch per day (thousands of pounds)
	Gulf of St. Lawrence			Grand Bank		
1951	8,517	353.1	24.12	29,900	445.5	67.12
1952	9,949	463.4	21.47	45,129	818.6	55.13
1953	16,026	681.7	23.51	73,593	1647.9	44.66
1954	37,981	1517.4	25.03	68,936	1785.9	38.60
1955	76,586	2397.1	31.95	29,555	1125.9	26.25
1956	54,729	2024.0	27.04	29,330	942.5	31.12
1957	40,385	1960.4	20.60	10,575	288.5	36.65
1958	16,611	843.6	19.69	23,939	687.9	34.80
1959	11,489	551.6	20.83	36,337	1093.8	33.22
1960	2,861.1	128.1	22.34	33,576.1	1038.2	32.34
1961	2,500*	--	--	31,400*	--	--
	Nova Scotian Banks			Gulf of Maine		
1951	151,679	6922.8	21.91	68,213	9814.8	8.95
1952	83,933	5013.9	16.74	47,128	6042.1	7.80
1953	29,606	1837.7	16.11	37,017	4459.8	8.30
1954	46,065	1899.5	24.25	28,633	3858.9	7.42
1955	20,569	1099.9	18.70	30,675	3089.1	9.93
1956	35,963	1460.7	24.62	31,720	3266.7	9.71
1957	46,519	1895.6	24.54	36,306	3862.3	9.40
1958	67,830	2555.8	26.54	35,725	3671.6	9.73
1959	54,448	2391.2	22.77	34,414	3599.8	9.56
1960	79,958.5	3320.5	24.08	25,036.7	2966.4	8.44
1961	70,700*	--	--	26,200*	--	--

* preliminary estimate - data for January-September, 1961.

Research. --The results of tagging redfish on the opercle with Petersen discs were reported to the ICNAF Marking Symposium in May, 1961. The effect of this tagging technique on the growth rate of the tagged fish was clearly shown. Growth was reduced to a very low value after the fish were tagged. This reduced rate of growth persisted for about 2-1/2 years, after which the rate increased gradually until it approached the pre-tagging rate at the end of 4-1/2 years.

Recent recaptures of Eastport redfish tagged with plastic dart spaghetti tags through the dorsum indicate that tagging in this manner has little effect on growth rate. Fish tagged with plastic darts on the dorsum grew an average of 31 mm. in 16 months, compared with the average of 1-2 mm. per year recorded earlier for Petersen discs on the opercle.

A small number of dart tags was recovered from fish that were tagged first with Petersen discs through the opercle and later were tagged with plastic darts through the dorsum. The fish grew an average of 17 mm. in 37 months while tagged with Petersen discs. When the Petersen discs were removed from the opercle and plastic darts were inserted in the muscle of the dorsum, the growth rate increased to an average of 23 mm. in 14 months. The difference in growth rate is thought to be mainly the result of the position of the dorsal tag, which did not interfere with feeding as did the opercle tag, rather than due to the difference in the type of tag used for tagging.

The pigmentation of pre-extrusion larvae of Sebastes from several locations in the western Atlantic was studied in relation to the morphometric measurement of the females. Variations in the caudal pigmentation were found to be more complex than that reported earlier by Templeman and Sandeman (1959). The number of caudal melanophores ranged between zero and four, and there was a relatively broad range in the number of melanophores found on the young from a single female. These variations indicate the value of counting the number of caudal melanophores as a possible racial characteristic rather than the less meaningful determination of the presence or absence of pigmentation reported earlier.

Flounders

The 5 species of flounders landed at New England ports, yellowtail (Limanda ferruginea) (Storer), winter flounder (Pseudopleuronectes americanus (Walbaun), fluke (Paralichtys dentatus) (Linnaeus), American plaice (Hippoglossoides platessoides) (Fabricius), and witch (Glyptocephalus cynoglossus) (Linnaeus), make up about 20 percent of the value of total fin fish caught in this region. Currently, biological studies are being carried out on the first 3 of these, which made up most of the flounder landings.

