INTERNATIONAL COMMISSION FOR  THE NORTHWEST ATLANTIC FISHERIES

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PART II — Reports on Researches in the ICNAF Area in 1963

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PART II. REPORTS ON RESEARCHES IN THE ICNAF AREA IN 1963

I. Canadian Research Report, 1963

A. Subareas 2 and 3
by W. Templeman

Canadian researches on groundfish and related hydrography in Subareas 2 and 3 were carried out in 1963 by the Biological Station of the Fisheries Research Board of Canada at St. John's. Oceanographic work related to fisheries was also carried out by the Atlantic Oceanographic Group and by the Department of Mines and Technical Surveys.

For location of the places mentioned in this report see the place name map, in ICNAF Redbook, 1962, Part 2, p. 4.

Subarea 2

A. Status of the Fisheries

1. Cod, Gadus morhua L.

There was an upward trend in the Labrador inshore catch of cod with an additional 12 schooners and longliners prosecuting this fishery and the operation of a floating freezing plant in the Labrador area.

Routine sampling of the inshore cod fishery by various gears was carried out in the spring, summer and fall in 15 separate localities on the Labrador coast between the Strait of Belle Isle and northern Labrador. Measurements of 15,000 cod were taken and 3000 pairs of otoliths collected. In all areas, there was a marked decline in fish sizes due to large numbers of young cod of ages 5 and 6 entering the commercial fishery for the first time. Cod of such early ages have contributed little to the Labrador inshore catch in the past several years, but their presence in quantity in 1963 indicates that these age-groups must be fairly abundant, and should contribute significantly to the success of the fishery for the next several years.

B. Special Research Studies

1. Environmental Studies

1. Hydrography. The monitoring hydrographic section off Seal Islands (Fig. 1) was taken at approximately the usual time, August 5-6. Temperatures at all depths in the colder part of the Labrador Current, extending over the area from Hamilton Inlet Bank to shore, were quite similar to those of 1962. In the warmer part of the Labrador Current in the deeper water seaward of Hamilton Inlet Bank temperatures were slightly higher than usual.

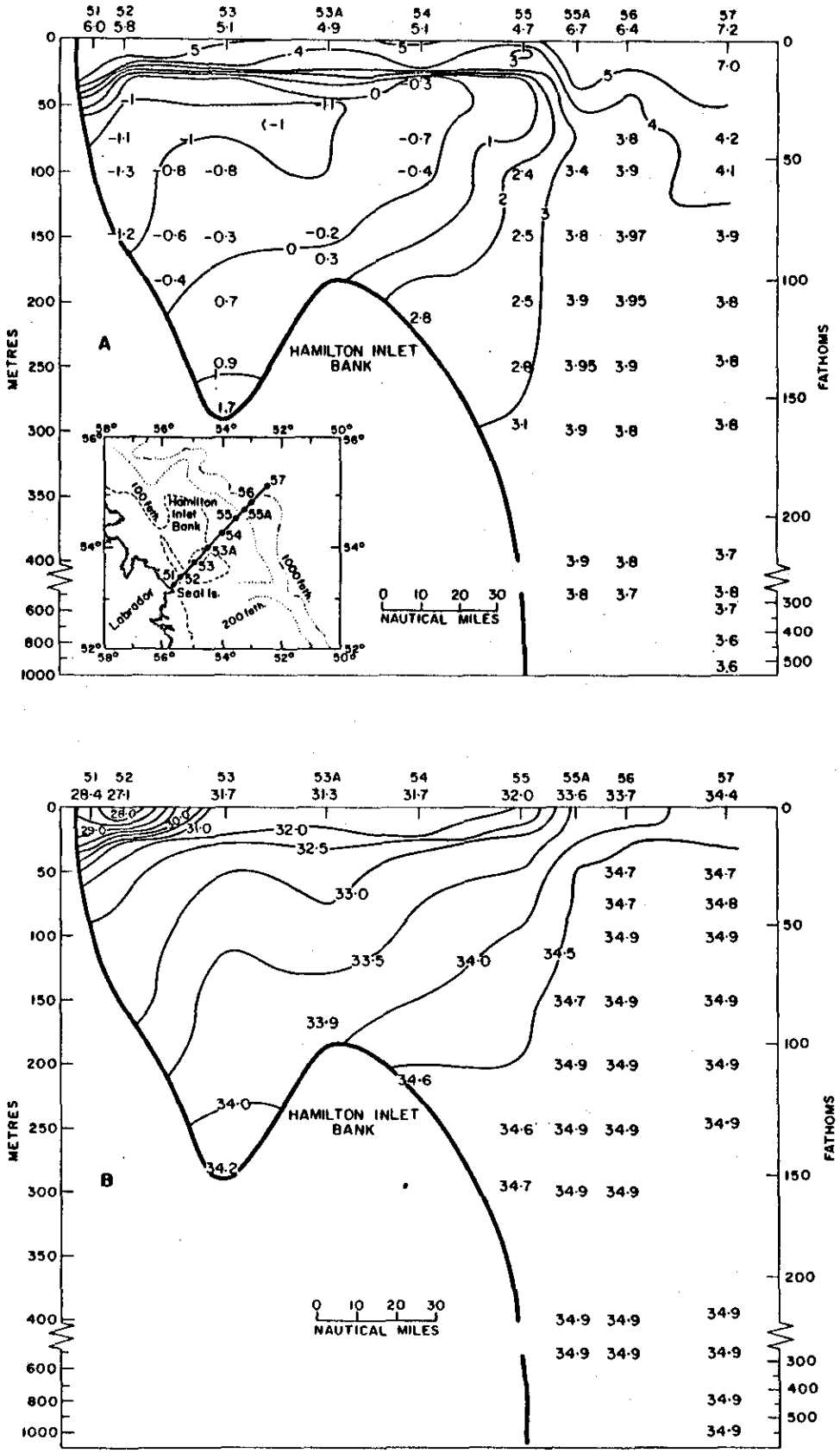


Fig. 1. A, temperature and B, salinity sections, °C and °/oo, off Seal Islands across Hamilton Inlet Bank, August 5-6, 1963.

II. Biological Studies

1. Cod. In April-early May 1963 the A. T. Cameron investigated the great cod concentrations on the eastern shore and southeastern slopes of Hamilton Inlet Bank where a new winter-spring fishery by European trawlers has arisen producing a very great increase in the Subarea 2 cod catch since 1960.

On April 9-12 on the southeastern slope of the bank the greatest cod concentrations were found at 275 m and 2.6°C. Here trawling was extended to 720 m, but only a few cod were found deeper than 370 m (2.6 to 3.4°C), and none between 545 and 720 m (3.3 to 3.4°C). On the northern part of the eastern slope the largest catch was at 250 m and 1.8°C. Here the fishery was at the edge of the ice and it was not possible to trawl deeper.

Sets in shallower water (175-190 m) and at lower temperatures (-0.1 to 1.6°C) on the eastern edge of the bank produced only a few small cod. Sets in deeper water in the western part of Hawke Channel at low temperatures (0.6 to 1.8°C) also produced few cod.

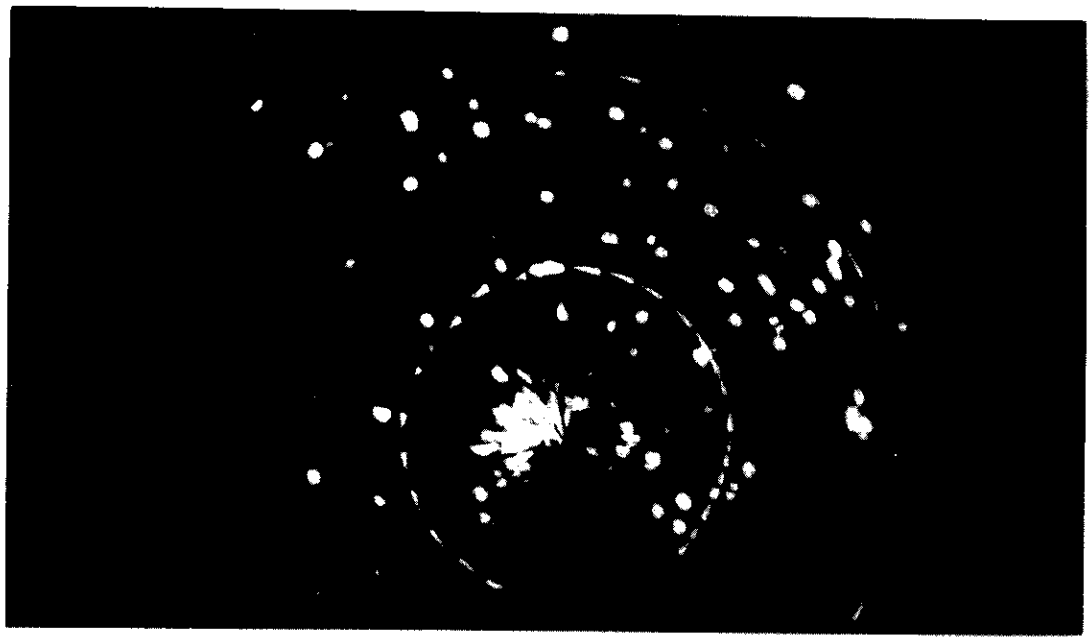
On May 2-3, 1963, very large catches of post-spawning cod were obtained on the southeastern slope of the bank just south of the ice edge at 225-280 m (2.8 to 3.0°C). From 90 to 100 large trawlers were fishing in the area within a radar range of 10 nautical miles (Fig. 2).

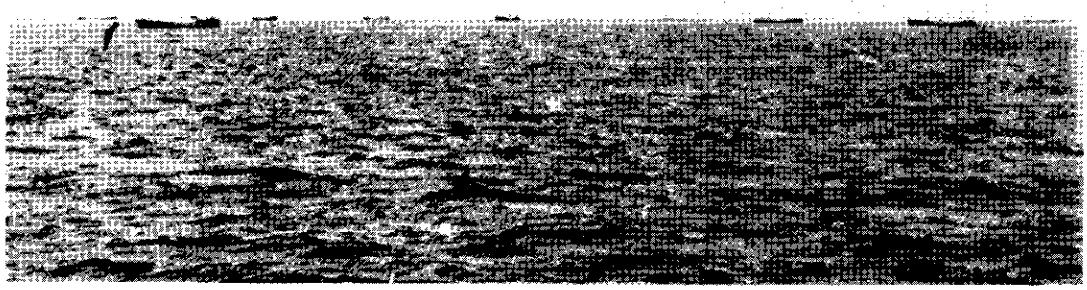
These spawning and post-spawning concentrations in April-early May appeared to be on the extreme eastern edge of the slope, and were chiefly at depths between 225 and 330 m at temperatures from 2.5 to 3.1°C. The larger mature fish were in the deeper water and higher temperatures, and smaller immature fish predominated in shallower water and lower temperatures.

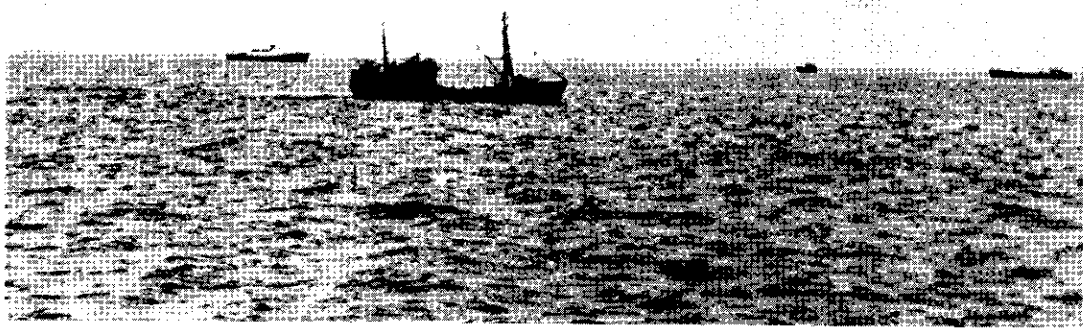
In September moderately large cod concentrations were found in 290 m on the southwest edge of Hamilton Inlet Bank, and again in October at 135-175 m.

In the regions of heavy concentration on the southeastern slope during April 9-11, 43-75% of the mature female cod taken in different sets had completed spawning. Spawning was proceeding rapidly and by April 16, in the same area, 91% of the mature females in the only large catch were spent. In Hawke Channel to the west of Hamilton Inlet Bank at this time only 22-31% were spent in the 2 small catches which contained mature females but quantities of cod in this area were almost negligible. On May 2-3 in the same area on the southeastern slope of Hamilton Inlet Bank 78-92% of the mature female cod in various sets were spent. On all lines cod sizes and the percentages of mature cod, and in the areas of concentration the percentage of females among the mature cod, usually increased with depth and increasing temperatures.

During this period from April 9 to May 3 the cod of the spawning and post-spawning concentrations were feeding very little except on viscera, heads and backbones of cod being discarded from trawlers. There was no evidence







from the net catches that any other food was abundant on or near bottom.

Cod were tagged in the inshore shallow-water area in August at Domino (770), Cape Harrison (1150), Hopedale (380) and Nain (770). Coastal tagging in 1962 has shown that the spawning concentrations on the eastern and southeastern slopes of Hamilton Inlet Bank in winter and spring receive contributions from inshore cod not only from Labrador but also from along the east coast of Newfoundland from St. Anthony to at least the Baccalieu area on the northern fringe of the Grand Bank.

2. Redfish, Sebastes mentella Travin and Sebastes marinus (L.). A section on the northern seaward slope of Hawke Channel was fished by the A.T. Cameron from 230 to 730 m on April 9-11 and September 13-14. The April catches of mentella (per half-hour tow) at 365, 460, 550, 640 and 730 m were 15, 1020, 860, 580 and 35 kg at bottom temperatures 2.6, 3.4, 3.4, 3.3 and 3.4°C and average weights of 1.0, 0.8, 0.5, 0.8 and 1.1 kg respectively. Catches of marinus were 480 kg at 460 m and 15 kg at 550 m with average weights of 2.8 and 4.9 kg.

As a contrast in the same area on September 13-14 significant catches of mentella were made from 310 to 620 m with the largest catches, 500 and 980 kg (average weights of 0.5 and 0.7 kg), being made at 310 and 540 m at 3.6 and 3.9°C. Also at this time the only marinus catch over 14 kg was one of 840 kg with an average weight 1.5 kg at 230 m and 2.4°C and only 1 marinus was caught below 310 m.

In spring the area from 230 to 365 m, deserted by both species of redfish and occupied by cod, had bottom temperatures of 2.5 to 2.6°C whereas in September bottom water temperature was slightly lower (2.4°C) in the 230 m area occupied by smaller marinus and higher (3.6 to 3.9°C) in the 310-620 m depths where mentella catches were made.

The marinus concentrated at the 460 m level in April were 87% females (83% pregnant females). The males were probably shallower, possibly near 410 m. Thus marinus were about 180-230 m deeper and mentella at least 90-140 m deeper in April than in September. All but insignificant catches of all redfish in this area were obtained in a 180 m range between 460 and 640 m in April whereas they ranged from 230 to 620 m in September. Thus the redfish

Fig. 2. (see page 6) Above, composite photograph, made from movie film, of part of the A. T. Cameron's radar screen showing part of concentration of trawlers on the southeastern slope of Hamilton Inlet Bank, May 3, 1963. (The photograph represents a circular area of radius 5 nautical miles with the A. T. Cameron at the centre. In the missing sector, now blank, the ships were also abundant. At this time there were 90-100 trawlers within a radar range of 10 nautical miles.) Below, 2 groups, each showing traces of about 15 trawlers in the original photograph. Photograph taken at the same time as those of the radar traces. (Photo by A. W. May).

in winter-spring and presumably winter are concentrated more than in summer-autumn and this concentration is likely to be most advantageous to fishing in an area with populations both of marinus and mentella which overlap in the winter-spring distribution but tend to become separated in summer-autumn.

Only 1 of 73 pregnant marinus females examined from the southeastern and eastern slopes of Hamilton Inlet Bank on April 9-16 possessed larvae 95% hatched and approximately ready for extrusion (Table 2). The remainder were all 50% hatched or less, the majority being less than 30% hatched and had moderately large or large external yolk sacs and were not ready for extrusion.

Only 7% of 149 pregnant mentella females examined at the same time from the same area were spent (Table 2) and it was our opinion that about half of these had spawned in 1962 and had not recovered.

During summer and autumn all mentella females in this area from 550 m and deeper are immature even at the largest sizes over 45 cm. In April 1963 the mature mentella females extended downward to 530-560 m where, also, no large immature females were present, but all mentella females at 640 and 730 m were immature although they reached lengths as great as 45-47 cm which was the maximum size of the mature females examined at the shallower depths.

Thus although the passage into deeper and warmer water in winter-spring is doubtless advantageous to the larval development and larval extrusion by females the movement is a natural one characteristic of both immature and mature fish since large immature females at the lower part of the redfish range also pass deeper in spring and presumably winter.

3. American plaice, Hippoglossoides platessoides (Fabricius). In the A. T. Cameron sets in April on the southeastern slope of Hamilton Inlet Bank the only 2 significant catches of American plaice (per half-hour set) were 180 kg at 320 m and 2.6°C and 140 kg at 640 m and 3.3°C. These fish were mainly mature males and mostly immature with a few mature females, the average weight being 1.0 kg. Although in summer plaice are usually in slightly colder water than the cod and the largest summer concentrations on Hamilton Inlet Bank were found in the Investigator II in September 1952 and 1953 at 179-183 m and -0.3 to 0.4°C, in these April sets the plaice concentrations encountered were much deeper and at higher temperatures than in September. The April catch at the greatest depth was well below the cod concentrations while in summer and early autumn plaice and cod on this bank are likely to be found at approximately the same depths with the plaice slightly shallower than the cod.

4. Witch flounder, Glyptocephalus cynoglossus (L.). In 550 and 640 m at the mouth of Hawke Channel a concentration of large witch flounder (1180 and 680 kg per half-hour tow) was found; these fish averaged about 1.4 kg. The mature witch females had small opaque eggs and would not spawn for about 2 months.

III. Gear and Selectivity Studies

The A. T. Cameron carried out selectivity cruises for cod in the Hamilton Inlet Bank area in August 1962 and October 1963 using a No. 41 trawl with codends of double twine, 50-yard, 4-ply manila. In the covered hauls the upper surface of the codend was provided with a cover of 50-mm courlene twice as wide as the codend, and in the alternate hauls the after belly and lengthening piece had meshes approximately the same size as those in the codend. All hauls were 1 hour long. The preliminary results are shown below (Table 1):

Table 1. Cod selection Hamilton Inlet Bank. (Internal wet mesh size measured with ICES gauge and 4 kg pressure).

Date	Av. codend mesh size (mm)	50% retention (cm)	Selection factor	No. hauls	Av. catch (kg)	Av. catch No.
	Covered hauls					
Aug. 1962	97	35.0	3.61	12	370	580
	113	38.2	3.38	4	620	1067
	120	47.5	3.96	8	560	857
	Alternate hauls with catches at larger mesh sizes compared with those with the 54 mm mesh codend					
Aug. 1962	54	-	-	16	520	761
	95	31.0	3.26	8	470	614
	106	36.8	3.47	16	350	367
	113	38.0	3.36	8	330	363
	Covered hauls					
Oct. 1963	109	37.0	3.39	9	1140	815
	120	42.0	3.50	12	930	667
	130	45.0	3.46	8	610	507

Subarea 3

A. Status of the Fisheries

I. Cod

Inshore fishery. Sampling of the inshore fishery by the various gears was carried out at St. Anthony, LaScie, Twillingate, Bonavista, St. John's, Trepassey, Burin and Port-aux-Basques on the Newfoundland coast.

On the east coast of Newfoundland, although the trap fishery in 1963 at St. Anthony, Twillingate and St. John's was fairly successful compared with the 1962 fishery, it was considered to be poor at LaScie and Bonavista. On the south coast, at Burin, the trap fishery was moderately good, at about the same level as in 1962, but at Trepassey it was generally poor, mainly because of adverse weather conditions. The handline fishery at St. Anthony, Twillingate and Bonavista was considered to be reasonably good, but at St. John's this fishery was very poor. Except for the fishery at Twillingate, which was considered

fairly good, the linetrawl fishery was very poor in all areas with the result that many fishermen turned almost entirely to using gillnets. The gillnet fishery began in autumn at St. John's with good results while in the Trepassey area catches with gillnets were high all season with 230 kg (round) per net per haul being realized. At Burin and Twillingate however, the gillnet fishery was only moderately successful for most of the season, 70 kg per net per haul being obtained at Burin. The longline fishery was generally poor at Bonavista and Trepassey but was good at Twillingate.

More detailed information on catches is available for Bonavista and Burin. At Bonavista the total catch in 1963 by all gears was 4.4 million kg, 20% lower than in 1962. Of this total 42% was landed by baited handlines and jigger, 31% by traps, 24% by longlines and 3% by linetrawl. At Burin the 1963 total catch by all gears was 1.6 million kg, 20% higher than in 1963, with 47% from trap, 45% from gillnet, 5% from linetrawl and 1% from jigger.

In the trap catches cod 4 to 6 years of age were the most abundant numerically along the east coast and on the south coast, and cod aged 7 and 8 years were present in varying numbers in different localities. At Trepassey, however, large numbers of older fish up to 10 and 11 years of age were common in trap catches, although the majority were 5 to 8 years old. In the handline catches fish of ages 5 and 6 years were the most abundant with ages 4, 7 and 8 also being represented. In the linetrawl catches cod of ages 4, 5 and 6 years were the most important contributors. In longline catches fish aged 5 to 10 years were the most abundant in all areas sampled, although fish older than 10 years contributed significant numbers to the catches in most areas. Along the northeast coast area and in the Trepassey area 8-year-old fish dominated the longline fishery while in the southwest coast area 9-year-old fish were dominant. In Bonavista the average size of longline fish decreased because of the increased abundance of 6- and 7-year-old fish. In the gillnet fishery there was an abundance of 8-year-old cod and fish aged 7, 9 and 10 were well represented.

The age and length compositions of samples of cod caught by the various gears reveal the dependence of the trap fishery upon the younger ages of cod, whereas in the longline and gillnet fisheries cod of older ages are important contributors to the catch after they are generally no longer available to the traps.

The inshore cod fishery with nylon gillnets. The use of nylon gillnets in the inshore cod fishery in Newfoundland was begun in 1960. By 1961 many fishermen had procured nylon gillnets and were using them either in conjunction with other gears or as their principal fishing gear. Nets were generally of Japanese or English manufacture, usually 91 m long, 25 meshes deep, of twine size 210d/15, and with mesh sizes ranging from 6 to 7 1/2 inches. By 1963, when it is estimated that about 13,000 nylon gillnets were used in the cod fishery, the main concentrations were in Trepassey, St. Mary's and Placentia Bays on the south coast and Notre Dame and Trinity Bays on the east coast.

Observations are being taken on the gillnet fishery at Twillingate, Trepassey and Burin. The nylon nets were fished in quantity at Trepassey in

1961, but at Twillingate and Burin not until 1962. The numbers of nets used per boat continues to increase each year as fishermen become more experienced in their use. Gillnets are used throughout the season in Burin, but at Twillingate mainly in the spring, late summer and fall, and at Trepassey chiefly in the spring and summer.

Catches at Twillingate and Burin were low in the gillnet fisheries in 1963 but with low total yield from the inshore fishery in these areas the daily catch from nylon nets was generally above those obtained with other gears fishing at the same time. At Trepassey, the longline boats equipped with gillnets have been very successful, with average daily catch per net per haul for the fleet amounting to 350 kg in 1961, 300 kg in 1962 and 230 kg in 1963. The average catch per net per haul has decreased each year as the number of nets has increased.

Large cod were caught by nylon gillnets in all areas, with about 90% ranging from 60 to 100 cm. The fish were mainly of ages 7 to 14, with fish of the 1955 year-class (age 8 in 1963) contributing heavily to the catches in 1962 and 1963.

Cod growth. Analysis of cod growth on an area basis for the years 1960-62 has shown that there is a progressive decline in average size at age proceeding from south to north. Also, fish from different areas, but inhabiting similar latitudes, exhibit similar patterns of growth. The differences between the area of slowest growth (in Subarea 2, northern Labrador) and fastest growth (southern Grand Bank) are so great that a fish from the latter area is 30% longer than the former at age 5, increasing to 75% greater length at age 15. Differences in weight at age are even more striking. These growth differences are considered to be related mainly to variations in temperature and food supply between areas.

II. Haddock, Melanogrammus aeglefinus (L.)

Trends in the commercial fishery and prospects for the future. The commercial haddock fishery, which began in 1945, rapidly increased and by 1949 the total haddock landings were 78,000 metric tons. After a decrease to 43,000 tons in 1953, an increase to 104,000 tons occurred in 1955 as a result of the recruitment to the fishery of a very abundant 1949 year-class. However, by 1959 total landings had declined to a low of 35,000 tons. Up to 1959 the haddock fishery was carried on almost exclusively by Canadian and Spanish trawlers, with the Spanish vessels particularly in the early years taking about three-quarters of the annual yield. However, Spanish landings declined in the late 1950's and early 1960's when the stock consisted mostly of small haddock. In 1960 and 1961 a very successful 1955 year-class, a moderately successful 1956 year-class, and the additional USSR exploitation of the haddock stock, increased the landings to 66,000 and 80,000 tons.

In 1962, while Canada maintained an annual landing of 28,000 tons from the winter and spring concentrations, the summer concentrations did not occur or were not found and only very small quantities were taken by other countries,

the total being 35,000 tons.

In 1963, after much effort in searching, Newfoundland trawlers were able to take only 8,000 tons as compared with nearly 21,000 tons in 1962. Also extensive surveys by Canadian research vessels in May and July failed to find any concentrations of haddock.

Although heavy exploitation has played its part in the present scarcity of haddock, the basic cause is the lack of successful survival of young haddock. The last very successful year-class was that of 1955, which dominated the catches during 1960-62. Since 1955-56 survival has been relatively poor and consequently the haddock fishery must inevitably continue to decline until a good brood occurs and is recruited to the stock.

Length and age composition of the Grand Bank stock. From the length and age frequencies of samples taken during the May survey, haddock of the 1955 and 1956 year-classes which were dominant in the catches during the surveys of 1959-61, were out-numbered in 1963 by 1- and 2-year-old fish of the 1961 and 1962 year-classes. However, when it is considered that the research vessel catch per unit effort was considerably lower than those of previous years both in number and weight, the apparent abundance of these 1- and 2-year-old fish may be only in relation to the presently reduced year-classes of earlier years. For example, the average number of haddock per half-hour tow was 70 in 1963 and 80 in 1962, while in 1960 it was 590.

III. Redfish

Redfish landings were higher than in 1962 mainly from increased fishing effort for small redfish on the southern part of the eastern slope of the Grand Bank.

IV. American plaice

The Newfoundland catch per unit effort for plaice on the Grand Bank showed a decline in 1962. At the same time there was a marked increase in total effort. In 1963 Newfoundland plaice landings were 60% higher than in 1962, mainly because of increased fishing effort.

V. Witch flounder

Newfoundland landings of witch flounder were 20% less than in 1962, mainly due to the decreased effort for haddock. A large proportion of the witch landings is taken on the southwest slope of the Grand Bank during the winter-spring haddock fishery. The analysis of the logs of 2 commercial trawlers indicates that the catch per unit effort for American plaice is greater for daylight fishing than it is at night.

B. Special Research Studies

I. Environmental Studies

1. Hydrography. The 5 monitoring sections across the Labrador Current and continental shelf from Bonavista to the southern Grand Bank were occupied by the Investigator II between July 27 and August 22.

In Fig. 3-7 the temperature and salinity profiles of the sections are illustrated.

In the triangular section extending eastwardly from Cape Bonavista, thence southwardly to the northern Grand Bank (Fig. 3) temperatures were fairly similar to those of 1962. The cold water, with temperatures below -1°C, extended deeper near the coast. Temperatures in the deep water offshore at the continental slope were slightly higher than in 1962 whereas temperatures at the core of the eastward-moving branch of the Labrador Current were lower.

In the section from St. John's across the northern part of the Grand Bank and Flemish Cap (Fig. 4) there was a much greater volume of water with temperatures below 0°C and below -1°C in the area from the Avalon Channel to the northeastern slope of the Grand Bank than was present in 1962.

In the section from St. John's to the southeastern slope of the Grand Bank (Fig. 5), apart from the occurrence of higher surface temperatures at the eastern edge of the Grand Bank, the temperature picture was generally similar to that of 1962.

In the section at about 75 m extending along the southwestern slope of the Grand Bank (Fig. 6) surface and upper layer temperatures over the bank were higher and bottom temperatures generally a little lower than in 1962.

In the section at 275 m along the southwestern edge of the Grand Bank (Fig. 7), minimum temperatures were lower than in 1962 and a considerably greater volume of water with temperatures below 1 and 2°C was present in the eastern section of the Labrador Current at stations near the southern part of the bank. Temperatures at the surface and in the upper layers were generally higher than in 1962. To the west, at Station 15 considerably higher midwater temperatures were present than in 1962.

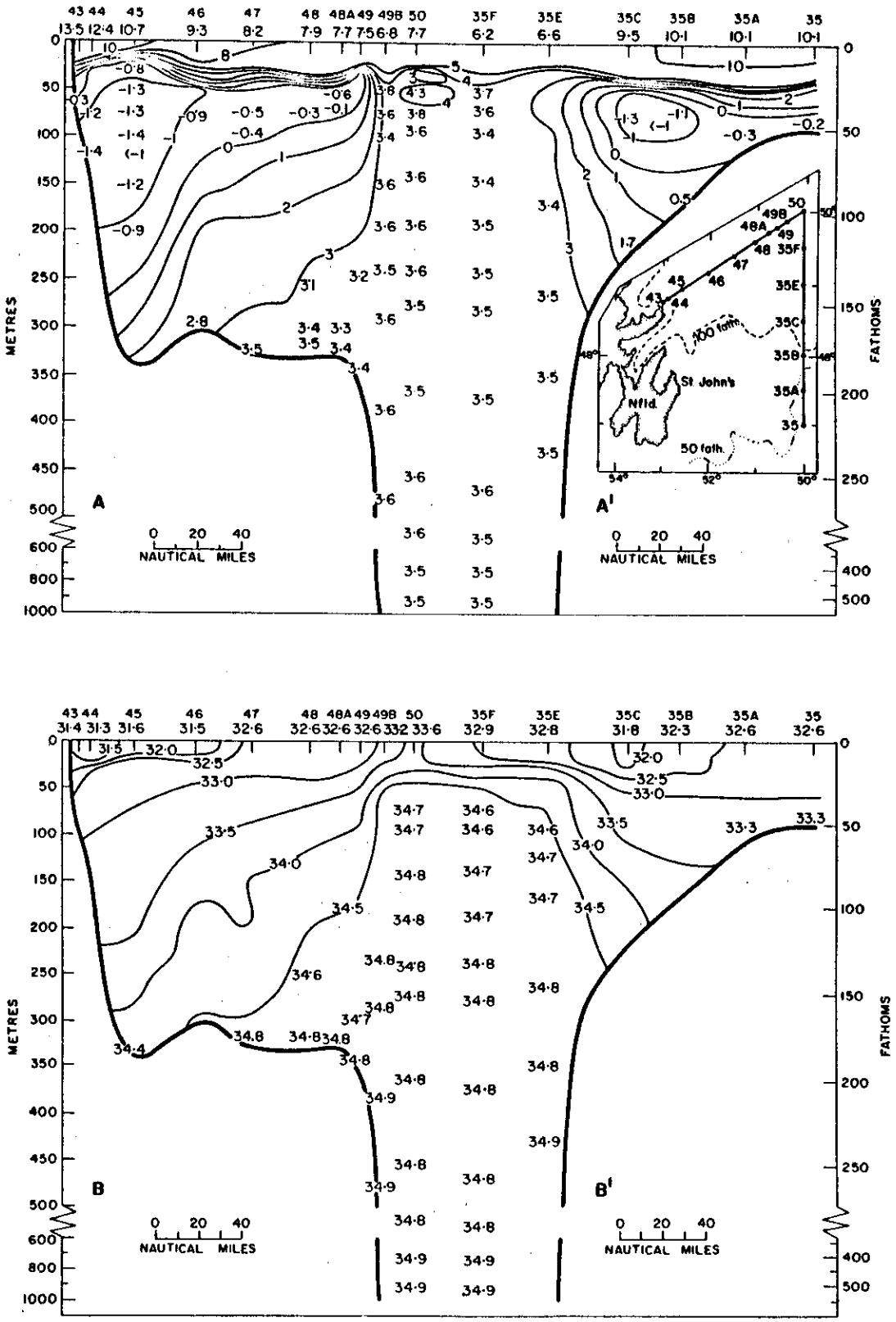


Fig. 3. A, A[1], temperature and B, B[1], salinity sections, °C and °/oo, off Cape Bonavista and southward to northern Grand Bank, A, B, August 1-2, 1963 and A[1], B[1], July-28-August 1, 1963.

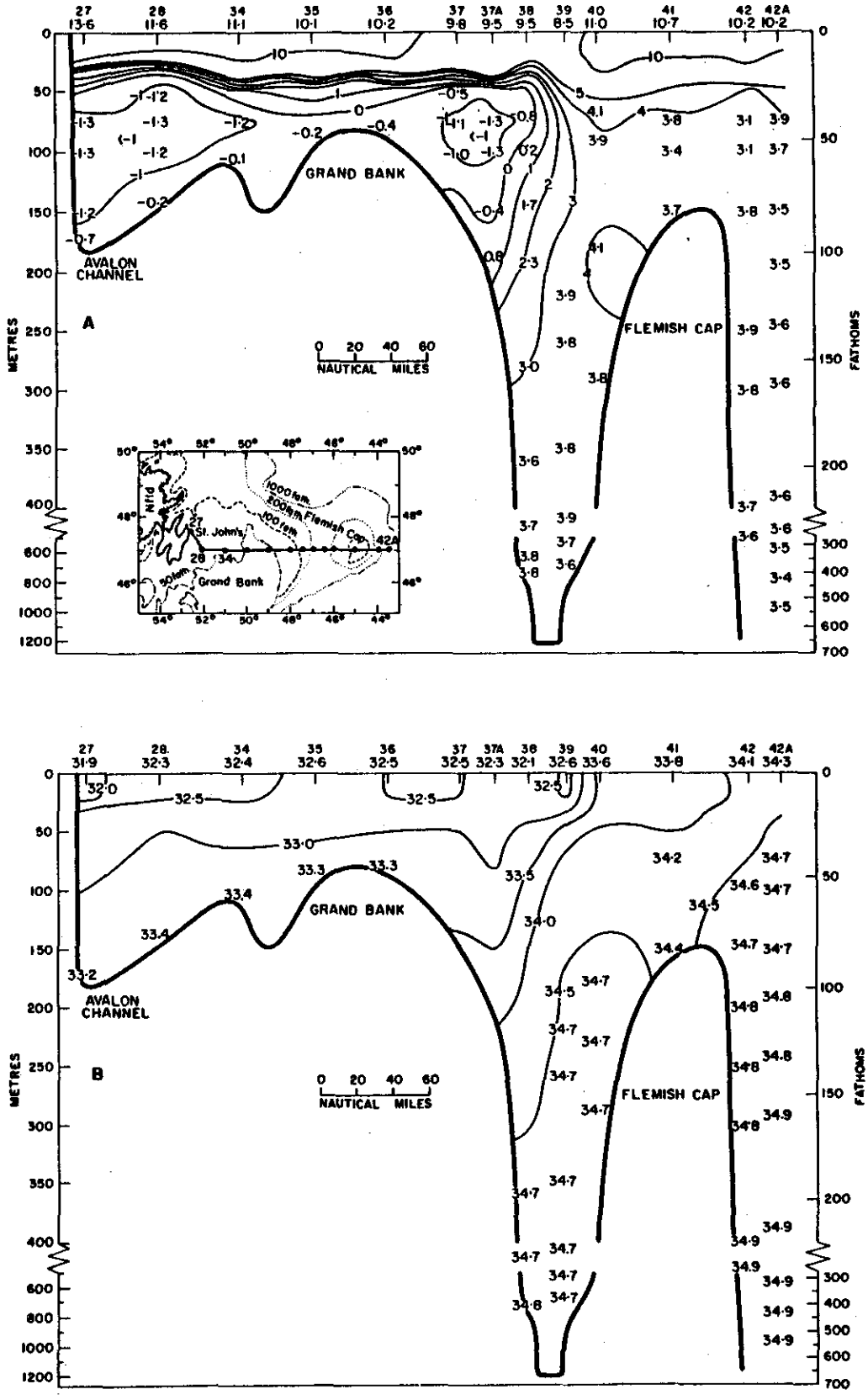


Fig. 4. A, temperature and B, salinity sections, °C and °/oo, St. John's - Grand Bank-Flemish Cap, July 27-30, 1963

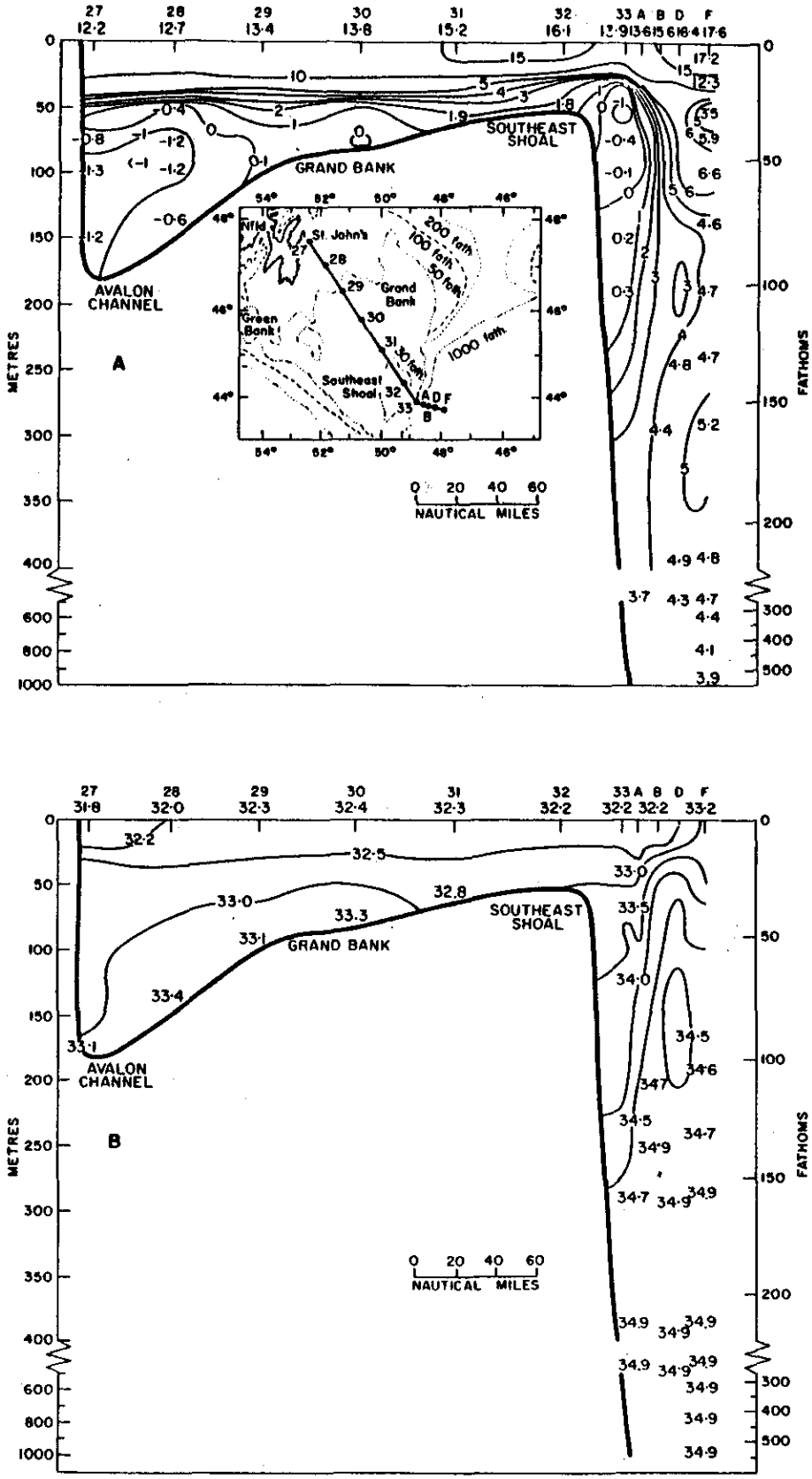


Fig. 5. A, temperature and B, salinity sections, °C and °/oo, St. John's-SE slope Grand Bank, August 16-18, 1963.

