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RESEARCH REPORTS BY MEMBER COUNTRIES

I. Canadian Research Report, 1962.

A. Subareas 2 and 3
by W. Templeman

This report describes the Canadian researches on groundfish carried out by the Biological Station of the Fisheries Research Board of Canada at St.John's. Hydrographic work is done by the Atlantic Oceanographic Group and by the St.John's Station. For location of the places mentioned in this report the reader is referred to the place name map in the Canadian Report for 1961, p.4 of the ICNAF Redbook 1962, Part II.

COD, Gadus morhua L. Although cod catches by the various inshore gears fluctuated widely throughout the fishing season, the fishery generally was considered to be reasonably good with total landings above the low level of 1961. To the north, early in the season, fishing operations were hampered and delayed by the presence of ice. The weather throughout the summer season was generally good but there were long stormy periods in the autumn which kept fishing activities at a low level. Squid only appeared inshore spasmodically, and in small numbers, so that there was a serious lack of bait in many areas for parts of the season.

Information on catch and effort was gathered in various areas where the commercial catches were sampled.

On the northeast coast of Newfoundland at St. Anthony and La Scie fishing by all gears was poor throughout most of the season. At Twillingate, for short periods, catches by codtraps and by linetrawls (longlines hauled by hand from a small boat) were moderately good but by gillnets and handlines they were very poor.

At Bonavista total landings by all gears were about 50% higher than in 1961. This increase was due largely to a successful handline fishery, averaging 1,200 pounds of cod per boat per day compared with 600 pounds in 1961. The traps did not consistently yield good results and, although the total trap landings were somewhat higher than in 1961, the average catch per haul was somewhat below the 1961 level. In the longline fishery the tendency seems to be for the catch to remain stable at the low level to which it has declined in the past few years, around 40 pounds of cod per line of gear for the deep-water fishery and 30-40 pounds for the shallow-water fishery.

At St.John's the codtrap is the main gear used. There was a short period of successful catches averaging 4,000 pounds of cod per haul in July but the fishery declined rapidly in August. The overall fishery was only moderately successful in comparison with other years.

The fishery in the Burin area was poor. Codtrap catches early in June gave indications of a successful fishery to follow but, although catches in late June were good, there was a rapid decline to an extremely low level for the remainder of the season. Total codtrap landings in the Burin area were 1.3 million pounds compared with 2 million pounds in 1961. For the linetrawl fishery the total catch was at about the same level as in 1961. Highest average daily catches per boat (800-1,000 lb) occurred in June but, similar to the codtrap results, declined afterwards and remained low for the rest of the season.

Sampling of the inshore cod fishery was carried out in the summer and autumn of 1962 at several of the larger Newfoundland fishing centres on the east and south coasts. Approximately 40,000 cod were measured, 5,000 pairs of otoliths collected and supporting biological data recorded from the various inshore gears.

In samples from codtraps, 80-95% of the fish were 4-7 years old (1955-1958 year-classes). Cod first appear in the trap fishery in significant numbers as 4-year-old-fish and pass out of this fishery as important contributors at 8 years of age.

The main age-groups supporting the handline and jigger fisheries are the 5-, 6- and 7-year-olds but 8- and 9-year old fish sometimes remain in the fishery in fairly large numbers, also. Cod aged 9 years and older were somewhat better represented in linetrawl samples than in handline and jigger samples.

In contrast to the shallow-water trap, handline and linetrawl fisheries which depend mostly upon young fish, the deep-water longline catches are maintained by fish of older age-groups together with cod of younger ages which have remained in deep water.

The 1962 observations indicate that there has been a high survival of young fish in recent years (1952-1958) and cod hatched in 1957 were especially numerous in the catches. Thus, the potential supply of cod for the inshore fishery is great enough to ensure successful fishing if environmental conditions make the fish available to the various gears.

The annual survey to obtain information on the inshore distribution and relative abundance of small cod of pre-commercial sizes was carried out from Sept. 17 to Oct. 26. Beaches were surveyed beginning in St. Mary's Bay and extending northward along the east coast to Green Bay on the northern part of Notre Dame Bay using a small Danish seine with the codend lined with fine-meshed nylon.

The survey consisted of 150 sets. In the majority of sets in which young cod were taken, cod of the year (zero cod) were dominant. Only in the southern areas, Trepassey and St. Mary's Bays, where catches were small, were the numbers of zero cod less than 50% of the total cod catch. To the north of these areas, from the southern shore of the Avalon Peninsula to Notre Dame Bay the zero cod were more numerous than the other groups (1- and 2-year-old cod) caught, ranging from 55% to 97% of the catch in the various regions.

In the total cod catch for all areas in 1962, zero cod made up over 80% by number. Only in 1959, when they made up 88% of the total catch by number, were the zero cod as plentiful. The survival of the 1959 year-class was quite good as was later demonstrated by the entrance in abundance of this year-class in the commercial fishery. It seems quite probable, therefore, that the 1962 year-class is a strong one as well.

The relative scarcity of one-year-old fish in 1962 supports the assumption, which was made following the 1961 survey, that the 1961 year-class probably did not survive well.

Sampling of the inshore Labrador commercial cod fishery was resumed during July and August of 1962 and extended to settlements on the Labrador side of the Strait of Belle Isle. Approximately 7,000 cod were measured and 2,000 pairs of otoliths collected between Anse au Loup and Nachvak Fjord. These included collections from the commercial trap fishery in southern Labrador (2J), from the jigger fishery in 2H and by jigger in 2G where there is no commercial fishery at present. Additional collections, involving some 3,900 length measurements and 360 pairs of otoliths, were made at 3 inshore localities in conjunction with tagging experiments.

A comparison of the length distributions from the commercial inshore fishery in 2H and 2J in 1959, 1960 and 1962 shows that the average size of fish taken has increased since 1959. The fishery in these years was based mainly on fish hatched in the years 1946-1953, and growth of these year-classes has caused the upward trend in average lengths. There has been no significant contribution to the Labrador inshore fishery by new year-classes since that of 1953.

Investigations of cod distribution and abundance were carried out on a number of cruises of the A.T.CAMERON, using a No.41 otter trawl with the codend either lined or covered with small-meshed netting. These surveys covered various parts of Hamilton Inlet Bank, the Northeast Newfoundland Shelf, the coastal shelf off the Newfoundland west coast, the southern Grand Bank and St. Pierre Bank. Detailed examinations of cod samples, including otolith collections, were made on most cruises.

A number of survey sets on Hamilton Inlet Bank in mid August failed to reveal the presence of any large cod concentrations, but fairly consistent catches of approximately 1,000 pounds per hour were taken in depths of 120-140 fathoms at

bottom temperatures mainly between 2.0 and 3.0°C. Superficial examination of stomach contents indicated that cod were feeding pelagically on amphipods and ctenophores. The age and length distributions of these fish were found to be unlike those seen in 1960. In 1960 the fish taken were relatively old and large in comparison with those taken in 1962, the 1962 catches consisting almost entirely of small fish of ages 3-6. In this respect the fish taken offshore in 1962 seemed to be quite a distinct group from those available to the inshore fishery at the same time. The younger ages found in quantity offshore were apparently not available to the inshore fishery and, conversely, the older age groups which were most abundant inshore were scarce on Hamilton Inlet Bank.

Cod catches from 6 sets in depths of 75-129 fathoms on the coastal part of the Northeast Newfoundland Shelf in mid August were in each case less than 700 pounds per 30-minute tow. One set off Belle Isle in 98 fathoms at 0.1°C produced a catch of 1,850 pounds in 30 minutes. Approximately 50% of the fish taken in this area were of ages 5-7. The 1957 year-class (age 5) was most prominent, as it was also in the otter-trawl catches from Division 2J.

Groundfish survey cruises to the southern Grand Bank were made in February, May and October. Cod catches were generally very small, averaging less than 300 pounds per 30-minute tow. Only 3 catches in excess of 1,000 pounds were obtained, 1 in February at 145 fathoms and 2 in May at 80 and 125 fathoms, although several catches of 500 700 pounds per 30-minute tow were obtained south of the Virgin Rocks in May. The catches in February and May were heavily dominated (more than 50% in each case) by fish of ages 3 and 4 (1959 and 1958 year-classes). These will reach commercial size in 1964 and 1963 respectively. Fish of the 1955 year-class (age 7) were most plentiful among the commercial-sized fish, as was also the case in 1960 and 1961. Cod older than age 10 are generally scarce in this area. Temperature conditions on the southern and southwestern slopes were extremely variable; highest bottom temperatures occurred in February.

Cod were very scarce in 13 sets in depths of 21-150 fathoms on St. Pierre Bank in May. Only 306 cod were taken in the thirteen 30-minute tows, the average weight of catch being 65 pounds per tow. It is apparent from age and length distributions of cod from surveys in 1958-1962 that the summer cod population in this area at present consists chiefly of small numbers of juvenile fish. Catches are composed mainly of fish less than 6 years of age. It is thought that the older and larger cod of this area move inshore in summer, and by winter retire to deep water near the north cape of St. Pierre Bank and in the channels. On a cruise to the Halibut Channel (Western Gully) in January 1963, the A.T.CAMERON located good catches (1,600-2,000 lb per 30 minute tow) in 65-85 fathoms at bottom temperatures of 0.6 to 3.0°C.

Age reading of some 21,000 pairs of otoliths collected from the Grand Bank and St. Pierre Bank between 1946 and 1962 has been completed, and the data transferred to cards for IBM processing.

Cod tagging was resumed, after a 7-year interval, mainly to study the interrelationships of the inshore and offshore cod populations. About 7,000 cod were tagged along the east coast of Newfoundland, inshore Labrador and on Hamilton Inlet Bank.

HADDOCK, Melanogrammus aeglefinus (L). Otter-trawling surveys over the southern half of the Grand Bank were carried out in February and in May. During the February cruise the best catches were obtained in depths between 125 and 160 fathoms on the southern part of the southwest slope. Three catches of 2,040-3,300 pounds per 30-minute tow were obtained; the bottom temperature ranged between 4 and 5°C. In contrast with the hydrographic conditions of March 1961, when most of the stations shallower than 65 fathoms had bottom temperatures less than 1°C, in February 1962 bottom temperatures of 8 to 10°C were prevalent at the 65- and 80-fathom stations and generally over 5°C as shallow as 45 fathoms.

The regular spring survey in May resulted in poor catches of haddock throughout the entire area. The best catch of 860 pounds was obtained on the northern part of the southwestern slope in 50 fathoms at 3.7°C. Near the central part of the slope in 80 fathoms at 3.9°C a catch of 640 pounds consisted mainly of small haddock averaging 19 cm in length. Associated with this was a large catch of cod which were found to be preying on the small haddock.

An abbreviated survey of St. Pierre Bank in May produced very low haddock catches. At 2 stations near the southern slope of this bank in 80 and 100 fathoms, catches of 260 and 430 pounds consisted largely of baby haddock averaging 21 cm in length. The bottom temperatures were 4.3 and 6.7°C. It is too soon to predict whether or not these small haddock are sufficiently abundant to sustain a fishery in the future.

From the catch-length frequencies and age determination of otolith samples obtained from Grand Bank haddock during the survey in February 1962, the most abundant group present was the 1955 year-class (mode at 38-39 cm) which accounted for about 60% of the research-vessel catches. A small group with a mode at 32-33 cm belongs to the 1959 year-class, but it will probably not be of much importance in sustaining the fishery. The year-class picture was not very different from that of the spring of 1961 when over 80% of the catches by number consisted of haddock of the 1955 and 1956 year-classes, the former being about 4 times as abundant as the latter.

From the length and age composition of the commercial haddock landings by Newfoundland trawlers, the fishery is at present almost entirely dependent on the 1955 and 1956 year-classes.

Fecundity estimates obtained from 229 ovaries of female haddock collected in the springs of 1957-1961 reveal that the rate of increase in fecundity with length is

considerably greater than that previously reported for North Sea haddock. For fish of the same length there is evidence of considerable variation in fecundity. Also, the larger fish of a year-class have more eggs than the smaller ones.

There is evidence that considerable variation in fecundity may occur from year to year, as indicated by the low fecundity of haddock in 1959 and the higher-than-average fecundity in 1960. Evidence from the work of earlier investigators indicates that about 2 years elapse between the initial formation of eggs and subsequent spawning and that fecundity may be determined at the early period of egg formation. If this is true for haddock, then the unusually low temperature conditions during the spring of 1957 and the higher-than-normal temperatures in 1958 probably had the effect of determining indirectly the fecundity in 1959 and 1960 respectively, the food supply being the direct determining factor.

REDFISH, Sebastes mentella Travin and Sebastes marinus (L). In 1962 the A.T.CAMERON surveyed the southwestern slope of the Grand Bank. A standard No.41 otter trawl with the codend lined with 1 1/8-inch nylon mesh was used. Trawling was limited to daylight hours and tows to 30 minutes.

On the southwestern slope of the Grand Bank catches of redfish were low in the southern part of the area, the best catches being obtained at the 150-, 175- and 200-fathom levels where catches of 1,400 to 1,600 pounds per tow occurred. These fish were rather small in size.

In the central part of the area (43°39' to 43°45' N; 52°14' to 52°24' W) catches of redfish greater than 2,600 pounds per tow were obtained at all depth levels between 125 and 250 fathoms. In general, the sizes of redfish increased with depth and whereas best catches (about 5,000 lb per tow) occurred around 200 fathoms the fish were, on the whole, rather small in size; at 250 and 300 fathoms, where catches of 3,580 and 2,220 pounds of redfish per tow were obtained, the fish were much larger in size (average weight per fish greater than 1 lb).

In the northern part of the area, redfish again were less abundant and catches greater than 2,000 pounds per tow were limited to depths of 150, 175 and 200 fathoms.

AMERICAN PLAICE, Hippoglossoides platessoides (Fabricius). The catch per unit effort for Newfoundland trawlers in all 3 major commercial plaice-fishing areas of the Grand Bank was approximately 1,500-1,800 pounds per hour in 1961. During 1961 the fishing effort along the eastern slope of the Grand Bank between Lat. 45° and 47°N was higher than in either of the areas to the north and south.

The size of plaice landed by the commercial fleet at Newfoundland ports has changed very little in the period 1954-1961. There appears to be no reduction in the larger sizes of plaice in the commercial landings.

Fecundity studies of American plaice indicate that the rate of egg production is slightly greater than the cube of the length.

HYDROGRAPHY. Six hydrographic sections from southern Labrador to the southern Grand Bank were taken by the INVESTIGATOR II between July 24 and Aug.20.

In the section extending off Seal Islands, Labrador (Fig.1) surface temperatures were a little higher than in 1961 but yet lower than usual. (The low 1961 surface temperatures in this area were possibly produced by the greater than usual abundance of ice.) In the intermediate layer there was more water with temperatures below -1°C than in 1961. Temperatures in the deep water at the continental slope were about the same in both years, but on the top of Hamilton Inlet Bank temperatures were lower in 1962.

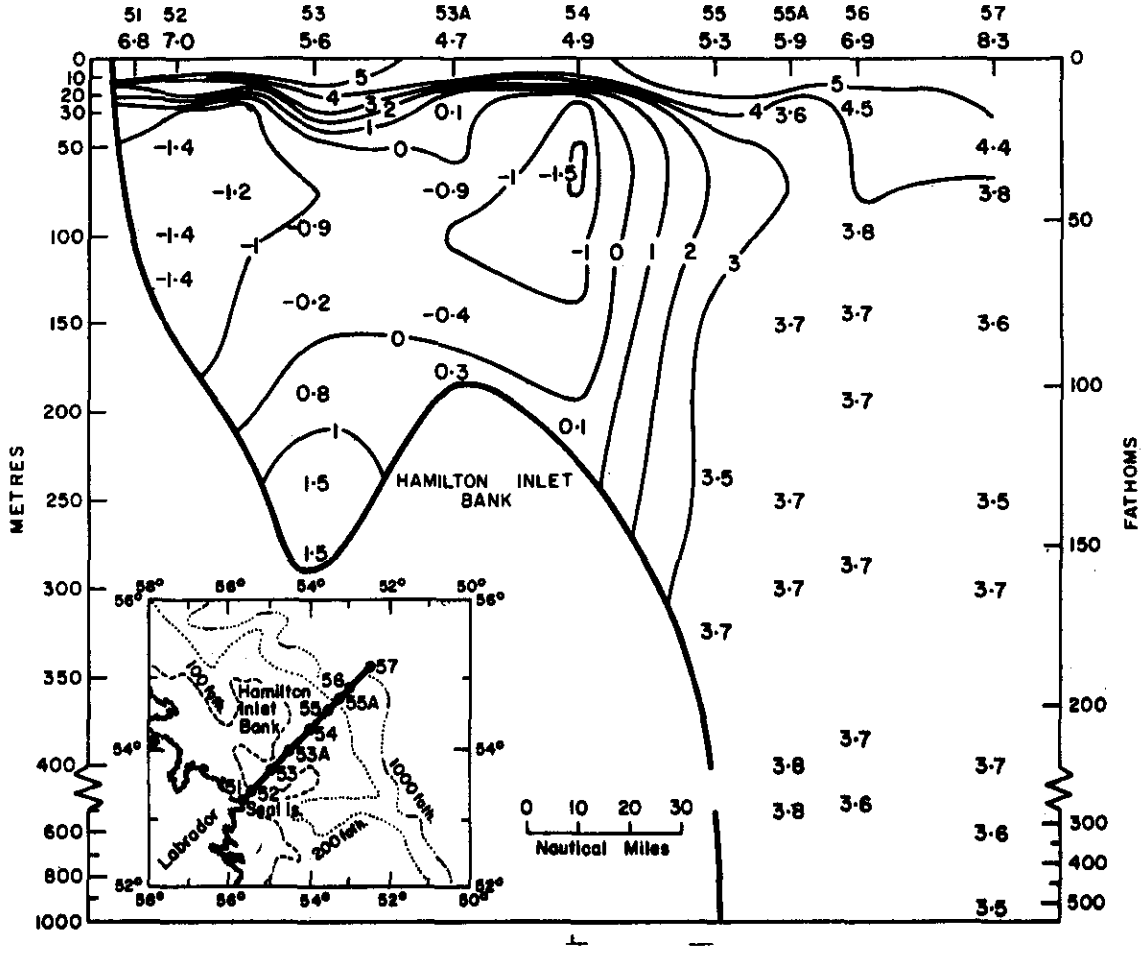


Fig. 1. Temperature section, °C, off Seal Islands across the southern tip of Hamilton Inlet Bank, Labrador, Aug.1-2, 1962.

In the triangular section eastward from Cape Bonavista and then southward to the northern Grand Bank (Fig.2) surface temperatures were lower and less water below 0°C (and especially below -1°C) was present in 1962. Deep-water temperatures at the continental slope were slightly lower than in 1961.

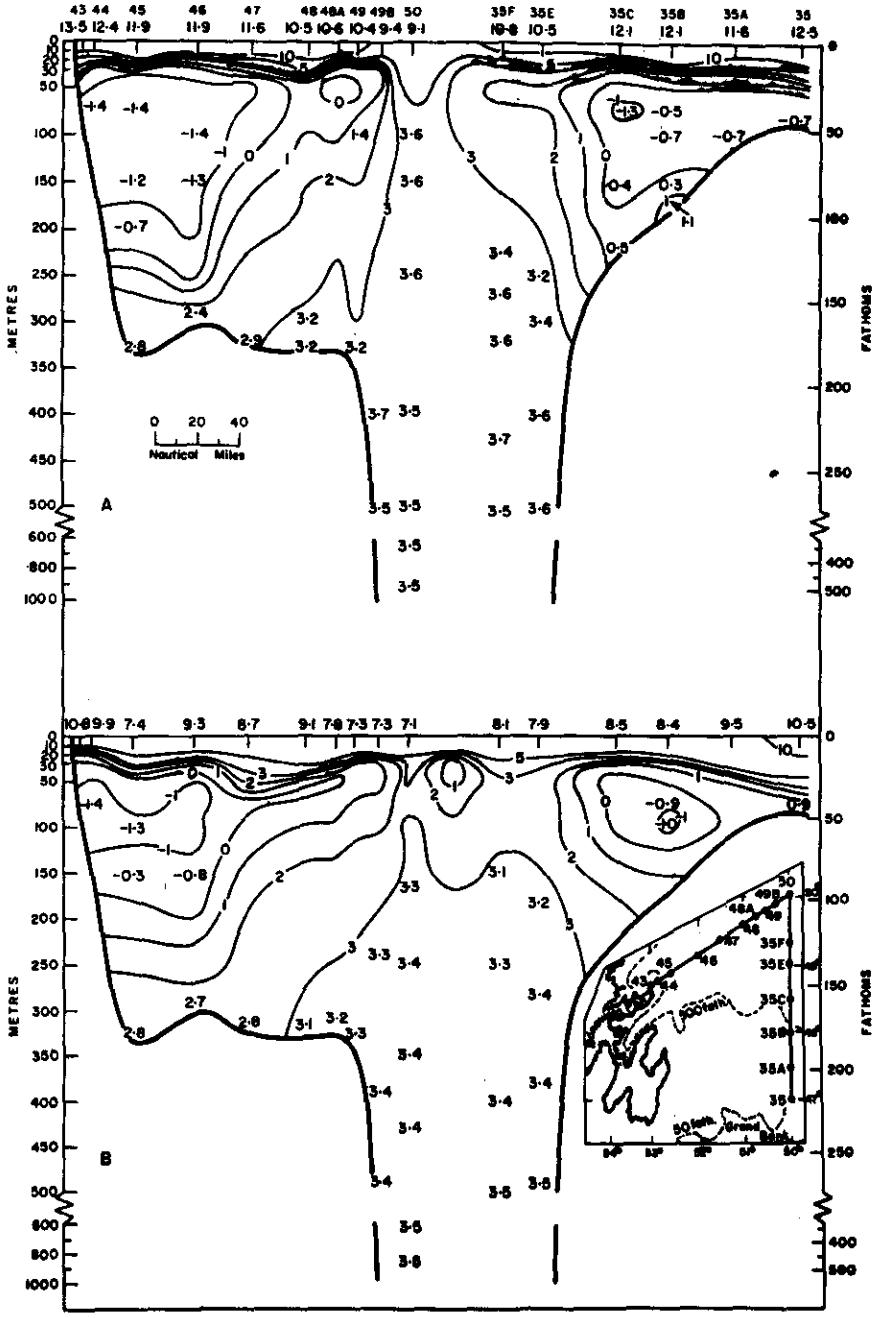


Fig. 2. Temperature sections, °C, off Cape Bonavista and southward to northern Grand Bank: A, July 26-28, 1961; B, July 25-30, 1962.

In the St.John's-Flemish Cap section (Fig.3A) surface temperatures were lower than in 1961 but there was less water with temperatures below 0°C and particularly below -1°C. The bottom temperatures, however, were distinctly higher than in 1961 on both the Grand Bank and the western side of Flemish Cap.

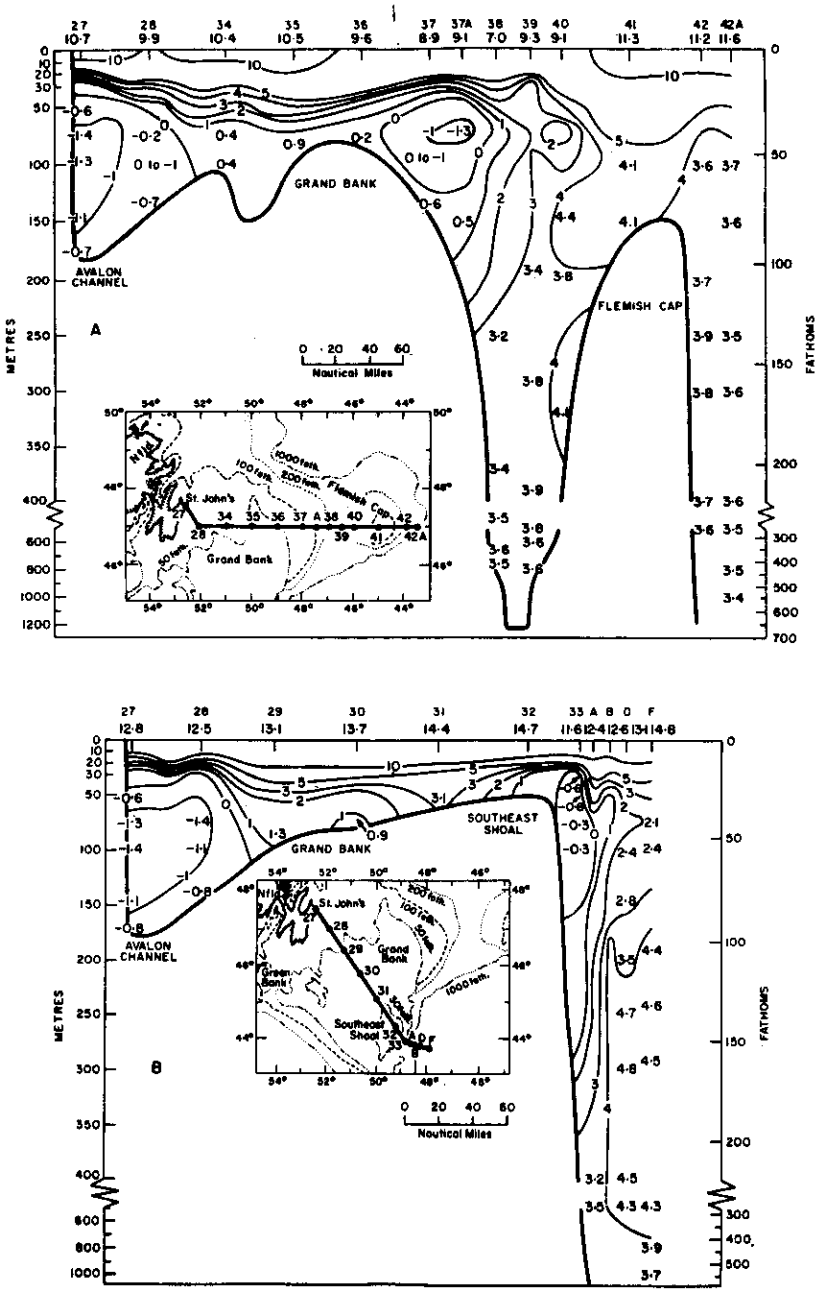


Fig. 3. Temperature sections, °C: A, St.John's-Grand Bank-Flemish Cap, July 24-26, 1962; B, St.John's-SE slope Grand Bank, Aug.14-16, 1962.

Compared with 1961 the section from St.John's to the southeastern edge of the Grand Bank (Fig.3B) showed considerably lower surface temperatures with about the same amount of cold water in the Avalon Channel but with higher bottom temperatures over the surface of the Grand Bank.

In the section at about 75 m (40 fath) extending along the southwestern slope of the Grand Bank (Fig.4A), surface temperatures were considerably lower than in 1961 but bottom temperatures on the Grand Bank and in the Halibut Channel were slightly higher.

In the section at 275 m (150 fath) along the southwestern edge of the Grand Bank (Fig.4B) surface temperatures were much lower and, except on the slope, the remaining temperatures slightly lower than in 1961. Also, more cold water was present in the central part but not as much on the eastern part of the section.

The most noticeable general picture was the occurrence of low surface temperatures over the whole area covered by the St.John's Station's sections, due to the cold weather and lack of sunshine in the summer of 1962.

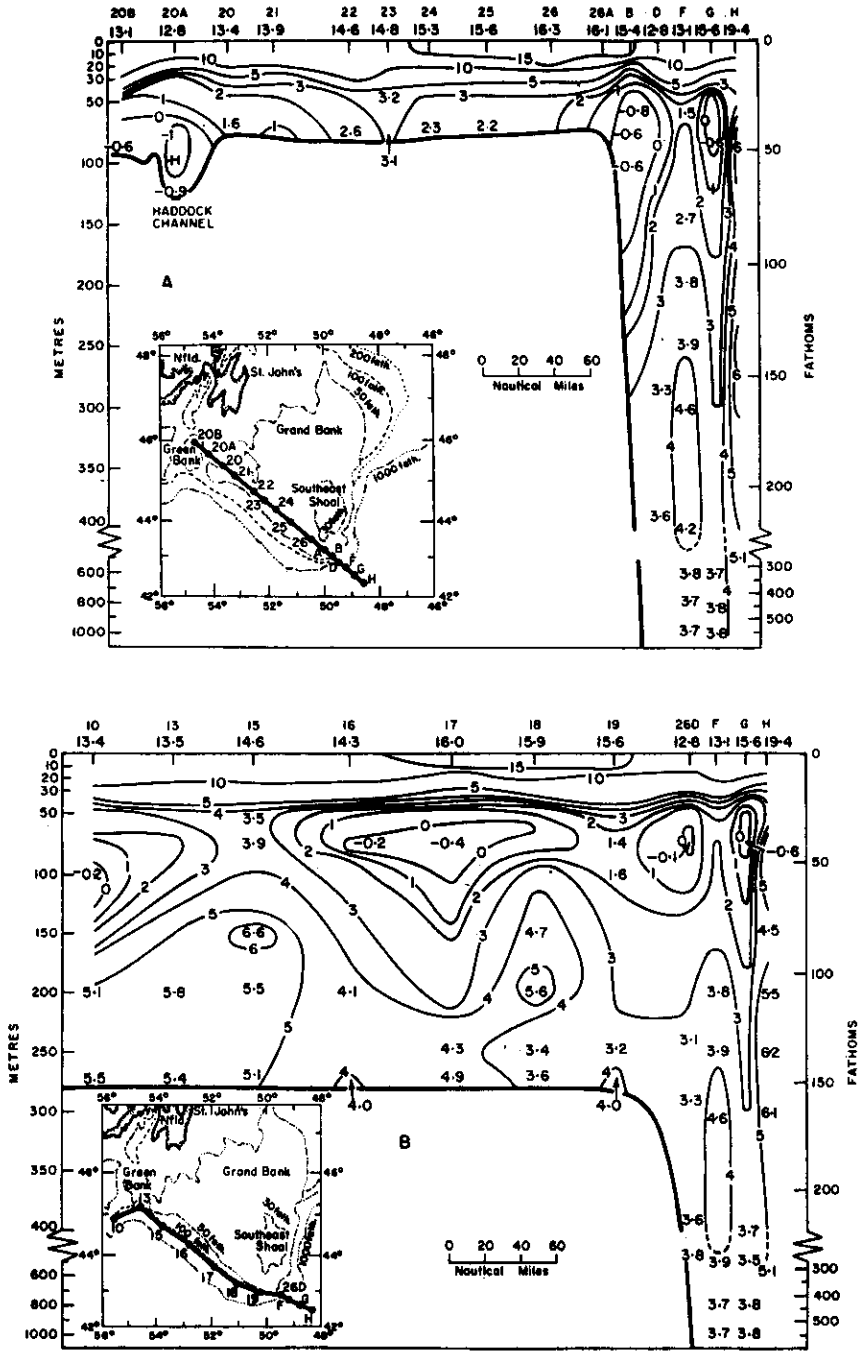


Fig. 4. Temperature sections, °C: A, Green Bank-SE Grand Bank, Aug.17-20, 1962; B, along the southwestern slope of the Grand Bank, Aug.17-20, 1962.

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

Canadian research of interest to ICNAF in Subareas 4 and 5 was carried out by the Biological Station of the Fisheries Research Board of Canada at St.Andrews, N.B.

COD, Gadus morhua L. The species of greatest international interest in Subarea 4 is cod. During recent years otter trawling for cod has become relatively more important than other fishing methods, and total fishing effort applied to this species has increased. These changes have greatly reduced the availability of large cod. Studies of the Gulf of St. Lawrence cod fishery are providing background knowledge for wise management of the fishery.

Returns from cod tagged in October 1961 off Seven Islands on the north shore of the Gulf have thrown new light on divisions and migrations of cod stocks. About 10% (148 fish) of the tags were returned by the end of 1962. During autumn months of 1961 and 1962 most recaptures were taken in the tagging area. In winter, returns came from the Cabot Strait area, mainly off southwestern Newfoundland. In summer, tagged cod were recaptured in the western Gulf, south of Gaspé, and along the north shore of the Gulf. It is apparent that some cod migrate through three Divisions of the Gulf. Cod of the southwestern Gulf (4T) cannot be considered to be completely distinct from those of the northern (4S) and eastern Gulf (4R). Further taggings on both sides of the Laurentian Channel, off Gaspé and off Seven Islands, planned for the early summer of 1963, will add more information on Gulf cod populations.

Winter and spring research-vessel surveys in the western Gulf of St. Lawrence provided new information on seasonal changes in cod distribution. In winter, cod were mainly distributed in deep water (80-125 fath) along the western edge of the Laurentian Channel. Cod were found in increasing numbers from Gaspé south to Scatari Bank, off eastern Nova Scotia, and in decreasing numbers from Scatari to Misaine and Canso Banks. Cod sizes increased from north to south. The few cod caught in shallow water south of Gaspé were shorter than 15 cm. Those caught in deep water off Gaspé were 20 to 40 cm in length. The concentrations of cod in the Sydney Bight area off eastern Nova Scotia were of commercial size, 40 to 70 cm. The largest catches were taken from water temperatures of 1 to 3°C.

During the last half of April an A.T.CAMERON survey showed that cod were moving north and into shoaler water. Large catches of commercial-size fish (mode 49 cm) were taken at Scatari from depths of 45 to 75 fathoms. Equally large catches (3,000 fish per half-hour tow with a 41 otter trawl) of smaller fish (modes at 25 and 40 cm) were taken at 75 to 100 fathoms off Bird Rocks. Catches south of Gaspé were small in quantity (less than 50 fish per tow) and the fish were small in size. Small cod do not migrate as far south as commercial-size fish, and they are the first to return north. In April, they were deeper than 50 fathoms, enroute to shoaler water where they are caught later in the spring.

Surface plankton tows taken during groundfish surveys in the southwestern Gulf of St. Lawrence from 1958 to 1962 were examined for cod eggs and larvae. Although the largest numbers of running female cod were observed in otter-trawl surveys during the last half of June, the greatest numbers of cod eggs in plankton tows were taken in May. Earlier observations of mature female cod spawning throughout summer months to late October conformed with collections of cod eggs in surface plankton tows during every month from May to November.

Very few cod larvae were taken in the southwestern Gulf plankton tows. It is suspected that the eggs and larvae were carried away from the spawning area by the counter-clockwise circulation of surface water. Inefficiency of gear for catching cod larvae, and heavy mortalities of eggs and larvae are probably less important explanations for their scarcity.

An October small-mesh otter-trawl survey in 4T provided information on the outlook for the 1963 fishery. The 1957 year-class, which was dominant in 1961 and 1962 survey catches of cod, is expected to be the dominant year-class in 1963 commercial landings. The 1956 and 1955 year-classes appeared in higher-than-average numbers as 6- and 7-year-old fish in the 1962 survey. These should appear in 1963 landings as 7- and 8-year-old fish. For these reasons it is predicted that the mean length of cod landed from the southwestern Gulf of St. Lawrence in 1963 should increase from 51 to 53 cm. Landings per hour fished are expected to increase to about the 1959 level.

Use of 4 1/2-inch-mesh otter trawls and a reduction in the minimum sizes of fish accepted by buyers have reduced the quantities of cod discarded at sea.

The cod of the western Gulf of St. Lawrence are fished intensively by otter trawlers, and fishing mortality is as high as that for any important cod population. Gulf cod are particularly vulnerable during winter months when they are concentrated in deep water off eastern Nova Scotia. It is mainly during this season that Gulf cod are fished by European trawlers. Ice cover in late winter off eastern Nova Scotia frequently blocks fishing operations and offers some protection to concentrations of Gulf cod. Such was the case in April 1962.

HADDOCK, Melanogrammus aeglefinus (L.). Another intensively fished species which is protected by an ICNAF 4 1/2-inch mesh regulation is the haddock. Studies of commercial landings, observations at sea on commercial trawlers, and surveys with research vessels have provided new information on the status of haddock stocks in Subarea 4.

Haddock are found in warmer water than cod. They are less abundant than cod in the Gulf of St. Lawrence and more abundant than cod on Nova Scotia banks. During winter surveys from 1959 to 1962, haddock were taken at 125 fathoms along the western edge of the Laurentian Channel (4T), off eastern Nova Scotia (2-4°C); at

55 to 80 fathoms in the gully between Sable Island, Banquereau and Middle Ground (4V), and at 45 to 70 fathoms in the Western-Emerald Bank (4W) area (4-6°C). Catches increased from east to west.

Surface plankton tows from the A.T.CAMERON in March and April of 1959, 1961 and 1962 provided information on the distribution of gadoid eggs in the Sable Island-Emerald Bank region of the Nova Scotian shelf (4W). In all three years the greatest abundance of eggs was found over the Western and Emerald Banks. The distribution of eggs corresponded closely with the winter distribution of haddock as observed in otter-trawl surveys. Small annual variations in the distribution of eggs reflect differences in distribution of spawning fish and differences in the drift of eggs in surface waters. The proximity of centres of egg abundance to the edge of the Scotian Shelf suggests that we should expect annual differences in the numbers of haddock settling on and off the banks, and thus a mechanism for variation in year-class strength.

Research-vessel surveys of haddock in 1961 and 1962 showed strong 1956, 1957 and 1959 year-classes. Both 1958 and 1960 year-classes are weak. The 1956 year-class was dominant in 1961 and 1962 landings from Division 4W. The 1957 year-class contributed large numbers of fish to commercial catches in 1962, but with a modal length of 43 cm many were discarded at sea. Observations at sea on a commercial trawler on Nova Scotia banks in July showed that substantial numbers of haddock are still discarded at sea. Discarded fish were 35 to 40 cm long.

In 1963, the 1957 year-class will be dominant in haddock landings from Division 4W. With poor recruitment from the 1958 year-class, reduced catches of small scrod haddock are expected. A series of relatively poor year-classes among the fish of pre-commercial size will result in reduced catches of haddock from the Sable Island-Emerald Bank area (4W). No compensation for anticipated poor haddock fishing in Subarea 3 can be expected from Subarea 4 during the next few years.

POLLOCK, Pollachius virens (L.). A species of increasing commercial importance in Division 4X, the pollock, has been studied since 1960. Largest catches are made at temperatures above 1°C at depths down to 100 fathoms. As noted in cod and haddock, pollock migrate south in winter, and north for summer months. Spawning takes place in the southern Gulf of Maine and probably also on the Scotian Shelf in winter. By summer, 0-class pollock are found inshore. The 1-year-old pollock disappear from the sublittoral zone in early August when 20 to 25 cm in length. The 2-year-old pollock may be found in deeper water near shore or on offshore banks. Large offshore pollock show a marked gradient in size composition across the Bay of Fundy, with large fish (65-85 cm) on the northern size, medium-size fish (60-75 cm) around Grand Manan, and small fish (45-60 cm) on the southern size, off western Nova Scotia. Schooling by size-groups is an important feature of pollock behaviour.

Bay of Fundy pollock have a growth rate similar to that of pollock off western Norway, and more rapid than those of Faroese and Barents Sea pollock. Growth is rapid

to maturity at about 6 years and slow thereafter. Plankton, particularly the euphausiid Meganyctiphanes norvegica, is the main food of Bay of Fundy pollock. Fish is relatively more important in the diet of pollock on the Scotian Shelf.

The segregation of pollock by sizes implies that relatively few small pollock would be released by applying a minimum mesh size to otter trawling for pollock.

HALIBUT, Hippoglossus hippoglossus (L.). Halibut studies are concerned with the effects of incidental catches of small fish by otter trawlers, and of large fish discarded by European fishermen, on the longline fishery for large halibut.

In March, 707 halibut were tagged in the gully region between Sable Island and Banquereau (4V). Early returns indicate movement up the gully onto Middle Ground (4W).

Collections of halibut stomachs and gonads are made at sea on research vessels and by fishermen on commercial longliners. The main spawning takes place between December and February. Young halibut, up to about 75 cm fork length, feed mainly on crustaceans but also on molluscs, echinoderms and annelids. Halibut feed on fish at sizes as small as 35 cm, and fish becomes the main item of diet in halibut over 75 cm. By changing diet the halibut is able to maintain a rapid growth rate and reach a large ultimate size.

AMERICAN PLAICE, Hippoglossoides platessoides (Fabr.). The flounder species of greatest commercial interest in Subarea 4 is the American plaice. The plaice has been studied in the southwestern Gulf of St. Lawrence (4T), where this species is second only to cod in total landings. Intensive otter trawling and high discards at sea of small plaice are reducing the availability of large plaice to the commercial fishery.

Tagging studies since 1958 have provided information on stocks, migrations and fishing mortalities of 4T plaice. None of the plaice tagged in 4T were recaptured outside this Division. Within this Magdalen Shallows area, two groups of plaice have been distinguished, one from the northern Miscou-Magdalen sector and the other from the southern Cape Breton sector.

Recaptures of tagged plaice in fall and winter months were few in number, because of greatly reduced fishing effort. However, all recaptures, even though limited in number, conformed with evidence from survey studies in demonstrating an offshore migration of plaice to deep water of the Laurentian Channel in winter. Nearly all fall recaptures of fish tagged in Chaleur Bay came from outside the Bay. Fall recaptures of plaice tagged west of the Magdalen Islands were almost all taken offshore towards the Laurentian Channel (60-100 fath). The three winter recaptures were from deep water along the western edge of the Laurentian Channel. The majority of summer recaptures from all areas were from the release areas,

supporting survey evidence of a return spring migration inshore to shoal-water grounds.

High tag returns gave estimates of high total mortalities of marketable sizes of plaice (0.6-0.7).

Minimum mesh sizes in otter trawls and Danish seines would have to be considerably larger than 4 1/2 inches to release the large quantities of small unmarketable plaice which are currently discarded at sea as dead or dying fish.

HERRING, Clupea harengus L. There is little doubt that the herring stocks in the southern part of the ICNAF area are under-exploited. Canadian and international catches of herring have been increasing. An important part of the catch is taken at the mouth of the Bay of Fundy (4X) as small "sardine"-size fish. However, the expanding fishery is for large herring, principally off western Nova Scotia (4X) and on Georges Bank (5Z). Otter trawls and purse seines have become relatively more important than the traditional weir and gill-net gears.

Canadian herring research is directed toward providing a sound basis for efficient utilization of the resource. Research programs in 1962 were concerned mainly with: factors affecting the abundance and availability of small herring in the Bay of Fundy (4X); the recovery of Gulf of St. Lawrence (4T) herring from epizootic effects on stocks; a survey of herring spawning areas in Chaleur Bay (4T); and a study of the migrations of herring in the Bay of Fundy and in the Gulf of St. Lawrence. In addition, two exploratory fishing cruises were carried out in the Browns (4X) and Georges Banks (5Z) areas of the Gulf of Maine.

The distribution of herring catches in the Bay of Fundy has shown wide variation in recent years with no major change in total landings. In 1958 and 1961 most of the catch (up to 80%) was taken on the southern side of the Bay and this has been associated with an "open"-type surface circulation in these years. In 1959, 1960 and 1962 most of the catch was taken on the northern side of the Bay when surface circulation was of the "closed" type.

The commercial herring sampled in 1962 on the southern side of the Bay of Fundy (25-32 cm) were about twice as long as those sampled on the northern side (12-14 cm).

Studies of the production and dispersal of herring larvae were carried out on a monthly basis throughout the year at the mouth of the Bay of Fundy. Larval collections were considerably smaller (about half as many per tow) than in 1961. However, for the first time in more than 25 years of collecting, some newly-hatched (5-7 mm) larvae were found in the northern, Passamaquoddy region during the spring (May).

Beginning in the late spring and early summer of 1954 a heavy and widespread mortality of herring occurred in the Gulf of St. Lawrence (4T). The dying and dead fish

were infected with the fungus Ichthyosporidium hoferi, a pathogen which causes a systemic infection focused in the heart and lateral line musculature of herring and which, in an acute phase, results in the death of the fish. Mortalities reached a peak in June 1954 and continued to 1956. Conservative estimates place the destruction of herring in the Gulf of St. Lawrence at 50% of the mature fish present in the area at the time. Landing statistics, 112 million pounds in 1954 and 77 million pounds in 1957 with no change in effort, support this conclusion. Biological studies of the herring before and after the epidemic showed a decrease in the mean age and number of year-classes, and an increase in growth rate and relative abundance of the autumn-hatched herring. Changes in spawning habits, seasons, and in distribution and movements were also noted.

Recent studies of 4T herring have shown some evidence of return to pre-epidemic conditions. Average catches have increased about 20% in the Chaleur Bay area and nearly threefold in the Magdalen Island region. Additional evidence of recovery is seen in a gradual return to spring-hatched domination of the stock, and in increased mean age and number of year-classes.

A herring spawning survey was carried out in 1962 in Chaleur Bay by means of free (Scuba) diving techniques supplemented by sampling with a Petersen grab. The total spawning area surveyed was 375,000 square metres in extent. Eggs were attached to seaweeds and fishing gear but not to bare sand, gravel or rocks, and varied in density from about 1.4 to 21 million per square metre.

The estimated number of eggs on the spawning bed was 354×10^{10} and the number of spawners 185×10^{6}. When related to landings, mortality in the immediate vicinity was calculated to be not more than 4%. Hatching commenced May 24, about 3 weeks after the beginning of spawning, and such concentrations of 5- to 7-mm-long larvae occurred that they were observed visually as "clouds" in the water.