Yellowtail flounder (Limanda ferruginea)

The fishery. -- Stock identification studies of yellowtail indicate that there are 3 relatively distinct groups. Landings by ground and average landings per day or effort, 1950-1960, for the 2 groups which are of greatest importance in the catch, are given below. An examination of grounds where yellowtail are caught suggested

that fishing effort could not be estimated on the basis of ground fished, alone, since a number of other species also are found in abundance on parts of these grounds. Landings per day was therefore based on trips landing 75 percent or more yellowtail.

Table 5.-- Trends in the New England yellowtail fishery

Year	Southern New England ground		Georges Bank	
	Landings[1)]	Landings/day	Landings	Landings/day
1950	6,369	3.6	7,002	5.5
1951	3,787	3.8	7,913	5.5
1952	4,172	3.1	6,751	5.3
1953	3,255	3.4	6,356	5.3
1954	1,477	3.4	5,956	4.7
1955	2,919	3.3	6,049	5.4
1956	4,956	4.0	3,489	4.6
1957	9,586	5.4	5,074	6.7
1958	15,895	5.8	9,995	8.0
1959	13,294	3.8	9,106	4.7
1960	13,855	4.1	9,804	5.4
1961 [2)]	17,100		12,100	

1) All figures for landings and landings per day are in thousands of pounds. Landings are those at Massachusetts ports. Landings per day are for trips by 26-50 ton draggers landing 75 percent or more yellowtail.

2) Estimated.

Relative abundance has increased on both grounds in recent years, and it consistently has been highest on Georges Bank. Age composition studies show that strong year-classes in 1955, 1956, and 1958 have been principally responsible for the increase. The fish come into the catch at age 2 and they make their greatest contribution to landings at ages 3 and 4. The total New England landings from all grounds in 1961 were approximately 37 million pounds, the highest since 1948.

Preliminary information on the 1959 year-class suggests that it is of about average size. However, the landings during 1962 will probably remain at a high level because they will consist largely of fish from the strong 1958 year-class. Total catch very likely will be between 30 and 35 million pounds.

Research.--Research during 1961 was centered on studies of growth rate and age composition of fish from the 3 groups. Samples were obtained from 2 sources: (1) commercial vessels using large mesh (about 4-1/2 inches) trawls,

and (2) research vessel catches using small mesh gear. Increased sampling with small mesh gear is planned for future studies in order to provide additional information on recruitment and discards.

Recovery information for yellowtail tagged in earlier studies have been recorded. These data, along with fishing effort and age composition, will be used in mortality estimation.

Fluke (Paralichthys dentatus) (Linnaeus)

The fishery. -- Fluke studies in 1961 consisted of (1) studies of time and place of spawning in New England waters, (2) study of abundance and distribution of 0 age group fish, (3) stock identification, and (4) preliminary age and growth studies of fish from commercial landings.

Research. -- Spawning condition of fluke is being followed to determine when and where the fish spawn. Information so far collected suggests that spawning occurs in the fall during the migration from the summer inshore grounds to the winter offshore grounds.

A coastal water survey in the area from Long Island to Chesapeake Bay using a beach seine and otter trawl to collect young fish provided some information on distribution of 0-group fluke. It appears that Chesapeake Bay is an important nursery ground.

Tagging is being used to identify exploited groups. In a Bureau of Commercial Fisheries study 1,800 fluke were tagged on the offshore winter grounds southeast of Long Island in March and April, 1961. In a joint Bureau of Commercial Fisheries and New Jersey Conservation Department study 3,400 fluke were tagged in the summer months along the New Jersey coast by New Jersey biologists.

A study of the use of plastic impressions of fluke scales for age and growth assessment is in progress. Although interpretation of growth zones is difficult, it appears that scales can be used for this work.

Winter flounder (Pseudopleuronectes americanus) (Walbaum)

The fishery. -- A biological investigation of the Woods Hole population of winter flounder has been undertaken. Sampling trips, using a small otter trawl, are being made in local waters at approximately weekly intervals. A study of food habits, with respect to season, time of day, and spawning condition is now underway. Data also are being collected for age, growth, and sex ratio studies. Information on animal communities, as sampled by the trawl, is being collected at the same time.