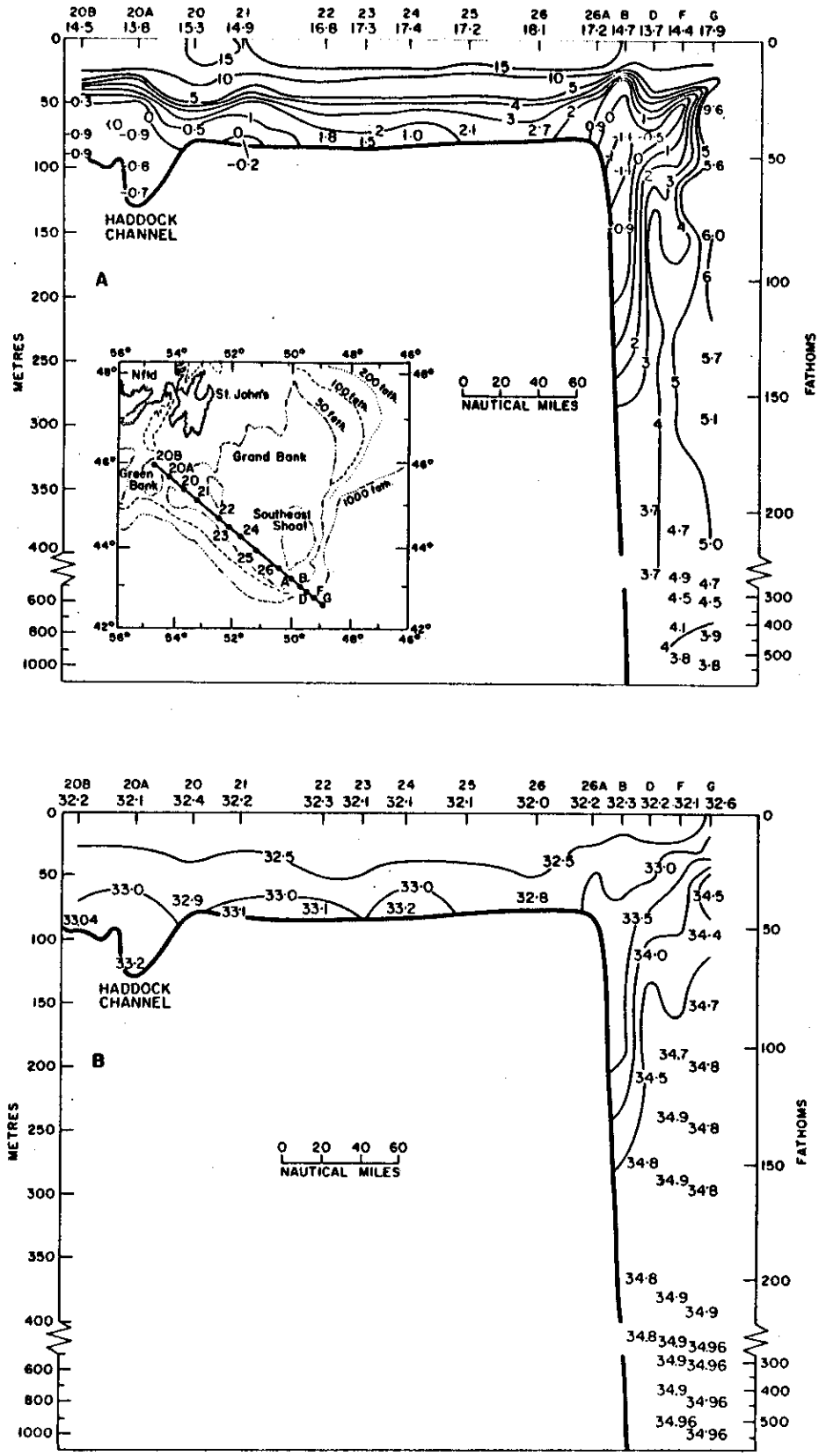


Fig. 6. A, temperature and B, salinity sections, °C and °/oo, Green Bank-SE Grand Bank, August 19-22, 1963.

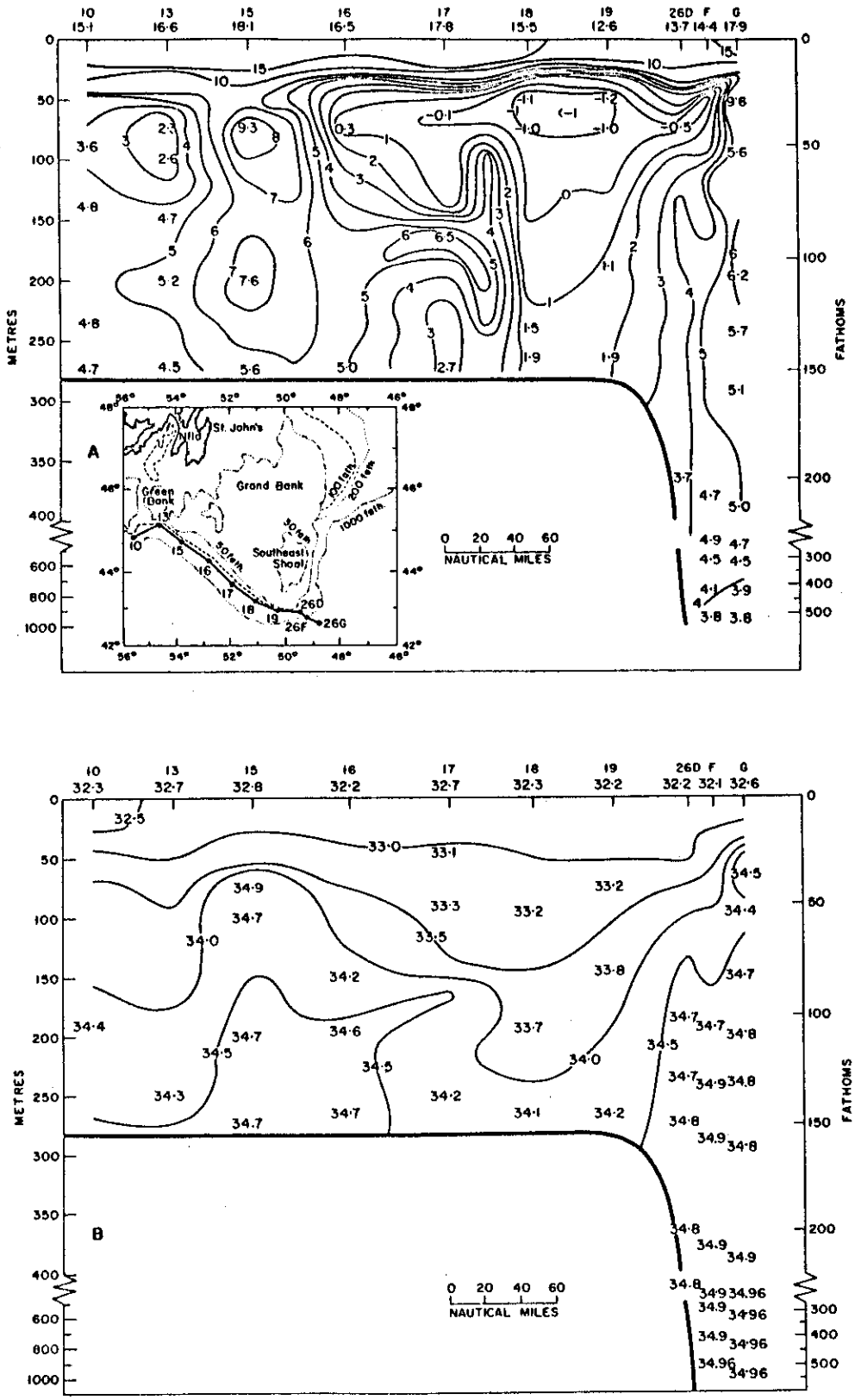


Fig. 7. A, temperature and B, salinity sections, °C and °/oo, along the southwest slope of the Grand Bank, August 19-22, 1963

II. Biological Studies

1. Cod. The annual survey designed to obtain information on the inshore distribution and relative annual abundance of small cod up to 2 years of age was carried out from September 19 to October 31. Beaches in areas selected in previous surveys were seined using a small-meshed Danish seine with the codend lined with fine-meshed nylon.

During the survey 141 successful sets were made on beaches from St. Mary's Bay to the northern part of Notre Dame Bay, and from 1 to over 600 small cod (total 5366) were taken in 89% of the sets. Cod of the year (zero cod) occurred in 71% and were in the majority in 40% of the successful sets. Zero cod made up 39% of the total cod catch from all areas. Cod of age 1 and older (1+) occurred in 88% and were in the majority in 48% of the successful sets. Of the total cod catch from all areas 1+ cod made up 61%. From St. Mary's Bay to Conception Bay the 1+ cod were generally more abundant than the zero cod whereas from Trinity Bay to Notre Dame Bay zero cod were somewhat more abundant in the catches. The numbers of 1+ cod taken in the northern areas were not consistent with reports of large numbers of these fish seen in harbours and around fish plants during the summer as was anticipated from the relatively large catches of zero cod during the 1962 survey. The numbers of zero cod caught in 1963 suggest only moderate survival and settlement of the 1963 year-class.

Survey cruises by the A. T. Cameron over the Northeast Newfoundland Shelf in April and May produced several good catches of cod between 220 and 320 m and a good catch was obtained on the northern slope of the Grand Bank in June. Length frequencies of cod from the Northeast Newfoundland Shelf indicate the presence of significant numbers of 3- to 5-year-old fish.

Catches in the Halibut Channel in January, on St. Pierre Bank in June, and on the Grand Bank in January, May, June and July were usually less than 450 kg per half-hour tow at all depths.

Cod were tagged in the following places, times and numbers: Halibut Channel, January, 770; off Port-aux-Basques, March, 1540; off Rose Blanche, March, 770; Penguin Islands-Ramea area, March-April, 1150; Burgeo Bank, March-April, 1150; northern St. Pierre Bank, May, 1150; Virgin Rocks, July, 1150; off Fermeuse, October, 1150; Cape Ballard Bank, October, 1150; off Cape Fogo, October-November, 1150; Grey Islands, November, 1150 and off Cape Pine, November-December, 1150.

2. Haddock. Otter-trawling surveys over the southern half of the Grand Bank were carried out in May and July. During the May cruises, from a total of 75 half-hour tows in depths ranging between 45 and 275 m only one tow produced more than 135 kg of haddock. This catch of 680 kg was taken in 145 m at 3.6°C on the western part of the southwest slope. At most of the fishing stations on the slope and adjacent bank areas water temperatures were favourable for haddock.

The survey in July resulted in even poorer catches throughout the entire area. The best catch of 195 kg was obtained in 120 m at 4.6°C near the station where the best catch was taken earlier in the spring survey. A number of exploratory tows were made on the Southeast Shoal, where in past years large concentrations of haddock were often found feeding on capelin eggs and capelin, but no significant quantities were taken. An interesting feature of the July survey was the presence of capelin in most tows, coincident with the scarcity of cod and haddock.

On St. Pierre Bank an otter-trawl survey in June once again produced very little haddock. In most of the tows no haddock or just a few individuals were caught, the best catch being 80 kg. Haddock fishing has been insignificant on this bank since the large fishery on the very abundant 1949 year-class came to an end in 1956.

3. Redfish. Funk Island Bank is the deep water ridge or bank with depths mainly greater than 220 m lying between Funk Island Deep and the continental slope. The western and eastern slopes and surface of the northern part of this bank were fished on April 17, May 8-9, 28-30 and September 8-9 in the general vicinity of 51°24'N to 51°28'N. On the first 2 of these occasions sets were limited to depths of 460 m and less. In the latter 2 periods the sets extended from 230-245 to 640 m. All tows were of half-hour duration.

In April redfish catches obtained in the 4 sets between 230 and 460 m (2.0-3.5°C) were insignificant. There were, however, redfish in the vicinity since on the same day we had observed a trawler taking back a very large catch of redfish at 51°44'N, 51°00'W in about 320 m and another trawler was fishing at about 350 m about 3 nautical miles north of this position.

On May 8-9 the largest redfish catch was 4300 kg of mentella in a standard half-hour tow at 275 m (2.3°C) on the Funk Island Deep side of the ridge. On the top of the bank in a tow at 230 m, 750 kg of marinus were caught of which 93% were males.

On May 28-30 the only significant catches were 2050 and 2270 kg of mentella per half-hour tow at 550 and 640 m (3.4 and 3.3°C) on the eastern slope of the bank. These were large mentella averaging 1.0 and 1.3 kg respectively and the females were immature. The only notable catch of marinus at this time was an unusual catch at 550 m of 34 marinus averaging 7.3 kg each: 13 of these were females of which all but one were spent.

In September the largest catch was 600 kg of mentella at 255 m.

A few female redfish apparently do not recover from the previous year's spawning in time to produce new eggs for the next season and are thus in a spent condition before spawning begins. Hence the small numbers of spents recorded at the beginning of the spawning season are maximal in relation to the present year's spawning. It is very likely, therefore, that in this area of the Northeast Newfoundland Shelf to the northern Grand Bank (Table 2) approximately two-

thirds of the mentella spawning occurs between mid-April and the end of May, and most of the remainder in early June with a very small amount in early April. Spawning is delayed slightly in the more coastal areas (off the Grey Islands and St. Anthony) where temperatures are lower in relation to the continental slope areas in which most of these redfish are found. Spawning in marinus on the slopes of Funk Island Bank was almost over by the end of May.

B. Subareas 4 and 5
compiled by J. C. Medcof

Canadian researches were carried out in Subareas 4 and 5 by the St. Andrews, Dartmouth and Montreal stations of the Fisheries Research Board of Canada. The Quebec Marine Laboratory at Grand River and the Department of Mines and Technical Surveys' Bedford Institute of Oceanography also made important contributions. Scientists responsible for the research are listed in ICNAF Annual Proceedings Vol. 13, p. 41.

Subarea 4

A. Status of the Fisheries

I. Cod

Cod continues to be the species of greatest international interest in Subarea 4. The mean size of the cod taken in parts of the Bay of Chaleur area (4T) was larger in 1963 than in 1962. The use of large mesh in trawls and the increasing market acceptability of small fish have reduced discards to 2% by weight and 1 to 3% by number in the Gulf of St. Lawrence where the average size of discards is 35 to 38 cm. On the Nova Scotia Banks (4V-W) the rate was higher (3 to 35% by weight and 10 to 55% by number). Recruitment and size-composition of cod stocks have not altered conspicuously from last year.

II. Haddock

Incomplete 1963 records indicate heavier Canadian landings than in 1962 from 4X where this is the principal species. Partial records also indicate decreased landings from 4W. Trawls with 4 1/2-inch (114 mm) mesh and market acceptability of small fish have conservation value but discards were high (2 to 7% by weight and 4 to 21% by number) compared with those for cod in the Gulf of St. Lawrence. This may be because of recruitment of an abundant 1959 year-class. The year-classes in 4W (except that for 1959) seem to be below average strength. Those in 4X seem strong and prospects for 1964 fishing in 4X are good.

III. Redfish

Total landings in Canada increased in 1963 in spite of the fact that the catch in the Gulf of St. Lawrence (4R-S-T) declined from 1955 to 1962 which is the last year for which complete statistics are available. The good fishing of

the 1950's depended on an accumulated stock. The catches are lower now because this stock has been substantially reduced and because recruitment has been slow. In 4S the fish were mostly of small size (15 to 25 cm fork length). Discards in this area by Quebec fishermen averaged 1% by weight. There are indications that a new year-class is being recruited. Good recruitment seems to be the exception, not the rule.

IV. Pollock, Pollachius virens (L.)

This is a species of increasing importance. For the most part the fishery appears to be regulated more by demand than supply but there are variations with area and season that appear in the statistics.

V. Halibut, Hippoglossus hippoglossus (L.)

This species is fished both in the Gulf of St. Lawrence (principally 4 R-S) and on the Nova Scotia Banks (4V-W). Because of its high market value it is more important to Canada than the size of landings would indicate. Statistics of catch and effort for 1963 are not available.

VI. American Plaice

This species continues important in the Gulf of St. Lawrence. The 1950, 1953, 1954 and 1957 year-classes are strong but there are many discards (up to 85% by count) because fish less than 7 or 8 years (length 32 cm) are not used.

VII. Sea Scallop, Placopecten magellanicus (Gmelin)

In 1963 the offshore fleet landed approximately 727 metric tons of scallop adductor muscles (equivalent to 6033 tons of whole scallops) from Division 4X. Most of the fishing took place on Browns Bank and in the lower Bay of Fundy. An additional 545 metric tons of meats (4524 tons, whole scallops) were landed from this area by the inshore fleet.

VIII. Herring, Clupea harengus L.

This is our most important pelagic species. Statistics of effort and catch by subareas are lacking but general observations indicate no spectacular changes from 1962. In most areas landings are regulated more by demand than by supply.

IX. Swordfish, Xiphias gladius L.

This fishery expanded several fold for the reasons outlined in the report on Subarea 5. There are no data from which to judge abundance changes. Conditions seem to favour further expansion in 1964.

X. Mackerel, Scomber scombrus L.

Statistics on effort and catch in 1963 are not available but changes from 1962 seem to have been minor except that there were almost no catches in the Newfoundland area which is the northern extremity of this species' range in the ICNAF area. There is no basis for predicting for 1964.

XI. Harp Seal, Phoca groenlandica

The fishery for this species in Subarea 4 centres in the region between the north shore of Prince Edward Island and Cape Breton including the Magdalen Islands (4T). In 1963, Canadian hunters took 87,000 seals here on the ice compared with 95,000 in 1962. The seal population is made up of long-lived animals which provide a relatively steady recruitment of young to the fishery. Variations in catch depend almost entirely on variations in weather and ice conditions affecting distribution patterns of the seals. The price of seal pelts at the present time is high, catching effort is intensive and catches remain at a high level.

B. Special Research Studies

I. Environmental Studies

1. Hydrography. The coastal surface temperatures were monitored at several stations from the Gulf of St. Lawrence to the Bay of Fundy. Long series of yearly records have shown clear patterns of change and in recent years the annual means have shown a downward trend. The 1963 means for most coastal stations were higher than those for 1962 but means for both these years were below the long-term average. Cooling during the latter part of 1963 was more pronounced than usual.

Monitoring sections were occupied in the Bay of Chaleur (4T) in July and August. The data are being analyzed.

The Halifax monitoring section (4W) extending from shore to the edge of the continental shelf was again occupied throughout the year (Fig. 8). This project looks for patterns in the long-term changing conditions over the Nova Scotia fishing banks and the continental shelf in general. This year accumulated data from several points were analyzed. The analysis shows that bottom temperature trends on the Scotian Shelf (4V-W), in the Bay of Fundy (4X), and in deeper layers of the Laurentian Channel (4V) are similar to those of surface temperatures at St. Andrews (4X). Comparisons of series of water temperatures recorded since the 1920's with series of air temperatures recorded since 1880 show that the trends are the same. Thus we can say that the banks waters warmed, 1880-1900; cooled, 1900-1920; warmed between approximately 1922 and 1953, but in this period showed a secondary maximum and minimum centred in the middle thirties and early forties respectively; and, finally, cooled rapidly since 1953. This generalization should help explain parts of the past history of fish stocks on the Nova Scotia Banks, in the Bay of Fundy, and probably the Gulf of St. Lawrence, because distribution and recruitment are related to

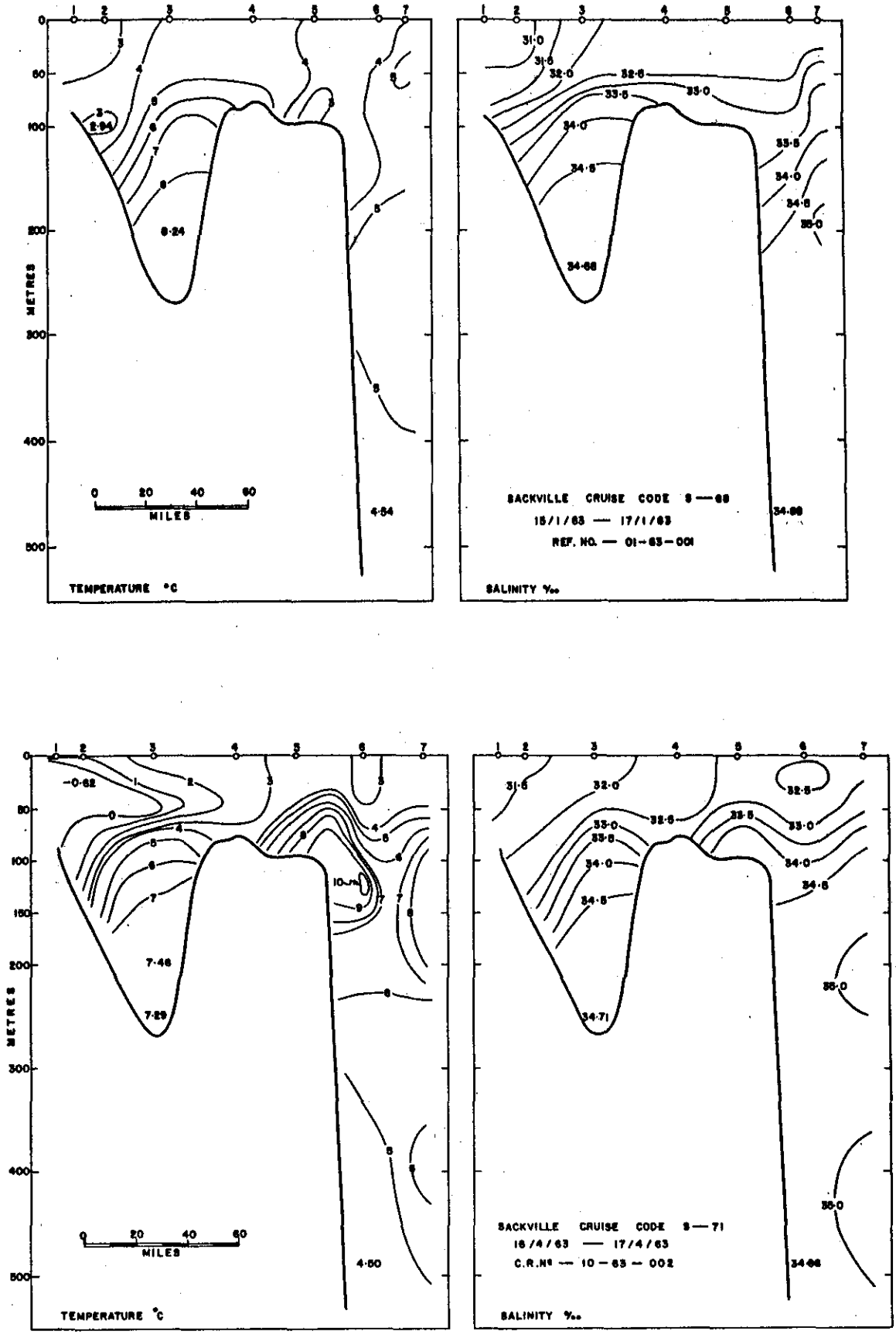


Fig. 8. Hydrographic section off Halifax, N.S. 1963

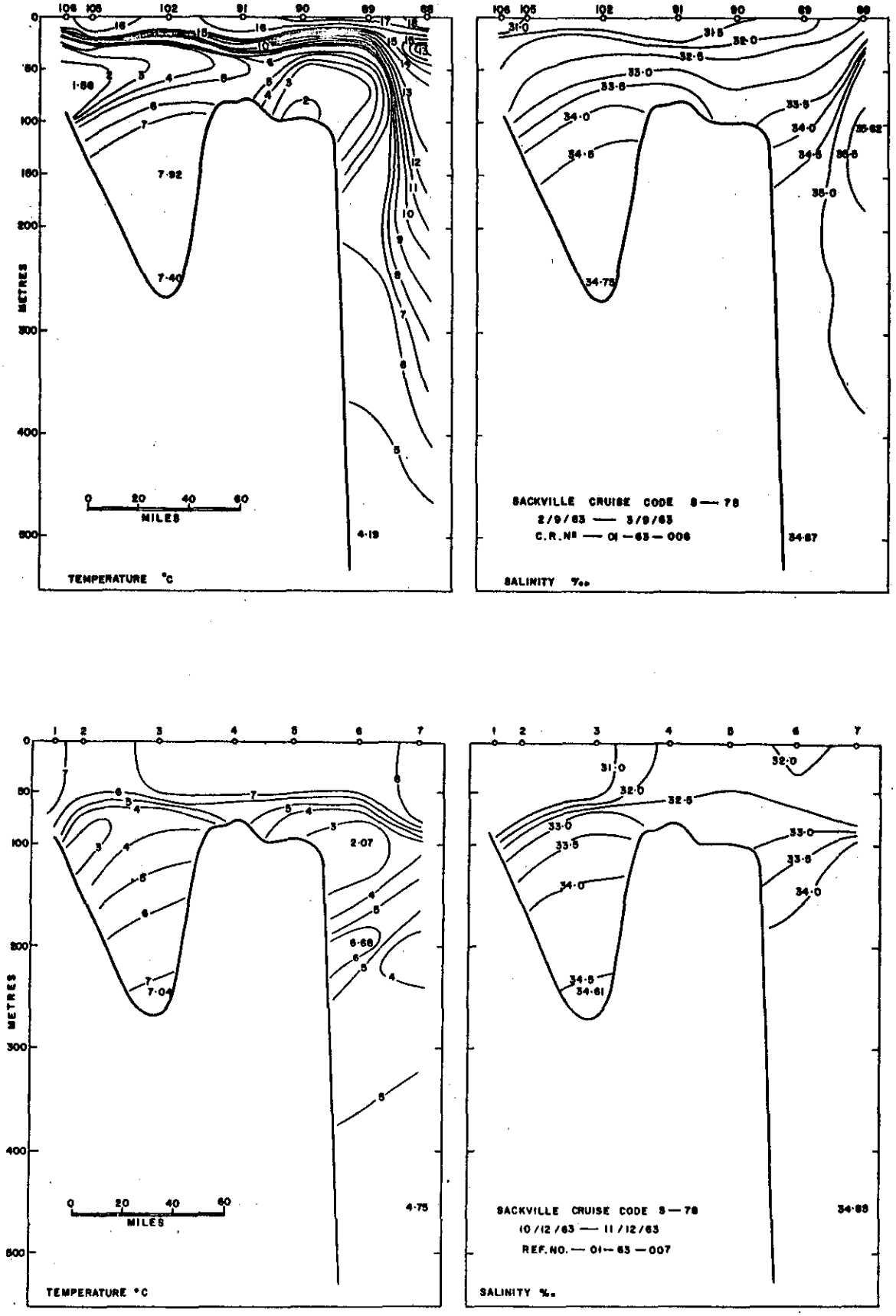


Fig. 8. (cont'd) Hydrographic section off Halifax, N.S. 1963 (partial results)

temperature. A method of multiple correlations and regressions is now being used for forecasting annual temperatures 10 months in advance.

Temperature-salinity relationships of bottom waters on the shelf in Subarea 4 indicate year-to-year variations in the composition of water masses. This suggests that in warming and cooling periods the shelf water is constituted of different proportions of Atlantic and Labrador water.

Substantial year-to-year variations of surface water conditions (temperature and salinity) in the Magdalen Shallows were observed in early spring (1960, 1963). The fate of the biological content of the surface waters is undoubtedly related to such variations.

Studies of non-tidal drift, as inferred from drift-bottle and seabed drifter recoveries, were continued. These support larval distribution studies and also monitor the year-to-year hydrographic variations themselves. The 1963 results indicate active circulation within the Bay of Fundy and a weak circulation along the coast of the New England States. In the western Gulf of St. Lawrence there was a relatively strong, predominantly easterly surface drift in 1963, contrasting with a south-easterly drift in the previous two years.

In 1963 twelve years' observations on bottom temperature distribution throughout the Gulf of St. Lawrence were compiled and are being plotted by months to show bottom temperature distribution in two-degree zones. Preliminary results are already clarifying our understanding of relationships between hydrography and fisheries.

2. Benthic studies. Bottom sampling in the southwestern part of the Magdalen Shallows (4T) was carried out with a 0.1 m^2 VanVeen bottom grab. The composition of the benthic communities at various stations in this predominantly sandy area was remarkably uniform. Annelids and crustaceans constituted a small fraction of the total wet weight of the samples. The major constituents were molluscs, echinoderms, coelenterates and bryozoans.

3. Other environmental studies. A beginning was made in the study of water transparency as it is affected by suspended material. In rocky areas the water is clearer than in silty areas.

Mapping of the southern Gulf of St. Lawrence (4T) according to the type of bottom was begun. The character of bottom deposits was determined from grab samples and the depth of superficial deposits was determined by echo sounding. Shallow gullies tributary to the Laurentian Channel were shown to have accumulated 7 to 10 m of a soft mixture of silt and clay. Geochemistry of these deposits is under study. Bottom photography was found helpful in this work.

II. Biological Studies

1. Cod. July plankton tows east of Gaspé (4T) yielded no cod larvae.

Much progress has been made recently in identifying cod stocks and in working out their annual migration patterns. To further this effort, 2,700 cod were tagged in September 1963 in 4S and vertebral counts and otolith studies were provided for. This complements earlier taggings of a stock resident in 4S-T.

Laboratory feeding studies with 50 to 51 cm fish for 30 weeks were carried out. Results verify earlier conclusions. With raw herring as food, feeding and growth in length and weight were highest at 12°C, intermediate at 8°C, and lowest at 5°C.

Field studies in 4T indicate that some of the factors regulating vertical migration are light, feeding and spawning, in that order of importance. In May and in the period mid July to October, upward movement is nocturnal and in June and part of July it is diurnal. Other field studies from January to March, using echo sounders in Divisions 4V, W and X, showed that nocturnal upward movement is great (as much as 30 m) in deep water compared with that in shallow water (Fig. 9).

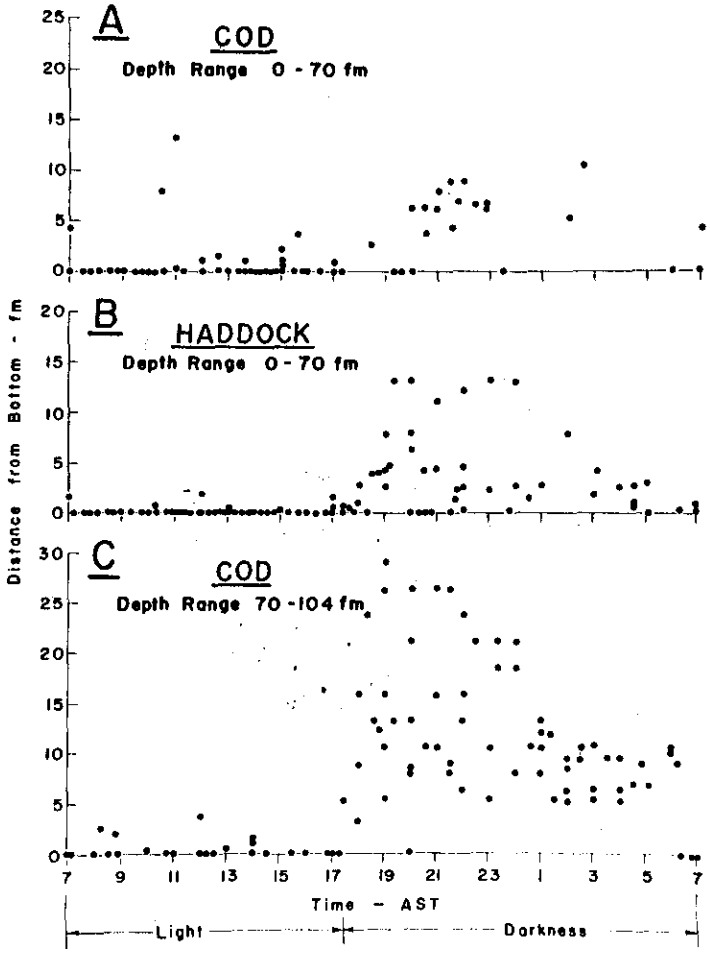


Fig. 9. Day-to-night differences in vertical distribution of cod above bottom in deep and shallow water in Subarea 4 (distances in fathoms: 1 fathom= 2 metres).

Laboratory experiments with cod show that lactic acid accumulates in the blood to such an extent during enforced exercise that the fish may die. The practical significance of this has yet to be demonstrated but it is possible that some fish which escape through the large mesh of "savings gear" may die from swimming fatigue.

2. Haddock. In March 1963 a research cruise was made to the shelf area of 4X. Interest centred on distribution patterns related to temperature, depth and bottom type. Catches alongshore east of Cape Sable were poor in depths less than 100 m. Here the fish are partly protected from exploitation by the unusually rough bottom which makes trawling difficult even with heavy steel rollers. Fish were also scarce on Roseway and LaHave Banks where temperatures were <3°C. They were more abundant between Browns Bank and Yarmouth but the bottom there was also rough. However, bottom character favoured trawling on little LaHave and Browns Banks and good catches of both large and small fish were made in 60 to 180 m at temperatures of 3 to 5°C. It appears that some 4X grounds are rich but that high temperatures in March 1963 encouraged dispersal.

3. Redfish. July plankton tows east of Gaspé (4T) yielded very few redfish larvae. Since 1950 research sampling of the most likely fishing areas in the Gulf of St. Lawrence (4R-S-T) has been carried out at 2-year intervals. A conventional otter trawl (No. 41.5) with a nylon liner (mesh 27 mm) in the cod-end has been used for this work. Size-frequency distribution of these redfish samples always show a stationary mode at about 35 cm for males and 38 cm for females. These modes represent the accumulated stock. Data gathered in the early years of the fishery (1950's) showed that fish of these sizes composed a great part of the population, and catches were high (50,000 tons in 1955). Since then, their relative numbers have decreased, the modes are less conspicuous in the size-distribution, and the catches have dropped (6500 tons in 1962). Plots for the research samples now show other modes more clearly. These represent smaller and faster-growing fish. A mode was observed in 1953 at 24 to 25 cm, representing both males and females. By 1955 it had progressed to 28 cm for males and 31 cm for females. But by 1957 these had merged with the modes representing the accumulated stock.

A mode at 8 to 16 cm (apparently mostly 3-year-old fish) was detected in 1959 and has been followed closely in catches made in 1960, 1961 and 1963. In 1963 when these fish were 7 years old, the mode was at 26 cm for males and 28 cm for females. From these data it was possible to check growth rates determined by other means.

This new size-group is abundant. Research trawl catches as high as 3 metric tons per 30-minute haul were made in 1963. These came from the same areas that gave the highest catches of accumulated stock in the 1950's. It is expected that the growth rate of these new fish will decrease from now on and that the modes representing them will soon merge with those of the accumulated stock. It seems that there was a gap of 8 years between the appearance of the last strong size-group and the appearance of this new group which is now

exploitable.

In November it was found that the level of greatest abundance of these larger fish was deeper (300 to 350 m) than that of 20-cm fish (280 m). Thus better catches of large fish and some savings of small fish could be obtained by selectively fishing the deeper water.

4. Halibut. The 1963 returns from 1962 taggings in Divisions 4V and 4W indicate extensive movement but mostly to the eastward from the areas of release. The commercial fishery depends on large fish caught with bottom longlines. More information about migration is needed before we can decide whether it is worth trying to limit the wastage of young halibut caught incidentally in otter trawls. Information is also needed about what sector of the population is affected by trawls. For this purpose comparisons of catches by these two gears are being made.

Studies of age- and size-composition of catches are complicated by the fact that males and females grow at different rates. Results show that fish in southwest Nova Scotia (4X) are younger (Fig. 10) and smaller (mainly 6 to 14 years, 61 to 148 cm) than those from the Gulf of St. Lawrence (4R-S) (mainly 7 to 21 years, 61 to 166 cm). Thus the Gulf fish resemble those on the Grand Bank (Subarea 3). The tagging work is to continue in 1964 but other studies will be reduced.

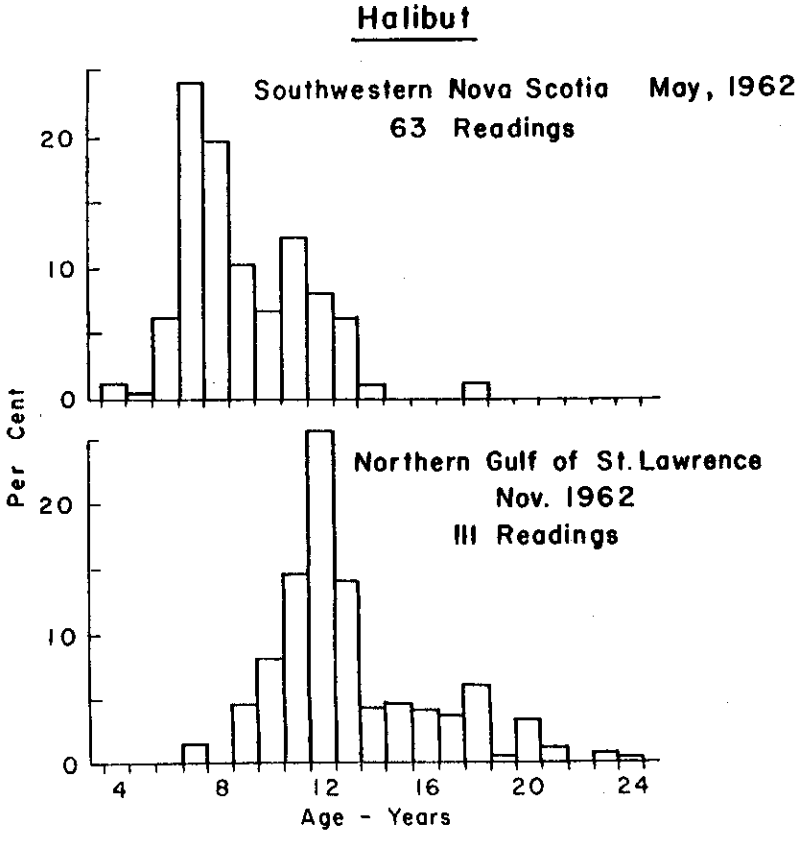


Fig. 10. Age-composition of halibut samples caught in 1962 with commercial longlines in Divisions 4X (63 fish) and 4R-S (111 fish).

5. American Plaice. A study of this species in the Magdalen Shallows was completed in 1963. Tagging indicates that there are two groups of fish in this area -- a northern group that concentrates in summer at 40 to 100 m in the Bay of Chaleur and Shippegan Gully (4T) and a southern group found off the western and eastern shores of Cape Breton (4T and 4V). In January, February and March, the fish are found in deep water (200 to 500 m) along the Laurentian Channel at 3° to 6°C. In April they move back to shallow water.

Males grow slower than females; 50% of males mature at 25 cm (6 years) and 50% of females at 41 (10 years). Adults feed largely on echinoderms and molluscs; 75 to 80% of discards die after 25 minutes of deck exposure. There has been a decrease in the mean size of fish in catches since 1950. The total annual mortality calculated from catch curves is 0.4 (instantaneous, i = 0.5).

6. Witch (Greysole). Substantial quantities are landed every year and in 1963 a study was begun in the Cape Breton area (4T and 4V). In winter the fish are found in muddy gullies as deep as 800 m. In summer they are taken in shallower water with best catches at 100 to 200 m. In October, 324 fish were tagged in this area. Males grow slower than females. Adults have a restricted diet, mostly annelid worms, amphipods and small crustaceans.

7. Wolffish (Anarhichas lupus L.) and Cusk (Brosme brosme (Müller)) are taken in southwestern Nova Scotia (4X) in small quantities -- wolffish mostly from April to July and cusk from April to October. Samples of commercial landings were taken for preliminary biological studies. The fisheries in this area are becoming more and more diversified and the study aims to assess possibilities of expanding catches of these under-exploited species.

Wolffish are taken in otter trawls and with bottom long-lines. Their otoliths are small and hard to read but vertebrae and scales show rings that may be less difficult to interpret. The modal value for fork (total) lengths of commercially-caught wolffish was 97 cm for offshore and 85 cm for inshore landings.

Cusk are usually taken incidentally on halibut longlines. Their otoliths show clear rings that may prove useful for age determination. The range in total lengths was 46 to 94 cm for offshore and 37 to 73 cm for inshore fish.

8. Herring. Annual June-to-September larval studies in the Gulf of St. Lawrence (4T) begun in 1951 and continued in 1963. A net with a rectangular mouth, 4m by 1 m, is towed at the surface for 30 minutes. The average catch of larvae per tow was 0.5 in 1959; 750 in 1952 and 730 in 1962. The aim is to discover relationships between larval abundance and subsequent recruitment to the commercial fishery. So far, no clear relationships have appeared.

Larval studies in the Bay of Fundy and southwestern Nova Scotia (4X) are designed to discover the source of supply of "sardine" herring to the Bay of Fundy. There is little spawning in the Passamaquoddy region of the Bay of Fundy but catches are maximum. Several years' catches are now being analyzed.

A study of water temperatures and the herring fishery of Magdalen Islands (4T) suggests the possibility of forecasting the starting date of the fishery and of the relative size of the landings in April.

The monitoring study of size-composition of herring stocks in Division 4X was continued in 1963. Mean lengths of weir-caught fish in the Bay of Fundy were 10.4 to 11.9 cm in April-May and 14.0 to 19.9 cm in August-September.

9. Mackerel, and Capelin, Mallotus villosus Müller. July plankton tows east of Gaspé (4T) showed that mackerel and capelin were dominant in the catches.

10. Sea Scallops. Laboratory studies of spawning of adults and rearing of larvae on cultured algae were continued. Spawning of ripe adults was induced by holding them in air for 3 hours then returning them to water. Larvae were reared up to 125 days to a size of 293 microns (length), although most larvae had died by 49 days and reached a size of approximately 250 microns. They are believed to settle at 300 microns. Mortalities in our cultures were believed due to bacterial or virus infections although a fungus-like organism was noted in two of the cultures. The larvae have never been described and their behaviour is unknown. Even the post-settlement stages less than 3 years old are little known. This makes it difficult to forecast recruitment.

Subarea 5

A. Status of the Fisheries

I. Haddock

Scarcity of haddock in Subarea 3 encouraged more fishing on westward grounds including Georges Bank (5Z). Statistics of effort and landings and results of sampling of landings for length composition are still to be compiled. They are to be analyzed by investigators of the U.S. Fish and Wildlife Service with whom we are collaborating in this project.

II. Cod

Considerable quantities were taken along with haddock but we have not studied the landings.

III. Herring

Indications are that there was little Canadian fishing in Subarea 5.

IV. Swordfish

The 1963 Canadian landings along the edge of the continental shelf (Fig. 11) were three times those of 1962 and showed increases in all areas exploited

including the edge of Georges Bank (5Z). This resulted from an increase in the number of boats and a change in fishing methods, from harpooning to longlining.