In 1962 a total of 25,466 herring were tagged at the mouth of the Bay of Fundy and in the southwestern Gulf of St. Lawrence. Three types of tags were used, one "celluloid" cheek tag and two back tags--a spaghetti and a nylon-covered elastic thread. About 1% of the tags released in the Passamaquoddy area were recovered, practically all from the same general area. Less than 1% of the southern Bay of Fundy tags were recaptured in 1962, mostly from the same area but with some from the northern side of the Bay of Fundy. About 1% of the Magdalen-tagged herring were recaught in 1962, all off the Magdalen Islands. Less than 1/2% of the herring tagged at Caraquet (northern 4T) were retaken in 1962, mostly in the tagging area, but with some southerly movement. The three types of tags yielded similar returns.

Exploratory fishing cruises in September 1962 showed herring to be abundant on Georges Bank and scarce on Browns Bank.

The few herring caught on Browns Bank in September averaged 21.4 cm long

while the numerous herring on the northern edge of Georges Bank in the same month ranged from 28.5 to 30.6 cm in length. Some of the schools consisted of fish almost ripe and a few were in a "running" condition.

SEA SCALLOP, Placopecten magellanicus Gmelin. Canadian sea scallop landings increased again in 1962 to a record 6.4 thousand tons of shucked meats (53 thousand tons whole weight). The bulk of this catch (94%; 6 thousand tons) was landed by the offshore fleet which fished almost exclusively on Georges Bank (5Z). A few trips were made to Port au Port, Newfoundland (4R), and Lurcher Shoals (4X) at the mouth of the Bay of Fundy. Landings from these areas amounted to less than half of 1% of those from Georges Bank. The increased landings by the offshore fleet resulted from increased effort (39 boats cfd. 28 in 1961). Crew sizes remained the same as in 1961 or even decreased slightly.

Two trips were made to Georges Bank on commercial boats to sample catches, study mortalities, measure sizes discarded and make biological observations. In 1962 Canadian scallopers fished continuously in order to keep crews busy. Deck loading, which was the accepted practice in 1960 and the first part of 1961, was uncommon in 1962 because the catch per unit effort decreased. Boats not only dragged continuously but fished over a greater area of the Bank (30 unit areas cfd. 19 in 1961). The minimum size retained for shucking dropped slightly in 1962, the 50% retention size being at a shell height of 90 to 95 mm. In the early part of 1962, six boats used 4-inch rings, but by the end of the year all except one reverted to the 3-inch ring.

The catch per unit effort, as measured by observers on commercial boats, has declined markedly over the past 3 years. Expressed as catch of market size scallops in bushels, per drag, per tow, per minute, it has decreased from 1.93 in 1960 to 0.58 in 1961 to 0.4 in 1962.

Results of gear studies, conducted in 1961 and reported at the Annual Meeting in June, showed that increasing the ring size on offshore drags to 4 inches will produce neither the sharp selection nor sufficient release of small scallops to increase yield by delaying age at first capture. In 1962 a program was begun to examine the present gear and determine whether it can be made more selective and more efficient or if a new design is necessary to achieve these ends. Work was done in the southern Gulf of St. Lawrence from the M/V HARENGUS. Scuba divers were employed in this study. Preliminary results indicate the present style drag is very efficient at catching market size scallops when they are sparsely distributed on smooth bottom.

The laboratory program, investigating aspects of the basic biology of the sea scallop, was continued in 1962 with major emphasis again devoted to a study of the larval stages. Larvae were obtained from six spawnings and reared under different temperatures and fed various foods. Larvae from one spawning were kept 58 days and measured 275 X 288 microns. They developed a foot and appeared ready to settle but did not.

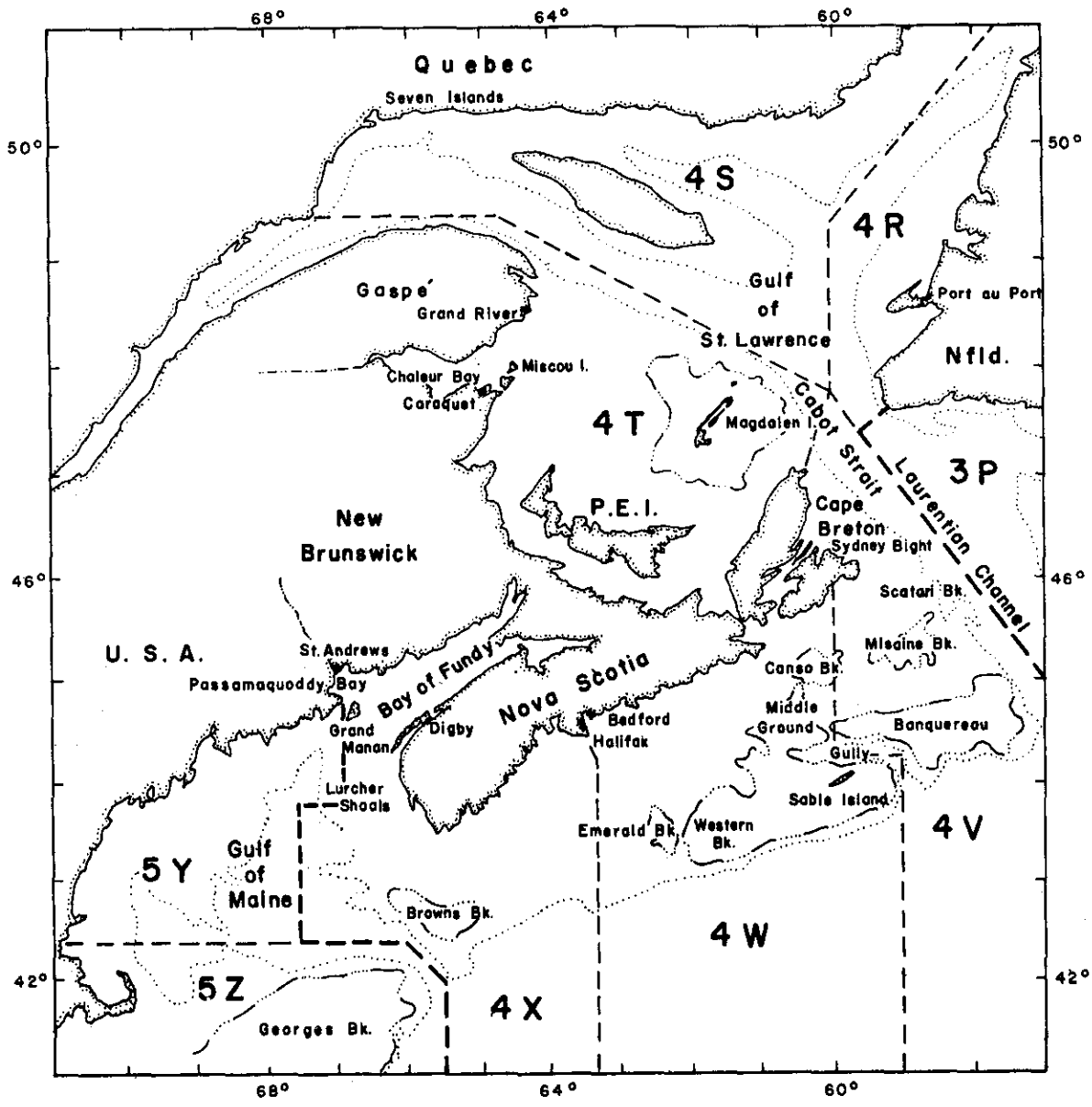


Fig. 1. Map showing locations of names mentioned in the text.

C. Subareas 4 and 5. Oceanography
by L.M.Lauzier and N.J.Campbell

Co-ordination and expansion of effort by several agencies are providing more intensive Canadian research in many phases of oceanography. The responsibility to fulfil Canadian commitments to ICNAF falls upon the Fisheries Research Board of Canada, with its various establishments on the east coast. Co-operating agencies were the Bedford Institute of Oceanography of the Department of Mines and Technical Surveys, the Marine Division of the Department of Transport and the Institute of Oceanography of Dalhousie University. Vessels employed in the research program were CGS A.T. CAMERON, CNAV SACKVILLE, CHS BAFFIN, CGS JOHN A. MACDONALD and M/V HARENGUS.

Monitoring of oceanographic conditions along the Halifax section over the Scotian Shelf (4W) and across Cabot Strait (4V-3P) was continued during 1962. An effort was made to cover the Halifax Section more frequently than in previous years. The seasonal coverage is reported here.

The temperature and salinity distributions for the section off Halifax, N.S. are given in Fig. 1. During 1962, the intermediate cold-water layer, present from spring to autumn, had a tendency to be less developed than in the previous three years. The maximum temperatures in the deep waters of the Scotian Gulf which extends from 4W to 4X showed little variation from February to September; on the average they were higher than during the period 1959-1961 but always below the long-term average. On Emerald Bank the bottom temperatures in February were the lowest ever observed at that time of the year. On the average, the bottom temperatures observed in May, July and September were below the seasonal normal by 1.5°C but higher than those observed during the previous three years. The waters along the edge of the continental shelf were featured by a steep vertical temperature gradient, resulting from incursions of warm, high-salinity waters of oceanic origin.

The Cabot Strait section was covered in February, June and November. The conditions in February 1962 were similar to those of 1957, as far as the temperature of the surface mixed layer was concerned; below-zero waters extended across the Strait in both years. The warm, deep layer in February 1962 had decreased in volume since November 1961. The maximum temperature observed in the warm layer was slightly lower than the long-term average, but much lower than in winter 1957. By summer, the temperature and the volume of the deep layer had increased to values greater than those observed in 1961, and the intermediate cold-water layer was not as developed as in 1961. Conditions observed in November suggest that the deep layer had regressed to smaller volume than at the same time in 1961. Within the surface layer the November temperatures were definitely lower in 1962 than in 1961, which, with an increase in the thickness, seems to indicate that the autumnal cooling in 1962 was more intense than in 1961.

Emphasis has been given to studies on the variation of properties related to the phase of tide. Repeated simultaneous current, temperature, and salinity observations were taken in Gaspe Passage (4T). Repeated temperature and salinity observations were also taken in Cabot Strait. Preliminary analysis points to no systematic variation of properties related to the phase of tide.

The study of the temperature conditions along the western slopes of the Laurentian Channel (4T-4V) was continued in 1962, and showed a variation in the thickness of temperature layers from north to south, at least during the winter season.

Summer and winter temperatures on offshore banks, mostly in 4W, as observed during groundfish survey cruises from 1958 to 1962, were analysed. An estimate of temperature coverage shows that more than 55% of the area studied had a bottom temperature lower than 4.0°C during summer and winter of a cold year (1959) and that less than 17% of the area had a bottom temperature lower than 4.0°C in an average year. These observations are related to those carried out along the Halifax section over a longer period of time.

The coastal surface temperatures were monitored at six stations from the Bay of Fundy to the Gulf of St. Lawrence. The 1962 surface temperatures were below the long-term average by 0.2 to 1.0°C. The bottom temperatures at these coastal stations were below average during 1962, with a greater departure from average in the Halifax region than in the Bay of Fundy area.

The surface and bottom non-tidal drift studies were continued in 1962. Increased efforts in the bottom drift studies are providing coverage of many areas of the Scotian Shelf and the eastern Gulf of Maine as well as the southwestern Gulf of St. Lawrence. Radar drift poles and Pisa tuba techniques were used in the Cabot Strait region. At 180 metres, on the bottom of the western slopes of the Laurentian Channel, Pisa tube measurements over a period of 66 hours gave an average velocity of 0.11 knots at 130°. Starting in mid December 1962, sea-bed drifters were released at a daily rate of 3 at each of 4 stations across Cabot Strait. It is hoped that many of these drifters will be recovered during the winter fishery in the area.

Studies undertaken by the Fisheries Research Board in the field of submarine geology and geochemistry currently pertain to the Gulf of St. Lawrence, the Scotian Shelf and the Grand Banks areas. The calcium carbonate cycle is being studied in the Gulf of St. Lawrence with special attention given to the sediment-water interface.

The benthic biological studies initiated in the Gulf of St. Lawrence (4T) in 1961 were modified in 1962, emphasizing the relationship between biological communities and sedimentary properties of a few distinct but homogeneous sectors of the bottom.

Assessment of sampling techniques has been carried out. The variability of

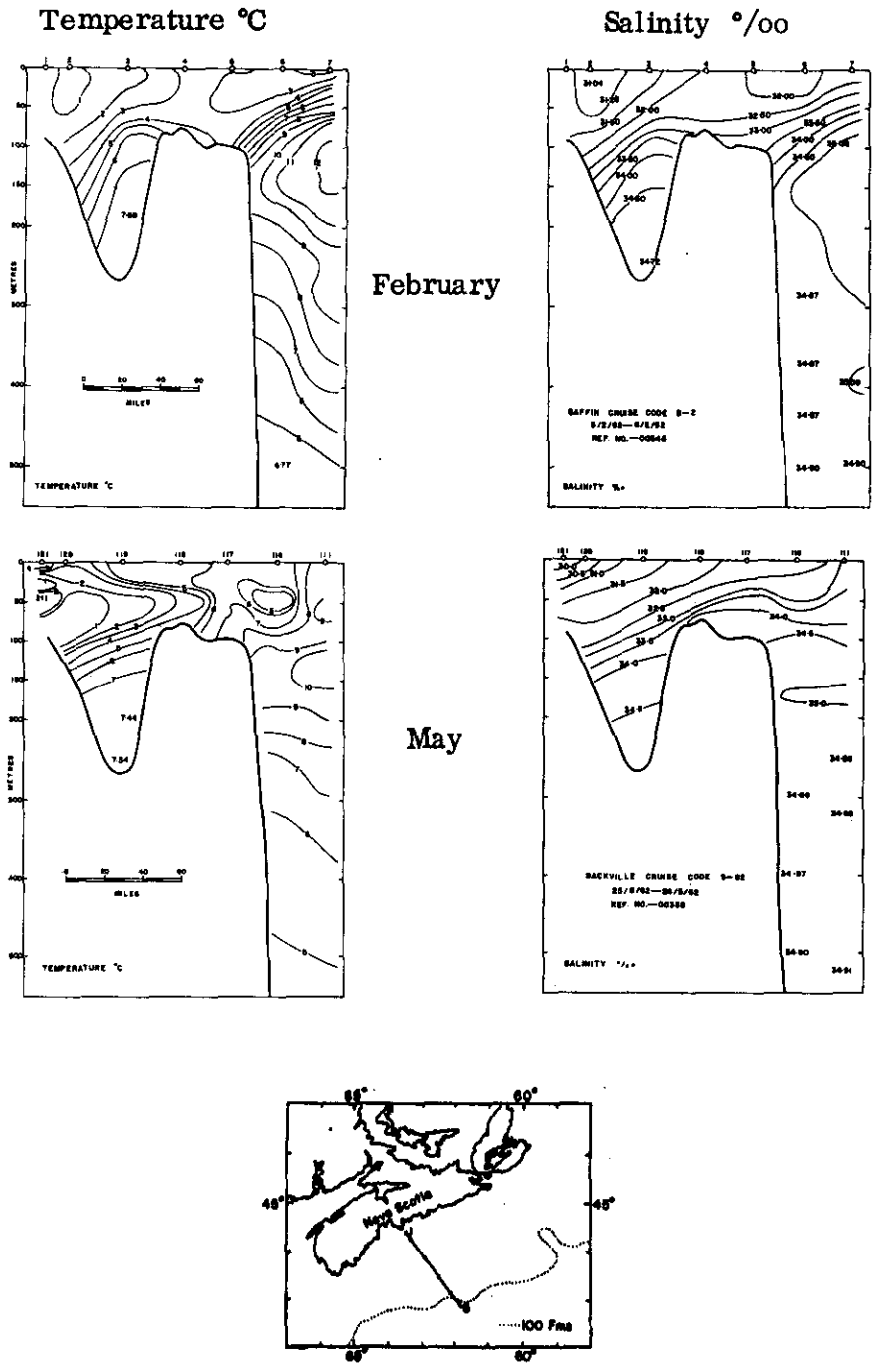


Fig. 1. Hydrographic section off Halifax, N.S. 1962.

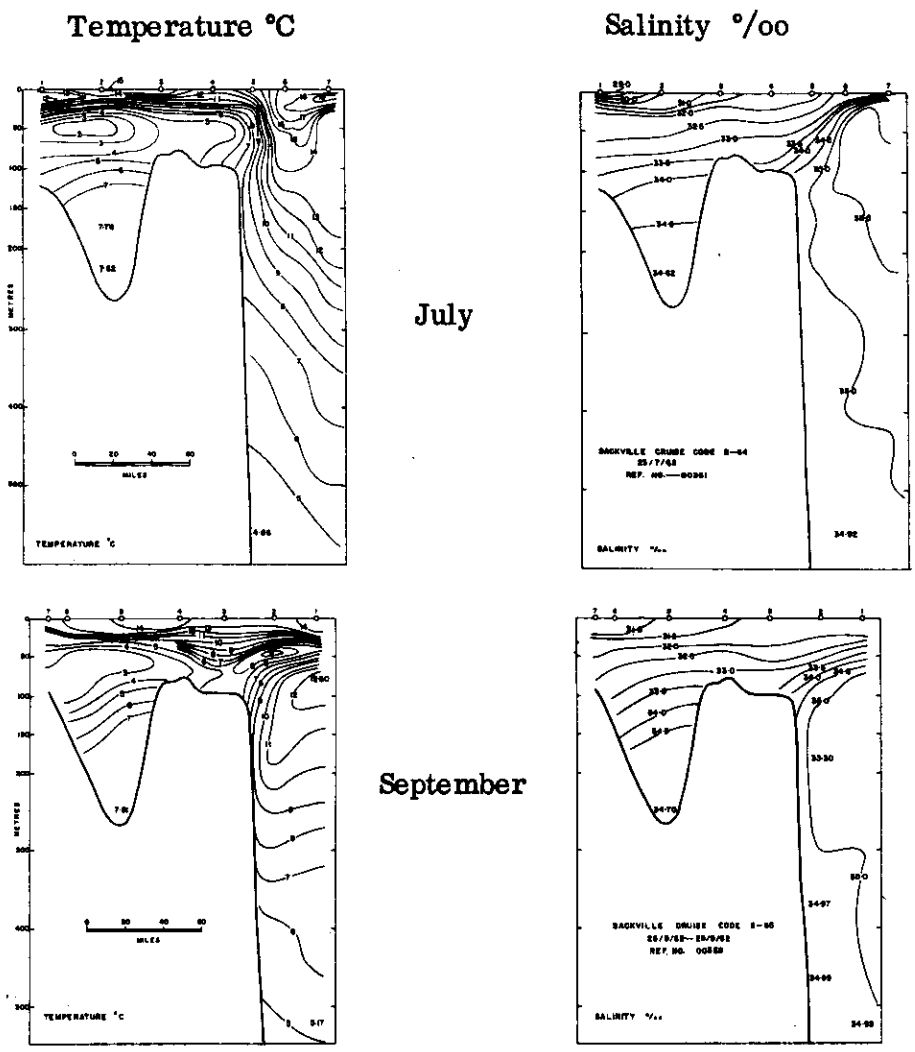


Fig. 1 (cont'd). Hydrographic section off Halifax, N.S. 1962.

species composition and of total biomass of communities has been studied. The greatest variations occurred in sediments of unsorted gravel rather than on level bottom composed of sand or mud.

D. Division 4T
by A. Marcotte

Part of the Canadian research in ICNAF Division 4T was carried out by the Quebec Marine Biological Station at Grand River, P.Q.

HYDROGRAPHY. Four hydrographic sections were made in Chaleur Bay (4T) from the first week of June to the end of August. A comparative analysis of data collected shows that warming of the bottom water took place earlier in 1962 than in 1961. Whereas in 1961 the bottom water remained cold for the whole season, in 1962 rather high temperatures were noted during the same period.

PLANKTON. For four consecutive years, fluctuations in the quantity and composition of zooplankton have been studied in Chaleur Bay. Compared to 1960 and 1961, the zooplankton production for 1962 was high. The mean production during the June to September period for 1962 was 0.51 ml/m^3 compared to 0.45 ml/m^3 in 1960 and 0.25 ml/m^3 in 1961. In 1962 peaks of production were observed in July (0.83 ml/m^3) and September (0.51 ml/m^3). As in 1961, Copepoda, Cladocera, larval Euphausiacea and Coelenterata were the dominant forms. Contrary to 1961, Appendicularia were scarcer.

FOOD OF COD. A limited number of observations on the food of cod in relation to their vertical migrations was made in 1962. These observations were similar to those made in 1961 (ICNAF Redbook 1962, Pt. II, pp.31-32). They were confined to four 24-hour stations during the months of May, June and July. Twenty-one otter-trawl hauls and seven sets with paired gill nets caught 789 cod. Of these, 434 were opened for analysis of stomach contents. All trawl and gill-net catches were smaller than those for the same months of 1961, and there was a larger proportion of small fish (69% shorter than 50 cm). A few more fish were caught in the daytime (33 per tow) than at night (22 per tow). As in 1961, 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 again taken in the upper trawl and upper gill net in the daytime rather than at night (17% versus 13% with otter trawl and 22% versus 21% with gill nets), but the day-and-night difference was much smaller than in 1961.

In the stomachs, the euphausid, Thysanoessa, and capelin were, as in 1960, most abundant. Herring were more abundant in stomachs than in 1960.

SURVEY. The annual groundfish survey with fine-mesh otter trawl in the Chaleur Bay area, initiated in 1957, was continued in 1962. Three series of observations were made from June 27 to October 12, covering 11 stations located at the entrance to Chaleur Bay. The main results obtained in 1962 are compared with those obtained in recent years as follows:

Year	Mean length of cod (cm)	Percentage of cod 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
1962	44.7	23	152

II. Danish Research Report, 1962.

A. Greenland Fisheries Investigations
by Paul M. Hansen

COD - West Greenland

a. Eggs and larvae

Hauls with 1 m stramin net (100-50 m wire out) were taken in Godthaab Fjord and in the coastal area near Godthaab from mid January to the end of July. Catches of cod eggs and larvae were, as in 1961, small.

The first catches of cod eggs were taken in the middle of March. Only in one single haul did the number of eggs exceed 1000. This haul took 1698 eggs, and was made on April 28 near a spawning place in the inner part of the fjord.

Three hauls (100-50 m wire out) were made on March 27 on the Fylla Bank section. On the station west of the Bank an additional haul with 600 m wire out was taken. Cod eggs were only taken in the two hauls west of the Bank, 19 eggs in the haul with 100-50 m wire out and 52 eggs in the haul with 600 m wire out.

Because of engine trouble R/V DANA could not work in Greenland waters in 1962 and no other vessels were available to replace her. It was therefore impossible to carry out research work on the distribution of cod fry in Davis Strait.

b. Age-groups I, II and III

Ten samples of small cod of age-groups I, II and III were collected in 1962. The length frequencies are given in Fig. 1. Date, position, gear and number of specimens in the samples are given in the following table.

Sample	Date	Locality	Position	Gear	No. of specimens
a	29 Jul	Christianshaab	68°50' N	seine	907
b	24 "	Holsteinsborg	66°55' N	"	927
c	8 Jan	Godthaab district	64°10' N	shrimp-trawl	498
d	9 Feb	" "	"	" "	1688
e	7 Mar	" "	"	" "	698
f	25 Apr	" "	"	" "	117
g	29 Jun	" "	"	seine	403
h	6 Jul	" "	"	"	516
i	24 "	" "	"	"	439
j	10 Sep	" "	60°45' N	"	105

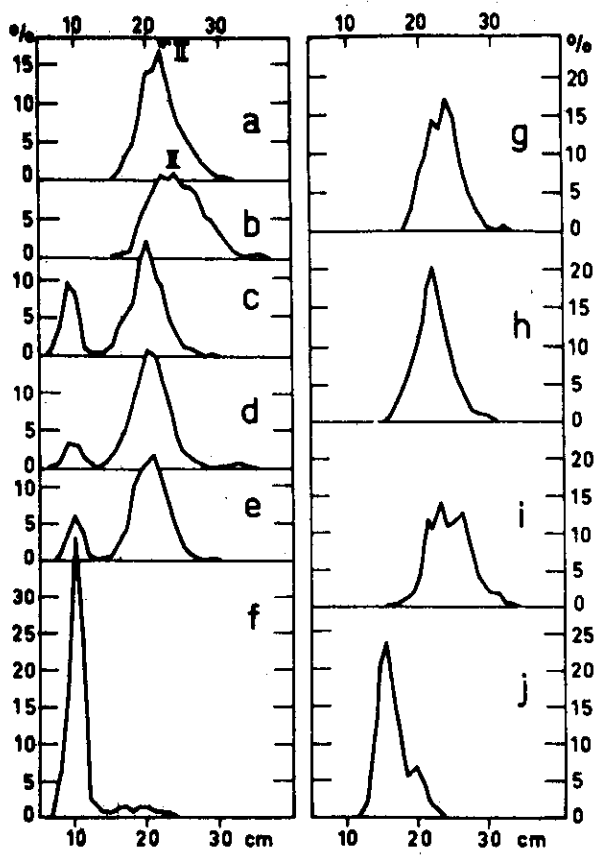


Fig. 1. Length distribution of small cod in coastal areas.

Age-group I (1961 year-class) occurred in five sample c-f and j, strongly predominating in f and j.

Age-group II (1960 year-class) was strongly represented in all samples except in f and j.

Age-group III (1959 year-class) was nearly absent in all samples.

There is reason to believe that 1959 is a poor year-class while 1960 is a rather rich year-class which will be of importance to the commercial fishery for the first time in 1965.

c. Commercial fish

Otoliths of 675 cod were collected on the offshore banks. The stations where the samples were collected and the age compositions and length frequencies (in 3-cm groups) of the fish in the samples are shown in Fig. 2. Samples 1 and 2 are from Division 1B and the samples 3 and 4 are from Division 1D

(Ann. Biol., XVI, p.115, Fig.3). Samples 1 and 3 are from long-line catches and samples 2 and 4 from hand-line catches.

The 1957 year-class predominates strongly in samples 1, 2 and 3 while the 1956 year-class is the predominant year-class in 4.

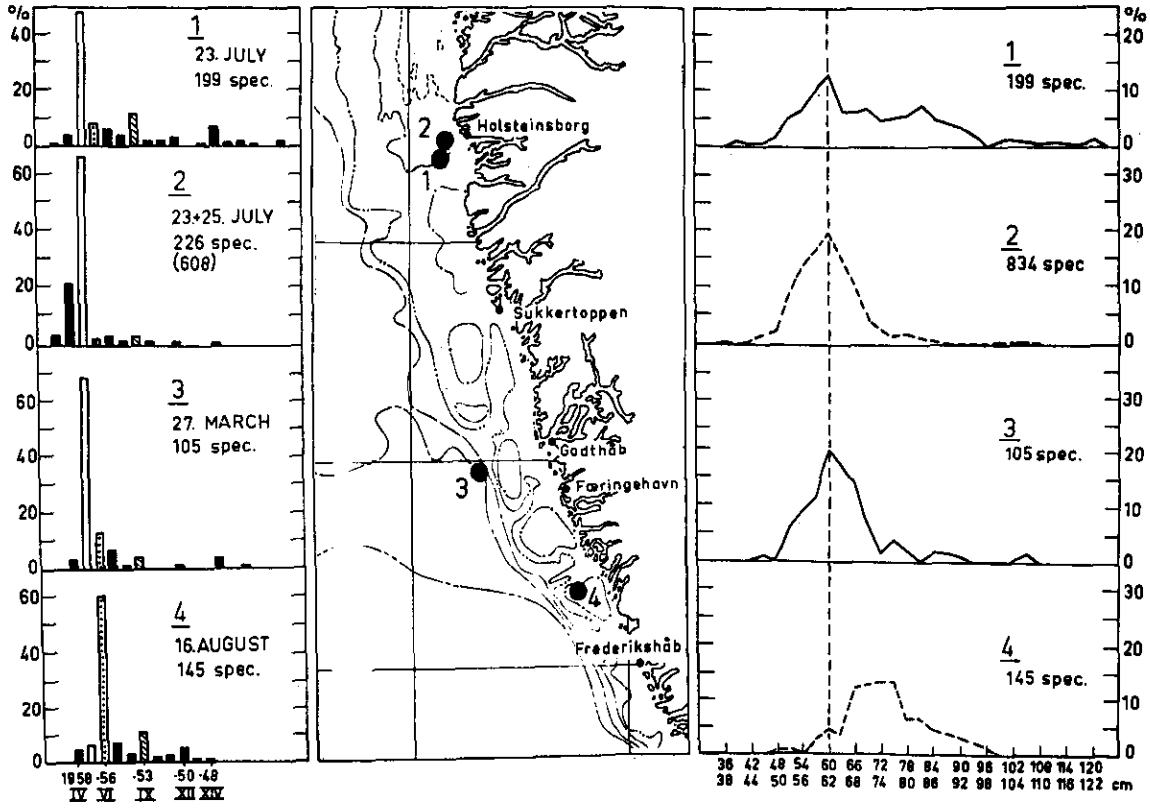


Fig. 2. Percentage age and length distribution of cod from the West Greenland banks in 1962.

In coastal waters, 17 samples totalling 2721 cod were taken for age estimation. The results are shown in Fig. 3. According to divisions the samples were distributed as following:

Division	Sample Nos.	No. of Specimens
1A	5	100
1B	6-12	1201
1C	13	44
1D	14-16	548
1E	17-18	299
1F	19-21	529

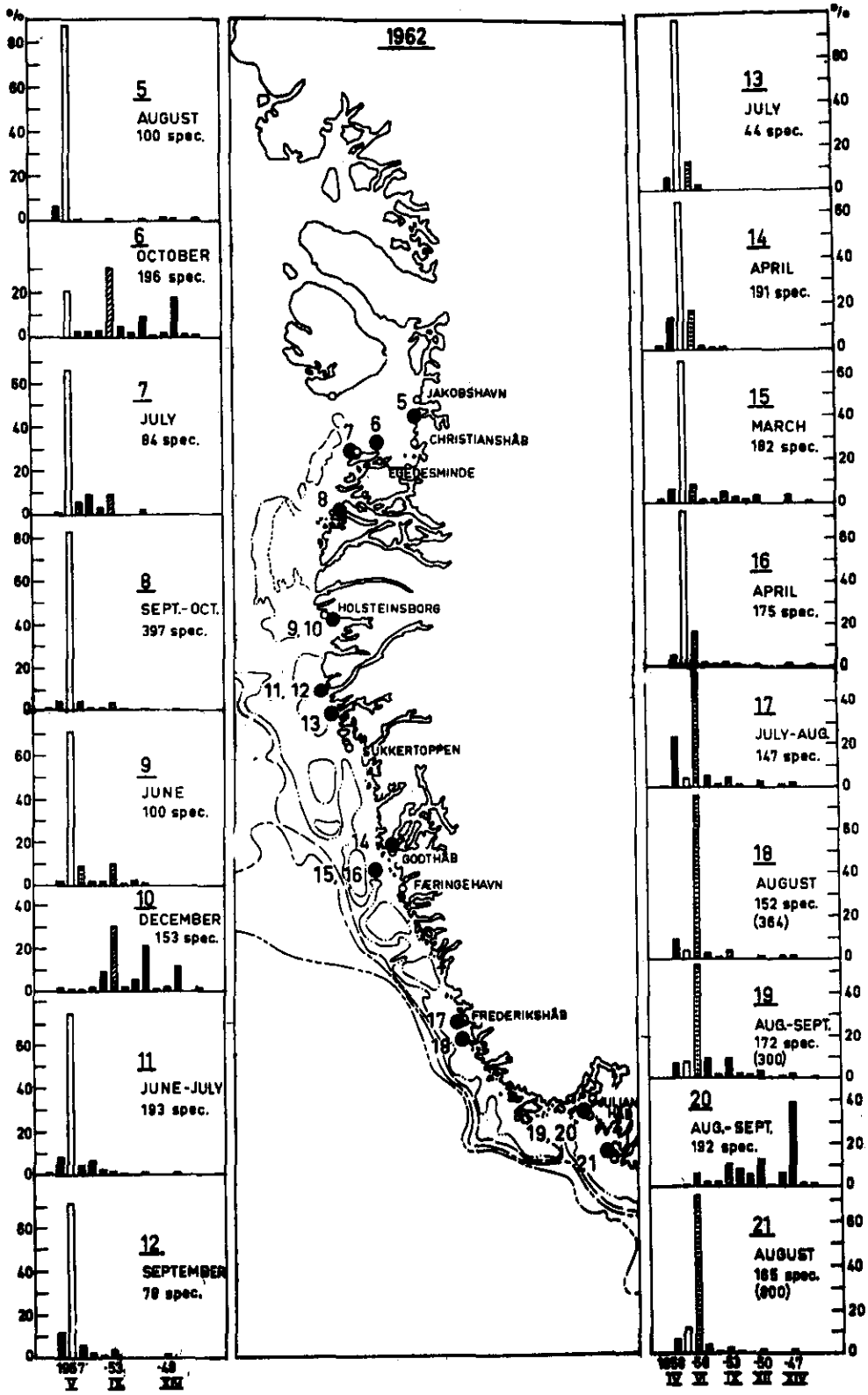


Fig. 3. Percentage age distribution of cod from coastal waters, West Greenland.

In the northern Divisions 1A-1D the 1957 year-class made up between 60-90% of all samples except Nos.6 and 10. In samples 6 and 10 the 1953 year-class was predominant with 30.1% in each sample. The two older (1950 and 1947) year-classes were represented with 9.2% and 17.9%, in No.6 and with 20% and 21% in No.10.

In the five samples from Divisions 1E and 1F the 1957 year-class was very poor. In four samples the 1956 year-class was strongly predominant. In sample 20, which is from a long-line catch, the 1947 year-class was predominant with 38.5% while the 1956 year-class was represented with 6.3%. Samples from the coastal region show the same pattern of age composition as samples from the off-shore banks, namely predominance of the 1957 year-class in the northern divisions and of the 1956 year-class in the southern divisions. The three old 1947, 1950 and 1953 year-classes which were of great value to commercial fishery some years ago, have almost disappeared from the catches. There is reason to consider the 1957 year-class as a true West Greenland year-class which originates from spawning on the banks in Davis Strait, while the 1956 year-class possibly originates from spawning grounds off East Greenland and Iceland. In 1959 these year-classes were predominant in the stock of young cod, the 1957 year-class as age-group II in the northern coastal areas of West Greenland and the 1956 year-class as age-group III in Division 1F (Ann. Biol., XVI, p.114-115), (ICNAF Ann. Proc., X, p.33-34). In 1958 the 1957 year-class was abundant among the small cod and predicted as a rich year-class (Ann. Biol., XV, pp.85-86), (ICNAF Ann. Proc., IX, pp.33-34).

d. Tagging

A total of 5001 cod were tagged in West Greenland waters (Subarea 1) in 1962. The taggings were distributed as follows:

Division	Coastal Waters	Offshore Banks
B	608	608
C	-	-
D	2019	302
E	364	-
F	1100	-
Total	4091	910

Of this total, 2472 cod were tagged with white Petersen discs, 1120 with spaghetti tags, 708 with small blue plastic tags and 701 with hydrostatic tags.

All reports of tagged cod in 1962 have not yet been registered. A total of 608 recaptures of cod tagged in West Greenland waters have been received in 1962. The reports are distributed according to year of tagging and place of recapture as follows:

Year of Tagging	Recaptures from: W. Grl.	Icel.	East Grl. and Dohrn Bank
1952	1	-	-
1953	1	-	-
1954	2	-	-
1955	1	-	-
1956	14	1	-
1957	57	5	-
1958	76	1	4
1959	89	-	5
1960	272	3	-
1961	76	-	-
Total	589	10	9

COD - East Greenland

Two samples of cod otoliths were collected off Skjoldungen (63°13' N, 41°30' W). The age compositions are given in Fig.4. The 1956 year-class predominates with 52.7% in the sample from August and with 57.4% in the sample from September. It is obvious that the age compositions in these samples are very similar to those from South West Greenland.

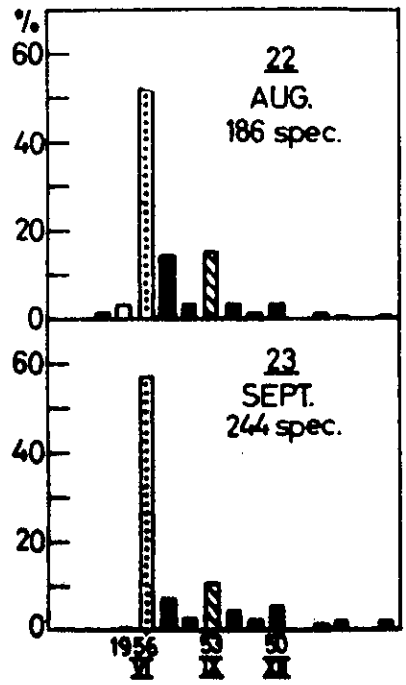


Fig. 4. Percentage age distribution of cod from Skjoldungen, East Greenland.

REDFISH - West Greenland

Ten hauls with shrimp trawl for small redfish were taken in Pisigsarfik in Godthaab Fjord. The hauls were made every month except May and June and August. A total of 8067 redfish were caught and measured (ICNAF Sampling Yearbook for 1962). Tagging experiments were carried out in Qorqut in Godthaab Fjord in May. A total of 561 redfish were tagged with white Petersen discs fixed in front of the dorsal fin by means of stainless steel wire. All redfish used for tagging were caught in pound nets.

B. Faroese Fisheries Investigations
by J. S. Joensen

Investigations of catches were carried out on board the Faroese commercial trawler SKALABERG (955 br.t.) fishing on the West Greenland banks from 17 March to 25 May, 1962. During these 72 days the trawler completed 604 hauls or 597 fishing hours. The total catch was 1535 metric tons round fresh. The used part of the catch was 1371 tons round fresh of which there were 1355 tons of cod and 16 tons of wolffish. Of the total catch 164 tons or 11% was discarded. The discarded part included small cod 44 tons, wolffish 30 tons, american plaice 39 tons and redfish 51 tons.

Data was collected from 11,133 cod. Measurements were made on 8,443 cod and otoliths were taken from 2,690 cod. The detailed data concerning the size and age distribution of the cod are given in the ICNAF Sampling Yearbook for 1962.

Fig. 1 shows the age and length distribution of the cod. In the northern divisions, 1B, 1C and 1D, age-group V (1957 year-class) predominate, constituting 92, 75 and 62% respectively of the fish sampled.

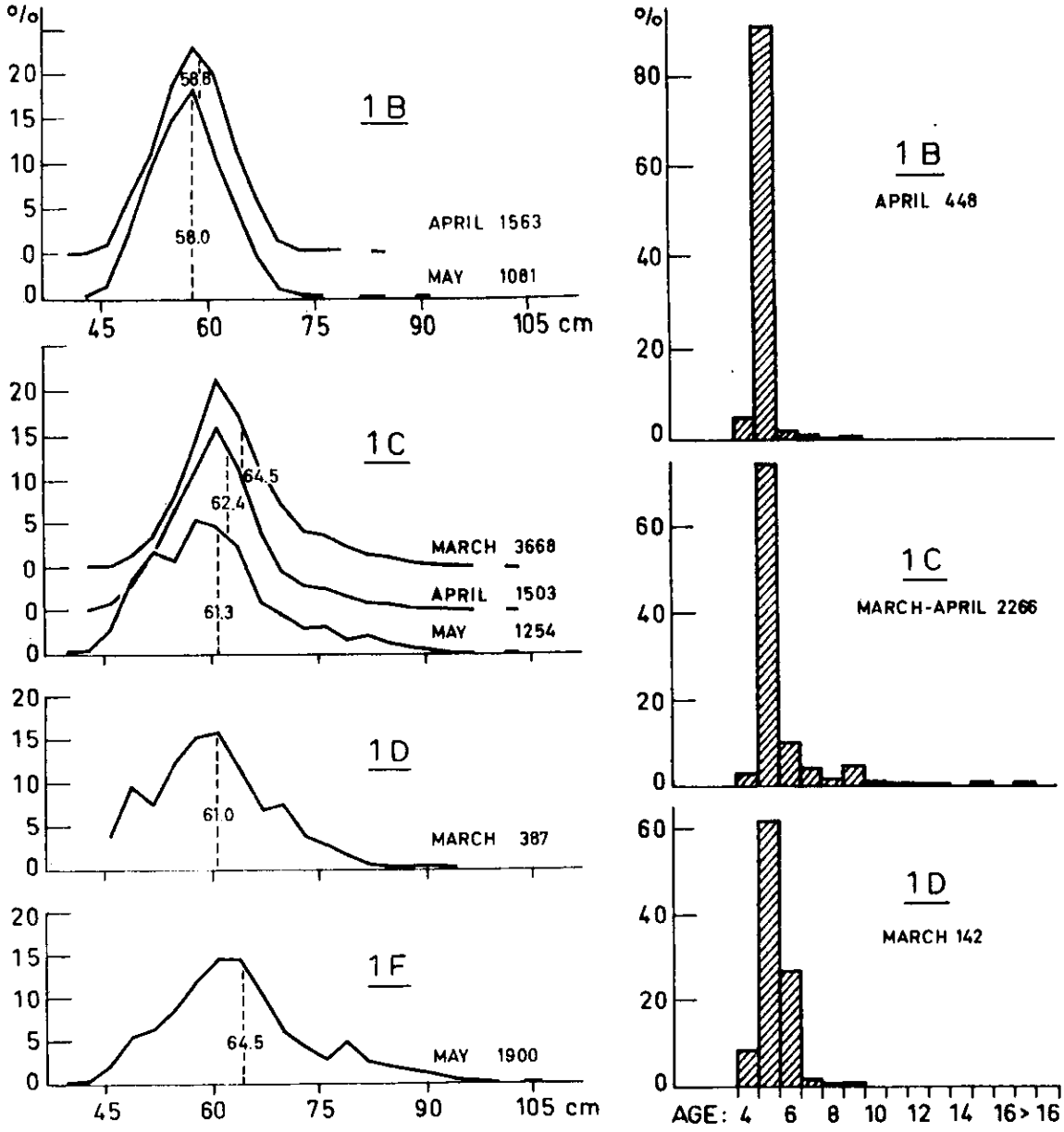


Fig. 1. Length and age distribution of cod in West Greenland waters, 1962.

III. French Research Report, 1962

Between 11 July and 10 September, 1962, the R/V THALASSA completed an exploratory cruise between Georges Bank and the Laurentian Channel in depths principally between 150 and 350 m.

Fishing was carried out with a trawl of 30 m headrope, 41 m footrope and 50 mm mesh size between knots.

Subarea 5 Region of the Gulf of Maine and Georges Bank

Herring were found principally in the cold waters (6°-8°C) of this region, namely: on Stellwagen Bank in the Gulf of Maine and along the northern and western slopes of Georges Bank and in the region northeast of this bank.

However, it should be noted that this species also appeared at the surface on the northern edge of Georges Bank, in about 14°-15°C water, as long narrow shoals. The presence of herring in this relatively warm layer can perhaps be explained by the abundance of Euphausiids, also visible at the surface.

Haddock were only found in notable quantities on the northeast edge of Georges Bank not far from one of the areas where herring were abundant.

Silver hake (Merluccius bilinearis) were never found in very great quantities. The best catches (NW and NE of Georges Bank) were made in water temperatures varying from 7° to 12°C. But on the southeast edge of Georges Bank, in analogous conditions, catches were very small. Hake (Merluccius albidus) were found, in very small quantities, in the southernmost part of the explored region, also, occasionally a few specimens, on the southeast slope of Georges Bank.

Some lobsters were caught in 11°-13° water, 80 miles south of Cape Cod. This species was also taken, but in appreciably less important quantities, on the southeast edge of Georges Bank, where the warm Atlantic influence is evident.

Subareas 4 and 3Ps

a. Brown, LaHave and Sambro Banks and the slopes between Emerald Bank and Sable Island

Redfish were taken in important quantities southeast of Sambro Bank in water 6°C and 120 m average depth. In the remainder of the region captures were sporadic: on the slopes one noted a concentration of catches at depths, in the cooler Atlantic waters, that is, waters more than 250-300 m deep and 5° to 7°C.

Silver hake were found especially on the slopes of the region. Here, the best catches of the cruise were made at 250 m in water about 6°C. All of the best catches were made between 5°C and 8°C and between 115 to 380 m. That is, the habitat of this species is not very restricted and is not limited to the regions warmed by the Atlantic influence.

Argentine were most abundance at about 300 m and 7°C.

Lobsters were sometimes found, in small quantities, along the slopes at 7.5°C to 9.5°C.

b. South-eastern and eastern edge of Banquereau

Redfish were noticeably dominant in catches from 140 to 240 m at 5°C to 7°C. Argentine were found especially from 230 to 260 m.

c. Western and eastern edge of the Laurentian Channel, Burgeo Bank and the middle of the Channel.

Redfish were dominant in all these regions, generally in water 5°-6°C, but sometimes colder (4°C on south-eastern Burgeo Bank) and at depths between 160 to 340 m with a noticeable increase in catch with depth.

Cod only appeared in the cold Labrador water layer or in the neighbourhood of this layer, at lesser depths not more than 200 m.

Argentine were almost always taken in small quantities on the western edge of St. Pierre Bank, mixed with redfish.

Finally, silver hake, present only on the western edge of St. Pierre Bank, were encountered especially on the north half at 220 m in waters about 6°C (conditions analogous to those observed last year). That this species did not appear frequently in the east and north part of the Laurentian Channel (the edge of Misaine and Burgeo Banks) is probably because of the too low temperatures in the region (3° to 5°C average), where the Atlantic influence is small. Likewise on the western edge of St. Pierre Bank, one notes a decrease of silver hake with depth (depths above 300 m) probably for the same reason.