Industrial Fishery

The industrial trawl fishery remains a minor factor in harvesting fish on the New England grounds. The production of meal is negligible, of mink food moderate but slowly increasing, and of cat and dog food, also moderate but with the potential for a sharp increase in the near future. Pending resolution of the difficulties facing the fish flour producers, their production is also low and will remain so at least for the time being. In the past two years, 1960-61, less than 50 million pounds of industrial trawl fish have been landed each year to serve the needs of all of these fisheries.

There is little research being done at this time on these fisheries as specific entities. Routine sampling continues.

Mesh Selection

Extensive experimentation was carried out in August, 1961, (Delaware cruise no. 61-12) by the Woods Hole Laboratory personnel on the possibilities of differentially selecting species as well as controlling the sizes retained.

Silver hake selection experiments were also carried out using 2-1/2, 3, and 3-1/2-inch double manila codends. For these experiments the basic net was a No. 36 Yankee of single manila 2-inch mesh twine. The lower half of the codend was lined with 1-inch cotton twine. The upper portion was covered with an additional loose bag (cover) of 1-inch cotton to retain those fish that escaped. All individuals of all species in both the cover and codend were measured, providing useful escapement data on all species captured in any number.

Silver hake appear to have reasonably sharp selection characteristics (Fig. 2). There was some evidence that gilling might account for some of the minor irregularity at the upper end of the selection curve. Unfortunately, there were relatively few fish in the population between 18 and 22 centimeters in length, accounting for the scatter in the data for those lengths.

The differential selection experiments were interesting and revealing although no immediately useful technique was developed that would enable a commercial boat to selectively catch either silver hake or haddock, the two species of principal concern. Different species did behave quite differently in the net. It was possible to differentially select for approximately 70 percent of the silver hake and about 80 percent of the cod and haddock, and in addition, to control in the usual manner, the sizes retained of each of these groups. The variability of species selection was considerable, and further behavioral research will be required before this variability can be reduced to reasonable limits.