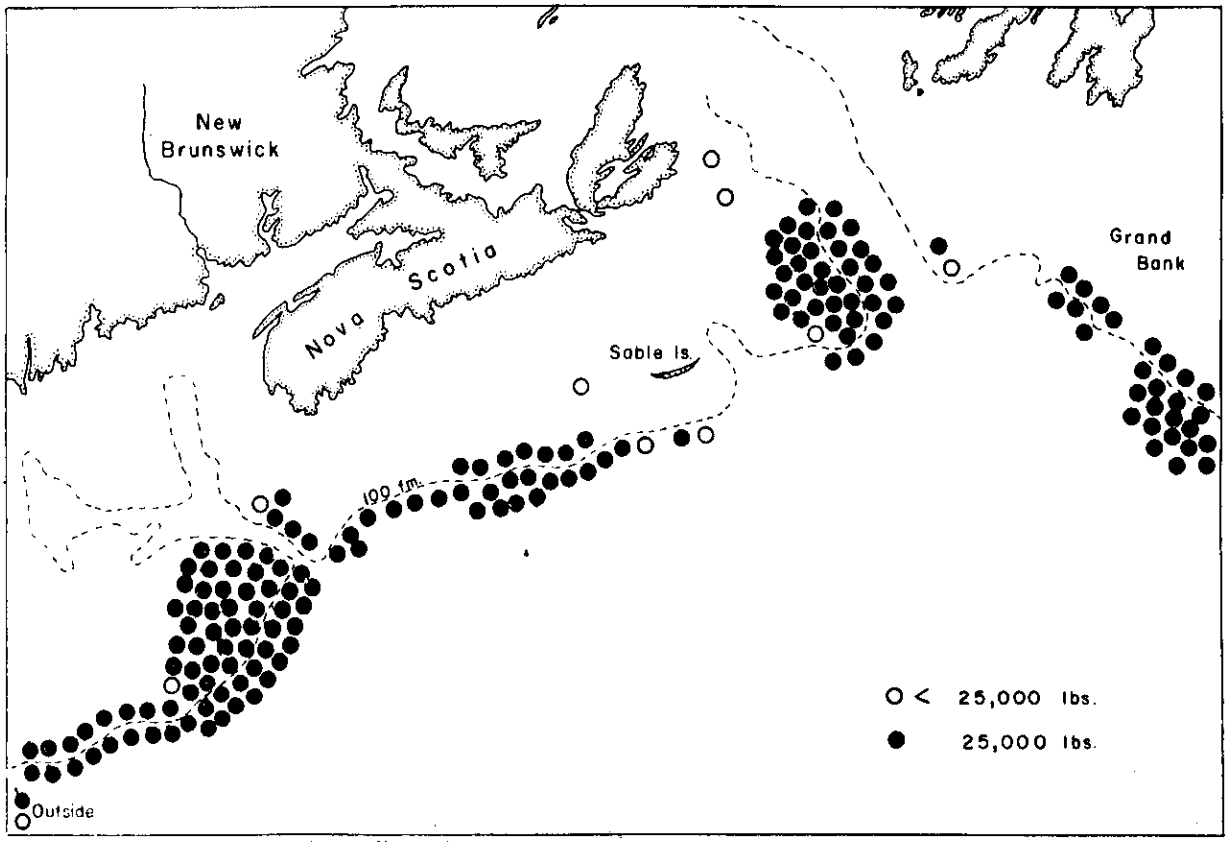


Fig. 11. Distribution of 1963 Canadian catches of swordfish (6000 metric tons) in relation to the 100-fathom (200 m) depth contour.

V. Bluefin tuna, Thunnus thynnus L., and Skipjack, Euthynnus pelamis L.

Canadian Atlantic purse seining for tuna began in August 1963. Two new 30-m boats landed approximately 300 tons of bluefin tuna and 50 tons of skipjack, taken partly from the Convention Area (5Y and 5Z) and the adjacent area southward to Long Island, New York, U.S.A. These fish were substantially smaller than the "giants" taken in Subarea 4 trap fishing.

VI. Sea Scallops, Placopecten magellanicus (Gmelin)

Preliminary statistics list 1963 Canadian landings of 7,390 tons of scallop meats (adductor muscles only) from Georges Bank (Division 5Z). This is equivalent to 61,360 tons of whole scallops and an increase of 10 to 15% over 1962 landings by this vigorous young Canadian fishery. This gain is attributed to an increase in fleet size from 39 to 49 boats. There appears to have been

some decrease in abundance -- catch per unit effort dropped and the maximum size of discards dropped from95 to 90 mm. Besides this, the fleet fished parts of the bank that have previously been considered too poor, and all boats used 3-inch (76 mm) rings although many had used 4-inch rings in 1962. Toward the end of the 1963 season a few boats entered the lucrative swordfish fishery. The size-composition of the stock indicates no unusually abundant year-classes. There are indications that abundance of usable scallops will be lower in 1964 than in 1963.

B. Special Research Studies

I. Environmental Studies

Bottom photography on Georges Bank (5Z) with an Edgerton underwater camera was used to study bottom characteristics and abundance of scallops.

Drift-bottle and seabed-drifter releases were made in 5Y as part of a co-operative study, with the USA, of water circulation in the Bay of Fundy, Gulf of Maine and Georges Bank areas.

II. Biological Studies

1. Herring. Analysis of 1963 research samples from Georges Bank is incomplete.

2. Swordfish. Biological studies chiefly involved length-weight measurements. Unexplained differences between mean lengths of fish caught in October and November were observed. A wide range of length-weight data which were available this year permitted us to plot this relationship.

III. Gear and Selectivity Studies

Conservation and ring-size of scallop dredges. Analysis of data previously collected on Georges Bank (5Z) was completed. Increasing the ring size of offshore (Georges Bank) scallop drags from 75 mm (3 inches) inside diameter to 102 mm (4 inches) does not reduce the catch of 5-year-old scallops (height 95 mm) sufficiently to be an effective conservation measure, although it does reduce the catch of trash by 18%. This failure to produce "savings" effects may be because the increase in ring-size was not great enough or because scallops do not struggle to escape through the rings or because the large amounts of trash brought up by scallop drags (sometimes as much as 75% of the entire contents of the drag) interfere with mechanical sieving of the scallops caught, just as meshing of redfish interferes with the selectivity of otter trawls.

TABLE 2. NUMBERS OF MENTELLA AND MARINUS REDFISH OBTAINED IN 1963 IN VARIOUS STAGES OF LARVAL DEVELOPMENT AND EXTRUSION.

LOCALITY	DATE OF CAPTURE	DEPTH M	SPECIES	NUMBERS OF PREGNANT FEMALES WITH VARIOUS PERCENTAGES OF LARVAE HATCHED								
				0% HATCHED A)	5-20% HATCHED	30-60% HATCHED	70-90% HATCHED	95-100% HATCHED	PARTLY SPENT B)	SPENT	TOTAL	% SPENT AND PARTLY SPENT
SE SLOPE HAMILTON INLET BANK N OF HAWKE CHANNEL	APR.9-16	366-560	MENTELLA	60	48	21	5	4		11	149	7
FUNK I. BANK NE NFLD. SHELF	APR.17	229-457	"	3	14	10	5	1		1	34	3
N SLOPE GRAND BANK IMMEDIATELY E OF N CAPE	APR.18	457	"	13	37	25	20	16		5	116	4
FUNK I. BANK NE NFLD. SHELF	MAY 8	265-329	"	4	6	4	3	8	6	6	37	32
E OF GREY ISLANDS NE NFLD. SHELF	MAY 10	274-278	"		3	3	5	4	3		18	17
FUNK I. BANK NE NFLD. SHELF	MAY 27-30	227-655	"	1	3	3	1	9	6	36	59	71
E. OF ST.ANTHONY NE NFLD. SHELF	MAY 31	220-377	"		2	1	4	3		15	25	60
OFF BONAVISTA NE NFLD. SHELF	JUNE 2	291-327	"			2	1	1		19	23	83
SE SLOPE HAMILTON INLET BANK N OF HAWKE CHANNEL	APR.9-16	448-560	MARINUS	6	51	15		1			73	0
FUNK I. BANK NE NFLD. SHELF	MAY 8	223-227	"		1	1					2	0
FUNK I. BANK NE NFLD. SHELF	MAY 27-29	262-558	"			1		1		18	20	90

A) ALSO INCLUDES PRE-LARVAL STAGES

B) SEVERAL HUNDRED TO SEVERAL THOUSAND LARVAE REMAINING

II. Danish Research Report, 1963

by Paul M. Hansen

A. Status of the Fisheries in Subarea 1

I. Cod

Fig. 1 shows the output of the cod fishery carried out by Greenland fishermen during the years 1926-63. Since the middle of the fifties the increase has been very quick until it reached its maximum in 1962 with 36,300 tons. In 1963 the catch dropped to 23,300 which is the lowest in the last six years.

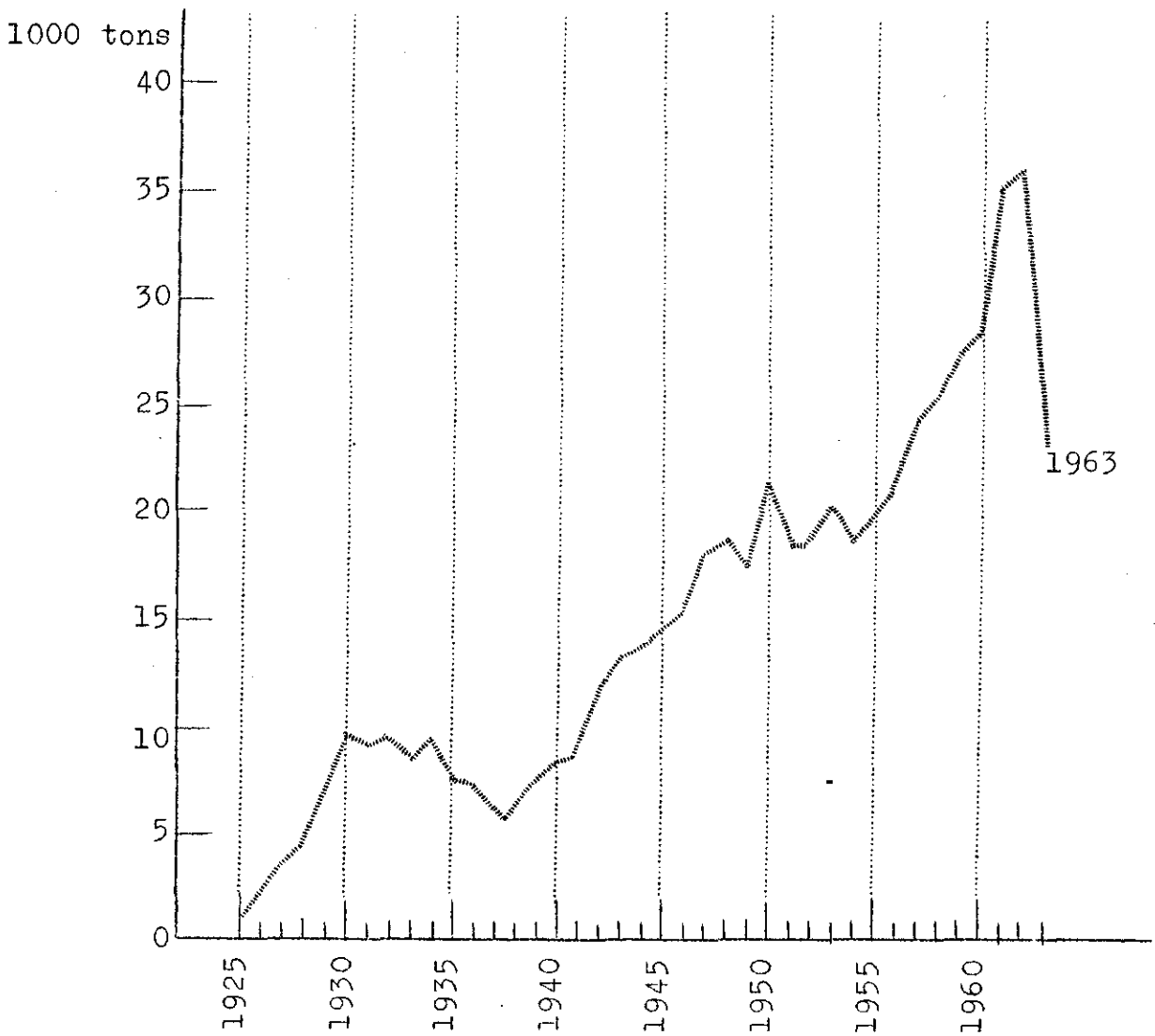


Fig. 1. Cod. West Greenland. Landings (thousands of tons) 1926-1963.

The pound net fishery which is a very important fishery in May and June failed totally. This fishery depends on the cod which comes to the shore pursuing the spawning shoals of capelin. The capelin came but not followed by cod. Also later in the season the cod failed to come to the inshore waters, where the Greenland fishermen have their fishing grounds. The reasons for this unusual behaviour of the cod in 1963 are difficult to explain. Perhaps it must be ascribed to unfavourable meteorological conditions. The temperatures in the winter months were unusually high followed by very low temperatures and heavy storms in the spring. The weather conditions have possibly been an obstacle to the stabilization of the water layers which is important for the plankton production and again for the food organisms on which the cod depend.

Plankton was very poor in 1963.

Forecast for 1964. It appears from the weather reports that the meteorological conditions in the winter and spring months in 1964 have been rather similar to those prevailing in the same season in 1963. The output of the Greenlanders' cod fishery has been very poor in the first four months of 1964 laying on about half the amount of the landings in the same period in 1963. It is therefore reasonable to believe that the total landings in 1964 will be on about the same level as in the year before, perhaps even lower.

Taking the composition of year-classes in the stock of cod in 1963 into consideration the year-class 1957 will still be the most important in the landings in 1964. The cod belonging to this year-class will have a mean length of 72-78 cm and a mean weight of 3.5-4.5 kg. The year-class 1956 will be of some importance in Div. 1F (mean length and weight about 80 cm, 4.8 kg). We can expect a rather strong reduction in the amounts of these two year-classes caused by heavy trawl fishing. The year-class 1958 will be of some importance but possibly only in the southern part of Div. 1D and in 1E.

In the stock of small cod in inshore waters in 1962 and 1963 the year-classes 1960 and 1961 were rather strongly represented and must be considered as rather rich year-classes which will be of importance to the fishery in the future. In the commercial catches in 1964 these two year-classes and especially the year-class 1960 will appear in rather large amounts. The mean lengths of cod belonging to the year-class 1960 will be about 45-53 cm and the average weight 0.9-1.5 kg. In 1965 it will reach commercial size with a mean length about 60 cm and a mean weight of 2 kg.

B. Special Research Studies

I. Environmental Studies

1. Hydrographic and plankton. Hydrographic and plankton studies have been carried out by the research vessel "Dana" in the Davis Strait in June and July according to the ICNAF NORWESTLANT programme. In inshore waters

hydrographic studies have been carried out on fixed stations all the year round. Plankton has been collected on the same stations. On one station productivity studies by means of carbon 14 have been continued.

II. Biological Studies of Fish by Species

1. Cod

a. Occurrence of cod eggs and larvae. In June and July hauls with 2-m stramin net have been taken by R/V Dana in the Davis Strait according to the ICNAF NORWESTLANT programme. A special report on this work will be published. Cod larvae were very scarce in the catches on all stations.

Hauls with 1-m stramin net (100-50 m wire out) were taken in Godthåb Fjord and in Ameralik Fjord from medio January to ultimo July. The catches of cod eggs were small like in 1961 and 1962.

The first catches of cod eggs (16 eggs) were taken February 13 near a spawning place in the inner part of the fjord. On the same place about 900 and 700 cod eggs were caught on April 8 and 13 respectively. The largest number of eggs (about 10, 500) were caught in the inner part of the Ameralik Fjord south of Godthåb. On all stations in the fjords the catches of cod eggs were very small except in a single catch with 1300 eggs. On April 17 hauls with 1-m stramin net were taken on 3 stations on the Fylla Bank section. The depths were 200, 50 and 500 m. Over the eastern slope of the bank only 5 eggs were caught. Over the middle of the bank no eggs were caught while the catch over the western slope of the bank was about 1000 eggs in a haul with 100-50 m wire out and about 800 in a haul with 500 m wire out.

Cod larvae were only caught on one station namely near a spawning place in the inner part of the Godthåb Fjord where 7 cod larvae were caught on July 3.

b. Occurrence of small cod (age-groups I, II and III). Fishery with fine meshed gears, hand seine and shrimp trawl, have been carried out to study the occurence of the I, II and III age-groups of cod (Fig. 2). The I-group (1962 year-class) was only found in two of thirteen catches and must possibly be considered as a poor year-class. The age-groups II and III (year-classes 1961 and 1960) were well represented in the catches. The year-class 1960 must be considered as a good year-class which will be of importance for the first time to the fishery in 1965. Also the year-class 1961 seems to be a good year-class.

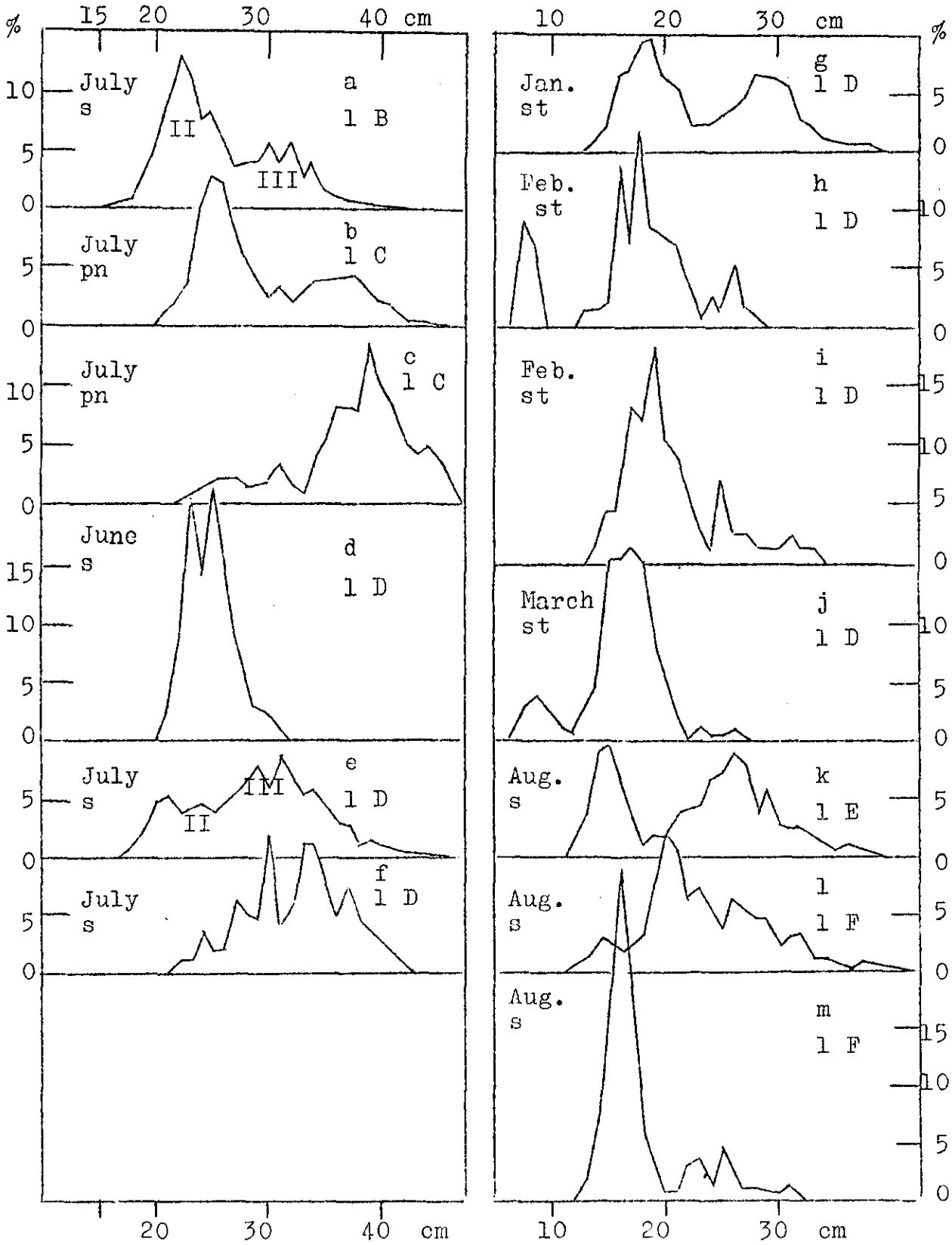


Fig. 2. Small cod (age-groups I, II and III). West Greenland. Length frequencies, 1963. (s = seine, pn = pound net, st = shrimp trawl).

c. Age composition of commercial stock. Otoliths of 6387 cod were collected in Subarea 1 in 1963. The samples were collected from catches taken with different gears (hand line, long line and commercial trawl) by the R/V's Dana and Adolf Jensen and a Faroese trawler and from Greenland fishermen's landings at different places in West Greenland. The distribution of samples according to divisions was following:

Division	No. of samples	Offshore banks	No. of samples	Inshore waters
1A	-	-	1	178
1B	3	373	2	905
1C	3	506	1	74
1D	3	352	4	747
1E	7	1943	3	432
1F	1	204	4	673
Total	17	3378	15	3009

On offshore banks the old year-classes 1947, 1950 and 1953 have been without importance to the commercial fisheries in 1963. In all samples they were below 10% except in two samples from Div. 1B and 1D where 1953 was represented with between 10 and 20%. The 1957 year-class predominated with between 30-56% in 11 of the 14 samples from the banks. The 1956 year-class was well represented in samples from Div. 1D and especially in 1E and 1F, where it was the predominating year-class in two samples. The 1958 year-class was well represented in samples from 1D, 1E and 1F. The 1959 year-class was sparsely represented in all samples except in a sample from a hand line catch on Store Hellefiske Bank. Cod belonging to this year-class were small cod (mean length about 50 cm). According to the estimates based upon occurrence of year-classes in the non-commercial stock in 1962 the 1959 year-class must be considered as a poor year-class.

In inshore waters the old rich year-classes 1947 and 1950 were nearly absent in most of the samples. Only in three samples was the 1947 year-class represented with between 10% and 15% (1A, 1E and 1F). The 1950 year-class was between 10% and 12% in two catches (1A and 1F). The 1953 year-class predominated in long line catches in 1A with nearly 40%. In all other samples it was very poorly represented in two long line catches where it amounted to between 10 and 15% (1E, 1F). As in 1962 the two rich year-classes 1957 and 1956 predominated the catches. The former in Div. 1B, 1C and 1D the latter in Div. 1E and 1F. In one great sample from 1B the 1957 year-class was represented with 73.3% and in two samples from 1C and 1D it was about 60%. The 1956 year-class was represented in samples from 1E and 1F with between 30% and 50%. The year-class 1958 was represented in four samples (1B, 1C, 1D and 1F) with 25-30% and in 1E it was predominating in one sample with 46%. The 1959 year-class was poorly represented in most samples except in two samples from Div. 1B and 1D where it was represented with 37% and 27% respectively. Only four years old the cod belonging to this year-class have been very small and have no value in commercial catches.

In Fig. 3 the summations of samples are given from offshore banks and inshore waters divided in northern (N) and southern (S) areas. The

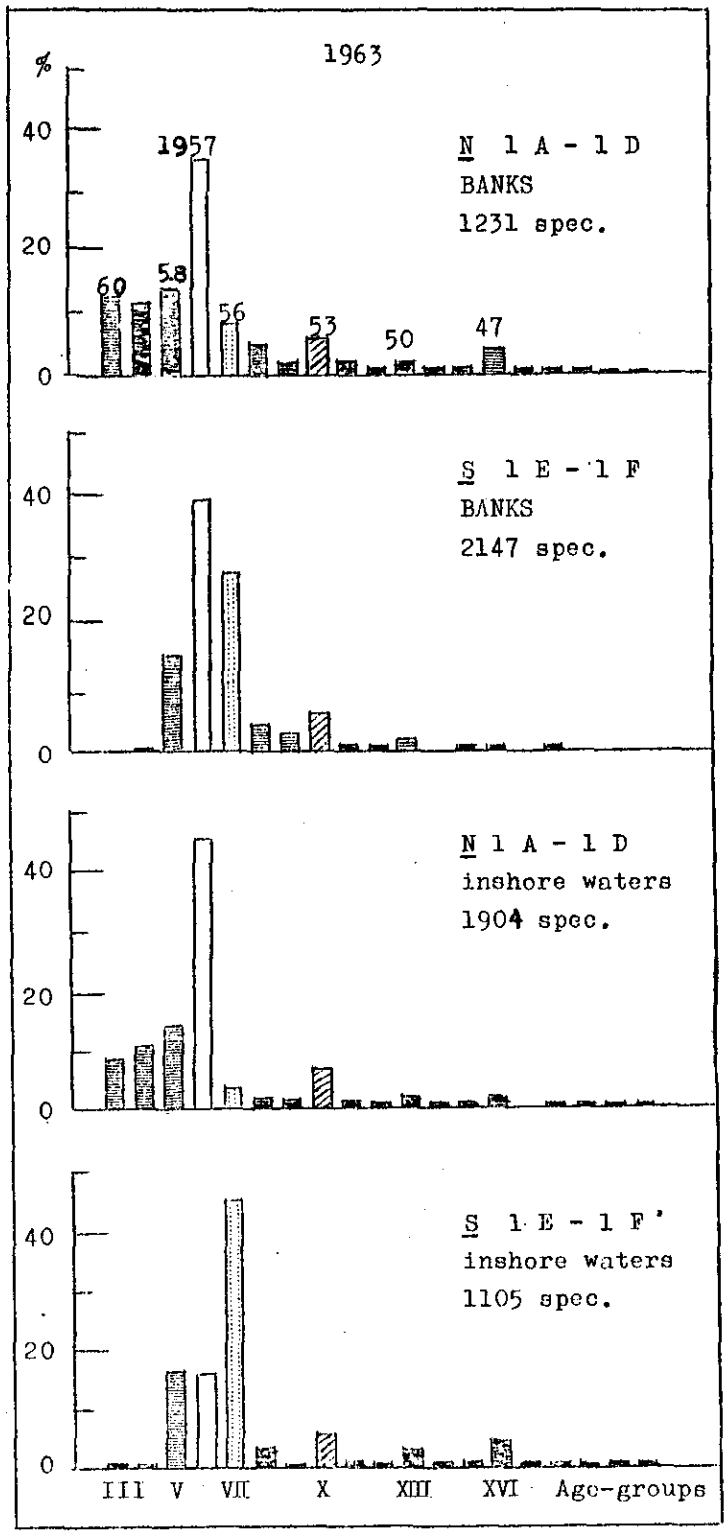


Fig. 3. Cod. West Greenland. Age composition, 1963.
N = northern area; S = southern area.

predominance of the year-class 1957 in both areas on the offshore banks is clearly seen. It appears also that the year-class 1956 was rather poor on the northern banks while it was nearly 30% on the southern banks. In 1962 it was strongly predominating in the southern divisions. There is reason to believe that cod belonging to year-class 1957 have migrated from the northern to the southern banks. In inshore waters the 1957 year-class predominated in the northern divisions with 45.6% and in the southern divisions the 1956 year-class predominated with 45.4%.

d. Tagging experiments with cod. 4616 cod were tagged in 1963. The distribution of the taggings are given below (small cod in brackets):

Division	Offshore	Inshore	
1A	-	-	(215)
1B	236	-	(170)
1C	719	-	(406)
1D	847	86	(683)
1E	182	182	(366)
1F	-	524	-
Total	1984	792	(1840)

2. Redfish. Redfish are only of slight importance to the Greenlanders' fishery. The production of frozen redfish fillets was only 31 tons in 1963.

a. Growth studies. In the Godthåb Fjord fishing with shrimp trawl for small redfish was carried out several times during the whole year. All fish caught were measured (3816 redfish). These experiments have been carried out since 1952 and have given good information about the growth of the age-groups from 1 to about 10 years old.

b. Tagging experiments with redfish caught in pound nets in the Godthåb Fjord have been continued. A number of 743 redfish has been tagged.

III. German Research Report, 1963

Subarea 1
by Arno Meyer

A. Status of the Fisheries

I. Cod

In 1963 the German trawlers fished off West, South and East Greenland again over the whole year. The landings increased further to 211,198 tons (242,964 tons round fresh weight), of which cod accounted for 58.4% and redfish for 35.2%. (Table 1).

Table 1. German landings from Greenland 1959-1963 in tons, average annual catch per fishing day in brackets.

		Cod		Redfish		Total	
	1959	13,394	(7.6)	17,600	(13.9)	33,056	(23.0)
	1960	19,186	(7.9)	20,289	(13.1)	42,978	(23.3)
W. Greenland	1961	70,156	(11.4)	39,959	(8.6)	120,900	(22.0)
(Subarea 1)	1962	102,129	(15.7)	51,308	(7.7)	168,452	(25.7)
	1963	112,325	(16.1)	39,525	(5.5)	168,907	(24.1)
	1959	9,691	(6.4)	19,186	(13.6)	30,869	(21.1)
	1960	15,378	(5.2)	30,250	(11.0)	49,421	(17.5)
E. Greenland	1961	11,232	(4.1)	24,292	(12.5)	37,968	(18.6)
	1962	11,489	(7.2)	23,103	(15.1)	36,334	(23.4)
	1963	10,979	(5.1)	28,893	(14.2)	42,365	(20.4)
	1959	23,082	(7.1)	36,785	(13.8)	63,927	(22.2)
Total	1960	34,560	(6.3)	50,538	(12.0)	92,389	(20.0)
Greenland	1961	81,388	(9.7)	64,249	(9.6)	158,871	(21.1)
	1962	113,618	(14.1)	74,410	(9.1)	204,787	(25.2)
	1963	123,305	(14.0)	68,414	(7.2)	211,267	(23.4)

Whilst the landings increased by 3.1% (1962 by 42%!), the effort (fishing days) increased by 13.5%. Thus the catch per fishing day dropped from 25.2 tons to 23.4 tons. The small increase in landings was only caused by increased fishing for redfish off East Greenland.

From West Greenland (Subarea 1) the landings were the same as in 1962. There was a further increase in cod landings by 10.0%, but a marked decrease in redfish catches by 23.0%. Fishing off West Greenland in 1963 was characterized by two very different seasons, extremely good fishing possibilities (relatively warm winter and good weather) during the first half of the year (average daily catch 28.9 tons), but very poor fishing from July to December (average daily catch 17.7 tons). Fig. 1 shows that these poor fishing results in

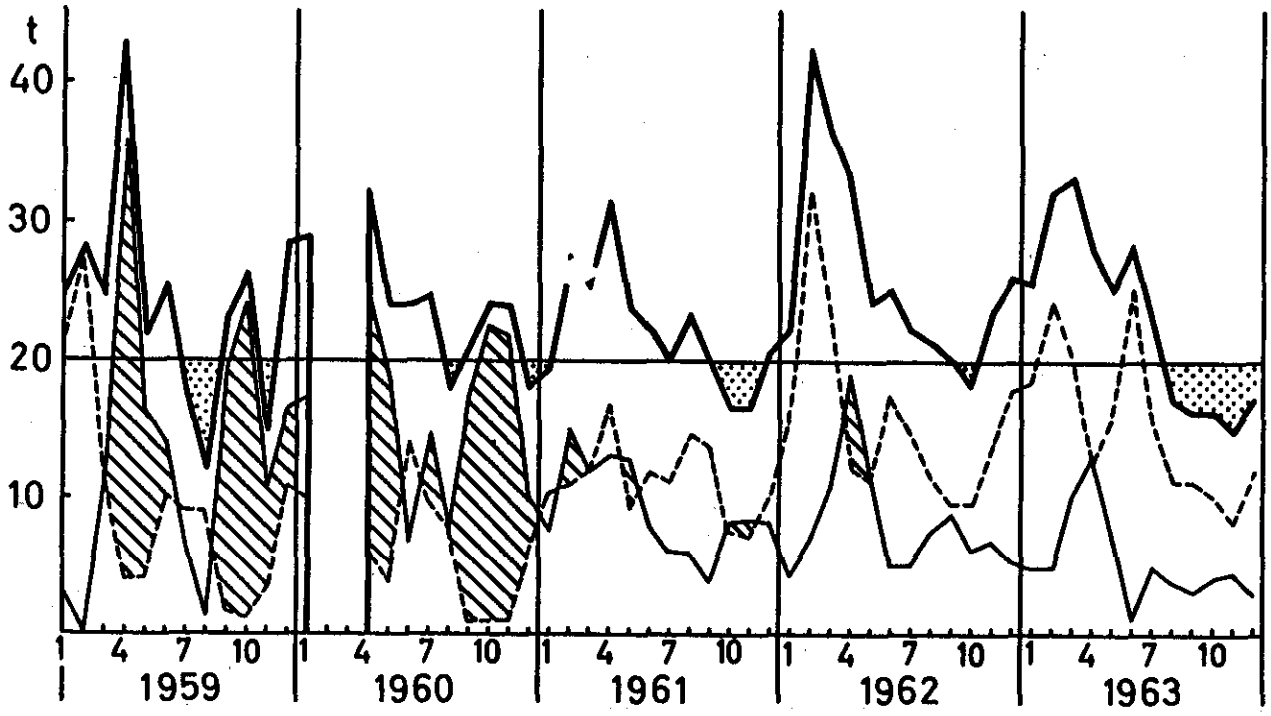


Fig. 1. Average monthly catch per fishing day of German trawlers in Subarea 1 in tons from 1959 to 1963. Thick solid line: total catch, broken line: cod, thin solid line: redfish, hatched section: redfish catches exceeding cod catches, dotted area: monthly catch per fishing day less than 20 tons.

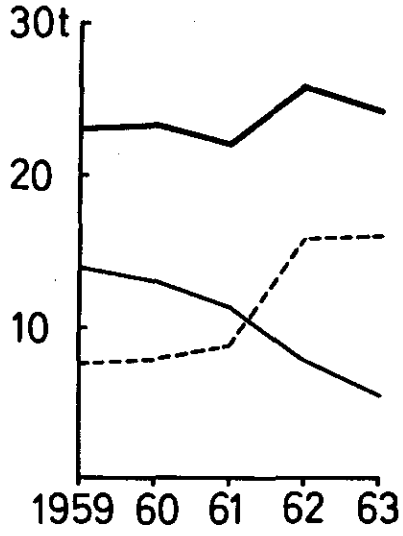


Fig. 2. Average annual catch per fishing day of German trawlers in Subarea 1 in tons from 1959 to 1963. Thick solid line: total catch, broken line: cod, thin solid line: redfish

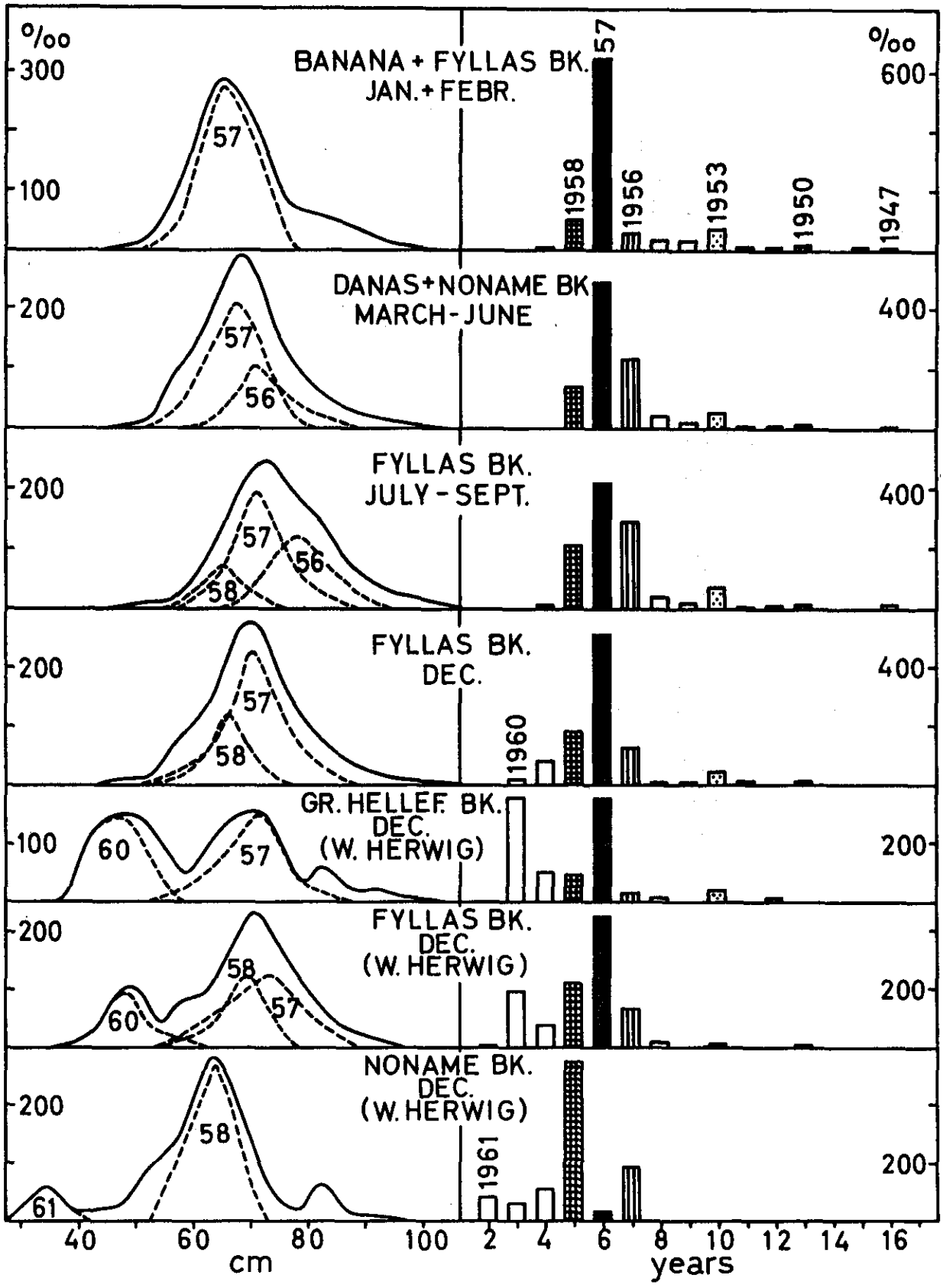


Fig. 3. Cod. Length and age distribution off West Greenland in 1963.

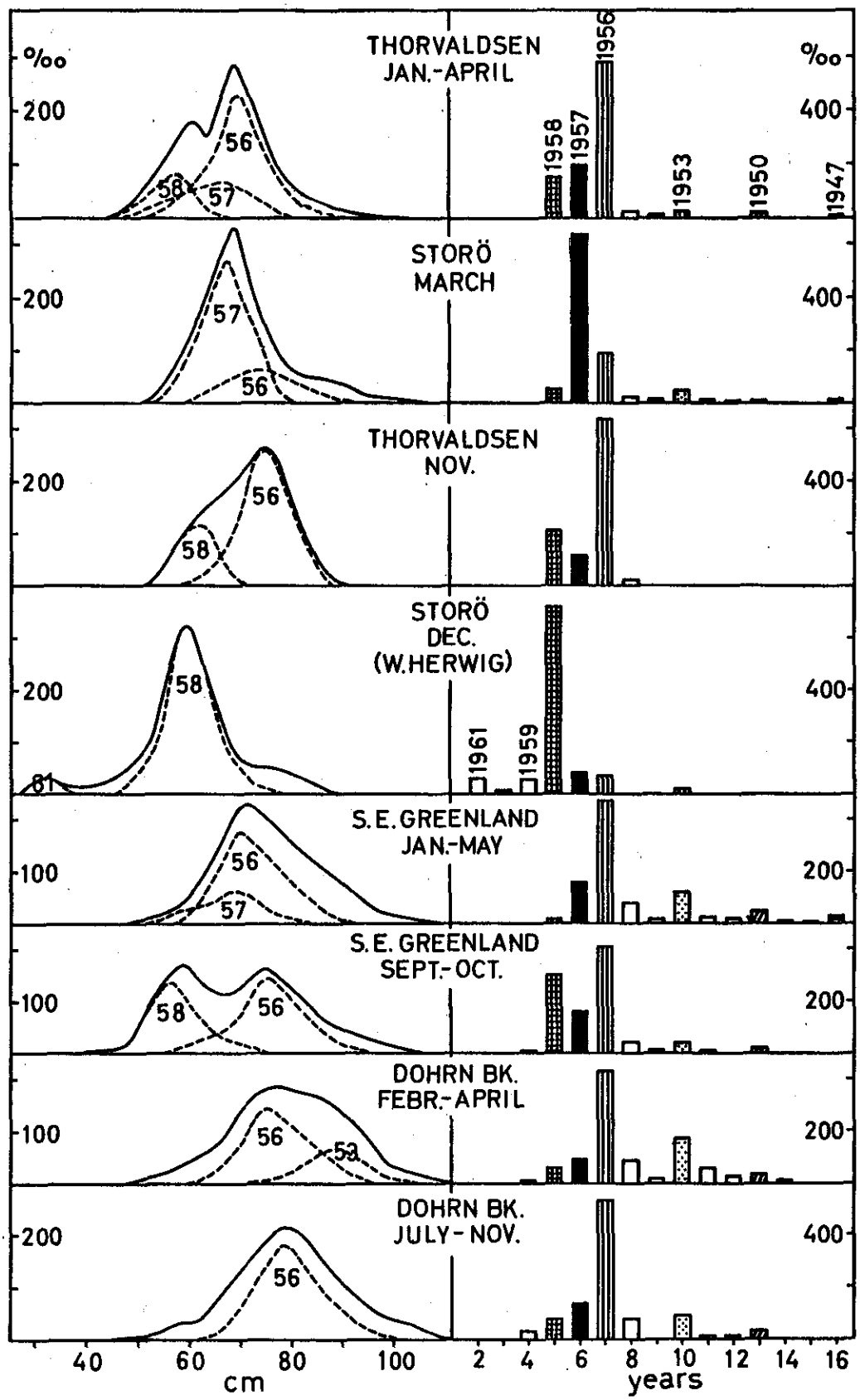


Fig. 4. Cod. Length and age distribution off South and East Greenland in 1963.

the autumn were caused by a pronounced slack period of cod, but much more by a lack of redfish. Since 1961, the West Greenland stock of redfish has gradually decreased to such a degree, that it can no longer fill the gap during the slack period of cod as in former years (1960, 1959 and the years before). The average annual catch of redfish per fishing day constantly dropped (Fig. 2) from 13.9 tons in 1959 to 5.5 tons in 1963. Thus, German trawler captains, greatly interested in catching the more profitable redfish, had to intensify cod fishing. Thus the average annual catch of cod per fishing day increased from 7.9 tons in 1959 to 16.1 tons in 1963. The poor yields from fishing off West Greenland during the second half of the year resulted in an increased fishing effort off East Greenland by 126%. But there are several indications that the output of redfish is also decreasing in the East Greenland area.