The following table summarizes the observations made on the catch per hour and the species composition of the catches in the various regions fished.

Region	Total Catch (Kg.) per hour Trawling	Percentage by Weight of the Different Species in the Total Catch per hour Trawling					
		Silver Hake	Herring	Redfish	Argentine	Haddock	Lobster
Cape Cod	645	3.6	47.1	7.4	-	7.8	-
North, north-west western Georges Bank	965	10.2	66.4	0.3	-	3.0	-
Slopes 80 miles south of Cape Cod	120	11.7	-	-	-	-	42.5
South-eastern Georges Bank	76	25.0	-	-	-	-	7.1
North-east Georges Bank and channel separating it from Browns Bank	4,062	1.2	79.2	-	-	16.7	-
Browns Bank	386	-	-	-	70.5	12.7	-
LaHave and Sambro Banks	1,367	0.4	-	91.5	-	-	-
Southern edge of Emerald Bank and Sable Island	356	34.0	-	18.8	11.5	8.1	0.4
South and south-east Banquereau	1,642	0.5	-	53.5	29.6	-	-
Western St. Pierre Bank	498	12.6	-	41.9	15.9	-	-
Misaine Bank Laurentian Channel	513	0.1	-	87.5	-	-	-
Burgeo Bank	476	-	-	85.5	-	-	-

IV. German Research Report, 1962

A. Cod Investigations in Subarea 1

by Arno Meyer

In 1962 the German trawlers have fished off West, South and East Greenland again over the whole year. The landings increased by 42% to 205,000 tons (landed weight), of which cod account for 55.5% and redfish for 36.4%. This further rapid increase was chiefly caused by a more intensive fishery in the divisions 1B, 1C and 1E. The trend of the German fishery for cod and redfish in the different regions off Greenland during the last 3 years is shown in Table 1.

Table 1. German landings from Greenland 1960-1962 in tons, percentage of total landings in brackets

		Cod	Redfish	Total
West Greenland (1A-1E)	1960	18664 (50.9)	14894 (40.6)	36662 (39.7)
	1961	61514 (62.3)	27964 (28.3)	98805 (62.2)
	1962	94176 (61.9)	44214 (29.0)	152201 (74.3)
South Greenland (1F)	1960	522 (8.3)	5395 (85.5)	6310 (6.8)
	1961	8642 (39.1)	11995 (54.3)	22095 (13.9)
	1962	7953 (48.9)	7094 (43.7)	16251 (7.9)
East Greenland	1960	15378 (31.1)	30250 (61.2)	49421 (53.5)
	1961	11232 (29.6)	24292 (64.0)	37968 (23.9)
	1962	11489 (31.6)	23103 (63.4)	36334 (17.8)
Total Greenland	1960	34560 (37.4)	50538 (54.7)	92389
	1961	81388 (51.2)	64249 (40.4)	158871
	1962	113618 (55.5)	74410 (36.4)	204787

Investigations at sea could only be carried out during a cruise with the R/V ANTON DOHRN off South Greenland in the beginning of March (mainly fishery protection cruise) and during an experimental trip of a trawler (for pelagic fishery) in September. All other data are from landings of trawlers including samples of ungutted cod preserved especially for research. A total of 48 samples are available including 19205 measurements, 7344 otoliths, and 1428 observations on maturity.

West Greenland (1A-1E)

Fishing was carried out off West Greenland throughout the year. During the period from April to June most trawlers were fishing in 1E (mainly for redfish), the remainder of the year most trawlers worked the northern divisions 1D to 1A, mainly 1C. By this change in spring to a more profitable redfish fishery in 1E no real fishery for spawning cod could be developed in 1D and 1C as in 1960.

Age determinations of cod showed again that the rich 1957 year-class is of West-Greenlandic origin and concentrated north of Fyllas Bank, while the rich 1956 year-class is distributed in the southern part and is of East-Greenlandic-Icelandic origin. The line separating these two important year-classes lies between Fyllas and Banana Bank. The 1957 year-class made up 64-77% of the total landings from Banana and Little Halibut

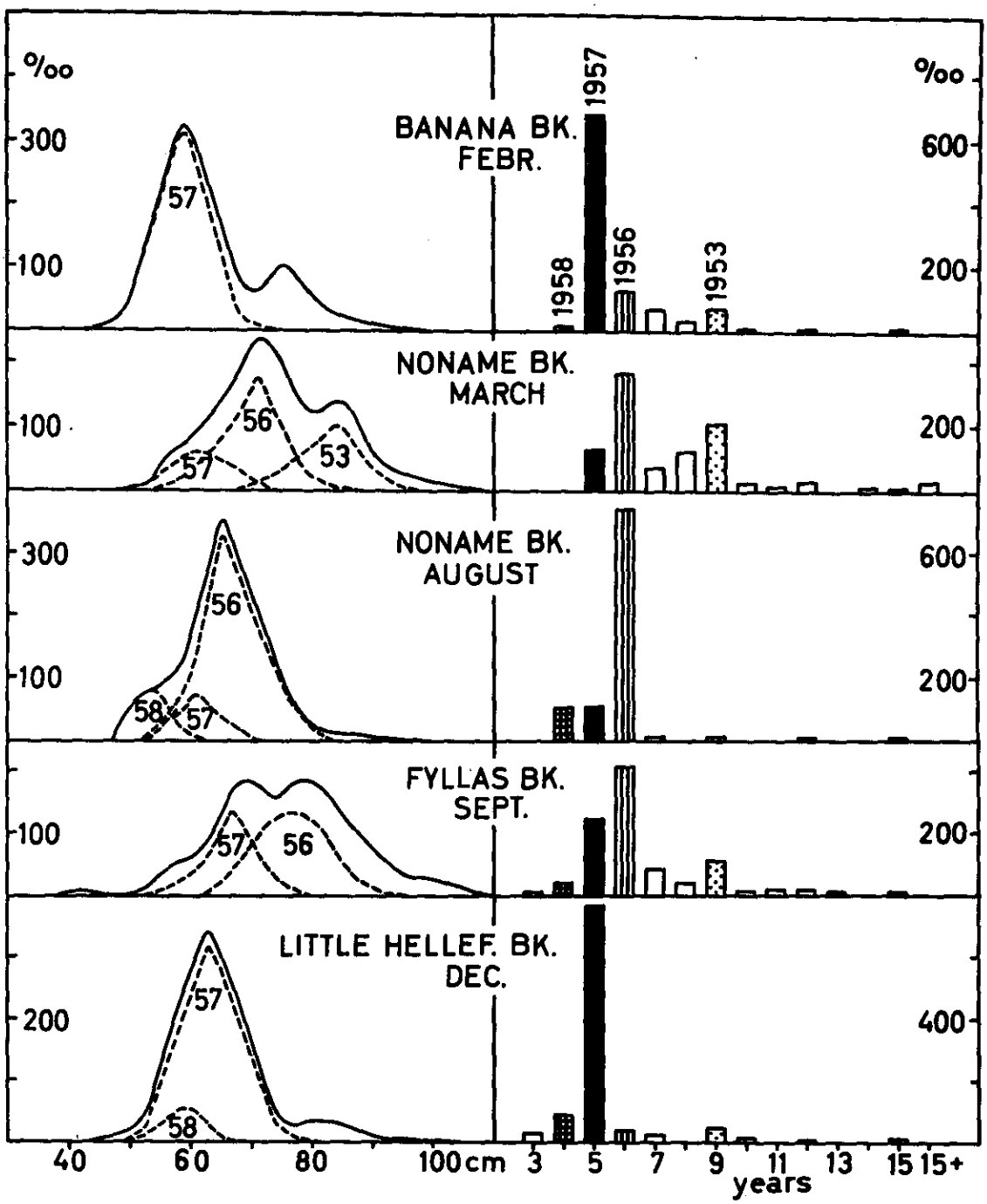


Fig. 1. Cod. Length and age distribution off West Greenland.

Bank in February, October and December (Fig. 1) and only 25-28% on Fyllas Bank in September and 9-13% on Noname and Frederikshaab Bank in March, June and August. The 1956 year-class, however, was predominant with up to 74% in the south and 42-49% on Fyllas Bank. In contrast to the preceding years the 1953 year-class was only of commercial importance during spring and early summer when the trawlers

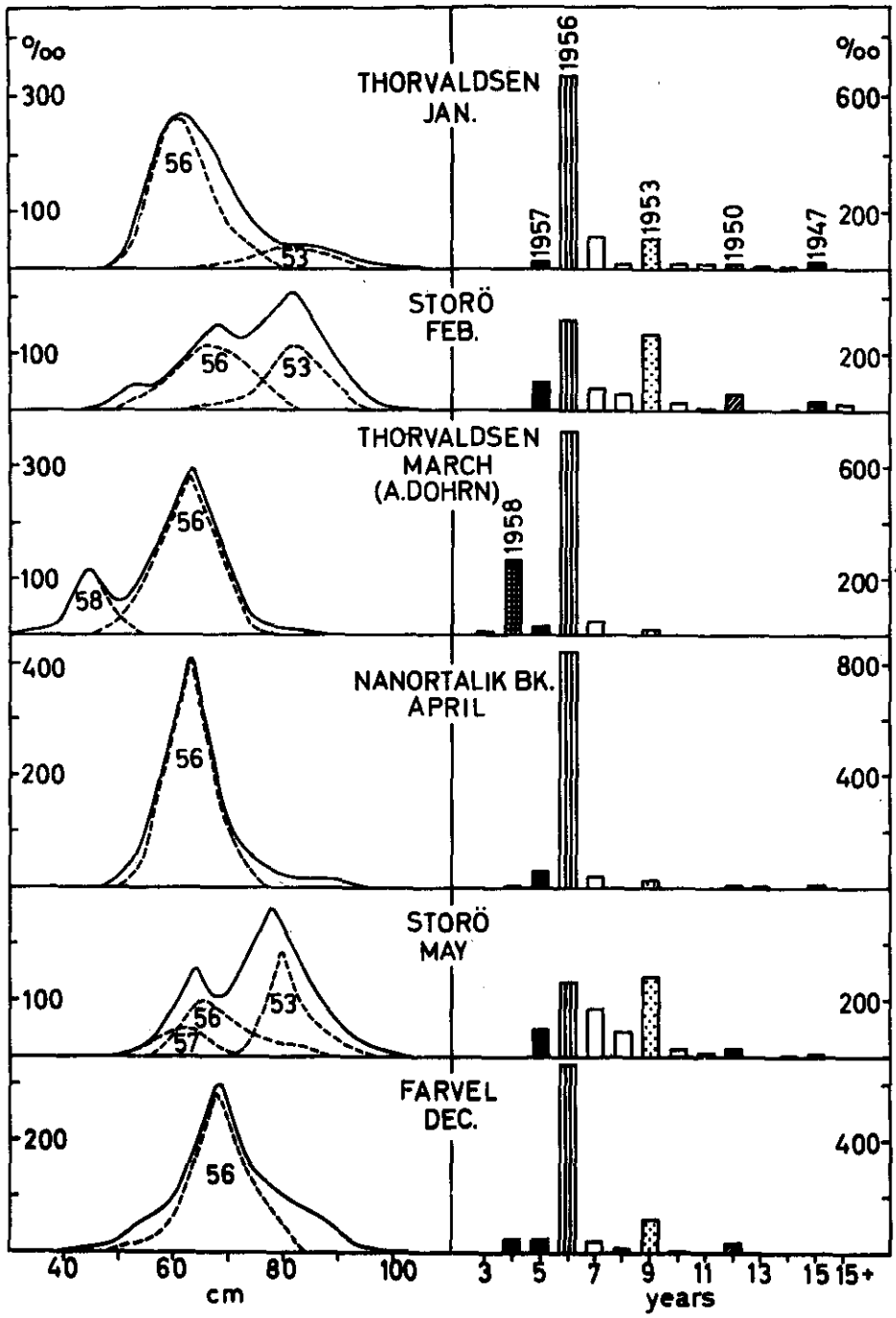


Fig. 2. Cod. Length and age distribution off South Greenland.

were fishing in deeper waters for big migrating mature cod. The once important year-classes of 1950 and 1947 have become very weak.

Observations on maturity of cod from Banana Bank in February revealed that 20% of the 5-year-old fish and 73-81% of the 6-year-old fish and 100% of all those older were mature. Spawning west of Banana Bank occurred 2-3 weeks later than observed in 1961, when spawning was at its peak by the end of March and the beginning of April. On 21 March most mature cod had reached stage V and only very few (3%) were spawning (stage VI). On 21 April, however, 27% were about to spawn, 15% were spawning, and 58% were close to finishing or had finished spawning.

South Greenland (1F)

In 1962 the landings from Division 1F, especially those of redfish, decreased and the mean length of the cod was considerably smaller than in 1961. As predicted the rich year-class of 1956 was predominating in most cod landings with up to 67-84%. The older year-classes of 1947 and 1950, until 1961 of great commercial value, were weak. Only in catches in deep water for migrating spawners (February) and remigrating postspawners (May) did the 1953 year-class reach 22-28% of the total catch (Fig.2). During winter and spring a reverse depth-distribution of cod and redfish was again observed (ICNAF Redbook 1962, Pt.II, p.57). Spawning of cod was observed only in the northwestern part of Division 1F off Storð. Farther to the south off Cape Thorvaldsen and on Nanortalik Bank only immature cod were found. On 10 April off Storo, 81% of the mature cod were about to spawn and 19% were spawning or were close to finishing. It was not only noteworthy in this sample, that the 1957 year-class - otherwise of small importance off South and South-West Greenland - was predominating, but that 80% of the 5-year-old cod were mature while of the 1956 year-class only 42% had reached maturity.

The growth of cod off South Greenland is slower than off West Greenland. The 6-year-old cod had reached an average length in autumn of 68 cm off Farvel and of 76 cm on Fyllas Bank, that means that off West Greenland the 5-year-old cod were almost the same length as the 6-year-old cod off South Greenland.

East Greenland

a) Southeast Greenland (Wailoe Bank to Moesting Ground)

The profitable winter and spring fishery for redfish and cod has developed more and more into a fishery of specialists, well experienced in the difficult fishing grounds and the varying and severe ice conditions. Off Southeast Greenland, cod is only of minor importance. Bigger catches of cod can only be made during late winter and spring, when mature cod pass through this region on their spawning migration to East Greenland and Iceland or come to the area to spawn. From February to June, cod made up 18% of the total catch.

The age composition of the cod was varying, mirroring the migration of the spawners, but similar to that of South Greenland. At the beginning of the spawning migration in February and at the end of May the older year-classes (1953; 1952, 1950 and 1947) were dominant, while in April the 1956 year-class was strongest with 45%. In June, when all spawners had left Southeast Greenland the 6-year-old cod made up 66% (Fig.3). Spawning must have occurred late in 1962, for on 19 April

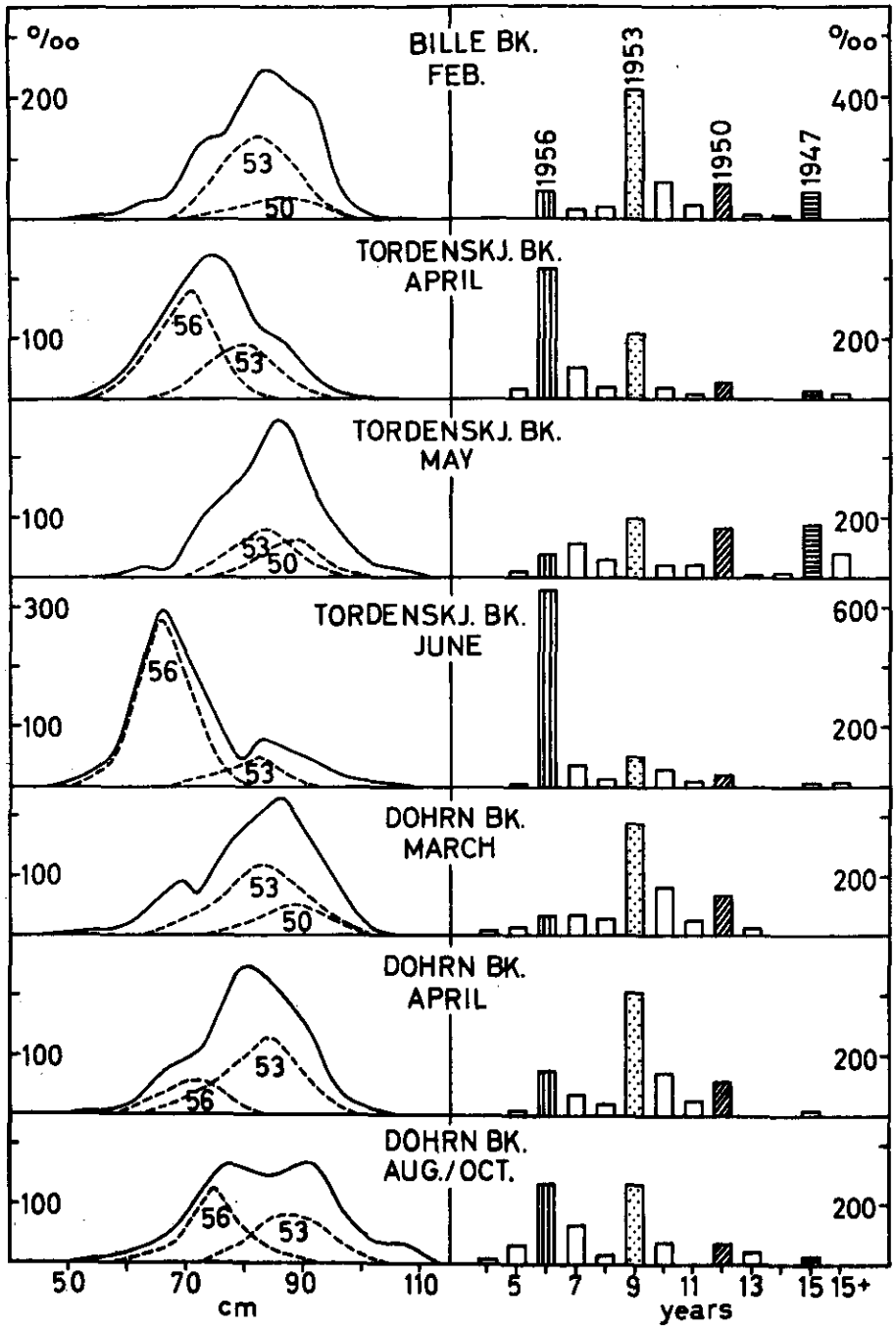


Fig. 3. Cod. Length and age distribution off Southeast and East Greenland.

only 20% were spawning or had nearly finished and 80% were about to spawn.

b) East Greenland (Heimland Ridge to Dohrn Bank)

In contrast to Southeast Greenland, off East Greenland cod accounted for 58% of the total catch. The most profitable cod fishery lasted from February to May with a peak in March and April on Dohrn Bank. The age composition was similar to that of South and Southeast Greenland with the only exception that the stock of cod on Dohrn Bank has more older year-classes. Large cod with an average length of 80 to 82 cm (68% of the older year-classes 1953, 1952 and 1950) were caught in March. In April the share of the 1956 year-class rose to 14-17%, in the beginning of May to 23% and in August and October to 26 and 28% (Fig.3). The average length of the 1956 year-class increased from 71 cm in May to 79 cm in November.

Cod Taggings

105 recoveries (5%) were reported to January 1963 of the 2081 taggings made off Greenland since 1959. From the 1962 taggings off Cape Thorvaldsen (1 March) and on Fyllas Bank (18-19 September) the number of returns was considerably higher, 8.3% and 5.5% respectively. A further 7 returns in 1962 came from big mature cod caught during the spawning season off SW, W and NW Iceland and tagged off SW and E Greenland (Table 2).

Table 2. 1962 returns of Greenland-tagged cod from Iceland

Tagged			Found					
Date	Locality	Length cm	Date	Locality	Length cm	Growth cm	Year-Class	First Spawning
18.12.59	61.19N, 49.49W	66	15.5.62	NW Iceland	91	25	-	-
19.12.59	62.37N, 51.28W	55	15.5.62	NW Iceland	82	27	1955	1962
29.4.60	61.10N, 49.41W	68	3.4.62	W Iceland	81	13	1953	1962
" " "	" "	66	2.5.62	W Iceland	72	6	1954	1962
" " "	" "	71	25.4.62	SW Iceland	86	15	1953	1962
" " "	61.58N, 50.22W	65	28.4.62	SW Iceland	-	-	-	-
27.7.61	64.43N, 35.08W	86	2.5.62	SW Iceland	93	7	1950	1961 ?

Of great interest is the return of the tagging off Angmagssalik (E. Greenland). While all other returns from Iceland (from 1960 to 1962 a total of 18 cod) seem to be first time spawners (from interpretation of otoliths) this 12-year-old cod has probably spawned the second time in 1962. If the interpretation of the spawning zones is right, the question rises, where (E. Greenland or Iceland) this cod has spawned for the first time? Further tagging experiments, especially off East Greenland and on Icelandic spawning places, are urgently required to clear up the migrations of Greenlandic cod after having spawned for the first time off Iceland. Are the cod staying in Icelandic waters or are they returning to East Greenland?

Hydrography

During the cruise in the beginning of March only 19 stations off West and South Greenland could be worked by the ANTON DOHRN. The section across the southernmost part of the Banan Bank (Fig. 4) shows that the highest temperatures of 4.82°C lie between 600 and 800 m and thus confirms the experience of the German trawlers in 1961 that a profitable fishery for spawning cod requires trawling in very

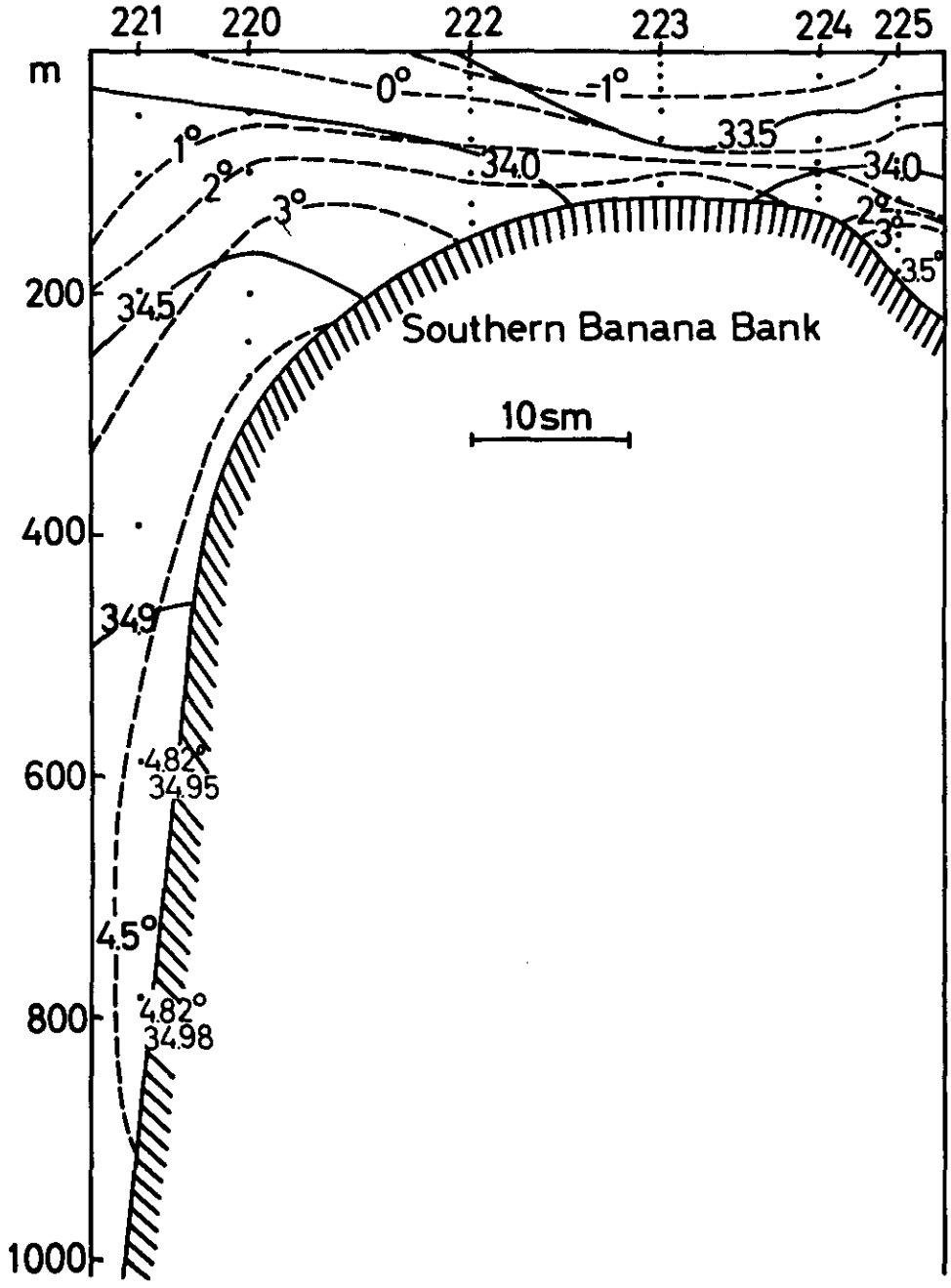


Fig. 4. Hydrographic section across southern Banana Bank, 4-5 March 1962. Salinity °/oo - solid lines; temperature °C - broken lines.

deep water. (In the middle of March 1963, trawler captains had the same experience off Storð and got good pure catches of big cod only below 470 m, while catches of redfish were best in about 300 m). Also off Cape Desolation (Fig.5) the highest temperature was found in 700 m. Some hydrographic stations off Frederikshaab, southwest of Cape Thorvaldsen and south southwest of Cape Egede show the following observations. On the

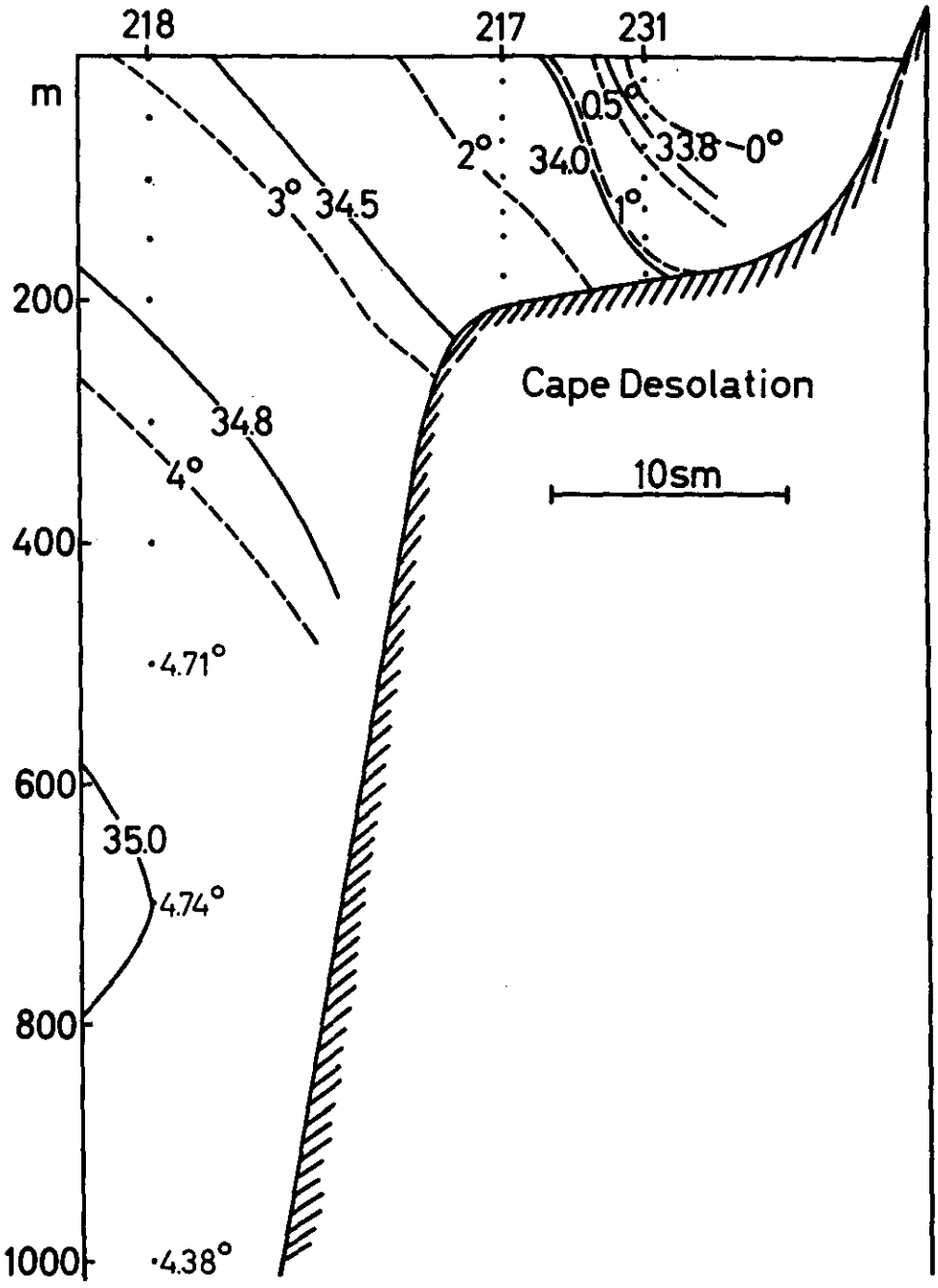


Fig. 5. Hydrographic section off Cape Desolation, 2-8 March 1962. Salinity °/oo - solid lines; temperature °C - broken lines.

western slope off Frederikshaab the highest temperature was found in 600 m with 4.59°C (salinity 34.96 °/oo). On the northern top of Noname Bank the bottom temperature in 75 m was only 0.8°C. Off Cape Thorvaldsen the edge of the shelf below 200 m had temperatures of more than 3.5°C. On the shelf in 125 and 130 m and 10 to 22 miles south southwest of Cape Egede only arctic water with temperatures of -0.36°C (33.76 °/oo) and -0.18°C (33.87 °/oo salinity) was found.

B. Subareas 2 and 3
by J. Messtorff

Early in 1962 the R/V ANTON DOHRN paid a short visit to Divisions 3M and 3K (23-27 February) on her way to West Greenland. Due to very bad weather conditions and to limited time only few experimental hauls and hydrographic stations could be carried out. For the hauls the trawl codend was fitted with small meshed netting (inside) in order to get information on the distribution of small cod. The percentage length compositions of cod caught on the southern slope of Flemish Cap (3M) in 310 m and at the shelf edge east of Belle Isle (3K) in 330 m are given in Fig. 1. On Flemish Cap small cod ranging from 17 to 26 cm in length (mean length 22 cm) - forming the outstanding first peak in the length composition - were dominating with 60% and were all 2 years of age (1960 year-class). The remaining 40% were 3 to 5 years old (mean length 40.1 cm). The total average length was 29.4 cm. Off northern Newfoundland (3K) in about the same fishing depth (330 m) the smallest cod measured 24 cm with less than 3% below 30 cm and only a few 2-year-old fish. About 50% measured between 40 and 50 cm. The total average length was here 43.7 cm.

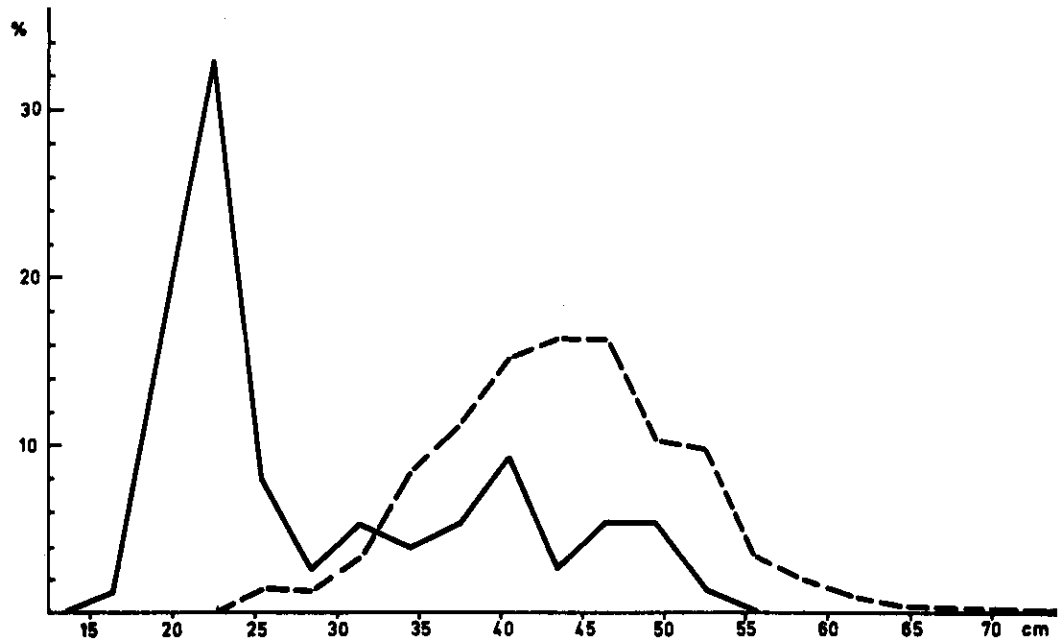


Fig. 1. Cod. Length composition. Division 3M (solid line) and 3K (broken line). February 1962.

On the southern slope of Flemish Cap water temperatures were rather uniform with about 4°C between surface and 270 m depth. In the northern part of Division 3K surface temperatures near the shelf edge were between -0.4° and +0.8°C and surface salinities between 33.79 and 34.15 °/oo. Both temperatures and salinities were increasing slowly with depth. Bottom temperatures and salinities at the same stations were +2.5°C and 34.46 °/oo at 350 m, +3.3°C and 34.74 °/oo at 500 m, and +3.5°C and 34.89 °/oo at 680 m.

Cod Taggings

In November 1960 a total of 141 cod were tagged on board a commercial trawler in Division 2J (the trawler was originally bound for Greenland waters where a cod tagging programme was to be carried out). Release position: 53°20'N, 52°25'W. The fishing depth was 260-275 m. All cod were in relatively poor condition. At the end of August 1961 one cod was recovered by a Portuguese trawler on the northern slope of the Newfoundland Bank, Division 3L. The position of recapture was 48°50'N, 50°09'W. The fish measured 57 cm at release and a reported 58 cm at recapture. All fish were tagged with yellow plastic tags with the letters DHB and a number.

Commercial fishery

Because of good fishing conditions in Greenland waters, fishing activity of German trawlers was very low during 1962 in Labrador and Newfoundland waters. Only a total of 14 trips to Labrador and Newfoundland were carried out in January, February and March 1962. From these trips, however, two trawlers landed mixed catches from Newfoundland/West Greenland and two from Labrador/West Greenland. The landings in metric tons are given below:

	Labrador	Newfoundland		Total
	2J	3K	3L	
Cod	557	296	49	902
Redfish	1452	1567	90	3109
Other fish incl. fishmeal etc.)	189	234	66	489
Total	2198	2097	205	4500
Trips	7	6	1	14
Fishing days	75	69	9	153

From April until the end of October no fishing was carried out by German trawlers off Labrador or Newfoundland and in November/December only two trips were reported. Both deepfreezing trawlers fished partly in Divisions 2J, 3K, 3L and 3M and additionally in West Greenland waters.

V. Icelandic Research Report, 1962

by Jón Jónsson

Fishing

In 1962 Icelandic trawlers only spent 342 days fishing in the Convention area as compared to 1,312 fishing days in 1961.

This very low fishing effort is largely due to a long strike by the trawlers during the spring months. In 1962 only 10 fishing trips were made to the Labrador-Newfoundland banks and 22 to the West Greenland banks.

The catch of redfish on the Labrador-Newfoundland banks amounted to 2,106 tons compared with 4,527 tons the year before. At West Greenland the redfish catch was 4,493 tons compared with 7,805 tons in 1961. In this area the catch of cod was 1,157 tons compared with 11,032 tons in the year before.

The catch per day fishing for redfish in the Labrador-Newfoundland area was substantially lower in 1962 than in 1961, but at West Greenland the opposite was the case. As for cod at West Greenland, the catch per day fishing was much lower in 1962 than in 1961.

Sampling

Collection of samples from the trawlers was very difficult because of the few trips made, and no material is available from the Labrador-Newfoundland area, whereas some samples of cod and redfish were taken from trawlers fishing at West Greenland.

A sample of cod from Dana's bank in February 1962 shows the strong year-class from 1953, but it is mostly dominated by the year-classes from 1956 and 1957 which is in good agreement with the age distribution in the catches of Icelandic trawlers in 1961.

VI. Norwegian Research Report, 1962
by Erling Bratberg

WEST GREENLAND

In 1962 the Norwegian R/V G.O.SARS worked in West Greenland waters between 19 April and 4 May (Fig.1). Ice conditions were not as good as in 1961. Heavy drift ice was met with on Nanortalik Bank and in Julianehaab Bay. Further north heavy pack ice also interfered with the investigations off Holsteinsborg.

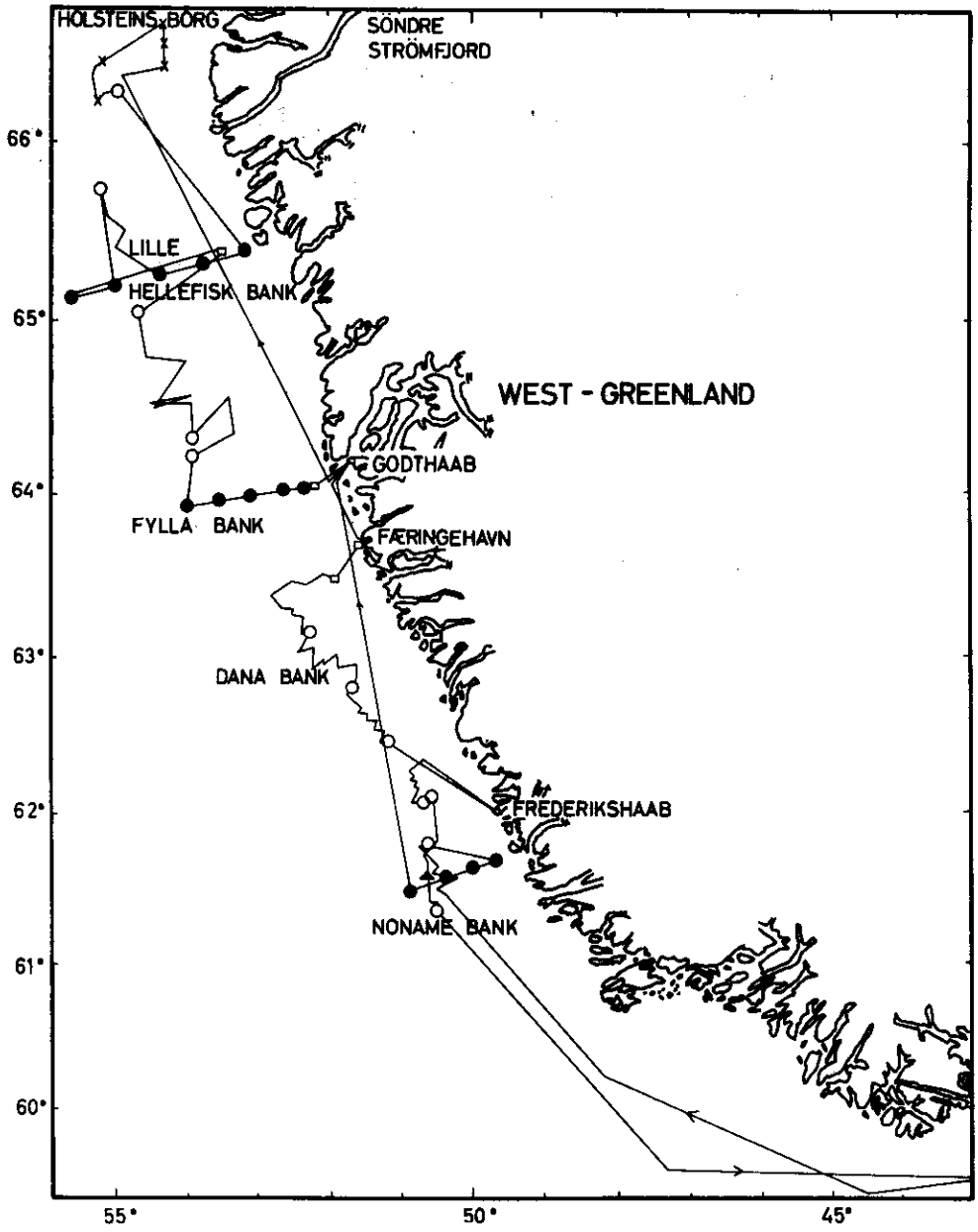
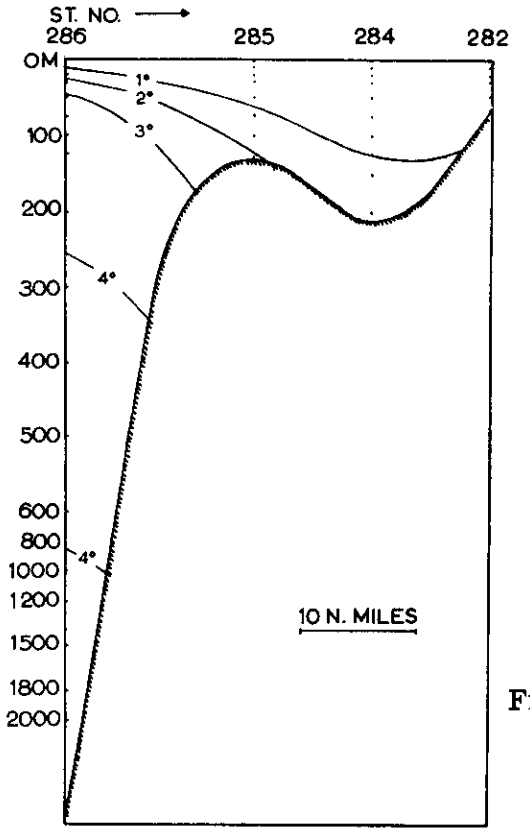


Fig. 1. G.O.SARS, West Greenland, April, 1962. Route and network of stations.



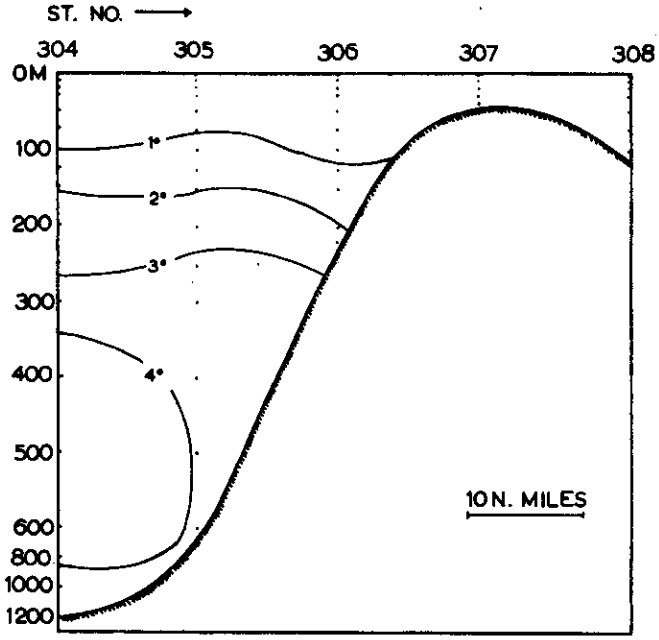


Fig. 3. G.O.SARS, West Greenland, April, 1962. Temperature section from Fylla Bank and westward.

Fig. 2. G.O.SARS, West Greenland, April, 1962. Temperature section from Noname Bank and westward.

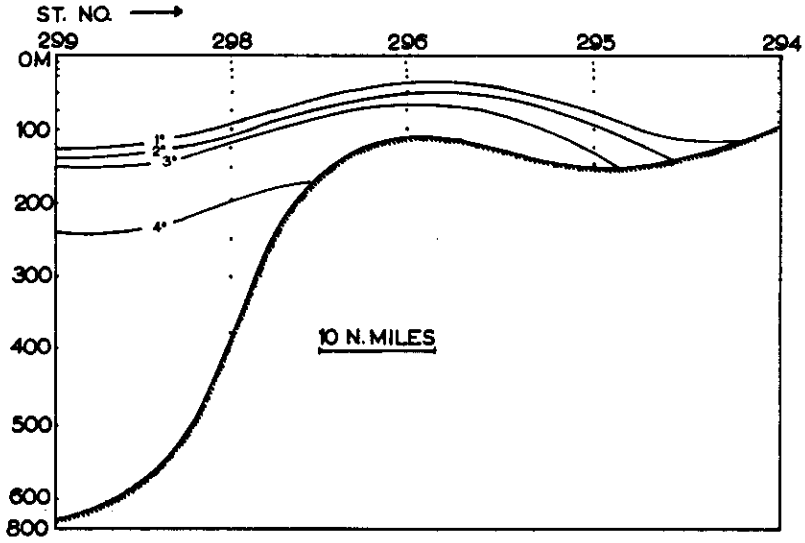


Fig. 4. G.O.SARS, West Greenland, April, 1962. Temperature section from Sukkertoppen and westward.

a. Hydrography

Three hydrographical sections were worked during the cruise:

1) From Noname Bank and westward (61°41' N, 49°40' W - 61°29' N, 50°52' W);
2) From Fylla Bank and westward (64°03' N, 52°16' W - 63°55' N, 54°00' W);
3) From Sukkertoppen and westward (65°23' N, 53°10' W - 65°06' N, 55°38' W).