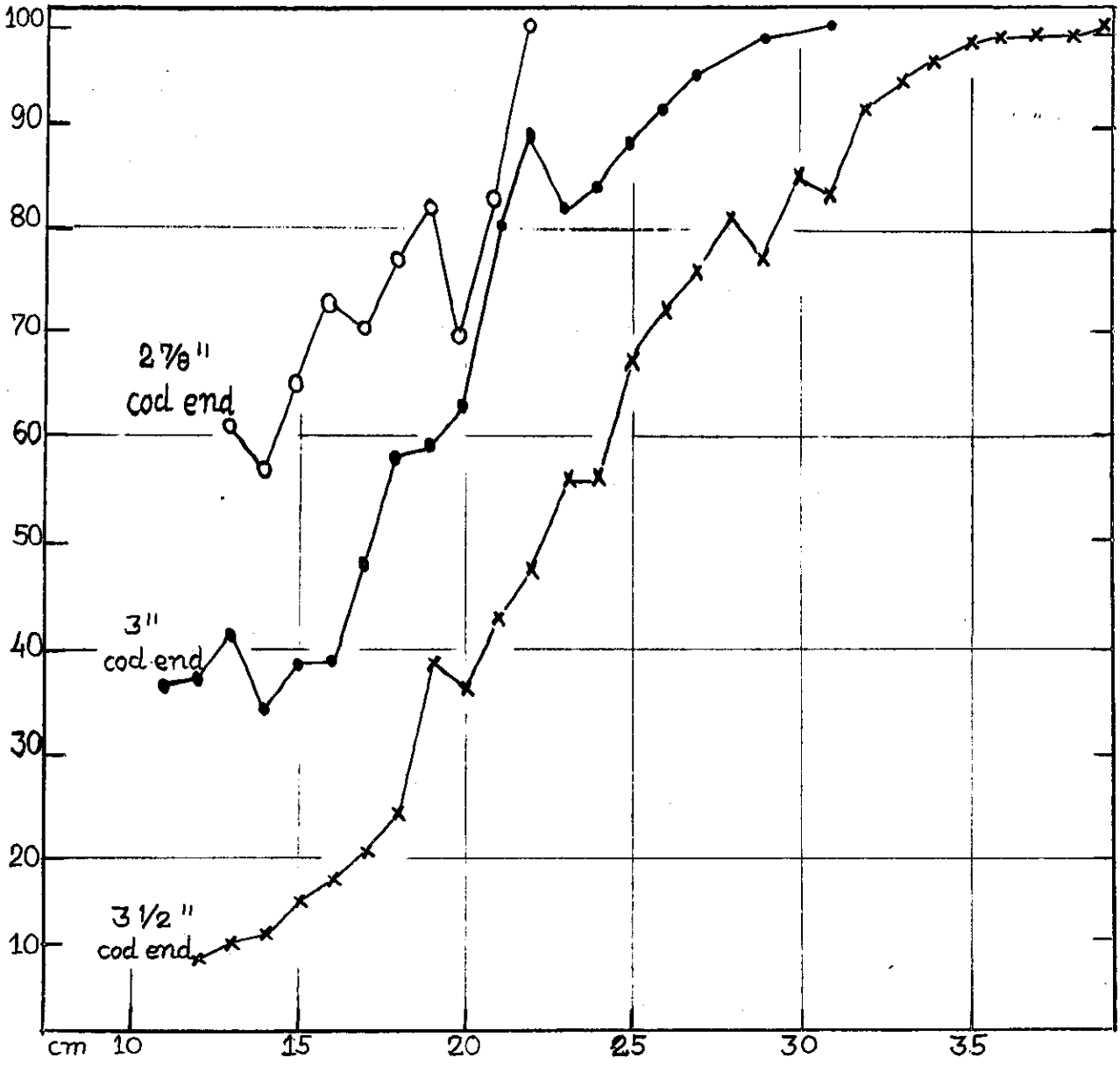


Fig. 2. Silver hake selection D-61-12 double manila 1" cover.

Groundfish Ecology

The program of study of the relationship of environmental conditions to the distribution and abundance of groundfish species was continued. An annual fall survey cruise (Delaware cruise no. 61-19) was conducted which extended from the Bay of Fundy southward to the Hudson Canyon to determine the distribution of groundfish species and the year-class strength of the young-of-the-year haddock (Fig. 3). Sixty-five different species of fish were caught, counted and measured during the cruise.