As in 1962, the two rich year-classes of 1957 (of West Greenlandic origin) and 1956 (of East Greenlandic origin) were of essential importance (Fig. 3 and 4). They show the same typical distribution as in the preceding year, but the 1957 year-class has spread in the meantime more southward as all West Greenlandic year-classes do when they grow older. The previous rich year-classes of 1953, 1950, and 1947 nearly vanished, only off East Greenland were the 10 year old cod of some commercial importance. The research catches taken by the new German research ship "Walther Herwig" revealed two new year-classes of future importance for the Greenland fishery: the 1960 year-class on the northern banks of West Greenland and the 1958 year-class, apparently of East Greenlandic origin, on the southern grounds. On account of the age and length composition it may be expected that, in 1964, fishing for cod will be more profitable (especially during the first half of the year) in the southern part of Subarea 1 and off East Greenland.

B. Special Research Studies

I. Environmental Studies

1. Hydrography. 5 sections (Fig. 5) were worked in December in spite of low temperatures, gales and ice. They indicate that the northern banks, particularly the Lille Hellefiske Bank, had temperatures higher than the southern banks. On the Lille Hellefiske Bank the 2°C isotherm was found at 75 m depth and the 5°C isotherm at 200 m. The Atlantic component of the West Greenland current was well developed with high temperatures of 5.55° to 5.75°C and salinities of 34.93 to 35.06 °/oo.

Unfortunately, little hydrographic work has been done up to now in winter. Thus we cannot say whether these temperatures were normal or not. Compared with some German data collected in the middle of December, 1959, the upper cold water layer with less than 2°C was much thinner in December 1959, as on Fyllas Bank the 2°C isotherm only reached 30 m and 60 m on Noname Bank. The warm water of more than 5°C was found in 1959 in 220 m on Fyllas Bank. But it is known that 1959 was one of the warmer years.

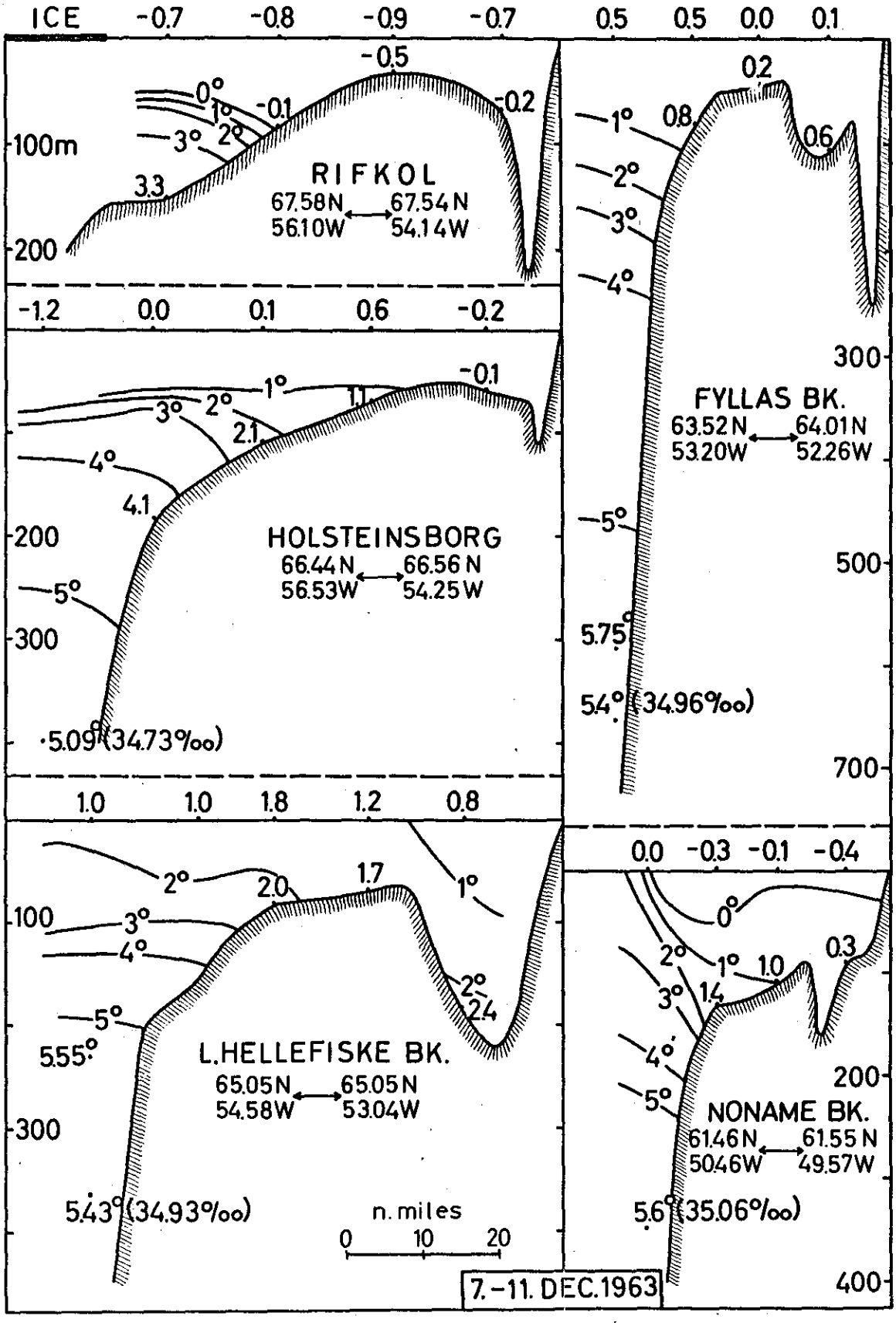


Fig. 5. Hydrographic sections off West Greenland, 7-11 December 1963.

II. Biological Studies

1. Cod. 135 recoveries from 2081 taggings (6.5%) mostly made off SW, S and SE Greenland were reported up to March, 1964. 26 cod (19%) were recovered off Iceland (15 off NW, 7 off SW, 1 off S, and 2 off E Iceland), 6 cod (4%) were found off E Greenland. All cod caught around Iceland were big, probably mature fish of 71-94 cm (average length 83.4 cm) and 7-12 years of age. Most of them were caught in spring. 93 cod were tagged in Div. 1D and 1E in December, 1963.

South East Greenland
by Arno Meyer

A. Status of the Fisheries

I. Haddock

In the ICNAF Annual Proceedings, Vol. 11, p. 51, the increasing occurrence of young haddock, 1-3 years old (mostly year-class 1958) off SW Greenland in 1960 was reported. In 1963, haddock were caught off SE Greenland primarily in fall and winter. Some trawlers landed up to 100 baskets per trip. The given length and age composition was collected from a landing of 84 baskets (2.7% of the total landing) from Walloe Bank in January 1964. The 1959 year-class is dominating with 68%. The 1960 year-class follows with 25%. As found in the 1960 catches the investigation of this sample again shows the fast growth of Greenlandic haddock. At the end of the fifth feeding period the 1959 year-class had reached an average length of 55.3 cm. This is approximately the same growth as off Iceland, but a more accelerated growth than in the NE Atlantic. From a comparison with the different strengths of the year-classes of haddock around Iceland (Table 2) we may presume that these haddock are of East Greenlandic origin. This is further to the evidence of Corlett who found spawning haddock in April, 1963, on Fylkir Bank. This increase of haddock off SE Greenland - haddock are also often caught on the north-eastern grounds of E Greenland, mainly on Gauss Bank (33-34°W) - corresponds with the constant increase in temperature off East Greenland (1951-1961: +0.8°C anomaly of surface water temperature and 0.2°C further increase in the last ten years as compared with the period of 1926-1950) as shown by Smed in Contribution No. H-5 to the ICNAF Environmental Symposium, 1964.

Table 2. Length and age composition of haddock caught off SE Greenland (January 1964) and off NW Iceland (June-July, 1963).

	SE Greenland				NW Iceland		
Length (cm)	°/oo	Year-class	°/oo	av. length	Year-class	°/oo	av. length
40-44	35	1960 :	250	47.2	1960 :	198	41.6
45-49	215	1959 :	682	55.3	1959 :	119	50.8
50-54	329	1958 :	38	-	1958 :	139	54.9
55-59	320	1957 :	26	-	1957 :	554	59.9
60-64	79	1956 :	4	-	1956 :	80	66.7
65-69	18				1955 :	7	-
70-74	3				1954 :	1	-
75-79	1				1953 :	2	-

Subarea 2
by J. Messtorff

A. Status of the Fisheries

I. Cod and Redfish

In 1963 fishing activity of German trawlers was again relatively low in Subarea 2. Only the landings of three trips had been exclusively caught off Labrador (mainly 2J). On one further trip also Subarea 3 was visited. The landings in metric tons are given below:

Month	Sept.		Oct.	Nov.	Dec.	1963
Division	2G	2J	2J	2J	2J	Total
Cod	9	574	150	4	6	743
Redfish	37	439	160	54	84	774
Other fish	30	270	88	1	14	403
Total	76	1283	398	59	104	1920
trips	1		1	*	1	3
fishing days	5	47	15	3	6	76

*) part of one trip to Division 3K!

The total landings of cod and redfish were of about the same quantity. The main quantities of cod (97%) as well as of redfish (78%) were landed in September and October.

A direct comparison with the landings of the preceding year is not possible because the fishery was carried out at different seasons of the year (1962: January -March). The 1962 landings consisted of only 25% cod but 66% redfish. The catch per fishing day was for cod about 7 tons (1962) and 10 tons (1963) and for redfish about 19 tons (1962) and 10 tons (1963).

B. Special Research Studies

No market samples could be taken because catches were processed and deep-frozen at sea. Special field work was not carried out.

Subarea 3
by J. Messtorff

A. Status of the Fisheries

I. Cod and Redfish

In 1963 fishing activity of German trawlers in the subarea was restricted to one trip per month from June until December (none in August!). A pure cod-fishery was carried out in Div. 3L on two trips in June and July and yielded 80% of the total German cod landings from Subarea 3.

From September until December fishery took place mainly in Div. 3K. During this period cod catches yielded only 22% but redfish catches 52% of the landings. The mean length of cod from Div. 3K was 66.7 cm in October 63 and from the same division only 61.1 in November 63. The landings in metric tons are given below:

Month	June	July	September		Oct.	Nov.	Dec.	1963
Division	3L	3L	3L	3K	3K	3K	3K	Total
Cod	363	779	28	190	17	6	35	1418
Redfish	-	-	106	149	142	80	175	652
Other fish	52	109	21	94	23	1	32	332
Total	415	888	155	433	182	87	242	2402
trips	1	1	1		1	1	1	6
fishing days	12	29	11	25	10	5	21	113

The composition of the total German landings from Subarea 3 was 59% cod and 27% redfish in 1963 whereas in 1962 only 15% cod but 72% redfish were landed. The catch per fishing day of cod was 4 tons in 1962 but 13 tons in 1963 and of redfish 21 tons in 1962 against only 6 tons in 1963. A real comparability of these changes, however, does not exist because of seasonal and local differences.

B. Special Research Studies

Only few market samples could be taken, because most catches were processed and deep-frozen at sea. Special field work was not carried out.

Subarea 4

by J. Messtorff

A. Status of the Fisheries

I. Haddock

Fishery mainly for haddock was carried out off Nova Scotia by one German trawler in April and by a second vessel in May. A third trip in July was broken off after few days of unsatisfactory fishing and was continued in Subarea 3 (Div. 3L). On the first trip in April satisfactory fishing conditions for haddock were located in Div. 4W. The average haddock catch per fishing day was 16 tons at that time. As the fish were processed at sea only a small sample of 73 ungutted haddock was available for examination. The length distribution ranged from 40 to 71 cm and the mean length was 53.4 cm. The following table shows the age distribution ranging from 3 to 10 years. Most abundant was year-class 1957 (6 years) with 34% followed by year-classes 1956 and 1958. 36% of the examined fish were juvenile. The gonads of 47% were found in more or less advanced developing stages whereas 12% of the fish were shortly before or in the spawning stage. The latter were all over 50 cm in length. Only some larger haddock over 60 cm were already spent.

Haddock age-distribution

year-class	age	%
1960	3	1
1959	4	6
1958	5	17
1957	6	34
1956	7	26
1955	8	9
1954	9	6
1953	10	1

On the second trip in May the average haddock catch per fishing day decreased to 10 tons and concentrations were fished in Div. 4W as well as in 4X and 4Vs. In July only Div. 4Vs was visited. The total German landings in metric tons from Subarea 4 are given below:

Month Division	April 4W	May 4Vs+W+X	July 4Vs	1963 Total
Cod	76	63	42	181
Haddock	641	195	38	874
Pollock	19	56	16	91
Redfish	-	3	-	3
Other fish	99	55	11	165
Total	835	372	107	1314
trips	1	1	*	2
fishing days	40	19	6	65

*) part of one trip to Div. 3L!

B. Special Research Studies

Except the above mentioned sample no further market or field investigations.

IV. Icelandic Research Report, 1963

by Jón Jónsson

Subareas 1, 3 and East Greenland

A. Status of the Fisheries

In 1963 Icelandic trawlers fished for redfish and cod in ICNAF Subareas 1, 3 and in East Greenland waters. They made 48 trips to the ICNAF areas compared with 32 in 1962. In addition 36 trips were made to East Greenland waters. Total fishing effort in 1963 is shown in Table 1.

Table 1. Fishing effort of Icelandic trawlers at East Greenland and in the ICNAF area in 1963

	No. hours	No. hauls	No. days fished	Trips
Subarea 1				
Div. 1C	56	44	6	1
Div. 1D	1,727	1,815	216	18
Div. 1E	731	757	101	10
Subarea 3				
Div. 3K	1,966	1,710	174	19
East Greenland	4,832	3,891	441	36

I. Redfish

Table 2 shows that the most important area for redfish was Div. 3K, where the catch per 100 hours fishing was 224 tons, about the double of that in Div. 1D and East Greenland.

The catch of redfish in Subarea 3 was about double that in 1962, but this is caused by a similar increase in fishing effort. On the other hand, redfish seem to have been less abundant in Subarea 1 in 1963 than in 1962 so far as Icelandic trawlers are concerned.

Table 2. Total catch of redfish and cod and catch per 100 hours fishing of Icelandic trawlers at East Greenland and in the ICNAF Area in 1963 (tons)

	Redfish		Cod	
	Total catch	Catch/100 hours	Total catch	Catch/100 hours
Subarea 1				
Div. 1C	7	12.5	103	183.9
Div. 1D	1,871	108.3	2,173	125.8
Div. 1E	350	47.9	1,605	219.5
Subarea 3				
Div. 3K	4,405	224.1	756	38.5
East Greenland	5,941	122.9	1,443	29.9

II. Cod

Table 2 shows that cod were found in greatest abundance in Div. 1D and 1E. In the latter division, the catch per 100 hours fishing was 220 tons. The catch per trip was two and a half times that of 1962.

Fig. 1 shows the age distribution of cod in the catches of Icelandic trawlers from East Greenland, West Greenland and Labrador in April-May 1963.

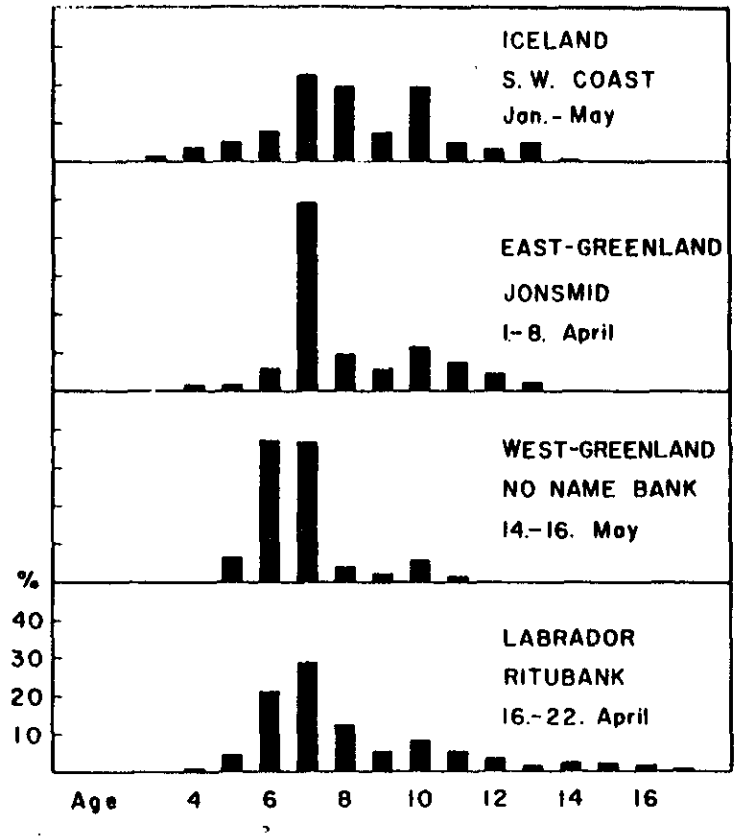


Fig. 1. Age distribution, 1963.

For comparison there is also shown the age distribution of the spawning stock of cod in Iceland in January-May of the same year. There is a remarkable agreement in the age distribution. The 1956 year-class is abundant in all areas, together with the 1957 year-class at West Greenland and Labrador. The 1953 year-class also seems to have been strong in all areas.

Fig. 2 shows the average lengths of the age groups in Fig. 1. The well known differences in the growth rate of cod in these areas are clearly demonstrated.

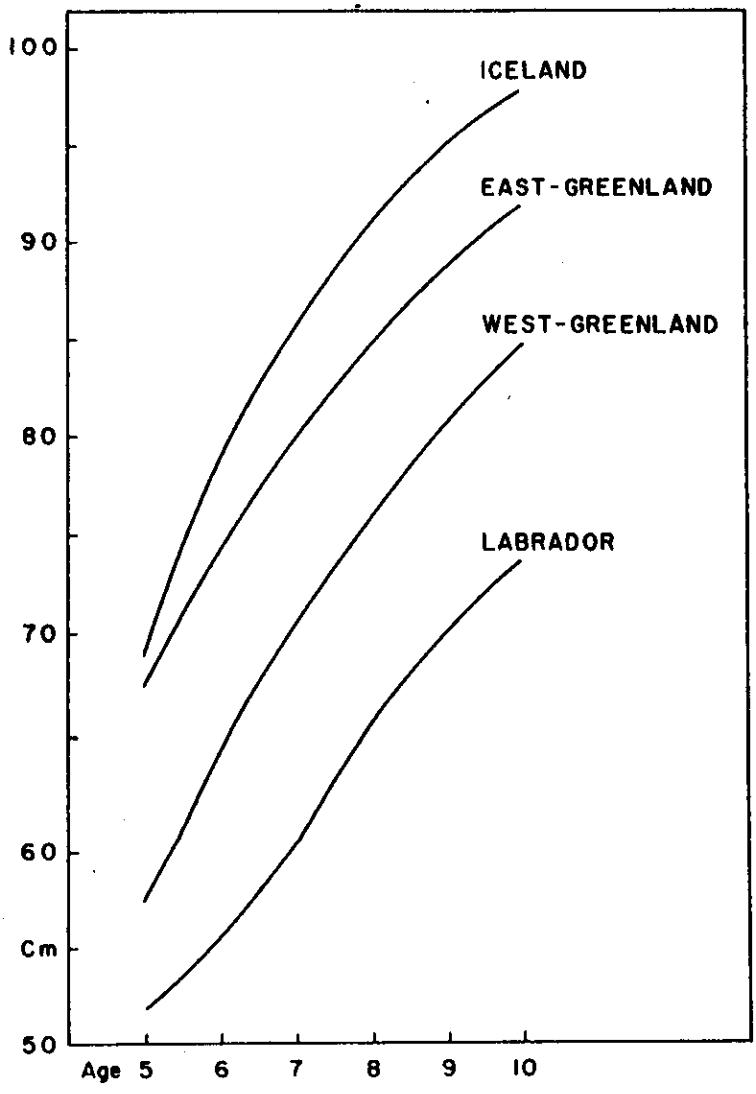


Fig. 2. Average lengths of age groups at Iceland, East Greenland, West Greenland, and Labrador, January-May 1963.

V. Norwegian Research Report, 1963

by Johan Blindheim and Erling Bratberg

Norwegian research of interest to ICNAF was carried out operating from the Institute of Marine Research, by the R/V G.O.Sars, in Subarea 1 (7 April-6 May) (Fig. 1), and by the R/V Johan Hjort in East Greenland waters (12 August-16 September) (Fig. 4).

Subarea 1

A. Status of the Fisheries

I. Cod

From 22 April-6 May, fishing experiments with trawl and bottom long-line were carried out from just north of Holsteinsborg in the north to Nunarsuit in the south and west to the drift ice border (Fig. 1). The experiments showed that cod were present on all the banks investigated. Heavy concentrations of cod were found on Banan Bank and the northwestern part of Fylla Bank. On Banan Bank some cod were pelagic and good records were obtained using the echo sounder.

Both in the trawl and bottom long line catches the mean length of the cod varied very much. The smallest fish were taken with trawl on the northwestern part of Fylla Bank, mean length 57.2 cm, and on the northern part of Lille Hellefiske Bank, mean length 59.0 cm. The largest fish were taken on bottom long line on Fiskenaes Bank and off Sukkertoppen, mean length 68.3 cm and 68.2 cm respectively. The largest fish in the trawl catches, mean length 67.9 cm, were found on Dana Bank. The mean length of three trawl catches on the Banan Bank was 63.8 cm. On the same bank the mean length in one bottom long line catch was 63.9 cm. The overall mean length in the trawl catches was 62.6 cm and in the bottom long line catches 66.4 cm. This is a very marked decrease in mean length from last year when the mean length on bottom long line was 70.5 cm.

The age distribution in the total catches on bottom long-line and in the total trawl catches are shown on Fig. 2 and 3. From the figures we see that both the 1947 and 1950 year-classes are of no importance. Further, the 1953 year-class has decreased considerably, from about 20% of the total catch on bottom long line last year to about 5% of the total bottom long line catch and slightly less than 3% of the total trawl catch this year. Also the 1956 year-class has diminished, and in all only about 29% of the total long line catch and about 16% of the total trawl catch are of fish 7 or more years old. In 1962 slightly less than 49% of the catch on bottom long line belonged to these year-classes. The 1957 year-class, over all mean length in all catches 64.45 cm, is strongly dominant and has increased in importance from about 36% to 45% of the total catch on bottom long line. In the trawl catches this year-class constitutes 50.2%.

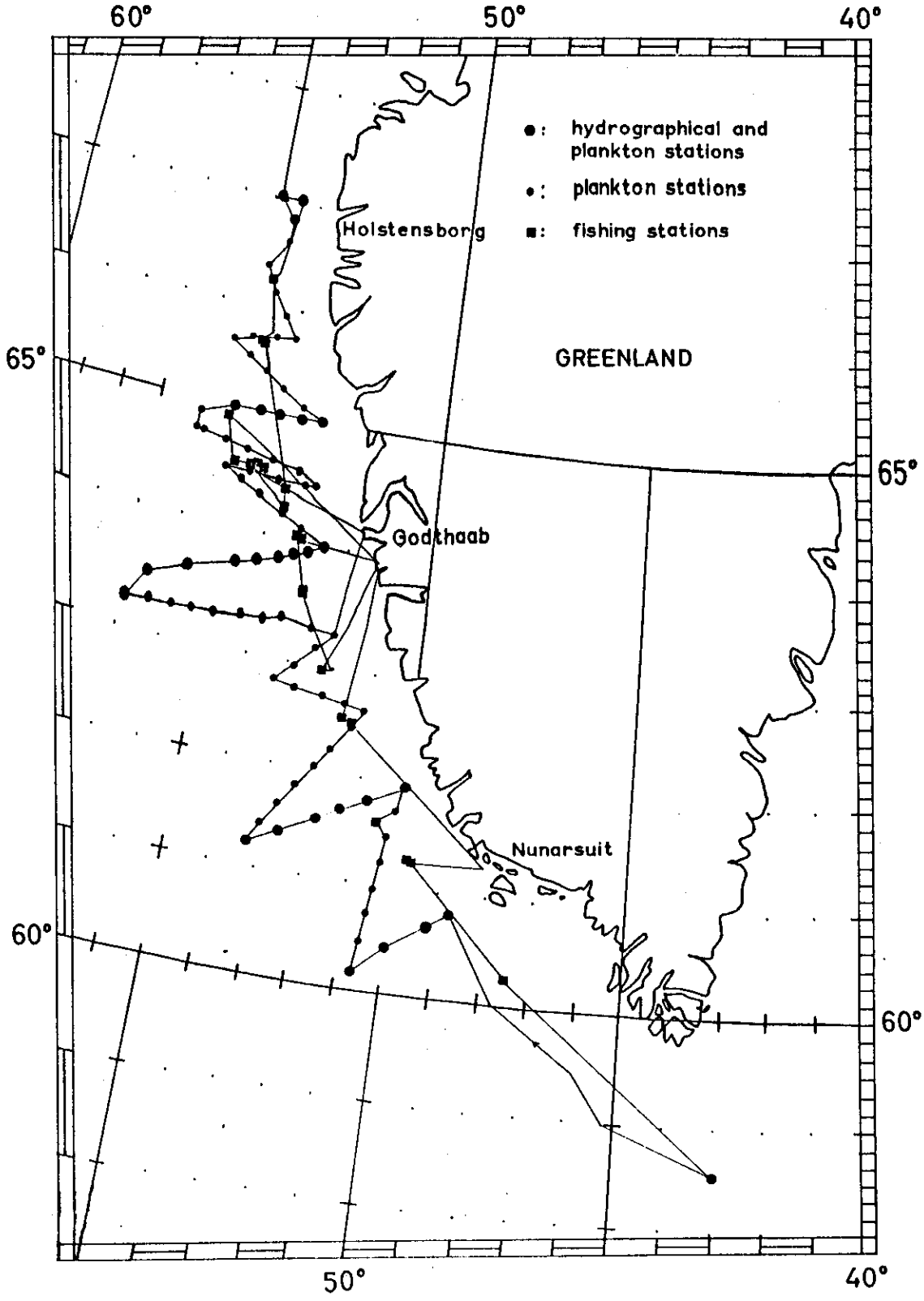


Fig. 1. "G. O. Sars", West Greenland, April-May 1963. Route and stations worked.

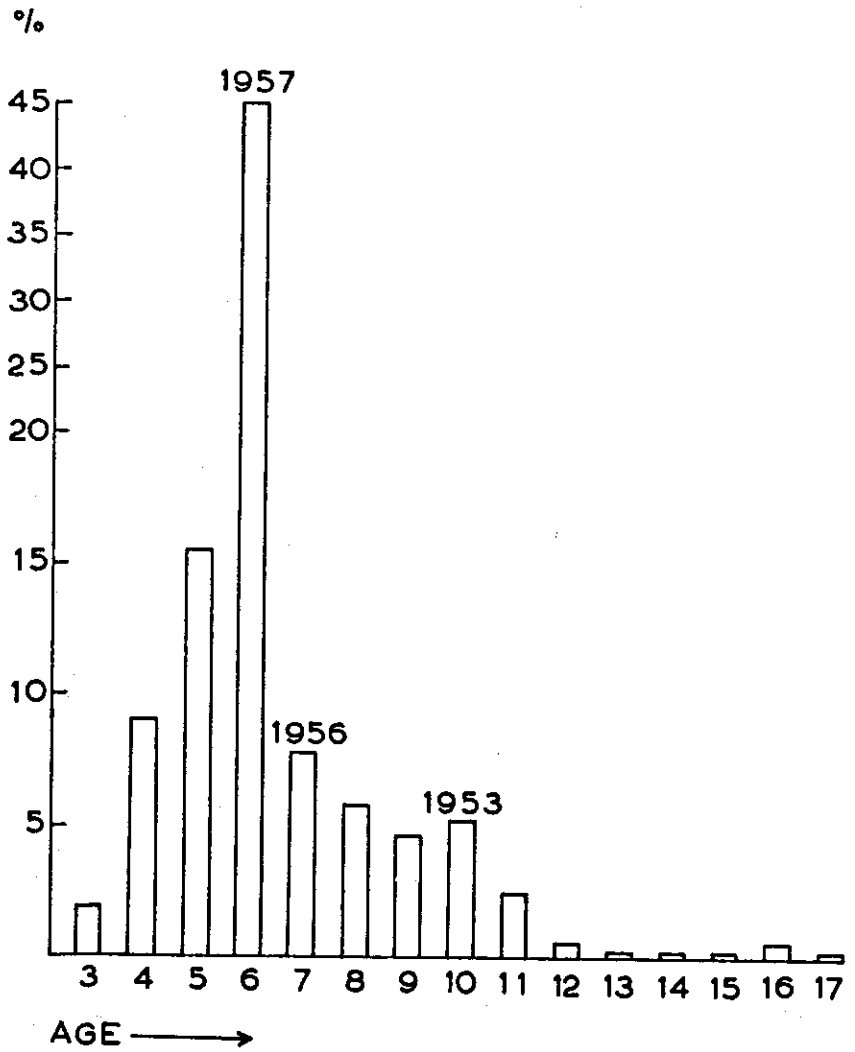


Fig. 2. "G. O. Sars", West Greenland, April-May 1963. Cod. Age distribution. Total bottom long line catch.

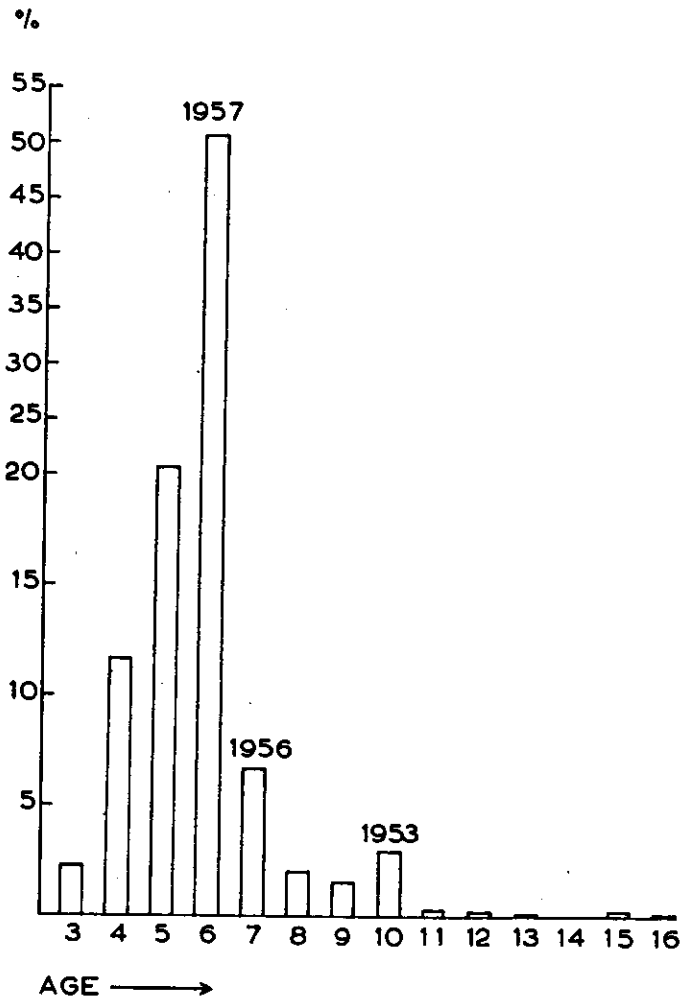


Fig. 3. "G. O. Sars", West Greenland, April-May 1963. Cod. Age distribution. Total trawl catch.

Last year a slight increase in the mean length of the cod off West Greenland was expected for 1963. Instead of the increase a decrease in mean length has found place. This must for some part be due to the great decrease in importance of the 1953 year-class. A decrease in this year-class was expected but not that much. On the other hand all the catches are taken in the spawning season and so it is possible that some big late spawners have not yet joined the shoals fished. It is therefore possible that the overall mean length in the G. O. Sars catches is not representative for the West Greenland cod population but it is thought that the difference is not big and that the observed age and length distribution give us a good hint.

Both for the bottom long-line and the trawl fishery off West Greenland in 1964 it is expected that fish which are 8 or more years old will play a very little part in the catches. The 1957 year-class will be dominant and probably increase in importance. It is possible that the mean length of the cod will increase but this will depend upon the strength of the year-classes which are younger than seven years.

B. Special Research Studies

I. Environmental Studies

Research included studies of the hydrography, distribution and abundance of cod eggs and larvae and zooplankton from 7 April-22 April as part of Norwegian participation in the ICNAF Environmental Survey (NORWESTLANT 1-3) in Subarea 1. This research is reported separately in 1964 Meeting Document No. 25 "Report on Norwegian participation in NORWESTLANT I, April, 1963".

East Greenland

A. Status of the Fisheries

1. Cod

In 1963 fifteen Norwegian commercial fishing vessels were working in East Greenland waters. Some were operating for both cod and halibut. In the cod fishery both hand line and bottom long line was used. Early in the season the fishery for cod was relatively good, but later on ice hampered the fishery and catches were poor.

R/V Johan Hjort worked off East Greenland (Fig. 4) in the late part of the fishing season and concentrations of cod were not found by means of the echo sounder or by fishing experiments with bottom long line on the banks. Relatively good concentrations of cod were located in the mouth of Prins Christian Sund and in the Angmagssalik Fjord. Due to the ice conditions other fjords could not be investigated.

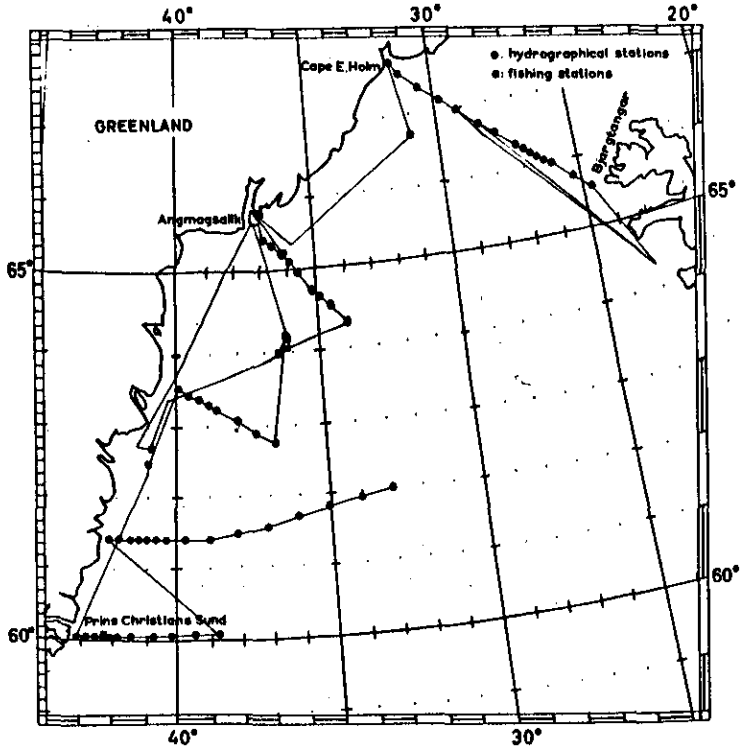


Fig. 4. "Johan Hjort", East Greenland, August-September 1963. Route and stations worked.

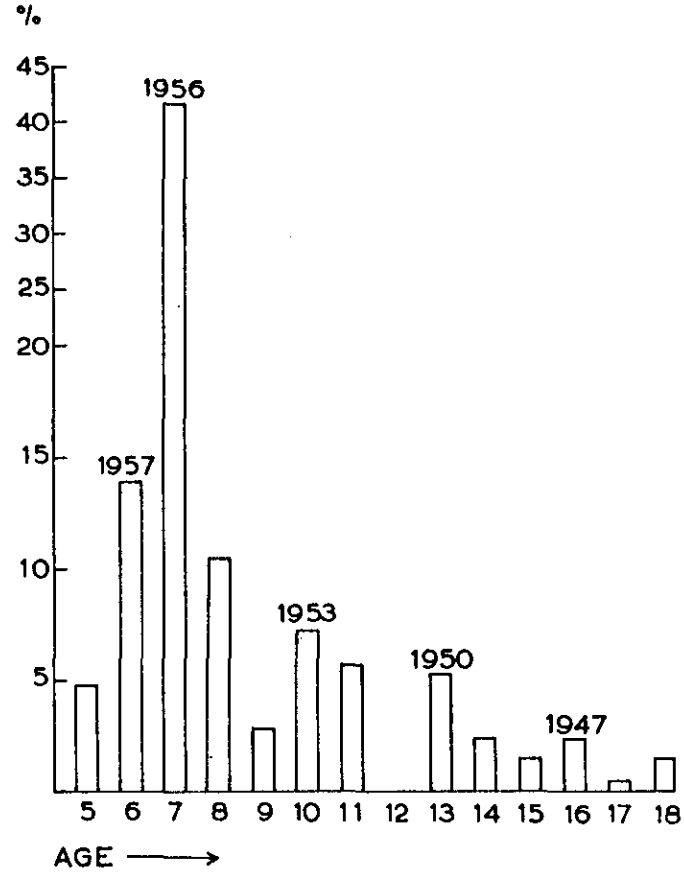


Fig. 5. "Johan Hjort", East Greenland, August-September 1963. Cod. Age distribution. Total hand line catch.

The age distribution of the cod caught on hand line in the mouth of Prins Christian Sund is shown on Fig. 5. The 1947, 1950 and 1953 year-classes still make up about 14.5% of the total catch, but the young fish dominate. The 1956 year-class is the most important. More than 41% of the total catch belongs to this year-class. The 1957 year-class has diminished compared with the age distribution last year, but last year the samples were taken in another area. The 1956 and 1957 year-classes make up slightly more than 55% of the total sample. In 1962 about 50% of the catch was of these two year-classes.

The overall mean length in 1963 was 77.0 cm. This is a marked increase compared with the catches from last year in the North Fjord in Skjoldungen and in the Angmagssalik area where the mean lengths were 73.6 and 73.3 cm respectively. The increase in mean length must be due partly to the relatively increased importance of the 1956 year-class, mean length 74.1 cm, and the decrease of the 1957 year-class. Another factor is that last year about 37% of the fish in the total catch was more than 6 years old, in 1963 about 39% was more than 7 years old. If the catches from 1962 and 1963 are comparable, it is expected that the mean length of the cod in the Norwegian hand-line fishery off East Greenland will be approximately the same in 1964 as in 1963. The 1956 and 1957 year-classes probably will have the same importance in the catches while the older year-classes will decrease.

B. Special Research Studies

I. Environmental Studies

In 1963 the Norwegian research vessel Johan Hjort worked in East Greenland waters between 17 August and 10 September. Concentrations of drift ice off the Southeast Greenland coast were heavier this year. Off Cape Dan the ice disappeared in the middle of August. Further south drift ice was extended 15-20 nautical miles offshore. Between Prins Christian Sund and Cape Bille there seemed to be no drift ice on the 23 August. Further north drift ice extended to Cape Møsting. Most likely there was also plenty of drift ice north of this position. At this time the ice belt covered the sea to a distance of 20 nautical miles from Skjoldungen and Cape Møsting. At the end of the cruise (6 September) there was also plenty of ice along the coast in this area.

1. Hydrography

Fig. 4 shows the route and the net of stations from the cruise. During the cruise the following sections were worked:

1. From Prins Christian Sund and eastwards:
   60°03'N, 42°55'W - 60°03'N, 38°50'W

2. Between Cape Tordenskjold and Ocean Weather Station 'Alpha':
   61°24'N, 42°10'W - 62°00'N, 33°00'W

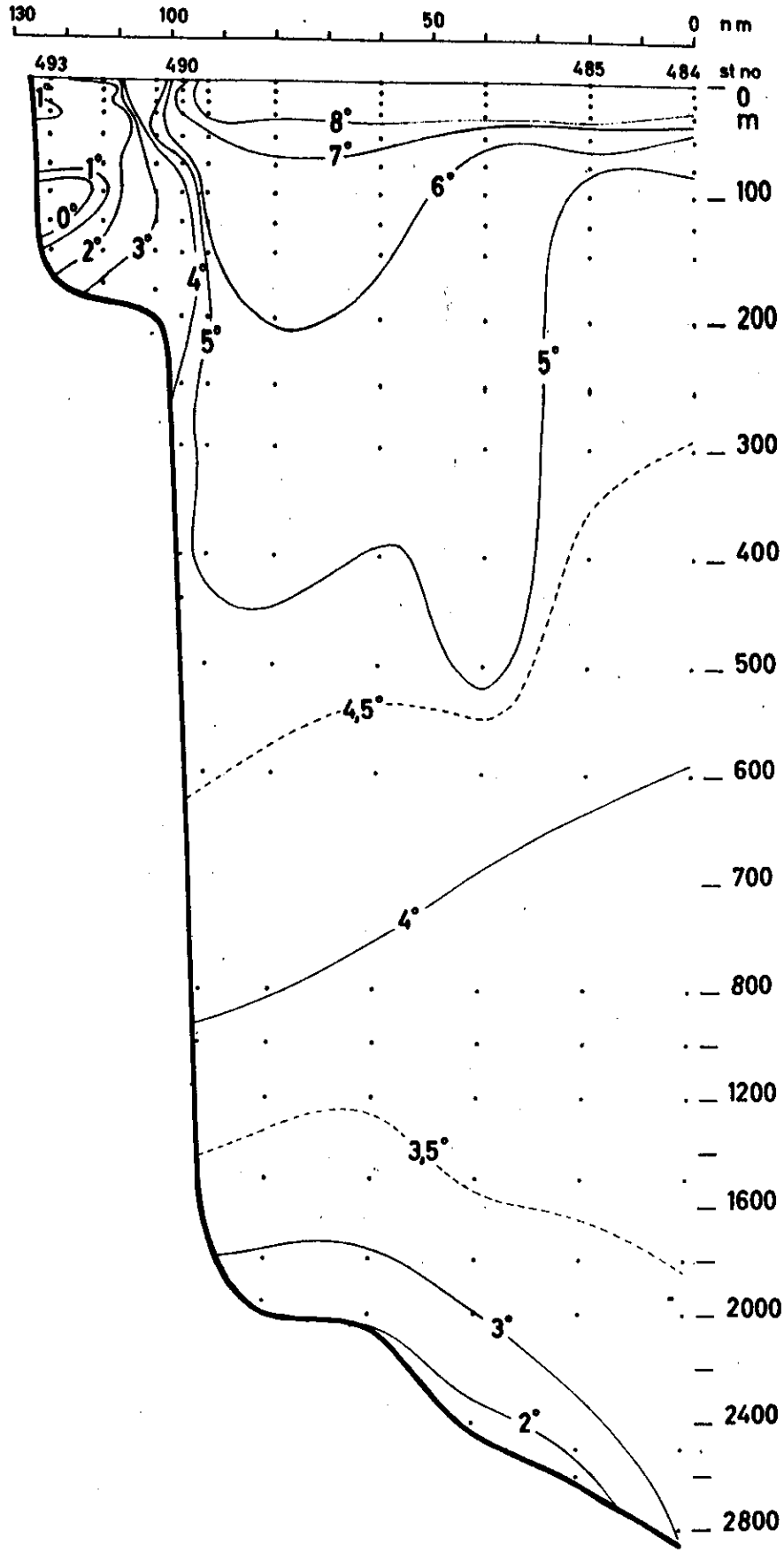


Fig. 6. "Johan Hjort", East Greenland, August-September 1963. Section eastwards from Prins Christian Sund. Vertical distribution of temperature (°C).