In addition 20 temperature observations were made, most of them in connection with the fishing experiments. The isotherms in the three sections are shown in Fig. 2-4.

The West Greenland Current showed no exceptional features. As usual water of Arctic origin characterized the surface layers, mixed Arctic and Atlantic water the intermediate layers. Compared with 1961 the surface water was colder in 1962. Water below 1°C had a larger extention than last year. The low surface temperatures were probably not caused by a stronger inflow of Arctic water, but more likely by a cooling due to the drift ice and the stable weather conditions. In the southern part of the investigated area the 4°C isotherm lies deeper than in 1961 while farther north it seems to lie higher. The temperature conditions were nevertheless very good for the fish all over the western slopes of the banks.

b. Cod eggs and larvae

In 1960 sampling of cod larvae and eggs was started and only 9 stations were worked. In 1961 55 stations were worked, in 1962 30 stations. At some stations hauls were made from different depths to the surface, at all stations hauls were made from the bottom or 250 m to the surface. One m egg net made of perlon with 500 (0.5 mm) mesh size was used for the sampling. Fig. 5 and 6 show the distribution of cod eggs in 1961 and 1962.

Cod eggs are found in the whole area investigated. In 1961 and 1962 the main spawning area seemed to be on the banks south of the Godthaab Fjord, while in 1960 the heaviest spawning was on the western slope of the Banan Bank. North of Søndre Strømfjord only a few eggs were found. These eggs had probably drifted northwards, as spawning cod were not found in these localities.

Cod larvae (25 specimens) were only found in 1962. As the investigations took place very early in the spawning season, one did not expect to find many cod larvae.

c. Cod investigations

During the survey with the echo sounder no pelagic concentrations of cod were recorded but the fishing experiments with bottom longline showed that cod were present in the whole area investigated. The best concentrations were found on the northern and western slopes of Lille Hellefisk Bank. The largest fish were taken on the southern banks. On the Noname Bank the mean length was 82.84 cm, at Frederikshaab Bank 78.08 cm. On the northernmost fishing station relatively large fish were also found, mean length 73.17 cm. The overall mean length was only 70.47 cm. There is a marked

decrease from last year when the mean length was 76.27 cm. Fig. 7 and 8 show the length distributions of cod caught on bottom longline on the different banks and the overall length distribution.

The overall age distribution of cod caught on bottom longline is shown on Fig. 9. Compared with last year the overall age distribution is different. The age distribution varies greatly from one bank to another but there are some main features.

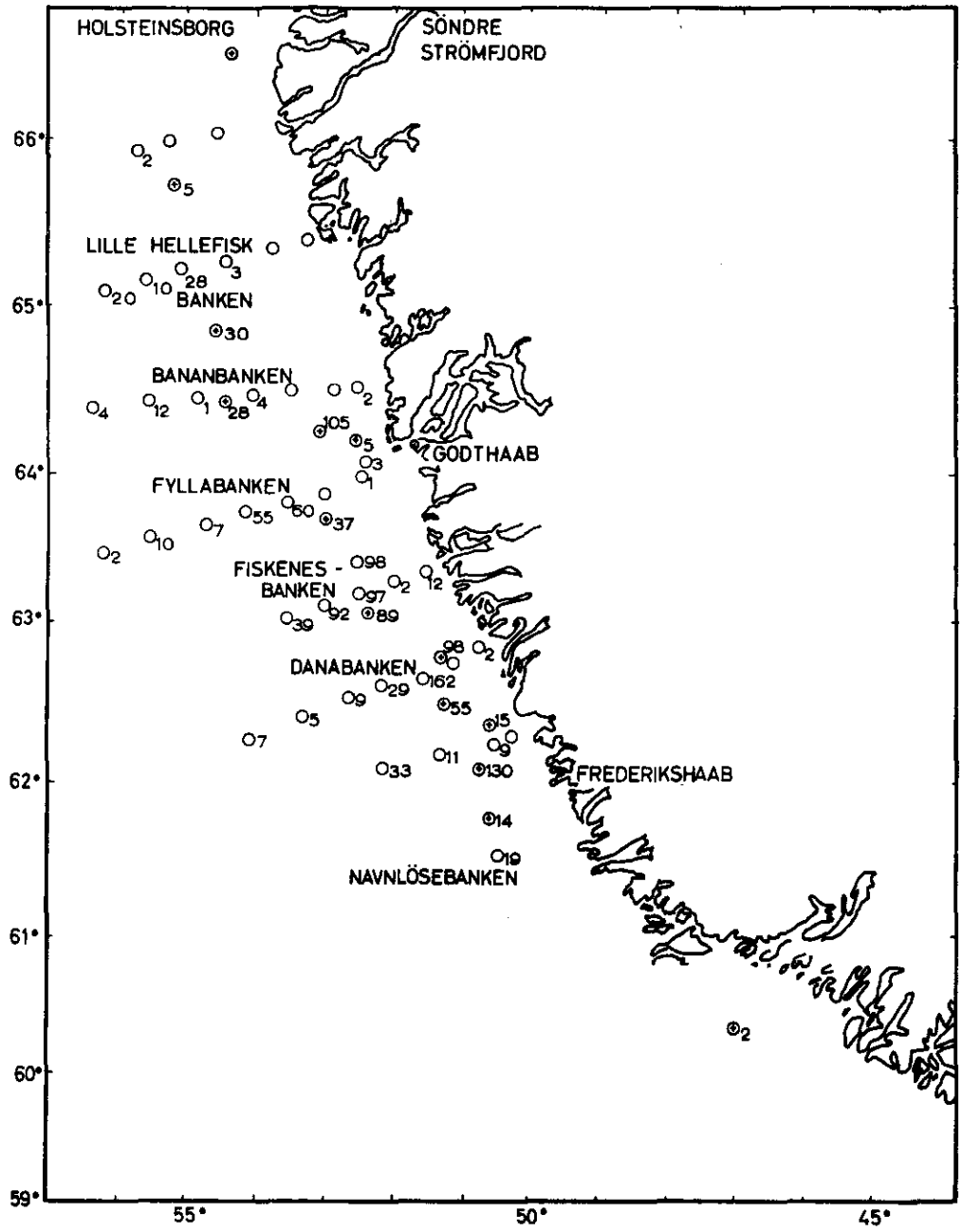


Fig. 5. JOHAN HJORT, West Greenland, April-May, 1961. Distribution and number of cod eggs.

The promising 1956 year-class has decreased considerably in importance except in three localities, namely on the Dana Bank, the Fiskenaes Bank and on the northern slope of the Lille Hellefisk Bank, where the percentages of the 1956 year-class in the catches are 15.5, 12.7 and 13.0 respectively. As expected the 1950 and 1947 year-classes have decreased further and are only of real importance in the catches from the Noname Bank and the Frederikshaab Bank. Compared with the preceding years the 1953 year-class has also diminished. In the total catch this year-class makes up

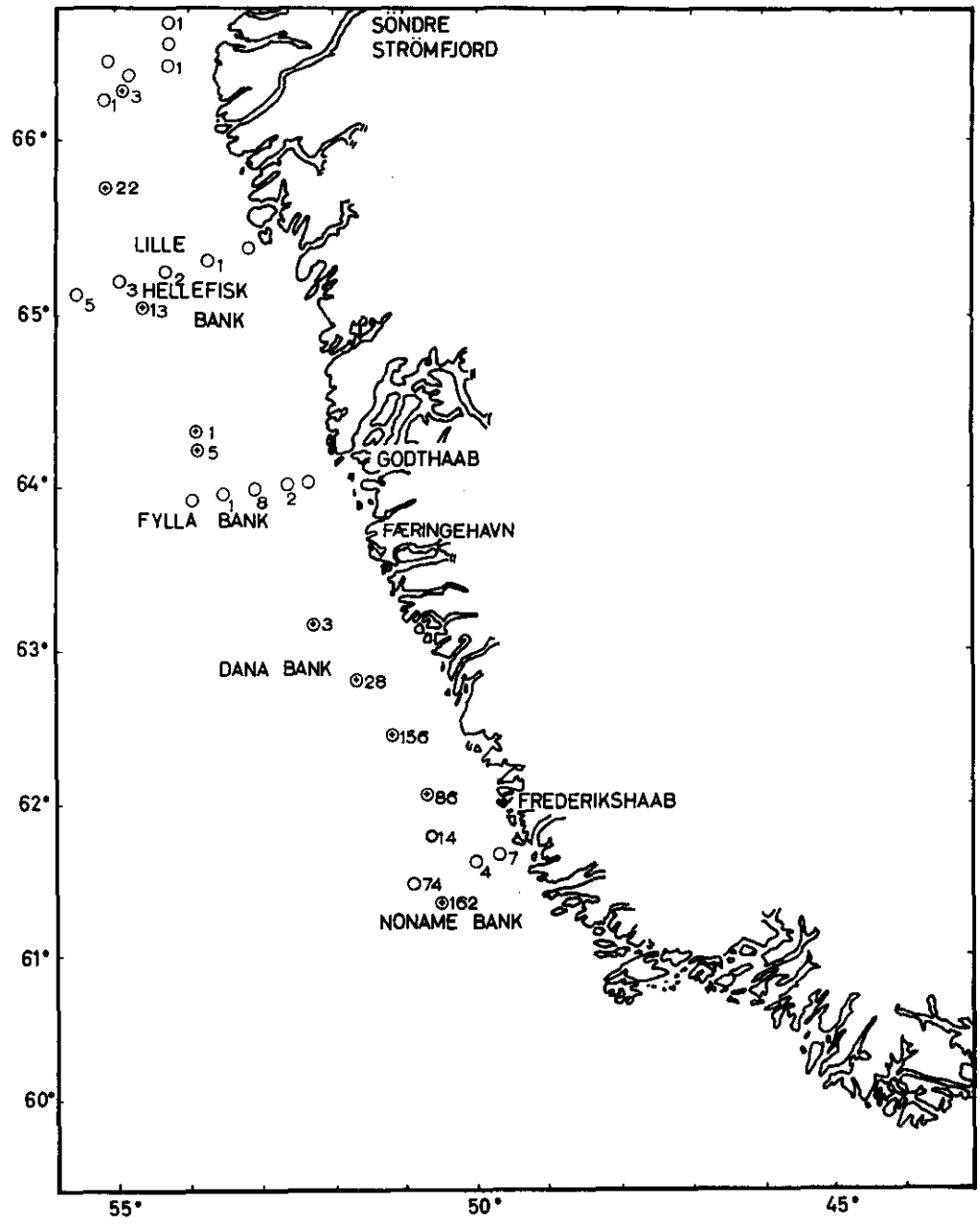


Fig. 6. G.O.SARS, West Greenland, April, 1962. Distribution and number of cod eggs.

slightly more than 20%; however, on the two southernmost localities it is between 30 and 40%. The 1957 year-class, which in 1961 dominated the JOHAN HJORT trawl catch, in 1962 strongly dominated the bottom longline catches. This year-class makes up 36.1% of the total catch and on the Banan Bank alone made up nearly 70% of the catch. The dominance of the 1957 year-class must be the cause of the decrease in total mean length.

For the bottom longline fishery off West Greenland in 1963, the year-classes 1947 and 1950 will probably be of little or no importance. The 1953 year-class should diminish further and accordingly play a less important part in the catches.

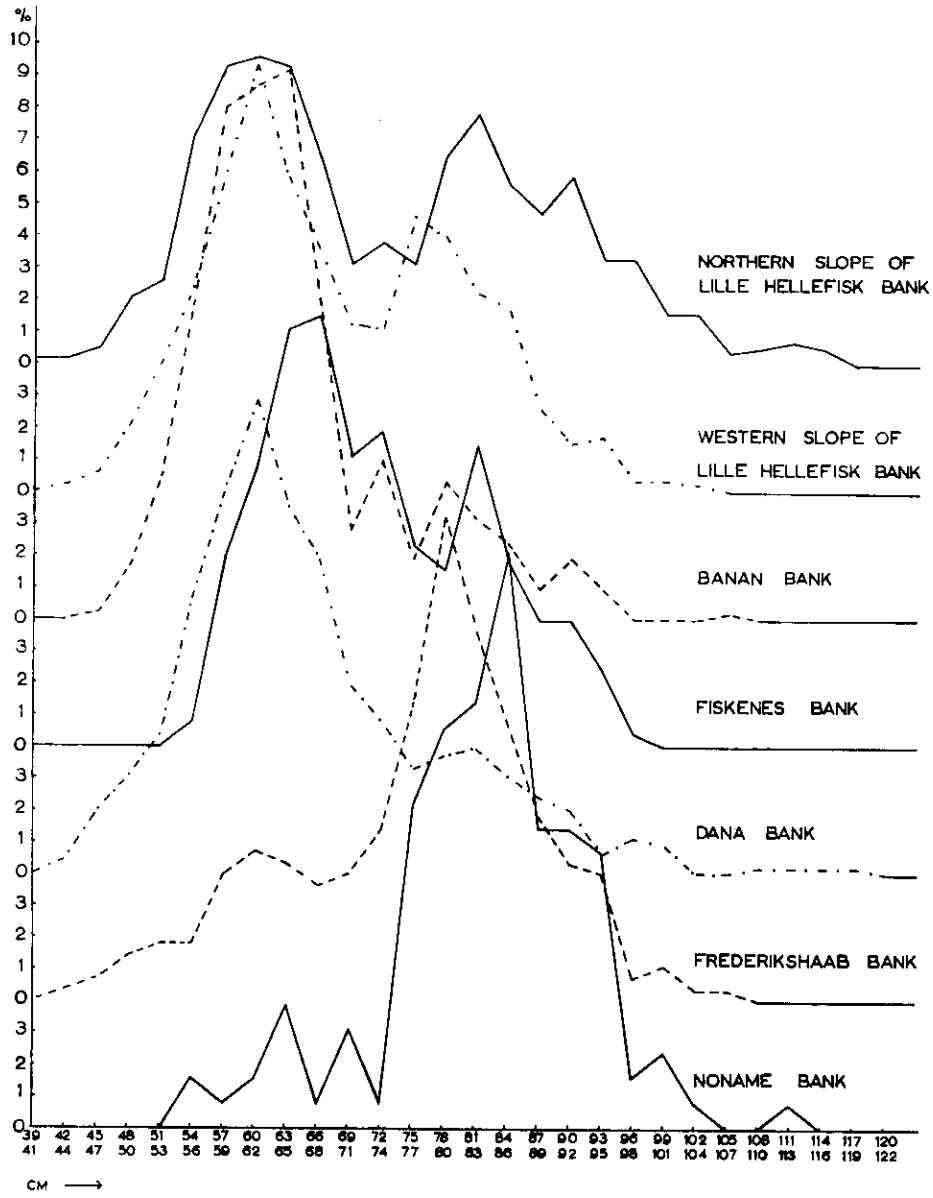


Fig. 7. G.O.SARS, West Greenland, April, 1962. Length distribution of cod caught on bottom longline on the different banks.

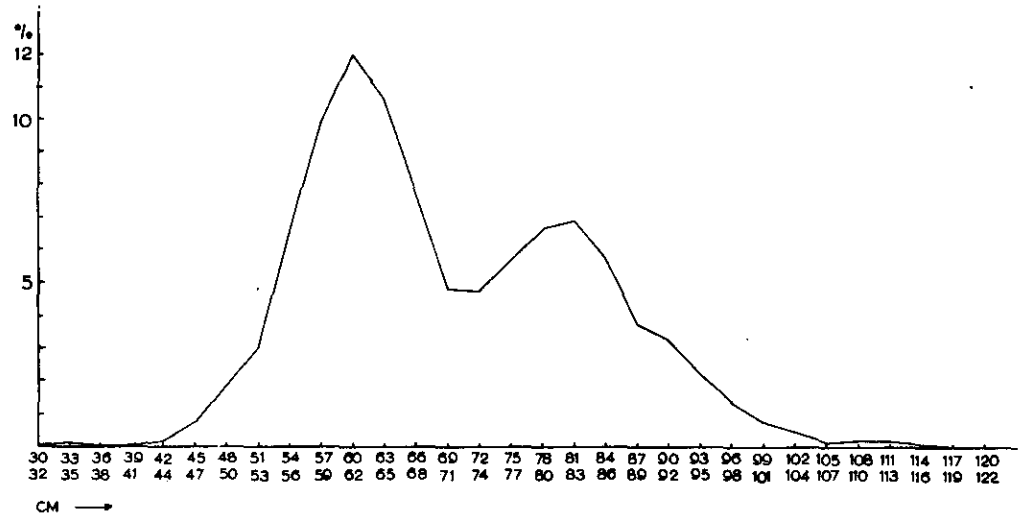


Fig. 8. G.O.SARS, West Greenland, April, 1962. The overall length distribution of cod caught on bottom longline.

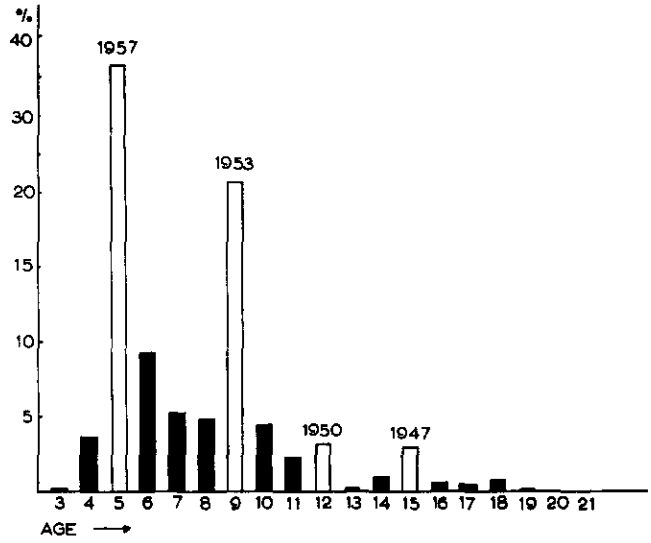


Fig. 9. G.O.SARS, West Greenland, April, 1962. The age distribution of cod caught on bottom longline.

The 1957 year-class will probably increase in importance, and thereby cause a slight increase in the mean length.

d. Halibut investigations

Halibut longlines were tried in only 2 localities, and took only 5 halibut. Cod bottom longline caught 39 halibut. All the halibut were small and immature. 33 halibut were tagged with the usual yellow plastic disk in the gill cover.

EAST GREENLAND

R/V JOHAN HJORT worked in East Greenland waters from 13 August to 8 September (Fig.10). At this time the ice conditions were very favourable and better than last year.

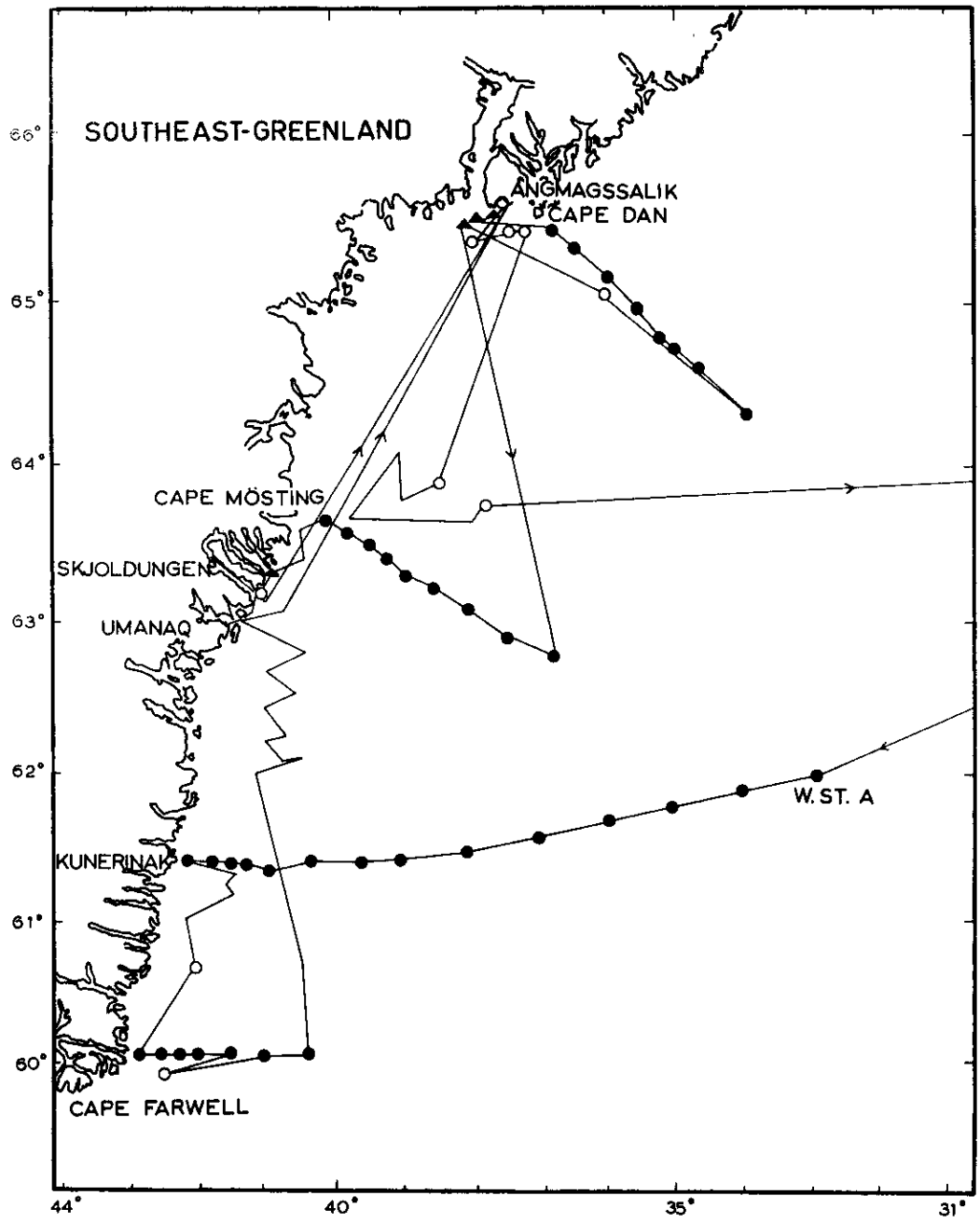


Fig. 10. JOHAN HJORT, East Greenland, August-September, 1962. Route and net of stations.

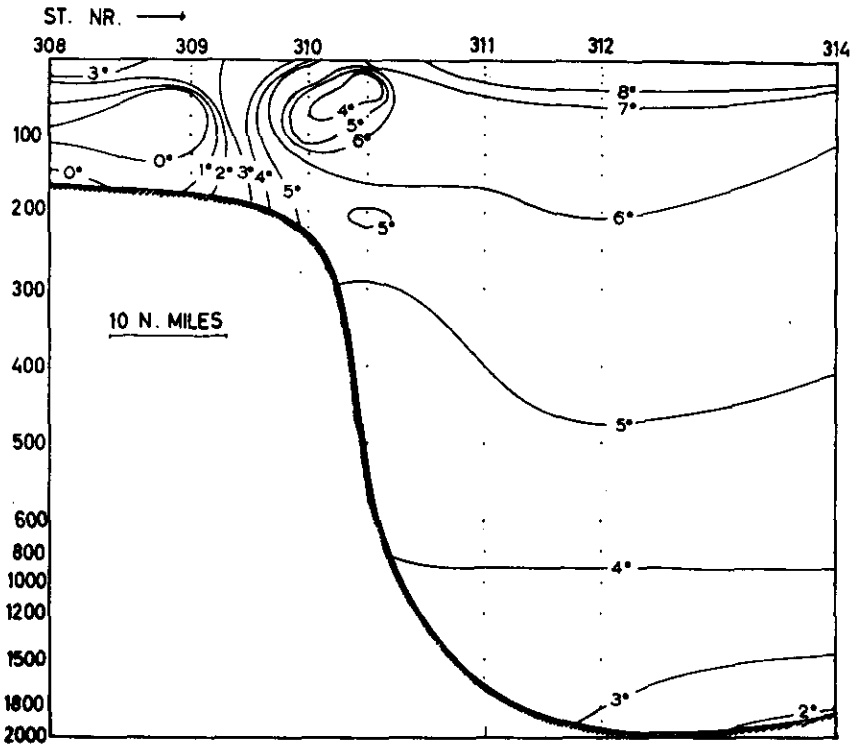


Fig. 11. JOHAN HJORT, East Greenland, August-September, 1962. Temperature section from Prins Christian Sund and eastward.

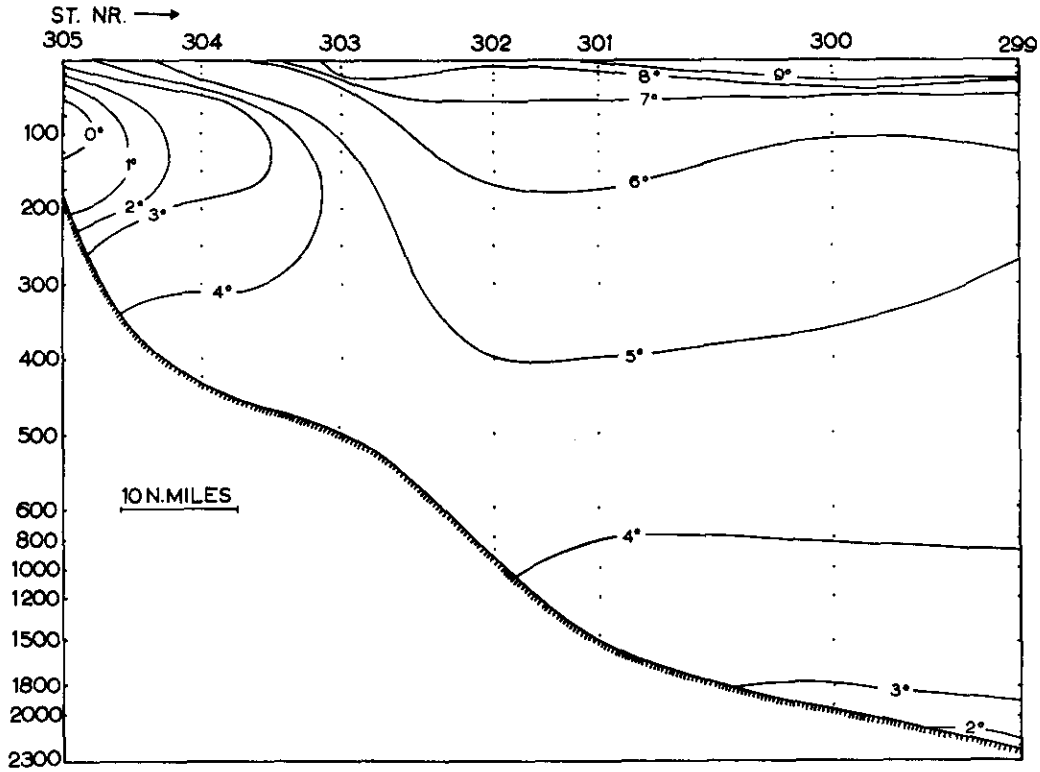


Fig. 12. JOHAN HJORT, East Greenland, August-September, 1962. Temperature section from Cape Tordenskjold and eastward.

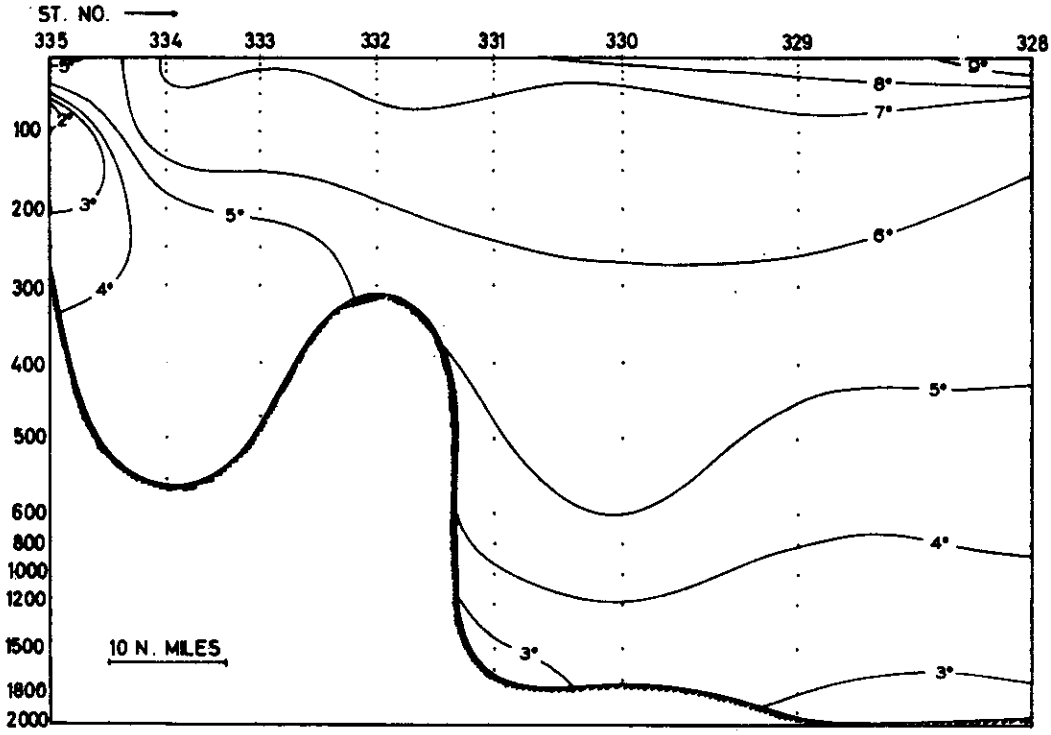


Fig. 13. JOHAN HJORT, East Greenland, August-September, 1962. Temperature section from Cape Møsting and eastward.

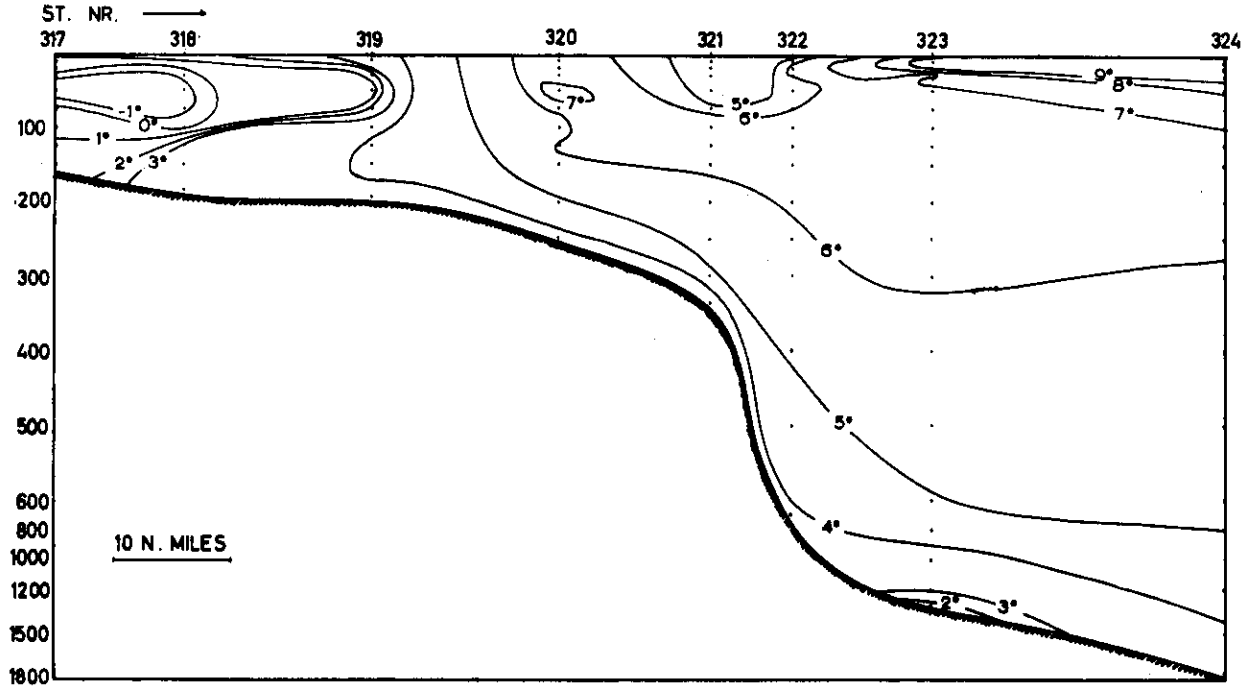


Fig. 14. JOHAN HJORT, East Greenland, August-September, 1962. Temperature section from Cape Dan and southeastward.

a. Hydrography

Four sections were worked: 1) from Prins Christian Sound and eastward (60°03'N, 42°55'W - 60°03'N, 40°24'W); 2) from Cape Tordenskjold and eastward (61°24'N, 42°15'W - 62°00'N, 33°00'W); 3) from Cape Møsting and southeastward (63°38'N, 40°10'W - 62°45'N, 36°50'W); 4) from Cape Dan and southeastward (65°27'N, 36°50'W - 64°19'N, 34°00'W).

The water off East Greenland was colder than last year (Fig.11-14). This was especially true for the Polar component of the East Greenland Current where the temperatures were about 1°C lower than in 1961 with some about 2°C lower at some stations. The influx of Polar water seemed thus to have been heavier than last year. The differences in temperatures from last year were not so evident in the Atlantic component of the current. This was also true in the surface water.

b. Cod investigations

Echo sounding showed no pelagic concentrations of cod on the banks and fishing experiments with bottom longline gave very small catches. Good catches were taken on handline off Cape Dan and Angmagssalik, about 5-10 nautical miles offshore. Shoals of cod were located close to a few of the icebergs. Stomach contents were almost entirely euphausiids. Concentrations of cod were also found in the Skjoldungen area. During the survey the echo sounder showed large concentrations of capelin, on which the cod were feeding heavily.

The length composition of the cod caught in the Angmagssalik area and the North Fjord in Skjoldungen did not differ greatly, the mean length being 73.3 cm and 73.6 cm respectively. In 1961 the mean length of cod caught on handline in the North Fjord was 80.3 cm. This marked decrease in mean length is probably due to new year-classes (Fig.15). In 1961, the 1947, 1950 and 1953 year-classes were dominant in the handline

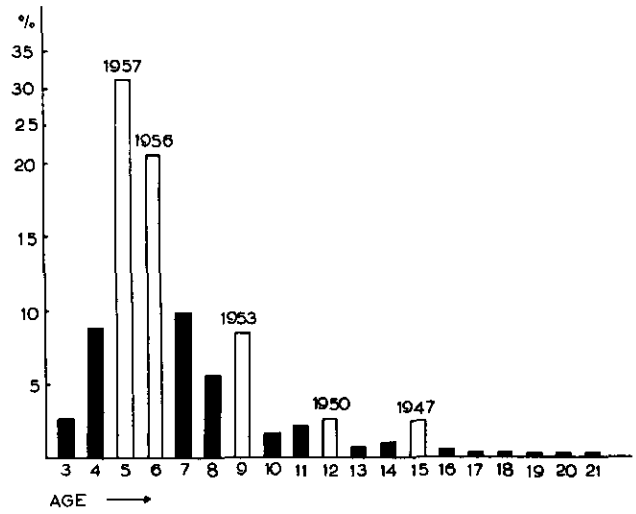


Fig. 15. JOHAN HJORT, East Greenland, August-September, 1962. The age distribution of cod caught on handline.

catches. In 1962, these year-classes did not play any important part. Instead the 1956 and 1957 year-classes were dominant, constituting more than 50% of the catch.

c. Halibut investigations

Only 63 halibut were caught at the 9 bottom longline stations. Most of the fish were rather small. The best catch, 18 halibut, was taken off Cape Dan. The bottom longline was used in shallow water and this may account in part for the poor catches.

d. Tagging experiments

A total of 1,087 cod were tagged in East Greenland waters. In the Angmagssalik area only Lea tags were used. In the Skjoldungen area 49 cod were tagged with yellow plastic disks in the left gill cover and 498 with Lea tags. The Lea tags were attached just in front of the first dorsal fin.

Thirty halibut were tagged with yellow plastic disks.

VII. Portuguese Research Report, 1962
by Glicinia V. Quartin

This report summarizes the Portuguese research carried out on cod from dory vessels fishing in Subarea 1 (Greenland) and 3 (Newfoundland). Data on size and age composition, weight, sex-ratio, stage of maturity and first spawning were obtained from each sample collected.

Methods used for this study were the same as in previous years (vide Portuguese Research Report, Annual Proceedings Vol.7).

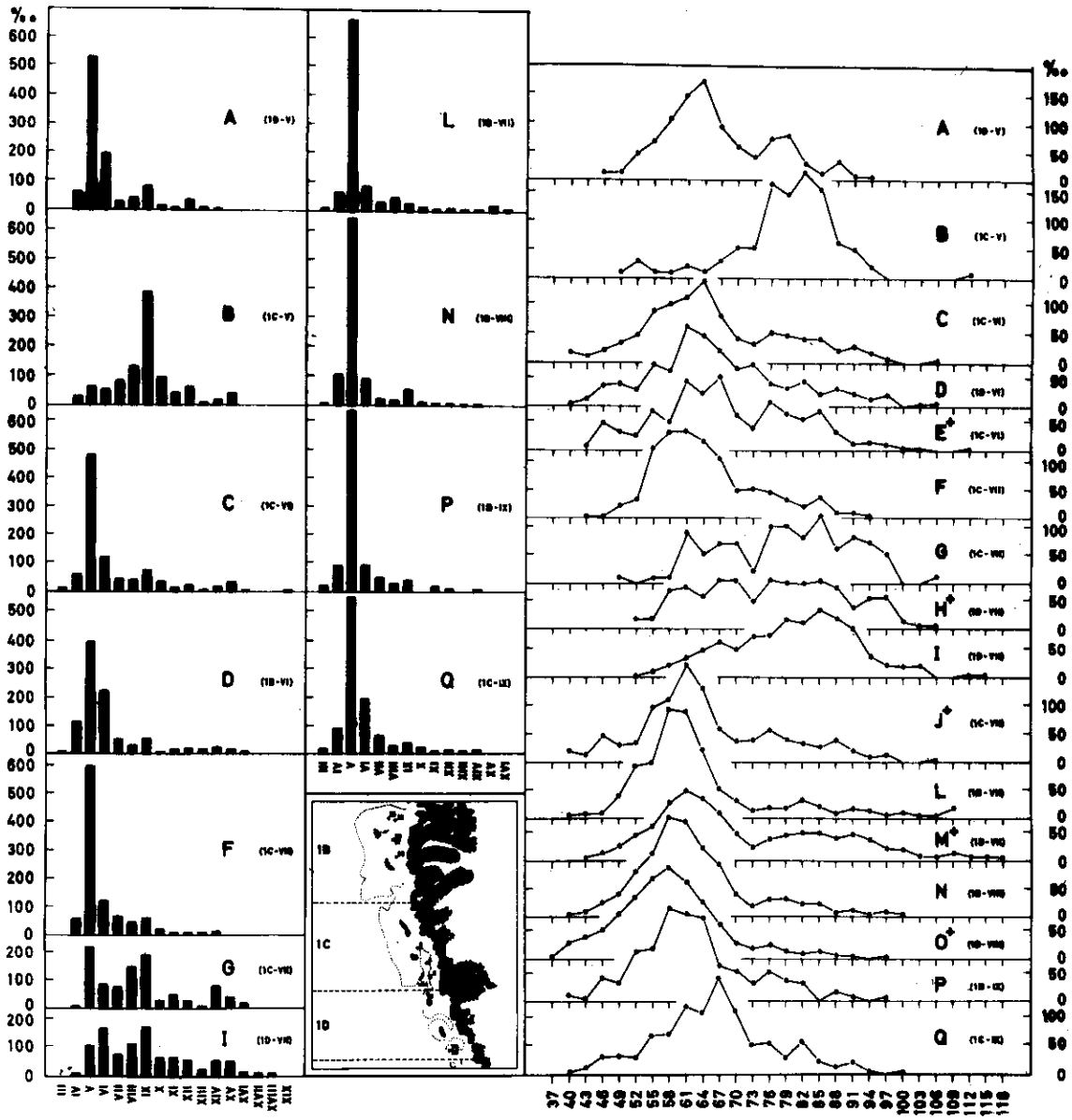


Fig. 1. Cod, Subarea 1, 1962. Line trawl. Age and length composition of samples taken between May and September from Divisions 1B, 1C and 1D.

Subarea 1

A total of 7,300 cod were collected in 52 samples from dory vessels. Of 4,300 otoliths collected, 3,000 were taken for age determination. The samples were grouped by divisions and months of capture as far as it was possible (Table I, Fig. 1). [1)]

TABLE I - Cod, Subarea 1, 1962. Sample groupings.

Sample Group	Sample no.	ICNAF Division	Date	Gear
A	1,2	1D	25-26 May	Line
B	3	1C	30 May	"
C	4,7,13,14	1C	1-29 June	"
D	8,10,11	1D	12-23 June	"
E	6,15	1C	8-30 June	"
F	16,25,27	1C	2-21 June	"
G	24	1C	17 July	"
H	18	1D	7 July	"
I	17,19,20,22	1D	6-14 July	"
J	28	1C	22 July	"
L	29,30,32	1B	25-29 July	"
M	31	1B	27 July	"
N	33,36,38,41,47	1B	3-31 August	"
O	39,42,45	1B	18-29 August	"
P	48,49	1B	1-2 September	"
Q	50,51,52	1C	6-8 September	"

a. Age distribution (Fig. 1)

In Division 1D, samples taken in May (Sample group A) show that age-groups V (533 °/oo) and VI (193 °/oo) are predominant. The remaining groups are represented by less than 100 °/oo. In June samples (D) there is a dominance of age-groups V (395 °/oo), VI (221 °/oo) and IV (114 °/oo), while in July samples (I) there is a different distribution. Here the old age-groups IX (178 °/oo) and VIII (115 °/oo) and the younger age-groups VI (173 °/oo) and V (115 °/oo) are dominant.

In Division 1C, samples taken in May (B) show that age-groups IX (384 °/oo) and VIII (131 °/oo) predominate. The remaining age-groups are represented by less than 100 °/oo. Samples taken in June show a dominance of age-groups V (487 °/oo) and VI (123 °/oo), while July samples also show age-group V (600 °/oo) and VI (127 °/oo) dominant.

[1)] Tables of data on length and age will be published in the ICNAF Sampling Yearbook Vol. 7 for 1962.

Another group of samples (G) taken in July shows a different age distribution with age-groups V (220 °/oo), IX (190 °/oo) and VIII (150 °/oo) dominant. Samples taken in September (Q) show dominance of age-groups V (550 °/oo) and VI (190 °/oo).

In Division 1B, samples taken in July (L), August (N) and September (P) show dominance of age-group V (638, 647 and 669 °/oo respectively). In August age-group IV, which was almost non-existent, is now present (108 °/oo).

In summary it is apparent that the 1957 year-class is predominant in the samples investigated. In Division 1C in May and July and in Division 1D in July the 1953 year-class, predominant since 1959, is still dominant. The 1958 year-class appeared for the first time this year.

b. Length distribution (Fig. 1)

In Division 1D, samples taken in May (A) show that lengths range from 46-94 cm. The length curve is bimodal with peaks at 64.0 and 79.0 cm. The mean length is 66.4 cm. Samples taken in June (D) show that the length curve is unimodal with the peak at 61.0 cm. Lengths range from the 40 to 106 cm classes. The mean length is 67.0 cm. Samples taken in July (H) show that the length of the fish varies from the 52 to 106 cm classes. The length curve is normal and the mean length is 76.5 cm. Other samples taken in July (I) show that the length curve is unimodal with the peak at 79.0 cm. The range in length is from the 52 to 115 cm classes. The mean length is 77.4 cm.

In Division 1C, samples taken in May (B) show that the length distribution ranges between the 49 to 112 cm classes. The length curve is bimodal with peaks at 76.0 and 82.0 cm. The mean length is 78.7 cm. June samples (C) show the range of lengths is from the 40 to 106 cm classes. The curve is unimodal with the peak at the 64 cm class. The mean length is 66.1 cm. Other June samples (E) show that the length curve is plurimodal with the peak at the 61 to 67 cm classes. Lengths range from the 43 to 112 cm classes. The mean length is 68.6 cm. July samples (F) show the range of lengths is from the 43 to 94 cm classes. The length curve is unimodal with the peak at the 68 cm class. The mean length is 54.2 cm. Other July samples (G) show a range of lengths from the 49 to 106 cm classes. The length curve is multimodal, with the peak at the 61 to 76 and 85 cm classes. The mean length is 78.7 cm. Further July samples (J) show that lengths range between the 40 and 60 cm classes. The length curve is unimodal with the peak at the 61 cm class. The mean length is 64.6 cm. September samples (Q) show a unimodal length curve with the peak at the 67.0 cm class. The range of lengths is from 40 to 100 cm. The mean length is 67.7 cm.