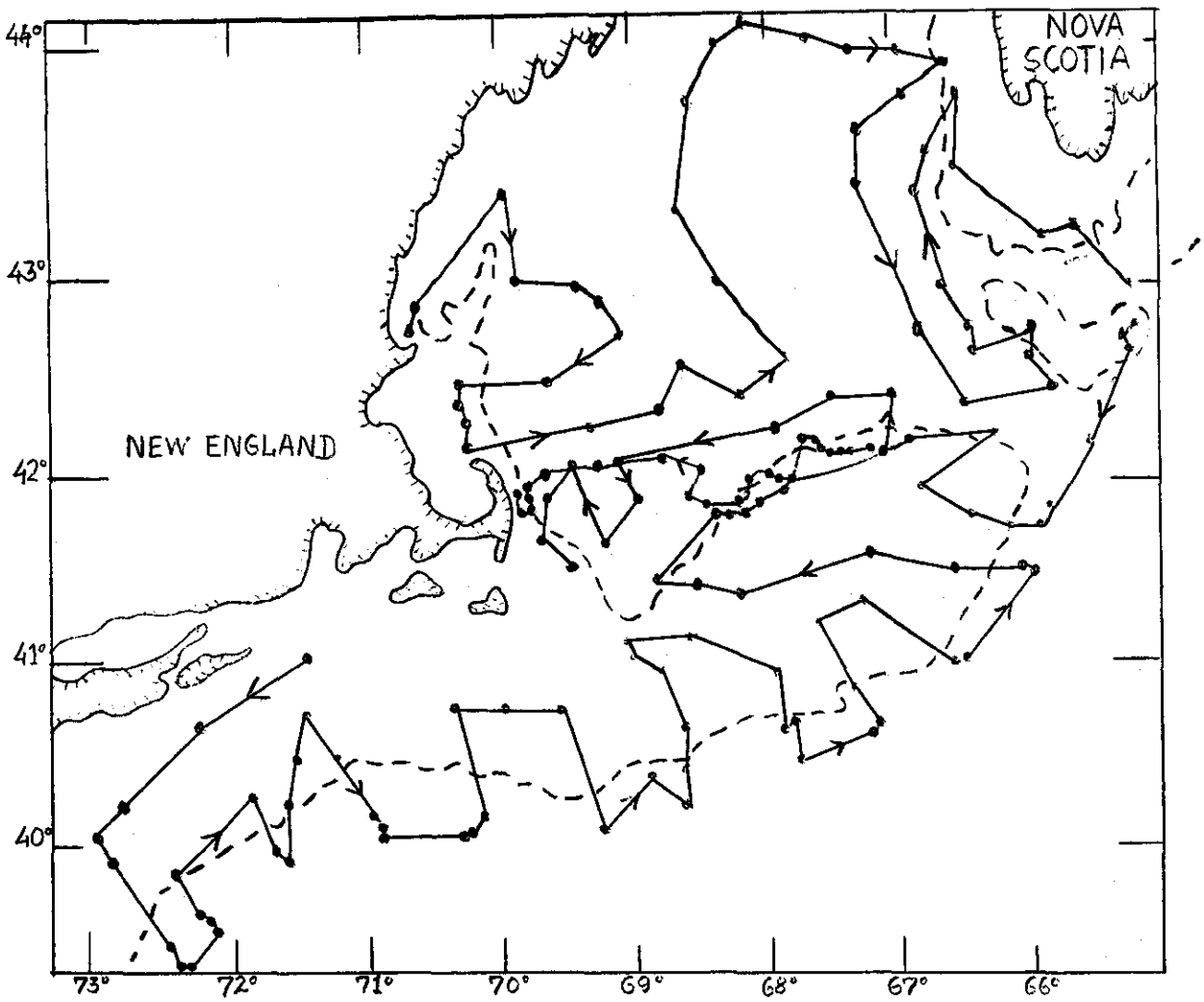


Fig. 3. R. V. "Delaware" Cruise 61-19, 26 Oct.,-20 Nov.,1961. Location of the 161 stations occupied.

Preliminary results showed that no haddock were caught south of 41°00'N. Lat., while haddock were caught at 81 percent of the stations fished north of this latitude. Catches for the northern part of the cruise showed that haddock were caught at all depths fished, but the greatest quantity were taken between 60 and 90 fathoms. These data also indicate that the larger size haddock inhabited the deeper waters.

The silver hake (Merluccius bilinearis), white hake (Urophycis tenuis), and the red hake (Urophycis chuss) were also found at all depths fished, but the silver hake were concentrated at depths greater than 90 fathoms, while the white hake were found between 60 and 120 fathoms, and the red hake between 60 and 90 fathoms.

The most frequently caught species on the northern half of the cruise were the silver hake, haddock, redfish, and dabs; while the silver hake, butterfish, scup, and red hake were the most frequently caught species on the southern part of the cruise.

Mesh Assessment

We have continued our studies of the effects on the yield of increasing the size of mesh in codends of trawl nets. These studies involve two different aspects: one is assessing the effectiveness of the current 4-1/2 inch mesh regulation for cod and haddock; the other is how increases in mesh size would effect the yields of other species.

The latter studies have been carried out in conjunction with the mesh assessment working group of ICNAF, and the initial results are summarized in Document 20 of the 1961 Annual Meeting of ICNAF. The important redfish, silver hake, and industrial fisheries in Subarea 5 could not be sustained with a mesh as large as 4 1/2 inches; however the dynamics of the species involved are not well enough known to provide a precise estimate of the effects of various mesh sizes. These studies are continuing as further information becomes available.