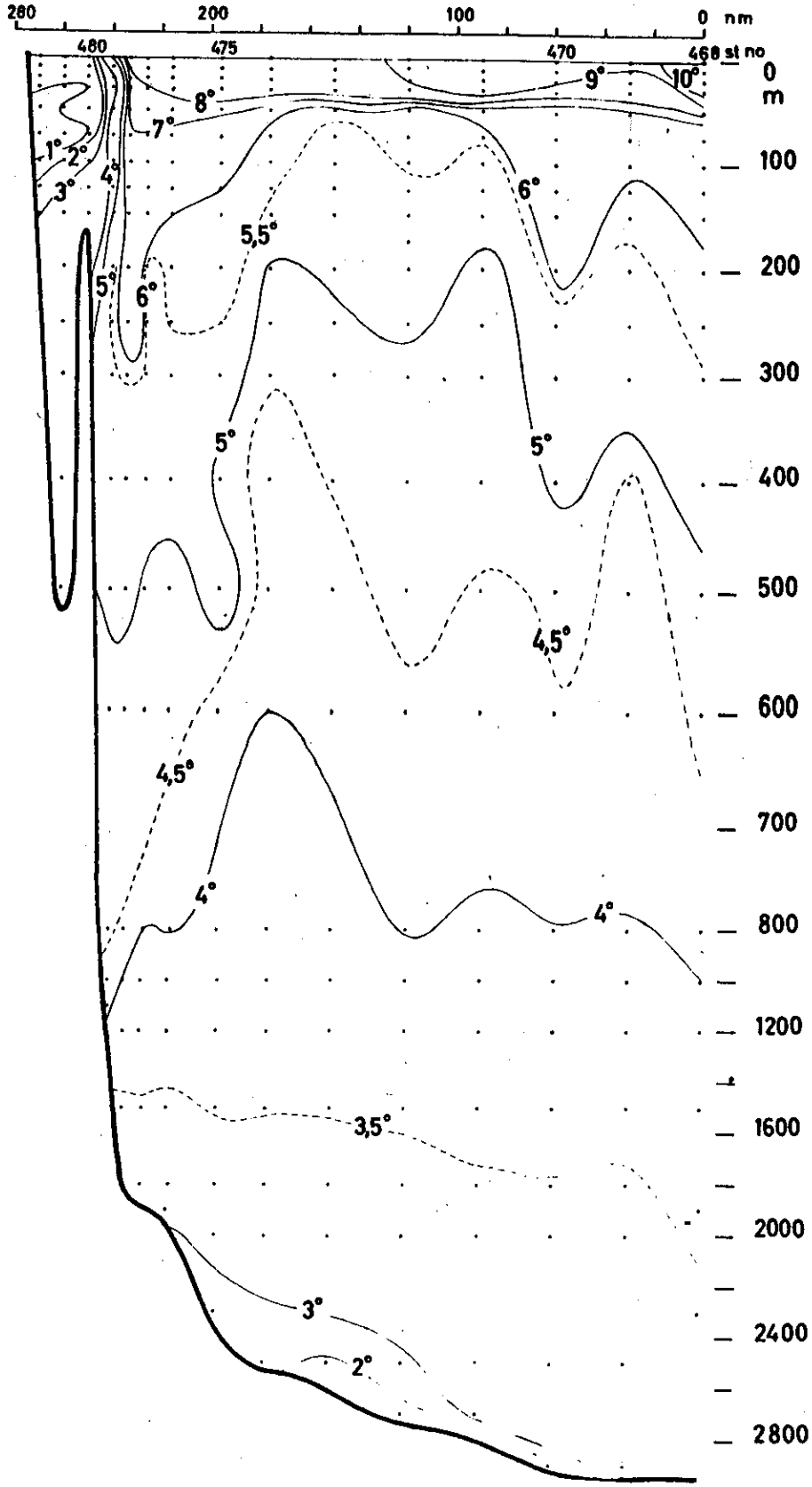


Fig. 7. "Johan Hjort", East Greenland, August-September 1963. Section between Cape Tordenskjold and Ocean Weather Station "Alpha". Vertical distribution of temperature (°C).

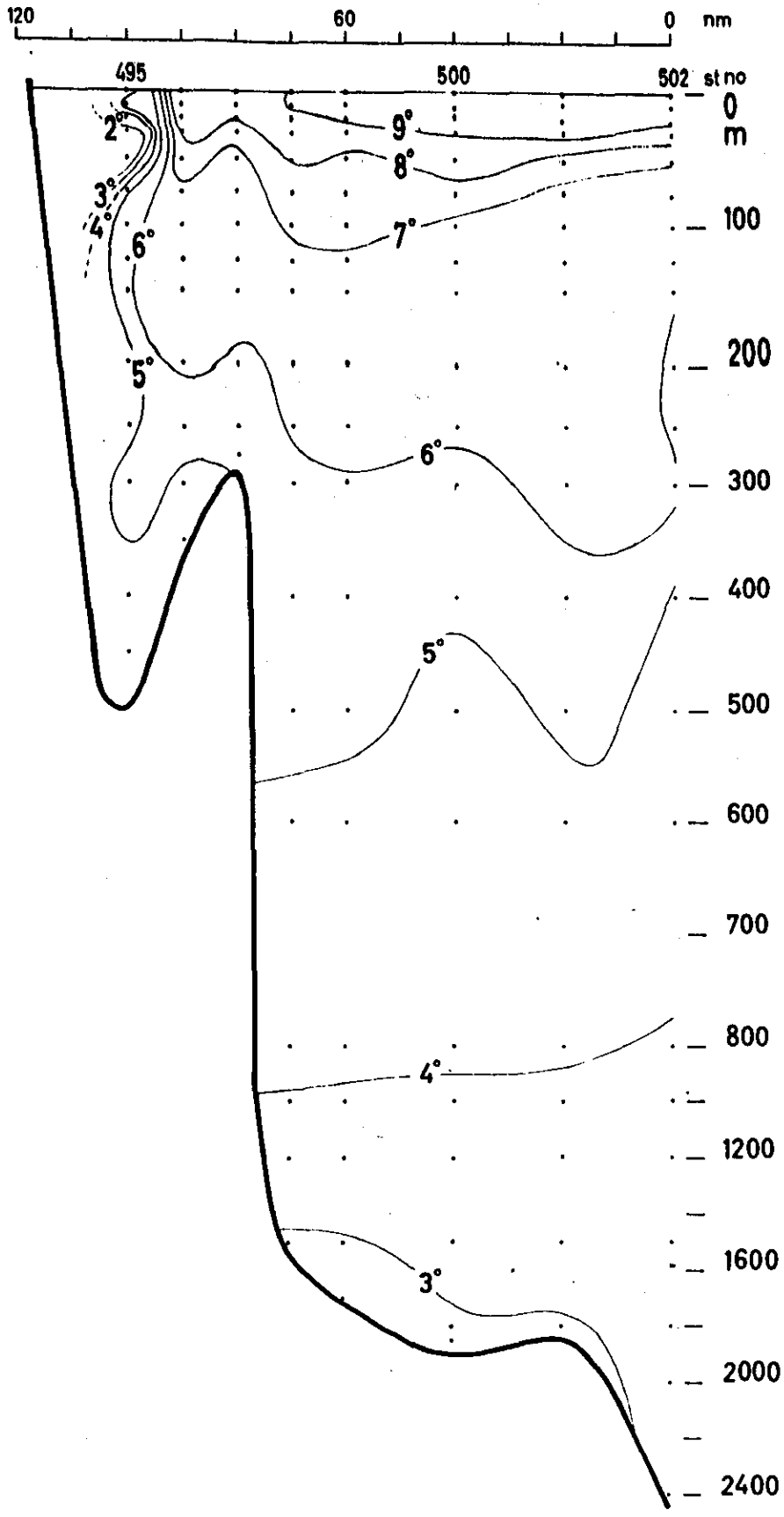


Fig. 8. "Johan Hjort", East Greenland, August-September 1963. Section towards south-east from Cape Møsting. Vertical distribution of temperature (°C).

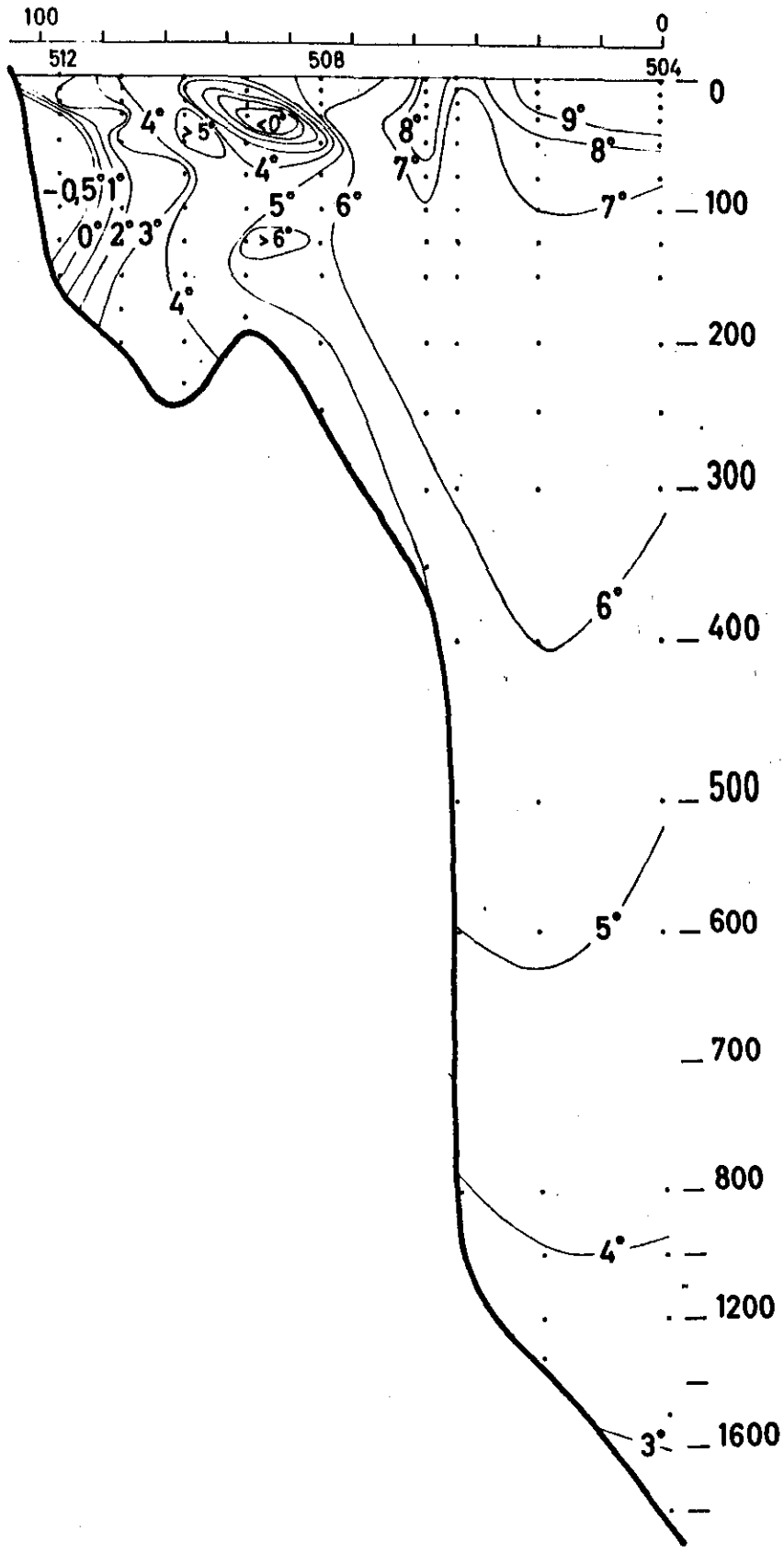


Fig. 9. "Johan Hjort", East Greenland, August-September 1963. Section towards south-east from Cape Dan. Vertical distribution of temperature (°C).

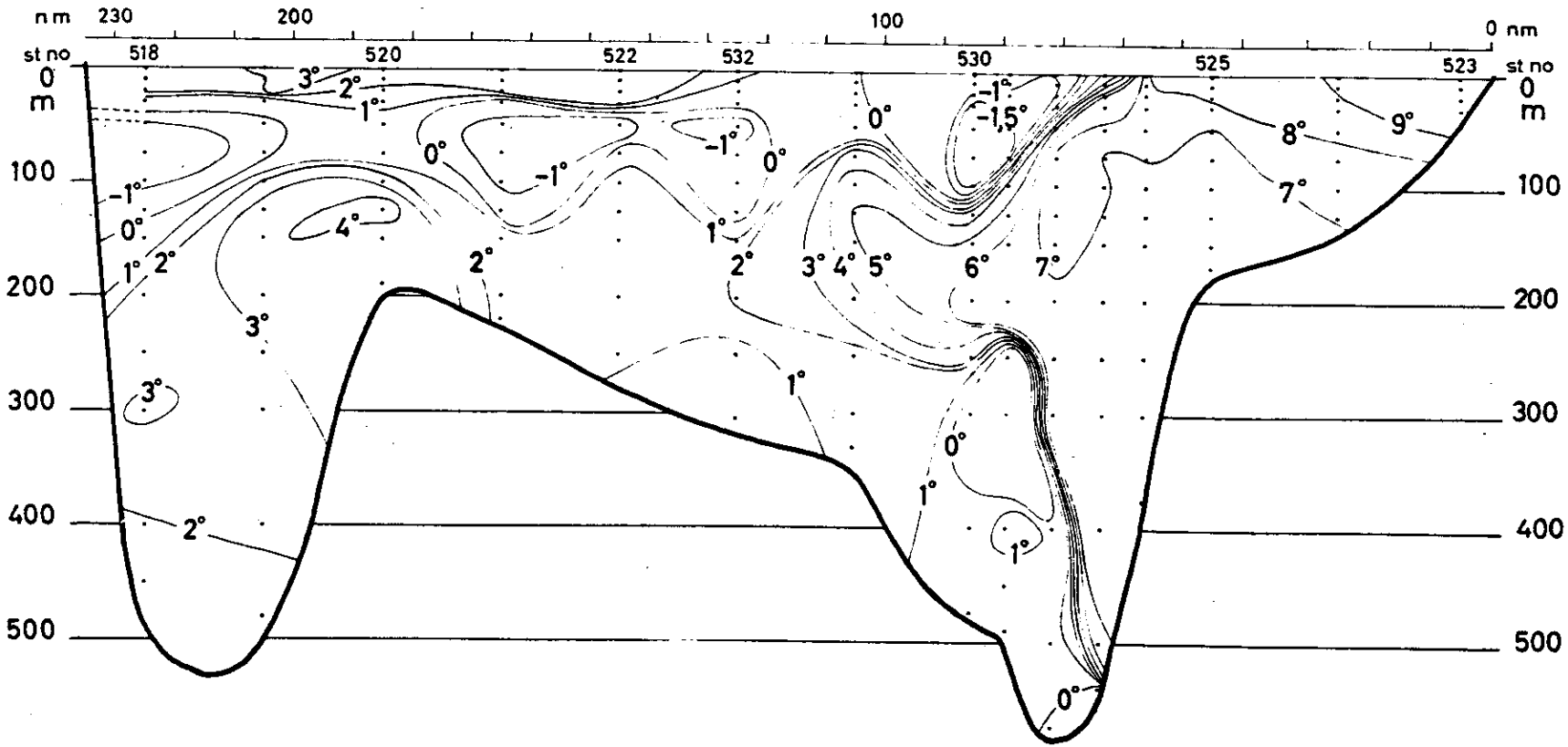


Fig. 10. "Johan Hjort", East Greenland, August-September 1963. Section across the Denmark Strait. Vertical distribution of temperature (°C).

3. From Cape Møsting and southeastwards:
   63°35'N, 39°35'W - 62°44'N, 36°45'W

4. From Cape Dan and southeastwards:
   65°26'N, 36°50'W - 64°19'N, 34°00'W

5. Across the Denmark Strait from Cape E. Holm to Bjargtangar:
   67°45'N, 31°49'W - 66°46'N, 28°32'W.

In these sections a total of 57 stations were worked. In connection with the fishing experiments seven hydrographic stations were made. Figs. 6-10 show the isotherms in the sections. Compared to 1961 and 1962, the continuous temperature observations at the surface showed that cold water, temperature near 0°C, had a great extension this year. South of Cape Møsting this water was found relatively wide offshore. It seems safe to conclude that the reason for this was the melting of ice which took place in this area. The sections at Prins Christian Sund, Cape Tordenskjold and Cape Møsting showed that the cold water was limited to the surface layer. From 50 m to the bottom the temperature was about the same as in 1962 or probably a little higher. Bottom temperatures at depths from 200 to 500 m were between 3 and 5°C.

The section off Cape Dan was worked 26 August, about two weeks after the drift ice had disappeared. Higher temperatures than in 1962 were found, both at the surface and in the deeper layers. The influx of warm water of Atlantic origin seemed therefore to be relatively heavy at this time. The bottom temperatures at depths from 200 to 500 m were also between 3° and 5°C.

The most striking characteristic of the section across the Denmark Strait was that the Polar Current was not only limited to the coastal water. The current had in that area more branches and the main branch was found over the steepest slope on the western side of the Denmark Strait, which is situated nearer to Iceland than to Greenland. Here temperatures down to -1.73°C were found. Farther west over the eastern slope of the Øst Bank, one branch with water of temperature down to -1.5°C was located. A third branch was located near the coast of Greenland.

Over the northern slope of the Kangerdlugsuak Deep warm water with temperatures up to 4°C was found, and the bottom temperature on the Øst Bank was above 3°C. This water is of Atlantic origin and flows northwest along the northern slope of the Kangerdlugsuak Deep.

VI. Polish Research Report, 1963

by F. Chrzan and S. Laszczynski

Polish catches were made by five factory trawlers and a side trawler and amounted to over 23,000 metric tons compared with 9,000 tons taken in 1962 and almost 4,000 tons taken in 1961. The increased Polish catches were due mainly to the increase in fishing effort and the increase in the catch per day fishing and catch per one hour trawling. This is illustrated by the following data on the exploitation of the factory trawlers:

Year	Total catch (tons)	Landings	Days fished	Hours fished	Yield per 1 day fished (tons)	Yield per 1 hour's trawling (tons)
1961	3,923.1	3	236	2,488	16.6	1.58
1962	8,677.4	6	409	5,243	21.1	1.65
1963	22,991.6	14	850	10,733	27.0	2.15

Catches of major species in metric tons in 1963 and 1962 were as follows:

	1963		1962	
Redfish	12,975	(56%)	4,104	(45%)
Cod	7,736	(33%)	4,196	(46%)
Flatfish	2,193	(9%)	456	(5%)
Other groundfish and herring	344	(2%)	365	(4%)
Total	23,248	(100%)	9,121	(100%)

As in other years, fishing was carried out mainly in Subarea 3 (88% in 1963, 75% in 1962 and 85% in 1961) followed by Subarea 2 (10% in 1963) and Subareas 1 and 4 (1% each in 1963).

Biological sampling of catches was carried out on board the factory trawler Dalmor as follows:

	Cod	Redfish	Flatfish
Winter (Jan-March)			
Nos. for Lengths only	13,727	9,043	2,623
No. for size, sex, maturity and age	1,622	969	610
Autumn (Sep.-Nov.)			
Nos. for Lengths only	-	2,822	392 (332 Am. plaice, 60 witch flounder)
Nos. for size, sex, maturity and age		682	721 (215 Am. plaice, 498 Greenland halibut, 8 halibut)

Data collected on the biological characteristics of cod from Div. 2J, 3K, 3L and 3M from January to March have been analysed and presented to the 14th Annual Meeting as Meeting Document No. 28. In addition, data on catches (amount and composition) in relation to trawl depths have been analysed and presented to the 14th Annual Meeting as Meeting Document No. 32.

Observations from the Dalmor compared catches from Div. 3K and 3L from September to November made by day and night. Best catches of redfish were made in daytime (10 a.m. to 4 p.m.). Cod catches were apparently not so closely related to the time of day, although some very good catches were made at night.

Subarea 2

I. Redfish

Catches amounting to 12% of total redfish catch were made in Div. 2J, mainly in April. Samples taken in the winter period showed the average length of redfish to be 35.8 cm.

II. Cod

Samples taken by the factory trawler Dalmor between 8 January and 29 March in Div. 2J showed the average length of cod to be 53.6 cm.

Subarea 3

I. Redfish

Over 74% of the redfish catches came from Div. 3K with over half of that quantity being caught during July and August. About 12% of the catches came

from Div. 3L mainly in July. Average lengths of redfish taken from January to March were 35.1 cm in Div. 3L, 37.7 cm in Div. 3K in February and 33.5 cm in 3M in March. In November in Div. 3K the average length was 38.7 cm.

II. Cod

Over 56% of the cod catch came from Div. 3K mainly in February, April and August. About 54% came from Div. 3M, mainly in March. Average lengths of cod samples from January to March were 41.2 cm in Div. 3L, 51.7 cm in Div. 3K in February and 56.9 cm in Div. 3M in March.

III. Flatfish

About 55% of these fish were taken in Div. 3K mainly in May and about 36% in Div. 3L mainly in November. Average lengths of fish taken from January to March were 25.3 cm for American plaice, 52.1 cm for witch in Div. 3L; 33.1 cm for American plaice and 50.2 cm for witch in Div. 3K and 45.1 cm for American plaice in Div. 3M.

Subarea 4

I. Herring

About 1% of the total catch of all species were herring and came from Div. 4W in May and June.

VII. Portuguese Research Report, 1963

by Rui Monteiro and Manuel Lima Dias

Portugal landed a total of almost 230,500 metric tons of cod from Subareas 1, 2, 3 and 4 in 1963. This is a considerable increase from the 217,700 metric tons of the same species taken in 1962.

Cod caught by commercial trawlers were sampled, at random, after discarding, for data on length and age composition, weight, girths, sex ratio, stage of maturity and age at first maturity. Details of length and age composition will be published in ICNAF Sampling Yearbook Vol. 8 for 1963. Data on girth, length and weight measurements have been analysed for the 1964 Annual Meeting in Meeting Document No. 51.

The author in charge of age reading (Manuel Lima Dias) wishes to thank Mr. B. D. Bedford for help at the Lowestoft Laboratory, England.

Subarea 1

A. Status of the Fisheries

I. Cod

Landings from Subarea 1 decreased over 30% from 1962 to 63,200 metric tons in 1963. Landings were sampled in Div. 1F between 6-9 July, as follows:

Sample Group	Sample No.	No. Fish	Depth m
A	1	100	139
	3	75	159
	4	74	137
B+	2	200	145

+ = sample not aged

a. Lengths (Fig. 1) ranged from 43 to 85 cm classes with means for sample groups A and B, 61.5 and 61.7 cm respectively, although sample group B had a more irregular distribution.

b. Ages (Fig. 1) were determined on the sample group A only and were distributed from IV to X with a predominance of the V and VII age-groups (1958 and 1956 year-classes). Mean age is 6.2 years.

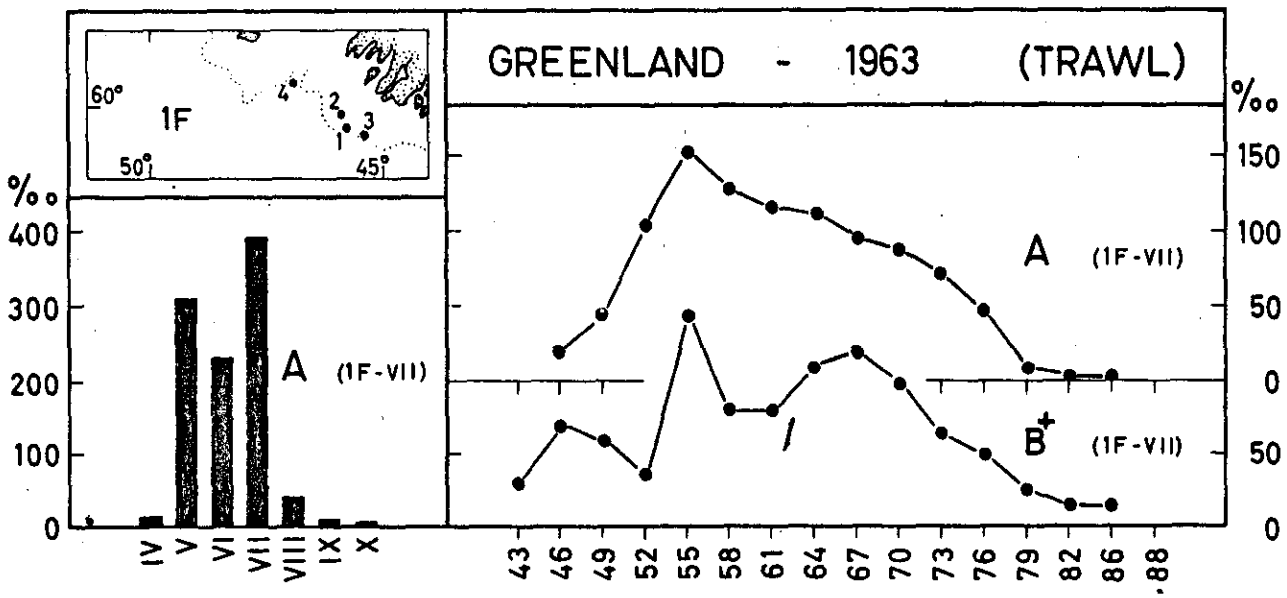


Fig. 1. Cod. Div. 1F. Length and age composition, July 1963.

Quartin, from data collected in 1962, (1963 Redbook, Pt. II: 62-69) found the 1957 year-class dominant in Div. 1B, 1C and 1D with the 1958 year-class making its first appearance. Data from 1963 show these year-classes are still important but the 1956 year-class which was second in importance in 1962 is now dominant.

c. Growth is shown in the following table of average lengths, male and female, of fish from age-groups IV to X (1959-1953 year-classes). (Figures in brackets are numbers of fish).

Age Group	Mean length (cm) ♂♂	♀♀
IV	-	47.3 (3)
V	54.8 (43)	54.3 (35)
VI	59.9 (33)	58.9 (24)
VII	67.8 (46)	67.1 (52)
VIII	71.8 (4)	69.2 (6)
IX	-	72.0 (2)
X	-	77.0 (1)

d. Sex ratio from combined samples was 51% males to 49% females, while sample group B showed a ratio of 46% males to 54% females.

e. Stage of Maturity of male and female cod in samples from sample group A are shown in Fig. 2.

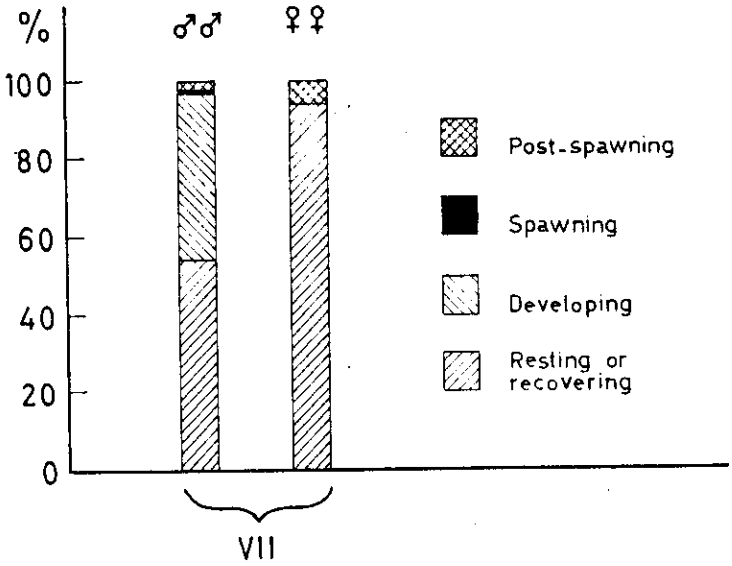


Fig. 2. Cod. Div. 1F. Stages of maturity, July, 1963.

f. Age at First Spawning for male and female cod in sample group A (Div. 1F taken in July) are shown in the following table:

Age Group	1st Spawn.	♂♂ VII	♂♂ θ	♂♂ ?	Total No. %	♀♀ VI	♀♀ VII	♀♀ VIII	♀♀ IX	♀♀ θ	♀♀ ?	Total No. %
IV	No.	-	-	-	-	-	-	-	-	3	-	3
	%	-	-	-	-	-	-	-	-	100	-	100
V	No.	-	43	-	43	-	-	-	-	34	1	35
	%	-	100	-	100	-	-	-	-	97	3	100
VI	No.	-	32	1	33	1	-	-	-	23	-	24
	%	-	97	3	100	4	-	-	-	96	-	100
VII	No.	4	35	7	46	-	3	-	-	42	7	52
	%	9	76	15	100	-	6	-	-	81	13	100
VIII	No.	-	2	2	4	-	-	1	-	4	1	6
	%	-	50	50	100	-	-	17	-	67	17	101
IX	No.	-	-	-	-	-	-	-	-	2	-	2
	%	-	-	-	-	-	-	-	-	100	-	100
X	No.	-	-	-	-	-	-	-	1	-	-	1
	%	-	-	-	-	-	-	-	100	-	-	100
No. of observ.		4	112	10	126	1	3	1	1	108	9	123

As may be seen, the majority of fish taken in Div. 1F in July have not yet reached first maturity.

Subarea 2

A. Status of the Fisheries

I. Cod

Landings of cod in Subarea 2 increased in 1963 by about 10,500 metric tons to almost 73,300 tons. Landings were sampled in Div. 2J during May and September as follows. (Numbers of fishes taken at night are shown in brackets).

Sample Group	Sample No.	No. of fish	Depth m	Date
A	2	99	256	3 May
	3	100	265	5 May
	4	100	293	8 May
B+	1	150	402	2 May
	5	150	304	9 May
	8	250	457	14 May
	10	392(147)	402	16 May
C	12	100	259	1 Sept.
	23	49	267	13 Sept.
	26	100	183	17 Sept.
	27	50	201	18 Sept.
	28	99	192	19 Sept.
D+	14	400(150)	183	3 Sept.
	17	400(150)	172	7 Sept.
	20	400(150)	304	10 Sept.
	25	400(150)	192	16 Sept.

+ = samples not aged

a. Lengths (Fig. 3) of cod in samples taken in May show quite similar distribution. For sample group A, mean length is 56.0 cm, for sample group B, means are 55.4 cm for day catches and 56.4 for night catches. In September distributions are similar. For sample group C, the mean is 53.7 cm; for group D, 53.4 cm, for day catches and 51.9 cm for night catches.

b. Ages (Fig. 3) of cod in May samples showed that the 1956 year-class (age-group VII) was dominant while in September samples the 1957 year-class (age-group VI) was dominant. Mean age in May is 8.1 years, in September 6.6 years.

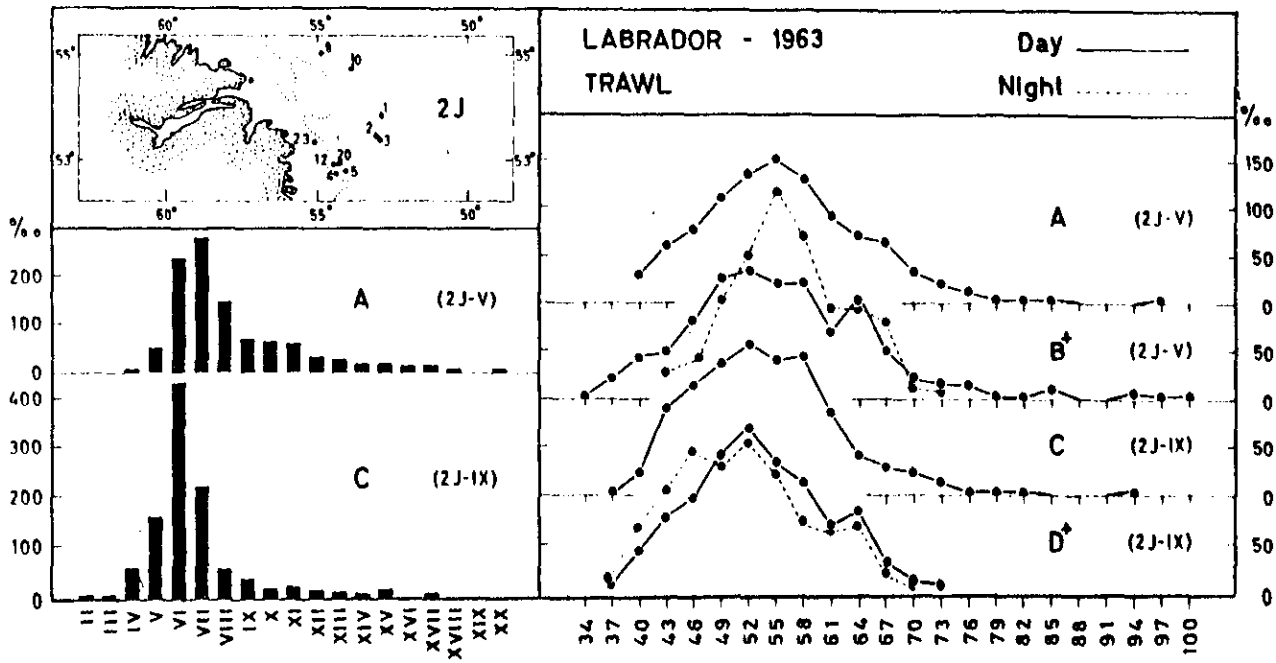


Fig. 3. Cod. Div. 2J. Length and age composition. May and Sept. 1963.

c. Growth is shown in the following table of average lengths of male and female fish of age-groups II to XX (1961 to 1943 year-classes) taken in May and September in Div. 2J. (Figures in brackets are numbers of fish).

Age Group	May ♂♂ cm	May ♀♀ cm	September ♂♂ cm	September ♀♀ cm
II	-	-	-	43.0 (1)
III	-	-	-	50.0 (1)
IV	39.0 (1)	-	45.3 (9)	43.1 (12)
V	42.6 (8)	48.4 (5)	46.9 (27)	48.9 (34)
VI	49.4 (42)	49.8 (29)	51.5 (84)	52.9 (86)
VII	52.5 (43)	53.1 (40)	55.3 (40)	56.7 (45)
VIII	57.5 (17)	59.7 (27)	59.7 (8)	60.5 (12)
IX	63.0 (10)	59.2 (10)	61.5 (4)	67.9 (9)
X	63.0 (3)	62.8 (15)	61.7 (3)	60.5 (2)
XI	66.5 (4)	63.2 (12)	62.5 (4)	62.7 (3)
XII	73.7 (3)	64.2 (6)	-	67.5 (4)
XIII	68.0 (1)	71.8 (6)	-	78.3 (3)
XIV	-	63.5 (4)	-	70.0 (1)
XV	64.0 (1)	63.0 (4)	61.0 (1)	67.0 (3)
XVI	72.0 (1)	72.0 (2)	-	-
XVII	78.0 (2)	67.0 (1)	-	76.0 (2)
XVIII	-	67.0 (1)	-	-
XIX	-	-	-	-
XX	-	65.0 (1)	-	-

d. Sex Ratio

May - sample group A: 45% males to 54% females
sample group B: Day catches, 49% males to 51% females
Night catches, 69% males to 31% females
September - sample group C: 45% males to 55% females
group D: Day catches, 45% males to 55% females
Night catches, 46% males to 54% females.

e. Stage of Maturity of male and female cod in samples taken in May (sample group A) and September (sample group C) are shown in Fig. 4.

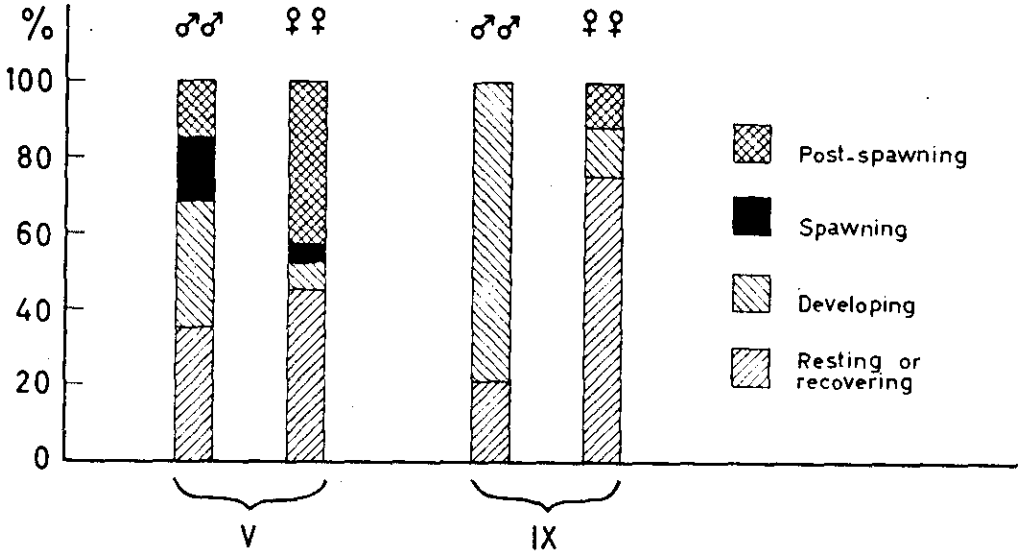


Fig. 4. Cod. Div. 2J. Stages of maturity, May and September, 1963.

f. Age at First Maturity for male and female cod taken in Div. 2J in May (sample group A) and in September (sample group C) are shown in the following table:

MAY (2J)

IST SPAWN AGE GROUPS		♂♂ V	VI	VII	VIII	IX	X	θ	?	TOTAL No. %	♀♀ V	VI	VII	VIII	IX	X	XI	θ	?	TOTAL No. %
IV	No.	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-
	%	-	-	-	-	-	-	100	-	100	-	-	-	-	-	-	-	-	-	-
V	No.	-	-	-	-	-	-	8	-	8	-	-	-	-	-	-	-	5	-	5
	%	-	-	-	-	-	-	100	-	100	-	-	-	-	-	-	-	100	-	100
VI	No.	1	-	-	-	-	-	39	2	42	1	3	-	-	-	-	-	24	1	29
	%	2	-	-	-	-	-	93	5	100	3	10	-	-	-	-	-	83	3	99
VII	No.	-	-	-	-	-	-	43	-	43	-	1	3	-	-	-	-	31	5	40
	%	-	-	-	-	-	-	100	-	100	-	3	8	-	-	-	-	78	13	102
VIII	No.	-	1	1	2	-	-	12	1	17	-	3	5	-	-	-	-	9	10	27
	%	-	6	6	12	-	-	71	6	100	-	11	19	-	-	-	-	33	37	100
IX	No.	-	1	2	3	-	-	1	3	10	-	-	1	1	1	-	-	3	4	10
	%	-	10	20	30	-	-	10	30	100	-	-	10	10	10	-	-	30	40	100
X	No.	-	-	1	1	-	-	1	-	3	-	-	1	3	6	1	-	3	1	15
	%	-	-	33	33	-	-	33	-	99	-	-	7	20	40	7	-	20	7	100
XI	No.	-	-	-	-	-	1	1	2	4	-	-	1	3	6	1	-	1	-	12
	%	-	-	-	-	-	25	25	50	100	-	-	8	25	50	8	-	8	-	99
XII	No.	-	-	-	-	-	-	2	1	3	-	-	1	1	1	-	-	1	2	6
	%	-	-	-	-	-	-	66	33	99	-	-	17	17	17	-	-	17	33	101
XIII	No.	-	1	-	-	-	-	-	-	1	1	-	1	1	1	-	-	-	2	6
	%	-	100	-	-	-	-	-	-	100	17	-	17	17	17	-	-	-	33	101
XIV	No.	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-	1	-	-	4
	%	-	-	-	-	-	-	-	-	-	-	-	-	25	50	-	25	-	-	100
XV	No.	-	-	-	-	-	1	-	-	1	-	-	2	1	1	-	-	-	-	4
	%	-	-	-	-	-	100	-	-	100	-	-	50	25	25	-	-	-	-	100
XVI	No.	-	-	-	-	-	-	-	1	1	-	-	-	-	1	-	-	-	1	2
	%	-	-	-	-	-	-	-	100	100	-	-	-	-	50	-	-	-	50	100
XVII	No.	-	-	-	-	1	-	-	1	2	-	-	-	-	1	-	-	-	-	1
	%	-	-	-	-	50	-	-	50	100	-	-	-	-	100	-	-	-	-	100
XVIII	No.	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
	%	-	-	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-	-	100
XX	No.	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
	%	-	-	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-	-	100
No. OF OBSERV.		1	3	4	6	1	2	108	11	136	2	7	17	11	20	2	1	77	26	163

SEPTEMBER (2J)

Age Groups	1st Spawn	♂♂ V	VI	VII	VIII	X	♀	?	Total No. %	♀♀ V	VI	VII	VIII	IX	X	XII	♀	?	Total No. %
II	No.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	-	100
III	No.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	-	100
IV	No.	-	-	-	-	-	8	1	9	-	-	-	-	-	-	-	12	-	12
	%	-	-	-	-	-	89	11	100	-	-	-	-	-	-	-	100	-	100
V	No.	1	-	-	-	-	23	3	27	1	-	-	-	-	-	-	33	-	34
	%	4	-	-	-	-	85	11	100	3	-	-	-	-	-	-	97	-	100
VI	No.	3	11	-	-	-	53	17	84	4	9	-	-	-	-	-	57	16	86
	%	4	13	-	-	-	63	20	100	5	10	-	-	-	-	-	66	19	100
VII	No.	-	5	9	-	-	18	8	40	1	2	8	-	-	-	-	24	10	45
	%	-	13	23	-	-	45	20	101	2	4	18	-	-	-	-	53	22	99
VIII	No.	-	-	2	-	-	1	5	8	-	1	1	1	-	-	-	5	4	12
	%	-	-	25	-	-	13	63	101	-	8	8	8	-	-	-	42	33	99
IX	No.	-	-	-	1	-	2	1	4	-	1	1	1	-	-	-	2	4	9
	%	-	-	-	25	-	50	25	100	-	11	11	11	-	-	-	22	44	99
X	No.	-	-	1	-	-	1	1	3	-	-	-	-	1	-	-	-	1	2
	%	-	-	33	-	-	33	33	99	-	-	-	-	50	-	-	-	50	100
XI	No.	-	-	1	-	1	-	2	4	-	-	-	1	-	-	-	1	1	3
	%	-	-	25	-	25	-	50	100	-	-	-	33	-	-	-	33	33	99
XII	No.	-	-	-	-	-	-	-	-	-	-	1	1	-	1	-	-	1	4
	%	-	-	-	-	-	-	-	-	-	-	25	25	-	25	-	-	25	100
XIII	No.	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	3
	%	-	-	-	-	-	-	-	-	-	-	-	-	-	33	-	-	66	99
XIV	No.	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
	%	-	-	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-	100
XV	No.	-	-	-	-	-	-	1	1	-	-	-	1	-	-	1	-	1	3
	%	-	-	-	-	-	-	100	100	-	-	-	33	-	-	33	-	33	99
XVI	No.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
XVII	No.	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	2
	%	-	-	-	-	-	-	-	-	-	-	-	50	-	-	-	50	-	100
XVIII	No.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
XX	No.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
No. of Observ.		4	16	13	1	1	106	39	180	6	13	11	7	1	2	1	137	40	218

The table shows that in both May and September and particularly in May the majority of cod samples have not yet reached first maturity. Some males and females reach first maturity between age-groups V to XII.