In Division 1B, samples taken in July (L) show that the length distribution ranges between 40-109 cm. The length curve is unimodal with the peak at the 58 cm class. The mean length is 63.9 cm. Other samples in July (M) show that the length curve is unimodal with the peak at the 61.0 cm class. Lengths range from the 43 to 118 cm class. The mean length is 71.9. August samples (N) show that lengths range between the 40 to 100 cm classes. The length curve is unimodal with the peak at 58 cm. The mean length is 62.5 cm. Other samples in August (O) show that lengths range between the 37 and 97 cm classes. The length curve is unimodal with the peak at 58 cm. The mean length is 58.6 cm. September samples (P) show that length distribution is between the 40 and 97 cm classes. The length curve is unimodal with the peak at 58 cm. The mean length is 62.3 cm.

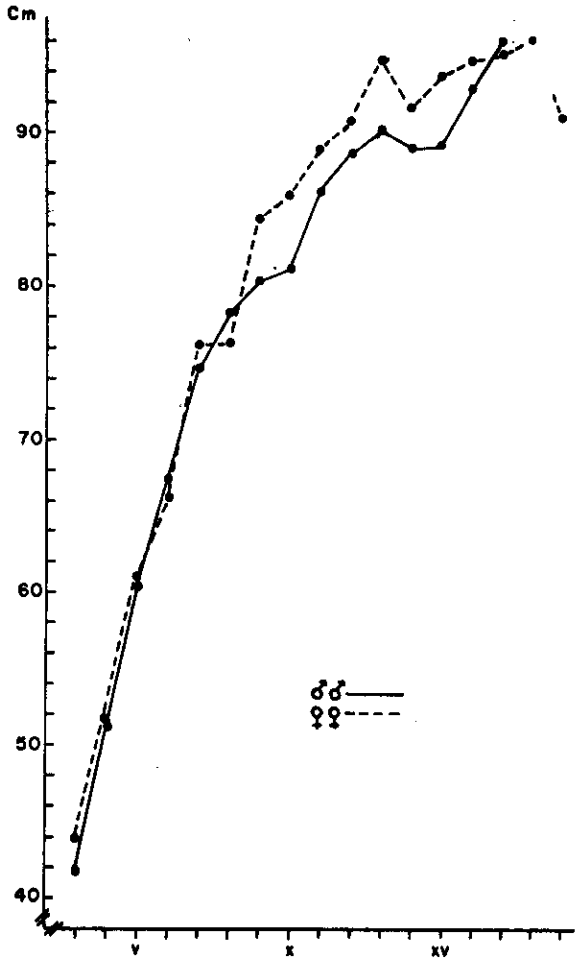


Fig. 2. Cod, Subarea 1, 1962. Line trawl. Mean lengths of age-groups III to XIX.

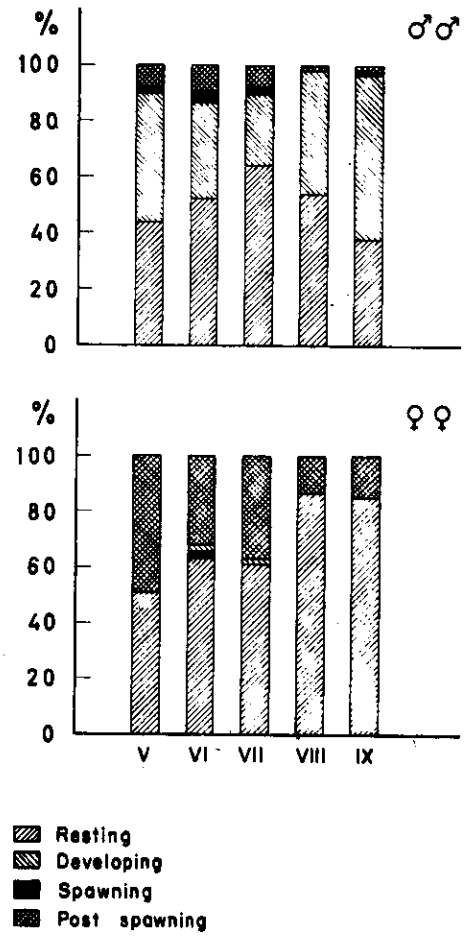


Fig. 3. Cod, Subarea 1, 1962. Line trawl. Stages of maturity of males and females, May to September.

c. Growth (Table II, Fig. 2)

Growth data for male and female cod were obtained from the combined samples from Divisions 1B, 1C and 1D. Male and female growth curves intersect at the 5th year. Growth is apparently greater for females than for males. A decreased growth rate is observed after the 7th year for females and after the 9th year for males.

TABLE II - Cod, Subarea 1, 1962. Mean lengths of males and females of the richer year-classes calculated from all samples.

Year-Class	Age-group	Mean Length ♂♂ cm	Mean Length ♀♀ cm
1959	III	41.8	43.9
58	IV	51.3	51.8
57	V	60.4	61.0
56	VI	67.4	66.2
1955	VII	74.8	76.2
54	VIII	78.3	76.3
53	IX	80.4	84.4
52	X	81.1	85.8
51	XI	86.2	88.8
1950	XII	88.6	90.7
49	XIII	90.1	94.6
48	XIV	89.0	91.6
47	XV	89.2	93.6
46	XVI	92.8	94.6
1945	XVII	96.5	95.0
44	XVIII	-	96.0
43	XIX	-	89.0

d. Sex-ratio

Data from combined samples show a slight predominance of females (517 °/oo to 667 °/oo) except in a sample from Division 1D and one from Division 1B, where the males are abundant (518 °/oo).

e. Stage of maturity (Table III, Fig. 3)

From May to September, the majority (38 to 64%) of males are in the resting or the recovering stage; 26 to 61 o/o are in the developing stage and the remainder are in the spawning (0.4-3.0 o/o) and the post spawning (1-9 o/o) stages.

TABLE III - Cod, Subarea 1, 1962. Stages in the maturity of the gonads of males and females. May to September. Data from all samples.

Stage of Maturity	May		June		July		August		September	
	♂♂ o/o	♀♀ o/o	♂♂ o/o	♀♀ o/o	♂♂ o/o	♀♀ o/o	♂♂ o/o	♀♀ o/o	♂♂ o/o	♀♀ o/o
Resting or Recovering	44	50	52	66	64	61	54	87	38	85
Developing	48	-	36	0.3	26	0.2	45	-	61	-
Spawning	1	-	3	0.3	2	-	-	-	0.4	-
Post-Spawning	7	50	9	34	8	39	1	13	1	15
	92	157	290	359	521	578	242	258	240	260

In May, 50 o/o of the females are in the resting stage and 50 o/o are post-spawners. In August and September 85-87 o/o of the females are in the resting stage and 15-13 o/o are post-spawners. In July and June 61-66 o/o are in resting-stage, 34-30 o/o are post-spawners and the remainder are spawning (0.3 o/o) and in the developing stage (0.3-0.2 o/o).

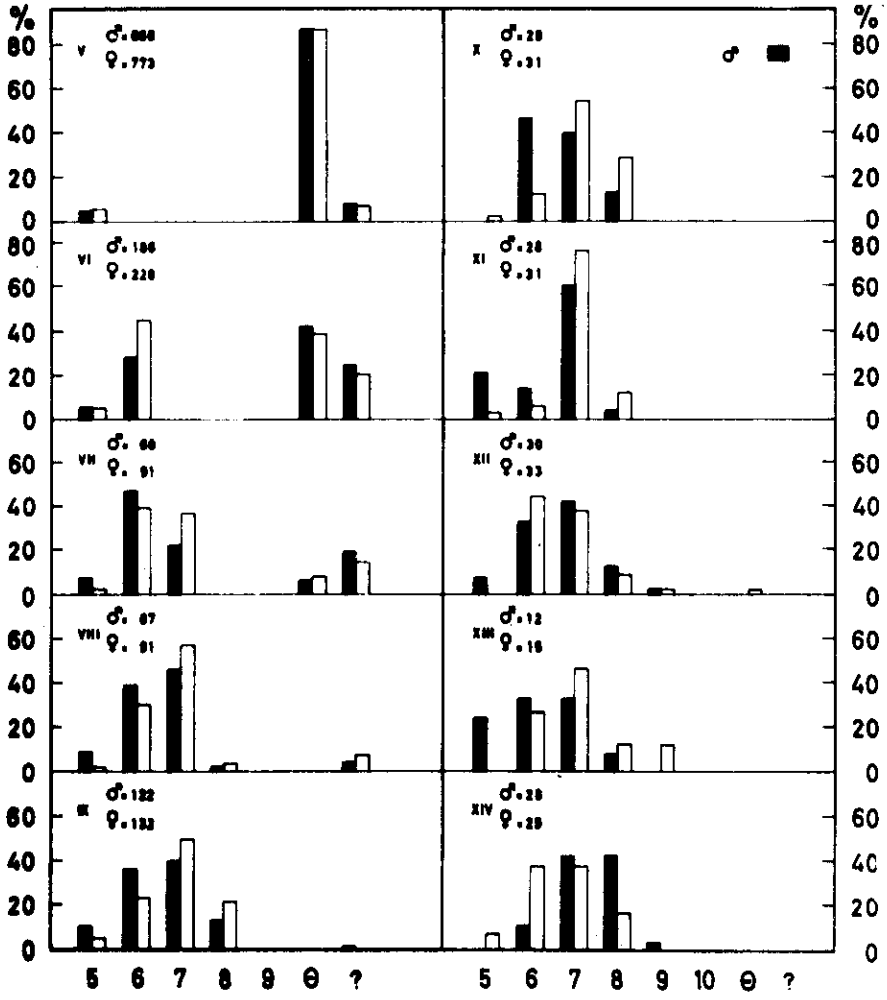


Fig. 4. Cod, Subarea 1, 1962. Line trawl. Age (5-9 years) at first maturity for males (black) and for females (white) of age-groups V to XIV.

f. Age at first maturity (Table IV, Fig.4)

Spawning zones on the otoliths showed that cod first mature between 5 to 8 years of age and the majority at 7 years of age (22-77 o/o). Females apparently mature earlier than males. Important numbers of females (45 o/o) reached maturity in their 6th year.

TABLE IV - Cod, Subarea 1, 1962. Age at first maturity of males and females of age-groups V-XIV.

Age Group		♂♂ 1st spawning								♀♀ 1st spawning							
		V	VI	VII	VIII	IX	0	?	Total	V	VI	VII	VIII	IX	0	?	Total
V	N	37	-	-	-	-	578	51	666	44	-	-	-	-	675	54	773
	%	5	-	-	-	-	87	8	100	6	-	-	-	-	87	7	100
VI	N	10	52	-	-	-	78	46	186	10	77	-	-	-	86	47	220
	%	5	28	-	-	-	42	25	100	5	35	-	-	-	39	21	100
VII	N	4	28	13	-	-	3	12	60	2	35	34	-	-	6	14	91
	%	7	47	22	-	-	5	20	101	2	39	37	-	-	7	15	100
VIII	N	6	26	31	1	-	-	3	67	2	27	52	3	-	-	7	91
	%	9	39	46	1	-	-	4	99	2	30	57	3	-	-	8	100
IX	N	12	44	49	16	-	-	1	122	6	31	66	29	-	-	-	132
	%	10	36	40	13	-	-	1	100	5	23	50	22	-	-	-	100
X	N	-	22	19	6	-	-	-	47	1	4	17	9	-	-	-	31
	%	-	47	40	13	-	-	-	100	3	13	55	29	-	-	-	100
XI	N	6	4	17	1	-	-	-	28	1	2	24	4	-	-	-	31
	%	21	14	61	4	1	-	-	100	3	6	77	13	-	-	-	99
XII	N	2	10	13	4	3	-	-	30	-	15	13	3	1	-	1	33
	%	7	33	43	13	-	-	-	99	-	45	39	9	3	-	3	99
XIII	N	3	4	4	1	-	-	-	12	-	4	7	2	2	-	-	15
	%	25	33	33	8	-	-	-	99	-	27	47	13	13	-	-	100
XIV	N	-	3	12	12	1	-	-	28	2	11	11	5	-	-	-	29
	%	-	11	43	43	3	-	-	100	7	38	38	17	-	-	-	100

Subarea 3

Five samples were collected from the Portuguese dory vessels (Table V). To date only 500 specimens have been studied to determine the length composition.

TABLE V - Cod, Subarea 3, 1962. Sample groupings

Sample group	Sample no.	ICNAF Division	Date	Gear
A	1,2	3O	11-13 May	Line
B	4,5	3N	27-29 June	"
C	3	3L	24 September	"

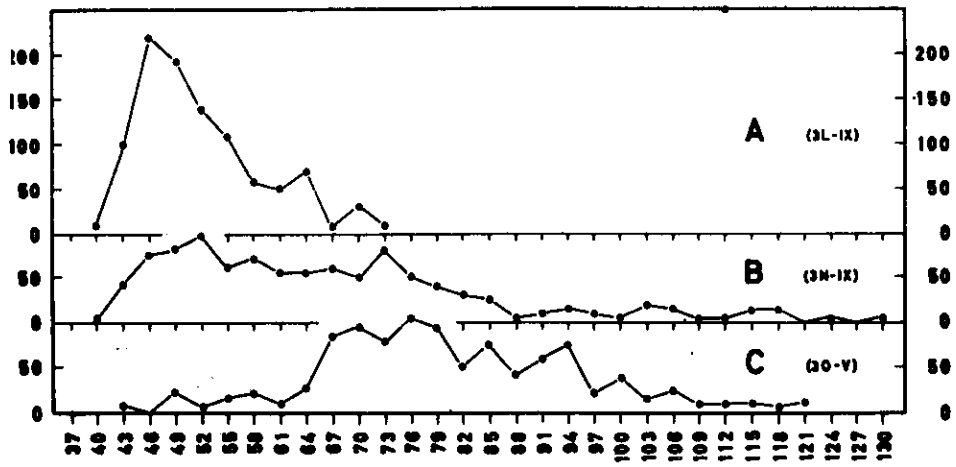


Fig. 5. Cod, Subarea 3, 1962. Line trawl. Length composition of samples taken from Divisions 3L, 3N and 3O in May and September.

a. Length distribution (Fig.5)

In Division 3L, samples taken in September (A) show that lengths range from the 40 to 73 cm classes. The length curve is unimodal with a peak at 46 cm. The mean length is 51.9 cm.

In Division 3N, September samples (B) show that the length curve is bimodal with peaks at 52 and 73 cm. Lengths range from the 40 to 130 cm classes. The mean length is 67.1 cm.

In Division 3O, May samples (C) show a multimodal length curve with the highest peaks at 76 (105%) and 70 cm. Lengths range from the 43 to 121 cm classes. The mean length is 80.8 cm.

VIII. Spanish Research Report, 1962

A. Size distribution of cod, 1962
by O. Rodriguez Martin

As in previous years, an observer aboard the trawler AQUILON collected data mainly for the study of the length and age distribution of cod.

The following table shows the numbers of cod measured for length[1] between March and November in Divisions of ICNAF Subareas 1, 2 and 3.

Month	1B	1C	2J	3K	3L	3M	3O	3Ps	Total
March	-	-	-	-	-	-	-	316	316
April	-	-	-	-	159	-	-	-	159
May	-	-	2,799	-	-	-	-	-	2,799
July	-	-	-	-	1,501	461	446	-	2,408
Aug.	627	204	1,037	-	-	-	-	-	1,868
Sept.	-	-	526	-	-	-	-	-	526
Oct.	-	-	530	616	-	-	-	-	1,146
Nov.	-	-	-	57	-	-	-	-	57
Total	627	204	4,892	673	1,660	461	446	316	9,279

An analysis of the length data is summarized in the following table and in Fig. 1.

ICNAF Division	Month	Mode 3 cm-gp	Maximum cm	Minimum cm
1B	August	54 - 56 66 - 68	80	40
1C	"	66 - 68	98	45
2J	May	57 - 59	86	35
	August	48 - 50 60 - 62	83	32
	September	51 - 53	89	35
	October	48 - 50	70	36
3K	October	60 - 62	92	35
	November	72 - 74	100	48
3L	April	60 - 62	83	42
	July	51 - 53	89	35
3M	July	63 - 65	107	44
3O	July	48 - 50	66	40
3Ps	March	51 - 53 60 - 62	98	38

[1] Tables of detailed data are included in the ICNAF Sampling Yearbook for 1962.

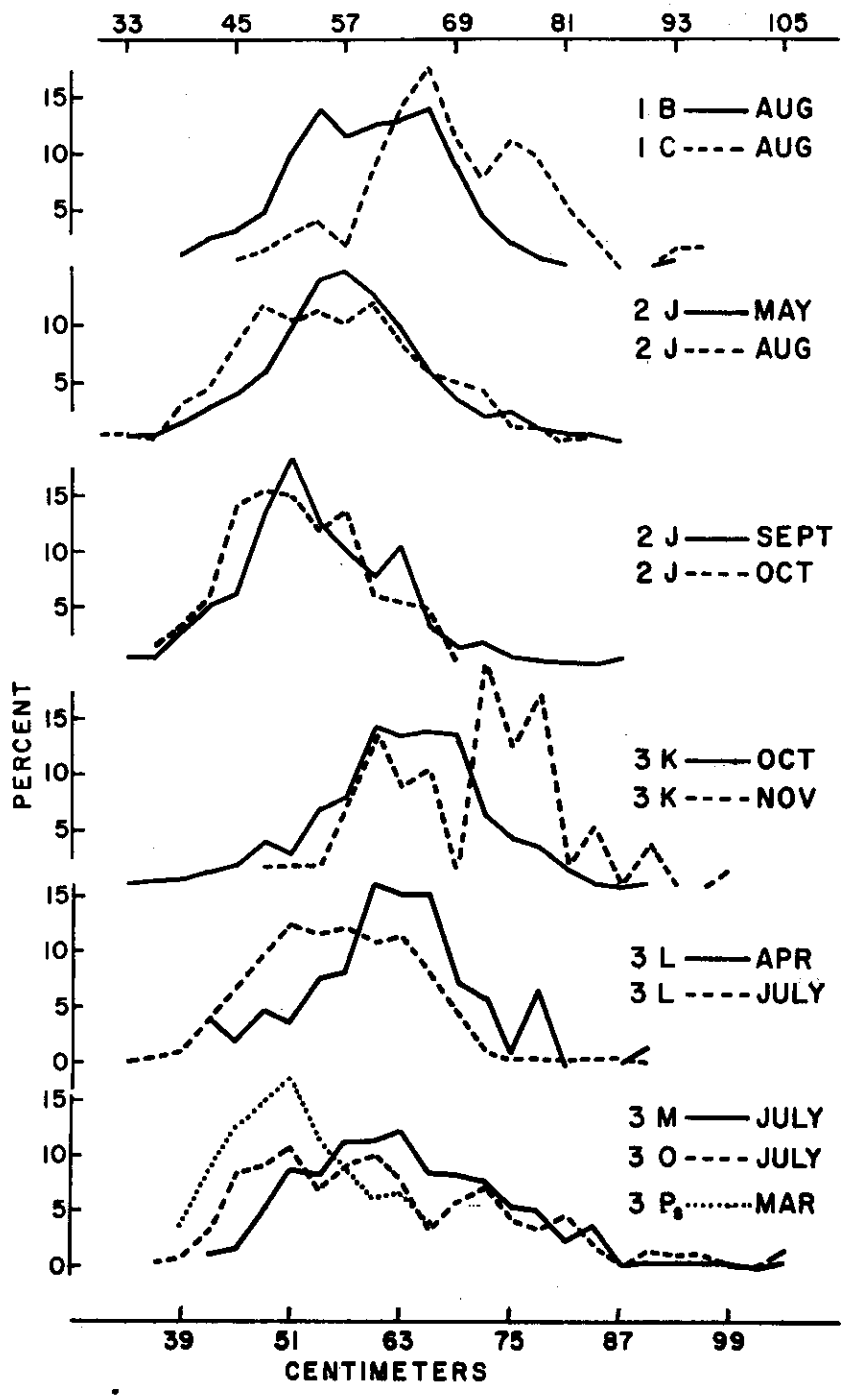


Fig. 1. Cod length distribution, 3 cm-gps, Subareas 1, 2 and 3

B. Age and growth of cod in 1962
by A. Figueras

This paper presents the results of a study on age and growth, sex ratio and age at first maturity of cod sampled from catches made by Spanish trawlers in the ICNAF area in 1962. In addition, growth rates and year-class strengths are compared for past years in the Divisions where sampling was adequate.

Materials were supplied by the Direccion General de Pesca Maritima through the Secretary of the Scientific Fishing Study Board, Dr. Olegario Rodriguez Martin, and was collected by the observer, Dr. Tomas Garcia Leston, on trawlers of the firm PYSBE. We are pleased to acknowledge this assistance.

Table 1 shows the distribution of the 1962 samples by month and Division, the numbers of fish, males and females, sampled in the Divisions, the number of otoliths read including those with spawning marks. Fig.1 shows the location and number assigned to each sample. Research methods used were similar to those for previous years (Figueras, 1962).

Table 1. Cod, Subareas 1, 2 and 3, 1962. Distribution of samples, sex ratio, otoliths read and otolith with spawning marks

Division	Sample No.	Date	No. Fish	% Males	Otoliths read	Otolith Spawning Marks
1B	21-23	August	71	36	67	0
1C	20	August	19	26	19	1
2J	4-12, 24-27 28-29	May, August September, October November	368	34	347	84
3K	33-35, 36	October November	52	44	46	10
3L	1, 3, 13-16, 17	March April July July	141	20	130	4
3M	18	July	11	18	10	0
3O	19	July	19	31	19	0
3P	2	March	16	25	16	0
Total			697	31	648	99

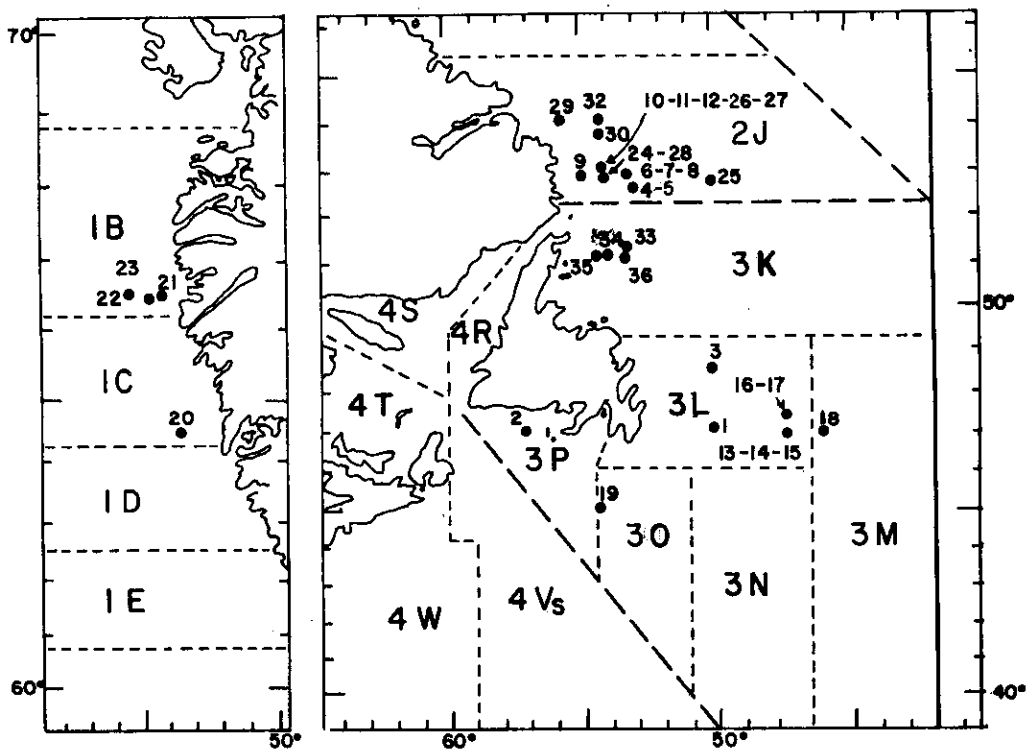


Fig. 1. Locations of samples from the cod fishery in 1962.

a. GROWTH CURVES obtained for cod sampled in Division 1B, 2J, 3L and 3K in 1962 are compared with curves for cod taken in the same Divisions in 1960 and 1961 (Fig.2). In Division 1B no conclusions can be drawn because of the scarcity of data for 1962. Division 2J offers better opportunity for comparison. Here the growth curve for 1962 lies below those for 1960 and 1961 to age group VI, then it lies above them except at age group X. This difference of lengths for each age-group ranges from 1 to 3 cm. There is well marked coincidence in 1960 and 1961. In Divisions 3K and 3L the latter shows generally a faster growth rate. Growth rate in 3L is slower in 1962 than in 1960 and 1961. Such a difference is not seen in Division 3K.

A comparison of growth data collected between 1955 and 1962 from all Divisions (Fig.3) shows that (i) the fastest growth rate is found in Subarea 1 (ii) growth rate decreases from north to south in Subarea 1, being faster in Division 1B than in Division 1D and (iii) growth rate increases from north to south in Subareas 2, 3 and 4, being faster in Division 4V, 3L and 3K than in Division 2J.

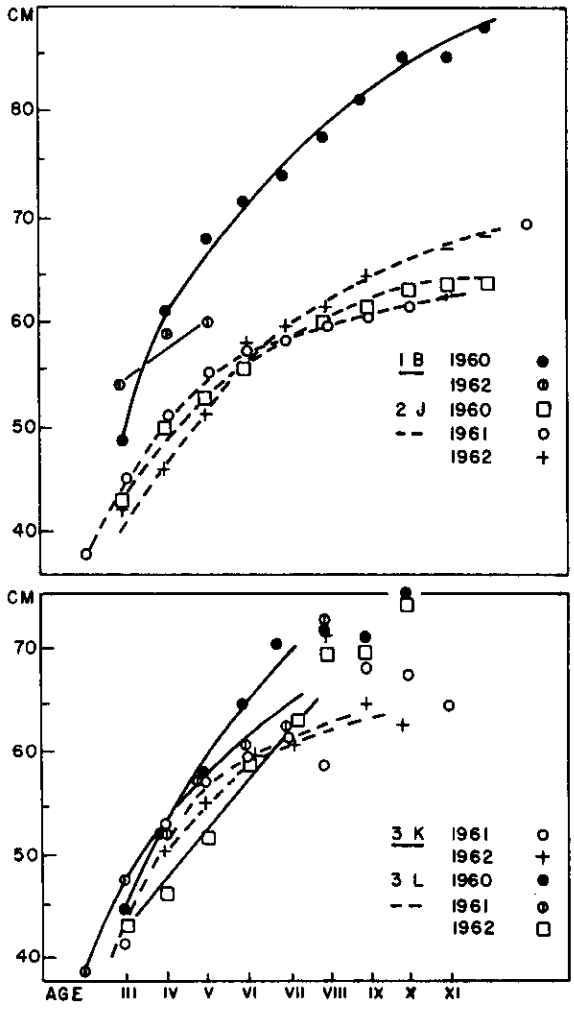


Fig. 2. Cod. Growth curves for Divisions 1B, 2J, 3K, and 3L for 1960, 1961 and 1962.

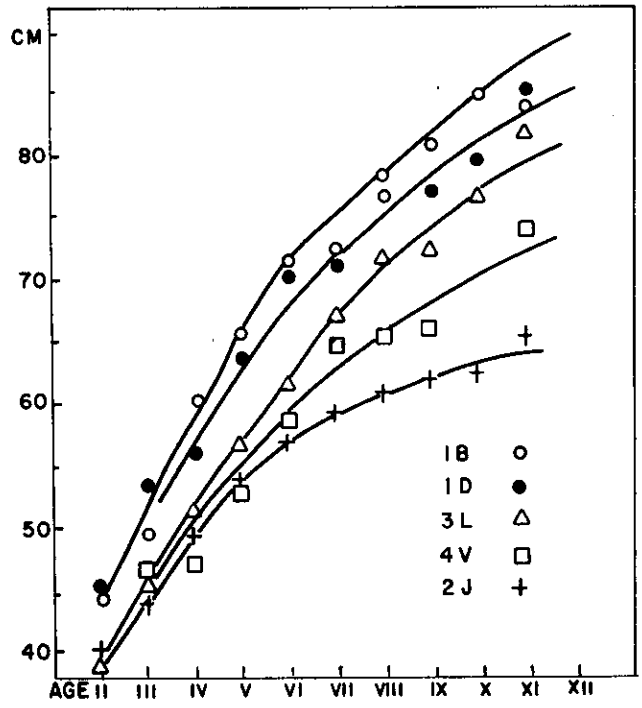


Fig. 3. Cod. Growth curves for Divisions 1B, 1D, 2J, 3L and 4V based on data collected between 1955 and 1962.

b. LENGTH FREQUENCIES of cod from Division 1B for 1960 and 1962 and Division 2J for 1960, 1961 and 1962 and Division 3K for 1961 and 1962 and 3L for 1960, 1961 and 1962 are compared in Fig. 4. In Division 1B, mean length decreased 7 cm. In Division 2J, mean length decreased from 1960, but in 1962 is over 1 cm greater than in 1961. In Division 3K mean length increased almost 2cm. In Division 3L, mean length decreased 6 cm in two years, from 62 cm in 1960 to 56 cm in 1962. The sharp decrease in average length needs confirmation but is not unlikely since the division is one of the most heavily fished in the Convention area.

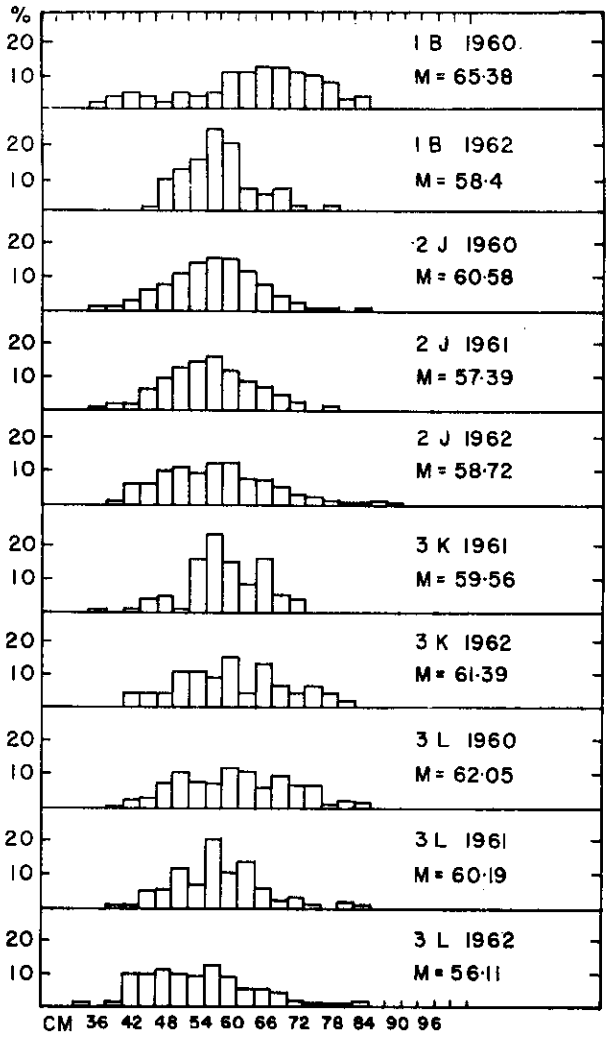


Fig. 4. Cod. Length frequencies for Divisions 1B, 2J, 3K and 3L for 1960, 1961 and 1962.

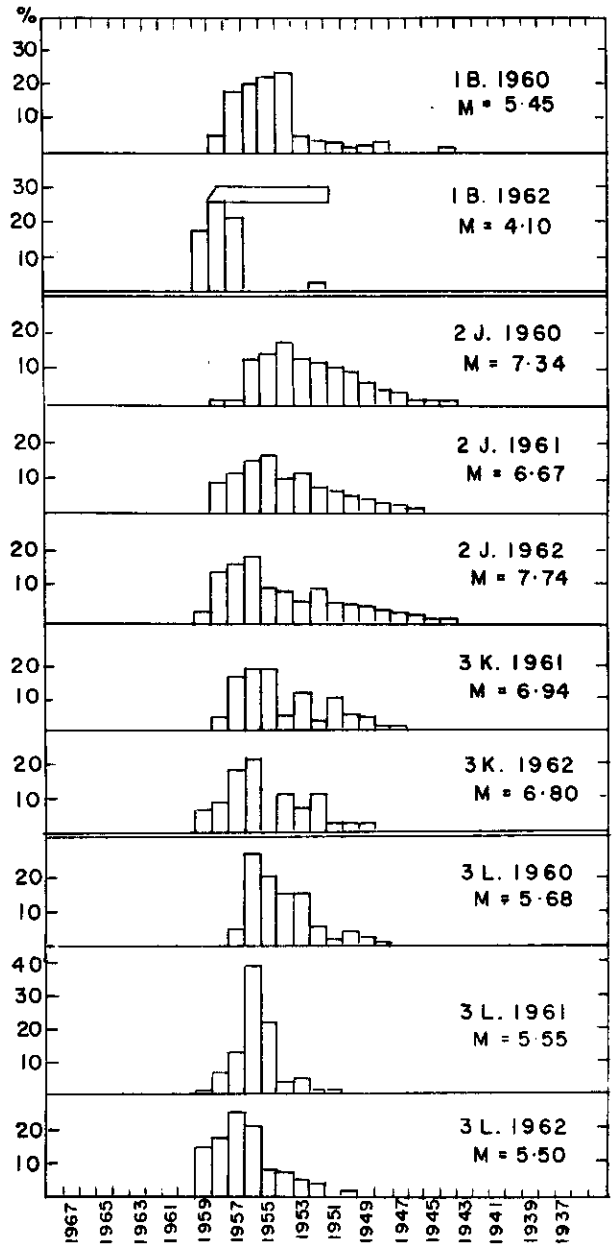


Fig. 5. Cod. Year-class frequencies for Divisions 1B, 2J, 3K and 3L for 1960, 1961 and 1962.

c. AGE AND YEAR-CLASS DISTRIBUTION of cod from the divisions and for the years sampled for lengths above are compared in Fig. 5. In Division 1B, mean age decreased from 5.45 years in 1960 to 4.1 years in 1962. This too should be confirmed by analysis of additional data. In 1962 the 1958 year-class is the most abundant whereas in 1960 the 1954 year-class was the most abundant. Age-group VI is also dominant in Division 2J with mean ages of 7.34, 6.67 and 7.44 for the years 1960, 1961 and 1962. This agrees fairly well with the stability of mean

lengths and slow growth rate typical for this Division. Division 3K shows a slight decrease in mean length with more evidence of dominance of the 1956 year-class in 1962. In Division 3L mean age remains almost the same with an accompanying decrease in mean length. The 1957 year-class dominates the 1956 year-class in 1962.

d. SEX RATIO. In 1962, 69% of the cod are females as compared to 76% in 1961. The highest percentage of females is found in Division 3M (82%) and the lowest in Division 3K (56%). In 1961, Divisions 2J and 3K had a larger proportion of males. In all other Divisions females were and still are widely predominant.

e. AGE AT FIRST MATURITY. Results of this study are quite similar to those obtained in 1961 and are presented in Table 2. Results show (i) that 71% of cod reach first maturity at 6 years of age, 10% at 5 years of age, 15% at 7 years of age and 3% at 8 years of age (ii) that there is no great difference in the age at first maturity between males and females from the same Division (iii) that the age at first maturity in the older year-classes seems to be greater than that in the younger year-classes. Additional data are needed to confirm this.

Table 2. Age at first maturity for the 1946-1955 year-classes of cod taken from Divisions 1C, 2J, 3K and 3L in 1962.

	2J								3K				3L		1C
Year-	Males				Females				Males		Females		Males	Females	Female
Class	5	6	7	8	5	6	7	8	6	7	6	7	6	6	6
1946 (16)						1									
1947 (15)								1							
1948 (14)		2	1			2	2								
1949 (13)		2				2	3								
1950 (12)		4	1			3	2	1				1		1	
1951 (11)		3		1		6	2		1						
1952 (10)	1	8			1	10	2				4			1	
1953 (9)	2	2			1	5	1		1		2		1	1	1
1954 (8)	2	3			3	2			1						
1955 (7)		1													
Totals	5	25	2	1	5	31	12	2	3		6	1	1	3	1
%	At the age of 5-10.2				At the age of 6-71.4				At the age of 7-15.3				At the age of 8-3.1		

f. SUMMARY. The main conclusions are (i) growth curves for cod taken in 1962 in Divisions 1B, 2J, 3K and 3L show a decrease in the general growth rate from those of preceding years, except for age groups over VI in Division 2J (ii) growth rate is faster in Subarea 1 than in the other subareas. In Subarea 1 it decreases from north to south and in Subareas 2, 3 and 4 it increases from north to south (iii) mean length is smaller in 1962 than in preceding years in Divisions 1B, 2J and 3L and higher in Division 3K (iv) dominant year-classes are the 1956 in Divisions 2J and 3K, the 1957 in Division 3L and the 1958 in Division 1B (v) the percentage of males is higher in 1962 (31%) than in 1961 (24%) (vi) in all year-classes sampled in 1962 the majority of cod reach first maturity at 6 years of age.

C. The cod fishery by large Spanish trawlers in 1962
by J.L.Arambarri

This report is based on information gathered by the large trawlers and does not include results of operations of the pair trawlers "parejas".

The 1962 fishing season for the Spanish fleet of large trawlers began in February on the western banks of Subareas 3 and 4. Catches were good but the size of the cod was generally smaller than in previous years. Smaller quantities of large cod were captured compared with 1961. Large quantities of small cod were found. These cod were not fished commercially and will form an important source during the coming years. Worms were found in the fish caught in the south part of the Gulf of St. Lawrence.

Division 3L was fished later and important quantities of fairly large cod were captured. The fishing in this area lasted only a short time because the cod were very active and, similar to other years, disappeared quickly. Good fishing lasted about 10 days to the end of March. Most of the fish were ready to spawn. The females were full of eggs and the males milt. Few fish were empty of sex products. Cod in this subarea were the largest caught during the year by the Spanish trawlers, except one taken in Greenland.

In April and May fishing was carried out in the Divisions 2J and 3K. Large quantities of cod were caught continuously during this period. They were, as usual, the only species sought by the Spanish trawlers and were, as in previous years, of medium size. Most of the trawlers finished their first trip and left to land their cargoes in Spain in May. The remaining trawlers left later.

Fishing was resumed in June in Subareas 2 and 3. Catches in both subareas consisted of medium-sized cod, which were smaller than the early spring fish and were very abundant. July marked a steady decline in fishery in both subareas. By the end of the month fish were scarce and reduced to small stocks. Presumably the fish moved toward the shore of Labrador into shoaler water. Fishing was poor during the following month except for a period during the first part of the month of September in Division 3K. The fishing season closed in this general subarea at the beginning of December without any improvement in the catches.

In September a cod, presumably tagged in Greenland, with a Danish tag, was caught in Division 2J. This is the third record of a cod with a Danish tag caught in or near Hamilton Bank off Labrador.

In Divisions 2J and 3K large schools of cod which were too small for the Spanish market were noticed.

Several Spanish trawlers fished on Greenland banks (Subarea 1) during the month of August mainly. At this time fish were abundant and were active. The trawlers moved continuously from place to place inside Great and Little Hellefiske Banks. The fish were found to be pelagic or off the bottom for long periods. Most of the cod caught were 70 cm and over.

In Subareas 1, 2 and 3, on the edges of the fishing grounds, large quantities of redfish were caught and discarded. Often they were mixed with the cod.

Flatfish were abundant in the central region of Subarea 3 and more halibut were present than in previous years. All flatfishes were discarded.

IX. USSR Research Report, 1962

by A.S.Noskov, G.P.Zakharov
and I.N.Sidorenko

In 1962 fishery investigations in the Northwest Atlantic were carried out mainly by exploratory and partly by fishing vessels under the leadership of the Polar and Atlantic Institutes of Marine Fisheries and Oceanography. Altogether 25 of such exploratory and research cruises were made during the year. The R/V AKADEMIK KNIPOVICH and SRT-R 9048 each made two cruises in the ICNAF area. Oceanographic observations were also carried out on board the R/V TOPSEDA during hydrological surveys in the areas of Greenland, Labrador and Newfoundland in June-July and again in August-September.

During the above investigations distribution and feeding of fish, specific and size-age compositions of catches were studied. Spawning grounds and seasons were determined as well as the conditions necessary for the formation of commercially important fish concentrations. Zoo- and ichthyoplankton were studied. One of the cruises was entirely devoted to the estimation of the young commercial fish in the area of Labrador and Newfoundland. Vertical distribution of redfish was studied in the Labrador area. In some areas with greater depths (over 1000 m) between Greenland and Iceland investigations were aimed at detecting the midwater concentrations of redfish.

A. Subarea 1

In spring and autumn 1962 oceanographic observations in Subarea 1 were carried out by the vessels TOPSEDA, NOVOROSSISK and POBEDA. Preliminary analysis of collected data revealed that the cold waters of polar origin were more extensive in eastern, southern and western Greenland than in 1961. This may be related to the slackening of the Irminger component of the West Greenland Current. In September 1962 the mean temperatures of the 0-200 m layer on the sections intersecting the main fishery banks of West Greenland (Fyllas, Fiskenas and others) were from 0.5° to 1.0° lower than in 1961.

Investigations in the waters of West Greenland were carried out in April-June and August-September.

COD. In spring no commercial concentrations of cod were observed in Subarea 1F. Small catches of mainly immature cod were composed of 42-86 cm fish. The mature specimens were in the post-spawning maturation stage. In August-September, catches were largely composed of young immature cod (mode 60-65 cm). In August-September the near-bottom temperatures in the places of cod concentrations varied from 2.5° to 3.7°C

In late April on the western slope of Frederikshaab Bank (1E) catches of both

redfish and large spawning cod (mode 74-80 cm) were made at the depths 370-600 m. However, trawl catches of cod did not exceed 0.6-0.8 tons per trawling hour. During the same period small catches of immature cod (mode 45-50 cm) were made in shallow waters in Subarea 1E. The cod were rather sluggishly feeding on planktonic and benthic invertebrates (Fig. 1). The predominance of 5-9 year-olds on the diagram of age composition of cod in Subarea 1E results from the fact that sampling was done from the catches taken at greater depths.

During the repeated surveys in Subarea 1E in June, trawl catches of cod in some cases amounted to 1.0-1.5 tons per trawling hour. The catches were composed chiefly of large (mode 74-86 cm) post-spawning cod feeding sluggishly at that time on Euphausiacea. Feeding conditions in summer are usually unfavourable for cod in the area and do not stimulate the formation of dense concentrations of fish.

In the end of April-the beginning of May, spawning cod occurred also on the western slope of Danas Bank (1D) at the depths 370-470 m with specimens of 74-80 cm predominant in catches. In this area trawl catches varied from 0.5 to 0.8 tons per trawling hour. More than half of the fish were in the post-spawning stage. Catches decreased with the depth, while the spawning cod increased in number. Only individual specimens of small cod occurred in the shallow waters of Danas and Fiskenas Banks. In April-early May the near-bottom temperatures in these shallow-waters were below 0°C. Towards the end of May the near-bottom temperature in the shallows of Danas Bank had risen to 1.5°C. During this period good catches (up to 3 tons per trawling hour) of small and medium cod (mode 47-53 cm) of the 1958 year-class were taken in this area (Fig. 1, diagram for 28-30th May). Cod were feeding heavily on Euphausiacea and sand launce.

In early May cod, mainly immature, were detected on Fyllas bank at 225-250 m. The bulk of catches was made of 59-71 cm fish of the 1957 year-class. Among the mature fish male specimens with gonads in the liberation stage were predominant. In the second half of May, catches on Fyllas Bank at 100 to 150 m were mainly composed of 74-83 cm cod of the 1953 year-class. The cod were feeding on sand launce and Euphausiacea.

In Division 1C no dense concentrations of cod were observed in May. Only in some instances did the catches reach one ton per trawling hour. Catches contained both immature and mature post-spawning cod. Specimens of 62-65 and 77-80 cm were predominant in catches. The fish fed on Euphausiacea, Pandalidae and benthic invertebrates.

In mid May trawl catches of cod in the southern part of Store Hellefiske Bank (1B) did not exceed 0.5 tons per hour. The catches were mainly composed of immature cod of the 1957 year-class (mode 51-56 cm). Fish of the 1958 and 1959 year-classes made up an insignificant part of catches. Main food organisms were Euphausiacea, Pandalidae, and Amphipoda.