We have tried, by several methods of analysis, to determine the effects of the current 4 1/2-inch mesh regulation on haddock yield-per-recruit. The results of these analysis have not been definitive. Only one complete year-class has passed through the fishery since the regulation has been fully implemented. Additional data from subsequent year-classes are needed for further analysis.

Sea scallop (Placopecten magellanicus (Gmelin))

The fishery.-- United States landings of sea scallop meats from Subarea 5 in 1961 were greater than in 1960, the previous record year.

Table 6.-- Trends in the sea scallop fishery

Year	Landings (millions of pounds)	Days fished	Average landings per day (pounds)
1952	12.1	7,742	1,563
1953	16.3	10,031	1,625
1954	15.5	9,343	1,659
1955	18.3	11,619	1,575
1956	17.5	12,246	1,429
1957	17.3	10,500	1,651
1958	14.4	8,775	1,637
1959	18.7	8,556	2,189
1960	21.9	8,039	2,725
1961	23.6	8,655	2,724

Research.-- One cruise was made to test the effect of various combinations of ring size and ring linkage on the size composition of the catch. Two survey cruises were made to collect data on the abundance of the fishable stock, and strength of the pre-recruit year-classes. Results of the analysis of these data are reported elsewhere in Commission documents.

An experiment was conducted in a large aquarium tank to see if the tag used in previously reported tagging experiments inhibited movement. Results show that tagged animals move about in the same manner as untagged animals, and that the small amount of dispersion of recaptured tagged scallops from the point of release can be regarded as typical of the untagged part of the population as well.

Two meetings were held during the year between Canadian and United States biologists interested in the sea scallop fishery to discuss and compare results of their programs of investigations. The reports of these meetings are to be found in other Commission documents.

Benthic Studies

Studies of bottom sediments, macroscopic benthic invertebrates, and food habits of groundfish were continued in 1961. A preliminary examination of bottom sediment samples recently taken from the central and northern sections of the Gulf of Maine indicate that silt and clay are the principal substrate components. However, in some shallow areas, such as Cashes Ledge and Jeffreys Ledge, mixtures of sand and gravel are predominant. Also in certain deepwater areas near Browns Bank and in moderately shallow water between Browns Bank and the Lurcher Shoal region, sand and shell are the major sediment components.

Although haddock are exceedingly omnivorous feeders and were long considered to be non-selective in their choice of foods, recent information has been obtained which reveals selective feeding, at least in some localities. Haddock from the northeastern section of Georges Bank appeared to favor crustaceans and, to a lesser extent, echinoderms, over mollusks, annelids, and miscellaneous groups.

Table 7.-- Comparison of haddock diet and available bottom food on northeastern Georges Bank

Group	Benthic fauna (% weight)	Haddock stomachs (% volume)
Mollusca	38	22
Echinodermata	10	13
Miscellaneous	34	27
Annelida	10	6
Crustacea	8	32
Total	100	100

A study of food habits of haddock from one locality throughout a one-year period has shown there are no important differences between males and females in the kinds of animals preyed upon or the quantities of food ingested. A moderately low feeding rate prevailed throughout the year except in June when feeding was intensified remarkably. Differences in diet composition were associated with haddock size and season of the year.

Environmental Studies

Bureau of Commercial Fisheries Studies

Plankton. -- Analysis of the zooplankton samples collected in 1953 have been completed and the analysis of the 1955 samples is underway.

Hydrography. -- Temperature norms for the area bounded by latitudes 39°00'N. and 45°30'N. and longitudes 64°00'W. and 72°00'W. are being computed by analysis of bathythermographic and hydrographic station data collected between 1940 and 1960.

Hydrography - by Dean F. Bumpus, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts.

Hydrographic research by the U.S.A. in the Convention area was carried out by three agencies during 1961: the U.S. Coast Guard, the Bureau of Commercial Fisheries, and the Woods Hole Oceanographic Institution.