Subarea 3

A. Status of the Fisheries

1. Cod

Landings of cod in Subarea 3 increased about 60% in 1963 to 50,600 tons. Landings were sampled in Div. 3K and 3L in June, July, August and September as follows (numbers of fish taken at night are in brackets):

Sample Group	Sample no.	No. of fish	Depth m	Date
For ICNAF Div. 3K				
A	20	50	218	26 July
	21	100	223	27 July
	22	99	243	29 July
B+	25	400(150)	276	2 August
	29	150	218	10 August
C+	37	400(150)	256	24 September
For ICNAF Div. 3L				
D	4	74	192	17 June
	5	100	182/192	20 June
	8	50	165	24 June
	12	100	172	30 June
E+	3	150	110/220	16 June
	6	350/100	177/183	21 June
	11	150	165	28 June
F	13	50	274	16 July
	17	100	294	22 July
G+	15	150	287	18 July
	18	400(150)	274	23 July
H+	34	400(150)	258	22 August
I+	40	250	287	28 September
J	38	100	221	26 September
	39	100	271	27 September
	41	50	223	29 September

+ = samples not aged

a. Lengths (Fig. 5)

From Div. 3K	Mean Length (cm)	
	Day	Night
July	56.5	-
Aug.	53.5	51.9
Sept.	58.1	57.9
From Div. 3L		
June	66.4	-
June	69.0	64.2
July	58.4	-
July	54.9	53.8
Aug.	62.4	62.9
Sept.	63.5	-
Sept.	58.3	-

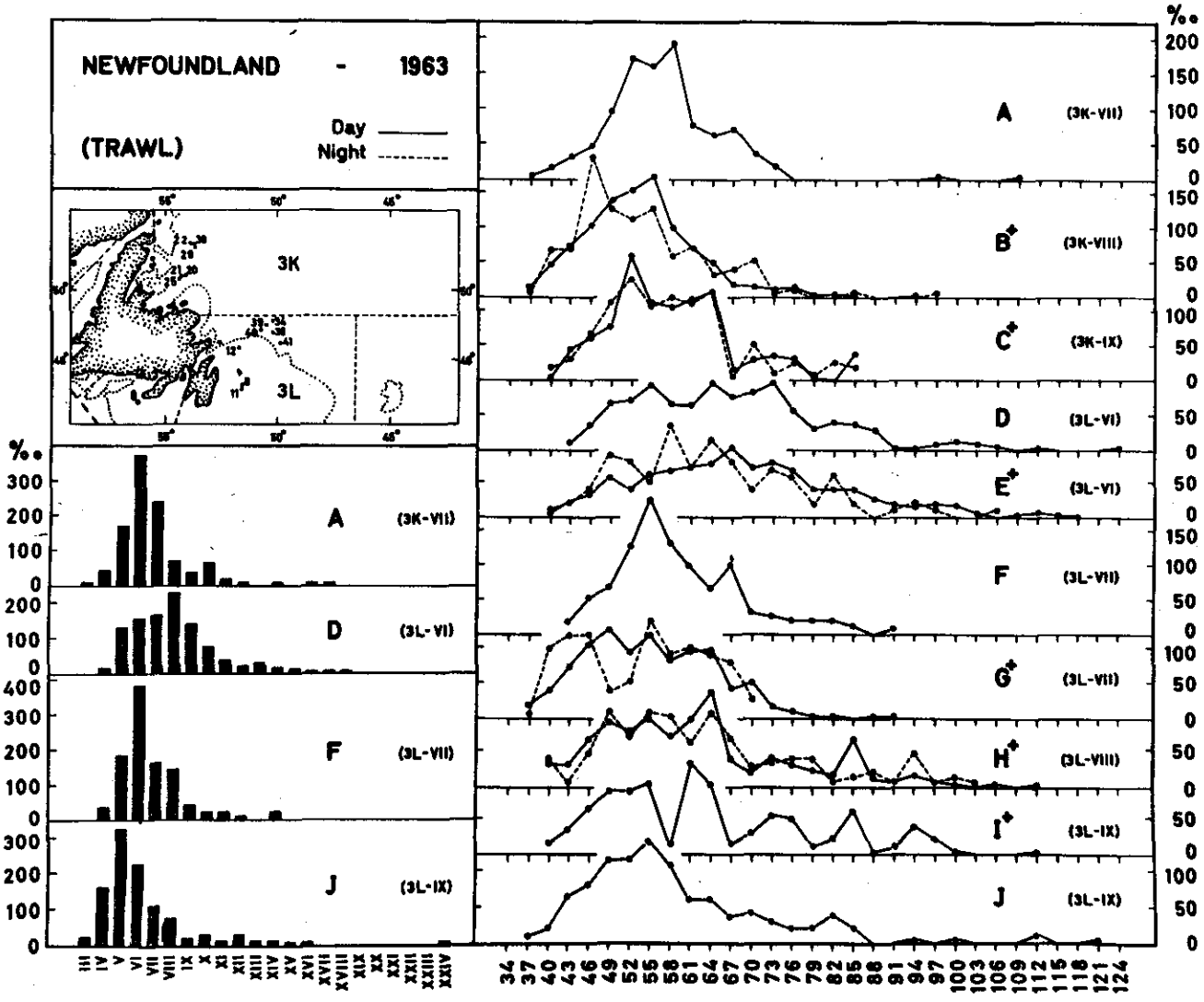


Fig. 5. Cod. Div. 3K and 3L. Length and age composition, 1963.

b. Ages (Fig. 5)

Div. 3K - July - Mean age, 6.7 years; 1957 year-class (age-group VI) is dominant.

Div. 3L - June - Mean age, 7.9 years; 1955 year-class (age-group VIII) is dominant.

July - Mean age, 6.7 years; 1957 year-class (age-group VI) is dominant.

Sept. - Mean age, 6.2 years; 1958 year-class (age-group V) is dominant.

c. Growth is shown in the following table of average lengths of male and female cod of age-groups III to XXIV (1960 to 1939 year-class) taken in Div. 3K in July and Div. 3L in June, July and September.

Age Group	Div. 3K (July) ♂♂		Div. 3K (July) ♀♀		Div. 3L (June) ♂♂		Div. 3L (June) ♀♀	
III	39.0	(1)	-		-		-	
IV	45.7	(3)	46.4	(7)	-		47.8	(4)
V	49.1	(17)	50.8	(24)	52.9	(22)	53.3	(19)
VI	54.3	(41)	54.5	(51)	55.0	(28)	53.4	(22)
VII	57.0	(23)	58.3	(35)	62.5	(30)	63.0	(23)
VIII	64.3	(6)	63.5	(11)	67.5	(43)	69.9	(30)
IX	62.0	(2)	65.3	(6)	70.4	(30)	74.1	(14)
X	66.5	(2)	69.8	(13)	78.2	(13)	78.2	(11)
XI	67.0	(3)	-		88.2	(6)	81.0	(5)
XII	63.0	(1)	-		84.5	(2)	86.5	(4)
XIII	-		-		87.3	(4)	94.3	(4)
XIV	63.0	(1)	-		86.0	(2)	97.0	(2)
XV	-		-		80.3	(3)	-	
XVI	68.0	(1)	-		-		124.0	(1)
XVII	109.0	(1)	-		87.0	(1)	-	
XVIII	-		-		-		102.0	(1)

Age Group	Div. 3L (July) ♂♂	Div. 3L (July) ♀♀	Div. 3L (September) ♂♂	Div. 3L (September) ♀♀
III	-	-	41.3 (3)	41.0 (2)
IV	45.0 (1)	47.3 (4)	47.0 (12)	49.0 (27)
V	49.5 (8)	51.5 (19)	51.4 (33)	52.4 (48)
VI	55.3 (23)	55.2 (34)	56.1 (28)	57.3 (27)
VII	58.5 (10)	59.1 (14)	57.3 (7)	65.9 (20)
VIII	67.0 (9)	67.8 (12)	72.3 (8)	75.3 (10)
IX	65.3 (4)	72.0 (2)	75.5 (2)	74.5 (2)
X	66.0 (2)	69.0 (1)	74.5 (2)	74.0 (4)
XI	75.0 (1)	85.5 (2)	76.0 (2)	-
XII	-	72.0 (1)	81.0 (2)	84.5 (4)
XIII	-	-	85.0 (1)	112.0 (1)
XIV	79.5 (2)	84.0 (1)	77.0 (1)	113.0 (1)
XV	-	-	-	100.0 (1)
XVI	-	-	-	83.0 (1)
XXVI		-	-	121.0 (1)

d. Sex ratio (%)

From. Div. 3K	Day ♂♂	Day ♀♀	Night ♂♂	Night ♀♀
July	41	59	-	-
Aug.	43	57	48	52
Sept.	46	54	51	49
From Div. 3L				
June	57	43		
	55	45	40	60
July.	40	60		
	86	14	39	61
Aug.	51	49	35	65
Sept.	70	30		
	40	60		

e. Stage of Maturity of male and female cod in samples taken in Div. 3K in July and in Div. 3L in June, July and September are shown in Fig. 6

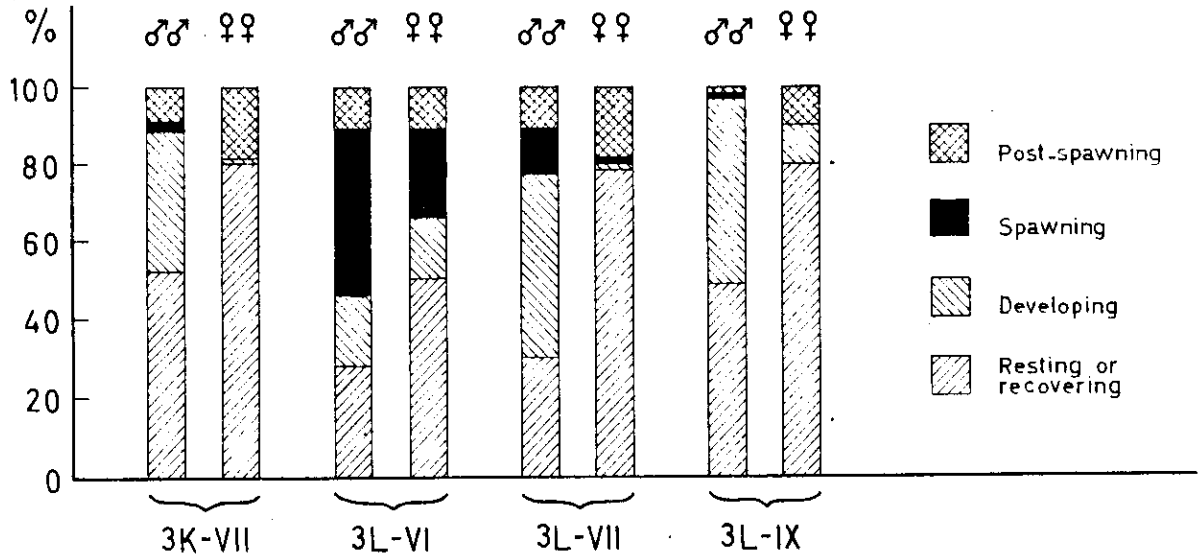


Fig. 6. Cod. Div. 3K and 3L. Stages of maturity. 1963.

f. Age at First Maturity for male and female cod taken in Div. 3K in July and in Div. 3L in June, July and September are shown in the following table:

JULY (3K)

Age Groups	1st Spawn	♂♂ V	VI	VII	VIII	IX	XI	0	?	Total No. %	♀♀ V	VI	VII	VIII	IX	X	0	?	Total No. %
III	No.	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-
	%	-	-	-	-	-	-	100	-	100	-	-	-	-	-	-	-	-	-
IV	No.	-	-	-	-	-	-	3	-	3	-	-	-	-	-	-	7	-	7
	%	-	-	-	-	-	-	100	-	100	-	-	-	-	-	-	100	-	100
V	No.	1	-	-	-	-	-	16	-	17	1	-	-	-	-	-	21	2	24
	%	6	-	-	-	-	-	94	-	100	4	-	-	-	-	-	88	8	100
VI	No.	1	2	-	-	-	-	35	3	41	3	9	-	-	-	-	36	3	51
	%	2	5	-	-	-	-	85	7	99	6	18	-	-	-	-	71	6	101
VII	No.	1	-	8	-	-	-	12	2	23	-	1	3	-	-	-	24	7	35
	%	4	-	35	-	-	-	52	9	100	-	3	9	-	-	-	69	20	101
VIII	No.	-	-	1	1	-	-	3	1	6	-	-	3	3	-	-	4	1	11
	%	-	-	17	17	-	-	50	17	101	-	-	27	27	-	-	36	9	99
IX	No.	-	-	1	-	1	-	-	-	2	-	1	1	2	-	-	-	2	6
	%	-	-	50	-	50	-	-	-	100	-	17	17	33	-	-	-	33	100
X	No.	-	-	1	-	-	-	-	1	2	-	-	2	3	4	1	1	2	13
	%	-	-	50	-	-	-	-	50	100	-	-	15	23	31	8	8	15	100
XI	No.	-	-	1	2	-	-	-	-	3	-	-	-	-	-	-	-	-	-
	%	-	-	33	67	-	-	-	-	100	-	-	-	-	-	-	-	-	-
XII	No.	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-
	%	-	-	-	-	-	100	-	-	100	-	-	-	-	-	-	-	-	-
XIV	No.	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-
	%	-	-	-	-	-	-	-	100	100	-	-	-	-	-	-	-	-	-
XVI	No.	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-
	%	-	-	-	-	-	-	-	100	100	-	-	-	-	-	-	-	-	-
XVII	No.	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-
	%	-	-	-	-	-	-	-	100	100	-	-	-	-	-	-	-	-	-
No. of Observ.		3	2	12	3	1	1	70	10	102	4	11	9	8	4	1	93	17	147

JUNE (3L)

Age Groups	1st Spawn	♂♂ V	VI	VII	VIII	IX	X	θ	?	Total No. %	♀♀ V	VI	VII	VIII	IX	X	θ	?	Total No. %
IV	No.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	4
	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	-	100
V	No.	-	-	-	-	-	-	22	-	22	-	-	-	-	-	-	19	-	19
	%	-	-	-	-	-	-	100	-	100	-	-	-	-	-	-	100	-	100
VI	No.	-	2	-	-	-	-	25	1	28	-	3	-	-	-	-	18	1	22
	%	-	7	-	-	-	-	89	4	100	-	14	-	-	-	-	82	5	101
VII	No.	-	1	-	-	-	-	28	1	30	1	-	-	-	-	-	19	3	23
	%	-	3	-	-	-	-	93	3	99	4	-	-	-	-	-	83	13	100
VIII	No.	1	-	2	5	-	-	20	2	30	-	6	4	2	-	-	29	2	43
	%	3	-	7	17	-	-	67	7	101	-	14	9	5	-	-	67	5	100
IX	No.	-	-	3	5	1	-	18	3	30	-	-	3	3	-	-	5	3	14
	%	-	-	10	17	3	-	60	10	100	-	-	21	21	-	-	36	21	99
X	No.	-	-	3	2	2	-	4	2	13	-	-	2	1	1	-	4	3	11
	%	-	-	23	15	15	-	31	15	99	-	-	18	9	9	-	36	27	99
XI	No.	-	-	-	-	1	2	2	1	6	-	1	1	-	-	-	1	2	5
	%	-	-	-	-	17	33	33	17	100	-	20	20	-	-	-	20	40	100
XII	No.	-	-	-	-	-	-	2	-	2	-	-	2	1	-	-	-	1	4
	%	-	-	-	-	-	-	100	-	100	-	-	50	25	-	-	-	25	100
XIII	No.	-	-	-	-	1	1	-	2	4	-	-	-	-	1	1	-	2	4
	%	-	-	-	-	25	25	-	50	100	-	-	-	-	25	25	-	50	100
XIV	No.	-	-	1	-	1	-	-	-	2	-	-	-	-	-	-	-	2	2
	%	-	-	50	-	50	-	-	-	100	-	-	-	-	-	-	-	100	100
XV	No.	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	1	3
	%	-	-	-	-	-	-	-	-	-	-	-	33	33	-	-	-	33	99
XVI	No.	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
	%	-	-	-	-	-	-	-	-	-	-	-	-	-	100	-	-	-	100
XVII	No.	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-
	%	-	-	-	-	100	-	-	-	100	-	-	-	-	-	-	-	-	-
XVIII	No.	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
	%	-	-	-	100	-	-	-	-	100	-	-	-	-	-	-	-	-	-
XXIV	No.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
No. of Observ.		1	3	9	13	7	3	121	12	169	1	10	13	8	3	1	99	20	155

JULY (3L)

Age Groups	1st Spawn	♂♂ V	VI	VII	VIII	IX	θ	?	Total No. %	♀♀ V	VI	VII	VIII	IX	θ	?	Total No. %
IV	No.	-	-	-	-	-	1	-	1	-	-	-	-	-	4	-	4
	%	-	-	-	-	-	100	-	100	-	-	-	-	-	100	-	100
V	No.	-	-	-	-	-	8	-	8	2	-	-	-	-	16	1	19
	%	-	-	-	-	-	100	-	100	11	-	-	-	-	84	5	100
VI	No.	4	2	-	-	-	16	1	23	2	5	-	-	-	24	3	34
	%	17	9	-	-	-	70	4	100	6	15	-	-	-	71	9	101
VII	No.	-	2	5	-	-	3	-	10	-	5	2	-	-	7	-	14
	%	-	20	50	-	-	30	-	100	-	36	14	-	-	50	-	100
VIII	No.	1	-	-	1	-	5	2	9	1	-	4	1	-	5	1	12
	%	11	-	-	11	-	56	22	100	8	-	33	8	-	42	8	99
IX	No.	-	-	-	-	1	2	1	4	-	-	1	1	-	-	-	2
	%	-	-	-	-	25	50	25	100	-	-	50	50	-	-	-	100
X	No.	-	-	-	-	-	1	1	2	-	-	-	-	1	-	-	1
	%	-	-	-	-	-	50	50	100	-	-	-	-	100	-	-	100
XI	No.	-	-	-	-	-	1	-	1	-	-	-	-	1	-	1	2
	%	-	-	-	-	-	100	-	100	-	-	-	-	50	-	50	100
XII	No.	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
	%	-	-	-	-	-	-	-	-	-	-	-	-	100	-	-	100
XIV	No.	-	-	-	2	-	-	-	2	-	-	-	-	1	-	-	1
	%	-	-	-	100	-	-	-	100	-	-	-	-	100	-	-	100
No. of Observ.		5	4	5	3	1	37	5	60	5	10	7	2	4	56	6	90

SEPTEMBER (3L)

Age Groups	1st Spawn	♂♂ IV	V	VI	VII	VIII	X	θ	?	Total No.	%	♀♀ IV	V	VI	VII	IX	X	XI	XIII	θ	?	Total No.	%
III	No.	-	-	-	-	-	-	3	-	3		-	-	-	-	-	-	-	-	2	-	2	
	%	-	-	-	-	-	-	100	-	100		-	-	-	-	-	-	-	-	100	-	100	
IV	No.	-	-	-	-	-	-	12	-	12		-	-	-	-	-	-	-	-	27	-	27	
	%	-	-	-	-	-	-	100	-	100		-	-	-	-	-	-	-	-	100	-	100	
V	No.	-	1	-	-	-	-	32	-	33		-	4	-	-	-	-	-	-	43	1	48	
	%	-	3	-	-	-	-	97	-	100		-	8	-	-	-	-	-	-	90	2	100	
VI	No.	2	-	-	-	-	-	25	1	28		1	1	3	-	-	-	-	-	22	-	27	
	%	7	-	-	-	-	-	89	4	100		4	4	11	-	-	-	-	-	81	-	100	
VII	No.	-	-	-	1	-	-	5	1	7		-	1	2	1	-	-	-	-	13	3	20	
	%	-	-	-	14	-	-	71	14	99		-	5	10	5	-	-	-	-	65	15	100	
VIII	No.	-	-	1	-	2	-	3	2	8		-	-	2	2	-	-	-	-	4	2	10	
	%	-	-	13	-	25	-	38	25	101		-	-	20	20	-	-	-	-	40	20	100	
IX	No.	-	-	-	1	-	-	1	-	2		-	-	-	-	-	-	-	-	1	1	2	
	%	-	-	-	50	-	-	50	-	100		-	-	-	-	-	-	-	-	50	50	100	
X	No.	-	-	-	1	-	-	1	-	2		-	-	-	-	-	2	-	-	1	1	4	
	%	-	-	-	50	-	-	50	-	100		-	-	-	-	-	50	-	-	25	25	100	
XI	No.	-	1	-	-	1	-	-	-	2		-	-	-	-	-	-	-	-	-	-	-	
	%	-	50	-	-	50	-	-	-	100		-	-	-	-	-	-	-	-	-	-	-	
XII	No.	1	-	1	-	-	-	-	-	2		-	-	-	-	1	-	-	-	2	1	4	
	%	50	-	50	-	-	-	-	-	100		-	-	-	-	25	-	-	-	50	25	100	
XIII	No.	-	-	-	-	1	-	-	-	1		-	-	-	-	-	-	-	1	-	-	1	
	%	-	-	-	-	100	-	-	-	100		-	-	-	-	-	-	-	100	-	-	100	
XIV	No.	-	-	-	-	-	1	-	-	1		-	-	-	-	-	-	-	-	1	-	1	
	%	-	-	-	-	-	100	-	-	100		-	-	-	-	-	-	-	-	100	-	100	
XV	No.	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	1	1	
	%	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	100	100	
XVI	No.	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	1	-	-	-	1	
	%	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	100	-	-	-	100	
XXIV	No.	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	1	-	-	1	
	%	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	100	-	-	100	
No. of Observ.		3	2	2	3	4	1	82	4	101		1	6	7	3	1	2	1	2	116	10	149	

Again in all samples the majority of the cod from age-group III to XXIV have not yet reached maturity.

Subarea 4

A. Status of the Fisheries

I. Cod

Landings of cod from Subarea 4 decreased slightly from 14,400 tons in 1962 to 13,600 tons. One sample was taken from Div. 4R in 91 m on 7 August. Mean length of 150 fish was 62.5 cm. Length frequency is shown in Fig. 7. Sex ratio determined from 100 fish was 60% males to 40% females.

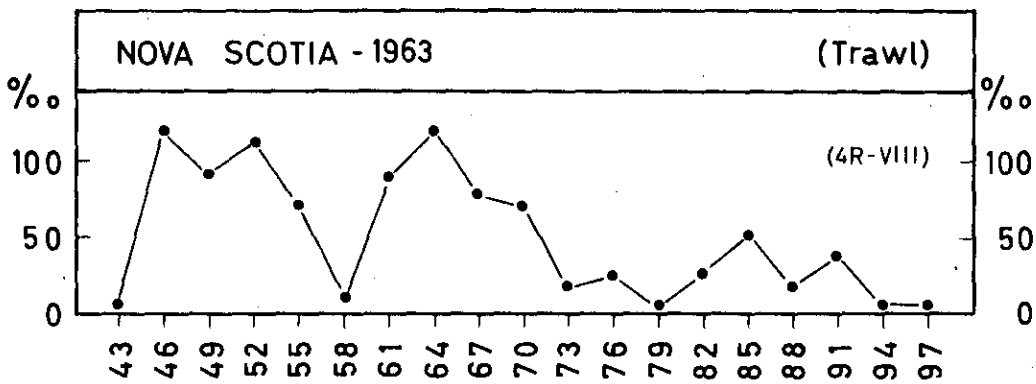


Fig. 7. Cod. Div. 3K and 3L. Length and age composition, 1963.

VIII. Spanish Research Report, 1963

by J. L. Arambarri

Subarea 1

Spanish trawlers did not conduct commercial fishing in the subarea in 1963. A few trials were made in late summer by two vessels but the amount of cod caught was negligible. The explorations were made mainly on the Lille and Store Hellefiske Banks and due to the poor results the ships returned to Subarea 2. During the voyage towards Subarea 2 all the banks between Lille Hellefiske Bank and the southern tip of Greenland were explored with fish-finders without success. According to the records of the shipmasters, the weather was fairly good and temperatures were much the same as in previous years when the fisheries were successful.

Captains were advised to keep statistics of places and number of salmon caught but none was taken. This may be due to the fact that they did not fish close enough to coastal waters. Searches were made in the central and western edges of the banks.

In mid-November some trawlers steamed towards Greenland but, when fishing was called off, they changed course for their home base.

Subarea 2

As in past seasons, this subarea was one of those most actively fished by large Spanish trawlers in spring and summer and part of the autumn.

Catch statistics show that the fishery was more successful in the first half than in the second half of the time spent in this subarea.

Commercially, no difference was apparent in the size of cod in the 1962 and 1963 catches. Cod was the only species sought by trawlers, but as in previous years redfish was caught frequently either with or without cod.

Although meteorological conditions were average and did not interfere much with fishing operations, ice interrupted fishing on several occasions until the end of May.

The subarea was fished periodically until the end of November.

Subarea 3

Large side trawlers resumed fishing in the subarea in early spring. Pair trawlers started some time earlier. Fishing continued most of the year by pair trawlers with few interruptions and by side trawlers periodically.

In summer on the western edges of the Grand Bank and Flemish Cap, redfish were taken with cod in varying amounts from a few individuals to 100% of the catches. Redfish were smaller and clogged the nets more than in the past. They were all discarded.

Compared with previous years, large cod were more abundant in the catches in 3L and 3N. Cod from 3K were also larger, on the average, than in 1962.

In this subarea there appears to be a return to the commercial fishing conditions that were common over ten years ago. Areas that, in past years, were unproductive showed that they were coming back in the 1963 season.

Subarea 4

Fishing was carried out from early February by Spanish trawlers in 4V with fairly good success around the month of March. The majority of trawlers left the subarea and during the rest of the year only pair trawlers fished it. No difference from last year was apparent in the size of cod.

Tags

A large number of tags was recovered and sent as soon as possible to the stations from the taggings originated. A remarkable number of tags belonged to the Biological Station at St. John's, Newfoundland.

IX. United Kingdom Research Report, 1963

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

Subarea 1

A. Status of the Fisheries

Preliminary figures show that the total U.K. catch from the ICNAF area increased substantially to over 40,000 tons in 1963, compared with about 25,000 tons in 1962. The biggest increases were from Newfoundland, where the catches, principally of cod, more than doubled to around 12,000 tons, and from Greenland, particularly the central part (regions 1C, D and E) where the catches increased from about 5,000 tons to 12,000 tons. The catches from the southern part of Greenland (1F) increased very slightly and there was a substantial fall in the landings from Labrador. The increase at Greenland was mainly due to more fishing (nearly double that in 1962), particularly in regions 1C, D and E, where there was also a rise (by about 40%) in the catch per unit effort. In the southern area (1F), the catch per unit fell slightly, though the effort rose.

B. Special Research Studies

I. Environmental Studies

R/V Ernest Holt made two cruises to East Greenland to take part in the NORWESTLANT Surveys I and III. During NORWESTLANT I the ship worked in the sector between Cape Farewell and Cape Mosting from 9th April to 1st May, completing three hydrographic sections, a grid of stations for fish eggs and plankton, and some direct current measuring over Fylkir Bank. The main finding was of large numbers of cod eggs at stations over the coastal banks all the way from Cape Farewell to Cape Mosting. The sector worked on NORWESTLANT III from 30th June to 23rd July was between Cape Mosting, the Denmark Straits and Faxa Bay. It included three hydrographic sections and an extensive grid of plankton stations. Some cod larvae were caught in the Anton Dohrn Bank area of the Denmark Straits, but few elsewhere: redfish larvae were scattered throughout the area. A bottom temperature recorder was laid in the Denmark Straits in 225 fathoms and successfully recovered three weeks later.

The Scottish R/V Explorer took part in NORWESTLANT III in the waters to the south of those occupied by Ernest Holt, again with hydrographic sections and a grid of plankton stations. Intercalibration was arranged with Ernest Holt. No cod larvae were caught and seldom were redfish larvae found to be abundant. No fish eggs were found, but significant information was obtained on the distribution of plankton indicator species. Significant anomalies were recorded between chart soundings off the Greenland coast and echosounder records. By the kind cooperation of other research vessels, productivity studies were made

in the Irminger Sea over the course of NORWESTLANT I-III.

In addition to the research vessels, the NORWESTLANT environmental surveys were also supported by the Continuous Plankton Recorder service operated from the Edinburgh Oceanographic Laboratory, which maintained recordings in the ICNAF area throughout the year. Attached is a more detailed account of that laboratory's work, by Mr. R. S. Glover.

II. Biological Studies

Routine sampling was continued at the ports of Grimsby and Hull, and on board the Fairtry factory vessels. At the ports 9,000 cod from Greenland, 500 from Labrador and 250 from Newfoundland landed by conventional trawlers were measured, and 350 cod otoliths from Greenland were collected. On board the factory trawlers 44,000 cod, 2,000 haddock and 240 coalfish (pollock) were measured, mainly at Newfoundland. The results will be presented for inclusion in the Sampling Yearbook.

Annex to United Kingdom Research Report, 1963

by R. S. Glover

Continuous Plankton Recorders were towed at monthly intervals throughout the North Atlantic. In the ICNAF area, Danish, Icelandic and British merchant ships and United States Coast Guard cutters provided 26,659 miles of continuous sampling (compared with 18,000 miles in 1962 and 7,500 miles in 1961). The programme was supported by grants from the British Treasury and by contracts N62558 - 2834 and 3612 between the Scottish Marine Biological Association and the Office of Naval Research, Department of the United States Navy.

The routes which sampled in the ICNAF area were as follows: an asterisk indicates a new route started during 1963.

D - British merchant ships steaming between Liverpool and St. John's, Nfld. (sampling in ICNAF Subarea 3).

Ea - British merchant ships, between St. John's and Halifax, N.S. (sampling in ICNAF Subareas 3 and 4).

Eb - British merchant ships, between Halifax and Boston, Mass. (sampling in ICNAF Subareas 4 and 5).

F* - British merchant ships, between the north of Scotland and Canadian ports (sampling in ICNAF Subarea 3).

G - A ship of the Royal Greenland Department of Trade between the north of Scotland and Cape Farewell (sampling in ICNAF Subarea 1).

Gd - A ship of the Royal Greenland Department of Trade from Cape Farewell northwards along the west coast of Greenland, depending on the ice conditions (sampling in ICNAF Subarea 1).

Na* - United States Coast Guard cutters between Newfoundland and ocean weather station BRAVO (sampling in ICNAF Subareas 2 and 3).

Nb* - United States Coast Guard cutters between Newfoundland and ocean weather station DELTA (sampling in ICNAF Subareas 3 and, occasionally, 4).

Z - Icelandic merchant ships between Reykjavik and Newfoundland (sampling in ICNAF Subareas 1, 2 and 3).

The mileage sampled in 1963 is shown below for each of the ICNAF subareas in each month and for the whole year.

Month	Area 1	Area 2	Area 3	Area 4	Area 5	Total	No. of Records
	miles	miles	miles	miles	miles	miles	
Jan	-	-	-	-	-	-	-
Feb	-	277	1280	337	-	1894	5
Mar	-	220	1566	256	-	2042	6
Apr	259	247	735	200	-	1441	4
May	325	452	1269	-	-	2046	8
June	1352	460	1152	353	83	3400	11
July	889	1143	1024	472	85	3613	11
Aug	298	894	752	385	122	2451	7
Sept	542	1175	919	-	-	2636	9
Oct	435	803	1026	349	84	2697	9
Nov	767	1308	529	-	-	2604	9
Dec	140	569	1126	-	-	1835	6
Total	5007	7548	11378	2352	374	26659	85

The analyses of this material will be incorporated into the long-term study of variation in the plankton of the North Atlantic and North Sea which is the major objective of the Edinburgh Laboratory.

Among the topics studied during 1963 from material collected in the ICNAF area were:

a. The distribution and abundance of cold- and warm-water species in relation to the hydrographical conditions in the Newfoundland-Labrador area.

b. Biogeography; for example, a new species of diatom was found extensively and abundantly distributed in the ICNAF area.

c. The distribution (in relation to the temperature regime) of the larvae and post-larvae of two species of echinoderms for which there are no known adults.

d. The life history, growth and population characteristics of Calanus finmarchicus (including C. glacialis) and Thysanoessa longicaudata, two of the most important constituents of fish food in the area.

e. The distribution and abundance of the larvae of Sebastes.

Although, strictly, the work lies just outside the ICNAF area, it should be mentioned that the pelagic fishing experiments for redfish (started in 1962) were continued throughout 1963. The crews of Dutch, Norwegian, French and British weather ships used rods and lines when they were on duty at weather station ALPHA. Adults of Sebastes mentella have been returned to the laboratory for studies of the reproductive cycle, fecundity, food and parasites. It seems likely that there is a resident stock in this position throughout the year.

The laboratory has collaborated in the NORWESTLANT surveys, both through the Plankton Recorder survey and by assisting in the analysis of plankton samples collected by Danish and German research ships. A special attempt is being made to study the food of larval redfish in this material.

X. Soviet Research Report, 1963

by A. S. Noskov and G. P. Zakharov

In 1963 Soviet fishing fleet took about 492,000 tons of fish in the ICNAF area.

The distribution of catches by main commercial species is given in Table 1.

Table 1. Specific composition of Soviet catches in the ICNAF area

	1962		1963	
Species	tons	%	tons	%
Cod	100791	27.3	81658	16.6
Haddock	5315	1.4	6504	1.3
Redfish	32269	8.7	37535	7.6
Herring	160404	43.5	100036	20.4
Silver hake	50725	13.8	230380	46.9
Other groundfish	18233	5.3	18429	7.2
Other pelagic fish	2057		4567	
Others	-		12337	
Total	369794	100.0	491446	100.0

The main changes in the fishery were the growth of silver hake catches and some corresponding shifting of fishing operations to Subareas 4 and 5. The catches of cod and herring have shown some decline.

Tables 2 and 3 show the Soviet catches by Subareas and the subareal distribution of catches by main commercial species.

Table 2. Distribution of Soviet catches by ICNAF subareas

	1962		1963	
Subareas	tons	%	tons	%
1	-	-	6302	1.3
2	68059	18.4	25116	5.1
3	61774	16.8	63756	13.0
4	30591	8.4	165440	33.6
5	209370	56.4	230832	47.0
Total	369794	100.0	491446	100.0

Table 3. Catches of main commercial species in ICNAF subareas in 1962-1963 (in tons)

Species	1		2		3		4		5		Total	
	1962	1963	1962	1963	1962	1963	1962	1963	1962	1963	1962	1963
Cod	-	5053	60072	20833	32954	40201	2463	10221	5302	5350	100791	81658
Haddock	-	62	-	8	1614	372	2567	3701	1134	2361	5315	6504
Redfish	-	868	5896	3808	20808	19485	3975	12288	1590	1086	32269	37535
Herring	-	-	-	-	-	-	9260	2707	151144	97329	160404	100036
Silver hake	-	-	-	-	-	-	8825	123023	41900	107357	50725	230380
Others*	-	319	2091	467	6398	3698	3501	13500	8300	17349	20290	35333
Total	-	6302	68059	25116	61774	63756	30591	165440	209370	230832	369794	491449

*Others include halibut, flatfish, argentine, ray, horse mackerel, mackerel, wolffish, and unidentified ground and pelagic fishes

Subarea 1

A. Status of the Fisheries

I. Cod

Several BMRT-type trawlers operated in the area of West Greenland during the first half of 1963. In the second part of the year the subarea was surveyed by one scouting vessel and by one fishing vessel. In February-March catches were good in the area of Banan Bank (1C) where dense concentrations of wintering cod were found at the depths 130 m to 250 m. Catches amounted 10-17 tons per one hour of trawling. The bulk of catches in February was composed of a very rich 1957 year-class (dominant sizes 66-68 cm). Cod of 1956, 1958 and 1959 year-classes (Fig. 1) were much less represented in catches.

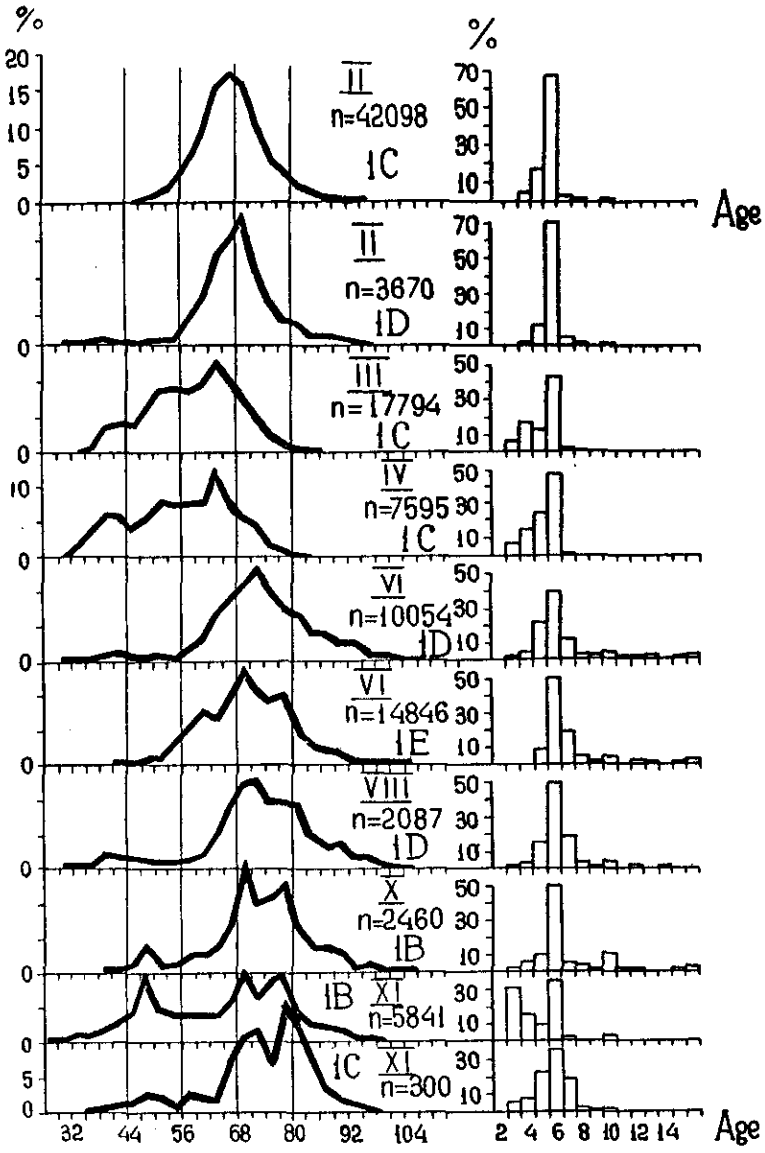


Fig. 1. Size-age composition of cod in Subarea 1 (by Divisions).