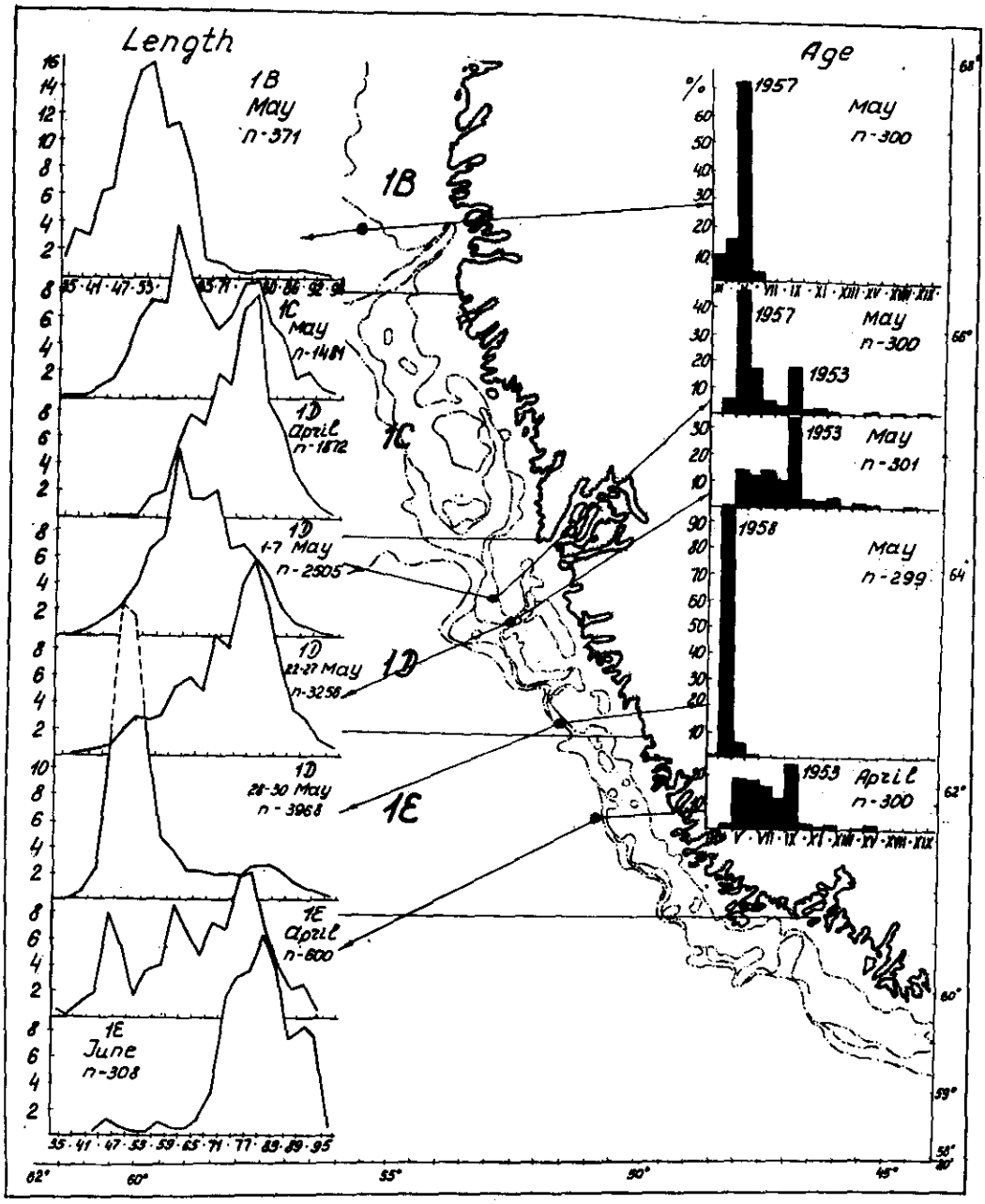


Fig. 1. Cod, Subarea 1. Size and age composition, 1962.

REDFISH (Sebastes marinus marinus) occurred in spring everywhere along the West Greenland shelf area. In southern subareas from Cape Farewell to 64°N redfish were caught at 350-500 m. Further northward on the western slope of Lille Hellefiske Bank redfish were caught at 220-270 m. No stable concentrations of redfish were registered at that time. On the western slope of Frederikshaab Bank occasional trawl catches yielded up to 3 tons per hour (mode 40 cm, male and female). Much bigger redfish (mode 57-60 cm) were caught on the southern slope of Danas Bank. Commercial catches were taken on

the eastern slope of Banan Bank and on the western slopes of Lille Hellefiske and Helder Banks. Catches reached 5.0-7.0 tons per hour and consisted of fish mostly of 39-43 cm long.

On the eastern slope of Banan Bank a few scores of small redfish (6-16 cm) were caught in the trawl provided with a small-meshed cover. The number of small redfish on the western slope of this Bank was insignificant.

In all subareas of West Greenland the ratio of males to females was close to 1:1. As in 1961, most of the redfish were immature. Only a few females had gonads with developing embryos. Mature males were more numerous than mature females.

B. Subarea 2

Throughout the year the research and exploratory fishing vessels of the Polar and Atlantic Institutes carried out standard hydrological sections and bottom temperature and salinity measurements in places of intensive fishing operations in Subareas 1 and 2. In the Newfoundland area in the first half of 1962 water of polar origin occupied less space than usual. The mean temperatures in the 0-50 m layer, section 3A (eastern slope of the Grand Bank), were higher than in moderately warm 1960, their values being close to the temperatures of the warm year of 1958. The results of estimations on other sections (6A and others) provide further evidence in support of these observations. Towards the end of August the onflow of cold Labrador waters has somewhat intensified. At the end of 1962 the sea off Labrador coast was colder than at the end of 1961.

These changes have left the near-bottom layers of the sea (below 200 m) almost unaffected. Analysis of the long-term hydrological changes in Subareas 2 and 3 has revealed that in most cases the temperature and salinity in the near-bottom layers undergo very little variation.

1. Baffin area

In 1962 research in the Labrador area covered areas north to the waters flowing round Baffin Land where investigations were made in September on board a scouting trawler. The area from 69°N down to the northern edge of Labrador was covered by instrumental investigations and experimental trawlings. No commercial concentrations of redfish or cod were discovered.

BLUE-BACK HALIBUT (Reinchardtius hippoglossoides), with 50 to 70 cm specimens predominant, occurred in all places with low near-bottom temperatures. Most specimens were immature, only a few were in the post-spawning stage. The halibut were feeding heavily on Boreogadus saida and other boreal species.

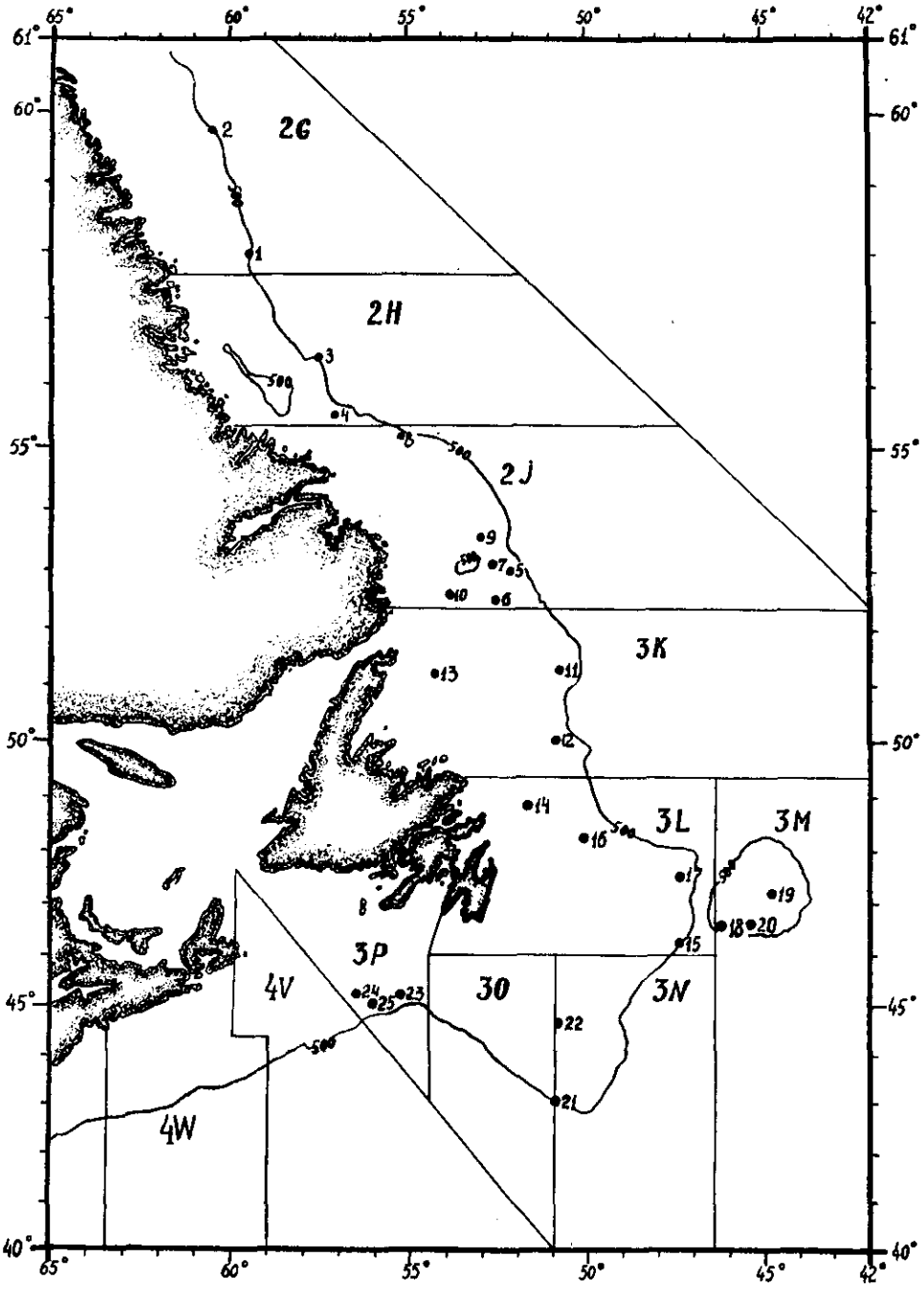


Fig. 2. Cod, Subareas 2 and 3, Sampling locations, 1962.

REDFISH (S. marinus mentella) began to show up in the area from 66°40' N at 400-500 m and in waters with negative near-bottom temperatures (-1.3°C) south of 64°45' N where they were greatly affected by a warm branch of the West Greenland Current, attracting the growing number of redfish. Maximum catches of 0.3-0.5 tons per trawling hour were made at 61°30' N at 480-520 m when the near-bottom temperature was 3.2°C. With the decrease of depth the redfish decreased both

numerically and in size: in the 400-500 layer the length range was 17-49 cm, the mode being 24-32 cm; in the 300-400 m layer the size range was 9-27 cm and the mode 12-19 cm. The majority of redfish taken by trawl were immature specimens. Their food consisted of planktonic crustaceans and young cod and halibut.

2. Labrador area

COD. Between 59° and 58°N dense shoals of post-spawning cod were observed in mid April at 400-500 m. Trawl catches amounted to 4.0-6.0 tons per hour. Cod 53-68 cm in length and 7-10 years of age were predominant in catches (Fig. 3 and 4). In September-October cod were dispersed in this area. The catches did not exceed several hundred kilograms per trawling hour. During this period fish were smaller than in spring (modal length 47-53 cm at age 5-6 years).

In May dense shoals of cod were encountered in the central part of Labrador (2H). The catches were dominated by fish 56-62 cm long and age 9-12 years (Fig. 3 and 4). In autumn the catches of cod in this division were insignificant because the fish kept in small shoals. Fish 6-8 years of age were predominant.

The main cod fishery in 1962, as in past years, was off southern Labrador (2J). In April-May both pre-spawning and post-spawning cod were fished successfully on Hamilton and Sundal Banks. Immature cod were concentrated in the shallower depths. In April, catches were dominated by fish 43-62 cm long, in May - by those 53-62 cm long (Fig. 3). The proportion of fish of different ages varied in relation to the place and time of fishing. Most important in catches were cod of the 1955-1957 year-classes (Fig. 4).

As in the other areas, no large commercial concentrations were observed in Division 2J in autumn.

In Division 2J stable diurnal vertical migrations of cod were recorded in spring. During daylight the fish were up in the water and at night sank to the near-bottom layers. These migrations greatly influenced the productivity of the fisheries, i.e. during the day catches were smaller than at night. The migrations were evidently caused by peculiar trends of feeding: the cod fed on planktonic organisms during the day and on benthic forms at night.

REDFISH. Fishing for redfish (S. marinus mentella) in Division 2J was conducted in January-May. Here the pre-spawning and spawning concentrations of redfish were represented mainly by males 34-38 cm in length and females 43-48 cm in length (Fig.5).

In Division 2H commercial catches of redfish were obtained in April-May. The prevailing sizes of fish were 30-40 cm. In the second half of the year fishing operations in the Labrador area were mainly conducted by exploratory vessels. In November commercial concentrations of redfish were discovered on the northeast slope of

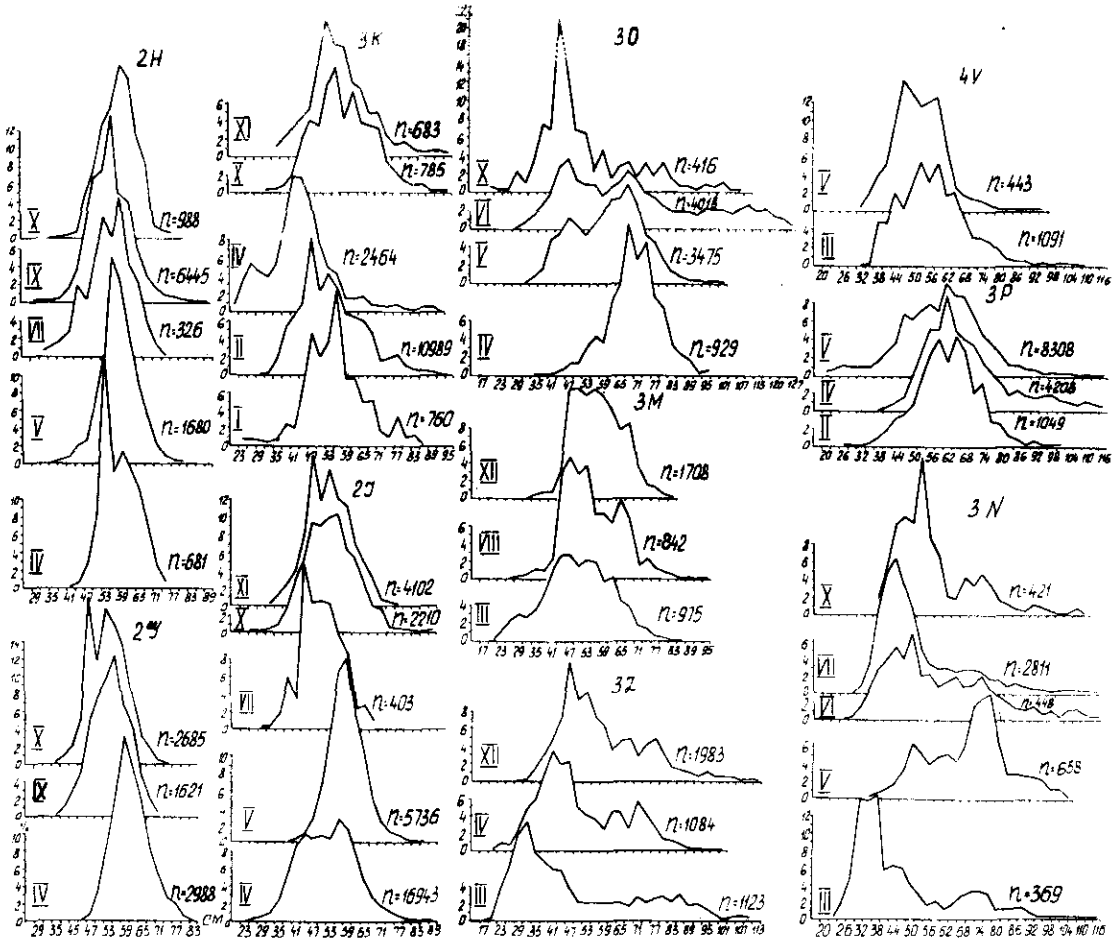


Fig. 3. Cod, Subareas 2, 3 and 4. Size composition, 1962.

Hamilton Bank. Dominant lengths of females and males were 32 cm and 35 cm respectively (Fig. 5).

C. Subarea 3

COD. On the northern part of Newfoundland Bank (3K) the cod fisheries continued throughout the winter and spring. In winter catches were dominated by 53-65 cm fish, in spring - 41-56 cm. Most important in catches were cod 4-8 years of age of the 1954-58 year-classes (Fig. 3 and 4).

On the northern slope of the Grand Newfoundland Bank (3L) the commercial fishing fleet operated mainly in winter. In the other seasons of the year cod served as a by-catch in the redfish fisheries. The prevailing sizes of cod in catches taken by a research vessel were 44-53 cm in April and December and 32-35 cm in March. The age varied from 3 to 9 years (Fig. 3 and 4).

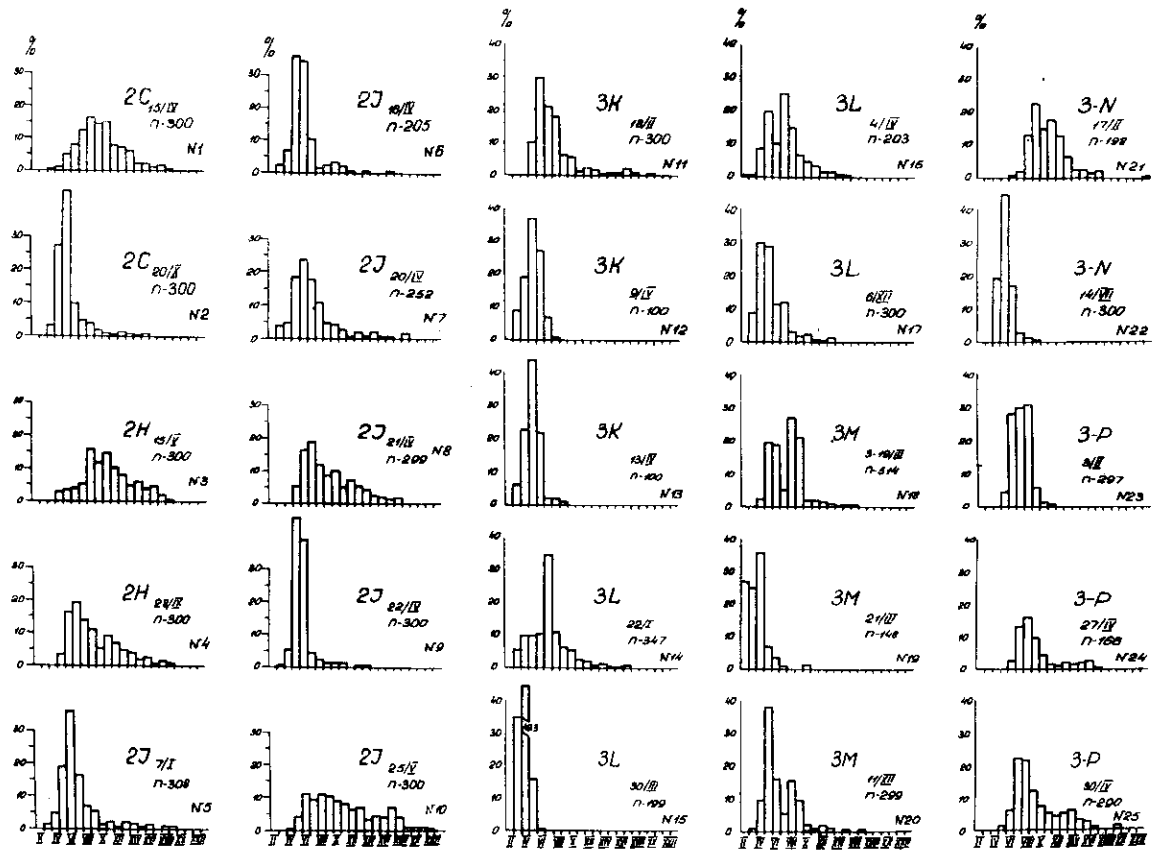


Fig. 4. Cod, Subareas 2 and 3. Age composition, 1962.

On Flemish Cap Bank (3M) cod formed dense and stable concentrations, in winter on the southeastern part of the Bank, and in spring on the spawning grounds on the southwestern slope of the Bank at depths exceeding 300 m. In 1962 the commercial fishing fleet exploited the pre-spawning concentrations in December. The catches were composed mainly of fish 45-62 cm in length and 5, 6, 8, and 9 years of age (Fig. 3 and 4). Fish caught by a research vessel in March in shallow waters (less than 200 m) were 2 to 4 years of age.

During the spawning period immature cod were spread over the Bank, whereas the fish with gonads in higher stages of development were predominant on the spawning grounds. There were more males than females among the mature fish. The spawning season continued from the end of February till early April, reaching a peak in mid March. The older fish spawned first: on March 3 the spawning grounds were dominated by cod 8-9 years of age and on March 19 by those 5-6 years of age.

Second-time spawners were dominant during the initial period of spawning. Recruits (mature fish with no spawning marks on their otoliths) made up 32.7% of the spawners on March 3 but by March 19 the number of recruits grew to 49.9%.

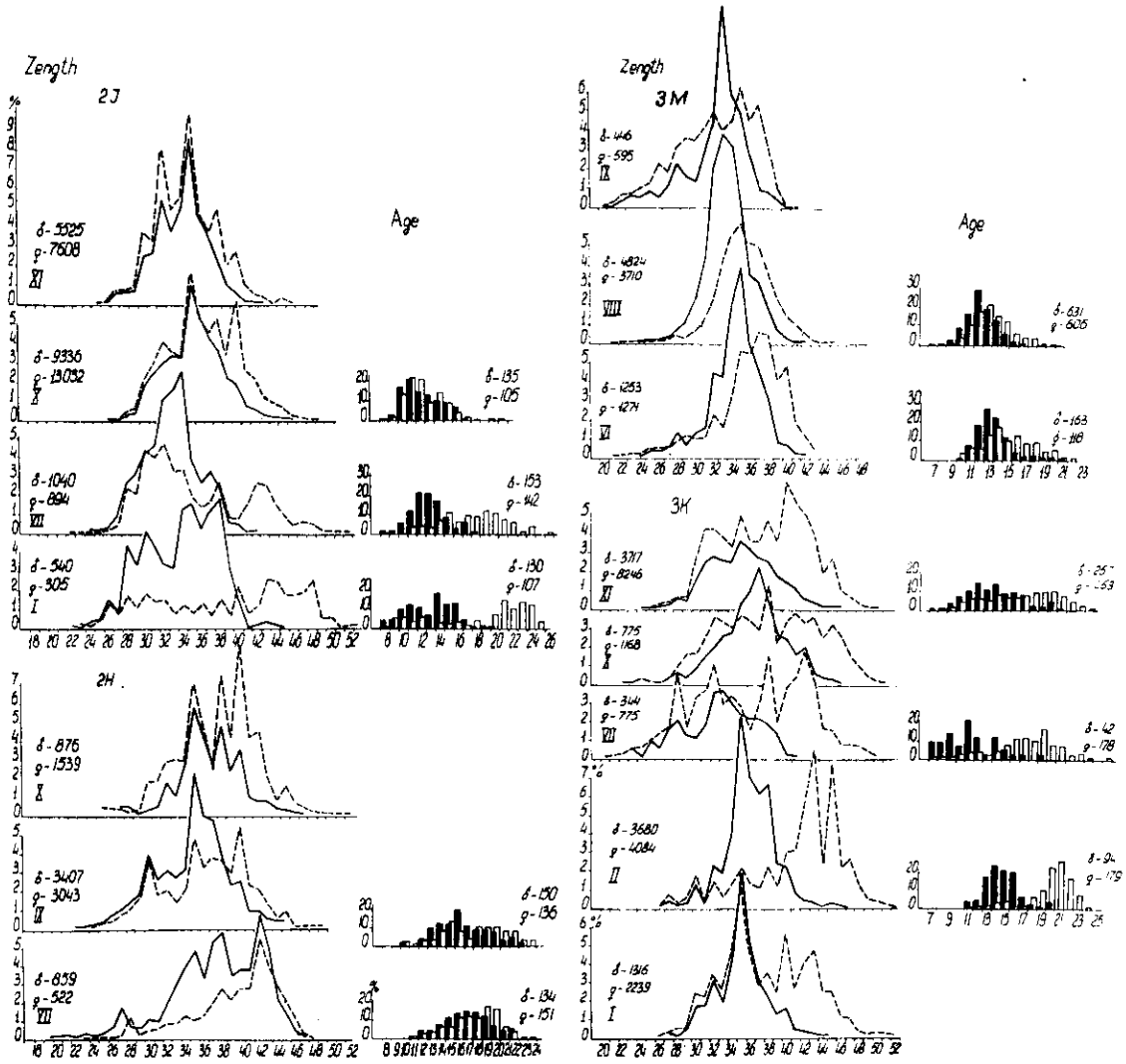


Fig. 5. Redfish (Sebastes marinus mentella), Subareas 2 and 3. Size and age composition, 1962.

In 1962 the catches on Flemish Cap Bank were dominated by cod of the rich 1957 year-class. The linear rate of growth of cod on Flemish Cap Bank is higher than that in Divisions 2J and 3K, and lower than that in 3L, 3N, 3O, 3P.

On the southwestern slope of the Grand Newfoundland Bank cod were fished from February till July and in December; on Green and St. Pierre Banks in February; on the southeastern slope of the Grand Bank in April. The size and age composition of cod in these Divisions is shown on Fig. 3 and 4.

REDFISH. Catches of redfish (S. marinus mentella) in 1962 were considerably lower than in previous years. Lack of stable concentrations did not facilitate the shift of fishing effort to redfish. In Divisions 3K and 3L redfish were caught in the first half of the year during the period of formation of pre-spawning and spawning

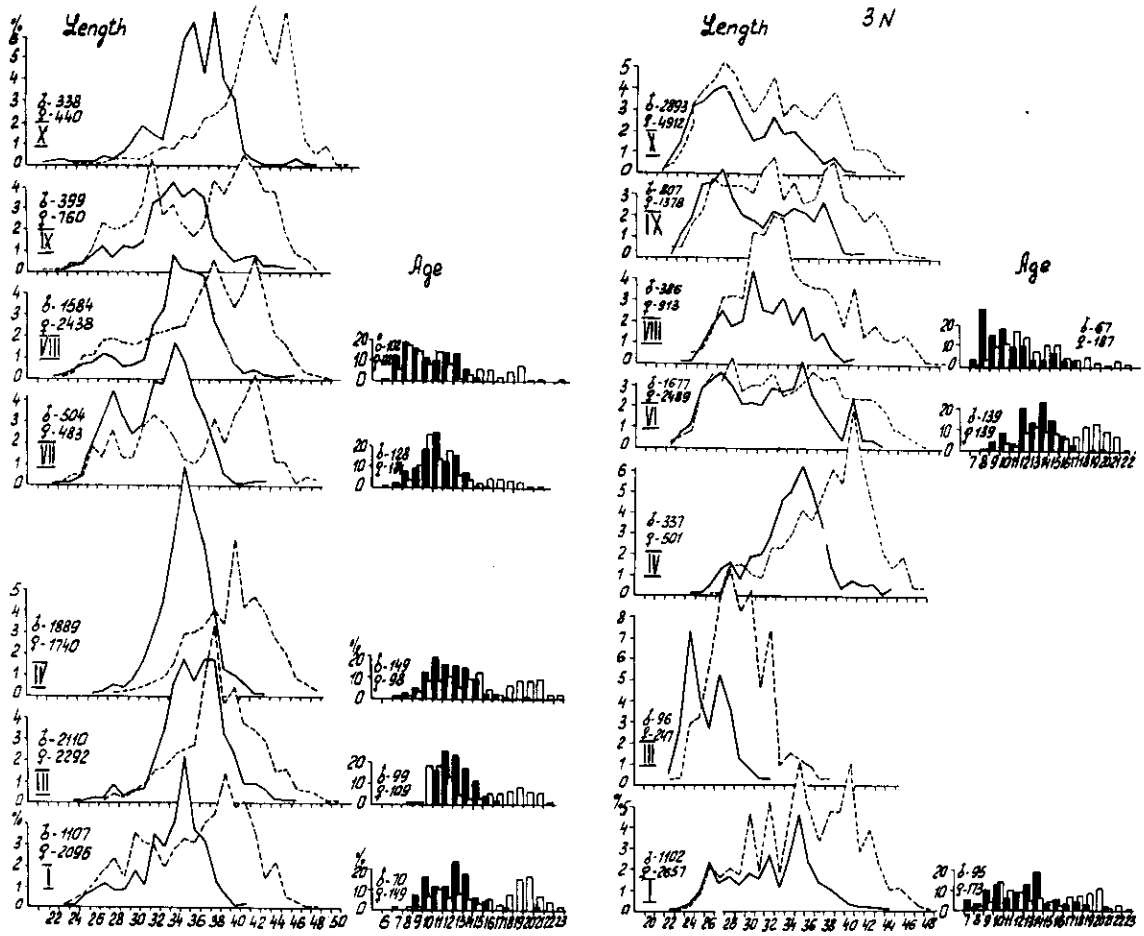


Fig. 6. Redfish (Sebastes marinus mentella), Subarea 3. Size and age composition, 1962.

concentrations. Prior to liberation of larvae the females concentrated on the northeastern slope of the Grand Newfoundland Bank in intrusions of the warm Atlantic Current. Redfish concentrated at 300-400 m where the near-bottom temperatures were 3.0-3.9°C. The prevailing sizes for males were 35-36 cm, for females 43-45 cm (Fig. 6). Before the extrusion of larvae the females descended to 500-600 m where the near-bottom temperature reached 4-6°C. Mass liberation of larvae was observed within 3 to 4 days after which the redfish dispersed. Males made up from 25 to 50% of the fish in catches of pre-spawning redfish concentrations were males. With the departure of females to deep water, the catches decreased in the areas of pre-spawning concentrations. Mainly females were caught in the places of liberation of larvae.

Apart from other reasons, the decline in the catch of redfish on Flemish Cap Bank was influenced by the reduced fishing time and effort and by the decrease in catch per hour of trawling. In the summer of 1962, the trawl catch of redfish per hour by SRT and SRT-R vessels was 0.30-0.45 tons, and in 1960-61 it was 0.55-0.60 tons.

In summer, concentrations of redfish were observed on the northwestern and northeastern slopes of the Flemish Cap Bank at 300-400 m. The prevailing lengths of

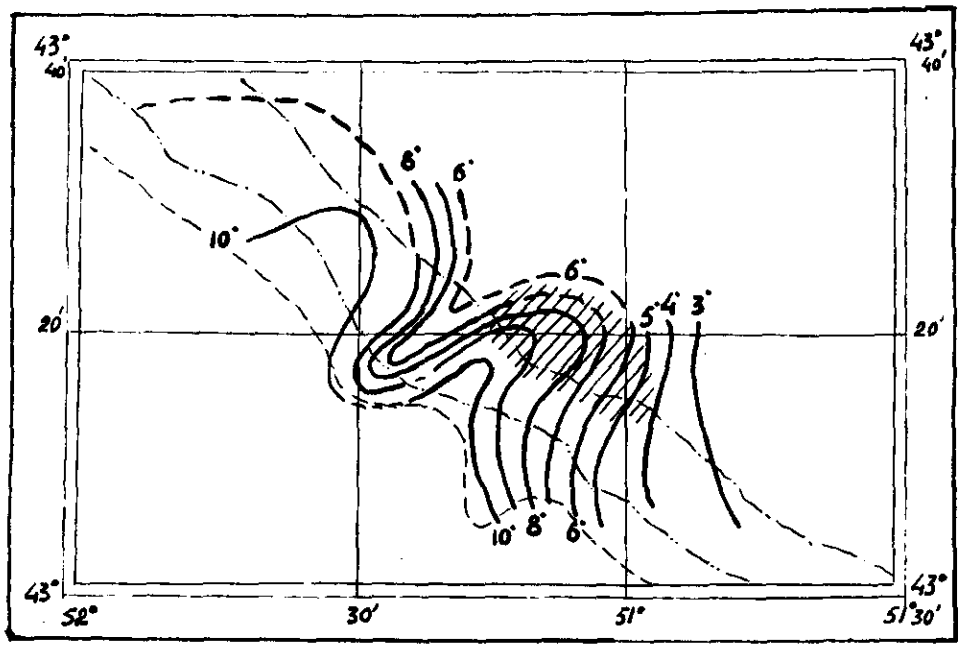


Fig. 7. Haddock and near-bottom water temperatures (°C), Division 3O, February 1962.

males were 31-33 cm and females were 34-35 cm (Fig. 5). The sex ratio was 1:1. About 25% of the fish were immature. The redfish were feeding heavily on Amphipoda, Pandalidae, capelin, and lantern anchovy. Golden redfish (S. marinus marinus) constituted a considerable portion of the catches taken on the northern slope of the Flemish Cap Bank.

Early and late in the year the commercial fishing fleet fished for redfish on the southern slope of Flemish Cap. In the second half of the year the Bank was visited regularly by exploratory vessels. In autumn the sizes of redfish were 33-35 cm for males and 35-38 cm for females.

The exploratory fishing vessels operated on the southeastern slope of the Grand Newfoundland Bank (3N) and sometimes obtaining very good catches of redfish. In Division 3O the catches were dominated by redfish males 26-27 cm in length and females 27-29 cm in length. There were up to 50% immature specimens. Larvae were extruded in June at 160-220 m. During the daylight the redfish stayed at the bottom and at night ascended to the middle layers. They fed on Euphausiacea.

HADDOCK. Concentrations of haddock (Melanogrammus aeglefinus) were discovered in February on the southwest slope of the Grand Newfoundland Bank (3O). The fish kept in the zone of intrusion of the warm Atlantic Current waters at 100-390 m (Fig. 7) where the near-bottom temperature was 4.5-9.0°C. The expeditionary vessel SRT-R 9048 took the maximum trawl catch of 1.2 tons per hour at 150-200 m (near-bottom temperatures being 5-7°C). Prevailing sizes were 38-42 cm (Fig. 8). The

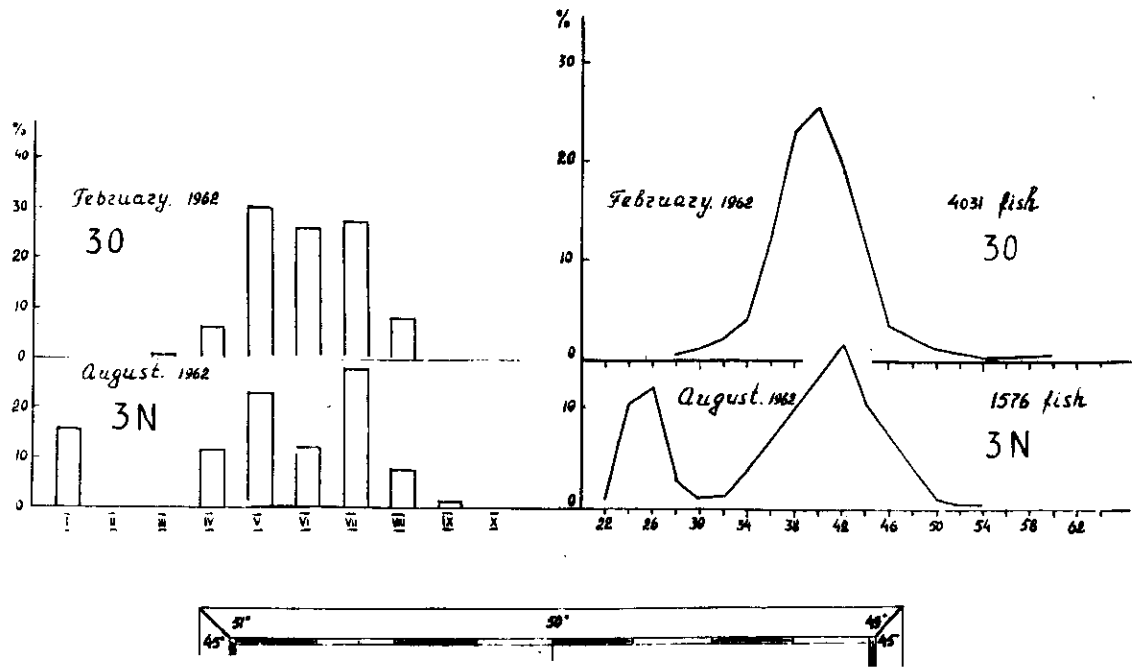


Fig. 8. Haddock, Division 3N and 3O. Size and age composition, 1962.

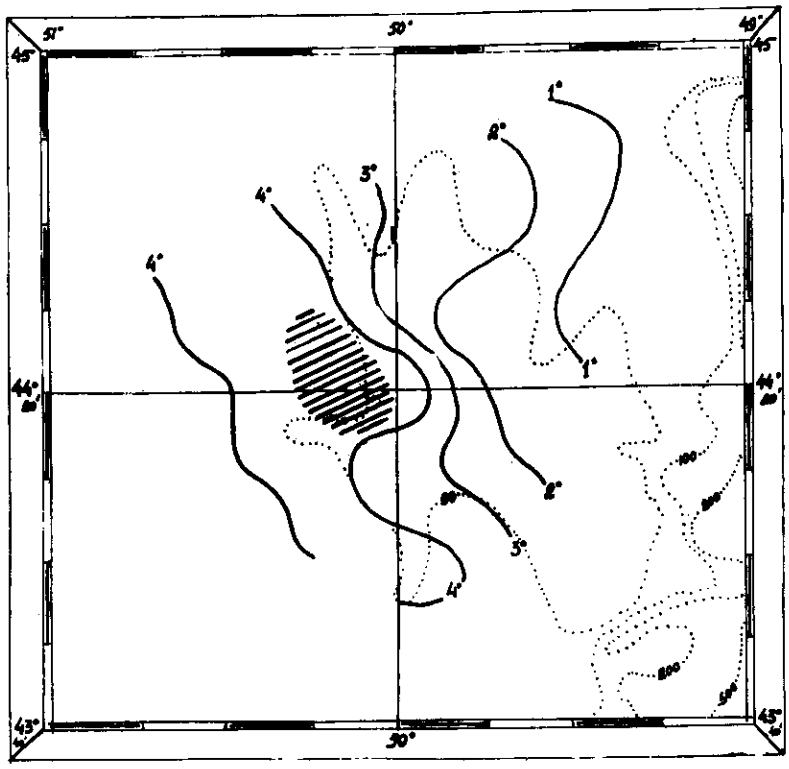


Fig. 9. Haddock and near-bottom water temperatures (°C). Division 3N, August 1962.

fish were smaller in shallow water than in deep water.

In spring and summer the haddock fisheries on the southwest and southeast slopes of the Grand Newfoundland Bank were much less extensive than during the same seasons in 1960 and 1961. No haddock concentrations were found in the usual habitats. The absence of haddock in the spring-summer period is explained by the unfavourable hydrological conditions in 1962. Normally in May-June the spawning concentrations of haddock were observed on the southwest slope of the Grand Newfoundland Bank at 40-100 m (near-bottom temperatures 4-8°C). In July-August haddock used to feed in the southeastern part of the Grand Bank at the depth 40-50 m (near-bottom temperatures 4-5°C).

From May till August 1962, along the whole southwest slope of the Grand Newfoundland Bank to a depth of 300 m, near-bottom temperatures never rose above 4°C. On the southeast slope of the Grand Bank the near-bottom temperatures remained low to the second half of August (2°C in May and 3-4°C in June).

At the end of August the near-bottom temperature in the southeast part of the Grand Newfoundland Bank had increased somewhat and exceeded 4°C. At that time haddock approached the shallow waters in this area and fed heavily on capelin eggs and Amphipoda (Fig. 9). Haddock catches made by a research vessel (trawl mesh 36 mm) were dominated by fish of 40-44 cm and 24-26 cm.

The catches were composed mainly of haddock of the 1955 year-class (27.7% in February and 28.2% in August). Haddock of the 1956 year-class made up in February 26.1% of the catch and in August 12.4%; the 1957 year-class haddock contributed 30.4% in February and 23.1% in August; the 1958 year-class contributed 6.6% in February and 11.6% in August. The 1959 and 1960 year-classes contributed very poorly but fish of the 1961 year-class were more abundant (16.0% in August).

Haddock of the 1961 year-class, 20-28 cm long (about 40%), were also present in considerable numbers on St. Pierre Bank. So, 1961 was apparently favourable for the survival of young haddock in this area.

D. Subarea 4

HAKE. In 1962 regular fishing for silver hake (Merluccius bilinearis) was carried out in the shelf area of Nova Scotia. In July-September the silver hake catches from pre-spawning and spawning concentrations southwest of Sable Island (4W) were composed of specimens from 20 to 45 cm (mode 27-28 cm). In December dense fishable concentrations were exploited westward of Sable Island. These concentrations were mainly immature fish 24-26 cm in length (Fig. 10).

HERRING. In April herring were caught successfully by drift nets on Banquero Bank. At the beginning of the month herring were concentrated chiefly in the southeast part of the Bank. By the end of the month they had departed to the north and

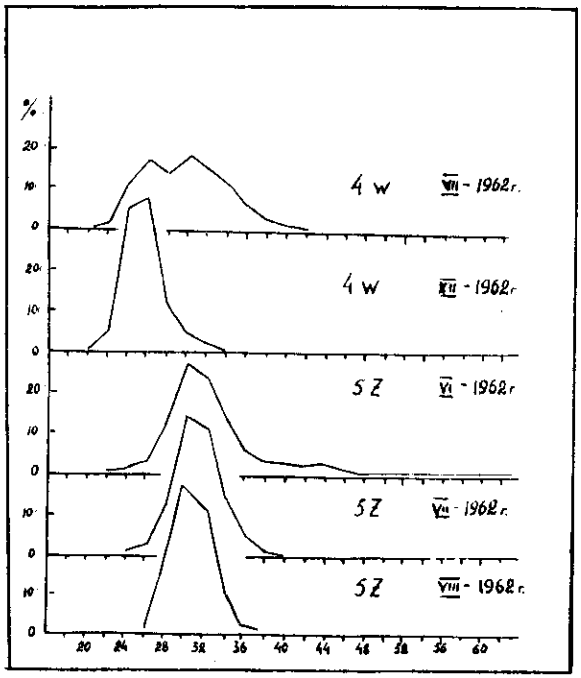


Fig. 10. Silver hake, Divisions 4W and 5Z.
Size and age composition, 1962.

...rthwest. The depths in the area of the fishery varied from 70 to 300 m. The sur-... temperature in July was 0.5-0.7°C and in the end of April, 0.9-1.2°C. During ...ylight herring remained in the deeper water layers and in the evening came closer ... the surface. The herring caught varied in length from 22 to 36 cm with specimens ... 25-27 cm (41%) and 32-35 cm (21%) prevailing.

E. Subarea 5

Four research cruises were made in the Georges Bank area (5Z) from March till December, during which, along with fish-scouting operations, observations were made on the hydrological conditions, distribution of herring and silver hake, and on the state of the numerical strength of the latter.

In Subareas 4 and 5 the Atlantic (ATLANTNIRO) and Polar (PINRO) Institutes carried out oceanographic research from April till November 1962 on Georges Bank and in the southern part of the Nova Scotian shelf. The section along 65°W was worked in June 1960, 1961, and 1962. The mean temperature of this section in 1962 was 0.17° higher than in 1961, and 0.92° higher than in 1960. This suggests a continuing rise in water temperature in the area.

In July a redistribution of water masses in connection with tide variations took place. The water temperature of the 50 m layer changed by 5.4° within 6 hours.

PLANKTON. In 1962 plankton was sampled on Georges Bank during exploratory cruises from February till August. Sampling was done by a Judey net of No.38 webbing.

In February plankton was sampled on the northern and southwestern slopes of the Bank. Diatom and peredinea bloom was observed in both areas. Specific composition at that time was very poor. In the northern part the biomass reached the value of 800-1000 mg/m^3, whereas in the southwest it was 180-400 mg/m^3. First spawning of Calanus finmarchicus began in the end of February. Warmwater forms of plankton occurred on the southwest slopes. Limacina retroversa, Metridia lucens. In March rather poor blooms of diatoms were observed on the southern and southwest edges of the Bank. Calanus finmarchicus continued to spawn. Biomass was 100-150 mg/m^3, with higher values on some of the stations at the expense of phytoplankton. The qualitative composition is mainly characterized by the boreal forms.

In May biomass on the northern part of the Bank reached 500-800 mg/m^3, on the northwest part it was 100-150 mg/m^3, and on the southeast part 20-40 mg/m^3. C. finmarchicus occurred everywhere.

In June zooplankton biomass sharply increased to the value of 500-1000 mg/m^3 on all slopes of the Bank except the southern part, where it did not exceed 100-150 mg/m^3. The qualitative composition has markedly increased.

In July mass development of diatoms was observed, especially in the northern and southeastern parts. Mass development of young C. finmarchicus and Euphausiacea took place at the same time. Compared with June, biomass decreased and became more evenly distributed. The northern slopes were dominated by C. finmarchicus and young Euphausiacea, the central part by small Calanoida forms, and the southern part by such warm water planktonic forms as Metridia longa, Limacina retroversa, etc.

SILVER HAKE (Merluccius bilinearis). In 1962 good concentrations of silver hake were observed on Georges Bank and were successfully exploited by large fish-freezing trawlers from April till October.

The body lengths varied from 22 to 68 cm. Catches consisted mainly of 28-32 cm specimens of 160-200 grams. Males were smaller than females. Thus, the average length of males was 30.1 cm and that of females 33.2 cm. The rich 1958 year-class made up, on the average, 94.1% of the catches. Some males first reach maturity when 24 cm in length; some females first mature when they reach 26 cm. All females and males were mature when 31 cm in length. Main concentrations of silver hake were observed on the southeast slopes of Georges Bank. These consisted of a dense spawning shoal. The hake were found at 50-150 m within the range of near-bottom temperatures of 7-11° (Fig. 11). Spawning continued from July to September, with a peak in the second half of July. On the southeast slopes the hake were not feeding actively.