A. The U.S. Coast Guard, as the agency operating the International Ice Patrol, examined the temperature and salinity distribution from the surface to 1,500 meters in 4 network surveys in the Grand Bank regions. The first survey, 2-15 April, covered waters over and immediately seaward of the southern and eastern slopes of the Grand Bank from just westward of the tail of the Bank northward to the latitude of Flemish Cap. The second survey, 29 April to 5 May, covered the area immediately seaward of the northeastern slope of the Grand Bank from Flemish Cap northwestward as far as, but not including, the Bonavista triangle. The third survey, 25 May - 5 June, covered an area similar to the first. The fourth survey, 14-22 June, covered an area similar to the second but included the Bonavista triangle. The post season cruise, 3-11 July, occupied the Bonavista triangle and the Labrador - Cape Farewell section to within 6 miles of Cape Farewell.

The season was characterized by an abnormal amount of sea ice on the east coast of Newfoundland and the eastern part of the south coast. Labrador Current water along the eastern slope of the Grand Banks was below normal and south of the latitude of Flemish Cap very nearly absent in early April. This was followed by a steady return toward normal conditions which were reached about mid-June.

The cold subsurface temperatures in the Labrador Current were warmer than normal in early season and also returned to about normal values in June. On the post-season cruise both the Labrador Current off the South Wolf Island the West Greenland Current off Cape Farewell showed positive anomalies in volume and temperature.

The report in toto will be published in U.S. Coast Guard Bulletin No. 47.

B. The Bureau of Commercial Fisheries Biological Laboratory, at Boothbay Harbor undertook a number of temperature surveys at monthly intervals from Gloucester, Massachusetts, to off Eastport, Maine.

C. The Woods Hole Oceanographic Institution together with the Fisheries Research Board of Canada released 23,378 drift bottles in areas 4 and 5 throughout the year with approximately 10 percent return.

The examination of non-tidal drift at the bottom using Woodhead Sea Bed Drifters was commenced during the year in area 5.

The 13 lightship stations from Maine to Georgia equipped, at the end of 1955 as observation posts to collect surface temperature and salinity observations daily, , bathythermograms daily and bottom water samples weekly, have continued in operation supplemented with surface water temperatures from several shore stations and Texas Towers 2 and 3. Many of the lightships also released drift bottles daily as part of the drift bottle program mentioned above.

Experimental Studies

The program of experimental studies has concentrated on the two major projects of racial stock identification and larval fish biology. The racial characterization of various geographically separate haddock populations has been undertaken using serological techniques. Specific erythrocyte precipitation (agglutination) reactions have been found using haddock sera (isoaglutinins) as well as miscellaneous fish, arthropod and rabbit anti-haddock sera (heteroagglutinins). Preliminary results show that while isoagglutinins are present in haddock their frequency and titre are low, and not useful for racial identification. Heteroagglutinations, on the other hand, show higher titres and a differential haddock cell response in several cases. These tools have not yet been applied on a large scale population analysis.

The work on larval fish biology has focused on a weekly survey of local waters to tabulate the numbers of species and individuals as a function of season. Eggs and larvae from the sampling have been used for laboratory growth and development experiments. Present information implies successful rearing of sculpin from prespawning adults through to month old larvae.

Danish Research Report, 1961.

A. Biology. Addendum

Tagging Experiments with Cod.

Tagging has been carried out on the banks as well as along the coast and in the Godthaab Fjord. On the banks a total of 2,954 cod were tagged, distributed from Store Hellefiske Bank until Dana Bank. At the coast from Sukkertoppen to Nanortalik and in the Godthaab Fjord a total of 1,599 cod were tagged.

Four different types of tags were used, namely; 3,779 white plastic discs, 115 hydrostatic tags, 421 small oval blue plastic tags and 238 yellow arrow-formed tags made of thin plastic. The three latter types are all attached to the back of the cod between the first and second dorsal fins. In the same way half of the number of white plastic tags were attached; the other half were attached to the gill cover as has been the case with all tagging experiments in the previous years. The experiments with attachment of the same type of tag in different ways were made in order to estimate which method will render the largest number of reports of recaptures and which, therefore, will have to be given preference in future tagging experiments.