Commercially important concentrations of pre-spawning cod were also observed in February on Danas Bank (1D). Specimens of the 1957 year-class dominated in catches.

In early June fishing was successful on the western slope of Frederikshob Bank (1E). Catches were dominated by post-spawning cod of the 1957 and 1956 year-classes with body lengths being correspondingly 66-68 cm and 75-77 cm.

In mid-June a stable concentration of cod was observed on Danas Bank.

Almost no fishing operations were conducted off Western Greenland in the second half of the year. Cod was caught only in October-November on the southern slope of Store Hellefiske Bank. Both large-sized cod of the 1957 and 1956 year-classes and smaller-sized cod of the 1960 year-class were represented in catches.

II. Redfish

In April redfish was caught together with cod at the depths 275-300 m on the western slope of Banan Bank where it made 30 to 40 per cent of the catches. The prevailing sizes were 35 to 40 cm. The sex ratio was 1 : 1. In June-July redfish occurred in catches in this area more frequently than in other areas. Catches did not exceed one or two tons per one hour of trawling. The prevailing sizes were 38 to 40 cm, the sex ratio 1 : 1. In November-December individual catches of redfish amounted to 3 to 6 tons per haul. In other areas redfish occurred in small numbers as by-catch in the catches of cod.

B. Special Research Studies

I. Environmental Studies

1. Hydrography. In 1963 the temperature minima in layers 0-200, 100-200 and 200-500 were observed towards the end of February and equalled, correspondingly, to 0.95°C, 1.61°C and 2.70°C.

Spring warming of waters began in the end of April. Maximum temperatures in 0-200 m and 100-200 m layers were observed in September being, accordingly 5.07°C and 4.87°C. In the 200-500 m layer temperature maximum at 5.20°C was registered only in November, one and a half months later than in the surface layers.

In the beginning of July 1963 an intermediate cold water layer with temperature below 1°C was clearly defined on Frederikshob and Danas Banks. In comparison with 1961 this layer was of much greater size.

On Fiskenaes, Fyllas and Banan Banks this layer was better warmed (up to 2°C) and was located more westwardly than in previous years.

Mean water temperature in September 1963 (as of 15th September) in layers 0-200 m, 200-500 m, and 100-200 m in Divisions 1F and 1E was 0.5-0.8° lower than in September 1961 and 1962.

On Fyllas and Fiskenaes Banks as well as in the gut between Banan and Fyllas Banks the temperature of these layers was higher than in 1962 but somewhat lower in comparison with 1961.

On Lille and Store Hellefiske Banks warming of 0-200 m and 100-200 m layers was also found to be 0.3-0.5° higher than in 1961-62. The temperature of the Canadian cold current was approximately 1° below that of the previous years.

Thus, the heat supply in the area from Cape Farewell to Fiskenaes Bank was lower than in 1961-1962.

Northward of Fiskenaes Bank up to Store Hellefiske Bank the sea water temperature in September 1963 was higher than in 1962 but lower than in 1961.

2. Plankton. In 1963 the workers of the Polar Research Institute (PINRO) took zooplankton and ichthyoplankton samples off Southwestern Greenland. In April there was but very little zooplankton; development of phytoplankton and the beginning of spawning of Copepoda were observed only occasionally in waters of Atlantic origin. Many cod eggs were found in April in shallow waters off the southwest coast of Greenland. In July Copepoda nauplii were observed almost on all the stations worked off West Greenland, so the spawning of Copepoda was still going on. In July redfish larvae were found; they are apparently brought here with the Irminger current and are dispersed over the southwest coast of Greenland.

II. Biological Studies

1. Redfish. In November-December 1963 and January 1964 distribution of young redfish (size 4 to 6 cm) was traced off West Greenland by the presence of the young in the stomachs of cod. Great numbers of young redfish were observed in November over the vast sea space from Division 1F to 1C (western slope of Banan Bank). In December young redfish of similar size was found in cod stomachs on Store Hellefiske Bank. Beginning from the middle of December and in January 1964 young redfish occurred very rarely.

Distribution of larger-sized young redfish up to 30 cm long was studied in summer and autumn. 184 trawlings were made. In July only a few scores of redfish of 15 to 30 cm long were caught on the western slopes of Banan and Helder Banks at the depths from 200 to 430 m. A few small-sized redfish (13-25 cm) were taken on the southeast slope of Banan Bank at the depth 300 m.

Subarea 2

A. Status of the Fisheries

I. Cod

Catches off Labrador dropped three-fold in comparison with 1962 and amounted to slightly over 20,000 tons. Such decrease in catches is explained by bad ice conditions in the area during the first part of the year that compelled the fishing vessels to leave the fishing grounds. The productivity of fishery during the short periods of fishing operations in ice-free areas was indicative of the good condition of the stock of Labrador cod: February - 5.64 tons, March - 3.27 tons, April - 3.71 tons, and May - 3.66 tons per one hour of trawling.

The prevailing sizes of cod in Division 2J in February-March were 45-56 cm. In April catches were mainly composed of cod of 6 to 8 years old and in May - 7 to 10 years old (Fig. 2).

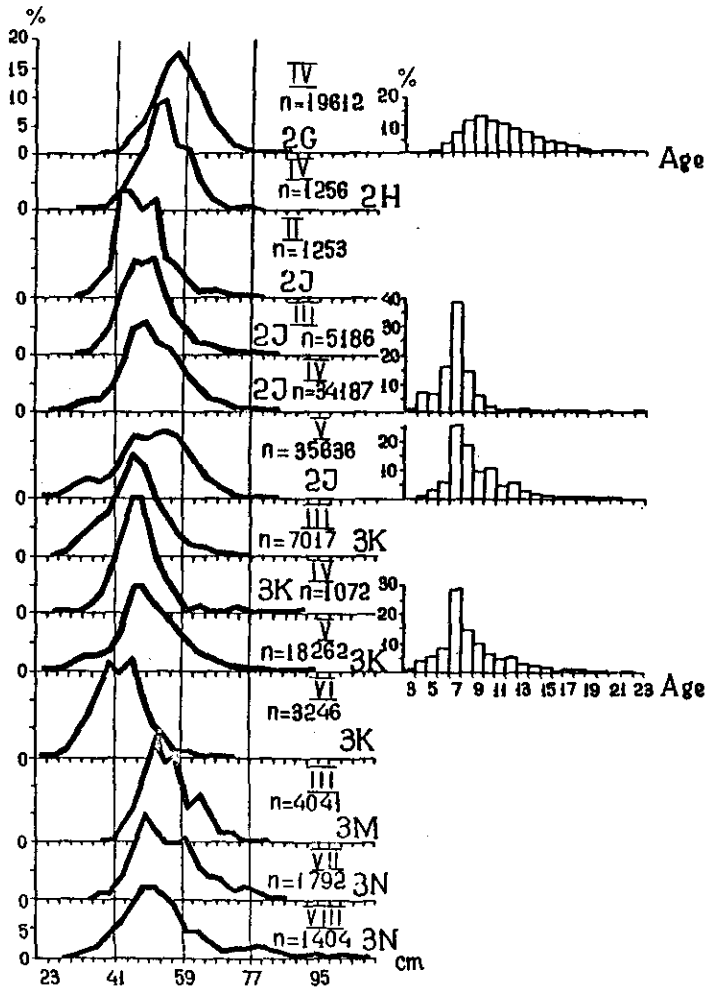


Fig. 2. Size-age composition of cod in Subareas 2 and 3 (by Divisions)

In March-April 1963 a scouting vessel met a dense concentration of cod in Division 2G. Several BMRT trawlers that were operating there in mid-April have taken 1185 tons of cod and reported good daily catches. The dominant sizes of cod were 53 to 62 cm.

II. Redfish

The catch has dropped by more than 2000 tons in comparison with 1962 and amounted to 3808 tons. The reason was the same - redislocation of the fishing fleet to other areas because of bad ice conditions. The main area of redfish fishing in April was off Southern Labrador where redfish was taken together with cod at the depths of 328 to 385 m and constituted up to 20% of the total catch.

B. Special Research Studies

I. Environmental Studies

1. Hydrography. In 1963 transport of arctic cold waters into the areas of Labrador and Newfoundland was much more vigorous than in previous years. As a result the heat supply in the active layer of the sea (0-200 m) was reduced. Thus, in spring 1963 a mean temperature of the 0-200 m layer at the standard stations in the area off northeast slope of the Grand Newfoundland Banks was 1-2° lower than in 1962. On the Grand Bank itself warm waters in July and September were observed less frequently than in 1962. Ice conditions in the Labrador and Newfoundland areas in 1963 were much more severe than in 1962.

II. Biological Studies

1. Cod. In March-April the area of Labrador was surveyed for the purpose of locating the spawning grounds of Labrador cod. In the middle of March concentrations of pre-spawning and spawning cod were observed in Division 2G at the depths 280 to 350 m near bottom at temperatures 2.0° to 3.5°C. This area apparently served as a place of mass spawning of cod that proceeded from mid-March to the end of April. The results of tagging and presence of great number of post-spawning cod specimens in Divisions 2J and 3K indicate that after spawning in Division 2G the cod migrate southward to Divisions 2J and 3K. The main spawning grounds of Labrador cod may be supposed to be off North Labrador (2G) from where the eggs are drifted southward.

During two expeditions especially organised for the purpose of estimation of the young in the areas of Labrador and Newfoundland in December-January 1961-62 and 1962-63 a great number of data was obtained on the age composition of young cod. The results of age determinations are summarized in Table 4 where size fluctuations and mean sizes of young cod are given by age categories and by divisions. The size groups of the young cod are considerably extended for each age category. The rate of growth of young cod in the northern divisions

Table 4. Size fluctuations and mean lengths of the young cod by age groups

Age	0+			1+			2+			3+		
Division	cm from-to	M	n	cm from-to	M	n	cm from-to	M	n	cm from-to	M	n
2G				17	17.0	1	20-29	25.4	12	26-35	31.7	71
2H	8	8.0	1	-	-	-	20-30	26.1	58	26-35	32.0	315
2J	7-15	10.0	30	12-22	17.7	96	17-32	25.3	826	24-35	31.3	3246
3K	7-15	10.5	34	15-25	18.1	139	17-35	25.4	310	25-35	31.9	409
3L	6-14	9.5	39	14-26	19.7	104	18-34	26.1	118	20-35	32.1	196
3M	6-17	10.9	132	18-22	19.3	19	18-34	23.9	131	25-35	32.1	549
3N	9-15	12.2	12	14-29	22.7	109	21-35	29.3	35	30-35	33.6	4
3O	7-14	10.4	109	15-26	20.2	42	21-34	28.3	26	28-35	32.7	18
3P	6-16	9.6	837	15-25	19.1	121	26-35	26.4	97	24-35	30.8	31

is somewhat slower than in the southern ones. It must be observed that the mean sizes and the length fluctuations for the year-class 3+ are undoubtedly underestimated due to the intentional limitation of this size group of the young by 35 cm length.

2. Redfish. Distribution of redfish was studied on scouting vessels; these studies covered the size and sex compositions of redfish in catches.

In June redfish was scattered over a wide area off Central Labrador (2H). No commercially important concentrations were observed. The area of Southern Labrador (2J) was surveyed from March through May and in December. Liberation of larvae took place in April-May. Male specimens prevailed in catches made in May-June at the depths 500 to 600 m. Sex ratio was 2 : 1, 3 : 1 and even 4: 1. In other seasons of the year the sex ratio was close to 1 : 1.

In July small concentrations of S. marinus L. consisting of post-spawning and spawning females (90%) were found at the depths 210 to 540 m.

Subarea 3

A. Status of the Fisheries

I. Cod

The catch in this subarea in 1963 has somewhat increased (40201 tons against 32954 tons in 1962).

In Division 3K fishing operations were conducted in February-April. Wind-influenced changes in ice conditions frequently compelled the fishing boats to leave the area despite the good concentrations of cod being available there. In February the daily catch per one BMRT-type trawler amounted to 34 to 45 tons. The size of cod was 45 to 56 cm.

In March a group of BMRT operated on Flemish Cap Bank (3M) where the average catch per one hour of trawling was 3.7 tons. The bulk of catches was composed of cod of a rich 1957 year-class.

In June-July trawlers of the SRT and SRT-R type conducted fishing operations in Division 3M, and in June in Division 3L. There they took more than 7000 tons of cod whereas in Division 3O the boats of this type took in May about 10,000 tons of cod.

II. Redfish (S. mentella Tr.)

The catch in 1963 has somewhat dropped in comparison with the previous year (19485 tons in 1963 against 20808 tons in 1962). The significance of

certain areas as the redfish fishing grounds has undergone some changes. In Division 3K the catch has decreased three-fold because of unfavourable ice conditions. In Division 3L the catch has grown by 8 times in comparison with the previous years. There was no redfish fishing in Division 3N and reduced catches were taken in Division 3O.

III. Haddock

No sizeable commercial concentrations of haddock were observed in the southern part of the Grand Newfoundland Bank during the spawning and summer feeding periods. This is accounted for by a poor abundance of the 1957-60 year-classes of haddock. Distribution of fish was also considerably influenced by hydrological conditions.

B. Special Research Studies

I. Biological Studies

1. Haddock. Distribution of young and mature haddock was the main subject of fishery investigations in Subarea 3.

During the first half of January young haddock was caught in the south of Saint Pierre Bank (3P) at the depths 100-180 m. The near bottom temperature at that time was from -0.6° to +1.4°C (Fig. 3A). The best catch (433 specimens per one hour of trawling) was taken at the depth 160-165 m at temperature 1.3°C. Haddock of 24-27 cm long of the 1961 year-class dominated in catches.

In Division 3O young haddock was caught at the depths 70 to 250 m with the temperature observed near bottom being 2-4°C. The richest catch (124 specimens per hour of trawling) was taken at the depth 155-170 m with water temperature near bottom being 6.9°C. Specimens of the 1962 year-class were prevailing. No commercially important concentrations of mature haddock were observed during this period.

Small concentrations of pre-spawning haddock (Fig. 3B) were available in the southern Saint Pierre Bank in the first half of April. Maximum catches of 0.5 tons per one hour of trawling were obtained at the depths 175 to 200 m with water temperature observed near bottom being 3-4°C. The sizes of haddock were 42-47 cm. Catches were mainly composed of specimens of the 1958 year-class (51.6%) and 1956 year-class (8.2%).

In Division 3O haddock was caught in April at the depths 200-300 m with water temperature observed near bottom being at 0.5-0.6°C.

The best catches up to 1.3 tons per one hour of trawling were taken at the depth 250-300 m with 42-45 cm haddock of the year-classes 1955 (37.5%) and 1956 (25%) prevailing in catches.

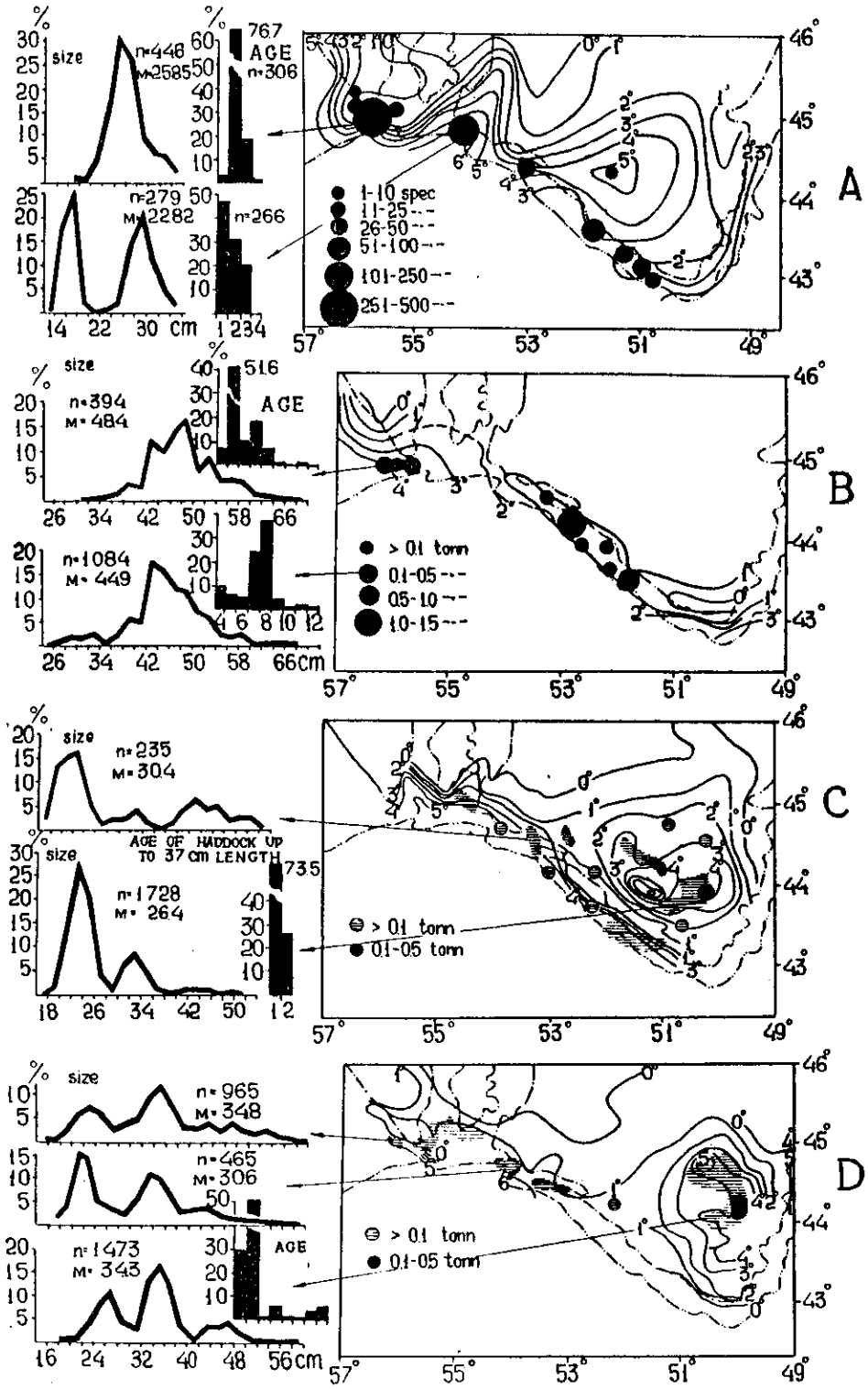


Fig. 3. Size-age composition and distribution (catch/one hour of trawling) of haddock in Subarea 3 in 1963.

A. Young haddock (up to 35 cm), 1-15 January

B. Mature haddock, April

C. Mature haddock, end of July

D. Mature haddock, 25 August to 17 September

Fishery investigations were resumed in Subarea 3 in July-September. Haddock catches brought up to 0.5 tons of fish per one hour of trawling (Fig. 3C). The temperature of water near bottom was 3.9-4.2°C.

Catches were dominated by 22-25 cm haddock of the 1961 year-class and 30-33 cm haddock of the 1962 year-class. Mature specimens occurred in catches only as individuals. Young and mature haddock occurred as individuals throughout the slope in Division 3O at the depths from 70 to 300 m. The water temperature near bottom was 0.7°-5.8°C.

In late August-September catches of haddock in shallow waters of the Grand Newfoundland Banks yielded up to 0.5 tons of fish per one hour of trawling (Fig. 3D). By this time the shallows have been sufficiently warmed and haddock spread northward up to 45°N. The best catches (0.5 tons) were registered at the depths 42 to 54 m with water temperature observed near bottom being 4.1-4.7°C. The bulk of catches was again composed of haddock of the 1961 and 1962 year-classes.

In Division 3O up to 230 young haddock specimens of the 1962 year-class were taken per one hour of trawling at the depths 108 to 160 m with water temperature being 0.2°C. Individual specimens occurred in catches in the south of Saint Pierre Bank at the depths 140 to 310 m.

The results of observations make it possible to consider the haddock year-classes of 1961 and 1962 as generations of average abundance. The haddock of these year-classes will most likely form the basis of fisheries in the summer-autumn period of 1964.

Subarea 4

A. Status of the Fisheries

I. Silver hake

Soviet trawl fishery for silver hake commenced in the end of 1962 was successfully expanded in 1963. The greatest and densest concentrations of silver hake were observed off Sable Island in Division 4W. It was in that area where the bulk of the silver hake catch was taken (109,000 tons). In much smaller numbers hake was observed in Divisions 4V and 4X.

From November 1962 to February 1963 concentrations of silver hake were encountered northwest of Sable Island in the gut at the depths 100 to 150 m; this deep was penetrated by an inflow of warm water from between Emerald and Sambro Banks. The densest concentrations of silver hake were observed on the border of the warm tongue and cold Labrador waters within the near bottom temperatures ranging from 5.5° to 7.8°C. Specimens of 25-29 cm long constituted the bulk of catches.

Though the catches were composed of haddock of 2 to 10 years old, they were mainly represented by first time spawners (3-4 year-old specimens).

Catches of BMRT-type trawlers amounted to 1.5-3.0 tons per one hour of trawling.

Starting from the second half of February 1963 hake concentrations were noticed to begin moving gradually in the northwestward direction along the warm water tongue, and in April they appeared on the continental slope southwest of Sable Island. Here hake preferred the depths from 140 to 250 m below the layer of cold Labrador waters with near bottom temperatures keeping within the range of 7° to 10°C. Dense concentrations of hake were successfully fished by trawlers from April till June. The catches by BMRT-type trawlers amounted to 2-5 tons per one hour of trawling. Hake in the area of continental slope southwest of Sable Island was bigger than that in the catches made in January and February northwest of Sable Island. In May catches on the slope southwest of Sable Island were mainly composed of specimens with prevailing sizes of 29-35 cm and mean length of 32.6 cm. The observed changes in the size composition of catches towards the end of spring are explained by the fact that only mature and prespawning specimens migrated to the slope area from the area of winter fishery, and also by the fact that this area was approached by large-sized mature specimens of older age groups. Age samples showed that catches in May did not contain two-year-old immature haddock, the share of three-year-olds declined to 26.9% and that of four-year-olds increased to 67.6%. Moreover, catches contained up to 16% of five-year-old specimens.

During summer there was only sporadic fishing in the area of Sable Island in June and July by the trawlers sailing through the area. The catches remained to be high and amounted to 5 tons per hour of trawling.

In the end of August and in September concentrations of hake were observed on the shallows near Sable Island. By this time the water mass has already been warmed throughout from surface to bottom and the near bottom temperature on the shallows (depth up to 50 m) amounted to 9-12°C.

By the end of August and in September the main mass of hake had mature gonads and was involved in the process of mass spawning. Mean size of hake at that time was somewhat lesser than in the end of spring which is possibly accounted for by the departure of larger-sized post-spawners. Catches of hake in August-September amounted to 3-4 tons per one hour of trawling. In the end of autumn and in the beginning of winter 1963 catches of hake per hour of trawling showed a decline in comparison to the previous year. Dense concentrations of hake were observed only in the end of February 1964 in the area northwest of Sable Island.

Comparison of the age-composition of spawning hake from autumn catches made in 1962 with the age composition of hake in the corresponding period of 1963 shows that the bulk of spawning population of hake in both years was composed of specimens at the age of 3-4, while older specimens of hake occurred

in small numbers. It is quite possible that spawning populations of hake are mainly composed of first time spawners and that silver hake die in mass after spawning. Similar thing is observed on Georges Bank.

II. Cod and Haddock were not subjects of specific fishery, however they were always present in silver hake catches as by-catch.

Cod was caught during the first part of the year and haddock in September and October. Rather great concentrations of haddock appeared in the shallow waters of Sable Island by the end of summer and in autumn; in some cases its catches amounted to 10-20% of the total catch.

Rather dense concentrations of haddock were observed in late October in the Nova Scotian gut at the depth of 50 to 90 m. At that time the catches of BMRT amounted up to 5 tons per one hour of trawling. Haddock was usually observed in the places where the near bottom temperature kept within the range of 4° to 8°C.

III. Redfish (Sebastes mentella) was taken, like cod and haddock, as by-catch during silver hake fishing. Small numbers of redfish occurred in catches in winter and spring, and in the area of Nova Scotian gut off Emerald Bank - in spring.

IV. Argentina

Argentina fishery was conducted mainly in spring in the area of Emerald Bank where mass spawning of this species was observed in March. At that time it was caught together with hake. Individual catches were wholly composed of argentina alone. Catches of argentina by BMRT-type trawlers in March amounted to 5 tons per one hour of trawling.

B. Special Research Studies

I. Environmental Studies

1. Hydrography. During 1963 seven hydrological surveys were made in Subarea 4 in the waters from Saint Pierre Bank to Browns Bank (in January, May, June, July, September, October and November) that provide sufficiently good coverage of hydrological conditions in all seasons.

In winter the whole shelf was covered by cold Labrador waters with temperatures 2-3°C. These waters were observed in the layer from 30 to 100 m. In areas with depths less than 100 m cold waters reached the bottom. In deeper parts of the shelf penetration of warm Atlantic waters was registered, their temperature being 5.5°-7.5°C. The areas with warmer waters were located between Georges and Browns Banks in Nova Scotia gulf and in the channel between Banquereau and Saint Pierre Banks.

Cold waters with temperatures 1.0°-2.0°C were observed in the northeast of Banquereau Bank. Southern slopes of the shelf (south and southwest of Sable Island) were covered by waters with temperature not exceeding 4°C.

In spring southern slopes of the shelf were, as in winter, covered by cold waters with temperature 2°-4°C. The front dividing the borders of Labrador and Atlantic waters was beyond the shelf slope.

In summer period more intensive penetration of Atlantic waters into the shelf area was registered. In the areas of convergency of warm and cold waters substantial gradients were observed: from 3° to 7° within 10 miles.

Especially marked temperature gradients were registered in the northern and northeastern parts of Nova Scotian gulf. Shallow areas of the shelf with depths less than 50 m were covered by warm water with temperatures 7°-9°C. Southern slopes of the shelf were covered by warm Atlantic waters.

In autumn the area covered by cold Labrador waters was gradually expanding. Warm waters near bottom were observed in Nova Scotian gulf and on Middle and Sable Island Banks. On the southern slope of the shelf layers near bottom were filled with warm Atlantic waters.

Subarea 5

A. Status of the Fisheries

In 1963 the Soviet catches in Subarea 5 have grown to 231000 tons (as against 209400 tons in 1962). As in previous years the overwhelming part of catches was taken in Division 5Z (Georges Bank). A special feature of 1963 fishery was an increase in catches of silver hake and a decline in catches of herring.

I. Silver hake

As in 1962, the main area of silver hake fishery was the southeast part of Georges Bank.

Concentrations of hake appeared in the southeast part of the bank in the second half of May. Catches were almost entirely represented by mature specimens; mass spawning took place in the end of June - in the beginning of July. After the termination of spawning no dense concentrations were observed and the catches declined. In June catches of hake per one hour of trawling by BMRT averaged 4.44 tons and towards the end of July 1.0 ton per one hour of trawling. Beginning from the second part of July till October hake was caught together with herring in the northwest part of Georges Bank.

In November dense concentrations of silver hake were observed north of

Georges Bank at the depths 240-280 m. Successful fishing for hake continued here till the end of the year. Catches per one hour of trawling amounted to 1.5-2.0 tons.

Size and age compositions of hake catches in the southeast part of Georges Bank in 1963 were essentially the same as in 1962. The mean length of hake in the southeast part of the bank in 1962 was 31.3 cm and in 1963 30.2 cm. In the northwestern part of the bank the mean length of hake in catches was 28 cm both in 1962 and in 1963.

In the area north of Georges Bank the catches in November and December were dominated by small-sized hake of 24-28 cm long. The bulk of catches in 1962 and 1963 was composed of 3-4 year old hake specimens. In 1962 three-year-old hake made up 37.4% of the catch, four-year-old 50.8%, and five-year-old and older 7.5%.

In 1963 fish at the age of 3 composed 32.3% of the catch, at the age of 4 47.2%, and at the age of 5 17.2%. The number of specimens of 6 years old and older did not exceed 3% of the catch.

Males of silver hake of Georges Bank attain the stage of sexual maturity at the length from 24 to 31 cm, in mass - at the length of 26-29 cm; females - at the lengths from 26 to 31 cm, in mass - from 29 to 31 cm. 60% of males become mature at the age of 3 and 100% at the age of 4. 10% of females attain maturity at the age of 3, 70% at the age of 4, and 100% at the age of 5.

The bulk of catches is composed of first-time spawning hake. After spawning the number of hake is greatly reduced due to high mortality, so only a small part survive to the age of 5. The total relative mortality of hake over 5-years-old was more than 80% in 1962-63; instant mortality Z (F+M)=1.46.

In the report of the working group on regulation of fishery presented to the 11th Annual Meeting of ICNAF in 1961 the value of (F+M) was cited to be 0.45 as determined according to Ricker's method on the basis of weight composition of catches intended for consumption as food. In our opinion the value of Z in this case is under-estimated. The error made in estimating this value was probably caused by the fact that the data on weight composition of the catch were collected on those vessels where the fishermen picked out only big specimens for food purposes and discarded the smaller ones into the sea which made the correct estimation of instant mortality impossible. Composition of these catches evidently greatly differs from that of the Soviet catches where all fish is used for consumption.

II. Herring

Conditions of herring fishery on Georges Bank in 1963 were less favourable than in 1961 or in 1962. Catches of herring declined from 151,000 tons in

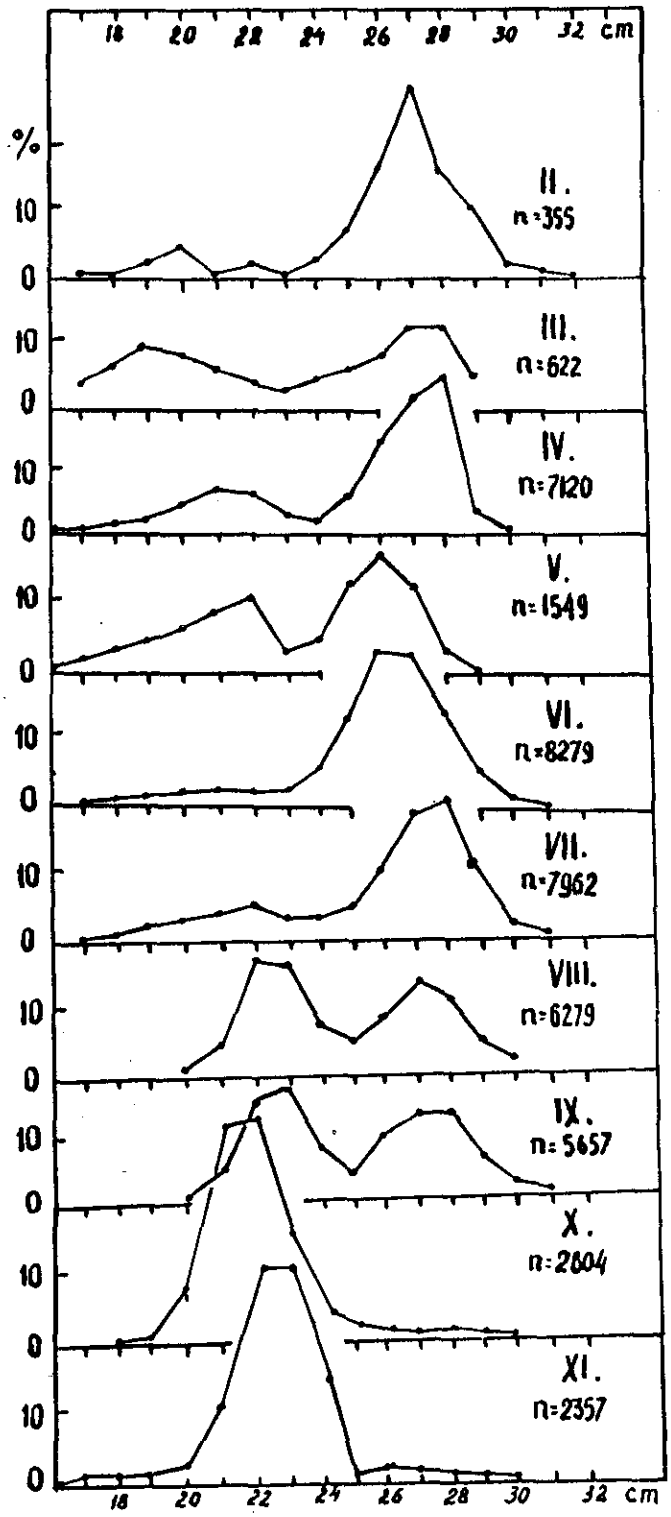


Fig. 4. Length of herring in trawl catches in Division 5Z in 1963.

1962 to 97000 tons in 1963. Most pronounced decrease was observed in the drift-net fishery.

The trawl catches remained at the level achieved in the previous years.

Unlike the previous years spawning concentrations in 1963 were observed on a narrower space and the spawning itself has been completed within shorter time.

Considerable changes in the size composition of herring catches were observed in 1963 in the period from February to November (Fig. 4). If in the first part of the year the bulk of catches was composed of herring of 25 to 29 cm long (80%), then beginning from August small-sized herring (20-24 cm) became prevalent as a result of recruitment of a new generation of 1960 which is likely to be an abundant one. Herring of the 1960 year-class composed the bulk of autumn catches.

Age composition changed in a similar manner. Until August catches were dominated by herring of the 1957 and 1958 year-classes (60%) and since August the 1960 year-class took the leadership (47%).

In comparison with 1961-62 the composition of herring catch in 1963 has markedly changed.

In 1961-62 the bulk of catches was composed of the 1956 year-class. Younger herring, especially under 4-years-old was poorly represented in catches. In 1963 young herring of

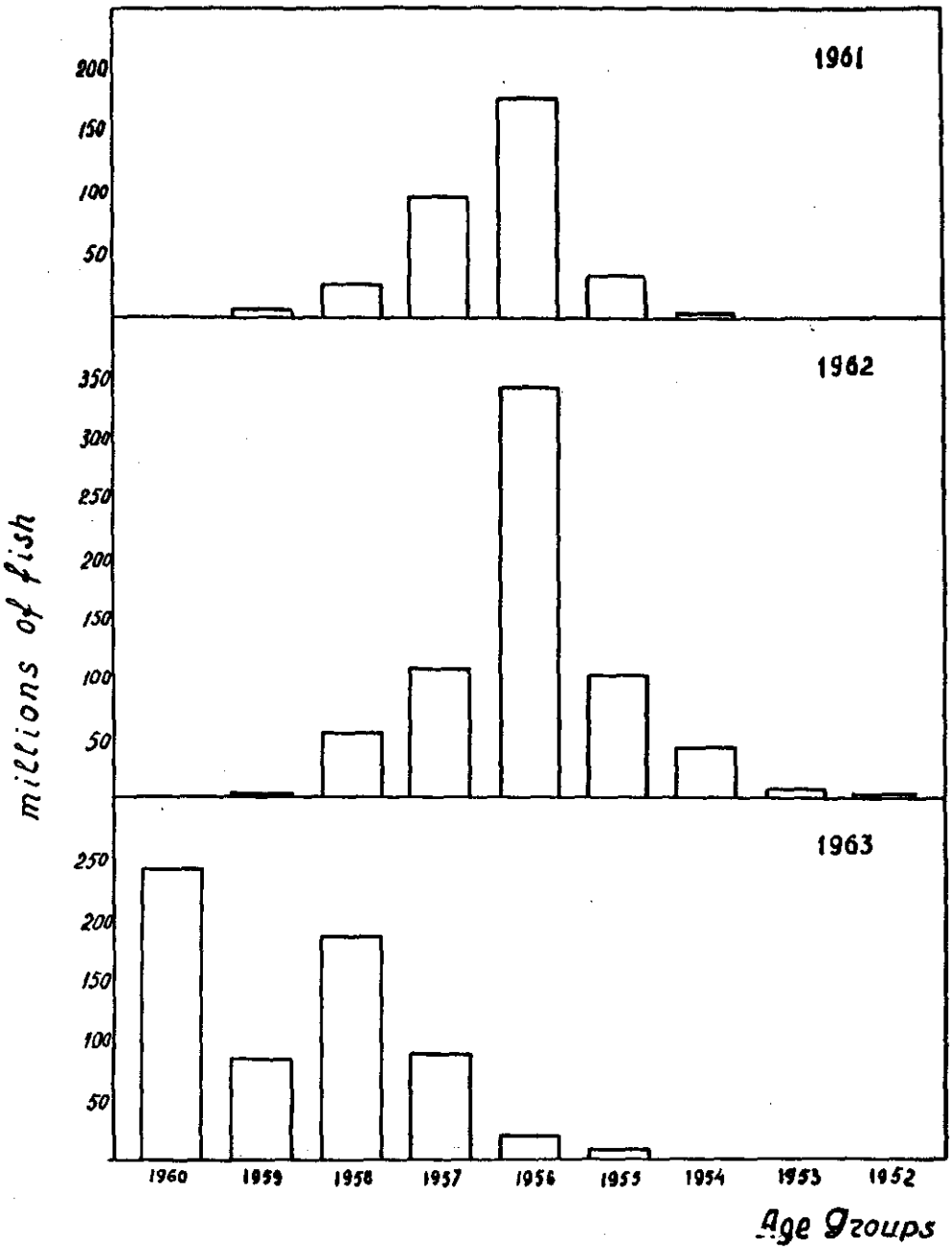


Fig. 5. Age composition of herring catches in Subarea 5 in 1961-63

the 1960 year-class has taken the lead by the number of specimens in catches (Fig. 5). This may be explained by the fact that by 1963 an abundant generation of 1956 and an average (by numerical strength) year-class of 1957 had already been withdrawn from fishery due to natural and fishing mortality. The numerical strength of poor 1959 and 1958 year-classes has been reduced. Consequently, fishery then had to place emphasis on the young herring of the 1960 year-class which, unlike the previous generations, has attained mass maturity already in 1963.

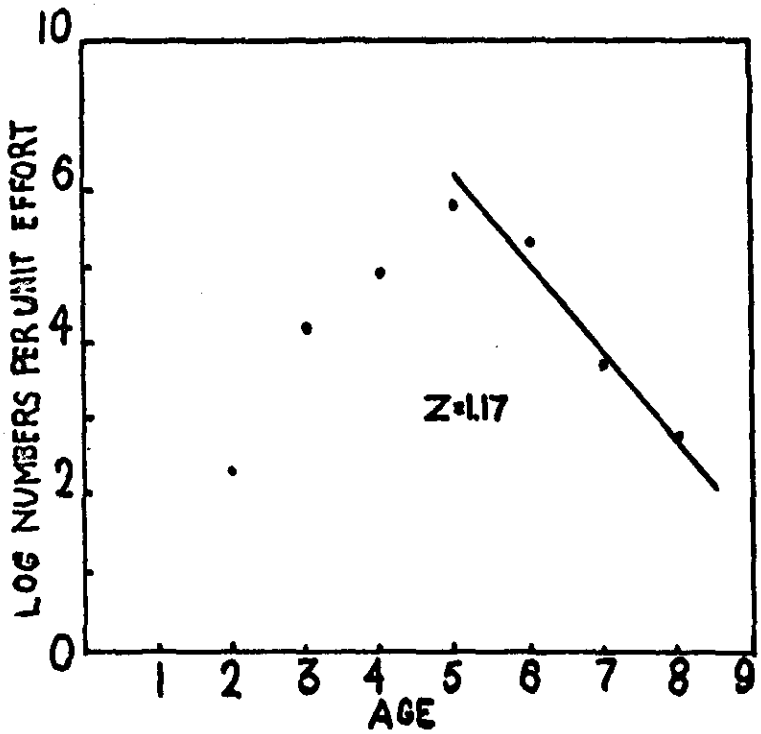


Fig. 6. Age and log of the number of fish in catches per one drift net in 1961-63.

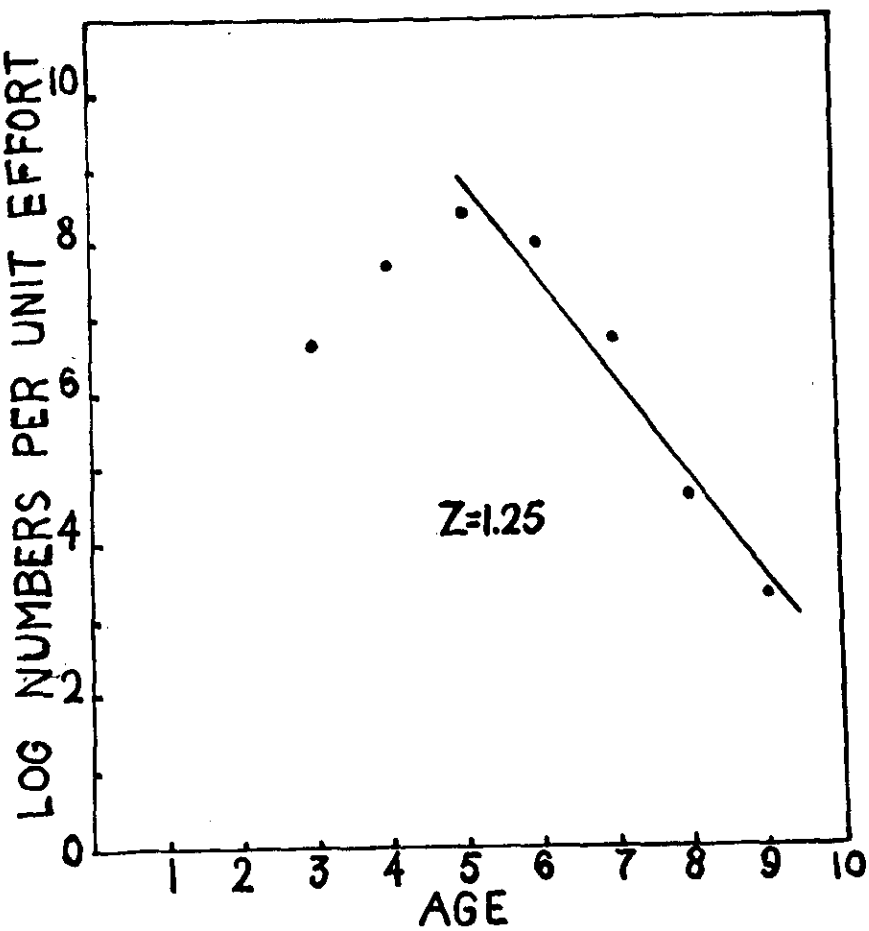


Fig. 7. Age and log of the number of fish in catches per one hour of trawling by BMRT-type trawlers in 1961-63.