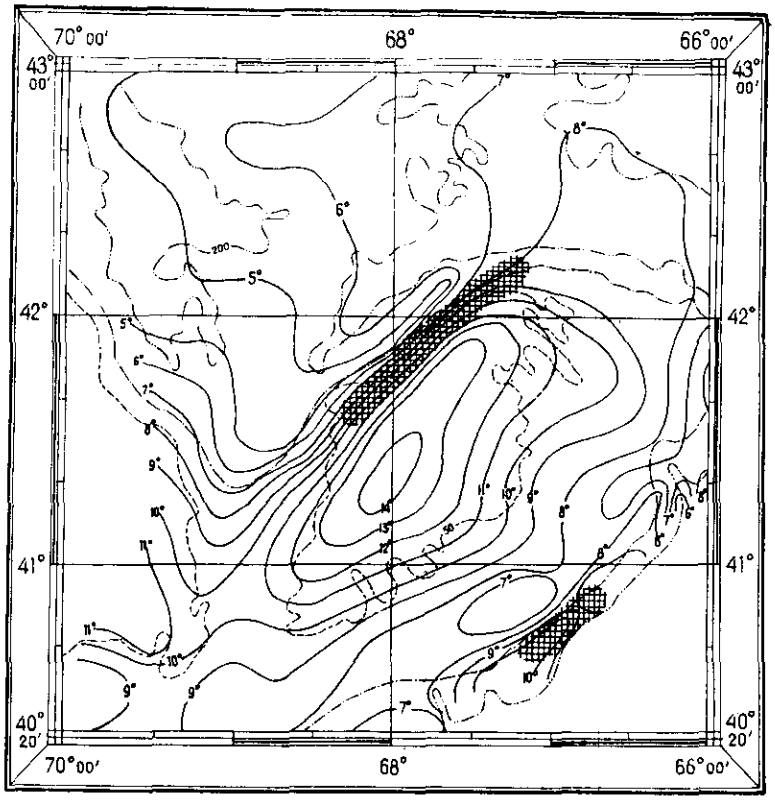


Fig. 11. Silver hake and near-bottom water temperatures (°C), Division 5Z, June-July, 1962.

On the northwest slopes, herring catches contained considerable quantities of hake. The majority of the hake were feeding and only a small proportion were in the spawning stage. In July and August, hake were found at 40-110 m in the near-bottom temperatures from 5.0 to 11.5°. On the northwest slopes hake were feeding actively. Main food items were invertebrates, particularly Euphausiacea and prawns. Hake more than 35 cm in length were feeding mainly on small silver hake, young haddock and red hake.

There are differences in both biology and systematic characteristics between the silver hake of Georges Bank and those of the Sable Island area. Spawning on Georges Bank took place mainly in July whereas in the Sable Island area it was in September. The average number of vertebrae of hake on Georges Bank was from 54.76 to 56.88 and in the Sable Island area 55.00. Thus, these areas seem to have independent local stocks.

Prospects for the hake fisheries on Georges Bank in 1963 indicate that it will be successful because the bulk of catches will be composed of the abundant 1958 year-class.

HERRING (Clupea harengus). During the period of 1959-61 the Atlantic (ATLANTNIRO) and Polar (PINRO) Institutes of Marine Fisheries and Oceanography have undertaken a few research cruises in the shallow waters off Nova Scotia and on Georges Bank for the

purpose of oceanological and ichthyological studies. As a result, concentrations of herring were discovered on Georges Bank. Most stable and densest concentrations were observed from May to October. Herring fisheries commenced in May 1961 and were successfully maintained through 1962. In 1961 the catches of herring on Georges Bank reached 67,584 tons of which 36,567 were taken by large fish-freezing trawlers of the BMRT type and 31,017 by medium-size fishing trawlers (SRT and SRT-R) using drift nets. In 1962 the herring catch increased to 151,144 tons of which 44,549 tons were taken by BMRT, while SRT and SRT-R took 88,197 tons by means of drift nets and 18,398 tons by trawls.

In 1961-62 regular research cruises were undertaken during which observations were made on the biology and condition of the stock. The main results of these observations are briefly summarized below.

a. Size and age composition of herring catches. Herring caught on Georges Bank form a discrete population spawning on the Bank itself. The adult herring remain on the Bank almost the year round. Immature specimens are occasionally encountered in small numbers in the western and northern parts of the Bank. The young herring dwell in the coastal areas of the Gulf of Maine where they are the object of a local fishery. In samples taken on Georges Bank from both commercial and experimental catches, body length of the herring ranged from 18 to 32 cm. The minimum age of herring in catches (age determinations were based on scale readings) was 2 years, the maximum age was 9 years (Fig.12). The 1956 year-class made up 54.4% of the catch in 1961 and 49% of the catch in 1962. This generation in comparison with the others may be considered an abundant one and is followed, in numerical strength, by the 1955 year-class which contributed 20.3% in 1961 and 23.5% in 1962. The 1953 and 1954 year-classes were not important in catches. In 1961 they yielded 6.6% and in 1962 4.6% of the total catch. The 1957 year-class was also numerically weak contributing 14% in 1961 and 16.3% in 1962. Still younger herring was observed only in insignificant numbers, e.g. the 1958 generation averaged 4.4% in the 1961 catch and 7.1% in the 1962 catch.

The predominance of the successive 1956 and 1957 year-classes also resulted in one modal group dominating the size composition of catches.

Fig.12 shows that the modal length of herring in the May 1961 samples was 25 cm (the body length in this case is estimated in accordance with Smith, i.e. the length is measured from the tip of the snout to the middle of the caudal fin) and shifted to the right with the increasing age of the herring. In August 1961 the size of the modal group was 26 cm. No marked changes in the size composition were observed throughout the fall, winter and spring to June of 1962. This is explained by the fact that herring's growth is retarded during this period. By July 1962, following intensive growth in May-June, the mode fell on 27 cm.

Simultaneous with the shift of the peak of the size composition curve, a decrease in the number of specimens of less than 24 cm was noted during 1961-1962.

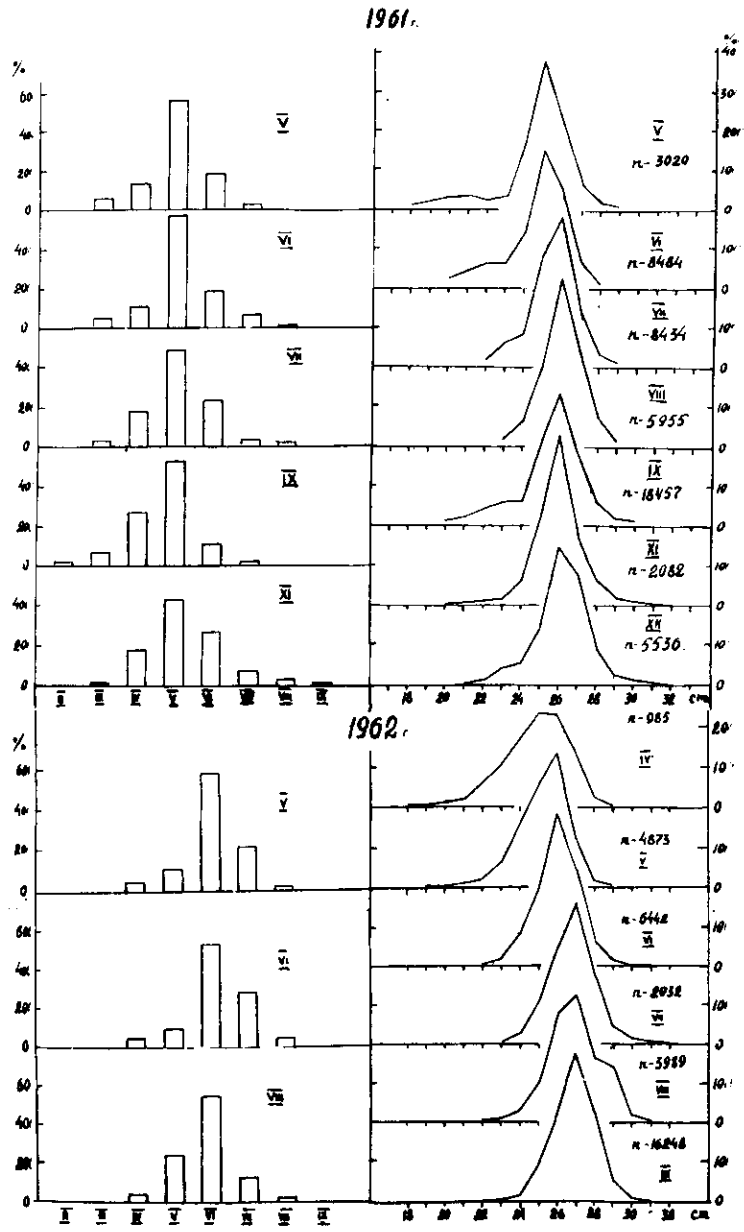


Fig. 12. Herring, Division 5Z. Size and age-composition, 1961-1962.

From the results of the above observations on the size and age composition, the following conclusions can be drawn:

1. Georges Bank is inhabited mainly by adult herring.

2. In 1961-1962 the herring stock was dominated by the strong 1956 year-class. Of the other year-classes only those of 1955 and 1957 were of commercial value.

3. Herring older than 9 years did not occur in catches. This is attributed to a high rate of natural mortality when they reach this age.

4. The stocks in 1961 and 1962 were mainly composed of the 1955, 1956, and 1957 year-classes. Because of the reduced numerical strength, resulting from both natural and fishing mortality, the size of the stock of herring has decreased in 1962 and is bound to decrease even further in future, which should adversely affect, first of all, the productivity of herring fishery.

Thus, a considerable decline in herring catches per drift net was observed in 1962. Data in Table 1 shows that the average monthly catch per net varied from 90 kg to 550 kg in 1961 and from 12 to 192 kg in 1962. However, in 1962, more fishing vessels were engaged in fishing operations in the area. Thus space for fishing the herring concentrations was more limited and to a certain extent contributed to the decline of catch per net.

Nevertheless, in November 1962 the catch per net with the number of vessels reduced by several times from the number operated in the same period in 1961, was three times lower than in 1961. This is another evidence of declining stocks.

b. Distribution of herring on Georges Bank. Data based on the results of observations obtained by exploratory vessels and the commercial fishing fleet during the period of 1961-62 seem to show the following pattern of distribution of herring.

In late autumn, winter and in early spring, when the numerical strength of food zooplankton on the Bank is low, herring is observed sporadically on the northwest slopes of the Bank and in adjacent areas of the Gulf of Maine.

During this period herring settle in small separate groups over a considerable area, though these groups are, as a rule, observed for a short time only. Fishing operations in this period are generally inefficient except during January 1962 when herring was taken successfully by big fish-freezing trawlers. However, no commercial concentrations were observed in the corresponding period of 1963.

Stable concentrations of herring on Georges Bank begin to appear in April-May with the development of zooplankton. From this time through October the herring are distributed along the northern, northwestern, eastern and southeastern slopes of the Bank, and sometimes on the Bank itself (Fig. 13). Such a distribution is explained by the intermingling of cold waters from the Nova Scotian shelf and the Gulf of Maine with warm waters of the Gulf Stream which flows along the southeastern part of the Bank. The intermingling results in the higher production of zooplankton. Distribution of zoo- and phytoplankton biomass in late June-early July 1962, i.e. during intensive feeding by the herring, is outlined in Fig. 14.

Table 1. Summary of the results of drift net herring fishery in 1961/62.

Year	Fishing effort	Months Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1961	Days fishing	-	-	-	-	37	45	212	97	-	1126	2829	337
	Nets	-	-	-	-	2233	1722	3273	2019	-	58620	124568	26391
	Average catch/ net (kg)	-	-	-	-	90	370	550	500	-	130	120	170
	Catch (tons)	-	-	-	-	201	638	1800	1002	-	7522	15318	4536
1962	Days fishing	-	4	127	1456	2787	3036	3242	2663	1440	1169	690	177
	Nets	-	1025	36219	83922	191133	205669	160325	85844	33389	51297	62677	20031
	Average catch/ net (kg)	-	12	21	62	83	102	110	68	192	54	35	36
	Catch (tons)	-	12.5	755.6	5157.0	15981.8	19997.6	17580.4	5873.7	6419.3	2783.0	2170.9	714.9

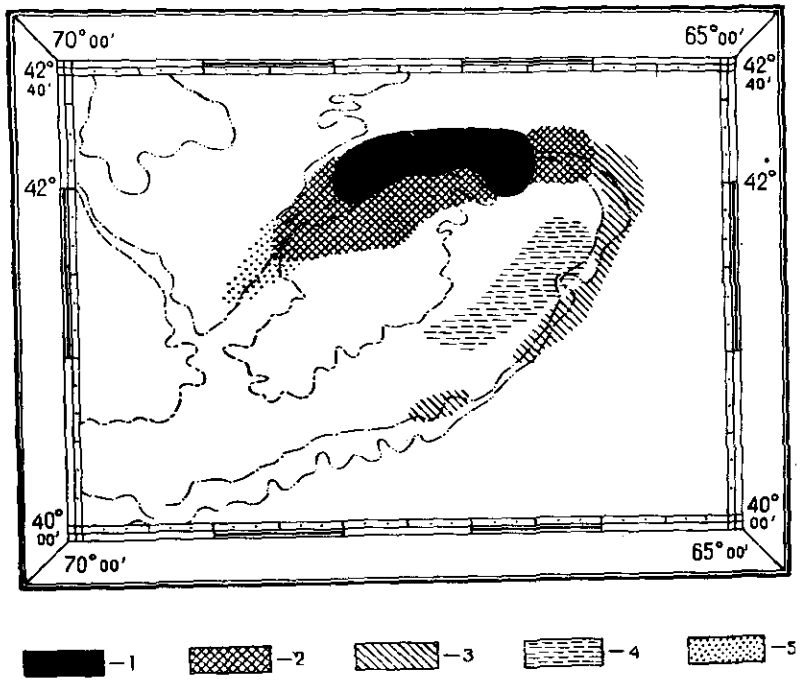


Fig. 13. Herring fishing operations, Division 5Z, May-October, 1962.
1. Active 90% of time. 2. Active 50% of time. 3. June-July distribution.
4. May-June distribution.. 5. August distribution

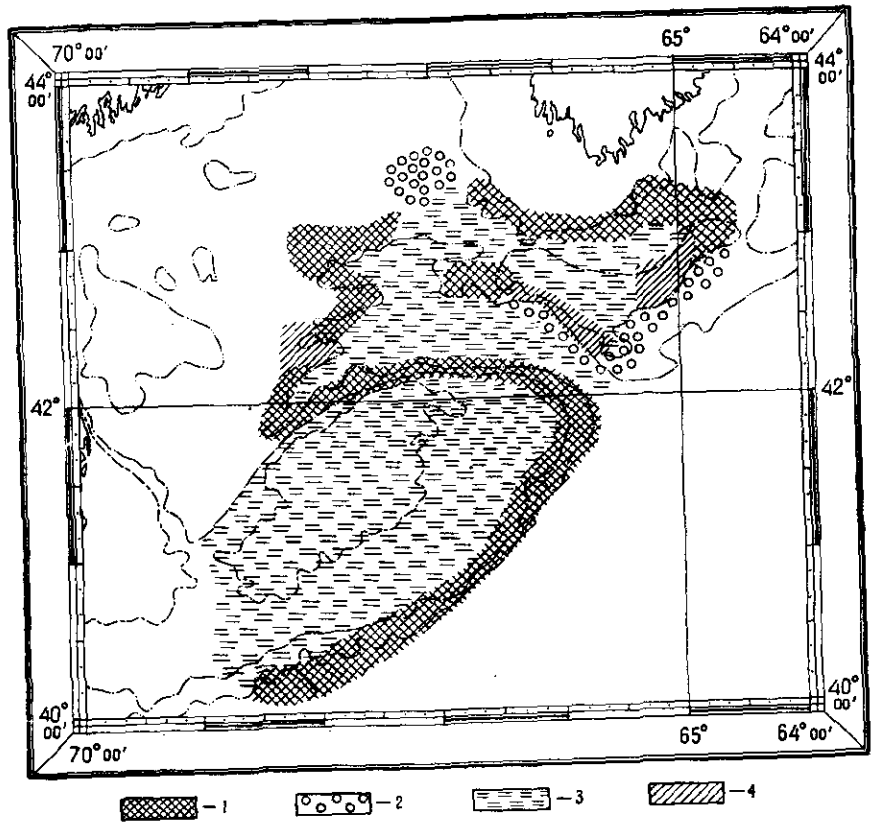


Fig. 14. Plankton distribution, Division 5Z, June 29-July 3, 1962.
1. Calanus finmarchicus from 100 to 250 mg/m^3.
2. Calanus finmarchicus up to 500 mg/m^3.
3. Phytoplankton. 4. Calanus finmarchicus, Euphausiacea.

During May and June the feeding herring moved from one area to another. This led to corresponding movements of the fishing fleet. Thus, on the northern slopes of the Bank, where herring concentrations were present almost continuously from May to October, 90% of the time during this period in 1962 was spent on active fishing operations. On the southern and southeastern parts of the Bank the fishing fleet conducted operations in May and June. In July-August herring formed the pre-spawning concentrations on the northern slopes and remained there till spawning terminated in October. In October separate shoals of post-spawning herring moved along the slope to the eastern part of the Bank, and from there proceeded first to the north, then to the northwest into the Gulf of Maine.

c. Feeding of herring. Feeding was very sluggish in March-April, both in 1961 and in 1962. According to the data collected by Ju. K. Benko and A.P.Wilson, over 50% of analysed herring had empty stomachs. Stomachs of those feeding contained such items as Euphausiacea, C. finmarchicus, phytoplankton, and young sand eels.

During this period herring normally remain in the near-bottom layers in the daytime, and rise to the surface at night. However, in certain areas where concentrations of food organisms could be observed, herring were feeding intensively during this period as well. For example, in April 1962, herring were feeding actively on the spawning concentrations of Euphausiacea in the southeastern part of the Bank and remained at the surface both day and night.

In May a sharp increase in the numerical strength and biomass of C. finmarchicus was observed almost everywhere. The biomass reaching the maximum value in June. In the middle of June 1962 the biomass on the northern slopes of the bank was 500-1000 mg/m^3 and 100-150 mg/m^3 on the southern slopes. May-June is the period when the feeding of herring reaches its highest point. It was during this period that a relatively fast growth and accumulation of fat were observed. According to the unpublished data collected by senior scientist of the Atlantic Institute Dr. Rulev, the fat content increases from 3% in May to 14% in June. By the end of June, when the numerical strength of C. finmarchicus has markedly decreased, feeding of herring became less intensive. In July-August the main item of the herring's diet was Euphausiacea. From that period herring remained continuously on the bottom, whereas in May and June they kept mainly in the water thickness during the day-time, ascending to the surface at night. For this reason the drift net fishing is most efficient from April till July and trawl fishing from August till October.

The fat ratio achieves maximum value (16%) in July and declines in August because this period is characterised by intensive development of gonads. During the spawning season in September-October the amount of fat drops to 4.5% decreasing still further during the winter season. In April the percentage of fat was as low as 1.4%.

d. Spawning of herring. Georges Bank herring reach maturity at the age of 4 years and since the majority of herring (over 80%) in 1961-1962 were of 4 years or

older, the main mass of herring was composed of mature specimens. Fig.15 shows that in spring 1961 the main mass of herring were sexually mature and only a small proportion remained immature.

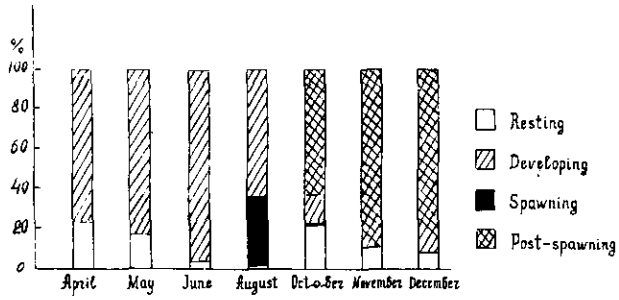


Fig. 15. Herring, Division 5Z, April-December, 1961. State of maturity.

Intensive development of sexual glands was taking place in June-July, and in the end of August part of the specimens were sexually mature. Spawning was at its height in the first half of September and continued through the end of October. Spawning took place in the northern part of the Bank at 50 to 150 m. In 1962 the development of gonads followed the same course as in 1961. Spawning took place in the same area, however its peak was observed somewhat later - in the middle of September.

X. United Kingdom Research Report, 1962

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

Commercial Fishing

Catches from the ICNAF area increased in 1962, to nearly 25,000 tons, compared with just over 15,000 tons in 1961. This was mainly due to a big increase in the catches from Subarea 1 (16,000 tons compared with 7,400 tons). Catches from Subarea 2 increased, but those from Subarea 3 decreased slightly.

The increased catches of conventional trawlers fishing at West Greenland was due to an increased amount of fishing rather than an increased stock, as the catch per hour's fishing in fact fell from 0.98 to 0.94 tons.

Sampling

Routine length sampling was continued at Hull and Grimsby markets, where 1,500 and 2,800 cod respectively were measured, and on board factory ships, where 33,000 cod and a few haddock, redfish and pollock were measured. Details will be given in the Sampling Yearbook.

Research Vessels

R/V ERNEST HOLT made a cruise to Labrador waters in late November. Seven groups of trawl hauls were made between 52°20' N and 55°30' N, most of them around the Hamilton Inlet Bank.

The best catches of cod were about 3,500 lb per hour. 372 cod were marked with yellow plastic flag tags. The Canadian hydrographic section north-east from Seal Islands was worked on 26th and 27th November.

On the homeward passage the section from St.John's to Flemish Cap was worked between 4th and 6th December. (An account of this cruise with details of the hydrographic sections is presented in 1963 Meeting Document #30. Cod age and lengths will be published in the Sampling Yearbook).

Although she did not operate west of Cape Farewell, R/V EXPLORER spent part of a cruise in waters to the southwest of Iceland, investigating the distribution of redfish larvae. Results were in close agreement with those found by the Continuous Plankton Recorder (see below).

Environmental Studies

Continuous Plankton Recorders were towed at monthly intervals throughout the North Atlantic. In the ICNAF area, Danish, Icelandic and British ships provided over

18,000 miles of sampling (compared with 7,500 miles in the previous year). One new route was introduced, through the co-operation of the Royal Greenland Department of Trade and the officers and crew of M/S UMANAK. The route provides sampling between Scotland and Cape Farewell and, as far as the ice allows, northwards along the west coast of Greenland.

A special attempt was made to sample the adults of the Sebastes young stages which appear every year in large numbers in the Plankton Recorder samples from the south and southwest of Iceland. The crews of British and Dutch weather ships were asked to use a rod and line whilst the ships were on duty at weather station ALFA (62°N: 33°W). A total of 120 adults were taken, mostly from a depth of 120 metres. Most of the fish were females and they yielded valuable information about food, parasites and the morphology of the young. All the fish were of the mentella type but their young were without the caudal melanophores and would previously have been described as S. marinus.

Among other topics studied from material collected in the ICNAF area have been the distribution of cold- and warm-water plankton off the Grand Banks of Newfoundland, the distribution of Ophiopluteus ramosus (of which the adult is unknown) and the distribution and morphology of Calanus finmarchicus and Calanus glacialis. As material from this area accumulates, it will be incorporated into a general study of variation in the plankton of the North Atlantic.

The survey was supported by a grant from Her Majesty's Treasury and by contract N62558-2834 from the Office of Naval Research of the United States Navy. Two Research Fellows from the United States joined the staff of the Edinburgh laboratory in 1962. The management of the survey was eased by the collaboration of members of the staff of the Icelandic Fisheries Research Institute and the Woods Hole laboratory of the US Bureau of Commercial Fisheries.

XI. United States Research Report, 1962
by Herbert W. Graham

Analysis of commercial landings statistics has been greatly facilitated by the installation of a data processing unit at the Woods Hole Laboratory of the Bureau of Commercial Fisheries. Analyses are now being made on a back log of data relating to species previously neglected and to many aspects of the major species which previously could not be treated because of the enormity of the mass of data.

Surveys in Subareas 4 and 5 were made using primarily the Bureau's research vessel DELAWARE and to a lesser extent charter of small fishing vessels. Nine cruises, averaging two weeks each, were made by the DELAWARE in groundfish research, and two in herring research.

HADDOCK (Melanogrammus aeglefinus (L.))

The Fishery. Georges Bank is the main source of haddock to the US fishery. During the period 1957-61 about 75 percent of the landings came from Georges Bank (Division 5Z), 10 percent from the Gulf of Maine (Division 5Y), and 15 percent from Browns Bank (Division 4X). Average landings from Georges Bank in this period were 79 million pounds. This was 10 percent below the 1931-60 average of 89 million pounds. In 1962, US landings from Georges Bank were 9.3 million pounds and from all areas 115 million pounds.

The comparatively high figure for Georges Bank in 1962 was probably due to an increased abundance over levels of the few years preceding. The mean catch per day for Georges Bank for the period 1931-60 was 13,000 pounds. For the period 1957-61 this had dropped to about 10,000 pounds. In 1961 the index was back up to 13,000 pounds per day and the estimated figure for 1962 is about the same. The fact that larger fish were landed in 1962 may indicate some change in fishing habit in reference to change in size composition of the populations.

These recent fluctuations in abundance have been due to variations in strengths of year classes (Fig.1). The lower figures for the period 1957-60 were due to a succession of weak or moderate year classes. The relatively strong 1958 and 1959 year classes account for the increased abundance in 1961 and 1962.

Abundance is expected to remain high until the summer of 1963 when scrod abundance probably will decline because of the apparently weak incoming 1960 year class. Catches of young-of-the-year haddock in the 1961 and 1962 fall surveys suggest that the broods for these years are also weak.

Canadian - United States 4X Program. This program was started in 1956 and included the exchange of catch-effort statistics and size-age samples between the US and Canada, with the US assuming primary responsibility for analyzing commercial

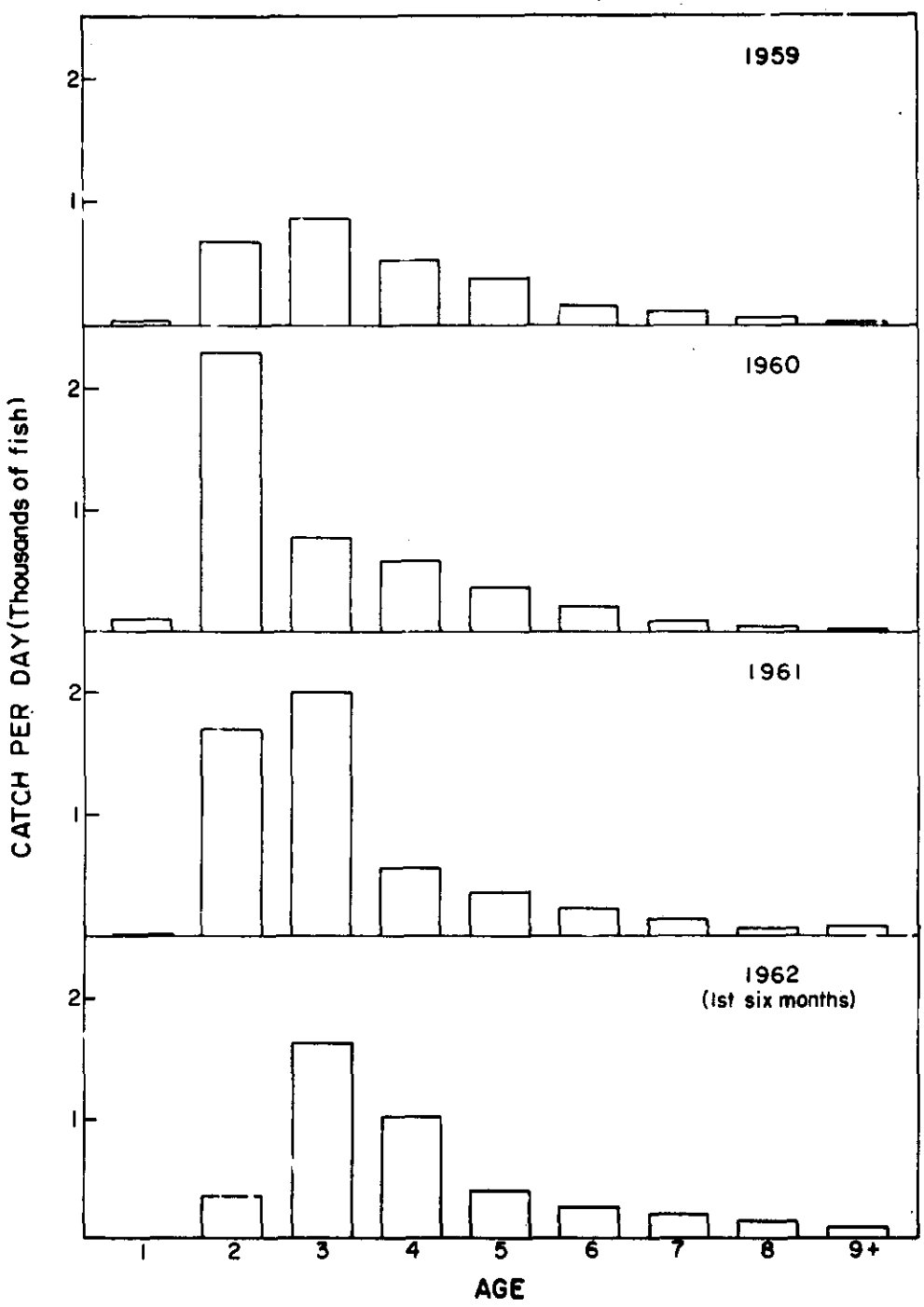


Fig. 1. Georges Bank Haddock. Catch per day (thousands of fish) at each age. 1959-1962.

landings. During the initial stages of this program a backlog of otoliths accumulated. These have now been read and a preliminary analysis of all the data has been completed. A preliminary report has been discussed by Canadian and US biologists at a joint meeting and some of the findings are presented here.

The average age of haddock in the Browns Bank landings is higher than for Georges Bank. About 90 percent (by number) of first quarter landings from Browns Bank is composed of ages 4-8, whereas the same proportion of first quarter Georges Bank landings is composed of ages 3-7 (Fig.2)

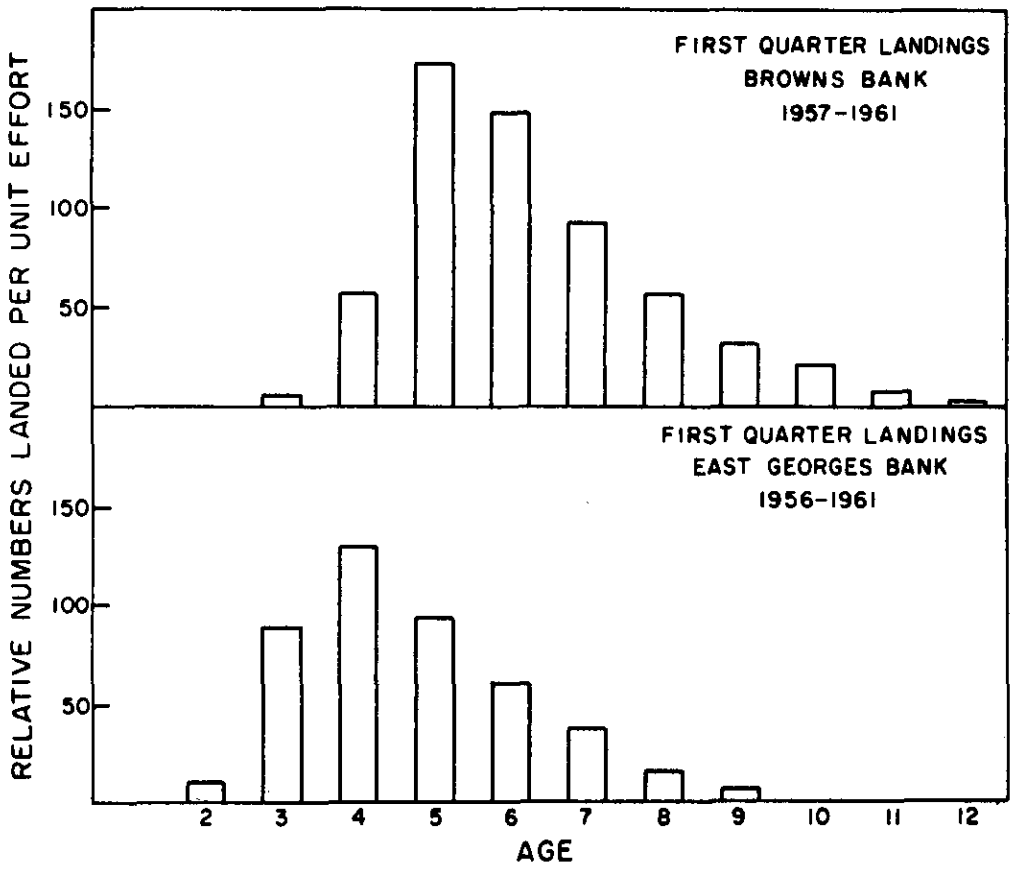


Fig. 2. Age composition of haddock landings from Georges Bank and Browns Bank.

Catch curves based on first quarter age compositions show that recruitment into the spring fishery is completed between ages 4 and 5 on Georges Bank, and between ages 5 and 6 on Browns Bank (Fig.3). After full availability to the gear, the relative abundance of comparable ages in the spring appears to be substantially higher on Browns Bank than on Georges Bank. The estimated total annual mortality rate for age 6 and older is 42 percent for Browns Bank as compared to 50 percent for Georges Bank.

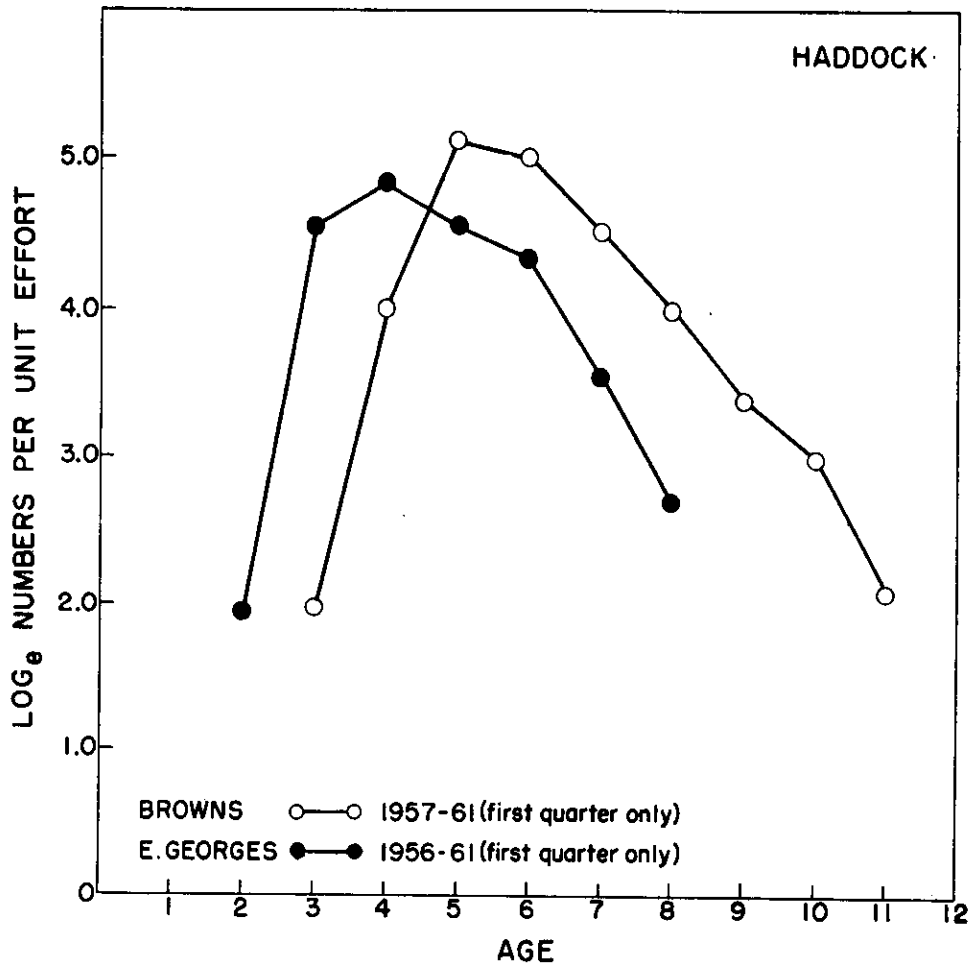


Fig. 3. Catch curves for haddock from Georges Bank and Browns Bank.

Georges Bank haddock grow faster than Browns Bank haddock and the average difference in length increases with age (Fig. 4).

COD (Gadus morhua L.)

The Fishery (Table 1). The 1961 landings which amounted to 32 million pounds represented a 10-year high, exceeded only by the 36 million pounds landed in 1951 and the preliminary estimate for 1962 is somewhat higher than the figures for 1961.

Previous peak landings were recorded in 1958 and again in 1959 when the trawlers brought in more cod to compensate for the scarcity of haddock at that time. When haddock again became abundant, as in 1960, cod landings decreased slightly. It is interesting to note, however, that in 1961, when scrod haddock landings were the heaviest they had been in 5 years, cod landings also increased. This may have been due to an increased market demand for food fish of all species.

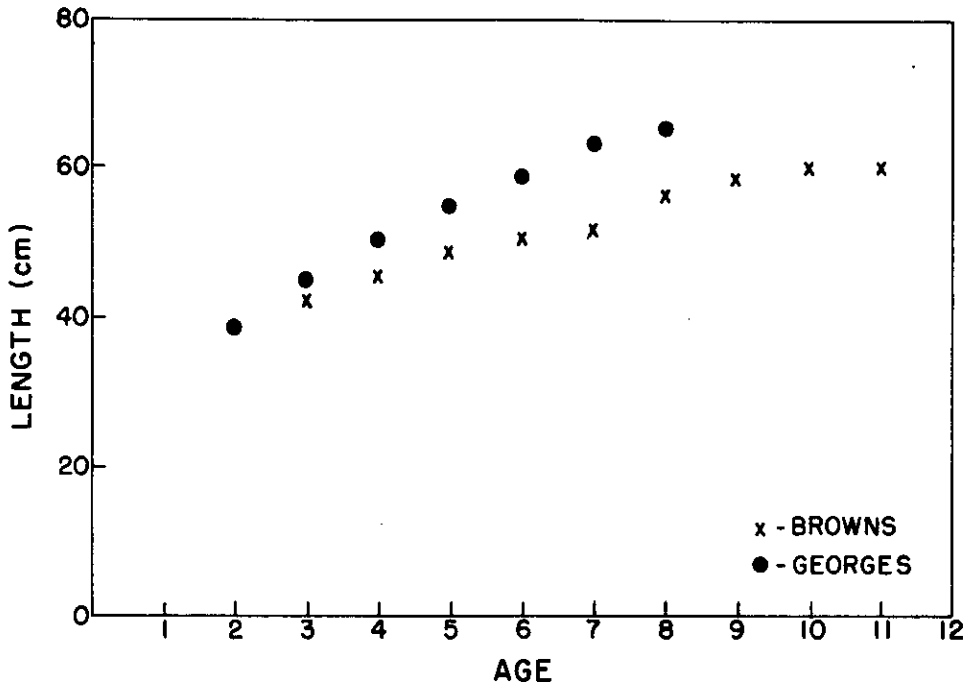


Fig. 4. Mean length at each age in commercial haddock landings from Georges Bank and Browns Bank.

Studies of commercial landings and research vessel catches, and our knowledge of the biology of the species, suggest that cod will be abundant on the traditional New England fishing grounds in 1963. Our research in the coming year will be directed in part to monitoring the commercial landings, particularly the length and age composition of the catch.

Table 1. Trends in the cod fishery (New England ports, gutted weight in 000's pounds).

Year	Landings
1957	24,177
1958	29,857
1959	30,559
1960	26,117
1961	32,442
1962 (estimated)	32,713

SILVER HAKE (Merluccius bilinearis (Mitchill))

The Fishery. Landings of silver hake have shown a steady decline since 1959 due first to a decline in the industrial fishery and then to a decrease in landings for food (Table II). A good index of abundance for this species has not yet been developed but there is no reason to believe that abundance has changed markedly over the last few years.

Research. Silver hake undergoes a pronounced seasonal migration, retreating to deeper offshore waters in the winter which results in extreme variations in availability. The fishery accordingly is markedly seasonal. More information is needed on the winter distribution of the species and on the relation of this species to depth, temperature, and other ecological factors. This kind of information is now emerging from an analysis of past survey cruises which are conducted mainly in summer and fall but will not be adequate until the new year round program of groundfish surveys is initiated.

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

Year	For Food	For Industrial	For Animal Food	Total
1957	117	38	16	171
1958	107	23	17	147
1959	110	26	20	156
1960	103	5	20	128
1961	84	7	10	101
1962	60	7	16	83

FLOUNDER

The Fishery. The high level of New England flounder landings in recent years has been due largely to increases in yellowtail flounder abundance (Table III). Of particular importance to the high yellowtail landings for 1962 were contributions from the strong year classes of 1958 and 1959. Landings of fluke dropped sharply in 1962. (Fluke length and age data now available are insufficient to show the reason for this decline.)

Table III. Flounder landings (millions of pounds).

Species	1958	1959	1960	1961	1962-Preliminary
Yellowtail flounder (Limanda ferruginea)	32.8	29.0	29.9	37.1	53.1
Blackback (Pseudopleuronectes americanus)	14.1	14.3	17.1	17.5	16.3
Fluke (Paralichthys dentatus)	5.5	5.5	6.7	6.3	4.2
Dab (Hippoglossoides platessoides)	3.0	3.1	3.0	3.5	4.0
Graysole (Glyptocephalus cynoglossus)	3.1	2.9	3.1	2.6	2.2
Total	58.1	54.8	59.8	67.0	79.8

Yellowtail fishing effort and relative abundance, as shown by landings per day for the three New England grounds, was calculated from fishing trip weighout schedules for the port of New Bedford for 1943-61. Fluctuations in landings were found to be largely related to abundance changes. Shifts in fishing effort generally followed the changes in abundance. Relative abundance was highest from Georges Bank, an offshore ground, and lowest from the Cape Cod ground, which is inshore. Trends in abundance were similar on all three grounds, suggesting that factors affecting year class strength operated on all grounds simultaneously.

Tagging Experiments. Of the 4,960 yellowtail flounder tagged in 1955, 1957, and 1959, 1020 tagged fish representing 20.6 percent of those released, were recaptured. Analysis of the returns show a definite seasonal pattern of movement which repeated in each of the three years. There is an easterly migration in the spring and summer and a westerly return in the fall and winter.

The high abundance of yellowtail flounder in 1962 was due to the presence of three strong year-classes: 1958, 1959 and 1960. These year-classes will continue to support the fishery in 1963 so this year should also be a good one for the yellowtail fishery.

REDFISH (Sebastes marinus)

The Fishery. Judged from preliminary catch data, the 1962 United States redfish landings will total approximately 122 million pounds, the lowest annual total since 1944 (Fig.5). This represents a continuation of the steady decline in United States redfish landings since 1951, to a level of about half the average annual landings for 1948-51, the peak period in the fishery.

Abundance Studies in the Gulf of Maine. United States landings from the Gulf of Maine have declined steadily since the peak year of 1941 (Fig.6). Landings and fishing effort data for the entire Gulf of Maine do not show evidence of replenishment of the redfish stocks as would be expected to result from an extended period of diminished fishing effort following the initial reduction of the accumulated fish stocks. Detailed studies of the data from smaller areas within the Gulf were undertaken to determine the effect of heavy exploitation on small, isolated redfish stocks that were fished heavily in the early years of the fishery, and then received several years of light fishing intensity (Fig.7).

Data from US Statistical Subarea XXII F (groundfish unit area F of ICNAF Division 5Y) are representative of trends in other areas in the Gulf (Fig.8). The fishery began there in 1936, rose rapidly to a peak of 70 million pounds by 1941, and declined quickly to less than 21 million pounds by 1949. Landings from that area have fluctuated between 12 and 25 million pounds each year since that time.

Growth of Tagged Fish. A tagging experiment is currently in progress at Eastport, Maine, on the redfish stock that occurs there. Results during the past year

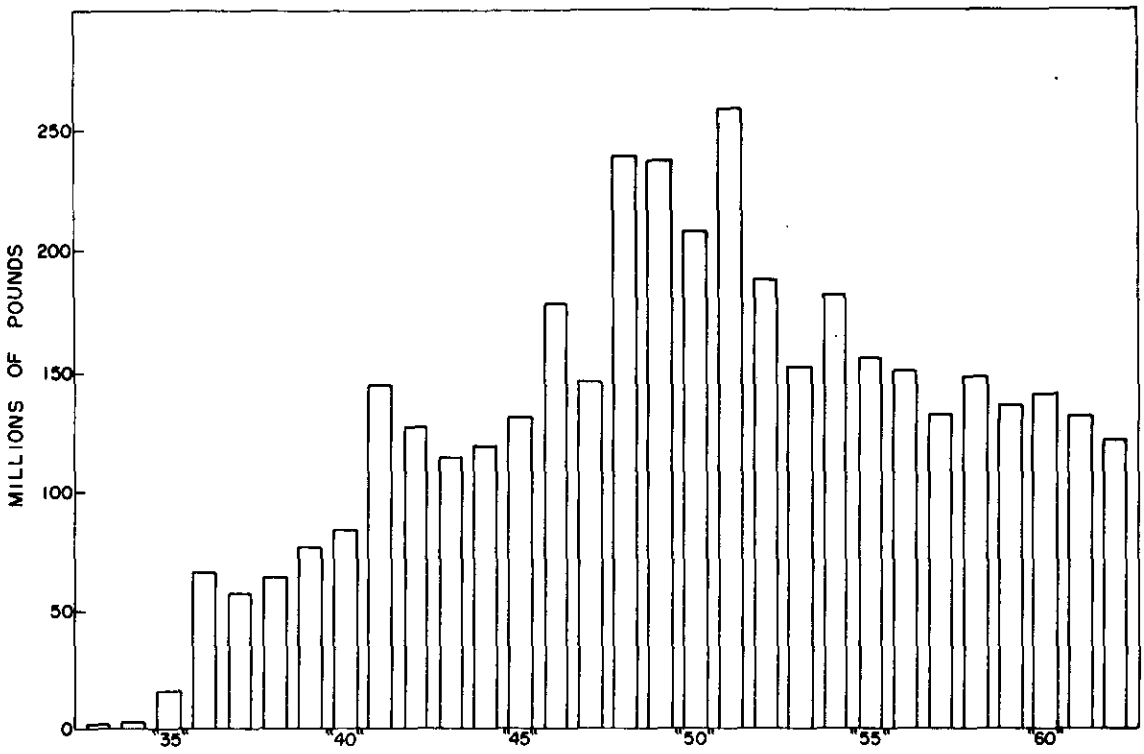


Fig. 5. United States Redfish Landings - 1933 - 1962.