Observation on the composition of catches during the period from 1961 to 1963 showed that the life cycle of herring on Georges Bank is comparatively limited. The relative mortality according to the age composition data as estimated per fishing effort (per one net and one hour of trawling) amounts to 80% at the age of 5 and older (the age of herring in this case is estimated on the basis of calendar time, i.e. the spring fry on the 31st December is referred to yearlings, and on the 31st Dec. of the following year it is classified as two-years-old etc.).

According to the age composition data, instant mortality value in drift catches during 1961-63 amounted to 1.17 and according to data collected on BMRT-type trawlers 1.25 (Figs. 6, 7).

In 1964 the catches will be based on the 1960 year-class, so the commercial stocks in 1964 will evidently not exceed the level of 1963.

B. Special Research Studies

I. Environmental Studies

1. Hydrography. In 1963 research-scouting vessels made regular hydrological surveys from February to November on Georges Bank and in adjacent areas with temperature-salinity determinations.

These observations enabled to define the following seasonal peculiarities of temperature regime:

In winter the water mass throughout the surveyed area was characterized by homogeneous temperature in the whole water thickness. Cold Labrador waters were observed on the slopes with the temperature being 4°-5°C.

In April spring heating was observed to begin on the slopes of Georges Bank. In May the temperature gradients on the slopes have risen from 4.5° to 7.5° at a 5 to 10 miles distance.

In summer, due to heating, the near bottom temperature on Georges Bank has increased to 9-14°C and on the northern slopes to 5-6°C. In August the influence of Labrador waters was not very great on the southeast part of the bank. On the northern slopes the temperature gradients remained to be relatively high: 5-12°C per 10 miles.

In autumn the shallow part of Georges Bank (up to 100 m isobath) was covered in September by warmed waters with temperatures 9-15°C. Cooling began in October. Maximum temperatures at that time did not exceed 10-11°C. Waters of Labrador origin were located in the same areas as in summer.

2. Plankton. In 1963 observations on seasonal development of

zooplankton were continued. Three surveys were performed one in late April-early May, the second one in the beginning of June, and the third one in the beginning of August. Altogether 334 samples were taken on 123 stations.

Results of observations have enabled us to draw the following conclusions:

In 1963 the composition of phytoplankton was dominated by peridinaceous and in 1962 by diatomaceous.

Phytoplankton in May-June 1963 was more abundant than in the corresponding period of 1962.

Seston biomass in 1963 was somewhat greater than in 1962.

Spawning of Calanus finmarchicus and Euphausiacea sp. began in 1963 10-15 days earlier than in 1962.

II. Biological Studies

In 1963 tagging of herring and hake was carried out on Georges Bank by means of hydrostatic and flat tags. Both type tags were fastened by kapron thread ahead of the dorsal fin. Altogether 1760 specimens of herring and 220 specimens of silver hake were tagged during the summer.

XI. United States Research Report, 1963

by H. W. Graham

The United States landed fish from Subareas 3, 4 and 5 in 1963 and conducted research in these three subareas as well.

Subarea 3

A. Status of the Fisheries

I. Redfish

United States landings for Subarea 3 have been mostly from the Grand Bank, Div. 3N and 3O, with occasional trips from St. Pierre Bank, Div. 3P.

Landings in 1963 dropped about 15% over 1962, probably due to decreased effort since abundance in these areas has held steady during the past few years (Table 1).

Table 1. U.S. redfish statistics, Subarea 3 (metric tons, round weight)

Year	Landings	Days fished	Catch per day
1954	31,269	1,786	17.51
1955	13,406	1,126	11.91
1956	13,304	943	14.12
1957	4,797	289	16.62
1958	10,859	688	15.79
1959	16,871	1,120	15.07
1960	15,393	1,049	14.67
1961	16,706	1,056	15.83
1962	14,257	---	15.88
1963	12,098	---	---

B. Special Research Studies

I. Environmental Studies

1. Hydrographic. The U.S. Coast Guard, as the agency operating the International Ice Patrol, examined the temperature and salinity distribution from the surface to 1500 m in 4 network surveys of the Grand Banks region. The first survey, 30 March-8 April, covered the waters over and immediately seaward of the southern and eastern slopes of the Grand Banks from just westward of the Tail of the Banks northward to Section T, approximately 45-40 N. The

second survey, 15 April-25 April, covered the area immediately seaward of the eastern and northeastern slope of the Grand Banks from section T northwestward and included Flemish Cap and the Bonavista Triangle. The third and fourth surveys, 14 May-31 May, were combined into a single survey and covered an area similar to the first and second. The postseason survey, 13 July-21 July, occupied the Bonavista Triangle and the Labrador Sea section, (South Wolf Island, Labrador, to Cape Farewell, Greenland) to within 20 miles of shore at Cape Farewell.

The season was characterized by a less than normal amount of sea ice and icebergs along the east Newfoundland coast. Labrador Current volume along the eastern slope of the Grand Banks was slightly below normal for the entire season although well defined, was on the average warmer and saltier than normal, but with lower minimum observed temperatures. As the season progressed, conditions tended more toward the normal but still remained below normal. On the postseason survey, the Labrador Current off South Wolf Island had a positive volume anomaly and a negative temperature anomaly while the West Greenland Current off Cape Farewell had a negative volume anomaly and a positive temperature anomaly. The report in toto will be published in the U.S. Coast Guard Bulletin No. 49.

Subarea 4

A. Status of the Fisheries

I. Haddock

United States landings from Browns Bank and LaHave Bank were about the same in 1963 as in 1962 (Table 2). Total landings for the U.S. and Canada combined will probably also be about the same as in 1962. The abundance was about the same as last year, actually showing a slight drop. Total effort in 1963 will probably show an increase over the relatively low level of 1962.

Table 2. U.S. haddock statistics, Subarea 4 (metric tons, round fresh)

Year	Landings	Days fished	Landings/day
1956	14,024	1,215	11.540
1957	8,951	1,015	8.818
1958	12,639	1,374	9.199
1959	10,544	1,777	5.933
1960	8,466	1,169	7.239
1961	9,330	1,318	7.076
1962	6,440	739	8.709
1963	7,286	1,013	7.185

The age composition of landings for 1963 and previous years (Fig. 1) indicates an increased proportion of four and five-year-olds in 1962 and 1963. The 1963 fishery depended heavily on the 1958 and 1959 year-classes as did the Georges Bank fishery. However, because of the slower growth rate in Subarea 4 these year-classes should sustain the fishery during 1964, and provide a level of abundance near that of 1963.

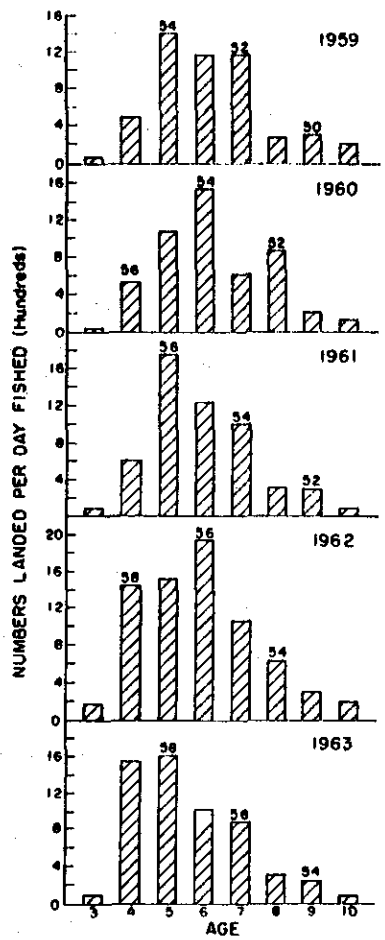


Fig. 1. Browns Bank haddock age composition.

A U.S.-Canada cooperative study of the Div. 4X haddock fishery for the period 1956-1961 was completed and a manuscript submitted for publication in the new ICNAF research journal. The study describes the general characteristics of the fishery and presents estimates of abundance, growth, year-class strength, and total mortality.

Average annual survival rate of Div. 4X stocks was approximately 0.50 corresponding to an instantaneous total mortality of 0.70. However, growth and age composition was not uniform in all parts of Div. 4X. Bay of Fundy haddock exhibit faster growth and a younger age composition than those from waters off southern Nova Scotia (including Browns Bank). Age composition of the Bay of Fundy haddock is similar to that of Div. 5Z (Georges Bank), but growth is still faster in the latter area. Both growth and age composition of haddock off southern Nova Scotia are similar to that for stocks off central Nova Scotia (Div. 4V-W).

Certain year-classes appeared strong in all Div. (5Z to 4W) suggesting that factors common to the entire area may often control brood success, or that some stocks mix at a pre-recruit stage.

II. Cod

United States landings of cod from the subarea were up slightly in 1963 but were near the 10-year average (Table 3).

Table 3. U.S. cod statistics, Subarea 4 (metric tons, round weight)

Year	Landings
1954	2,659
1955	1,371
1956	1,624
1957	1,083
1958	1,147
1959	862
1960	1,605
1961	1,261
1962	1,197
1963	1,347

III. Redfish

The steady decline in U.S. landings from the Gulf of St. Lawrence from a high of 34,739 metric tons in 1955 to 68 metric tons in 1962 was reversed in 1963 when 4,879 tons were landed. This was the result of increased effort (Table 4).

Table 4. U.S. redfish statistics, Subarea 4 R-S-T (Gulf of St. Lawrence) (metric tons, round weight)

Year	Landings	Days fished	Catch per day
1954	17,228	1,517	11.35
1955	34,739	2,397	14.49
1956	24,825	2,024	12.26
1957	18,319	1,960	9.34
1958	7,535	844	8.93
1959	5,406	572	9.45
1960	1,412	139	10.13
1961	200	20	9.84
1962	68	---	---
1963	4,879	---	---

The catch from Nova Scotian banks decreased about 20% in 1963 also due to change in effort. The abundance has been steady in this area for several years (Table 5.)

Table 5. U.S. redfish statistics, Subarea 4 V-W-X (Nova Scotia Banks) (metric tons, round weight)

Year	Landings	Days fished	Catch per day
1954	20,895	1,900	11.00
1955	9,330	1,100	8.48
1956	16,313	1,461	11.17
1957	21,101	1,896	11.13
1958	30,768	2,556	12.04
1959	25,281	2,448	10.33
1960	36,612	3,352	10.92
1961	28,957	3,000	9.65
1962	29,375	---	10.89
1963	23,282	---	---

B. Special Research Studies

I. Biological Studies

Serology of haddock. Preliminary results with a rabbit anti-haddock serum have revealed statistically significant serological differences between haddock from Cape Cod, Browns Bank, and Emerald Bank. However, the genetic significance of these differences has not yet been established. Haddock blood samples from Nova Scotian waters were obtained through the generous cooperation of Canadian scientists aboard the R/V A. T. Cameron.

Subarea 5

A. Status of the Fisheries

I. Haddock

The U.S. landings of haddock from Georges Bank dropped 5,000 metric tons in 1963 (Table 6). This was due to a decreased abundance of fish, the index of abundance dropping from 6.6 in 1962 to 4.6 metric tons per day in 1963.

Table 6. U.S. haddock statistics, Subarea 5 (metric tons in round weight)

Year	Total Subarea 5 Landings	Div. 5Z (Georges Bank) Abundance index	Div. 5Z (Georges Bank) Effort days fished
1954	53,539	8.382	5,807
1955	50,344	9.491	5,059
1956	58,422	7.566	6,794
1957	54,702	6.205	7,825
1958	44,404	4.790	7,836
1959	40,548	4.028	9,432
1960	45,341	5.661	7,669
1961	51,681	6.858	7,192
1962	54,412	6.641	7,833
1963	48,868	4.572	10,098

The 1958 and 1959 year-classes which have supported the fishery in the past few years are losing their dominance in the age structure of the populations while the following year-classes, 1960 to 1962, are weak ones (Fig. 2). Thus the abundance of haddock on Georges Bank is expected to remain relatively low during 1964.

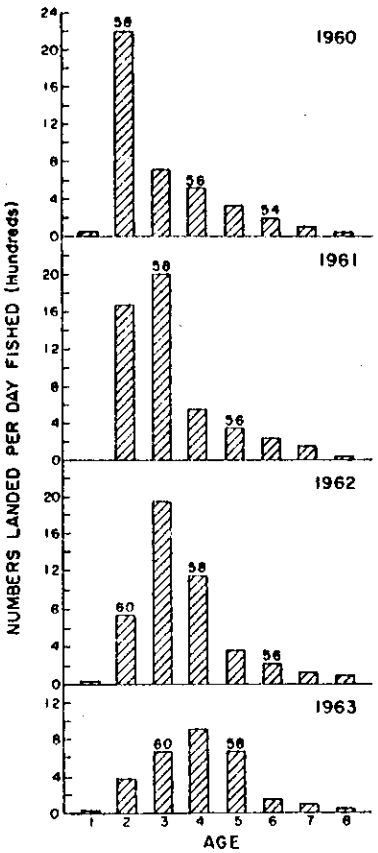


Fig. 2. Georges Bank haddock age composition.

On R/V Albatross IV groundfish survey cruises during the summer and fall of 1963 an unusual abundance of young-of-the-year haddock were found which indicates that the 1963 year-class is an unusually large one. On this basis we can expect an abundance of scrod to appear in the fishery early in 1965, and that landings would begin to improve during that year.

Refining abundance index. Relative abundance and total effort for haddock and cod in Subarea 5 have been estimated from a constant, small group of large Boston otter trawlers since about 1920. This index is not entirely satisfactory, and we have begun studies directed towards providing a more appropriate index based on a greater and more representative segment of the fleet. These studies will include a comparison of temporal and spatial variation in catch and

effort of the several component fleets, and estimation of relative efficiency of various types of gear and vessel size. These studies involve data covering over 30 years of fishing; hence will require some time for completion.

Estimating pre-recruits. In recent years the United States has conducted fairly regular surveys each fall of the distribution and abundance of otter trawl-caught fish from the Bay of Fundy to the Hudson Canyon off New York. A preliminary analysis was completed of catches of young-of-the-year haddock to determine annual fluctuations free from potential errors due to effects of area, depth, and time of day. A log transformation markedly reduced but did not eliminate the correlation between mean and variance of catches. Nevertheless a preliminary analysis of variance (ignoring interaction terms involving factors of depth, area, and time of day) indicated significant between-year differences in mean catch rate. More important, there is a fairly good correspondence between young-of-the-year haddock abundance indices on Georges Bank, and the subsequent abundance of the same year-classes at ages 2 and 3 in the commercial landings (Fig. 3). This suggests not only the potential predictive value of the surveys, but also tends to confirm the long held view that factors determining year-class strength operate chiefly in the first few months of life.

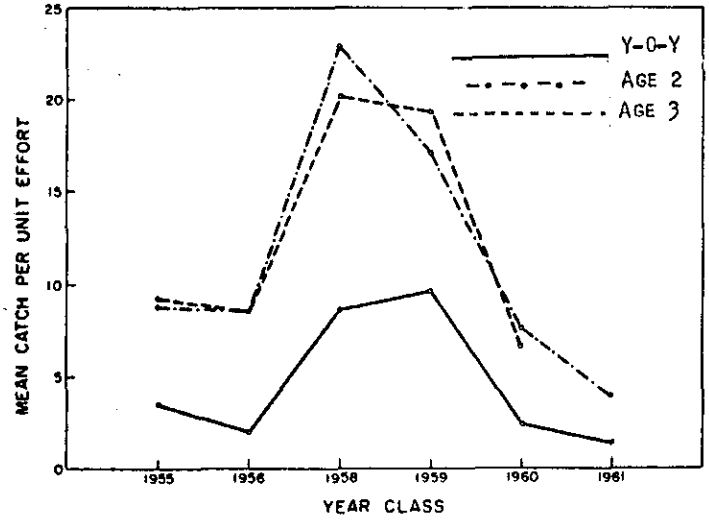


Fig. 3. Comparison of haddock year-class abundance indices on Georges Bank (Y-O-Y based on fall surveys, ages 2 and 3 based on annual catch per day in numbers in commercial landings

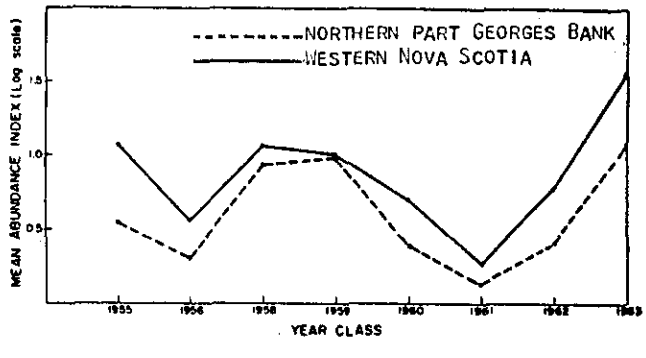


Fig. 4. Comparison of Y-O-Y haddock abundance indices of Western Nova Scotia and Northern part of Georges Bank

Another interesting feature is the correspondence between young-of-the-year indices on Georges Bank and off western Nova Scotia. It appears that strong and weak broods tend to occur in the same years in both areas (Fig. 4). This is further evidence of the correspondence in brood success among New England and Nova Scotian haddock stocks, and lends additional support to the hypothesis that pre-recruit dispersion or environmental factors common to the entire area, may be involved. Finally, it may be noted that the brood index is consistently higher off western Nova Scotia than on Georges Bank. The significance of this feature is not yet known.

II. Cod

U.S. landings of cod dropped about 2,000 metric tons in 1963 after reaching a 10-year high of 18,000 metric tons in 1962 (Table 7). This change is probably related to abundance as the index also reached a 10-year high in 1962. Although we do not have age compositions it appears from length frequencies that the changes in abundance have been due to changes in year-class strength. Abundance is expected to remain high for a year or so.

Table 7. U.S. cod statistics, Subarea 5 (metric tons, round fresh)

Year	Landings	Catch per day	
		Total cod	Scrod cod
1954	12,237	1.143	0.125
1955	12,457	1.393	0.129
1956	13,238	1.477	0.113
1957	13,160	1.313	0.077
1958	16,252	1.072	0.297
1959	16,218	1.402	0.316
1960	14,282	1.407	0.284
1961	17,669	2.071	0.492
1962	18,626	2.268	0.465
1963	16,499	---	---

III. Silver hake

United States foodfish landings amounted to about 39,000 metric tons, a slight decrease from 1962. The preliminary estimate of abundance, 17.4 metric tons per day-fished is nearly the same as in 1962 (Table 8). However, the U.S. vessels fished more on inshore grounds in 1962 and again in 1963 and thus avoided the principal areas fished by the USSR on Georges Bank.

Table 8. U.S. silver hake statistics, Subarea 5 (metric tons, round weight)

Year	For Food	For Industrial	For Animal Food	Total	Catch per day
1954	40,823	9,525	2,722	53,070	---
1955	50,348	10,433	4,536	65,317	---
1956	40,370	13,608	4,989	58,967	---
1957	45,300	17,200	7,200	69,700	---
1958	48,500	10,400	7,700	66,600	---
1959	49,900	11,800	9,100	70,800	---
1960	46,700	2,300	9,100	58,100	17.5
1961	38,100	3,200	4,500	45,800	23.8
1962	37,200	3,200	7,200	47,600	18.5
1963	39,205	8,478	*	47,683	17.8

*Value not available

Examination of length-frequency compositions of port landings and catches aboard fishing vessels has indicated that in 1962 and 1963 fish under 25 cm were rather less abundant than in previous years. This is not reflected in the abundance index because the small sizes are not landed for food in the U.S. If these observations do, in fact, reflect on the population, the combination of weak recruitment and increased fishing effort may cause a decrease in abundance in the next few years.

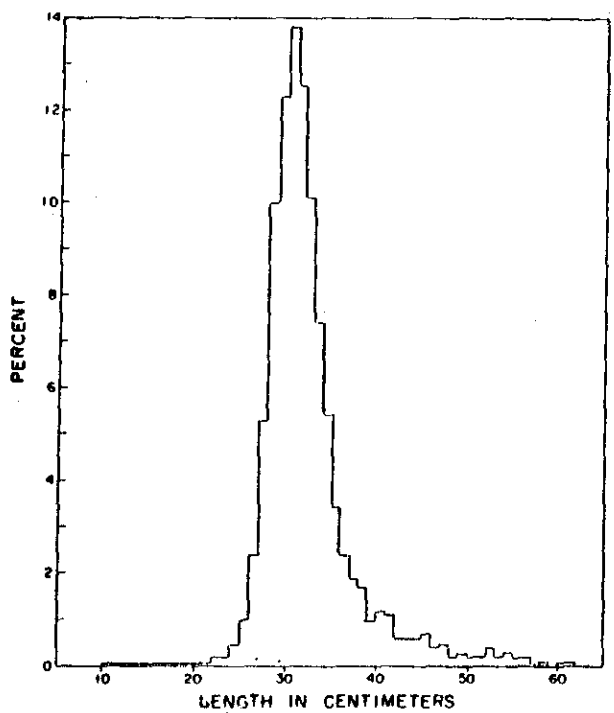


Fig. 5. Length-frequency of Silver Hake, U.S. landings for food in 1963.

The majority of fish in the U.S. landings in 1963 is in the 25-40 cm length classes (Fig. 5). The results from ageing studies thus far conducted indicate that these fish are mostly 3 and 4 years old, and that only the largest 10% were over 5 years of age.

IV. Redfish

United States landings of redfish from the Gulf of Maine dropped significantly in 1963 in the face of increased abundance (Table 9). This was due to a decrease in effort. The length frequencies show that small fish are relatively more abundant than they usually are. The increased abundance coupled with the large proportion of small fish indicates that one or more strong year-classes are entering the fishery. On this assumption we can expect abundance to hold up for a few years.

Table 9. U. S. redfish statistics, Subarea 5 (Gulf of Maine) (metric tons, round weight)

Year	Landings	Days fished	Catch per day
1954	12,988	3,859	3.37
1955	13,914	3,089	4.50
1956	14,388	3,267	4.40
1957	16,468	3,862	4.26
1958	16,112	3,636	4.43
1959	14,435	3,329	4.34
1960	10,716	2,799	3.83
1961	14,040	3,077	4.56
1962	12,540	---	4.76
1963	8,871	---	---

Through 1960 it was not possible to discern any trend in the average size of redfish in the Gulf of Maine. With the addition of the 1961 and 1962 data there now appears to have been a long term reduction in average size of fish in both males and females. However, as pointed out above, the recent low average size may bode well for the fishery during the next few years (Fig. 6 and 7).

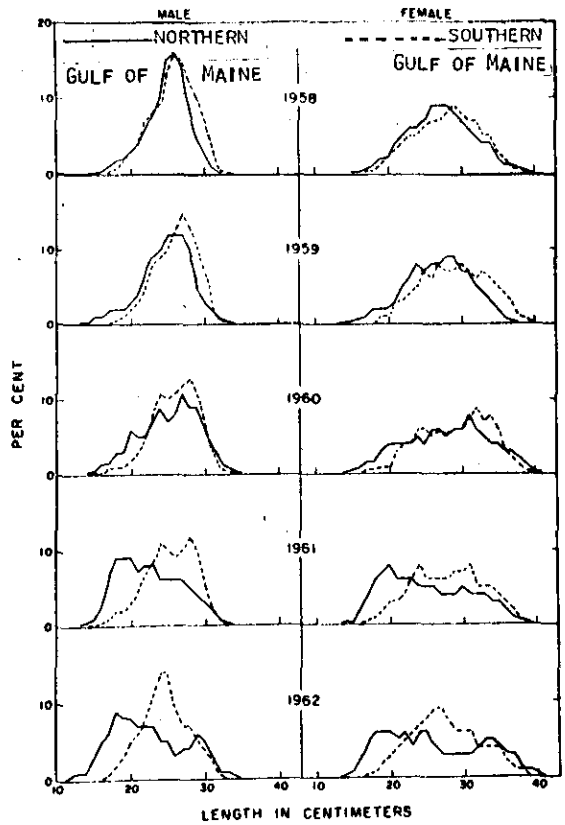


Fig. 6. Redfish length frequencies, Gulf of Maine.

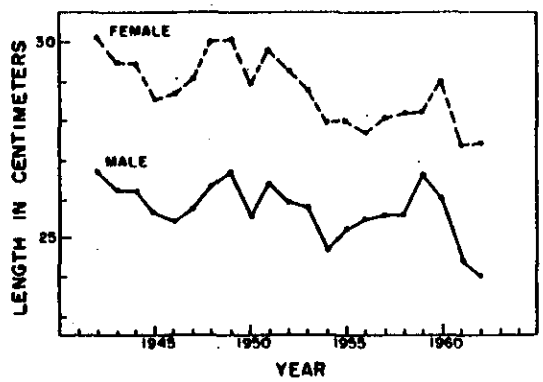


Fig. 7. Average length of landed redfish from the Gulf of Maine, 1942-1962.

V. Yellowtail flounder (Limanda ferruginea)

United States landings of yellowtail flounder reached an all-time high of 35,000 tons in 1963 (Table 10). This was due to unusually high abundance caused by three strong consecutive year-classes, 1958, 1959, and 1960.

Table 10. U.S. yellowtail flounder statistics, Subarea 5 (metric tons in round weight)

	South. New England Grounds		Georges Bank		Cape Cod Grounds	
Year	Landings	Landings per day	Landings	Landings per day	Landings	Landings per day
1954	1,515	1.270	2,887	2.086	1,120	1.270
1955	2,180	1.406	2,946	2.404	1,304	1.315
1956	3,542	1.542	1,594	2.041	1,472	1.089
1957	5,441	2.313	2,302	2.812	2,357	1.633
1958	8,907	2.449	4,534	3.220	1,613	1.724
1959	7,738	1.587	4,130	2.086	1,526	1.996
1960	7,843	1.769	4,447	2.222	1,812	1.633
1961	11,632	2.495	4,248	2.359	1,880	2.041
1962	15,669	3.674	7,769	3.583	1,973	1.724
1963 1/	21,882	4.672	10,990	4.173	2,186	1.950

1/ Preliminary

During the coming year the 1959 and 1960 year-classes will continue to contribute heavily to the fishery, but the 1961 year-class appears to be a weak one. The overall abundance of marketable sizes will probably drop slightly during 1964.

VI. Industrial Fishery

The industrial fishery catches fish primarily for purposes of reduction to meal and oil, and for purposes of supplying animal food products. The fishery began in the late 1940's, reached a peak in 1956 when 111,000 metric tons were landed. The fishery gradually declined to a level of 24,000 metric tons in 1960, but is beginning to increase again and 54,000 metric tons were landed in 1963 (Table 11).

Table 11. U.S. landings of industrial trawl fish from Subarea 5 (tons in round weight)

Year	Landings
1956	110,786
1957	97,736
1958	88,927
1959	75,706
1960	24,492
1961	32,132
1962	30,094
1963*	53,707

*Preliminary

The fish are caught with small mesh nets, are generally not culled at sea as are the food-fish catches, and provide, therefore, more direct information on size and species composition of the area stocks. This is the only fishery which utilizes red hake, one of the species of major importance in the subarea's biomass.

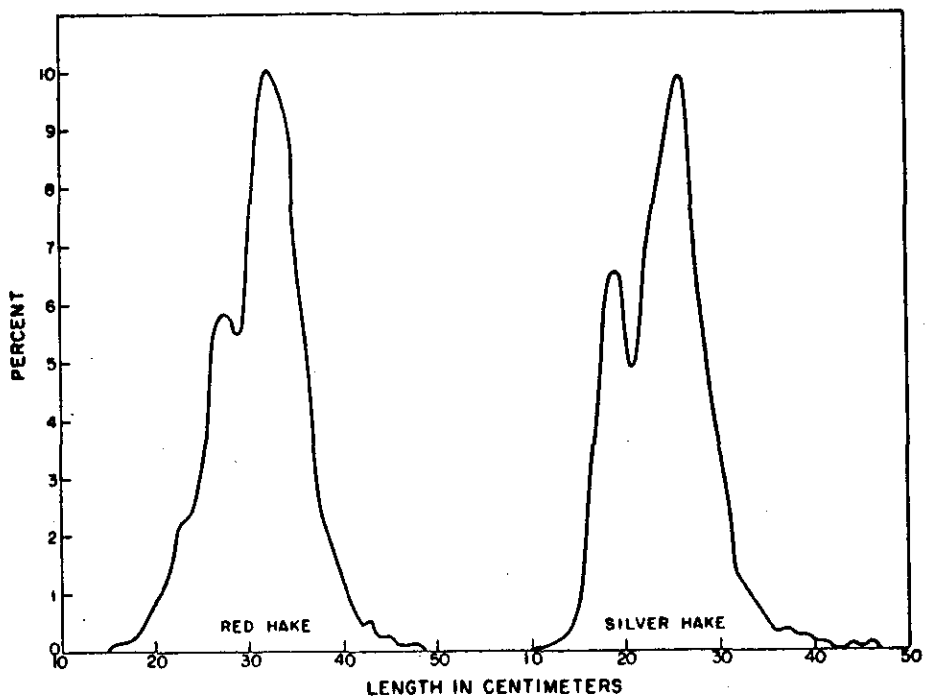


Fig. 8. Length frequencies of Silver and Red Hake in industrial catches from southern Subarea 5, 1963.

The landings are not reported by species, and a special sampling program is required to obtain estimates of species composition. The estimated species composition in 1963 (Table 12) indicates red hake and silver hake are the major components of the catch. These estimates apply to catches from the southern part of the subarea, where the fishery was concentrated. The length-frequency of these two main species is presented in Fig. 8.

Table 12. Species composition of industrial trawl fish caught in southern part of Subarea 5, 1963

Species	Percent	Metric Tons
Red hake	44.7	19,511
Silver hake	29.6	12,920
Sea robins	6.0	2,619
Skates	6.0	2,619
Flounders	6.3	2,750
Other	7.4	3,230
Total	100.0	43,649

VII. Herring

The total Maine catch of herring for 1963 was 70,090 metric tons, a slight increase from the 1962 catch of 69,473 metric tons. In 1963 only 46,457 metric tons were processed as sardines and for reduction purposes as compared with 58,302 metric tons in 1962. This change reflects a condition of market inventories and is not related to changes in abundance or availability. The sardine canneries ceased operation in the early autumn of 1963, while the fish supply was still plentiful. The quantities of herring sold for lobster bait in 1963 increased 40% over 1962 and totalled 16,921 metric tons.

In the sardine fishery, the total units of gear decreased from 278 in 1962 to 224 units in 1963, a decrease of 20% as compared with a catch decrease of only 4%. This indicates that the availability of fish may have been greater in 1963 even though the case-pack was much lower. The decrease in gear units was apparent in the three major types: weirs, stop-seines and purse seines.

The age compositions of the herring taken by the sardine fishery were dominated, as usual, by fish in their second year of life. Three-year-olds contributed a relatively greater proportion than usual during June, July and August -- accounting for 10,000 of the 50,000 metric tons taken in that period.

VIII. Other pelagic fish

An Atlantic tuna purse seine fishery has started in the U.S. and, to obtain records pertinent to the catch, a log book system was introduced in the fleet in 1962.

IX. Sea scallops

United States landings of sea scallop meats from Div. 5Z have been declining since 1961 while Canadian landings have continued to rise (Fig. 9). Ten years ago, the Canadian fishery accounted for less than 1% of the landings while in 1963 it accounted for almost half of them. The large increase in total landings since 1958 has been a reflection of the expansion of the Canadian fleet coinciding with a real increase in abundance during the years 1959-61 (Fig. 10).

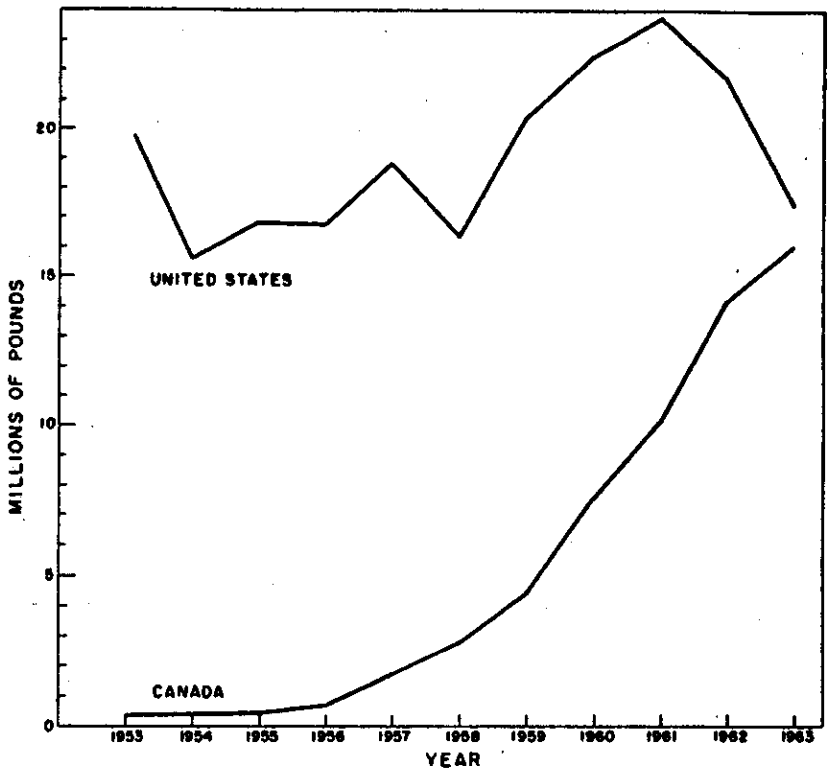


Fig. 9. Landings of sea scallop meats by the United States and Canada, 1953-1963.

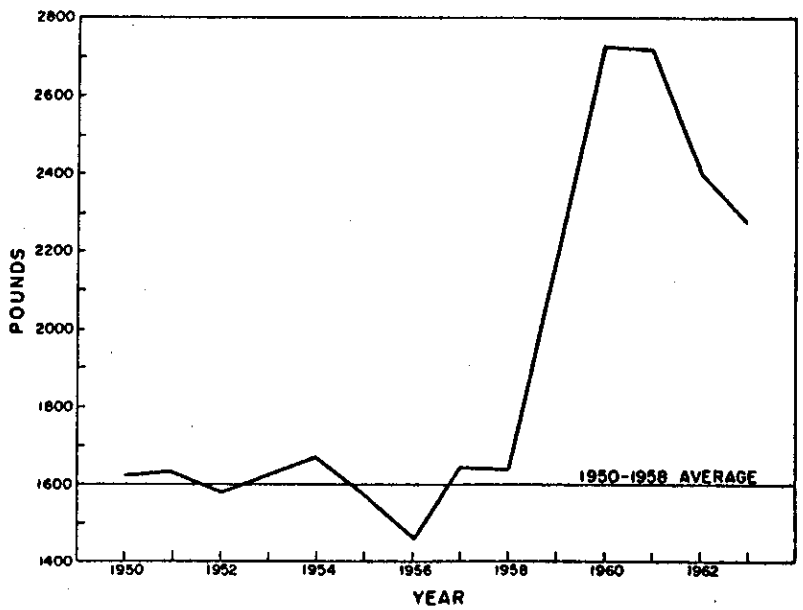


Fig. 10. Relative abundance of sea scallops from Georges Bank (catch per day of U.S. fleet).

This increase was caused by the recruitment of a dominant year-class to the fishery in 1959. Although the phenomenon of occasional dominant year-classes is well-known in other fisheries, this is the first record of it having occurred in the sea scallop fishery. This single year-class has supplied a large fraction of the catch for the past few years. It is largely fished out now and there is no evidence to suggest that it has or will be replaced with an equally large one.

We can also estimate relative abundance from quantitative samples collected on research vessel cruises. In May of 1961 our data showed an average catch of 106.6 scallops over 70 mm in length per 10,000 square feet dredged. Returning to the same areas in May of 1962 we found concentrations of 97.6 per 10,000 square feet, an 8% decline. Similar cruises were carried out in September of both years. Comparing these samples we found a 40% decline.

These figures cannot be accepted as strictly valid measures of change in abundance with time since the cruises did not cover all of Georges Bank and the sampling density was something less than satisfactory. They do, however, indicate a trend downward and coupled with the drop in the landings per day fished during 1962-63 as compared with 1960-61 suggest that perhaps the level of abundance on Georges Bank is returning to that which prevailed during 1950-58.

B. Special Research Studies

I. Environmental Studies

1. Hydrographic. The BCF Biological Laboratory at Boothbay Harbor continued their environmental surveys in the nearshore waters from Cape Ann to Grand Manan. The surveys were designed to study prerecruit herring and involved measures of herring abundance and availability and environmental factors controlling their recruitment to the coastal sardine fishery. Hydrographic observations obtained concurrently with larval herring collections were concerned with detecting seasonal and areal changes in the environment. Temperature, salinity, transparency, density, and nontidal drift (drift bottles and sea-bed drifters) were monitored along the coast and inshore. Analyses of these observations suggest: (1) that the movement of larval herring into some estuaries and embayments along the coast is not dependent upon a nontidal two layer current system, but rather a lateral system or merely inshore and upstream stranding of the larvae by tides, (2) that there are differences in the physical oceanic characteristics along the Gulf of Maine coast and these differences divide the eastern and western sectors of the coast, (3) that monitored inshore stations show appreciable differences in their salinity and density distributions from year to year dependent upon river discharge and runoff.

Bathythermograph traces were collected routinely by BCF research vessels Albatross IV and Delaware.

2. Benthic. United States benthic studies of the Gulf of Maine, Georges Bank, and southern New England waters were continued. More than 1000 samples were collected, 505 of which were analyzed during the year. The biomass in the Gulf of Maine is, on the average, about half of that on Georges Bank. South of Nantucket Island, where the biomass is generally comparable to that on Georges Bank, there appear to be five macrobenthic faunal communities.

II. Biological Studies

1. Cod. Analysis of tag returns showed that growth of cod is not inhibited with either the Petersen disc or Lea hydrostatic capsules with coelomic anchors.

2. Silver hake. Studies of methods of ageing silver hake were carried out in 1963 with the examination of otoliths collected in previous years. The otoliths had been stored in alcohol and lacked the clarity necessary for consistent detection of differential growth zones. We have, therefore, initiated the collection and analysis of fresh otoliths over a year's time to permit more consistent interpretation and validation of annual growth zones.

3. Redfish. Further studies of Eastport redfish corroborated earlier findings that different types of tags have quite different effects on the growth rate of the fish.

Analysis of the records of incidence of the parasite Sphyrion lumpi (Krøyer) collected continuously since 1942 was completed. Parasite increase during the period 1957-1962 was more than double the incidence during the period 1942-1947. There are indications that Sphyrion infestation is important in the natural mortality of redfish in the Gulf of Maine.

4. Yellowtail flounder. A study of the relation of abundance to fishing effort over the past 20 years for the three separate New England stocks was completed. It was concluded that the fluctuations in abundance which occurred were unrelated to fishing effort.

5. Winter flounder. About 10,000 winter flounder were tagged by the U.S. during March to May, 1964. The fish were tagged in both inshore and offshore waters as follows: (1) north of Cape Cod from Cape Ann to Cape Cod Bay, 3,000 fish; (2) south of Cape Cod in Nantucket and Vineyard Sounds and in Buzzards Bay, 3,000 fish; (3) off the eastern end of Cape Cod from Race Point to Chatham, 1,000 fish; (4) on Nantucket Shoals, 1,300 fish; and (5) on Georges Bank, 1,075 fish. The tags used were Bureau of Commercial Fisheries 1/2-inch Petersen discs fastened to the nape. This tagging endeavor was a joint project of the Massachusetts Division of Marine Fisheries and the U.S. Bureau of Commercial Fisheries; the Massachusetts Division tagging in inshore waters while the Bureau of Commercial Fisheries tagged on the offshore banks.

6. Herring. Samples of adult herring were collected whenever possible on a monthly basis from Georges Bank and the Gulf of Maine to compare spawning time, age-length data, meristic characters, and blood groups. Analysis of maturity stages indicated that spawning occurred principally from late September to early November. Some evidences of spawning was recorded during late July in the Gulf of Maine and late August on Georges Bank. December spawning in both areas was more evident in 1963 than in past years. There was no evidence of spring spawning on the Bank, while a few full and recently spent herring were taken in May and June in the Gulf of Maine. Spawning herring were principally 22 cm (standard length) at their first spawning, generally during the fourth year of life, though occasional three-year-old herring were found spawning on the Bank. Immature fish were found on occasion from January through October and their numbers increased in the November and December samples.

Age composition of samples from January through October from Georges Bank indicated that 1958 was the dominant year-class; followed in rank of percentage occurrence by the 1960, 1959, 1957, 1956 and 1955 year-classes. In November and December over 70% of the herring sampled were of the 1960 year-class. In the Gulf of Maine, the 1958 year-class was dominant in samples obtained from January through June; followed in rank of percentage occurrence by the 1960, 1957, 1959, 1956, and 1954 year-classes. From July through October, the 1959 year-class dominated the samples. In November and December, 1960 was the dominant year-class. In November representatives of the 1961 year-class were obtained.

Studies of the seasonal and areal changes in the distribution and abundance of herring larvae along the Gulf of Maine coast were continued during the past year. An abundance of yolk-sac herring larvae were obtained for the first time in an inshore area, documenting the existence of coastal spawning. Larval herring were "tracked" throughout the winter by utilizing newly developed high speed trawls and anchored nets. Results of this study have added to our knowledge of herring larval growth, distribution, and abundance in the inshore habitat. Analyses of previously collected data and the results of exploration during the past year demonstrate that herring larvae significantly utilize estuaries and embayments along the coast of the Gulf of Maine.

7. Other pelagic fish. R/V Delaware conducted exploratory fishing operations in the area during which 29 bluefin were tagged. Four fish have already been recovered by the purse seine fishery.