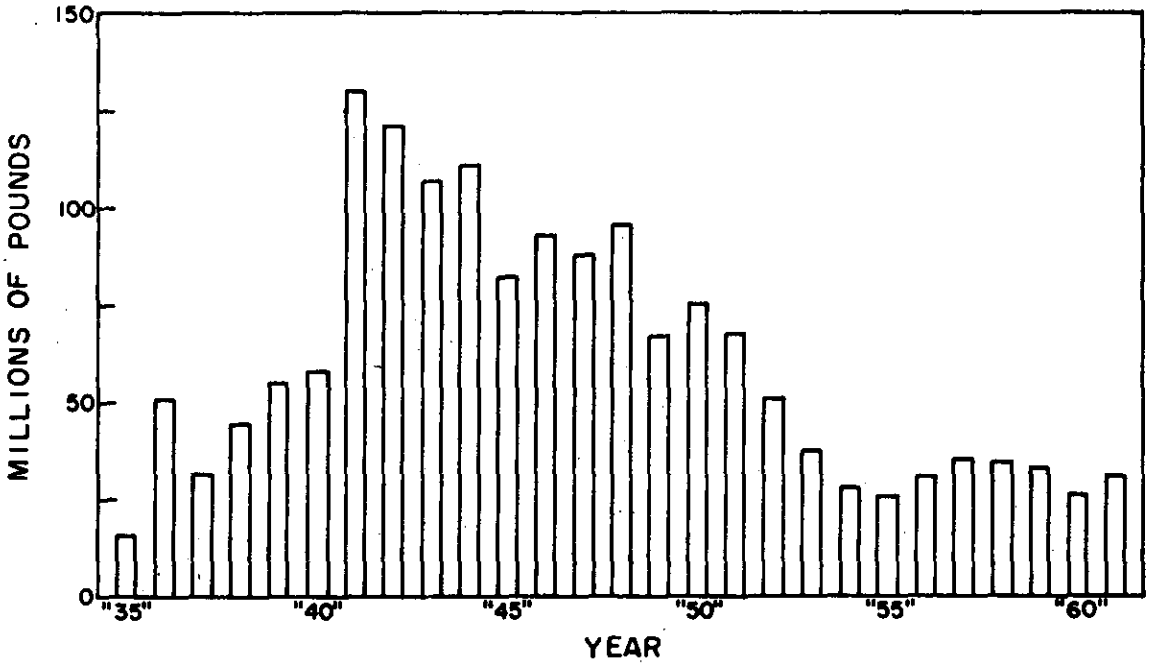


Fig. 6. Trends in Redfish fisheries - Gulf of Maine landings.

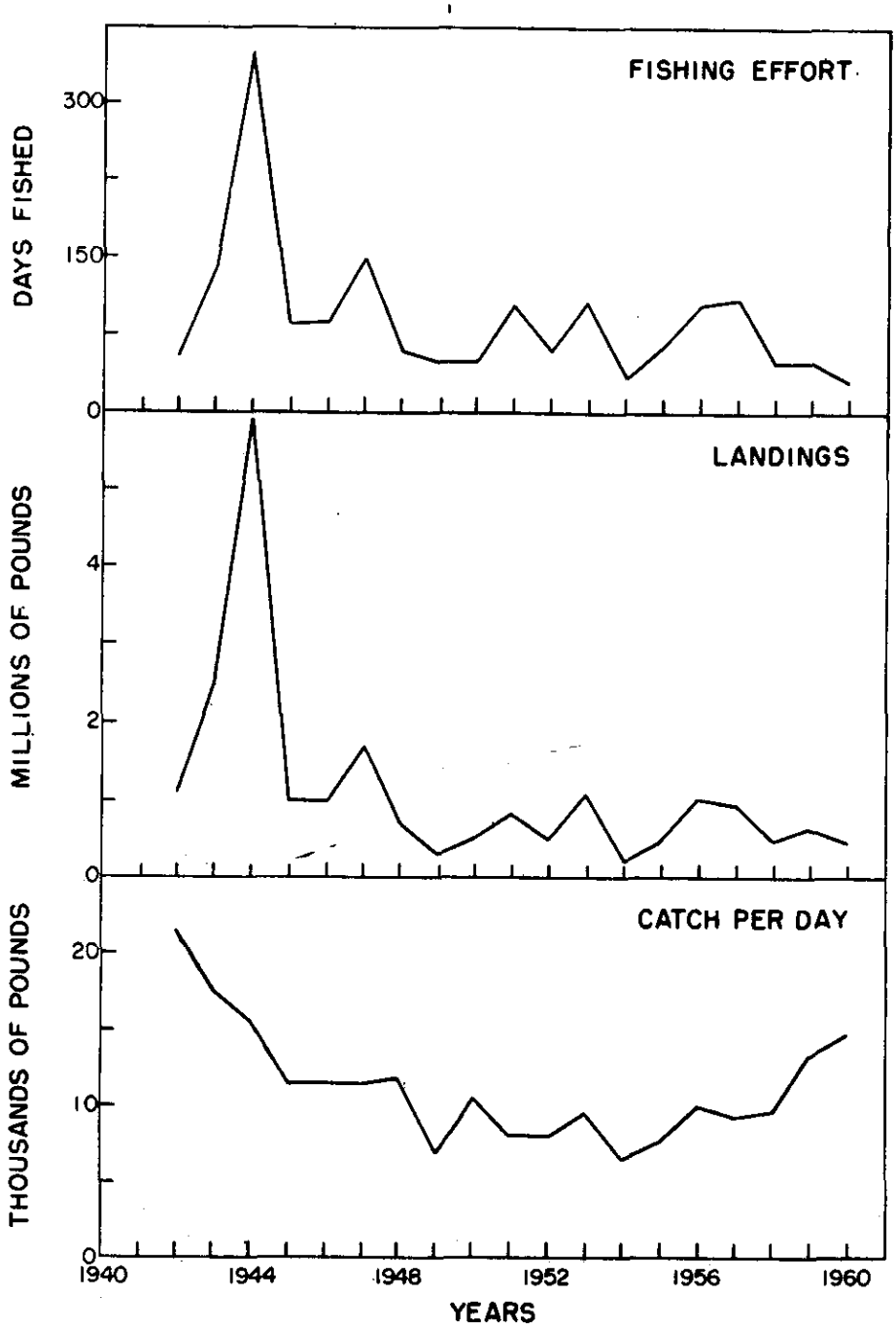


Fig. 7. Redfish catch and effort data for small interview area (42-68 B,C,D-1) of U.S. statistical area XXII F (groundfish unit area F of ICNAF Division 5Y) in central Gulf of Maine, 1942-1960.

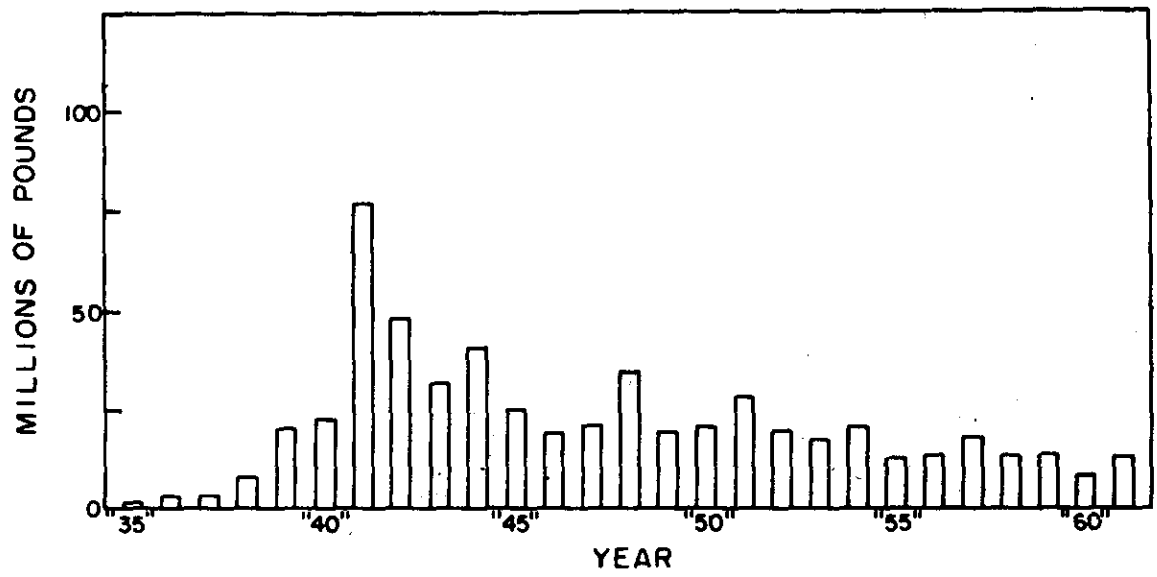


Fig. 8. Trends in Redfish fisheries - landings from U.S. statistical subarea XXII-F (groundfish unit area F of ICNAF Division 5Y).

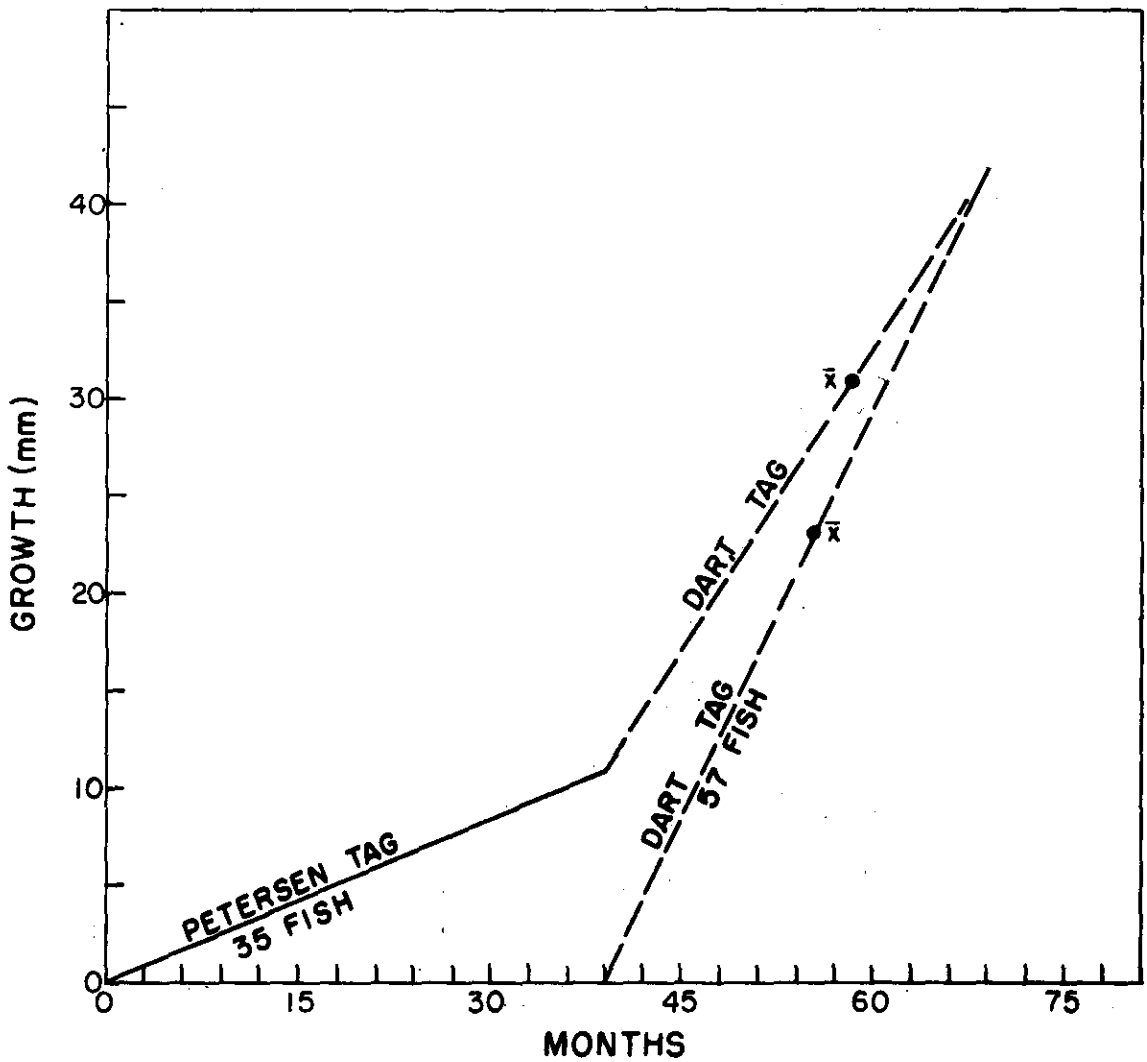


Fig. 9. Comparative growth rates of redfish tagged with two types of tags.

have demonstrated dramatically the effect that different types of tags can have on the growth rate of tagged fish.

Earlier experiments had shown the growth rate of fish to be reduced to about 1 mm per year when they were first tagged with Petersen disc tags on the opercle. After two or three years of living with the opercle discs, the growth rate slowly increased toward the normal growth rate of the untagged fish. In the present work, we were able to remove Petersen disc tags from fish that had carried them for years and replace them with small plastic dart tags placed in the flesh of the dorsum. The recapture of a large number of these fish has shown them to be growing at the same rate as fish tagged for the first time with dart tags (Fig.9), and very close to the rate of growth of the untagged fish.

Thirty-five fish tagged initially with Petersen discs on the opercle grew an average of 11 mm in 39 months. When the tags were removed and plastic dart-spaghetti tags were inserted in the flesh of the dorsum, growth rate increased to an average of 20 mm in 19 months. The higher growth rate approached that of a group of 57 fish tagged with dart tags from the outset.

In this instance it would appear that the influence of the tag has been primarily caused by the position of attachment rather than any special attribute of the tag. The Petersen tag clearly inhibits growth, whereas the dart tag does not.

GROUNDFISH ECOLOGY

This program depends largely upon surveys conducted by research vessels operating throughout the area of interest through all seasons of the year for a number of years. Analysis of the accumulated data is not a simple task. For example, it has been found that comparisons of abundance of young of the year haddock cannot be made between years without taking into consideration the relative number of tows made at night and in the daytime since there appears to be a diurnal difference in availability of these fish on the bottom.

Table IV shows a comparison of abundance indices for day and night tows for haddock of different ages. It is evident that haddock under 2 years of age are more available to an otter trawl in the night time while haddock over 2 years of age are more available during daylight hours. The latter observation is known to the commercial fisherman.

Further investigation of the ecology of groundfish will undoubtedly reveal other environmental factors which must be taken into consideration in refining our estimates of abundance which are based on comparative data.

Table IV. Comparison of day and night catches of haddock. Research vessel tows during September, 1953, and 1955, November, 1956, and September-October, 1958.

		Day (0730-1629)			Night (1930-0429)		
		Number of Tows	Number of Fish	C/T	Number of Tows	Number of Fish	C/T
Age Group 0	1953	35	30	0.9	24	32	1.3
	1955	46	218	4.7	53	732	13.8
	1956	34	72	2.1	37	58	1.6
	1958	46	264	5.7	50	1216	24.3
	Total	161	584	3.6	164	2038	12.4
Age Group I	1953	38	33	0.9	24	2	0.1
	1955	42	45	1.1	54	349	6.8
	1956	35	74	2.1	37	48	1.3
	1958	46	286	6.2	50	548	11.0
	Total	161	438	2.7	162	947	5.8
Age Groups II and greater	1953	28	33	1.2	24	17	0.7
	1955	42	466	11.0	51	256	5.0
	1956	35	285	8.1	37	212	5.7
	1958	46	958	20.8	50	732	14.6
	Total	161	1753	10.9	162	1217	7.5

POPULATION DYNAMICS

The Woods Hole Laboratory has recently installed an automatic data processing unit which has greatly increased the Laboratory's ability to analyse the accumulation of back data as well as the voluminous quantity of current data which flows in from the fishing ports.

In our population dynamics studies emphasis has been placed on developing methods for computing indices of abundance and effort, for estimating size and age compositions of stocks; and in investigating mathematical models to which these variables may be applied to describe the effects of fishing.

Abundance indices. A proper, standard measure of catch-per-unit of fishing effort is needed to provide a relative index of abundance of commercial stocks, and to provide a means of measuring total effective fishing intensity. Our investigations depend quite critically upon this index. We are, therefore, devoting time to study and further development of such indices for the various species of commercial importance.

Of particular concern in our mixed fishery is the problem of species directed fishing effort. Because of differential temporal and spatial variations in distribution

of the various species, the fisherman can direct, to some degree, his efforts so that the probability of catching one species or another is substantially increased. A common procedure has been to use, for calculating relative abundance of a given species, only those trips for which the amount landed is greater than some arbitrarily chosen proportion of the total. The proportion of the catch made up of a species is related to the abundance of the species itself, however, and there is a definite upward bias introduced which is particularly important when the range of abundance experienced is great. An illustration of this effect is provided by comparing the landings-per-days-fished of silver hake by medium-sized otter trawlers landing in Gloucester, 1960, as estimated from (A) all trips and (B) those trips in which silver hake were greater than 50 percent of the total (Fig. 10). The A index is generally lower and indicates a sharper seasonal index of what we purport to measure; the magnitude of the stock at the time and in the area concerned.

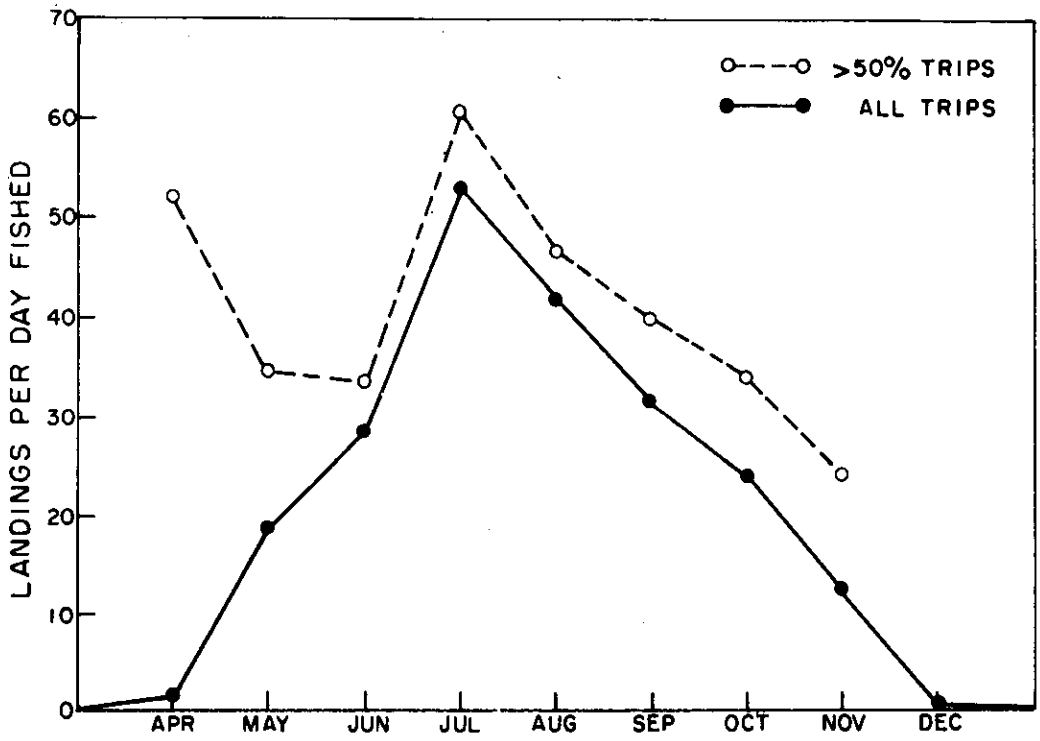


Fig. 10. Silver Hake Gloucester OTM 1960.

Mesh Assessment. We have continued to study the effects on yield of changing the size of mesh in cod ends of trawl nets. This work is co-ordinated by the mesh assessment working group of ICNAF. Most of the results of these studies are summarized in the "Report of Working Group of Scientists on Fishery Assessment in Relation to Regulation Problems" published this year by ICNAF as a supplement to the Annual Proceedings, Volume 11, and will not be repeated here. The main conclusion is that in most instances very moderate increases (on the order of 5 percent) in yield-per-recruit would be obtained by increasing mesh size beyond that now in use. A rather more important aspect is the effects on yield of increasing fishing intensity being experienced in Northwest Atlantic waters, and the working group is now emphasizing studies of this.

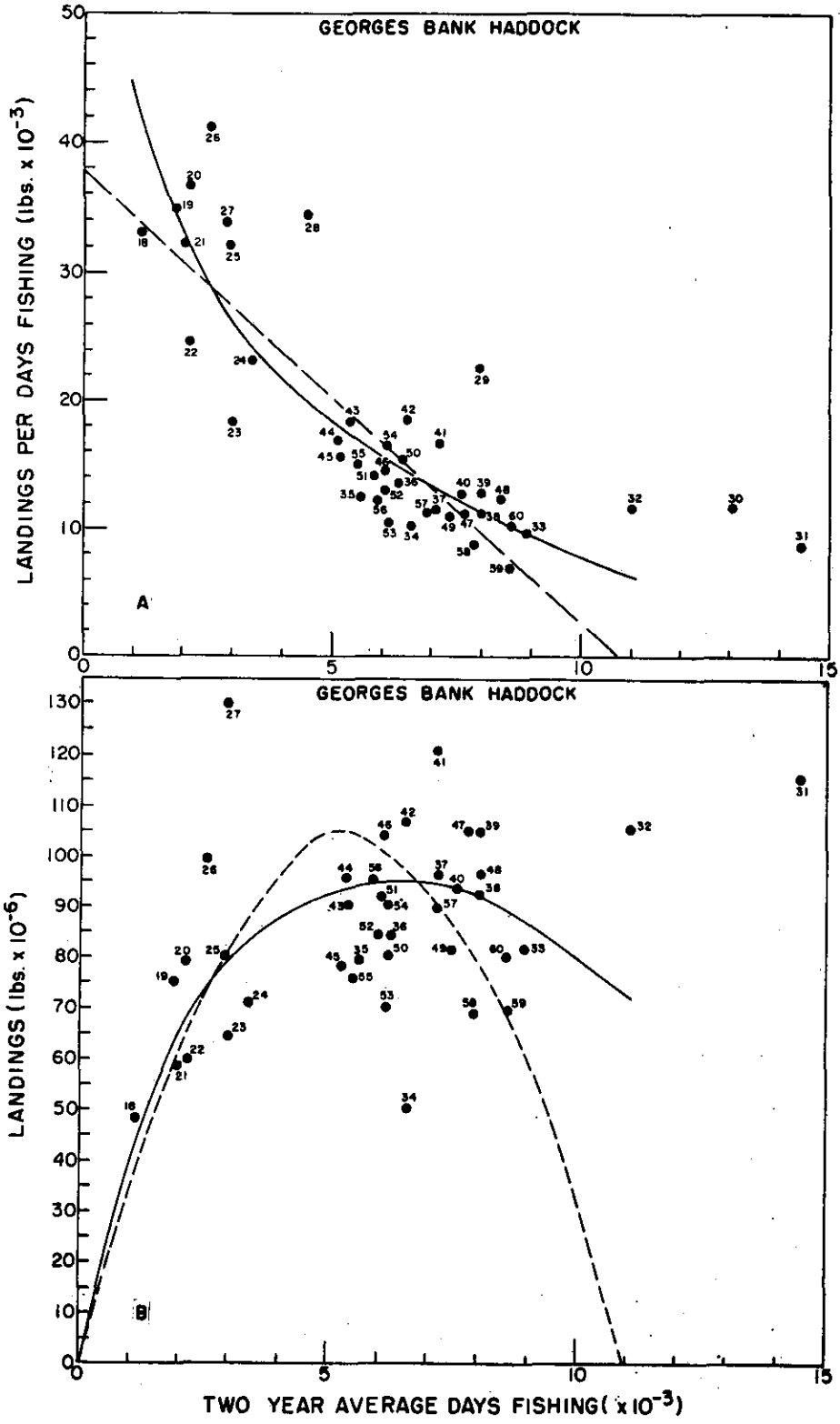


Fig. 11. Haddock yield.

Haddock yield. Data on the landings of haddock caught on Georges Bank have been collected since 1931. These data have enabled us to calculate an index of apparent abundance, in terms of landings-per-standard days fished, and estimate the total effort experienced in each year since 1919. A standard day is that fished by a selected group of large otter trawlers fishing in depths of 30 to 60 fathoms.

Landings-per-days-fished in a given year has been plotted against the two year average of days fished culminating in the given year (Fig. 11a). The observed relationship between these two variables indicates a definite drop in apparent abundance with increasing fishing intensity. A straight line was fitted to these data to approximate the equilibrium, or long-term average relationship. The landings are also plotted against effort, and fitted with a curve derived from the linear relationship above (Fig. 11b).

The analysis indicates that the maximum equilibrium yield is in the neighbourhood of 100 million pounds annually, and at the level of 5 to 6 thousand standard days fishing. A curved line was also drawn in by size, because the landings-per-day and effort variables may be more closely related by a slightly curvilinear relationship, although the variability of the data precludes a more refined estimation at the present time. The curvilinear fit would have the effect of lowering somewhat the maximum yield and increasing the effort level at which it would be obtained to between 6 and 7 thousand standard days.

In either case, recent levels of effort of over 8 thousand standard days exceed that corresponding to the maximum yield, and further increases in fishing intensity would not, in the long run, increase landings; rather it seems more likely the landings would decrease.

It is of interest to note the rapid increase in landings and effort from 1926 to 1932, apparently stimulated, at least in part, by an increase in abundance in 1926 and 1927. The high effort levels quickly produced a drop in landings-per-day and landings in the years 1930-34, so that by 1935 all three variables had returned to a point close to the estimated equilibrium condition. Because of the non-equilibrium state, the data points for the years 1926-33 were not used in fitting the curves.

HERRING

United States research on herring in the past has been concentrated on the younger stages which support the sardine industry, but recently attention has been directed toward the larger problems of the populations throughout the Gulf of Maine and on Georges Bank.

A statistical system set up in 1947 is providing detailed information on the US landings, some of which is imported from Canada.

Abundance of the sardines is difficult to estimate since there is evidence that

availability to the traps or inshore seines is extremely variable. Success has been achieved in age reading of otoliths so that age determinations can now be made of fish three years old and younger. The US catch is being sampled for age composition of the sardine sizes.

Subpopulations of herring are studied through serological techniques and some meristic work. A new blood group has been found which is a valuable addition to the many factors which must be used to differentiate the subpopulations in the Gulf of Maine. So far nothing has been found to associate the Maine sardine definitely with Georges Bank herring.

Offshore populations are studied for age structure and other population characteristics of all known spawning groups, and sampling of the Georges Bank area for adult and larval herring is under way.

Behaviour and migration studies concentrate on understanding the nature of and reasons for the inshore movements of immature herring. The final experimental phases in development of a suitable long-term herring tag should be completed this winter, and a major tagging effort is planned.

Studies designed to shed light on the environmental factors that control or affect the abundance and availability of herring are divided into two parts: (1) surveys in the Sheepscot-Boothbay-Damarascotta area of Maine where 18 stations are established in three somewhat different environments: Lower estuary, Bay area, and combined weak lower estuarine and Bay, and (2) surveys inshore along the Maine coast. Measurements are made of temperature, salinity, density, currents, transparency, and plankton collections are made monthly. There appears to be a peak in abundance of larvae during the period September-November and sometimes a secondary peak. The collected data are being analyzed to determine the critical period in the life history as related to environmental conditions.

SEROLOGY

In the summer of 1961 attention was directed toward developing a technique for distinguishing haddock blood groups. Blood samples have been processed from about 700 haddock and although problems still remain with storage and processing techniques, some encouraging results have been obtained in finding blood groups.

Tests for isoagglutinations, haddock blood cells vs. haddock blood serum, were run using more than 3600 individual cross-matches with practically no differential results. It was concluded that naturally occurring isoagglutinins in haddock have a low frequency of positive tests and are low in strength of reaction or titre. Consequently isoagglutination tests are not a useful tool in haddock serology.

Heteroagglutinations, haddock blood vs. blood of other species have been made

between haddock blood cells and/or sera and a variety of potential agglutinins such as seed extracts and blood serum from other marine organisms, including four arthropods and 21 fish species. Among these, the best differential agglutinations were obtained in several experiments with inshore blackback flounder serum, and at least three distinct antigen types were distinguished by the absorption technique in one sample of 20 haddock. Problems in obtaining samples and storage of blood made it desirable to seek other reagents, and further tests have not been made with blackback serum.

Tests were conducted with anti-haddock serum from rabbits and chickens, but so far no differential results have been obtained. Still another test matched blood sera from 90 haddock against Hemantigen (a commercially available product containing human type-O cells with many known secondary groupings) with only one questionable agglutination.

Best results have been obtained between haddock cells and rabbit anti-scup serum; every sample tested so far has yielded highly differential agglutinations. Recent tests on 204 haddock from several locations in the Gulf of Maine suggest that there might be gene-frequency differences between areas. Attempts will be made to test anti-scup serum with haddock blood samples from major haddock spawning grounds in March 1963, and also from the waters of eastern Nova Scotia and Newfoundland.

A final technique has been the electrophoretic separation of hemoglobin proteins. With this technique evidence has been reported for a simple two-allele system of hemoglobin types in whiting and cod in the Northeast Atlantic. Hemoglobin patterns have been obtained on 77 Gulf of Maine haddock and in virtually every case an identical 2-band pattern was observed.

SEA SCALLOPS (Placopecten magellanicus)

The Fishery. Pertinent statistics regarding the Georges Bank sea scallop fishery are presented in Table V. It will be noted that the total landings (United States and Canadian combined) increased markedly in 1959, and continued to increase through 1962; the 1962 figure being more than double that of 1959. This phenomenal and unprecedented increase was due to an increased abundance of the shellfish and an increased effort on the part of the Canadians. The days fished by US vessels actually dropped in 1959 and 1960, although US landings increased somewhat due to the high abundance of the scallops.

Abundance. The rather sudden increase in abundance that occurred in 1959 was due to an unusually large year-class of scallops that arrived at commercial size that year. This year-class supported the fishery for four years. It is now declining and we see no similar year-classes coming along.

We have three methods for estimating relative abundance; comparison of quantitative research vessel samples, landings per day on the grounds for the fleet, and

Canadian records of catch per minute towed on commercial vessels carrying sea samplers. For various reasons none of these gives a very precise estimate, but all of them show a decline for the marketable sizes (greater than 95 mm) of about 30 percent in 1962, as compared with 1961.

Table V. Statistics of the Georges Bank Sea Scallop Fishery.

	United States		Canada		Total	Average US Fleet	
Year	Landings lbs x 10^6	Effort Days	Landings lbs x 10^6	Effort Days	Landings lbs x 10^6	Landings per day	Gross Stock ($) per day
1953	16.3	10031	0.3	180*	16.6	1627	717
1954	15.5	9343	0.2	120*	15.7	1671	748
1955	18.3	11619	0.3	190*	18.6	1570	821
1956	17.5	12246	0.7	490*	18.2	1442	778
1957	17.3	10500	1.8	1197	19.1	1650	800
1958	14.4	8775	2.6	1598	17.0	1637	793
1959	18.7	8556	4.4	2098	23.1	2187	1057
1960	21.9	8039	7.5	2601	29.4	2722	949
1961	23.6	8671	10.0	3147	33.6	2719	1030
1962	21.9	9070	13.0*	5400*	34.9	2410	980

* Estimated

None of these methods gives even an approximate measure of the strength of the pre-recruit year-classes. We can say, however, that nowhere on the grounds sampled with the research vessel in 1962, was the year-class to be recruited during 1963 present in large numbers. It is possible, but we believe unlikely, that there are any large concentrations of this year-class in areas that we did not investigate.

BENTHIC STUDIES

Principal work performed by the Benthos Program during the past year was the quantitative benthic fauna study of: (1) the northern Gulf of Maine, and (2) the continental shelf south of Martha's Vineyard and Nantucket Island. Based on the analysis of 100 samples from the northern Gulf of Maine, the macroscopic benthic fauna was found to average 80 grams per square meter of bottom. The fauna was particularly dense (300-1000 g/m^2) off Penobscot Bay, Maine. Moderately dense concentrations occurred on Cashes Ledge and adjacent areas north and east of Cashes. In general, the benthic biomass in the western section of the Gulf of Maine was considerably lower than that occurring in the central and eastern parts of the Gulf. General comparisons indicate that the Gulf of Maine benthos is only about half as dense as that occurring on Georges Bank. Analyses of the samples from south of Martha's Vineyard and Nantucket have not yet been completed. However, preliminary results

indicate the presence of 5 macro-benthic faunal communities. Biomass at the shallow, inshore stations was moderately low (20-40 g/m^2), whereas over most of the shelf the biomass was moderate to very rich (50-300 g/m^2). Exceedingly high faunal density (over 1000 g/m^2) occurred at a few localities, usually associated with aggregations of mollusks. From the analyses made so far, the biomass and faunal composition in this area appears to be generally comparable to that occurring on Georges Bank.

The benthic studies program is providing a rich body of information on the distribution and abundance of bottom fauna which will be used in preparing charts of faunal types, and in providing very useful knowledge for an understanding of the nutritional support of our commercial bottom fish as well as an understanding of the ecosystem dynamics of the area.

HYDROGRAPHY - by Dean F. Bumpus, Woods Hole Oceanographic Institution

WHOI under contract with the USBCF has continued the Oceanographic Observation Post program throughout 1962 from Maine to Georgia at 15 offshore locations (lightships and towers) and at several shore stations. The drift bottle and sea bed drifter program has also been continued.

According to the data so far received from the oceanographic observation posts at Mt. Desert Light, Portland, Boston and Nantucket Lightships, Texas Towers Nos. 2 and 3 (Georges Bank and Nantucket Shoals), and Woods Hole, the temperatures of eastern New England waters were near normal during most of the year 1962. At Woods Hole the water was colder than normal in both November and December and this may prove to be the case also at the other stations when the data for those months are received.

In comparison with 1961 the temperatures of 1962 tended to be somewhat higher during the first half of the year and slightly lower in the latter half.

That the water temperatures remained near normal is perhaps surprising in view of the cold air temperatures which prevailed in New England. Boston, for example, had its coldest year since 1940, the average air temperature being only 49.8°F as compared with a normal of 51.4°F. Nine months, including the last six were colder than normal.

Salinity followed its usual course at most stations; higher in the cold months and lower in the summer and early fall.

At Portland lightship, where the minimum salinities normally occur in the spring following the maximum river runoff, the minimum average salinity was 30.68 ‰ for the month of May following the maximum of river runoff in April at the representative station on the Pemigewasset River. An unusual second peak in the runoff curve in October was followed by a freshening of the water at Portland lightship from 31.67 ‰ in

September to 31.24 ‰ in November. No salinity data are available as yet for October or December so that it is not possible to ascertain the minimum month.

The increase in runoff is attributable to high rainfall in October and November (as much as 300 % of normal in some areas in October) and in particular to a storm on October 5-7 which broke all existing records in eastern sections of New England.

One end product of the drift bottle program will be a series of charts depicting the non-tidal drift along the east coast of North America from Cabot Strait to the Straits of Florida. The reduction of the data for the years 1959, 1960 and 1961 to chart form is now completed. These charts will show on a monthly basis the direction and speed of the drift and also per cent recovery from 30 minute rectangles. The data for 1962 must be added to make the charts reasonably complete. It is apparent that departures from the normal condition of drift are quite frequent. For example, off the coasts of the Mid-Atlantic states the percent recovery of drift bottles released by lightships was higher this year, 1962, and also a large percentage of the bottles released during June and July at the lightships off that coast was recovered to the north, suggesting that the normal non-tidal drift to the south was interrupted and reversed from time to time, Figures 12 and 13. These data require further analysis as to the causes.

Sea bed drifters have become a really useful tool during the past year. Results suggest that the non-tidal drift along the bottom in the Gulf of Maine area is in the same direction, in general, as the surface drift, but about one tenth as fast.

In all this work we have received excellent co-operation from Biological Station, St. Andrews; USFWS Biological Laboratory, Boothbay Harbor; USFWS Biological Laboratory, Woods Hole; USWB, Atlantic Weather Project, Boston; USFWS Biological Laboratory, Sandy Hook, N.J.; Virginia Institute of Marine Science; USFWS Biological Laboratory, Beaufort, N.C.; USC&GS, USCG Lightships and Towers; USAF Weather Observers on Texas Towers.

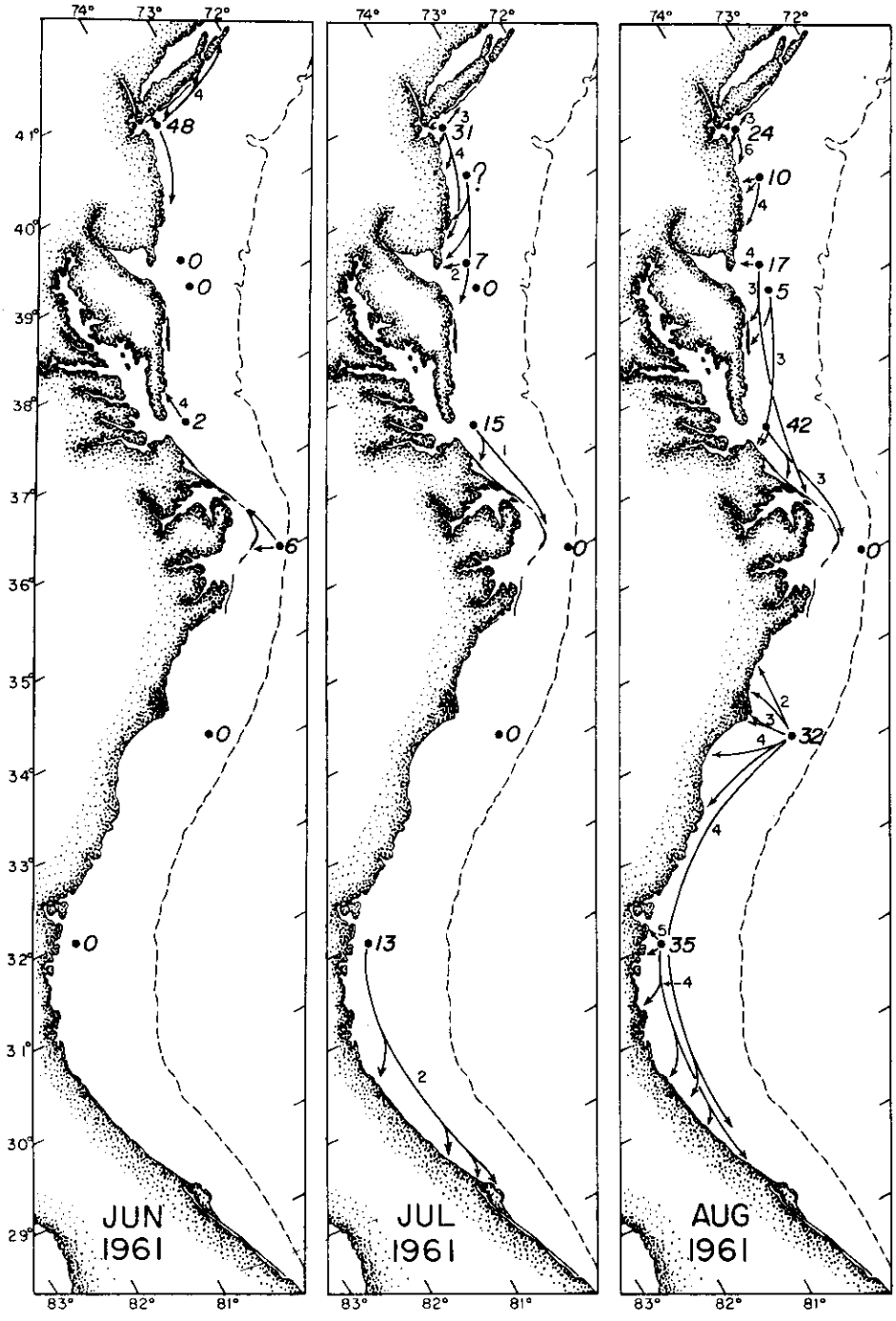


Fig. 12. Recovery of drift bottles released by lightships off the coast of the Mid-Atlantic states, 1961.

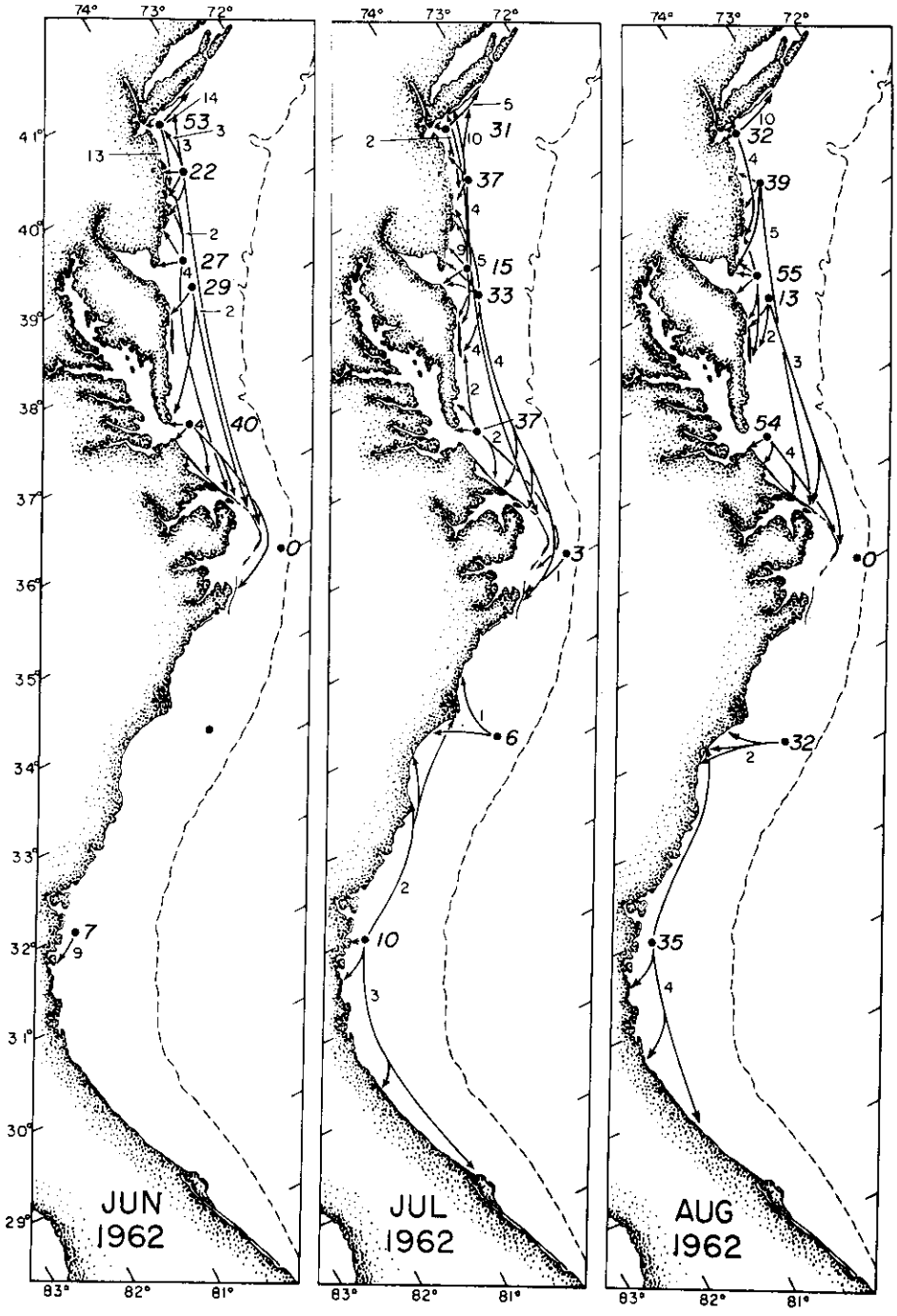


Fig. 13. Recovery of drift bottles released by lightships off the coast of the Mid-Atlantic states, 1962.